

Individualized vs. Guideline-based Management

2022. 6. 4(토)

경주화백컨벤션센터 (HICO)

연수평점: 6점





인 사 말

안녕하세요. 대한뇌졸중학회 회원 여러분,

2019년말부터 시작된 코로나 팬데믹으로 인해 지난 2년간 우리 학회는 정부시책에 따라 각종 학술행사를 online 중심의 비대면 모임으로 진행하였습니다.

비대면 학술대회는 접근성이 좋아 평상시 학술대회보다 참석자 수가 증가하였으며, 지식의 전달과 나눔이라는 측면에서도 만족스러운 호응을 얻었습니다. 하지만, 비대면 학술대회를 지속하면서 직접 만남에 대한 심한 갈증을 느끼게 되었습니다. 얼굴을 마주하면서 인사를 하고 사적인 이야기를 나누거나, 프로그램에 포함되지 않은 이야기들, 얼굴을 마주하면서 자연스럽게 얻을 연구에 대한 조언이나 공동 연구에 대한 기획.. 등. 온라인 비대면 학술대회에서는 할 수 없었던 많은 것들에 대한 갈증이 커지고 있었습니다.

코로나 감염자수가 지난 1달간 크게 증가하여, 저를 포함한 주변의 많은 사람들이 코로나에 감염되어 어려움을 겪고 있습니다. 하지만, 격리와 회피만으로는 더 이상 코로나로부터 우리를 지켜줄 수 없다는 것을 알게 되면서 학술대회를 포함한 각종 모임에 대한 정부의 규제가 완화되었습니다.

이에 대한뇌졸중학회는 이번 6월4일(토)에 경주에서 개최하는 춘계학술대회를 전면 대면 학술대회로 진행하기로 하였습니다. 코로나 감염의 걱정보다는, 만남에 대한 우리의 갈증을 해소하는 것이 더 중요하다고 생각합니다. 이제 모여서 뇌졸중에 대한 연구나 정책에 대해서 진지한 토론과 제언을 하면서 뇌졸중 분야의 발전을 위해서 함께 노력해봅시다.

오랜 만에 가지는 대면 학술대회에 회원 여러분들의 적극적인 참여를 부탁드립니다. 특히, 젊은 전공의나 전임의들이 많이 참석하여, 선배 연구진들과 나눔을 가질 수 있도록 각 수련병원에서 선배 교수님들의 많은 배려를 부탁드립니다.

대한뇌졸중학회 회장 권순억 드림



Program at a glance

Individualized vs. Guideline-based Management

Time	Room A	Room B	Room C	Room D
08:50-09:00	Opening Remark			
09:00-10:30	Focused Session 1. Novel biomarkers for stroke	Focused Session 2. Genetic screening for CVD	질향상위원회/KSR위원회	
10:30-10:50		Coffee	Break	
10:50-11:50	Plenary Session. Individualized vs. Guideline-based Management			
11:50-12:20	General Assembly			
12:20-12:40		Coffee	Break	
12:40-13:40	Symposium 1 Symposium 2	Symposium 3 Symposium 4	정책/질향상위원회 (12:40~13:35)	
13:40-14:00		Coffee	Break	
14:00-15:20	Scientific Session 1	Scientific Session 2	Nursing Symposium	Special Session. Connection of acute
15:20-15:40		Coffee Break		stroke care participants in Korea (14:00~15:30)
15:40-17:00	진료지침위원회	심장색전연구회	재관류치료연구회	
17:00-18:00	Poster Presentation Professor-Led Poster Tour(@ 3F Poster Room)			







Daily program

Room A

08:50-09:00	Opening Remark	권순억 (대한뇌졸중학회 회장)
Focused Ses	sion 1. Novel biomarkers for stroke	좌장: 장대일 (경희의대), 김한영 (건국의대)
09:00-09:30	Novel blood biomarker for stroke	남기웅 (서울의대) ·········2
09:30-10:00	Novel image biomarker for acute stroke	허준녕 (연세의대) 4
10:00-10:30	Novel image biomarkers for cerebral atherosclerosis	김형준 (이화의대) 5
10:30-10:50	Coffee Break	
Plenary Sess	ion. Individualized vs. Guideline-based management 좌장: 권순억 (대한뇌졸중	학회 회장), 배희준 (대한뇌졸중학회 이사장)
10:50-11:10	Global perspectives for guideline update	Alejandro A. Rabinstein (Mayo clinic)8
11:10-11:30	Thrombus-based decision making	허지회 (연세의대) 12
11:30-11:50	Principle of genetic screening for antiplatelet therapy	이경열 (연세의대) 14
11:50-12:20	General Assembly	
12:20-12:40	Coffee Break	
Symposium :	1	좌장: 김종성 (울산의대)
12:40-13:10	Lowering the 'bad' cholesterol with high dose atorvastatin :	What is it and why it's important 송태진 (이화의대) 16
Symposium 2	2	좌장: 이병철 (한림의대)
13:10-13:40	Moderate-intensity rosuvastatin plus ezetimibe versus high- goal achievement in patients with recent ischemic stroke (R	intensity rosuvastatin for target LDL-C OSETTA-Stroke) 홍근식 (인제의대) 20
13:40-14:00	Coffee Break	
Scientific Se	ssion 1	좌장: 나정호 (인하의대), 손성일 (계명의대)
14:00-14:10	Presence of embolic source and favorable outcome in centra	l retinal artery occlusion 강동완 (서울의대) 22
14:10-14:20	Deep hybrid learning algorithm integrating clinical and magr imaging data for predicting early neurological deterioration	netic resonance after acute stroke 강동원 (울산의대) 23
14:20-14:30	Thromboelastography can predict the functional outcome af treatment in patients with acute ischemic stroke	ter endovascular 장준영 (울산의대) 25

14:30-14:40 Temporal muscle thickness can predict outcomes in patients who underwent reperfusion therapy 남효석 (연세의대) ………… 26



14:40-14:50	Functional outcome prediction based on machine learning model using images and clinical data	박성호 (인제의대) 27
14:50-15:00	Targeted metabolomic biomarkers for stroke subtyping	이응준 (서울의대) 28
15:00-15:10	Global hyperperfusion is associated with a worse outcome among acute ischemic stroke patients underwent successful endovascular treatment	양욱진 (서울의대) 30
15:10-15:20	Tldc1 and Mtnr1b: Atherosclerosis-related epigenetic biomarkers identified from blood inflammatory cells	김제 (충남의대) 32
15:20-15:40	Coffee Break	

진료지침위원회	i. Current updates of the Korean stroke guidelines	좌장: 흥근식 (인제의대)
15:40-15:45	Introduction of the Korean stroke guideline development	홍근식 (인제의대) 34
15:45-16:10	Endovascular reperfusion therapy in acute large vessel occlusion:	고상배 (서울의대) 35
16:10-16:35	Blood pressure management for stroke prevention	박종무 (을지의대) 36
16:35-17:00	Antithrombotic therapy in acute ischemic stroke	박홍균 (인제의대) 38
17:00-18:00	Poster Presentation Professor-Led Poster Tour(@ 3F Poster Room)	

박형종 (계명의대), 정혜선 (충남의대) 황재춘 (경북의대), 유성욱 (고려의대) 안성환 (조선의대), 김창헌 (경상의대)

Room B

Focused Session 2. Genetic screening for CVD	좌장: 김경문 (성균관의대), 남효석 (연세의대)
09:00-09:30 Intracranial stenosis (MMD, dissection)	김진권 (연세의대) 46
09:30-10:00 Small vessel disease	최재철 (제주의대) 51
10:00-10:30 Embolic stroke & coagulopathy	박홍균 (인제의대) 53
10:30-10:50 Coffee Break	
Symposium 3	좌장: 이광호 (성균관의대 명예교수)
12:40-13:10 Pluripotent effect of Cilostazol: Current and future perspe	ectives 김범준 (울산의대) 60
Symposium 4	좌장: 윤병우 (을지의대)
13:10-13:40 The clinical benefits of clopidogrel in patients with ischemi	ic stroke 김치경 (고려의대)62

13:40-14:00 Coffee Break



Daily program

Scientific Se	ssion 2 좌장: 김 응규 (인제의대), 이준	홍 (국민건강보험 일산병원)
14:00-14:10	Statement of the primary and thrombectomy-capable stroke centers for the establishment of the stroke system of care from the Korean stroke society	e development and 안상준 (가톨릭관동의대)64
14:10-14:20	Long sleep duration and dissatisfaction with sleep quality are associated with schemic stroke in young patients	th 김낙훈 (한양의대)66
14:20-14:30	Characteristics of wall shear stress according to mechanism of ischemic strewith atherosclerotic plaque of middle cerebral artery	oke 우호걸 (경희의대)68
14:30-14:40	Arterial dissection: A still underestimated cause of lateral medullary infarct	ion 양욱진 (서울의대) 70
14:40-14:50	Clinical significance of dizziness and imbalance in cervicocephalic arterial dissections of the posterior circulation	이성준 (아주의대) 71
14:50-15:00	Cardiovascular risk with proton pump inhibitors	김진권 (연세의대) 72
15:00-15:10	Association of free fatty acid level with cardioembolic stroke: A systematic review and meta-analysis	정다다 (성균관의대) 73
15:10-15:20	Impact of neuroimaging patterns for the detection of atrial fibrillation by implantable loop recorders in patients with embolic stroke of undetermined	d source 고지희 (제주의대) 75
15:20-15:40	Coffee Break	
심장색전연구호	희 좌장: 서우근 (성금	군관의대), 박만석 (전남의대)
15:40-16:00	Imaging patterns and pitfalls of embolic stroke 김범준 (서울의대), 김도연 (서울의대)78
16:00-16:20	Diagnostic approach and work up in the patients with embolic stroke of und 정종원 (성균곡	letermined source 관의대), 정다다 (성균관의대) 81

- 16:20-16:40
 Therapeutic intervention for the stroke patients with PFO
 김범준 (울산의대), 하상희 (울산의대)

 16:20-16:40
 지범준 (울산의대), 하상희 (울산의대)
- 16:40-17:00
 Panel discussion
 정진만 (고려의대), 우호걸 (경희의대), 은미연 (경북의대)
- 17:00-18:00 Poster Presentation Professor-Led Poster Tour(@ 3F Poster Room)

Room C

질향상위원회 / KSR위원회		좌장: 차재관 (동아의대), 박종무 (을지의대)
09:00-09:15	Stroke center 인증 소개	박희권 (인하의대) ········94
09:15-09:30	KSR소개	이경복 (순천향의대) 102
09:30-09:45	Stroke classification for KSR	김준태 (전남의대) 109
09:45-10:00	KSR 등록시 주의점과 stroke center인증에서의 팁	정한영 (서울의대) 112



안상준 (가톨릭관동의대), 안성환 (조선의대) 조방훈 (고려의대), 김예슬 (동강병원)

10:20-10:30	Q&A		
10:30-10:50	Coffee Break		
정책 / 질향상위	원회	좌장: 차재관 (동아의대), 빅	'태환 (서울의료원)
12:40-12:45	Opening	배희준 (대한	뇌졸중학회 이사장)
12:45-13:00	응급센터 및 지역 뇌혈관센터 시스템 개편 및 취약 지역 지원 방안	o	·l경복 (순천향의대) ······· 114
13:00-13:05	공공의료 및 1차 급성 뇌졸중 응급진료에 대한 학회 지원 방안	안상큼	준 (가톨릭관동의대) 115
13:05-13:10	Voting		이응준 (서울의대)
13:10-13:30	Panel discussion		
13:30-13:35	Closing	김경문 (대한뇌	졸중학회 부이사장)
Nursing sym	posium	좌장: 최수정 (성균관대),	이수주 (을지의대)
14:00-14:20	The acute stroke treatment before arriving at stroke unit		김중구 (제주의대) 118
14:20-14:40	The assessment of NIHSS by case studies		한정훈 (고려의대) 119
14:40-15:00	Nursing management in stroke unit	정원	년제 (삼성서울병원) 120
15:00-15:20	Patient discharge education	한경	성희 (서울아산병원) 121
15:20-15:40	Coffee Break		
재관류치료연구	¹ 회 Some issues in endovascular treatment of acute isch	emic stroke under curr 좌장: 허지회 (연대의대),	ent guideline 정철규 (서울의대)
15:40-15:55	Pearls and pitfalls in automated perfusion imaging in acute	ischemic stroke: RAPID	김영대 (연대의대) 124
15:55-16:10	Decision making for extended time window in non-RAPID	stroke center	박무석 (이화의대) 125
16:10-16:20	Q&A		
16:20-16:40	Adjunctive intra-arterial thrombolysis for large-vessel occl	usion	백성현 (서울의대) 128
16:40-17:00	Recent updates and issues in the endovascular treatment of	of the posterior circulation	n 김중구 (제주의대) 130

17:00-18:00 Poster Presentation Professor-Led Poster Tour(@ 3F Poster Room)

10:00-10:20 Panel discussion



Daily program

Room D

Special Session. Connection of acute stroke care participants in Korea			
		<u>ع</u>	장: 유경호 (한림의대), 홍지만 (아주의대)
14:00-14:15	Development of stroke education	program for EMS in Korea	홍지만 (아주의대) 134
14:15-14:30	Destination hospital selection for	severe acute diseases in Kore	ea 홍원표 (소방청 품질관리팀장) 139
14:30-14:45	Metrics and renovation of inter ho	ospital transfer for stroke	강지훈 (서울의대) 141
14:45-15:00	심뇌혈관질환 예방관리 극복을 위한 이	행연구 추진 전략	김원호 (질병관리청 심혈관질환연구과장) 147
15:00-15:30	Panel discussion	김원호 (질병관리청 심혈 이경복 (대한뇌졸중학회 정책이	관질환연구과), 흥원표 (소방청 품질관리팀) 사), 정근화 (서울의대), 이민우 (한림의대)



	Poster Presentation	
P001	Cerebral air or septic embolism associated with atrioesophageal fistula after atrial fibrillation ablation: 3 case reports	이한빈 (가톨릭의대) 150
P002	Efficacy and safety of emergency extracranialeintracranial bypass for revascularization within 24 hours in resolving large artery occlusion with intracranial stenosis	오재상 (순천향의대) 152
P003	Hypoperfusion even after successful mechanical thrombectomy	이응준 (서울의대) 153
P004	Case report of successful induced hypertension therapy in MCA dissection	송용권 (강원의대) 155
P005	Simultaneous cerebral and systemic embolism caused by aortic arch thrombus	고은별 (가톨릭의대) 156
P006	Different etiologic mechanisms and outcomes of isolated posterior inferior cerebellar artery infarction in young adults	김재우 (서울의료원) 158
P007	Non-contrast computed tomography versus computed tomography perfusion or magnetic resonance imaging for selecting thrombectomy candidates in early time window A single center experience 심근	w: 동현 (대구가톨릭의대) 159
P008	Repeated brachiocephalic vein thrombosis in a minor stroke patient	이창주 (조선의대) 161
P009	Acute cerebral infarction in a young patient with HIV and COVID-19 infection	조경준 (가천의대) 163
P010	Long-term outcomes of local tirofiban infusion for intracranial atherosclerosis-related oc	cclusion 최우찬 (경북의대) 165
P011	The long segmental carotid artery dissection treated with triple stents deployment	방성조 (계명의대) 167
P012	Untreated hypertension and prognosis paradox in acute ischemic stroke	임한솔 (가톨릭의대) 168
P013	Crossed aphasia after right frontal lobe and caudate nucleus infarction in a dextral: A cas	e report 김의현 (한림의대) 170
P014	Comparison of pharmacological induced hypertension and anticoagulation for rescue therapy of early neurological deterioration in lacunar stroke	박수현 (인하의대) 171
P015	Vertebral artery dissection with acute ischemic stroke after COVID-19 vaccination: Three case reports	김현기 (한양의대) 172
P016	Fibrosis-4 index and liver fibrosis are risk factors for long-term outcomes in atrial fibrillation-related stroke	정진만 (고려의대) 174
P017	Prediction of post-stroke cognitive impairment after acute ischemic stroke using machin learning approach	e 이민우 (한림의대) 175
P018	Cerebral small vessel disease burden and futile reperfusion after endovascular treatmen for acute ischemic stroke patients	t 이민우 (한림의대) 177
P019	HbA1c level and functional outcome by ischemic stroke subtypes and age $\frac{\circ}{2}$	상문 (국립보건연구원) 178
P020	Acute-phase brain natriuretic peptide as a marker of poor prognosis of ischemic stroke related to atrial fibrillation with preserved ejection fraction	김호규 (고려의대) 180

Poster presentation

P021	Euglycemic diabetic ketoacidosis in patients with postoperation stroke, taking SC	GLT2 inhibitor
		박희권 (인하의대) 181
P022	Comparison of acute ischemic stroke management before and after the addition COVID-19 screening in the emergency room	of 김제 (충남의대) 182
P023	Long-term care insurance service utilization among stroke survivors: National he insurance database study in South Korea	ealth 박덕호 (에스포항병원) 183
P024	A clinical study of 288 patients with anterior cerebral artery infarction	임한솔 (가톨릭의대) 184
P025	Cerebrovascular fibromuscular dysplasia with extracranial artery involvement	정매튜 (서울의대) 185
P026	Right frontal lobe lesion on diffusion-weighted imaging during transient global an A case report	nnesia: 최문관 (서울의료원) 187
P027	Left vertebral artery hypoplasia is associated with posterior circulation stroke, ba artery occlusion, and poor functional outcomes in patients with cardioembolic str	asilar roke 배재한 (울산의대) 188
P028	Are basal ganglia and corona radiata more susceptible to cerebral infarction cause by hypertension?	ed 김도형 (을지의대) 189
P029	Sudden sensorineural hearing loss due to basilar artery plaque without diffusion	restriction 김낙훈 (한양의대) 190
P030	Differences in recurrence rates of cardioembolic stroke according to the type of sused in patients with stroke caused by atrial fibrillation	statin 이준범 (홍익병원) 192
P031	Cerebral infarction with concomitant patent foramen ovale and pulmonary arter malformation: A case report	iovenous 노상미 (가톨릭의대) 194
P031 P032	Cerebral infarction with concomitant patent foramen ovale and pulmonary arter malformation: A case report Association between statin use and blood viscosity in patients with acute ischem	iovenous 노상미 (가톨릭의대) 194 ic stroke 황재춘 (경북의대) 195
P031 P032 P033	Cerebral infarction with concomitant patent foramen ovale and pulmonary arter malformation: A case report Association between statin use and blood viscosity in patients with acute ischem A case of pontine infarction presenting with contralateral conjugate eye deviatio	iovenous 노상미 (가톨릭의대) 194 ic stroke 황재춘 (경북의대) 195 n and hemiplegia 주요한 (충북의대) 196
P031 P032 P033 P034	Cerebral infarction with concomitant patent foramen ovale and pulmonary arter malformation: A case report Association between statin use and blood viscosity in patients with acute ischem A case of pontine infarction presenting with contralateral conjugate eye deviatio U-shaped associations between glycated albumin and obesity and role of il-10 in ischemic stroke	iovenous 노상미 (가톨릭의대) ······ 194 ic stroke 황재춘 (경북의대) ····· 195 n and hemiplegia 주요한 (충북의대) ····· 196 hyperacute 김예림 (한림의대) ····· 198
P031 P032 P033 P034 P035	Cerebral infarction with concomitant patent foramen ovale and pulmonary arter malformation: A case report Association between statin use and blood viscosity in patients with acute ischem A case of pontine infarction presenting with contralateral conjugate eye deviatio U-shaped associations between glycated albumin and obesity and role of il-10 in ischemic stroke Development of a flexible self-calculation scoring model to determine stroke risk	iovenous 노상미 (가톨릭의대) ······ 194 ic stroke 황재춘 (경북의대) ····· 195 n and hemiplegia 주요한 (충북의대) ····· 196 hyperacute 김예림 (한림의대) ···· 198 c 김대현 (연세의대) ···· 199
P031 P032 P033 P034 P035 P036	Cerebral infarction with concomitant patent foramen ovale and pulmonary arter malformation: A case report Association between statin use and blood viscosity in patients with acute ischem A case of pontine infarction presenting with contralateral conjugate eye deviatio U-shaped associations between glycated albumin and obesity and role of il-10 in ischemic stroke Development of a flexible self-calculation scoring model to determine stroke risk Effect of IoT wearable devices-applied daily walking activities on the managemen metabolic syndrome: Utilization of lifelog big data platform	iovenous 노상미 (가톨릭의대) ······ 194 ic stroke 황재춘 (경북의대) ····· 195 n and hemiplegia 주요한 (충북의대) ····· 196 hyperacute 김예립 (한림의대) ····· 198 c 김대현 (연세의대) ····· 199 nt of 조훈 (연세의대) ····· 201
P031 P032 P033 P034 P035 P036 P037	Cerebral infarction with concomitant patent foramen ovale and pulmonary arter malformation: A case report Association between statin use and blood viscosity in patients with acute ischem A case of pontine infarction presenting with contralateral conjugate eye deviatio U-shaped associations between glycated albumin and obesity and role of il-10 in ischemic stroke Development of a flexible self-calculation scoring model to determine stroke risk Effect of IoT wearable devices-applied daily walking activities on the managemen metabolic syndrome: Utilization of lifelog big data platform The risk of stroke and major bleeding in patients with non-valvular atrial fibrillati A comparative analysis between non-vitamin K antagonist oral anticoagulants ar warfarin in clinical data warehouse	iovenous 노상미 (가톨릭의대) ······ 194 ic stroke 황재춘 (경북의대) ····· 195 n and hemiplegia 주요한 (충북의대) ····· 196 hyperacute 김예립 (한림의대) ···· 198 c 김대현 (연세의대) ···· 199 nt of 조훈 (연세의대) ···· 201 on: dd 권덕 (국민건강보험 일산병원) ···· 203
P031 P032 P033 P034 P035 P036 P037	Cerebral infarction with concomitant patent foramen ovale and pulmonary arter malformation: A case report Association between statin use and blood viscosity in patients with acute ischem A case of pontine infarction presenting with contralateral conjugate eye deviatio U-shaped associations between glycated albumin and obesity and role of il-10 in ischemic stroke Development of a flexible self-calculation scoring model to determine stroke risk Effect of IoT wearable devices-applied daily walking activities on the managemen metabolic syndrome: Utilization of lifelog big data platform The risk of stroke and major bleeding in patients with non-valvular atrial fibrillati A comparative analysis between non-vitamin K antagonist oral anticoagulants an warfarin in clinical data warehouse	iovenous 노상미 (가톨릭의대) ······ 194 ic stroke 황재춘 (경북의대) ····· 195 n and hemiplegia 주요한 (충북의대) ····· 196 hyperacute 김예림 (한림의대) ····· 198 c 김대현 (연세의대) ····· 199 nt of 조훈 (연세의대) ····· 201 on: d 권덕 (국민건강보험 일산병원) ···· 203
P031 P032 P033 P034 P035 P036 P037 P038 P039	Cerebral infarction with concomitant patent foramen ovale and pulmonary arter malformation: A case report Association between statin use and blood viscosity in patients with acute ischem A case of pontine infarction presenting with contralateral conjugate eye deviatio U-shaped associations between glycated albumin and obesity and role of il-10 in ischemic stroke Development of a flexible self-calculation scoring model to determine stroke risk Effect of IoT wearable devices-applied daily walking activities on the managemen metabolic syndrome: Utilization of lifelog big data platform The risk of stroke and major bleeding in patients with non-valvular atrial fibrillati A comparative analysis between non-vitamin K antagonist oral anticoagulants ar warfarin in clinical data warehouse Multiple antithrombotic therapy in ischemic stroke of two or more causes with atrial fibrillation based on linked data Endovascular reperfusion therapy beyond 24 hours in large vessel occlusion pati- neurologic deterioration	iovenous 노상미 (가톨릭의대) ······ 194 ic stroke 황재춘 (경북의대) ····· 195 n and hemiplegia 주요한 (충북의대) ····· 196 hyperacute 김예립 (한림의대) ····· 198 c 김대현 (연세의대) ····· 198 c 김대현 (연세의대) ····· 199 nt of 조훈 (연세의대) ····· 201 on: id 너전덕 (국민건강보험 일산병원) ····· 203 김태정 (서울의대) ····· 205 ents with 이동건 (조선의대) ····· 207



P041	A case with endovascular treatment failure associated with distal embolism in a patient of acute embolic tandem occlusion	고은별 (가톨릭의대) 209
P042	A case of successful intracranial artery stenting in patient with dissection of right distal internal carotid artery	송용권 (강원의대) 211
P043	Sudden cardiac arrest after carotid artery stent insertion in a patient who experienced recent acute myocardial infarction	김민경 (고려의대) 212
P044	Delayed rupture of an anterior communicating artery pseudoaneurysm caused by distal occlusion thrombectomy using a stent retriever: Case report and mechanism of inju 심금	ury 동현 (대구가톨릭의대) 213
P045	M2 stenting in patients with perfusion defect on computed tomography without diffusion restriction in magnetic resonance imaging	이동환 (을지의대) 214

"Individualized vs. Guideline-based Management"

Room A

Focused Session 1. Novel biomarkers for stroke

좌장 | 장대일 (경희의대), 김한영 (건국의대)





Novel blood biomarker for stroke

Ki-Woong Nam

Seoul Metropolitan Government-Seoul National University Boramae Medical Center

Although stroke is a vascular disease, many factors are involved in its occurrence, progression, and prognosis. Prior to the development of neuroimaging techniques, efforts were made to find blood biomarkers for the diagnosis of stroke. As the diagnosis of stroke lesions became easier with the advent of magnetic resonance imaging, the use of blood biomarkers changed to predict the prognosis of stroke or to select and manage high-risk groups. In this process, various glycemic profiles, lipid profiles, inflammatory markers, endothelial markers, cardiac markers, and thrombotic markers appeared and have been widely used in the clinical fields. Furthermore, recently, there is a movement for the development of novel biomarkers for the purpose of discovering new pathophysiology of stroke and finding a new therapeutic target.

With the concept of the brain-gut axis, interest in changes in intestinal microbiota after stroke is increasing. The gastrointestinal tract is a major immune organ that is directly affected after stroke, and the gut inflammatory and immune response generated here also plays a key role in the pathophysiology of stroke. Thus, the relationship between the types of microbiota or their metabolites and the occurrence, mechanisms, and prognosis of stroke is being studied, and it has potential as a new therapeutic target. All diseases are influenced by genetic factors, large or small. Stroke research has also tried to identify the influence of genetic factors, but there has been no significant progress other than the genes of certain conditions (e.g., NOTCH3, MTHFR, etc.) related to some strokes. With the subsequent technological development, analysis of various specimens such as microRNAs and extracellular vesicles became possible gradually, and recently, as a genome-wide association study (GWAS) became possible, numerous (single nucleotide polymorphism) SNP variants related to stroke are being revealed. Although it can only reveal a correlation, not a causal relationship, and is not currently being applied in the clinical field, GWAS is expected to play a major role in the development of new treatments in the future.

Finally, new indices are emerging that quantify specific pathological conditions related to stroke using a combination of well-known biomarkers. Neutrophil-to-lymphocyte ratio, platelet-to-lymphocyte ratio, and systemic immune-inflammation index have been proposed on the theoretical background of changes in neutrophils, lymphocytes, and platelets in the post-stroke immunosuppression status, and many studies show higher predictive power than white blood cell counts or high-sensitivity C-reactive protein. For insulin resistance, triglyceride-glucose index is widely used to replace the conventional HOMA-IR. In addition, to represent atherogenic dyslipidemia (i.e., high triglyceride, low HDL-cholesterol, small/dense LDL-cholesterol) that is closely related to atherosclerotic complications, the triglyceride/HDL-cholesterol

ratio and atherogenic index of plasma appeared, suggesting the predictability of large artery stroke. With the advent sensitive and specific techniques such as magnetic resonance imaging, blood biomarkers are unlikely to replace brain imaging in stroke diagnosis. However, to reveal the pathophysiology of stroke and to develop therapeutic agents, new biomarkers for research purposes will still be constantly needed. In addition, it is thought that it will be useful in the clinical field to create a new index or ratio that reflects a specific pathological condition with a combination of existing well-known biomarkers.

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Novel image biomarker for acute stroke

JoonNyung Heo^{1,2}

¹Department of Radiology, Yonsei University College of Medicine, Seoul, Korea ²Department of Neurology, Yonsei University College of Medicine, Seoul, Korea

Brain imaging is the most important diagnostic test for patients with acute ischemic stroke. Recent advances in the area enabled multiple choices for treatment in hyperacute stage of stroke. In addition to intravenous alteplase thrombolysis, mechanical thrombectomy is becoming widely accepted as a safe but effective treatment when large vessel occlusion is seen on angiographic imaging. In this context, for patients with onset within 6 hours, noninvasive angiographic evaluation including CT angiography and MR angiography is recommended by current guidelines. Ischemic core and penumbra estimation using perfusion imaging is recommended for patients whose onset is between 6 hours and 24 hours. Numerous solutions were developed to automatically perform calculation for ischemic core and penumbra However, there are many technological and clinical pitfalls concerning this methodology and is subject to improvement. Perfusion imaging is known to be especially ineffective for posterior circulation stroke. Recent studies developed novel scoring system for posterior circulation stroke, which showed promising results. In addition to cerebral blood flow and time to maximum flow on perfusion imaging, hypoperfusion index and perviousness may provide additional insight into ischemic core and penumbra for acute stroke. Permeability calculated from perfusion CT may help in prediction of hemorrhagic transformation after thrombolysis. Net water uptake derived from the density difference between potentially infarcted tissue and normal tissue on CT may be predictive of malignant infarction. Recent research concerning machine learning and radiomics methodology may provide a novel methodology for image interpretation in acute ischemic stroke.

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Novel image biomarkers for cerebral atherosclerosis

Hyung Jun Kim

Department of Neurology, Seoul Hospital, College of Medicine, Ewha Woman's University, Seoul, Korea

Ischemic stroke secondary to intracranial atherosclerosis (ICAS) is common in the Asian population. ICAS-related large vessel occlusion (LVO) necessitates endovascular thrombectomy (EVT) in a significantly high percentage of patients. The EVT strategy required in these patients differs from that used in patients with embolic infarction (more rescue treatments and longer procedure times are required for successful recanalization owing to higher re-occlusion rates) [1]. Also, it has also been reported that atherosclerosis (mild to moderate stenosis) in proximal vessels was observed in a large proportion of cryptogenic strokes [2]. Therefore, accurate diagnosis of intra- and extracranial atherosclerosis using various imaging tools is important for acute management and secondary prevention in patients.

Transcranial Doppler, carotid duplex, magnetic resonance (MR) angiography, computed tomography angiography, and digital subtraction angiography (DSA) represent conventional modalities used for detection of atherosclerosis. Each imaging technique is associated with specific advantages and disadvantages, and these modalities complement each other. Recent technological advances have led to the introduction of novel imaging tools with improved diagnostic accuracy for intracranial large artery disease (ILAD), to overcome the limitations of conventional techniques. Conventional DSA-documented truncal-type occlusion, collateral status, and atherosclerotic burden of vessels can indicate ICAS-related LVO in patients deemed eligible for EVT [3]. However, additional analysis of clot composition on gradient echo images using the machine learning technique aids with more accurate identification of a clot to diagnose ICAS-related LVO.

High-resolution MR imaging (HR-MRI) can confirm the characteristic findings of atherosclerosis, including eccentric enhancement and intraplaque hemorrhage in patients with ILAD, which is useful to differentiate between moyamoya disease and arterial dissection [4]. Notably, 7T HR-MRI can detect culprit plaques in patients with cryptogenic stroke. Intravascular ultrasonography is useful to confirm the characteristics of atherosclerosis, and fractional flow reserve analysis is used for perfusion analysis in patients with ICAS.

In this lecture, we will discuss innovative imaging biomarkers of cerebral atherosclerosis and the usefulness of each technique for diagnosis of cerebral atherosclerosis

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"Individualized vs. Guideline-based Management"

Room A

Plenary Session. Individualized vs. Guideline-based management

좌장 | 권순억 (대한뇌졸중학회 회장), **배희준** (대한뇌졸중학회 이사장)



Global perspectives for guideline update

Alejandro A. Rabinstein

Mayo clinic











Korean Stroke Society 9











Back to the global guidelines: what we are doing at WSO

- Build a true international, representative team
- Use rigorous methods of systematic review to identify all relevant guidelines (registered in PROSPERO)
- Grade the quality of the guidelines (AGREE II tool)
- Maintain categorization of minimal, essential and advanced resource requirements
- Integrate guideline development with implementation teams
- Plan how to support subsequent evaluation of performance measures

Conclusions

- Global stroke guidelines must be applicable and useful in regions with various levels of resources
- Even the best practice guidelines are not be helpful unless adequately disseminated and implemented
- Successful global adoption of guidelines will demand local champions and time and money for dissemination and implementation efforts
- Evaluation and feedback are crucial for sustained adherence to guidelines in daily practice

43

Thrombus-based decision making

Ji Hoe Heo

Department of Neurology, Yonsei University College of Medicine

Decision making for preventive treatment of stroke depends on the etiologic mechanism and subtype classification of stroke. However, the presence of certain stroke etiology does not necessarily mean that it is an actual cause of the stroke. In addition, stroke patients may often have multiple etiologies or do not have any identifiable etiologies. Thus, etiologic classification of the stroke subtype is probabilistic. Thrombus is an end-product of thrombosis, and is the cause of vascular events. Thrombus is also the primary target of acute and preventive treatment. Characteristics of thrombus may somehow reflect the mechanism of thrombosis. In stroke patients with cancer and cardiac vegetation, thrombi retrieved from the occluded cerebral artery are platelet-rich and erythrocyte-poor. In contrast, thrombi from the occluded vein in patients with cancer are erythrocyte-rich and platelet-poor, which suggests that the thrombosis mechanism is different between arterial and venous thrombosis in cancer. The histologic examination in stroke patients with cancer and co-existing other etiologies may provide a clue of the most probable stroke etiology, and may help to make a decision for the appropriate preventive treatment. Traditional teaching was that the cardioembolism induces erythrocyte-rich thrombus while atherosclerosis induces platelet and fibrin-rich thrombus. However, studies on histology of thrombi from occluded cerebral arteries showed that the thrombus composition does not differ between patients with cardioembolism and those with atherothrombosis. Future studies are required to identify markers in thrombus for accurate diagnosis of various stroke etiologies.

While histologic examination of thrombus may provide direct information on its characteristics and thrombosis mechanism, thrombus is obtainable only in a small portion of stroke patients. Furthermore, it does not provide timely information for decision making for acute treatment. Imaging analysis of thrombus may be helpful for decision making in situation of acute treatment. Since the successful introduction of endovascular treatment in large cerebral artery occlusion, it has been questioned whether IV thrombolysis can be skipped prior to endovascular thrombectomy. Recent randomized trials on this issue do not support skipping IV thrombolysis prior to endovascular thrombectomy. In this context, patient selection based on thrombus imaging may be helpful for decision making of direct endovascular thrombectomy. Volume and density of thrombus can be measured on thin-section noncontrast CT scan. Thrombus volume on initial CT is closely associated with recanalization following IV thrombolysis. Early recanalization by IV thrombolysis fails in almost all patients with thrombus >200 mm³.Direct endovascular thrombectomy may be considered in selected patients with large thrombus volume. Although evidence

is still insufficient or lacking, histologic and imaging analyses of thrombus may help to determine the most likely etiology of stroke and to enhance individualization and precision in decision making for acute and preventive treatment in the future.

Principle of genetic screening for antiplatelet therapy

Kyung Yul Lee

Department of Neurology, Yonsei University College of Medicine

Clopidogrel is widely used as a single or dual combination antiplatelet for secondary prevention in patients with ischemic stroke. The CYP2C19 genotype differentially affects the liver metabolism of clopidogrel, which may influence the preventive effect. Patients with CYP2C19 loss-of-function (LOF) genotype are unable to metabolize clopidogrel effectively and hence are at an increased risk for cardiovascular (CV) ischemic events. Studies on whether the stroke preventive effect differs by CYP2C19 genotype in ischemic stroke patients have shown controversial results. However, a meta-analysis showed that carriers of CYP2C19 LOF genotype had greater risk of stroke than non-carriers. Also recently published clinical trial (CHANCE 2) showed better stroke preventive effect of ticagrelor than clopidogrel in acute minor ischemic stroke or TIA patients with CYP2C19 LOF carrier. Although more studies are warranted to endorse the routine use of CYP2C19 genetic testing in clinical practice, the available evidence does provide relevant support for the use of a precision medicine approach based on geno-type-guided selection of P2Y12 inhibitor therapy.

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"Individualized vs. Guideline-based Management"

Room A

Symposium 1

좌장 | 김종성 (울산의대)





Lowering the 'bad' cholesterol with high dose atorvastatin : What is it and why it's important

Tae Jin Song

Department of Neurology, Ewha Womans University Hospital

SPARCL trial을 비롯하여 여러 연구에서 뇌졸중에서 스타틴 투여의 이점이 입증된 바 있다. 스타틴은 뇌졸중 환자의 2차예방을 위한 1차 치료제이다. 스타틴은 HMG-CoA 환원효소를 억제하고, 주로 LDL-C 감소를 통해 혈관질환 발생의 위험성을 낮추며, 최대강도의 스타틴은 LDL-C 수치를 기저치 대비 55-60% 감소시킨다. 최근의 가이드라인들은 LDL-C를 적극적으로 낮추는 것을 권장하고 있다. 가이드라인에서 제시하는 바를 종합하면 뇌졸중 환자에서는 최대 내약용량의 스타틴을 우선적으로, 그리고 가급적 빠르게 투약하는 것이 권장된다.

스타틴은 LDL-C 감소 효과 이외에도 여러가지 다면발현성 (pleiotropic) 효과들이 있는데, 혈관내피세포 기능 호전, 산화질소 생체이용률 향상, 항산화효과, 염증반응 억제, 동맥경화반의 안정 등이 있다 (Figure 1). 이러한 다면발현성 효과들은 뇌졸중환자에서 스타틴 사용이 도움된다는 근거로서 활용되고 있다.

스타틴은 뇌졸중 발병 전, 즉 뇌졸중 환자에서 스타틴을 질병 발생 전에 복용하고 있었던 경우 뇌졸중의 예후가 좋았다는 연구결과가 있으며 예후 뿐만 아니라 뇌경색의 크기나 곁순환의 유지 또는 발달 등과도 유의하게 연관되어 있음이 확인되었다.

급성기 뇌졸중 환자에서 스타틴 투여에 대한 연구에서는 허혈성 뇌졸중 발생 2일 이내의 환자를 대상으로 로슈바스타 틴 20mg과 위약을 비교한 EUREKA trial에서 로슈바스타틴 투여군에서 출혈성 변환이 상대적으로 적게 발생하였다. 혈전용해치료를 받은 환자를 대상으로 한 관찰 연구에서 스타틴 투여는 향후 좋은 예후와 연관되어 있었으며 특히



고강도이거나 조기 투여시에 더 예후가 좋았다. 또한 고강도, 조기투여에도 불구하고 출혈성 변환이나 뇌내출혈의 위험성이 증가되지 않았다. 최근 연구 중 Treat Stroke to Target (TST) trial은 대한민국과 프랑스에서 시행된 임상시험으로 죽상동맥경화를 동반한 뇌졸중에서 LDL-C 수치 조절의 목표를 70mg/dL미만과 70~100mg/dL로 나누어 양 군에서 심뇌혈관질환 발생 위험성을 확인한 연구이다. 이 연구에서는 70mg/dL 군에서 뇌내출혈 발생의 위험성은 유의하게 증가시키지 않으면서 심뇌혈관질환 발생 위험성은 70~100mg/dL 군보다 낮았다. 따라서, 급성기 뇌졸중환자, 혈전용해치료를 받은 뇌졸중 환자, 2차예방이 필요한 뇌졸중 환자 모두에서 특별한 금기증이 없다면 고강도 스타틴을 가급적 빠르게 투여하는 것이 합리적이라 할 수 있다.

"Individualized vs. Guideline-based Management"

Room A

Symposium 2

좌장 | 이병철 (한림의대)





Moderate-intensity rosuvastatin plus ezetimibe versus high-intensity rosuvastatin for target LDL-C goal achievement in patients with recent ischemic stroke (ROSETTA-Stroke)

Keun-Sik Hong

Department of Neurology, Inje University Ilsan Paik Hospital

Background and aims: In patients with ischemic stroke due to atherosclerosis or having other comorbid atherosclerotic disease, statin therapy is recommended to prevent recurrent stroke and other atherosclerotic cardiovascular events. However, the target LDL-C goal achievement rate in patients with recent ischemic stroke has not been well studied. Ezetimibe added to moderate-intensity rosuvastatin versus high-intensity rosuvastatin alone may provide a greater LDL-C reduction in patients with recent ischemic stroke.

Methods: This randomized, open-label, controlled trial assigned patients with recent ischemic stroke <90 days to rosuvastatin 10 mg plus ezetimibe 10 mg once daily (ROS/EZT 10/10) or to rosuvastatin 20 mg once daily (ROS 20). Key inclusion criteria were statin therapy indicated by guidelines and no pre-stroke statin use. The primary endpoint was the rate of LDL-C reduction >50% at 3 months. Key secondary endpoints were the rate of achieving LDL-C <70 mg/dL, the absolute LDL-C level change, proportion of patients achieving multiple lipid goals, and composite of major vascular events. Safety endpoints included all cause of death, new onset diabetes, fatigue assessed using the Fatigue Severity Scale, rhabdomyolysis, and significant hepatic dysfunction (AST or ALT elevation >3 times of baseline levels). Baseline LDL-C levels should be measured before or within 3 days of statin therapy initiation. This trial was funded by Hanmi Pharm and registered at ClinicalTrials.gov (NCT03993236)

Results: Of 584 randomized, 530 were included in the modified intention-to-treat analysis. Per-protocol analysis included 499 and safety analysis included 582 patients. The median interval from index stroke to initiation of study medications was 3.0 (IQR 2.0-4.0) days. The baseline LDL-C level was 130.2±34.7 mg/dL in the ROS/EZT-10/10 group and 132.2±39.6 mg/dL and in the ROS-20 group. The main results will be presented at the conference.

Conclusions: ROSETTA-Stroke is the first trial comparing moderate-intensity rosuvastatin plus ezetimibe and high-intensity rosuvastatin in Korean patients with recent ischemic stroke. The trial findings will inform clinical decision for the selection of lipid-lowering therapy to achieve the target LDL-C effectively and safely.

"Individualized vs. Guideline-based Management"

Room A

Scientific Session 1

좌장 | 나정호 (인하의대), 손성일 (계명의대)





Presence of embolic source and favorable outcome in central retinal artery occlusion

Dong-Wan Kang¹, Keun-Hwa Jung¹, Wookjin Yang¹, Youngjoon Kim¹, Matthew Chung¹, Jiyeon Ha¹, Eunchae Park¹, Sohyun Jeon¹, Hyein Jeong¹, Eung-Joon Lee¹, Han-Yeong Jeong¹, Jeong-Min Kim¹, Sang-Bae Ko¹, Seung-Hoon Lee¹

¹Neurology, Seoul National University Hospital, Seoul, Korea, Republic of

Purpose: Central retinal artery occlusion (CRAO) is a form of ischemic stroke. Although thromboembolism is known to be the most common cause, 38~50% of CRAOs remain unknown etiology, which may potentially be a distinct pathomechanism. Little is known about functional outcomes according to the etiologies. Here, we investigated the visual outcome of the CRAO with and without the presence of embolic sources.

Methods: We retrospectively reviewed the patients with CRAO who visited the hospital within 7 days from symptom onset between 2000 and 2021. Baseline characteristics including initial VA, follow-up VA at 1 month, use of thrombolytics, onset-to-visit time, and comorbidities, and brain images including MR angiography and CT angiography were reviewed. CRAO with the embolic source was defined when there was evidence of cardioembolism (CE), large artery atherosclerosis (LAA), diseases causing hyper-coagulable state, or carotid dissection. CRAO without embolic source was defined when there was no evidence of embolic source despite workups or the presence of vasculitis that can directly involve the central retinal artery. Improvement of VA was defined by a more than 0.3 decrease of the logarithm of the minimum angle of resolution (LogMAR) at 1 month.

Results: Of the 114 patients, the median onset-to-visit time was 24h [IQR 8.4–72]. VA was improved in 38.6% of the cases (initial LogMAR, 2.2 \pm 0.5; LogMAR at 1 month, 2.0 \pm 0.6, n = 44). Sixty-three (55.3%) and 51 (44.7%) patients were classified as CRAO with and without embolic source, respectively. Patients with the embolic source were more commonly associated with improvement of VA than no improvement (70.5% vs. 55.3%, P = 0.017). In a multivariable logistic regression analysis, CRAO with embolic source remained an independent predictor of improvement of VA (OR 2.52, 95% CI 1.04–6.09). Intraarterial thrombolysis did not predict improvement of VA (OR 0.99, 95% CI 0.31–3.17).y

Conclusions: CRAO with the presence of an embolic source was closely related to the functional improvement of VA. This observation might be linked to the difference in etiological mechanisms of CRAO.
Deep hybrid learning algorithm integrating clinical and magnetic resonance imaging data for predicting early neurological deterioration after acute stroke

Dong-Won Kang¹, Young-Sun Kim¹, Ga-Young Park¹, Eun-Jae Lee¹, Jong-Ho Park², Jae-Guk Kim³, Ji-Hyun Kwon⁴, Geun-Sik Hong⁵, Eung-Gyu Kim⁶, Dae-II Chang⁷, Hahn-Young Kim⁸, Yeong-Bae Lee⁹, Man-Seok Park¹⁰, Ja-Seong Koo¹¹, Keun-Hwa Jung¹², Jin-Kuk Do¹³, Won-Chul Shin¹⁴, Yong-Seok Lee¹⁵, Jay-Chol Choi¹⁶, Seong-Ho Koh¹⁷, Ji-Man Hong¹⁸, Moon-Ku Han¹⁹, Tae-Kyeong Lee²⁰, Jun Lee²¹, Dong-Wha Kang^{1,#}, PRECISE investigators

¹Department of Neurology, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea.

²Department of Neurology, Myongji Hospital, Goyang, Korea.

- ³Department of Neurology, Daejeon Eulji Medical Center, Daejeon, Korea.
- ⁴Department of Neurology, Ulsan University Hospital, Ulsan, Korea.

⁵Department of Neurology, Ilsan Paik Hospital, Ilsan, Korea.

⁶Department of Neurology, Busan Paik Hospital, Busan, Korea.

⁷Department of Neurology, Kyung Hee University Medical Center, Seoul, Korea.

⁸Department of Neurology, Konkuk University Hospital, Seoul, Korea.

⁹Department of Neurology, Gachon University Gil Medical Center, Incheon, Korea.

¹⁰Department of Neurology, Chonnam National University Hospital, Gwangju, Korea.

¹¹Department of Neurology, Seoul St. Mary's Hospital, Seoul, Korea.

¹²Department of Neurology, Seoul National University Hospital, Seoul, Korea.

¹³Department of Neurology, Daegu Catholic University Medical Center, Daegu, Korea.

¹⁴Department of Neurology, Kyung Hee University Hospital at Gangdong, Seoul, Korea.

¹⁵Department of Neurology, Seoul National University Boramae Medical Center, Seoul, Korea.

¹⁶Department of Neurology, Jeju National University Hospital, Jeju, Korea.

¹⁷Department of Neurology, Hanyang University Guri Hospital, Guri, Korea.

¹⁸Department of Neurology, Ajou University Hospital, Suwon, Korea.

¹⁹Department of Neurology, Seoul National University Bundang Hospital, Seongnam, Korea.

²⁰Department of Neurology, Soonchunhyang University Bucheon Hospital, Bucheon, Korea.

²¹Department of Neurology, Yeungnam University Hospital, Daegu, Korea.

[#]corresponding author

Purpose: Predicting early neurological deterioration (END) in the acute stroke stage is challenging. We aimed to develop a novel prediction model for END based on clinical and imaging data using a Deep Hybrid Learning (DHL) algorithm. Methods: The anti-platelet Precision Medicine to Prevent Stroke Early Progression and Recurrence (PRECISE) database constitutes in-hospital data from 21 stroke centers in South Korea between 2019 and 2021. In this database, patients with acute ischemic stroke who visited the hospital within 72 hours of symptoms onset were prospectively enrolled if they gave their informed consent. Clinical and MRI data were also collected. In terms of the outcome, END during admission was also recorded, with the occurrence being determined by the attending physician's judgment. We created a DHL algorithm model based on clinical and MR imaging data to predict END during admission. Only MR images taken within 72 hours of onset were used in this study. The data were divided into the train (70%), and test (30%) sets. The learning process of the DHL algorithm's END prediction consisted of three stages. The first stage used a 3D-convolutional neural network to extract 512 image features from MRI images. In the second stage, multimodal features, which integrated 43 clinic test features (demographic, blood pressure, etc.) and 512 image features, were used as input data for machine learning (random forest algorithm). Finally, some features for learning were chosen and trained using feature importance analysis and forward feature selection. The algorithm's performance was calculated as the area under the curve (AUC) through the test set and compared with the performance results of single modal data Results: During the study period, 842 stroke patients were enrolled; 76 patients developed END while in the hospital. The DHL algorithm used a combination of 4 clinical test features and 7 MR image features. The final algorithm for END prediction using multimodal data had an AUC of over 0.8, higher than the algorithm developed solely using clinical or imaging data

Conclusion: Combining clinical and imaging data may be more beneficial than clinical data alone in predicting END in acute stroke. DHL may be an appropriate algorithm to develop a prediction model due to the difference in the nature of clinical and imaging data

Thromboelastography can predict the functional outcome after endovascular treatment in patients with acute ischemic stroke

Jae-Chan Ryu¹, Jun Young Chang¹

¹Neurology, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea, Republic of

Purpose: Thromboelastography (TEG) is a useful for predicting hemorrhagic transformation, early neurological deterioration (END), and functional outcome after stroke. We investigated whether TEG value could also be useful in predicting functional outcome via various intraprocedural and postprocedural factors in patients with acute large vessel occlusive (LVO) stroke who underwent endovascular treatment (EVT).

Methods: Patients with LVO stroke who underwent EVT between March 2018 and March 2020 at two tertiary hospitals were included. The association between R on TEG and functional outcome was evaluated. The primary outcome was the achievement of functional independence defined as the achievement of a modified Rankin Scale (mRS) score of 0–2 at 3 months after the index stroke. As a secondary outcome, mRS score measured as an ordinal variable and mRS score of 0–1 (disability free) at 3 months were also evaluated.

Results: Among a total of 160 patients (mean age, 70.6 \pm 12.3 years; 103 [64.4%] men), 57 (56.4%) achieved functional independence at 3 months. R, both as a continuous (odds ratio [OR]: 1.45, 95% confidence interval [95% CI]: 1.09–1.92, P = 0.011) and dichotomized parameters (R < 5 min [OR: 0.37, 95% CI: 0.16–0.82, P = 0.014]), were inversely associated with increased odds of achieving functional independence (mRS score 0-2) after multivariable analysis. The association was still consistent when the outcome was the achievement of disability free (mRS score 0–1) or mRS score analyzed as an ordinal variable.

Conclusions: Our study revealed that decreased R was negatively associated with favorable functional outcome in patients with acute LVO stroke who underwent EVT irrespective of periprocedural outcomes and END. R can be a useful TEG parameter for predicting functional independence after EVT, which needs further validation with larger prospective cohort study.

Temporal muscle thickness can predict outcomes in patients who underwent reperfusion therapy

Hyo Suk Nam¹, Young Dae Kim¹, Inhwan Lim¹, Soon-Ho Hong¹, Ji Hoe Heo¹

¹Neurology, Yonsei University College of Medicine, Seoul, Korea, Republic of

Purpose: Temporal muscle thickness (TMT) has been reported as a novel surrogate marker for skeletal muscle mass, function, and nutritional status. A few studies reported the association between TMT and outcome in patients with ischemic stroke. Moreover, the prognostic significance of TMT on outcomes in reperfusion therapy has not been reported. We investigated the value of TMT in predicting outcomes of acute ischemic stroke patients who underwent reperfusion therapy.

Methods: We analyzed data of patients who underwent reperfusion therapy from the Selection Criteria in Endovascular Thrombectomy and Thrombolytic Therapy (SECRET) registry. Using CT images before reperfusion therapy, TMT was measured bilaterally perpendicular to the long axis of the temporal muscle at the slice 5 mm above the orbital roof. TMT on the left and on the right were determined separately and calculated as mean values for analysis. Primary outcomes were defined as poor functional outcome at 3 months (modified Rankin scale score, \geq 3) and secondary outcomes were defined as death within 6 months. We developed statistical models to predict outcomes using univariate and multivariate logistic regression analyses with backward (Wald) selection.

Results: Prospective SECRET cohort included 333 patients. Among them, patients who had poor CT image qualities were excluded and 304 patients were finally included. Median age was 71 years old [interquatile range (IQR) 59 - 78] and men were 61.8%. Initial National Institutes of Health Stroke Scale (NIHSS) score was 11 (IQR 5 - 16). Mean TMT was 7.7 \pm 2.3 mm. Poor outcomes at 3 months occurred in 100 patients (33.4%). TMT was thinner in patients with poor outcomes (7.0 \pm 2.2 mm) compared to good outcomes (8.0 \pm 2.2 mm, p <0.001). Death within 6 months were occurred in 21 patients (6.9%). TMT was thinner in dead patients (5.5 \pm 1.5 mm) compared to survival patients (7.8 \pm 2.2 mm, p <0.001). Multivariate logistic regression analysis showed that TMT was an independent predictor of poor outcome at 3 months [odds ratio (OR) 0.857, 95% confidence interval (CI) 0.742 - 0.989]. TMT was also an independent predictor of death within 6 months (OR 0.563, 95% CI 0.414 - 0.766).

Conclusions: We demonstrated that TMT was predictive of poor functional outcome at 3 months and death within 6 months after reperfusion therapy. Because of simple measurement using routine CT before reperfusion therapy, TMT might be helpful to predict outcomes after reperfusion therapy.

Functional outcome prediction based on machine learning model using images and clinical data

Seongho Park¹

¹Neurology, Inje University Haeundae Paik Hospital, Busan, Korea, Republic of

Purpose: Predicting functional outcome following ischemic stroke may aid in therapeutic decision-making. The purpose of this study was to predict a three-month functional outcome using a deep learning model that combines clinical and neuroimaging features.

Methods: 4445 patients were included in the derivation cohort, while 114 patients diagnosed with acute ischemic stroke were included in the external validation cohort. We used a convolutional neural network (CNN) to extract neuroimaging features (Model A), and then used a standard machine learning model to select the most essential clinical features (Model B). Finally, an ensemble model was built by combining neuroimaging and clinical data (Model C). At three months, an unfavorable outcome was defined as a modified Rankin Scale score of 3 or above. The model's performance was evaluated as the area under the receiver operating characteristic curve (AUC). Gradient-weighted Class Activation Mapping (Grad-CAM) was used to determine the model's explainability.

Results: Model A had an AUC of 0.741, Model B had an AUC of 0.773, and Model C had an AUC of 0.795. AUCs for the external validation cohort were 0.810, 0.936, and 0.954 in models A, B, and C, respectively. Grad-CAM appeared to be more focused on the location of cerebral infarction lesions as well as on the eloquency area known to be associated with clinical outcome.

Conclusions: The ensemble model using neuroimaging and clinical features as multimodal inputs predicts ischemic stroke outcome more accurately than models with each component alone.

Targeted metabolomic biomarkers for stroke subtyping

<u>Eung-Joon Lee</u>¹, Da Jung Kim², Joon-Youn Cho², Han-Yeong Jeong¹, Dong-Wan Kang¹, Wookjin Yang¹, Jeong-Min Kim¹, Seung-Hoon Lee¹, Keun-Hwa Jung¹

¹Neurology, Seoul National University Hospital, Seoul, Korea, Republic of

²Clinical Pharmacology and Therapeutics, Seoul National University, College of Medicine and Hospital, Seoul, Korea, Republic of

Purpose: Ischemic stroke is a heterogeneous disease with various etiologies. The current subtyping process is complicated and time and cost-consuming. Metabolite-based biomarkers have promising potential to improve classification and to deliver optimal treatment. We aimed to identify novel targeted metabolomics-based biomarkers for the discrimination of large-artery atherosclerosis (LAA) and cardioembolic (CE) stroke.

Methods: We acquired serum samples and clinical data from a hospital-based acute stroke registry (ischemic stroke within a week of symptoms onset). A total of 346 participants (169 LAA, 147 CE, and 30 healthy older adults) were included and divided for the training and test set. A targeted quantitative and quality-controlled liquid chromatography with tandem mass spectrometry metabolomics analysis was performed. A multivariate regression model with metabolomic signatures was created to independently distinguish the LAA and CE stroke.

Results: Training set (n=193) identified metabolomic signatures regulated differently in LAA and CE stroke. Six metabolomic biomarkers, including lysine, serine, threonine, kynurenine, putrescine, and lysophosphatidylcholine acyl C16:0 discriminated the LAA and CE stroke after adjustment for sex, age, body mass index, stroke severity, and comorbidities. The enhanced diagnostic power of key metabolite combinations for discriminating the LAA and CE stroke was validated by the test set (n=123).

Conclusions: LAA and CE stroke could be determined by metabolomic biomarkers. The targeted metabolomics approach might provide an enhanced diagnostic yield for stroke subtypes. A pathophysiological pathway of the identified metabolites should be explored in the further study.



Figure 2. Comparisons among metabolomics biomarkers Box plots represents the concentrations of each metabolites. All the metabolites have FDR-adjusted p-values < 0.05 compared between large artery atherosclerosis (LAA) and cardioembolic (CE) stroke groups. LAA and CE belong to training set and LAA-V and CE-V belong to the test set; LAA, Large artery atherosclerosis stroke; CE, Cardioembolic stroke.

Global hyperperfusion is associated with a worse outcome among acute ischemic stroke patients underwent successful endovascular treatment

Wookjin Yang¹, Jeong-Min Kim¹, Chul-Ho Sohn², Dong-Wan Kang¹, Eung-Joon Lee¹, Han-Yeong Jeong¹, Keun-Hwa Jung¹, Seung-Hoon Lee¹

¹Neurology, Seoul National University Hospital, Seoul, Korea, Republic of ²Radiology, Seoul National University Hospital, Seoul, Korea, Republic of

Purpose: Patients with stroke may sometimes develop hyperperfusion after successful endovascular treatment (EVT). It is yet to be elucidated which factors affect post-EVT hyperperfusion and how hyperperfusion is associated with clinical outcome.

Methods: Consecutive patients who underwent EVT for anterior circulation occlusion and achieved successful recanalization (modified treatment in cerebral ischemia 2b–3) were reviewed. Hyperperfusion was categorized as follows based on post-EVT arterial spin labeling MRI: global hyperperfusion, increased cerebral blood flow (CBF) in \geq 50% of previously occluded territory; focal hyperperfusion, increased CBF in <50% of previously occluded territory; and no hyperperfusion, no visible CBF increase. Factors associated with hyperperfusion were assessed and clinical outcome was compared among the hyperperfusion categories.

Results: Among 125 eligible patients, 23 and 37 patients developed global and focal hyperperfusion, respectively. Compared with patients without hyperperfusion (n=65), global hyperperfusion group had worse neurologic severity and larger pre-EVT core. No significant difference was found between focal and no hyperperfusion groups. Pre-EVT core volume predicted global hyperperfusion with 92.9% sensitivity and 65.7% specificity (area under receiver operating characteristic curve, 0.867; 95% CI, 0.779–0.956). Global hyperperfusion group had worse 90-day outcome compared with focal hyperperfusion (modified Rankin Scale 0–2, 34.8% vs. 62.2%, p=0.072), and no hyperperfusion (34.8% vs. 64.6%, p=0.025) groups. Hemorrhagic transformation occurred similarly in the three groups.

Conclusions: Global hyperperfusion was associated with worse clinical outcome and tended to occur in patients with larger pre-EVT core. Future research is warranted to determine whether intervention such as blood pressure lowering improves outcomes in patients with global hyperperfusion.





Korea, Republic of

Tldc1 and Mtnr1b: Atherosclerosis-related epigenetic biomarkers identified from blood inflammatory cells

Su Hyun Ryu^{1,2}, Jee Yeon Kim², Jaroslav Jelinek³, Hye Rin Moon¹, Young Ho Lee^{1,2}, Jean-Pierre Issa³, Jei Kim^{2,5}

¹Graduate School of Medical Science, Chungnam National Univeristy, Daejeon, Korea, Republic of
 ²Neurology, Chungnam National University Hospital, Daejeon, Korea, Republic of
 ³Epigenetics Lab., Coriell Institute for Medical Research, New Jersey, United States
 ⁴Anatomy, Chungnam National University, Daejeon, Korea, Republic of
 ⁵Daejeon-Chungnam Regional Cerebrovascular Center, Chungnam National University Hospital, Daejeon,

Purpose: The present study profiled and validated gene-specific promoter methylation changes developing in blood inflammatory cells of patients having severe stenosis defined as radiophenotype for atherosclerosis presence.

Methods: We first profiled and identified gene-specific promoter methylation changes using Digital Restriction Enzyme Analysis of Methylation (DREAM) sequencing with buffy coats of 8 severe stenosis and other 8 no-stenosis in extra- and intra-cranial vessels on magnetic resonance angiography and carotid duplex ultrasonography. We select candidate gene-specific promoter methylation sites located in upstream 1,000 bp from transcription start sites. Finally, we validated whether the gene-specific promoter methylation changes could enhance prediction of stenosis prediction by combination with the traditional clinical and laboratory cardiovascular risk factors using logistic regression analysis in 24 no-stenosis and 146 stenosis in ischemic stroke patients.

Results: On DREAM sequencing, CpG sites located in promoter regions of TLDC1 (no-atherosclerosis, 15.7±5.6% vs. atherosclerosis patients, 18.3±6.2%) and MTNR1B (27.0±10.3% vs. 23.7±7.5%) had over 5% of the methylation differences with <0.05 false positive rate. On validation analysis, TLDC1 (p=0.011) and MTNR1B (p=0.015) as well as traditioanl risk factors including history of hypertension (p=0.053) and diabetes (p=0.058), creatine (p=0.007) and lipoprotein(A) (p=0.002) was as the variables included for the LRA prediction model to predict the presence of cranial vessel stenosis.

Conclusions: We identified and validated TLDC1 and MTNR1B promoter methylation changes as epigenetic markers to predict the presence of cranial vessel stenosis. The gene-specific promoter methylation changes of TLDC1 and MTNR1B might have possibilities as epigenetic markers to predict atherosclerosis defined as stenosis radiophenotype by combination with the traditional cardiovascular risk factors.

2022 대한뇌졸중학회 **춘계학술대회**

"Individualized vs. Guideline-based Management"

Room A

진료지침위원회. Current updates of the Korean stroke guidelines

좌장 | 홍근식 (인제의대)



Introduction of the Korean stroke guideline development

Keun-Sik Hong

Department of Neurology, Inje University Ilsan Paik Hospital

In 2009, the Clinical Research Center for Stroke funded by the Korean Government collaborated with the Korean Stroke Society (KSS) developed and published the first edition of Clinical Practice Guidelines (CPG) for Stroke, which included primary stroke prevention, acute stroke management, and secondary stroke prevention. During the last 13 years, we have updated 14 guidelines for specific topics reflecting new evidences: asymptomatic carotid artery stenosis, aspirin on primary prevention of stroke, public awareness and education, antithrombotic therapy for non-cardioembolic stroke or transient ischemic stroke, extracranial symptomatic carotid artery stenosis, antithrombotic therapy in atrial fibrillation for primary and secondary stroke prevention, screening and treatment of unruptured intracranial aneurysm, primary intracerebral hemorrhage, intravenous thrombolysis, endovascular recanalization therapy, antithrombotic therapy in acute ischemic stroke, and blood pressure management for stroke prevention. For the guideline updates, the Guideline Oversight Committee of the KSS decided to updates and appointed members of the writing group recommended by the CPG Committee of the KSS. Panels of experts recommended by relevant academic societies were organized to achieve consensus for the recommendations proposed by the writing group. The final drafts were reviewed and approved by the Guideline Oversight Committee, and were published in relevant journals. Development and implementation of clinical practice guidelines for stroke care based on evidences and tailored to individual healthcare systems would help healthcare providers, patients, and their caregivers make well-informed decisions and improve the quality of stoke care. This session will introduce the recent updated guidelines of endovascular reperfusion therapy in acute large vessel occlusion, blood pressure management for stroke prevention, and antithrombotic therapy in acute ischemic stroke.

Endovascular reperfusion therapy in acute large vessel occlusion:

Sang-Bae Ko

Department of Neurology, Department of Critical Care Medicine, Seoul National University Hospital, Seoul, Korea

The success of stentriver endovascular recanalization therapy (ERT) trials led to the update of the American Stroke Association guideline, which prompted Korean Stroke Society to revise the existing own stroke treatment guideline in 2016. In addition, the success of delayed ERT therapy in patients with large vessel occlusion who presented up to 16 or 24 hours after the onset underscored the importance of target mismatch profile. Korean Stroke Society also updated the guideline on endovascular recanalization therapy in 2019. Meanwhile, several breakthrough clinical trials were undergone especially focusing on the clinical meaning of direct thrombectomy without bridging of tissue plasminogen activator (tPA), infusion of tPA after ERT, the direct evidence of ERT in basilar artery occlusion. Here, we will briefly review the recent update of several clinical trials after the publication of ERT guideline.

Blood pressure management for stroke prevention

Jong-Moo Park

Department of Neurology, Uijeongbu Eulji Medical Center, Eulji University, Republic of Korea

Elevated blood pressure (≥140/90 mmHg) is so common that it is observed in 70% of patients with acute ischemic stroke (AIS), but the pathophysiology of the hypertensive response is poorly understood. Despite substantial research efforts, optimal post-stroke blood pressure management in these patients remains controversial and unresolved. Because randomized controlled clinical trials (RCTs) on this subject are limited and difficult, clinical decisions are often made based on observational studies that are prone to bias, confounding, and random error. Numerous observational studies have shown that very low blood pressure and high blood pressure are associated with worse outcomes in patients with AIS, however, the results of multiple RCTs with different antihypertensive strategies for acute stroke subtypes have been inconsistent. The management of high BP in AIS remains unclear. Future well-designed randomized controlled trials are needed to understand the thresholds, timing, and strategies for lowering blood pressure in different acute stroke patient subgroups.

Primary prevention of stroke by hypertension treatment was shown to be 30 to 40% risk reduction of stroke in randomized controlled trials. Nonetheless, evidence is relatively insufficient for hypertension treatment aimed at secondary prevention of stroke. In 2017, the AHA/ACC hypertension guideline defined hypertension as BP >130/80 mmHg. However, there is concern that a lower blood pressure threshold may increase the risk of stroke or J-curve effect in patients who have had a stroke or transient ischemic attack. In the past, post hoc analyses of RCTs, meta-analyses, and population-based studies of patients with cerebrovascular disease have shown an inconsistent relationship between the achieved SBP <120 mmHg and poor outcomes. New data from RCT and large meta-analysis suggest that neurologically stable patients with cerebrovascular disease, particularly lacunar infarction, may benefit from a blood pressure goal of less than 130/80 mmHg. However, a slightly more liberal goal of less than 140 mm Hg is recommended for stroke patients with intracranial atherosclerotic stenosis. There are several planned or recruiting randomized trials of intensive BP lowering after ischemic and hemorrhagic stroke, which should provide some clarity.

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Antithrombotic therapy in acute ischemic stroke

Hong-Kyun Park

Department of Neurology, Inje University Ilsan Paik Hospital







vestions and recommendations	Delphi round achieving consensus	Agreement (score 7-9) (%)	Uncertainty (score 4-6) (%)	Disagreeme (score 1-3)
3.4 Antiplatelet agents Q1-1. Do you think that the recommendation of dual antiplatelet therapy in minor ischemic stroke or high-risk TA patients is necessary to be added in Korean stroke	First round	97.1	0.0	2.9
guidelines based on the results of recent clinical trials (CHANCE and POINT): 20.2 Myrs, do you agree with this new reconnectation? Recommendation 5.1 is patient parsenting with a base minor inchemic strate (RMRS 500 error 2 or behavior 11 R MPAC) process 4.0 and antipatient througy with agains and clopidoget indicated within 2.4 hours from the onest and maintained for up to 21–30 days is recommended to further reduce the risk of early recommendations taketed and major backmice overtil (DEC & QGRA).	First round	round 80.0 14.7		2.9
			Commen	t
Antiplated agents 3. For patients treated with intravenous thrombolysis, it is generally recommended to de hours. However, when the benefit is expected to outweigh the risk, antithrombotic th hours after intravenous tPA (LOE: III, GOR: B).	lay antithrombotic the erapy may be initiated	rapy up to 24 F within 24	Revised from the p recommendation	previous
 In general, intravenous glycoprotein IIB/III areceptor antagonists is not recommended (LOE: Ib, GOR: A). However, intravenous and/or intra-arterial use of glycoprotein IIb/III considered in lighly selected patients who require rescue therapy during mechanical angioplasty/stenting, taking into account benefit and risk (LOE: N, GOR: C). 	in patients with acute a receptor antagonists thrombectomy or emer	ischemic stroke F can be gent	levised from the p recommendation	previous
5. In patients presenting with acute minor ischemic stroke (NIHSS score 0–3) or high-ris antiplatelet therapy with aspirin and clopidogrel initiated within 24 hours from the or	k TIA (ABCD, score ≥4) set and maintained fo	, dual 1 r up to 21–30	Vew recommenda	tion

Triple antiplatelet therapy Antiplatelet therapy with aspirin, clopidogrel, and P: 3,096 acute non-cardioembolic ischemic stroke or TIA dipyridamole versus clopidogrel alone or aspirin and dipyridamole versus clopidogrel alone or aspirin and dipyridamole in patients with acute cerebral ischaemia (TARDIS): a randomised, open-label, phase 3 superiority trial Lancet 2018;391:850:859 within 48 hr of symptom onset is a pirin, dipyridamole, and clopidogrel (30d) C: clopidogrel or (aspirin + dipyridamole) (30d) O: recurrence of stroke or TIA by severity at 90d → Early termination because of a significant increase in major bleeding event and no signs of efficacy with triple therapy Stee Adjusted cOR or HR (95% CI) p value antiplatelet 56) therapy (n=1540) 2-54 (2-05-3-16) <0-0001 3-48 (0-89-13-63) 0-074 3/1531 (<1%) Hatar Major Moderat Mild 31/1541 (2%) 25/1541 (2%) 14/1531 (1%) 13/1531 (1%) 1/5 42 4 95 96 Distribution (%) ę. da la 109/1531 (7%) Figur mRS 4-5, mRS 2-3, mRS 0-1) and TIA at day 90











Juestions and recommendations	Delphi round achieving consensus	Agreement (score 7-9) (%)	Uncertainty (score 4-6) (%)	Disagreement (score 1-3) (%)	in IIb/IIIa receptor antagonists
3.4 Antiplatelet agents Q4-1. Do you think that the recommendation of avoidance of aspirin within 24 hours after intravenous thromodysis needs to be revised? Recommendation 3. Agains should not be taken within 24 hours of thrombolysis (UCE is, d0Fit, A).	First round	88.6	8.6	2.9	ees: A daministration of Abcichands for Treatment of International Phase III Trial Main is Energyency Treatment of Streke Trial (MISTE4): 2002;39:29:29
O4-2. If yes, do you agree with the revised recommendation? Recommendation 3. For patients treated with intravenous thrombolysis, it is generally recommended to delay authinhomotic therapy up to 24 hours. However, when the benefit is expected to outweigh the risk, antithrombolic therapy may be initiated within 24 hours after intravenous thrombolysis (LOE: III, GOR: B).	First round	88.6	0.0	0.0	▲ · · · · · · · · · · · · · · · · · · ·
Antiplatelet agents 3. For patients treated with intravenous thrombolysis, it is generally recommended to hours. However, when the benefit is expected to outweigh the risk, antithrombolic t hours after intravenous OPA (LOC: III, GOR: B). 4. In americal. Intravenous devocation III/BIII accreator antaoonists is not recommended to a more an intravenous devocation III/BIII accreator antaoonists is not recommended.	lelay antithrombotic the herapy may be initiated d in patients with acute	apy up to 24 within 24 schemic stroke	Commen Revised from the recommendation Revised from the	revious	Computered 1049年2月9日2日 1049日 (1995年1月1日日) Computered 1049年2月9日2日 1049日 (1995年1月1日日) Computered 1049年2月9日2日 1049年2月1日日 1049年1月1日日 1049年1月1月1日日 1049年1月1月1日日 10月1日日 10月1月1日日 10月1日1月1日日 1
(DCE: 6.0FXA.) However, intervences and/or intra-strill use of glocopartic III0 considered in high selected patients who require scess. It here, a similar mechanica angioplashyltenting, taking into account benefit and rikk (IDE: M. ODR: Q. E. In patients presenting with assert and colorised trained with ISES score 0-31 or high-angiplance through audit and and object initiate within 15 Auson from the days is recommended to further reduce the risk of early recurrent stroke and major is	I thrombectom with a gradient of the second se second second sec	dual rup to 21–30 iOR: A).	recommendation	ition	ver, in patients treated with mechanical thrombectomy, therapy is often required for those with incomplete recanalization or re- on due to in-situ thrombosis

v Radiol 2019; I	30:141-147	Thrombe	ctomy							
	All	All patients, Tirofiban, n = 154	n = 632 Without tirofiban,	P value	LAA Tirofiban, n = 80	Without tirofiban,	P value	Cardioem Tirofiban, n = 63	Without tirofiban,	= 325 P valu
Any ICH	313 (49.5)	67 (43.5)	246 (51.5)	086	27 (33.8)	68 (45.7)	069	37 (58.7)	n = 262 145 (55.3)	627
SICH	101 (16.0)	21 (13.6)	80 (16.7)	.361	7 (8.8)	24 (12.8)	.347	12 (19.0)	54 (20.6)	.78
ASICH	212 (33.5)	46 (29.9)	166 (34.7)	.267	20 (25.0)	62 (33.0)	.195	25 (39.7)	91 (34.7)	.463
mRS at 90	davs									
mRS 0-1	167 (26.4)	45 (29.2)	122 (25.5)	.365	31 (38.8)	57 (30.3)	.179	12 (19.0)	59 (22.5)	.54
mRS 0-2	281 (44.5)	74 (48.1)	207 (43.3)	.303	44 (55.0)	91 (48.4)	.323	35 (39.7)	100 (38.2)	.82
mRS 6	166 (26.3)	34 (22.1)	132 (27.6)	.174	9 (11.3)	44 (23.4)	.042	21 (33.3)	82 (31.3)	.75

			Non-techan group is	+58 Test	ban group (n = 59)	
Local tirefiban infusion for rempont	Fold KL 2-1		41.69393	41.8	0.510	
Local thomain musion for remindrit	Final mITO 2b-3		25 (42.4%)	51.0	6.46)	0
stenosis in large vessel occlusion: tirofiban	Postprocedural recochaion		12 (075%, n = 32)	2 (4/	1%, n = 45)	<
ASSIST study	Intracerebral hemorrhage					0.
	HT type 1		415899	2(3)	190	
Tong-Won Nm, Sung-Lison Lee ² , J. Man Hone ² , Jin Work Che ³ , Yana Ku Haano ² , and Jin Son Lee ² , B.	HT type 2		6 (10.29)	3.05.1	190	
	PHope 1		3 (5199	100	192	
8MC Neurol 2020;20:284	PH type 2		6 (10.2%)	3.6.	190	
	Subarachnoid hemonhage		6(30.2%)	0		0
	Plaverbicuar renormage		8 (1104)		140	
	Serious remomagic compication*		905,860	3.0.	190	
	Frid Fridit, Volume, IN (1994) 6, 5, 59		368(163/927)	- 40	0.04.00.00	
	with 0.5 at her rates		16.03363	31.0	2.00	
cunical and population sciences frincipal infrastructure and the construction of the c	P: 98 patients wh followed by ar	o underwent gioplasty,	19 (02290 12 (0390) thrombecto	31 G 4954	23%) 99	60
CLUNCLI AND PRPULITION SCIENCES C Intravenous Tirofiban Infusion After Angioplasty and Stenting in Intracranal Atheroscierotic Stenosis-Related Stroke Insurementa Mittane Chronic pure Charles to Laure to Re No to the No.	etto 6-2 at Jecords Monity P: 98 patients wh followed by ar with or withou atherosclerotic st Table 2. Comparison of T	o underwent gioplasty, it stenting for enosis	19 02290 12 00390 thrombecto the residual Between Patients	ny lintracrania	259) PN Hour IV	0
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Anticoagulants in patients with acute ischemic stroke with atrial fibrillation Rivaroxaban vs Warfarin Sodium in the Ultra-Early Period After Atrial Fibrillation-Related Mild Ischemic Stroke A Randomized Clinical Trial JAMA Neurol 2017;74(10)1206-1215 org MG Soci Urwa MG Sorginini et MD, J Sorgine RM, Tong Jamon MD, Bell King MD, The Unit Read Society and Targe Spectra MD. Society and S Rivanovahan Wartarin Sodium Group, No. (1) Group, No. (1) Risk Difference (a + 55) (a + 85) (55% Cl) 47 (49.5) 48 (54 %) 4.07 5 End Point Intraconal benorhage or recurret bachenic lesion or results of 4 with MSI (primmy or dipoint) Recurrent bachenic lesion on results of 4 with MSP Intraconali benorhage on results of 4 with MSP Chinical recurrent bachenic syste Adjusted Relative Risk (95% CI)² Relative Risk (95% CD 0.51 (0.59 to 1.20) Pila P: 195 AF-related stroke within the previous 5 days mild severity (infarct size on DWI less than 1/3 of MCA territory, 1/2 of ACA territory, 1/2 of PCA territory, and 1/2 of one cerebellar hemisphere) -6.16 0.83 .38 (-20.48 to 8.45) (0.54 to 1.26) 2.04 1.30 .68 0.85 (0.56 to 1.30) ischemic stroke Symptomatic hemonhagic conversion or hemonhagic stroke Major bleeding 1 (1.1) ×.99 &A NA I: Rivaroxaban 10mg (5d) followed by 15 or 20mg daily 1(1.1) 1.05 (~13.44 to 15.53) NA M Systemic embolism C: Warfarin (target INR 2.0-3.0) 0 0 1 (1.1) MA MA MA V V Acore convery syndhome 0 Composite of strake, MI, or vascular death 1 (1.1) Composite of strake, MI, vascular death, or major bleeding 2 (2.1) Composite of chickal bullenci events 1 (1.1) 0 0 1(1.1) BA nn -0.08 0.53 (-14.54 to 14.42) (2.06 to 14.59) 0.97 1.85 (-13.50 to 15.46) (2.17 to 20.08) 1 (1.1) MA (-13.56 to 13.46) (8.17 to 28.08) 1 (1.1) 1 (1.1) -0.08 (-14.54 to 14.42) 0.03 (1.00 to 14.59) 4.0 (2.0-6.0) 6.0 (4.0-8.0) NA NA >.99 5A 5A NA 79-(84.0) 64-(74.4) 9.62 1.13 (-5.06 to 23.95) (8.97 to 1.31) 1.04 (0.83 to 1.29)







2022 대한뇌졸중학회 **춘계학술대회**

"Individualized vs. Guideline-based Management"

Room B

Focused Session 2. Genetic screening for CVD

좌장 | 김경문 (성균관의대), 남효석 (연세의대)





Intracranial stenosis (MMD, dissection)

JinKwon Kim

Department of Neurology, Yonsei University Yongin Severance Hospital



Genetic screening for CVD Intracranial stenosis

Genes involving intracranial atherosclerotic/non-atherosclerotic stenosis/occlusion

- RNF213 in MMD or Intracranial major cerebral artery stenosis/occlusion (ICASO)
 - Epidemiologic evidence
 - Clinical information
 - Prognostic value
 - What we know



(2) 8인세브란스병원	an own how many of the second
Genetic factors for Intracranial Atherosclerotic/Non-atherosclerotic CAS > Predominancy in Asian > Women > Men • Genetic factors • Link with vascular risk factor (HTN, Dyslipidemia, DM) • Systemic atherosclerosis • ICAS specific factors	Image: Note of the second o
	Construction of the data and a set of the data and ata and ata and

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🛞 용인세브란스병원

- c.14576G>A RNF213 variant is risk factor for stroke ?
 Yes
- Prevalence of c.14576G>A variant RNF213 in Korean general population

• 1~2%

Population	c.14429G > A ger	otype		Sample	Carrier frequency %	MAF %
(sample type)	Wild-type: G/G	Hetero-zygous: G/A	Homo-zygous: A/A	size	(95 % CI)	(95 % CI)
Korean (adults)	693	19	0	717	2.65 (1.70-4.10)	1.32 (0.85-2.05)
Korean (cord blood)	781	18	0	799	2.25 (1.43-3.53)	1.13 (0.72-1.78)
Korean (unknown)	286	8	0	294	2.72 (1.38-5.28)	1.36 (0.69-2.66)
Korean (unknown)	217	6	0	223	2.69 (1.24-5.74)	1.35 (0.62-2.91)
Japanese (unknown)	1,437	34	3	1,474	2.51 (1.83-3.44)	1.36 (1.00-1.85)
Japanese (unknown)	374	9	1	384	2.60 (1.42-4.72)	1.43 (0.80-2.54)
Chinese (unknown)	582	5	0	587	0.85 (0.36-1.98)	0.43 (0.18-1.00)
Chinese (unknown)	148	2	0	150	1.33 (0.36-4.73)	0.67 (0.18-2.40)

bbreviations: MAF, minor allele frequency; CI, confidence interv





Table 2. Correlation between the B4810K Variant and Clinical Features.						
Clinical variables -		Genotype		- P		
	Homozygote (n=12)	Heterozygote (n=42)	Wild type (n=11)			
Familial MMD	2 (16.7%)	6 (14.3%)	2 (18.2%)	0.9		
Early onset (<4 years)	9 (75.0%)	14 (33.3%)	2 (18.2%)	0.0		
Infarctions at initial presentation	9 (75.0%)	19 (45.2%)	2 (18.2%)	0.0		
Involvement of posterior cerebral artery	4 (33.3%)	12 (28.6%)	4 (36.4%)	0.8		
Neurocognitive function test abnormality	6/7 (85.7%)	21/32 (65.6%)	3/4 (75.0%)	0.3		
Intelligence impairment (IQ<90)	4/7 (57.1%)	6/31 (19.496)	0/4 (0.0%)	0.0		
Dect. execution expansion () (of a proble)	3 (25 096)	5 (11 906)	0.00.000	0.0		





Small vessel disease

Jay Chol Choi

Department of Neurology, Jeju National University Hospital

Cerebral small vessel disease (SVD) is an important cause of lacunar stroke, deep intracerebral hemorrhage, mood disorder, cognitive impairment, and gait disturbance. In Asia, cerebral SVD is responsible for even greater proportion of ischemic stroke than that of other regions. Although traditional risk factors including hypertension and advanced age are important in developing cerebral SVD, exact pathogenesis of cerebral SVD still is uncertain. In addition to common sporadic cerebral SVD, several single gene disorders causing cerebral SVD have been discovered and the number of reported cases is increasing as the clinical features are known and genetic analyses are becoming more readily available. Among them, cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL), cerebral autosomal recessive arteriopathy with subcortical infarcts and leukoencephalopathy (CARASIL), and COL4A1-related cerebral SVD are well known and have been investigated extensively. The exact diagnosis of such genetic stroke disorders is important for both patients and clinicians because clinical courses are different from those of sporadic stroke caused by SVD, timely treatment can be useful in certain disorders, and genetic counseling is crucial in reproductive planning and education. Cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL) is one of the most common single gene disorders of the cerebral small blood vessels caused by mutations in the NOTCH3 gene on chromosome 19q12. Main clinical features included recurrent stroke, migraine, psychiatric symptoms, and progressive cognitive decline. Originally, CADASIL was known to be very rare with an estimated prevalence of 2-4 per 100,000 people. However, recent studies suggest much higher prevalence of pathogenic NOTCH3 variants among general population and the presence of the variants was associated with increased risk of stroke and radiological marker of cerebral SVD. Interestingly, common variants in both HTRA1 and COL4A1/2 have been shown to increase risk of lacunar stroke and white matter hyperintensities in stroke genome-wide association studies (GWAS). Abnormalities in extracellular matrix (ECM) and associated proteins have been suggested as a common mechanism of CADASIL, CARASIL and COL4A1-related cerebral SVD. Therefore, thorough understanding of pathogenesis of these single gene disorders causing cerebral SVD may facilitate discovery of underlying mechanisms of more common form of conventional cerebral SVD. Over the past decade, large-scale GWAS have found several important loci closely linked with sporadic cerebral SVD and MRI markers for SVD. Several biological processes have been implicated by genetic associations, including the structure and function of the ECM, myelination, and membrane transport. Genetic research will enable us to reveal novel pathophysiological processes underlying cerebral SVD, to accelerate the discovery of new therapeutic approaches, and to identify individuals in the population who are at high risk of developing SVD and could be targeted for tailored preventative interventions.

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	CADASIL	CARASIL	COL4A1
Inheritance pattern	AD	AR	AD
Chromosome locus	19q12	10q25	13q34
Gene	NOTCH3	HTRA1	COL4A1
Gene product	Notch3 receptor	HtrA serine peptidase/protease 1	Type IV collagen α 1
Clinical features			
Lacunar infarct	+	+	+
Cognitive deficits	+	+	+
Intracerebral hermorrhage	Rare	Rare	+
Migraine	+	-	+
Renal involvement	±	-	+
Other	Psychiatric symptoms, reversible encephalopathy	Alopecia, low back pain	Porencephaly, infantile hemiparesis cataracts, retinal vascular tortuosity, retinal hemorrhage, Anxfeld-Riger anomaly
Neuroimaging findings	Typical of cerebral SVD plus WMH in anterior temporal lobe and external capsule	Similar to CADASIL	Typical of cerebral SVD
Pathological findings	Granular osmiophilic material found in the walls of affected arterioles	Extensive degeneration of vascular smooth muscle cells and reduction in the mural extracellular matrix	Defects of basement membrane.

Table. Characteristics of single gene disorders causing cerebral small vessel diseases

Embolic stroke & coagulopathy

Hong-Kyun Park

Department of Neurology, Inje University Ilsan Paik Hospital









Cardioembolic Stroke – Atrial fibrillation	Cardi	oembo	lic Stroke – Atrial fi	brillati	on	K+	channels
	Gene	Locus	Product	Function	Type	Mechanism	References
Mendelian pattern	RCNQ1	11p15.5-p15.4	α-Subunit of voltage-gated potassium channel Kv7.1	l _{ia}	GOF	increased ka	6-17
Potassium channels: KCNO1_KCNE2_KCNH2	KONE1	21622.12	B-Sabunit of voltage-gated potassium channel Kv7.1	I _{st} modulation	GOF	increased ka	18
	KONE2	21g22.11	β-Subunit of voltage-gated potassium channel Kv7.2	I _{Ka} modulation	GOF	Increased Ika	19 and 20
Rare genotypes with clear phenotypes	KONE3	11013.4	5-Subunit of voltage-galed potassium channel Kv7.3	I _{ka} modulation	GOF	Increased ka	21
Monogenic disorders of AF inheritance	KCNE4	2036.1	β-Subunit of voltage-gated potassium channel Kv7.4	I _{ka} modulation	GOF	Increased ka	22
	KONES	X123	8-Subunit of voltage-gated potassium channel Kv7.5	In modulation	GOF	increased k.	23
Delugenic and multifactorial nature	KCNH2	7q36.1	HERG human ether-a-go-go (x-subunit of voltage-galed potassium channel Kv11.1)	I _{N2} modulation	GOF, LOF		22, 24, and 25
Polygenic and multilactorial nature	KCND3	1p13.2	α-Subunit of voltage-galed potassium channel Kv4.3	l <u>o</u>	GOF		22 and 26
• GWAS	KCNJ2	17q24.3	α-Subunit of inwardly rectifying potassium channel Kir2.1	ka	GOF	Increased kr	27 and 28
• Ch' 4g25 page PITY2	RDNJ5	11q24.3	$\alpha-Subunit of inwardly rectifying potassium channel Kir3.4$	laca	LOF		29
	RNCJB	12p12.1	a-Subunit of inwardly rectifying potassium channel Kir6.1	K _{42P}	GOF		30 and 31
 Intron 1 of ZFHX3 (Zinc finger homeobox protein 3) on ch' 16q22 	ABCC9	12P12.1	SUR2A subunit of the K _{#ZP} channel	K _{RD}	LOF		32
 Intron 1 of KCNN3 (Calcium-activated potassium channel) on ch' 1g21 	RCNA5	12p13.32	α-Subunit of voltage-gated potassium channel Kv1.5	lear .	GOF, LOF	LOF with reduced lear	33-35
	HOW	15q24.1	Hyperpolarization activated cyclic nucleotide-gated potassium channel 4	k.	LOF		37
	KCNN3	1q21.3	Intermediate/small conductance calcium-activated potassium channel, KCa2.3	les :			38
Science 2003;299:251-254, J Hum Genet 2004;75:899-905, J Cardiovasc Electrophysiol 2005;16:394-396 Nature 2007;448:353-357, Nat Genet 2009;41:879-381, Nat Genet 2012;44:670-675	AF indicates att dependent pota receptor 2A	ial Rolliation; GOF, gain of sistem current; I _{co} rapidy re	Tunction, HERL, human rebora go ga L, hanny cament, L, sinand mctifier aphilology potassion commit. Su, diagond mctifier potassion commit. Suo, ap	surrent, l _{okou} , acetyloholise dy mpolarläng potassium	-induced inwardly rec current; t _{ion} transient	olying ourset: W _{ADD} ATP-sensitive outward potassium current; LOF, to J Am Heart J	potassien channel, l _{loss} , calican as of herction; SUR2A, sufforylane Assoc: 2018;7:e009884

Gene	Locus	Product	Function	Type	Mechanism	References
SCN5A	3p22.2	∞-Subunit of Nav1.5	l _{he}	GOF, LOF	LOF: reduced sodium current density, hyperpolarizing shift in channel steady-state activation GOF: depolarized shift of voltage dependence of steady-state inactivation	41-46
SCN1B	19q13.11	β-Subunit of Nav1.5 (Navb1)	I _{Ne} modulation	LOF	Reduced sodium current and altered channel gating	47
SCN2B	11q23.3	β-Subunit of Nav1.5 (Navb2)	I _{NB} modulation	LOF	Reduced sodium current and altered channel gating	47
SCN3B	11q24.1	β-Subunit of Nav1.5 (Navb3)	I _{Ne} modulation	LOF		48 and 49
SCN4B	11q23.3	β-Subunit of Nav1.5 (Navb4)	IN modulation	LOF		50
SCN1Bb	19q13.1	β-Subunit of Nav1.5 (Navβ1B)	IN modulation	LOF		51 and 52
SCN10A	3p22.2	α-Subunit of Nav1.8	I _{NI-L} modulation	GOF, LOF		54 and 55

Cene Los	0.0	Protect	Factor Metalan	See	Beforenzes
MP1S5 Se	132	Naciemorie 155	Nuclear core consiste/reduction in nuclear membrane permetability	LOF	\$7 and \$8
LANKA 10	22	Lamin A/C	Nuclear envelope structure		60 and 61
S.H1 84	22.31	Commine 3	Gap-junction protein/monined intracellular transport and intercellular electrical coupling	LOF	62
6.85 1s	21.2	Consectine(2)	Gen-iunction centrial-masinel intracellular transport and intercellular electrical coupling	LOF	63-67
NP74 16	36.22	Natriuretic pectide precursor	Bood pressure regulation/viewated inveits of mutant ANP	00F	11 and 68-70
SAT44 80	23.1	Cardiac transcription factor	Cardioxenesis	LOF	71 and 72
SAULS 20	lat3.33	Cardiac transcription factor	Cardiopenetis	LOF	73 and 74
SAT46 18	a11.2	Cardiac transcription factor	Cardiopresis	LOF	75-77
AR02-5 56	35.1	Homeobex protein Mka-2.5	Cardiopenesis	LOF	80-82
1026 80	21.2	Homeobex gratein Mar-2.6	Cardioxenesis		84
802 40	25	Pitulary homeobox 2	Cardiopenesis	LOF	85
SNEM7 10	p43	Gemin-2	Bone morphogenetic protein antagonist	COF	87
JRC 20	lq13.12	Juctophile-2	Calcium homeostasis	LOF	88
<i>R182</i> 10	43	Pyanodine receptor 2	Calcium homeostasis	GOF	89
AST 10	42.2	Angiotensieogen	Renis-angistensin system		90
AQE 13	1423.3	Angiotensizogen converting enzyme	Renis-angistensin system		90
SNB3 12	lp13.31	(3-Subunit of heterotrimeric G protein	Signal integration	1000	92
1.6 70	15.3	Interleukin-6	Cybkine		93
£10 14	32.1	Interieujún-10	Cybkine		94
AMP2 16	iqt2.2	Matrix metalloproteinase-2	Znc dependent enzyme		94
SUN 15	1922.3	Sarcolipin	Sarcoplasmic reticulum calcium-ATPase		95
eNOS 74	(96.1	Endothelial NO synthase	Regulates L-type calcium channel		96
QETP 16	iq13	Cholesteryl ester transfer protein	Transfer between lipoproteins		97
SYNE2 14	4423.2	Neprin-2	Cytoskekton LINC complex		38
27907 16	kg22.2 to 2g22.3	Znc finger homedbax 3	Transcription factor		38









Future direction

In the era of GWAS, - we can identify numerous genes that were unlikely to have been found in the candidate gene analysis era.

- the accumulation of numerous small risks will determine the genetic association with stroke.

- the accumulation of evidences allows for the development of risk scores, and targets for potential treatment and prevention.
2022 대한뇌졸중학회 춘계학술대회

"Individualized vs. Guideline-based Management"

Room B

Symposium 3

좌장 | 이광호 (성균관의대 명예교수)





Pluripotent effect of Cilostazol: Current and future perspectives

Bum Joon Kim

Asan Medical Center, University of Ulsan

The mechanism of stroke is diverse, and still the treatment strategy of stroke is based on mechanisms and the stage of ischemic stroke. Especially, large artery atherosclerosis of intracranial stenosis and small vessel disease is a major cause of stroke in our country. Carotid disease, more in the acute phase, stroke is caused by artery-to-artery embolism which may need a potent antiplatelet inhibition. However, in cases of the intracranial atherosclerosis, the pathomechanism is much diverse and at the chronic stage, reducing the atherosclerotic burden may be important.

Cilostazol, shows not only antiplatelet effect, but also anti-inflammatory, antiatherogenic effect which stabilize the plaque and increase plaque regression. The antiatherogenic effect was proven by various studies using IMT, TOSS-1 and TOSS-2 trials. In cases of small vessel disease, potent antiplatelet treatment increased the risk of bleeding without reducing recurrent ischemic stroke. In the other hand, in comparison to aspirin, cilostazol reduced recurrent stroke in this population. This may not be explained by the antiplatelet effect, and can be explained by cilostazol.

The pathomechanism which we must focus may differ according to the stage of stroke. In the acute stage - which vulnerable plaque matters - reducing distal embolization with potent antiplatelets may be important. However, in the chronic stage, when we should more consider reducing the plaque burden or at least inhibiting the progression of atherosclerosis, pleiotropic effect may be beneficial. The result of CSPS.com study shows that cilostazol based dual antiplatelet may reduce recurrent ischemic stroke without increasing the risk of bleeding. There have been several studies showing benefit of cilostazol in subcortical infarction reducing early neurological deteriorations. Cilostazol may be beneficial in acute stage for specific patients, but may need more investigation in the future.

2022 대한뇌졸중학회 춘계학술대회

"Individualized vs. Guideline-based Management"

Room B

Symposium 4

좌장 | 윤병우 (을지의대)





The clinical benefits of clopidogrel in patients with ischemic stroke

Chi Kyung Kim

Department of Neurology, Korea University Kuro Hospital

뇌경색 이후에 항혈소판제 치료는 수많은 임상경험과 관찰연구들이 보고되고 있지만 아직 완전하게 밝혀지지 않은 부분들이 많다. 아스피린과 클로피도그렐을 비교하는 연구가 많이 있을 것 같지만 예상외로 두 개의 약제를 직접 비교한 연구는 고전적인 임상시험인 CAPRIE 연구 이후에는 없었으며 대부분 단일 항혈소판제와 복합 항혈판제를 비교한 연구가 대부분이었다. 다만 순환기내과 영역에서는 최근 국내에서 심혈관중재시술 이후 1년이 경과한 시점에서 아스피린과 클로피도그렐의 효과를 비교한 임상시험을 시행하여서 Lancet에 클로피도그렐의 우월성을 국내에서 다기관 임상시험을 통해 보고한 경력이 있다. 뇌경색 이후에는 초기 재발 위험이 높은 시기를 대상은 CHANCE, POINT, CHANCE-2 연구를 통해서 클로피도그렐을 기반으로 복합 항혈소판제의 치료에 대한 근거가 확립되고 있다. 다만 이 경우 클로피도그렐 저항성에 대한 고민이 필요한 상환으로 최근에는 유전자검사를 통해 CYP2C19의 변이에 의한 클로피도그렐 저항성이 나오는 환자에서는 티카그렐러의 효과에 대한 보고도 있다. 여전히 클로피도그렐 저항성에 대해서는 논란의 여지가 많아서 이 것이 약물 선정의 기준이 된다고 할 수는 없지만, 재발위험이 매우 높은 시기라던지 혹은 중재시술 이후 혈소판에 의한 혈전 형성 위험이 높은 시기 또는 뇌혈관의 협착정도는 심하지만 중재적 시술을 할 수 없어서 장기가 항혈소판제를 투여해야하는 경우에는 고려의 대상이 될 수 있다.

다만 클로피도그렐 저항성은 주로는 약물대사와 관련된 유전적 이유로 또는 다양한 환경적 환자개인적 특성에 의해 존재한다는 것은 알려져 있으나, 이를 정확하게 측정하는 것에는 한계가 있다. 왜냐하면 혈관 외에서 혈소판 응집을 모사하는 것은 주변 환경, 혈소판이 응집되는 상황, 혈액의 보관방법, 칼슘의 존재 등 다양한 원인에 의해서 좌우되기 때문이다. 또한 다양한 클로피도그렐 저항성을 측정하는 검사법이 존재하긴하지만 이 역시 같은 환자에서도 검사의 방법에 따라 다양한 결과를 보고하고 있어서 표준화의 문제가 존재한다. 이러한 이유로 뚜렷한 유용성을 찾지 못하고 있었지만 뇌경색과 관련해서는 CHANCE-2 연구가 보고되어서 클로피도그렐을 포함한 다양한 항혈소판 제를 환자 상황과 입상 상황에 맞추어서 사용할 수 있는 길이 열리고 있다. 또한 국내에서는 다양한 형태의 약물과 관련된 공공데이터 기반 빅데이터 연구가 이루어지고 있으며 이러한 연구들에서도 고전적인 주제이긴하지만 항혈소판 제간의 비교에 대한 연구가 이루어질 수 있다. 다만, 임상현장에서는 측정되지 않은 바이어스 혹은 의사들이 모종의 이유로 약물 선정을 하는 기준이 연구디자인만으로 충분히 보정되지 않을 수 있기 때문에 이에 대한 결과를 신중하게 해석해야할 필요가 있다. 그렇지만 여전히 아스피린과 클로피도그렐이 단일 제제로 쓰던 복합 제제로 쓰던 뇌경색 환자에서 어떻게 약물을 효과적으로 투여할지는 아직 모두다 연구되었다고는 할 수 없으므로 환자의 특성과 상황에 맞는 약물 치료가 더욱 연구되어야 할 것이다.

2022 대한뇌졸중학회 춘계학술대회

"Individualized vs. Guideline-based Management"

Room B

Scientific Session 2

좌장 | 김응규 (인제의대), **이준홍** (국민건강보험 일산병원)





Statement of the primary and thrombectomy-capable stroke centers for the development and establishment of the stroke system of care from the Korean stroke society

Sang Joon An¹, Hee-Kwon Park², Jihoon Kang³, Hong-Kyun Park⁴, Chang-Hun Kim⁵, Jae Kwan Cha⁶

¹Neurology, Catholic Kwandong University of Korea College of Medicine, Incheon, Republic of Korea ²Neurology, Inha University of Korea College of Medicine, Incheon, Republic of Korea

³Neurology, Seoul National University Bundang Hospital, Seoul National University College of Medicine,

Seongnam, Republic of Korea

⁴Neurology, Inje University Ilsan Paik Hospital, Inje University College of Medicine, Goyang, Republic of Korea
⁵Neurology, Gyeongsang National University College of Medicine, Jinju, Republic of Korea

⁶Neurology, Dong-A University Hospital, Busan, Republic of Korea

Purpose: To apply scientific advances of stroke care to clinical practice, well-organized system that facilitate the optimal healthcare delivery is indispensable. The Korean Stroke Society (KSS) contructed, discussed, and proceeded with stroke unit (SU), primary stroke center(PSC), and thrombectomy-capable stroke centers (TSC) project. Authors aimed to investigate the current status of stroke centers in Korea and the characteristics of the TSC outcomes and facility.

Methods: The KSS proposed a stroke unit in 2007 and initiated stroke unit certification process in 2012. The PSC certification project was started from 2018. The KSS have started the certification project for the TSC December 2021. We collected data of IVtPA (intra-venous tissue plasminogen activator), IAT (intra-arterial thrombectomy), door-to-needle (DTN) time, door-to-puncture (DTP) time, SU bed, SU nurses, neurointerventionists (over 12 cases), neurologists for neurocritical care, neuro-surgeons for neurocritical care.

Results: There was an increase of hospitals providing KSS-certified stroke units from 32 in 2012 to 43 in 2014. As of 2021, 70 institutes have received PSC certification. Until April 2022, a total of 37 stroke hospitals has been certified as TSC, and 15 hospitals are awaiting certification. The maximum number of IVtPA/IAT cases is 142/170 in each hospital. The shortest minutes to door to needle and door to puncture time is 26 and 66. The maximum number of stroke unit beds and nurses is 12 and 22. The maximum number of neurointerventionist (over 12 cases) per hospital is 11(5). The number of hospitals containing neuro-ICU is 15. The highest number of neurologists and neurosurgeons for neurocritical care in each hospital is 2 and 1.

Conclusions: For the past 20 years, KSS has been leading the development of the stroke system of care through the stroke center accreditation. In accordance with recent advances in diagnosis and

treatment of reperfusion therapy including endovascular treatment, this revision of stroke center certification and the development of TSC designation are expected to improve the prognosis of stroke patients nationwide through s reorganization and refinement of a new stroke care system and emergency transportation.

Table 1. Baseline characteristics of the Thrombectomy Capable

	Mean	SD	Median	25%	75%	Min	Max	Frequency
Number of IVtPA	48	30.4	41.5	24.25	63	7.	142	
Number of IAT	51.7	33.5	46	29.3	46	9	170	
DTN time (minute)	49.2	25.3	47	38	47	26	203	
DTP time (minute)	124.16	44.6	114.5	95.75	138.8	66	314	
Number of Stroke Unit Bed	6.45	2.2	6	5	8	4	12	
Number of Stroke Unit Nurse	7.52	4.2	5	5	10	5	22	
Number of Neuroint.	3.45	1.9	3	2	4	1	n	
Number of Nueroint. over 12 case	2.05	1.1	2	1	3	1	5	
Presence of Neuro-ICU								15
Neurologist for Neurocritical care	0.32	0.5	0	0	ĩ	0	2	13
Neurosurgeon for Neurocritical care	0.19	0.4	0	0	0	0	1	9

Stroke Center Outcomes and Facility.

IVtPA, Intravenous tissue plasminogen activator; IAT, Intra-arterial thrombectomy; DTN, Door-to-needle time; DTP, Door-to-puncture; SD, Standard deviation; Min, Minimum; Max. Maximum; Neuroint., Neurointerventionist

Long sleep duration and dissatisfaction with sleep quality are associated with ischemic stroke in young patients

Hyuk Sung Kwon¹, Chulho Kim², Youngseo Kim¹, Seong-Ho Koh¹, Hyun Young Kim¹, <u>Nakhoon Kim</u>¹, Seung-Hoon Lee³, Keun-Hwa Jung³, Jeong-Min Kim³, Young Dae Kim⁴, Hyung-Min Kwon⁵, Dae Lim Koo⁵, Beom Joon Kim⁶, Bum Joon Kim⁷, Sung Hyuk Heo⁸, Dae-II Chang⁸, Cheryl D Bushnell⁹

¹Department of Neurology, Hanyang University College of Medicine, Seoul, Korea, Republic of
 ²Department of Neurology, Hallym University Sacred Heart Hospital, Chuncheon, Korea, Republic of
 ³Department of Neurology, Seoul National University Hospital, Seoul, Korea, Republic of
 ⁴Department of Neurology, Yonsei University College of Medicine, Seoul, Korea, Republic of
 ⁵Department of Neurology, Seoul National University College of Medicine, Seoul Metropolitan Government
 Seoul National University Boramae Medical Center, Seoul, Korea, Republic of
 ⁶Department of Neurology and Cerebrovascular Center, Seoul National University Bundang Hospital,
 Seongnam, Korea, Republic of
 ⁷Department of Neurology, Asan Medical Center, University of Ulsan College of Medicine, Seoul, Korea,

Republic of

⁸Department of Neurology, Kyung Hee University College of Medicine, Seoul, Korea, Republic of ⁹Department of Neurology, Wake Forest School of Medicine, Winston-Salem, Nc, United States

Purpose: Suboptimal sleep duration and poor sleep quality have been proposed to increase stroke risk. However, their significance in young ischemic stroke is unclear. We aimed to investigate the importance of sleep duration and quality on young ischemic stroke patients.

Methods: A multicenter matched case-control study was performed to evaluate under-recognized risk factors in young (<45 years) ischemic stroke patients in 8 tertiary hospitals in Korea A total of 225 patients and 225 age- and sex-matched controls were enrolled in the same period. Detailed information about patients' demographics, socioeconomic state, traditional and nontraditional risk factors including sleep-related factors were obtained using structured questionnaires. Risk of ischemic stroke were estimated using conditional logistic regression analysis.

Results: Although average sleep duration was similar in patients and controls, patients were more likely to have long (\geq 9 hours) or extremely short (< 5 hours) sleep durations. In addition, the proportion of subjects with dissatisfaction with sleep quality was higher in patients than controls (66.2% versus 49.3%, p < 0.001). In multivariable conditional logistic regression analysis, long sleep duration (OR: 11.076, 95% CI 1.819-67.446, p = 0.009) and dissatisfaction with sleep quality (OR: 2.116, 95% CI 1.68-3.833, p = 0.013) were independently associated with risk of ischemic stroke.

Conclusions:

Long sleep duration and dissatisfaction with sleep quality may be associated with increased risk of ischemic stroke in young adults. Improving sleep habit or quality could be important for reducing the risk of ischemic stroke.



Figure 1. . Mean (±SD) sleep duration (A) and distributions of sleep duration (B) of ischemic stroke patients and healthy controls

Characteristics of wall shear stress according to mechanism of ischemic stroke with atherosclerotic plaque of middle cerebral artery

<u>Ho Geol Woo¹</u>, Sang Hee Ha², Sung Hyuk Heo¹, Dae-II Chang¹, Bum Joon Kim²

¹Neurology, Kyung Hee University College of Medicine, Seoul, Korea, Republic of ²Neurology, Asan Medical Center, Seoul, Korea, Republic of

Purpose: The mechanism of stroke caused by atherosclerotic plaque of middle cerebral artery (MCA) was differed according to the pattern of lesion. The aim of this study was to compare the characteristics of wall shear stress (WSS) according to the stroke mechanism in the patients with atherosclerotic plaque of MCA.

Methods: We prospectively recruited consecutive patients with symptomatic and asymptomatic atherosclerosis of the MCA (≥50% diameter stenosis). The mechanism of stroke caused by atherosclerosis of the MCA was determined by a lesion pattern on diffusion-weighted image. The characteristics of the MCA plaque and WSS were measured by high-resolution vessel wall imaging and GT-Flow software. The characteristics of the MCA plaque and WSS were compared among patients with asymptomatic atherosclerosis of the MCA and those with stroke caused by different mechanism.

Results: A total of 110 patients (46 asymptomatic, 32 artery-to-artery embolism, and 32 local branch occlusion) were investigated. Plaque in the distal MCA was more common in the artery-to-artery embolism patients and plaque in the middle MCA was more common in the local branch occlusion patients. Location of plaque enhancement and maximum WSS in the artery-to-artery embolism patients were more prevalent in the upstream point and those in the local branch occlusion patients were more prevalent in minimum lumen area Elevated variability of maximal WSS was related to the stroke caused by artery-to-artery embolism.

Conclusions: Stroke caused by artery-to-artery embolism are more related to the elevated variability of maximum WSS and are commonly developed at upstream point of plaque.



Arterial dissection: A still underestimated cause of lateral medullary infarction

<u>Wookjin Yang</u>¹, Dong-Wan Kang¹, Eung-Joon Lee¹, Han-Yeong Jeong¹, Jeong-Min Kim¹, Keun-Hwa Jung¹, Seung-Hoon Lee¹

¹Neurology, Seoul National University Hospital, Seoul, Korea, Republic of

Purpose: Although the association between vertebral artery or posterior inferior cerebellar artery dissection and lateral medullary infarction (LMI) has been established, the actual prevalence of dissection among patients with LMI may still be underestimated.

Methods: Consecutive patients with acute pure LMI admitted between 2010 and 2021 were included. High-resolution vessel wall MRI (VWMRI) and/or transfemoral cerebral angiography (TFCA) were performed in a part of patients and were regarded as gold standard tests. Factors associated with definite dissection based on VWMRI or TFCA findings were assessed. Risk scoring for dissection was created based on multivariate logistic regression and applied to estimate the number of possible dissection. **Results:** Eighty-seven LMI patients were eligible and 47 (54.0%) of them underwent VWMRI (n=43) and/or TFCA (n=7). Among these 47 patients, 24 were definite dissection. Three out of 40 patients without gold standard tests were diagnosed with definite dissection based on conventional MRI findings. Preceding headache and normal body weight were independently associated with dissection in LMI patients. A risk scoring which includes age, body mass index, and headache predicted dissection with 91.7% sensitivity and 69.6% specificity (area under the receiver operating characteristic curve, 0.889; 95% confidence intervals, 0.802–0.977) in our population. Additional nine out of 37 patients without gold standard tests nor diagnosis of definite dissection in conventional MRI could be considered as possible dissection based on the scoring. Definite and possible dissections together comprised 41.4% (n=36) of LMI in our study.

Conclusions: Arterial dissection may be more prevalent among LMI patients than reported before. Thorough diagnostic effort for dissection is necessary based on scrutinizing risk stratification.

Clinical significance of dizziness and imbalance in cervicocephalic arterial dissections of the posterior circulation

Seong-Joon Lee¹, Jin Soo Lee¹, Min Kim¹, So Young Park¹, Ji Man Hong¹

¹Neurology, Ajou University School of Medicine, Suwon, Korea, Republic of

Purpose: Dizziness and imbalance (D&I) is a common presenting symptom of cervicocephalic arterial dissections (CCAD) of the posterior circulation (PC). We aimed to evaluate the clinical patterns of D&I in CCAD, and its association with outcomes.

Methods: From a single-center database, we identified patients admitted from January 2001 to June 2019 with a diagnosis of PC CCAD. Clinical presentation was trichotomized to ischemic stroke (IS), subarachnoid hemorrhage (SAH), and others (headache, transient ischemic attack [TIA], or others). In each presentation category, the significance of D&I and its association with clinical and radiologic outcomes was sought by comparative and multivariable analyses.

Results: A total of 385 patients were included. Among 170 IS patients, the presence of D&I (n=100) was associated with lower NIHSS (1.0 [0.0-3.0] vs. 2.0 [1.0-4.0], p=0.012) and lower 3 month mRS (1.0 [0.0-1.0] vs. 1.0 [0.5-2.0], p=0.026) It was also associated with higher rates of intracranial to extracranial extended dissections (34% vs. 12.9%, P<0.001), occlusive rather than aneurysmal dilatation luminal morphology (dilatation: vs. 25.0% vs38.6%; occlusion: 44.0% vs. 22.0%, p=0.015). There was a tendency for association with recurrent ischemic stroke (8.2% vs. 1.5%, p=0.061), and reverse association with aneurysmal enlargement (1.2% vs. 13.8%, p=0.002). In multivariable analysis, D&I was reversely associated with aneurysmal enlargement (OR: 0.07, 95% CI: 0.008 - 0.656, p=0.019). In patients that presented with other symptoms (n=154), 30 (19.4%) patients presented with D&I, in which 8 were classified as TIA or MR negative stroke, and 22 (14.2%) were isolated vertigo or imbalance. D&I was associated with a lower rate of headaches (53.3% vs. 94.5%, p<0.001), higher diabetes (20.0% vs. 4.0%, p=0.002), and reverse association with spontaneous arterial healing (25.0% vs. 66.3%, p=0.001). In multivariable analysis, D&I was reversely associated with arterial healing (OR: 0.16,3 95% CI: 0.047 - 0.564, p=0.004). However, it lost its clinical significance when headache was included as a variable, in which headache was a strong predictor of arterial healing. No subarachnoid hemorrhage patients presented with D&I. Conclusions: In CCAD patients presenting with ischemic stroke, D&I seems to predict against pathologic aneurysmal arterial modification. In CCAD patients presenting with other symptoms, a significant number of patients presented with isolated D&I. Its presence does not seem to be associated with rapid arterial changes, which is in contrast to accompanied headaches.

Cardiovascular risk with proton pump inhibitors

Joonsang Yoo¹, Ju-Young Park², Jimin Jeon¹, Jinkwon Kim¹, Sangwook Kang²

¹Department of Neurology, Yongin Severance Hospital, Yonsei University College of Medicine, Seoul, Korea, Republic of

²Statistics and Data Science, Yonsei University, Seoul, Korea, Republic of

Purpose: Proton pump inhibitors (PPI) are a class of acid-suppressive medications, which are among the most frequently prescribed medications. Studies have debated whether treatment with PPI may increase the incidence of cardiovascular complications. To clarify this, we conducted a retrospective analysis using a nationwide population-based health claims cohort database in Korea with two different research designs: a conventional cohort and self-controlled case series (SCCS), in which individuals act as their own control and eliminate between-person confounding and invariant confounding.

Methods: From the NHIS-HEALS database, a conventional cohort study included 303,404 adult participants without prior cardiovascular events who had completed a national health screening program in 2004–2005. The primary outcome was the development of stroke or myocardial infarction until December 2015. In a cohort study, a multivariate Cox proportional regression analysis was performed including the exposure to PPI during follow-up as a time-dependent variable. The SCCS method estimated age-adjusted incidence rate ratios (IRR) between periods with and without exposure to PPI in 10,952 patients who had primary outcomes during the study period.

Results: In the cohort study, a time-dependent Cox regression analysis showed that treatment with PPI was associated with an increased risk of the primary outcome (adjusted HR 1.36, 95% CI 1.24–1.49; P<0.001). However, in the SCCS study, there was no association between PPI exposure and primary outcome (adjusted IRR 0.98, 95% CI 0.89–1.09, P=0.745).

Conclusions: Our data of discordant findings in the two study designs suggests that the association between increased cardiovascular risk and PPI, frequently reported in prior observational studies, is likely due to residual confounding related to conditions with PPI treatment rather than the true relationship.

Association of free fatty acid level with cardioembolic stroke: A systematic review and meta-analysis

Darda Chung¹, Jong-Un Choi¹, Jong-Won Chung¹, Oh Young Bang¹, Gyeong-Moon Kim¹, Woo-Keun Seo¹

¹Neurology, Samsung Medical Center, Seoul, Korea, Republic of

Purpose: Free fatty acids (FFAs) are major components of epicardial fat and known to be associated with the presence and chronicity of atrial fibrillation (AF). Previous studies have shown that high FFA level in plasma or cerebrospinal fluid (CSF) is associated with unfavorable functional outcome after acute ischemic stroke as well as increased risk of cardioembolic (CE) stroke. The purpose of this systematic review and meta-analysis is to synthesize the evidence from all available studies for this association. **Methods:** A systematic search of PubMed, EMBASE, and Google Scholar was performed to identify studies that analyzed the stroke subtype in patients with acute ischemic stroke (AIS) with available data on FFA level in plasma or CSF. Search terms included free fatty acid and stroke. The outcomes of this review consisted of CE stroke, AF-related stroke, and early functional outcome after the index stroke.

Results: Of the total of 71 records retrieved, 9 eligible studies (5873 subjects) were included in the meta-analysis, excluding those that were duplicates or were judged to be inappropriate based on reviewing titles or abstracts. CE stroke was reported in 1138 patients with plasma FFA levels, and the pooled standardized mean difference (SMD) of plasma FFA was 0.72 (95% CI, 0.51–0.93; $I^2 = 89\%$; P < 0.01). CE stroke was reported in 357 patients with CSF FFA levels, and the pooled SMD of CSF FFA was 1.89 (95% CI, 1.63–2.15; $I^2 = 0\%$; P = 0.43). AF-related stroke was reported in 348 patients with plasma FFA levels, and the pooled standardized mean difference (SMD) of plasma FFA was 0.90 (95% CI, 0.58–1.21; $I^2 = 64\%$; P = 0.10). Early functional outcome after stroke was reported in 524 patients with plasma FFA levels, and the pooled standardized mean difference (SMD) of plasma FFA was 0.67 (95% CI, 0.63–0.71; $I^2 = 45\%$; P = 0.18). It was also reported in 762 patients with CSF FFA levels, and the pooled SMD of CSF FFA was 0.68 (95% CI, 0.65–0.71; $I^2 = 8\%$; P = 0.34).

Conclusions: This systematic review and meta-analysis presented that FFA levels in plasma and CSF showed fairly consistent trends and were significantly positively associated with the risk of CE- or AF-related stroke, and poor functional outcome after stroke, respectively. This supports the expectations that FFA level might be a meaningful biomarker for CE- or AF-related stroke, and a predictor of prognosis after embolic stroke.

Study ID	Study design	Region	setting	Study period	Sample type	Sample size	Total FFA (median (IQR) or mean±SD)	No. of cases (CE stroke)	Study quality (NOS)
W-K Seo et al, 2011	Cohort	Korea, republic of	Hospital	2007.07~ 2009.12	Plasma FFA (Eq/L)	715	853.73 ± 659.79	107	8
W-K Seo et al, 2016	Cohort	Korea, republic of	Hospital	2010.01 ~ 2012.12	Plasma FFA (µEq/L)	1307	739.80 ± 440.27	298	7
K-I Cho et al, 2018	Cohort	Korea, republic of	Hospital	2011.03 ~ 2014.06	Plasma FFA (µEq/L)	214	859.5±601.5	33	6
G I Sup et al. 2016	Cohort	Weihai,	Hospital	2011.12~	Plasma FFA (mmol/L)	119	0.78 (0.45-1.12)	42	e
G-J Suit et al, 2015	Conore	China	ricopitat	2014.10	CSF FFA (mmol/L)		0.22 (0.11-0.31)		0
D Chung et al, 2021	Cohort	Korea, republic of	Hospital	2017.01~ 2021.10	Plasma FFA (mEq/L)	2515	0.70 ± 0.4	459	7
Z. NIU et al, 2017	Cohort	Shaoxing, China	Hospital	2013.12~ 2015.05	Plasma FFA (mmol/L)	296	0.55 (0.36-0.73)	106	7
Xue-Jun Wei et al, 2015	Cohort	Laiwu, China	Hospital	2012.11 ~ 2014.09	CSF FFA (mmol/L)	238	0.24 (0.15-0.34)	84	7
Xiao-Xia Duan et al, 2017	Cohort	Luzhou, China	Hospital	2012.11 ~ 2014.12	Plasma FFA (mmol/L)	252	0.53 (0.35-0.71)	93	6
Xinlei Wang et al, 2016	Cohort	Linyi, China	Hospital	2013.02~ 2014.12	CSF FFA (mmol/L)	217	0.22 (0.12-0.33)	67	6

Table 1. Characteristics of included studies

Abbreviations: FFA, free fatty acid; CE, cardioembolic; IQR, interquartile range; SD, standard deviation; NOS, Newcastle-Ottawa Scale

Impact of neuroimaging patterns for the detection of atrial fibrillation by implantable loop recorders in patients with embolic stroke of undetermined source

Jihee Ko¹, Joong-Goo Kim¹, Jay Chol Choi¹

¹Neurology, Jeju National University Hospital, Jeju, Korea, Republic of

Purpose: Atrial fibrillation (AF) is a well-known etiology of ESUS, although the optimal detection strategy of AF was not been fully evaluated yet. We assessed AF detection rate by ILR in patients with ESUS and compared the clinical characteristics and neuroimaging patterns between the patients with AF and those without AF.

Methods: We used data (August 1, 2019, and January 31, 2021) of patients with an ESUS from the single comprehensive stroke center in the South Korea. We compared patients with AF+ with AF-about clinical characteristics and neuroimaging patterns. Ischemic stroke patterns were classified as 1) tiny scattered infarction, 2) whole-territorial infarction, 3) lobar infarction and 4) multiple-territorial infarction.

Results: A consecutive series of 41 ESUS patients who underwent ILR for detection of AF were retrospectively evaluated. The rate of AF detection at 6 months was 34% among all study patients (14 patients), and the mean time from ILR insertion to AF detection was 52.5 days (interquartile range, 45 to 69.5). AF- and AF+ patients showed no significant differences in baseline characteristics, including initial ECG and $CHA_{e} DS_{e}$ -VASc scores, but hypertension, smoking, and alcohol intake presented small differences between the two groups. The median initial NIHSS scores were significantly more severe in the AF+ group than in the AF- group [6.5 (interquartile range, IQR, 2.0-16.0) vs. 3 (IQR)1.0-6.0); P = 0.019]. There were no significant differences among patients who received mechanical thrombectomy, TEE or warfarin anticoagulation therapy. The mean times from index stroke to TEE [6.0 (IQR, 3.0-18.0) vs. 5.0 (IQR, 2.0-10.0) days; P = 0.337] and from index stroke to 24-hour Holter monitoring [3.5 (IQR, 2.0-6.0) vs. 3.5 (IQR, 2.0-6.0)) days; P = 0.926] were not significantly different between the groups. The mean times from stroke to AF detection was 52.5 (IQR, 44.5-97.0). The whole-territorial infarction pattern was significantly higher in AF+ patients than in AF- patients [AF+: 9 (64.3%) vs. AF-:3 (11.1%)]. However, multiple-territory infarction patterns were much more frequent in the AF- group than in the AF+ group [AF-: 8 (29.6%) vs. AF+: 2 (14.3%)].

Conclusions: Higher covert AF detection rates within the ESUS patients were most often associated with higher NIHSS score and whole-territorial infarction patterns on brain imaging.

2022 대한뇌졸중학회 춘계학술대회

"Individualized vs. Guideline-based Management"

Room B

심장색전연구회

좌장 | 서우근 (성균관의대), 박만석 (전남의대)





Imaging patterns and pitfalls of embolic stroke

Beom Joon Kim

Department of Neurology, Seoul National University Bundang Hospital





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H 192/113 190/115 182/110 180/109 178/107 180/96 182/97 183/110 188/101

ger A1/M1 Diameter Cerebral Arte	Ratio Pred ry Territor	icts Emb rial Strok	olic Ant e	erior (Stroke. 2014;45:2798-28))0.)			▲ MCAOPCA PCAOACA ✓ borderzone은 통상 혈	류량이 떨어	져있는	곳
in Shoamanesh, MD; Hesham Maso Jelena Lau, MSPH; Jose R. Romero Thanh N. Nguyen, MD; Carl	id, MD; Katrina l MD; Aleksandra s S. Kase, MD; ¹	Furey, MD; Ka Pikula, MD; F viken L. Babik	dyn Duerfela hilip Teal, M an, MD	k, MD; D;				✓ 전신 혹은 국소적 관류	저하에 의한	t global i	schemi
Table 1. Demographics an Compared With MCA Stroke	Arterial Mea	surements ir	ACA	Table 2. Univariable Logistic Regree Backward Regression Analysis Deter Stroke	ssion a mining	nd Multivaria Predictors of	ble FACA	✓ 혈류량에 의존하여 색	전이 도착한	local isc	hemia
	ACA Strokes	MCA Strokes			OR	95% CI	P Value			Blanco. Strok	e Vasc Neurol.
	(n=27)	(1=28)	PValue	Adjusted final models						SBP/DBP	
Ipsilateral arterial measurements m	ean (SD)			Model A*				Artery	Diameter (mm)	N	н
A1 diameter, mm	2.5 (±0.5)	2.1 (±0.5)	0.003	MIDDELA				Brachial Internation	3.880	117/75	192/113
M1 diameter, mm	2.6 (±0.5)	2.9 (±0.5)	0.11	Ipsilateral A1D (per 1 mm increment)	8.5	1.4-53.3	0.02	Beelar	3.448	113/73	182/110
A1/M1 diameter ratio	1.0 (±0.2)	0.7 (±0.2)	< 0.001	Ipsilateral M1D (per 1 mm increment)	0.2	0.0-0.9	0.04	Eng. 2014 Posterior cerebral artery precommunicating part	1.633	111/71	180/109
ICA-ACA angle. *	109 (+13)	108 (+18)	>0.20	Contralateral anlastic/hypoplastic	81	0.84-78.3	0.07	Distal medial striate	0.545	110/70	178/107
ICA-MCA apple 9	142 (+16)	126 (+14)	0.15	A1 segment		010111010		Prefrontal	0.962	95/61	160/96
IOL AGE IOA 1404 anala antia	0.0 (.0.0)	0.0 (214)	0.13	Madal D4				Temporal branch of middle cerebral	0.923	98/62	162/97
тил-лилитил-мGA angle ratio, mean (SD)	u.o (±0.2)	U.6 (±0.2)	>0.20	wodel RL				Lenticulostriate	0.582	113/73	183/110
moan (ovy				Ipsilateral A1/M1 diameter ratio (per	1.8	1.1-2.9	0.01	190 µm, 210 µm arterioles of lenticulostriate arteriolar bed	0.190/0-210	102/65	169/101
	11 (41%)	1 (4%)	<0.001	10% increment)				30 µm, 50 µm artericles of lenticulostriate artericlar bed	0.030/0-050	91/58	157/92
Contralateral aplastic or hyperlastic A1 commant in (%)								Postenor panetal branch of middle cerebral artery	1.039	85/54	145/86
Contralateral aplastic or hypoplastic A1 segment, n (%)	-1 0.0		104	Contralateral aplastic/hypoplastic	8.3	0.9-77.6	0.06	100 um 010 um exterioles el conterior parietel asterioles had	0.100/0.010	00145	105/74

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Imaging patterns and pitfalls of embolic stroke

Do Yeon Kim

Seoul National University Bundang Hospital, Seongnam, Korea

Background: Multiple acute infarction, and simultaneous involvement of different circulations, multiple infarcts of different ages, and isolated cortical ischemia are commonly suggested as imaging features of embolic stroke. Symptomatic extracranial or intracranial atherosclerosis of \geq 50% luminal stenosis is considered as a significant embolic source.

Case 1: 76-year old man complained of right veering tendency with right homonymous hemianopsia on neurologic exam. Brain MRI/A was done. Acute infarction in the left middle cerebral artery (MCA) and posterior cerebral artery territories, and severe stenosis in the left M1 segment were found. Does acute infarction in the multiple territories always mean "cardioembolic infarction?"

Case 2: 58-year old man complained of left side weakness, right gaze preponderance, hemineglect on neurologic exam. Brain MRI/A was done. Acute infarction in the right MCA territory and mild stenosis in the right proximal ICA was found. Could mild stenosis or nonstenotic plaque (<50%) not be an embolic source?

Conclusion: Individual application of imaging features of embolic stroke including other patients' factors and detailed imaging findings are warranted for the investigation of stroke mechanism.



Figure. 76-year old man complained of right veering tendency. Acute infarction in the left middle cerebral artery (MCA) and posterior cerebral artery territories, and severe stenosis in the left M1 segment were found.

Diagnostic approach and work up in the patients with embolic stroke of undetermined source

Jong-Won Chung

Department of Neurology, Samsung Medical Center

Embolic stroke of undetermined source (ESUS) designates patients with nonlacunar cryptogenic ischemic strokes in whom embolism is the likely stroke mechanism. Targeted diagnostics in ESUS patients can reduce the number of cryptogenic strokes by making a specific diagnosis. In this lecture we will look at two cases of ESUS patients and suggest selection of diagnostic evaluation methods and discuss possible underlying mechanisms.

Criteria for diagnosis of ESUS

- Stroke detected by CT or MRI that is not lacunar
- Absence of extracranial or intracranial atherosclerosis causing ≥50% luminal stenosis in arteries supplying the area of ischemia
- No major-risk cardioembolic source of embolism
- No other specific cause of stroke identified (eg, arteritis, dissection, migraine/vasospasm, drug misuse)

Proposed diagnostic assessment for ESUS

- Brain CT or MRI
- 12-leadECG
- Precordial echocardiography
- Cardiac monitoring for ≥24 h with automated rhythm detection
- Imaging of both the extracranial and intracranial arteries supplying the area of brain ischemia (catheter, MR, or CT angiography, or cervical duplex plus transcranial doppler ultrasonography)

Diagnostic approach and work up in the patients with embolic stroke of undetermined source

Darda Chung

Department of Neurology, Samsung Medical Center



	ogic assessment			
NIH Stroke Scale	Catecogy	Score		
1a	Level of Consciousness	0		
1b	LOC Questions	0		
1c	LOC Commands	0		
2	Best Gaze	0		
3	Visual Fields	0		
4	Facial Palsy	0		
5	Motor Arm	Rt: 0	Lt: 0	
6	Motor Leg	Rt: 0	Lt: 0	
7	Limb Ataxia	0		
8	Sensory	0		
9	Best Language	0		
10	Dysarthria	0		
		0		





Labora	tory f	indings			
WBC Count, Blood	:	4.14 x10∛µL	Cholesterol		: ▲211 mg/dℓ
RBC Count, Blood	:	5.20 x10^6/µL	Triglyceride		: 126 mg/dl
Hemoglobin, Blood	I :	15.8 g/dL	HDL-C		: 47 mg/dl
Hematocrit, Blood	:	45.5 %	LDL-C		: ▲154 mg/dl
Platelet Count, Blo	od :	216 x10∛µL	Calculated LDL-C		: 139 mg/dl
PT(sec)	: 1	.3.2 sec	Protein, Total		: 6.8 g/dl
PT(%)	: :	100 %	Albumin		: 4.7 g/dl
PT(INR)	: 1	LOO INR	Bilirubin, Total		: 1.2 mg/dl
APTT	: 3	37.5 sec	AST		: 14 U/ℓ
Fibrinogen	: :	255 mg/dL	ALT		: 16 U/ℓ
D-Dimer	: C).27 ug/mL(FEU)	Glucose, Fasting		: 97 mg/dl
			BUN		: 10.8 mg/dl
Free Fatty Acid	:	378 µEq/ℓ	Creatinine		: 1.02 mg/dl
Glucose (POCT)	:	95 mg/dl	Estimated GFR		: 90.2 mL/min/1.73m ²
Hemoglobin A1c	:	5.5 %	Na	:	140 mmol/ℓ
HbA1C, IFCC (mmol	/mmol)	: 37 mmol/mol	Potassium (K)	:	4.2 mmol/ℓ
eAG (mg/dL)	:	111 mg/dL	CI	:	103 mmol/ℓ
		0	CRP. Quantitative	(His	h Sensitivity) : 0.03 mg/









• Laboratory findings (young-age stroke)

① Serologic marker for systemic vasculitis or thrombotic disorder: WNL

184888 SMC

② Thyroid function test: WNL







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• Presen	t illness		• Initial neurol	ogic assessment		
F/79 Rt hand	ded		NIH Stroke Scale	Catecogy	Score	
			1a	Level of Consciousness	0	
DM/HTN/Dyslipidemia/A.fib (-/+/-/) on medi			1b	LOC Questions	0	
			1c	LOC Commands	0	
			2	Best Gaze	0	
Onset date	Sudden general weakness after taking a shower	akness after taking a shower	3	Visual Fields	0	
onset dute.			4	Facial Palsy	0	
	She complained of dysarthria & Rt arm weakness when 119 a	arrived.	5	Motor Arm	Rt: 0 Lt: 0	
	ightarrow All neurological symptoms improved during the ER visit.		6	Motor Leg	Rt: 0 Lt: 0	
			7	Limb Ataxia	0	
			8	Sensory	0	
			9	Best Language	0	
			10	Dysarthria	0	
			11	Extinction and Inattention	0	
					Total Score:	0
		20				21







· 2 함께하는 진료 함께하는 행복						1004808 SIMC
• Labora	atory	/ fir	ndings			
WBC Count, Blood RBC Count, Blood Hemoglobin, Bloo Hematocrit, Blood Platelet Count, Blo	d I Dod		5.204 x10∛µL 3.92 x10^6/µL 12.5 g/dL 39.5 % 219 x10∛µL	Cholesterol Triglyceride HDL-C LDL-C Calculated LDL-C		: 170 mg/dl : 126 mg/dl : 47 mg/dl : 103 mg/dl 95 mg/dl
PT(sec) PT(%) PT(INR) APTT Fibrinogen D-Dimer		13 10 28 21 1.1	.1 sec D1 % 99 INR .0 sec 23 mg/dL 22 ug/mL(FEU)	Protein, Total Albumin Bilirubin, Total AST ALT Glucose, Fasting BLIN	:	: 6.6 g/dl : 4.2 g/dl : 0.4 mg/dl : 28 U/l : 15 U/l : 103 mg/dl - 19.8 mg/dl
Free Fatty Acid Glucose (POCT) Hemoglobin A1c HbA1C,IFCC (mmo eAG (mg/dL)	ol/mm	: ; ol) :	891 µEq/ê 91 mg/dê 5.7 % 39 mmol/mol 117 mg/dL	Creatinine Estimated GFR Na Potassium (K) Cl CRP, Quantitative	: : (Higl	 1.373 mg/dl 1.73 mg/dl 1.78.6 mL/min/1.73m' 1.41 mmol/l 4.1 mmol/l 1.08 mmol/l h Sensitivity): 0.03 mg/dl
						25







		Enter patient values in this column	
linical and Imaging Information	Units	Value	Acceptable range of values
ge	years	79	1 or higher
itial Neurologic Severity	NHSS score	0	0-42
ypertension	1 (for yes) or 0 (for no)	1	1 or 0
arge Ischemic Lesion, Largest Diameter of Ischemic Lesion ≥ 20 mm	1 (for yes) or 0 (for no)	0	1 or 0
chemic Lesions Involving Posterior Circulation	1 (for yes) or 0 (for no)	0	1 or 0
ultiple Ischemic Lesions	1 (for yes) or 0 (for no)	0	1 or 0
chemic Lesions Involving Multiple Vascular Territories [†]	1 (for yes) or 0 (for no)	0	1 or 0
50.0%			
50.0% 40.0%			
50.0% 40.0% 49.7% 49.7%	PAF score	-0.465	
80 0%	PAF score PFO score	-0.465 -0.953	
50 0%	PAF score PFO score AAA Probability	-0.465 -0.953 49.7%	
60 % 40 % 40 % 10 % 10 % 10 % 10 % 10 % 1	PAF score PFO score AAA Probability PAF Probability	-0.485 -0.953 49.7% 31.2%	
00% 00% 00% 00% 00% AAA Probability PAF Probability PFO Probability	PAF score PFO score AAA Probability PAF Probability PFO Probability	-0.465 -0.953 -49.7% -31.2% -19.1%	





· 함께하는 진료 함께하는 행복

• ESUS work-up

① Serial ECG follow-up

(2) Transthoracic echocardiography:

- Diastolic dysfunction grade 1 with LA enlargement (LAVI: 54.0ml/m²)
- No LV systolic dysfunction (EF: 68%)
- No regional wall motion abnormality

③ 24hr Holter monitoring:

- Sinus rhythm with RBBB pattern
- 3 episode of atrial tachycardia (the longest one = 7 beats, 114bpm, 20:58)
- APCs (80 isolated, 8 couplets, 3 triplets)
- VPCs (94 isolated)

1841888 SIMC



	884888 SIMC
Lt insular infarction with Lt inferior MCA territory perfusion	delay
✓ Sx. Transient dysarthria & Rt arm weakness	
✓ Et. Cardioembolism (Paroxysmal A.fib)	
✓ Tx. Edoxaban 30mg, Atorvastatin 40mg	
	37

Therapeutic intervention for the stroke patients with PFO

Bum Joon Kim

Asan Medical Center, University of Ulsan

Embolic stroke of unknown source (ESUS) is an important issue in managing stroke, as usually the treatment of stroke is based on mechanism. Atrial fibrillation, patent foramen ovale (PFO), cancer associated stroke, aortic arch is the potential source of stroke among those diagnosed as ESUS. We have shown a case here to discuss the evaluation, and treatment strategy in such a patient. Especially in an elderly patient with PFO who have an embolic stroke, efforts to evaluate another potential cause must be made. To close or not, a study with elderly ESUS patients with PFO is ongoing (ClinicalTrials.gov Identifier: NCT05238610)

Therapeutic intervention for the stroke patients with PFO

Sang Hee Ha

Department of Neurology, Asan Medical Center





 Alert and oriented Language: intact, Neglect: none Isocoric pupil with prompt light reflex EOM limitation: none Facial palsy: none Dysarthria: none Tongue deviation Motor Power: UEx 5 / 5 LEX 5 / 5 Sensory: pinprick intact Ataxia: FTN -/- HTS -/- DTR Biceps brachii ++/++ Knee jerk ++/++ Pathologic reflex Babinski -/- Hoffman -/- NIHSS (0) 	[Initial assessment] #1. TIA [Initial plan] #1. Imaging study #2. Lab





Laborat	ory st	udy				
СВС				Biochemist	ry	
검사명	검사값	참고치		검사명	검사값	참고치
Hemoglobin	15.3	12.0	0 – 16.0 g/dL	HbA1c	8.1	4
Hematocrit	43.4	3	36.0 - 48.0 %	Homocysteine	9.9	umol,
WBC	10.4	4 - 10	*10^3 /mm3	Na	139	135 - 145 mmol,
Platelet	192	150 - 350	*10^3 /mm3	К	4.3	3.5 - 5.1 mmol
MCV	89.7	83.0 - 101.0 fL		CI	102	98 - 110 mmol
MCH	31.6		20 - 44 pg	BUN	11	10 - 26 mg/
мснс	35.3	31.	5 - 34.5 g/dL	Creatinine	1.10	0.7 - 1.4 mg/d
RDW	11.7		11.6 - 14.5 %	CRP	0.1	0 - 0.6 mg/d
				D-dimer	0.26	< 0.5 ug/n
Lipid batte	ery			PT(INR)	1.00	0.8 - 1.3 IN
건사명	건/	u zł		aPTT	95.0	24.0 - 33.0 s
Total cholesterol		209	ma/dl	Fibrinogen	249	200 - 400 mg/d
I.D.L. cholesterol		154	ma/dl			
Trialyceride		163	ma/dl			
HDL cholesterol		45	ma/dl			

Assessment and plan	Evaluation
[Assessment] #. Lt PCA territory embolic infarction r/o cardio embolism r/o other cause (i.e. Hidden malignancy, Aortic arch, PFO)	TTE EF 61 % LA 40mm I. Normal LV size and systolic function Z. Right-to-left shunt on agitated saline study, R/O Intracardiac shunt
[Plan] <u>Diagnostic plan</u> #. Embolism work up: TTE, Holter, TCD-PFO test # if needed consider TEE	 Holter Basically normal sinus rhythm Few PVCs (<1% of total QRS complexes) Few PACs (<1% of total QRS complexes) Otherwise no remarkable finding
	TCD – PFO test 1. MES was detected in 3 sec after intravenous injection 2. During normal respiration, there was right-to-left shunting. (Grade 3) 3. After valsalva strain, there was right-to-left shunting. (Grade 4)



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"Individualized vs. Guideline-based Management"

Room C

질향상위원회 / KSR위원회

좌장 | 차재관 (동아의대), 박종무 (을지의대)





Stroke center 인증 소개

Hee Kwon Park

Department of Neurology, Inha University Hospital
















ESO SUC background	Service Elements of S versus Stroke Units	troke Centers	SATION
	Stroke Center	Stroke Unit]
Mandate from the ESO Ex-Committee: certification	IV Thrombolysis	IV Thrombolysis	1
processes for SU and SC – 2007	Endovascular Revascularisation	e.g. Drip & ship	
ESO Recommendations to establish a SU and SC	Stroke Physician	Stroke Physician	
Ringelstein BE et al. Stroke 2013;44:828-40	Diagnostic/interventional Neuroradiology		
	Angiography (DSA) 24/7]
Application forms			
Lyrer P et al. Web-site publishing, ESOC 2016	CT & MRT 24/7	CT 24/7	
ESO Guideline Certification of SU and SC			
Waje-Andreassen U et al. Eur Stroke J 2018;3:220-26	6 beds with automated monitoring	4 beds with automated monitoring	
	Acute Strokes treated/y : minimum 400	Acute Strokes treated/y: minimum 200	









Characteristics of the Performance and Facility of Korean TSC

	Mean	SD	Median	25%	75%	Minimum	Maximum
Number of IVtPA	48	30.4	41.5	24.25	63	7	142
Number of IAT	51.7	33.5	46	29.3	46	9	170
DTN time (minute)	49.2	25.3	47	38	47	26	203
DTP time (minute)	124.16	44.6	114.5	95.75	138.8	66	314
Number of Stroke Unit Bed	6.45	2.2	6	5	8	4	12
Number of Stroke Unit Nurse	7.52	4.2	5	5	10	5	22















4. 5	Stroke	e Do	octo	r		2 * 9 8 8 85 8 8	sticlet a bad vitre face for Panale 2011 foreidar; Brake doctors – s unreg In Managar ⁽²⁾ Bakas ministrator ⁽²⁾ Status ministrator ⁽²⁾ Status ministrator ⁽²⁾ Status ministrator ⁽²⁾	ning the data are not the second seco	eld Strake Organia eld Strake Organia ela Alanyen ² , Bruse De Rakaste Roger ² , John Inner Brann ¹⁹ , Ba Ker	talion Naac) Nag ^o set	
ton store against	Inex	Baspay	inted	brad	Augus	Mexico	Switzerland	Theland	ux	UM	130
Sanika degree type	Acadonic degrae	Star Lioner (previously (Apiona of Hargatian Starke Society)	Andenic depre	Felevskip	Catification by Appen Stocke Notice	Academic degree	Cotification by Status Neurological Society	Acadomic degree	Academic degree	Catification by American Board of Prochiatry and Neurology	Manter in Stroke Moticine an- bosted by the ESO and Donas University Kreen
Initiation year	1996	2000.0km.) 2000.0kp0	2889	2011	2960	1990	Early 2992's	2985	2964	2005	2886
Degree kolden Specialisti entry organiste	-50 Noarring, Sugary, Radiology, Pandantos, Carliology, Vocalar surgery, Rahak-real.	60(Dipl.) Nourilags, Cardinlags, Internal modeline	NA. Molicil degree	NA Nandeg, Noaroary, Intenal mediate	Jas7 Nanning, Rafiology, Paolamor, Inanad Innogency/ Richal-mod.	-50 Noardigy	NA	m NA	N.A. Naarology, Dardiology, Batemal mobilism, Gentarico, Clinical pharmacol, Rahab mol.	-130 Norsleg	-18
Deration, y Brief description of stroke degree contrast	2 Theoretical: 6 modules (2 days each): Practical: Min. 1 year as existent or exist, formerflow and at some final mode and at least 20 dots in surveilled stocke with	2 NA	0.75 Teoreticat 7 mobiles (2 deps calit)	1 Asservative claics, strate- tratics, manu- strategy, moder motions, motio	3 hypersecont mode patients ours in waising sile	Theoretical Courses Research projects Participation in clinical and academic continen Provident Storike clinic dary	l Obscation in sinske arbecking and abrecond, final examp	2 Social followship program include materials proteins and neuro-sociology	2 Theoretical and practical training	1 Theoretical and procisol insisting	2.5 Theoretical Four works in America manary theories Practical Four works in International stroke condenser

KSR 소개

Kyung Bok Lee

Department of Neurology, Soonchunhyang University Seoul Hospital













	KSR vs. KSI	R-Core vs. CF	RCS-K Data capture: 2020.10
	Korean Stroke Registry (KSR)	KSR-Core	Clinical Research Collaboration for stroke in Korea (CRCS-K)
	Since 2001	Since 2013.10	Since 2008.04
Center #	78 centers	47 centers	17 centers
Subject #	231,941	83,847	88,515
characteristics	Large representative nationwide DB Missing and incomplete data	Multi-center and complete DB Essential core data field Auditing and QI	Extended data field High quality DB Small centers, not representative
Num	ber of subjects 83,847 231,941	CRCS-K	Number of centers 47 centers 78 cent
	88 515		17 centers

NUMBER Care B Sector 100 Note there Wide Stream Provide Stream



	OI in KSR	
NO	Indicators	definition
1	Neuroimaging in 60 minutes (%)	Among the patients within 6 hours after stroke onset
2	Door to needle time (min)	Among the patients within 4.5 hours after stroke onset
3	tPA in 60 minutes (%)	Among the patients treated with tPA
4	tPA rate (%)	Among the patients within 4.5 hours after stroke onset
5	IA thrombolysis rate (%)	Among the patients within 6 hours after stroke onset
6	Door to puncture time (min)	Among the patients within 6 hours after stroke onset treated with IA thrombectomy
7	Antithrombotics in 48 hours (%)	Among the patients with ischemic stroke
8	Discharge antithrombotics (%)	Among the patients with ischemic stroke
	D ¹ I	Among the natients with ischemic stroke and atrial fibrillation



Usefulness of KSR beyond QI

· Characteristics and secular trends of stoke in Korea

- · Immediate analysis of nationwide data for urgent purposes
- CER (comparative effectiveness research) -> RRCT (Registrybased Randomized Controlled Trial)
- Research opportunity for the individual researchers (open proposal system)

Key findings of 1st KSR

Analysis of 10,811 Cases with Acute Ischemic Stroke from Korean Stroke Registry: Hospital-Based Multicenter Prospective Registration Study

Kingde Tu MLL, the an Bas, MLL, Sin Lis, King MLD, Dong-Wai, King MLD, Kang Shi, King MLD, King



Adm <3 hrs after stroke onset: 20.5%
IV tPA: 2.1%
In-hospital mortality: 5.2%

J Korean Neurol Assoc. 200













Usefulness of KSR beyond QI

- · Characteristics and secular trends of stoke in Korea
- Immediate analysis of nationwide data for urgent purposes
- RRCT (Registry-based Randomized Controlled Trial)
- Research opportunity for the individual researchers (open proposal system)







빅데이터 연구

- 우리나라 가용 빅데이터 (건강보험공단, 심평원)
- 약점
 - 부정확한 진단명
 - 교란변수 통제 어려움 (변수 부족)

Combining the CRCS-K with other data sources (2010-)

Authors	Last Author	Title	Year	Journal
Wi-Sun Ryu et al.	Dong-Eog Kim	White matter hyperintensity load on stroke re	2019	Neurology
Kyung Bok Lee et al.	on behalf of the CRC	The Epidemiology of Fracture in Patients with	2019	Journal of Korean medical science
Dong-Eog Kim et al.	Hee-Joon Bae	Supratentorial Cerebral Arterial Territories for	2019	Nature Publishing Group
Dong-Eog Kim et al.	Hee-Joon Bae	Estimation of Acute Infarct Volume with Refer	2019	Journal of Stroke
Beom Joon Kim et al.	Hee-Joon Bae	Trajectory Groups of 24-Hour Systolic Blood Pres	2018	Stroke
Won-Sep Kim et al.	Hyung Ik Shin	Status of Rehabilitation After Ischemic Stroke:	2018	Annals of Rehabilitation Medicine
Keon-Joo Lee et al.	CRCS-5 investigators	Predictive Value of Pulse Pressure in Acute Ische	2018	Stroke
Dong-Eog Kim et al.	Hee-Joon Bae	Mapping the Supratentorial Cerebral Arterial Terri	2018	JAMA Neurology
Wi-Sun Ryu et al.	Dong-Eog Kim	Hemispheric Asymmetry of White Matter Hyp	2018	Journal of the American Heart Associat
Wi-Sun Ryu et al.	Dong-Eog Kim	Stroke outcomes are worse with larger leukoaraio	2016	Brain
Joon-Won Chung et al	Hee- loop Rae	Air Pollution Is Associated With Ischemic Stroke v	2016	Stroke



Stroke classification for KSR

Joon-Tae Kim

Department of Neurology, Chonnam National University Hospital, Gwangju-Jeonnam Cerebrovascular Center





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KSR 등록시 주의점과 stroke center인증에서의 팁

Han-Yeong Jeong

Department of Neurology, Seoul National University Hospital

한국뇌졸중등록사업(Korean Stroke Registry)은 한국의 급성 뇌졸중 및 일과성허혈발작 환자의 데이터를 수집하고, 한국 뇌졸중 진료의 질을 모니터링하고, 평가하여 이를 개선하기 위한 활동을 하는 범국가적인 뇌졸중 레지스트리이다. 2001년 23개 의과대학의 33개 대형병원이 참여하여 처음 발족한 한국뇌졸중등록사업은 2022년 현재 전국의 84개 병원에서 참여하고 있고, KSR CORE DB까지 참여하고 있는 병원은 62개로 확장되어, 다양한 사업을 수행하고 있다.

한편 대한뇌졸중학회에서는 뇌졸중 치료 발전과 진료 체계의 변화에 따라서, 새로이 뇌졸중센터(SC)-재관류치료뇌 졸중센터(TSC)의 인증사업을 사작하고 있는 바, 센터 인증 시에 KSR에 적극적으로 참여하는 병원들에게 다양한 방면으로 실질적인 혜택을 제공하고자 하고 있다.

본 발표에서는 KSR 등록 시 주의점과 Stroke center 인증에서의 팁이라는 주제로, 이래와 같은 사항에 대해서 짚어보고자 한다.

KSR 입력을 용이하게 해주는 시스템

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- KSR 다중신환일괄등록시스템
```

- KSR-권역레지스트리 연계 시스템 KSR 입력 시에 자주 틀리는 에러들 KSR을 이용하는 팁들

- KSR 환자관리 시스템
- KSR CORE QI system
- KSR News letter
- KSR 연례보고서
- KSR Open proposal system

KSR 협력병원 및 참여병원 등급과 이에 따른 리워드 KSR 참여병원 심사자료 제출 및 질향상위원회 - KSR 위원회 인증 프로세스 뇌졸중센터 인증에서 이용되는 KSR 항목들: 핵심질지표와 질 향상활동

2022 대한뇌졸중학회 춘계학술대회

"Individualized vs. Guideline-based Management"

Room C

정책 / 질향상위원회

좌장 | 차재관 (동아의대), 박태환 (서울의료원)





응급센터 및 지역 뇌혈관센터 시스템 개편 및 취약 지역 지원 방안

Kyung Bok Lee

Department of Neurology, Soonchunhyang University Seoul Hospital

뇌졸중은 국내 단일질환 중 가장 많은 사망원인이며 후유 장애에 의한 사회적 부담 또한 많은 질환이다. 하지만 우리나라는 다른 OECD 국가에 비하여 뇌졸중 전문 의료기관의 부재, 체계적인 응급 뇌졸중 이송 체계의 부재, 지방과 대도시간 의료시설의 불균형, 뇌졸중 환자에 대한 국가적인 데이터 및 관리체계 부재 등 많은 뇌졸중 의료관련 여러 문제를 가지고 있다. 특히 전국적으로 최소한의 관련시설과 인력을 갖춘 일차뇌졸중센터(Primary Stroke Center, PSC)가 고르게 분포되어 있어야 전국 어디서든지 지역적, 사회적으로 소외되지 않고 뇌졸중 초기에 적절한 치료를 받아 환자의 후유증을 최소화할 수 있으나, 우리나라에서 이러한 뇌졸중 안전망의 구축은 아직 시작 단계에 불과하다.

뇌졸중 응급의료는 현장에서부터 의료 서비스의 제공이 필요할 수도 있을 정도로 발생 초기의 시간적 대응이 매우 중요하다. 따라서 뇌졸중을 담당하는 응급의료기관은 즉각적인 환자이송을 위해 전국에 지리적으로 균형 배치가 필수적이고, 24시간 운영되어야 하며, 다수의 서비스 제공자보다는 통합된 시스템으로 진료권역을 설정하여 관리하는 것이 효과적이다. 우리나라에서는 2020년 38개 권역응급의료센터와 125개 지역응급의료센터를 지정하여 각 응급의 료권역을 담당하게 하고 있다. 또한, 최근 코로나19 위기에서 나타난 과제들을 고려하여 지역완결형 응급의료체계를 구축하고자, 의료이용 자료와 최소 배경인구수, 자체충족률, 병합인정거리 등을 통해 70개 중진료권으로 구분하여, 각 중진료권마다 최소 1개 이상의 중증응급의료센터를 설치하여 중증응급진료 인프라를 대폭 확충하는 계획을 발표하였다. 하지만, 응급의료 중진료권은 애초에 외상이나 감염 등의 중증응급질환에 초점이 맞추어 설정되었기 때문에, 전문진료가 가능한 적정진료기관에 훨씬 더 빨리 도착해야 하는 심뇌혈관질환 센터로 그대로 이용되기에는 어려운 실정이다. 특히 뇌혈관질환인 경우는 진단과 치료의 특성상 세부 전문과 이외의 타과는 물론이고 응급의학과에서 도 대응하기가 어렵기 때문에 반드시 전문인력과 시설을 필수적으로 갖추고 있어야 한다.

비록 현재 응급의료 중진료권이 실제 의료이용 행태를 충분히 반영하지 못한다는 지적이 있지만, 병원에 내원할 때 대부분 119 구급대를 이용해야 하며 중증응급질환인 급성기 뇌졸중의 특성을 고려할 때 앞으로 뇌졸중의 의료자원분 포나 치료 결과의 평가에서 현재 지정된 70개 응급의료중진료권 체계가 기본적인 틀이 될 것으로 예상된다. 따라서 현행 응급의료 중진료권역 내에서 심뇌혈관질환을 담당할 수 있는 의료기관의 인력, 시설 현황 및 진료 수준을 분석하는 것은 향후 전국적인 심뇌혈관질환 안전망 확보나 일차심뇌혈관질환센터의 구축에 필수적이며, 취약지역을 파악하여 국가 지원 등 정책 자료로 활용될 수 있을 것이다.

공공의료 및 1차 급성 뇌졸중 응급진료에 대한 학회 지원 방안

Sang Joon An

Department of Neurology, Catholic Kwandong University Hospital

2022 대한뇌졸중학회 춘계학술대회

"Individualized vs. Guideline-based Management"

Room C

Nursing symposium

좌장 | 최수정 (성균관대), **이수주** (을지의대)





The acute stroke treatment before arriving at stroke unit

Joong-Goo Kim

Department of Neurology, Jeju National University Hospital

Stroke is a devastating disease and is currently one of the leading cause of death in South Korea Also, given the social and economic burden of the stroke, reducing the risk of poor outcomes after undergoing stroke is markedly dependent upon what management when each patient is first struck with stroke. The phrase 'time is brain' is a vital concept in relation to the acute management of stroke, emphasizing that for every second that passes without proper treatment following an ischemic stroke, millions of neurons can destroy. Thus, acute ischemic stroke is highly time-dependent and requires effective protocolized triage, diagnosis, and critical management. Crucial interventions include early recognition of stroke symptoms, precise diagnosis using highly protocolized neuroimaging devices, immediate initiation of thrombolysis or endovascular reperfusion therapy, exact prescription of stroke unit. These sequences are critical in the first few hours of the acute ischemic stroke patient's admission to the emergency department (ED).

Following the arrival of a patient to the emergency room setting, every stroke patient should be stabilized and undergo assessment for whether potential candidates for intravenous alteplase (IV tPA) treatment. Assessments include diagnostic tests, neuroimaging, and standardized stroke evaluations. The administration of IV tPA has specific requirements for monitoring and should be standardized via protocol across hospitals. This includes respiratory and cardiac care, such as the provide of supplemental oxygen and an electrocardiogram in ED; fluid and metabolic management, such as fluid balance and electrolyte monitoring; and management of the patient's blood pressure, blood glucose levels and temperature. The treatment of stroke-related neurological complications such as delirium, and confusion are also important. Hyperacute management for patients who have experienced an acute ischemic stroke does not only involve medical management. Patients also need considerable engagement from nurses from the point of their arrival ED through to their acute treatment and eventual transfer to the stroke unit. For nurses, not only neurologic status, hyperacute care includes monitoring and stabilizing patients' physiological parameters, assessing factors such as swallowing function, bladder and bowel status, and skin integrity and identifying stroke complications. Therefore, it is key to have the comprehension and skills required to prepare evidence-based care for patients who underwent ischemic stroke.

The assessment of NIHSS by case studies

Jung Hoon Han

Department of Neurology, Korea University Kuro Hospital

National Institutes of Health Stroke Scale (NIHSS)는 뇌졸중과 관련하여 현재 전 세계적으로 가장 널리 사용되고 있는 뇌졸중 검진 척도이다. 1980년대 Cincinnati/Naloxone 버전의 원조 NIHSS를 시작으로, 1995년 시행된 National Institutes of Neurological Disorders and Stroke (NINDS) rt-PA 입상실험에서 개정된 NIHSS가 도입된 이후 이를 현재까지 사용 중이다. NIHSS는 그 타당성 및 신뢰도가 인정받은 입상진료 척도로, 일정 수준의 훈련을 완수한 이후에는 신경과 뇌졸중 담당 의사 뿐 아니라 뇌졸중 담당 간호사, 응급의학과 의료진 등 뇌졸중을 자주 접하는 모든 의료진들이 유용하게 사용할 수 있다. 이러한 장점으로 인해 뇌졸중과 관련된 거의 대부분의 입상연구들은 연구 디자인과 무관하게 급성기 뇌졸중 환자에서 NIHSS에 대한 분석을 시행하며, 실무 진료에서는 환자 진찰, 의료진간 소통의 도구, 치료방침의 결정에 중요하게 사용되고 있다.

NIHSS는 11개의 항목으로 구성되어 있고 1번 항목인 의식은 3개의 세부 항목이 포함된다. 총 0 ~ 42점의 범위를 가지며 신경학적 증상이 없는 경우가 0점에 해당된다. 각각은 의식 수준 0-3점, 의식 수준에 대한 질문 0-2점, 의식 수준에 관한 지시 0-2점, 최적의 주시 0-2점, 시야 0-3점, 안면마비 0-3점, 상지 근력 0-4점, 하지 근력 0-4점, 사지 운동 실조 0-2점, 감각 0-2점, 최상 언어 능력 0-3점, 구음 장애 0-2점, 소멸과 무관심 0-2점으로 분류 된다. 해당 항목들은 크게 좌뇌와 우뇌 진찰로 분류할 수 있고, 조금 더 국소적으로는 좌측 피질, 우측 피질, 좌측 근력 및 우측 근력으로 분류 해 볼 수 있어 진료 시 가장 중요하게 생각될 수 있는 요소들의 대부분이 포함된다. NIHSS의 간결 명확성에 의해 대부분의 경우 측정에 어려움이 없으나, 실어증, 기도 삽관 및 사지 절단 등의 특수 상황 환자들에 있어서 혼란이 발생한다. NIHSS는 평가의 정확성과 함께, 재현성이 중시되며 병원 별 근무 순환이 빈번함을 고려할 때 뇌졸중 환자의 NIHSS 교육 및 훈련의 중요성이 강조된다.

Nursing management in stroke unit

정원제

삼성서울병원 뇌졸중센터

뇌졸중 전문치료실(Stroke unit)은 뇌졸중 환자에게 최적화된 진료를 제공하기 위해 일정한 시설과 감시 장비를 갖추고 체계적이고 명문화된 진료계획 및 임상진료경로에 따라 다학제 간 의료진이 조직화된 진료를 제공하는 병실을 뜻한다. 이러한 뇌졸중 전문치료실에서의 급성 뇌졸중 간호의 목표는 신경학적 악화의 빠른 발견, 합병증의 예방일 것이다. 이번 강의에서는 뇌졸중 전문치료실에서 간호사가 집중 관리해야 하는 부분에 대해 다룬다.

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Patient discharge education

한정희

서울아산병원

뇌졸중 급성기 치료와 더불어 중요한 것은 재발을 예방하기 위한 퇴원 후 관리이다. 뇌졸중 환자의 퇴원 교육 중 가장 중요한 것 중 하나는 뇌졸중 예방약제에 대한 이해이다. 퇴원 시 항혈소판제나 항응고제에 대한 복약 이행도가 낮은 경우가 많아, 이로 인한 재발 가능성에 대한 주지를 시키는 것이 중요하다. 또한 해당 약제를 중단해야 하는 경우(예: 내기경, 시술 및 수술, 치과 치료 등), 임의로 중단하지 말고 신경과 전문의과 먼저 상담하여야 함을 알려주어야 한다.

생활습관병 중 고혈압은 뇌졸중에 영향을 미치는 것 중 대표적이다. 고혈압이 있는 경우 정상 혈압 기준에 대한 내용과 함께, 꾸준한 혈압약의 복용이 중요함을 설명해야 한다. 또한 올바른 혈압기 구입 및 가정 혈압 측정 방법에 대한 교육이 필요하다.

당뇨병에 대한 관리도 중요하다. 당뇨의 경우 혈당의 정상 범주, 혈당 측정 시기, 당뇨식 방법, 저혈당 증상에 대한 교육 등이 필요하다. 자가 혈당 측정에 대한 거부감이 많아 이행도가 낮을 수 있어 이에 대한 지지가 필요하다.

고지혈증 역시 중요한 관리 요소이다. 고혈압과 당뇨, 고지혈증은 음식과 운동 관리가 동반되어야 하므로 이에 대한 설명이 필요하다. 음식은 맵고 짜지 않은 음식으로 야채를 많이 드시고, 매일 30분 이상의 유산소 운동을 하는 게 중요하다. 운동의 강도나 종류를 특정 지을 수는 없으나 무리하지 않는 선에서 강도를 조절하도록 해야 하며 이는 환자의 마비 정도, 심장, 관절 상태 등에 따라 달라질 수 있다.

심방세동 등의 심장 문제가 있는 경우도 항응고제를 잘 드시면서 주기적인 외래를 내원해야 함을 교육해야 한다. 와파린은 비타민 K 상호작용이 있어 이에 대한 음식과 약물 상호작용에 대한 설명이 필요하며 주기적인 PT-INR 확인이 중요함을 교육해야 한다. NOAC은 반감기가 짧으므로 약물을 정해진 시간에 잘 드시는 것이 중요하며, 프라닥스의 경우 캡슐을 열어서 복용하면 생체이용률이 상승할 수 있으므로 캡슐채로 먹어야 한다. 자렐토 고용량(15, 20mg)은 식사와 함께 천천히 흡수되어야 생체이용률을 높게 유지할 수 있어 식사와 함께 드시는 것이 좋다. NOAC을 복용하는 경우 치과치료, 내시경 등으로 인해 약물을 중단할 때는 와파린처럼 5일 이상 길게 중단할 필요가 없다. 따라서 이러한 경우 전문의 진료를 통해 중단 시기와 재개 시점에 대해 정확히 확인을 받아야 함을 안내해주어야 하겠다.

금연은 필수이다. 금연 5년 정도가 되어야 비흡연자와 비슷한 수준이라고 판단하기 때문에 이는영구적으로 되어야 한다. 금연껌, 전자담배 등은 니코틴 흡수량에 차이가 있을 수 있어 권하지 않으며 필요시 금연클리닉에 대한 정보를 제공해주어야 한다.

절주보다는 금주에 대한 교육도 필요하다. 소량의 알코올도 뇌졸중 재발에 영향을 주는 것으로 최근 많은 논문에서 보고되고 있다.

뇌졸중 발병 이후 집에서 안정을 취해야만 좋은 것으로 생각하는 경우도 있다. 안정의 시기는 뇌졸중 상태에 따라 다를 수 있으나 일상생활을 최대한 유지하도록 돕는 것이 필요하겠다. 마비 정도에 따라 낙상, 욕창, 흡인성 폐렴, 방광염 등의 합병증이 발생할 수 있어 이에 대한 간호 정보를 제공해야 한다. 시야 장애 환자의 경우 운전으로 인한 사고가 일어나는 경우도 있으므로 전문의 상담이 필요할 수 있겠다.

퇴원 후 응급실에 즉각 내원해야 하는 증상(예: F.A.S.T.)에 대한 교육과 함께 집 근처에서 뇌졸중 급성기 치료가 가능한 병원을 미리 알아두도록 정보를 제공하는 것도 중요하다.

뇌졸중은 퇴원 후 관리가 동반되어야 한다. 뇌졸중 약제의 지속적인 복용과 생활습관병 관리, 합병증 예방 및 일상생활로의 복귀를 돕는 정보를 제공하는 것이 중요하겠다.

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2022 대한뇌졸중학회 **춘계학술대회**

"Individualized vs. Guideline-based Management"

Room C

재관류치료연구회 Some issues in endovascular treatment of acute ischemic stroke under current guideline

좌장 | 허지회 (연대의대), 정철규 (서울의대)



Pearls and pitfalls in automated perfusion imaging in acute ischemic stroke: RAPID

Young Dae Kim

Department of Neurology, Severance Hospital, Yonsei University College of Medicine, Seoul, Korea.

The reperfusion therapy of patients presenting with acute ischemic stroke has its foundation on identification and reperfusion of the ischemic penumbra Perfusion imaging is one of most promising technique to select patients who are likely to benefit from reperfusion therapy. The major drawback of this method is a need for ischemic core estimation. Determining patterns of perfusion images has traditionally been done through simple visual inspection and therefore, is affected by the subjectivity and biases inherent to this approach. However, increasingly, utilization of analytic software is being implemented to provide quantitative assessment of ischemia and penumbra

RAPID, an automated computerized software of perfusion imaging, has been used in more than 10 clinical trials including EXTEND, SWIFT-PRIME, DAWN, EXTEND-IA, and DEFUSE 3, and is the only clinically validated software with an FDA indication to aid in the selection of patients eligible for reperfusion therapy. It can calculate stroke lesion volumes within 2-10 minutes and without operator input. The analytic results are automatically sent to physicians by PACS, email, the RPAID mobile or web apps, which can help stroke team members identify patients suitable for reperfusion therapy promptly. Additional program for identification of ASPECTS, blood vessel density asymmetry, intracerebral hemorrhage was also available. However, stroke physicians should interpret these results with caution because the RAPID could not determine the stroke lesion accurately in about 10%. Substantial variability in report quality is also possible if local technical and physiologic factors are not taken into account.

In conclusion, RAPID software has been shown to be a great diagnostic tool in stroke management. Successful implementation depends on several factors including a fundamental understanding of how the software works, controlling for technical factors, and those with technical flaws. These factors must be taken into account when implementing RAPID in real clinical practice.

Decision making for extended time window in non-RAPID stroke center

Moo-Seok Park

Neurology, Seoul Hospital, Ewha Womans University College of Medicine

이학여자대학교 의료원 ^{The Moderator Market Contral}	EUMC EVITA WOMANS UNIVERSITY S EO U L S EO U L	이학여자대학교의료원 Insta Science Laboration Accel Contra	EVING EVINA WOMANS UNVERSITY S E O UL HOSPITAL
Contents		Patient selection	
1. Non-RAPID method 2. Decision making in non-RAPID stroke center		Patient outcome ↓ Save the Brain ↓ Time ↓ Infarct Core – Irreversible damage	+@

(교) 이화 Table 1. Pi Assessing F	여자대학교의료원 (GOMANG LIANTERTY MIDEAL CIVITE ros and Cons of Different In Patients Presenting With S	naging Appr	roaches for nown Time			EU		WHA WOMANS UNIVERSITY OUL HOSPITAL		(R) 013	학여자대학교의료원 avvouve uneterr refer contre CT vs. MRI((DWI)			EUMA WOMANS UN S E O U L
of Onset	Dep	Con			DWI-FLAIR mismatch	Largest trial for P No perfusion ima	NT aging required	No evidence for EVT Contraindications against		8	·	. ,			
Perfusion- core mis- match	Can be used with MRI or CTP	Processing or or automater required	with manual d software			Simple visual ass specific postpro-	isessment, no icessing or	May miss patients who can benefit from IVT despite visible lesions in							400
	Evidence for IVT and EVT	Misses patie	nts with			Also effective for	r lacunar stroke	FLAIR							SEA
	Can also be used in late known time window	If CTP is use	id, contrast			Identifies more p penumbral mism	patients than natch				E Y				
	May identify patients with already visible lesions in FLAIR based on penumbral pattern	y n			CTP indica imaging; EVT,	No contrast ager tes computed tom endovascular therap	int required nography perfusi ipy; FLAIR, fluid-a	n; DW, diffusion-weighted terwated inversion recovery;		- 06		(A)			
		Clinical-core	Can be used	i with MRI or CTI	P No evide	nce for IVT	a Miki, magnetic re	esonance imaging.					Just		
		mismatch	If used with imaging req	MRI, no perfusion uired	or autom required	ng with manual ated software						/		/	
					If CTP is agent rec	used, contrast juired									
								Stroke. 2021;52:373-380							
									L						











Adjunctive intra-arterial thrombolysis for large-vessel occlusion

백성현

서울의대

Background: The aim of this study is to evaluate the efficacy and safety of the local intra-arterial (IA) urokinase (UK) as an adjunct to mechanical thrombectomy (MT) for refractory large vessel occlusion (LVO).

Methods: We retrospectively evaluated acute ischemic stroke patients who underwent MT for anterior circulation LVO between January 2016 and December 2019. Patients were divided into two groups, based on the use of IA UK as an adjunctive therapy during MT for refractory thrombus: the UK group and non-UK group. Herein, refractory thrombus was defined as target occlusion with minimal reperfusion (TICI 0 or 1) despite more than three attempts of conventional MT. The baseline characteristics, procedural outcomes and clinical outcome were compared between the two groups.

Results: One hundred fourteen cases of refractory thrombus were identified. A total of 45 and 69 patients were in the UK and the non-UK groups, respectively. The UK group, when compared with the non-UK group, showed a higher rate of successful reperfusion (82.2% vs 63.8%, P=.034), with lower procedural time (54 vs 69 min, P=.137). The rates of good clinical outcome, distal embolism, and symptomatic intracranial hemorrhage were similar between the two groups. The use of IA UK (OR 3.865, 95% CI 1.208 to 12.368; P=.023) was an independent predictor of successful reperfusion. **Conclusions:** The use of local IA UK as an adjunct to MT may be an effective and safe method that provides better recanalization than the conventional MT for refractory thrombus in patients with embolic LVO.

Study	Adjunctive	Number	Indication	Method	Outcome
Kaesmacher. 2021 ¹	UK	100	during or after failed or incomplete MT improvement of reperfusion	300k (50k~1000k) IU	Not associated with increased of sICH or mortality improved angiographic grade
Zaidi. 2021	tPA	129	rescue therapy after unsuccessful MT (Solitaire)	4 mg (IQR 2-12mg)	Not associated with an increased risk of sICH or mortality.
Zaidi. 2019 ²	tPA	37	rescue therapy after unsuccessful MT (Solitaire)	N/A	Similar rate of sICH More revascularization success.
Anadani. 2018 ³	tPA	67	refractory or distal occlusion after incomplete MT (ADAPT)	3 to 5 mg (maximum 15mg)	Comparable recanalization rate No increased hemorrhage risk
Yi. 2018 ⁴	tpA	37	administration via delivery microcatheter	total amount < 5 mg	improved angiographic results shortened the procedure time
Heiferman. 2017	tPA	28	post-thrombectomy (SR, CA) 1) proximal ICA 2) stent retriever 3) postrecanalization	5mg	Hemorrhagic conversion, neurologic outcome, and mortality were equivalent

Table.	Recent	studies	of	IA	thrombolysis	adjunct	to	mechanical	thrombectom	y
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Recent updates and issues in the endovascular treatment of the posterior circulation

Joong-Goo Kim

Department of Neurology, Jeju National University Hospital

The benefit of endovascular reperfusion therapy (EVT) in the treatment of anterior circulation acute large-vessel occlusions (ALVO) has been extensively studied in large prospective randomized trials and meta-analyses. Comparatively, fewer data exist on the use of EVT in treating posterior circulation occlusions. My presentation aims to review the existing data on EVT techniques in the treatment of ALVO in the vertebrobasilar system and evaluate reported concerns.

severity of neurologic deficit in patients with basilar-artery occlusion differ from those in patients with anterior circulation strokes. Unlike hemispheric stroke of the anterior circulation, in which there is usually a sudden onset of focal neurologic deficit, basilar artery occlusions (BAOs) may mimic other non-stroke conditions resulting in a delay in proper neurologic evaluation and treatment. Even with an accurate and timely diagnosis, optimal management remains unclear. The efficacy and safety of acute basilar occlusion are still under debate despite the recent completion of two randomized controlled trials. In the context of this clinical and scientific background, this presentation covers relevant aspects of recent updates and issues in the endovascular treatment of the posterior circulation. Four main aspects are discussed. First, the clinical assessment of posterior circulation ischemic stroke is frequently difficult using the current tools of the National Institutes of Health Stroke Scale (NIHSS). It does not include clinical components typical of the posterior circulation, such as nystagmus or gait disturbances, leading to the underestimation of stroke severity in these cases. There are still doubts regarding whether the NIHSS can be used for posterior strokes, as reflected, for example, in the qualification of thrombectomy. This scale is an insensitive instrument in this context for determining whether a therapy is beneficial because the brain stem is a compact structure in which many vital functions are subserved and small or medium-sized infarctions may lead to substantial disability. Second, the role of pc-ASPECTS is significantly lower in specificity and sensitivity than in the anterior circulation. Unproperly selected patients by initial neuroimaging influenced the outcome, it is critical for patient selection. Third, as outlined above, the stroke etiology in patients with basilar artery occlusion seems more heterogenous compared to anterior circulation. Artery-to-artery embolism or in-situ thrombosis due to the intracranial atherosclerotic stenosis may play an important role in elderly Asians. Characterization and localization of such stenosis of the posterior circulation are important for acute treatment decision making and for precise management in patients who need stent placement and angioplasty. Fourth, the high rate of crossover in BEST trial and the long-term of recruitment in BASICS trial influenced the validity of
the results.

Further trials of EVT are needed to determine whether this approach is efficacious for basilar-artery occlusion. These trials should ideally include the use of advanced neuroimaging at baseline to determine tailored patient selection. In addition, more properly measurement of clinical outcome in patients with strokes in the posterior circulation should be considered.

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"Individualized vs. Guideline-based Management"

Room D

Special Session. Connection of acute stroke care participants in Korea

좌장 | 유경호 (한림의대), 홍지만 (아주의대)



Development of stroke education program for EMS in Korea

Ji Man Hong

Department of Neurology, Ajou University Hospital













Prehospital TFT

1. 심뇌혈관환자 응급처치관련 교육수요파악

- 이론교육 (감별진단 기본교육, 응급처치법), 실기교육 (빠른 사정법, 실제 환자 시례)
 교육계획 (9차 교육, 지역별)
- 전국단위로 확신계획 (각 중앙 및 지역 재난안전본부 교육담당자, PSC & 권역센터 기반 교육위원)

2. Prehospital EMS 시범사업 발표(2019.09.21)

- Stepwise prehospital score system
- 경기도 재난안전본부 시범사업결과발표

3. 교육자료표준화

- 응급신경소생 (emergent neurological life support, ENLS)
- 재관류치료기관선정 (PSC기반 및 권역센터기반 접근)















Destination hospital selection for severe acute diseases in Korea

홍원표

소방청 품질관리팀장

Objectives: 소방청의 중증응급환자 이송병원 선정지침을 살펴보고 그 개선점을 제안하고자 한다. Methods: 119 구급대원 현장응급처치 표준지침, 119 구급대원 이송병원 선정 적절성 평가 도구 개발 연구용역, 중증환자 이송병원 선정지침을 살펴보고 향후 도입될 병원전 중증도 분류체계(Pre-KTAS)의 활용방안을 살펴본다. Results: 심정지, 중증외상, 심혈관, 뇌혈관 질환의 현 이송병원 선정지침에는 각 수용기관의 수용능력이 반영되지 못하고 있으며, 이송한 환자의 진료 결과의 환류가 이루어지지 않아 구급대원의 적절한 환자 평가 및 이송병원 선정에 활용이 되지 못하고 있다. 병원 전 중증도 분류체계를 개선하고, 각 기관의 수용 능력과 진료 결과의 환류가 이루어지는 지역별 이송병원 선정지침의 제정이 무엇보다도 시급하다.

Conclusion: 중증응급환자의 이송병원 선정지침에 대한 지속적인 평가와 개선에 대한 노력이 필요하다.





그림 1. 병원전 중증도 분류체계(Pre-KTAS) 앱(App) 화면

참고문헌

- 1. 119 구급대원 현장응급처치 표준지침 (2021, 소방청)
- 2. 119 구급대원 이송병원 선정 적절성 평가 도구 개발 연구용역 (2020, 대한응급의료지도의사협의회)
- 3. 중증환자 이송병원 선정지침 (2021, 소방청)
- 4. 한국형 병원전단계 응급환자 분류 도구 시범사업 교육 매뉴얼 (2022, 소방청)

Metrics and renovation of inter hospital transfer for stroke

Jihoon Kang

Seoul National University Bundang Hospital











병원 연계의 사용자 요구 (Hub-and-spoke system)

In Orange county, officially changed to require 24/7 neuro-interventional capabilities for all hub centers and extended the patients covered by this policy from 5 to 7 hours from symptom onset.

Patients could be transferred for higher-level care. Transfers could occur when (1) a patient walked into a spoke hospital and was subsequently transported to a hub via EMS, (2) EMS took a patient to a spoke, which then deemed higher-level care was needed, or (3) a hub hospital for whatever reason felt the transfer to another hub to be optimal.

On physician evaluation at the spoke after consulting with the responsible neurologist who was immediately available at a hub.





















심뇌혈관질환 예방관리 극복을 위한 이행연구 추진 전략

김원호

질병관리본부 국립보건연구원 심혈관질환연구과 과장

심뇌혈관질환은 전 세계 사망원인 1위로 지속적으로 증가하는 추세이며 국내의 경우에도 심장질환과 뇌혈관질환이 사망원인 2위와 4위의 질환으로 잘 알려져 있다. 최근 약물 및 중재 치료기술 발달로 인해 사망률이 크게 감소하는 추세이나 여전히 심뇌혈관질환으로 인한 사망률은 높은 수준으로 국가적으로 가장 큰 질병 부담 요인으로 작용을 하고 있다. 실제로 2006년 이후 심뇌혈관질환자수는 연평균 3.6%씩 지속적으로 증가를 하는 추세이고, 2017년을 기점으로 우리나라는 65세 이상 노인 인구가 14%를 넘어선 고령사회로 이미 접어든 상황으로 심뇌혈관질환의 발생률과 사망률은 향후 인구 고령화가 심화될수록 매우 크게 증가할 것으로 예측되고 있다.

심뇌혈관질환 발생은 개인의 삶 뿐만 아니라 가정 및 사회경제적 손실이 매우 큰 질환으로 국가적으로 효율적인 대응 및 관리를 위한 종합적이고 체계적인 이행계획 및 전략수립이 필요하고, 국가 주도의 안정적인 통합조정 및 관리가 매우 필요한 영역이라 하겠다. 이를 위해 정부는 2016년 5월 「심뇌혈관질환 예방 및 관리법」을 제정·시행 ('17.5)하였다. 한편, 법에서 규정한 사업들을 중심으로 정책 결정의 과학적 근거를 마련하고 심혈관질환의 예방부터 사후 관리까지 전주기적인 관리체계를 구축하여 일관된 정책 방향을 제시하고자 최초의 법정 계획인 **「심뇌혈관질환관리 종합계획(2018~2022)」**(보건복지부)이 수립되었다. 이를 기반으로 종전에는 개발사업 위주로 진행되어오던 심뇌혈관 질환 관리정책을 예방사업 및 연구사업 등으로 전환하였으며, 심뇌혈관질환 국가통계 생산 체계 구축, 심뇌혈관질환 등록사업 및 조사 감시 체계를 구축하여 심뇌혈관질환을 체계적으로 관리하고자 노력하고 있다. 심뇌혈관질환관리 종합계획은 **'심뇌혈관질환 걱정 없는 건강한 사회'**를 비전으로 5가지 추진전략과 14개의 중점과제들을 설정하였다. 각 추진전략이 성공적으로 수행된 후에는 심혈관질환 증상 인지율 증가, 고위험군(고혈압, 당뇨 등) 조절률 증가, 응급환자의 치명률 감소, 재활률 증가 및 국가통계 산출 인프라 구축 등에서 괄목할만한 성과를 이룰 수 있을 것으로 기대하고 있다.

사실, 심뇌혈관질환은 질환별로 발생원인, 질환 중증도 등이 크게 다르고, 환자 대부분이 생사를 가르는 응급환자들이 기에 신속한 응급 대응 치료 및 적정한 중재법 적용이 절실히 요구되는 영역이다. 다행히 각 학회를 중심으로 심뇌혈관질환자 예방관리 및 중재치료 등을 위한 지침 마련들을 통해 임상현장에서의 이행 실천 노력들을 열심히 하고 있으나, 여전히 임상현장 곳곳에서 미충족 수요와 이행 실천을 가로막는 저해요인들이 나타나고 있는 실정이다. 이러한 문제들을 해결하고 각 추진전략의 성공적인 수행 및 성과 창출을 위한 R&D 연구 활성화를 위해 질병관리청 국립보건연구원에서 최근 "국가 심뇌혈관질환 R&D 종합계획('22~'26)" 및 "이행연구계획('20~'24)"을 수립하였다. 이를 기반으로, 심뇌혈관질환 예방관리 및 극복을 위한 과학적 근거 생산에 대한 안정적인 투자 및 지원을 위한 예산 확보를 추진하고자 하고, 향후 국가 소속기관으로서의 최초인 국립심혈관연구소 설립을 통해 국내 관련 연구 활성화를 통한 성과 생산성 강화를 위한 국가 심뇌혈관질환 R&D 거버넌스를 구축해 나가고자 한다.



"Individualized vs. Guideline-based Management"

Poster Presentation





Cerebral air or septic embolism associated with atrioesophageal fistula after atrial fibrillation ablation: 3 case reports

Han-Bin Lee¹

¹Neurology, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Korea, Republic of

Purpose: Radiofrequency ablation for atrial fibrillation is an increasingly performed procedure. Atrioesophageal fistula (AEF) is a rare but devastating complication encountered after radiofrequency ablation. Also, cerebral air or septic embolism due to AEF is considered a poor prognostic factor. We present 3 cases of cerebral air or septic embolism associated with AEF after ablation of atrial fibrillation. **Methods:** Not Applicable

Results: Case(1): A 69-year-old woman presented with drowsy mentality and aphasia 3 weeks after atrial radiofrequency ablation for atrial fibrillation. MRI brain showed multiple acute infarctions. CT brain angiography showed no significand steno-occlusive lesion in large intracranial and cervical arteries but small amount of air in the nondependent portion of the ascending aorta Portable echocardiography showed no abnormality. Thoracic aorta computed tomography performed for suspected AEF and showed air densities in the dependent portion of the left atrium, possibly, left AEF. After admission to cardiac surgery intensive care unit for emergency operation, cardiac arrest occurred and the patient was expired. Case(2): A 68-year-old man developed amnesia and severe sepsis 25 days after catheter ablation for atrial fibrillation. MRI brain showed bilateral frontoparietal infarcts. Echocardiography showed no abnormality. Blood cultures were positive for organisms from the oral cavity. He had a seizure and was stuporous. Head CT showed multifocal infarct lesions in both cerebral hemispheres. CT chest with contrast showed anterior esophageal wall injury and air bubble in the left atrium. Cardiothoracic surgery was done but he remained comatose. After 26 days he was discharged to a nursing hospital.

Case(3): A 59-year-old man presented with epigastric pain, fever and confusion 1 month after atrial radiofrequency ablation for atrial fibrillation. Blood cultures were positive for organisms from the oral cavity. He was started on antibiotics for infective endocarditis. MRI brain showed multifocal extensive diffusion restriction lesions and some internal hemorrhagic signals. The patient had a cardiac arrest. CT chest with contrast showed abnormal linear air densities in left atrium. CT brain afterwards demonstrated linear gas densities along the right frontal, parietal and occipital sulci. Cardiothoracic surgery was done. He was drowsy mentality but no awareness. After 39 days he was discharged in a vegetative state.

Conclusions: AEF is the second leading cause of mortality in radiofrequency ablation. Therefore, AEF should be suspected when neurological symptoms occur after radiofrequency catheter ablation. If AEF is confirmed, emergency surgical repair should be prepared. Also, it must be considered that rescue extracorporeal bypass may be helpful for prevention of embolism.

Efficacy and safety of emergency extracranialeintracranial bypass for revascularization within 24 hours in resolving large artery occlusion with intracranial stenosis

Jae Sang Oh¹

¹Neurosurgery, Soonchunhyang University, Cheonan/Chungchungnam-Do, Korea, Republic of

Purpose: Endovascular treatment (EVT) is less effective for intracranial atherosclerosis-induced emergent large vessel occlusion. Extracranialeintracranial (EC-IC) bypass surgery is a possible treatment option to augment cerebral blood flow in the perfusion defect area. We compared the efficacy and safety of EC-IC bypass surgery with those of EVT and maximal medical treatment for acute ischemic stroke. **Methods:** The data from 39 patients, for whom vessel revascularization had failed despite mechanical throm- bectomy, were retrospectively analyzed. Of the 39 patients, 22 had undergone percutaneous transluminal angioplasty or intracranial stenting (PTA/S), 10 had undergone emer- gency EC-IC bypass surgery within 24 hours of symptom onset, and 7 had received maximal medical treatment (MMT) only. The patency, perfusion status, an postoperative infarct volume were evaluated. The clinical outcomes were assessed at 6 months postoperatively using the modified Rankin scale.

Results: The mean reperfusion time was signifi- cantly longer for the EC-IC bypass group (14.9 hours) compared with that in the PTA/S group (4.1 hours) and MMT group (7.5 hours; P < 0.05). The postoperative infarct volume on diffusion-weighted magnetic reso- nance imaging was significantly lower in the emergency EC-IC bypass group (11.3 cm3) than in the MMT group (68.0 cm3) but was not significantly different from that of the PTA/S group (14.0 cm3; P < 0.05). The proportion of patients with a modified Rankin scale score of 0e2 at 6 months after surgery was significantly higher in the EC- IC bypass group (80%) than in the PTA/S (59%) and MMT (14%) groups (P < 0.05).

Conclusions: Acute EC-IC bypass within 24 hours is useful in resolving large artery occlusion with intracranial stenosis.

P003

Hypoperfusion even after successful mechanical thrombectomy

<u>Eung-Joon Lee</u>¹, Wookjin Yang¹, Dong-Wan Kang¹, Han-Yeong Jeong¹, Jeong-Min Kim¹, Sang-Bae Ko¹, Keun-Hwa Jung¹, Seung-Hoon Lee¹

¹Neurology, Seoul National University Hospital, Seoul, Korea, Republic of

Purpose: Intra-arterial thrombectomy is the optimal treatment in acute ischemic stroke with large vessel occlusion. Despite successful recanalization, only 27% of the patients were disability-free at 90 days in previous mechanical thrombectomy (MT) trials. Surprisingly, even after revascularization, it is reported that around 40% showed hypoperfusion area on the perfusion imaging at the end of the intervention. Therefore, we aim to investigate factors related to hypoperfusion after successful thrombectomy.

Methods: We retrospectively reviewed 145 patients treated with mechanical thrombectomy that resulted in angiographic findings of successful recanalization, defined as a TICI score of 2b or greater. All patients took arterial spin-labeling (ASL) magnetic resonance imaging perfusion weighted image (PWI) within 3 days after the procedure. We classified the patients into hypoperfusion after MT and control groups. Then, we compared their clinical details. Multivariate analysis was performed to investigate independent predictors of hypoperfusion after successful MT.

Results: Of a total of 145 patients who received successful MT, 40 (27.6%) showed hypoperfusion on follow-up ASL PWI. Hypoperfusion after MT group showed more hemorrhagic transformations (55% vs. controls 35.2%, p=0.001) and unfavorable functional outcomes at 90 days (mean modified Rankin scale score 3.18 vs. controls 2.13, p=0.002). In the multivariate analysis, active cancer (Odds ratio [OR]=5.948, p=0004), uncontrolled diabetes mellitus (OR=1.68, p=0.004), and longer procedure time (OR=1.123, p=0.002) were independent predictors of hypoperfusion after successful recanalization. **Conclusions:** If the active caner or uncontrolled diabetes is accompanied or the procedure time of mechanical thrombectomy is prolonged, the cerebral blood flow was not improved even after a successful MT. In addition, hypoperfusion after MT was also significantly associated with a high incidence of hemorrhagic transformation and poor clinical outcomes. Further research is needed on novel treatments that can enhance perfusion conditions in these cases.

	Factors associated with Hypoperfusion after successful mechanical thrombectomy					
	Univariate			Multivariate		P-value
	Exp (B)	95% CI	P-value	Exp (B)	95% CI	
Age	1.001	0.974-1.030	0.992			
Sex, Male	0.953	0.458-1.982	0.897			
Previous history of Stroke or	TIA					
Coronary artery diseases	2.758	1.027-7.405	0.044	3.426	0.959-12.243	0.058
Hypertension	0.597	0.247-1.440	0.251			
Diabetes mellitus	1.385	0.662-2.896	0.387			
Dyslipidemia	1.143	0.551-2.369	0.720			
Active Cancer	11.333	2.937-43.842	0.000	5.948	1.211-21.410	0.004
TOAST classification						
Large artery atherosclerosis		ref				
Cardioembolism	2.414	0.599-9.731	0.215			
Other determined	1.509	0.387-5.880	0.553			
Undetermined	4.375	0.882-21.707	0.071			
Use of IV-rtPA	1.096	0.482-2.489	0.827			
Prior Antithrombotics use	1.117	0.538-2.317	0.767			
Onset-to-puncture time	1.000	0.999-1.001	0.479			
Puncture-to-Reperfusion time	1.020	1.008-1.032	0.001	1.123	1.009-1.338	0.002
Initial NIHSS score	1.017	0.968-1.068	0.509			
Laboratory findings						
White blood cells	1.188	1.055-1.338	0.004	1.093	0.932-1.283	0.272
Hematocrit	1.023	0.966-1.084	0.436			
Platelet count	0.998	0.993-1.003	0.405			
Creatinine	0.775	0.436-1.377	0.385			
LDL	1.012	1.004-1.021	0.006	1.009	0.999-1.020	0.075
Total cholesterol	1.006	0.997-1.014	0.180			
HbA1c	1.795	1.330-2.423	0.000	1.682	1.181-2.396	0.004
C-reactive protein	1.100	0.982-1.232	0.099			
Prothrombin time	0.340	0.046-2.510	0.290			

Case report of successful induced hypertension therapy in MCA dissection

Yong Kwon Song¹, Jeong Yun Song¹, Seong Hun Kim¹, Sung Hun Kim¹

¹Neurology, Kangwon National University Hospital, Chuncheon, Korea, Republic of

Purpose: Maintaining appropriate cerebral blood flow and systemic organ function, systemic hypotension and hypovolemia should be corrected.

To empower collateral flow to restoring blood flow, several strategy was introduced. One of them therapeutic induced hypertension has been studied.

Methods: A healthy 50-year-old Korean man with no known underlying disease was admitted to the emergency room with a left-sided weakness that occurred 4 days before hospitalization. At that time, there were no abnormal findings on imaging tests and neurologic exam, and he was discharged under the diagnosis of TIA.

On the day of hospitalization (3/12), he re-visited the emergency room due to left side weakness and dysarthria

At the time of admission, blood pressure was 171/117 mmHg. On neurological examination, he showed clear mental status, mild Left CTFP, dysarthria, and Lt.side weakness. Pathologic reflexes were not observed. In brain MRI, acute infarction was observed in Rt.BG & CR areas. SWI imaging showed segmental thrombosis and intimal flap in Rt.MCA M1 branch. The patient was hospitalized to stroke unit under the diagnosis of MCA territory infarction due to MCA dissection. After hospitalization, patient was treated with dual-antiplatelet and statin along with fluid administration, neurological symptoms worsened around midnight on the day of hospitalization. Therapeutic induced HTN (SBP target>180) administration of xarelto 2.5mg bid were started.

Patient showed fluctuation of neurologic symptom(Lt. side weakness, facial palsy, NIHSS11, MRS 4) according to blood pressure.

Results: Phenylephrine was used for therapeutic induced hypertension, and the target systolic blood pressure was set to 180 mmHg or higher. Therapeutic induced hypertension was continued until there was no change in the patient's neurologic symptoms.

He was discharged with NIHSS socre 1(Left leg weakness), MRS score 1

Conclusions: We report successful induced hypertension treatment of early neurological deritioriation of MCA dissection. Futher study are need to establish efficacy and safety.

Simultaneous cerebral and systemic embolism caused by aortic arch thrombus

Eunbuel Ko¹, Jungwoo Kim¹, Jaseong Koo¹, Han-Bin Lee¹, Min Hwan Lee¹

¹Neurology, Seoul St. Mary's Hospital, Seoul, Korea, Republic of

Purpose: Aortic arch atheroma (AAA) is recognized as a potential cause of ischemic stroke. Thrombus at AAA is also an uncommon cause of systemic embolism. We report a patient with simultaneous cerebral and systemic embolism caused by AAA thrombus.

Methods: A 50-year-old female patient presented to the emergency room due to sudden dizziness and discomfort of left hand. She had no underlying disease but she was current smoker, 1pack-year. Dizziness was improved rapidly but she also complained pain and coldness at left hand. Brain magnetic resonance imaging (MRI) showed small acute infarct at left occipital lobe. Laboratory blood test showed newly diagnosed diabetes (HbA1C 7.1%) and low-density lipoprotein cholesterol was high at 151 mg/dl. During acute treatment at stroke unit, pain at left hand persisted and physical examination revealed pallor and coldness at left 3Trd and 5th finger and capillary filling was delayed though brachial and radial pulses were intact. MR angiogram (MRA) did not show significant stenosis of intracranial and extracranial arteries. 24-hour Holter monitoring and transthoracic echocardiogram (TTE) also show no significant abnormal findings. Micro-embolic signals (MES) tested by transcranial Doppler was negative. Transesophageal echocardiogram (TEE) did not show any abnormalities. To evaluated pain, pallor, coldness of left hand, finger Finger-Brachial index (FBI) was performed and showed decreased finger blood pressure and no arterial waves on left 35rd and 5rd fingers. For further evaluation, upper extremity artery computed tomography (CT) was done small atheromatous plaque with mural thrombus at aortic arch was identified. Results: We report a patient with simultaneous embolic ischemic stroke and peripheral embolism to upper extremities caused by AAA thrombus.

Conclusions: The most common cause of embolic stroke and peripheral embolism is atrial fibrillation. However, thrombus at AAA also can be a cause of simultaneous embolism to brain and systemic arteries.



Figure : (A) Upper extremity artery CT shows Mural thrombus at the aortic arch(thick arrow), (B) Mural thrombus at the aortic arch(thin arrow), (C) Brain MRI shows small acute infarct at left occipital lobe. (D) Brain MRA shows unremarkable intracranial arteries. (E) Unremarkable carotid arteries,

Different etiologic mechanisms and outcomes of isolated posterior inferior cerebellar artery infarction in young adults

<u>Jae-Woo Kim</u>¹, Moon Gwan Choi¹, Sang Soon Park¹, Jin Kyo Choi¹, Tai Hwan Park¹, Hee-Joon Bae²

¹Neurology, Seoul Medical Center, Seoul, Korea, Republic of
²Neurology, Seoul National University Bundang Hospital, Seongnam-Si, Gyeonggi-Do, Korea, Republic of

Purpose: About 30% of posterior inferior cerebellar artery (PICA) infarctions are known to be caused by cardioembolism, and it has been reported that one thirds of patients has more than moderate degree of disability. We aimed to analyze how the etiologic mechanism and outcome of isolated PICA infarction differ in young patients.

Methods: Using a multicenter prospective stroke registry database, we identified ischemic stroke cases involving isolated PICA territory. Demographic information, risk factors, etiologic subtypes according to the modified Trial of ORG 10172 in Acute Stroke Treatment criteria, initial National Institutes of Health Stroke Scale (NIHSS) score, relevant steno-occlusion of vertebral artery, combined lesion on medullar, and outcome were examined. We compared the clinical characteristics of young stroke patients aged less than 55 years to elderly patients aged 75 years or more. Outcome was assessed with modified Rankin scale (mRS) at 3 months after stroke.

Results: Among 70,450 ischemic stroke patients registered between 2011 and 2020, 2,501 (3.6%) patients (68.6% male; mean age, 64.2 years) with isolated PICA infarction were identified. Isolated PICA infarction was more prevalent in young age group than old age group (5.8% vs. 2.5%). Young patients (n=621) were more likely to be male (80.8%), smoker (41.7%) and have a milder severity, less frequent cardioembolic subtype (10% vs. 27.9%), more frequent combined medullar lesion (8.5% vs. 4.7%) as compared to older patients. The overall frequency of vertebral artery stenosis (>50%) or occlusion was 37.3%, and there was no difference between the age groups. The proportion of patients with excellent functional outcome (mRS 0-1) was 83.7% in young and 51.8% in old age group, respectively. In young patients, higher initial NIHSS score (HR 1.45, 95% CI 1.28-1.66) was the only independent predictor for poor outcome (mRS 2) while the accompanied medullar lesion was not statistically significant, but increased the risk (HR 1.89, 95% CI 0.93-3.83, p=0.08).

Conclusions: Our study demonstrates that the clinical characteristics and prognosis of isolated PICA infarction in patients younger than 55 years of age differ from those of older patients. Although most isolated PICA infarction was minor stroke, about one in five young patients remained disabled.

Non-contrast computed tomography versus computed tomography perfusion or magnetic resonance imaging for selecting thrombectomy candidates in early time window: A single center experience

Dong-Hyun Shim¹, Jin Kuk Do¹, Sung Won Youn², Youngrok Do¹

¹Neurology, Daegu Catholic University Medical Center, Daegu, Korea, Republic of ²Radiology, Daegu Catholic University Medical Center, Daegu, Korea, Republic of

Purpose: Appropriate image modality for mechanical thrombectomy(MT) in large vessel occlusion ischemic stroke in the early time window (within 6 hours of symptom onset) is still unclear.

Methods: We performed retrospective review of our registry collected in a prospective manner. Among 243 patients who received MT for 4 years from 2018 to 2021, patients with middle cerbral and internal cerebral artery occlusion who visited the hospital within 6 hours were enrolled. They were divided into two groups: a group that had noncontrast computed tomography (NCCT) with computed tomography angiography (CTA) and those undergone advanced imaging including computed tomography perfusion (CTP) or magnetic resonance imaging (MRI). We compared their good functional outcome rate as modified Rankin scale 0 to 2 at 90 days, symptomatic intracranial hemorrhage rate, successful recanalization rate, and death rate at 90 days.

Results: A total of 112 patients were enrolled in the study, including 22 in the NCCT with CTA group and 90 in the CTP or MRI group. There was no significant difference between the two groups in good functional outcome (OR, 1.21 [95% CI, 0.42-3.71]; P = 0.80) and symptomatic hemorrhage (OR, 2.02 [95% CI, 0.58-8.96]; P = 0.29). Advanced imaging group shows higher rate of successful recanalization rate (OR, 5.41 [95% CI, 1.40-21.18]; P = 0.006), and lower rate of the 90-day death (OR, 0.24 [95% CI, 0.06-0.88]; P = 0.01).

Conclusions: In the early time window, there was no significant difference in the good functional outcome between NCCT and advanced imaging group. However, successful recanalization and 90 day death rate were better in advanced imaging group. Further analysis is needed.



mRS 0 mRS 1 mRS 2 mRS 3 mRS 4 mRS 5 mRS 6

Repeated brachiocephalic vein thrombosis in a minor stroke patient

<u>Chang Ju Lee</u>¹, Byoung Wook Hwang¹, Min A Lee¹, Ju Hye Kim¹, Hyeo Seo Moon¹, Seong Hwan Ahn¹

¹Neurology, Chosun University, Gwangju, Korea, Korea, Republic of

Background: In stroke patients, venous thrombosis in upper extremity is uncommon compared with lower extremity. Suggested common mechanism is the stasis of venous circulation related with decreased motor function. However, venous thrombosis is rarely developed in stroke patients without motor weakness. We reported a rare stroke case of brachiocephalic venous thrombosis in a patient with minor focal neurologic symptoms.

Case: A 57-year-old male patient visited our emergency room with left hand weakness and numbness. He had medicated for diabetes mellitus and previous myocardial infarction. Three months ago, during the evaluation for a cervical pain, idiopathic right brachiocephalic venous thrombosis was diagnosed. He has been treated with rivaroxaban.

A neurological examination showed a left hand grasp power decrease and numbness (National institute of health stroke scale 2) and MRI showed multiple small lesions in the bilateral middle cerebral artery territory. Transesophageal echocardiography revealed 4mm size mass in the mitral valve. Empirical antibiotics were used for infective endocarditis. On the fifteenth day of hospitalization, he suddenly complained of swelling and pain below left mid-clavicle area, progressed to the entire left upper extremity with discoloration and subcutaneous venous dilatation (Fig 1A). Thorax computed tomography showed left brachiocephalic vein thrombosis (Fig 1B). After additional subcutaneous low molecular weight heparin, pain was improved. However, subclavian venous thrombosis was not. In the thorax CT, we found a small nodule in the right lower lobe and multiple lymphatic nodule around both cervical area Finally, pulmonary adenocarcinoma was diagnosed by a lymph node biopsy.

Conclusion: Our case showed that underlying pulmonary cancer could be related with stroke and venous thrombosis of upper extremity. Venous thrombosis in unusual sites should be evaluated for the possibility of underlying etiology.



Acute cerebral infarction in a young patient with HIV and COVID-19 infection

Kyung Joon Jo¹, Min Kim¹, Yeong-Bae Lee¹

¹Neurology, Gil Medical Center, Gachon University College of Medicine, Incheon, Korea, Republic of

Purpose: Acute cerebral infarction, or more simply 'stroke', is a life-threatening medical condition that requires immediate medical attention. Its well-established risk factors include hypertension, diabetes, dyslipidemia, smoking, and alcohol, many of which take a long, insidious course. As such, acute cerebral infarctions in a young patient implies an unconventional etiology. HIV infection is a rare but acknowledged risk factor for stroke, given the differences in risk factors between the HIV population and its conventional counterpart. Coronavirus disease 2019 (COVID-19) infection has also been linked to stroke, with multiple studies holding COVID-19-associated coagulopathy responsible for organ infarctions not limited to the brain. We present a case in which the patient with HIV and COVID-19 infection suffered an acute cerebral infarction.

Methods: A 36-year-old male with a known HIV infection was admitted to the ER after a sudden onset of left-sided weakness 1 day before admission. On presentation, his vital signs were stable, and physical examination found no abnormalities. Neurologic examination revealed isolated motor weakness in his left leg.

Results: Brain computed tomography showed a low attenuation change of acute infarction in the right anterior cerebral artery (ACA) territory. Brain diffusion-weighted imaging showed acute infarction with diffusion restriction in the right ACA territory. Brain magnetic resonance imaging and angiography showed acute infarction with diffusion restriction on the right ACA territory with microbleeds without intracranial and carotid vascular stenoses.

The patient was given daily aspirin and clopidogrel with high-dose atorvastatin. No abnormal finding was present in transcranial Doppler sonography, transthoracic echocardiography, and 24-hour Holter monitor. His left leg motor showed gradual improvement (from MRC grade I to grade IV). On hospital day 9, he tested positive for COVID-19. He has been treated with Paxlovid, azithromycin, and trimetho-prim/sulfamethoxazole. As of hospital day 15, his vital signs are stable without neurologic changes. **Conclusions:** HIV is thought to induce various cerebrovascular changes like stenoses and aneurysms. Studies suggest that such 'HIV-associated vasculopathy' may be due to factors such as endothelial damage through continuous viral exposure and cell adhesion molecule overexpression causing increased endothelial transmigration of leukocytes.

Likewise, COVID-19 may predispose individuals to stroke by multiple methods collectively known as 'COVID-19 associated coagulopathy'. A rapid increase in proinflammatory cytokines from the early stages of infection may perpetuate cerebrovascular inflammation and induce a hyper-viscous, hyper-thrombotic state, ultimately leading to multi-organ failure.

Our current case of HIV and COVID-19 co-infection may provide new insights on rare etiologies of stroke and its populations' characteristics.

Long-term outcomes of local tirofiban infusion for intracranial atherosclerosis-related occlusion

Woochan Choi¹, Yang-Ha Hwang^{1,2}, Yong-Won Kim^{1,2}

¹Neurology, Kyungpook National University Hospital, Daegu, Korea, Republic of ²Neurology, School of Medicine, Kyungpook National University, Daegu, Korea, Republic of

Purpose: Intracranial atherosclerotic stenosis (ICAS) related to large vessel occlusion (LVO) is a common cause of stroke, and often requires rescue treatment following endovascular reperfusion therapy (ERT). Local tirofiban infusion has been reported as a rescue strategy for ICAS-related stroke. However, the long-term outcomes of local tirofiban infusion during ERT for ICAS-related stroke are still uncertain. This study aimed to investigate the long-term outcomes of local tirofiban infusion during ERT.

Methods: We retrospectively analyzed consecutive acute ischemic stroke patients with ICAS-related stroke who were treated with local tirofiban as a rescue strategy during ERT. Surrogate markers of ICAS-related LVO were retrospectively determined as underlying fixed focal stenosis at the occlusion site on cerebral angiography during ERT and confirmed focal stenosis on MRA or CTA within 7 days after ERT. The primary clinical outcomes were ischemic stroke, transient ischemic attack, symptomatic brain hemorrhage, and stroke-related death within 30 days, or ischemic stroke and TIA beyond 30 days, up to 2 years after ERT.

Results: Of 113 patients, 93 patients had a clinical follow-up period of over 12 months. During a median follow-up of 24.0 months, 12 patients developed a primary clinical outcome (4 within 30 days and 8 afterward). Regarding safety outcomes, intracranial hemorrhage occurred in 6 patients and subarachnoid hemorrhage occurred in 1 patient. The 1-year risk of primary clinical outcome was 9.4% (95% Cl, 8.1%-18.7%). Early reocclusion within 7 days occurred in 13 patients (11.5%, 13/113). Among 55 patients with follow-up angiographic imaging after 1 month, 14 patients (25.5%, 14/55) had stenosis progression, including 3 (5.4%, 3/55) with reocclusion.

Conclusions: This study demonstrated that 1-year outcomes of local tirofiban infusion were comparable to the results of intracranial stenting in patients with ICAS-related LVO. Local tirofiban infusion for ICAS-related LVO may be a feasible rescue strategy that can have a bridging role until maximum effect of antiplatelet agents are achieved.


The long segmental carotid artery dissection treated with triple stents deployment

Sung Jo Bang¹, Hyungjong Park¹

¹Department of Neurology, Keimyung University, School of Medicine, Daegu, Korea, Republic of

Purpose: Spontaneous dissection of the carotid artery account for relatively uncommon causes of all ischemic strokes, but they can be life-threatening and often lead to devastating outcomes. The optimal treatment of dissection remains a challenge due to diagnostic difficulties and low incidence. For patients with acute ischemic stroke caused by carotid dissection, angioplasty and endovascular stenting may be treatment options.

Methods: We experienced a case of long-segmental internal carotid dissection treated with triple stents placement.

Results: A 55-year male patient was visited in our emergency department with sudden transient visual loss at right side before 3 hours ago On computed tomography (CT) angiography, right internal carotid artery (ICA) was not visualized. On digital subtraction angiography (DSA), long segmental dissection from carotid bulb to C1 segment was observed. Despite medical therapy, repeated visual loss at right side was developed. Therefore, three self-expandable stents deployment at from C1 to cavernous ICA for 1st stent, petrous to cervical and carotid bulb for 2nd and 3rd stent were done. On follow-up DSA, dissection was resolved, and no cerebral infarction was noted on diffusion-weighted image on magnetic resonance (MR) imaging.

Conclusions: Endovascular treatment using multiple self-expandable stents is feasible option for long-segmental carotid artery dissection in medically intractable patients.

Untreated hypertension and prognosis paradox in acute ischemic stroke

Hansol Im¹, Taewon Kim¹, Jaseong Koo², Hyunji Cho¹, In-Uk Song¹, Sung-Woo Chung¹

¹Department of Neurology, Incheon St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Incheon, Korea, Republic of

²Department of Neurology, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Korea, Republic of

Purpose: To explore the long-term functional outcome of antihypertensive medication-naïve, untreated hypertension (HTN) patients with acute ischemic stroke compared to those with no prior HTN or treated HTN.

Methods: We analyzed a prospectively collected stroke registry of all acute ischemic stroke patients consecutively admitted to the hospital. Long-term functional outcomes were assessed at 3-month follow-up visits using the modified Rankin scale.

Results: A total of 1,044 patients were enrolled. Compared to the patients with no HTN or treated HTN, patients with untreated HTN had higher odds for more favorable outcomes (adjusted OR: 1.7 (95% CI: 1.0–2.8, p = 0.050*) and 1.7 (95% CI: 1.0–2.7, p = 0.050*), respectively), when the stroke was LAA (large vessel atherosclerosis)/CE (cardioembolic) with large vessel occlusion/stenosis. The initial systolic BP (blood pressure), diastolic BP, and mean arterial pressure (MAP) values were significantly higher in the untreated HTN group. In untreated HTN patients with LAA/CE and large vessel occlusion/stenosis, when compared to patients in the lowest MAP quartile (< 96.7 mmHg), patients in the upper two and three quartiles had higher odds of favorable outcomes (adjusted OR: 1.8 (95% CI: 1.0–3.3, p = 0.047*) and 2.4 (95% CI: 1.4–4.2, p = 0.002*, respectively).

Conclusions: Patients with untreated HTN had significantly more favorable outcomes three months after an ischemic stroke compared to those with no HTN or treated HTN when the stroke was LAA/CE with large vessel occlusion/stenosis. In untreated HTN patients, a U-shaped relationship between MAP and favorable outcomes was observed.

Adjusted* OR (95% CI) for favorable outcomes at 3 months									
LAA	or CE								
	Large vessel occlusion/stenosis in relevant vessels	Untreated vs. No HTN (references)		-			1.7 (1.0	0-2.8)	0.05*
		Untreated vs. Treated HTN (references)					1.7 (1.0)-2.7)	0.05*
	No large vessel occlusion/stenosis in relevant vessels	Untreated vs. No HTN (references)		-			1.0 (0.2	2-3.9)	0.95
		Untreated vs. Treated HTN (references)					0.6 (0.2	2-2.2)	0.46
svo		Untreated vs. No HTN (references)	<u> </u>	•			1.1 (0.5	5-2.7)	0.80
		Untreated vs. Treated HTN (references)		•			1.0 (0.5	5-2.3)	0.96
		Г о		1	2	3	4	5	

Crossed aphasia after right frontal lobe and caudate nucleus infarction in a dextral: A case report

Euihyun Kim¹, Byung-Chul Lee¹, Kyung-Ho Yu¹, Minwoo Lee¹

¹Neurology, Hallym Neurological Institute, Hallym University Sacred Heart Hospital, Anyang, Korea, Republic of

Purpose: Crossed aphasia (CA) refers to language impairment which is secondary to a right hemisphere lesion. The prevalence of CA is reported to be between 0.38 and 3% of all aphasic patients. The diagnostic criteria for CA are 1) aphasia with a lesion in the right unilateral hemisphere; 2) Right handed without familial history of left handedness; and 3) absence of brain damage in childhood. Here, we present a case with crossed aphasia, who had acute stroke lesions at right frontal lobe and caudate nucleus **Methods:** A 60-year-old man presented with acute motor aphasia and left side weakness. The patient had been diagnosed with hypertension. A 60-year-old man presented with acute motor aphasia and left side weakness. He was alert and aware. Cranial nerve function tests revealed left facial palsy but otherwise normal. Aphasia examination revealed non-fluent motor aphasia, as comprehension and fluency were preserved, but naming, repetition were impaired. Brain diffusion-weighted image (DWI) revealed diffusion restricted lesions in the right frontal lobe and the head of the caudate nucleus. His MRA showed right proximal ICA occlusion with cross collaterals originating from the left anterior circulation.

Results: As he arrived at the emergency department within 90 minutes after symptom onset, he received combined intravenous alteplase and intraarterial thrombectomy, but recanalization was not achieved. On the first day of admission, while he was able to comprehend commands, he was not able to speak any comprehensible sounds. However, his left side motor weakness was improved from MRC grade 4 to 4+. Even after several days later his neurological deficits including motor aphasia remain unchanged. The final NIHSS score was 3, including left facial palsy and motor aphasia We described a patient showing a non-fluent crossed aphasia after right frontal lobe and caudate nucleus infarction. His clinical manifestation met all the diagnostic criteria of CA. Contrary to most cases of CA, however, he did not present apraxia or visuo-spatial neglect.

Conclusions: While most cases of CA had ischemic lesions in the right frontal lobe or lentiform nucleus from the previous literature, our case had lesions involving the head of caudate nucleus. While Caudate nucleus is known to play a significant role in cognitive functions after ischemic stroke, the role of the right caudate nucleus in language functions in acute stroke may be considered in future lesion symptom mapping studies

Comparison of pharmacological induced hypertension and anticoagulation for rescue therapy of early neurological deterioration in lacunar stroke

Soo-Hyun Park¹, Cindy W Yoon², Hee-Kwon Park², Joung-Ho Rha²

¹Department of Neurology, Department of Critical Care Medicine, Inha University Hospital, Incheon, Korea, Republic of

²Department of Neurology, Inha University Hospital, Incheon, Korea, Republic of

Purpose: The early neurological deterioration (END) has occurred by various causes in many patients with acute ischemic stroke. Although pharmacologically induced hypertension (PIH) and the anticoagulant, argatroban, are being studied in several clinical trials for the treatment of END, the efficacy and safety of these treatments are still unclear. Here, we investigated which PIH or anticoagulation is better as a rescue therapy for the stroke progression-related END in the patients with lacunar stroke.

Methods: Among the prospective registry of the patients with acute ischemic stroke, admitted to our hospital between April 2014 and August 2021, we reviewed the subjects with lacunar stroke who received the PIH or intravenous infusion of argatroban for rescue therapy of END within 3 days of symptom onset. In the PIH group, phenylephrine was administered intravenously over 24 hours and tapered off slowly when the symptoms improved or after 4 days of PIH. In the anticoagulation group, argatroban was administered intravenously for 4 days. We compared the END recovery defined as the improvement of NIHSS down to the ones on admission, the excellent outcomes (0 or 1 mRS at 3 months), and the safety profile.

Results: Among the 4818 patients with the lacunar stroke, END occurred in the 147 patients. Seventy-nine of END patients received the PIH and 68 patients took the anticoagulation therapy, respectively. Two groups had no difference age (64.4; PIH vs. 64.8; argatroban, P = 0.82) and sex (man, 58.2%; PIH vs. man, 55.9%; PIH, P = 0.87). Compared to the anticoagulation group, PIH group had the higher incidence of the END recovery (77.2% vs. 51.5%, P < 0.01) and excellent stroke outcome (34.2% vs. 16.2%, P = 0.04), significantly. After adjustment of age, man, dyslipidemia branch atheroma using phenyl-ephrine, NIHSS on END (\geq 8), and SBP on END (>145 mmHg), PIH was associated with END (HR 2.49; 95% CI 1.06–5.81, P = 0.04), compared to the anticoagulation therapy. After adjusting for the propensity for the rescue therapy as well as other possible confounders, PIH remaivned associated with END recovery (adjusted HR 3.91; 95% CI 1.19–12.90, P = 0.02). Safety outcomes, like hemorrhagic conversion and mortality, did not significantly differ between the two groups.

Conclusions: As rescue therapy for the stroke progression-related END in the lacunar stroke patients, PIH was more effective with similar safety, compared to the anticoagulation therapy using argatroban.

Vertebral artery dissection with acute ischemic stroke after COVID-19 vaccination: Three case reports

<u>Hyunkee Kim</u>¹, Ji Hyun Kim¹, Young Joo Lee¹, Kyu-Yong Lee¹, Seong Ho Koh¹, Hojin Choi¹, Hyuk Sung Kwon¹

¹Department of Neurology, Hanyang University Guri Hospital, Guri, Korea, Republic of

Purpose: The relationship between intracranial artery dissection and COVID-19 vaccines has not been previously reported.

Methods: Three case reports of vertebral artery dissection after BNT162b2 COVID-19 vaccination (Pfizer/BioNTech Comirnaty vaccine).

Results: The first case was of a 52-year-old man with a history of hypertension. He complained of dizziness, ptosis in the right eye, and hypesthesia of the right side of the face and left extremities four weeks after injection of the 2nd Pfizer COVID-19 vaccination (Oct. 2021). He had received the 1st vaccination 4 months ago (June 2021) and had persistent headaches. Acute infarction in the right medulla and dissection of the right vertebral artery were diagnosed (Fig.1a-c). Except for a mild increment in D-dimer (68 ng/mL), other laboratory tests were normal.

The second case was of a 46-year-old man with no underlying diseases. He received the 2nd Pfizer COVID-19 vaccination in October 2021 and had a headache shortly thereafter. After 20 days, he presented with dysarthria and hypesthesia of the right side of the face and left extremities. There were no abnormal findings in the laboratory tests. Brain magnetic resonance imaging (MRI) with angiography was performed, and an acute right medullary infarction and pearl-and-string sign with a double lumen in the right vertebral artery which can be considered a dissection, were noted (Fig. 1d-f).

The third case was of a 53-year-old-man with no underlying disease. A week after the 1st Pfizer covid vaccination (January 2022), the patient suddenly collapsed. Dysdiadochokinesia was observed. Serum glucose level was 435mg/dL, but laboratory tests showed no evidence of thrombosis or connective tissue disease. MRI revealed a right cerebellar infarction with right vertebral artery dissection diagnosed by a double luminal sign (Fig. 1g-i).

All three patients took antiplatelet agents and statins, and the patients' symptoms gradually improved **Conclusions:** The causal relationship between COVID-19 vaccination and vertebral artery dissection remains unclear. However, there is growing evidence that messenger RNA (mRNA) vaccines, are associated with endothelial dysfunction and arterial stiffness. There is indirect evidence that spike protein without viral RNA is present in endothelial cells of the brain, and this spike protein is associated with microthrombi. The viral spike protein, which is the target of major COVID-19 vaccines, may be the key agent causing endothelial damage. An increase in inflammatory biomarkers and endothelial dysfunction were also

demonstrated after BNT162b2 mRNA COVID-19 vaccination.

Thus, cerebral artery dissection should be recognised as a possible side effect of vaccination.

Fibrosis-4 index and liver fibrosis are risk factors for long-term outcomes in atrial fibrillation-related stroke

<u>Jin-Man Jung</u>¹, Tae-Hyung Kim², Seong-Young Kim², Young Kul Jung², Hyung Joon Yim², Woo-Keun Seo³

¹Neurology, Korea University Ansan Hospital, Ansan, Korea, Republic of ²Division of Gastroenterology, Department of Internal Medicine, Korea University Ansan Hospital, Ansan, Korea, Republic of ³Neurology, Samsung Medical Center, Seoul, Korea, Republic of

Purpose: Liver fibrosis (LF) is associated with a poor prognosis in patients with ischemic stroke (IS). We aimed to assess whether LF affects long-term outcomes in patients with atrial fibrillation-related stroke or such effects vary according to sex.

Methods: We conducted a multicenter prospective cohort study of Korean patients with atrial fibrillation-related IS. We calculated the fibrosis-4 (FIB-4) index, and LF degree was categorized into two groups (non-advanced vs. advanced) based on the FIB-4 index. Recurrent IS, major adverse cardiac events (MACEs), and all-cause mortality were evaluated using Cox proportional hazard model.

Results: A total of 2,897 patients were included; the median age was 75 (interquartile range 68–80) years, and 51.8% were men. The median follow-up period was 16.3 months. Of these patients, 23% had advanced LF indicated by FIB-4 index. Multivariable analysis in all populations demonstrated that the FIB-4 index and advanced LF were significantly associated with MACEs and all-cause mortality but not with recurrent IS. Furthermore, a sex disparity was observed in the outcomes of the patients. A high FIB-4 index in men was a significant predictor of recurrent IS [subdistribution hazard ratio (95% confidence interval): 1.08 (1.02–1.14)]. However, the significance of advanced LF disappeared in MACEs in women and in all-cause mortality in men.

Conclusions: The FIB-4 index and advanced LF indicated by FIB-4 index are independent prognostic factors for long-term outcomes in Asian patients with atrial fibrillation-related IS. However, these predictors may contribute differently to patient outcomes depending on the sex.

Prediction of post-stroke cognitive impairment after acute ischemic stroke using machine learning approach

<u>Minwoo Lee</u>^{1,4}, Na-Young Yeo^{3,4}, Hyo-Jeong Ahn^{3,4}, Mi Sun Oh¹, Kyung-Ho Yu^{1,4}, Byung-Chul Lee¹, Chulho Kim^{2,4}

¹Department of Neurology, Hallym University Sacred Heart Hospital, Anyang, Korea, Republic of ²Department of Neurology, Chuncheon Sacred Heart Hospital, Chuncheon, Korea, Republic of ³Chuncheon Artificial Intelligence Center, Chuncheon Sacred Heart Hospital, Chuncheon, Korea, Republic of

⁴Institute of New Frontier Research Team, Hallym University College of Medicine, Chuncheon, Korea, Republic of

Purpose: Post-stroke cognitive impairment (PSCI) may occur in up to 50% of patients with acute ischemic stroke. Thus, the prediction of cognitive outcomes in acute ischemic stroke may be useful in treatment decisions. Machine learning methods are being adopted for use in the prediction, treatment decisions, and prognostication of patients with acute stroke due to their high accuracy. This PSCI cohort study aimed to determine the applicability of the machine learning approach to predict post-stroke cognitive impairment after stroke.

Methods: This was a retrospective study using a prospective PSCI cohort that enrolled patients with acute ischemic stroke. Demographic features, clinical characteristics along with brain image variables formerly known to be associated with PSCI were included in the analysis. The primary outcome was PSCI, defined as having an adjusted z-score of less than -2.0 standard deviation in at least one of the 4 cognitive domains (memory, executive/frontal, visuospatial, and language) from the Korean version of vascular cognitive impairment harmonization standard. The secondary outcome was PSCI defined as having scores of the Korean version of the mini-mental status examination less than 24. We developed 4 machine learning models (logistic regression, Support Vector Classifier, XGBoost, and Artificial Neural Network) and compared their accuracy in both outcomes.

Results: A total of 1047 patients(mean age 65.7±11.9; male 61.5%) with acute ischemic stroke were included in this study. The area under the curve for the Support Vector Machine was the highest (0.704) among the 4 models in predicting PSCI according to the VCIHS-NP definition. The area under the curves for the Multilayer Perception Artificial Neural Network was the highest (0.919) in predicting PSCI using K-MMSE scores. The most important features for the prediction of PSCI included the presence of cortical infarcts, mesial temporal lobe atrophy, higher initial stroke severity, previous stroke history, and strategic lesion infarcts.

Conclusions: Our findings indicate that machine learning algorithms, particularly support vector classifiers

and artificial neural networks can predict cognitive outcomes after ischemic stroke. Prediction of PSCI using mini-mental status examination, reflecting general cognitive deficits, was significantly more accurate than using the domain-based definition.

Cerebral small vessel disease burden and futile reperfusion after endovascular treatment for acute ischemic stroke patients

<u>Minwoo Le</u>e¹, Mi Suh Oh¹, Kyung-Ho Yu¹, Byung-Chul Lee¹, Chul Ho Kim², Yerim Kim³, Hee Jung Mo⁴, Sang-Hwa Lee²

¹Department of Neurology, Hallym University Sacred Heart Hospital, Anyang, Korea, Republic of ²Department of Neurology, Chuncheon Sacred Heart Hospital, Chuncheon, Korea, Republic of ³Department of Neurology, Kangdong Sacred Heart Hospital, Seoul, Korea, Republic of ⁴Department of Neurology, Dongtan Sacred Heart Hospital, Dongtan, Korea, Republic of

Purpose: Cerebral small vessel disease (SVD) burden has been associated with an increased risk of poor functional outcomes after acute ischemic stroke. We aimed to investigate the impact of cerebral SVD on 3-month functional outcome in patients with acute ischemic stroke who received endovascular treatment (EVT), and more specifically, whether SVD is associated with futile reperfusion (FR).

Methods: Based on a prospective multicenter stroke registry, we analyzed consecutive acute ischemic stroke patients with either intracranial and/or extracranial large artery occlusion at anterior circulation, treated with EVT achieving successful arterial reperfusion (Thrombolysis in Cerebral Infarction grade 2b-3). The cerebral SVD burden was evaluated on baseline brain magnetic resonance imaging T2 Fluid-attenuated inversion recovery using a modified Fazekas Score(mFS). The main outcome variable was FR, defined as poor functional outcomes (modified Rankin scalse 3–6) at 3 months after stroke despite successful recanalization.

Results: Among 10,890 patients with acute ischemic stroke, 577 (5.3%) received EVT within 12 hours of onset, including 354 who met study eligibility criteria FR was observed in 191 patients (53.5%) and was positively associated with SVD burden: mFS 1; 40.9% mFS 2; 60.3% and mFS3; 82.5%. After adjustment of covariates including age, sex, stroke etiology, initial stroke severity, collateral status, Alberta stroke program early CT score, initial serum glucose, systemic blood pressure, and vascular risk factors, mFS grade 3 was significantly associated with FR (odds ratio 3.93[95% Confidence interval 1.602-9.619], p=0.003)

Conclusions: Our study demonstrated that cerebral SVD assessed with brain MRI on the baseline is associated with the futility of successful recanalization after EVT and symptomatic hemorrhagic transformation, but not with early stroke progression or recurrence. Nevertheless, our findings do not justify withholding EVT in otherwise eligible patients with AIS based on the presence of severe SVD.

HbA1c level and functional outcome by ischemic stroke subtypes and age

Sang-Moon Yun¹, Jihyun Jeong², Jaekyung Park³

¹Division of Cardiovascular Disease Research, Korea National Institute of Health, Cheongu-Si,

Chungcheongbuk-Do, Korea, Republic of

²Division of Injury Prevention and Control, Korea Disease Control and Prevention Agency, Cheongu-Si,

Chungcheongbuk-Do, Korea, Republic of

³Division of Brain Disease Research, Korea National Institute of Health, Cheongu-Si,

Chungcheongbuk-Do, Korea, Republic of

Purpose: Stroke is a global health problem and major causes of morbidity and disability. Although several studies have been assessed an association between HbA1c and functional loss in all ischemic (IS) or specific IS subtype, there are few studies to investigate HbA1c effects for long-term poor functional outcome and compare this association according to stroke subtype and age. We aimed to find the high HbA1c level related with short- and long-term functional outcome and to determine whether this association differs by IS subtype and age.

Methods: A total of 8,219 stroke patients from the Clinical Research Center for Stroke in Korea-National Institutes of Health (CRCS-K-NIH) database between May 2017 and December 2019. Among this participants, 5,096 patients were followed-up until 1-year. The HbA1c levels were classified into three groups (<5.7%, 5.7% to <6.5%, \geq 6.5%). The short- and long-term poor functional outcome were defined using the modified Rankin Scale score at 3-months and 1-year with modified Rankin Scale score 2 to 6, respectively. Ischemic stroke subtype was categorized by the Trial of ORG 10172 in Acute Stroke Treatment (TOAST) classification.

Results: There was an association between higher HbA1c (≥6.5%) and poor functional outcome at 3-months and 1-year in all patients and younger patients (<65 aged), but not in those aged 65 years and older (all aged; 3-months, OR, 1.319, 95%CI 1.120, 1.552, 1-year, OR, 1.250, 95% CI 1.013, 1.543, <65 aged; 3-months, OR, 1.414, 95%CI 1.071, 1.868, 1-year, OR, 1.546, 95% CI 1.049, 2.277). Among all-aged and <65 aged groups, the higher HbA1c level was related short-term and long-term functional loss in patients with SVO subtype (all aged; 3-months, OR, 1.652, 95%CI 1.138, 2.397, 1-year, OR, 1.814, 95% CI 1.091, 3.016, <65 aged; 3-months, OR, 2.337, 95%CI 1.334, 4.095, 1-year, OR, 3.002, 95% CI 1.30, 6.932). However, in patients with the other TOAST subtypes, high HbA1c does not increase the risk of poor outcomes, regardless of age of onset.

Conclusions: The high HbA1c level was increased the risk of short-term and long-term poor functional outcome after ischemic stroke onset. However, this association was different according to stroke subtype

and age. Thus, stroke care and treatment may be considering characteristics of patients such as stroke subtype and age from time of admission.

Acute-phase brain natriuretic peptide as a marker of poor prognosis of ischemic stroke related to atrial fibrillation with preserved ejection fraction

Hokyu Kim¹, Minkyung Kim¹, Chi Kyung Kim¹, Kyungmi Oh¹

¹Department of Neurology, Korea University Guro Hospital, Seoul, Korea, Republic of

Purpose: Brain natriuretic peptide (BNP) is a well-known biomarker for cardiac ventricular function. It is scarce to evaluate the role of acute-phase BNP as a prognostic marker with echocardiographic data in ischemic stroke related to atrial fibrillation.

Methods: We recruited 128 ischemic stroke patients who have atrial fibrillation for two years. The level of acute-phase BNP was measured in all patients and underwent trans-thoracic echocardiograms and 24-hr Holter monitoring. Poor prognosis of this patients was defined by modified Rankin score (mRS) \geq 3 at discharge or 7 days (if discharge date is within 7 days from admission date).

Results: Among a total of 128 patients, 85 (66%) patients had poor outcome (mRS \geq 3) at discharge, 22 (17%) had low ejection fraction in echocardiography (< 50%), and 19 (15%) had regional wall motion abnormalities. The BNP level was significantly lower in poor outcome group than good outcome (2463±2783 pg/ml vs. 1096±872, P < 0.01), and even in sub-group with preserved ejection fraction (pEF, \geq 50%; n=106) BNP was decreased in poor outcome group (2037±2325 pg/ml vs. 921±692, P < 0.01). After adjusting ejection fraction, age, sex, and conventional risk factors, in the highest quartile of BNP (\geq 2375 pg/ml) the proportion of poor prognosis increased significantly compared with the lowest quartile (< 530 pg/ml) of(adjusted odds ratio, 4.76; 95% confidence interval, 1.12 – 20.3). In sub-group with pEF, thwe adjusted odds ratio for poor prognosis in the highest quartile of BNP was higher than the lowest quartile (adjusted odds ratio, 6.99; 95% confidence interval, 1.11 - 44.1). **Conclusions:** From this study, acute-phase BNP can be used as a poor prognostic marker in ischemic stroke related to atrial fibrillation. This result was persistent after adjusting heart function and remained in the sub-group with pEF in echocardiography.

Euglycemic diabetic ketoacidosis in patients with postoperation stroke, taking SGLT2 inhibitor

Hee-Kwon Park¹, Young Chan Kim¹, Seo Hee Choi¹, Soo Hyun Park¹, Joung-Ho Rha¹

¹Neurology, Inha University, Incheon, Korea, Republic of

Purpose: Diabetic ketoacidosis (DKA) is a serious acute complication of diabetes mellitus that occasionally can become fatality. Although DKA is usually associated with severe hyperglycemia and dehydration, it can occur rarely in the setting of normal glucose concentrations, known as euglycemic DKA, defined as DKA with a blood glucose level of <300 mg/dL. Euglycemic DKA develops mostly in individuals with type 1 diabetes, or pregnant diabetic women. Sodium-glucose cotransporter 2 (SGLT2) inhibitors are new oral hypoglycemic drugs indicated for type 2 diabetes mellitus The drugs have a relatively pronounced glucose-lowering effect with a low risk of hypoglycemia and could reduces body weight and has pleiotropic effects attributable to amelioration of insulin resistance, dyslipidemia, nonalcoholic fatty liver disease, congestive heart failure and cardiovascular diseases. We present a case of a woman with type 2 diabetes mellitus hospitalized for postoperation stroke, who developed empagliflozin-associated euglycemic diabetic ketoacidosis

Methods: Here, we describes a 69-year-old woman diagnosed with type 2 diabetes mellitus (DM) who presented with left midbrain infarction during operation for intertrochanter fracture in other hospital and then was transferred to our hospital. On admission, she had euglycemic DKA and she had the history of medication of empagliflozin for one month. The Hba1c level was 12.1% and the ketone serum level of ketone body was over 9600 mmol/L. After hydration, the laboratory findings did not improved. After 3 days of discontinuation of empagliflozin, ketone bodies decreased to less than 200 mmol/L.

Results: Surgical stress, and decreased carbohydrate intake also could be contributing factors to the development of ketosis in this patient. Early recognition of this medical emergency like euglycemic DKA and timely intervention can reduce the consequences of serious complication. However, this form of DKA could be missed by normal serum glucose levels. Especially, the DKA could result in severe dehydration, which might evoke the neurologic deterioration in patients with acute stroke.

Conclusions: Clinical considerations to ensure safe SGLT2 inhibitor therapy should include appropriate monitoring parameters for timely diagnosis of euglycemic diabetic ketoacidosis.

Comparison of acute ischemic stroke management before and after the addition of COVID-19 screening in the emergency room

Nathan Jo¹, Heekyong Kang¹, Hakin Lee¹, Inyoung , Lee¹, Sung Hye , Kim², Hyeon Jeong Yang², Hyeran Im², Seoro Kang², Seung Ryu³, Jei Kim^{1,2}

¹Neurology, Chungnam National University Hospital, Daejeon, Korea, Republic of

²Daejeon-Chungnam Regional Cerebrovascular Center, Chungnam National University Hospital,

Daejeon, Korea, Republic of

³Emergency Medicine, Chungnam National University Hospital, Daejeon, Korea, Republic of

Purpose: After the coronavirus disease 2019 (COVID-19) outbreak, a strict quarantine clinical pathway for patients suspected of having COVID-19 was executed in the emergency department. We analyzed whether the clinical pathway to quarantine suspected COVID-19 cases could be followed without delay by acute ischemic stroke management in the emergency department.

Methods: We compared acute ischemic stroke management executed for 868 patients who arrived at the emergency department after the COVID-19 outbreak (April 1, 2020–March 31, 2021), 31 of whom were quarantined (post-COVID-19-quarantine) and 837 of whom were not (post-COVID-19-no-quarantine), with the indices for 929 patients (pre-COVID-19) who received acute stroke management prior to the outbreak (January 1, 2019-December 31, 2019).

Results: After arrival at the emergency department, brain CT scans occurred within an average of 20 min for both post-COVID-19-no-quarantine and pre-COVID-19 patients, but within 77 min for post-COVID-19-quarantine patients. Admission to the stroke unit took an average of 200 and 230 min for post-COVID-19-no-quarantine and pre-COVID-19 patients, respectively, but took 825 min for post-COVID-19-quarantine patients. Thrombolysis was performed in 7.5% (65 patients) of post-COVID-19 patients and 10.9% (102 patients) of pre-COVID-19 patients. No post-COVID-19-quarantine patients were candidates for thrombolytic therapy. Intravenous thrombolysis was performed within a median of 30 min and intra-arterial thrombectomy within a median of 120 min in both pre- and post-COVID-19 periods.

Conclusions: The COVID-19 clinical pathway caused little delay for efficient acute stroke management in no-quarantine stroke patients. For quarantined stroke patients, the quarantine process must be modified and shortened for effective treatment.

Long-term care insurance service utilization among stroke survivors: National health insurance database study in South Korea

Dougho Park¹, Su Yun Lee², Eunhwan Jeong², Haejong Kim², Daeyoung Hong³, Mun-Chul Kim³, Hyoung Seop Kim⁴

¹Rehabilitation Medicine, Pohang Stroke and Spine Hospital, Pohang, Korea, Republic of

- ²Neurology, Pohang Stroke and Spine Hospital, Pohang, Korea, Republic of
- ³Neurosurgery, Pohang Stroke and Spine Hospital, Pohang, Korea, Republic of

⁴Physical Medicine and Rehabilitation, National Health Insurance Service IIsan Hospital, Goyang, Korea, Republic of

Purpose: Stroke mainly occurs in the elderly and is a disease with high morbidity. Therefore, there is a need for an appropriate long-term care system for stroke survivors. South Korea launched the long-term care insurance (LTCI) system in 2008 to provide services to the elderly and patients with geriatric diseases, including stroke. This study estimated the factors affecting the utilization of LTCI after stroke.

Methods: This is a retrospective cohort study using the Korean National Health Insurance Service Database. We included patients with the first-ever stroke in 2009 and followed them until 31 December 2018. The dependent variable was defined as LTCI beneficiary approval. Determinants consisted of demographic (age, gender), socio-environmental factors (household income levels, residence area), and comorbidities. **Results:** A total of 10,549 patients were included, and 2732 patients received the LTCI approval. In the multivariable cox-regression analysis, older age groups and comorbidities such as diabetes, atrial fibrillation, and chronic kidney disease significantly increased the probability of LTCI approval. On the other hand, male gender, higher household income levels, and dyslipidemia were significantly related to less probability of LTCI approval (Table 1).

Conclusions: Our results demonstrated that LCTI utilization after stroke was affected by various determinants such as gender, age, income level, and comorbidities. This study is significant as the first large-scale report on LTCI utilization in patients with stroke after the LTCI launch in Korea and can be referred by policymakers for the long-term stroke care system.

A clinical study of 288 patients with anterior cerebral artery infarction

Hansol Im¹, Jeong Hyun Park¹, Taewon Kim¹, Jaseong Koo²

¹Department of Neurology, Incheon St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Incheon, Korea, Republic of

²Department of Neurology, Seoul St. Mary's Hospital, College of Medicine, The Catholic University of Korea, Seoul, Korea, Republic of

Purpose: Acute ischemic stroke in the territory of anterior cerebral artery (ACA) is uncommon. Therefore, large population studies evaluating ACA infarction are scarce. We sought to evaluate epidemiological and etiological characteristics of ACA infarction compared to other territorial infarctions.

Methods: We analyzed a prospectively collected stroke registry of all acute ischemic stroke patients for 19 years at two tertiary hospitals. We included patients with acute ischemic stroke caused by large vessel stenosis or occlusion including ACA, middle cerebral artery (MCA), posterior cerebral artery (PCA), and vertebrobasilar artery (VBA).

Results: A total of 4171 patients were enrolled. Patients with ACA infarction (N = 288) were significantly older with more females than those with MCA, PCA, or VBA infarction. There were more patients with history of prior ischemic stroke in the ACA infarction group than in other groups. The etiology of the ACA infarction was similar to those of the MCA, PCA and also the total population (66.7–71.8% of LAA and 17.9–20.9% of CE). When patients had prior ischemic stroke history, ACA infarction was more likely to be caused by LAA than MCA or PCA infarction (OR = 6.2, 95% CI 2.0–19.2, p = 0.002 and OR = 4.0, 95% CI 1.1–14.6, p = 0.038, respectively).

Conclusions: Patients with ACA infarction had significantly more prior ischemic stroke than those with MCA, PCA, or VBA infarction. The etiology of ACA infarction in patients with prior ischemic stroke showed significantly more LAA than that of MCA or PCA infarction.

Table 2 Etiology by large artery infarction in the total population and in patients with prior ischemic stroke

		MCA	ACA	PCA	VBA	Total	p value	Post hoc analys	is for LAA	
Total patients	Number of patients (N, %)	2711 (65.0)	288 (6.9)	476 (11.4)	695 (16.7)	4171 (100)	< 0.001**	VBA>MCA	VBA>ACA	VBA>PCA
	LAA (N, %)	1874 (69.1)	192 (66.7)	329 (69.1)	526 (75.7)	2996 (71.8)		<0.001**	0.017*	0.036*
	CE (N, %)	566 (20.9)	56 (19.4)	85 (17.9)	93 (13.4)	800 (19.2)				
	Other or undetermined (N, %)	271 (10.0)	40(13.9)	62 (13.0)	76 (10.9)	375 (9.0)				
Patients with prior	Number of patients (N, %)	276 (66.2)	51 (12.2)	40 (9.6)	50 (12.0)	417 (100)	0.006**	ACA> MCA 0.001**	ACA>PCA 0.021*	
ischemic stroke	LAA (N. %)	164 (59.4)	41 80.4)	25 (62.5)	36 (72.0)	261 (62.6)				
	CE (N, %)	82 (29.7)	4(7.8)	11 (27.5)	9(18.0)	106 (25.4)				
	Other or undetermined (N, %)	30 (10.9)	6(11.8)	4 (10.0)	5 (10.0)	50 (12.0)				

CA middle cerebral artery. ACA anterior cerebral artery, PCA posterior cerebral artery, VBA vertebrobasilar artery, LAA large artery atherosclerosis, CE cardioembolic. Values are the number of patients (%). Chi-square test and Fisher's exact analysis were used for categorical variables and analysis of variance (ANOVA) for continuous variables. (*p < 0.05, **p < 0.01)

Cerebrovascular fibromuscular dysplasia with extracranial artery involvement

Matthew Chung¹, Jeong-Min Kim¹

¹Neurology, Seoul National University Hospital, Seoul, Korea, Republic of

Purpose: Fibromuscular dysplasia (FMD) is an idiopathic, noninflammatory, nonatherosclerotic vascular disease of small to medium-sized arteries. Cerebrovascular FMD is rare and may present with headache, pulsatile tinnitus, or carotid bruit. Herein, we present a case of cerebrovascular fibromuscular dysplasia with extracranial artery involvement.

Methods: A 53-year-old female patient presented with headache that had persisted for 12 years. Moderate-to-severe throbbing pain at the right periorbital to temporal head occurred 3 to 4 times monthly, with each attack resolving within 2 days. Nausea, vomiting, photophobia, and phonophobia were denied. Treatment including propranolol, ibuprofen, naratriptan, nortriptyline, and topiramate was ineffective, but after being started on nebivolol her headache attacks subsided.

Neurological examination was unremarkable except for carotid bruit at the left carotid artery. Computed tomography angiography of the intracranial and extracranial vessels showed diffuse arterial dilatation and constriction at the bilateral internal carotid arteries prompting further workup (Figure 1A).

She had hypertension, hyperlipidemia, subclinical hypothyroidism, and received surgery for colon cancer 16 years ago. She rarely drank alcohol and never smoked.

Results: During transfemoral cerebral angiography, the "string of beads" sign was seen at the bilateral carotid arteries (Figure 1B). Angiography also revealed collateral vessels near the celiac artery (Figure 1C). Computed tomography angiography of the abdominal aorta showed total occlusion and reconstitution of the celiac axis and superior mesenteric artery (Figure 1D). Evidence of atherosclerosis or inflammation of the bilateral carotid arteries was not found on high-resolution vessel wall imaging. As the patient had no symptoms at the time of visit, she received aspirin and was discharged.

Conclusions: Fibromuscular dysplasia is a risk factor for artery dissection and ischemic stroke yet may remain undiagnosed in patients with non-disabling symptoms due to its low prevalence. Due to frequent involvement in other arterial beds, head-to-pelvic vascular imaging is recommended in patients diagnosed with FMD.



Figure 1. Vascular imaging results of the patient.

(A) Computed tomography angiography showing bilateral "String-of-beads" appearance of the bilateral internal carotid arteries (arrows).

(B) "String-of-beads" appearance of the left internal carotid artery (arrow) on digital subtraction arteriography.

(C) Fine collaterals near the celiac trunk (arrow) revealed during transfemoral angiography, indicative of celiac artery occlusion and reconstitution

(D) Computed tomography angiography of the abdominal aorta with occlusion of the celiac trunk (larger arrow) and superior mesenteric artery (smaller arrow).

Right frontal lobe lesion on diffusion-weighted imaging during transient global amnesia: A case report

Moon-Gwan Choi¹, Dong-Hyun Kim¹, Jae-Woo Kim¹, Hye-Yun Kim¹, Seung-Hyun Lee¹

¹Neurology, Seoul Medical Center, Seoul, Korea, Republic of

Background: The most pronounced clinical feature during transient global amnesia (TGA) is a transient disturbance in anterograde episodic long-term memory lasting several hours or up to 1 day. Although the precise pathophysiology of TGA remains unclear, a focal ischemia in the hippocampus is considered to be one of the possible mechanisms. In studies using diffusion-weighted imaging (DWI), subacute punctate lesions of the hippocampus were consistently identified in patients with TGA. However, there have been few reports of extrahippocampal DWI lesions in TGA cases, especially in the hyperacute phase with symptoms of amnesia Herein, we report the case of a patient with TGA who presented with a focal hyperintense lesion in the right frontal lobe prior to the bilateral hippocampal lesions on DWI.

Case report: The patient is a 55-year-old woman with a past medical history of hyperlipidemia She was diagnosed with COVID-19 infection five days ago and guarantined at home. She complained of a mild cough but no other symptoms or fever. On the day of the event, at 5:30 p.m., she spoke to her family over the phone, and it was nothing out of the ordinary at the time. However, at 9:00 p.m., when the family came home, she could not remember that she had been diagnosed with COVID-19 infection and was shown repeating the same questions about it to her family. She also couldn't remember buying a new car last week. Thereafter, she was admitted to the emergency department. On neurological examination, the orientation to date was defected, but there were no other abnormalities. Magnetic resonance imaging (MRI) of the brain revealed that a focal diffusion restricted lesion in the right frontal lobe with corresponding focus of low signal intensity on the apparent diffusion coefficient (ADC). She was admitted to the neurologic department with suspicion of strategic infarction or TGA. By the next morning, her amnesia completely resolved. Two days after the onset of symptoms, additional bilateral hippocampal DWI lesions were newly confirmed in the follow-up MRI scan. There were no remarkable findings in the brain angiography, electroencephalogram (EEG), electrocardiogram (ECG), 24-hour holter monitoring, and transthoracic echocardiography. The patient was diagnosed with TGA and was discharged without residual neurological deficit.

Conclusion: While the etiologies of TGA is not fully understood, the findings in our case suggest that concomitant dysfunction in the frontal lobe may be involved in the network dynamics of the hippocampus during TGA.

Left vertebral artery hypoplasia is associated with posterior circulation stroke, basilar artery occlusion, and poor functional outcomes in patients with cardioembolic stroke

<u>Jae-Han Bae</u>¹, Jae-Chan Ryu¹, Sang H Ha¹, Bum J Kim¹, Dong-Wha Kang¹, Sun U Kwon¹, Jong-Sung Kim¹, Jun Y Chang¹

¹Neurology, Asan Medical Center, Seoul, Korea, Republic of

Purpose: Cardiac emboli pass through the right subclavian artery rather than the left subclavian artery due to the regional anatomy. In cases of left vertebral artery hypoplasia, cardiac emboli may pass through the right vertebral artery due to its larger diameter. We investigated whether left vertebral artery hypoplasia is associated with cardiac embolism in the posterior circulation and the functional outcomes 3 months after cardioembolic stroke.

Methods: Patients with acute cardioembolic stroke with atrial fibrillation were enrolled. All patients had CT or MR neck angiography, visualizing the aortic arch and subclavian arteries. Vertebral artery hypoplasia was defined as a diameter \leq 2mm on CT or MR angiography. The laterality and size of vertebral artery hypoplasia were recorded. The presence of a posterior circulation stroke, basilar artery occlusion, and the functional outcomes after 3 months were investigated.

Results: This study included 407 patients with cardioembolic stroke. Patients with left vertebral artery hypoplasia experienced a higher rate of posterior circulation stroke (42.2% vs. 20.2%, p=0.003) and basilar artery occlusion (11.1% vs. 2.8%, p=0.005). Patients with right PICA infarction showed a higher rate left vertebral artery hypoplasia rate (28.6% vs. 3.6%, p=0.013) than that of patients with left PICA infarction. Multivariate analysis revealed that left vertebral artery hypoplasia had an independent predictive value of poor functional outcomes (OR, 2.336; 95% CI, 1.103 –4.947).

Conclusions: Patients with cardioembolic stroke and left vertebral artery hypoplasia were associated with posterior circulation stroke, basilar artery occlusion, and poor functional outcomes after 3 months.

Are basal ganglia and corona radiata more susceptible to cerebral infarction caused by hypertension?

Do-Hyung Kim¹

¹Neurology, Eulji University Hospital, Eulji University School of Medicine, Daejeon, Korea, Republic of

Purpose: Hypertension, diabetes mellitus, hyperlipidemia and atrial fibrillation are a risk factor for stroke and transient ischemic attack (TIA). Especially, hypertension is a major risk factor and the risk can be reduced by persistent correction of the hypertension. Therefore, antihypertensive therapy can reduce the rate of recurrence of stroke and TIA. Our case suggests that repetitive TIA can be induced by an uncontrolled hypertension, which can be prevented with strict blood pressure control.

Methods: A 58-years-old woman visited the emergency department due to Rt leg weakness (MRC grade III) and severe dysarthria which suddenly occurred at 1 hour ago. The patient had history of hypertension, diabetic mellitus and smoking (15 pack-years). The patient took diabetes medication and her blood glucose level was normal range. However, despite taking the anti-hypertensive drug regularly, she had high blood pressure at the time of the emergency department (SBP/DBP 219/85 mmHg, HR: 112/min). It was planned to be administered tPA, but tPA could not be used because the neurological symptoms improved within 30 minutes. After cardiac evaluation were performed, anti-hypertensive drugs were regulated, and the patient was discharged.

However, 12 days later, the patient re-visited the emergency department due to Rt side weakness and mild dysarthria She had high blood pressure (SBP/DBP: 221/102 mmHg, HR: 88/min). Within 30 minutes after visit emergency department the neurological symptoms had complete resolved. After anti-hypertensive drugs were added on, the patient was discharged. However, 4 months later, the patient re-visited the emergency department due to transient right-side weakness that was resolved within 1.5hr. The patient's blood pressure was as high as before (SBP/DBP: 168/83 mmHg, HR: 75/min). **Results:** After being visited to the emergency department, the patients underwent brain MRI-DWI, brain CT 3D angiography, blood test. Brain DWI image showed high signal intensity in the left corona radiata and basal ganglia However, after admission, a brain DWI follow-up showed that the lesions on previous MRI had resolved. These changes were repeated and blood pressure was high at the time of visit to the emergency department. Brain CT angiography showed complete occlusion of the right proximal ICA.

Conclusions: Basal ganglia, thalamus, internal capsule, pons and corona radiata may be vulnerable to cerebral infarction or TIA that caused by uncontrolled hypertension. Nevertheless, it was a peculiarity of our patient that had lesions repeatedly appear and disappear at the same location in all three recurrences of TIA.

Sudden sensorineural hearing loss due to basilar artery plaque without diffusion restriction

Nakhoon Kim¹, Young Seo Kim¹

¹Neurology, Hanyang University Hospital, Seoul, Korea, Korea, Republic of

Purpose: This study addressed a case of sudden sensorineural hearing loss and vertigo due to basilar artery plaque without diffusion restriction.

Methods: Sudden sensorineural hearing loss (SSNHL) is a clinical condition characterized by a sudden unilateral or bilateral hearing loss that occurs within a 72-hour period. SSNHL can be caused by various medical conditions although idiopathic SSNHL is not uncommon. Vascular disorder, especially ischemia localized in vertebrobasilar artery, can result in SSNHL. A 66-year-old man presented with unilateral sudden hearing loss and vertigo as a sole clinical manifestation. The patient was initially admitted to otorhinolaryngology department and the pure-tone audiometry (PTA) showed that the patient was suffering from right side sensorineural deafness and his vestibular function test (VFT) presented possible direction-changing bilateral gaze-evoked nystagmus (BGEN).

Results: The patient was treated with intra-tympanic injection of 5mg dexamethasone and 60mg per oral (PO) methylprednisolone per day for five consecutive days and the patient's right side PTA improved to 85dB. The patient was referred for consultation to the neurology department for evaluation of central vertigo. The patient's brain magnetic resonance imaging (MRI) showed old lacunar infarction at right corona radiata and small meningioma at left medial tentorium; neither lesion correlated with the patient's symptoms. Likewise, time-of-flight brain magnetic resonance angiography (TOF-MRA) was unremarkable. Interestingly, high resolution MRA (HRMRA) revealed atherosclerotic plaque in right side of basilar artery. More specifically, plaque was located in the middle third of basilar artery where his right anterior inferior cerebellar artery (AICA) originates from. We applied 200mg of Cilostazol and the patient's symptom has remained stable.

Conclusions: The patient's MRI did not show AICA territory infarction and his basilar artery seemed unremarkable in TOF-MRA. However, the atherosclerotic plaque which might have caused the patient's SSNHL and vertigo was visible in HRMRA. We suggest basilar artery plaque alone itself without infarction can cause SSNHL and direction-changing BGEN when the plaque involves the origin of AICA, which supplies the internal auditory arteries and pontomedullary lesion. Furthermore, the case supports the argument that HRMRA is capable of disclosing cryptogenic vascular cause of SSNHL patients who originally thought to be idiopathic.



Differences in recurrence rates of cardioembolic stroke according to the type of statin used in patients with stroke caused by atrial fibrillation

Jun-Beom Lee¹

¹Neurology, Hongik General Hospital, Seoul, Korea, Republic of

Purpose: Statins are suggested to decrease the incidence of atrial fibrillation (AF). Many studies suggest regarding pleiotrophic effect of statin in the prevention and treatment of AF. However, there is no clinical studies comparing effect between types of statins. This study investigated the association of types of statins with preventive effect on AF induced cardioembolic stroke.

Methods: Consecutive patients with acute cerebral artery infarction due to atrial fibrillation from January 2017 to May 2019 were encountered in a single stroke center. Three groups were retrospectively revised for 2 years based on medical records (Group 1 -NOAC only, Group 2- NOAC plus statin, Group 3- NOAC plus statin and ezetimibe). Two study object were observed. First, stroke recurrence among three groups in follow up period were compared. Second, stroke recurrence between two statin group (atorvastatin or rosuvastain) with or without ezetimibe were evaluated. Kaplan-Meier curve analysis and log rank test were used to compare incidence among three groups and T-test were used to compare incidence between atorvastatin and rosuvastatin groups.

Results: A total of 73 patients were classified into three groups (24, 27 and 22 in group 1, 2, 3 respectively). Patient characteristics were not different among three groups. After 2 years of follow up period, 11 (45.8 %), 8 (29.6 %) and 7 (31.8 %) recurred stroke from atrial fibrillation in group 1, 2, and 3 respectively (p<0.05) (figure 1). There was no Inter-group difference between group 2 and 3. Instead, stroke recurrence between atorvastatin and rosuvastatin group showed statistically significant difference (atorvastatin (24%) 6 out of 25 vs. rosuvastatin (41.7%) 10 out of 24) (p<0.05).

Conclusions: Atorvastain showed more preventive effect on ischemic stroke recurrence from atrial fibrillation than rosuvastatin, which implies statin type could give affect on atrial fibrillation related stroke. Further studies with large number and randomized prospective study are needed.



Cerebral infarction with concomitant patent foramen ovale and pulmonary arteriovenous malformation: A case report

Sang-Mi Noh¹, Jeonghyun Park¹

¹Neurology, Catholic University of Korea St. Vincents Hospital, Suwon, Korea, Republic of

Purpose: Patent foramen ovale (PFO) is common developmental cardiac defect which is incomplete closure of the atrial septum. The incidence of PFO in general population is 25% and 40~50% in cryptogenic stroke population. Right to left shunt via PFO can cause paradoxical embolism therefore high risk PFO combined with ischemic stroke may be targeted for PFO closure treatment. Pulmonary arteriovenous malformation(AVM) can also cause paradoxical embolism, and right to left shunt are commonly confirmed by TCD-PFO study. Here we report rare cases of cerebral infarction patient with PFO and pulmonary AVM confirmed by TCD.

Methods: A 54 years old woman referred to neurology because of thalamic infarction. The patent had no traditional risk factor such as hypertension or diabetes. There was no evidence of vasculitis and no high risk cardio-embolic sources were identified in heart work up such as atrial fibrillation. In TCD-PFO study, right to left shunt was confirmed. However, the microbubble signal lasted more than 3 minutes.

Results: Transesophageal echocardiography(TEE) showed visible PFO with large amount of shunt flow. However, in the TCD study, it was difficult to explain the shunt flow lasting several minutes only with PFO. Chest CT was performed to confirm extracardiac shunt and pulmonary AVM was found in the right lung. First, PFO closure was implemented using an Amplatzer septal occluder. After the acute phase of cerebral infarction, surgical treatment was performed for pulmonary AVM.

Conclusions: This case is a pulmonary AVM was diagnosed by performing additional imaging test to confirm extracardiac shunt based on the findings of TCD- PFO study despite the fact that a prominent PFO was identified in TEE. Both PFO and pulmonary AVM can case embolic infarction. TCD-PFO study with microbubbles is useful for diagnosing right to left shunt via PFO or pulmonary AVM. It is helpful to refer to the findings of the TCD-PFO study as to which patient to perform further chest evaluation and it is important to observe the shunt flow for at least 1 to 3 minutes when conducting the examination.

Association between statin use and blood viscosity in patients with acute ischemic stroke

Jaechun Hwang¹, Mi-Yeon Eun¹

¹Neurology, School of Medicine, Kyungpook National University, Kyungpook National University Chilgok Hospital, Daegu, Korea, Republic of

Purpose: Blood viscosity is the intrinsic resistance of blood to flow and is a measure of blood stickiness. Several clinical and epidemiologic studies have demonstrated an association between blood viscosity and the occurrence of major thromboembolic events including ischemic stroke. Hypercholesterolemia has been reported to increase viscosity in patients with acute ischemic stroke, but it is not known whether statin treatment improves viscosity. We aimed to investigate the effect of statins on blood viscosity in patients with acute cerebral infarction.

Methods: We prospectively enrolled 120 patients with acute stroke within 7 days of symptom onset. Patients were divided into two groups according to prior use of statin. (Group I: previous use of statins for at least 3 months; Group II: statin-naïve patients). In both groups, treatment for cerebral infarction such as statins were conducted according to the guidelines. The blood visibility test was performed as initial within 24 hours of the visit, and additional three months later. A scanning capillary-tube viscometer was used to assess whole blood viscosity.

Results: The mean age of the total patients was 69.7 ± 13.1 years, and 44 were female. The previous statin-using group was 40 and the statin naïve group was 80. The history of dyslipidemia and hypertension was higher in the statin-treated group, but there were no other demographic differences. There was no significant difference between the two groups except for LDL cholesterol in the basic laboratory test. Initial blood viscosity was significantly lower in the previous statin using group (systolic 4.384 \pm 0.475 vs. 4.639 \pm 0.698, p=0.040; diastolic 26.617 \pm 6.498 vs. 30.499 \pm 9.538, p=0.022). After three months of treatment for cerebral infarction including statins, the difference in blood viscosity between the two groups disappeared.

Conclusions: Prior statin use is significantly associated with decreased blood viscosity in patients with acute ischemic stroke. Statin use after acute cerebral infarction may improve blood viscosity.

A case of pontine infarction presenting with contralateral conjugate eye deviation and hemiplegia

Jeungwan Han¹, Yohan Ju¹, Yoon-Shik Chun¹, Hyun-Jae Kim¹, Dongick Shin¹

¹Neurology, Chungbuk National University Hospital, Cheongju, Korea, Republic of

Purpose: Forced eyeball deviation with contralateral hemiplegia usually results from a stroke involving ipsilateral cerebral hemisphere with the frontal eye field. The above symptoms appear due to pontine infarction is very rare.

Methods: A 60-year-old right-handed woman was admitted to the emergency room 30 minutes after onset of a left side weakness. Her history included hypertension, dyslipidemia, and diabetes mellitus controlled well with medications. On neurological examination, the patient had a drowsy mentality, left-sided weakness, conjugate eyeball deviation and severe dysarthria. The National Institutes of Health Stroke Scale score was 12.

CT angiography showed near occlusion of the basilar artery with thrombus. MR diffusion weighted imaging revealed right pontine infarction. Intravenous tissue plasminogen activator(tPA) administration was done after 49 minutes of arrival. After tPA treatment, her conjugate eyeball deviation and hemiplegia was improved. The follow-up CT angiography showed patent basilar artery without thrombus.

Results: Here, we report a case of conjugate eye deviation with contralateral hemiplegia caused by a pontine infarction.

Conclusions: Hemiplegia and dysarthria are the most common symptoms of pontine infarction. In our patient, conjugate eyeball deviation and hemiplegia was apparent. Therefore, patients with these symptoms should be aware of the potential risk of pontine lesion.



U-shaped associations between glycated albumin and obesity and role of il-10 in hyperacute ischemic stroke

<u>Yerim Kim</u>¹, Byung-Woo Yoon², Sang-Hwa Lee¹, Chulho Kim¹, Minwoo Lee¹, Min Kyung Kang², Tae Jung Kim³, Hee Jung Mo¹, Ju-Hun Lee¹

¹Neurology, Hallym University College of Medicine, Seoul, Korea, Republic of ²Neurology, Uijeongbu Eulji Medical Center, Eulji University College of Medicine, Seoul, Korea, Republic of ³Neurology, Seoul National University College of Medicine, Seoul, Korea, Republic of

Purpose: There is growing interest in the use of new biomarkers such as glycated albumin (GA). In contrast to glycated hemoglobin (HbA1c), GA showed an inverse correlation with prestroke obesity status, but data are limited for ischemic stroke (IS). We explored the association between GA and body mass index (BMI) and investigated inflammatory cytokines to support the academic background. **Methods:** In total, 155 patients with hyperacute IS (HIS) between 2011 and 2019 were included. To identify the association between GA and BMI, patients were divided into four groups according to BMI quartiles. Levels of inflammatory cytokines, including IL-1 β , IL-10, IL-6, TNF- α , and TNF-R1, were determined by ELISA using a ProcartaPlex multiplex immunoassay.

Results: The mean age of the 155 patients was 68±12 years, and 67.1% were men.

The lowest BMI group had higher GA levels (GA 2T and 3T =80%) (p-value=0.017), and these U-shaped associations were maintained only for small vessel occlusion etiology (p-value= 0.004). Plasma IL-10 levels were positively correlated with BMI and showed a U-shaped pattern (p-value= 0.001).

Conclusions: GA levels and BMI had U-shaped associations with HIS. IL-10, which acts as a protective cytokine for cardiovascular disease, may play a novel role in this association. Although GA is an emerging favorable clinical marker of cardiovascular outcomes, obesity status should be considered when interpreting these associations.

Development of a flexible self-calculation scoring model to determine stroke risk

Dae Hyun Kim¹, Sunghyon Kyeong²

¹Department and Research Institute of Rehabilitation Medicine, Yonsei University College of Medicine, Seoul, Korea, Republic of

²Institute of Behavioral Science in Medicine, Yonsei University College of Medicine, Korea, Korea, Republic of

Purpose: Stroke is the leading cause of severe disability and has become a significant threat to global public health. Although the management of stroke has evolved in recent decades, primary prevention is the ideal solution. Risk factor identification and management of individuals' own risk factors are essential measures for the primary prevention of stroke. This study aimed to develop a flexible and simple disease scoring model to determine stroke risk.

Methods: A public dataset containing 41,931 cases with 643 occurrences of stroke was randomly divided into training and test datasets comprising 28,093 (66.7%) and 13,838 (33.3%) cases, respectively. Ten variables in the public dataset were converted using weight of evidence, and significant variables were selected using univariate and multivariate logistic regression analyses. The scoring model for stroke risk was developed in the training dataset, and performance was evaluated in the test dataset.

Results: The scoring model, comprising scores ranging from 296 to 980, calculated 732 base points with four selected variables, including age, average glucose level, heart disease, and hypertension. The stroke risk ranged from 0.01–11.67%, according to the range of the scoring model. The performance of the scoring model on the test dataset was similar to that on the training dataset.

Conclusions: This novel point scoring model is flexible enough to modify various datasets and can be used for risk factor identification. Furthermore, its simplicity allows users to manage the risk factors by self-calculating their stroke risk. Our model contributes to primary prevention using risk factor identification and management.



Base p	oints	As	ge	Heart Disease			
73	2	Intervals	Points	Intervals	Points		
		0 - 29	-313	No	-6		
Avg. Gluco	ose Level	30 - 39	-109	Yes	50		
Intervals	Points	40 - 49	-63				
0 - 119	-9	50 - 59	7	Hypert	ension		
120 - 150	1	60 - 69	30	Intervals	Points	Ī	
150 - 200	18	70 - 79	88	No	-9		
200 - Inf	34	80 - Inf	115	Yes	42		

Effect of IoT wearable devices-applied daily walking activities on the management of metabolic syndrome: Utilization of lifelog big data platform

<u>Hoon Jo</u>^{1,2}, So Yeon Park², Jin Hyong Lee², Youngtae Kim², Kyu Hee Lee^{1,2}, Eunyoung Lee², Hyun Youk^{2,3}, Sang-Baek Koh^{2,4}, Erdenebayar Urtnasan^{1,2}

¹Artificial Intelligence Big Data Medical Center, Yonsei University, Wonju, Gangwon, Korea, Republic of ²Big Data Platform Business Group, Yonsei University, Wonju, Gangwon, Korea, Republic of ³Regional Trauma Center, Yonsei University, Wonju, Gangwon, Korea, Republic of

⁴Preventive Medicine, Yonsei University, Wonju, Gangwon, Korea, Republic of

Purpose: Our purpose is to investigate the effect of health management through walking activities using IoT wearable devices to participants with metabolic syndrome for the prevention of cardiovascular diseases including stroke.

Methods: An observational study was conducted with 223 participants diagnosed with metabolic syndrome (MetS), aged 50 and over. All participants were health checked two times during the study that was 8 months (32 weeks, Oct. 2019 to Sept. 2020). At the first visit, we performed a MetS screening, Yonsei Health app installing for health monitoring, and IoT wearable devices distribution for lifelog data acquisition. We analyzed the participants's walking activities from smartwatch through an mobile app for 221(95% CI: 219-224) days. The average number of steps per day was categorized into four levels ('sedentary', less than 5,000 steps; 'low active', 5,000 to 7,499 steps; 'somewhat active', 7,500 to 9,999 steps; and 'active', more than 10,000 steps per day, prospectively), and the relationship with the treatment of MetS was generated by adjusted odds ratio (aORs) and 95% CIs through multivariate logistic regression.

Results: At the end of the application period and the measurement was completed, 206 (92.4%) participants were freed from MetS. Compared to the participants who performed the walking activity corresponding to 'sedentary', the aOR of healing from metabolic syndrome was 6.418 (95% CI: 5.826-7.071) in participants who performed 'active' level walking. Among the diagnostic components for MetS, a higher aOR was observed for fasting blood sugar (aOR: 3.610, 95% CI: .3.012-3.316).

Conclusions: To maintain a healthy lifestyle to manage MetS and prevent cardiovascular diseases such as stroke, application of IoT-based mobile health care can be strongly recommended.



<Lifelog Data Acquisition Process>
The risk of stroke and major bleeding in patients with non-valvular atrial fibrillation: A comparative analysis between non-vitamin K antagonist oral anticoagulants and warfarin in clinical data warehouse

Kwon-Duk Seo¹, Hancheol Lee², Kyung-Yul Lee³

¹Neurology, National Health Insurance Service Ilsan Hospital, Goyang, Korea, Republic of

²Cardiology, National Health Insurance Service Ilsan Hospital, Goyang, Korea, Republic of

³Neurology, Gangnam Severance Hospital, Yonsei University College of Medicine, Seoul, Korea, Republic of

Purpose: Non-vitamin K antagonist oral anticoagulant (NOAC) has been the drug of choice for preventing ischemic stroke in patients with atrial fibrillation (AF) since 2014. Many studies based on claim data revealed that NOAC had comparable effect to warfarin in preventing ischemic stroke with fewer hemorrhagic side effects. We analyzed the difference in clinical outcomes according to the drugs in patients with AF based on the clinical data warehouse (CDW).

Methods: We extracted data of patients with AF from our hospital's CDW and obtained clinical information including test results. And then, all claim data of the patients were extracted from nationwide database of Health Insurance Review & Assessment Service, and combined with the CDW data. The patients were divided into three groups: no-anticoagulation, warfarin, and NOAC. The occurrence of ischemic stroke, intracranial hemorrhage and gastrointestinal bleeding were confirmed through the clinical outcome data of the patients. The factors influencing the risk of clinical outcomes were analyzed.

Results: The data of 5,203 patients who were diagnosed AF between 2009 and 2020 were analyzed. 858 patients (16.5%) were treated with warfarin, 2,343 (45.0%) patients were treated with NOAC, and 2,002 (38.5%) patients did not take any anticoagulants. After the diagnosis of AF, the incidence of ischemic stroke during follow-up was 199 (23.2%) in the warfarin group, 209 (8.9%) in the NOAC group, and 63 (3.1%) in the no-anticoagulation group. Intracranial hemorrhage occurred in 70 patients (8.2%) among the warfarin group, 61 (2.6%) of the NOAC group, and 76 (3.8%) of the no-anticoagulation group. Gastrointestinal bleeding occurred in 69 patients (8.0%) in the warfarin group, 78 patients (3.3%) in the NOAC group, and 113 patients (5.6%) in the no-anticoagulation group. The occurrence rate of relevant clinical outcome was statistically the highest in the warfarin group. Time dependent cox regression analysis was performed to investigate the risk of NOAC on clinical outcome compared to warfarin. NOAC's hazard ratio (HR) of ischemic stroke was 0.387 (95% CI 0.273-0.549, p<0.0001), and HR of intracranial hemorrhage was 0.430 (95% CI 0.236-0.785, p=0.006).

Conclusions: In this CDW based study, the benefit of NOAC was proved similarly to the previous

claim data studies. Based on the result of our study, more aggressive use of NOAC is recommended for patients with AF.

Multiple antithrombotic therapy in ischemic stroke of two or more causes with atrial fibrillation based on linked data

<u>Tae Jung Kim</u>¹, Ji Sung Lee⁴, Jae Sun Yoon¹, Mi Sun Oh², Soo-Hyun Park⁵, Keun-Hwa Jung¹, Kyung-Ho Yu², Byung-Chul Lee², Byung-Woo Yoon³, Sang-Bae Ko¹

¹Neurology, Seoul National University Hospital, Seoul, Korea, Republic of
²Neurology, Hallym University Sacred Heart Hospital, Anyang, Korea, Republic of
³Neurology, Uijeongbu Eulji Medical Center, Uijeongbu, Korea, Republic of
⁴Clinical Epidemiology and Biostatistics, Asan Medical Center, Seoul, Korea, Republic of
⁵Neurology, Inha University Hospital, Incheon, Korea, Republic of

Purpose: Atrial fibrillation (AF) is a common cause of cardioembolic ischemic stroke. However, the optimal antithrombotic therapy for patients with ischemic stroke of multiple possible causes associated with AF remains unknown. Thus, this study aimed to evaluate the effect of multiple antithrombotic therapies on vascular and safety outcomes at 1 year after ischemic strokes of two or more possible causes with AF.

Methods: We linked the Clinical Research Center for Stroke Registry and the Health Insurance Review and Assessment Service data from January 2008 to December 2014 and identified 862 patients with ischemic stroke of two or more possible causes with AF. The included patients were categorized into three groups according to antithrombotic therapy at discharge after ischemic stroke: 1) antiplatelet agent, 2) anticoagulants, and 3) antiplatelet agent plus anticoagulants. The study outcomes were recurrent ischemic stroke, composite outcomes including ischemic stroke, myocardial infarction, intracerebral hemorrhage and death, and major bleeding (intracerebral hemorrhage and gastrointestinal bleeding) at 1 year. Inverse probability of treatment weighting (IPTW) was used to balance the three groups using propensity scores.

Results: Among 862 patients (mean age 72.6 years, men 58.4%), 169 (19.6%) were treated with antiplatelet agents, 405 (47.0%) were treated with anticoagulants, and 288 (33.4%) were treated with antiplatelet agents and anticoagulants. After applying IPTW, only anticoagulants had a significant beneficial effect on the 1-year composite outcome (hazard ratio [HR] 0.37 [95% confidence interval, CI, 0.23–0.60], P < 0.001) and death (HR 0.35 [95% CI, 0.19–0.63], P < 0.001) compared with the other therapies. Patients treated with a combination of antiplatelet agent and anticoagulants had an increased risk of major bleeding complications (HR, 5.27 [95% CI, 1.31–21.16], P = 0.019) compared with those treated with antiplatelet agents. However, there was no significant difference in the risk of 1-year recurrent stroke among the groups.

Conclusions: This study revealed that anticoagulant monotherapy was associated with lower risks of

composite outcome and all-cause death at 1 year following ischemic stroke in patients with ischemic stroke of multiple possible causes with AF. In addition, the combination of antiplatelet agent and anticoagulants resulted in a higher rate of major bleeding events. Therefore, multiple antithrombotic therapies may not be beneficial for outcomes of ischemic stroke owing to multiple possible causes associated with AF.

Endovascular reperfusion therapy beyond 24 hours in large vessel occlusion patients with neurologic deterioration

Dong Kun Lee¹, Min A Lee¹, Byung Wook Hwang¹, Chang Ju Lee¹, Ju Hye Kim¹, Sang Woo Ha², Seong Hwan Ahn¹

¹Neurology, Chosun University School of Medicine, Gwangju, Korea, Republic of ²Neurosurgery, Chosun University School of Medicine, Gwangju, Korea, Republic of

Purpose: In patients with acute ischemic stroke, mechanical reperfusion therapy is limited up to the last known normal time of 24 hours. Acute ischemic stroke patients with large vessel occlusion can become neurological deterioration beyond 24 hours after the last known normal time. Our study aimed to find out the safety and efficiency of reperfusion therapy in patients that had passed 24 hours after occurrence. Methods: From January 2019 to December 2020, we selected the patients who received the reperfusion therapy beyond 24 hours from the onset. The decision of endovascular treatment was based on these criteria; 1) the initial National Institute Health Stroke Scale (NIHSS) was below 6 without cortical signs, 2) neurological symptoms worsening with cortical signs, 3) Alberta Stroke Program Early CT Score (ASPECT) over 6 points, 4) large artery occlusion confirmed using CT angiography, and 5) enough salvageable tissues on CT perfusion. Onset time and small definitive lesions were not considered. For safety, cerebral hemorrhage was evaluated after 24±6 hours MR images. Treatment outcome was evaluated with modified Rankin scale (mRS) after 3 months. Good outcome was defined as mRS 0,1, and 2. **Results:** Of the 398 patients who received reperfusion therapy, 21 were selected. Mean age was 76.9 (±8.6) and female was 8 (38%). Middle cerebral artery occlusion was 11, internal carotid artery occlusion 8, basilar artery occlusion 2. Mean onset to puncture time was 62 hours 20 minutes (±42:09). Initial median NIHSS was 3 (range 0-6). After progression, median NIHSS was 8 (range 4-19). Initial median ASPECT Score was 9 (range 7-10). Etiology of stroke was large artery atherosclerosis in 19 patients. 13 patients received mechanical thrombectomy and 10 patients received additional balloon angioplasty and/or stenting. 6 patients received balloon angioplasty and stenting without thrombectomy. One patient received stenting only. One patient only received intra-arterial tirofiban. In 24 hours brain MR images, hemorrhagic infarction was 3 and subarachnoid hemorrhage was 3. There was no symptomatic parenchymal hematoma Good outcome was 15 patients (71.4%). The factors related with good outcome were younger age (p =0.002), stenting procedure (p=0.053), and carotid occlusion (p=0.075).

Conclusions: Our data showed that endovascular reperfusion therapy could be performed safely for selected patients with progressing stroke that exceed the last known normal time of 24 hours. Large vessel occlusion or atherosclerosis with minor symptom should be carefully monitored for rapid endovascular treatment.

Idarucizumab for end-vascular thrombectomy in acute ischemic stroke: A case report

Geun Yeong Kim¹, Hyungjong Park¹

¹Department of Neurology, Keimyung University, School of Medicine, Daegu, Korea, Republic of

Purpose: Direct oral anticoagulants (DOAC)s have been widely used for the prevention of ischemic stroke by non-valvular atrial fibrillation (NVAF). Despite the benefit in safety compared to vitamin K antagonist, measuring the DOAC activity has been challenging in emergency room.

Methods: Thus, thrombolysis and/or endovascular thrombectomy (EVT) with large vessel occlusion in the patients with recent DOAC administration should be cautious. According to the current guideline about EVT, recent DOAC administration has not been contraindicated to EVT. However, there may be the increased possibility for intracranial hemorrhage during EVT and hematoma in puncture site after EVT could be increased. Idarucizumab, a humanized monoclonal antibody fragment reverses the biological activity of dabigatran within a few minutes. Thus, idarucizumab could be administered for the EVT candidate for preventing the bleeding complication. We report the case of successful recanalization using EVT without bleeding complication with dabigatran reversal.

Results: A 75-year old female patient was visited in emergency room. Her main symptom was sudden onset aphasia that was developed about 5 hours ago. She had a history of NVAF and had been taking dabigatran 110mg bid. Initial National Institute of Health Stroke Scale score was 10. and On computed tomography angiogram showed occlusion of left middle cerebral artery. The last time for taking dabigatran was 1 hours before the symptom onset. The idaruzicumab 5g was administered before the initiation of EVT. After first-pass of stent retriever, mTICI 3 recanalization was noted. On follow-up computed tomography after EVT, no hemorrhage was noted. In addition, no hematoma or any other bleeding complication was observed. She was discharged with mild dysarthria

Conclusions: The idarucizumab, the antidote for dabigtran, could be feasible option for safety before EVT in patients with the history of recent administration of dabigatran.

A case with endovascular treatment failure associated with distal embolism in a patient of acute embolic tandem occlusion

Min Hwan Lee¹, Jungwoo Kim¹, Eunbuel Ko¹

¹Neurology, Seoul St. Mary's Hospital, Seoul, Korea, Republic of

Purpose: Endovascular thrombectomy(EVT) improves the prognosis of acute large vessel occlusive stroke; however, it cannot successfully reperfuse in about 30%. Tandem occlusion is a significant cause of these EVT failures. Recently, research suggested various EVT strategies for tandem occlusion with atherosclerotic proximal cervical disease. In contrast, studies are relatively lacking for tandem occlusion of proximal embolism, with high morbidity and mortality. We report a case of acute ischemic stroke with embolic tandem occlusion treated by EVT complicated with distal embolism resulting in a large hemispheric infarction.

Methods: A 77-year-old woman presented with right weakness and global aphasia 2 hours after onset. Initial NIHSS was 22, and ECG showed sinus rhythm. Multimodal CT imagings indicated left cervical carotid artery occlusion and tandem proximal M2 occlusion with a large penumbra area. Intravenous tPA was administrated, and subsequent endovascular treatment was planned. Left CCA angiography demonstrated distal CCA occlusion. Intermediate catheter with guidewire navigated to the occlusion site and passed smoothly to petrous ICA. Then angiography showed proximal M2 occlusive thrombus dissolved partially to migrate further distal.

For distal CCA occlusion, direct aspiration with Peumbua system at distal CCA removed plenty of thrombi, and subsequent stent retriever with continuous aspiration also extracted clot fragmentation. The following angiogram demonstrated CCA recanalization but showed occlusion at the carotid terminus, which was normal on initial angiography. Repeated aspiration and stent retriever thrombectomy cannot recanalize carotid terminus occlusion. The following day, Brain imaging showed large left-hemispheric infarction, and paroxysmal atrial fibrillation was noted. The family refused decompressive craniectomy, and the patient expired five days after the stroke.

Results: In this case, EVT with a direct aspiration first pass technique(ADAPT), and subsequent stent retriever with continuous aspiration with Penumbra system cannot prevent embolism to distal ICA. Generally, these techniques have a role in mitigating the risk of distal embolism. Thrombus fragmentation is inevitable during EVT, and subsequent distal embolism is one of the significant determinants of prognosis. Embolism from CCA thrombus can occlude carotid terminus with disruption of direct collaterals across the anterior communicating artery, resulting in huge cerebral infarction. In a case series, an

embolic protection device, introduced at petrous ICA during proximal CCA thrombectomy, captured thrombus effectively. The balloon-guided catheter is another option for preventing distal embolism. **Conclusions:** ADPAT and stent retriever with aspiration were incomplete to prevent distal embolization during EVT of acute tandem occlusion; therefore, various integrated strategies for preventing distal embolism should be considered.

A case of successful intracranial artery stenting in patient with dissection of right distal internal carotid artery

Yong Kwon Song¹, Jeong Yun Song¹, Seongheon Kim¹, Sung Hun Kim¹

¹Neurology, Kangwon National University Hospital, Chuncheon, Korea, Republic of

Purpose: Recent randomized clinical trials have shown the benefits of endovascular therapy in patients of acute ischemic stroke(AIS) caused by large vessel occlusion(LVO). Spontaneous intracranial artery dissection with a concomitant occlusion is considered as the main causes of acute ischemic stroke in young patients. However, the efficacy and safety of endovascular therapy in patients with intracranial artery dissection as the first choice of treatment are uncertain because of a high risk of arterial rupture. We herein report a case of successfully treated with intra-arterial thrombectomy and stenting in AIS patient with suspicious right distal internal carotid artery(ICA) and middle cerebral artery(MCA) dissection. Methods: A 21-year-old man with no underlying disease presented to the emergency department with transient loss of consciousness and fall down at the subway station 40 minutes ago. The initial neurologic examination demonstrated left facial palsy, left hemiparesis, left gaze palsy, dysarthria and sensory extinction to light touch with a NIHSS score of 16. On arrival, his blood pressure was 140/90mmHg and a serum glucose level was 97mg/dL. In magnetic resonance image(MRI) of the brain, diffusion restricted lesions in right basal ganglia, internal capsule and right temporal and insular cortex were seen. In addition, we could not observed the flow of ICA from proximal to distal in brain MRA image. The luminal irregularity of right proximal M1 was also seen. We planned for endovascular therapy because there was mismatch of symptom and brain images. First, mechanical thrombectomy for right ICA occlusion was tried and it was recanalized. However, tight stenosis in right distal ICA bifurcation remained and intra-arterial thrombolysis was done. After manual thrombectomy one more time and IA thrombolysis with injection of tirofiban, partial filling defect of right proximal MCA and distal ICA was still observed and intracranial artery dissection was suspected. We finally performed permanent stenting between the siphon of right ICA and distal M1.

Results: It was successfully done and he was discharged with a NIHSS score of 3.

Conclusions: Although endovascular therapy has become a standard treatment in AIS patients with LVO, its efficacy and safety in acute intracranial artery dissection as the first choice of treatment have been poorly studied. In our case, favorable clinical outcome of endovascular therapy has been shown in AIS patients with intracranial artery dissection. Further study is needed to evaluate the efficacy and safety of endovascular therapy in patients with intracranial artery dissection.

Sudden cardiac arrest after carotid artery stent insertion in a patient who experienced recent acute myocardial infarction

<u>Minkyung Kim</u>¹, Keon-Joo Lee¹, Jung Hoon Han¹, Han Jun Kim¹, Chi Kyung Kim¹, Kyungmi Oh¹

¹Neurology, Korea University Guro Hospital, Seoul, Korea, Republic of

Purpose: Sudden cardiac arrest is known to be a rare but devastating complication after carotid artery stenting (CAS). However, it is not well known about who is at risk of such condition and especially whether performing CAS is safe in those who experienced recent heart diseases such as acute myocardial infarction.

Methods: Here we report a patient who experienced sudden cardiac arrest after CAS which was done during the acute period of myocardial infarction.

Results: A 70-year-old male visited our emergency room with complaint of chest pain and dyspnea Electrocardiography showed ST elevation in lead V6 and ST depression in lead V1 to V4 along with elevated cardiac markers suggesting acute inferior and posterior wall myocardial infarction. Coronary angiography indicated proximal left circumflex artery occlusion and recanalization followed by stent insertion was immediately done. After the procedure, symptoms were relieved and cardiac enzymes were normalized. Two days later, dysarthria right facial palsy, right hemiparesis, and language disturbance suddenly developed. Diffusion weighted MRI showed multifocal acute infarctions predominantly in the left internal carotid artery territory. There was no major cerebral artery occlusion but a moderate degree stenosis with ulcerative atheromatous plaque in the left proximal carotid artery was shown in the conventional angiography. A week later, elective CAS was performed for the left internal carotid artery lesion. Although the patient was hemodynamically stable right after the procedure, sudden cardiac arrest occurred 4 hours after the procedure with no pulse detected on the ECG monitoring. Despite immediate cardiopulmonary resuscitation, the patient was unable to achieve the return of spontaneous circulation (ROSC) until 30 minutes and finally died of cardiac arrest.

Conclusions: Authors report a rare case of sudden cardiac arrest which occurred within few hours after CAS. As the patient experienced a recent ST-elevation myocardial infarction followed by acute cerebral infarction before CAS, clinicians should be aware of sudden cardiac arrest as a possible complication of CAS during the acute period of myocardial infarction.

Delayed rupture of an anterior communicating artery pseudoaneurysm caused by distal occlusion thrombectomy using a stent retriever: Case report and mechanism of injury

Dong-Hyun Shim¹, Youngrok Do¹, Jin Kuk Do¹, Sung Won Youn²

¹Neurology, Daegu Catholic University Medical Center, Daegu, Korea, Republic of ²Radiology, Daegu Catholic University Medical Center, Daegu, Korea, Republic of

Purpose: We report a case of delayed rupture of an anterior communicating artery (Acom) pseudoaneurysm following mechanical thrombectomy (MT) of a distal occlusion using a stent retriever. An elderly patient with right hemiparesis showed left proximal internal cerebral artery and middle cerebral artery occlusions. During MT, a fragmented thrombus moved to the anterior cerebral artery (ACA). A stent retriever was deployed to the occluded ACA, and the Acom and proximal ACA segment were significantly straightened. Additionally, we attempted a blind exchange mini-pinning (BEMP) technique, but a sub-arachnoid hemorrhage (SAH) occurred. Bleeding was almost entirely absorbed 9 days after the procedure, but the SAH recurred at 20 days, and CT angiography revealed a new pseudoaneurysm formation in the Acom. We suggest that the proposed mechanism of pseudoaneurysm formation was likely due to the dislocation and avulsion of the Acom perforators when the ipsilateral ACA was pushed and pulled during MT.



M2 stenting in patients with perfusion defect on computed tomography without diffusion restriction in magnetic resonance imaging

Dongwhane Lee¹, Jong-Moo Park¹, Min Kyoung Kang¹, Joong Goo Kim²

¹Neurology, Uijeongbu Eulji Medical Center, Eulji University School of Medicine, Uijeongbu, Korea, Republic of

²Neurology, Jeju National University Hospital, Jeju National University School of Medicine, Jeju, Korea, Republic of

Purpose: In intracranial arterial stenosis (ICAS), balloon angioplasty and stenting are often performed when there are limitations as medical treatment. We report a case where balloon angioplasty and stenting were performed in the ischemic stroke patient with a previous ICAS-induced cerebral infarction due to a perfusion defect on computed tomography (CT) without diffusion restriction in diffusion weighted image (DWI) of magnetic resonance imaging.

Methods: A 75-year-old female patient visited with right hemiparesis. 10 months before this admission, she had an ischemic stroke due to occlusion of the M2 segment of the left middle cerebral artery (MCA), but was treated medically as a minor symptom (NIHSS 4). The occluded M2 segment was recanalized, but severe stenosis remained and she discharged with triflusal and apixban.

On examination strength in her right arm and leg had decreased to 4/5, however, she had no aphasia CT perfusion and angiography revealed more aggravated stenosis of M2 segment of left MCA and perfusion defect. Nonetheless, DWI of the brain demonstrated no acute infarction in the territory of left MCA. Right hemiparesis continued, but repeat DWI revealed no acute abnormality.

Results: In order to improve perfusion status, revascularization was performed after 5 days of use of dual antiplatelet agents. A 8F Neuron Max guiding catheter and a 5F SOFIA intermediate catheter were advanced to M1 segment of left middle cerebral artery with co-axial technique. Balloon Angioplasty was performed twice using Gateway balloon dilatation catheter, and the Enterprise Stent was deployed. Instant thrombosis was not observed in delayed angiography and completion angiogram demonstrated improvement of M2 flow with mild stenosis. After the procedure, the patient's strength improved, but follow up CT of the brain showed small amount of subarachnoid hemorrhage at left sylvian fissure. Hemorrhage did not increase in the repeat CT, the patient was discharged. After a month, the patented flow was observed at CT angiography, and the patient was rehabilitated without neurologic deterioration. **Conclusions:** Although there was no acute cerebral infarction in the continuous DWI, we performed Balloon angioplasty and stenting for reasons for the patient's paralysis lasted. In patients with intractable ICAS, if the perfusion defect persists without DWI abnormality, intracranial arterial stenting could be considered.

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03163 서울시 종로구 인사동길 12, 1012호(인사동, 대일빌딩) 전화: (050) 2277-1919 / 팩스: (050) 2277-2929 E-mail: stroke@stroke.or.kr Homepage: http://www.stroke.or.kr

인쇄처 | 5 대하 고서출판 진기획

04550 서울시 중구 충무로 49-2(을지로 3가) 동주빌딩 5층 전화: (02)2271-6789(대) / 팩스: (02)2277-5194 E-mail: jin@ijpnc.com / Homepage: www.ijpnc.co.kr