

2022 뇌졸중 재개통 심포지엄 및 대한뇌혈관내치료의학회 춘계보수교육

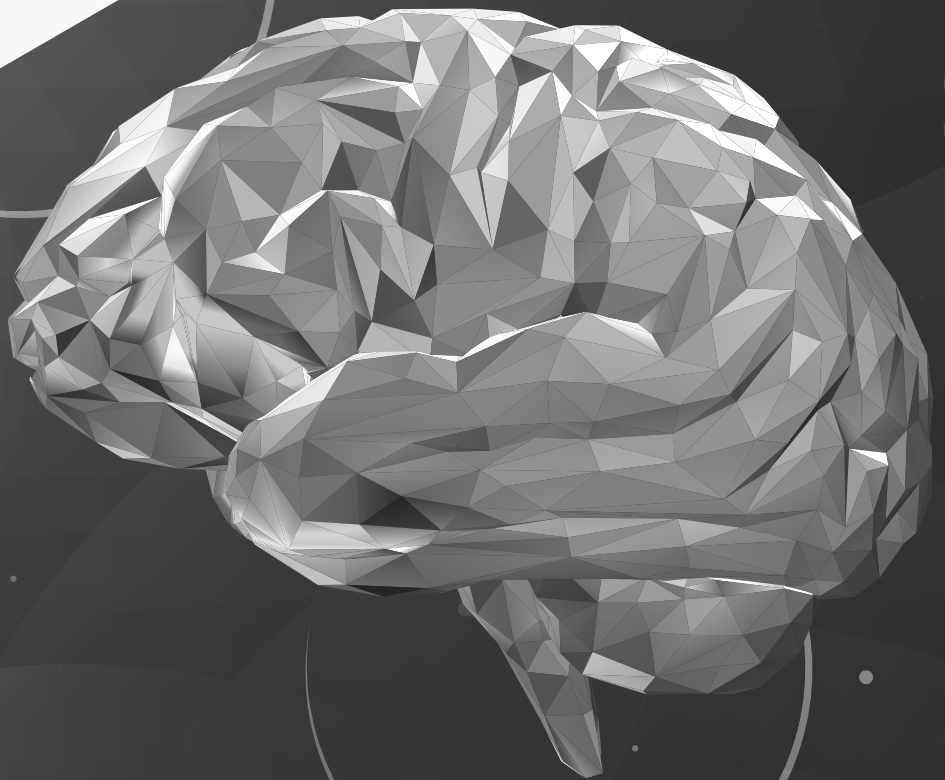
일시 | 2022년 2월 26일(토)

장소 | 판교 차바이오컴플렉스 지하1층 국제회의실

연수평점 | 5점

주최 | 대한뇌혈관내치료의학회

주관 | 대한신경외과학연구재단



존경하는 대한뇌혈관내치료의학회 회원 여러분!



대한뇌혈관내치료의학회는 회원들의 임상 역량 강화를 위해 항상 노력하고 있습니다.

이미 잘 알고 있는 것처럼 뇌혈관질환에 대한 혈관내 치료 분야는 그 어떤 분야보다도 발전 속도가 빠르며, 그 중에서도 급성기 뇌졸중 치료 분야는 임상 지침, 치료 적응증, 치료 방법 및 기구의 변화 속도가 더욱 빠른 분야입니다.

ARCS (Arterial Recanalization in Cerebral Stroke) symposium은 대한뇌혈관내치료의학회가 주관하는 춘계 보수교육입니다

이번 “ARCS 2022”에서는 특히 우리 나라 등 동양에서 유병률이 높은 두개강내 협착과 관련된 부분, 최신 임상 정보와 관련된 부분 그리고, 우리가 지향해야 하는 이상적 뇌혈관 질환 센터 등에 대한 심도 있는 발표와 토론이 예정되어 있습니다.

2022년 현 시점에서의 소망은 마스크가 없는 전면 대면보수교육 이었습니다. 하지만 현재의 상황은 우리의 소망과는 아직도 거리가 있는 듯 합니다. 그럼에도 불구하고 회원 여러분들의 적극적인 참여를 부탁드립니다.

마지막으로 “ARCS 2022”를 준비해 주신 김영우 총무 이사, 권현조 학술 이사, 신승훈 급성뇌경색치료연구회 회장, 강동훈 급성뇌경색치료연구회 학술 이사께 감사의 말씀을 전합니다.

2022년 2월 마지막 토요일 판교에서 뵈 수 있기를 기원합니다.

2022.2

대한뇌혈관내치료의학회 회장 장 철 훈

2022~2023 대한뇌혈관내치료의학회 임원진

상임 운영 위원회

직 위	성 명	소 속
회장	장 철 훈	영남대학교병원
부회장	권 순 찬	울산대학교병원
총무	김 영 우	가톨릭대학교 의정부성모병원
학술	권 현 조	충남대학교병원
정책	신 승 훈	차의과대학교 분당차병원
	박 석 규	순천향대학교 서울병원
	권 오 기	분당서울대학교병원
재무	고 준 경	부산대학교병원
수련교육	김 태 곤	차의과대학교 분당차병원
	박 중 철	울산대학교 서울아산병원
간행	하 성 곤	고려대학교 안산병원
보험	박 석 규	순천향대학교 서울병원
	정 준 호	연세대학교 세브란스병원
대외협력	김 성 림	가톨릭대학교 부천성모병원
	강 동 훈	경북대학교병원
	김 범 태	순천향대학교 부천병원
국제교류	정 진 영	연세에스병원
법제윤리	이 종 영	한림대학교 강동성심병원
홍보	신 희 섭	강동경희대학교병원
전산정보	신 동 성	순천향대학교 부천병원
	남 택 균	중앙대학교병원
회원관리	장 인 복	한림대학교 평촌성심병원
진료지침	최 재 형	동아대학교병원
연보·학회사편찬	임 용 철	아주대학교병원
진료심의	조 준 성	단국대병원
별정직 이사 (학술지편집)	김 대 원	원광대학교병원
별정직 이사 (인증관리)	성 재 훈	가톨릭대학교 성빈센트병원
	오 인 호	중앙보훈병원
별정직 이사 (다기관임상)	황 교 준	한림대학교 한강성심병원
여의사회	심 숙 영	인제대학교 일산백병원
전문병원	김 문 철	에스포항병원
	허 준	명지성모병원
	전 우 열	대구굿모닝병원
	김 희 섭	청주효성병원
특별이사 (의학회)	윤 석 만	순천향대학교 천안병원
특별이사(신의료기술/장비/재료)	강 현 승	서울대병원
특별이사 (해외학회 유치)	신 용 삼	가톨릭대학교 서울성모병원

2022~2023 대한뇌혈관내치료의학회 임원진

직 위	성 명	소 속
특별이사 (CME)	고 준 석	강동경희대학교병원
광주/전라지회	김 대 원	원광대학교병원
대구/경북지회	이 혁 기	안동병원
대전/충청지회	정 승 영	을지대학교 대전병원
부산/울산/경남지회	고 준 경	부산대학교병원
인천지회	유 찬 중	가천대학교 길병원
감사	장 경 술	연세에스병원
	윤 원 기	고려대학교 구로병원
회장 간사	하 성 곤	고려대학교 안산병원
총무 간사	김 훈	가톨릭대학교 부천성모병원
학술 간사	오 재 상	순천향대학교 천안병원

명예회장

직 위	성 명	소 속
명예회장	백 민 우	인봉의료재단 뉴고려병원
	권 도 훈	울산대학교 서울아산병원

전임회장단

직 위	성 명	소 속
초대, 제2대	백 민 우	인봉의료재단 뉴고려병원
제3대	김 영 준	단국대학교병원
제4, 5대	권 도 훈	울산대학교 서울아산병원
제6대	안성기(작고)	(전) 한림대학교 성심병원
제7대	신 용 삼	가톨릭대학교 서울성모병원
제8대	권 오 기	분당서울대학교병원
제9대	김 범 태	순천향대학교 부천병원
제10대	성 재 훈	가톨릭대학교 성빈센트병원
제11대	고 준 석	강동경희대학교병원
제12대	윤 석 만	순천향대학교 천안병원

초청연자



백 병 현

전남대학교병원 영상의학과

[Education and Professional Experience]

2007	전남대학교 의과대학 졸업
2010	전남대학교 의과대학 의학과 석사
2019	전남대학교 의과대학 의학과 박사
2015-2016	전남대학교병원 영상의학과 전임의
2016-2020	전남대학교병원 영상의학과 임상교수
2020-	전남대학교병원 영상의학과 기금부교수

초청연자



김치경

고려대 구로병원 신경과 부교수

[Education]

1999.03-2005.02 서울대학교 의과대학 의학사

2009.03-2013.02 서울대학교 의과대학 뇌신경과학 석사 (지도교수: 윤병우)

2013.03-2016.02 서울대학교 의과대학 뇌신경과학 박사 (지도교수: 윤병우)

Thesis: Effects of fimasartan, one of angiotensin receptor blockers, on tissue damages and inflammation after focal ischemia in rat brain

[수련 경력]

2005.03-2006.02 서울대학교병원 인턴

2006.02-2010.02 서울대학교병원 신경과 레지던트

2013.05-2015.04 서울대학교병원 신경과 뇌졸중 및 신경중환자의학 임상강사

2015.05-2016.02 서울대학교병원 의생명연구원 뇌혈관신경과학 연구강사

2015.08-2016.02 캘거리대학교 풋힐병원 연구전임의 (지도교수: Andrew Demchuk, Bijoy Menon)

[경력]

2010.04-2013.04 공중보건 의사 (보건복지부 정신건강정책과 / 중앙정신보건사업지원단)

2016.03-2018.08 임상조교수 (고려대학교 구로병원 신경과)

2018.09-2020.02 조교수 (고려대학교 의과대학 / 고려대학교 구로병원 신경과)

2020.03-현재 CTO (젠하임바이오텍)

2020.03-현재 부교수 (고려대학교 의과대학 / 고려대학교 구로병원 신경과)

초청연자



문 성 우

고려대부속 안산병원 응급의학과

[Education]

- 1989-1996 고려대학교 의과대학 의학사
- 2001-2003 고려대학교 의과대학원 의학석사(응급의학)
- 2005-2008 고려대학교 의과대학원 의학박사(응급의학)

[Professional Experience]

- 2006-2009 고려대학교 의료원 응급의학 임상조교수
- 2009-2016 고려대학교 의과대학 응급의학 조교수, 부교수
- 2014-2019 고려대 안산병원 응급의학과 과장
- 2012-2013 Visiting Scholar, Arizona Department of Health Services, USA
- 2014-2018 안산소방서 응급의학 지도의사
- 2014-2018 소방청 중앙구급지도협의회 위원
- 2014-2018 경기도 응급의료협의회 위원
- 2014-2018 국립중앙의료원 경기응급의료지원센터 센터장
- 2014-2017 안산시 응급의료협의회 위원
- 2015-2018 경기도 응급의료지원단 단장
- 2015-2019 질병관리본부 국가심장정지조사, 감시 자문위원회 위원
- 2015-2019 경기도 재난안전본부 경기구급품질향상지원단 부위원장
- 2016-현재 고려대학교 의과대학 응급의학 교수
- 2018-2020 질병관리본부 중증외상 생존조사 자문위원회 위원
- 2019-2021 중앙응급의료센터 응급의료체계 센터장
- 2021-현재 고려대 안산병원 홍보실장

[Membership]

- 2005-현재 대한응급의학회 응급의학 정회원
- 2007-현재 대한임상독성학회 독성학 정회원
- 2008-2012 대한응급의학회 고시위원회 고시위원
- 2009-현재 대한응급의료지도의사협의회 응급의학 정회원
- 2017-2018 대한응급의료지도의사협의회 응급의학 교육이사
- 2019-2019 대한응급의료지도의사협의회 응급의학 정책이사



박 희 권

인하대병원 신경과 부교수

[Education]

1. Ph.D. (2007-2011.2.)
Program in Neuroscience, Seoul National University, College of Medicine, Seoul, Republic of Korea
2. M.S. (2002-4)
Department of Neurology, Seoul National University, College of Medicine, Seoul, Republic of Korea
3. M.D. (1991-7) #66684 (1999.3)
Seoul National University, College of Medicine, Seoul, Republic of Korea.

[Professional Experience]

1. Associate Professor (2015.9.-present)
- Department of Neurology, Inha University Hospital, Incheon, Republic of Korea
2. Instructor (2009-2010.4.)
- Department of Neurology, Kangwon National University Hospital, Chuncheon, Kangwon-do, Republic of Korea
3. Research Associate and Clinical Fellow (2007-9)
- Stroke & Stem Cell Laboratory, Clinical Research Institute, Neuroscience Research Institute, SNUMRC, Seoul National University, Seoul, Republic of Korea
- Department of Neurology, Seoul National University Hospital, Seoul, Republic of Korea
4. Public Health Doctor / Neurology Consultant (2004-7)
- Department of Neurology, Bokok National Hospital, Kyongsangnam-do, Republic of Korea
5. Neurology Residency (2000-2004) (2004.3)
- Department of Neurology, Seoul National University Hospital, Seoul, Republic of Korea

[Research Interest]

1. Intervention related to ischemic stroke
2. Stroke Prevention and Etiology
3. Stroke Center (stroke Unit) Policy
3. Identification of Adult Stem Cells and Applications to Neurological Therapeutics
4. Autophagy and neuroprotection

2022 뇌졸중 재개통 심포지엄 및 대한뇌혈관내치료의학회 춘계보수교육



일시 | 2022년 2월 26일(토)

장소 | 차바이오텍플렉스 지하1층 국제회의실

PROGRAM

09:30-10:10	Registration	
10:10-10:30	Opening remark	장철훈 (대한뇌혈관내치료의학회 회장)
	Congratulatory address	백민우 (대한뇌혈관내치료의학회 초대회장)
	Course introduction	권현조 (대한뇌혈관내치료의학회 학술이사) 강동훈 (급성뇌경색치료연구회 학술이사)
10:30-11:50	Session I. Intracranial atherosclerosis and stroke	좌장: 유승훈 (울산대), 이병희 (목포한국병원)
10:30-10:50	Radiologist's perspective	백병현 (전남대 영상의학과) 13
10:50-11:10	Neurologist's perspective	김치경 (고려대 신경과) 22
11:10-11:30	Endovascular surgeon's perspective	오재상 (순천향대) 32
11:30-11:50	Microvascular surgeon's perspective	주성필 (전남대) 33
11:50-13:00	Lunch	
13:00-14:00	Session II. 뇌혈관질환정책 - 뇌혈관질환 센터, 어느 방향으로 가야 하는가?	좌장: 김범태 (순천향대), 장철훈 (영남대)
13:00-13:20	응급의료전달 체계 현황과 개선방향	문성우 (고려대 응급의학과) 41
13:20-13:40	국내 뇌졸중센터의 현황과 전망	박희권 (인하대 신경과) 46
13:40-14:00	국내 뇌혈관질환센터의 현재와 방향	신승훈 (차의과학대) 53
14:00-15:20	Session III. Review of the latest evidences (1) - The updates	좌장: 윤석만 (순천향대), 권순찬 (울산대)
14:00-14:20	New targets of EVT: TIMI, TICI, mTICI, and eTICI	김명진 (가천대) 57
14:20-14:40	Update of EVT techniques: CAT vs SRT vs combination	손원수 (경북대) 62
14:40-15:00	Update of recent EVT guidelines	김소연 (가톨릭관동대) 63
15:00-15:20	EVT for posterior circulations stroke	김영수 (에스포항병원) 67
15:20-15:40	Coffee break	
15:40-17:00	Session IV. Review of the latest evidences (2) - The debates	좌장: 성재훈 (가톨릭대), 고준석 (경희대)
15:40-16:00	EVT for large infarct core	심유식 (인하대) 73
16:00-16:20	EVT for clinically mild stroke with LVO	김창현 (계명대) 75
16:20-16:40	Patients presented beyond 24 hrs	이종영 (한림대) 81
16:40-17:00	Direct EVT without IV-rtPA	김성태 (인제대) 85
17:00	Closing Remark	신승훈 (급성뇌경색치료연구회 회장)

2022
뇌졸중 재개통 심포지엄 및
대한뇌혈관내치료의학회
춘계보수교육

Session I

Intracranial atherosclerosis and stroke

좌장: 유승훈 (울산대), 이병희 (목포한국병원)

Radiologist's perspective

Neurologist's perspective

Endovascular surgeon's perspective

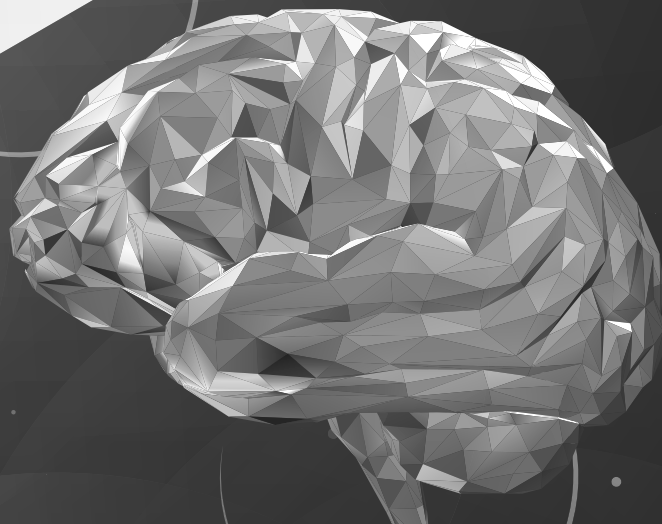
Microvascular surgeon's perspective

백병현 (전남대 영상의학과)

김치경 (고려대 신경과)

오재상 (순천향대)

주성필 (전남대)



Radiologist's perspective

백 병 현

전남대 영상의학과

Intracranial atherosclerosis and Stroke; Radiologist perspective

전남대학교병원 영상의학과
백병현

Intracranial atherosclerotic stenosis (ICAS)

- Results of endovascular therapy for ICAS-related acute stroke
 - ✓ Failure and reocclusion are more frequently seen than embolic occlusion
 - ✓ Rescue treatment is often required
- Incidence of severe ICAS: 1.52-30.3%
Kang DH, Yoon W. *KJR*. 2018
- It is very important to differentiate ICAS-O from Emb-O before starting the procedure

- Diagnostic considerations for ICAS-LVO during EVT
 - ✓ Predictive CT and MR imaging findings for underlying ICAS
 - ✓ Conventional angiography before and during EVT

Imaging predictors for ICAS-related LAO

- CT
 - Negative hyperdense artery sign
- GRE or SWI
 - Negative susceptibility vessel sign
- CT angiography
 - Truncal type occlusion
- Diffusion weighted image (DWI)
 - Borderzone infarction
 - Small core (Low ASPECTS)
 - Isolated basal ganglia infarction
 - Deep brain infarction

Negative hyperdense artery sign

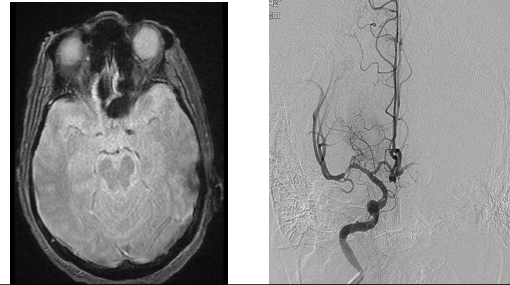
- Hyperdense MCA sign: cardioembolism
- Negative HMCAS is predictive of in-situ thrombotic occlusion due to underlying ICAS
 - Underlying severe MCA stenosis was more frequently observed in patients with a negative HMCAS (25.5 vs 3.4%, $P < 0.001$)
 - Negative HMCAS had a high sensitivity (85.7%) and a negative predictive value (96.6%)



Kim SK et al. J Neurol. 2017

Negative susceptibility vessel sign (NSVS)

- NSVS on gradient-echo image is associated with a smaller clot burden or a fibrin-dominant clot



Negative Susceptibility Vessel Sign and Underlying Intracranial Atherosclerotic Stenosis in Acute Middle Cerebral Artery Occlusion

S.K. Kim, W. Yoon, T.W. Heo, M.S. Park, and H.K. Kang

ABSTRACT

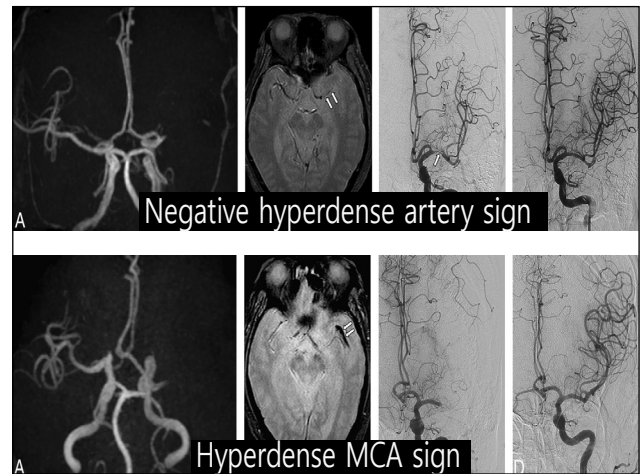
BACKGROUND AND PURPOSE: The role of MR imaging in predicting underlying intracranial atherosclerotic stenosis before endovascular stroke therapy has not been studied. Our aim was to determine the diagnostic value of the negative susceptibility vessel sign on T2*-weighted gradient-echo MR imaging for predicting underlying intracranial atherosclerotic stenosis in patients with acute MCA occlusion.

MATERIALS AND METHODS: Ninety-one consecutive patients with acute stroke because of MCA occlusion underwent gradient-echo MR imaging and MRA before endovascular therapy. The negative susceptibility vessel sign was defined as an absence of a hypointense signal change within the occluded MCA on gradient-echo imaging. Underlying intracranial atherosclerotic stenosis was determined by conventional angiography. The sensitivity, specificity, predictive values, and accuracy of the negative susceptibility vessel sign for predicting the presence of underlying intracranial atherosclerotic stenosis were assessed.

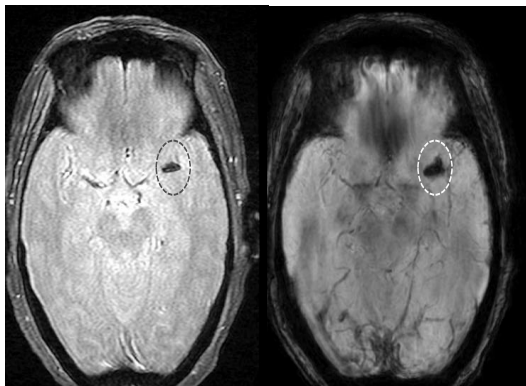
RESULTS: The negative susceptibility vessel sign was identified in 42 (46.1%) of 91 patients, and 18 (19.8%) patients had an underlying intracranial atherosclerotic stenosis responsible for acute ischemic symptoms. The negative susceptibility vessel sign was more frequently observed in patients with intracranial atherosclerotic stenosis than in those without it (100% versus 32.9%, $P < .001$). In the prediction of an underlying intracranial atherosclerotic stenosis, the negative susceptibility vessel sign had 100% sensitivity, 67.1% specificity, 42.9% positive predictive value, 100% negative predictive value, and an accuracy of 73.6%.

CONCLUSIONS: The negative susceptibility vessel sign on gradient-echo MR imaging is a sensitive marker with a high negative predictive value for the presence of an underlying intracranial atherosclerotic stenosis in patients with acute ischemic stroke because of MCA occlusion. The susceptibility vessel sign can be used in decision-making when performing subsequent endovascular revascularization therapy in patients with acute MCA occlusions.

Kim SK et al. AJNR. 2015



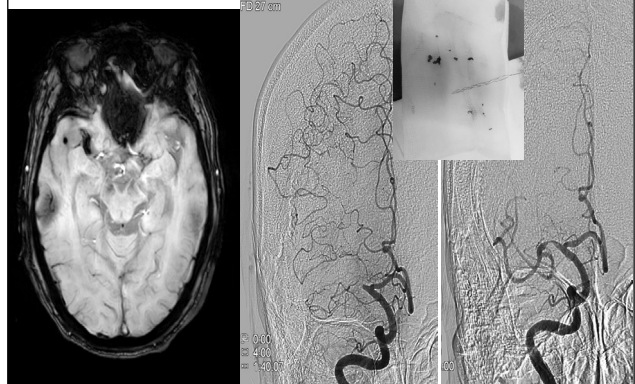
85/F, same patient



GRE

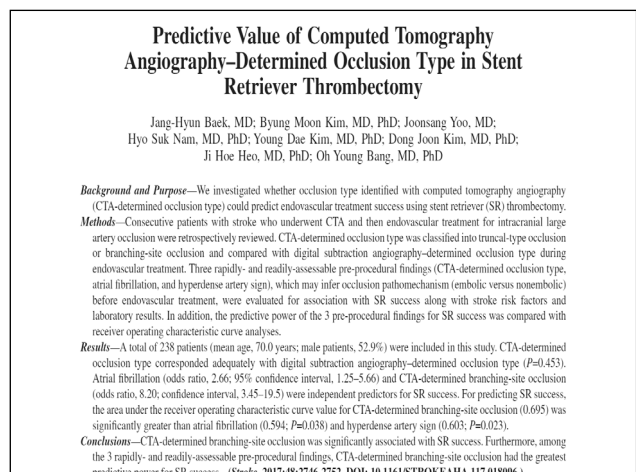
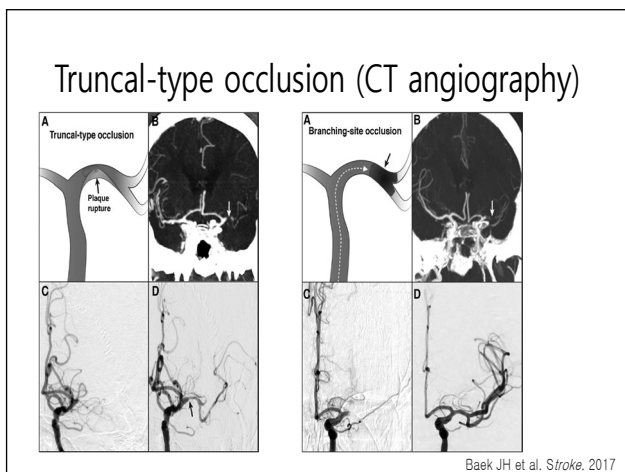
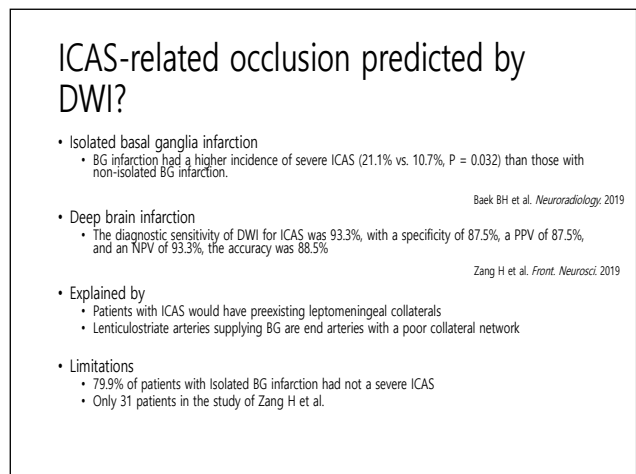
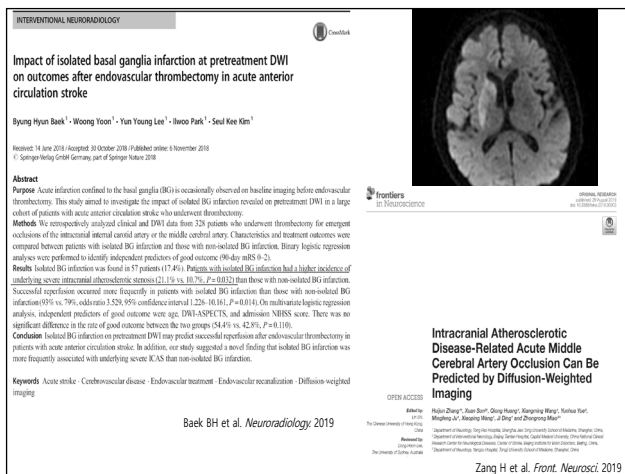
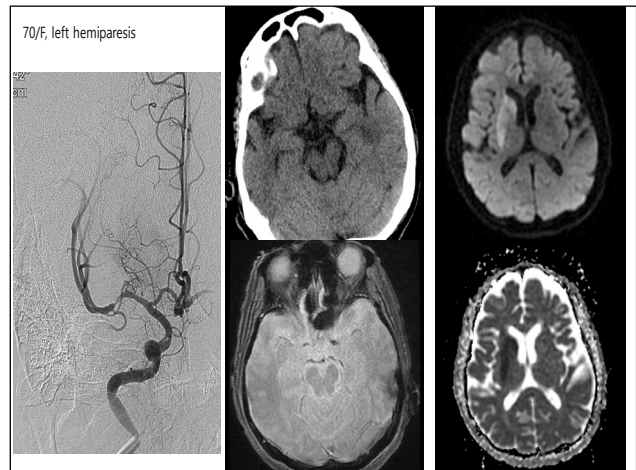
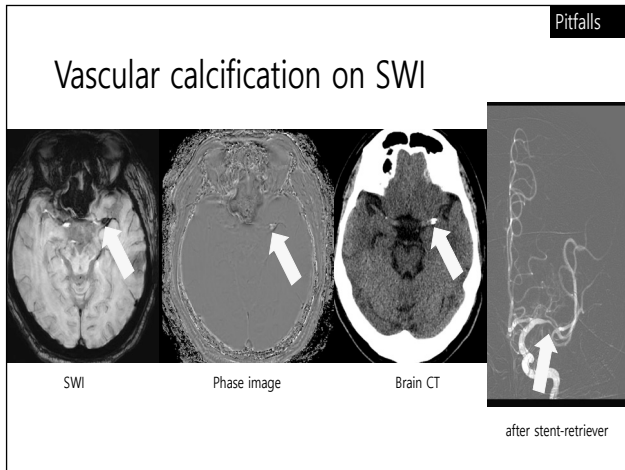
SWI

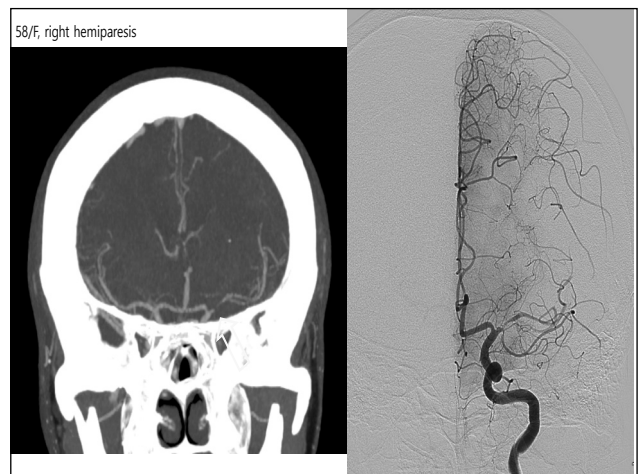
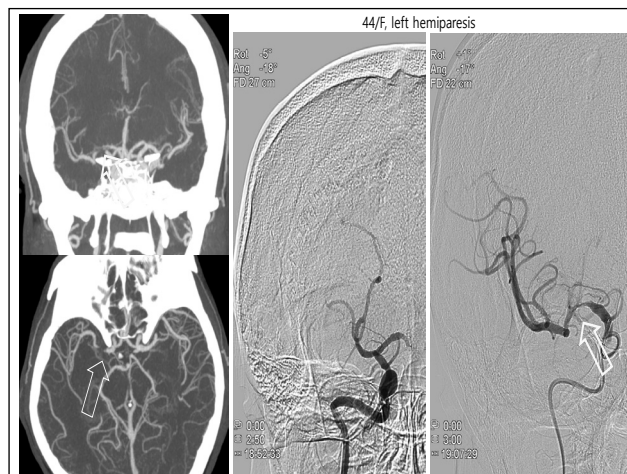
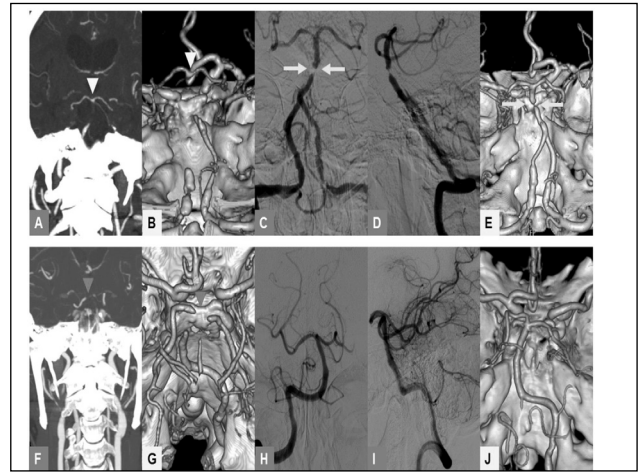
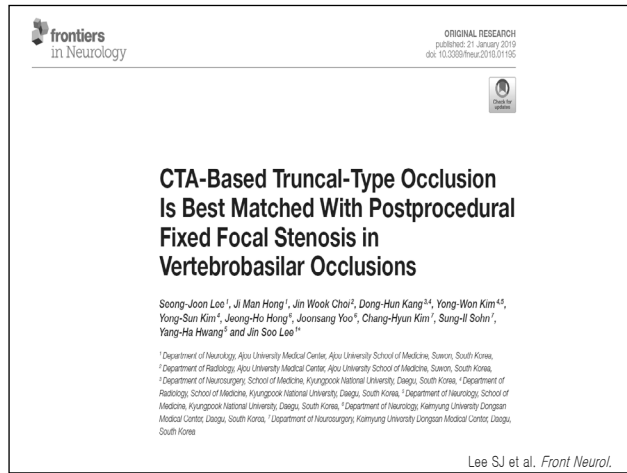
70/M, no embolic source



SWI

Pitfalls





Diagnosis of ICAS related occlusion

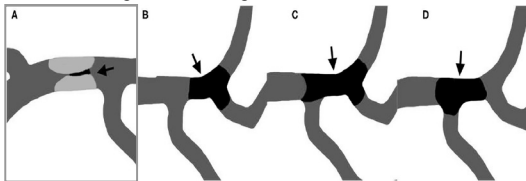
- Based on angiographic findings
- ❖ Severe underlying stenosis (>70%) ICAS of the target artery on diagnostic angiography or after mechanical thrombectomy
Yoon W et al. *Neurosurgery*. 2015
- ❖ Fixed stenosis $\geq 70\%$
plus, less-degree of stenosis or $\geq 50\%$
; either flow impairment or reocclusion tendency after sufficient treatment with stent retrievers
- ❖ Truncal type occlusion

Conventional angiography

- Jet-like Appearance
- Intracranial non-occlusive intraluminal thrombus
- Microcatheter first-pass effect
- Truncal type occlusion
- Instant reocclusion following thrombectomy

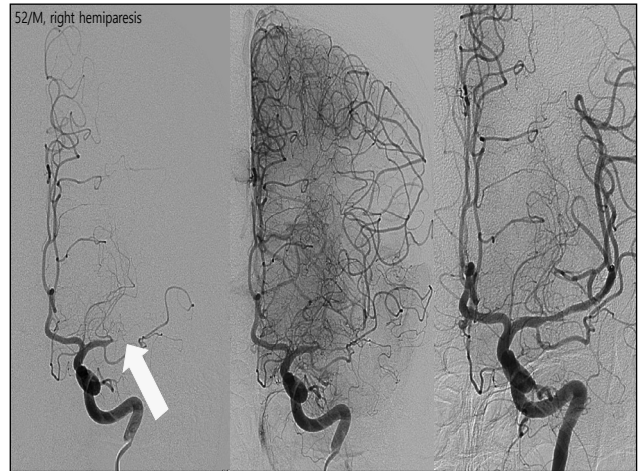
Jet-like Appearance

- Definition: Pencil tip-like or line-like contrast filling on the occlusion edge on DSA image

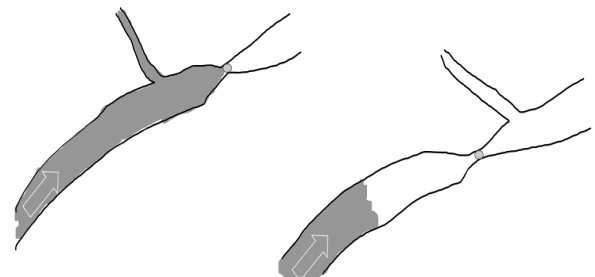


- Incidence of Jet like appearance: 20.7%
- ICAS-O rate was higher in the jet-like appearance group (82.9 vs. 8.5%, $p < 0.001$)

Jin X et al. *Front. Neurol.* 2020



Jet-like Appearance; Depending on a large branch take-off



Intracranial non-occlusive intraluminal thrombus (iNOT)

- Definite evidence of iNOT was the presence of contrast around the intravascular thrombus on pretreatment DSA
- Incidence of iNOT: 8.1% in patients with LVO who underwent EVT
- There were no differences between the two groups regarding successful reperfusion, post-procedural re-occlusion, 3 months functional outcome

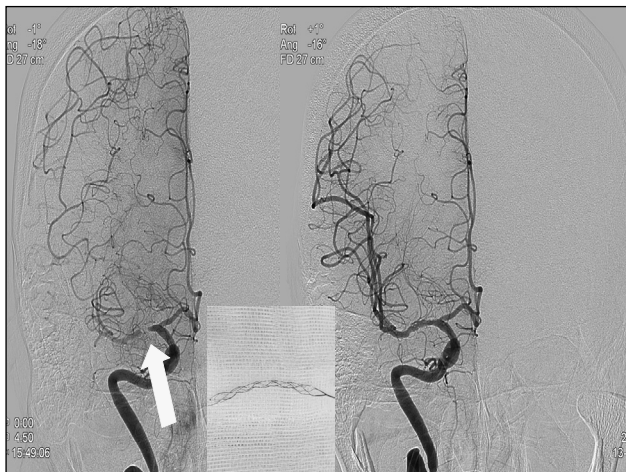
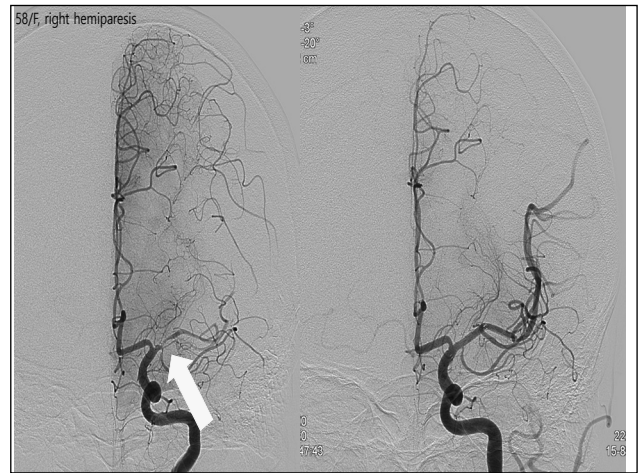
Jang SH et al. *J Neurointerv Surg.* 2021 [e-pub]

	iNOT (-) (n=502)	iNOT (+) (n=44)	P value
Age (years)	70.0 (61.0-77.0)	61.5 (53.0-71.5)	<0.001
Sex (male) (n (%))	262 (52.2)	27 (61.4)	0.312
NHRS at baseline	17.0 (13.0-21.0)	13.0 (8.5-19.0)	<0.001
Vascular risk factors (n (%))			
Hypertension	316 (62.9)	20 (45.5)	0.034
Diabetes mellitus	113 (22.5)	15 (34.1)	0.129
Hyperlipidemia	149 (29.7)	10 (22.7)	0.423
Atrial fibrillation	278 (55.4)	15 (34.1)	0.011
Coronary artery disease	62 (12.4)	1 (2.3)	0.078
Previous TIA or stroke	94 (18.7)	4 (9.1)	0.164
Smoking	111 (22.1)	14 (31.8)	0.200
Prior antiplatelet	146 (29.1)	4 (9.1)	0.044
Prior anticoagulant	73 (14.5)	5 (11.4)	0.724
Procedure related time			
Onset to puncture time (min)	246.0 (170.0-388.0)	306.5 (247.0-445.0)	0.019
Onset to recanalization time (min)	310.0 (233.0-407.0)	380.5 (290.0-509.0)	0.023
Puncture to recanalization time (min)	59.5 (40.0-85.0)	68.0 (44.0-98.5)	0.164
Imaging analysis			
Occlusion site (n (%))			0.001
ICA-T	198 (39.4)	5 (11.4)	
MCA M1	258 (51.4)	34 (77.3)	
MCA M2	46 (9.2)	5 (11.4)	
Etiology of LVO (n (%))			
Embolic occlusion	419 (83.5)	23 (52.3)	<0.001
ICAS related occlusion	82 (16.5)	21 (47.7)	

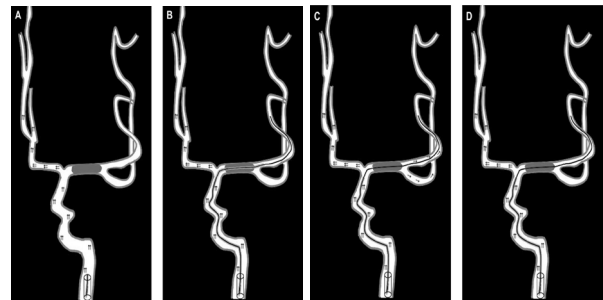
How to show iNOT in ICAS related occlusion?

- aggregation of platelets on a ruptured plaque
- plaque occupying vessel lumen
- impaired flow, but contrast could pass through the remaining vessel lumen in DSA

- the presence of iNOT was significantly associated with ICAS related LVO (adjusted OR 3.04; 95% CI 1.33 to 6.90; $p=0.007$)

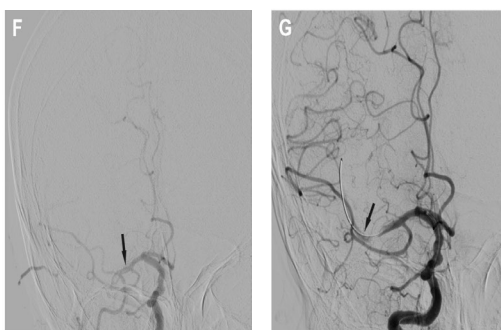


Microcatheter First-Pass Effect



Yi TY, et al. *Neurosurgery*. 2019

Microcatheter First-Pass Effect



Microcatheter First-Pass Effect

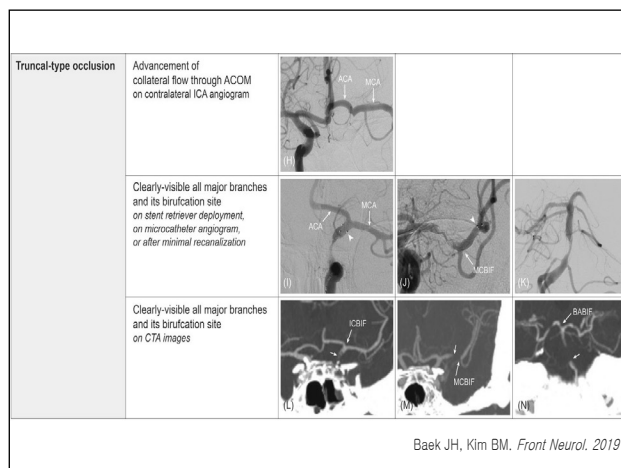
- The microcatheter first-pass effect was observed in 25 (41.0%) of the 61 study patients.
- Association between the microcatheter first-pass effect and ICAS (90.9% in the ICAS group vs 12.8% in the non-ICAS group, $P < .001$)
- May result from
 - ; fresh clot burden is low in a stenotic intracranial artery
 - ; the clot may easily break loose

Yi TY, et al. *Neurosurgery*. 2019

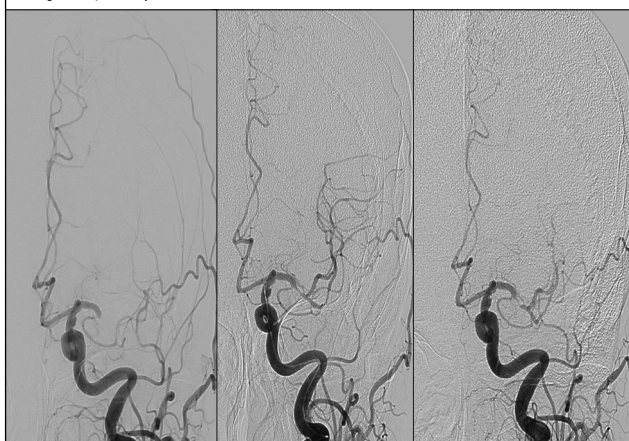
Truncal-type occlusion

- When all major branches and its bifurcation site was clearly visible beyond the occlusion segment
- Independent predictor of embolic source (-) and stentriever failure

Baek JH et al. *Neurology*. 2016
Baek JH, Kim BM. *Front Neurol*. 2019



77F right hemiparesis, dysarthria



Instant reocclusion after thrombectomy

- Incidence of reocclusion was significantly higher in the ICAS-related occlusion group compared with the embolism-related occlusion group (65% vs. 3.3%, $p < 0.001$)
- Low-dose intra-arterial tirofiban infusion
 - 85.7% of the reocclusion patients finally achieved a thrombolysis in cerebral infarction score 2/3 recanalization

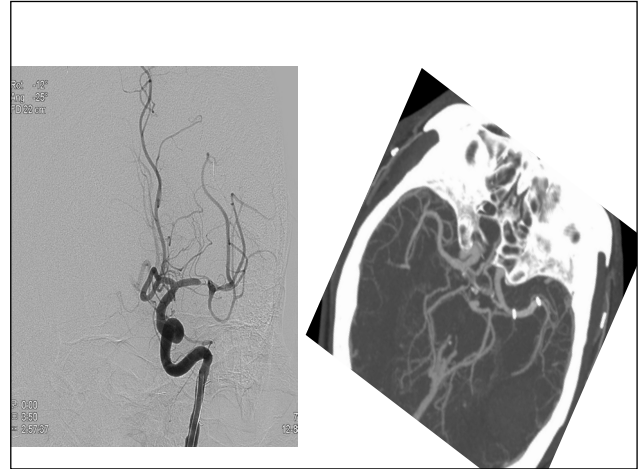
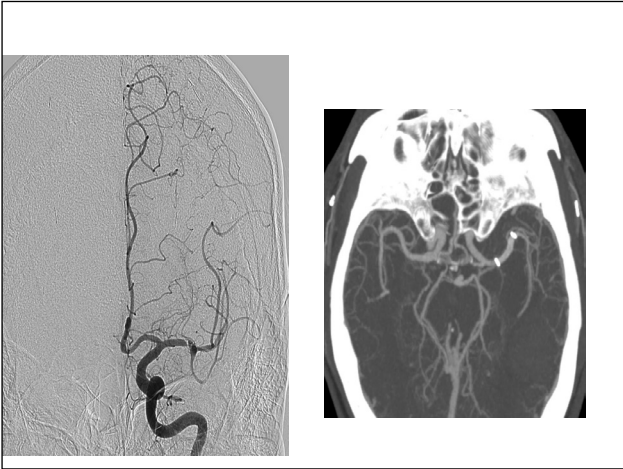
Kang DH et al. *Cerebrovasc Dis*. 2014

Appropriate angiographic view

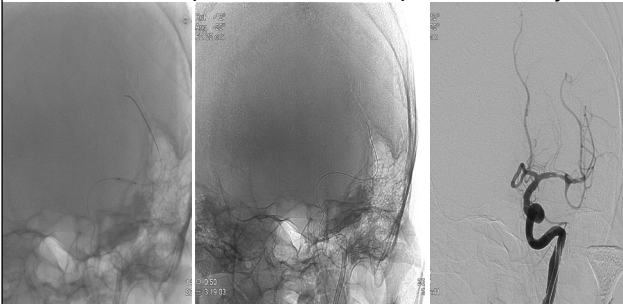
- Make working angle parallel to parent artery
- Avoid overlapping bony structure
- Orbital window

52/M, language disturbance





Under the parallel view to patent artery



Instant reocclusion?



RAO through orbit



Acute basilar artery occlusion

- ICAS-related O: more frequent in the posterior circulation
- Helpful findings for predicting underlying intracranial atherosclerotic stenosis
 - ✓Occlusion segment of the basilar artery: proximal
 - ✓Absence of bilateral thalamic infarction on pretreatment DWI
- ✓Truncal type occlusion on CTA

Lee YY et al. AJNR 2019

Imaging findings of ICAS

- Pretreatment imaging
 - Negative hyperdense artery sign on CT
 - Negative susceptibility vessel sign on GRE or SWI
 - Truncal type occlusion on CTA
- DWI (borderzone, small core, isolated basal ganglia or deep brain infarct)
- Conventional angiography
 - Jet-like Appearance
 - Intracranial non-occlusive intraluminal thrombus
 - Microcatheter first-pass effect
 - Truncal type occlusion
 - Instant reocclusion following thrombectomy

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1. Kang DH, Yoon W. Current Opinion on Endovascular Therapy for Emergent Large Vessel Occlusion Due to Underlying Intracranial Atherosclerotic Stenosis. *Korean J Radiol*. 2019;20(5):739-748.
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4. Lee SJ, Hong JM, Choi JW, et al. CTA-Based Truncal-Type Occlusion Is Best Matched With Postprocedural Fixed Focal Stenosis in Vertebrobasilar Occlusions. *Front Neurol*. 2019;9:1195.
5. Baek JH, Kim BM, Kim DJ, et al. Importance of truncal-type occlusion in stentriever-based thrombectomy for acute stroke. *Neurology*. 2016;87(15):1542-1550.
6. Jang SH, Park H, Yoo J, et al. Intracranial non-occlusive intraluminal thrombus may indicate underlying etiology of large vessel occlusion in patients undergoing endovascular therapy [published online ahead of print, 2021 Oct 6]. *J Neurointerv Surg*. 2021.
7. Baek JH, Kim BM, Yoo J, Nam HS, Kim YD, Kim DJ, Heo JH, Bang OY. Predictive Value of Computed Tomography Angiography-Determined Occlusion Type in Stent Retriever Thrombectomy. *Stroke*. 2017 Oct;48(10):2746-2752.
8. Kang DH, Kim YW, Hwang YH, Park SP, Kim YS, Baik SK. Instant reocclusion following mechanical thrombectomy of in situ thromboocclusion and the role of low-dose intra-arterial trofiban. *Cerebrovasc Dis*. 2014;37(5):350-355.

Neurologist's perspective

김 치 경

고려대 신경과

고려대학교
KOREA UNIVERSITY

대한뇌혈관내치료의학회
2022년 2월 23일

Intracranial atherosclerosis and Stroke:

Neurologist's perspective

고려대학교 의과대학 (고려대학교 구로병원)
신경과학교실 부교수

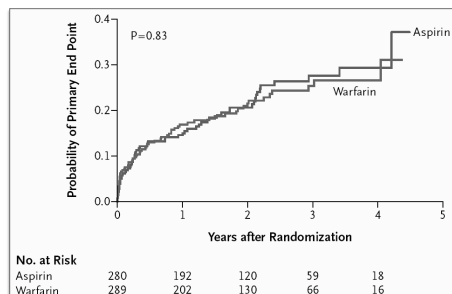
김 치 경

90 YEARS OF
KOREA UNIVERSITY
MEDICINE

Intracranial atherosclerosis

- Important cause of ischemic stroke
- More prevalent in Korea, Japan, China, and other Asian countries
- High risk of recurrent stroke
- No proven management strategy to reduce the risk of ischemic stroke

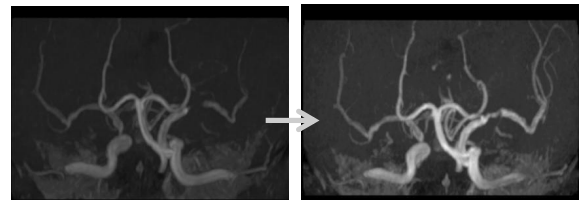
Classics



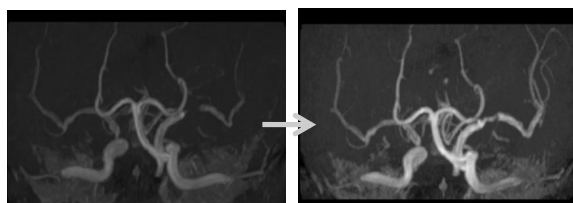
WASID trial. NEJM 2005;352:1305

Progression

- Worsened by one or more grade on final MRA compared with baseline MRA



Regression



Progression of Symptomatic ICAS may Predict Clinical Recurrence

Progression of ICAS	Clinical events	
	Yes (n=8)	No (n=32)
Yes (n=13)	6	7
No (n=27)	2	25

Arenillas et al. Stroke 2001;32:2898

Change of ICAS	Clinical events	
	Yes (n=18)	No (n=125)
Progressed (n=13)	5	8
Stable (n=88)	11	77
Normalized (n=42)	2	40

Wong et al. Stroke 2002;33:532

Trial of Cilostazol in Symptomatic Intracranial Stenosis-1

Cilostazol significantly reduced progression of symptomatic ICAS

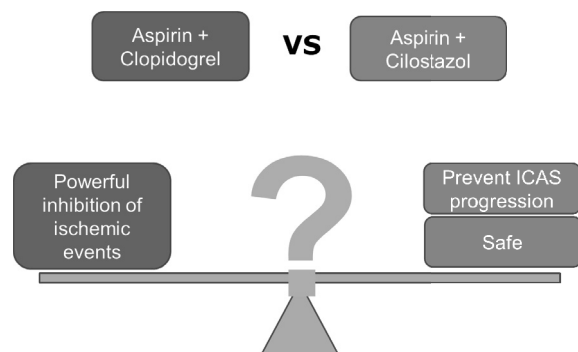
	Cilostazol	Placebo	Total
Progression	3 (6.7%)	15 (28.8%)	18 (18.6%)
Stationary	31 (68.9%)	29 (55.8%)	60 (61.9%)
Regression	11 (24.4%)	8 (15.4%)	19 (19.6%)
Total	45	52	97

Kwon et al. Stroke 2005;36:782

Aspirin + Clopidogrel in ACS

One year clinical outcomes in two clinical trials

	Clopidogrel	Placebo	RRR, % (95% CI)
CREDO study			
Death, MI, Stroke	89 (8.5%)	122 (11.5%)	26.9% (3.9 to 44.4)
MI	70 (6.6%)	90 (8.5%)	21.7% (-7.1 to 42.7)
Stroke	9 (0.9%)	12 (1.1%)	25.0% (-77.9 to 68.4)
			JAMA 2002; 288: 2411
CURE study			
MI, stroke, CV death	582 (9.3%)	719 (11.4%)	20% (10 to 28)
MI	324 (5.2%)	419 (6.7%)	23% (11 to 33)
Stroke	75 (1.2%)	87 (1.4%)	14% (-18 to 37)
			N Engl J Med 2001; 345: 494

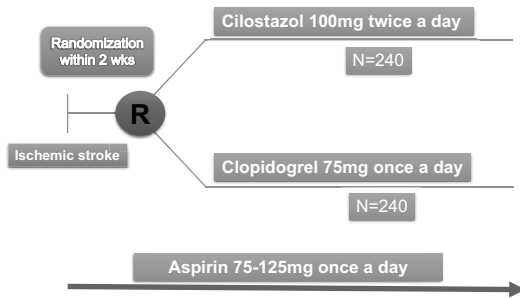


Study Design

- Double blind randomized trial
- Active controlled double dummy method
- 30 investigators of 20 centers from 4 countries actively recruited the patients
- Korea, Hongkong, Thailand, Philippines

TOSS2

Treatment for 7 Months



Primary Endpoint Progression of symptomatic ICAS

	Cilostazol (n=202)	Clopidogrel (n=207)	P-value*
Progression	20 (9.9%)	32 (15.5%)	0.092
others	182 (90.1%)	175 (84.5%)	

P-value* ; Pearson's chi square



Introduction Methods Results Discussion Conclusions

Outcome of Symptomatic Stenosis

Test for trends of outcome of symptomatic stenosis.

	Cilostazol (n=202)	Clopidogrel (n=207)	P-value
Progression	20 (9.90%)	32 (15.46%)	0.049*
No change	121 (59.90%)	126 (60.87%)	
Regression	61 (30.20%)	49 (23.67%)	

P-value* ; chi-square trend test



Introduction Methods Results Discussion Conclusions

Outcome of Asymptomatic Stenosis

	Cilostazol	Clopidogrel	P-value
Progression	8 (1.98%)	13 (3.14%)	0.306*
No Change	370 (91.58%)	386 (93.24%)	
Regression	26 (6.44%)	15 (3.62%)	0.037**

P-value* for progression vs others

P-value** ; chi-square trend test



Introduction Methods Results Discussion Conclusions

Asymptomatic New Ischemic Lesions on brain MRI

	Cilostazol	Clopidogrel	P-value
Any new ischemic lesions			0.0775
New lesion +	34 (18.68%)	23 (12.04%)	
New lesion -	148 (81.32%)	168 (87.96%)	
New ischemic lesions in the territory of symptomatic ICAS			0.321
New lesion +	22 (12.09%)	17 (8.90%)	
New lesion -	160 (87.91%)	174 (91.10%)	



Introduction Methods Results Discussion Conclusions

Clinical Events

	Cilostazol	Clopidogrel	P-value
Total CV events	15 (6.46%)	10 (4.83%)	0.283
Nonfatal stroke	11 (4.74%)	6 (2.67%)	0.324
Ischemic stroke in the territory of symptomatic ICAS	9 (3.88%)	5 (2.22%)	0.417
Ischemic stroke	10 (4.31%)	6 (2.67%)	
Hemorrhagic stroke	1 (0.43%)	0 (0%)	
Nonfatal MI	3 (1.3%)	1 (0.4%)	0.624
Vascular death	1 (0.43%)	2 (0.89%)	0.607
Nonvascular death	0 (0%)	1 (0.4%)	
Major bleeding complications	2 (0.86%)	6 (2.67%)	0.163
Life threatening hemorrhage	1 (0.43%)	2 (0.89%)	
Other major bleedings	1 (0.43%)	4 (1.78%)	
Minor bleedings	17 (7.33%)	19 (8.44%)	

cilostazol

clopidogrel

Consistency of ICAS Outcomes

TOSS-1

	Cilostazol (45)	Placebo (52)	Total (97)
Progression	3 (6.7%)	15 (28.8%)	18 (18.6%)
Stationary	31 (68.9%)	29 (55.8%)	60 (61.9%)
Regression	11 (24.4%)	8 (15.4%)	19 (19.6%)

TOSS-2

	Cilostazol (202)	Clopidogrel (207)	Total (409)
Progression	20 (9.90%)	32 (15.46%)	52 (12.7%)
No change	121 (59.90%)	126 (60.87%)	247 (60.4%)
Regression	61 (30.20%)	49 (23.67%)	110 (26.9%)

Introduction Methods Results Discussion Conclusions

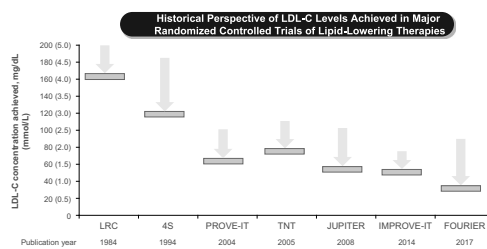
Symptomatic ICAS is Dynamic

	Symptomatic ICAS	Asymptomatic ICAS	P-value
Regression	110 (26.89%)	41 (5.02%)	<0.0001
No Change	247 (60.39%)	756 (92.40%)	
Progression	52 (12.71%)	21 (2.57%)	



Introduction Methods Results Discussion Conclusions

The era of high dose and high intensity statin



Guideline for lipid lowering

For patients who have had a stroke, current guidelines recommend LDL-C lowering for ASCVD risk reduction

ACC/AHA guidelines ¹	ESC/EAS guidelines ²	NLA recommendations ^{3,4}
Very high risk of future ASCVD events include a history of multiple major ASCVD events (eg, history of ischemic stroke or 3 major ASCVD events) and multiple high-risk conditions such as: • Heterozygous FH • Persistently elevated LDL-C (≥ 300 mg/dL) despite maximally tolerated statin therapy and ezetimibe • Age ≥ 65 years • Diabetes mellitus, etc High-intensity statin therapy ($\geq 50\%$ LDL-C $\downarrow$) or moderate-intensity statin therapy ($30\text{--}50\%$ LDL-C $\downarrow$)	4 risk groups (LDL-C goals) • Very high ($\geq 50\%$ LDL-C reduction from baseline^a and LDL-C < 55 mg/dL) • Includes smokers, T2D, CKD • No current statin use (likely requires high-intensity statin) • High ($\geq 50\%$ LDL-C reduction from baseline^a and LDL-C < 70 mg/dL) • Moderate (LDL-C < 100 mg/dL) • Low (LDL-C < 116 mg/dL) Concomitant diseases used to stratify risk categorization	4 risk groups (LDL-C goals)⁵ • Very high (< 70 mg/dL, including ischemic stroke) • High (< 100 mg/dL) • Moderate (< 105 mg/dL) • Low (< 100 mg/dL) Risk factors and concomitant diseases used to stratify risk categorization 3 high-risk subgroups with ASCVD, including ischemic stroke (LDL-C thresholds)⁶ • Extremely high (≥ 70 mg/dL) • Very high (≥ 100 mg/dL) • High (≥ 130 mg/dL)

Target intensity of statin therapy and LDL-C reduction (percentage reduction)
Recommended LDL-C threshold of 70 mg/dL to consider addition of non-statins to statin therapy

Target LDL-C levels (absolute value)

2018 한국지질·동맥경화학회 이상지질혈증 치료지침

위험도		LDL 콜레스테롤 (mg/dL)	Non-LDL 콜레스테롤 (mg/dL)
초고위험군	관상동맥질환	<70	<100
	극심경화성 허혈뇌졸중 및 일과성 뇌허혈발작		
	일차성당뇨병		
고위험군	관동맥질환 ^a	<100	<130
	복부동맥류		
	당뇨병 ^a		
중등도위험군	주요위험인자 2개 이상	<130	<160
저위험군	주요위험인자 1개 이하	<160	<190

ASCVD Risk Estimator

10-Year ASCVD Risk: ~9%
Lifetime ASCVD Risk: ~9%

ASCVD Risk Estimator
Intended for patients with LDL-C < 190 mg/dL (4.92 mmol/L), without ASCVD, not on LDL-C lowering therapy

Demographics

Sex: Male Female Age: Race: White African American Other

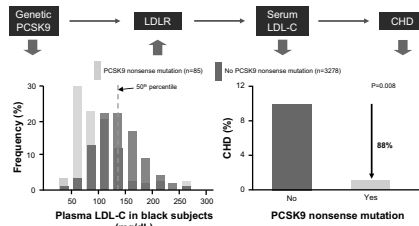
Labs

Total Cholesterol (mg/dL): HDL Cholesterol (mg/dL): Systolic Blood Pressure (mmHg):

Personal History

Diabetic: Yes No Smoker: Yes No Treatment for Hypertension: Yes No

Loss-of-function Variants in PCSK9, With Lifetime Low LDL-C, Are Associated With a Lower Risk of CV Events



In frequency distribution of plasma LDL-C levels, green represents overlap in frequency of patients with and without PCSK9 mutations.
CHD = coronary heart disease; CV = cardiovascular; LDL-C = low-density lipoprotein cholesterol.
LDL-R = low-density lipoprotein receptor; PCSK9 = proprotein convertase subtilisin-kexin type 9.

Cohen JC, et al. *N Engl J Med*. 2005;354:1271-1272.

Individuals With LOF PCSK9 Mutations Appear to be Healthy

PCSK9 Compound Heterozygote (Little to No Circulating PCSK9 and Very Low LDL-C)^{1,2}

Case study¹

Background	32-year-old African American female: healthy, fertile, normotensive, college-educated woman with normal liver and renal function tests (including urinalysis) who works as an aerobics instructor
PCSK9 genotype	Y142X (nonsense mutation)
Triglycerides, mg/dL (mmol/L)	119 (1.3)
LDL-C levels, mg/dL (mmol/L)	14 (0.36)

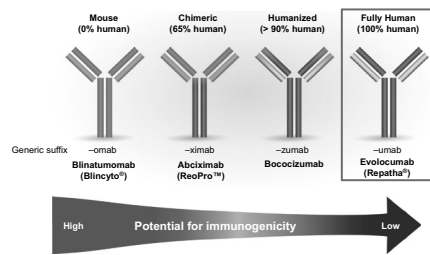
Case study²

Background	21-year-old black African female attending postnatal clinic
PCSK9 genotype	C679X (nonsense mutation)
Triglycerides, mg/dL (mmol/L)	71 (0.8)
LDL-C levels, mg/dL (mmol/L)	15 (0.4)

LDL-C, low-density lipoprotein cholesterol; LOF, loss-of-function; PCSK9, proprotein convertase subtilisin-kexin type 9.

1. Zhao Z, et al. *Am J Hum Genet*. 2008;79:1023-1025. 2. Hooper AJ, et al. *Atherosclerosis*. 2007;163:465-466.

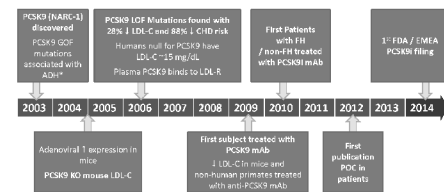
Fully Human Antibodies Have Reduced Immunogenicity



1. Warner LM, J Immunother. 2008;20:1-6. 2. Yong KD, et al. *Cell Rev Clin Immunol*. 2010;2:17-23. 3. Lohning N. *Nat Biotechnol*. 2003;21:117-125. 4. Garber OD, *Am Fam Physician*. 2008;77:211-216.

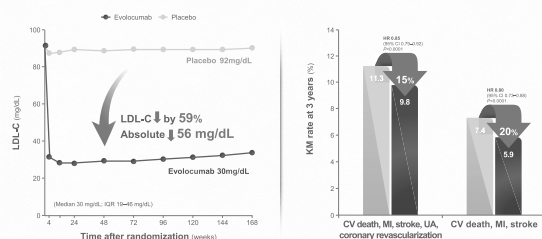
5. Pospisil S, et al. *Methods Mol Biol*. 2014;1000:171-173. 6. Pospisil S, et al. *Methods Mol Biol*. 2014;1000:171-173.

PCSK9 Inhibitors: From Target Discovery To Phase III in 10 years



1. Adams J, et al. *Science*. 2005;308:1072-1075. 2. Adams J, et al. *Science*. 2005;308:1072-1075. 3. Adams J, et al. *Science*. 2005;308:1072-1075. 4. Adams J, et al. *Science*. 2005;308:1072-1075. 5. Adams J, et al. *Science*. 2005;308:1072-1075. 6. Adams J, et al. *Science*. 2005;308:1072-1075. 7. Adams J, et al. *Science*. 2005;308:1072-1075. 8. Adams J, et al. *Science*. 2005;308:1072-1075. 9. Adams J, et al. *Science*. 2005;308:1072-1075. 10. Adams J, et al. *Science*. 2005;308:1072-1075.

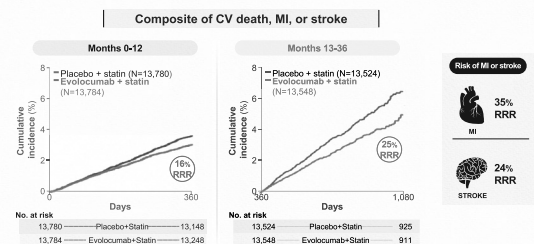
Evolocumab Significantly Reduced the Risk of Cardio-cerebrovascular Disease in ASCVD Patients



CV, cardiovascular disease; HDL, high-density lipoprotein; LDL, low-density lipoprotein; K-M, Kaplan-Meier; UA, uric acid; UA, uric acid.

1. Sabatine MS, et al. *N Engl J Med*. 2017;376:1713-1722.

The Longer, The Better! Evolocumab Showed a Greater Risk Reduction Over Time



For the analysis the relative risk reduction for the composite endpoint from month 13-36 was driven by a reduction in the risk of MI (RR 0.65 [0.54-0.77]) and stroke (RR 0.75 [0.62-0.91]).

Observed HR for CV death: 1.12 (95% CI 0.77-1.64).

RRR=relative risk reduction; HR=hazard ratio; MI=myocardial infarction; CV=cardiovascular.

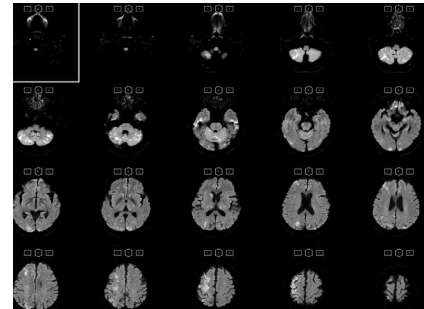
1. Sabatine MS, et al. *N Engl J Med*. 2017;376:1713-1722.

Case 1

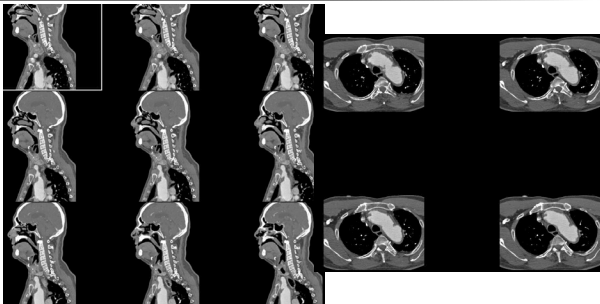
- M / 71
- 의식저하 및 왼쪽 편마비
- HT (+) DM (+) Chronic kidney disease (+)
- Onset: 4 hour ago

41

Case 1



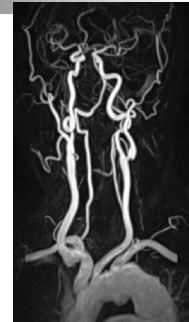
42



43

Case 1

- Aspirin, Clopidogrel, Lipitor 80 mg
- Initial Lab
 - Cholesterol: 172, TG: 246, HDL: 33, LDL: 99
 - 기존 약제: aspirin, amlodipine, losartan, thiazide, no statin



44

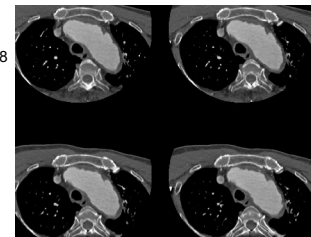
3 mo OPD f/u

- 근육통, 허리 통증이 심하다
- Lipitor 40 mg → Crestor 20 mg → Mevalotin 20 mg → Livalo 4 mg
- Chol: 116, TG: 366, HDL: 30, LDL: 48
- CK: 72

45

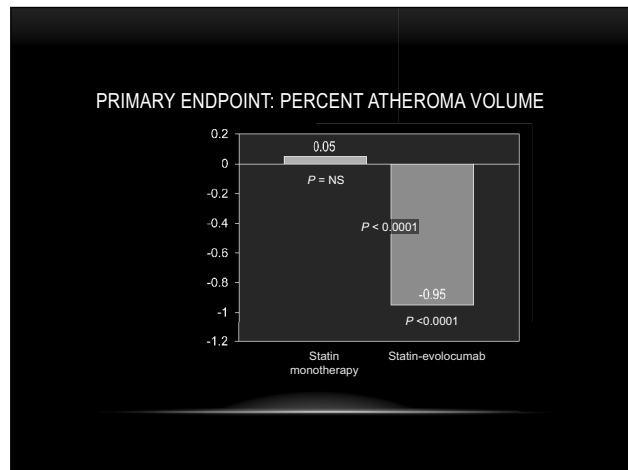
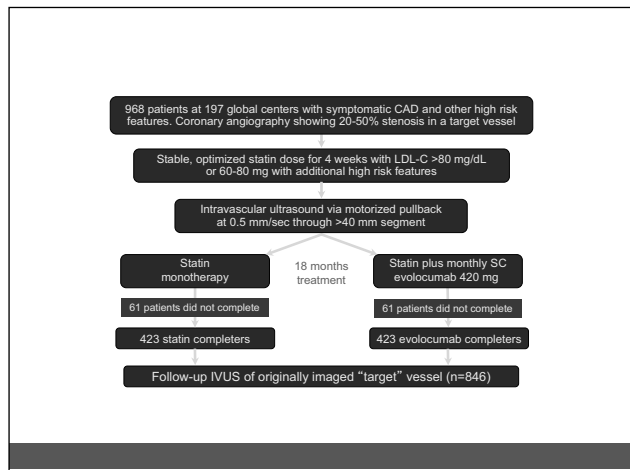
Repatha 시작

- 근육통, 허리 통증 없어짐
- Chol: 109, TG: 195, HDL: 33, LDL: 48
- CK: 83
- Repatha 지속 투여 중



2 year f/u

46



Case 2

F/65
Rt MCA infarction
고지혈증은 10년전에 진단을 받았으나 스타틴 또는 중성지방 저하제를 복용하지 않던 1, 2달 내에 몸무게가 급속히 증가하고, 발진, 발열, 관절통, 근육통이 발생하여 입원하였다. 입원 후 statin - statin 투여 필요성, ezeti 등 필요성 설명 - refuse
항혈소판제제만 투여 중 1년 뒤 재발 (aspirin, clopidogrel)
레파타 추천 (비급여), 420mg/month

레파타 시작 전 레파타 투여 1년 6개월

	Initial	1개월	1Yr	1.5Yr
BMI	24	24	24	24
LDL	193	71	68	66
TG	305	96	88	92
HDL	36	36	45	45
CK	56	47	58	47
Cr (eGFR)	58	59	57	58
MMSE	28	28	28	28

New drugs

- Ticagrelor
- Prasugrel

and new-typed clinical trials...

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Therapeutic Anticoagulation with Heparin in Noncritically Ill Patients with Covid-19

The ATTACC, ACTIV4, and REMAP-CAP Investigators*

ABSTRACT

BACKGROUND: Thrombosis and inflammation may contribute to morbidity and mortality among patients with coronavirus disease 2019 (Covid-19). We hypothesized that therapeutic-dose anticoagulation would improve outcomes in critically ill patients with Covid-19.

DESIGN: In an open-label, adaptive, multicenter, randomized clinical trial, critically ill patients with severe Covid-19 were randomly assigned to a pragmatically defined regimen of either therapeutic-dose anticoagulation with heparin or placebo. The primary end point was organ support-free days, evaluated as an ordinal scale (the number of days free of cardiovascular or respiratory organ support up to day 21 among patients who survived to hospital discharge).

SETTING: The trial was stopped when prespecified criteria for the superiority of therapeutic-dose anticoagulation were met. Among 2219 patients in the final analysis, the probability that therapeutic-dose anticoagulation increased organ support-free days compared with usual care (therapeutic-dose heparin was 98.0% without odds ratio, 1.25 [95% confidence interval, 1.01 to 1.56]. The absolute difference between usual care and placebo was 1.3 days.

CONCLUSIONS: In noncritically ill patients with Covid-19, an initial strategy of therapeutic-dose anticoagulation with heparin increased the probability of survival to hospital discharge with reduced use of cardiovascular or respiratory organ support as compared with usual care (therapeutic-dose heparin was 98.0% without odds ratio, 1.25 [95% confidence interval, 1.01 to 1.56]. The absolute difference between usual care and placebo was 1.3 days).

Overview

- International, adaptive, multiplatform, randomized, controlled trial to determine whether an initial strategy of therapeutic dose anticoagulation with unfractionated or low-molecular-weight heparin improves in-hospital survival and reduces the duration of ICU level cardiovascular or respiratory organ support among hospitalized patients with Covid-19

Endovascular surgeon's perspective

오 재 상

순천향대

What is atherosclerosis? Atherosclerosis was an inflammatory disease. Because high plasma of lipoprotein cholesterol are one of the principal risk factors for it. As time goes, the concepts of atherosclerosis has been changed to immune mechanism since 2005. The role of inflammation in pathogenesis of atherosclerosis changed to immune mechanism interact with metabolic risk factors. Next concepts of atherosclerosis became the hemostatic system as a modulator of atherosclerosis. As an endovascular neurosurgeon, intracranial stenosis seems to be very impregnable and unassailable part of ischemic stroke because of high percent of re-occlusion or complications. We'd better try another approach to ICAS rather than recanalization or not. So I recommend to study about various aspect of atherosclerosis as neurosurgeon.

Microvascular surgeon's perspective

주 성 필

전남대

IntraCranial Aterial Stenosis

- ✓Neurvascular surgeon's perspective ?
- ✓EC-IC bypass for Carotid / ICA / MCA stenosis/occlusion

Sung-Pil Joo, Yoo-Sub Kim, Tae-Sun Kim

DEPARTMENT OF NEUROSURGERY,
CHONNAM NATIONAL UNIVERSITY, GWANGJU, KOREA

STA-MCA Anastomosis

- Histroical Background -

- Yasargil MG: 1967 first reported
⇒ Performed for occlusive lesions of ICA & MCA inaccessible by CEA
- EC-IC Bypass Study Group: 1985
 - No reduction of ischemic stroke risk
 - Inclusion criteria:
 - Symptomatic ICA or MCA steno-occlusive lesions

Why do we have this topics ?

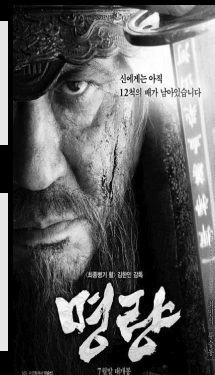
1985, NEJM
EC-IC Bypass Study Group.
Failure of extracranial-intracranial
arterial bypass to reduce the risk of
ischemic stroke.

2011, JAMA
Extracranial-intracranial
bypass surgery for stroke prevention
in hemodynamic cerebral ischemia:
the Carotid Occlusion
Surgery Study (COSS)



2002; JET Study Group
Japanese EC-IC bypass trial (JET study):
the second interim analysis. Surg Cereb
Stroke 30: 434-437, 2002

2015, JWR Study 2
Results of Prospective Cohort Study on
Symptomatic Cerebrovascular Occlusive
Disease Showing Mild Hemodynamic
Compromise



Shortcomings of EC-IC Bypass Study & Carotid Occlusion Surgery Study (COSS)

1985, NEJM
EC-IC Bypass Study Group.
Failure of extracranial-intracranial
arterial bypass to reduce the risk of
ischemic stroke.

2011, JAMA
Extracranial-intracranial
bypass surgery for stroke prevention
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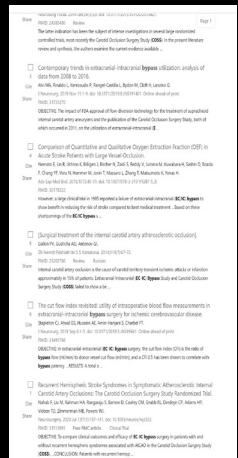
- ✓ Short follow-up time
- ✓ Limited bypass experience by
surgeons higher than expected
- ✓ Perioperative stroke rate
- ✓ Extended length of time between
last
ischemic event and surgery

Aftermath of COSS

The Role of MCA-STA Bypass
Surgery After COSS and JET: The
European Point of View,
2014 Acta Neurochir



Extracranial-intracranial bypass for
ischemic cerebrovascular disease:
what have we learned from the
Carotid Occlusion Surgery Study?
~2014



Ischemic Cerebral Stroke

- Embolic vs. Hemodynamic
- Therapeutic Strategy for Prevention
 - Embolic: prevent thrombus formation
 - Hemodynamic: revascularization

Stroke with ICAS

- Hypoperfusion
- Artery-to-artery embolism
- Plaque involving a small perforating artery ostium

Hemodynamic Impairment

Stage	CPP(%)	CBF	OEF	CMRO ₂	CBV
Autoregulation	60-100	N	N	N	↑
Oligemia	40-60	↓	↑	N	↑↑
Penumbra	20-40	↓↓	↑↑	↓	↑
Infarction	<20	↓↓↓	↑↑	↓↓	↓

Cerebral Perfusion vs. Stroke Risk

- Autoregulation stage
 - Impaired hemodynamic reserve capacity
 - Dilated resistance arteries
 - Variable risk for stroke
- Oligemia stage
 - Miser perfusion
 - Increased OEF
 - Definite risk for Stroke !!

Impaired CVRC vs. Stroke Risk - Diamox SPECT -

Authors	Normal	Dec. CVR	Tracer
Kuroda et al, 2001	0.6%	2%	¹³³ Xe
Ogasawara et al, 2002	1%	17%	¹³³ Xe
Yokota et al., 1998	4%	4%	¹²³ I-IMP
Ipsilateral annual stroke risk			

Misery Perfusion vs. Stroke Risk - PET Study -

Ipsilateral Stroke OEF(39)	Normal OEF(42)	Increased
1 year	2.4%	10.6%
2 year	5.3%	26.5%

St. Louis Carotid Occlusion Study, Grubb et al., 1998

Misery Perfusion vs. Stroke Risk - PET Study -

Ipsilateral Stroke OEF(7)	Normal OEF(33)	Increased
1 year	6%	57%
5 year	15%	57%

Yamauchi et al., 1999

STA-MCA Anastomosis

- personal experience -

- 2004. ~ 2021
- STA-MCA anastomosis: 120 cases
 - ASD: 61
 - Intracranial: 38
 - ICA origin: 23
 - MMD: 56 (unilateral 7 cases)
 - Ischemic: 51
 - Hemorrhagic: 5
 - Others 3
 - Radiation arteritis: 1
 - r/o vasculitis 2 (bilateral op.)

Indication of Surgery for ICAS

- Recent ischemic Sx (<6 months)
- Misery perfusion on SPECT
 - Jet study: SPECT- dec. perfusion & CVRC
 - COSS study: dec. OEF
- No serious preop. co-morbidity
 - Serious cardiologic problem
 - Serious neurologic deficit
- < 2% of acute ischemic Pt. undergo surgery

Case reviews for my experience

- OP timing: Urgent vs. chronic
- Bypass type: Single or double
- Additional bypass
- Others – STA is not good ?

OP timing: Urgent vs. chronic ?

Early versus Delayed EC-IC Bypass Surgery in Symptomatic Atherosclerotic Occlusion
 - Neurosurgery 2019

EC-IC bypass in setting of acute symptomatic stroke within 1wk may confer higher risk of perioperative stroke.

Rescue Cerebral Revascularization in Patients with Progressive Steno-Occlusive Ischemia of the Anterior Intracranial Circulation
 - World Neurosurgery, 2020

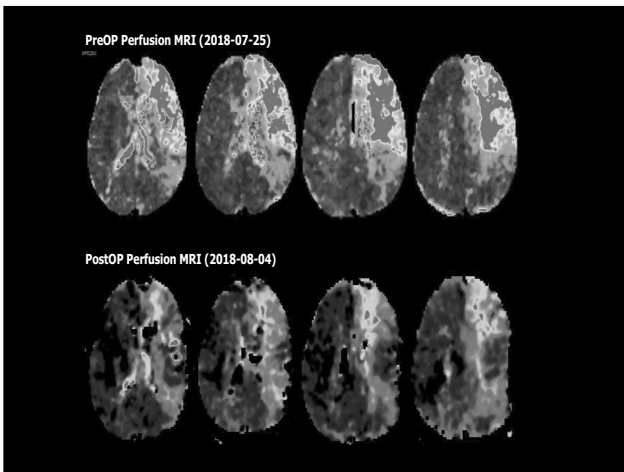
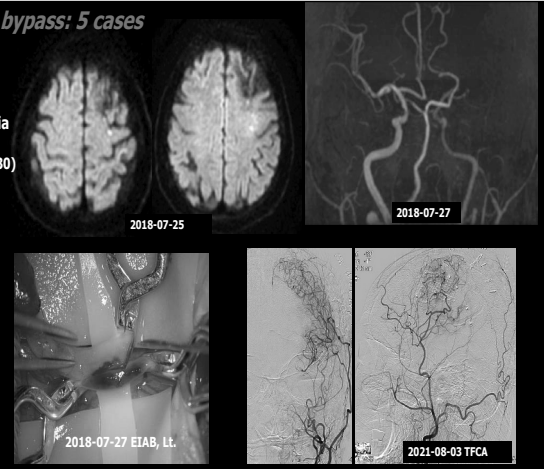
Bypass for steno-occlusive disease of the anterior intracranial circulation is a potentially effective treatment for patients with progressive and/or refractory ischemic symptoms, although the complication rate is significant.

Efficacy and Safety of Emergency EC-IC Bypass for Revascularization within 24 Hours in Resolving Large Artery Occlusion with Intracranial Stenosis
 - World Neurosurgery, 2021

Emergency EC-IC bypass within 24 hours of symptom onset is as effective as PTA/S after failed MT and superior to MMT.

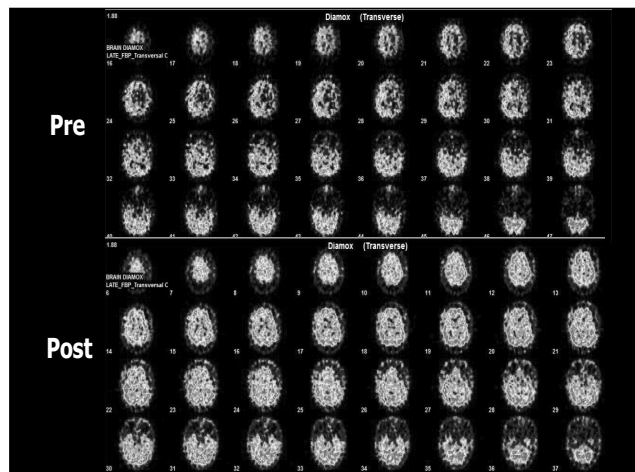
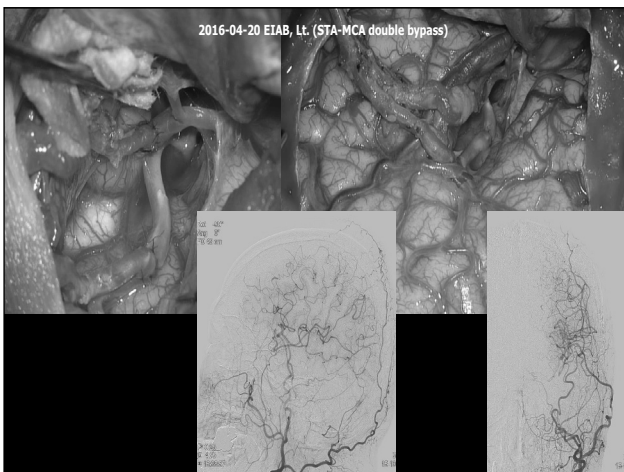
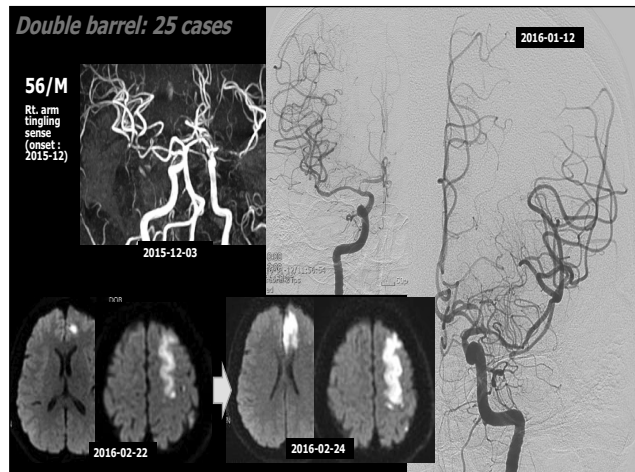
Urgent bypass: 5 cases

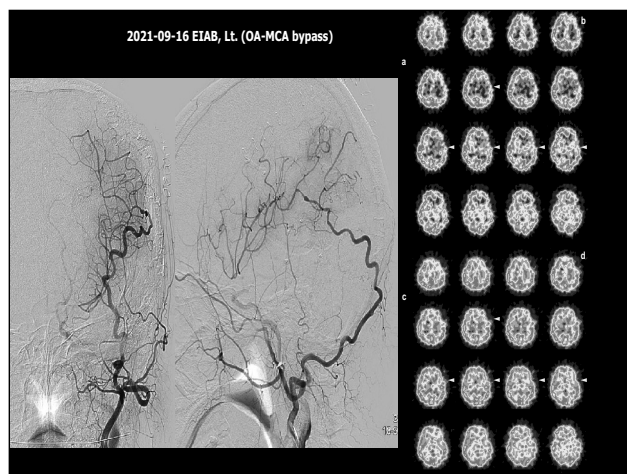
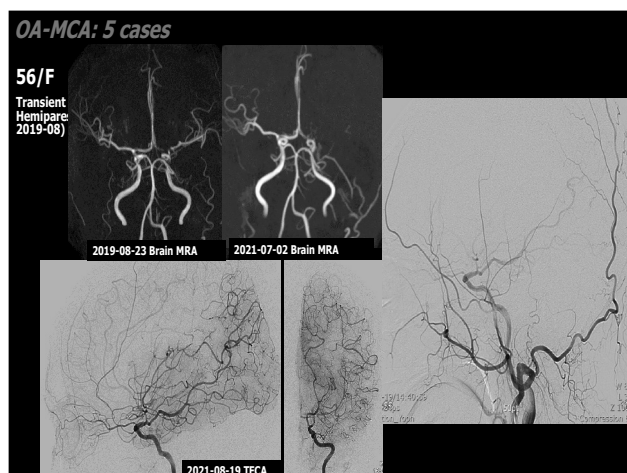
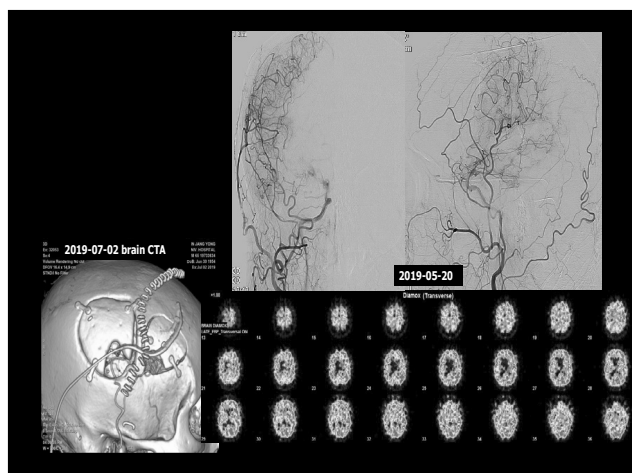
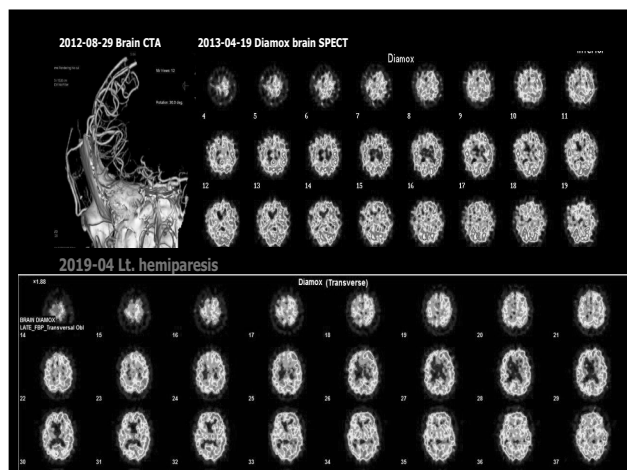
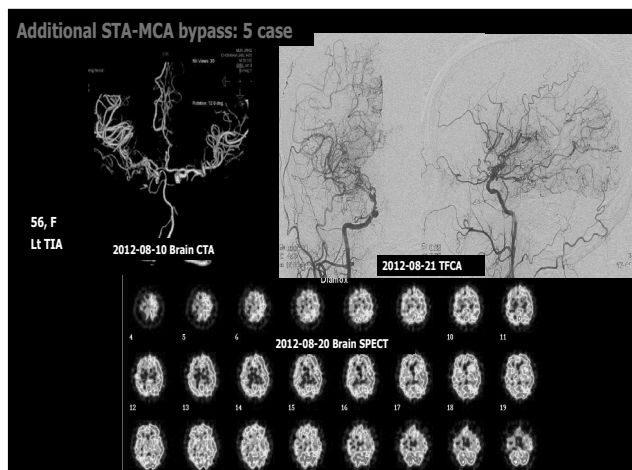
85/F,
 Dysarthria
 (onset :
 2018-05-30)



Double barrel: 25 cases

56/M
 Rt. arm
 tingling
 sense
 (onset :
 2015-12)





Effect of revascularization on cognitive outcomes in

intracranial steno-occlusive disease: a systematic review

OBJECTIVE Steno-occlusive diseases of the cerebral vasculature have been associated with cognitive decline. The authors conducted a systematic review of the existing literature on intracranial steno-occlusive disease, including intracranial atherosclerosis and moyamoya disease (MMD), to determine the extent and quality of evidence for the effect of revascularization on cognitive performance.

METHODS A systematic search of PubMed/MEDLINE, the Thomson Reuters Web of Science Core Collection, and the KCI Korean Journal Database was performed to identify randomized controlled trials (RCTs) in the English-language literature and observational studies that compared cognitive outcomes before and after revascularization in patients with

steno-occlusive disease of the intracranial vasculature, from which data were extracted and analyzed.

RESULTS Nine papers were included, consisting of 2 RCTs and 7 observational cohort studies. Results from 2 randomized

trials including 142 patients with symptomatic intracranial atherosclerotic steno-occlusion found no additional benefit to revascularization when added to maximal medical therapy. The certainty in the results of these trials was limited by concerns for bias and indirectness. Results from 7 observational trials including 282 patients found some cognitive benefit for revascularization for symptomatic atherosclerotic steno-occlusion and for steno-occlusion related to MMD in

children. The certainty of these conclusions was low to very low, due to both inherent limitations in observational studies

for inferring causality and concerns for added risk of bias and indirectness in some studies. *Koib B et al, Neurosurg Focus 46, 2019*

CONCLUSIONS Revascularization for symptomatic intracranial steno-occlusive disease may be associated with cognitive benefits, but the evidence is low quality and requires further investigation.

Revascularization surgery for symptomatic non-moyamoya intracranial arterial stenosis or occlusion

OBJECTIVE Previous trials rejected a role of extracranial-to-intracranial bypass surgery for managing symptomatic atheromatous disease. However, hemodynamic insufficiency may still be a rationale for surgery, provided the bypass can be performed with low morbidity and patency is robust.

METHODS Consecutive patients undergoing bypass surgery for symptomatic non-moyamoya intracranial arterial stenosis or occlusion were retrospectively identified. The clinical course and surgical outcomes of the cohort were evaluated at 6 weeks, 6 months, and annually thereafter.

RESULTS From 1992 to 2017, 112 patients underwent 127 bypasses. The angiographic abnormality was arterial occlusion

in 80% and stenosis in 20%. Procedures were performed to prevent future stroke (76%) and stroke reversal (24%), with revascularization using an arterial pedicle graft in 80% and venous interposition graft (VIG) in 20%. A poor outcome

(bypass occlusion, new stroke, new neurological deficit, or worsening neurological deficit) occurred in 8.9% of patients,

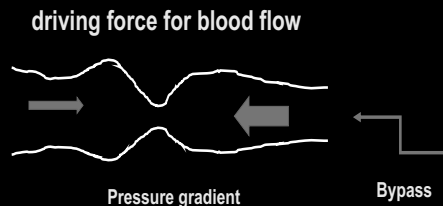
with arterial pedicle grafts (odds ratio [OR] 0.15), bypass for prophylaxis against future stroke (OR 0.11), or anterior circulation

bypass (OR 0.17) identified as protective factors. Over the first 8 years following surgery the 66 cases exhibiting all three of these characteristics had minimal risk of a poor outcome (95% confidence interval 0%–6.6%).

CONCLUSIONS Prophylactic arterial pedicle bypass surgery for anterior circulation ischemia is associated with high graft patency and low stroke and surgical complication rates. Higher risks are associated with stroke procedures.

STA-MCA bypass surgery for refractory Symptomatic Intracranial Atherosclerotic Stenosis

For refractory ICAS in patients with compromised hemodynamics, direct bypass might induce early occlusion of a stenotic area. MCA lesions may have a greater tendency toward early occlusion conversion.



Yan ma et al, World neurosurgery, 2017



2022
뇌졸중 재개통 심포지엄 및
대한뇌혈관내치료의학회
춘계보수교육

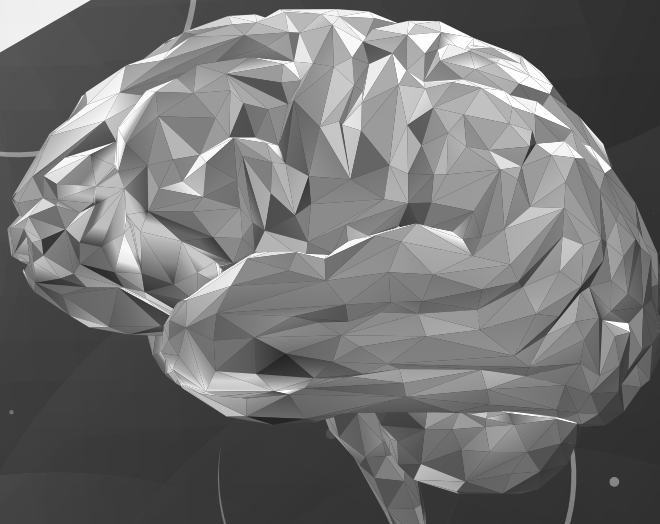
Session II

뇌혈관질환정책 - 뇌혈관질환 센터,
어느 방향으로 가야 하는가?

좌장: 김범태 (순천향대), 장철훈 (영남대)

응급의료전달 체계 현황과 개선방향
국내 뇌졸중센터의 현황과 전망
국내 뇌혈관질환센터의 현재와 방향

문성우 (고려대 응급의학과)
박희권 (인하대 신경과)
신승훈 (차의과학대)



응급의료전달 체계 현황과 개선방향

문 성 우

고려대 응급의학과



응급의료체계 현황과 발전방향

- 지역책임진료체계 구축을 위한 응급의료전달체계 개선방안

문성우
응급의학전문의, 교수
고려대부속 안산병원



내 용

- 응급의료체계 개요와 현황
- 응급의료체계 개선을 위한 최근 경과
- 응급의료전달체계 개선안



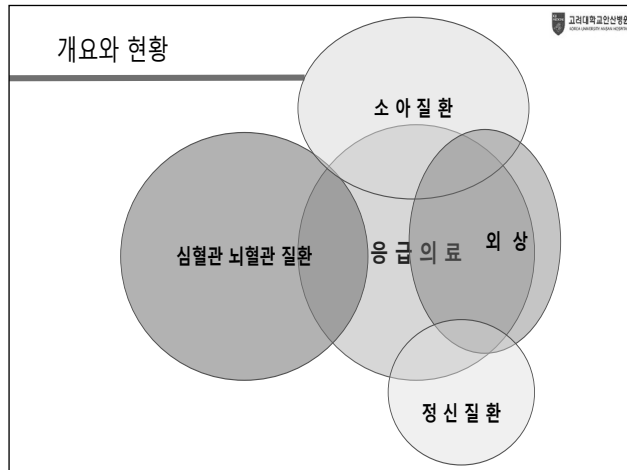
개요와 현황

- 응급의료체계는
 - 특정 지역사회에서 응급환자 발생에 효과적이고 신속하게 대응하기 위한 인력, 시설, 장비의 유기적 운영체계 전반
 - 병원 전단계 (환자발생현장, 이송과정)와 병원 단계로 구성



개요와 현황

- 응급의료는
 - 시간민감성 (Time Sensitive)
 - 수요자 의사에 따른 서비스 선택이 제한
 - 각 단계(현장/발생, 구급, 병원) 균형 있는 발전이 요구
 - 유관 기관, 관련종사자들(Stakeholders)의 상호협력, 통합된 계획(Coordination, Integration)
 - 공공의 개입 필요, 사회 안전망(Safety Net)으로서 기능



개요와 현황

연도	주요내용	의의
1990	-응급의료체계 구축 추진 기본계획 수립 -응급의료체계 세부추진 계획 수립	정보센터 설치, 통신망 확보, 응급진료권 및 응급센터 지정, 전문인력 양성 등
1994	-응급의료에 관한 법률 제정(1999년 시행)	응급의료체계 기틀 마련
2000	-응급의료에 관한 법률 전면개정	3단계 응급의료전달체계 (지역응급의료센터-지역응급의료센터-지역응급의료기관) 중앙응급의료센터의 설치
2003 ~	-응급의료기관 평가 시행 -응급의료기관 확대 -광역응급의료센터 개소수 확대	품질관리 재활확보 공급확대

• 수요 (2019)

- 전체 응급실 내원수: 9,055,186
- 중증외상: 356,946
- 심근경색: 45,444
- 뇌졸중: 145,516
- 소아(18세이하): 1,838,828

• 공급 (2019)

- 지역응급의료센터: 38개소
- 지역응급의료센터: 125개소
- 지역응급의료기관: 239개소
- 기타 응급의료시설: 110개소

응급진료제공 기관

권역응급의료센터 (38개소)

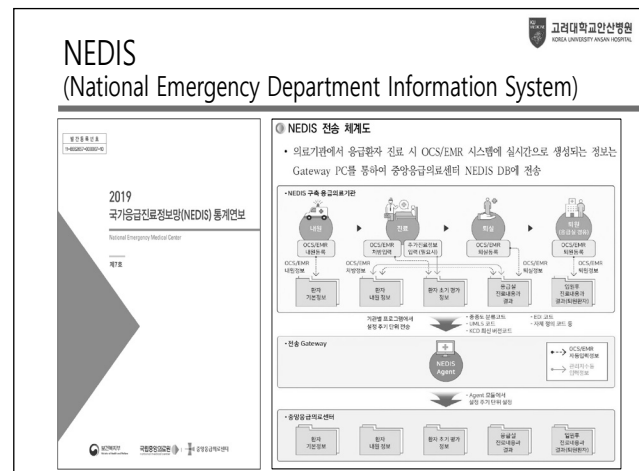
지역응급의료센터 (124개소)

지역응급의료기관 (248개소)

응급실 운영기관 (119개소)

야간진료의원

**심혈관 뇌혈관 질환
응급실 운영기관
야간진료의원**



'19 '20 응급센터 내원환자

	2019	2020
전체 응급실 내원	6,146,688	4,809,661 (78.2%)
급성심근경색	37,988	35,717 (94%)
뇌졸중	120,584	116,368 (96.5%)

한 거레

세상을 바꾸는 첫 번째

전통 시장, 서점, 편의점, 2022 대선, 부동산, 대안, 단거리, 일주일, 오라클, BSC

사회 의료 건강

"29곳 전화해도 발열 환자 갈 응급실 없었다"...'골든타임' 위기

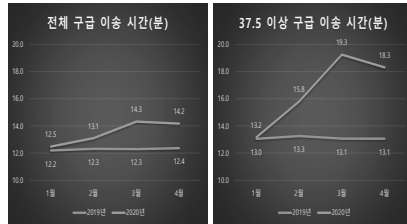
이민우 기자

등록: 2021-11-24 17:59 | 수정: 2021-11-25 08:00

사회 많이 보는 기사

1. 국유-유류비 상승, 국민적 관심
2. 전통 시장, 소상공인 위기

구급이송시간



11

개선을 위한 경과

- 지속적으로 제기되는 응급의료현장에서의 문제 → 체계 개선에 대한 요구와 노력
- 2019년 '응급의료체계 개선을 위한 민관 협의체'
- 2020년 1월 중앙응급의료위원회
- 2020년 '실무협의체' (복지부, 현장전문가, 중앙응급의료센터)
- 2021년 2월 중앙응급의료위원회:
응급의료체계 개선 실행계획(3대 분야, 11개 실행과제)에 대한 심의 의결

경과

< 3개 분야, 11개 실행과제 >

현장·이송 단계	(1) 병원 전단계 환자평가와 중증도 분류체계 개선 (2) 지역단위 이송체계 마련 (3) 적정병원 이송 관리체계 확립
병원 단계	(1) 중증응급환자 수용능력 강화 위한 응급의료체계 개편 (2) 중증응급환자 수용능력 고지 관리체계 마련 (3) 수용공간 고지관리 정보시스템 구축 (4) 중증환자 병원간 전원체계 구축 (5) 환자의 합리적 응급의료기관 이용 유도 (6) 응급의료기관의 감염병 위기대응 역량 강화
응급의료기관 단계	(1) 지역 응급의료 거버넌스 강화 (2) 지역완결적 응급의료체계 지원을 위한 중앙지원조직 강화

경과

- 2000년 응급의료에 관한 법률 개정: 현행 3단계 응급의료기관 분류체계 마련
권역응급의료센터 - 지역응급의료센터 - 지역응급의료기관

종별(개소)	근거법령	법정기능
권역응급의료센터(38)	「응급의료법」 제26조	1. 중증응급환자 중심의 진료 2. 재난 대비 및 대응 3. 권역 내 응급의료종사자에 대한 교육훈련 4. 권역 내 다른 의료기관에서 이송되는 중증응급 환자에 대한 수용
지역응급의료센터(125)	「응급의료법」 제30조	1. 응급환자의 진료
지역응급의료기관(238)	「응급의료법」 제31조	2. 해당 기관의 역량을 초과하는 응급환자의 신속한 이송

※ 종별 개소 수 기준: 2020. 6.

응급의료체계 개편의 주요 과제

- 중증응급환자에 대한 적절한 수용과 치료 제공
 - 지속적으로 발생하는 현장에서의 문제를 해소
 - 환자로서의 권리(안전망으로서의 역할) 보장 + 응급의료종사자의 어려움과 한계상황 개선
 - 코로나19 대유행에서 응급의료의 경험
- 일반(비중증 또는 경증) 응급환자에 대한 최선의 치료(서비스) 제공
 - 대형병원으로의 응급환자 쏠림 개선
 - 응급의료 전반에 대한 국민만족도 향상

응급의료체계 개편의 주요 과제

- 중증응급치료 제공 인프라는 적절한가? (기능을 수행할 적절한 개소수는?)
→ 수요와 공급의 세팅은 합리적인가?
- 중증환자 발생 대비 또는 인구수 대비 부족한 (법정규정에 따른)중증응급의료기관 수
 - '19년 기준 권역응급의료센터는 하루 평균 1,064명의 중증응급환자(28개 중증응급질환자 기준)를 진료
→ 전체 중증응급환자의 약 32.3%
(지역응급의료센터 1,545명, 46.9%, 지역응급의료기관 684명, 20.8%)
 - 영국의 A&E (acute and emergency center), 일본의 구급구명센터: 인구 30 ~ 50만 명당 1개소 이상 지정 운영
우리나라: 137만 명당 1개소의 권역응급의료센터

응급의료체계 개편의 주요 과제

- 다양한 스펙트럼의 지역응급의료센터의 합리적인가?
- 응급의료기관 중별 기능과 역할 재정립 필요성

<전국 308개 응급의료기관의 응급응급환자의 구성비, 수용률, 진원율, 재진원율의 중65%>
(자료원: NEDIS, '19)

지표	전체	권역응급의료센터 (38개소)	지역응급의료센터 (125개소)	300병상 이상 (90개소)	300병상 미만 (35개소)	지역응급의료기관 (239개소)
구성비(%)	10.0	16.6	12.5	12.9	10.5	7.7
수용률(%)	63.1	75.1	67.4	70.4	60.6	52.9
진원율(%)	6.8	3.0	4.5	3.8	8.0	9.2
재진원율(%)	4.3	2.6	3.4	2.9	5.9	5.3

1) 구성비: 28개 응급응급환자로 응급실을 내원한 환자 수/ 응급실 내원 환자 수+100
2) 수용률: 28개 응급응급환자 중 응급실 퇴실과 입원, 사망(DCA제외), 기말 없는 퇴실한 환자/ 28개 응급응급환자+100
3) 진원율: 28개 응급응급환자 중 응급실 퇴실과 입원한 환자/ 28개 응급응급환자+100
4) 재진원율: 28개 응급응급환자 중 응급실 퇴실과 입원한 환자/ 28개 응급응급환자 중 내원영양과 외부에서 진원한 환자 -100

개편방향

종별(개소)	근거법명	법정기능
권역응급의료센터(38)	'응급의료법 제36조	1. 응급응급환자 중심의 진료 2. 재난 대비 및 대응 3. 응급응급환자(응급응급환자)에 대한 응급응급 4. 응급응급환자(응급응급환자)에 대한 응급응급
지역응급의료센터(125)	'응급의료법 제37조	1. 응급응급환자 진료
지역응급의료기관(239)	'응급의료법 제38조	2. 응급응급환자 진료

(중증)응급의료제공 체계 강화 → 인프라 확대 + 기능과 역할 재정립

1. 권역응급의료센터의 지속적 확충 ?
- 10개소(00) → 20개소(12) → 39개소(15)
- 거버넌스 기능과 진료기능을 동시에 부여하는 구조
→ 추가 지정 · 운영을 통한 문제해결의 한계
2. 지역응급의료센터에 응급응급환자 진료기능 명시 ?
- 다양한 스펙트럼 (상급종합 19, 대학병원 26, 그 외 80)
- 기준과 기능 강화 → 센터와 기관의 재편으로 귀결
- '센터'와 '기관' → 명칭은 합리적으로 표현되고 있는가

개편방향

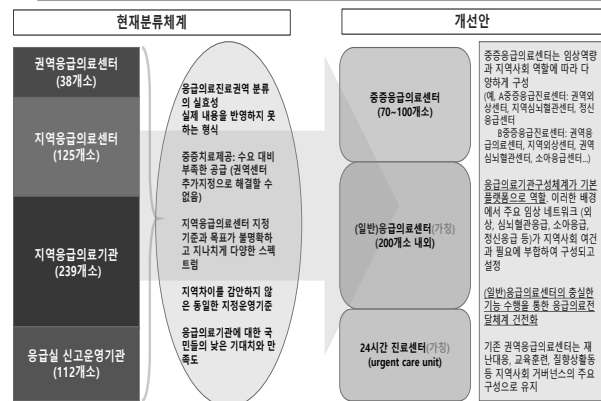
응급의료기관 분류체계 개편은

- 수요 공급 고려 응급응급진료제공 인프라 확충
- 내용을 담을 수 있는 형식으로서 응급의료기관분류체계:
- 대형병원의 응급응급진료기능 수행 반영 - 인구/수요/지역 대비 적절한 분포 - 명칭이 역할과 연계
- 일반(비중증) 응급환자에 대한 치료 제공 강화

- ① (중증응급의료센터) 응급응급환자에 대한 신속하고 전문적인 최중증치료 제공(약 70개소~100개소)
- 70개 중증응급의료센터 지정, 응급응급환자 등 응급응급환자 진료역량
* 취직지 등은 지역책임병원(공공의료체계 강화방안) 지정상황 등 고려 추진
- ② (일반 응급의료센터, 가정) 비중증 응급환자 진료, 응급환자는 안정화 및 이송
- 중증응급환자, 응급응급환자 등 시설장비 구비
- ③ (24시간 진료센터, 가정) 야간·휴일 진료제공(봉합, 발열, 단순골절 등)
- 입원이 불필요한 경증 응급환자 및 비응급환자 대상, 병원급 지정

※ 권역응급의료센터는 응급응급진료센터 중에서 지정, 지역사회 재난가정병원, 교육훈련, 질향상 활동 등 거버넌스 작동의 주요 역할 수행

개편방향



기대효과와 활용방안

기대효과

- 응급의료기관 단계별 역할과 기능 재정립을 통한 중증응급환자에 대한 대응 역량 강화
- 지역 단위 응급의료서비스 접근성 향상을 통해 국민의 생명과 건강 증진

활용방안

- 지역 책임 응급의료체계 구축을 위한 전달체계 개편 및 운영에 활용

현장 적용 계획 - 중앙응급의료위원회(안)

시 기	추진 내용
'21. 상반기	- 응급의료 전달체계 개편방안 연구
'21. 하반기	- 응급의료법 개정안 마련(응급의료 전달체계 개편) * 학회 등 의견수렴 - 응급의료 전달체계 개편방안 마련(지정기준, 평가, 수가 등) * 학회 등 의견수렴
'22년	- 응급의료법 개정 및 시행 * 국회의 의결 필요 - 중증(중증)응급의료센터 지정(1차)
'23년 이후	- 중증(중증)응급의료센터 지정(2차, '25년)

법령 개정사항
○ 응급의료기관의 정의(응급의료법 제2조), 응급의료기관의 종류 및 중별 기능(제6장) 등
○ 응급의료기관 중별 지정기준 등(응급의료법 시행규칙)

→ 시기에 대한 적절한 조정과 합리적인 현장 적용 절차가 필요

고려 사항

- 현장 응급의료종사자와 기관들의 이해
- 지역 차이에 대한 고려
- 추가 재원에 대한 면밀한 검토
 - 다양하고 충분한 의견수렴 과정 → 행정적으로 합당한 현실적 개선안
- COVID-19 pandemic의 경험
 - 응급의료에 주어진 숙제 → 미래 응급의료에 대한 준비
- 전문진료체계(외상, 심뇌, 소아, 정신, 중독 등)와의 정합성

감 사 합 니 다.

yg9912@korea.ac.kr

국내 뇌졸중센터의 현황과 전망

박 희 권

인하대 신경과

국내 뇌졸중센터의 현황과 전망

2022.2.26.

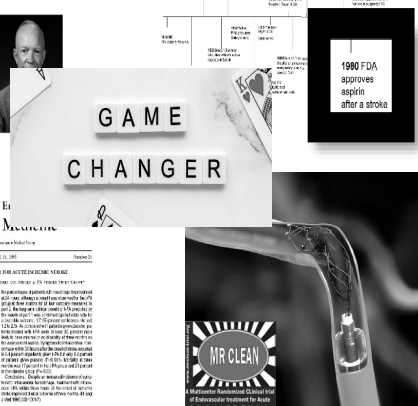
인하대병원 박희권

Disclosure

- Nothing

History of Warfarin

- In 1954, warfarin was approved for clinical use, and prescribed to President Eisenhower for an acute MI
- Prior to 2009, warfarin was the only oral anticoagulant available



When it comes to stroke:
TIME IS BRAIN.
Every 10 minutes can **SAVE**
up to 20 MILLION brain cells

Follow us @ @ @

WORLD STROKE DAY
25 MAY 2021

TIME IS BRAIN

Treatment within 1 hour of symptoms ensures the best chances of a full recovery

Treatment within 3 hours of symptoms improves chances of recovery with little or no disability

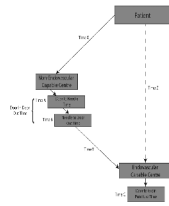
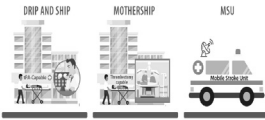
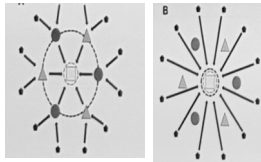
The brain ages 3.6 years each hour without treatment in the event of a stroke
"What's your reason for preventing stroke?"

NHS
NHS & NHS SUPERSTYLING
W O R L D S T R O K E D A Y

Opp. Sports College, 300m from Kapurthala Chowk, Jalandhar

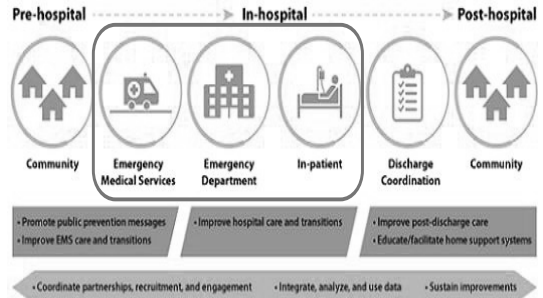
Getting patient and Team to the Right Place at Right Time

- Drip and ship
- Drip and Keep
- Mothership: Direct transportation
- Trip and Treat/drip and drive
- Hub and Spoke



Holodinsky et al. Stroke 2017

Care Continuum



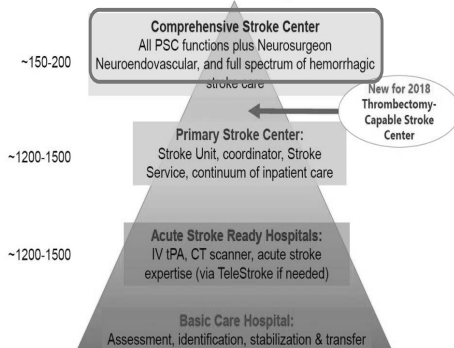
Certification of Stroke Center in US

Current Stroke Certifications



From JCI homepage

The Stroke Care Pyramid



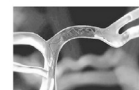
From JCI homepage

Why Thrombectomy-Capable Stroke Center (TSC) Certification?

- Recent studies have shown efficacy of mechanical thrombectomy for large vessel occlusive (LVO) ischemic strokes
- Not all PSCs are alike -1/3 of Joint Commission certified PSCs perform mechanical thrombectomy
- Importance of having a dispersed network of hospitals that are certified so patients can receive the care they need.

Recognition of Current Practice

- Approximately 1/3 of PSCs offer mechanical thrombectomy



Joint commission, TSC Overview –September 13, 2017

Positioning of Stroke Center

Table 1. Levels and Capabilities of Hospital Stroke Designation

	ASRH	PSC	TSC	CSC
Location	Likely rural	Likely urban/suburban	Likely urban	Likely urban
Stroke team accessible/available 24 h/d, 7 d/wk	Yes	Yes	Yes	Yes
Noncontrast CT available 24 h/d, 7 d/wk	Yes	Yes	Yes	Yes
Advanced imaging (CTA/CTP/MRA/MRP) available 24 h/d, 7 d/wk	No	Yes	Yes	Yes
Intensive care unit available	Yes	Yes	Yes	Yes
Thrombectomy capable	No	Possibly	Yes	Yes
Diagnoses stroke pathogenesis/manage poststroke complications	Unlikely	Yes	Yes	Yes
Admits hemorrhagic stroke	No	Possibly	Possibly	Yes
Clinical/ICU captured aneurysms	No	Possibly	Possibly	Yes
Dedicated stroke unit	No	Yes	Yes	Yes
Dedicated neurocritical care unit/ICU	No	Possibly	Possibly	Yes

ASRH indicates acute stroke-ready hospital; CSC, comprehensive stroke center; CT, computed tomography; CTA, computed tomography angiography; CTP, computed tomography perfusion; ICU, intensive care unit; MRA, magnetic resonance angiography; MRP, magnetic resonance perfusion; PSC, primary stroke center; and TSC, thrombectomy-capable stroke center.

Adeoye et al Stroke Systems of Care: A 2019 Update

The Joint Commission Stroke Certification Programs – Program Concept Comparison

Program Concept	ASRH	PSC	TSC	CSC
Eligibility	General eligibility requirements: use of a standardized method of delivering care centered on evidence-based guidelines for stroke care.	General eligibility requirements: use of a standardized method of delivering care centered on evidence-based guidelines for stroke care.	General eligibility requirements: use of a standardized method of delivering care centered on evidence-based guidelines for stroke care. *Organization must have performed mechanical thrombectomy and post-procedure care for at least 15 patients with ischemic stroke over the past 12 months (or 30 over past 24 months). *Neurointerventionalists who perform mechanical thrombectomy at the organization applying for certification must perform 15 mechanical thrombectomies over the past 12 months (or 30 over past 24 months) (procedures performed at hospitals other than the one applying for TSC certification can be included).	General eligibility requirements: use of a standardized method of delivering care centered on evidence-based guidelines for stroke care. *Treatment of 20 SAH caused by aneurysm annually (40 over 2 years) *Capable of treating aneurysms by performing 15 endovascular coiling or microvascular clipping procedures annually (30 over 2 years) *Administering IV thrombolytic therapy 25 times annually (50 times over 2 years) *Organization must have performed mechanical thrombectomy and post-procedure care for at least 15 patients with ischemic stroke over the past 12 months (or 30 over past 24 months). *Neurointerventionalists who perform mechanical thrombectomy at the organization applying for certification must perform 15 mechanical thrombectomies over the past 12 months (or 30 over past 24 months) (procedures performed at hospitals other than the one applying for TSC certification can be included).

The Joint Commission. The Stroke Certification Programs – Program Concept Comparison is used by American Heart Association/American Stroke Association with permission. Current as of 08/01/19

The Joint Commission Stroke Certification Programs – Program Concept Comparison

Program Concept	ASRH	PSC	TSC	CSC
Stroke Unit	No designated beds for acute care of stroke patients	Stroke unit or designated beds for the acute care of stroke patients	Has a neurointensive care unit or designated intensive care beds for complex stroke patients available 24/7; on-site critical care coverage 24/7	Has a neurointensive care unit or designated intensive care beds for complex stroke patients available 24/7; on-site critical care coverage 24/7
Neurological Services	Within 3 hours (provided through transferring the patient)	Within 2 hours; OR is available 24/7 in PSCs providing neurological services	Within 2 hours; OR is available 24/7 in TSCs providing neurological services	24/7 availability: Neurointerventionist; Neurodiagnostic; Neurologic; Neurosurgery
Staff Stroke Education Requirements	ED staff – a minimum of twice a year; core stroke team at least 4 hours annually	ED staff – a minimum of twice a year; core stroke team at least 8 hours annually	Nurses and other ED staff – 2 hours annually; Stroke nurses and core stroke team – 8 hours annually	Nurses and other ED staff – 2 hours annually; Stroke nurses and core stroke team – 8 hours annually
Provision of Educational Opportunities	Provides educational opportunities to prehospital personnel	Provides educational opportunities to prehospital personnel; Provides at least 2 stroke education activities per year to public	Provides educational opportunities to prehospital personnel; Provides at least 2 stroke education activities per year to public	Sponsors at least 2 public educational opportunities annually; LPs and staff present 2 or more educational courses annually for internal staff or individuals external to the comprehensive stroke center (e.g., referring hospitals)

The Joint Commission. The Stroke Certification Programs – Program Concept Comparison is used by American Heart Association/American Stroke Association with permission. Current as of 08/01/19

Program Concept	ASRH	PSC	TSC	CSC
Clinical Performance Measures	Standardized Measures: 3 inpatient ASR-PP and 2 inpatient ASR-PP acute stroke ready measures for a total of 5 measures.	Standardized Measures: 8 inpatient stroke (STR), 2 outpatient (STR-PP) measures, and 1 ischemic comprehensive stroke (CSTR-CL) measures for a total of 11 measures.	Standardized Measures: 8 inpatient STR measures and 5 ischemic comprehensive stroke measures for a total of 13 measures.	Standardized Measures: 8 inpatient STR measures and 10 comprehensive stroke measures (ischemic and hemorrhagic) for a total of 18 measures.
Research	N/A	N/A	N/A	Participates in patient-centered research that is approved by the IRB
Guidelines	Recommendations from Brain Attack Coalition for Acute Stroke Ready Hospitals, 2013 2018 Guidelines for the Early Management of Patients with Acute Ischemic Stroke: A Guideline for Healthcare Professionals from the American Heart Association/American Stroke Association	Recommendations from Brain Attack Coalition for Primary Stroke Centers, 2011 2018 Guidelines for the Early Management of Patients with Acute Ischemic Stroke: A Guideline for Healthcare Professionals from the American Heart Association/American Stroke Association	AHA/ASA Focused Update for the Early Management of Patients with Acute Ischemic Stroke: A Guideline for Healthcare Professionals from the American Heart Association/American Stroke Association 2018 Guidelines for the Early Management of Patients with Acute Ischemic Stroke: A Guideline for Healthcare Professionals from the American Heart Association/American Stroke Association	Recommendations from Brain Attack Coalition for Comprehensive Stroke Centers, 2005 2018 Guidelines for the Early Management of Patients with Acute Ischemic Stroke: A Guideline for Healthcare Professionals from the American Heart Association/American Stroke Association
Review	One Reviewer, One Day	One Reviewer, One Day	One Reviewer, Two Days	Two Reviewers, Two Days

The Joint Commission. The Stroke Certification Programs – Program Concept Comparison is used by American Heart Association/American Stroke Association with permission. Current as of 08/01/19

Staffing Key Areas

NICU STAFFING

- Dedicated Neuro-intensive care beds
- 24/7 on-site care by a neurointensivist, fellows, residents

NEURO SURGERY

- Stroke surgeon must be able to demonstrate the ability to care for two complex stroke patients at one time with appropriate providers
- Be prepared to discuss and document your neurosurgical coverage including on call and back up on call MDs and staff for 24/7 coverage.

IR

- IR must be able to demonstrate the ability to care for two complex stroke patients at one time with appropriate providers

* Note: please see Joint Commission standards for explanation referring back to this section.

- Be prepared to discuss and document your IR coverage including on call and back up on call MDs and staff for 24/7 coverage.

STROKE RESEARCH

- Active IRB's
- Currently enrolling patients

Tips for Our Customers

- The Stroke Coordinator should be available to accompany the reviewer for the on-site event.
- The Medical Director should be available to respond to reviewer's questions as needed during the on-site event.
- Be prepared to discuss how you care for two stroke cases at one time (ED, ICU, IR, neurosurgery)
- All staff should be prepared to discuss their stroke education on a yearly basis:
 - Physicians (ED, ICU, Neuro, IR)
 - Other staff (ED, ICU, step-down units, IR, etc.)
 - OT/PT/Speech/Case Managers, if they are part of the core stroke team
- All staff should be able to demonstrate to the reviewer how they find CPT's and additional resources in their department (electronically and printed in applicable).
- Short term and long term goals must be documented in the MR, other clinical recording.
- Documentation in the MR should demonstrate the patient is involved in goal setting.
- Patient/care give education regarding stroke care should be readily visible in every chart.
- Reviewers will speak to EMs providers if they are in the ED at the time of the tracer.
- Ensure your CMIP data is up to date
- Provide for two teams with scribes and your observers.

2018 Checklist for Applying for CSC

CURRENT VOLUMES

- 20 SAH by aneurysm per year
- 15 endovascular coiling and surgical clippings per year for aneurysm
- 25 tPA eligible patients per year (50 over 2 years)
- IV tPA ordered & monitored via telemedicine at another hospital is acceptable
- IV tPA administered at outside hospital and transferred to CSC site is acceptable

POST-HOSPITAL CARE COORDINATION

- Follow up phone calls (home/transfers)
- Involvement of case managers/social workers
- Physical Therapy involvement
- Occupational Therapy involvement
- Speech Therapy involvement
- Review of all information gathered from phone calls/transfers must be utilized to drive a dynamic change in the program. Prepare to speak to this process.
- Multi-disciplinary teams should be able to discuss intervention and involvement of the teams into the patient's plan of care, teaching, goal setting with the patient/family, assuring the goals are individualized to meet the needs of the patient.
 - Discussion of risk factors and strategies for modifications.
 - Discussion of the patient's willingness and ability to learn.
 - Discussion of support services: dietary, activity, medications, follow up appointments and other self-support requirements.

Key differences

	TSC	CSC
MT	15/y	N/A
SAH	N/A	20/y
Intervention for Aneurysm	N/A	15/y
Interventionist Competency	CAST-certified 15MT/yr	CAST-certified 15MT/yr
SU /ICU	Yes Critical Care services	Yes Neuro-Critical Care services
24/7 Neurosurgical Services	Not Mandatory	Mandatory
Research	N/A	Required (IRB)
Rehabilitation	N/A	Required (speech/occupation)
Multi-disciplinary Team	possible	Required (2 complex stroke at one time)
Guidelines	AHA/ASA, Joint Commission	AHA/ASA, Joint Commission 2005 Brain attack Coalition

**COVID-19 로 계속 구체적인 숫자는 변경중임.

SVIN 2018

History of CSC Certification Development -Limitation of Stroke Center before certification

- Many iv tPA cases but **DTN time < 1hr** for **only 25% Pts**
- Inaccurate Stroke type(etiology)
- No data about **Early Neurological Deficit** or other complication
- **Many Transfer d/t NICU and specialist**

Cramer et al 2012
Gibbs et al 2013

Concept of Comprehensive Stroke Center (2013)

- Provides complete care to patients
- with **the worst, most severe, most complex strokes**
 - Large ischemic strokes (might need ICP interventions)
 - ICH
 - SAH
 - Multi-system disease
 - Cryptogenic strokes
- Might require **surgical or endovascular** therapy
- Might require **NICU** level care
- Has all services **available 24/7, 365 days/year**

Alberts et al. 2013

Concept of Comprehensive Stroke Center (2021)

- Number of CSCs in US. 113(2015)→ 194(2020.5.)
- Definition: The comprehensive stroke center (CSC) is the **highest level of stroke care** with a comprehensive team of **vascular neurologists, neurosurgeons, vascular surgeons** who perform treatments with tPA for **Complex Stroke** on and door-needle **Emergency** imaging and **other more complex measures** making it an all-in-one shop for acute stroke patients. **Multi-disciplinary Team** the most advanced instrumentations key to deliver endovascular therapy continues to advance, the stroke system will continue to evolve.

Waldman et al. 2021

Certification of Stroke Center in Europe & UK

ESO SUC background



- **Mandate from the ESO Ex-Committee:** certification processes for SU and SC – 2007
- **ESO Recommendations** to establish a SU and SC
Ringelstein BE et al. Stroke 2013;44:828-40
- **Application forms**
Lyrer P et al. Web-site publishing, ESOC 2016
- **ESO Guideline Certification of SU and SC**
Waje-Andreassen U et al. Eur Stroke J 2018;3:220-26

ESOC 2021

Service Elements of Stroke Centers versus Stroke Units



Stroke Center	Stroke Unit
IV Thrombolysis	IV Thrombolysis
Endovascular Revascularisation	e.g. Drip & ship
Stroke Physician	Stroke Physician
Diagnostic/interventional Neuroradiology	
Angiography (DSA) 24/7	
CT & MRT 24/7	CT 24/7
6 beds with automated monitoring	4 beds with automated monitoring
Acute Strokes treated/y : minimum 400	Acute Strokes treated/y: minimum 200
Standard Operating Procedures	Standard Operating Procedures

ESOC 2021

Definitions

Ringelstein et al. Stroke 2013;44:828-40



Stroke Unit

A dedicated geographically clearly defined area or ward in a hospital, where stroke patients are admitted and cared for by a multi-professional team (medical, nursing, and therapy staff) who have specialist knowledge, training and skills in stroke care with well-defined individual tasks, regular interaction with other disciplines, and stroke leadership. This team co-ordinates care through regular (weekly) multidisciplinary meetings.

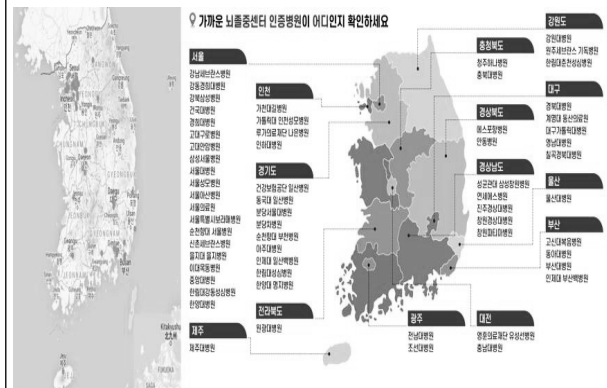
Stroke Centre

A hospital infrastructure and related processes of care that provide the full pathway of stroke unit care. A stroke centre is the co-ordinating body of the entire chain of care. This covers pre-hospital care, ongoing rehabilitation and secondary prevention, and access to neurosurgical and vascular intervention. A stroke unit is the most important component of a stroke centre. An ESO Stroke Centre provides stroke unit services for the population of its own catchment area and serves as a referral centre for peripheral hospitals with ESO stroke units in case their patients need services which are not available locally.

ESOC 2021

In Korea

뇌졸중센터



뇌졸중센터 인증 고도화 및 확대

1주기 (2018년 ~ 2021년)

2주기 (2021년 ~)

목적 및 정리

뇌졸중 센터
(70개 센터)

뇌졸중센터
(SU, tPA 등)

- EVT등의 중요성에 따른 인증제도 고도화
- 질적/양적 향상 보조

재관류치료 뇌졸중센터
(뇌졸중센터 + 혈전제거술)

- 학회 차원의 교육/ QI등의 환자관리 체계 도움

비참여병원

뇌졸중 교육, DB 관리
도움

인증 병원 확대

Concern

1. Why apply for Certificaton?

Session II. 뇌혈관질환정책 – 뇌혈관질환 센터, 어느 방향으로 가야 하는가?

Quick Guide Comprehensive Stroke Center (CSC) Certification



Your inside track for applying, on-site process checklists, helpful tips, and more.

Benefits in CSC

- Designation for excellence in the care of stroke patients
- Creates a loyal, cohesive clinical team
- Assists organizations in establishing a consistent approach to care, reducing variation and the risk of error
- Demonstrates commitment to a higher standard of clinical service
- Provides a framework to improve patient outcomes
- Helps to organize teams across the continuum of care
- **Provides a competitive edge in the marketplace**
 - supports marketing, contracting and reimbursement
- Enhances the facility's ability to attract top-level talent
- **Strengthens community confidence** in the quality and safety of care, treatment and services
- Potential to **increase patient volumes due to EMS routing protocols**

From JC, homepage

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From JC, homepage

2. Optimal Number of CSCs in Korea

Comprehensive

Covering a wide range; being thorough; and including everything. Another synonym for comprehensive is exhaustive – these two words used together might describe an academic study or research project.

Comprehensive

Concept of Comprehensive Stroke Center (2021)

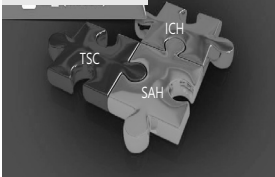
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imaging and **other more complex measures** making it an **all-in-one shop** for acute stroke patients. Co

advanced instrumente **Multi-disciplinary Team : all in one shop** the most continues to advance, the stroke

TSC+ICH, SAH



TSC+ICH, SAH
+AVM
+CEA
+Rehab
+Neurocritical Care
+Research + ...

→ all-in-one shop



Strategy Algorithm

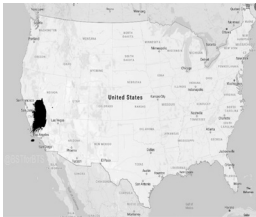
The Drip 'n Ship Strategy vs The mothership or bypass Strategy

The 2018 AHA/ASA guidelines state, "It remains unknown whether it would be beneficial for emergency medical services to bypass a closer IV tPA-capable hospital for a thrombectomy-capable hospital."



뇌졸중 재개통 심포지엄 및
대한뇌혈관내치료의학회 춘계보수교육

	Population (2018)	Gross Domestic Product (2016)	Total Area	CSCs(N)
South Korea	51 million	\$1.4 trillion	100,032 km ²	??
California	40 million	\$2.6 trillion	423,970 km ²	9
Germany	83 million	\$ 3.8 billion	357,022 km ²	36



United States

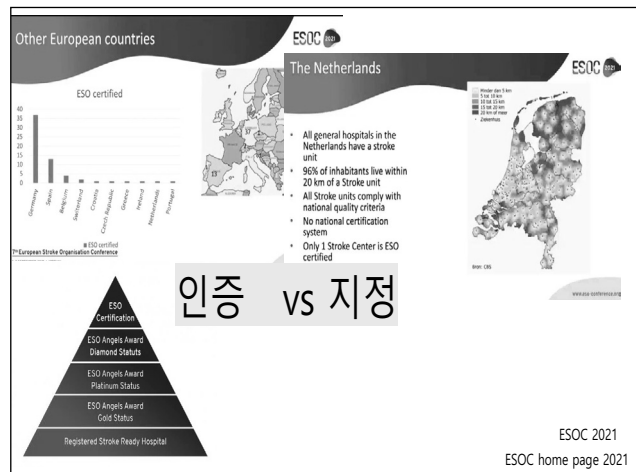
List of stroke centers in the United States

California	Golden State Hospital	Los Angeles	Los Angeles
California	Johns Hopkins at Irvine	Whittier/Fullerton	Fullerton area
California	Kaiser Permanente Northern California Department	San Jose	San Jose
California	Harborview Medical Center/Hopkins	Seattle	Los Angeles
California	Good Samaritan Hospital	San Jose	San Jose
California	Sevenson Medical Center/Kaiser Permanente	San Jose	San Jose
California	Two Rivers Hospital/Good Samaritan Hospital/University of Michigan	Ypsilanti	San Jose
California	Stanford Health Care Comprehensive Stroke Center	Palo Alto	San Jose
California	UC Davis Medical Center	San Francisco	San Francisco

California: 9 CSCs

Reference	California(9)	Germany(36)
GDP	5	13
Population	11	22
Area	3	10

Wikipedia 2021.12



권역 심뇌혈관센터

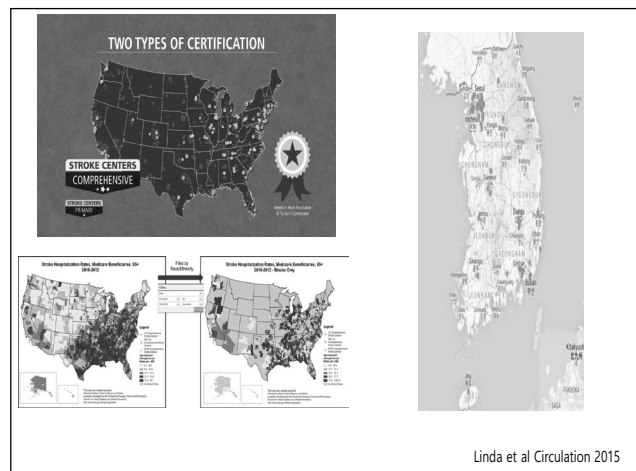
Stroke unit

지역 뇌혈관(뇌졸중)센터

권역/지역 응급센터,

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뇌졸중 센터/재관류치료 전문 뇌졸중 센터



In conclusion

- Time is Brain
- Right Organization Healthcare is needed
For **Optimal** acute ischemic Stroke treatment
(**Right patients , Right time and Right Place**)
- **Concept of Stroke Center certification** would be prepared by multidisciplinary approach and might be **modified for the Korean clinical environment.**

2022 뇌졸중 재개통 심포지엄 및 대한뇌혈관내치료의학회 춘계보수교육

Session III

Review of the latest evidences (1) – The updates

좌장: 윤석만 (순천향대), 권순찬 (울산대)

New targets of EVT: TIMI, TICI, mTICI, and eTICI

Update of EVT techniques: CAT vs SRT vs combination

Update of recent EVT guidelines

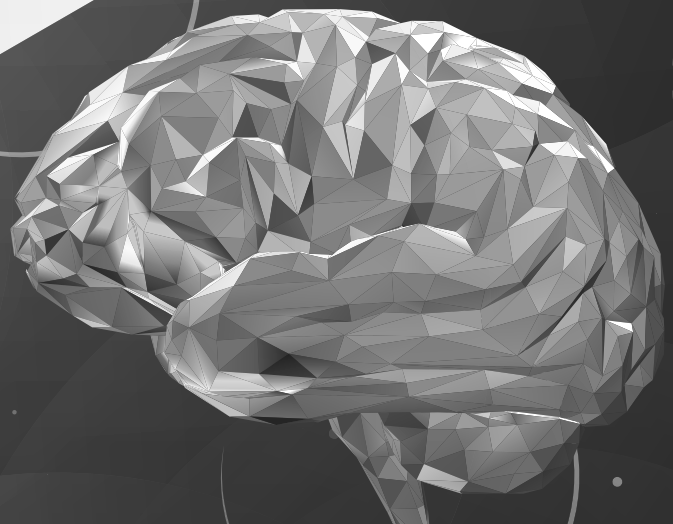
EVT for posterior circulations stroke

김명진 (가천대)

손원수 (경북대)

김소연 (가톨릭관동대)

김영수 (에스포항병원)



New targets of EVT: TIMI, TICI, mTICI, and eTICI

김 명 진

가천대

Revascularization is variably defined in acute ischemic stroke (AIS) studies as recanalization, which represents restoration of vessel patency at the site of occlusion; angiographic reperfusion, which includes contrast opacification of the distal arterial territory; and a combination of these definitions. Recanalization does not guarantee angiographic or tissue reperfusion, as the no-reflow phenomenon may preclude perfusion of target tissue because of distal branch occlusions, despite restoration of proximal vessel patency.

Reperfusion refers to antegrade perfusion of patent microvasculature supplying the target tissue after recanalization. It is important to note that distal territory may also receive perfusion in a retrograde flow pattern from collateral supply; therefore, angiographic perfusion distinctly involves perfusion of distal territory in an antegrade manner following recanalization.

Recanalization scoring seems to be intuitive, requiring grading of vessel patency or, in other words, residual clot burden. Reperfusion, on the other hand, involves a more intricate set of parameters including distinguishing antegrade perfusion, quantifying the extent of the reperfused vascular bed, and accessing the perfusion time.

The association between adequate recanalization and good functional outcome has been well-documented in several studies. However, the definition of 'successful' or adequate recanalization/reperfusion as an angiographic endpoint for treatment effect in such trials has become increasingly varied and confusing.

Thrombolysis In Myocardial Infarction (TIMI) scale

The TIMI Study Group devised the first angiographic score for reperfusion in acute myocardial infarction. In AIS trials, TIMI has been applied in a variable manner and with variable operating definitions to assess recanalization, angiographic reperfusion, or both (table1). Some applications of the TIMI scale that have been associated with clinical functional outcomes have been demonstrated in studies of in-

tra-arterial thrombolysis for AIS. However, the variability in the operating manual/grading definition of the TIMI scoring system was the main disadvantage of its use across clinical trials.

Table 1. Thrombolysis In Myocardial Infarction (TIMI)

Grade	Definitions
0	Absence of any antegrade flow beyond the target occlusion (no perfusion)
1	Any faint antegrade flow beyond the target occlusion, with incomplete filling of the distal branches (penetration without perfusion)
2	Delayed or sluggish antegrade flow with complete filling of the distal M2 branches flow (partial perfusion)
3	Normal flow that fills all distal branches, including M3 and M4 (complete perfusion)

Thrombolysis In Cerebral Infarction (TICI) scale

With the growth of AIS studies, standards for design and reporting were proposed in 2003 by Higashida et al., including recommendation of the TICI scale (table 2). This scale is a modified version of the TIMI scale that provides a subcategorization of the second perfusion score into grades 2a and 2b. The TICI grading approach uses contrast filling and clearance time to further stratify the wide range of partial perfusion that exists between the TIMI grade 1 (minimal perfusion) and 3 (complete reperfusion).

Table 2. Thrombolysis In Cerebral Infarction (TICI)

Grade	Definitions
0	<u>No perfusion</u> . No antegrade flow beyond the point of occlusion.
1	<u>Penetration with minimal perfusion</u> . The contrast material passes beyond the area of obstruction but fails to opacify the entire cerebral bed distal to the obstruction for the duration of the angiographic run.
2	<u>Partial Perfusion</u> . The contrast material passes beyond the obstruction and opacifies the arterial bed distal to the obstruction. However, the rate of entry of contrast into the vessel distal to the obstruction and/or its rate of clearance from distal bed are perceptibly slower than its entry into and/or clearance from comparable areas not perfused by the previously occluded vessel, eg, the opposite cerebral artery or the arterial bed proximal to the obstruction.
2a	Only partial filling ($< \frac{2}{3}$) of the entire vascular territory is visualized.
2b	Complete filling of all of the expected vascular territory is visualized, but the filling is slower than normal
3	<u>Complete Perfusion</u> . Antegrade flow into the bed distal to the obstruction occurs as promptly as into the obstruction and clearance of contrast material from the involved bed is as rapid as from an uninvolved other bed of the same vessel or the opposite cerebral artery.

Modified TICl

Subsequently, the original TICl grade system was modified to mTICl by the IMS investigators, which uses a threshold of more than half of the target downstream territory (table 3).

Table 3. Modified TICl

Grade	Definitions
0	No perfusion
1	Perfusion past the initial obstruction but limited distal branch filling with little or slow distal perfusion
2	Perfusion with incomplete or slow distal branch filling
2a	Perfusion of less than half of the vascular distribution of the occluded artery (eg, filling and perfusion 1 M2 division)
2b	Perfusion of half or greater of the vascular distribution of the occluded artery (eg, filling and perfusion 2 or more M2 divisions)
3	Full perfusion with filling of all distal branches, including M3, M4

However, it has been shown that patients with TICl 2b reperfusion has a poorer outcome than patients with complete (TICl 3) reperfusion. Thus, recent studies have proposed to add mTICl 2c (near-complete perfusion except for slow flow in a few distal cortical vessels or presence of small distal cortical emboli) as a new reperfusion grade (table 4). Indeed, patients achieving mTICl 2c may have better functional outcomes than those achieving TICl 2b reperfusion and may resemble the clinical course of patients with TICl 3 reperfusion.

Table 4. Modified TICl with 2c

Grade	Definitions
0	No perfusion beyond the occlusion
1	Penetration but not perfusion. Contrast penetration exists past the initial obstruction but with minimal filling of the normal territory
2	Partial perfusion with incomplete distal branch filling
2a	Partial perfusion with incomplete distal branch filling of < 50% of the expected territory
2b	Partial perfusion with incomplete distal branch filling of ≥ 50%-99% of the expected territory
2c	Near complete perfusion without clearly visible thrombus but with delay in contrast run-off
3	Full perfusion with normal filling of all distal branches of the expected territory in a normal hemodynamic fashion

Extended TICI

Since the original description of TICI, several intermediate grades of reperfusion have been introduced. The entire range of grade 2 TICI reperfusion, extending from a minimum of any distal branch filling to almost complete downstream perfusion, has been subdivided and confusingly labeled with inconsistent terminology.

For standardization TICI grading in clinical practice and future trial, Liebeskind et al. (2019) reestablished previous mTICI scoring system using individual patient data in the Highly Effective Reperfusion Evaluation in Multiple Endovascular Stroke (HERMES) trials that comprise the majority of randomized controlled trials undertaken with modern endovascular treatments (table 5). Previously established consensus recommendations for angiographic standards in endovascular therapy have defined successful reperfusion as exceeding 50% of the territory. However, the investigators have demonstrated that within the > 50% reperfusion category, a considerable number of cases fell into the finer subdivisions of 50-66%, 67-89%, and 90-99%, and that these refinements identify meaningful differences in clinical outcomes.

Table 5. Extended TICI

Grade	Definitions
0	No perfusion or 0% filling of downstream territory
1	Thrombus reduction without any reperfusion of distal arteries
2a	Reperfusion in less than half or 1-49% of the territory
2b50	50-66% reperfusion; exceeding mTICI 2b threshold (below original TICI 2b cut-off point)
2b67	67-89% reperfusion; exceeding mTICI 2b threshold (below mTICI 2c)
2c	90-99% reperfusion
3	Complete or 100% reperfusion

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Update of EVT techniques: CAT vs SRT vs combination

손 원 수

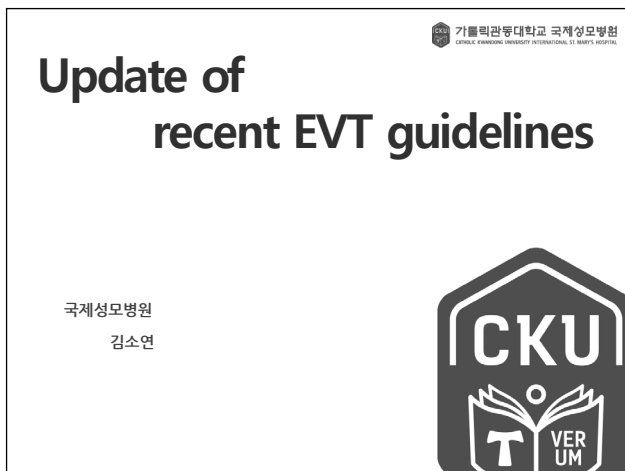
경북대

Endovascular thrombectomy has been recently validated in several randomized controlled trials. Accordingly, it is now the standard of care according to international guidelines. In this report the author provides a comprehensive review of the latest developments in the field of endovascular treatment. This review includes the evolution of device technologies and Tactics.

Update of recent EVT guidelines

김 소 연

가톨릭관동대



목차

- 1. Mechanical Thrombectomy
 - 1. Concomitant with iv Alteplase
 - 2. 0 to 6 Hours From Onset
 - 3. 6 to 24 Hours From Onset
 - 4. Technique
 - 5. BP Management
- 2. Other Endovascular Therapies

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1. Mechanical thrombectomy

1. Concomitant with iv Alteplase

3.7.1. Concomitant With IV Alteplase	COR	LOE
1. Patients eligible for IV alteplase should receive IV alteplase even if mechanical thrombectomy is being considered.	I	A

3.7.1. Concomitant With IV Alteplase (Continued)	COR	LOE
2. In patients under consideration for mechanical thrombectomy, observation after IV alteplase to assess for clinical response should not be performed.	III: Harm	B-R

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1. Mechanical thrombectomy

2. 0 to 6 Hours From Onset

3.7.2. 0 to 6 Hours From Onset	COR	LOE
1. Patients should receive mechanical thrombectomy with a stent retriever if they meet all the following criteria: (1) prestroke mRS score of 0 to 1; (2) causative occlusion of the internal carotid artery or MCA segment 1 (M1); (3) age ≥ 18 years; (4) NIHSS score of ≥ 6 ; (5) ASPECTS of ≥ 6 ; and (6) treatment can be initiated (groin puncture) within 6 hours of symptom onset.	I	A

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CORR: MECHANICAL THROMBECTOMY: 01 MEAT'S KEYNOTE | 5

1.2. 0 to 6 Hours From Onset

3.7. Mechanical Thrombectomy (Continued)	COR	LOE
12. The use of mechanical thrombectomy devices other than stent retrievers as first-line devices for mechanical thrombectomy may be reasonable in some circumstances, but stent retrievers remain the first choice.	IIb	B-R

Changed

3.7.2. 0 to 6 Hours From Onset (Continued)	COR	LOE
2. Direct aspiration thrombectomy as first-pass mechanical thrombectomy is recommended as noninferior to stent retriever for patients who meet all the following criteria: (1) prestroke mRS score of 0 to 1; (2) causative occlusion of the internal carotid artery or M1; (3) age ≥ 18 years; (4) NIHSS score of ≥ 6 ; (5) ASPECTS ≥ 6 ; and (6) treatment initiation (groin puncture) within 6 hours of symptom onset.	I	B-R

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COMPASS, 2019 Lancet

Aspiration thrombectomy versus stent retriever thrombectomy as first-line approach for large vessel occlusion (COMPASS): a multicentre, randomised, open label, blinded outcome, non-inferiority trial

Aquila S, Turk W, Adnan Siddiqui, Johanna T Fijl, Rosalee A DeLacy, David J Flinn, Eugene Gu, Elad Levy, Kenneth V Stryker, Ricardo A Hanel, Amin Aghaebrahim, B Keith Woodward, Harry R Hoon, Mohammed Chaudry, Alejandro M Spietta, Anwar T Rai, Donald Frei, Josselyn E Delgado Almandoz, Mike Kelly, Adam Arthur, Blake Baxter, Joey English, Italo Linfante, Kyle M Fargen, J Mocco

- Inclusion criteria**
 - (1) prestroke mRS 0 to 1; (2) causative occlusion of the ICA or M1;
 - (3) age ≥ 18 years; (4) NIHSS score of ≥ 5 ; (5) ASPECTS ≥ 6 ;
 - (6) groin puncture within 6 hours of symptom onset to aspiration or stentriever as first-line technique
- Primary outcome** - noninferiority of mRS score at 90 days
- mRS score of 0 to 2** - 69/134 (52%) in the aspiration group vs 67/36 (50%) in the stentriever group ($P_{\text{noninferiority}}=0.0014$)

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ASTER, 2017 JAMA

Original Investigation
August 1, 2017

Effect of Endovascular Contact Aspiration vs Stent Retriever on Revascularization in Patients With Acute Ischemic Stroke and Large Vessel Occlusion

The ASTER Randomized Clinical Trial

Bertrand Laperque, MD, PhD¹, Raphael Blanc, MD, MSc², Benjamin Gory, MD, PhD³, et al.
> Author Affiliations | Article Information
JAMA. 2017;318(5):443-452. doi:10.1001/jama.2017.9644

- Primary outcome – successful revascularization**
85.4% in contact aspiration group vs 82.1% in stent retriever group ($P=0.53$)
- Failed superiority trial**
→ Underpowered to demonstrate a significant difference between the two techniques

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Penumbra Separator 3D trial, 2017 JAMA Neurology

Original Investigation
March 2018

Safety and Efficacy of a 3-Dimensional Stent Retriever With Aspiration-Based Thrombectomy vs Aspiration-Based Thrombectomy Alone in Acute Ischemic Stroke Intervention

A Randomized Clinical Trial

Raul G. Nogueira, MD¹, Donald Frei, MD², Jawad F. Kirmani, MD³, et al.
> Author Affiliations | Article Information
JAMA Neurol. 2018;75(3):304-311. doi:10.1001/jamaneurol.2017.3967



- 3-D stent retriever + aspiration vs aspiration alone**
- Within 8 hours**
- Primary end point : mTICI 2 or 3**
- 87.2% in combination group vs 82.3% in aspiration along group

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CORR: MECHANICAL THROMBECTOMY: 01 MEAT'S KEYNOTE | 9

1.2. 0 to 6 Hours From Onset

3. Although the benefits are uncertain, the use of mechanical thrombectomy with stent retrievers may be reasonable for carefully selected patients with AIS in whom treatment can be initiated (groin puncture) within 6 hours of symptom onset and who have causative occlusion of the MCA segment 2 (M2) or MCA segment 3 (M3) portion of the MCAs.	IIb	B-R
4. Although its benefits are uncertain, the use of mechanical thrombectomy with stent retrievers may be reasonable for patients with AIS in whom treatment can be initiated (groin puncture) within 6 hours of symptom onset and who have prestroke mRS score >1 , ASPECTS <6 , or NIHSS score <6 , and causative occlusion of the internal carotid artery (ICA) or proximal MCA (M1).	IIb	B-R
5. Although the benefits are uncertain, the use of mechanical thrombectomy with stent retrievers may be reasonable for carefully selected patients with AIS in whom treatment can be initiated (groin puncture) within 6 hours of symptom onset and who have causative occlusion of the anterior cerebral arteries, vertebral arteries, basilar artery, or posterior cerebral arteries.	IIb	C-LD

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CORR: MECHANICAL THROMBECTOMY: 01 MEAT'S KEYNOTE | 10

1. Mechanical thrombectomy

3. 6 to 24 Hours From Onset

NEW

3.7.3. 6 to 24 Hours From Onset	COR	LOE
1. In selected patients with AIS within 6 to 16 hours of last known normal who have LVO in the anterior circulation and meet other DAWN or DEFUSE 3 eligibility criteria, mechanical thrombectomy is recommended.	I	A
2. In selected patients with AIS within 16 to 24 hours of last known normal who have LVO in the anterior circulation and meet other DAWN eligibility criteria, mechanical thrombectomy is reasonable.	Ila	B-R

1.3. 6 to 24 Hours From Onset

DAWN, 2018 NEJM

Thrombectomy 6 to 24 Hours after Stroke with a Mismatch between Deficit and Infarct

R.G. Nogueira, A.P. Jadhav, D.C. Haussen, A. Bonafe, R.F. Budzik, P. Bhuva, D.R. Yavagal, M. Ribo, C. Cognard, R.A. Hanel, C.A. Sila, A.E. Hassan, M. Millan, E.I. Levy, P. Mitchell, M. Chen, J.D. English, Q.A. Shah, F.L. Silver, V.M. Pereira, B.P. Mehta, B.W. Baxter, M.G. Abraham, P. Cardona, E. Veznedaroglu, F.R. Hellinger, L. Feng, J.F. Kirmani, D.K. Lopes, B.T. Jankowitz, M.R. Frankel, V. Costalat, N.A. Vora, A.J. Yoo, A.M. Malik, A.J. Furlan, M. Rubiera, A. Aghaebrahim, J.-M. Olivot, W.G. Tekle, R. Shields, T. Graves, R.J. Lewis, W.S. Smith, D.S. Liebeskind, J.L. Saver, and T.G. Jovin, for the DAWN Trial Investigators*

- **6-24 hours**
- **Clinical-core mismatch-NIHSS score and imaging(CTP or DW-MR)**
- **A clinical-core mismatch according to age:**
 - Age ≥ 80 years: NIHSS ≥ 10 and an infarct volume
 - Age < 80 years: NIHSS 10 to 19 and an infarct volume < 31 mL
 - Age < 80 years: NIHSS ≥ 20 and an infarct volume < 51 mL
- **Overall benefit in function outcome at 90 days in the treatment group (49% vs 13%)**

1.3. 6 to 24 Hours From Onset

DEFUSE 3, 2018 NEJM

Thrombectomy for Stroke at 6 to 16 Hours with Selection by Perfusion Imaging

G.W. Albers, M.P. Marks, S. Kemp, S. Christensen, J.P. Tsai, S. Ortega-Gutierrez, R.A. McTaggart, M.T. Torbey, M. Kim-Tenser, T. Leslie-Mazwi, A. Sarraj, S.E. Kasner, S.A. Ansari, S.D. Yeatts, S. Hamilton, M. Mlynash, J.J. Heit, G. Zaharchuk, S. Kim, J. Carrozella, Y.Y. Palesch, A.M. Demchuk, R. Bammer, P.W. Lavori, J.P. Broderick, and M.G. Lansberg, for the DEFUSE 3 Investigators*

- **6-16 hours**
- **Perfusion-core mismatch and maximum core size**
- **A target mismatch profile :**
 - Ischemic core volume < 70 ml
 - mismatch ratio > 1.8 , mismatch volume > 15 ml
- **benefit in functional outcome at 90 days in the treated group (44.6% vs 16.7%)**

1. Mechanical thrombectomy

4. Technique

3.7.4. Technique	COR	LOE
1. Use of stent retrievers is indicated in preference to the Mechanical Embolus Removal in Cerebral Ischemia (MERCI) device.	I	A
2. The technical goal of the thrombectomy procedure should be reperfusion to a modified Thrombolysis in Cerebral Infarction (mTICI) grade 2b/3 angiographic result to maximize the probability of a good functional clinical outcome.	I	A
3. To ensure benefit, reperfusion to mTICI grade 2b/3 should be achieved as early as possible within the therapeutic window.	I	A

1.4. Technique

NEW

4. In the 6- to 24-hour thrombectomy window evaluation and treatment should proceed as rapidly as possible to ensure access to treatment for the greatest proportion of patients.	I	B-R
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- **mRS scale distribution declined with longer time from symptom onset to expected arterial puncture**
- **Each 1-hour delay to reperfusion**
 - less favorable degree of disability (cOR, 0.84; ARD, -6.7%),
 - less functional independence (OR, 0.81; ARD, -5.2%)

1.4. Technique

3.7.4. Technique (Continued)	COR	LOE
5. It is reasonable to select an anesthetic technique during EVT for AIS on the basis of individualized assessment of patient risk factors, technical performance of the procedure, and other clinical characteristics.	Ila	B-R
6. The use of a proximal balloon guide catheter or a large-bore distal-access catheter, rather than a cervical guide catheter alone, in conjunction with stent retrievers may be beneficial.	Ila	C-LD
7. Treatment of tandem occlusions (both extracranial and intracranial occlusions) when performing mechanical thrombectomy may be reasonable.	Iib	B-R

1.4. Technique

NEW

8. The safety and efficacy of IV glycoprotein IIb/IIIa inhibitors administered during endovascular stroke treatment are uncertain.	IIb	C-LD
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- IV glycoprotein IIb/IIIa inhibitors, including abciximab
- limited literatures - case series and retrospective reviews of single-center databases
- Mostly administration of IV GP IIb/IIIa inhibitors to prevent thrombus formation during emergent CAS or VBA stenting and EVT

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1.4. Technique

9. Use of salvage technical adjuncts, including intra-arterial fibrinolysis, may be reasonable to achieve mTICI grade 2b/3 angiographic results.	IIb	C-LD
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- Usage as rescue therapy, but no effect on outcomes

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1.4. Technique

5. BP Management

NEW

3.7.5. Blood Pressure Management	COR	LOE
1. In patients who undergo mechanical thrombectomy, it is reasonable to maintain the BP at $\leq 180/105$ mm Hg during and for 24 hours after the procedure.	IIa	B-NR
2. In patients who undergo mechanical thrombectomy with successful reperfusion, it might be reasonable to maintain BP at a level $< 180/105$ mm Hg.	IIb	B-NR

- No RCT on BP management during and after EVT
- ESCAPE protocol : Labetalol or an IV β -blocker
 - SBP ≥ 150 mmHg during EVT $\rightarrow$ normal BP after reperfusion
- DAWN protocol: SBP < 140 mmHg in the first 24 hours after reperfusion

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2. Other Endovascular Therapies

2. Other Endovascular Therapies

3.8. Other EVTs	COR	LOE
1. Mechanical thrombectomy with stent retrievers is recommended over intra-arterial fibrinolysis as first-line therapy.	I	C-EO
2. Intra-arterial fibrinolysis initiated within 6 hours of stroke onset in carefully selected patients who have contraindications to the use of IV alteplase might be considered, but the consequences are unknown.	IIb	C-EO

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감사합니다



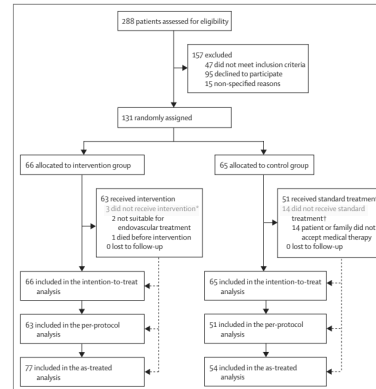
Endovascular treatment versus standard medical treatment for vertebrobasilar artery occlusion (BEST): an open-label, randomised controlled trial

Lancet Neurol 2019
Published Online
December 9, 2019
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- First RCT
- 8 h of VB occlusion in China (2015~2017)
- EVT vs standard medical therapy
- Trial was terminated early after 131 patients
 - High crossover and poor recruitment
- No evidence of a difference in favorable outcome

Trial profiles and baseline characteristics



	Intervention (n=66)	Control (n=65)
Age (years)	62 (55-70)	68 (57-74)
Sex		
Men	48 (72%)	52 (80%)
Women	18 (27%)	13 (20%)
Medical history		
Coronary heart disease	10 (15%)	8 (12%)
Atrial fibrillation	18 (27%)	10 (15%)
Hypertension	45 (68%)	42 (65%)
Hyperlipidaemia	3 (5%)	5 (8%)
Diabetes	10 (15%)	11 (17%)
Ischaemic stroke or transient ischaemic attack	14 (21%)	20 (31%)
Smoking	22 (33%)	19 (29%)
Drinking	15 (23%)	12 (18%)
Systolic blood pressure (mm Hg)	148 (131-170)	150 (133-177)
Diastolic blood pressure (mm Hg)	84 (78-96)	87 (78-100)
NIHSS score	11 (4-18)	16 (11-21)
Glasgow Coma Scale score	6 (5-8)	6 (5-12)
Information about prior stroke	18 (27%)	21 (32%)
Cause of stroke		
Atherosclerosis	37 (56%)	32 (49%)
Cardioembolism	14 (21%)	12 (18%)
Other intracerebral	15 (23%)	16 (25%)
Large artery atherosclerosis	8 (12%)	8 (12%)
Occlusion site		
Vertebral artery (V4 segment)	7 (11%)	5 (8%)
Basilar artery	59 (89%)	60 (92%)
Time interval (days)		
From onset to imaging	18 (11-27)	18 (11-24)
From onset to randomisation	24 (19-30)	27 (19-38)
From onset to reperfusion	40 (25-126)	41 (25-130)
From onset to randomisation	19 (10-31)	20 (10-30)
From onset to reperfusion	114 (66-150)	111 (65-160)

	Intervention (n=66)	Control (n=65)	Adjusted OR* (95% CI)	Unadjusted OR (95% CI)	p value
Primary outcome					
mRS 0-3 at 90 days	28 (42%)	21 (32%)	1.74 (0.81-3.74)	1.54 (0.76-3.15)	0.23
Secondary outcome					
mRS 0-2 at 90 days	22 (33%)	18 (28%)	1.40 (0.64-3.10)	1.31 (0.62-2.75)	0.48
mRS score at 90 days (ordinal)	4.5 (2-6)	4 (1.5-6)	1.36 (0.72-2.55)	1.13 (0.62-2.09)	0.69
mTICI	-	-	NA	NA	0.60
0-2a	18 (29%; n=63)	5 (36%; n=14)†	NA	NA	NA
2b-3	45 (71%; n=63)	9 (64%; n=14)†	NA	NA	NA
NIHSS score after 24 h	26 (11-38; n=62)	20 (9-38; n=62)	NA	NA	0.41
NIHSS score at 5-7 days	18 (8-27; n=51)	13 (4-31; n=53)	NA	NA	0.48
GCS score after 24 h	7 (5-11; n=62)	8 (5-13; n=62)	NA	NA	0.51
GCS score at 5-7 days	9 (7-14; n=51)	13 (6-15; n=53)	NA	NA	0.52
pcASPECTS score at 24 h	6 (4-7; n=60)	6 (4-8; n=47)	NA	NA	0.41

Data are n (%) or median (IQR). OR=odds ratio. mRS=modified Rankin Scale. mTICI=modified Thrombolysis In Cerebral Infarction scale. NIHSS=National Institutes of Health Stroke Scale. NA=not applicable. GCS=Glasgow Coma Scale. pcASPECTS=Posterior Circulation Acute Stroke Progression Early CT score. *Adjusted for age and baseline National Institutes of Health Stroke Scale score. †14 patients corresponding to the crossovers.

Table 2: Primary and secondary outcomes in the intention-to-treat analysis

	Intervention	Control	Unadjusted OR (95% CI)	Adjusted OR* (95% CI)
mRS score of 0-3 at 90 days				
Per-protocol	28 (44%; n=63)	13 (25%; n=51)	2.34 (1.05-5.22)	2.90 (1.20-7.03)
As-treated	36 (47%; n=77)	13 (24%; n=54)	2.77 (1.28-5.97)	3.02 (1.31-7.00)
mRS score of 0-2 at 90 days				
Per-protocol	22 (35%; n=63)	10 (20%; n=51)	2.20 (0.93-5.22)	2.57 (1.02-6.51)
As-treated	30 (39%; n=77)	10 (19%; n=54)	2.81 (1.23-6.41)	2.90 (1.20-7.04)
mRS score at 90 days (ordinal)				
Per-protocol	4 (2-6)	5 (3-6)	1.65 (0.85-3.21)	2.19 (1.08-4.44)
As-treated	4 (1-6)	5 (4-6)	2.00 (1.06-3.77)	2.36 (1.20-4.62)

Data are n (%) or median (IQR), unless otherwise specified. OR=odds ratio. mRS=modified Rankin Scale. *Adjusted for age and baseline National Institutes of Health Stroke Scale score.

Table 3: Adjusted analyses for the primary and secondary functional endpoints in the per-protocol and as-treated populations

- mTICI 2b or 3 ; 71%
- Stent 26% of pts.
- VAO faring better with standard medical treatment alone than with intervention
- BAO faring better with intervention treatment

ORIGINAL ARTICLE

Endovascular Therapy for Stroke Due to Basilar-Artery Occlusion

L.C.M. Langezaal, E.J.R.J. van der Hoeven, F.J.A. Mont'Alverne, J.J.F. de Carvalho, F.O. Lima, D.W.J. Dippel, A. van der Lugt, R.T.H. Lo, J. Boiten, N Engl J Med 2021;384:1910-20. DOI: 10.1056/NEJMoa2030297

- Basilar Artery International Cooperation Study [BASICS]
- First true RCT,
- 6 h of BA occlusion in Europe (2011~2019)
- EVT vs standard medical therapy
- 300 patients were enrolled
- No evidence of a difference in favorable outcome
 - as reflected by the wide confidence interval for the primary outcome, the results of this trial may not exclude a substantial benefit of endovascular therapy
- Larger trials are needed (to determine the efficacy and safety of endovascular therapy for basilar-artery occlusion)

Characteristic	Endovascular Therapy (N=154)	Medical Care (N=146)
Age — yr	66.8 (13.1)	67.2 (13.9)
Female sex — no. (%)	54 (35.1)	50 (34.2)
Clinical history — no./total no. (%)		
Posterior-circulation stroke	11/154 (7.1)	7/146 (4.8)
Hypertension	93/154 (60.4)	82/145 (56.6)
Diabetes mellitus	34/153 (22.2)	31/146 (21.2)
Atrial fibrillation or atrial fibrillation on 12-lead ECG	44/154 (28.6)	22/146 (15.1)
Prestroke modified Rankin scale score — no./total no. (%)†		
0	123/153 (80.4)	112/146 (76.7)
1	12/153 (7.8)	15/146 (10.3)
2	15/153 (9.8)	17/146 (11.6)
3	3/153 (2.0)	2/146 (1.4)
Treatment with intravenous thrombolysis — no. (%)	121 (78.6)	114 (79.5)
Time from stroke onset to intravenous thrombolysis — hr‡		
Median	2.0	2.3
Interquartile range	1.4–3.3	1.6–3.5
Time from stroke onset to endovascular therapy — hr‡		
Median	4.4	NA
Interquartile range	3.3–6.2	NA
NIHSS score¶		
Mean	21.9	22.1
Median	21	22
Reperfusion on digital subtraction angiography, modified TICI 2b or 3 — no./total no. (%)	63/88 (72)	NA

- The most frequent reasons for not enrolling potentially eligible patients were
- unavailability of the trial team (39 patients),
- transfer from another hospital with a specific request for endovascular treatment (14 patients),
- the opinion on the part of the treatment team that there was lack of equipoise regarding the appropriate treatment of a particular patient (10 patients)
- contraindication to intravenous thrombolysis (10 patients).

Outcome	Endovascular Therapy (N=154)	Medical Care (N=146)	Risk Ratio, Common Odds Ratio, or Mean Difference (95% CI)†
Primary outcome: favorable functional outcome at day 90: modified Rankin scale score ≤3 — no. (%)‡	68 (44.2)	55 (37.7)	1.18 (0.92 to 1.50)§
Secondary clinical outcomes			
Modified Rankin scale score at day 90			1.35 (0.88 to 2.88)¶
0	8 (5.2)	6 (4.1)	1.17 (0.44 to 3.09)§
0–1	27 (17.5)	19 (13.0)	1.32 (0.79 to 2.19)§
0–2	54 (35.1)	44 (30.1)	1.17 (0.87 to 1.57)§
0–4	78 (50.6)	71 (48.6)	1.05 (0.85 to 1.29)§
0–5	95 (61.7)	83 (56.8)	1.09 (0.92 to 1.29)§
NIHSS score at 24 hr — median (interquartile range)**	11.0 (3.0–37.5)	15.0 (5.0–36.5)	–0.79 (–3.90 to 2.31)††
EQ-5D questionnaire‡‡			6.0 (–1.9 to 13.8)††
Visual analogue scale at day 90	67.6 (21.3)	61.9 (24.8)	6.0 (–1.9 to 13.8)††
Index value at day 90	0.65 (0.32)	0.61 (0.32)	0.05 (–0.05 to 0.16)††
Secondary imaging outcomes			
Patency at 24 hr CT angiography — no./total no. (%)§§	93/110 (84.5)	54/96 (56.3)	1.43 (1.18 to 1.74)§
PC-ASPECTS at 24 hr — median (interquartile range)¶¶			
Noncontrast CT	8.0 (6.0–9.0)	8.0 (6.0–9.0)	–0.03 (–0.66 to 0.59)††
CT angiography	9.0 (8.0–10.0)	9.0 (7.0–10.0)	0.32 (–0.24 to 0.88)††
Primary safety outcome: overall mortality at day 90 — no. (%)	59 (38.3)	63 (43.2)	0.87 (0.68 to 1.12)§

^a Plus-minus values are means ± SD. CT denotes computed tomography.
[†] Estimates were adjusted for intravenous thrombolysis, NIHSS score, and atrial fibrillation. The 95% confidence intervals were not adjusted for multiple comparisons.
[‡] Scores on the modified Rankin scale of functional disability range from 0 to 6, with 0 indicating no disability, 3 indicating moderate disability, and 6 indicating death. A score of 2 or less indicates an excellent outcome (functional independence). P=0.19 for the comparison of the risk ratios.
[§] The effect measure was expressed as a risk ratio.

Variable	Endovascular Therapy (N=154)	Medical Care (N=146)
Serious adverse events — no. (%)		
0	82 (53.2)	95 (65.1)
1	48 (31.2)	33 (22.6)
>1	24 (15.6)	18 (12.3)
Symptomatic intracranial hemorrhage 43 days after initiation of treatment — no. (%)	7 (4.5)	1 (0.7)
Serious events detected on noncontrast CT at 24 hr — no./total no. (%)		
Parenchymal hemorrhage		
Type 1	2/129 (1.6)	4/115 (3.5)
Type 2	4/129 (3.1)	3/115 (2.6)
Subarachnoid hemorrhage	3/129 (2.3)	3/115 (2.6)
Subdural hemorrhage	0	3/115 (2.6)
Intraventricular hemorrhage	1/129 (0.8)	0
Other serious events — no. (%)		
Cerebral ischemia	13 (8.4)	10 (6.8)
Malignant brain edema	3/129 (2.3)	7 (4.8)
Cardiac ischemia	3 (1.9)	2 (1.4)
Pneumonia	30 (19.5)	26 (17.8)
Other infection	7 (4.5)	6 (4.1)
Extracranial hemorrhage	5 (3.2)	2 (1.4)
Procedural complication	5 (3.2)	0
Other complication	20 (13.0)	23 (15.7)

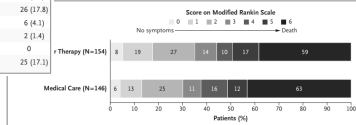


Figure 1. Distribution of Modified Rankin Scale Scores at Day 90, According to Assigned Treatment. Scores on the modified Rankin scale range from 0 to 6, with 0 indicating no disability, 3 indicating moderate disability, and 6 indicating death.

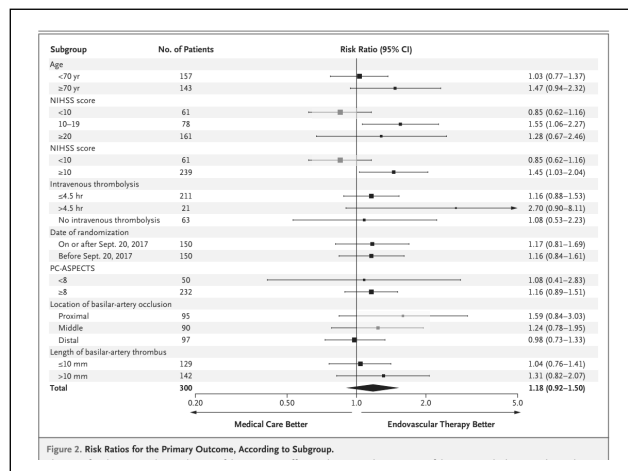


Figure 2. Risk Ratios for the Primary Outcome, According to Subgroup.

Vertebrobasilar Occlusion Randomization to Endovascular Reperfusion versus Intravenous Thrombolysis or Medical Treatment Alone Systematic Evaluation (VERITAS) Collaboration
Raul G Nogueira; Xinfeng Liu; Jan Albert Vos; Qiliang Dai; Ruidong Ye; Wenjie Zi; Gelin Xu; Ruidong Ye; Lucianne C.M. Langezaal; Ale Algra, MD; Erik J.R.J. van der Hoeven; Heinrich J. Audebert; Octavio Pontes-Neto; Jaap Kappelle; Francisco J.A. Mont'Alverne; Volker Puetz; Patrik Michel; Jacoba Greving; Wouter J Schonewille
for the BASICS and BEST Investigators

+ =

사용 미승인으로 발표 시 언급

Revenge match

- The Basilar Artery Occlusion Chinese Endovascular Trial (BAOCHE)
 - focuses on patients presenting within 6–24 h of symptoms onset.
 - 12 hours of estimated time of basilar artery occlusion (defined as the sudden onset of stroke symptoms consistent with acute occlusion of the basilar artery)
- As of Aug 6, 2019, 125 patients have been randomly assigned, of a total planned sample size of 318 patients to show a treatment difference of 20%.
- We hope that these studies will shed additional light on this crucial issue and will be able to address the considerable logistical compromises in trial conduct caused by crossovers.

Endovascular treatment versus standard medical treatment for vertebralbasilar artery occlusion (BEST): an open-label, randomised controlled trial

Wong J et al. *Stroke* 2019;50:1443-1451. doi:10.1161/STROKEAHA.118.050000

Kang et al. ³⁹	Jan 2011–Aug 2017	212	Posterior	71	17	242 min	92%	45%
SECRET ³⁸	Jan 2012–Dec 2017	85	Posterior	72	15	365 min	80%	45%
ASIAN KR ¹	Jan 2011–Feb 2016	72	Posterior	67	19	298 min	86%	42%

- Kang et al.39 Jan 2011–Aug 2017 212 Posterior 71 17 242 min 92% 45%
 - Kang DH, Jung C, Yoon W, Kim SK, Baek BH, Kim JT, et al. Endovascular thrombectomy for acute basilar artery occlusion: a multicenter retrospective observational study. *J Am Heart Assoc* 2018;7:e009419
- SECRET38 Jan 2012–Dec 2017 85 Posterior 72 15 365 min 80% 45%
 - Kim YD, Heo JH, Yoo J, Park H, Kim BM, Bang OY, et al. Improving the clinical outcome in stroke patients receiving thrombolytic or endovascular treatment in Korea: from the SECRET study. *J Clin Med* 2020;9:717
- ASIAN KR1 Jan 2011–Feb 2016 72 Posterior 67 19 298 min 86% 42%
 - Lee JS, Lee SJ, Hong JM, Choi JW, Hong JH, Chang HW, et al. Temporal changes in care processes and outcomes for endovascular treatment of acute ischemic stroke: retrospective registry data from three Korean centers. *Neurointervention* 2018;13:2-12

JoS
JOURNAL OF STROKE

Journal of Stroke 2021;22(4):443-453
https://doi.org/10.1177/10775019211010000
Special Review

Diagnostic and Therapeutic Strategies for Acute Intracranial Atherosclerosis-related Occlusions

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Table 1. Frequency of angiographically identified etiology of acute intracranial large artery occlusions per vascular bed*

	MCA M1 occlusion (n=78)	ICA T occlusion (n=54)	Vertebrobasilar occlusion (n=25)
Atherosclerotic	18 (23)	3 (6)	10 (40)
Embolic	58 (74)	44 (81)	13 (52)
Dissection	1 (1)	1 (2)	1 (4)
Undetermined	1 (1)	6 (11)	1 (4)

Values are presented as n (%).

- 2 times

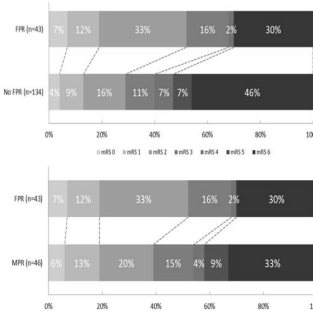
OPEN ACCESS

Original research

Effect of first pass reperfusion on outcome in patients with posterior circulation ischemic stroke

NeuroIntervent Surg
2021;0:1–8. doi:10.1136

Sanne J den Hartog^{1,2,3}, Bob Roozenbeek^{1,2}, Nikki Boodt^{1,2,3}, Agnetha A E Bruggeman^{1,2}, Adriaan C G M van Es², Bart J Emmer⁴, Charles B L M Majoie², Ido R van den Wijngaert^{1,2}, Pieter Jan van Doormaal², Wim H van Zwam^{1,2}, Hester F Lingsma³, Diederik W J Dippel^{1,2}, MR CLEAN



Difference in Posterior circulation stroke EVT

- Anatomy
 - Collateral P-com 등
 - Hemorrhage transformation
 - Access problem – 시술 불가능한 case 높음
 - 양측 VA
 - VA-BA-PCA ; medulla-pons-midbrain +cerebellum +occipital lobe
- Etiologies of P.C. stroke
 - AS의 빈도
 - AS (BASICS, 33%; BEST, 52%)나 Rescue stenting (BEST 26%)
 - Dissection의 빈도가 높다
- Limitation of NIHSS (is less sensitive)
- Basilar artery occlusion has a pleomorphic presentation (dizziness-coma)
- Small numbers and evidences (AC에서는 맞고 PC에서는?)
- Procedure
 - BGC 을 사용할 때 제한적인 경우가 있고 contralateral VA control 하기 어렵다.
 - AC ; SRT+BGC >=CAT, PC ; SRT + BGC ~ CAT

Conclusion

2022
뇌졸중 재개통 심포지엄 및
대한뇌혈관내치료의학회
춘계보수교육

Session IV

Review of the latest evidences (2)
– The debates

좌장: 성재훈 (가톨릭대), 고준석 (경희대)

EVT for large infarct core

EVT for clinically mild stroke with LVO

Patients presented beyond 24 hrs

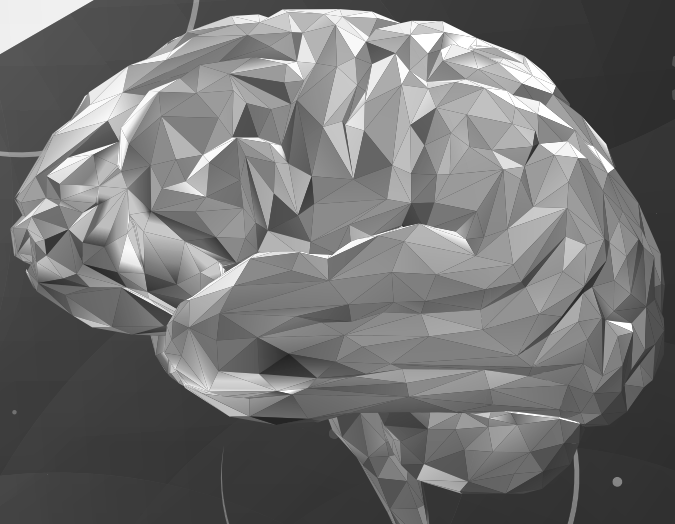
Direct EVT without IV-rtPA

심유식 (인하대)

김창현 (계명대)

이종영 (한림대)

김성태 (인제대)



EVT for large infarct core

심 유 식

인하대

2015년 혈관내혈전제거술(endovascular thrombectomy, EVT)의 안전성과 유용성이 입증된 5개 무작위 대조연구들과 뒤이어 적용을 24시간까지 연장시킨 연구들이 보고 되었고, 이제 EVT는 대혈관폐색에 의한 급성뇌경색 치료의 중심이 되었다. 그러나 이 연구들의 환자 선정은 매우 제한적이었고 CT에서 허혈성변화는 없거나 미미한 정도의 수준이었으며 치료를 하면 좋아질 가능성이 높은 환자들이 대부분이었다. 이들을 분석한 HERMES메타분석에 따르면 실제로는 대부분 ASPECTS 9 이하였고 평균 뇌경색 중심부피(median ischemic core volume)는 CT관류영상에서 10mL 이내였다고 한다. 시간 반경을 연장한 DAWN연구나 DEFUSE-3연구에서도 큰 뇌경색 병변은 모두 제외시켰다. 이처럼 큰 뇌경색 환자들에서 EVT의 안전성과 유용성에 대한 무작위 근거는 아직까지 없는 실정이다.

현재 큰 뇌경색에서 EVT의 안전성과 유용성에 대하여 TESLA, TENSION, IN EXTREMIS-LASTE, SELECT 2, RESCUE-Japan LIMIT 등 5개 연구들이 진행되고 있다. 그 중 RESCUE-Japan LIMIT 연구가 International Stroke Conference 2022와 2월 9일자 NEJM 온라인판에 동시 공개되었다. 이 연구는 일본 45개 병원에서 총 203명의 환자를 등록하였으며(표준치료군102명, EVT치료군101명), 증상발생 6시간 이내이거나 Diffusion/FLAIR mismatch가 있는 경우에는 6~24시간 이내의 ASPECTS 3~5 환자들이었다. 1차 목표점은 90일째 평가한 mRS 0~3점 비율이었는데 EVT치료군 31.0%, 표준치료군 12.7%로 EVT 진행 시 기능적 예후가 2.43배 유의하게 개선되는 것으로 조사되었다(RR2.43;95%CI1.35-4.37). 이와 함께 NIHSS가 48시간째 최소 8점 개선된 비율은 EVT치료군 31.0%, 표준치료군 8.8%로 EVT의 혜택이 3.51배 높은 것으로 알려졌다(RR3.51;95%CI1.76-7.00). 두개강내출혈에 대해서는 EVT치료군이 좋지 않은 결과를 얻었는데(EVT치료군 58.0%, 표준치료군31.4%) EVT치료군의 위험이 1.85배 의미 있게 높았다(RR1.85;95%CI1.33-2.58). 다만 48시간 이내 증상이 있는 두개강내출혈발생, 90일 이내 사망, 90일 이내 뇌경색 재발, 7일 이내 감압개두술 시행률 등은 치료에 따른 차이가 없었다.

어떤 기준으로 큰 뇌경색의 EVT를 결정 해야 하는가는 비슷하면서도 더 복잡한 문제이다. 뇌경색의 범위가 클수록 신경손상은 더 빠르게 진행되고 좋은 치료 결과의 가능성은 낮아지며 재개통 뒤 출혈의 발생 위험성은 높

아진다. EVT를 하지 않는 자연경과 역시 매우 불량해서 뇌경색의 진행, 뇌일탈(brain herniation), 신경학적 악화, 출혈변환(hemorrhagic transformation)과 궁극적으로는 사망으로 진행할 가능성도 높다. EVT의 결정 시 필요한 앞으로의 연구 방향은 뇌경색중심부피(core volume), 시간반경(time window), EVT결정을 위해 가장 적합한 최초 영상의 선택 등으로 요약 할 수 있다. 이러한 숙제가 해결되고 임상연구들을 바탕으로 우리 신경외과 의사들은 전방순환계 뇌경색의 20~25%를 차지하는 큰 뇌경색환자의 EVT에 대한 시행 여부를 결정해야 한다.

EVT for clinically mild stroke with LVO

김 창 현

계명대

2022
뇌졸중 재개발 심도지원 및
급성뇌졸중치료지원사업
중재연구사업

EVT for clinically mild stroke with LVO

Kim Chang-Hyun, Sohn Sung-Il, Hong Jung-Ho, Park Hyeong Jong
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Keimyung University Dongsan Medical Center

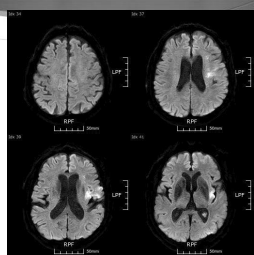
Patient presentation (I)

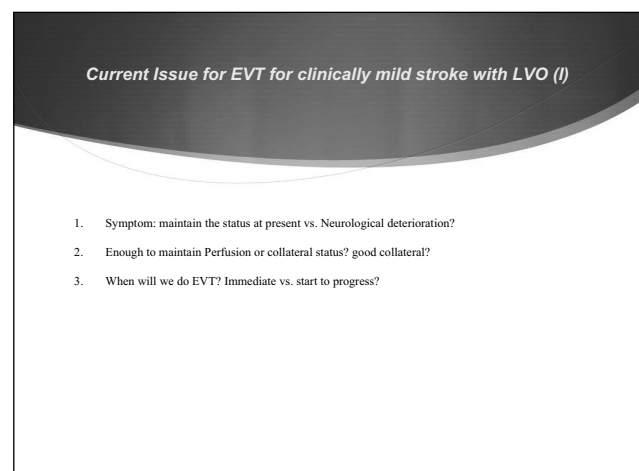
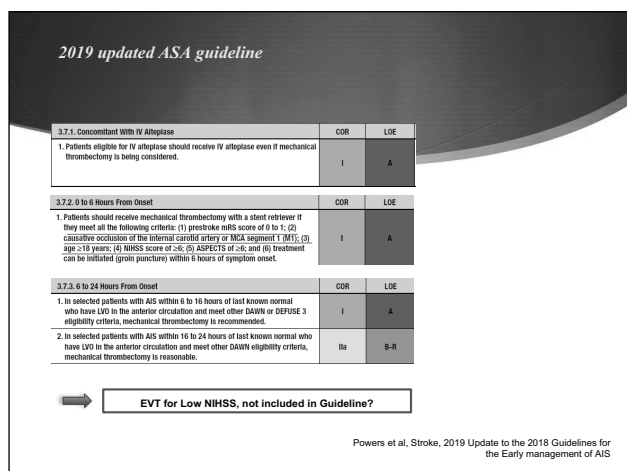
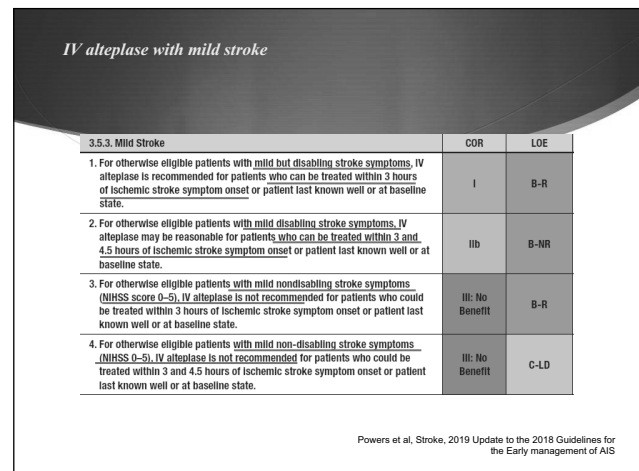
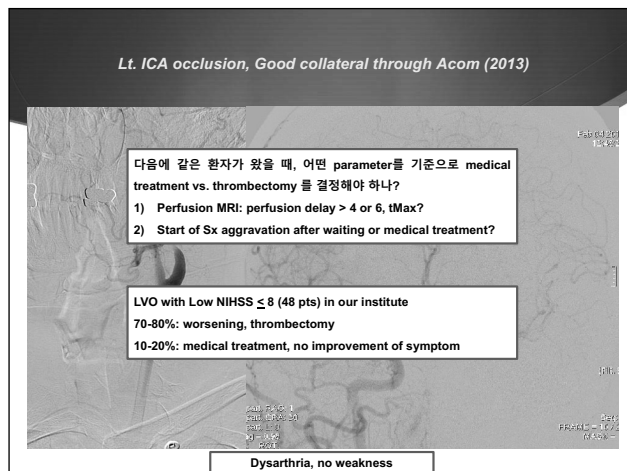
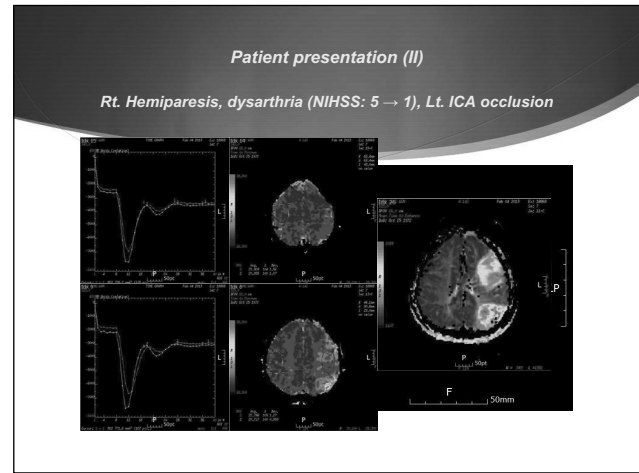
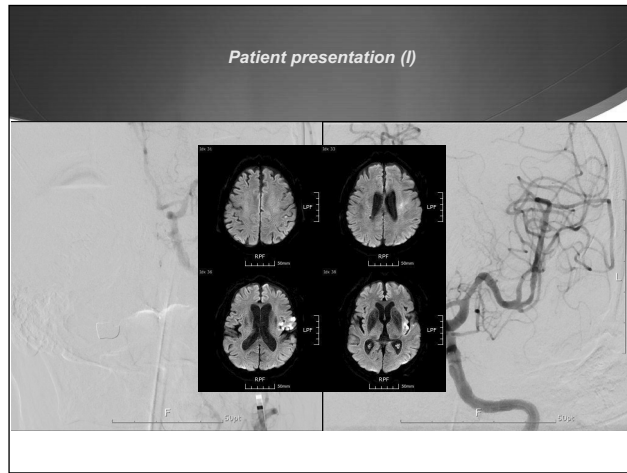
2/5 20:00 hemiparesis, dysarthria, NIHSS 3
21:00 Brain MRI and MRA, Lt. MCA M1 distal segment occlusion, NIHSS 1
2/6 05:30 NIHSS 1 to 3, deteriorated
06:00 NIHSS 3 to progression
IA thrombectomy, stent retriever 1, Reperfusion catheter 1
TICI 3 recanalization

Patient presentation (I)



Patient presentation (I)





Current Issue for EVT for clinically mild stroke with LVO (II)

1. Is it possible to achieve recanalization SAFELY without any complication?
2. Neurologic deterioration happen due to distal emboli despite reperfusion?
3. Will the EVT make this patient worse than before?
4. When we can predict high probability of neurological worsening → start EVT!
5. We need the evidence that EVT might be optimal for preventing neurological deterioration in clinically mild stroke.

Mechanical thrombectomy in ELVO with low NIHSS patients

- 신경영상평가 (neuroimaging evaluation)
1. 동맥뇌졸중이나 다른 뇌졸중 이외의 원인을 배제하기 위해 비조영술상 CT나 MRI를 시행하여야 한다 (GPP).
Noncontrast CT or MRI should be conducted to exclude hemorrhagic stroke or other non-stroke etiologies (GPP).
 2. 중증 뇌혈관질환 환자에서 급성 관동맥 폐색을 확인하기 위해 비침습적 혈관조영술(CT 및 MR 혈관조영술)을 권고한다 (GPP).
Non-invasive vascular imaging (CT angiography or MR angiography) is recommended to confirm acute large artery occlusions for patients with major ischemic stroke (GPP).
 3. 비침습적 혈관영상 평가가 불가능한 환자에서는, 뇌졸중 중증도 또는 비조영술상 CT의 혈관신호 등이 ERT 결정에 도움이 될 수 있다 (GPP).
For patients who are not able to perform non-invasive vascular imaging, stroke severity or clot sign on noncontrast CT can guide decision for ERT (GPP).
 4. 광범위한 초기 뇌혈관상 변화를 평가하는 신경영상평가를 이용하여 ERT 대상환자를 선별할 수 있다 (GPP).
For selecting patients, neuroimaging evaluation for extensive early ischemic injury can guide decision for ERT (GPP).
 5. ERT 효과가 있을 확률을 선별하기 위해, 최신 다중기법영상으로 결손된 허혈중심 (ischemic core) 크기, 또는 관류-확산불일치 정도에 대한 평가를 고려할 수 있다 (GPP). 그러나 다중기법영상으로 인해 ERT가 지연되어서는 안 된다.
Advanced multimodal imaging to assess collateral, extent of ischemic core, or perfusion-diffusion mismatch can be considered to identify patients who are likely to benefit from ERT (GPP). However, the multimodal imaging should not significantly delay ERT.

Low NIHSS, minimal neurological deficits → not exclude CTA or MRA

Too good to intervene? Thrombectomy for large vessel occlusion strokes with minimal symptoms: an intention-to-treat analysis
Hasssen DC, et al. J Neurointervent Surg 2017;9:917-921.

Endovascular Thrombectomy for Mild Strokes: How Low Should We Go?

A Multicenter Cohort Study (Stroke, 2018;49:2391-2405).

Mechanical Thrombectomy in Patients With Milder Strokes and Large Vessel Occlusions

A Multicenter Matched Analysis (Stroke, 2018;49:2391-2397).

Mechanical Thrombectomy for Minor and Mild Stroke Patients Harboring Large Vessel Occlusion in the Anterior Circulation

A Multicenter Cohort Study (Stroke, 2017;48:3274-3281).

Endovascular Management of Stroke Patients with Large Vessel Occlusion and Minor Stroke Symptoms

Alghamdi S, Danner A, B, Mousalgh M F, et al. (June 15, 2017) Endovascular Management of Stroke Patients with Large Vessel Occlusion and Minor Stroke Symptoms. Current 9(5): e1355. DOI: 10.7799/curneu.1355

Endovascular Mechanical Thrombectomy in Large-Vessel Occlusion Ischemic Stroke Presenting with Low National Institutes of Health Stroke Scale: Systematic Review and Meta-Analysis

WORLD NEUROSURGERY 11(2): 263-269, February 2018

Too good to intervene? Thrombectomy for large vessel occlusion strokes with minimal symptoms: an intention-to-treat analysis
Hasssen DC, et al. J Neurointervent Surg 2017;9:917-921.

1. Mild or rapidly improving stroke symptoms on initial presentation
→ neurological decline and poor outcomes at discharge
2. LVO and low NIHSS score: compare medical therapy vs. thrombectomy prospectively

1. NIHSS < 5
2. LVO on CTA: M1, M2, ICA, ACA, or BA
3. Baseline mRS: 0-2
4. Deterioration (aphasia, neglect, weakness) at least 2 points NIHSS, thrombectomy

Too good to intervene? Thrombectomy for large vessel occlusion strokes with minimal symptoms: an intention-to-treat analysis
Hasssen DC, et al. J Neurointervent Surg 2017;9:917-921.

1. Careful discussion between treating physicians and patients/families
2. The decision of most patients: have medical therapy
3. Double antiplatelet agents (if not given IV IPA) and IV hydration
4. BP: auto-regulate, head: flat
5. Monitored for deterioration with hourly neurological checks
6. Intention-to-treat analysis: initially receiving medical therapy alone who subsequently deteriorated and thrombectomy: analyzed in conservative arm
7. NIHSS shift: discharge NIHSS score minus admission NIHSS score: primary outcome measure

Too good to intervene? Thrombectomy for large vessel occlusion strokes with minimal symptoms: an intention-to-treat analysis
Hasssen DC, et al. J Neurointervent Surg 2017;9:917-921.

1. 32 patients
2. 22 (69%): primarily treated with medical therapy, 10 (31%): intervention
3. 9 (41%) of 22 medically treated: subsequent deterioration, thrombectomy
4. 19 thrombectomy: TICI 2b-3 in all patients
5. NIHSS shift: significantly favored thrombectomy (p<0.01)
6. Median NIHSS at discharge: thrombectomy 1 vs. medical therapy 2
7. 90-Day mRS 0-2: thrombectomy 100% vs. 77%

Outcomes	Thrombectomy (n=19)	Medical (n=22)	p Value*
Perioperative hemorrhages	0 (0)	0 (0)	1.00
NIHSS score			
NIHSS score at discharge, median (IQR)	1 (0-3)	2 (0.5-4.5)	0.31
NIHSS score worsening +deaths	1 (1/19)	5 (2/22)	0.63
NIHSS shift	-12.5	0	0.01
90-Day mRS			0.19
0	4 (4/19)	5 (2/22)	
1	3 (3/19)	7 (3/22)	
2	3 (3/19)	5 (2/22)	
3	0 (0)	1 (0.5)	
4	0 (0)	0 (0)	
5-6	0 (0)	4 (1/18)	
90-Day mRS 0-2	10 (10/19)	17 (7/22)	0.15
90-Day mortality	0 (0)	3 (1/14)	0.53
Discharge home	9 (9/19)	16 (7/22)	0.38

Supplementary Table: Baseline characteristics of medically treated patients stratified by deterioration or non-deterioration.

	Deterioration n=13	Non-Deterioration n=13	P-value
Age	67.27 ± 14.27	68.07 ± 14.8	0.87
Gender (n)	6 (46%)	7 (54%)	1.00
Hypertension	4 (31%)	5 (38%)	0.64
Hyperlipidemia	1 (8%)	4 (31%)	0.36
Alcohol Intake	1 (8%)	5 (38%)	0.30
Diabetes	2 (15%)	2 (15%)	1.00
Smoking	1 (8%)	1 (8%)	1.00
Mean Arterial Pressure(mmHg)	111.54 ± 15.54	98.81 ± 20	0.15
Quick Fracture (%)	56.72 ± 14.48	59.38 ± 9.80	0.87
Baseline NIHSS	2.5 (1.25-4.75)	2.5 (0.5-5)	0.74
Wake-up Stroke	1 (8%)	6 (46%)	0.17
IV t-PA	1 (8%)	1 (8%)	1.00
NICT ASPECTS	9.38 ± 0.77	9 ± 0.87	0.30
CT Perfusion (n)	5 (38%)	5 (38%)	0.59
Ischemic Core	211.49 ± 145.42	150.43 ± 73.22	0.34
MTmax	75.77 ± 51.43	64.41 ± 45.47	0.54
MTmax>10s	7.47 ± 8.68	11.62 ± 15.10	0.49
Time to Recanalization	5.25 (3.5-17)	7 (6.15-15)	0.54
Last Known Normal Arrival	5.25 (3.5-17)	7 (6.15-15)	0.54
OCclusion Site	0 (0%)	0 (0%)	0.60
MCA M1	1 (8%)	7 (54%)	
MCA M2	2 (15%)	3 (23%)	
Internal Carotid	1 (8%)	1 (8%)	
Extracranial ICA	1 (8%)	0 (0%)	
Basilid	1 (8%)	2 (15%)	
Tandem	2 (15%)	1 (8%)	0.54
Stroke Etiology			0.67
Cardioembolic	4 (31%)	4 (31%)	
Large Vessel Atherosclerosis	2 (15%)	5 (38%)	
Intermediate Atherosclerosis	1 (8%)	1 (8%)	
Other Determined	1 (8%)	0 (0%)	
Cryptogenic	1 (8%)	3 (23%)	

22 primary medical therapy
Baseline characteristics of medically treated patients
1) Deteriorated
2) Non-Deteriorated
→ failed to indicate significant differences

	1 (8%)	1 (8%)	1.00
IV t-PA	1 (8%)	1 (8%)	1.00
NICT ASPECTS	9.38 ± 0.77	9 ± 0.87	0.30
CT Perfusion (n)	5 (38%)	5 (38%)	0.59
Ischemic Core	0.73 ± 1.93	0.29 ± 0.72	0.59
MTmax>4s	211.49 ± 145.42	150.43 ± 73.22	0.34
MTmax>6s	75.77 ± 51.43	64.41 ± 45.47	0.54
MTmax>10s	7.47 ± 8.68	11.62 ± 15.10	0.49
Time to Recanalization	5.25 (3.5-17)	7 (6.15-15)	0.54
Last Known Normal Arrival	5.25 (3.5-17)	7 (6.15-15)	0.54

- Thrombectomy led to a shift towards lower NIHSS in LVO presenting with minimal stroke symptoms
- Despite this condition is benign, nearly a quarter of patients primarily treated with medical therapy did not achieve independence at 90 days.

Endovascular Thrombectomy for Mild Strokes: How Low Should We Go?
A Multicenter Cohort Study (Stroke, 2018;49:2398-2405)

- Effectiveness and safety of EVT in LVO patients with NIHSS < 6 in large, multicenter retrospective study
- 8 US and Spain centers, anterior circulation LVO and NIHSS<6, within 24 hrs
- LVO: ICA, MCA (M1, M2, M3, M4, and ACA)
- Compare EVT and medical treatment
- Multivariate logistic regression: to evaluate differences in outcome between 2 groups after adjustment for pre-specified variables, age, presentation NIHSS, time last seen normal to arrival, center, IV alteplase, ASPECTS, and thrombus location
- Matched EVT and medical management using propensity scores

Endovascular Thrombectomy for Mild Strokes: How Low Should We Go?
A Multicenter Cohort Study (Stroke, 2018;49:2398-2405)

- 214 patients included: 124 EVT and 90 medical management
- Excellent outcome (mRS 0-1): no difference, 55.7% EVT vs. 54.4% medical Tx
- In a propensity matching analysis, Matched 62 pairs of EVT and medical Tx
- No treatment effect in 62 matched pairs (EVT vs. medical Tx)
- No difference by any thrombus location, M1 approached significance (p=0.07)
- Symptomatic ICH: 5.8% EVT vs. 0% medical Tx (p=0.02)

- No improvement in excellent and independent functional outcomes in mild stroke (NIHSS<6) receiving thrombectomy irrespective of thrombus location
- With symptomatic ICH rates were higher with thrombectomy
- A signal toward benefit with EVT only in M1 occlusion!

Mechanical Thrombectomy in Patients With Milder Strokes and Large Vessel Occlusions
A Multicenter Matched Analysis (Stroke, 2018;49:2391-2397)

- Prospective data of 6 international stroke centers, LVO, NIHSS 0-5
- LVO: distal ICA, MCA (M1, M2), BA w/ or w/o tandem occlusion
- Immediate MT or initial medical Tx which included rescue MT after neurological deterioration (best medical management-MT)
- The matched cohort analysis: 77 pairs of IMT-BMM-MT patients

Mechanical Thrombectomy in Patients With Milder Strokes and Large Vessel Occlusions
A Multicenter Matched Analysis (Stroke, 2018;49:2391-2397)

- Immediate MT (n=80). Compared with best medical management-MT (n=220)
- Younger age (65 vs. 69; p=0.021)
- More often atrial fibrillation (44.8% vs. 28.2%; p=0.012)
- Higher baseline NIHSS (4, 0-5 vs. 3, 0-5; p=0.005)
- Higher ASPECT score (10, 7-10 vs. 10, 5-10; p=0.023)
- More MCA-M1, less MCA-M2 (p=0.016)
- In matched analysis, Good outcome at 90 day (84.4 vs. 70.1%; p=0.03)

- Immediate MT in LVO with low NIHSS on presentation may be safe and has the potential to result in improved outcomes.

Clinical effect of successful reperfusion in patients presenting with NIHSS < 8: data from the BEYOND-SWIFT registry
Shang et al. BMC Neurology 2019;19:1510

Medical Management vs Mechanical Thrombectomy for Mild Strokes
An International Multicenter Study and Systematic Review and Meta-analysis
JAMA Neurology January 2020 Volume 77 Number 1

Efficacy and safety of endovascular thrombectomy in mild ischemic stroke: results from a retrospective study and meta-analysis of previous trials

Mechanical Thrombectomy for Acute Stroke Due to Large-Vessel Occlusion Presenting With Mild Symptoms
October 2021 | Volume 12 | Article 730267

Acute Stroke With Large Vessel Occlusion and Minor Clinical Deficits: Prognostic Factors and Therapeutic Implications
October 2021 | Volume 12 | Article 730705

Session IV. Review of the latest evidences (2) – The debates

Medical Management vs Mechanical Thrombectomy for Mild Strokes An International Multicenter Study and Systematic Review and Meta-analysis

JAMA Neurology January 2020 Volume 77 Number 1

1. 5-year period from 16 centers, retrospectively
2. 251 patients: 138 MT vs. 113 bMM (best medical management)
3. Asymptomatic ICH: lower in bMM ($p=0.002$)
4. The rate of 3-month FI: lower in MT (77.4 vs. 88.5%, $p=0.02$)

1. multicenter study coupled with the meta-analysis
2. Similar outcomes of MT and bMM in stroke with mELVO
3. No conclusions about treatment effect

Efficacy and safety of endovascular thrombectomy in mild ischemic stroke: results from a retrospective study and meta-analysis of previous trials

Zhang et al. BMC Neurology 2019 19:126

1. 177 patients with NIHSS $\leq$ 8, LVO, from 2014 to 2017, 7 comprehensive stroke centers
2. Logistic regression analysis, propensity score matching, meta-analysis from 6 studies (n=733)
3. mRS 0-1, good outcome, 58.2% MT vs. 46.9% medical Tx, no significance
4. Thrombectomy did not result in excessive mortality or symptomatic intracranial hemorrhage after adjustments.
5. The meta-analysis did not confirm the associations between good outcome and endovascular treatment.

Mechanical Thrombectomy for Acute Stroke Due to Large-Vessel Occlusion Presenting With Mild Symptoms

Frontiers in Neurology October 2021 | Volume 12 | Article 780102

1. Prospective cohort, propensity score matching
2. 105 patients: 43 MT vs. 62 MM group
3. sICH: No significant difference in two groups
4. Independent outcomes: 83.7% MT vs. 67.4% MM, especially in ant. Circulation
5. Small infarct core volume and MT treatment: independently associated with excellent outcomes

MT in stroke patients with mild Sx, ant. circulation occlusion: satisfactory clinical outcomes

Acute Stroke With Large Vessel Occlusion and Minor Clinical Deficits: Prognostic Factors and Therapeutic Implications

Frontiers in Neurology October 2021 | Volume 12 | Article 780102

1. LVO with NIHSS $\leq$ 4, 3-year period
2. immediate MT vs. initial medical Mx with rescue intervention in case of secondary deterioration
3. 88 minor stroke and LVO (13 MT vs. 75 medical Mx)
4. primary endpoint: secondary deterioration (NIHSS increase $\geq$ 4 during in-hospital stay, clinical outcome at 3-month, ICH, mortality)
5. 19 secondary deterioration: associated with poor outcome, occlusion site M1 11 (58%), $p<0.001$
6. Immediate Thrombectomy (n=8) was associated with a lower intrahospital mortality compared to MM (n=5).

Secondary deterioration: associated with poor outcome and occlusion site (M1) in LVO with minor deficits

Mechanical thrombectomy for patients with low NIHSS in ELVO

Conclusion? Discussion...

1. Symptom: maintain the status at present vs. Neurological deterioration?
2. Enough to maintain Perfusion or collateral status? good collateral?
3. When will we do EVT? Immediate vs. start to progress?

Symptom progression will be predicted more confidently..

Mechanical thrombectomy for patients with low NIHSS in ELVO

The literatures recommend...

1. MCA (M1) occlusion, ACA-MCA collateral circulation despite low NIHSS
→ possibilities of symptom progression ↑
2. ICA occlusion, very? good collateral through Acom
: No symptom progression or rapidly improving symptom (very careful monitoring in ICU)
→ carefully selected Indication of medical treatment !
3. M2 or posterior circulation: ?

2022

뇌졸중 재개통 심포지엄 및

대한뇌혈관내치료의학회 춘계보수교육

Mechanical thrombectomy for patients with low NIHSS in ELVO

The literatures recommend...

1. Timing of EVT: low NIHSS, immediate vs. at progression?
2. Low NIHSS: divide the subgroup into 1-2 vs. 3-5?
3. Mechanical thrombectomy vs. medical treatment? MT superior?
4. Careful discussion with patient's family before EVT...in practical clinical field
3. Further study including RCT is necessary.

Thank you for your attention !!!



Patients presented beyond 24 hrs

이 종 영

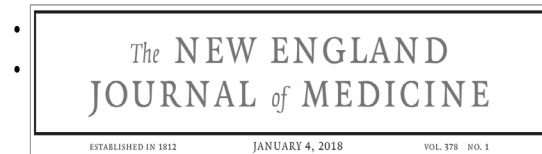
한림대

Patients presented beyond 24 hours

Jong Yong Lee

Hallym University Kangdong Sacred Heart Hospital

DAWN trial



Thrombectomy 6 to 24 Hours after Stroke with a Mismatch between Deficit and Infarct

R.G. Nogueira, A.P. Jadhav, D.C. Haussen, A. Bonafe, R.F. Budzik, P. Bhuva, D.R. Yavagal, M. Ribo, C. Cognard, R.A. Hanel, C.A. Sila, A.E. Hassan, M. Millan, E.I. Levy, P. Mitchell, M. Chen, J.D. English, Q.A. Shah, F.L. Silver, V.M. Pereira, B.P. Mehta, B.W. Baxter, M.G. Abraham, P. Cardona, E. Veznedaroglu, F.R. Hellinger, L. Feng, J.F. Kirmani, D.K. Lopes, B.T. Jankowitz, M.R. Frankel, V. Costalat, N.A. Vora, A.J. Yoo, A.M. Malik, A.J. Furlan, M. Rubiera, A. Aghaebrahim, J.-M. Olivrot, W.G. Teekle, R. Shields, T. Graves, R.J. Lewis, W.S. Smith, D.S. Liebeskind, J.L. Saver, and T.G. Jovin, for the DAWN Trial Investigators*

DAWN trial (inclusion criteria)

- **Mismatch btw severity of clinical deficit and infarction volume**
 - ≥ 80 yrs: ≥10 NIHSS, infarction volume <21ml
 - < 80 yrs: ≥10 NIHSS, infarction volume <31ml
 - < 80 yrs: ≥10 NIHSS, infarction volume 31ml ~ 51ml
- ≥18 yrs
- LKTW (last known to be well): **6~24 hrs**
- Intracranial ICA, proximal MCA
- No evidence of ICH,
- No evidence of infarction volume >1/3 of MCA territory

DAWN trial

Outcome	Thrombectomy Group (N=107)	Control Group (N=99)	Absolute Difference (95% CI)†	Adjusted Difference (95% Credible Interval)‡	Posterior Probability of Superiority
Primary end points					
Score on utility-weighted modified Rankin scale at 90 days§	5.5±3.8	3.4±3.1	2.1 (1.2–3.1)	2.0 (1.1–3.0)	>0.999
Functional independence at 90 days — no. (%)¶	52 (49)	13 (13)	36 (24–47)	33 (21–44)	>0.999
Secondary end points					
Early response — no. (%)	51 (48)	19 (19)	29 (16–41)	3 (2–4)	<0.001**
Recanalization at 24 hr — no. (%)††	82 (77)	39 (39)	40 (27–52)	2 (2–4)	<0.001**
Change from baseline in infarct volume at 24 hr — ml††					0.003‡‡
Median	1	13			
Interquartile range	0–38	0–42			
Infarct volume at 24 hr — ml††					<0.001‡‡
Median	8	22			
Interquartile range	0–48	8–68			
Grade of 2b or 3 on mTICI scale — no. (%)§§	90 (84)	NA			

DAWN trial

Outcome	Thrombectomy Group (N=107)	Control Group (N=99)	Absolute Difference (95% CI)	Risk Ratio (95% CI)
	no. (%)	no. (%)	percentage points	
Stroke-related death at 90 days	17 (16)	18 (18)	-2 (-13 to 8)	1 (1 to 2)
Death from any cause at 90 days	20 (19)	18 (18)	1 (-10 to 11)	1 (1 to 2)
Symptomatic intracranial hemorrhage at 24 hr ^b	6 (6)	3 (3)	3 (-3 to 8)	2 (1 to 7)
Neurologic deterioration at 24 hr ^c	15 (14)	26 (26)	-12 (-23 to -1)	1 (0 to 1)
Procedure-related complications	7 (7)	NA		
Distal embolization in a different territory	4 (4)	NA		
Intramural arterial dissection	2 (2)	NA		
Arterial perforation	0	NA		
Access-site complications leading to intervention	1 (1)	NA		

DIFFUSE 3 trial

ORIGINAL ARTICLE

Thrombectomy for Stroke at 6 to 16 Hours with Selection by Perfusion Imaging

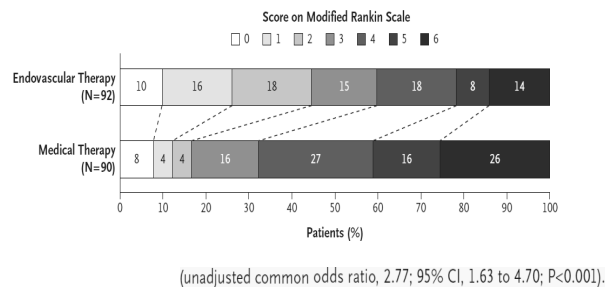
G.W. Albers, M.P. Marks, S. Kemp, S. Christensen, J.P. Tsai, S. Ortega-Gutierrez, R.A. McTaggart, M.T. Torbey, M. Kim-Tenser, T. Leslie-Mazwi, A. Sarraj, S.E. Kasner, S.A. Ansari, S.D. Yeatts, S. Hamilton, M. Mlynash, J.J. Heit, G. Zaharchuk, S. Kim, J. Carrozella, Y.Y. Palesch, A.M. Demchuk, R. Bammer, P.W. Lavori, J.P. Broderick, and M.G. Lansberg, for the DEFUSE 3 Investigators*

N ENGL J MED 378:8 NEJM.ORG FEBRUARY 22, 2018

DIFFUSE 3 trial (inclusion criteria)

- **Perfusion imaging**
 - Initial infarction volume < 70 ml
 - Ischemic tissue / initial infarction volume < 1.8
 - Absolute penumbra ≥ 15 ml
- 18-85 yrs
- LKTW (last known to be well): 6~16 hrs
- NIHSS ≥ 6
- Cervical segment or intracranial ICA, proximal MCA
- No evidence of ICH,

DIFFUSE 3 trial



DIFFUSE 3 trial

Outcome	Endovascular Therapy (N=92) ^a	Medical Therapy (N=90)	Odds Ratio or Risk Ratio (95% CI) ^b	P Value
Primary efficacy outcome: median score on modified Rankin scale at 90 days (IQR) ^c	3 (1-4)	4 (3-6)	2.77 (1.63-4.70)	<0.001
Secondary efficacy outcome: functional independence at 90 days — no. (%) ^d	41 (45)	15 (17)	2.67 (1.60-4.48)	<0.001
Safety outcomes — no. (%)				
Death at 90 days	13 (14)	23 (26)	0.55 (0.30-1.02)	0.05
Symptomatic intracranial hemorrhage ^e	6 (7)	4 (4)	1.47 (0.40-6.55)	0.75
Early neurologic deterioration	8 (9)	11 (12)	0.71 (0.30-1.69)	0.44
Parenchymal hematoma type 2	8 (9)	3 (3)	2.61 (0.73-14.69)	0.21
Imaging outcomes ^{g,h}				
Median infarct volume at 24 hr (IQR) — ml	35 (18-82)	41 (25-106)	—	0.19
Median infarct growth at 24 hr (IQR) — ml	23 (10-75)	33 (18-106)	—	0.08
Reperfusion >90% at 24 hr — no./total no. (%)	59/75 (79)	12/67 (18)	4.39 (2.60-7.43)	<0.001
Complete recanalization at 24 hr — no./total no. (%)	65/83 (78)	14/77 (18)	4.31 (2.65-7.01)	<0.001
TICI score of 2b or 3 — no./total no. (%)	69/91 (76)	—	—	—

2019 update to the 2018 AHA guidelines

2018 AHA guidelines

3.7. Mechanical Thrombectomy (Continued)	COR	LOE	New, Revised, or Unchanged
7. In selected patients with AIS within 6 to 16 hours of last known normal who have LVO in the anterior circulation and meet other DAWN or DEFUSE 3 eligibility criteria, mechanical thrombectomy is recommended.	I	A	New recommendation.
8. In selected patients with AIS within 16 to 24 hours of last known normal who have LVO in the anterior circulation and meet other DAWN eligibility criteria, mechanical thrombectomy is reasonable.	Ila	B-R	New recommendation.

2019 update

2.2.4. Mechanical Thrombectomy Eligibility—Multimodal Imaging	COR	LOE	New, Revised, or Unchanged
1. When selecting patients with AIS within 6 to 24 hours of last known normal who have LVO in the anterior circulation, obtaining CTP or DW-MRI, with or without MRI perfusion, is recommended to aid in patient selection for mechanical thrombectomy, but only when patients meet other eligibility criteria from one of the RCTs that showed benefit from mechanical thrombectomy in this extended time window.	I	A	New recommendation.

Thrombectomy over 6 hours

- Paradigm shift
 - Time based patient selection
 - Pathophysiology-based patient selection
 - Clinical core mismatch (DAWN)
 - Target mismatching on perfusion imaging

Fast and Slow Progressors of Infarction

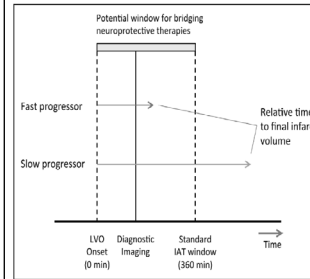


Table 1. Incidence of Collateral Grades and Respective Clinical Outcomes in Anterior Circulation LVO

Scoring System	Imaging Modality	Collateral Grade	Incidence, n (%)	% mRS 0-2 (90 d)
Mittle et al ^{1*}	CTA/dynamic CTP	Poor	17/92 (18)	0
		Moderate	24/92 (26)	13
		Good	51/92 (56)	47
Liebeskind et al ^{2†}	Cerebral angiography	Poor (0-1)	32/119 (27)	4
		Intermediate (2)	48/119 (40)	28
		Good (3)	55/199 (29)	56
		Excellent (4)	4/199 (3)	66
Menon et al ^{3†}	CTA	Poor (0-5)	38/126 (30)	18
		Intermediate (6-7)	42/126 (33)	45
		Good (8-10)	46/126 (37)	57

(Stroke. 2017;48:2621-2627. DOI: 10.1161/STROKEAHA.117.017673.)

Thrombectomy 24 hours after stroke

CASE SERIES

Thrombectomy 24 hours

Shashvat M Desai,¹ Diogo C Hausse Roberta Santos,³ Raul G Nogueira,²

Table 3 Outcomes	DAWN eligible (>24 hours since TLKW) n=21	DAWN trial intervention arm n=107	P values
Procedural outcomes, n (%)			
Rates of TICI ≥2b	17 (81%)	90 (84%)	0.72
Efficacy outcomes, n (%)			
Early neurologic recovery	6 (29%)	51 (48%)	0.10
mRS 0-2 at 90 days	9 (43%)	51 (48%)	0.68
Safety outcomes, n (%)			
Neurologic deterioration	2 (10%)	15 (14%)	0.57
Symptomatic ICH	1 (5%)	6 (6%)	0.87
Mortality	4 (19%)	20 (19%)	0.96

Thrombectomy 24 hours after stroke

Endovascular thrombectomy beyond 24 hours from ischemic stroke onset: a propensity score matched cohort study

Permish Singh Dhillon^{1,2}, Waleed Butt,³ Anna Podlasek^{1,2}, Emma Barrett,^{4,5} Norman McConachie,¹ Robert Lenthall,¹ Sujit Nair,¹ Luqman Malik,¹ Martin A James,^{6,7,8} Robert A Dineen,^{2,9} Timothy J England^{10,11}

J NeuroIntervent Surg 2022;0:1-5.

Thrombectomy 24 hours after stroke

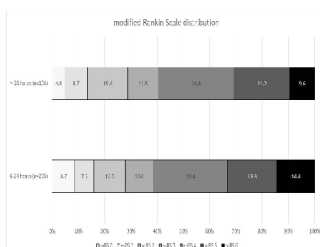


Table 2 Outcomes dichotomized by time from stroke onset or last known well to endovascular treatment after propensity score matching in the late (6-24 hours) and very late (>24 hours) time windows

Outcome measures	Late window (6-24 hours) (n/N) (%) or median (IQR)	Very late window (>24 hours) (n/N) (%) or median (IQR)	Very late vs late window OR (95% CI)*	P value
mRS at discharge (ordinal)	4 (0-5)	4 (0-5)	1.08 (0.49 to 1.47)	0.70
mRS ≤1	33/208 (15.8)	14/104 (13.4)	0.82 (0.42 to 1.62)	0.57
mRS ≤2	61/208 (29.3)	30/104 (28.8)	0.97 (0.58 to 1.64)	0.93
mRS at 6 months (ordinal)	2 (0-3)	2 (0-3)	1.20 (0.75 to 1.98)	0.45
mRS ≤2	31/57 (54.4)	22/55 (40.0)	1.42 (0.59 to 3.55)	0.42
TICI ≥3	169/208 (81.3)	83/104 (80.0)	0.92 (0.50 to 1.65)	0.77
TICI ≥3	100/208 (48.0)	49/104 (47.1)	0.99 (0.62 to 1.58)	0.97
Futile recanalization†	126/208 (60.5)	62/104 (59.6)	0.96 (0.59 to 1.55)	0.87
ENI	79/195 (40.5)	46/97 (47.4)	1.35 (0.83 to 2.20)	0.22
END	44/195 (22.5)	16/97 (16.5)	0.66 (0.25 to 1.26)	0.21
Any ICH	19/151 (12.6)	8/71 (11.2)	0.86 (0.36 to 2.08)	0.75
sICH	10/125 (8.0)	3/61 (4.8)	0.58 (0.15 to 2.20)	0.43
In-hospital mortality	30/208 (14.4)	10/104 (9.6)	0.63 (0.29 to 1.34)	0.23

Case 1

- 75/M
- LKTW: 42 hours
- Lt. M1 occlusion
- NIHSS: 14
- NIHSS at discharge : 8
- NIHSS at 90 days : 4

2022

뇌졸중 재개통 심포지엄 및

대한뇌혈관내치료의학회 춘계보수교육

Case 2

- 74/F
- LKTW: 38 hours
- Lt. ICA occlusion (cavernous segment)
- NIHSS: 7
- NIHSS at discharge : 2
- NIHSS at 90 days : 1

Direct EVT without IV-rtPA

김 성 태

인제대

2022 뇌졸중 재개통 심포지엄 및
대한뇌혈관내치료학회 춘계보수교육
일시: 2월26일(토) 판교 차박이옴플렉스

Direct EVT without IV-rtPA

(16:40-17:00)
Session IV – The debates

김 성 태
인제대학교 부산백병원 신경외과

IV thrombolytics, Alteplase

- 1995 NIND
- 2008 ECASS III
- 2018 WAKE-UP, 2019 EXTEND
- 2020 Meta analysis of WAKE-UP, EXTEND, THAW and ECASS-4

3h

3 - 4.5h

>4.5h

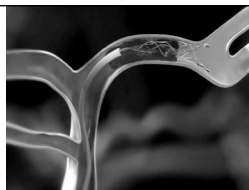


IA thrombectomy

- 2015 MR CLEAN, ESCAPE, EXTENDED-IA, SWIFT-PRIME, REVASCAT
- 2018 DAWM, DIFFUSE-3

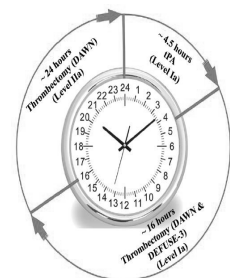
6h

24h



Ischemic Stroke due to LAO (<4.5h)

- IV-rtPA and EVT
"Bridging therapy"



2020 JKNS

Direct EVT without IV-rtPA (<4.5h)

- Clx of IV-rtPA
- Ix of IV-rtPA, but concern of Cx
 - Low potency at Large artery occlusion (4% in ICA)
 - High ICH risk
 - Time delay

Table. Pros and Cons of Bridging Therapy

Potential benefit	Effect
Early reperfusion at first angiography (40-50%), especially if short thrombus or residual flow	High rates of excellent clinical outcome for this subpopulation
Thrombus softening and facilitation of successful reperfusion	Fewer passes of stent devices/less cost, shorter procedure time, and better outcomes
Chance of reperfusion when no EVT access to thrombus possible	Higher proportion with early reperfusion translating to better outcomes
Reperfusion of remaining distal occlusions after mechanical thrombectomy	Potential better outcomes since more complete reperfusion (TICI 3) and less severe capillary microthrombosis
Potential harm	Effect
IV tPA-related local and systemic bleeding complications	Puncture-site hematomas (1%-2%) and major systemic bleeding (1%)
IV tPA-related coagulopathy and small vessel fragility	More large symptomatic intracerebral parenchymal hemorrhage (1%-2%)
IV tPA-related coagulopathy and sICH in patients at risk	Higher rates of sICH and aICH with poor functional outcome
IV tPA-related blood-brain barrier breakdown, coagulopathy, and potentiated large vessel damage because of stent retrieval	Increased symptomatic parenchymal hemorrhage when infarct. Poorer functional outcome and increased infarct volume
Tandem intracranial and extracranial occlusions may require additional procedures during EVT and potentially immediate antiplatelet therapy	Increased symptomatic intracranial hemorrhage (10%)
Distal thrombus migration	Inability to retrieve thrombus with MT. Neurological deterioration and more severe/extended ischemia
Increase thrombus fragility by softening the thrombus	Higher rates of pre-interventional thrombus fragmentation leading to lower rates of complete (TICI 3) reperfusion
IV tPA lysis of left atrial appendage or other proximal thrombus	Early stroke recurrence or multiple systemic emboli
Delay to MT initiation	Later median onset to reperfusion resulting in worse outcomes
IV tPA-associated allergic reactions (1%)	During IV tPA infusion-EVT procedure, which may worsen ischemia or require intubation/prolonged ICU stay
IV tPA-related susceptibility in animal models	More neuronal loss
IV tPA cost	Adds to procedural cost

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Topical Review

Section Editors: Ryan J. Becker, MD, and Emanuele Keller, MD

Direct Mechanical Thrombectomy Versus Combined Intravenous and Mechanical Thrombectomy in Large-Artery Anterior Circulation Stroke

A Topical Review

Urs Fischer, MD, MSc; Johannes Kasanmocher, MD; Vitor Mendes Pereira, MD; René Chapot, MD; Adam H. Siddiqui, MD; Michael T. Froehner, MD, PhD; Christopher Cogland, MD; Anthony J. Fulton, PhD; Jeffrey L. Saver, MD; Jan Gralla, MD, MSc

3 hours after application of IV tPA in 21% of M1 occlusions, in 38% of M2 occlusions, and in 4% of internal carotid artery (ICA) occlusions.¹⁸ However, in clinical practice, recanalization

The positive trials also demonstrated that MT alone is an effective therapy for acute ischemic stroke, improving outcomes among patients ineligible for IV tPA.¹⁷ Whether MT alone is as good, worse, or better than pretreatment with IV tPA before MT among EVT-eligible AIS patients with LVO in the AC has now become a matter of debate. This topical review addresses this question, summarizing evidence in favor and against treatment with IV tPA before MT in patients with LVO in the AC.

(Stroke, 2017;48:2912-2918. DOI: 10.1161/STROKEAHA.117.017208)

Summary of Current Evidence

Available clinical evidence from several single-center studies and limited multicenter studies demonstrates that immediate and direct MT is equally effective and not inferior to bridging thrombolysis if patients are immediately treated in a stroke center with rapid access to endovascular procedures. Two clinical series addressing the efficacy of direct MT in patients eligible for IV tPA have suggested that direct MT may be at least as effective as bridging thrombolysis.

MT. Several trials (SWIFT DIRECT [SolitaireTM Versus Intention for Thrombectomy Plus Intravenous t-PA Versus DIRECT SolitaireTM Stent-Retriever Thrombectomy in Acute Anterior Circulation Stroke], and MR CLEAN-NO IV) are in preparation or under way to address this urgent clinical question. SWIFT DIRECT will assess whether tPA-eligible subjects with AIS because of LVO in the AC presenting to a stroke center with endovascular facilities will have noninferior functional outcome at 90 days when directly treated with MT alone compared with IV tPA plus MT. A total of 404 subjects will be included in the trial. The sample size calculation is based on a noninferiority margin of 12%. However, SWIFT DIRECT will not provide the answer whether IVT should be skipped in the prehospital phase. The RACECAT trial (Direct Transfer to an Endovascular Center Compared to Transfer to the Closest Stroke Center in Acute Stroke Patients With Suspected Large Vessel Occlusion; NCT02795962) addresses the question whether patients with suspicion of LVO in the prehospital setting should directly be referred to the next stroke center for endovascular treatment, bypassing the next IVT capable stroke unit.

Literature review of RCTs

- Several RCTs are finished or ongoing

< 4.5H

≥ 18Y

≤ Prestroke mRS 2

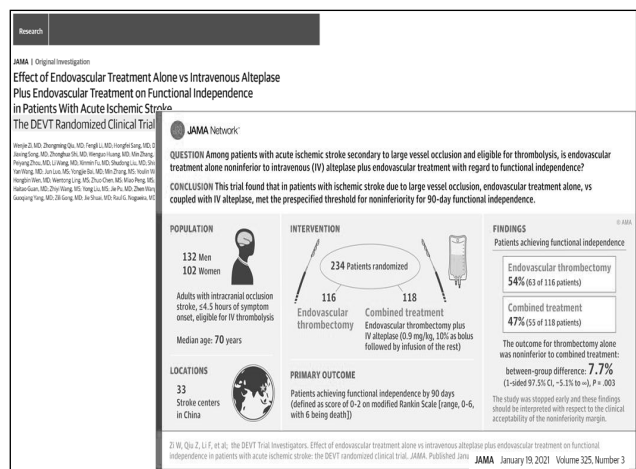
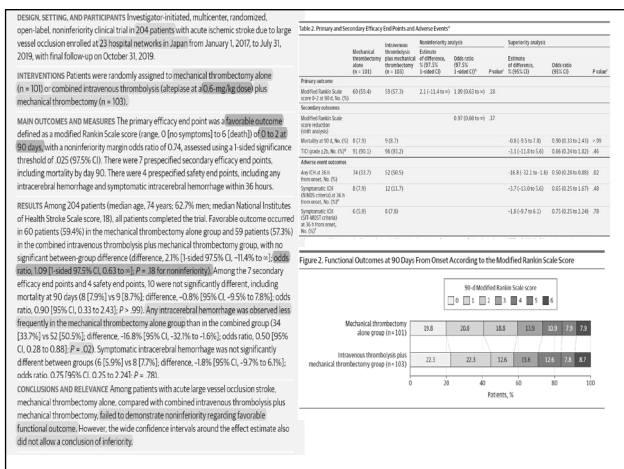
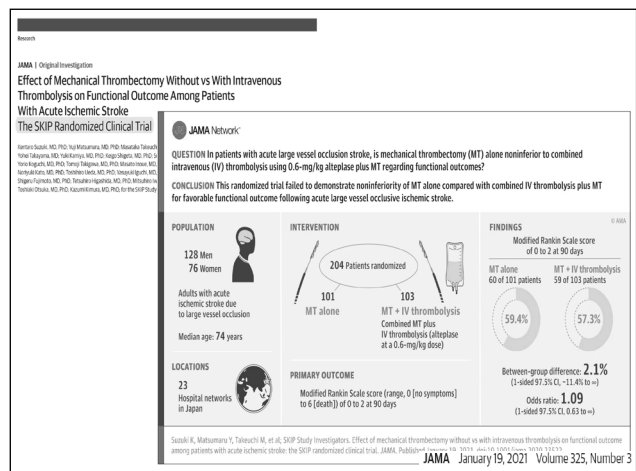
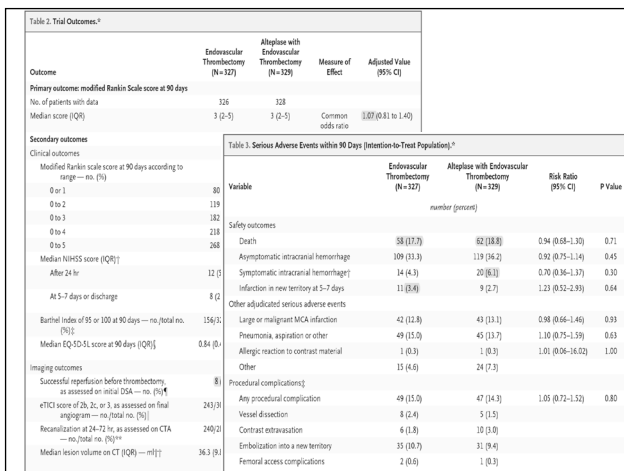
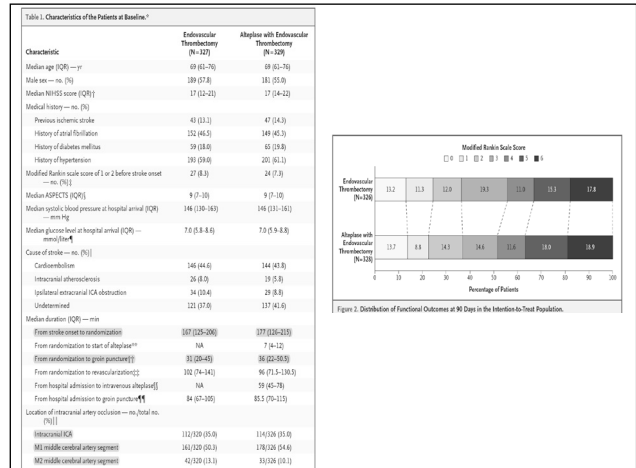
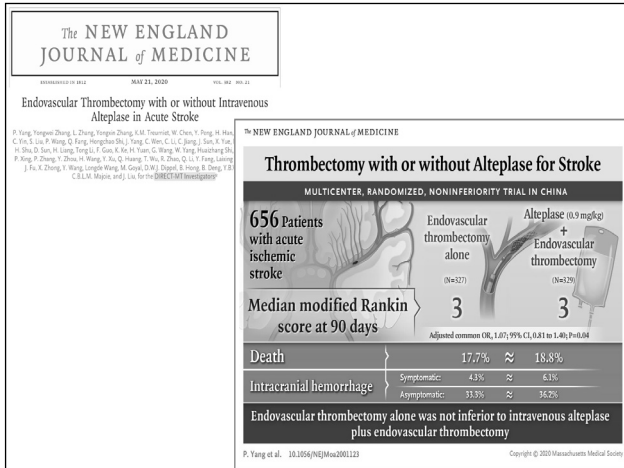
Anterior circulation Large artery occlusion (ICA, M1, prox M2)

- MT alone VS IV-rtPA and EVT “Bridging therapy”

Characteristic	DIRECT-MT ¹⁸	SWIFT ¹⁹	DEVT ²⁰	MR CLEAN-NO IV ²¹	SWIFT-DIRECT ²²	DIRECT-SAFE ²³
Main inclusion criteria	Age ≥18 years mRS 0 or 1 ICA, MCA-M1 or M2 occlusion on CTA NIHSS: no limit Onset to IV tPA ≤4.5 hours	Age ≥18 & <86 years mRS 0 or 1 ICA, or MCA-M1 occlusion on CTA or MRA NIHSS: ≤6 Onset to IV tPA ≤4.5 hours	Age ≥18 years mRS 0 or 1 ICA, or MCA-M1 occlusion on CTA or MRA NIHSS: no limit Onset to IV tPA ≤4.5 hours	Age ≥18 years mRS 0 or 1 ICA, or MCA-M1 or proximal M2 occlusion on CTA or MRA NIHSS: ≤2 Onset to IV tPA ≤4.5 hours	Age ≥18 years mRS 0 or 1 ICA, or MCA-M1 or M2 or basilar on CTA or MRA NIHSS: ≤5 or <30 Onset to randomization ≤4 hours 15 minutes Hospital arrival to puncture ≤90 minutes	Age ≥18 years mRS 0-3 ICA, MCA-M1 or M2 or basilar on CTA or MRA NIHSS: no limit Onset to IV tPA ≤4.5 hours Hospital arrival to puncture ≤90 minutes
Country	China	Japan	China	Europe	North America & Europe	Australia, New Zealand, China, Vietnam
Device	Any approved device	Any approved device	Any approved device	Any approved device	Solitaire stent retriever with proximal protection device first	Trevo stent retriever first
Thrombolysis	Alteplase, 0.6 mg/kg	Alteplase, 0.6 mg/kg	Alteplase, 0.6 mg/kg	Alteplase, 0.6 mg/kg	Alteplase, 0.6 mg/kg	Alteplase, 0.6 mg/kg OR Tenecteplase 0.25 mg/kg
Design	Non-inferiority	Non-inferiority	Non-inferiority	Superiority	Non-inferiority	Non-inferiority
Non-inferiority margins	mRS shift with a non-inferiority margin OR 0.80	mRS 0-2 with a non-inferiority margin OR 0.74	mRS 0-2 with a risk difference non-inferiority margin 10%	mRS shift with a non-inferiority margin OR 0.80	mRS 0-2 with a non-inferiority margin 12%	mRS 0-2 or return to baseline with risk difference non-inferiority margin 10%
Treatment	MT (n=227) IV before MT (n=229)	MT (n=100) IV before MT (n=103)	MT (n=116) IV before MT (n=118)	MT (n=273) IV before MT (n=268)	MT (n=201) IV before MT (n=207)	NA
Publication status	2020	2021	2021	Abstract at the International Stroke Congress February 2021	Abstract at the European Stroke Organization Congress September 2021	NA
Main outcome	Demonstrated non-inferiority	Did not demonstrate non-inferiority	Demonstrated non-inferiority	Did not demonstrate superiority	Did not demonstrate non-inferiority	NA

DIRECT-MT, Direct Intra-arterial Thrombectomy in Order to Revascularize AIS Patients With Large Vessel Occlusion Efficiently in Chinese Tertiary Hospitals; SWIFT, Direct Mechanical Thrombectomy in Acute LVO Stroke; DEVT, Direct Endovascular Thrombectomy in Combined IV and Endovascular Thrombolysis for Patients With Acute Large Vessel Occlusion in the Anterior Circulation; MR CLEAN-NO IV, Multicenter Randomized Clinical Trial of Endovascular Treatment for Acute Ischemic Stroke in the Netherlands-NO IV; SWIFT-DIRECT, Bridging Thrombolysis Versus Direct Mechanical Thrombectomy in Acute Ischemic Stroke; DIRECT-SAFE, A Randomized Controlled Trial of Direct Endovascular Clot Retrieval versus Standard Bridging Therapy; mRS, modified Rankin Scale; ICA, internal carotid artery; MCA, middle cerebral artery; CTA, computed tomography angiography; NIHSS, National Institutes of Health Stroke Scale; IV tPA, intravenous tissue plasminogen activator; MRA, magnetic resonance angiography; MT, mechanical thrombectomy; IV tPA, intravenous thrombolysis; NA, not applicable.

JoS 2022





Direct mechanical thrombectomy fails to show non-inferiority compared with IV tPA plus thrombectomy for LVsOs

Dr Michael J. and Dr David A.

The preliminary results of the DIRECT3* (Collaborative with the intention for thrombectomy plus IV tPA versus direct Solitaire plus intravenous thrombectomy) a acute anterior circulation stroke trial have indicated that in the treatment of large vessel ischaemic stroke, direct mechanical thrombectomy failed to demonstrate non-inferiority to intravenous tissue plasminogen activator (IV tPA) plus thrombectomy (or "bridging thrombectomy"). These results were presented by Jan Golka, chair and director of the Department of Diagnostic and Interventional Neurosurgery at the Hospital, University Hospital of Bonn, Bonn, Germany, and Udo Fischer, chairman and head of the Department of Neurology at the University Hospital of Bonn (Bonn, Germany), at the 7th European Stroke Organisation Conference (ESOC 2015, 3-5 September, Vienna).

JOS
JOURNAL OF STROKE

DIRECT-SAFE: A Randomized Controlled Trial of DIRECT Endovascular Clot Retrieval versus Standard Bridging Therapy

Peter J. Mitchell,¹ Bernard Yan,¹ Leonid Churilin,² Richard J. Dowling,³ Steven Bush,⁴ Thang Nguyen,⁴ Bruce C. Campbell,⁵ Geoffrey A. Donnan,⁶ Zhongrong Miao,⁷ Stephen M. Davis,⁸ on Behalf of the DIRECT-SAFE Investigators

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²Department of Medicine and Neurology, Melbourne Brain Centre at The Royal Melbourne Hospital, University of Melbourne, Parkville, Australia
³Melbourne Medical School, University of Melbourne, Parkville, Australia
⁴Comprehensive Stroke Centre, Department of Neurology, The Prince's Hospital VIC, Parkville, The University of Melbourne, He Chai-Mei City, Vietnam
⁵The Henry Institute of Neuroscience and Medical Research, Parkville, Australia
⁶Department of Interventional Neurology, Beijing Tiantan Hospital, Capital Medical University, Beijing, China
⁷Department of Neurology, Beijing Tiantan Hospital, Capital Medical University, Beijing, China

Background and Purpose: The benefit regarding re-treatment with intravenous (IV) thrombolysis before mechanical thrombectomy in acute ischemic stroke with large vessel occlusion remains unclear. To test the hypothesis that clinical outcome of ischemic stroke patients with (a) fractional internal carotid artery, middle cerebral artery or basilar artery occlusion treated with direct endovascular thrombectomy within 4.5 hours will be non-inferior compared with that of standard bridging IV thrombolysis followed by endovascular thrombectomy.

Methods: To randomize 700 patients 1:1 to direct thrombectomy or bridging IV thrombolysis with thrombectomy. An international multicenter prospective randomized open label blinded endpoint trial (PRORISE) (ClinicalTrials.gov identifier: NCT04040001).

Results: Primary endpoint is functional independence defined as modified Rankin Scale (mRS) 0-2 at 90 days. Secondary end points include ordinal mRS at 90 days, good neurological improvement (modified Thrombolysis in Stroke score [TACS] ≥ 5), safety endpoints include symptomatic intracerebral hemorrhage and death.

Conclusions: DIRECT-SAFE will provide unique information regarding the impact of direct thrombectomy in patients with large vessel occlusion, including patients with **large vessel occlusion** with comparison across different ethnic groups.

Keywords: Ischemic stroke; Thrombectomy; Thrombolytic therapy

Editor's column

Optimal transfer paradigm for emergent large vessel occlusion strokes: recognition to recanalization in the RACECAT trial

Shashvat M Desai¹, Thabile M Leslie-Mazwi², Joshua A Hirsch³, Ashutosh P Jadhav⁴

Of the various forms of stroke, emergent large vessel occlusion (ELVO) stroke produces the majority of disability and death after stroke,¹ but some represents a target for highly efficacious endovascular thrombectomy (EVT).² Intravenous tissue plasminogen activator (IV-tPA) remains otherwise the standard of care for all qualifying patients with ischemic stroke, with or without IV-tPA within 4.5 hours of onset.

Evaluation (RACE) scale, demonstrates a sensitivity of 0.85 and a specificity of 0.68 for ELVO using a threshold of RACE scale ≥5.³ The presence and severity of stroke may influence where a patient receives the most appropriate stroke care.

TYPE OF CENTER AND TRANSFER MECHANISMS

The RACECAT trial (ClinicalTrials.gov identifier: NCT02795942) is a multicenter, superiority, cluster randomized within a cohort trial with blinded endpoint assessment. The objective was to establish whether patients with a stroke with symptoms of a large vessel occlusion in the field have higher rates of favorable outcome when transferred directly to an EVTSC as compared with the standard transfer to the closest PSC. Briefly, patients with a stroke and suspected ELVO (RACE ≥5), transferred to an endovascular center were randomized to either direct transfer to an EVTSC or standard transfer to a PSC.

RACECAT RESULTS

The RACECAT trial (ClinicalTrials.gov identifier: NCT02795942) is a multicenter, superiority, cluster randomized within a cohort trial with blinded endpoint assessment. The objective was to establish whether patients with a stroke with symptoms of a large vessel occlusion in the field have higher rates of favorable outcome when transferred directly to an EVTSC as compared with the standard transfer to the closest PSC. Briefly, patients with a stroke and suspected ELVO (RACE ≥5), transferred to an endovascular center were randomized to either direct transfer to an EVTSC or standard transfer to a PSC.

Table 1. Transfer to PSC versus Direct Transfer to EVTSC: Advantages and Disadvantages

	Transfer to PSC	Direct Transfer to EVTSC
Potential advantages	► Early endovascular stabilization ► Early IV-tPA administration ► Rapid triaging to either PSC and enrich subsequent transfer population	► Early EVT ► High volume center resources and expertise
Potential disadvantages	► Delay in EVT transfer to EVTSC ► Interhospital transfer associated with inherent logistical challenges	► More positive EVT transfer due to only moderate severity of large vessel occlusion ► Decreased in expertise at PSC
Implementation barriers	► Stronger primary stroke center capabilities to be superior ► Optimal inter-hospital and intra-hospital data management and transport systems	► Stronger primary stroke center capabilities to be superior ► Optimal inter-hospital and intra-hospital data management and transport systems

EVT, emergent large vessel occlusion; EVT, endovascular thrombectomy; PSC, large vessel occlusion; PSC, primary stroke center; PSC, stroke center; PSC, stroke management system.

• Mothership < drip and ship

Discussion

- East Asian 3 RCTs - noninferior
- Western RCTs - ?
- 인종적 차이, Cause of stroke, 의료 환경 등 고려
- 환자 개개인의 상황을 고려할 필요 있음 (e.g. ICH risk)

Conclusion

1. Direct EVT without IV-rtPA (<4.5h)
– Noninferior ? Still debate
2. Should follow the guideline
3. Make decision by considering
1,2 and Individual situation of the patient

감사합니다.

MEMO

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†January 2020 Finance Report. Data on file at Abbott

*On Nov. 8, 1993, the first (Perclose) patent was filed for the percutaneous suture vascular closure device. The Perclose portfolio includes all percutaneous suture closure devices. Data on file at Abbott.

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Cilostazol + Ginkgo biloba ext. 복합 서방정

혈전생성 억제¹와 신경보호²를 동시에



Renexin CR

1일 1회 복용으로 복약순응도 향상 기대³

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Renexin CR Tab.

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[References] 1. Ryu KH, et al. Ginkgo biloba extract enhances antiplatelet and antithrombotic effects of cilostazol without prolongation of bleeding time. *Thrombo Res.* 2009;124:328-334 2. Kwak PA, et al. Supra-Additive Neuroprotection by Renexin, a Mixed Compound of Ginkgo Biloba Extract and cilostazol, Against Apoptotic White Matter Changes in Rat after Chronic Cerebral Hypoperfusion. *J Clin Neurol.* 2012 Dec; 8(4): 284-292 3. Bae JP, et al. Adherence and dosing frequency of common medications for cardiovascular patients. *Am J Manag Care.* 2012 Mar;18(3):139-46 4. SID142 임상3상, Data on file, SK케미칼. [Updated 2019.04.09]

리넥신서방정 제품요약정보

【제품명】 · 리넥신서방정 **【원료약품 및 그 분량】** 이 약 1정 중 유효성분 : 실로스타졸(JP)···200 mg, 은행엽건조엑스(생규)···160 mg **【성상】** 연두색의 타원형 서방성 필름코팅정 **【효능·효과】** 다음 질환에 대하여 실로스타졸 단독요법으로 효과가 불충분한 경우, 실로스타졸과 은행엽건조엑스 제제의 병용요법에 대한 대체요법 1. 만성동맥폐색증(버거씨병, 폐색성 동맥경화증, 당뇨병성 말초혈관병증 등)에 따른 계양, 동통 및 냉감 등 허혈성 증상상의 개선 2. 뇌경색(심인성 뇌색전증 제외) 발증 후 재발억제 **【용법·용량】** 이 약은 서방정 정제이므로 분쇄하거나 분할 또는 씹지 않고 전체를 복용하며, 식사를 피하여 공복 상태에서 복용한다. 이 약은 1회 용량으로 실로스타졸 100밀리그램과 은행엽건조엑스 80밀리그램을 1일2회 병용투여시 효과가 충분한 성인 환자에 대하여 대체요법으로 투여한다. 통상 성인에 대하여 1일1회, 1회 1정을 경구 투여한다. **【사용상의주의사항】** 1. 경고, 이 약은 실로스타졸 투여로 인해 맥박수가 증가하여 협심증이 발현될 수 있으므로 협심증의 증상(가슴통증 등)에 대한 문진을 주의깊게 실시한다(뇌경색 재발 억제효과를 검토하는 시험에서, 장기간에 걸쳐 PRP(pressure rate product)를 의미있게 상승시키는 작용이 인정되었다. 또한, 실로스타졸 투여군에서 협심증이 발현된 증례가 나타났다). 2. 다음 환자에는 투여하지 말 것. 1) 출혈(혈우병, 모세혈관 취약증, 두개내출혈, 상부소화관출혈, 요로출혈, 객혈, 초저출혈 등) 또는 그러한 소인(활동성 소화궤양, 최근 6개월 이내에 출혈성뇌졸중, 3개월 이내에 외과수술, 증식당뇨망막병증, 조절되지 않는 고혈압)이 있는 환자(출혈을 조장할 우려가 있다) 2) 출혈성심부전 환자(증상을 악화시킬 우려가 있다) 3) 이 약 및 이 약의 구성성분에 과민반응의 병력이 있는 환자 4) 임부 또는 임신하고 있을 가능성이 있는 여성 및 수유부 3. 다음 환자에는 신중히 투여할 것. 1) 항응고제(와파린 등), 항혈소판제(아스피린, 티클로피딘 등), 혈전용해제(우로키나제, 알테플라제 등), 프로스타글란딘 E1 제제 및 그 유도체(알프로스타딜, 리마프로스트 알파엑스 등)를 투여중인 환자 2) 월경기간 중인 환자(출혈을 조장할 우려가 있다) 3) 관동맥 협착의 합병증 환자(이 약의 투여에 의한 맥박수 증가로 협심증을 유발할 가능성이 있다). 4) 중증 신장에 환자(크레아티닌 청소율 ≤ 25 mL/분)(이 약의 대사물의 혈중농도가 상승될 수 있다). 5) 중등도 또는 중증 간장애 환자(이 약의 혈중농도가 상승될 수 있다). 6) 당뇨병 또는 내당능 장애가 있는 환자(출혈성 유해증상이 발현하기 쉽다). 7) 지속적으로 혈압이 상승하고 있는 고혈압 환자(약성고혈압 등) 8) 심방이나 심실전위 환자, 심방세동이나 조동 환자, 심실빈맥, 심실세동 또는 다초점성심실이상성박동 환자, QT간격의 연장이 있는 환자 9) 5자형 심실 중격이 있거나 위험이 있는 환자(특히 고령자) : 5자형 심실 중격 환자에서 좌심실 유출로 폐쇄가 보고되었다. 실로스타졸 복용 시작 후 새로운 수축기 잡음 혹은 심장 증상의 발생 여부를 모니터링 한다. **【제조자】** 에스케이케미칼(주) 충청북도 청주시 흥덕구 산단로 149 **【판매자】** 에스케이케미칼(주) 경기도 성남시 분당구 판교로 310 2020.03.24

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Reference. 리넥신서방정 허가정보, 의약품안전나라 [Cited 2020.03.25] Available from : <https://nrdug.mfds.go.kr/>

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