



2023 뇌졸중 재개통 심포지엄

(ARCS Arterial Recanalization in Cerebral Stroke) 및

대한뇌혈관내치료의학회 춘계보수교육

- New Era of Endovascular Stroke Treatment -

일시: 2023년 2월 25일 (토)

장소: 판교 차바이오컴플렉스 지하1층 국제회의실



| 주최 | 대한뇌혈관내치료의학회 급성뇌경색치료연구회

| 주관 | 대한신경외과학연구재단

존경하는 대한뇌혈관내치료의학회 회원 여러분!



대한뇌혈관내치료의학회 회장 장철훈입니다.

대한뇌혈관내치료의학회는 회원들의 임상 역량 강화를 위해 항상 노력하고 있습니다.

그리고 이번 ARCS(Arterial Recanalization in Cerebral Stroke) symposium은 대한뇌혈관내치료의학회 내 유일한 연구 단체인 급성 뇌경색치료연구회가 주관하는 춘계 보수교육입니다.

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

이번 ARCS 2023에서는 급성기 뇌경색 치료 분야에 대한 최신 정보를 공유하고 현재 복지부가 주도하는 뇌혈관질환정책에 대한 소개, 최근 변화된 치료 환경에서 iv t-PA의 기능에 대하여도 좋은 강의가 준비되어 있어 기대감이 큰 연수강좌가 될 것으로 생각합니다.

마지막으로 ARCS 2023을 준비하시느라 수고하신 김영우 총무이사, 권현조 학술이사, 신승훈 급성뇌경색치료연구회 회장께 감사의 말씀을 전합니다.

2023년 2월 마지막 토요일 판교에서 뵙 수 있기를 기원합니다.

2023. 2

대한뇌혈관내치료의학회 회장 장 철 훈 배상

전국의 급성 뇌경색 치료에 여념이 없으신
대한뇌혈관내치료학회 회원 및 급성뇌경색치료연구회 회원 여러분!



대한뇌혈관내치료의학회 급성뇌경색치료연구회가 주최하고, 대한신경
외과학연구재단이 주관하는

2023년도 뇌졸중 재개통 심포지움(Arterial Recanalization in Cerebral
Stroke, ARCS)이 2023년 2월 25일 토요일 개최됩니다.

올해의 테마는 “New Era of Endovascular Stroke Treatment”입니다.

대뇌혈관 폐색의 치료방법, 급성 기저동맥 폐색, 뇌혈관정책, 정맥내 혈
전용해제, 뇌혈관 협착증과 연관된 대뇌혈관 폐색의 치료방법 등 다양한 주제에 대한 훌륭한 강
의가 준비되어 있습니다. 이번 강의를 통해 회원 여러분들의 급성 뇌경색에 대한 학술적인 발전
이 있기를 기대하겠습니다.

학술대회 준비에 많은 도움을 주신, 장철훈 대한뇌혈관내치료의학회 회장, 권순찬 부회장, 김영
우 총무이사, 권현조 학술이사(ASTRO 부회장), 진성철 ASTRO 총무이사, 강동훈 ASTRO 학
술이사께 감사의 말씀을 전합니다.

아무쪼록 새해 건강하시고, 많은 회원 여러분들의 참석을 기대하겠습니다.

2023. 2

급성뇌경색치료연구회 회장 신 승 훈 배상

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
	이 성 호	서울대학교병원
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
여의사회	심 숙 영	인제대학교 일산백병원
전문병원	김 문 철	에스포항병원
	허 준	명지성모병원
	전 우 열	대구굿모닝병원
	김 희 섭	청주효성병원
심뇌혈관정책	윤 창 환	분당서울대학교병원 순환기내과
	이 찬 희	영남대학교병원 순환기내과
	옥 민 수	울산대학교병원 예방의학과
뇌신경마취	전 영 태	분당서울대학교병원 마취통증의학과
의료기기 연구	양 수 근	인하대학교 의생명학과
뇌신경재활	김 수 아	순천향대학교 천안병원 재활의학과
	김 여 형	가톨릭대학교 의정부성모병원 재활의학과
	김 기 훈	고려대학교 안산병원 재활의학과
다학제연구	이 학 승	원광대학교병원 신경과
	정 용 안	가톨릭대학교 인천성모병원 핵의학과
	이 아 름	순천향대학교 부천병원 영상의학과
	김 광 준	연세대학교 세브란스병원 노년내과

2022~2023 대한뇌혈관내치료의학회 임원진

직 위	성 명	소 속
별정직 이사 (학술지편집)	김 대 원	원광대학교병원
별정직 이사 (인증관리)	성 재 훈	가톨릭대학교 성빈센트병원
	오 인 호	중앙보훈병원
	김 소 연	가톨릭관동대학교 국제성모병원
별정직 이사 (다기관임상)	황 교 준	분당제생병원
특별이사 (의학회)	윤 석 만	순천향대학교 천안병원
특별이사 (신의료기술/장비/재료)	강 현 승	서울대학교병원
특별이사 (해외학회 유치)	신 용 삼	가톨릭대학교 서울성모병원
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 종	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	인보의료재단 뉴고려병원
	권 도 훈	울산대학교 서울아산병원
	김 영 준	단국대학교병원

전임회장단

직 위	성 명	소 속
초대, 제2대	백 민 우	인보의료재단 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



윤 창 환

분당서울대학교병원 부교수

[학력]

1993.03-1999.02	서울대학교 의과대학 의학과 (학사)
2002.03-2004.02	서울대학교 의과대학 대학원 의학과 (내과학, 석사)
2007.03-2011.02	서울대학교 의과대학 대학원 의학과 (내과학, 박사)

[경력]

1999.03-2000.02	서울대학교병원 수련의
2000.03-2004.02	서울대학교병원 내과 전공의
2004.04-2007.04	공군 항공우주의료원 항공의학과장
2007.06-2009.03	독일 프랑크푸르트 의과대학 순환기내과 연구실 postdoc
2009.05-2010.02	서울대학교병원 순환기내과 전임의
2010.03-2011.02	분당서울대학교병원 내과 진료 조교수
2011.03-2015.02	분당서울대학교병원 내과 임상 조교수
2015.03-2020.02	분당서울대학교병원 내과 임상 부교수
2020.03-현재	분당서울대학교병원 내과 임상 교수

[연구관심분야]

- Clinical researches related to interventional cardiology, cardiovascular outcome
- Basic researches on vascular biology (diabetic vasculopathy, chronic total occlusion, ischemia-reperfusion injury)

초청연자



최 정 남

건강보험심사평가원 평가4부 부장

[주요 경력]

2016~2018	보건복지부 파견
2019~2020	평가운영실 평가보상부
2021~현재	평가실 평가4부

초청연자



이 석 윤

인제대학교 부산백병원 신경과/외과계중환자실

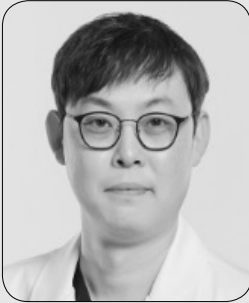
[Education]

2004-2010	인제대학교 의과대학 의학과
2010-2011	인제대학교 부산백병원 인턴
2011-2015	인제대학교 부산백병원 신경과 전공의
2018-2019	인제대학교 부산백병원 신경과 임상강사
2019-2020	분당서울대학교병원 중환자진료부 임상강사

[Professional Experience]

2015-2016	경상남도 통영시 욕지면 보건지소장
2016-2018	태황의료재단 한성병원 신경과 과장
2020-현재	인제대학교 부산백병원 신경과 진료교수/외과계중환자실 전담전문의

초청연자



김 형 찬

인제대학교 해운대백병원 조교수

[Education and Professional Experience]

2008	동국대학교 의과대학 졸업
2017	인제대학교 해운대백병원 신경과 수료
2018	인제대학교 해운대백병원 임상강사
2021	인제대학교 해운대백병원 진료교수
2022	인제대학교 해운대백병원 조교수

초청연자



김 용 원

경북대학교 의과대학 신경과학교실 경북대학교병원 신경과

[Education]

1997.03-2003.02	경북대학교 의과대학 (학사)
2007.03-2009.08	경북대학교 의학대학원 (석사)
2003.03-2004.02	경북대학교병원 인턴
2007.03-2011.02	경북대학교병원 신경과 전공의

[Professional Experience]

2011- 2012	경북대학교병원 신경과 임상강사
2013	경북대학교병원 신경과, 영상의학과 임상교수
2014	경북대학교병원 신경과 조교수
2019- 현재	경북대학교병원 신경과 부교수
2014.11	Department of Interventional Neurology, Froedtert Hospital and Medical College of Wisconsin (Vascular observership)
2020	Melbourne Brain Centre, Royal Melbourne Hospital, Australia (Research fellowship)

[Membership]

대한신경과학회
대한뇌졸중학회
대한신경중재치료의학회

2023

**뇌졸중 재개통 심포지엄 (ARCS) 및
대한뇌혈관내치료의학회 춘계보수교육**

- New Era of Endovascular Stroke Treatment -

2023

뇌졸중 재개통 심포지엄 (ARCS) 및 대한뇌혈관내치료의학회 춘계보수교육

- New Era of Endovascular Stroke Treatment -

PROGRAM

09:30-09:50	Registration	
09:50-10:00	Opening remark	장철훈 (대한뇌혈관내치료의학회 회장)
	Congratulatory Address	김범태 (대한신경외과학회 회장)
10:00-11:20	Session I. Recent Debate in Large Vessel Occlusion Strokes 좌장: 김문철 (에스포항병원), 강현승 (서울대)	
10:00-10:30	Support: Combined mechanical thrombectomy and IV Thrombolysis	박희권 (인하대병원 신경과) 17
10:30-11:00	Support: Primary mechanical thrombectomy	이현곤 (동남권원자력병원) 18
11:00-11:20	Endovascular Thrombectomy >24-hr From Stroke Symptom Onset	이동훈 (가톨릭대) 24
11:20-12:30	Session II. Endovascular Treatment of Acute Basilar Artery Occlusions 좌장: 고준석 (경희대), 김영우 (가톨릭대)	
11:20-11:40	Review of the recently published trials	오재상 (순천향대) 39
11:40-12:00	Stent retriever frst	하상우 (조선대) 40
12:00-12:20	Contact aspiration frst	손원수 (경북대) 45
12:20-12:30	Discussion - all attendees	
12:30-13:30	Lunch	
13:30-14:30	Session III. 국가의료정책의 방향 좌장: 백민우 (뉴고려병원), 장철훈 (영남대)	
13:30-13:50	제4차 응급의료 기본계획(안) 소개	신승훈 (차의과학대) 49
13:50-14:10	필수의료에 관한 심혈관계의 시각	윤창환 (분당서울대병원 순환기내과) 55
14:10-14:30	급성기뇌졸중 적정성평가 결과 및 개선 방향	최정남 (건강보험심사평가원 평가4부 부장) 57
14:30-15:10	Session IV. General Management of Acute Ischemic Stroke 좌장: 윤석만 (순천향대), 권현조 (충남대)	
14:30-14:50	Non-large vessel occlusions	김훈 (가톨릭대) 65
14:50-15:10	Critical care in severe AIS patients	이석윤 (인제대 부산백병원 신경과) 69
15:10-15:30	Coffee Break	

일시 | 2023년 2월 25일(토)

장소 | 판교 차바이오컴플렉스 지하1층 국제회의실

15:30-16:10	Session V. Role of IV Thrombolysis in the New Era of Endovascular Stroke Treatment	
	좌장: 박석규 (순천향대), 진성철 (인제대)	
15:30-15:50	Alteplase is better?	김형찬 (인제대 해운대백병원 신경과) 81
15:50-16:10	Tenecteplase is better?	반승필 (서울대) 85
16:10-17:00	Session VI. Primary stenting is feasible for ICAS-related Large Vessel Occlusions?	
	좌장: 유승훈 (울산대), 권순찬 (울산대)	
16:10-16:30	Interventional Neurologist's perspective: Rescue stenting	김용원 (경북대병원 신경과) 93
16:30-16:50	Endovascular Neurosurgeon's perspective: Primary stenting	정영진 (영남대) 97
16:50-17:00	Discussion - all attendees	
17:00	Closing Remark	신승훈 (급성뇌경색치료연구회 회장)

2023

뇌졸중 재개통 심포지엄 (ARCS) 및 대한뇌혈관내치료의학회 춘계보수교육

- New Era of Endovascular Stroke Treatment -

Session I

Recent Debate in Large Vessel Occlusion Strokes

좌장: 김문철 (에스포항병원), 강현승 (서울대)

**Support: Combined mechanical thrombectomy
and IV Thrombolysis**

Support: Primary mechanical thrombectomy
Endovascular Thrombectomy >24-hr From
Stroke Symptom Onset

박희권 (인하대병원 신경과)

이현곤 (동남권원자력병원)

이동훈 (가톨릭대)

Support: Combined mechanical thrombectomy and IV Thrombolysis

박 희 권

인하대병원 신경과

Support: Primary mechanical thrombectomy

이 현 곤

동남권원자력병원

2023 뇌졸중 재개통 심포지엄 및 대한 뇌혈관내 치료의학회 춘계 보수교육

Recent Debate in Large Vessel Occlusion Strokes

Support : Primary mechanical thrombectomy

동남권 원자력 의학원 신경외과
이현곤



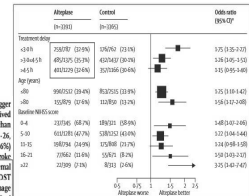
Recanalization of Large Vessel Occlusion

• Intravenous thrombolysis

1995 NEJM, Tissue Plasminogen Activator for Acute Ischemic Stroke
2014 Lancet, Meta-analysis

Effect of treatment delay, age, and stroke severity on the effects of intravenous thrombolysis with alteplase for acute ischaemic stroke: a meta-analysis of individual patient data from randomised trials

Findings Alteplase increased the odds of a good outcome, with earlier treatment associated with higher proportional benefit. Treatment within 3 h resulted in a good outcome for 259 (32.9%) of 787 patients who received alteplase versus 174 (23.1%) of 762 who received control (OR 1.75, 95% CI 1.35-2.27; delay of greater than 3 h, up to 6 h, resulted in good outcome for 485 (31.3%) of 1553 versus 432 (28.1%) of 1547; OR 1.36, 95% CI 1.05-1.76; and delay of more than 6 h resulted in good outcome for 401 (32.4%) of 1238 versus 357 (28.6%) of 1244; OR 1.35, 95% CI 1.05-1.76). Proportional treatment benefits were similar irrespective of age or stroke severity. Alteplase significantly increased the odds of symptomatic intracranial haemorrhage type 2, parenchymal haemorrhage, and haemorrhage within 36 h of treatment (OR 1.35, 95% CI 1.05-1.76; OR 1.35, 95% CI 1.05-1.76; OR 1.35, 95% CI 1.05-1.76).



Recanalization of Large Vessel Occlusion

• Intravenous thrombolysis

- 90-day mRS (0-1) is about 30% (vs 13%)
- ICH is 6.8% (1.3%)
- It was the benefit of clinical outcome over the harmful of ICH.
- Limitation: Large clots and more proximal clots (ICA)

Atherosclerotic lesions



Recanalization of Large Vessel Occlusion

• Intravenous thrombolysis

Alteplase Reduces Downstream Microvascular Thrombosis and Improves the Benefit of Large Artery Recanalization in Stroke

Results—Immediately after MCAO, platelet and leukocyte accumulation were observed mostly in the venous compartment. Within 30 minutes after MCAO, microthrombi and parietal fibrin deposits were detected in postcapillary microvessels. Alteplase treatment significantly ($P=0.006$) reduced infarct volume and increased the percentage of perfused vessels during MCAO ($P=0.02$) compared with saline. Plasma levels of fibrinogen from alteplase-treated rats showed a rapid and profound hypofibrinogenemia. In vitro platelet aggregation demonstrated that alteplase reduced platelet aggregation ($P=0.0001$) and facilitated platelet disaggregation ($P=0.001$). These effects were reversible in the presence of exogenous fibrinogen.

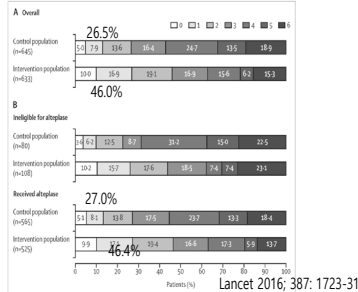
Conclusions—Our data demonstrate that DMT is an early phenomenon initiated before recanalization. We further show that alteplase-dependent maintenance of downstream perfusion during MCAO improves acute ischemic stroke outcome through a fibrinogen-dependent platelet aggregation reduction. Our results indicate that early targeting of DMT represents a therapeutic strategy to improve the benefit of large artery recanalization in acute ischemic stroke. (Stroke. 2015;46:3241-3248. DOI: 10.1161/STROKEAHA.115.010721.)



Recanalization of Large Vessel Occlusion

In 2015, five RCT were published at NEJM for Thrombectomy Effect !

- MR CRAIN
- ESCAPE
- REVASCAT
- SWIFT PRIME
- EXTEND IA

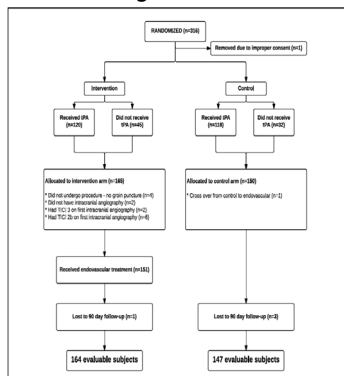


Recanalization of Large Vessel Occlusion

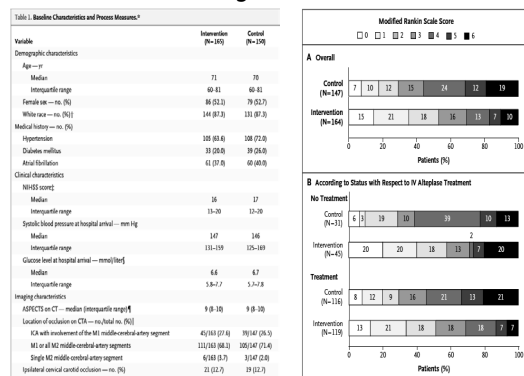
ESCAPE trial NEJM 2015;372:1019-30

- 목적: Should this patient undergo endovascular thrombectomy?
- Inclusion: 증상 발생 12시간 이내, 18세 이상, NIHSS 6점 이상, ASPECTS score 6점 이상, CTA에서 ICA/M1 occlusion 확인, Moderate collaterals이 확인, IV tPA를 사용하거나 IV tPA 적응증이 다음의 이유로 안되는 경우-발생시간이 불분명
- 무작위: 기존 치료(Control) / Endovascular Tx+기존 치료(Intervention)
(기존 치료 : IV tPA, IV tPA 사용을 못 할 때 시행한 medical treatment)

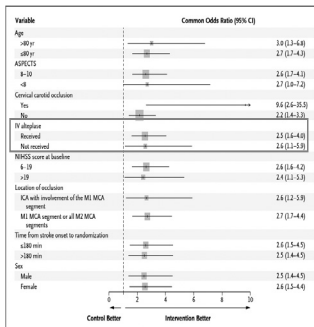
Recanalization of Large Vessel Occlusion



Recanalization of Large Vessel Occlusion



Recanalization of Large Vessel Occlusion



Confounding variable를 보정하고자 subgroup analysis 시행하였으나, 모든 변수와 거의 영향을 크게 받지 않고 MT에 유리한 결과가 도출

- IV alteplase 사용해도 MT가 유리
 - IV alteplase 사용해도 MT가 유리
- ⇒ IV alteplase 를 사용 여부가 Endovascular treatment의 결과 큰 영향을 미치지 못 할 가능성이 있지 않을까?

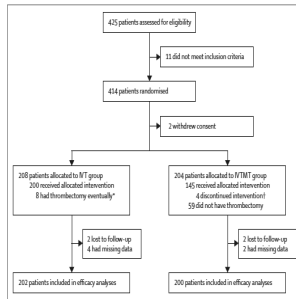
Recanalization of Large Vessel Occlusion

In 2016-2017, IV thrombolysis versus IV Thrombolysis + IA thrombectomy (Comparative study design)

- 2016 TRANCE Lancet
- 2016 THERAPY Stroke
- 2017 PISTE J Neurosurg Psychiatry

Recanalization of Large Vessel Occlusion

- TRANCE RCT Lancet Neuro 2016; 15:1138-47

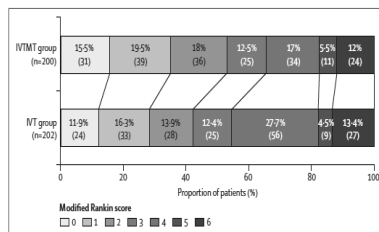


Recanalization of Large Vessel Occlusion

	IVT group (n=208)	IVTMT group (n=204)
Age, years		
Median (IQR)	68 (54-75)	66 (54-74)
<70	121 (58%)	122 (60%)
≥70	87 (42%)	82 (40%)
Sex		
Male	104 (50%)	116 (57%)
Female	104 (50%)	88 (43%)
Concomitant risk factors*		
Hypertension	118/208 (57%)	96/200 (47%)
Type 2 diabetes	35/208 (17%)	13/204 (6%)
History of stroke	14/208 (7%)	14/204 (7%)
Hypercholesterolaemia	109/189 (58%)	89/179 (49%)
Current or past tobacco use	79/182 (43%)	85/179 (47%)
Coronary disease	39/198 (19%)	33/195 (16%)
Clinical examination		
Systolic blood pressure, mm Hg	142 (119-160)	140 (127-157)
Blood glucose, g/L	1.2 (1.0-1.4)	1.2 (1.0-1.4)
NIHSS score	17 (13-20)	18 (15-21)
Imaging location*		
Left hemisphere	96/204 (47%)	101/198 (51%)
Right hemisphere	108/204 (53%)	95/198 (48%)

Occlusion site		
ICA	39 (19%)	24 (12%)
M1	164 (79%)	176 (86%)
TB	2 (1%)	2 (1%)
M2	2 (1%)	0
ASPECTS score		
0-4	35 (17%)	27 (13%)
5-7	52 (26%)	80 (40%)
8-10	115 (57%)	94 (48%)
Workflow duration, min		
From onset to imaging	111 (88-145)	112 (86-136)
From onset to intravenous thrombolysis	153 (124-180)	150 (120-178)
From onset to randomisation	170 (138-199)	168 (143-195)
From onset to thrombectomy	NA	259 (210-290)
From onset to the end of thrombectomy	NA	303 (261-345)

Recanalization of Large Vessel Occlusion



Mechanical thrombectomy alone

Meta-Analysis (2017 Ther Adv Neurol Disord 10(3) 151-160)

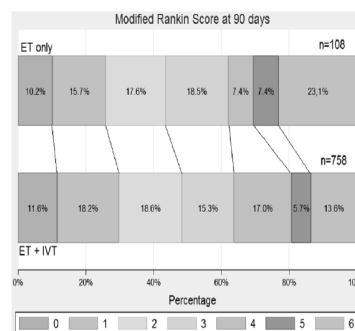
- IV tPA alone vs IV tPA + MT의 RCT 논문을 이용
- Direct MT versus IVT + MT

Mechanical thrombectomy alone

Study name	Patients	Mean age (years)	Males (%)	Median NIHSS (IQR) or (range)**	ET (n, %*)	IVT (n, %**)
ESCAPE	315	70.5	47.6%	16 (13-20)	165 (52%)	No: 45 (27%) Yes: 120 (73%)
EXTEND-IA	70	69.4	49%	17 (13-20)	35 (50%)	Yes: 35 (100%)
MR CLEAN	500	65	58.3%	17 (14-21)	233 (47%)	No: 30 (13%) Yes: 203 (87%)
PISTE	65	65.5	44.6%	18 (6-24)	33 (51%)	Yes: 33 (100%)
REVASCAT	206	66.4	52.3%	17 (14-20)	103 (50%)	No: 33 (32%) Yes: 70 (68%)
SWIFT-PRIME	196	65.7	50.5%	17 (13-20)	98 (50%)	Yes: 98 (100%)
THRACE	412	62.8	53.4%	18 (15-21)	204 (49.5%)	Yes: 204 (100%)

ET, endovascular thrombectomy; IQR, interquartile range; IVT, intravenous thrombolysis; NIHSS, National Institute of Health Stroke Scale.
*among all patients; **among patients randomized to ET.

Mechanical thrombectomy alone



Limitation: IVT에 대하여 randomized 된 논문을 이용한 결과가 아니니 이에 따른 교란 인자가 완전히 배제되지 못한다.

Conclusion: 교란 변수의 영향이 있더라도 MT와 MT+IVT는 서로 동등한 효과가 있을 가능성이 있다. 또한 MT와 IVT가 서로 보완적인 치료의 방향으로 가야한다

Mechanical thrombectomy alone

- Direct comparison study (MT + IV tPA vs MT alone)
 - 2017년, 이전 RCT 연구 기반으로 Meta-analysis 1)
 - SWIFT trial + STAR study

Figure. Flowchart of Patient Selection

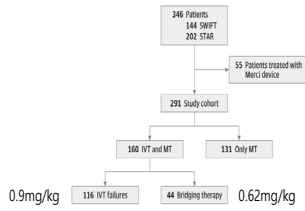


Table 2. Baseline Characteristics of the Study Patients^a

Characteristic	MT and IVT (n = 160)	MT Alone (n = 131)	P Value
Age, mean (SD), y	67 (13)	69 (12)	.14
Female	97/160 (60.6)	73/131 (55.7)	.41
NIHSS, median (IQR)	17 (13-20)	17 (13-20)	.86
Medical history			
Atrial fibrillation	53/160 (33.1)	62/131 (47.3)	.02
Hypertension	99/160 (61.9)	87/131 (66.4)	.46
Diabetes	22/160 (13.8)	32/131 (24.4)	.02
Hyperlipidemia	69/160 (43.1)	57/131 (43.5)	> .99
Current smoker	21/160 (13.1)	19/131 (14.5)	.74
Prior stroke or TIA	25/160 (15.6)	30/131 (22.9)	.13
Antiplatelet use	37/160 (23.1)	40/131 (30.5)	.18
Systolic blood pressure, mean (SD), mm Hg	145 (23)	147 (25)	.49
Diastolic blood pressure, mean (SD), mm Hg	80 (15)	80 (15)	.86
Left side occlusion	78/157 (49.7)	64/129 (49.6)	> .99
ASPECTS, mean (SD)	8.1 (1.8)	8.5 (1.6)	.03
ASPECTS, median (IQR)	8.0 (7.0-10.0)	9.0 (8.0-10.0)	.04
Location of occlusion			
Carotid	31/153 (20.3)	23/129 (17.8)	.72
M1	99/153 (64.7)	88/129 (68.2)	
M2 or M3	23/153 (15.0)	17/129 (13.2)	
Posterior circulation	0/153 (0)	1/129 (0.8)	
Serum glucose, mean (SD), mg/dL	126 (50)	130 (64)	.56
Platelets, mean (SD), $\times 10^3/\mu\text{L}$	228 (74)	239 (85)	.23

Table 1. Contraindications for IVT

Contraindication	No. (%) of Patients Undergoing MT without IVT (n = 131)
Oral anticoagulation or INR >1.7	38/122 (31.1)
Symptom onset to hospital arrival <4 h	40/124 (32.3)
Systolic blood pressure ≥ 185 mm Hg	11/129 (8.5)
Diastolic blood pressure ≥ 110 mm Hg	3/129 (2.3)
Glucose >400 mg/dL	5/126 (4.0)
Glucose <50 mg/dL	5/126 (4.0)
Platelets <100 $\times 10^3/\mu\text{L}$	2/131 (1.5)
APTT >39 s	9/111 (8.1)
Prior stroke or TIA and diabetes	8/131 (6.1)

Table 3. Details of Procedural, Clinical, and Safety Outcomes^a

Variable	MT and IVT (n = 160)	MT Alone (n = 131)	P Value
Times, median (IQR), min			
Symptom onset to hospital arrival	171 (75-245)	190 (108-274)	.04
Symptom onset to groin puncture	254 (195-305)	282 (201-375)	.10
Hospital arrival to groin puncture	79 (40-111)	77 (54-120)	.46
Symptom onset to reperfusion	308 (253-361)	315 (242-424)	.15
No. of passes with stent retriever, mean (SD)	1.7 (1.0)	1.8 (1.0)	.28
No. of passes with stent retriever, median (range)	1 (1-5)	1 (1-7)	.30
mTICI 2b or 3 reperfusion	127/151 (84.1)	105/124 (84.7)	> .99
mTICI 3	86/151 (57.0)	66/124 (53.2)	.54
Rescue therapy	20/160 (12.5)	17/131 (13.0)	> .99
Complications			
Embol to uninvolved territory	7/156 (4.5)	3/126 (2.4)	.52
Device-related serious adverse events	8/160 (5.0)	8/131 (6.1)	.80
Vasospasm	43/160 (26.9)	18/131 (13.7)	.006
sICH	2/160 (1.1)	5/131 (3.8)	.25
aICH	2/160 (1.1)	4/131 (3.1)	.41
PH1	1/160 (0.6)	4/131 (3.1)	.38
PH2	1/160 (0.6)	2/131 (1.5)	.59
HI1	29/160 (18.1)	25/131 (19.1)	.88
HI2	19/160 (11.9)	11/131 (8.4)	.44
Remote ICH	1/160 (0.6)	0/131 (0)	> .99
Vessel perforation	0/160 (0)	1/131 (0.8)	.45
Crohn hematoma	3/160 (1.9)	2/131 (1.5)	> .99
Outcome at 90 d			
mRS score of 0-1 ^b	65/156 (41.7)	46/128 (35.9)	.33
mRS score of 0-2 ^b	90/156 (57.7)	61/128 (47.7)	.10
Mortality	13/160 (8.1)	16/131 (12.2)	.32

Mechanical thrombectomy alone

- Direct comparison study (MT after IV tPA vs MT alone)

- 2017년 Stroke registries 연구(observation) 2)

- Essen stroke registry(2012-2013) 독일
- Bern stroke registry(Feb. 2009- Aug. 2014) 스위스 MR CREAM (Dec. 2010-Mar. 2014)

2)Stroke. 2017;48:3283-3288

Mechanical thrombectomy alone

- Anterior circulation 환자만 남기고
- IVT 사용의 적응증이 되는 환자만 남김

- 249명 MT after IV tPA vs 111명 MT alone
- 일반적인 치료 과정을 따랐지, 고의적으로 MT alone만을 하지는 않았다.

Table 1. Univariate Comparison of Bridging Thrombolysis With Direct MT in IVT Eligible Patients^a

	Bridging Thrombolysis (n=249)	Direct Mechanical Thrombectomy (n=111)	P Value
Baseline characteristics			
Sex female	122/249 (49)	49/110 (44.5)	.49
Age, y (SD)	73 (14)	75 (15)	.18
NIHSS on admission, median (range)	16 (1-30)	15 (0-30)	.74
Vascular risk factors			
Diabetes mellitus	42/249 (17.1)	17/108 (15.7)	.88
Hypertension	171/249 (68.5)	85/110 (77.3)	.03
Hypercholesterolemia	98/242 (40.5)	49/108 (45.4)	.73
Current smoking	47/214 (22)	21/104 (20.2)	.77
Atrial fibrillation	85/227 (37.4)	47/101 (46.5)	.14
Coronary heart disease	49/241 (20.3)	29/107 (27.1)	.029
Laboratory findings			
INR, mean (SD)	1.05 (0.13)	1.07 (0.2)	.98
Platelet count, mean (SD), $\times 10^3/\mu\text{L}$	218 (68)	240 (94)	.04
Serum glucose, mean (SD), mmol/L	7.14 (2.05)	7.22 (2.13)	.62
Vessel occlusion site			.17
ICA	102/249 (41)	53/111 (47.7)	
M1	122/249 (49)	43/111 (38.7)	
M2	25/249 (10)	15/111 (13.5)	

Mechanical thrombectomy alone

	Bridging Thrombolysis (n=249)	Direct Mechanical Thrombectomy (n=111)	P Value
Treatment			
Median time from symptom onset to diagnosis, h (IQR)	1.78 (1.32)	1.47 (1.05)	.0002
Median time from symptom onset to endovascular treatment, h (IQR)	4.26 (2.02)	3.29 (1.37)	<.0001
Median time from image to endovascular treatment, h (IQR)	2.12 (1.26)	1.57 (0.90)	<.0001
Software stent retriever	206/249 (82.8)	96/109 (88.1)	.034
Permanent intracranial stenting	8/249 (3.2)	1/111 (0.9)	.028
Permanent extracranial stenting	36/249 (14.5)	23/111 (20.7)	.017
Outcome			
Reperfusion after endovascular intervention (TICI 2b-3)	193/247 (78.1)	90/111 (81.1)	.058
Reperfusion after endovascular intervention (TICI 0-1)	19/247 (7.7)	6/111 (5.4)	.051

	Bridging Thrombolysis (n=249)	Direct Mechanical Thrombectomy (n=111)	P Value
Bleeding complications			
sICH	13/246 (5.3)	3/110 (2.7)	.041
aICH	49/246 (19.9)	13/110 (11.8)	.007
CRUISE outcome			
mRS score 0-2 ^b	102/249 (41)	49/111 (44.1)	.664
mRS score 0-1 ^b	72/249 (28.9)	31/111 (27.9)	.930
Mortality	68/249 (27.3)	30/111 (27)	.1

MT alone group에서 고령에 CAOD가 더 많지만, 더 빨리 치료 하고 혈의 정도 적었다.

양 군의 차이나는 점을 매칭해서 보정

Table 2. Comparison of Bridging Thrombolysis With Direct MT in MT-Eligible Patients Using Multivariate Matching*				
Baseline characteristics	Bridging Thrombolysis (n=102)	Direct Mechanical Thrombectomy (n=102)	P Value	
Sex female	49/102 (47.6)	45/102 (44.1)	0.77	
Age, y (SD)	75 (14)	75 (16)	0.35	
NIHSS on admission, median (range)	18 (0-38)	18 (0-38)	0.96	
Vessel occlusion site			1	
ICA	46/102 (44.7)	46/102 (44.7)		
M1/M2	57/102 (55.3)	57/102 (55.3)		
Outcome				
Reperfusion after endovascular intervention (TICI 2b-3)	79/102 (78.3)	84/102 (81.6)	0.72	
Reperfusion after endovascular intervention (TICI 0-1)	9/102 (9.1)	5/102 (4.9)	0.38	
Bleeding complications				
ICH	2/102 (2.0)	2/102 (2.0)	0.18	
ICH	2/102 (2.0)	1/102 (1.0)	0.17	
Clinical outcome after 90 days				
mRS 0-1	41/102 (39.8)	47/102 (45.6)	0.44	
mRS 0-1	24/102 (23.3)	30/102 (29.1)	0.39	
Mortality	30/102 (29.2)	37/102 (36.2)	0.41	

Thrombectomy alone

IVT 적용중이 되는 환자들 중에서 서로 영 군과 Matching 할 경우, 임상적 예후는 차이가 없지만, ICA 가 막힌 경우에서는 MT alone이 임상적 예후가 좋았다.

현재

Observation study (Selection bias)

IV tPA indication 맞는 사람만 모았

는데 왜 baseline 값이 다르지

tPA를 안 쓴 사람은 왜 안 썼지?

-> 여기에 대한 명확한 이유 X

Bern stroke registry (2009년 자료?)

Table 3. Comparison of Bridging Thrombolysis With Direct MT in Patients With ICA Occlusions Using Multivariate Matching Analysis*

Baseline characteristics	Bridging Thrombolysis (n=48)	Direct Mechanical Thrombectomy (n=48)	P Value
Sex female	20/48 (41.7)	15/48 (31.3)	1
Age, y (SD)	78 (13)	77 (13)	0.73
NIHSS on admission, median (range)	19 (0-33)	18 (0-38)	0.86
Vascular risk factors			
Hypertension	35/48 (72.9)	35/48 (72.9)	1
Outcome			
Reperfusion after endovascular intervention (TICI 2b-3)	32 (71.1)	37 (80.4)	0.45
Reperfusion after endovascular intervention (TICI 0-1)	7/45 (15.6)	4/46 (8.7)	0.55
Bleeding complications			
ICH	2/45 (4.4)	2/45 (4.4)	1
ICH	1/45 (2.2)	2/45 (4.4)	0.24
Clinical outcome			
mRS 0-1	7/45 (15.6)	8/46 (17.4)	1
mRS 0-1	9/45 (20.0)	13/46 (28.3)	0.18
Mortality	25/48 (52.1)	13/48 (27.1)	0.01

Mechanical thrombectomy alone

• 기존의 RCT 연구 기반의 Meta-analysis 나, observation study로는 본 연구의 가설을 검증하기에는 부족함이 있다.

• 각 치료 방법에 따른 환자의 선택이 동일하지 않다. IV tPA의 사용 기준은 좁고 명확한 반면, Thrombectomy를 하는 환자의 기준은 너무나 넓고 불명확한 면이 있다(Randomized, Blinded)

• MT가 예후에 미치는 영향이 너무나도 크다. -> 비용을 제외한 IV tPA로 임상적으로 문제가 되는 건 출혈과 혈전의 Migration 이다. 이 영향 인자는 MT의 기술적 요소로 유발될 수도, 해결될 수 있다. 이러한 문제는 IV tPA의 효과를 떨어 뜨리는 요소가 된다. (Non-inferior study)

Mechanical thrombectomy alone

• 기존의 RCT 연구 기반의 Meta-analysis 나, observation study로는 본 연구의 가설을 검증하기에는 부족함이 있다.

• 고려해야 할 변수가 많다 -> 막힌 혈관의 위치 (ICA vs MCA), 막힌 이유 (Cardio vs Atherosclerosis), 혈전의 크기, 시간, 기저질환 등. (이로 인해 충분한 환자의 수가 필요하다.)

⇒ 결국 확실한 결론을 위해서 RCT가 필요하다

⇒ 하지만, non-inferior design이라면, 결국 우리가 얻게 되는 결론이 현재 상황에서 다를 건가?

Mechanical thrombectomy

The NEW ENGLAND JOURNAL of MEDICINE ESTABLISHED IN 1882 MAY 21, 2020 VOL. 382 NO. 20 Endovascular Thrombectomy with or without Intravenous Alteplase in Acute Stroke DIRECT-MT trial 41개 대학병원 (중국) Randomized 1:1 matching (IV+MT vs MT alone) Non-inferiority Design (margin -20%) 1586명 중 656 명 선택 327명(MT alone) vs 329명(IV+MT) Odds ratio, 1.07; CI 95%, 0.81-1.40, p=0.04
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BACKGROUND
In acute ischemic stroke, there is uncertainty regarding the benefit and risk of administering intravenous alteplase before endovascular thrombectomy.

METHODS
We conducted a trial at 41 academic tertiary care centers in China to evaluate endovascular thrombectomy with or without intravenous alteplase in patients with acute ischemic stroke. Patients with acute ischemic stroke from large-vessel occlusion in the anterior circulation were randomly assigned in a 1:1 ratio to undergo endovascular thrombectomy alone (thrombectomy-alone group) or endovascular thrombectomy preceded by intravenous alteplase, at a dose of (0.9 mg) per kilogram of body weight, administered within 4.5 hours after symptom onset (combination-therapy group). The primary analysis for noninferiority assessed the between-group difference in the distribution of the modified Rankin scale scores (range, 0 [no symptoms] to 6 [death]) at 90 days on the basis of a lower boundary of the 95% confidence interval of the adjusted common odds ratio equal to or larger than 0.8. We assessed various secondary outcomes, including death and reperfusion of the ischemic area.

RESULTS
Of 1586 patients screened, 656 were enrolled, with 327 patients assigned to the thrombectomy-alone group and 329 assigned to the combination-therapy group. Endovascular thrombectomy alone was noninferior to combined intravenous alteplase and endovascular thrombectomy with regard to the primary outcome (adjusted common odds ratio, 1.07; 95% confidence interval, 0.81 to 1.40; P=0.04 for noninferiority) but was associated with lower percentages of patients with successful reperfusion before thrombectomy (2.4% vs 7.0%) and overall successful reperfusion (79.4% vs 84.5%). Mortality at 90 days was 17.7% in the thrombectomy-alone group and 18.8% in the combination-therapy group.

CONCLUSIONS
In Chinese patients with acute ischemic stroke from large-vessel occlusion, endovascular thrombectomy alone was noninferior to endovascular thrombectomy preceded by intravenous alteplase administered within 4.5 hours after symptom onset. (Funded by the Stroke Prevention Project of the National Health Commission of the People's Republic of China and the Wu Jieping Medical Foundation; DIRECT-MT Clinical-Trials.gov number, NCT03409206.)

Mechanical thrombectomy

JAMA | Original Investigation
Effect of Endovascular Treatment Alone vs Intravenous Alteplase Plus Endovascular Treatment on Functional Independence in Patients With Acute Ischemic Stroke
The DEVT Randomized Clinical Trial

JAMA 2021;325(3):234-243

33개 대학병원 (중국)

Randomized 1:1 matching (IV+MT vs MT alone)

Non-inferiority Design (margin -10%)

234명, early stop (계획은 970명)

116명(MT alone, 54.3%) vs 118명(IV+MT, 46.6%)

Odds ratio 1.36; CI 95%, 0.82 to 2.28, p=0.03

ICH: no difference (6.1% vs 6.8%)

IMPORTANCE Whether intravenous thrombolysis is needed in combination with mechanical thrombectomy in patients with acute large-vessel occlusion stroke is unclear.

OBJECTIVE To investigate whether endovascular thrombectomy alone is noninferior to intravenous alteplase followed by endovascular thrombectomy for achieving functional independence at 90 days among patients with large-vessel occlusion stroke.

DESIGN, SETTING, AND PARTICIPANTS Multicenter, randomized, noninferiority trial conducted at 33 stroke centers in China. Patients (n = 234) were 35 years or older with proximal anterior circulation intracranial occlusion strokes within 4.5 hours from symptom onset and eligible for intravenous thrombolysis. Enrollment took place from May 20, 2018, to May 2, 2020. Patients were enrolled and followed up for 90 days (final follow-up was July 22, 2020).

INTERVENTIONS A total of 116 patients were randomized to the endovascular thrombectomy alone group and 118 patients to combined intravenous thrombolysis and endovascular thrombectomy group.

MAIN RESULTS AND MEASURES The primary end point was the proportion of patients achieving functional independence at 90 days (defined as score 0-2 on the modified Rankin Scale; range, 0 [no symptoms] to 6 [death]). The noninferiority margin was -10%. Safety outcomes included the incidence of symptomatic intracerebral hemorrhage within 48 hours and 90-day mortality.

RESULTS The trial was stopped early because of efficacy when 234 of a planned 970 patients had undergone randomization. All 234 patients who were randomized (mean age, 68 years; 102 women [43.6%]) completed the trial. At the 90-day follow-up, 63 patients (54.3%) in the endovascular thrombectomy alone group vs 55 (46.6%) in the combined treatment group achieved functional independence at the 90-day follow-up (difference, 7.7%; 1-sided 97.5% CI, -5.1% to 20.1% for noninferiority + 20.1%). No significant between-group differences were detected in symptomatic intracerebral hemorrhage (16.1% vs 16.8%; difference, -0.8%; 95% CI, -7.7% to 5.6%) and 90-day mortality (17.2% vs 17.8%; difference, -0.5%; 95% CI, -10.3% to 9.2%).

CONCLUSIONS AND RELEVANCE Among patients with ischemic stroke due to proximal anterior circulation occlusion within 4.5 hours from onset, endovascular treatment alone, compared with intravenous alteplase plus endovascular treatment, met the prespecified statistical threshold for noninferiority for the outcome of 90-day functional independence. These findings should be interpreted in the context of the clinical acceptability of the selected noninferiority threshold.

Mechanical thrombectomy

JAMA | Original Investigation
Effect of Mechanical Thrombectomy Without vs With Intravenous Thrombolysis on Functional Outcome Among Patients With Acute Ischemic Stroke
The SKIP Randomized Clinical Trial

JAMA 2021;325(3):244-253

23개 병원 (일본)

Randomized 1:1 matching (IV+MT vs MT alone)

Non-inferiority Design (odds ratio 0.74, p=0.025)

204명

116명(MT alone 59.4%) vs 118명(IV+MT 57.3%)

Odds ratio 1.09 CI 97.5%, 0.63-∞, p=0.18

ICH: no difference (6.1% vs 6.8%)

IMPORTANCE Whether intravenous thrombolysis is needed in combination with mechanical thrombectomy in patients with acute large-vessel occlusion stroke is unclear.

OBJECTIVE To examine whether mechanical thrombectomy alone is noninferior to combined intravenous thrombolysis plus mechanical thrombectomy for favorable poststroke outcome.

DESIGN, SETTING, AND PARTICIPANTS Investigator-initiated, multicenter, randomized, open-label, noninferiority clinical trial in 204 patients with acute ischemic stroke due to large vessel occlusion enrolled at 23 hospital networks in Japan from January 1, 2017, to July 31, 2019, with final follow-up on October 31, 2019.

INTERVENTIONS Patients were randomly assigned to mechanical thrombectomy alone (n = 101) or combined intravenous thrombolysis (alteplase at 0.6 mg/kg dose) plus mechanical thrombectomy (n = 103).

MAIN RESULTS AND MEASURES The primary efficacy end point was a favorable outcome defined as a modified Rankin Scale score (range, 0 [no symptoms] to 6 [death]) of 0 to 2 at 90 days, with a noninferiority margin (odds ratio of 0.74) assessed using a 1-sided significance threshold of 0.025 (97.5% CI). There were 4 prespecified safety end points, including any intracranial hemorrhage and symptomatic intracranial hemorrhage within 36 hours.

RESULTS Among 204 patients (median age, 74 years; 62.7% men; median National Institutes of Health Stroke Scale score, 18), all patients completed the trial. Favorable outcome occurred in 60 patients (59.4%) in the mechanical thrombectomy alone group and 59 patients (57.3%) in the combined intravenous thrombolysis plus mechanical thrombectomy group, with no significant between-group difference (difference, 2.1%; 1-sided 97.5% CI, -1.4% to 5.6%; odds ratio, 1.09 [1-sided 97.5% CI, 0.63 to 1.74]; P = .18 for noninferiority). Among the 7 secondary efficacy end points and 4 safety end points, 10 were not significantly different, including mortality at 90 days (8 [7.9%] vs 9 [8.7%]; difference, -0.8%; 95% CI, -2.8% to 1.2%), odds ratio, 0.90 (95% CI, 0.37 to 2.13); P = .99). Any intracranial hemorrhage was observed less frequently in the mechanical thrombectomy alone group than in the combined group (14 [13.9%] vs 15 [14.6%]; difference, -0.8%; 95% CI, -2.7% to 1.1%; odds ratio, 0.50 (95% CI, 0.28 to 0.88); P = .025). Symptomatic intracranial hemorrhage was not significantly different between groups (8 [5.9%] vs 8 [7.7%]; difference, -0.8% [95% CI, -2.7% to 1.1%]; odds ratio, 0.75 [95% CI, 0.25 to 2.24]; P = .78).

CONCLUSIONS AND RELEVANCE Among patients with acute large vessel occlusion stroke, mechanical thrombectomy alone, compared with combined intravenous thrombolysis plus mechanical thrombectomy, failed to demonstrate noninferiority regarding favorable functional outcome. However, the wide confidence intervals around the effect estimate also did not allow a conclusion of inferiority.

Opinion for Primary thrombectomy



- 향후, MT+ IV tPA 의 치료가 MT alone에 비하여 임상적 예후에 심각한 영향을 미칠 정도의 부작용이 있음이 증명되지 않고 서는 Primary thrombectomy는 현재 상태로 임상 적용될 것으로 전망
- 추후 MT+IV tPA가 유리한 경우, MT alone이 유리한 경우에 대하여 연구가 필요. (서로 보완적인 치료법으로)
Stroke의 원인별 각 치료 결과 분류 : ICAS vs Cardio-embolism, Dissection, Tandem occlusion (Proximal ICA+MCA),

Endovascular Thrombectomy >24-hr From Stroke Symptom Onset

이 동 훈

가톨릭대

Endovascular Thrombectomy >24-hr From Stroke Symptom Onset

Department of Neurosurgery, St. Vincent's Hospital
The Catholic University of Korea, Suwon, Korea

Lee Dong Hoon, Jae Hoon Sung, Seung Yoon Song

 가톨릭대학교 성빈센트병원
THE CATHOLIC UNIV. OF KOREA ST. VINCENT'S HOSPITAL

Introduction

- current guidelines endorse endovascular thrombectomy in appropriately selected patients up to 24 hours from symptom onset.

3.7.3.6 to 24 Hours From Onset	COF	LOE	New, Revised, or Unchanged
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	New recommendation.
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.	IIa	B-R	New recommendation.

- The expansion of the time window to 24 hours : time for determining eligibility to undergo MT → tissue-based and patient-specific selection criteria.

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- potentially salvageable tissue
 - ① severity and duration of ischemia
 - ② extent of collateral circulation
 - ③ speed of the "tissue clock"
 may differ in individuals.
- Variability in collateral circulation : likely a major determinant of the speed of infarct evolution.
- infarct growth occurs at a different pace across patients : applying a fixed time window may result in excluding patients who may otherwise benefit from this procedure.

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- Another often-ignored fact that the last known well (LKW) time is occasionally not when the stroke actually occurs.
 - ① Patients living alone
 - ② waking up



- stroke within a short time window, although their time LKW may have been many hours before the stroke.

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- These are reasons why recanalization treatments ought to be offered to patients after assessing the ischemic pathophysiology and not after assessing time from LKW.
- Recent literature has suggested that a target mismatch profile persists up to several days after stroke onset in patients with LVO.
- The large treatment effect that MT for patients presenting within 24 hours has shown raises the question of whether thrombectomy could still be safe and effective beyond this 24-hour time window.

Endovascular Thrombectomy >24-hr From Stroke Symptom Onset

Nathan W. Manning^{1,2,3,4*}, Jason Wenderoth^{1,2,3,4}, Khalid Alsahli¹, Dennis Cordato^{3,5,6}, Cecilia Cappelen-Smith^{1,2,3}, Alan McDougall^{1,2,3}, Alessandro S. Zagari^{4,6} and Andrew Cheung^{1,2,3}

Objective To perform a retrospective review of all patients undergoing EVT for anterior circulation LVO stroke beyond 24-h from symptom onset and assess safety and efficacy.

Method A prospectively maintained database of EVT patients treated at two comprehensive stroke centers between January 2016 and December 2017 was retrospectively screened. Patients undergoing EVT for anterior circulation AIS >24-h from symptom onset were selected. A total of 429 AIS patient underwent EVT in the study period. Five patients treated >24-h from symptom onset were identified.

Conclusion Endovascular thrombectomy for AIS patients beyond 24-h from symptom onset appears to be safe and effective in this limited study. There is a need for further evidence-based trials of benefit vs. risk in very prolonged time windows.

Leaving the day behind: endovascular therapy beyond 24 h in acute stroke of the anterior and posterior circulation

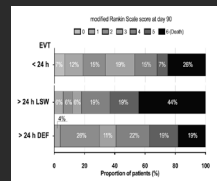
Jan C. Pernerseil¹, Peter A. Ringleb, Fath Selzer, Armin Petrick, Simon Nagel, Silvia Schönsberger, Anne Berenski, Olaf Neudörger, Markus Hiltebeitel² and Charlotte Weyland³

Objective To extend evidence of efficacy and safety of EVT after more than 24 h in both anterior and posterior circulation stroke.

Method



Result



CASE SERIES

Thrombectomy 24 hours after stroke: beyond DAWN

Shashvat M Desai¹, Diogo C Haussen², Amin Aghaeabrahim³, Alhamza R Al-Bayati², Roberta Santos³, Raul G Nogueira², Tudor G Jovin⁴, Ashutosh P Jadhav⁵

Objective to evaluate the characteristics and outcomes of patients who met DAWN criteria but underwent thrombectomy beyond 24 hours of TLKW.

Method performed to identify all patients who received thrombectomy beyond 24 hours of TLKW and otherwise met the DAWN criteria.

Result

Table 3 Outcomes	DAWN criteria (n=10)	DAWN trial (n=10)	P-value
Procedural success, n (%)	10 (100)	10 (100)	0.02
Rate of LVO	10 (100)	10 (100)	0.02
Thrombolysis, n (%)	10 (100)	10 (100)	0.02
Early neurological recovery	6 (60%)	10 (100%)	0.02
mRS 0-2 at 90 days	9 (90%)	10 (100%)	0.02
Long-term success, n (%)	10 (100)	10 (100)	0.02
Strokeless destination	2 (20%)	10 (100%)	0.02
Symptomatic ICH	1 (10%)	0 (0%)	0.02
Mortality	4 (40%)	0 (0%)	0.02

Conclusion

Thrombectomy appears to be safe and feasible in patients with acute ischemic stroke due to LVO meeting all DAWN trial criteria but treated beyond 24 hours of TLKW with outcomes comparable to patients in the DAWN trial intervention arm.

CLINICAL AND POPULATION SCIENCES

Clinical Outcomes and Identification of Patients With Persistent Penumbra Profiles Beyond 24 Hours From Last Known Well

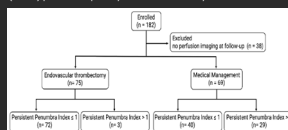
Analysis From DEFUSE 3

Armin Selzer¹, MD, Michael Mlynarski, MD, MS, Jeremy P. Meyer, MD, PhD, Deep P. Pappas, MD, PhD, Walter L. Jorgensen, MD, PhD, Michael Mlynarski, MD, PhD, Gregory W. Albers, MD

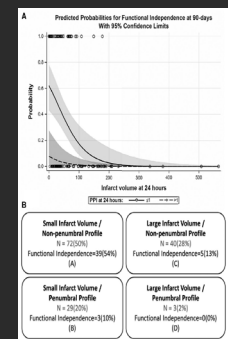
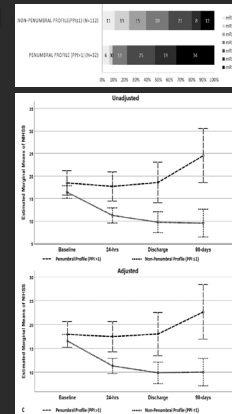
Objective to assess the clinical outcomes in patients with persistent penumbral profile >24 hours from last known well and identify them based on the Persistent Penumbra Index (PPI, time-to-maximum of the residue function >6 s perfusion lesion divided by diffusionweighted magnetic resonance imaging lesion volume on 24-hour postrandomization imaging).

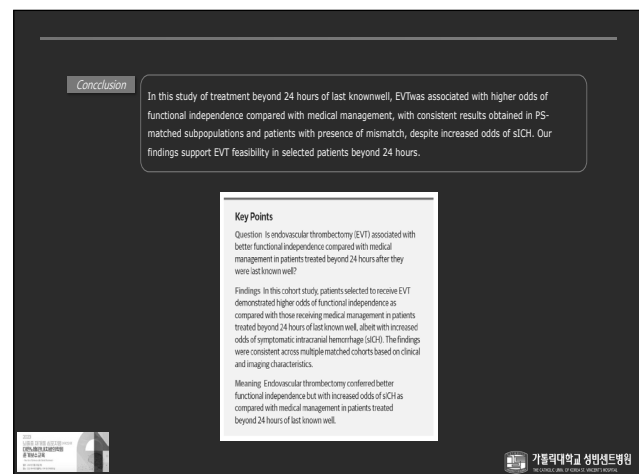
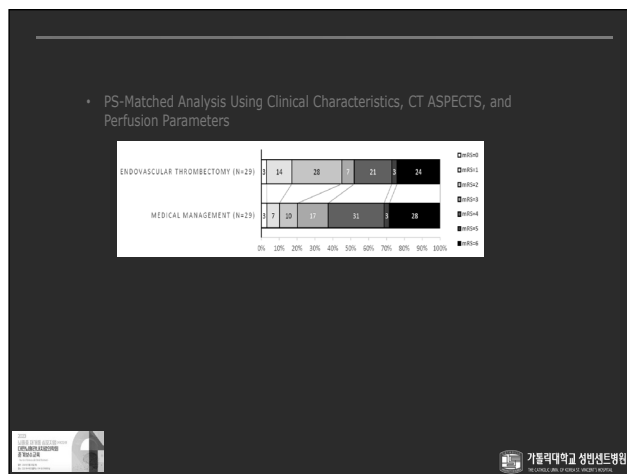
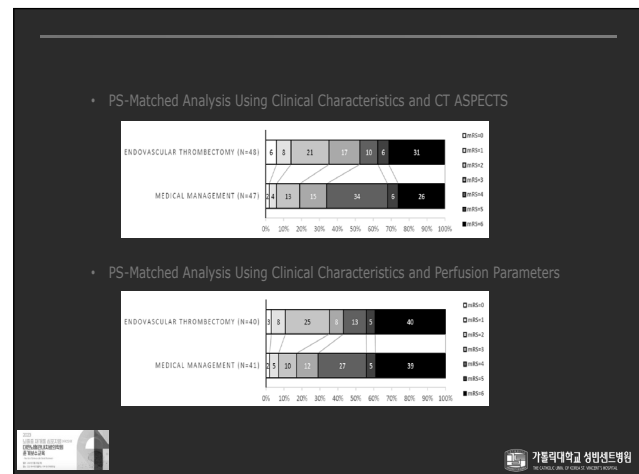
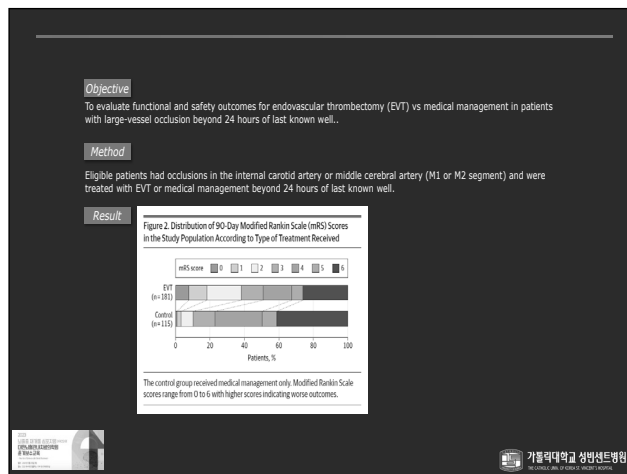
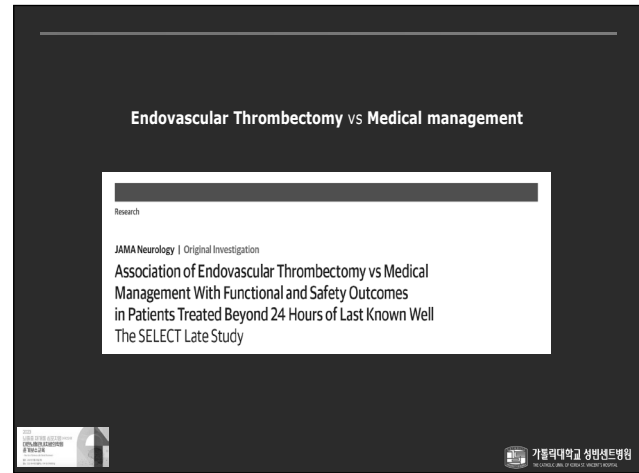
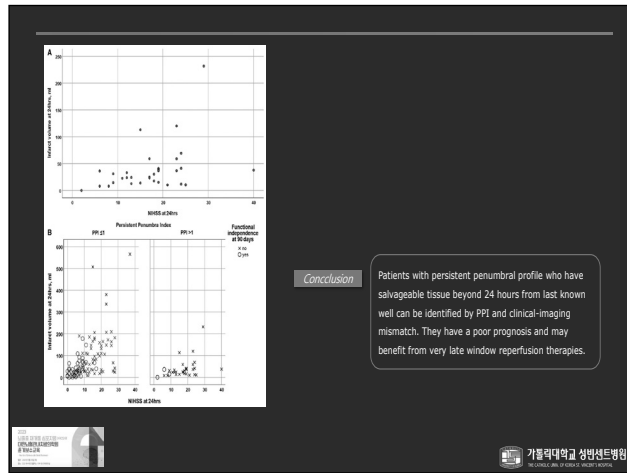
Method

Patients were stratified into those with a 24-hour postrandomization penumbral (PPI>1) versus a nonpenumbral (PPI≤1) profile. The primary outcome was 90-day modified Rankin Scale.



Result





6-24 hours vs 24 hours +

Ischemic stroke Original research Mechanical thrombectomy for large vessel occlusion strokes beyond 24 hours

Objective objective is to examine the safety and efficacy of thrombectomy beyond the standard of care window.

Method patients who underwent mechanical thrombectomy for large vessel occlusion beyond 24 hours. selected a matched control group from patients who underwent thrombectomy in the 6-24-hour window.

Result 121 patients who underwent thrombectomy beyond 24 hours and 1824 in the 6-24-hour window. beyond 24 hours were less likely to be independent at 90 days (18 (18.8%) vs 73 (34.9%), $P=0.005$). higher odds of mortality at 90 days in the adjusted analysis (OR 2.34, $P=0.023$). Symptomatic intracerebral hemorrhage and other complications were similar.

Conclusion

Mechanical thrombectomy beyond 24 hours appears to be safe and tolerable with no more hemorrhages or complications compared with standard of care thrombectomy. Outcomes and mortality in this time window are worse compared with an earlier time window, but the rates of good outcomes may justify this therapy in selected patients.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Mechanical thrombectomy is superior to medical management for large vessel occlusion for up to 24 hours from onset.

WHAT THIS STUDY ADDS

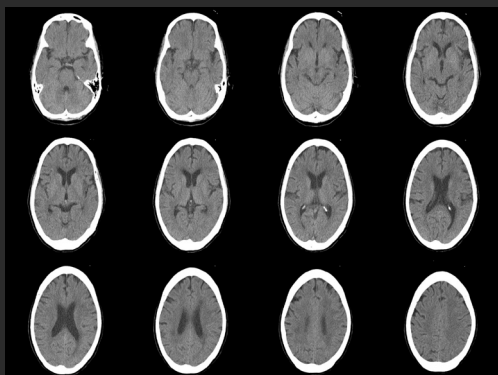
⇒ Mechanical thrombectomy beyond 24 hours does not carry higher hemorrhages or peri-procedure complications compared with standard of care thrombectomy.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

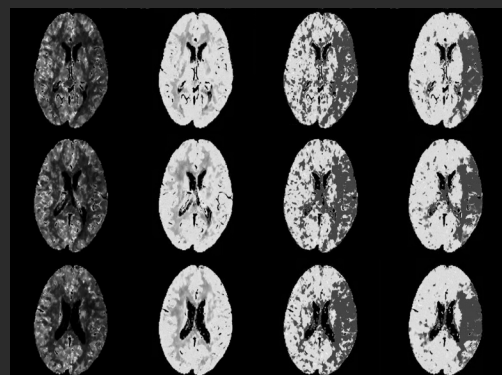
⇒ In clinical practice, providers should be aware that outcomes and mortality in this later time window are worse compared with the standard of care time window. However, the rates of patients recovering with good outcomes may justify this therapy in selected patients.

Case

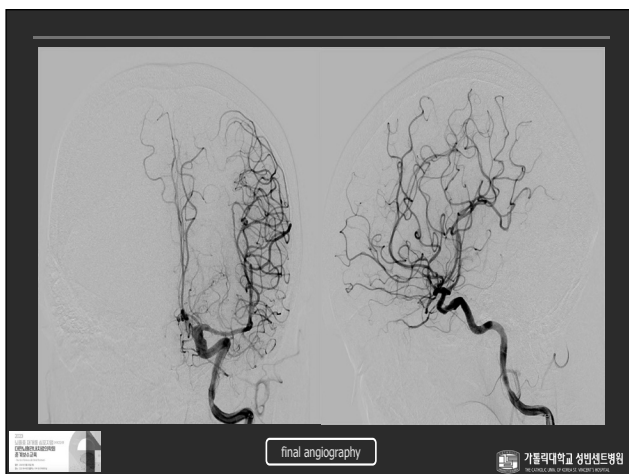
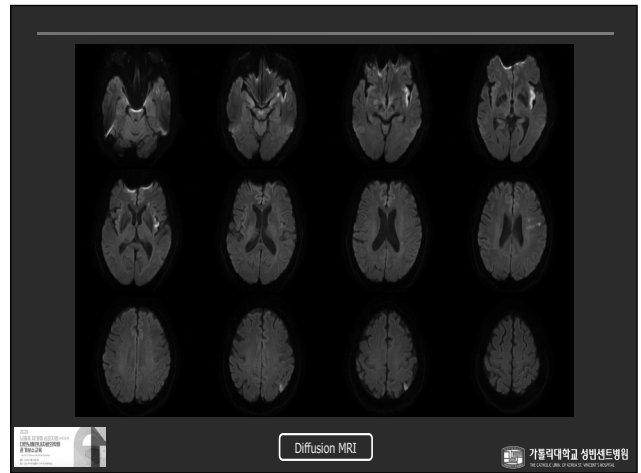
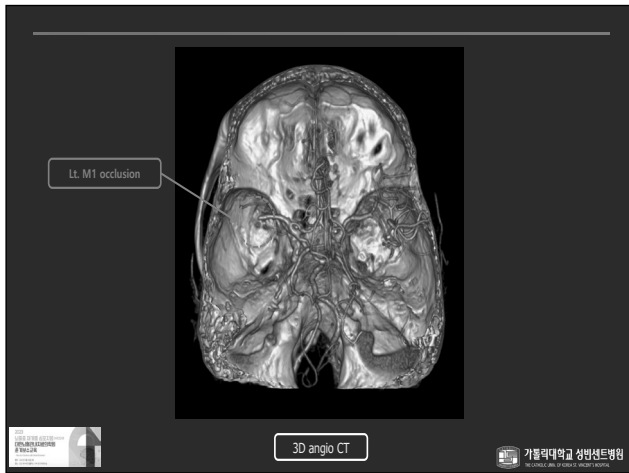
- F/69
- NIHSS : 7, aphasia
- Onset : 2018.04.21
- 내원일시 : 2018.04.22



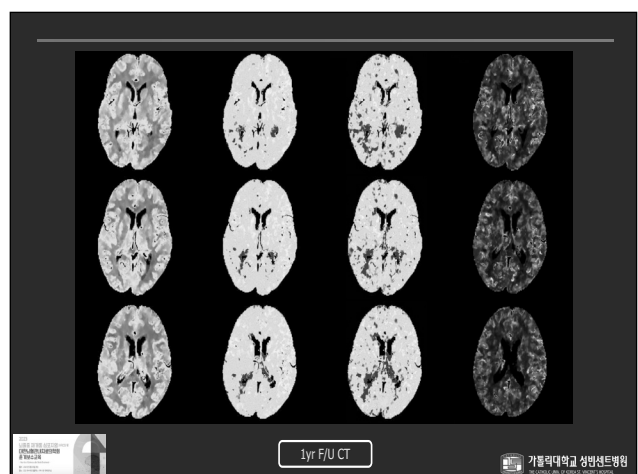
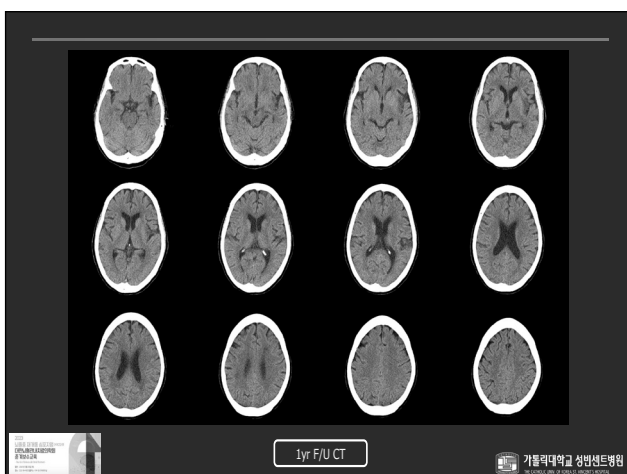
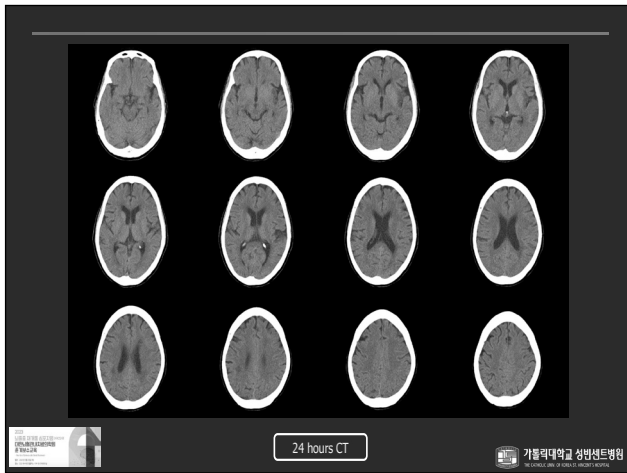
Initial Brain CT

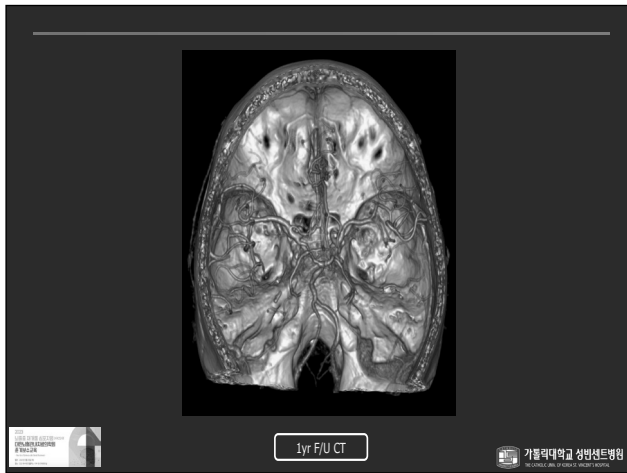


perfusion CT



Session I. Recent Debate in Large Vessel Occlusion Strokes

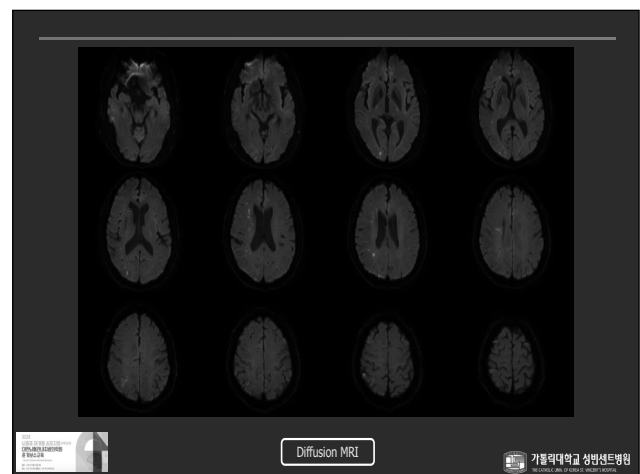
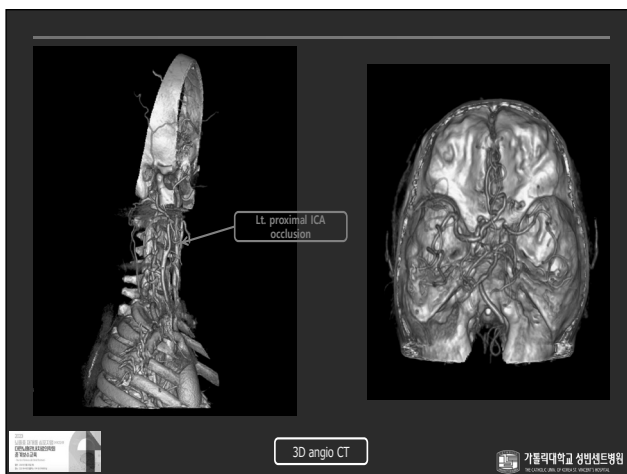




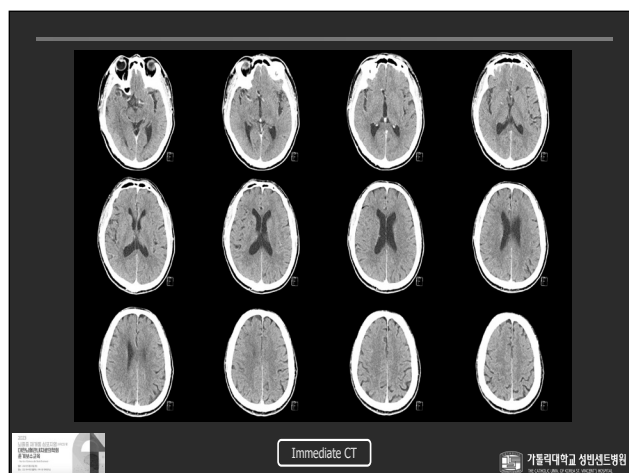
Case

- M/69
- NIHSS : 5, Lt side weakness c dysarthria
- Onset : 2021.05.21 PM 09:00
- 내원일시 : 2021.05.22 PM 09:10

가톨릭대학교 성빈센트병원



Session I. Recent Debate in Large Vessel Occlusion Strokes

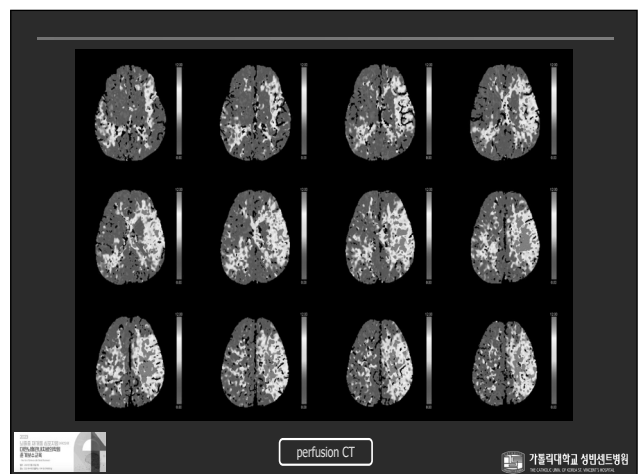




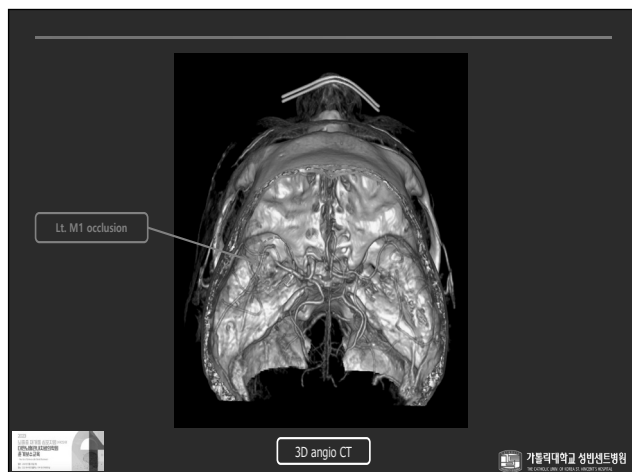
Case

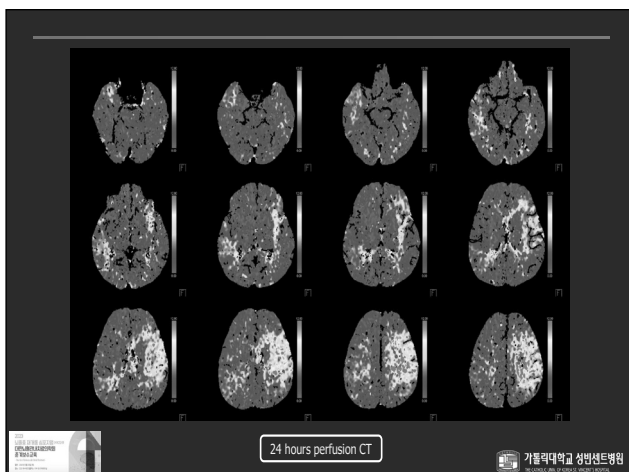
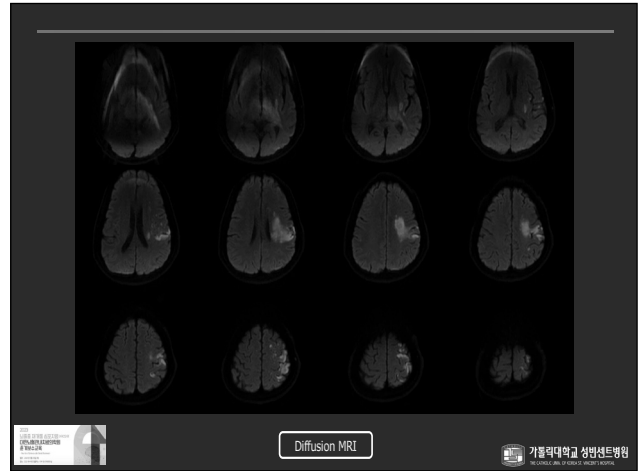
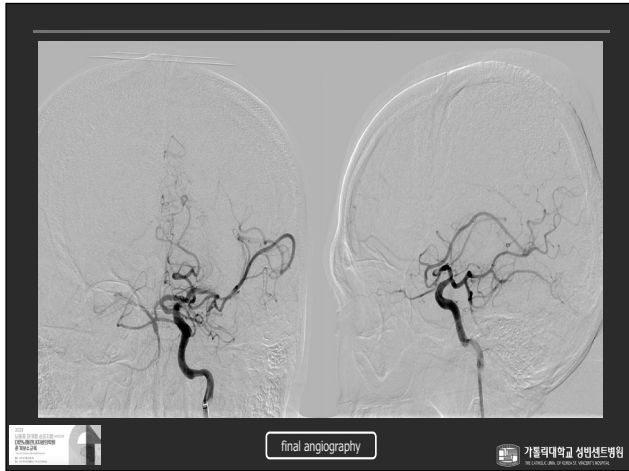
- M/47
- NIHSS : 7, aphasia
- Onset : 2022.12.17
- 내원일시 : 2022.12.18

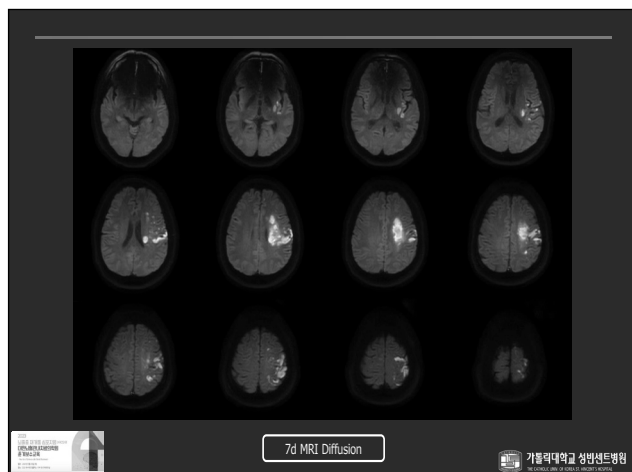
가톨릭대학교 성빈센트병원



Session I. Recent Debate in Large Vessel Occlusion Strokes







Conclusion

- MT beyond 24 hours appears to be a safe procedure with no more hemorrhages or complications than the standard of care thrombectomy performed within 24 hours.
- Need randomised controlled trials in endovascular thrombectomy beyond 24 hours.

가톨릭대학교 성빈센트병원
CATHOLIC UNIVERSITY OF KOREA VINCENT HOSPITAL



2023

뇌졸중 재개통 심포지엄 (ARCS) 및 대한뇌혈관내치료의학회 춘계보수교육

- New Era of Endovascular Stroke Treatment -

Session II

Endovascular Treatment of Acute Basilar Artery Occlusions

좌장: 고준석 (경희대), 김영우 (가톨릭대)

Review of the recently published trials

Stent retriever frst

Contact aspiration frst

Discussion – all attendees

오재상 (순천향대)

하상우 (조선대)

손원수 (경북대)

Review of the recently published trials

오 재 상

순천향대

Acute basilar occlusion is a serious condition that can cause significant disability or death if left untreated. Thrombectomy is a procedure in which a clot is removed from a blood vessel using a device such as a stent retriever. In recent years, thrombectomy has become an important treatment option for acute basilar occlusion, and there have been several clinical trials investigating its effectiveness.

One of the most notable trials is the BASICS trial, which was published in the New England Journal of Medicine in 2020. This trial compared thrombectomy plus standard medical treatment to standard medical treatment alone in patients with acute basilar occlusion. The results showed that patients who received thrombectomy had a significantly better chance of a favorable outcome compared to those who only received medical treatment.

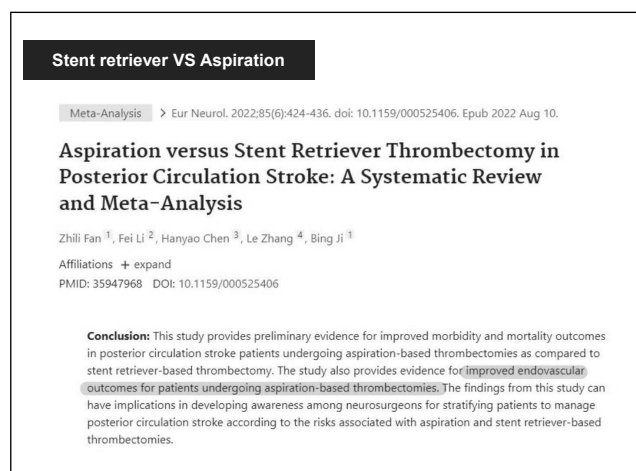
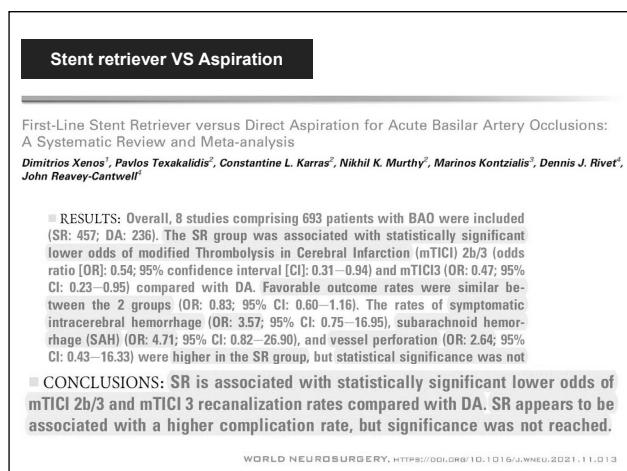
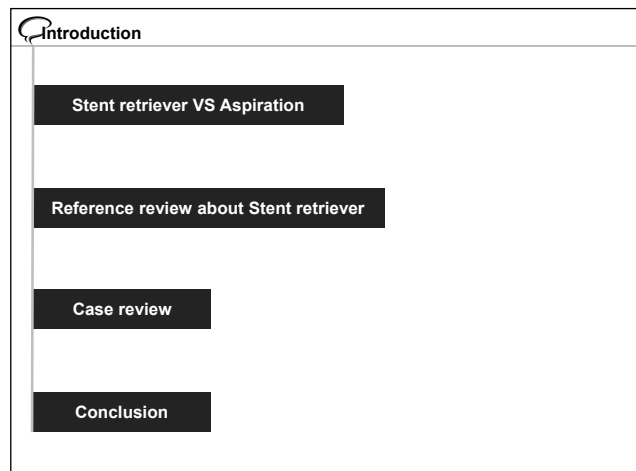
Another recent trial is the BOTTOM line trial, which was published in the Lancet in 2020. This trial also compared thrombectomy plus medical treatment to medical treatment alone in patients with acute basilar occlusion. The results showed that thrombectomy was associated with better functional outcomes and a lower rate of death compared to medical treatment alone.

These trials have provided strong evidence for the benefits of thrombectomy in the treatment of acute basilar occlusion, and have helped to establish thrombectomy as a standard of care for this condition. However, it is important to note that the best approach to treatment may depend on the individual patient and the specific circumstances of each case, and patients should discuss their options with their healthcare provider to determine the best course of action.

Stent retriever frst

하 상 우

조선대



Stent retriever VS Aspiration

Stroke

CLINICAL AND POPULATION SCIENCES

Aspiration Versus Stent Retriever Thrombectomy for Posterior Circulation Stroke

Marie Louise E. Bernsen¹, MD; Agnetha A.E. Bruggeman², MD; Josje Brouwer³, MD; Bart J. Emmer⁴, MD, PhD; Charles B.L.M. Majole⁵, MD, PhD; Jonathan M. Coutinho⁶, MD, PhD; Robert-Jan B. Goldboom⁷, MD, PhD; Robert J. van Oostenbrugge⁸, MD, PhD; Wim H. van Zwam⁹, MD, PhD; Christiaan van der Leij¹⁰, MD, PhD;

RESULTS: Overall, 71 of 205 patients (35%) were treated with aspiration, and 134 (65%) with stent retriever thrombectomy. Patients in the aspiration group had a lower pc-ASPECTS on baseline computed tomography, and general anesthesia was more often applied in this group. First-line aspiration was associated with better functional outcome compared with stent retriever thrombectomy (adjusted common odds ratio for a 1-point improvement on the modified Rankin Scale 1.94 [95% CI, 1.03–3.65]). Successful reperfusion (extended Thrombolysis in Cerebral Infarction $\geq 2B$) was achieved more often with aspiration (87% versus 73%, $P=0.03$). Symptomatic hemorrhage rates were comparable (3% versus 4%). Procedure times were shorter in the aspiration group (48 versus 69 minutes $P<0.001$).

CONCLUSIONS: In this retrospective nonrandomized cohort study, our findings suggest that first-line aspiration is associated with a shorter procedure time, better reperfusion, and better clinical outcome than stent retriever thrombectomy in patients with ischemic stroke based on large vessel occlusion in the posterior circulation.

Stent retriever VS Aspiration

Stroke: Vascular and Interventional Neurology

ORIGINAL RESEARCH

Basilar Artery Occlusion Thrombectomy Technique: An International Survey of Practice Patterns[†]

Stent retriever VS Aspiration

- 543 neurointerventionalists
- Embolic etiology
 - Aspiration only : 50.3% / Combined : 27.1%
- intracranial atherosclerotic disease (ICAD)
 - Combined : 40.5% / Aspiration only : 16.4%
- Proceed to stenting after 3 or fewer : 88.0%
- Anti-Plt. Regimen → Aspirin and clopidogrel : 52.4%
- High-income countries vs Middle-income countries
 - : Aspiration only (62.2% vs 36.8%)
 - : Combined (21.1% vs 33.9%)

Stent retriever VS Aspiration

JAMA Neurology | Original Investigation

Thrombectomy for Primary Distal Posterior Cerebral Artery Occlusion Stroke The TOPMOST Study

Lukas Meyer, MD; Christian Paul Stracke, MD; Noël Jungi, MD; Marta Wallocha, MD; Gabriel Brooks, MD; Peter B. Sporns, MD, MHB; Christian Maerlein, MD; Franziska Dorn, MD; Hanna Zimmermann, MD; Weis Nazir, MD; Nuran Abdullayev, MD; Christoph Kabbasch, MD; Daniel Behme, MD; Ala Jamous, MD; Volker Maus, MD; Sebastian Fischer, MD; Markus Möhlenbruch, MD; Charlotte Sabine Weyland, MD; Sonke Langner, MD; Dan Meek, MD; Milena Maszcuk, MD; Eberhard Siebert, MD; Stephan Lowens, MD; Lars Udo Krause, MD; Leonard L. L. Yeo, MBBS; Benjamin Yong-Qiang Tan, MD, PhD; Gopinathan Anil, MD; Benjamin Gory, MD, PhD; Jorge Galván, MD; Miguel Schüller Arteaga, MD; Pedro Navia, MD; Eytan Raz, MD; Maksim Shapiro, MD; Fabian Arnberg, MD, PhD; Kamil Zelenák, MD; Mario Martínez-Galdamez, MD; Urs Fischer, MD; Andreas Kastrup, MD; Christian Roth, MD; Panagiotis Papanagiotou, MD; André Kemmling, MD; Jan Gralla, MD; Marios-Nikos Psychogios, MD; Tommy Andersson, MD; Rene Chapot, MD; Jens Fiehler, MD; Johannes Kaesmacher, MD; Uta Hanning, MD

CONCLUSIONS AND RELEVANCE This study suggested that, although rarely performed at comprehensive stroke centers, mechanical thrombectomy for posterior circulation DMVO is a safe, and technically feasible treatment option for occlusions of the P2 or P3 segment of the PCA compared with standard medical treatment with or without IVT.

Stent retriever VS Aspiration

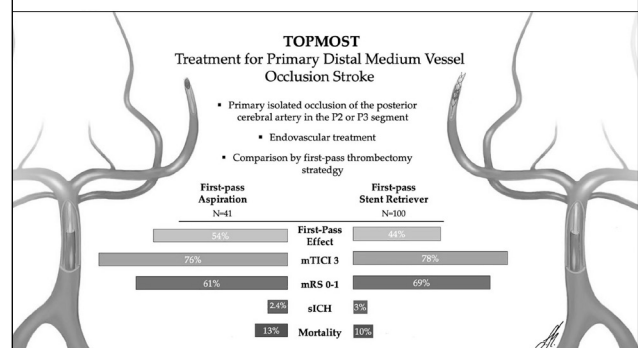
Stroke

CLINICAL AND POPULATION SCIENCES

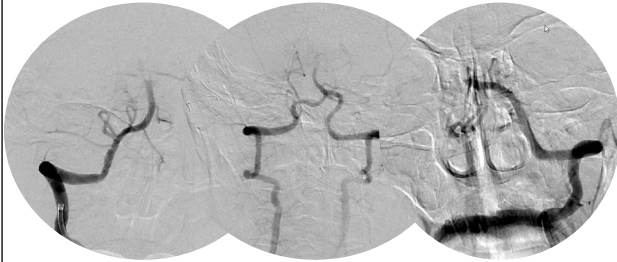
Aspiration Versus Stent Retriever Thrombectomy for Distal, Medium Vessel Occlusion Stroke in the Posterior Circulation: A Subanalysis of the TOPMOST Study

Lukas Meyer¹, MD; Paul Stracke², MD; Marta Wallocha³, MD; Gabriel Brooks⁴, MD; Peter Sporns⁵, MD; Eike I. Pischke⁶, MD; Johannes Kaesmacher⁷, MD; Christian Maerlein⁸, MD; Moritz Roman Hernandez Petzsche⁹, MD; Franziska Dorn, MD; Hanna Zimmermann¹⁰, MD; Weis Nazir, MD; Nuran Abdullayev¹¹, MD; Christoph Kabbasch¹², MD; Daniel Behme¹³, MD; Ala Jamous¹⁴, MD; Volker Maus¹⁵, MD; Sebastian Fischer, MD; Markus Möhlenbruch¹⁶, MD; Charlotte S. Weyland¹⁷, MD; Sonke Langner¹⁸, MD; Dan Meitall¹⁹, MD; Milena Maszcuk²⁰, MD; Eberhard Siebert²¹, MD; Stephan Lowens, MD; Lars Udo Krause, MD; Leonard Yeung, MBBS; Benjamin Tan²², MD; MBBS; Anil Gopinathan²³, MD; Benjamin Gory²⁴, MD; Jorge Galván-Fernández²⁵, MD; Miguel Schüller²⁶, MD; Pedro Navia²⁷, MD; Eytan Raz²⁸, MD; Maksim Shapiro, MD; Fabian Arnberg, MD; Kamil Zelenák²⁹, MD; Mario Martínez-Galdamez³⁰, MD; Andreas Kastrup, MD; Panagiotis Papanagiotou, MD; André Kemmling, MD; Marios Psychogios³¹, MD; Tommy Andersson³², MD; Rene Chapot³³, MD; Jens Fiehler³⁴, MD; Uta Hanning³⁵, MD; from the TOPMOST Study Group

Stent retriever VS Aspiration



Stent retriever VS Aspiration



Cases stent retriever is useful.

1. In situ atherosclerotic thrombosis

2. Tortuous anatomy

3. MeVO

Push and Fluff technique

Optimizing Clot Retrieval in Acute Stroke The Push and Fluff Technique for Closed-Cell Stent Retrievers

Diogo C. Haussen, MD; Leticia C. Rebello, MD; Raul G. Nogueira, MD

Background and Purpose—We aimed to investigate the safety and efficacy of the Push and Fluff technique (PFT) as compared with the standard unsheathing technique for closed-cell stent retrievers in acute ischemic stroke.

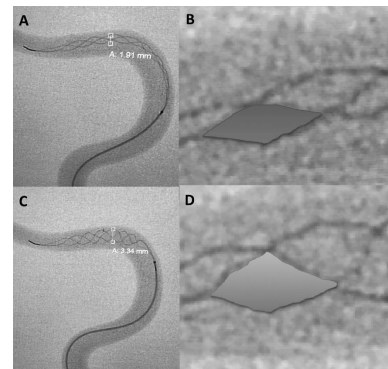
Methods—Acute ischemic stroke thrombectomy database was analyzed (September 2010 to January 2015) with the Trevo Retriever as a primary strategy. The PFT was compared with our internal standard unsheathing technique and with the Trevo Versus Merci Retrievers for Thrombectomy Revascularization of Large Vessel Occlusions in Acute Ischemic Stroke 2 (TREVOS2) trial. Additionally, a silicon flow model was used to compare cell size/configuration, wall apposition/device diameter, and degree of foreshortening/device length across the 2 techniques.

Results—One hundred fifty-one out of 662 patients qualified for the study. The PFT (n=71) was associated with higher rates of first-pass reperfusion (54% versus 35%, $P=0.03$; 54% versus 32.6%, $P<0.01$), lower number of passes (1.3±0.8 versus 1.8±1.0, $P<0.01$; 1.7±1.0 versus 2.4±1.6, $P<0.01$), and higher rates of modified treatment in cerebral ischemia-3 reperfusion (58% versus 40%, $P=0.03$; 58% versus 14%, $P<0.01$) as compared with the standard unsheathing technique (n=81) and the TREVOS2 Trevo arm (n=88), respectively. No differences in hemorrhagic complications were observed across the groups. The *in vitro* model indicated that, compared with standard unsheathing technique, PFT resulted in improved wall apposition (device diameter, 75% larger) and cell size (mean area, 51% larger) at the cost of a mild degree of foreshortening (25% length reduction).

Conclusions—The PFT is safe and leads to optimization of wall apposition and cell size/configuration, resulting in higher chances of first-pass reperfusion, lower number of passes, and better rates of complete reperfusion. (Stroke. 2015;46:2838-2842. DOI: 10.1161/STROKEAHA.115.010044.)

Key Words: cell size ■ human ■ reperfusion ■ stroke ■ stent

Push and Fluff technique



Number of Passes

Interdisciplinary Neurosurgery: Advanced Techniques and Case Management 24 (2021) 101041



Contents lists available at ScienceDirect
Interdisciplinary Neurosurgery: Advanced Techniques and Case Management

journal homepage: www.elsevier.com/locate/iat



Research Article

Influence of the number of passes of Stent-Retriever on the occurrence of parenchymal hematomas in stroke patients undergoing thrombectomy

Fernando Delgado Acosta^{a,*}, Elvira Jiménez Gómez^a, Isabel Bravo Rey^a, Francisco de Asís Bravo-Rodríguez^a, Roberto Valverde Moyano^b, Rafael Oteros Fernández^a

^a Neurosurgery Unit, Hospital Reina Sofía, Córdoba, Spain

^b Neurology Unit, Hospital Reina Sofía, Córdoba, Spain

Number of Passes

Interdisciplinary Neurosurgery: Advanced Techniques and Case Management 24 (2021) 101041



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journal homepage: www.elsevier.com/locate/iat



Table 2

Relationship between the evolution of groups ≤ 3 and > 3 passes.

Outcomes	≤ 3 passes	> 3 passes	p values
Favorable outcomes (%)	177/303 (58.42)	25/66 (37.88)	0.003
90-day mRS, median (IQR)	2 (1 to 6)	4 (2 to 6)	0.0008
Any ICH (%)	85/303 (28.05)	18/66 (27.27)	1.00
Parenchymal hematoma (%)	11/303 (3.63)	7/66 (10.61)	0.026
Subarachnoid hemorrhage (%)	26/303 (8.58)	12/66 (18.18)	0.026
90-day mortality (%)	78/303 (25.74)	28/66 (42.42)	0.011

ICH: Intracerebral hemorrhage.

Number of Passes

Journal of Stroke
S Cerebrovascular Disorders

FULL LENGTH ARTICLE | VOLUME 29, ISSUE 11, 105199, NOVEMBER 01, 2020

Number of Stent Retriever Passes Associated with Clinical Outcome After Mechanical Thrombectomy in Acute Ischemic Stroke

Zongjie Shi • Shunyan Guo • Sujei Zheng • Jiang yong Min • Yu Geng

Published: August 21, 2020 • DOI: <https://doi.org/10.1016/j.jstrokecerebrovasdis.2020.105199>

Conclusion
The need for more than three passes of SR may be used as an independent predictor of poor outcome after MT in patients with acute ischemic stroke at 90 days.

Stent retrieve는 3회까지만!!

Number of Passes

JoS
JOURNAL OF STROKE

Journal of Stroke 2017;19(2):121-130
<https://doi.org/10.5853/jos.2017.00752>
Special Review

Thrombectomy in Acute Ischemic Stroke: Challenges to Procedural Success

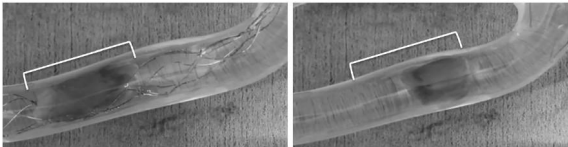
Albert J. Yoo,* Tommy Andersson^{b,c,d}

^aFox Stroke Institute, Dallas-Fort Worth, TX, USA
^bDepartment of Neuroradiology, Karolinska University Hospital, Stockholm, Sweden
^cDepartment of Clinical Neuroscience, Karolinska Institutet, Stockholm, Sweden
^dDepartment of Medical Imaging, AZ Groeninge, Kortrijk, Belgium

Number of Passes

JoS
JOURNAL OF STROKE

Journal of Stroke 2017;19(2):121-130
<https://doi.org/10.5853/jos.2017.00752>
Special Review



Before stent-retriever pass After one pass

Figure 9. Thrombus compression after stent-retriever attempt (Courtesy of Neuravi Inc.).

Number of Passes

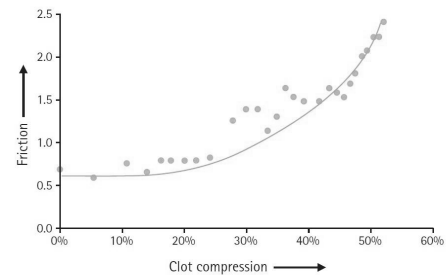


Figure 10. Relationship between thrombus compression and coefficient of friction (Courtesy of Neuravi Inc.).

Partial deploy/ Re-sheathing

NEUROINTERVENTION **TECHNICAL NOTE**

Neurointervention 2019;14:137-141
<https://doi.org/10.5469/neuroint.2019.00143>

Endovascular Thrombectomy for Distal Occlusion Using a Semi-Deployed Stentriever: Report of 2 Cases and Technical Note

Yue Wan, MD¹, I-Hsiao Yang, MD^{2,3}, Emanuele Orru, MD¹, Timo Krings, MD¹, Anderson Chun On Tsang, MBBS^{1,4}

¹Department of Neurology, The Third People's Hospital of Hubei, Wuhan, China
²Department of Medical Imaging, Kaohsiung Medical University Hospital, Kaohsiung, Taiwan
³Division of Neuroradiology, Joint Department of Medical Imaging, Toronto Western Hospital, Toronto, Canada
⁴Division of Neurosurgery, Department of Surgery, The University of Hong Kong, Hong Kong

Partial deploy/ Re-sheathing

- 2 patients with M2/3 bifurcation of MCA
- “Semi-deployment technique” of a 3mm stent (Trepo)
- Partial stent unsheathing
→ adequate clot engagement while avoiding excessive tension by the stent struts along the tortuous course of a distal vessel

Partial deploy/ Re-sheathing

Journal of Neuroendovascular Therapy 2020; 14: 488-494



Evaluation of the Partial Re Retrieval System *In Vitro* M and a Representative Case

Yoshihisa Matsumoto,¹ Yui Nagata,¹ Takuro Hashikawa,¹ Hideki Sakai,¹ Setsuko H Yoshinori Go,² Kiyoshi Kazekawa,² Yoshihisa Fukushima,³ and Kenji Takahashi¹

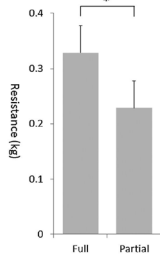


Fig. 4 Resistance to retrieval. Bar graph showing values measured using the spring scale. The average values for the full and half partial deployment were 0.32 ± 0.04 kg and 0.22 ± 0.04 kg, respectively. Error bars represent the standard deviation across subjects. *p < 0.05, Mann-Whitney U test.

Conclusion: In cases of high resistance to retrieval, minimal re-sheathing may be useful for capturing the thrombus without increasing the risk of vascular injury.

Blind exchange with mini-pinning technique

BMJ Journals

Journal of
NeuroInterventional Surgery

Ischemic Stroke
Original research

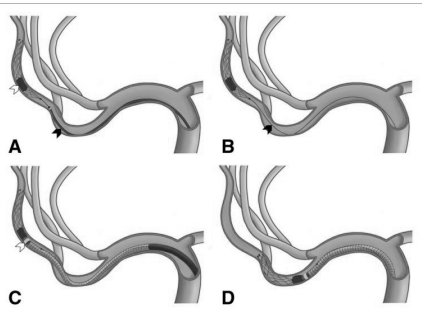
Blind exchange with mini-pinning technique for distal occlusion thrombectomy

Diogo C Haussen, Alhamza R Al-Bayati, Brendan Eby, © Krishnan Ravindran, © Gabriel Martins Rodrigues, Michael R Frankel, Raul G Nogueira

Correspondence to Dr. Raul G Nogueira, raul.g.nogueira@emory.edu

<http://dx.doi.org/10.1136/neurintsurg-2019-015205>

Blind exchange with mini-pinning technique



<http://dx.doi.org/10.1136/neurintsurg-2019-015205>

Case

Take Home Message

1. V4~prox.BA occlusion → ICAS
2. Transradial / Transbrachial approach
3. Partial deploy / re-sheathing
4. Retrieve는 3회이상 X
5. East or West, home is Best!!!

감사합니다

Contact aspiration first

손 원 수

경북대

The outcome and mortality associated with Basilar artery occlusions (BAO) are worse than those with anterior circulation stroke. However, the effectiveness and safety of modern thrombectomy including aspiration and stent retriever remains uncertain for patients with acute BAO.

Some studies aimed to compare the safety and efficacy of direct aspiration with that of a stent retriever in treating patients with posterior circulation stroke and optimize that the interventional strategy for mechanical thrombectomy in posterior circulation stroke.

According to several recent studies, patients with posterior circulation stroke receiving treatment with aspiration achieved better recanalization, first-pass effect, and shorter procedure time.

However, these conclusions should be interpreted cautiously, and future randomized controlled studies are warranted to confirm these findings.

2023

뇌졸중 재개통 심포지엄 (ARCS) 및 대한뇌혈관내치료의학회 춘계보수교육

- New Era of Endovascular Stroke Treatment -

Session III

국가의료정책의 방향

좌장: 백민우 (뉴고려병원), 장철훈 (영남대)

제4차 응급의료 기본계획(안) 소개

필수의료에 관한 심혈관계의 시각

급성기뇌졸중 적정성평가 결과 및 개선 방향

신승훈 (차의과학대)

윤창환 (분당서울대병원 순환기내과)

최정남 (건강보험심사평가원 평가4부 부장)

제4차 응급의료 기본계획(안) 소개

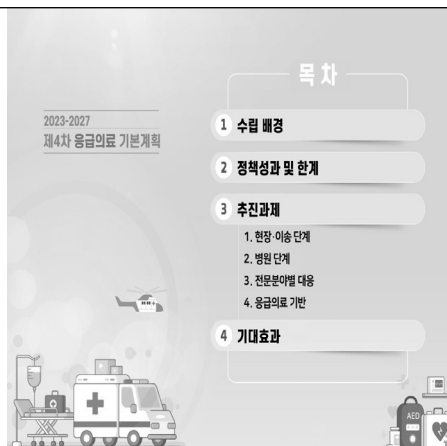
신 승 훈

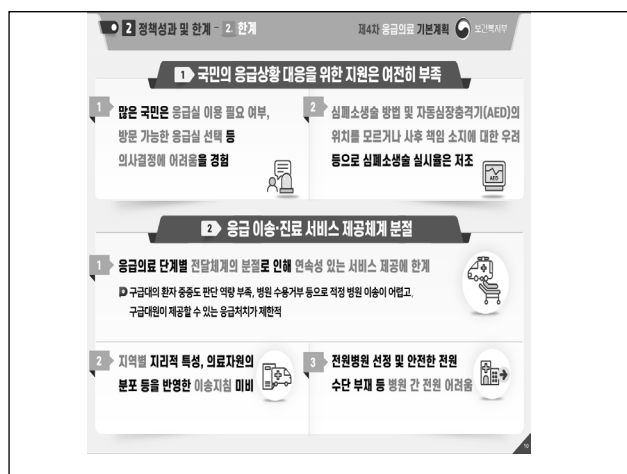
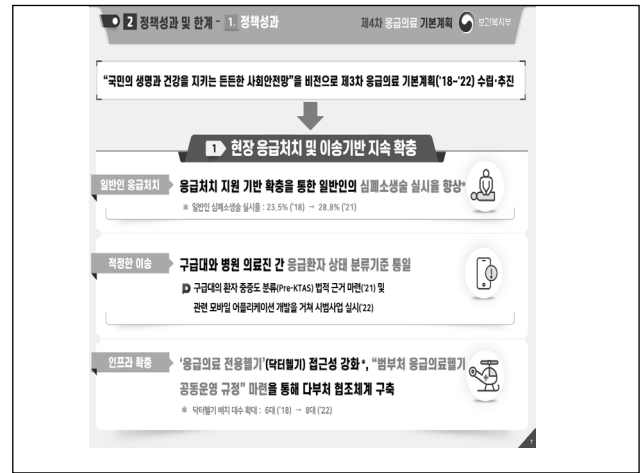
차의과학대

제4차 응급의료 기본계획(안) 소개

신승훈

CHA의과학대학교 분당차병원





제4차 응급의료 기본계획 (보건복지부)

2 정책성과 및 한계 - 2. 한계

5 취약한 응급의료 이용환경 및 정책 추진기반

- 1 폭력·감염병 등 위기 상황에 대한 지원은 미흡**
 ▶ 보안인력의 실질적인 역할 불분명, 새로운 감염병에 대응할 수 있도록 지속 관리 및 제도화 필요
- 2 재난·사건 대비 및 상황 발생 시 적절한 대응 위한 소방청 등 관계기관 간 유기적 협력체계 부족**
- 3 지방정부의 정책 추진기반이 취약하여 지역별 특성 반영이 어렵고, '이송 → 진료' 전 과정에 포괄하는 지역 응급의료체계에 대한 평가 부족**
- 4 효과적응급의료정책을 위한 정보의 정확성과 활용도 개선, 중앙응급의료센터의 응급의료 컨트롤타워로서 역할·전문성 강화도 필요**

제4차 응급의료 기본계획 (보건복지부)

3 추진과제

비전

전국 어디서나 최중치료까지 책임지는 응급의료

목표

중증응급환자 치료 성과 개선	지역 응급의료인프라 확충	신속하고 적절한 이송
중증응급환자 병원 내 사망률 6.2% (22)	광역응급의료센터 40개소 (22)	중증응급환자 적정시간 내 최종치료기관 도착률 49.6% (22)
5.6% (27)	중증응급의료센터 50~60개소 (27)	60% (27)

4개 영역별 16개 중점과제

1 현장·이송 단계	2 병원 단계	3 전문분야별 대응	4 응급의료 기반
1. 위기·이송 중환자 지원체계 마련 2. 응급·이송 의료 인력 확충 3. 이송서비스 품질 개선 4. 이송 및 수용 적정성 확보에 대한	1. 최중치료를 위한 최첨단 의료기관 마련 2. 응급·이송 의료 인력 확충 3. 최상·최저 의료 인력 4. 안전한 응급의료 환경 조성	1. 중환자실 인력 2. 응급·이송 의료 인력 3. 응급·이송 의료 인력 4. 응급·이송 의료 인력	1. 지역 응급의료체계 기반 강화 2. 응급·이송 의료 인력 3. 응급·이송 의료 인력 4. 응급·이송 의료 인력

제4차 응급의료 기본계획 (보건복지부)

3 추진과제 - 1. 현장·이송 단계

1-1 위기·이송 응급의료 이용체계 마련

- 1 응급의료 합리적 이용을 위한 정보 제공**
 ▶ 통장, 발원 등 주요 응급상황별 의심 질환 정보, 적정 이용 병원을 안내·추천·포함하고 연계 등
 ▶ 응급상황 실시간 혼잡도 정보 제공
- 2 심폐소생술 교육 및 자동심장충격기 확충, 활용성 제고**
 ▶ 일반국민의 심폐소생술 역량 강화를 위해 심폐소생술 의무 교육 대상 확대
 ▶ 선의의 응급의료행위 등(일반인 응급의료봉사자)에 대한 면책범위 확대
 ▶ 자동심장충격기(AED) 설치 확대 및 주요 모바일 지도앱을 통한 위치안내 추진
 (현역 응급의료정보 앱에서 제공 중)
- 3 합리적인 응급의료 이용문화 조성**
 ▶ 경중·병중환자에 대한 대량병원 이용 시 타 의료기관 이용 안내·높은 본인부담금 사전통보의 철저 마련
 ▶ 홍보 및 캠페인 실시, 교육과정 연계 등 국민 교육 강화

제4차 응급의료 기본계획 (보건복지부)

3 추진과제 - 1. 현장·이송 단계

1-2 중증도 기반 이송 인프라 확충

- 1 응급의료 전용헬기(터티헬기) 확충 및 활용 기준 개선을 통한 취약지 이송 지원**
 ▶ 도서·산간 등 의료취약지에서 신속 이송될 수 있도록 터티헬기 추가 확충(이송장비, 인력, 안전 운항 시범사업 추진·노출)
 ▶ 헬기 이송 안전 인력 및 중환자 지원·구제, '질 중심'의 성과평가 체계 마련
- 2 공공형 중증환자 전담 이송체계(Mobile ICU) 구축 통한 안전한 병원 간 이송 지원**
 ▶ '국립형 중증응급환자 병원간 이송체계' 모델개발 연구, 결과를 토대로 시범사업 우선 추진, 시범사업 결과를 토대로 전국 확대 검토

제4차 응급의료 기본계획 (보건복지부)

3 추진과제 - 1. 현장·이송 단계

1-3 이송서비스의 품질 개선

- 1 현장 응급의료 제공자 역량 강화**
 ▶ 구급대원의 응급환자 중증도 평가 기준을 병행하고 일차서술 중증도도 기반한 적정행위 이행행위 선정 유도
 ▶ 이송 중 필요한 조치를 즉시 제공할 수 있도록 응급구조사 업무 범위 확대 (현행 14종 ~ 19종)
- 2 응급의료 지도의사의 자격요건 강화 및 업무의 체계화를 통해 현장 이송, 응급처치의 전문성 제고**
- 3 스마트 의료지도·대상 질환 등 단계적 확대 (현행 : 심장·뇌·심근경색 등 중증응급질환)**
 * 구급대원이 스마트로 중환자 정보 제공을 통해 현장 상황 - 의료기관 응급의료 의사기 시시인근으로 현장 정보 의료지도 실시
- 4 민간 이송업체 전문성 강화 통한 안전하고 전문적 전문 서비스 제공**
 ▶ 이송업체 인종제 도입, 출동·재지·기록 작성 의무화 및 합선인력 기준 강화
 ▶ 중증응급환자 전문 이송 중 이루어진 조치 등에 대한 건강보험 보장 검토

제4차 응급의료 기본계획 (보건복지부)

3 추진과제 - 1. 현장·이송 단계

1-4 이송 및 수용 적정성 관리체계 마련

- 1 지역 맞춤형 이송지원 마련**
 ▶ 지역 내 응급의료자원을 주기적으로 조사하고, 그 결과를 바탕으로 병원별·영역별 이송지원체계 마련, 구급대 및 지역주민이 활용도 높고
- 2 이송 중인 응급환자에 대한 병원·수용 책임 강화**
 ▶ 지역별 및 의료기관 중환자실 책임으로 추가 응급환자 수용이 곤란한 경우(중환자실)에 병상·의료인 등 자원 부족을 즉시보고 지도·감독 강화
- 3 응급환자 '이송 → 수용' 과정에서 발생하는 정보를 통합관리**
 ▶ 이송 요청(119 구급상황창)·요청에 대한 대응(응급실·전환·수신·기타) 시 발생하는 정보를 연계하여 이송·수용 적정성 점검 기반 마련

	제3차 추진과제 - 2. 병원 간 연계	제4차 응급의료 기본계획 보건복지부
2	지역 내 병원 간 협력 네트워크 구축 ▶ 개별 의료기관에서 365일 대응이 어려운 중응급질환에 대해 지역 내 병원 간 순환당직제를 제도화하여 지역안전망의 대응 ▶ 자치세 주도의 응급의료 지원조사를 기반으로 권내 응급의료기관 간 조율을 통한 365일 종합당직 일정 편성 공유 (대응책외의 등 외부 응송질환은 현안연구에 수행(중앙정부 요청))	
3	최종치료 제공이 어렵거나 부적절한 경우 적정한 다기관으로 전환할 수 있도록 관련 보상·신설, 전산시스템 개선 등 제도적 지원 강화	
4	반도, 사망률 등이 높아 전문진료 필요성은 높은 일부 질환은 전문환원 진료센터*를 중응급의료센터 등에서 지정 * 환자섭취·집합센터, 건강지원센터, 소아전문응급의료센터 등	
5	상급종합병원 지정기준, 의료질평가 항목에 중응급환자 진료 성과를 확대 반영하여 의료기관의 적극적 대응, 투지 유도	

3 추진 과제 - 2. 병원 단계

제4차 응급의료 기본계획

보건복지부

2.4 안전한 응급진료 환경 조성

1 응급실 폭력 예방을 위한 종합적인 법적 근거 강화

- (해결) 응급의료 병행처리 규정의 보호령위 확대(보안인력 등 포함), 응급실 안전관리위원회 설치 운영, 응급실 환자 및 응급의료종사자 안전 관리 지원 등

- D 보안인력 배치기준 개정 및 보안인력 표준 업무 매뉴얼 수립
- D 폭력 조기 예방을 위해 응급실 안내·상담 인력 운영 내실화

2 감염병 유행 시 응급실 대응기관 고도화

- D 응급실 내부 격리방역 허용, 응급실 1인실화 등 환경 개선방안 마련
- D 감염병 유행 규모 및 특성 등에 따라 탄력적으로 대응이 가능하도록 가변형 코호트격리구획* 등 제도화
 - * 공간적 제약 등을 고려하여 응급실 내 수용 가능한 감염병성 위험도 주어진 동·차우 공간에서 설치 가능한 이동식 격리방역 시설
- D 상시적 응급실 감염관리 지킴* 수립

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		제4차 응급의료 기본계획	보건복지부
② 추진과제 - 3. 전문 분야별 대응			
	3-2 심뇌혈관질환 분야		
1	광역심뇌혈관관리센터 전문치료 역량 및 연계·협력 기능 강화 - D 지역 내 필수 진료 거대도 및 역권에 중증급을 두고 기존 센터 제형가 및 실제 수요 및 지원 분포를 반영한 진료권[※]에 따라 재지정 ※ 자연히 설립된 심장병, 천문치로 관아, 이송중계 등과 병합되는 진료권 도출 - D 권역 내 119 급대, 진료지원 연계 협력체계 구성 · 운영		
2	응급심뇌혈관 환자 최종치료시간 단축 전달체계 구축 - D 관급심뇌혈관관리센터(지역 의료기관(3~6개소), 119구급대로 협력체계 구성, 운영비용 사전(50%) 및 성과에 따른 사후 보상 지급 - D 목포질병원, 치료방법별 지역 전문의료 구성된 네트워크(전문치료팀)에 팀 단위 보상, 권역특성 기반 사업단 운영 ※ 전문치료팀 사후 비용의 경우 조당 및 팀 단위 보충방안 도출을 통해 응급 중심 심뇌혈관질환 전달체계 개선 전략사업 사업사업 추진		

3 추진과제 - 3. 전문 분야별 대응 제4차 응급의료 기본계획 보건복지부

3-3 소아응급 분야

- 1 모든 응급실에서 소아 응급환자에 대한 보편적 진료 보장
 ▷ 소아환자에 대한 진료실적을 응급의료기관 평가에 반영
- 2 미설치 권역 위주로 소아전문응급의료센터 확충, 응급처치부터 최종진료까지 원활히 이어질 수 있도록 응급실-후속진료 기관 연계 강화
- 3 응급실 외 소아환자 대상 야간·휴일 진료 제공 기관 확대, 야간진료 보상 강화
- 4 소아의 각격스러운 증상에 대해 의료인이 24시간 상담을 제공하는 '소아전문 상담센터' 시범사업' 추진 검토
 ※ 소아전문응급의료센터, 야간·휴일 진료기관 등에서 상시적으로 응급실 이용 필요성이 높은 병종에 대해 전문인력 배치 및 야간·휴일 운영 의료기관 연계를 통한 응급진료 제공

3 추진과제 - 3. 전문 분야별 대응 제4차 응급의료 기본계획 보건복지부

3-4 정신응급 분야

- 1 정신응급 상황 시(특히, 야간·주말) 경찰과 합동 대응이 가능하도록 정신건강복지센터 내 설치 중인 위기개입팀* 운영체계 정비
 ※ '22.12월 17개 시도 34개팀 운영 중, 경찰-위기개입팀 합동 근무 중
- 2 권역정신응급의료센터 운영 확대
 ▷ 외상 등 신체질환 동반 정신응급환자가 적시에 적절한 치료를 받을 수 있도록 응급의료센터(구역, 지역) 기반 정신응급대응체계 구축
- 3 신체적 문제 해소 후 정신병동 응급입원 등 입원이 필요한 정신질환자가 계속 치료를 받을 수 있도록 관련 수가 등 개선

3 추진과제 - 3. 전문 분야별 대응 제4차 응급의료 기본계획 보건복지부

3-5 재난대응 분야

- 1 재난 사전예방을 위한 협업체계 구축
 ▷ 지역별로 재난의협약체 구성, 사전 위험도 분석 및 대응
- 2 신속한 초동대응을 위한 의사소통 효율성 개선
 ▷ 중대한 상황 공유를 위한 기관 간 정보공유 체계 개선
 ▷ 현장 인력(경찰·소방·의료진) 간 원활한 의사소통을 위해 재난안전통신망(PS-LTE)의 표준운영절차(SOP) 마련
- 3 재난 상황 대응 역량 강화
 ▷ 소방, 보건소, DMAT 등 유관기관 간 합동훈련 체계 구축 및 관련자급 교육 훈련 추진
 ▷ 보건소장이 현장 응급의료소장으로서 역할을 충분히 수행할 수 있도록 적절한 권한 위임규정 마련
- 4 재난응급의료 정책 추진기반 강화
 ▷ DMAT 활동 여건 개선, 중앙응급의료상황실 인력 확충 추진
 ▷ 재난 대응 단계별 신속 방상 확보, 통령정보 관리체계 마련

3 추진과제 - 4. 응급의료 기반 제4차 응급의료 기본계획 보건복지부

4-1 지역 응급의료 정책기반 강화

- 1 지방정부가 지역응급의료시행계획 수립 시 지역 응급의료 자원조사, 지역 이송체계 마련 등 지역별 특성을 반영한 정책 계획을 포함하도록 내실화
- 2 시도응급의료지원단을 지역 특성을 반영한 정책 개발, 지역 내 관계기관 연계·조정 등 지역 응급의료정책 전문 지원 조직으로 육성 추진
- 3 응급의료과정 전 과정(진단-치료-이송-진료-전환)을 포괄하는 지역 응급의료체계 평가 도입
- 4 지역별 차이를 반영한 응급의료 정책 추진을 위한 지자체 예산 편성 및 집행의 자율성 확대 방안 마련
 ※ 응급의료기금 지원에 보조 방식(제1사업비 지원) - 포괄보조(block grant) 등 검토

3 추진과제 - 4. 응급의료 기반 제4차 응급의료 기본계획 보건복지부

4-2 응급의료 정보체계 선진화

- 1 응급의료 종합상황판을 이용자별 맞춤형 응급의료정보 제공 플랫폼으로 전면 개편하여 신속·관료한 응급의료 의사결정 지원
- 2 응급질환별 진료 가능 여부는 담당 진료과에서 직접 입력하도록 하고 정확성을 수시 점검, 평가 반영 등을 통해 정보의 책임성 확보
- 3 응급환자 발생 시부터 이송, 의료기관에서 퇴원하기까지 생성되는 정보를 하나로 통합하여 단절 없는(seamless) 연속적 데이터 구축
 ※ 응급환자 발생·이송·진료·퇴원·이송·응급진료정보(NEDS)-상생병원 수가 청구 데이터를 연결하여 단일 응급의료정보 흐름 생성
- 4 환자 상태 및 이송 중 처치 정보 등을 구급대가 단말기에 입력하면 이송이 예정된 의료기관으로 실시간 공유하는 연계 시스템 구축

3 추진과제 - 4. 응급의료 기반 제4차 응급의료 기본계획 보건복지부

4-3 중앙 응급의료정책 추진기반 내실화

- 1 중앙응급의료센터가 국가 응급의료 정책 컨트롤타워로서의 역할을 수행할 수 있도록 위상 강화 및 독립성 확보 추진
- 2 현 중앙응급의료센터 내 중앙응급의료상황실을 확장하여 병원 간 전환을 지휘·관제(위)하는 지역응급의료상황실 설치 검토
- 3 응급의료기관 평가를 구조(structure)에서 결과(outcome) 중심으로 개편하고 기관 종합 역할에 부합하는 기능 수행 수준을 평가할 수 있도록 개선
- 4 응급의료기금의 안정적 재원 확보방안 마련

핵심 성과지표로 보는 기대효과		
핵심 성과지표	'22년	'27년
중증응급환자 적정 시간 내 최종치료기관 도착률	49.6%	60% 약 20% 개선
대국민 응급의료 서비스 만족도	54.9%	60% 약 10% 개선
중증응급환자 병원 내 사망률	6.2%	5.1% 약 10% 개선
예방 가능한 외상 사망률	15.2%	10% 약 1/3 이상 감소
지역응급 의료체계 평가	미 실시	실시

필수의료에 관한 심혈관계의 시각

윤 창 환

분당서울대병원 순환기내과

사회적으로 힘든일을 회피하고 편한 삶을 추구하는 경향이 강해지며 의료계에도 같은 변화가 밀려드며 큰 위기가 닥쳐오고 있다. 순간의 치료에 의해 사람의 생명이 좌우되는 필수의료는 진단 및 치료 특성상 24시간 365일 진료가 이루어져야 하고 극한의 긴장과 책임이 부여되기 때문에 갈수록 지원자가 줄며 인력이 줄어 향후 지속적인 체계 유지가 가능할 지 의문이다. 특히 국내 수도권 집중화에 따른 지방의 인구 감소와 노령화, 이에 따른 사회 경제적 격차가 벌어지며 의료 격차 역시 심해지고 있으며 인력이 부족하고 시설이 낙후되고 있어 지방의 필수 의료 공백은 이미 현실화 되어 있고 그 해답을 찾기가 매우 어려운 상황이다.

심혈관질환 중 급성심근경색, 대동맥 박리, 급성 심부전 및 심인성 쇼크, 급성 폐색전증 등은 대표적인 중증 응급질환으로 필수적으로 현장에서 의료가 제공되어야 하는 질환이다. 최근 발전된 의학으로 이 질환의 치료는 급성기 체계적인 약물치료, 많은 인력과 장비가 소요되는 중재적 시술 및 응급 수술로 이루어 진다. 따라서 충분한 의료인력과 장비, 시설이 필요한 필수의료이다. 그러나 급성기 치료를 담당할 수 있는 병원 역시 수도권 및 대도시에 집중되어 있고 그나마 있는 지역 병원에서는 인력을 확보하지 못하고 있어 적절한 서비스가 이루어지지 못하고 있다. 병원 및 인력이 집중되어 있는 수도권이라고 해서 문제가 없는 것이 아니고 24시간 365일 진료 체계를 거의 모든 병원이 추구하고 있지만 거의 모든 병원이 항상 진료를 할 수 있는 것은 아니어서 실제 환자 발생시 치료 병원을 결정하고 이송하는데 혼란이 발생하고 적절한 시간내로 치료가 이루어지지 못하는 경우가 적지 않다.

따라서 심혈관계 필수의료 제공을 위해서 국가 전역에 걸쳐 대응시스템 구축이 필요하다. 그동안 급성심근경색의 치료를 위해 공공의료 영역에서 권역심혈관센터가 지정되어 서울을 제외한 지역의 심근경색의 치료를 24시간 365일 담당해 왔다. 그러나 권역심혈관센터는 전체 심근경색 발생의 약 20%를 담당해 왔을 뿐이고 권역심혈관센터가 모든 진료권에서 발생하는 환자를 수용할 수 있는 상황도 아니었고 서울은 권역심혈관센터가 지정되어 있지 않았다. 그리고 권역심혈관센터에 배정되던 예산은 점차 줄어들었고 대부분 지역에 위치한 관계로 인력확보도 충분치 않아 최근에는 센터운영의 동력이 사라져가고 있다. 이에 중앙센터를 새로 지정하여 권역심혈관센터의 운영을 지원하고 지역심혈관센터 지정을 통해 권역센터가 담당하지 못하는 진료권을 담당할 수 있도록 치료망을 정비하고자 하였다.

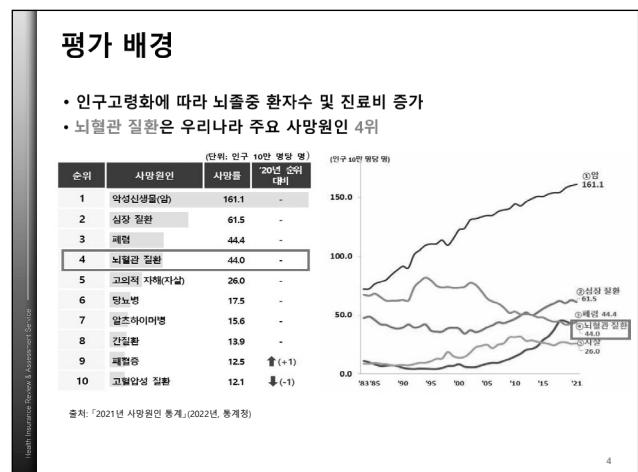
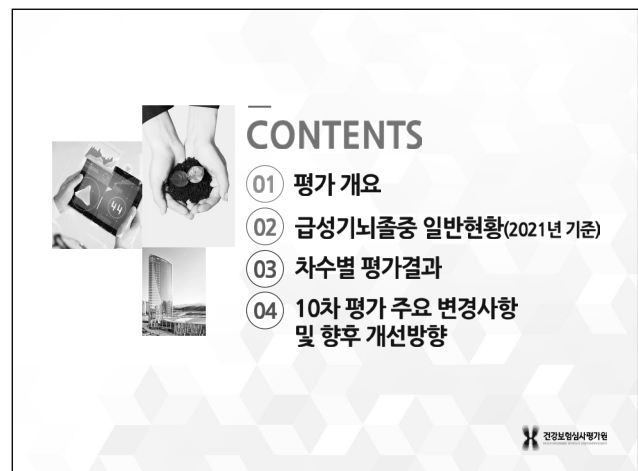
또한 진료 네트워크를 구축하여 환자가 발생한 순간부터 119구급대 및 지역병원으로부터 병원전단계 환자 후송 및 치료가 제대로 이루어 질 수 있도록 제도를 정비하고 있다. 한편 그동안 소외되었거나 참여가 미미했던 심혈관외과 계의 역할을 새로 부여하고 대동맥박리 등 응급치료가 필요한 질환군의 치료 대응 체계를 구축하려 하고 있다.

이런 변화를 성공시키기 위해서는 중앙정부와 지방정부의 관심과 지속적인 지원, 지역 및 권역내에서 공동의 치료 목표를 위한 네트워크를 지속 운영이 필수적이다. 현재 진행되고 있는 필수의료대책과 전문치료팀 지원사업 등이 결실을 맺을 수 있기를 간절히 바란다.

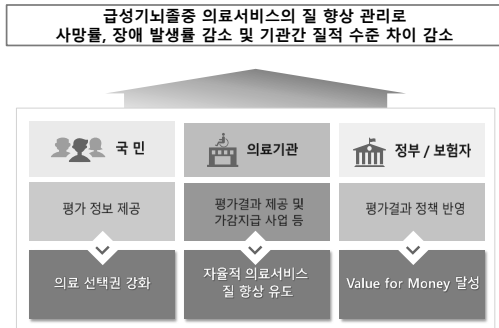
급성기뇌졸중 적정성평가 결과 및 개선 방향

최 정 남

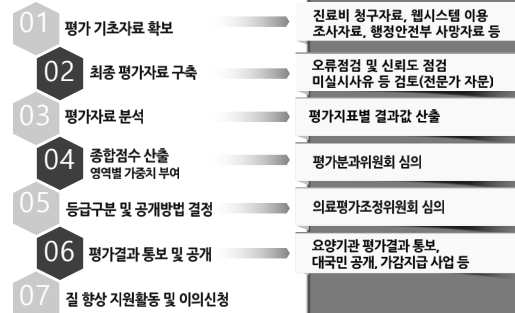
건강보험심사평가원 평가4부 부장



평가 목적



평가수행 절차



추진경과

- 2006.3. 급성기뇌졸중 1차 평가 보건의복지부 승인
- 2007~2010 1차~3차 평가결과 공개
- 2012~2015 4차~6차 평가결과 공개 및 1차~3차 가감지급
- 2015.12. 「급성기뇌졸중 평가 개선방안 연구」 수행('15.4~'12월)
- 2018~2020 7차~8차 평가결과 공개 및 4차~5차 가감지급
- 2022.7. 9차('20. 10.~'21.3.) 평가결과 공개 및 6차 가감지급
- 2022.7. 10차('22.10.~'23. 3. 진료분) 평가 세부시행계획 공개

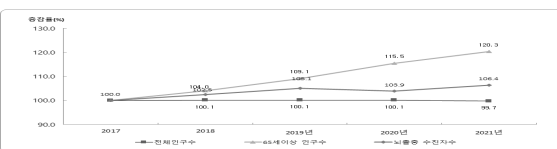


연도별 급성기뇌졸중 수진자 현황

*대상병이 뇌졸중(160~163)인 청구자료를 활용하여 분석 (단위: 명)

구분	2017년	2018년	2019년	2020년	2021년
인구수	51,778,544	51,826,059	51,849,861	51,829,023	51,638,809
65세 이상 인구수	7,356,106	7,650,408	8,026,915	8,496,077	8,851,033
계	605,607	620,892	636,230	628,982	644,500
뇌졸중 (160~163)					
입원	138,541	140,119	134,365	127,477	128,013
외래	549,512	564,088	584,758	579,836	595,488

· 2021년 연간 요양기관에서 뇌졸중으로 입원 또는 외래 치료를 받은 환자는 총 644,500명으로 2017년에 비해 38,893명(6.4%) 증가함



연도별 급성기뇌졸중 수진자 현황

- 출혈성뇌졸중 환자는 105,020명으로 2017년 대비 4.4% 증가함
- 허혈성뇌졸중 환자는 545,081명으로 2017년 대비 6.6% 증가함
- 허혈성뇌졸중 환자가 출혈성뇌졸중 환자에 비해 5.2배 많음

출혈성

(단위: 명)

구분	2017년	2018년	2019년	2020년	2021년
소계	100,556	104,093	104,652	118,098	105,020
I60(지주막하출혈)	33,574	35,253	36,367	36,286	37,127
I61(뇌내출혈)	59,133	60,983	60,031	58,685	60,229
I62(기타 비외상성 두개내출혈)	11,594	11,625	11,654	10,976	10,623

허혈성

구분	2017년	2018년	2019년	2020년	2021년
I63(뇌경색증)	511,453	523,188	537,887	531,680	545,081

급성기뇌졸중 환자 연령별 현황

· 급성기뇌졸중 환자의 평균연령은 점차 높아짐

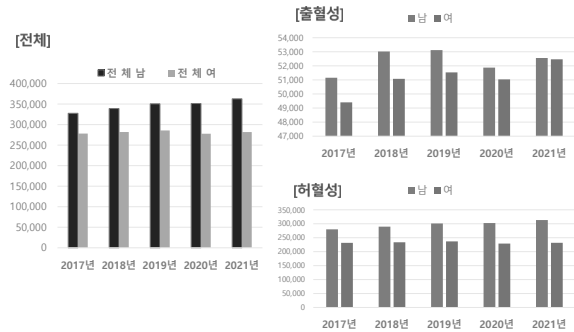
	2016년	2018년	2021년
평균 연령	68.5±12.5세	68.9±12.6세	69.9±12.6세

- (전체)급성기뇌졸중 수진자가 가장 많은 연령구간: 70대
- (출혈성)급성기뇌졸중 수진자가 가장 많은 연령구간: 60대
- (허혈성)급성기뇌졸중 수진자가 가장 많은 연령구간: 70대

(2021년 기준, 단위: 명, %)						
연령	40세 미만	40대	50대	60대	70대	80세 이상
전체	10,224(1.6)	27,998(4.3)	88,399(13.6)	173,273(26.7)	189,101(29.1)	161,106(24.8)
출혈성	4,467(4.3)	9,899(9.4)	23,120(22.0)	31,051(29.6)	22,121(21.1)	14,362(13.7)
허혈성	5,757(1.1)	18,099(3.3)	65,279(12.0)	142,222(26.1)	166,980(30.6)	146,744(26.9)

급성기뇌졸중 환자 성별 현황

· 전반적으로 급성기뇌졸중 환자 수는 남자>여자



CHAPTER 03 차수별 평가결과

평가대상(9차 기준)

대상환자

주상병이 I60~I63으로 증상발생 후 7일 이내 응급실을 통해 입원한 환자(건강보험 및 의료급여)

대상기간

2020.10.1~2021.3.31.(6개월) 입원 진료분

※ 요양개시일부터 종료일까지가 2020.10.1~2021. 3. 31. 이내인 건

대상기관 및 건수 현황

구분	전체	상급종합병원	종합병원
기관수	233기관	44기관	189기관
건수	계 30,900건(100%)	13,713건(44.4%)	17,187건(55.6%)
출혈성	7,888건(25.5%)	3,385건	4,503건
허혈성	23,012건(74.5%)	10,328건	12,684건
진료비	2,956억원	1,382억원	1,574억원

평가기준(9차 기준)

■ 평가지표(9개)

구분	평가지표
구조	· 전문인력 구성여부(신경과, 신경외과, 재활의학과 전문의) · Stroke Unit 운영 여부
과정	· 뇌영상검사 실시율(1시간이내) · 정맥 내 혈전용해제(t-PA)투여율(60분이내) · 조기재활 평가율(5일이내) · 연하장애 선별검사 실시율(첫식이전) · 항혈전제 퇴원처방률 · 항응고제 퇴원처방률(심방세동 환자)
결과	· 입원중 폐렴 발생률(출혈성)

- ◆ 허혈성뇌졸중(I63) 해당
- 출혈성뇌졸중(I60~I62) 해당

평가지표 차수별 결과

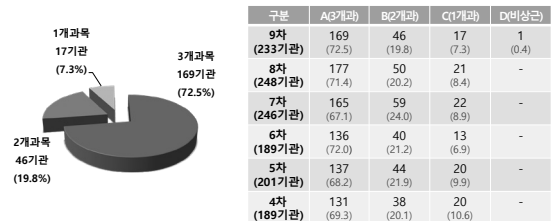
■ 구조지표 전문인력 구성여부

전문인력 구성여부(신경과, 신경외과, 재활의학과)

· 9차평가 결과 3개과 전문의 모두 상근하는 기관(A등급)은

전체기관의 72.5%로 8차대비 1.1%p 증가

(단위: 기관, %)

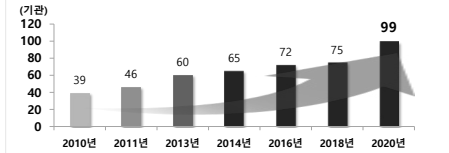


평가지표 결과

구조지표_Stroke Unit 운영여부

Stroke Unit 운영 99기관 8차 대비 24기관(12.3%p) 증가

Stroke unit 연도별 운영 현황



Stroke Unit 운영 세부현황

구분	진행	A등급	B등급	C등급
기관수(%)	233(100.0)	84(36.1)	15(6.4)	134(57.5)

A. Stroke Unit을 운영하면서 대한뇌졸중 학회 인증을 받았거나 '뇌졸중집중치료실 임원료' 산정 가능 기관
B. Stroke Unit을 운영하지만 대한뇌졸중 학회 미인증 기관 및 '뇌졸중집중치료실 임원료' 산정 불가 기관
C. Stroke Unit 미운영 기관

평가지표 결과

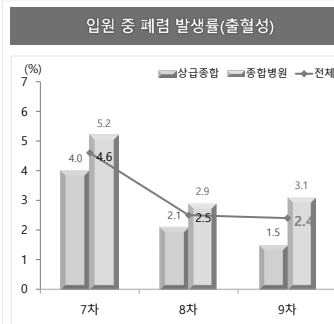
과정지표

구분	지표명	4차	5차	6차	7차	8차	9차
급성기 뇌졸중 (160-163)	뇌영상검사 실시율(1시간이내)	95.9	98.6	99.2	99.3	99.1	99.2
	조기재활 평가율(5일이내)	93.7	96.0	97.9	97.8	98.1	97.8
	연하장애선별검사 실시율(첫식이전)	-	97.4	97.4	97.8	98.3	97.5
허혈성 뇌졸중 (163)	정맥내 혈전용해제(t-PA)투여율(60분이내)	91.6	97.7	97.4	96.8	94.9	95.8
	항혈전제 퇴원처방률	99.6	99.9	99.9	99.9	99.8	99.8
	항응고제 퇴원처방률(심방세동)	98.5	99.7	99.8	99.9	99.8	99.5

평가지표 결과

결과지표

- 9차 결과 2.4 (8차 대비 0.1%p 감소)
- 지표 신설 이후로 감소 추세임
- 중합병원이 높음



평가기준(9차기준)

모니터링지표(11개)

· 중합점수 산출 시 반영되지 않으며, 해당 기관에만 결과 통보

구분	모니터링지표
구조	- 중상발생 후 응급실 도착시간 중앙값* - 구급차 이용률
과정	- Stroke Scale 실시율(2일이내) - Functional Outcome Scale 실시율(퇴원시) - 정맥내 혈전용해제(t-PA) 투여율(4.5시간 이내) - 뇌졸중 교육실시율(의사기록) - 조기재활치료 실시율
결과	- 입원 30일내 사망률(출혈성/허혈성)* - 건강 입원일수 장기도지표(LI)* - 건강 진료비 고가도지표(CI)* - 입원 중 폐렴발생률(허혈성)*

주. * 허혈성뇌졸중(163) 해당, * 낮을수록 좋은 지표

모니터링지표 결과

구조지표_구급차 이용률 및 중상발생 후 응급실 도착시간 중앙값

중상발생 후 응급실 도착까지 소요시간(중앙값) 9차기준 231분

중상발생 후 3시간이내(Goldentime) 도착환자
구급차 이용 55.2%
(구급차미이용 24.1% 보다 31.1%p 높아)



모니터링지표 결과

지표별 중합 결과

구분	지표명	4차	5차	6차	7차	8차	9차
구조	구급차 이용률	54.2	55.8	56.8	58.6	59.2	61.4
	중상발생 후 응급실 도착시간 중앙값(분)*	208	213	206	198	214	231
과정	정맥내 혈전용해제(t-PA) 투여율(4.5시간 이내)	87.3	96.2	99.2	97.5	97.8	91.1
	Stroke scale 실시율(2일이내)	96.8	97.7	98.1	98.3	98.7	98.1
	Functional outcome scale 실시율(퇴원시)	91.5	94.0	95.2	94.6	94.4	93.0
	뇌졸중 교육실시율(의사기록)	-	-	-	-	92.2	92.4
	조기재활치료 실시율	-	95.3	95.2	95.9	93.7	93.6
결과	입원 30일내 사망률(출혈성/허혈성)*	11.3	9.7	9.3	7.5	7.2	7.7
	건강 입원일수 장기도지표(LI)*	1.04	1.06	1.06	1.06	1.09	1.10
	건강 진료비 고가도지표(CI)*	0.98	0.99	1.03	0.98	0.99	0.99
	입원 중 폐렴 발생률*	-	-	-	-	-	2.2

주. * 허혈성뇌졸중(163) 대상, * 낮을수록 좋은 지표

종합점수 ■ 산출방법(9차 기준)

점수부여방식

영역	내용	점수부여방식	가중치
구조지표	전문인력 등급	• A등급(3개과상급): 100점 • B등급(2개과상급): 75점 • C등급(1개과상급): 50점 • D등급(없음): 0점	2.8
	Stroke Unit 점수	A등급: 100점, B등급: 50점, C등급: 0점	0.2
과정지표	6개 과정지표이용	산출된 과정지표별 점수의 합 산출된 과정지표 항목 수	4.3
과정지표 항목 수	결과 산출된 과정지표 항목 수 (분모건≥5건)	• 5항목이상 : 100점 • 4항목 : 90점 • 3항목 : 80점 • 2항목 : 70점	2.5
결과지표	입원중 폐렴 발생률(출혈성)	100-(입원중 폐렴발생률(출혈성))	0.2

● 산출 대상기관: 지표값이 산출된 과정지표 항목수가 2개 이상

종합점수 산출식

(전문인력 구조지표 x 2.8) + (Stroke Unit 구조지표 x 0.2) + (복합과정점수 x 4.3)
+ (과정지표 항목 수 점수 x 2.5) + (결과지표점수 x 0.2)
Σ 가중치

* 산출된 영역의 가중치

평가등급(9차 기준)

등급 구분

③ 종합점수 산출 구간에 따라 5등급으로 구분

※ 과정지표 결과산출이 1개 이하인 기관은 등급제외로 구분

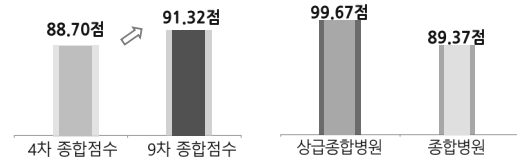
등급	종합점수 구간
① 등급	95점 이상 ~
② 등급	85점 이상 ~ 95점 미만
③ 등급	75점 이상 ~ 85점 미만
④ 등급	55점 이상 ~ 75점 미만
⑤ 등급	55점 미만
등급제외	산출된 과정지표 항목수가 1항목 이하

종합점수

산출 결과

9차 종합점수 평균 91.32점으로 4차 대비 2.62점 증가

* 9차 종합점수 상급종합병원 99.67점, 종합병원 89.37점



종합점수	4차	5차	6차	7차	8차	9차
	88.70점	90.56점	93.91점	91.55점	92.45점	91.32점

평가등급

등급 현황

원칙

(단위: 기관, %)

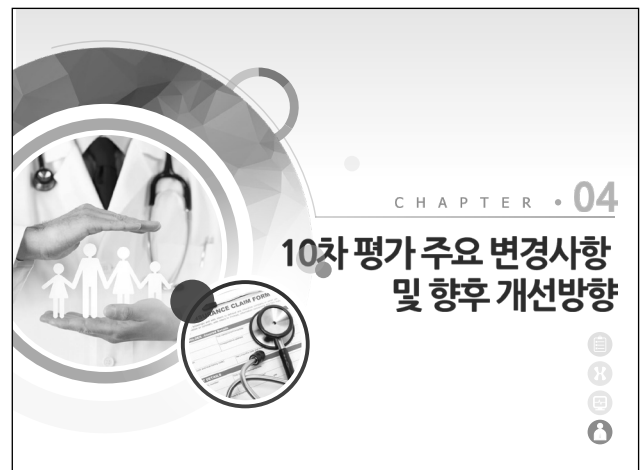
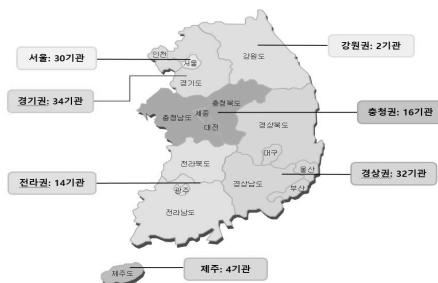
구분	4차	5차	6차	7차	8차	9차
계	189 (100.0)	201 (100.0)	189 (100.0)	246 (100.0)	248 (100.0)	233 (100.0)
1등급	88 (46.6)	98 (48.8)	106 (56.1)	134 (54.5)	143 (57.7)	132 (56.7)
2등급	28 (14.8)	26 (16.4)	30 (15.9)	48 (19.5)	36 (14.5)	45 (19.3)
3등급	17 (9.0)	26 (16.4)	13 (6.9)	21 (8.5)	27 (10.9)	36 (15.5)
4등급	22 (11.6)	13 (8.2)	9 (4.8)	18 (7.3)	19 (7.7)	16 (6.7)
5등급	9 (4.8)	5 (3.1)	1 (0.5)	5 (2.0)	2 (0.8)	3 (1.3)
등급제외	25 (13.2)	33 (20.8)	30 (15.9)	20 (8.1)	21 (8.4)	1 (0.5)

등급제외: 산출된 과정지표 항목수가 3항목 이하(4~6차)
산출된 과정지표 항목수가 2항목 이하(7~8차)
산출된 과정지표 항목수가 1항목 이하(9차)

평가등급(9차 기준)

권역별 등급별 분포 현황

• 전국 모든 권역에 1등급 기관 고르게 분포



HIRA 적정성평가 지표개선 방향

▶ 핵심지표 중심 평가지표 정비

■ 배경 및 목적

- 2001년 요양급여 적정성평가 시작 이후 평가항목·지표는 지속적으로 증가하였으나, **의료 질 개선을 위한 목적의 평가에는 한계**
*(22년 기준) 37개 평가항목, 338개 평가지표
- 2021년 평가체계 혁신방향에 따라 **국민중심 및 목표중심**의 핵심지표 평가로 패러다임을 전환

■ 추진 경과

- ('14년) 평가 목표수준 설정에 대한 정책 제언(국민의료평가발전위원회)
- ('22년) 평가항목 및 지표 일괄 재정비 추진
※ 2040 평가체계혁신 추진전략 7대 혁신과제 중 "핵심지표 중심 평가지표 정비"

10차 평가 주요 변경사항

지표 정비

• 10차 평가지표 6개, 모니터링지표 5개

구분	9차 평가	10차 평가
평가 지표	전문인력 구성여부	Stroke Unit(인력 및 시설) 구성여부로 통합
	Stroke Unit 운영여부	
	뇌영상검사 실시율(1시간 이내)	
	연하장에 선별검사 실시율(첫 식이 전)	
	항혈전제 퇴원처방률	중요
	항응고제 퇴원처방률(심방세동 환자)	
	조기재활 평가율(5일 이내)	
	입원 중 폐렴 발생률(출혈성)	조기재활 평가·실시율로 통합
		입원 중 폐렴발생률*로 통합

* '조기재활 평가율(5일 이내)'과 모니터링지표 '조기재활 치료 실시율'을 평가지표 '조기재활 평가·실시율'로 통합·전환
'입원 중 폐렴발생률(출혈성)'과 모니터링 지표 '입원 중 폐렴발생률(허혈성)'을 평가지표 '입원 중 폐렴발생률'로 통합·전환

10차 평가 주요 변경사항

지표 정비

• 10차 평가지표 6개, 모니터링지표 5개

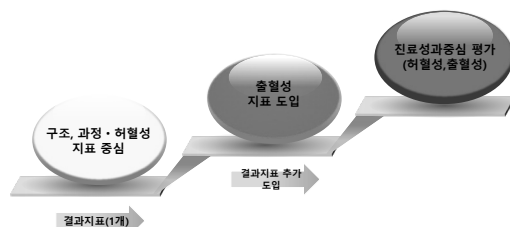
구분	9차 평가	10차 평가
모니터링 지표	Functional outcome scale 실시율(퇴원시)	평가지표로 전환
	조기재활치료 실시율	
	입원 30일내 사망률(출혈성/허혈성)	
	입원 중 폐렴 발생률(허혈성)	
	Stroke Scale 실시율(2일 이내)	중요
	뇌졸중 교육실시율(의사기록)	

10차 평가기준

항목	평가지표(6개)	모니터링지표(5개)
구조	○ Stroke Unit(인력 및 시설) 구성 여부	○ 급급차 이용률 ○ 증상발생 후 응급실 도착시간 증양값
과정	◆ 정맥 내 혈전용해제(t-PA) 투여율 (60분 이내) ○ 조기재활 평가·실시율 ○ Functional outcome scale 실시율(퇴원 시)	◆ 정맥 내 혈전용해제(t-PA) 투여율 (4.5시간 이내)
결과	○ 입원 중 폐렴 발생률 ○ 입원 30일내 사망률 (출혈성/허혈성)	○ 건당 입원일수 장기도지표(LI) ○ 건당 진료비 고가도지표(CI)

주1. ◆ 허혈성 뇌졸중(163) 대상
주2. 모니터링지표는 종합점수에 반영되지 않음

향후 급성기뇌졸중 적정성평가 개선방향



- 진료의 성과를 측정하는 지표의 추가 도입
- 출혈성 환자에 대한 과정지표 부재 -> 연구를 통한 새로운 지표 및 평가방향 설정
↳ "급성기뇌졸중 적정성평가 실효성 강화방안 연구"



앞으로도 전 임직원은 건강하고 안전한 의료문화를 열어가는
국민의료평가기관이 되고자 최선을 다하겠습니다.

감사합니다

2023

뇌졸중 재개통 심포지엄 (ARCS) 및 대한뇌혈관내치료의학회 춘계보수교육

- New Era of Endovascular Stroke Treatment -

Session IV

General Management of Acute Ischemic Stroke

좌장: 윤석만 (순천향대), 권현조 (충남대)

Non-large vessel occlusions

Critical care in severe AIS patients

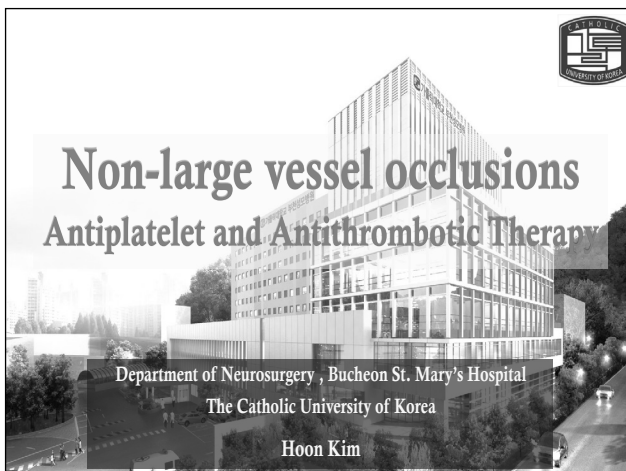
김훈 (가톨릭대)

이석윤 (인제대 부산백병원 신경과)

Non-large vessel occlusions

김 훈

가톨릭대



Mechanism

Large artery atherosclerosis

- artery to artery embolism
- in situ thrombosis
- hemodynamic
- local branch occlusion

Small artery occlusion

- lipohyalinosis
- Microatheroma
- arteriolosclerosis
- embolism

Cardioembolism

- AF
- valvular heart disease
- heart failure

Treatment differs according to the mechanism of stroke

Ischemic Stroke classification

	TOAST	SSS-TOAST	CCS	ASCO
Subtypes	LAA CE SVO OD UD	LAA CE SVO OD UD	Supra-aortic LAA CE SVO OD UD	Atherosclerosis CE Small-vessel disease Dissection Other
Significant stenosis degree for diagnosing LAA	>50%	>50% (evident)	>50% Stenosis with plaque ulceration or thrombus <50% at the site of penetrating artery	>50% <50% with endoluminal thrombus Mobile thrombus at aortic arch
Aortic atherosclerosis	Not described	Not described	Cardioembolism	Atherosclerosis
Diameter limitation for SVO	15 mm	20 mm	20 mm	15 mm
Other advantages	Simple Convenient Accurately predicts prognosis	Logicals Reduced prevalence of strokes of undetermined etiology	Web-based Evidence-based Convenient if equipment available	Integration of non-causative factors
Other Disadvantages	High prevalence of strokes of undetermined etiology Low validity and reliability in specific subtypes	Complex algorithm	Depends on modern diagnostic tools Needs equipment to connect to web site	Difficulty in interpretation Too many subtypes

Acute Stroke Treatment

❖ Aspirin

	IST (n=19 435)	CAST (n=20 655)
Time from onset, h	0-48	0-48
Aspirin dose, mg	300	160
Maximum duration, wk	2	4
Location	34 Other countries	China

Starting aspirin within 24 to 48 hours of ischemic stroke onset reduced the risk of early recurrent ischemic stroke

Benefit / 1000

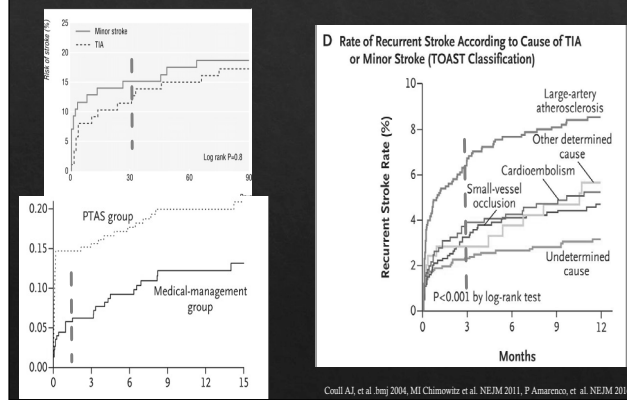
2P < 0.000001 7 SD 1 -2 SD 1

A Aspirin (20 055)
C Control (20 035)
* No. who survived

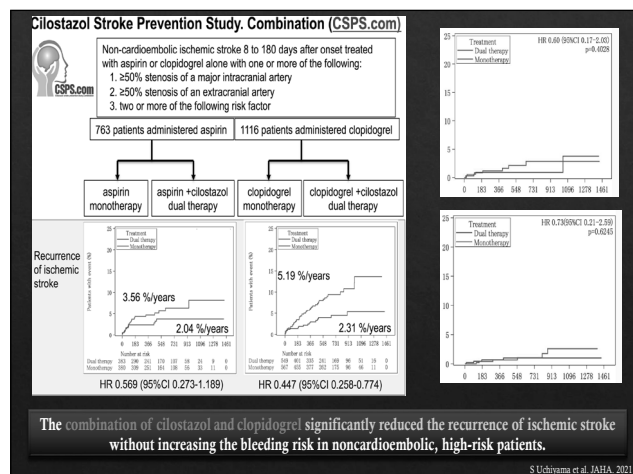
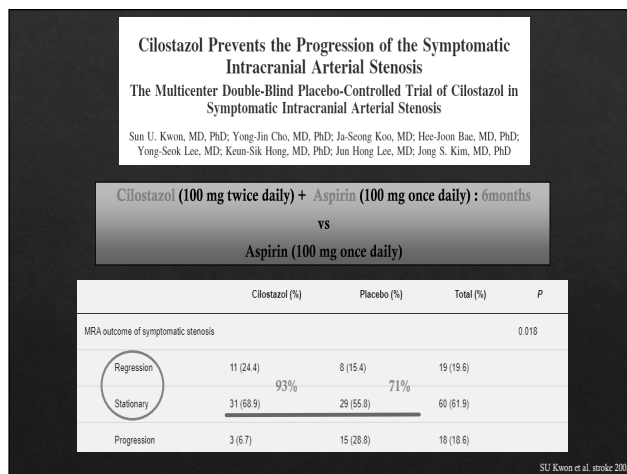
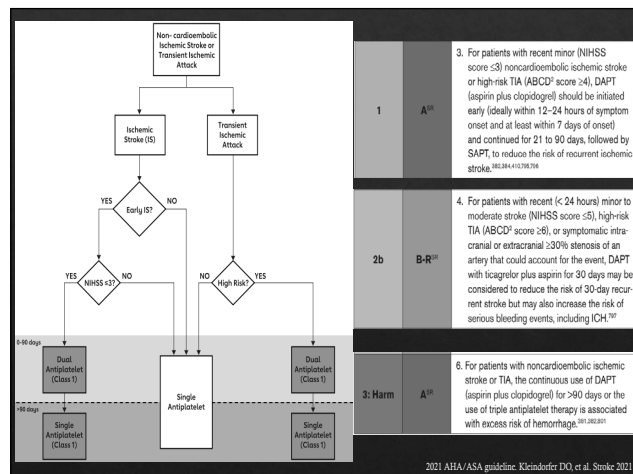
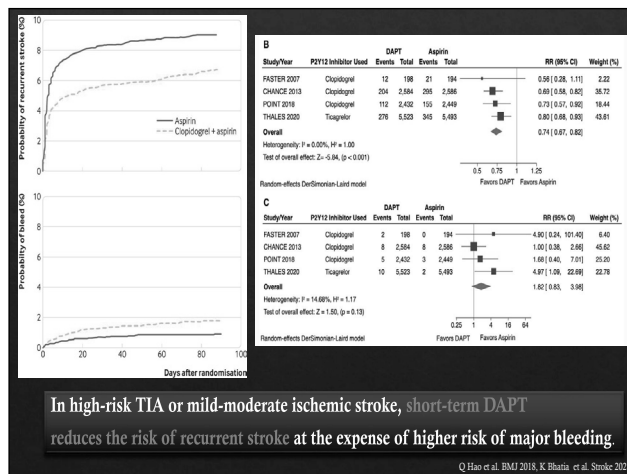
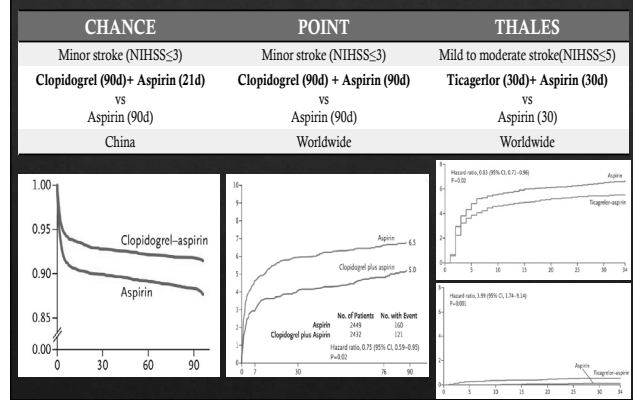
Outcome	A (n)	C (n)	A (%)	C (%)
Recurrent ischemic stroke	320	457	2.3*	1.6
Hemorrhagic stroke or transformation	196	107	1.0	0.8

International Stroke Trial Collaborative Group, Lancet 1997
Chinese Acute Stroke Trial Collaborative Group, Lancet 1997

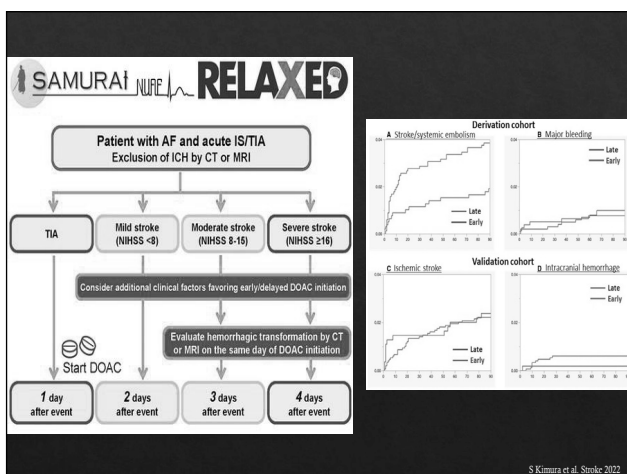
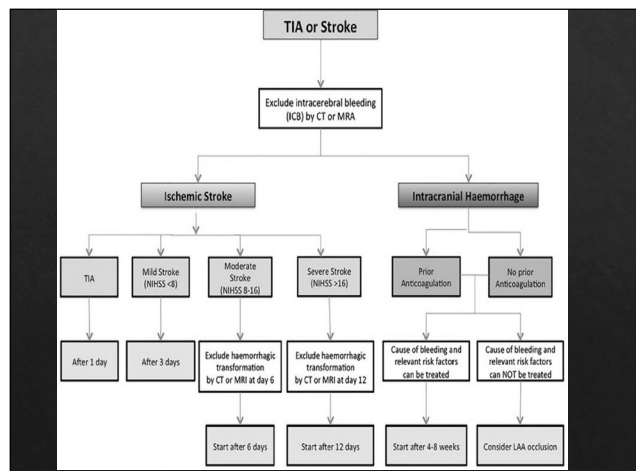
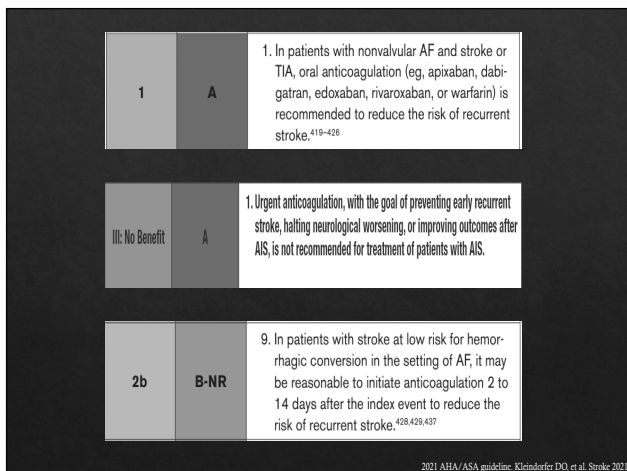
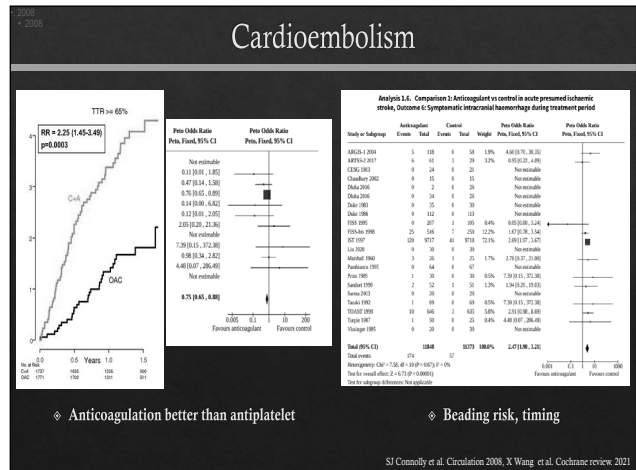
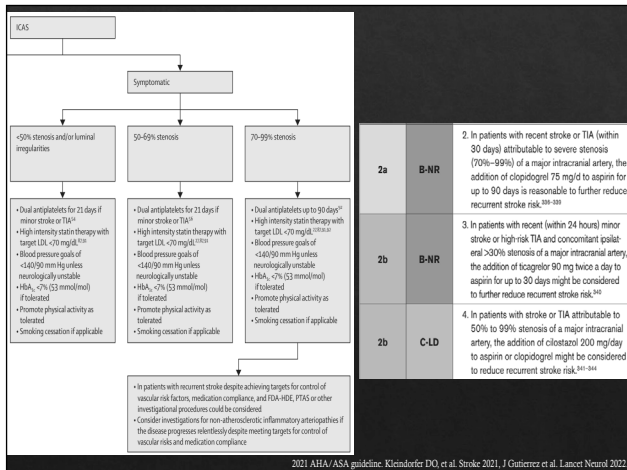
Recurrent Stroke



Acute Stroke Treatment - DAPT



Session IV. General Management of Acute Ischemic Stroke



Blood Pressure without reperfusion therapy

- ◆ Hypotension and hypovolemia **should be corrected**
- ◆ BP $\geq 220/120$ mm Hg
 - : effect of lowering BP within 48 ~ 72 hours is uncertain
 - lowering BP by 15% during the first 24 hours might be reasonable
- ◆ BP $< 220/120$ mm
 - : initiating or reinitiating BP medication within the first 48 ~ 72 hours is not effective
- ◆ Neurologically stable & BP $> 140/90$ mm Hg
 - : initiating or reinitiating BP medication

2023

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Conclusion

- ◇ Recurrent stroke risk is high in acute period
- ◇ We should consider the balance of the benefit and risk in using DAPT
- ◇ Minor ischemic stroke or high risk of TIA
 - DAPT (aspirin + clopidogrel) : 21 ~ 90 day
- ◇ Acute ischemic stroke with ICAS
 - DAPT (aspirin + clopidogrel) : 90 day
 - long term treatment : DAAP (aspirin or clopidogrel + cilostazol)
- ❖ AF – Anticoagulation after excluding hemorrhage transformation
- ❖ In spite of best medical therapy, ischemic stroke risk remind high !

Critical care in severe AIS patients

이 석 윤

인제대 부산백병원 신경과

2023-02-25 KoNES ARCS 판교 차바이오펀믹스

Critical Care in Severe Acute Ischemic Stroke Patients

인제대학교 부산백병원 신경과/외과계중환자실
이 석 윤

INJE UNIVERSITY BUSAN PAK HOSPITAL

Agenda

1. General critical care in severe AIS patients
2. Management of complication after severe AIS
3. Critical care after revascularization in AIS patients

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Acute Ischemic Stroke(AIS) severity

NIH (National Institutes of Health) Stroke Scale (0~42)

~~> 3 months functional status

- Mild stroke : NIHSS 0-4 or 0-5
- Moderate stroke : NIHSS < 9 or < 15
- Severe stroke : NIHSS ?

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Limitation of NIHSS

- Consciousness(7)
- Motor(12+facial3)
- Language(5+q2+c2)
- Brainstem – gaze2/face3
- Nondominant – neglect2

Item	Score	Response and Score	Item	Score	Response and Score
1	0-5	1-5	6	0-5	6-10
2	0-5	6-10	7	0-5	11-15
3	0-5	16-20	8	0-5	21-25
4	0-5	26-30	9	0-5	31-35
5	0-5	36-40	10	0-5	41-45
6	0-5	46-50	11	0-5	51-55
7	0-5	56-60	12	0-5	61-65
8	0-5	66-70	13	0-5	71-75
9	0-5	76-80	14	0-5	81-85
10	0-5	86-90	15	0-5	91-95
11	0-5	96-100	16	0-5	101-105
12	0-5	106-110	17	0-5	111-115
13	0-5	116-120	18	0-5	121-125
14	0-5	126-130	19	0-5	131-135
15	0-5	136-140	20	0-5	141-145
16	0-5	146-150	21	0-5	151-155
17	0-5	156-160	22	0-5	161-165
18	0-5	166-170	23	0-5	171-175
19	0-5	176-180	24	0-5	181-185
20	0-5	186-190	25	0-5	191-195
21	0-5	196-200	26	0-5	201-205
22	0-5	206-210	27	0-5	211-215
23	0-5	216-220	28	0-5	221-225
24	0-5	226-230	29	0-5	231-235
25	0-5	236-240	30	0-5	241-245
26	0-5	246-250	31	0-5	251-255
27	0-5	256-260	32	0-5	261-265
28	0-5	266-270	33	0-5	271-275
29	0-5	276-280	34	0-5	281-285
30	0-5	286-290	35	0-5	291-295
31	0-5	296-300	36	0-5	301-305
32	0-5	306-310	37	0-5	311-315
33	0-5	316-320	38	0-5	321-325
34	0-5	326-330	39	0-5	331-335
35	0-5	336-340	40	0-5	341-345
36	0-5	346-350	41	0-5	351-355
37	0-5	356-360	42	0-5	361-365
38	0-5	366-370	43	0-5	371-375
39	0-5	376-380	44	0-5	381-385
40	0-5	386-390	45	0-5	391-395
41	0-5	396-400	46	0-5	401-405
42	0-5	406-410	47	0-5	411-415
43	0-5	416-420	48	0-5	421-425
44	0-5	426-430	49	0-5	431-435
45	0-5	436-440	50	0-5	441-445
46	0-5	446-450	51	0-5	451-455
47	0-5	456-460	52	0-5	461-465
48	0-5	466-470	53	0-5	471-475
49	0-5	476-480	54	0-5	481-485
50	0-5	486-490	55	0-5	491-495
51	0-5	496-500	56	0-5	501-505
52	0-5	506-510	57	0-5	511-515
53	0-5	516-520	58	0-5	521-525
54	0-5	526-530	59	0-5	531-535
55	0-5	536-540	60	0-5	541-545
56	0-5	546-550	61	0-5	551-555
57	0-5	556-560	62	0-5	561-565
58	0-5	566-570	63	0-5	571-575
59	0-5	576-580	64	0-5	581-585
60	0-5	586-590	65	0-5	591-595
61	0-5	596-600	66	0-5	601-605
62	0-5	606-610	67	0-5	611-615
63	0-5	616-620	68	0-5	621-625
64	0-5	626-630	69	0-5	631-635
65	0-5	636-640	70	0-5	641-645
66	0-5	646-650	71	0-5	651-655
67	0-5	656-660	72	0-5	661-665
68	0-5	666-670	73	0-5	671-675
69	0-5	676-680	74	0-5	681-685
70	0-5	686-690	75	0-5	691-695
71	0-5	696-700	76	0-5	701-705
72	0-5	706-710	77	0-5	711-715
73	0-5	716-720	78	0-5	721-725
74	0-5	726-730	79	0-5	731-735
75	0-5	736-740	80	0-5	741-745
76	0-5	746-750	81	0-5	751-755
77	0-5	756-760	82	0-5	761-765
78	0-5	766-770	83	0-5	771-775
79	0-5	776-780	84	0-5	781-785
80	0-5	786-790	85	0-5	791-795
81	0-5	796-800	86	0-5	801-805
82	0-5	806-810	87	0-5	811-815
83	0-5	816-820	88	0-5	821-825
84	0-5	826-830	89	0-5	831-835
85	0-5	836-840	90	0-5	841-845
86	0-5	846-850	91	0-5	851-855
87	0-5	856-860	92	0-5	861-865
88	0-5	866-870	93	0-5	871-875
89	0-5	876-880	94	0-5	881-885
90	0-5	886-890	95	0-5	891-895
91	0-5	896-900	96	0-5	901-905
92	0-5	906-910	97	0-5	911-915
93	0-5	916-920	98	0-5	921-925
94	0-5	926-930	99	0-5	931-935
95	0-5	936-940	100	0-5	941-945
96	0-5	946-950	101	0-5	951-955
97	0-5	956-960	102	0-5	961-965
98	0-5	966-970	103	0-5	971-975
99	0-5	976-980	104	0-5	981-985
100	0-5	986-990	105	0-5	991-995
101	0-5	996-1000	106	0-5	1001-1005
102	0-5	1006-1010	107	0-5	1011-1015
103	0-5	1016-1020	108	0-5	1021-1025
104	0-5	1026-1030	109	0-5	1031-1035
105	0-5	1036-1040	110	0-5	1041-1045
106	0-5	1046-1050	111	0-5	1051-1055
107	0-5	1056-1060	112	0-5	1061-1065
108	0-5	1066-1070	113	0-5	1071-1075
109	0-5	1076-1080	114	0-5	1081-1085
110	0-5	1086-1090	115	0-5	1091-1095
111	0-5	1096-1100	116	0-5	1101-1105
112	0-5	1106-1110	117	0-5	1111-1115
113	0-5	1116-1120	118	0-5	1121-1125
114	0-5	1126-1130	119	0-5	1131-1135
115	0-5	1136-1140	120	0-5	1141-1145
116	0-5	1146-1150	121	0-5	1151-1155
117	0-5	1156-1160	122	0-5	1161-1165
118	0-5	1166-1170	123	0-5	1171-1175
119	0-5	1176-1180	124	0-5	1181-1185
120	0-5	1186-1190	125	0-5	1191-1195
121	0-5	1196-1200	126	0-5	1201-1205
122	0-5	1206-1210	127	0-5	1211-1215
123	0-5	1216-1220	128	0-5	1221-1225
124	0-5	1226-1230	129	0-5	1231-1235
125	0-5	1236-1240	130	0-5	1241-1245
126	0-5	1246-1250	131	0-5	1251-1255
127	0-5	1256-1260	132	0-5	1261-1265
128	0-5	1266-1270	133	0-5	1271-1275
129	0-5	1276-1280	134	0-5	1281-1285
130	0-5	1286-1290	135	0-5	1291-1295
131	0-5	1296-1300	136	0-5	1301-1305
132	0-5	1306-1310	137	0-5	1311-1315
133	0-5	1316-1320	138	0-5	1321-1325
134	0-5	1326-1330	139	0-5	1331-1335
135	0-5	1336-1340	140	0-5	1341-1345
136	0-5	1346-1350	141	0-5	1351-1355
137	0-5	1356-1360	142	0-5	1361-1365
138	0-5	1366-1370	143	0-5	1371-1375
139	0-5	1376-1380	144	0-5	1381-1385
140	0-5	1386-1390	145	0-5	1391-1395
141	0-5	1396-1400	146	0-5	1401-1405
142	0-5	1406-1410	147	0-5	1411-1415
143	0-5	1416-1420	148	0-5	1421-1425
144	0-5	1426-1430	149	0-5	1431-1435
145	0-5	1436-1440	150	0-5	1441-1445
146	0-5	1446-1450	151	0-5	1451-1455
147	0-5	1456-1460	152	0-5	1461-1465
148	0-5	1466-1470	153	0-5	1471-1475
149	0-5	1476-1480	154	0-5	1481-1485
150	0-5	1486-1490	155	0-5	1491-1495
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152	0-5	1506-1510	157	0-5	1511-1515
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154	0-5	1526-1530	159	0-5	1531-1535
155	0-5	1536-1540	160	0-5	1541-1545
156	0-5	1546-1550	161	0-5	1551-1555
157	0-5	1556-1560	162	0-5	1561-1565
158	0-5	1566-1570	163	0-5	1571-1575
159	0-5	1576-1580	164	0-5	1581-1585
160	0-5	1586-1590	165	0-5	1591-1595
161	0-5	1596-1600	166	0-5	1601-1605
162	0-5	1606-1610	167	0-5	1611-1615
163	0-5	1616-1620	168	0-5	1621-1625
164	0-5	1626-1630	169	0-5	1631-1635
165	0-5	1636-1640	170	0-5	1641-1645
166	0-5	1646-1650	171	0-5	1651-1655
167	0-5	1656-1660	172	0-5	1661-1665
168	0-5	1666-1670	173	0-5	1671-1675
169	0-5	1676-1680	174	0-5	1681-1685
170	0-5	1686-1690	175	0-5	1691-1695
171	0-5	1696-1700	176	0-5	1701-1705
172	0-5	1706-1710	177	0-5	1711-1715
173	0-5	1716-1720	178	0-5	1721-1725
174	0-5	1726-1730	179	0-5	1731-1735
175	0-5	1736-1740	180	0-5	1741-1745
176	0-5	1746-1750	181	0-5	1751-1755
177	0-5	1756-1760	182	0-5	1761-1765
178	0-5	1766-1770	183	0-5	1771-1775
179	0-5	1776-1780	184	0-5	1781-1785
180	0-5	1786-1790	185	0-5	1791-1795
181	0-5	1796-1800	186	0-5	1

1. General critical care in severe AIS patients

AHA/ASA Guideline

Guidelines for the Early Management of Patients With Acute Ischemic Stroke: 2019 Update to the 2018 Guidelines for the Early Management of Acute Ischemic Stroke
A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

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Airway, Breathing, and Oxygenation

1. Airway support and ventilatory assistance are recommended for the treatment of patients with acute stroke who have decreased consciousness or who have bulbar dysfunction that causes compromise of the airway.	I	C-E0	Recommendation and COR unchanged from 2013 AIS Guidelines. LOE amended to conform with ACC/AHA 2015 Recommendation Classification System.
2. Supplemental oxygen should be provided to maintain oxygen saturation $\geq 94\%$.	I	C-L0	Recommendation and COR unchanged from 2013 AIS Guidelines. LOE amended to conform with ACC/AHA 2015 Recommendation Classification System.

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Neurocritical care airway

- Indications for intubation in the neurocritically ill patients

- Failure of oxygenation (type 1 respiratory failure) = $\text{SaO}_2 \downarrow$
- Failure of ventilation (type 2 respiratory failure) = $\text{PaCO}_2 \uparrow$
- Failure to maintain airway

→ respiratory arrest !!

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Failure of ventilation in neurocritical ill patients

- Injury to the lower pons or medulla (respiratory center)
- Elevated ICP (especially in the posterior fossa)
- Uncontrolled seizures

→ unstable central ventilatory drive

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Failure to maintain airway in neurocritical ill patients

- Unfavorable oropharyngeal anatomy
- Severe bulbar dysfunction (brainstem compromise)
- Large-volume aspiration (food, secretions, gastric contents)

→ impaired airway

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Semiquantitative Assessment of Need for Airway Care

Spontaneous Cough		Gag		Sputum Quantity	
0	Vigorous	0	Vigorous	0	None
1	Moderate	1	Moderate	1	1 pass
2	Weak	2	Weak	2	2 passes
3	None	3	None	3	≥ 3 passes

Sputum Viscosity		Suctioning Frequency (last 8 h)		Sputum Character	
0	Watery	0	> 3 h	0	Clear
1	Frothy	1	2-3 h	1	Tan
2	Thick	2	1-2 h	2	Yellow
3	Tenacious	3	< 1 h	3	Green

(Adapted with permission from Coplin WM, Pierson DJ, Cooley KD, Newell DW, Rubenfeld GD. Implications of extubation delay in brain-injured patients meeting standard weaning criteria. Am J Respir Crit Care Med. 2000;161(5):1530-1536. Copyright © American Thoracic Society)

ACS ≥ 10 "poor airway function"

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Blood pressure

1. Hypertension and hypotension should be corrected to maintain systemic perfusion levels necessary to support organ function.	I	C-ED	New recommendation.
The blood pressure (BP) level that should be maintained in patients with AIS to ensure the best outcome is not known. Some observational studies show an association between worse outcomes and lower BP, whereas others have not. ¹¹⁻¹³ No studies have addressed the treatment of low BP in patients with stroke. In a systematic analysis of 12 studies comparing the use of IV colloids and crystalloids, the odds of death or dependence were similar. Clinically important benefits or harms could not be excluded. There are no data to guide volume and duration of parenteral fluid delivery. ¹⁴ No studies have compared different isotonic fluids.			See Table XXX in online Data Supplement 1.
2. Patients who have elevated BP and are otherwise eligible for treatment with IV alteplase should have their BP carefully lowered so that their SBP is <185 mmHg and their diastolic BP is <110 mmHg before IV alteplase therapy is initiated.	I	B-NR	Recommendation revised for clarity from 2013 AIS Guidelines. COR unchanged. LOE amended to conform with ACC/AHA 2015 Recommendation Classification System. See Table XCV in online Data Supplement 1 for original wording.
The NCTs of IV alteplase required the BP to be <185 mmHg systolic and <110 mmHg diastolic before treatment and <180/105 mmHg for the first 24 hours after treatment. Options to treat arterial hypertension in patients with AIS who are candidates for immediate reperfusion therapy are given in Table 5. Some observational studies suggest that the risk of hemorrhage after administration of alteplase is greater in patients with higher BP ¹⁵⁻¹⁷ and in patients with more BP variability. ¹⁸ The exact BP at which the risk of hemorrhage after IV alteplase increases is unknown. It is thus reasonable to target the BP used in the NCTs of IV alteplase.			See Tables XX and XXX in online Data Supplement 1.

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Blood pressure(2)

4. The usefulness of drug-induced hypertension in patients with AIS is not well established.

IIb	B-R	Recommendation and COR unchanged from 2013 AIS Guidelines. LOE amended to conform with ACC/AHA 2015 Recommendation Classification System.
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SETIN-HYPERTENSION 2019

NIHSS 4-18
No thrombolysis
Progressive stroke

A. NIHSS score, days 0-7

Induced hypertension	Control
Patients (%)	Patients (%)
Improvement of 2 points or more	Improvement of 2 points or more
Improvement of 1 point	Improvement of 1 point
No change	No change
Worsening of 1 point or more	Worsening of 1 point or more

B. 3-month mRS

Induced hypertension	Control
Patients (%)	Patients (%)
mRS	mRS
0	0
1	1
2	2
3	3
4	4
5	5

Table 2 Safety outcomes

Variables	Control group	Intervention group	p Value
Stroke recurrence	0 (0.0)	0 (0.0)	NA
Symptomatic ICH	0 (0.0)	1 (1.3)	0.313
Symptomatic edema	0 (0.0)	1 (1.3)	0.313
Acute myocardial infarction	0 (0.0)	0 (0.0)	NA
All-cause death	0 (0.0)	1 (1.3)	0.313
ICH on follow-up MRI	0 (0.0)	5 (6.4)	0.022
Other side effect*	0 (0.0)	8 (10.5)	0.003

Abbreviations: ICH = intracerebral hemorrhage; NA = not applicable.
*Other side effect: headache n = 6, palpitation n = 1, and urticaria n = 1.

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Temperature

1. Sources of hyperthermia (temperature >38°C) should be identified and treated, and antipyretic medications should be administered to lower temperature in hyperthermic patients with stroke.	I	C-LD	Recommendation and COR unchanged from 2013 AIS Guidelines. LOE amended to conform with ACC/AHA 2015 Recommendation Classification System.
Additional support for this recommendation unchanged from the 2013 AIS Guidelines is provided by a large retrospective cohort study conducted from 2005 to 2013 of patients admitted to intensive care units in Australia, New Zealand, and the United Kingdom. Peak temperature in the first 24 hours <37°C and >39°C was associated with an increased risk of in-hospital death compared with normothermia in 5366 patients with AIS. ¹⁹			See Tables XXX and XXXX in online Data Supplement 1.
2. In patients with AIS, the benefit of treatment with induced hypothermia is uncertain.	IIb	B-R	Recommendation revised from 2013 AIS Guidelines.
To date, studies of hypothermia in AIS show no benefit in functional outcome and suggest that induction of hypothermia increases the risk of infection, including pneumonia. ¹⁹⁻²² These studies use a variety of methods to induce hypothermia and are small/underpowered, meaning that a benefit for hypothermia in AIS cannot be definitively excluded. A large phase III trial of hypothermia in AIS is ongoing.			See Tables XXXIII and XXXIV in online Data Supplement 1.

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Anticoagulants for secondary stroke prevention

3. At present, the usefulness of apixaban, dabigatran, or other thrombin inhibitors for the treatment of patients with AIS is not well established.

IIb	B-R
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Several observational studies have demonstrated the safety and feasibility of treating AIS with thrombin inhibitors as either a single or an adjunct therapy to alteplase. The first direct thrombin inhibitor dabigatran was studied in 53 patients with TIA or minor stroke (NIHSS score ≤3) with no occurrences of aICH up to 30 days.²³ APTIS (Apixaban With Recombinant Tissue Plasminogen Activator for Acute Stroke)-1 was an open-label, pilot safety study of apixaban (100 mg plus IV alteplase) in 65 patients with complete or partially occluded thrombus diagnosed by transcranial Doppler.²⁴ In the APTIS-2 phase II study, patients with AIS treated with dabigatran (110 mg) were randomized to receive placebo or apixaban (100 mg plus alteplase), followed by infusion of either 1 (low dose) or 3 (high dose) mg/kg per minute for 48 hours. Rates of aICH were similar among the control, low-dose, and high-dose arms: 3 of 29 (10%), 4 of 30 (13%), and 2 of 31 (6%), respectively.²⁵ Further trials are necessary to clarify the safety and efficacy of this intervention.

4. The safety and usefulness of oral factor Xa inhibitors in the treatment of AIS are not well established.

IIb	C-LD
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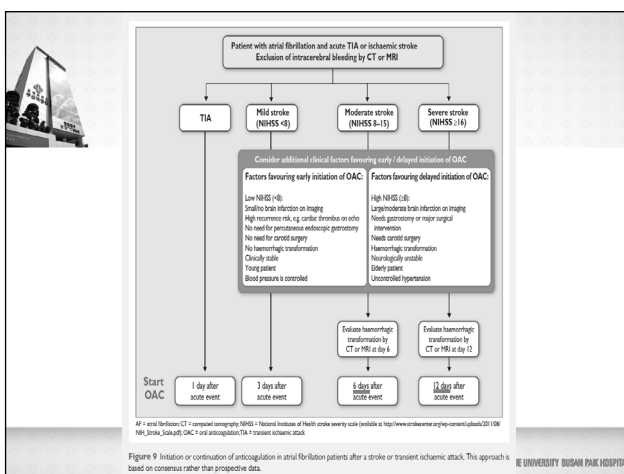
Limited data exist on the use of factor Xa inhibitors (eg, macranolam, apixaban, elonase) for treatment of patients with AIS.²⁶ Several prospective observational studies and early phase trials are ongoing (NCT02279940, NCT0242524, NCT02325294). Further clinical trials are needed.

5. Urgent anticoagulation, with the goal of preventing early recurrent stroke, halting neurological worsening, or improving outcomes after AIS, is not recommended for treatment of patients with AIS.

IIb	No Benefit	A
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Further support for this unchanged recommendation from the 2013 AIS Guidelines is provided by 2 updated meta-analyses that confirm the lack of benefit of urgent anticoagulation.^{27,28} An additional study, not included in these meta-analyses, investigated the efficacy of LMW compared with aspirin in preventing early neurological deterioration in an unblinded RCT. Although there was a statistically significant difference in early neurological deterioration at 10 days after admission (LMW, 27 [3.9%] versus aspirin, 61 [11.8%]; P=0.001), there was no difference in 6-month mRS score of 0 to 2 (LMW, 44.2% versus aspirin, 42.2%; P=0.33).

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Deep Vein Thrombosis Prophylaxis

1. In immobile stroke patients without contraindications, intermittent pneumatic compression (IPC) in addition to routine care (aspirin and hydration) is recommended over routine care to reduce the risk of deep vein thrombosis (DVT).	I	B-R	Recommendation revised from 2016 Rehab Guidelines.
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See Table LXII in online Data Supplement 1.

CLOTS 3 (CLOTS in Legs or stockings After Stroke) 3 was a multicenter trial enrolling 2867 patients in 34 centers in the United Kingdom and comparing the use of IPC with routine care and no IPC with routine care in immobile stroke patients for venous thromboembolism prophylaxis. Eligible patients were enrolled within 3 days of the acute stroke and could not mobilize to the toilet without the help of another person. Routine care was defined as the use of aspirin for nonhemorrhagic stroke, hydration, and possible compression stockings. A total of 31% of the patients received prophylactic or full-dose heparin or LMWH, but these patients were evenly distributed between both groups. After the exclusion of 323 patients who died before any primary outcome and 41 who had no screening, the primary outcome of DVT occurred in 122 of 1287 participants with IPC (9.4%) compared with 174 of 1245 participants without IPC (14.0%), giving an adjusted OR of 0.65 (95% CI, 0.51-0.84; $P=0.001$). Among patients treated with IPC, there was a statistically significant improvement in survival at 6 months (HR, 0.86 [95% CI, 0.73-0.99]; $P=0.042$) but no improvement in disability. Skin breaks were more common in the IPC group (3.1% versus 1.4%; $P=0.002$). Contraindications to IPC include leg conditions such as dermatitis, gangrene, severe edema, venous stasis, severe peripheral vascular disease, postoperative vein ligation, or grafting, as well as existing swelling or other signs of an existing DVT.²⁴ A meta-analysis including this trial and 2 smaller trials confirmed these results.²⁵

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2. Management of complication after severe AIS

- Hemorrhagic complication
- Brain swelling, edema
- Seizure

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Hemorrhagic complication

3. In otherwise eligible patients who have previously had a high burden of CMBs (>10) demonstrated on MRI, treatment with IV alteplase may be associated with an increased risk of sICH, and the benefits of treatment are uncertain. Treatment may be reasonable if there is the potential for substantial benefit.	IIb	B-AR	New recommendation.
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See Table XXI in online Data Supplement 1.

CMBs are common in patients receiving IV alteplase, occurring in 15% to 27%.⁴⁰⁻⁴² No RCTs of IV alteplase in AIS with baseline MRI to identify CMBs have been conducted, so no determination of the effect of baseline CMBs on the treatment effect of alteplase with CMBs is available. Two meta-analyses of the association of baseline CMBs on the risk of sICH after IV alteplase reported that sICH is more common in patients with baseline CMBs, whereas 2 other meta-analyses and 1 multicenter study did not.⁴⁰⁻⁴² In 2 studies using ECASS II sICH criteria, the rates in patients with CMBs were 5.8% and 6.5% compared with 5.2% in ECASS II.^{40,41} One study analyzing the risk of sICH in patients with CMBs detected after IV alteplase treatment reported sICH of 5% using the NINDS criteria compared with 6.4% in the NINDS-rPA trials.^{41,42} The risk of sICH in patients with >10 CMBs (30%-47%) is consistently reported as significantly greater than in those with no CMBs (1%-4.4%). However, these data are based on <50 patients, constituting <2% of these series.^{40,41} Meta-analysis of 4 studies that provide information on 3- to 6-month functional outcomes showed that the presence of CMBs was associated with worse outcomes after IV alteplase compared with patients without CMBs (OR, 1.58 [95% CI, 1.18-2.14]; $P=0.002$).⁴³ Thus, the presence of CMBs increases the risk of sICH and the chances of poor outcomes after IV alteplase, but it is unclear whether these negative effects fully negate the benefit of the IV alteplase. It is also unknown whether the location and number of CMBs may differentially influence outcomes. These questions deserve further investigation.

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Management of Symptomatic Intracranial Bleeding Occurring Within 24 Hours After Administration of IV Alteplase (COR IIb LOE C-EO)

- Stop alteplase infusion
- CBC, PT (INR), aPTT, fibrinogen level, and type and cross-match
- Emergent nonenhanced head CT
- Cryoprecipitate: 10 U infused over 10-30 min (onset in 1 h, peaks in 12 h); administer additional dose for fibrinogen level of <150 mg/dL
- Tranexamic acid 1000 mg IV infused over 10 min, followed by 1 g IV until bleeding is controlled (peak onset in 3 h)
- Hematology and neurosurgery consultations
- Supportive therapy, including BP management, ICP, CPP, MAP, temperature, and glucose control

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Hemorrhagic transformation

A Hemorrhagic infarction - 1	Isolated petechial staining of infarcted tissue without mass effect
B Hemorrhagic infarction - 2	Onfuent patches in infarcted tissue without mass effect
C Parenchymal Hemorrhage - 1	Homogeneous high attenuation lesion with minimal mass effect occupying less than 30% of the infarcted area
D Parenchymal Hemorrhage - 2	Lesion occupying more than 30% of the infarcted area with definite mass effect Possible extension of hemorrhage into the ventricular space, As well as any hemorrhage outside the infarcted area

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Hemorrhagic transformation

1. For patients with AIS and HT, initiation or continuation of antiplatelet or anticoagulation therapy may be considered, depending on the specific clinical scenario and underlying indication.	IIb	C-LO	Recommendation revised from 2014 Secondary Prevention.
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See Table U in online Data Supplement 1.

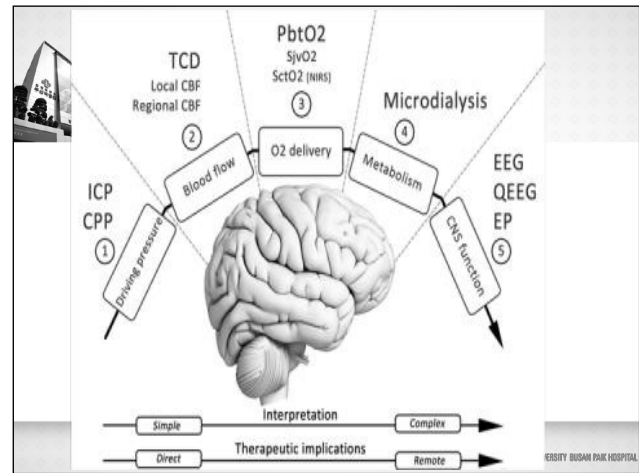
Several observational studies suggest that antithrombotics can be safely initiated or continued in patients with AIS and HT. In a prospective, open-label study of 60 patients with atrial fibrillation and either mild to moderate AIS with an NRS score <9 (n=45) or TA (n=11) who were treated with rivaroxaban within 14 days of onset, 50 were available for follow-up at 7 days after drug initiation. None developed symptomatic HT. Of the 23 with AIS who had HT at baseline, 5 demonstrated asymptomatic radiographic progression, and 18 showed neither clinical nor radiographic progression. Of the remaining 27 who did not have HT at baseline, 3 developed asymptomatic HT.⁷⁷ A retrospective stroke registry analysis identified 222 patients with AIS and HT. The frequency of composite events (neurological deterioration, vascular events, and death) at 1 month was significantly lower in patients treated with antithrombotics compared with those who were not (1.6% versus 11.1%; $P=0.041$). Neither antiplatelet (n=72) nor anticoagulant (n=28) treatment after HT was associated with enlargement of the original HT or development of new HT or neurological deterioration.⁷⁸ Individual assessment of the clinical indication, benefits, and associated risks is warranted.^{13,24,79}

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Brain swelling

1. Patients with large territorial cerebral and cerebellar infarctions are at high risk for developing brain swelling and herniation. Discussion of care options, and possible outcomes should take place quickly with patients (if possible) and family or next of kin. Medical professionals and caregivers should ascertain and include patient-centered preferences in shared decision-making, especially during prognosis formation and when considering interventions or limitations in care.	I	C-E0	New recommendation.
Brain swelling can cause serious and even life-threatening complications in patients with large territorial cerebral and cerebellar infarctions. Although less severe swelling can be managed medically, surgical treatment may be the only effective option for very severe cases; in such instances, timely decompressive surgery has been shown to reduce mortality. ²⁴⁰ Nevertheless, there is evidence that persistent morbidity is common, and individual preexisting decisions about end-of-life and degree of treatment performed in the face of severe neurological injury must be considered.			See Tables LXX and LXXI in online Data Supplement 1.
2. Measures to lessen the risk of swelling and close monitoring of the patient for signs of neurological worsening during the first days after stroke are recommended. Early transfer of patients at risk for malignant brain swelling to an institution with appropriate neurosurgical expertise should be considered.	I	C-LD	Recommendation reworded for brevity and consistency from 2013 AIS Guidelines. LOE revised. See Table XCV in online Data Supplement 1 for original wording.

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ICP - Noninvasive

- Automated Pupillometry
- Integrate, consistent light source
- Neurological Pupil index(NPi)
 - Calculated by a proprietary algorithm

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Pupillometer(NPi)

Table 2. A list of pupil size variables measured by the pupillometer and their corresponding descriptions

Variable reported by pupillometer	Unit of measure	Definition
Pupil Max Size	mm	The minimum pupil size is the pupil size at the peak of the constriction. Maximum pupil size is the initial resting pupil size, and is defined by the mean pupil size during the latest period.
Constriction % or Percentage Change	%	The constriction percentage is defined as maximum size minus minimum size divided by the maximum size.
Latency	seconds	The time difference between the initiation of initial light stimulation and the onset of pupillary constriction.
Constriction Velocity	mm/sec	The amount of the constriction divided by the duration of the constriction; this results in an average velocity.
Maximum	mm/sec	The peak value of the velocity during constriction; this is larger than the previous average velocity.
Constriction Velocity	mm/sec	The amount of pupil size recovery (after the constriction) divided by the duration of the recovery.
Recovery Velocity	mm/sec	The amount of pupil size recovery (after the constriction) divided by the duration of the recovery.
NPi (Neurological Pupil index)	Scalar value	Algorithm that takes all variables above as inputs and compares to normative model to give a composite score of pupillary response

Pupil Reactivity Assessment Scale

Measured Value*	Assessment
3.0 – 4.9	Normal/“Blink”
<3.0	Abnormal/“Sluggish”
0	Non-Responsive or Atypical Response

Figure 2: Peak of ICP was defined for each single patient as the maximum event of sustained ICP. The distribution of peak of ICP varied depending on the pupillary reactivity scores. These patients with normal pupillary reactivity NPi (c4, Group 1) had the lowest ICP. Those with one or more occurrences of abnormal NPi (c3, Group 2) had a significantly larger distribution of sustained ICP (Group 3), with the highest sustained ICPs, includes those patients who developed or had occurrence of a nonresponsive pupil. Red error bars indicate 95% Confidence Interval (CI).

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Brain swelling

1. Use of osmotic therapy for patients with clinical deterioration from brain swelling associated with cerebral infarction is reasonable.	IIa	C-LD	Recommendation reworded for clarity from 2014 Brain Swelling. COR unchanged. LOE amended to conform with ACC/AHA 2015 Recommendation Classification System. See Table XCV in online Data Supplement 1 for original wording.
2. Use of brief moderate hyperventilation (P _{CO2} target, 30–34 mm Hg) is a reasonable treatment for patients with acute severe neurological decline from brain swelling as a bridge to more definitive therapy.	IIa	C-LD	New recommendation.

A single nonrandomized study of 3 days of sustained hyperventilation in AIS designed primarily to investigate physiological changes showed no difference in mortality.²⁴¹ Data on the use of hyperventilation for the management of increased intracranial pressure from patients with traumatic brain injury show a rapid reduction in intracranial pressure with return toward baseline over the next few hours.^{242–244} The only RCT of sustained hyperventilation in traumatic brain injury demonstrated that prophylactic hyperventilation for 5 days was associated with worse outcomes.²⁴⁵

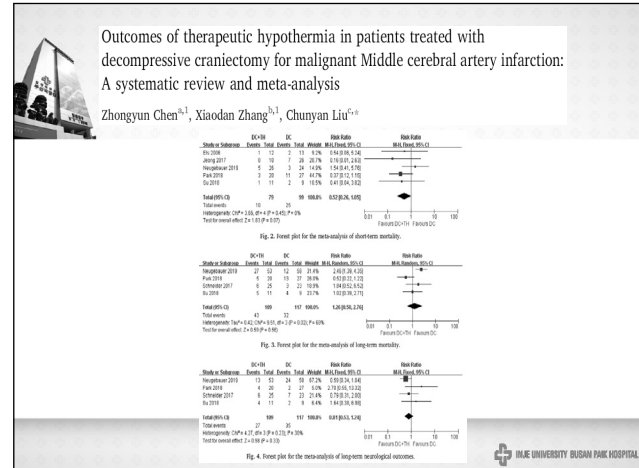
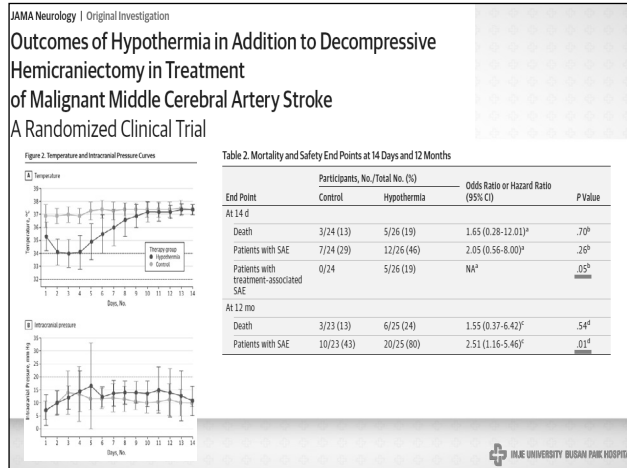
See Tables LXX and LXXII in online Data Supplement 1.

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Brain swelling

3. Hypothermia or barbiturates in the setting of ischemic cerebral or cerebellar swelling are not recommended.	III: No Benefit	B-R	Recommendation and LOE revised from 2014 Brain Swelling. COR amended to conform with ACC/AHA 2015 Recommendation Classification System.
The data on the use of hypothermia and barbiturates for the management of AIS continue to be limited. Such data include only studies with small numbers of patients and unclear timing of intervention with respect to stroke onset. Hypothermia use has recently been shown to have no impact on stroke outcomes in a meta-analysis of 6 RCTs. ²⁴⁶ Further trials are necessary to clarify the safety and efficacy of this intervention.			See Tables LXX and LXXI in online Data Supplement 1.
5.1.2. Medical Management (Continued)	COR	LOE	New, Revised, or Unchanged
4. Because of a lack of evidence of efficacy and the potential to increase the risk of infectious complications, corticosteroids (in conventional or large doses) should not be administered for the treatment of brain swelling complicating ischemic stroke.	III: Harm	A	Recommendation wording modified from 2013 AIS Guidelines to match COR III stratifications. LOE unchanged. COR amended to conform with ACC/AHA 2015 Recommendation Classification System.

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Brain swelling - Hemicraniectomy

1. Although the optimal trigger for decompressive craniectomy is unknown, it is reasonable to use a decrease in level of consciousness attributed to brain swelling as selection criteria.	IIa	A	Recommendation, COR, and LOE unchanged from 2014 Brain Swelling.
2. In patients <60 years of age who deteriorate neurologically within 48 hours from brain swelling associated with unilateral MCA infarctions despite medical therapy, decompressive craniectomy with dural expansion is reasonable.	IIa	A	Recommendation revised from 2014 Brain Swelling.
3. In patients >60 years of age who deteriorate neurologically within 48 hours from brain swelling associated with unilateral MCA infarctions despite medical therapy, decompressive craniectomy with dural expansion may be considered.	IIb	B-R	Recommendation revised from 2014 Brain Swelling.

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Evidence-Based Guidelines for the Management of Large Hemispheric Infarction

A Statement for Health Care Professionals from the Neurocritical Care Society and the German Society for Neuro-Intensive Care and Emergency Medicine

- To achieve the best neurological outcome, we recommend performing DHC within 24–48 h hours of symptom onset and prior to any herniation symptoms (*strong recommendation, moderate quality of evidence*).
- We recommend a size of 12 cm as an absolute minimum for DHC. Larger sizes of 14–16 cm seem to be associated with better outcomes (*strong recommendation, moderate quality of evidence*).

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Brain swelling - Cerebellum

1. Ventriculostomy is recommended in the treatment of obstructive hydrocephalus after cerebellar infarction. Concomitant or subsequent decompressive craniectomy may or may not be necessary on the basis of factors such as the size of the infarction, neurological condition, degree of brainstem compression, and effectiveness of medical management.	I	C-LD	Recommendation revised from 2014 Brain Swelling.
2. Decompressive suboccipital craniectomy with dural expansion should be performed in patients with cerebellar infarction causing neurological deterioration from brainstem compression despite maximal medical therapy. When deemed safe and indicated, obstructive hydrocephalus should be treated concurrently with ventriculostomy.	I	B-NR	Recommendation revised from 2014 Brain Swelling.

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Seizure

1. Recurrent seizures after stroke should be treated in a manner similar to when they occur with other acute neurological conditions, and antiseizure drugs should be selected on the basis of specific patient characteristics.	I	C-LD	Recommendation reworded for clarity from 2013 AIS Guidelines. COR unchanged. LOE amended to conform with ACC/AHA 2015 Recommendation Classification System. See Table XCV in online Data Supplement 1 for original wording.
2. Prophylactic use of antiseizure drugs is not recommended.	III: No Benefit	C-LD	Recommendation reworded for clarity from 2013 AIS Guidelines. COR and LOE amended to conform with ACC/AHA 2015 Recommendation Classification System. See Table XCV in online Data Supplement 1 for original wording.

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3. Critical care after revascularization in AIS patients

- Acute IA thrombectomy and thrombolysis
- Rescue stenting
- Carotid endarterectomy & stenting

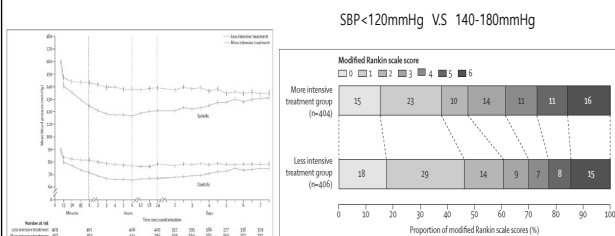


Post-IA thrombectomy management

3.7.5. Blood Pressure Management	COR	LOE	New, Revised, or Unchanged
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.	Ia	B-NR	New recommendation.
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	New recommendation.



Intensive blood pressure control after endovascular thrombectomy for acute ischaemic stroke (ENCHANT2/MT): a multicentre, open-label, blinded-endpoint, randomised controlled trial



Outcome in Patients Treated with Intra-arterial thrombectomy: The optiMAL Blood Pressure control (OPTIMAL-BP) Trial

- Intensive SBP < 140 mmHg
- Conventional SBP 140-180 mmHg
- Stop recruitment
- Conventional > Intensive

(confidential)



Rescue stenting

- Difficulty in antiplatelet preparation
- High risk of in-stent thrombosis and re-occlusion
- Option available:
 - Preprocedural dual antiplatelet loading
 - Preprocedural high intensity statin
 - Adjuvant IA tirofiban 0.5~1mg infusion
 - Adjuvant IV tirofiban 6~24hr infusion
 - Not using alteplase(?)



Preprocedural Statin use

J Vasc Surg. 2019 Jan;69(1):112-119. doi: 10.1016/j.jvs.2018.03.424. Epub 2018 Jun 15.

Statins reduce mortality and failure to rescue after carotid artery stenting

Muhammad Rizwan¹, Muhammad Farhat², Hanaa Diakour-Ardi³, Besma Najim⁴, Wafar Althawaly⁵, Mahmoud B Matar⁶

J Clin Med. 2021 Nov; 10(21): 5147.
Published online 2021 Nov 2. doi: 10.3390/jcm10215147

Impact of Prior Statin Use on Reperfusion Rate and Stroke Outcomes in Patients Receiving Endovascular Treatment

Sang-Hwa Lee^{1,2}, Min-Uk Jang³, Yeonim Kim⁴, So Young Park⁵, Chulho Kim^{1,2}, Yoo Jin Kim¹, and Jong-Ho Sohn^{1,2,*}

No RCT in stroke
1 RCT in Coronary (ARMYDA-ACS)

Atorvastatin 80mg loading을 추천

PMCID: PMC858466
PMID: 34768673



Adjuvant IA tirofiban

Low-Dose Tirofiban Improves Functional Outcome in Acute Ischemic Stroke Patients Treated With Endovascular Thrombectomy

Wenbo Zhao, Ruwen Chen, Shiyi Shang, Chuanjie Wu, Chuanhui Li, Longfei Wu, Jun Chen, Jiangang Qian, Haijing Song, Hongqiang Zhang, Feng Ling, Yaping Wang, David Liebeskind, Wuwei Feng and Xinning Ji

Efficacy and Safety of Low-Dose Tirofiban for Acute Intracranial Atherosclerotic Stenosis Related Occlusion with Residual Stenosis after Endovascular Treatment

Adjuvant Tirofiban Injection Through Deployed Solitaire Stent As a Rescue Technique After failed Mechanical Thrombectomy in Acute Stroke

Zhenhui Yan MD*, Li Zhenhui MD*, Liang Wang MD*, Chuanjie Zhang MD*, Jianming Cao MD*, Chuanjie Zhang*, Wang Qiyu MD*, Jiaohua Xu MD*, Jin Cui MD*, Jin Zhang MD*, A. W. Chuanjie Zhang MD*, A. W.

Jiang Hui Xu MD*, Han Wang MD*, Song Tiao Kim MD*, Eun-Gye Kim MD*

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Adjuvant IV tirofiban

Safety of bridging antiplatelet therapy with the gpIIb-IIIa inhibitor tirofiban after emergency stenting in stroke

John-H Lee, Michael Glem, Gieble Gerdas, Bernd Turawski, Marius Kachner, Bastian Kraus, Hans-Peter Hartung, Sebastian Jander

Intravenous Tirofiban Infusion After Angioplasty and Stenting in Intracranial Atherosclerotic Stenosis-Related Stroke

Byung Hyun Baik, Woong Yoon, Yan Young Lee, Seul Kee Kim, Joon-Tae Kim and Man Seok Park

Acute Stenting and Concomitant Tirofiban Administration for the Endovascular Treatment of Acute Ischemic Stroke Related to Intracranial Artery Dissections: A Single Center Experience and Systematic Review of the Literature

Charmarco Bernava, MD, A. B. Torslein R. Meiling, MD, Andrea Rossi, MD, Karl-Clod Lovblad, MD, Zolt Kulcsar, MD, Paolo Machi, MD, PhD, Show all authors

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Adjuvant IV tirofiban

- Loading dose 10microgram/kg for 10 min
- Maintenance dose 0.1microgram/kg/min for 6 or 12 or 24hrs
- Consider oral antiplatelet overlapping

Another protocol :

0.4-0.5 mg/h for 24hrs

0.2-0.25 mg/h for 12-24hr

....

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Monitoring of in-stent thrombosis

- Brain imaging (CTA or MRA)
- TCD
- TCCS (transcranial color-coded sonography)
- Bedside carotid duplex ultrasound

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Transcranial color-coded duplex sonography (TCCS)

- CBF & ICP evaluation via doppler mode (pulse wave or color)
- Structural evaluation via B-mode

TCD

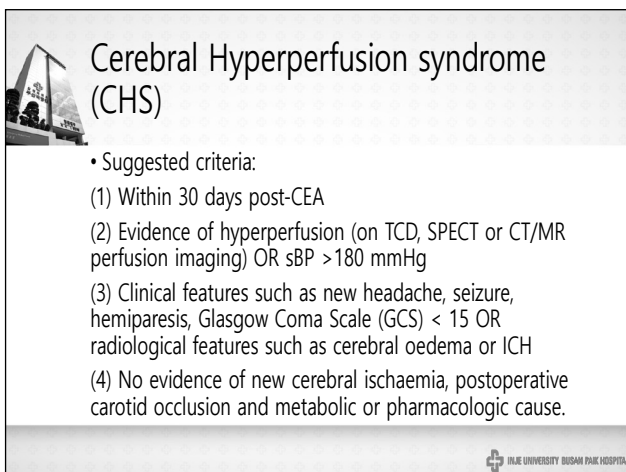
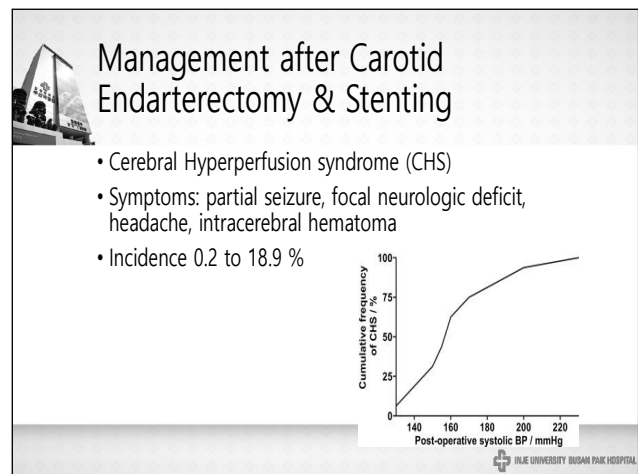
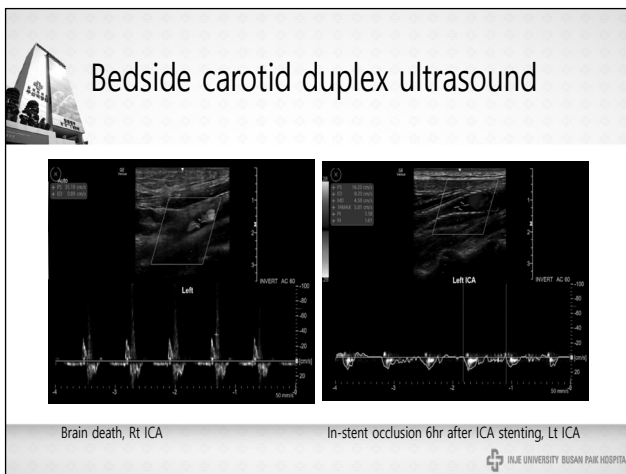
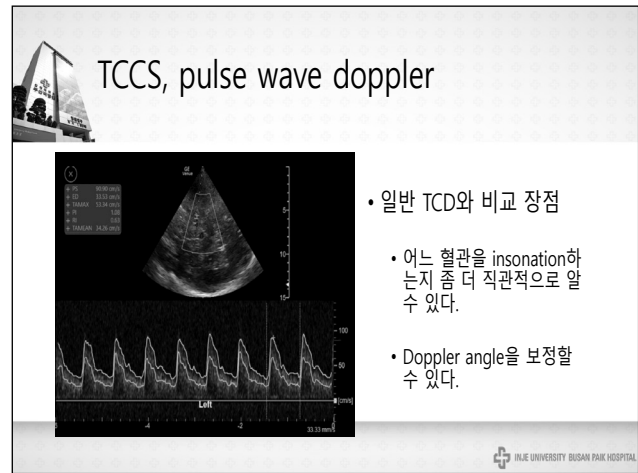
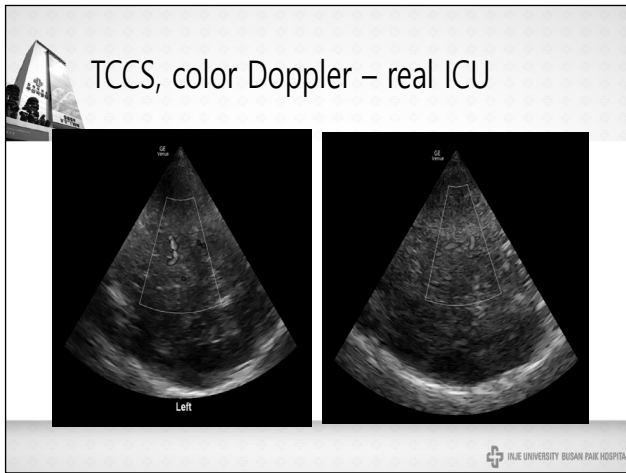
TCCS

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TCCS insonation

Low frequency probe (2~4MHz) for bone penetration

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2023

**뇌졸중 재개통 심포지엄 (ARCS) 및
대한뇌혈관내치료의학회
춘계보수교육**

- New Era of Endovascular Stroke Treatment -

Session V

Role of IV Thrombolysis in the New Era of Endovascular Stroke Treatment

좌장: 박석규 (순천향대), 진성철 (인제대)

Alteplase is better?

Tenecteplase is better?

김형찬 (인제대 해운대백병원 신경과)

반승필 (서울대)

Alteplase is better?

김 형 찬

인제대 해운대백병원 신경과

Role of IV Thrombolysis in the New Era of Endovascular Stroke Treatment - Alteplase is better?

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IV thrombolysis in AHA/ASA guideline

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3.5.1. General Principles	COR	LOE
1. In patients eligible for IV alteplase, benefit of therapy is time dependent, and treatment should be initiated as quickly as possible.	I	A
2. In patients undergoing thrombolytic therapy, physicians should be prepared to treat potential emergent adverse effects, including bleeding complications and angioedema that may cause partial airway obstruction.	I	B-MD

3.5.2. Time Windows	COR	LOE
1. In alteplase 0.9 mg/kg, maximum dose 90 mg over 60 minutes with initial 10% of dose given as bolus over 1 minute) is recommended for selected patients who can be treated within 3 hours of ischemic stroke symptom onset or patient last known well or at baseline state. Physicians should review the criteria outlined in Table 6 to determine patient eligibility.	I	A
2. In alteplase 0.9 mg/kg, maximum dose 90 mg over 60 minutes with initial 10% of dose given as bolus over 1 minute) is also recommended for selected patients who can be treated within 3 and 4.5 hours of ischemic stroke symptom onset or patient last known well or at baseline state. Physicians should review the criteria outlined in Table 6 to determine patient eligibility.	I	B-R
3. In alteplase 0.9 mg/kg, maximum dose 90 mg over 60 minutes with initial 10% of dose given as bolus over 1 minute) administered within 4.5 hours of stroke symptom recognition can be beneficial to patients with AIS who awake with stroke symptoms or have vascular time of onset >4.5 hours from last known well or at baseline state and who have a DW-MRI lesion smaller than one-third of the MCA territory and no visible signal change on FLAIR.	IIIa	B-R

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

IV thrombolysis in AHA/ASA guideline

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3.6. Other IV Fibrinolytics and Sonothrombolysis	COR	LOE
1. It may be reasonable to choose tenecteplase (single IV bolus of 0.25-mg/kg, maximum 25 mg) over IV alteplase in patients without contraindications for IV fibrinolysis who are also eligible to undergo mechanical thrombectomy.	IIb	B-R
2. Tenecteplase administered as a 0.4-mg/kg single IV bolus has not been proven to be superior or noninferior to alteplase but might be considered as an alternative to alteplase in patients with minor neurological impairment and no major intracranial occlusion.	IIb	B-R

Tenecteplase

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Tenecteplase

Metalyse 250

Pre-TNK period: 58:00

Post-TNK period: 41:00

Door-to-needle (alteplase)

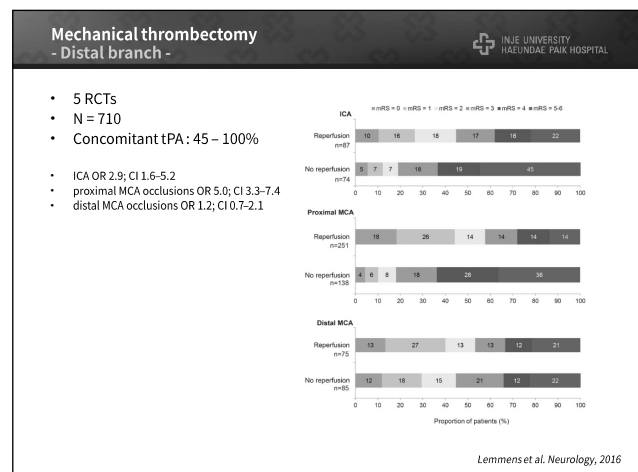
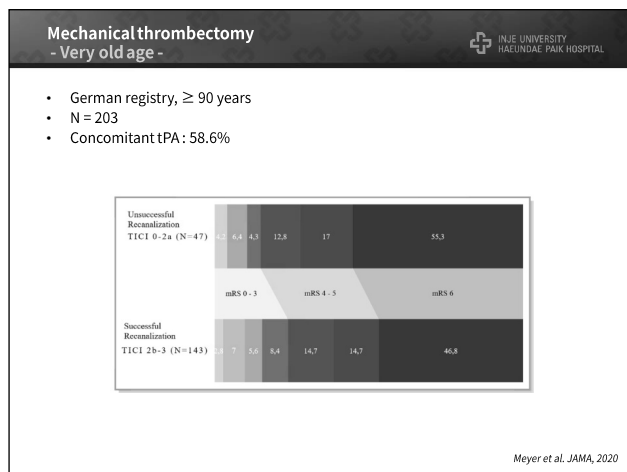
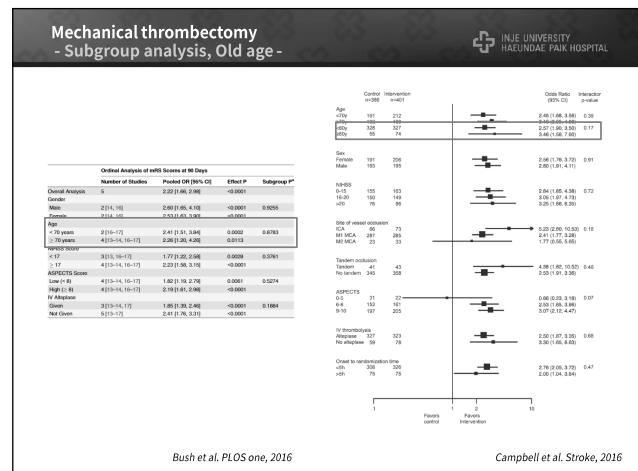
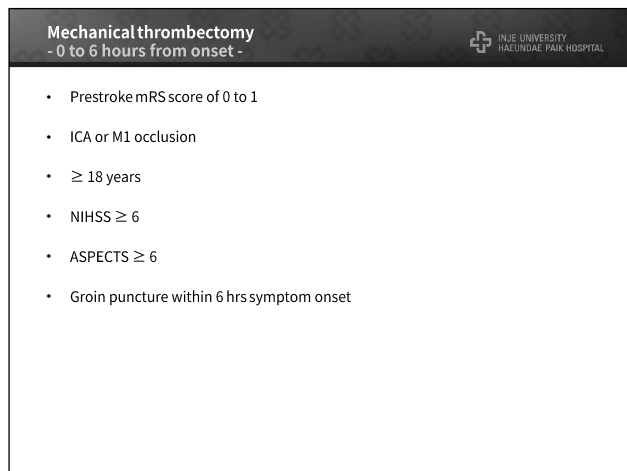
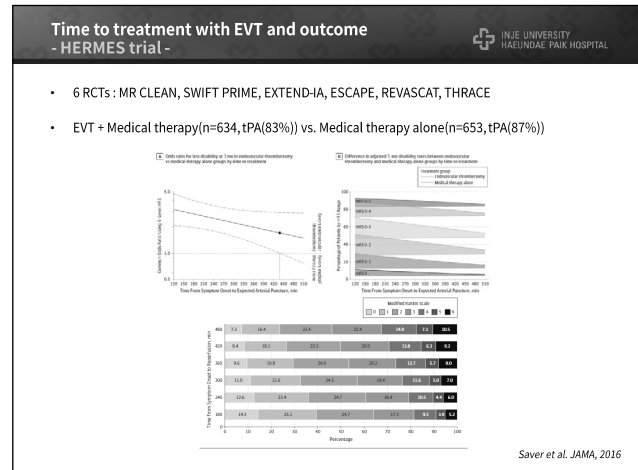
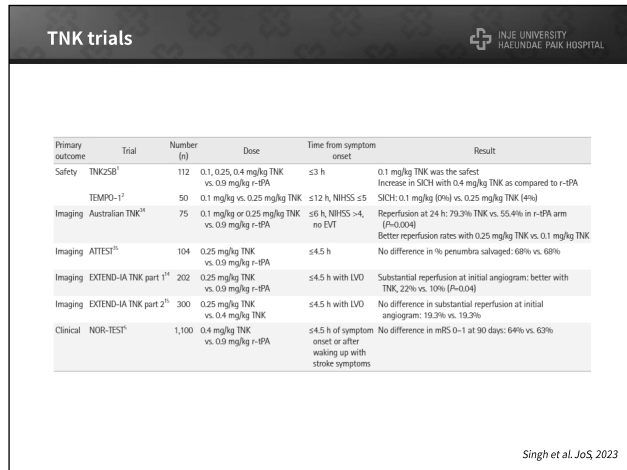
Door-to-needle (tenecteplase)

NO change in door-to-needle for rapid

NO change in door-to-puncture for UVO

CONCLUSION
Ease of TNK administration expedited acute stroke treatment

Hall et al. Stroke, 2021



Session V. Role of IV Thrombolysis in the New Era of Endovascular Stroke Treatment

"To tPA or Not to tPA, That Is the Question."



- Pros
 - Recanalization without the need for mechanical thrombectomy
 - May enhance the success of thrombectomy
 - May making clot extraction easier and lysing smaller fragment
 - May prevent microvascular thrombosis
 - Offers a chance : unable to MT, incomplete recanalization
- Cons
 - Limited efficacy in the presence of LVO (8-32%)
 - Produce delay
 - Potential for hemorrhage
 - No clear clinical benefit or harm

Leslie-Mazwi et al. AJNR, 2017

Mechanical thrombectomy ± tPA



- Retrospective study
- N = 250, 2012-2013

Table 3 Treatment details, complications and clinical outcomes

	Patients with MT and no tPA (n=152)	Patients with MT and tPA (n=98)	Patients with MT alone with contraindications for tPA (n=75)	P Value
Symptom-to-groin puncture time* (min), median (IQR)	239 (199-299)	210 (175-238)	183 (152-225)	<0.001
First imaging to groin puncture time (min), median (IQR)	148 (122-167)	112 (89-158)	85 (71-141)	0.022
Symptom-onset to thrombectomy time* (min), median (IQR)	298 (233-378)	272 (193-401)	221 (169-294)	<0.001
Successful recanalization (TICI score 2b/3), n (%)	76 (50.8)	106 (73.1)	52 (74.3)	0.006
30-day mortality, n (%)	1 (0.7)	2 (2.0)	2 (2.7)	0.857
30-day mRS, median (IQR)	5 (5-7)	5 (5-6)	5 (5-6)	0.684
30-day functional independence, n (%)	7 (4.6)	12 (12.5)	11 (14.7)	0.364
30-day modified Rankin Scale, n (%)	3 (1.9)	4 (4.1)	3 (4.0)	0.331
30-day mortality, n (%)	2 (1.3)	2 (2.0)	2 (2.7)	0.976
30-day mRS, n (%)	6 (3.9)	11 (11.5)	11 (14.7)	0.364
Any CTE, n (%)	18 (11.8)	22 (22.5)	9 (12.0)	0.405
30-day mortality, n (%)	3 (1.9)	5 (5.0)	3 (4.0)	0.331

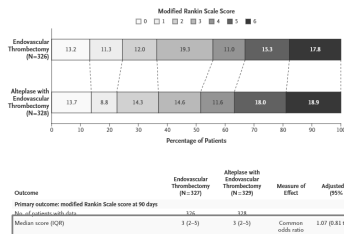
- Limitations
- Long term functional outcome
 - Selection bias (± tPA)
 - Heterogeneous patients group

Weber et al. J Neurointerv Surg, 2017

Mechanical thrombectomy ± tPA - DIRECT MT -



- Anterior circulation LVO, NIHSS ≥ 2
- N=656



p for noninferiority = .04

Yang et al. NEJM, 2020

Mechanical thrombectomy ± tPA - DEVT trial -



- Anterior circulation LVO, eligible for IVT
- N = 234 (Sample size : 918)

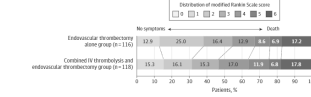


Table 3. Safety End Points*

End Point	EVT alone (n=116)	Alteplase followed by EVT (n=110)	Odds Ratio (95% CI)
Any intracranial hemorrhage - no (total n=234)	42 (36.2)	42 (38.2)	1.13 (0.82-1.58)
Any intracranial hemorrhage - yes (total n=234)	42 (36.2)	42 (38.2)	1.13 (0.82-1.58)
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Any intracranial hemorrhage - yes (total n=234)	42 (36.2)	42 (38.2)	1.13 (0.82-1.58)

Ziet et al. JAMA, 2021

Mechanical thrombectomy ± tPA - SKIP trial -



- Anterior circulation LVO, NIHSS ≥ 6
- N = 204
- tPA: 0.6mg/kg

Table 3. Safety End Points*

End Point	EVT alone (n=102)	Alteplase followed by EVT (n=102)	Odds Ratio (95% CI)
Any intracranial hemorrhage - no (total n=204)	42 (41.2)	42 (41.2)	1.13 (0.82-1.58)
Any intracranial hemorrhage - yes (total n=204)	42 (41.2)	42 (41.2)	1.13 (0.82-1.58)
Any intracranial hemorrhage - yes (total n=204)	42 (41.2)	42 (41.2)	1.13 (0.82-1.58)
Any intracranial hemorrhage - yes (total n=204)	42 (41.2)	42 (41.2)	1.13 (0.82-1.58)
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Any intracranial hemorrhage - yes (total n=204)	42 (41.2)	42 (41.2)	1.13 (0.82-1.58)
Any intracranial hemorrhage - yes (total n=204)	42 (41.2)	42 (41.2)	1.13 (0.82-1.58)
Any intracranial hemorrhage - yes (total n=204)	42 (41.2)	42 (41.2)	1.13 (0.82-1.58)
Any intracranial hemorrhage - yes (total n=204)	42 (41.2)	42 (41.2)	1.13 (0.82-1.58)

Suzuki et al. JAMA, 2021

Mechanical thrombectomy ± tPA - MR CLEAN-NO IV -

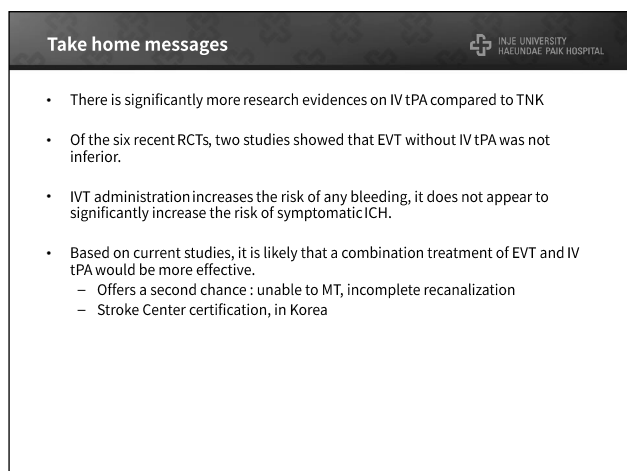
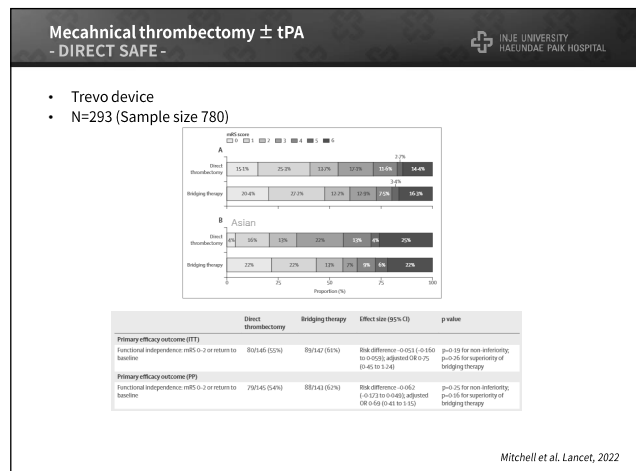
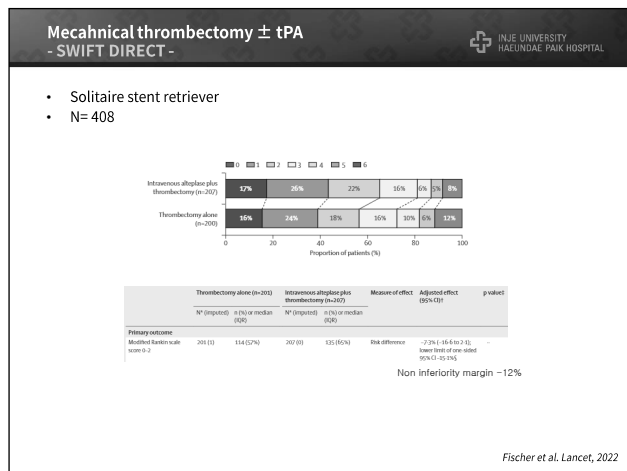
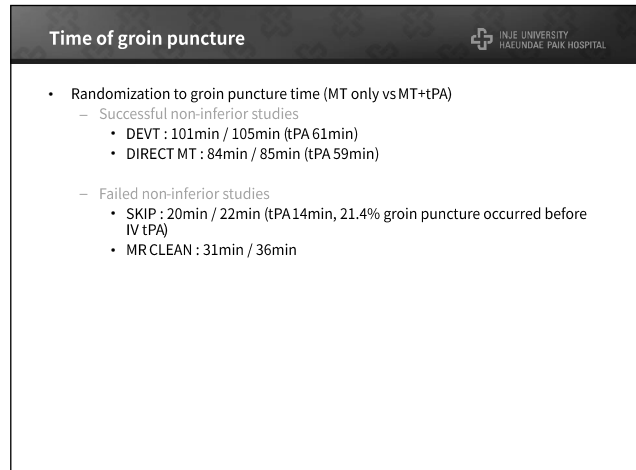
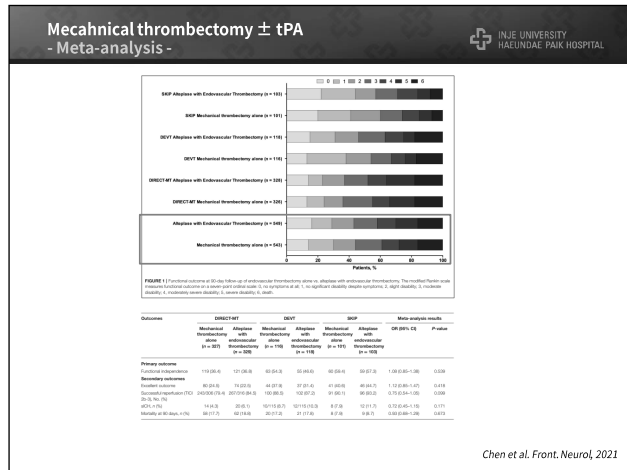


- Anterior circulation LVO, NIHSS ≥ 2
- N = 539

Table 3. Safety End Points*

End Point	EVT alone (n=270)	Alteplase followed by EVT (n=269)	Odds Ratio (95% CI)
Any intracranial hemorrhage - no (total n=539)	42 (15.6)	42 (15.6)	1.13 (0.82-1.58)
Any intracranial hemorrhage - yes (total n=539)	42 (15.6)	42 (15.6)	1.13 (0.82-1.58)
Any intracranial hemorrhage - yes (total n=539)	42 (15.6)	42 (15.6)	1.13 (0.82-1.58)
Any intracranial hemorrhage - yes (total n=539)	42 (15.6)	42 (15.6)	1.13 (0.82-1.58)
Any intracranial hemorrhage - yes (total n=539)	42 (15.6)	42 (15.6)	1.13 (0.82-1.58)
Any intracranial hemorrhage - yes (total n=539)	42 (15.6)	42 (15.6)	1.13 (0.82-1.58)
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Any intracranial hemorrhage - yes (total n=539)	42 (15.6)	42 (15.6)	1.13 (0.82-1.58)
Any intracranial hemorrhage - yes (total n=539)	42 (15.6)	42 (15.6)	1.13 (0.82-1.58)
Any intracranial hemorrhage - yes (total n=539)	42 (15.6)	42 (15.6)	1.13 (0.82-1.58)

LeCouffe et al. NEJM, 2021



Tenecteplase is better?

반 승 필

서울대

2023 ARCS (뇌졸중 재개통 심포지엄)

Tenecteplase is better?

Seoul National University Bundang Hospital

Seung Pil Ban



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✓ Tenecteplase (Metalyse, TNKase and Elaxim)

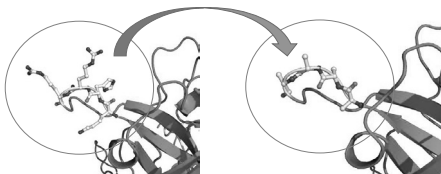
- **A single-bolus thrombolytic, or clot-busting agent**
 - an enzyme used as a thrombolytic drug
 - approved by the U.S. FDA
 - : used in mortality reduction associated with acute MI
 - recombinant DNA-derived version of naturally occurring t-PA
 - : 527 amino acid glycoprotein
 - : constructed with amino acid substitutions at 3 sites (T, N and K)

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✓ Tenecteplase (Metalyse, TNKase and Elaxim)

- Changed the amino acid at position 296-299



In human t-PA
- Lysine, Histidine, and
2 arginines

In Tenecteplase
- Replaced by 4 alanines
: increased resistance to
PAI-1

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✓ Tenecteplase (Metalyse, TNKase and Elaxim)

- **Characteristics**
 - binds to the fibrin component of the thrombus
 - : converts thrombus-bound plasminogen -> plasmin
 - => degrades the fibrin matrix of the thrombus
 - higher fibrin specificity
 - greater resistance to inactivation by its endogenous inhibitor (PAI-1)
 - prolong the half-life
 - can be given as a bolus dose than continuous infusion

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✓ Comparisons (Tenecteplase vs. Alteplase)

• Advantages of Alteplase

- extensively studied & used in clinical practice for a longer period of time compared to Tenecteplase
- : larger body of evidence to support its use / better understanding of its potential benefits & risks
- available in a number of different formulations
- : intravenous, intra-arterial, and catheter-directed
- => allows for greater flexibility in its administration

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✓ Comparisons (Tenecteplase vs. Alteplase)

• Advantages of Tenecteplase

- longer half-life compared to alteplase
- : remains in the bloodstream for a longer time (providing a more sustained effect in dissolving clots)
- more favorable safety profile compared to alteplase
- : fewer instances of major bleeding reported in clinical trials
- more effective in reopening occluded blood vessels in certain patients with AIS

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✓ Comparisons (Tenecteplase vs. Alteplase)

• Advantages of Tenecteplase

- preparation of a single bolus
- : simpler & less time consuming in an emergency setting
- : avoid the bolus-infusion delay issue that compromises therapeutic plasma concentrations of alteplase
- : avoidance of ongoing infusions
- => may reduce the need for medical supervision during transfer & improved door to needle time in hospitals

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✓ Comparisons (Tenecteplase vs. Alteplase)

• Advantages of Tenecteplase

- given as a single, 5-second IV bolus
- : requires approximately 2 minutes to mix, prepare, and administer
- ; whereas alteplase
- > require preparation of both a bolus syringe containing 10% of the weight-based dose and an IV pump set up for infusion of the remaining 90% of the dose over 60 minutes

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✓ High dose tenecteplase

• In Trials of AMI (coronary)

- 0.5 mg/kg dose of Tenecteplase
- : improve recanalization significantly prior to PCI
- : however, this came at a cost of a higher rate of major adverse events (ex, ICH)
- highest rates of ICH
- : aged > 75
- 0.25 mg/kg
- : no ICH occurred

=> on going study: 0.25 mg/kg in AMI to PCI

2006, Lancet (ASSENT-4)

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✓ Comparisons (Tenecteplase vs. Alteplase in AIS)

• Published studies

- 1st RCT of Tenecteplase
- : compared alteplase with Tenecteplase at 3 different doses
- > 0.1, 0.25, and 0.4 mg/kg
- : halted early due to funding & recruitment issues
- > low numbers recruited (0.4 mg/kg dose – discontinued after only 19 patients)
- => no firm conclusions were possible

2010, Stroke

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✓ Comparisons (Tenecteplase vs. Alteplase in AIS)

• Published studies

- 2 further Phase II trials
 - a. An Australian study
 - : compared alteplase with tenecteplase at 2 different doses
 - > 0.1 and 0.25 mg/kg
 - : patients with AIS presenting within 6 h of symptom onset and specific imaging (vessel occlusion on CTA and ischemic lesion $\geq 20\%$ greater than core lesion on CT perfusion)
 - > 0.25 mg/kg : superior to lower dose tenecteplase and to alteplase
 - => reperfusion of the ischemic lesion, clinical improvement at 24 h, and excellent recovery at 90 days

2012, NEJM

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✓ Comparisons (Tenecteplase vs. Alteplase in AIS)

• Published studies

- 2 further Phase II trials
 - b. ATTEST study
 - : compared alteplase with tenecteplase 0.25 mg/kg
 - : patients eligible for IVT presenting within 4.5 h of symptom onset
 - > no differences were found between treatments for proportion of penumbra salvaged and any other imaging or clinical outcome

2015, Lancet Neurol

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✓ Comparisons (Tenecteplase vs. Alteplase in AIS)

• Published studies

- Phase III trials
 - a. NOR-TEST study
 - : compared alteplase with tenecteplase 0.4 mg/kg
 - : patients eligible for IVT presenting within 4.5 h of symptom onset; or those presenting within 4.5 h of awakening with stroke symptoms and meeting MRI criteria for eligibility; or those eligible for IVT as a bridging therapy to mechanical thrombectomy
 - > no difference was found between groups in clinical or safety outcomes
 - ; 1100 pts recruited => large proportion of stroke mimics (17%), and the majority of pts had mild stroke (median NIHSS score of 4)

2017, Lancet Neurol

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✓ Comparisons (Tenecteplase vs. Alteplase in AIS)

• Published studies

- Phase III trials
 - b. NOR-TEST 2, part A study
 - : in recognition of the confounding issues of mild stroke (NOR-TEST)
 - : compared alteplase with tenecteplase 0.4 mg/kg
 - : patients with AIS of minimum severity (defined as NIHSS score > 5)
 - > The trial was discontinued at interim safety review
 - => 4-fold excess of symptomatic ICH was observed in the tenecteplase arm (16% tenecteplase versus 4% alteplase)

2022, Lancet Neurol

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✓ Comparisons (Tenecteplase vs. Alteplase in AIS)

• Published studies

- EXTEND IA-TNK trial
 - : patients eligible for mechanical thrombectomy within 4.5 h of symptom onset
 - > randomized to alteplase or tenecteplase 0.25 mg/kg
 - : primary outcome
 - > reperfusion of $\geq 50\%$ of the vascular territory or absence of the initial occluding thrombus
 - => more patients in the Tenecteplase (22%) than alteplase (10%) group (adjusted OR 2.6 [1.1-5.9], $p = 0.02$)
 - => no significant differences in patients achieving independent recovery (defined as mRS 0-2 at 90 days) or in early neurological improvement between groups

2018, NEJM

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✓ Comparisons (Tenecteplase vs. Alteplase in AIS)

• Published studies

- EXTEND IA-TNK trial part 2
 - : A follow-up study of EXTEND IA-TNK trial
 - : compared tenecteplase 0.25 mg and 0.4 mg/kg in a similar study design
 - => no significant differences were found in the radiological primary outcome or other clinical or safety outcomes, inferring that the 0.4 mg/kg offered no advantage over the lower 0.25 mg/kg dose in patients eligible for mechanical thrombectomy

2020, JAMA

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✓ Comparisons (Tenecteplase vs. Alteplase in AIS)

• Published studies

- TASTE-A trial
- : compared tenecteplase 0.25 mg/kg with alteplase
- : among patients treated in a mobile stroke unit setting (in Melbourne, Australia)
- > superior reperfusion in tenecteplase group

2022, JAMA

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✓ Tenecteplase: a non-inferior thrombolytics?

• Routine use of tenecteplase

- Zhong et al.
- routine use of tenecteplase compared with alteplase at 3 stroke centers in New Zealand
- : similar clinical and safety outcomes

2021, Stroke

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✓ Tenecteplase: a non-inferior thrombolytics?

• Routine use of tenecteplase

- Tenecteplase Treatment in Ischemic Stroke (TETRIS) study in France
- routine use of Tenecteplase 0.25 mg/kg within 270 minutes of LVO-AIS
- : Tenecteplase before MT is safe, effective, and achieves a fast recanalization in everyday practice in patients secondary transferred or directly admitted, in line with published results

2021, Neurology

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✓ Tenecteplase: a non-inferior thrombolytics?

• Move to adopt tenecteplase as routine thrombolytic agent of choice

- has been spurred on by the COVID-19 pandemic
- : placed unprecedented pressure on emergency departments globally
- => motivating calls for use of tenecteplase over alteplase as an easier and more quickly administered alternative

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✓ Tenecteplase: a non-inferior thrombolytics?

• ACT trial

- the first large trial comparing Tenecteplase 0.25 mg with alteplase
- : 1600 patients randomized within 4.5 h of AIS onset
- => Tenecteplase exhibited an increase in excellent recovery of 2.1% compared to alteplase, meeting the pre-specified non-inferiority margin
- => no significant differences in any outcome measure
- => large vessel occlusion, a trend towards superiority of tenecteplase was seen

2022, Lancet

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✓ Current guidelines of tenecteplase in AIS

• Disabling stroke <4.5 h

- The European Stroke Organization guidelines for IVT (2021)
- : maintained a recommendation of alteplase over tenecteplase for patients routinely eligible for IVT
- : but, recommended Tenecteplase 0.25 mg/kg over alteplase for patients receiving bridging IVT prior to mechanical thrombectomy

• 2019 update to the 2018 guidelines for the early management of AIS (AHA/ASA)

- : tenecteplase as a suitable alternative to alteplase in the pre-mechanical thrombectomy population

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✓ **Conclusions**

• **Tenecteplase**

- Pharmacological properties that suggest potential advantages over alteplase
- The dose of 0.25 mg/kg (to a maximum of 25 mg) has evidence of improved reperfusion compared to alteplase in selected patients with LVO
- Practical benefits over alteplase
 - : ease of administration by single bolus (especially advantageous in the common scenario of inter-hospital transfer)
- Guidelines did not recommended tenecteplase over alteplase for general use
 - : evidences for guidelines (prior to 2022)_3 small phase II & 1 phase III trial (NOR-TEST) => 0.4 mg/kg dose subsequently abandoned on safety grounds + larger proportion of minor strokes and stroke mimics
 - : recent data (ACT trial, 0.25 mg/kg) -> likely strengthen recommendations towards tenecteplase

2022 KoNES 정기학술대회

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Thank You !

2023

뇌졸중 재개통 심포지엄 (ARCS) 및 대한뇌혈관내치료의학회 춘계보수교육

- New Era of Endovascular Stroke Treatment -

Session VI

Primary stenting is feasible for ICAS- related Large Vessel Occlusions?

좌장: 유승훈 (울산대), 권순찬 (울산대)

Interventional Neurologist's perspective:
Rescue stenting

Endovascular Neurosurgeon's perspective:
Primary stenting

Discussion - all attendees

김용원 (경북대병원 신경과)

정영진 (영남대)

Interventional Neurologist's perspective: Rescue stenting

김 용 원

경북대병원 신경과

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**Primary stenting is feasible for ICAS-related
Large Vessel occlusion?**
Interventional Neurologist's perspective: Rescue stenting

Kyungpook National University Hospital
Department of Neurology and Cerebrovascular Center
Yong-Won, Kim



Background

Identification of ICAS related LVO during EVT

1. Determine whether a remnant focal stenosis is significant following primary thrombectomy, or spontaneous or intravenous thrombolysis induced partial recanalization.
 - It is significant if the stenotic degree is over 70%. [or]
 - It is significant if the reocclusion tendency or flow impairment seen although the stenotic degree is moderate.
2. To exclude periprocedural complications such as vessel injury or vasospasm.

Kim YW et al. ANR 2016;17:2072-2078

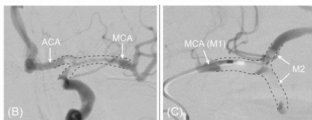
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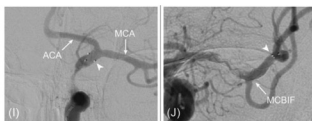
Background

Identification of ICAS related LVO during EVT

1. Occlusion type
Branching-site occlusion: involvement of bifurcation site



Truncal type occlusion: intact bifurcation and distal branches beyond occlusion



Beck JH et al. Front Neurol 2019;9:298
Beck JH et al. Neurology 2016;87:1542-1550

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Institutional Strategy

Atherosclerotic occlusion

Fast 1st recanalization

Follow up angiogram

2nd recanalization

IA tirofiban

Balloon angioplasty ± stent



Lee JS et al. Jns 2017;19:143-151
Kang DH et al. KJR 2019;20:739-748

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Institutional Strategy

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Institutional Strategy

Atherosclerotic occlusion

Fast 1st recanalization

Follow up angiogram

2nd recanalization

IA GpIIb/IIIa inhibitor

Balloon angioplasty ± stent

Lee JS et al. Jost 2017;19:143-151
Kang DH et al. KJR 2019;20:739-748

Background

Goal of ICAS related LVO in EVT

1. Reperfusion by removal of acute thrombosis
2. To prevent reocclusion by thrombosis

Characteristics of ICAS related LVO

1. Highly thrombogenic environment
- inflamed atheromatous plaque
- atheromatous plaque rupture
- endothelial irritations by EVT

Current Guidelines

Korean Clinical Practice Guidelines

- In general, intravenous glycoprotein IIb/IIIa receptor antagonists is not recommended in patients with acute ischemic stroke (LOE: Ib, GOR: A). However, intravenous and/or intra-arterial use of glycoprotein IIb/IIIa receptor antagonists can be considered in highly selected patients who require rescue therapy during mechanical thrombectomy or emergent angioplasty/stenting, taking into account benefit and risk (LOE: IV, GOR C).

1. Kim et al. J Stroke 2022;24:165-175

Session VI. Primary stenting is feasible for ICAS-related Large Vessel Occlusions?

Current Guidelines

AHA/ASA Guidelines

- The safety and efficacy of IV glycoprotein IIb/IIIa inhibitors administered during endovascular stroke treatment are uncertain. (COR 2b, LOE C-LD)
- In patients with severe stenosis (70%-99%) of a major intracranial artery and actively progressing symptoms or recurrent TIA or stroke after institution of aspirin and clopidogrel therapy, achievement of SBP <140 mm Hg, and high-intensity statin therapy, the usefulness of angioplasty alone or stent placement to prevent ischemic stroke in the territory of the stenotic artery is unknown. (COR 2b, LOE C-LD)
- In patients with stroke or TIA attributable to severe stenosis (70%-99%) of a major intracranial artery, angioplasty and stenting should not be performed as an initial treatment, even for patients who were taking an antithrombotic agent at the time of the stroke or TIA. (COR 3, LOE A)

Klinefelter et al. Stroke 2011;42:e44-e47
Powers et al. Stroke 2015;46:e44-e48

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IA tirofiban for ICAS

Instant Reocclusion following Mechanical Thrombectomy of in situ Thromboocclusion and the Role of Low-Dose Intra-Arterial Tirofiban

Dong-Hun Kang^{a,c}, Yong-Won Kim^{a,b}, Yang-Ha Hwang^b, Sung-Pa Park^b,
Yong-Sun Kim^a, Seung Kuk Baik^d

^aDepartments of Radiology, ^bNeurology and ^cNeurosurgery, Kyungpook National University Hospital, Daegu, and
^dDepartment of Radiology, Pusan National University Yangsan Hospital, Pusan, Republic of Korea

- Definition of underlying ICAS: confirmation of ICAS 5-7 days after MT on CTA or MRA

- Incidence of IST: 30.3%

- Tirofiban dosage: 0.5-1.0mg, Rate: 1ml/min

- Tirofiban failure: 14.3% (5/35)

	IST (n = 40)	Non-IST (n = 92)	p value
Mean age ± SD, years	67.15 ± 11.11	67.54 ± 10.06	0.848
Male	26 (65.0%)	46 (50.0%)	0.130
IV IPA	14 (35.0%)	47 (51.1%)	0.088
Mean baseline NIHSS score ± SD	14.55 ± 4.96	17.98 ± 4.62	<0.001
Occlusion site			0.187
Internal carotid artery	8 (20.0%)	33 (35.9%)	
Middle cerebral artery	27 (67.5%)	51 (55.4%)	
Vertebrobasilar artery	5 (12.5%)	8 (8.7%)	
Instant reocclusion during MT	26 (65.0%)	3 (3.3%)	<0.001
Mean procedural ACT ± SD, s	258.12 ± 33.26	264.03 ± 23.34	0.156
Risk factors			
Hypertension	31 (77.5%)	61 (66.3%)	0.198
Diabetes	17 (42.5%)	22 (23.9%)	0.031
Hyperlipidemia	17 (42.5%)	40 (43.5%)	0.917
Smoking	20 (50.0%)	18 (19.6%)	<0.001
Coronary heart disease	5 (12.5%)	14 (15.2%)	0.683
Atrial fibrillation	8 (20.0%)	56 (60.9%)	<0.001
Asymptomatic ICAS	20 (50.0%)	16 (17.4%)	<0.001
Asymptomatic ECAS	18 (45.0%)	19 (20.7%)	0.004
Prior antiplatelet medication	10 (25.0%)	39 (42.4%)	0.057
Prior oral anticoagulation	1 (2.5%)	10 (10.9%)	0.172
Symptomatic ICH	1 (2.5%)	5 (5.4%)	0.667
TICI 2b/3 recanalization	32 (80.0%)	77 (83.7%)	0.607
mRS score 0-2 at 3 months	26 (65.0%)	54 (67.5%)	0.496

Kang DH, Kim YW et al. Cerebrovasc Dis 2014;37:558-565

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IA tirofiban for ICAS

RESEARCH ARTICLE

Open Access

Local tirofiban infusion for remnant stenosis in large vessel occlusion: tirofiban ASSIST study

Yong-Won Kim¹, Sung-Il Sohn², Joonsang Yoo^{2,3}, Jeong-Ho Hong², Chang-Hyun Kim⁴, Dong-Hun Kang⁴,
Yong-Sun Kim⁵, Seong-Joon Lee⁶, Ji Man Hong⁷, Jin Wook Choi⁸, Yang-Ha Hwang⁹ and Jin Soo Lee¹⁰ *

- Definition of underlying ICAS:
Presence of residual stenosis over 70%
Reocclusion tendency or flow impairment with residual stenosis less than 70%
- Incidence of ICAS related LVO: 19.1% (118/619)
- Tirofiban dosage: 0.5-2.0mg, Rate: 1ml/min
- Tirofiban failure: 13.6% (8/59)

Kim YW et al. BMC Neurology 2020;20:244

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IA tirofiban for ICAS

	Non-tirofiban group (n = 59)	Tirofiban group (n = 58)	P value
Onset-to-procedure time	275 (210-462)	396 (274-568)	0.036
Puncture-to-final angiography time	81 (60-101)	65 (42-108)	0.064
Onset-to-reperfusion time	380 (298-446)	467 (345-475)	0.066
First-line endovascular treatment			0.096
Aspiration thrombectomy	29 (49.2%)	33 (56.9%)	
Stent retriever	23 (39.0%)	25 (42.4%)	
Local fibrinolytics	1 (1.7%)	1 (1.7%)	
Angioplasty	4 (6.8%)	0	
Immediate reocclusion after first endovascular method	10 (17.0%)	24 (41.4%)	0.006
Degree of residual stenosis prior to rescue treatment (%)	80 (71-86)	83 (79-90)	0.056
Rescue treatments			
Local tirofiban infusion only	0	48 (81.4%)	<0.001
Stent retriever to aspiration	1 (1.7%)	0	>0.999*
Aspiration to stent retriever	8 (13.6%)	3 (5.1%)	0.113
Intracranial balloon angioplasty	9 (15.3%)	2 (3.4%)	0.027
Intracranial stenting	12 (20.3%)	6 (10.2%)	0.124
Final mTICI 2b-3	25 (42.4%)	51 (86.4%)	0.016
Postprocedural reocclusion	12 (37.5%, n = 32)	2 (4.4%, n = 45)	<0.001
PI type 1	3 (5.1%)	1 (1.7%)	
PI type 2	4 (6.8%)	3 (5.1%)	
Subarachnoid hemorrhage	6 (10.2%)	0	0.027*
Intraventricular hemorrhage	8 (13.6%)	1 (1.7%)	0.032*
Serious hemorrhagic complication*	9 (15.3%)	3 (5.1%)	0.068
Final infarct volume, ml (median, IQR)	38.8 (14.3-62.7)	185 (7.9-37.2)	0.023
mRS 0-2 at 3 months	19 (32.2%)	31 (53.5%)	0.025
Mortality	12 (20.3%)	4 (6.9%)	0.031

Kim YW et al. BMC Neurology 2020;20:244

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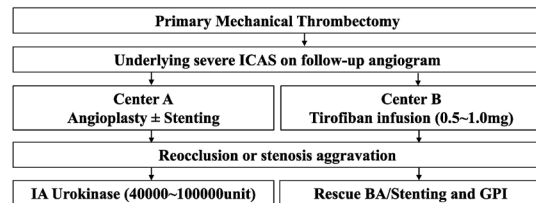
IA tirofiban/Rescue stenting for ICAS

CLINICAL ARTICLE

Endovascular treatment for emergent large vessel occlusion due to severe intracranial atherosclerotic stenosis

Dong-Hun Kang, MD,^{1,*} Woong Yoon, MD, PhD,² Seul Kee Kim, MD, PhD,³ Byung Hyun Baek, MD,²
Yun Young Lee, MD,² Yong-Won Kim, MD,² Yong-Sun Kim, MD, PhD,⁴ Yang-Ha Hwang, MD, PhD,⁵
Joon-Tae Kim, MD, PhD,⁶ and Man Seok Park, MD, PhD⁶

EVT strategy



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IA tirofiban/Rescue stenting for ICAS

Intracranial Angioplasty/Stenting Vs. IA-tirofiban

Variable	Center A (n = 72)	Center B (n = 68)	p Value
Site of occlusion, n (%)			
Middle cerebral artery	41 (56.9)	46 (67.6)	0.192
Internal carotid artery	13 (18.1)	11 (16.2)	0.768
Basilar artery	18 (25)	11 (16.2)	0.198
Median time to procedure, min (IQR)	240 (168.75-357.50)	378.50 (176.50-575)	0.001
Median procedure time, min (IQR)	37.5 (30.25-47.75)	53 (35.5-83.75)	<0.001
Median time to reperfusion, min (IQR)	275 (205-399.50)	463 (274-647.75)	<0.001
Median baseline NIHSS score (IQR)	11 (9-15)	15 (11-20)	<0.001
Intracranial angioplasty/stenting, n (%)	72 (100)	6 (8.8)	<0.001
Carotid artery stenting, n (%)	1 (1.4)	4 (5.9)	0.199
m-TICI 2b or 3, n (%)	69 (95.8)	64 (94.1)	0.713
Pericerebral hemorrhage, n (%)	3 (4.2)	1 (1.5)	0.620
Subarachnoid hemorrhage, n (%)	7 (9.7)	1 (1.5)	0.063
Symptomatic hemorrhage, n (%)	1 (1.4)	0	1
mRS score 0-2 at 3 mos, n (%)	41 (56.9)	43 (63.2)	0.448
Mortality, n (%)	7 (9.7)	4 (5.9)	0.534

Kang DH, Yoon W, et al. JNS 2019;130:1940-1956

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Long-term outcomes of tirofiban

Clinical and radiological outcomes

Primary Outcome	Patients (n = 115)
Ischemic stroke within 30 days	3 (2.6%)
Transient ischemic attack within 30 days	0 (0.0%)
Stroke-related death	1 (0.9%)

Secondary Outcome	Patients (n = 115)
Ischemic stroke beyond 30 days	6 (5.2%)
Transient ischemic attack beyond 30 days	2 (1.8%)
Any stroke outside of treated artery	0 (0.0%)
Symptomatic brain hemorrhage	0 (0.0%)
Non-stroke-related death	11 (9.6%)

Radiological Outcome	Patients (n = 115)	Sym:3, Asym:11
Change in stenosis within 7 days		
Stationary	99 (86.1%)	
Progression including reocclusion	16 (13.9%)	
Reocclusion	14 (12.2%)	
Long-term change in stenosis		
Stationary	42 (75.0%)	
Progression including reocclusion	14 (25.0%)	
Reocclusion	3 (5.4%)	Sym:1, Asym:2

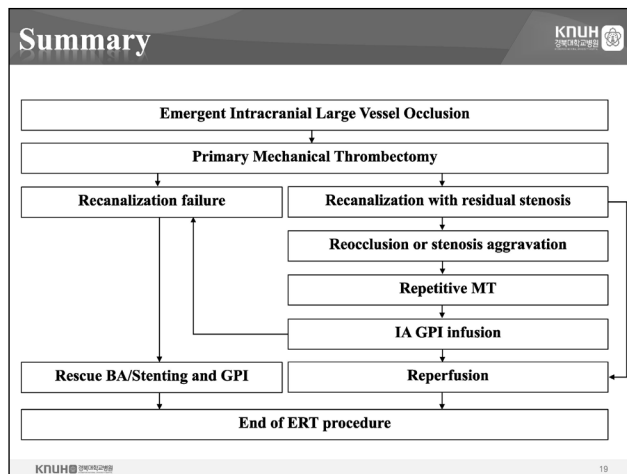
Choi W et al. Stroke Sci 2022;12:1089

Long-term outcomes of tirofiban

Comparison of early and delayed outcomes

Trial	Treatment Method	30-Day Event Rate	1-Year Event Rate	Progression of Stenosis
Current study (n = 115)	IA tirofiban, aspirin, clopidogrel, atorvastatin	3.5% (95% CI, 3.5-24.9%)	9.2% (95% CI, 8.0-18.6%)	25.0% (14/56)
WASID [27] ICAS, n = 206 [16], †	aspirin, statin	N/A	23% (95% CI, 15-30%)	N/A
SAMMPRIS [17], § (medical arm, n = 227)	aspirin, clopidogrel, rosuvastatin	5.8% (95% CI, 3.4-9.7%)	12.2% (95% CI, 8.4-17.6%)	N/A
VISIT [18], ††	aspirin, clopidogrel, atorvastatin	9.4% (95% CI, 3.0-20.7%)	15.1% (95% CI, 6.7-27.6%)	N/A
SAMMPRIS [17], § (WS arm, n = 224)	Wingspan stenting, aspirin, clopidogrel, rosuvastatin	14.7% (95% CI, 10.7-20.1%)	20.0% (95% CI, 15.2-26.0%)	N/A
VISIT [18], ††	Wingspan stenting, aspirin, clopidogrel, atorvastatin	24.1% (95% CI, 13.9-37.2%)	36.2% (95% CI, 24.0-49.9%)	29.4% (10/34)
WEAVE [19], ‡ (n = 159)	Wingspan stenting, aspirin, clopidogrel, statin	2.6% (WEAVE)	8.5% (WOVEN)	17.6% (18/102, WOVEN)

Choi W et al. Stroke Sci 2022;12:1089



- ### Summary
- Advantage of rescue stenting in ICAS related LVO**
- To avoid unnecessary intracranial stenting
 - Role of IA tirofiban as a rescue strategy
 - High rate of maintenance of reperfusion (EVT: 85-89%, Within 1 week: 87.8%, Beyond 1 month: 94.6%)
 - Low hemorrhagic complication rate
 - High concentration of thrombolytic agents to the target
 - Lower doses than systemic administration
 - Lower risk of vessel wall injury and in-stent thrombosis
- KNUH 20



Endovascular Neurosurgeon's perspective: Primary stenting

정 영 진

영남대

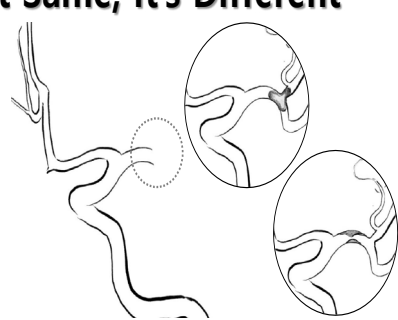
 2023 KONGUK UNIVERSITY ANNUAL MEETING
다문화협력연구사업(연구책임자 정영진교수)

**Endovascular Neurosurgeon's Perspective:
Primary stenting (Stent First, in ICAS-LVO)**

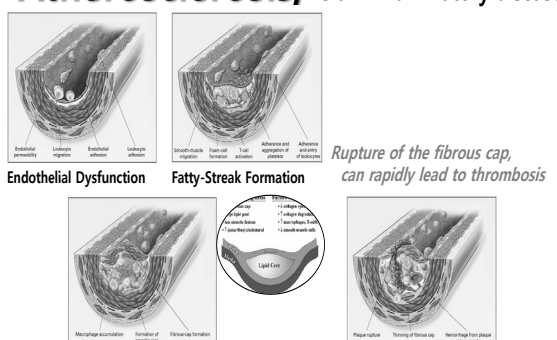
#ICAS-LVO #Well Selected **#FRESH** #Solitaire #without EVT, BAP

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Neurosurgery, Stroke Center, YUMC, Daegu, S. Korea

**MCA Occlusion,
Similar, Not Same, It's Different**



Atherosclerosis, is an inflammatory disease



Endothelial Dysfunction **Fatty-Streak Formation** **Formation of an Advanced, Complicated Lesion** **Unstable Fibrous Plaques**

Rupture of the fibrous cap, can rapidly lead to thrombosis

N Engl J Med. 1999 Jan 14;340(2):115-26. doi: 10.1056/NEJM199901143400207.

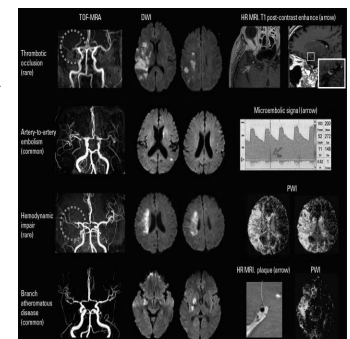
Mechanisms of stroke, ICAD

Thromboembolic ? (In situ, (rare) but EVT Travel ±)

Artery-to-artery embolism (common)

Hemodynamic impair (rare) but EVT

Branch atheromatous ds (common)



Journal of Stroke 2014;16(1):27-35. Published online: January 31, 2014

EVT Outcomes of ICAS-LVO

Review, Meta
2019 (2014-2018)

Table 1. Patient Population and Study Design of Included Studies

Author	Year	No. of ICAS-O	No. of Non-ICAS-O	% of ICAS-O Among All LVO	Population	% of Anterior Circulation	Study Design	Risk of Bias (NOS)
Kang et al ¹	2014	40	82	33.3%	Korea	90%	Retrospective, single-center	7
Lee et al ²	2015	24	134	15.2%	Korea	63%	Retrospective, single-center	6
Yoon et al ³	2015	40	132	23.3%	Korea	81%	Retrospective, single-center	5
Al-Kassab et al ⁴	2016	36	165	8.8%	United States	67%	Retrospective, single-center	6
Jia et al ⁵	2017	47	93	33.6%	China	100%	Prospective, multicenter	7
Lee et al ⁶	2017	15	47	24.2%	Korea	0%	Retrospective, single-center	7
Book et al ⁷	2018	56	262	17.8%	Korea	100%	Retrospective, single-center	8
Fan et al ⁸	2018	35	32	52.2%	China	0%	Retrospective, single-center	5
Lee et al ⁹	2018	99	421	19.0%	Korea	100%	Retrospective, multicenter	8
Tsang et al ¹⁰	2018	9	55	14.1%	Hong Kong	89%	Retrospective, single-center	6
Zhang et al ¹¹	2018	95	38	71.4%	China	0%	Retrospective, single-center	5

ICAS-O indicates intracranial atherosclerosis-related occlusion; LVO, large vessel occlusion; and NOS, Newcastle Ottawa Scale.

Stroke. 2019 Jun;50(6):1460-1466. doi: 10.1161/STROKEAHA.119.024889. Epub 2019 May 14.

#1, EVT Outcomes of ICAS-LVO vs Non-ICAS LVO

Review, Meta
2019 (2014-2018)

Table 2. Clinical Features and Risk Factors of ICAS-O Versus Non-ICAS-O

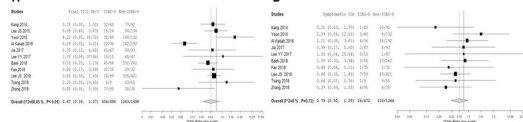
	ICAS-O	Non-ICAS-O	OR (95% CI)	P-value	I ² (%)
Male ^a	70.4%	51.8%	1.84 (1.45 to 2.34)	<0.001	2.8%
Hypertension ^a	71.4%	63.1%	1.46 (1.10 to 1.93)	0.009	21.3%
Diabetes mellitus ^a	31.9%	22.5%	1.68 (1.29 to 2.20)	<0.001	13.0%
Atrial fibrillation ^a	16.4%	54.1%	0.20 (0.13 to 0.31)	<0.001	48.6%
Coronary artery disease ^a	12.1%	14.7%	0.46 (0.42 to 1.49)	0.46	49.1%
Dyslipidemia ^a	36.0%	28.6%	1.94 (1.04 to 3.62)	0.037	69.5%
Smoking ^a	44.6%	21.8%	2.11 (1.40 to 3.17)	<0.001	58.6%
ICA occlusion ^a	27.3%	35.4%	0.72 (0.44 to 1.17)	0.19	58.3%
MCA occlusion ^a	67.7%	61.8%	1.17 (0.67 to 2.04)	0.59	71.8%
IV thrombolysis ^a	30.7%	43.9%	0.89 (0.56 to 1.42)	0.49	51.7%
Mean and mean difference (95% CI)					
Age (years) ^a	63.7	67.2	-3.17 (-4.68 to -1.66)	<0.001	25.4%
Baseline mRS ^a	14.5	17.0	-2.23 (-2.98 to -1.48)	<0.001	20.4%

ICA indicates internal carotid artery; ICAS-O, intracranial atherosclerosis-related occlusion; I, intravenous; MCA, middle cerebral artery; NIH Institutes of Health Stroke Severity Scale; and OR, odds ratio.
Stroke. 2019 Jun;50(6):1460-1466. doi: 10.1161/STROKEAHA.119.024889. Epub 2019 May 14.

#1, EVT Outcomes of ICAS-LVO vs Non-ICAS LVO

TICI 2b/3

A



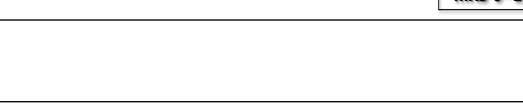
s ICH

B



Mortality

D



mRS 0-2

C



#1, EVT Outcomes of ICAS-LVO vs Non-ICAS LVO

Similar Results
-mTICI2b/3
-s ICH
-mRS
-Mortality

Table 3. Summary of Meta-Analysis Outcomes of Thrombectomy in ICAS-O Versus Non-ICAS-O

	ICAS-O	Non-ICAS-O	OR (95% CI)	P-value
Intraprocedural reocclusion ^a	36.9%	2.7%	23.7 (6.96-80.7)	<0.001
Rescue with balloon angioplasty alone ^a	9.0%	1.3%	9.49 (4.11-21.8)	<0.001
Rescue with intracranial stenting ^a	37.8%	2.6%	14.9 (7.64-29.2)	<0.001
Final mTICI 2b/3	81.5%	84.3%	0.67 (0.36-1.27)	0.22
Symptomatic intracranial hemorrhage	5.5%	8.1%	0.79 (0.50-1.25)	0.31
mRS score of 0-2 at 90 d	49.6%	47.9%	1.16 (0.85-1.58)	0.34
Mortality at 90 d	20.2%	18.0%	0.94 (0.64-1.38)	0.76
Mean and Baseline mHSS ^a	14.5	17.0		
Puncture-to-reperfusion (min) ^a	80.8	55.5	+21.3 (11.3-31.3)	<0.001
Onset-to-reperfusion (min) ^a	401.5	333.4	+56.4 (18.7-94.1)	0.003

ICAS indicates intracranial atherosclerosis-related occlusion; mRS, modified Rankin Scale; mTICI, modified Thrombolysis in Cerebral Infarction ratio.
Stroke. 2019 Jun;50(6):1460-1466. doi: 10.1161/STROKEAHA.119.024889. Epub 2019 May 14.

#2, EVT Outcomes of ICAS-LVO vs Non-ICAS LVO

Review, Meta, 2021 (-2020)

Table 1. Characteristics of the Included Studies

Author	Year	Population	Design	Sample Size	IV IPA (%)	% of ACA	Rescue treatment ^a	Rescue Stenting Type	NOS score
Dobrocky et al	2019	Switzerland	R	533	44.7%	100%	100%	Wingspan9	7
Al-Kassab et al	2017	United States	R	228	NA	NA	94.0%	Xience Xpedition2	6
Kang et al	2010	Korea	P	140	39.3%	79.3%	100%	Wingspan30	6
Lee et al	2017	Korea	P	62	27.4%	0	86.7%	Wingspan3	7
Wu et al	2019	China	P	113	33.6%	100%	100%	Apelco51	8
Fan et al	2019	China	P	67	16.4%	0	82.9%	Solitaire5	6
Kim et al	2016	Canada	R	51	47.1%	0	65.4%	Other stents10	7
Yoon et al	2015	Korea	R	172	50.6%	81.4%	95.0%	Wingspan24	6
Jia et al	2018	China	P	140	17.1%	100%	57.4%	Solitaire11	7
Zhang et al	2019	China	R	133	19.5%	0	60.0%	Other stents9	8

Abbreviations: ICAS, intracranial atherosclerosis; P, prospective; R, retrospective; IV, intravenous; ACA, anterior circulation stroke; NOS, Newcastle Ottawa Scale.

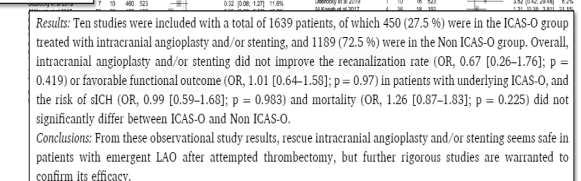
^a Defined as treatment with intracranial angioplasty and/or stenting.

^b Rescue therapy (Stent retriever detachment, Other stents, Balloon expansion, intra-arterial thrombolysis).

^c The rescue treatment was not for the intracranial occlusion site but for extracranial proximal vertebral artery stenosis. Those cases were related to extracranial-to-

EVT Outcomes of ICAS-LVO vs Non-ICAS LVO

TICI 2b/3



Mortality



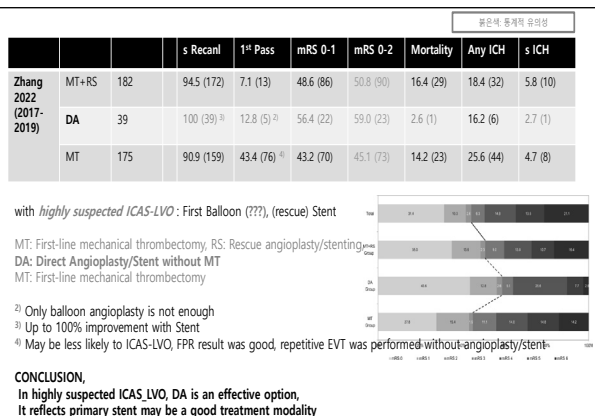
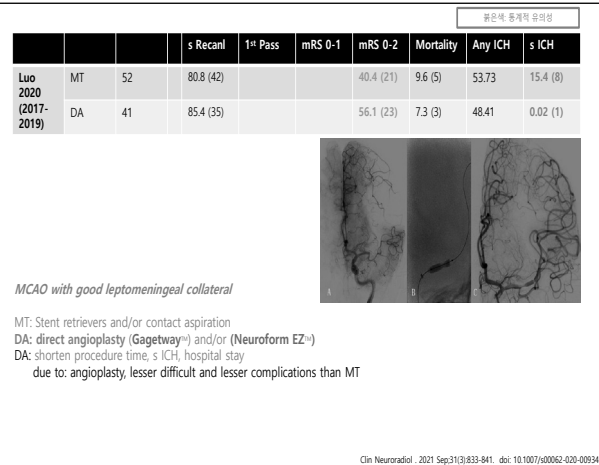
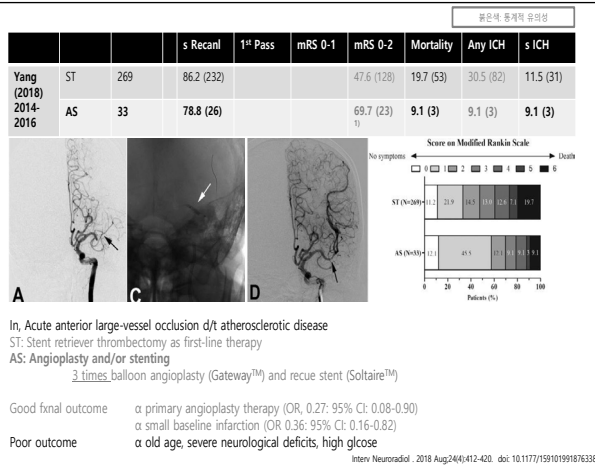
Cause of Reocclusion

CONCLUSION EVT outcome of ICAS-LVO:
with unique risk factors (특징을 가지고 있다)
technical challenge for EVT (EVT가 어렵다)
need, i.e. glycoprotein IIb/IIIa inhibitor, Balloon AP, intracranial stenting
✓ iNIHSS가 더 좋음에도 불구하고, i.e. tirofiban, BAP, Stenting등을 해서 겨우 겨우 비슷한 결과를 가져왔다.
✓ 왜? EVT를 하는것이 잘못되었을지도? 차다리 EVT를 하지 않으면?
✓ 아니면, 다른 방법으로 치료하는 것이 좋을지도?

Fibrous cap disruption
Intraplaque hemorrhage
↑ Subintimal dissection
V Subintimal hematoma
C Plaque, cholesterol, thrombus formation

Stroke. 2010 May;41(5):938-47. doi: 10.1161/STROKEAHA.109.576793.

First Angioplasty with/without Stent vs EVT & Rescue Stent



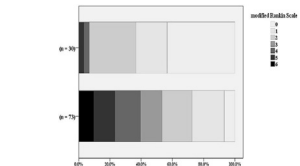
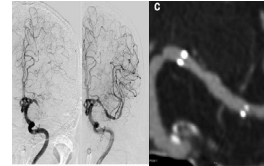
Results

	TICI 2b/3	s ICH	Mortality	mRS
EVT & Recue	81.5	5.5	20.2	49.8
Angioplasty with/without Stent	88.1	3.9	6.3	61.6

CONCLUSION of AP with/without Stenting
✓ lesser difficulty, complications
✓ good functional outcome ???

First Stent vs EVT & Rescue stent

				s Recanal	1 st Pass	mRS 0-1	mRS 0-2	Mortality	Any ICH	s ICH
Kim 2021 (2012- 2018)	MT	73		90.4			46.6 (34)	11.0 (8)	35.4 (26)	4.1 (3)
	DSP	30		93.3			80.0 (24) 1)	0 (0) 1)	16.7 (5)	0 (0) 1)

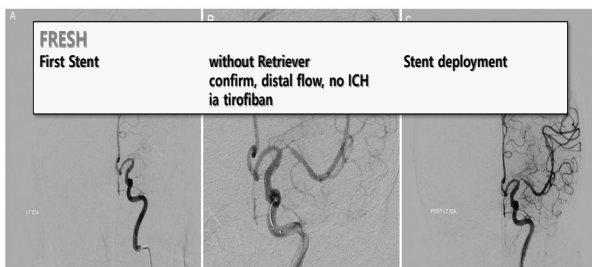


DSP: who met all the following criteria, judged as ICAS-related ALVO

MT: mechanical thrombectomy with/without rescue stenting with rescue balloon angioplasty
DSP: direct stent placement (Enterprise™) with/without pre/post-balloon angioplasty.

1) DSP: favorable outcome without increased s ICH and mortality
; simple one-step procedure without a complex strategy
; in well selected patients

Clin Neuroradiol. 2021 Sep;31(3):833-841. doi: 10.1007/s00062-020-00934-x



Inclusion, Embolic/ ICAS, Frist FRESH report (Solitaire™)

All, highly suspected ICAS-LVO

SRT: Stent retriever thrombectomy with Rescue/ FRESH: First stenting without retrieval

1) FRESH, significantly short procedure time, lower s ICH/ Mortality

2) FRESH, higher successful recanalization

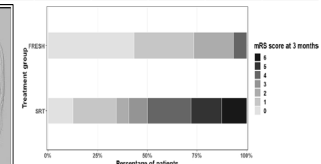
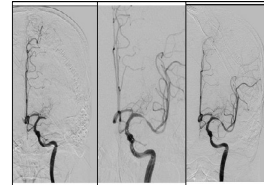
3) FRESH, dependent predictor for favorable functional outcome

; due to short procedure time, minimal vessel injury

FRESH: ia tirofiban infusion with good antegrade flow after stent deployment without SRT then detachment

J Neurosurg. 2021 Jan 29;1-8. doi: 10.3171/2020.8.JNS202594

				s Recanal	1 st Pass	mRS 0-1	mRS 0-2	Mortality	Any ICH	s ICH
Kim* 2022 (2017- 2019)	SRT	32		87.5 (28)			40.6 (13)	15.6 (5)		18.8 (6)
	FRESH 2)	30		100 (30) 1)			93.3 (28) 2)	0 (0)		0 (0)



All, highly suspected ICAS-LVO Solitaire™

1), s ICH was significantly lower in the FRESH group

2), favorable functional outcomes were significantly good

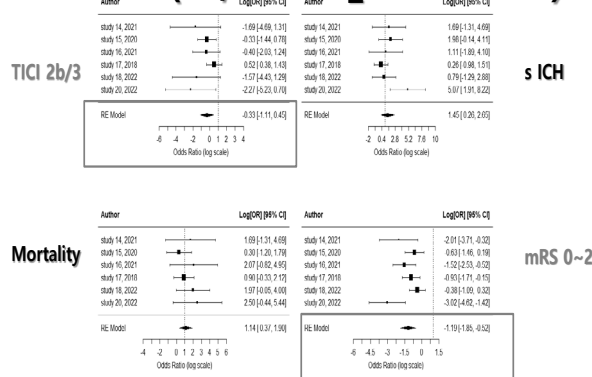
3), FRESH, independent predictor for favorable functional outcome

; due to short procedure time, minimal vessel injury

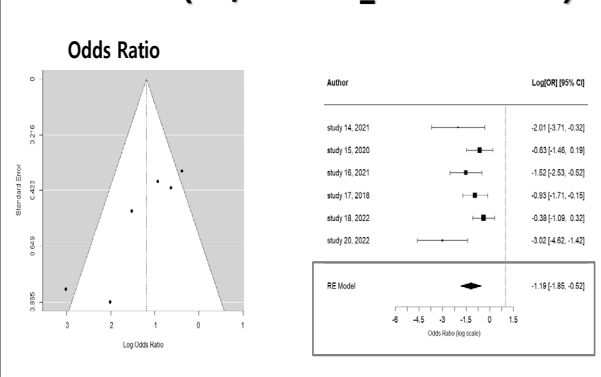
FRESH, might be an effective and safe alternative option for ICAS-LVO

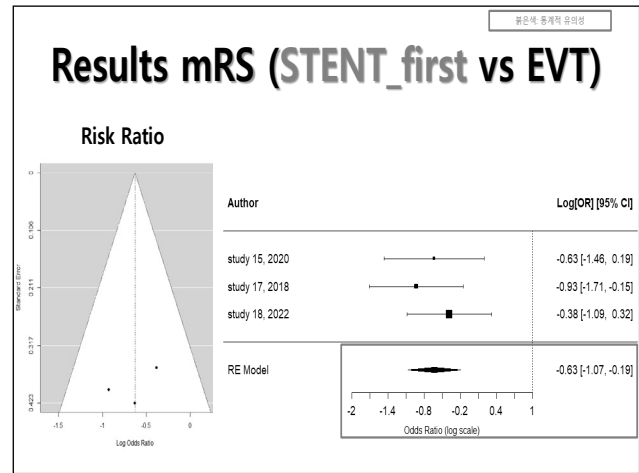
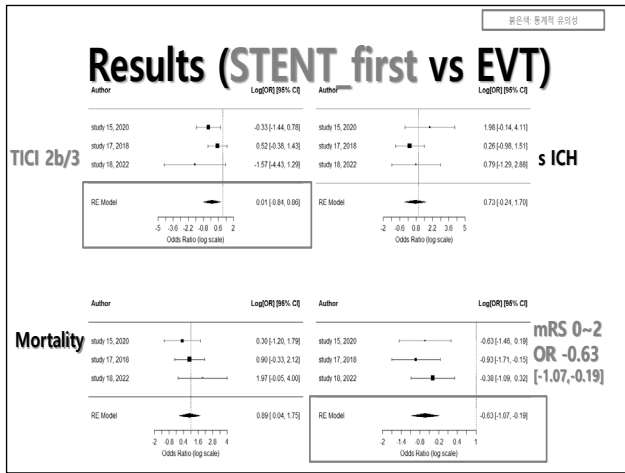
Clin Neurol Neurosurg. 2022 Nov;222:107464. doi: 10.1016/j.clineuro.2022.107464

Results (AP, STENT_first vs EVT)



Results (AP, STENT_first vs EVT)



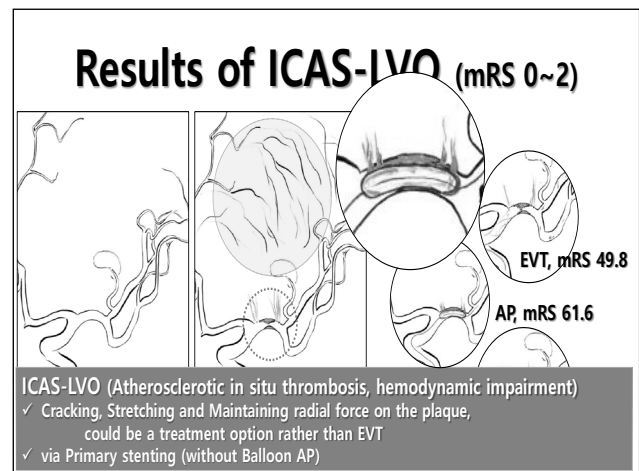


Results

	TICI 2b/3	s ICH	Mortality	mRS
EVT & Recue	81.5	5.5	20.2	49.8
Angioplasty with/without Stent	88.1	3.9	6.3	61.6
Stent, First	97.8	0	5.6	86.0

CONCLUSION of Stenting, First in ICAS-LVO

- ✓ well selected patients
- ✓ simple
- ✓ short procedure time, lesser vessel injury
- ✓ 다른 요인은 없을까?



Conclusion

- **First Stent (FRESH Technique)**
 - Well selected cases, in ICAS-LVO
 - Easy, Simple, Fast, Safe
 - with good recanalization
 - without additional complications
 - Good clinical outcomes

✓ Feasible solution in ICAS-LVO



2023

**뇌졸중 재개통 심포지엄 (ARCS) 및
대한뇌혈관내치료의학회
춘계보수교육**

인	쇄	2023년 2월 22일		
발	행	2023년 2월 25일		
발	행	처	대한뇌혈관내치료의학회	
회	장	장	철 훈	
총	무	이	사	김 영 우
학	술	이	사	권 현 조
주	소	서울시 서초구 서초대로 350 (서초동 동아빌라트 2타운) 407호		

Baxter

Floseal

HEMOSTATIC MATRIX

OPERATIONHERO

FAST & EASY TO USE^{1,2}



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1. Floseal hemostatic matrix 국내 제품 설명서(식품의약품안전처 (<https://nedrug.mfds.go.kr>) 의약품등 제품정보장 참조)
2. Tackett, Scott M., et al. "Real-world outcomes of hemostatic matrices in cardiac surgery." *Journal of cardiothoracic and vascular anesthesia* 28,6 (2014): 1558-1565.



신속한 목표 혈압 도달 낮은 혈압변동성¹



수술시 이상 고혈압의 구급처치
응급성 고혈압증



한국다이이찌산쿄주식회사

Daiichi-Sankyo 서울시 중구 을지로5길 26 미래에셋 센터원빌딩 동관 15층 Tel. 02-3453-3300

Injectable calcium channel blocker

Perdipine[®] Inj.
(Nicaldipine HCl)

[연구목적] Acute stroke 환자의 BP 조절시 Nicardipine과 Labetalol의 유효성 비교

[연구대상] 응급성 고혈압이 발생하는 뇌내출혈, 지주막하출혈, 급성뇌졸중으로 응급실에 내원한 18세 초과 성인환자대상으로 각 Nicardipine 26명, Labetalol 28명 총 54명 등록

[연구방법] Prospective, pseudo-randomized로 설계

Reference 1. Liu-DeRyke X., et al, Neurocrit Care, 2013;19(1):41-47.

동아페르디핀[®] 주사액(니카르디핀염산염) 10mg/10mL [원료약품 및 분량] 이 약 1mL 중 유효성분 : 니카르디핀염산염(IP)-1mg, 첨가제(용제) : 주사용수, 기타 첨가제 : 염산, D-소르비톨 [효능·효과] 수술시 이상고혈압의 구급처치, 응급성 고혈압증 [용법·용량] 1. 수술시 이상고혈압의 구급처치 : 이 약은 생리식염주사액 또는 5% 포도당주사액으로 희석하여, 염산니카르디핀염산염 0.01~0.02%(0.1~0.2mg/1mL) 용액을 점적정주하십시오. 2. 응급성 고혈압증 : 이 약은 생리식염주사액 또는 5% 포도당주사액으로 희석하여, 염산니카르디핀염산염 0.01~0.02%(0.1~0.2mg/1mL) 용액을 점적정주하십시오. [사용상의 주의사항] [경고] 1)염물주사제는 용기 절단시 유리파편이 혼입되어 부작용을 초래할 수 있으므로 특히, 어린이, 노약자는 주의합니다. 2) 이 약을 뇌출혈 급성기의 환자 및 뇌출중 급성기로 두개내압이 항진되어 있는 환자에게 투여하는 경우에는, 긴급 대응이 가능한 의료시설에서 최선의 관련 가이드라인을 참조하면서, 혈압 등 환자의 상태를 충분히 모니터링하며 투여합니다. [금기] 1)이 약 및 다른 디하드로피리딘계약물에 과민증 또는 과민증의 기왕력이 있는 환자 2)급성심부전으로서, 고도의 대동맥판협착 · 승모판협착, 비대형폐색성심근증, 저혈압(수축기혈압 90mmHg미만), 심원속속크가 있는 환자 3)급성심부전으로서 발병직후에 상태가 안정되어 있지 않은 중증의 급성심근경색환자 4)대동맥판협착증 환자 (이원기 혈압강하는 심근산소공급 증가보다는 악화시킬 수 있습니다. [이상반응] (1) 중대한 이상반응 - 저산소혈증(0.1~5% 미만) : 저산소혈증이 나타날 수 있으므로, 이상이 관찰되는 경우 투여를 중지하고 적절한 조치를 취합니다. - 폐수종, 호흡곤란(각 0.1% 미만) : 폐수종, 호흡곤란이 나타날 수 있습니다 - 협심증(빈도 불명) : 해외에서 본 주사제로 치료받은 관상동맥 질환 환자 중 1% 미만에게서 협심증의 발현 혹은 악화가 나타났다는 보고가 있습니다. [자장방법] 차광·실온(1~30℃) 보관 [포장단위] 페르디핀주사액 10mg : 10mL/병들 x 10병들 [제조원] 동아에스티 [판매원] 한국다이이찌산쿄주식회사 [개정년월일] 2019.11.04

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