



Rise of the Phoenix: The Evolution of Mechanical Thrombectomy for Ischemic Stroke

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Disclosures:
HEAT Trial: Northwestern and Microvention





Goals and Objectives

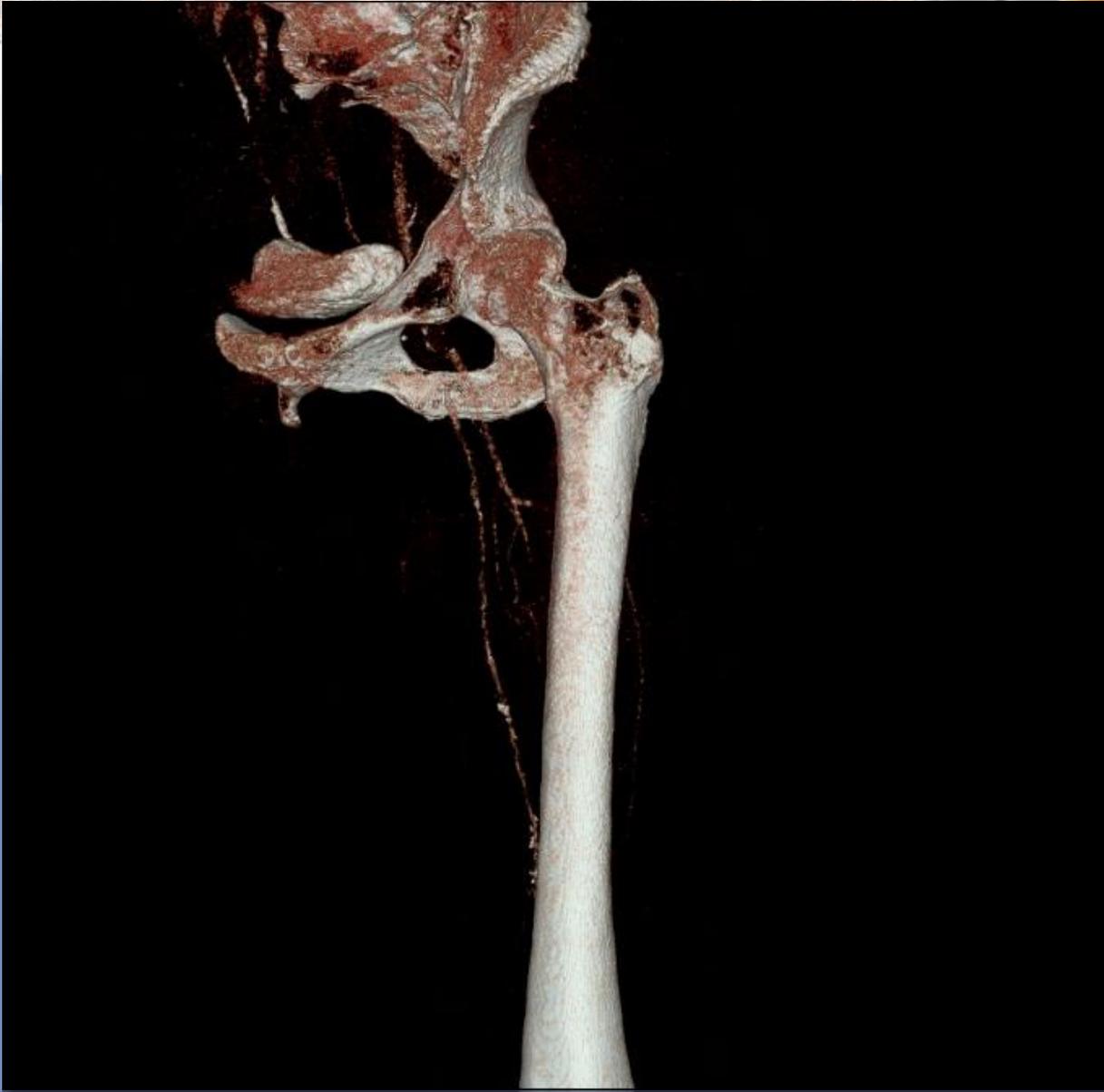
- Review the evolution of mechanical thrombectomy and reasons for past negative trial results
- Review the recent Level 1 Grade A evidence for mechanical thrombectomy
- Share practical guidelines for determining which stroke patients would most benefit from mechanical thrombectomy



Case 1

- 56 year-old female with atrial fibrillation and acute left leg pain and numbness.





Case 1

- Patient had successful left SFA thrombectomy by vascular surgery and placed on heparin drip.
- On post-operative day #1, the patient developed acute right hemiparesis and aphasia.





Case 1

- Patient with what appears to be a new left MCA syndrome and hyperdense left ICA sign.
- What are our options?

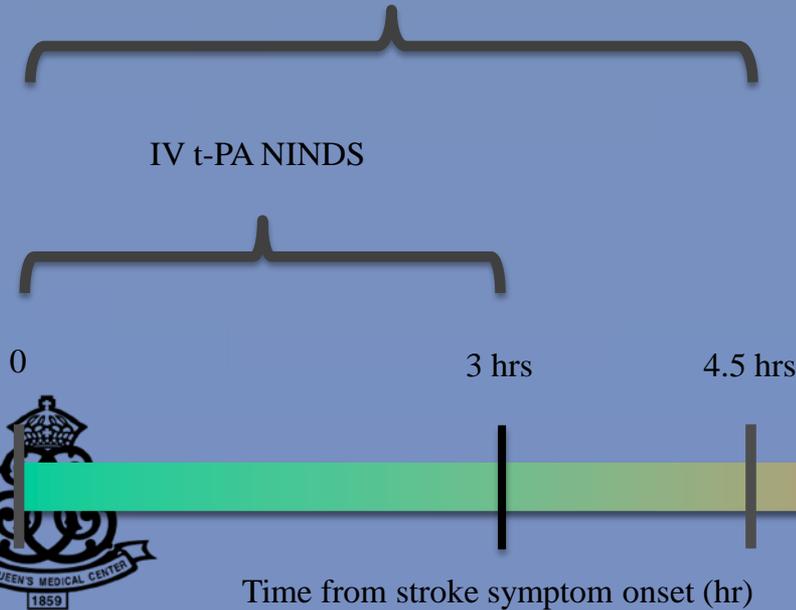


IV-tPA



IV t-PA ECASS III

IV t-PA NINDS



The **NEW ENGLAND**
JOURNAL *of* **MEDICINE**

ESTABLISHED IN 1812 SEPTEMBER 25, 2008 VOL. 359 NO. 13

Thrombolysis with Alteplase 3 to 4.5 Hours after Acute Ischemic Stroke

Werner Hacke, M.D., Markku Kaste, M.D., Erich Bluhmki, Ph.D., Miroslav Brozman, M.D., Antoni Dávalos, M.D.,
Donata Guidetti, M.D., Vincent Larrue, M.D., Kennedy R. Lees, M.D., Zakaria Medeghri, M.D.,
Thomas Machnig, M.D., Dietmar Schneider, M.D., Rüdiger von Kummer, M.D., Nils Wahlgren, M.D.,
and Danilo Toni, M.D., for the ECASS Investigators*

The New England Journal of Medicine

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Volume 333

DECEMBER 14, 1995

Number 24

TISSUE PLASMINOGEN ACTIVATOR FOR ACUTE ISCHEMIC STROKE

THE NATIONAL INSTITUTE OF NEUROLOGICAL DISORDERS AND STROKE t-PA STROKE STUDY GROUP*

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TISSUE PLASMINOGEN ACTIVATOR FOR ACUTE ISCHEMIC STROKE



IV-tPA

- Had contraindications to IV-tPA related to recent major surgery and current use of heparin drip.



Endovascular Intervention



Mechanical Thrombectomy



IV t-PA ECASS III



IV t-PA

IA pro-UK



0 3 hrs 4.5 hrs 6 hrs 8 hrs



Time from stroke symptom onset (hr)

WFNN Lecture Series



IA Thrombolysis

JAMA, December 1, 1999—Vol 282, No. 21 **2003**

Intra-arterial Prourokinase for Acute Ischemic Stroke

The PROACT II Study: A Randomized Controlled Trial

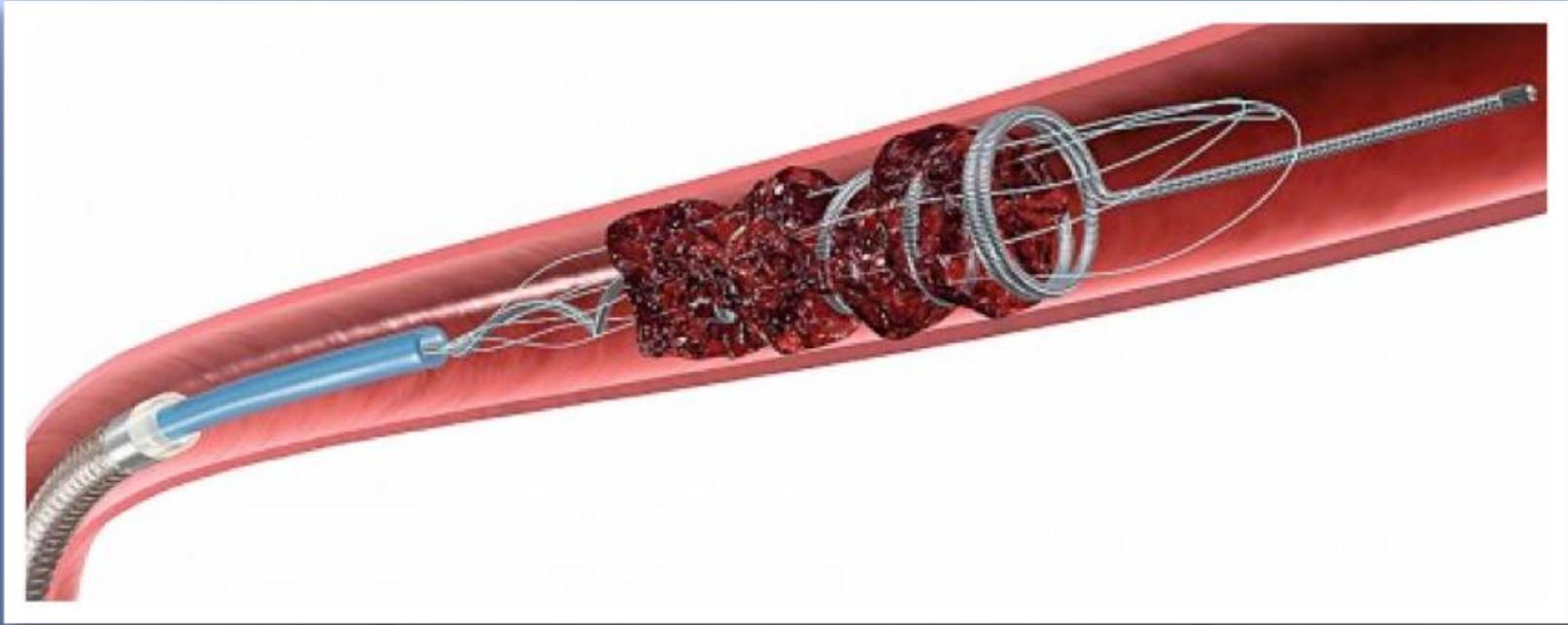
Anthony Furlan, MD
Randall Higashida, MD
Lawrence Wechsler, MD
Michael Gent, DSc
Howard Rowley, MD
Carlos Kase, MD
Michael Pessin, MD†
Arvind Ahuja, MD
Fred Callahan, MD
Wayne M. Clark, MD
Frank Silver, MD
Frank Rivera, MD
for the PROACT Investigators



WFNN Lecture Series



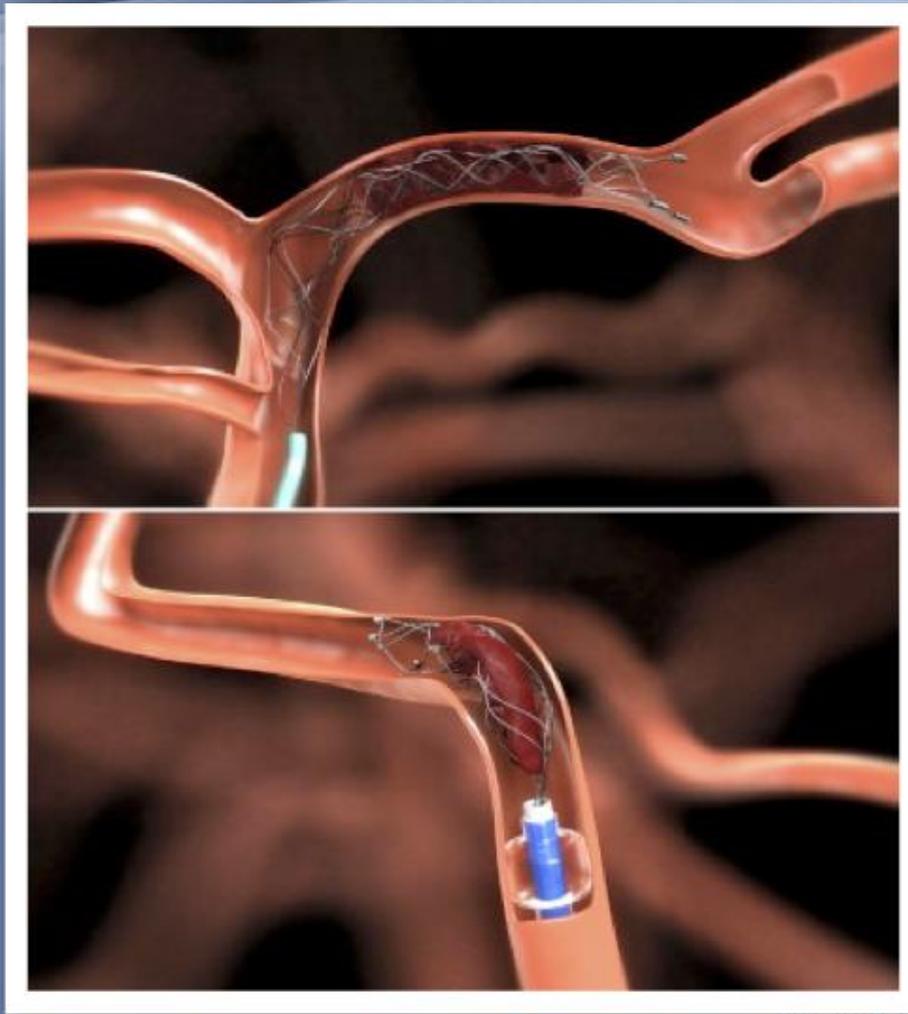
1st Generation Thrombectomy



Aspiration Catheters



Stent Retriever





International Stroke Conference 2013

Presentation of three major acute endovascular stroke interventional trials



IMS3

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812

MAY 17, 2018

VOL. 368 NO. 10

Endovascular Therapy after Intravenous t-PA versus t-PA Alone for Stroke

Joseph P. Broderick, M.D., Yuko Palesy, Ph.D., Andrew M. Demchuk, M.D., Sharon D. Yeatts, Ph.D., Pooja Khatri, M.D., Michael D. Hill, M.D., Edward C. Jauch, M.D., Tudor G. Jovin, M.D., Bernard Yan, M.D., Frank L. Silver, M.D., Rüdiger von Kummer, M.D., Carlos A. Molina, M.D., Bart M. Demaerschalk, M.D., Ronald Budzik, M.D., William J. Meurer, M.D., Osama O. Zaidat, M.D., Tim W. Malisch, M.D., Mayank Goyal, M.D., Wouter J. Schonewille, M.D., Mikael Mazighi, M.D., Ph.D., Stefan T. Engelter, M.D., Craig Anderson, M.D., Ph.D., Judith Spilker, R.N., B.S.N., Janice Carrozzella, R.N., B.A., R.T.(R.), Karla J. Ryckborst, R.N., B.N., L. Scott Janis, Ph.D., Robert H. Martin, Ph.D., Lydia D. Foster, M.S., and Thomas A. Tomsick, M.D.,
for the Interventional Management of Stroke (IMS) III Investigators

- The trial showed similar safety outcomes and no significant difference in functional independence with endovascular therapy after intravenous t-PA, as compared with intravenous t-PA alone.



Synthesis

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Endovascular Treatment for Acute Ischemic Stroke

Alfonso Cicco, M.D., Valvassori, M.D., Michele Nichelatti, Ph.D.,
Annalisa, M.D., Psych., Michela Ponzio, Ph.D., Roberto Sterzi, M.D.,
and Edoardo, M.D., for the SYNTHESIS Expansion Investigators*

NEGATIVE

- The results of this trial in patients with acute ischemic stroke indicate that endovascular therapy is not superior to standard treatment with intravenous t-PA.



MR Rescue

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

A Trial of Imaging Selection and Endovascular Treatment for Ischemic Stroke

Chelsea S. White, M.D., Reza Jahan, M.D., Jeffrey Gornbein, Dr.P.H., Jeffrey R. Alger, Ph.D., Val Denov, Ph.D., Zahra Ajani, M.D., Lei Feng, M.D., Ph.D., Brett C. Mitchell, M.D., Scott Olson, M.D., Lee H. Schwamm, M.D., Albert J. Yoo, M.D., Randolph S. Marshall, M.D., Philip M. Meyers, M.D., Dileep R. Yavagal, M.D., Max Wintermark, M.D., Judy Guzy, R.N., Sidney Starkman, M.D., and Jeffrey L. Saver, M.D., for the MR RESCUE Investigators*

- A favorable penumbral pattern on neuroimaging did not identify patients who would differentially benefit from endovascular therapy for acute ischemic stroke, nor was embolectomy shown to be superior to standard care.



Endovascular Stroke Treatment Unproven?

The NEW ENGLAND JOURNAL of MEDICINE

EDITORIAL



Endovascular Treatment for Acute Ischemic Stroke — Still Unproven

Marc I. Chimowitz, M.B., Ch.B.



NEJM February 8, 2013



Study Concerns

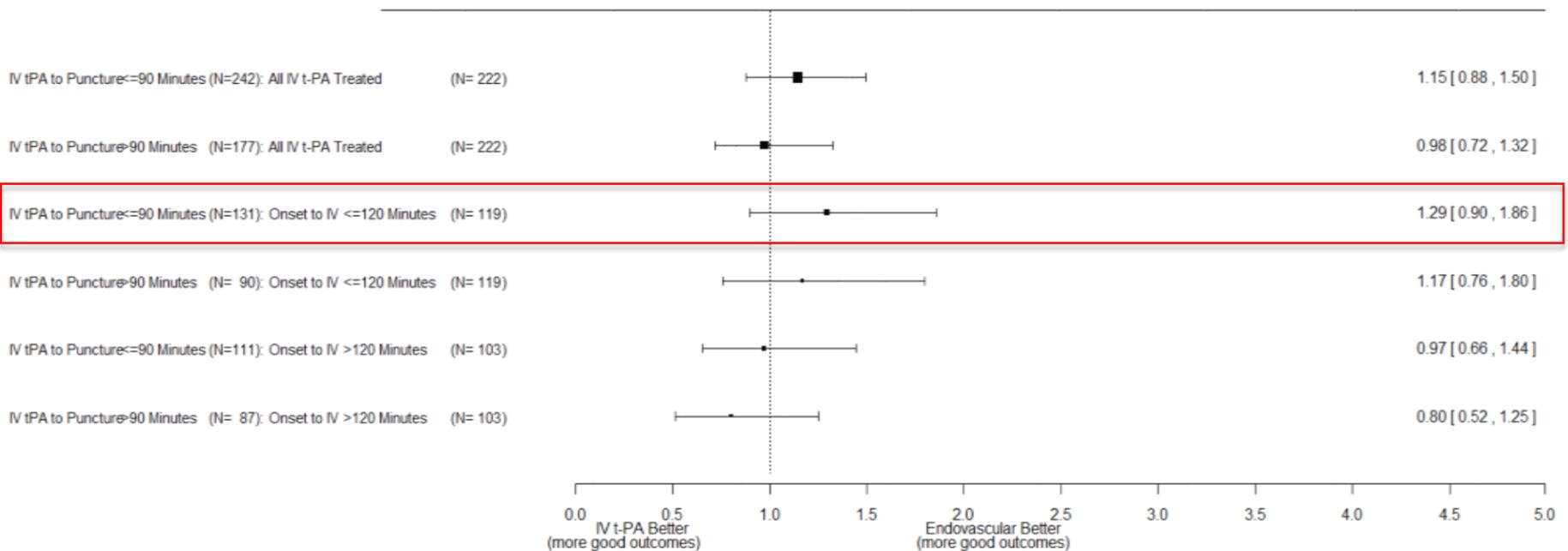
- Older generation devices
- Lower recanalization rates
- Longer time to recanalization
- Lower doses of IV tPA in endovascular arm
- Not all patient in the endovascular arm had proven occlusion



IMS 3 – The Concerns

	Endovascular	IV t-PA Alone
All Randomized	434	222
All Subjects	Lower Dose in IA Group	
Total t-PA Dose, mg: mean (SD)	60.3 (14.2)	72.5 (14.3)
Endovascular Group Only	3.5 hours	
Time from Onset to Groin Puncture, min: mean (SD)	208 (46.7)	
Received IA Therapy (%)	334 (77)	20% with no thrombus
Time from Onset to IA Therapy, min: mean (SD)	249.4 (50.6)	4.2 hours
Received IA t-PA (%)	266 (61.3)	
Total IV t-PA dose, mg: mean (SD)	52.1 (12)	
Total IA t-PA dose, mg: mean (SD)	13.3 (6.7)	

IMS3 Supplemental



When Onset to IV tPA < 120 mins and IVtPA to groin puncture < 90 mins revealed better outcome with endovascular therapy



IMS3 Supplemental

90-Day mRS Distribution, Baseline CTA Occlusion Present

	0	1	2	3	4	5	6
Endovascular N=180	13.3	21.7	12.2	13.3	17.8	6.1	15.6
IV tPA Alone N=91	5.5	14.3	18.7	11	16.5	7.7	26.4

van Elteren test **p-value 0.0114**

Endovascular confers a statistically significant benefit across the spectrum of mRS

A. Demchuk, IMS III: Comparison of Outcomes between IV and IV/IA Treatment in Baseline CTA Confirmed ICA, M1, M2 and Basilar Occlusions, slide 20, Presented at ISC 2013, Honolulu Hawaii



With CTA-confirmed occlusion at baseline, **representative of current practice**, IMS III has a statistically significant positive outcome for endovascular



MR CLEAN

The NEW ENGLAND JOURNAL *of* MEDICINE

ESTABLISHED IN 1812

JANUARY 1, 2015

VOL. 372 NO. 1

A Randomized Trial of Intraarterial Treatment for Acute Ischemic Stroke

O.A. Berkhemer, P.S.S. Fransen, D. Beumer, L.A. van den Berg, H.F. Lingsma, A.J. Yoo, W.J. Schonewille, J.A. Vos, P.J. Nederkoorn, M.J.H. Wermer, M.A.A. van Walderveen, J. Staals, J. Hofmeijer, J.A. van Oostayen, G.J. Lycklama à Nijeholt, J. Boiten, P.A. Brouwer, B.J. Emmer, S.F. de Bruijn, L.C. van Dijk, L.J. Kappelle, R.H. Lo, E.J. van Dijk, J. de Vries, P.L.M. de Kort, W.J.J. van Rooij, J.S.P. van den Berg, B.A.A.M. van Hasselt, L.A.M. Aerden, R.J. Dallinga, M.C. Visser, J.C.J. Bot, P.C. Vroomen, O. Eshghi, T.H.C.M.L. Schreuder, R.J.J. Heijboer, K. Keizer, A.V. Tielbeek, H.M. den Hertog, D.G. Gerrits, R.M. van den Berg-Vos, G.B. Karas, E.W. Steyerberg, H.Z. Flach, H.A. Marquering, M.E.S. Sprengers, S.F.M. Jenniskens, L.F.M. Beenen, R. van den Berg, P.J. Koudstaal, W.H. van Zwam, Y.B.W.E.M. Roos, A. van der Lugt, R.J. van Oostenbrugge, C.B.L.M. Majoie, and D.W.J. Dippel, for the MR CLEAN Investigators*

- In patients with acute ischemic stroke caused by a proximal intracranial occlusion of the anterior circulation, intra-arterial treatment administered within 6 hours after stroke onset was effective and safe.



Endovascular Intervention

Mechanical Thrombectomy



IV t-PA ECASS III



IV t-PA

IA pro-UK

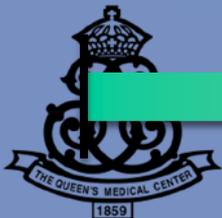


0

3 hrs

4.5 hrs

6 hrs



Time from stroke symptom onset (hr)

WFNN Lecture Series

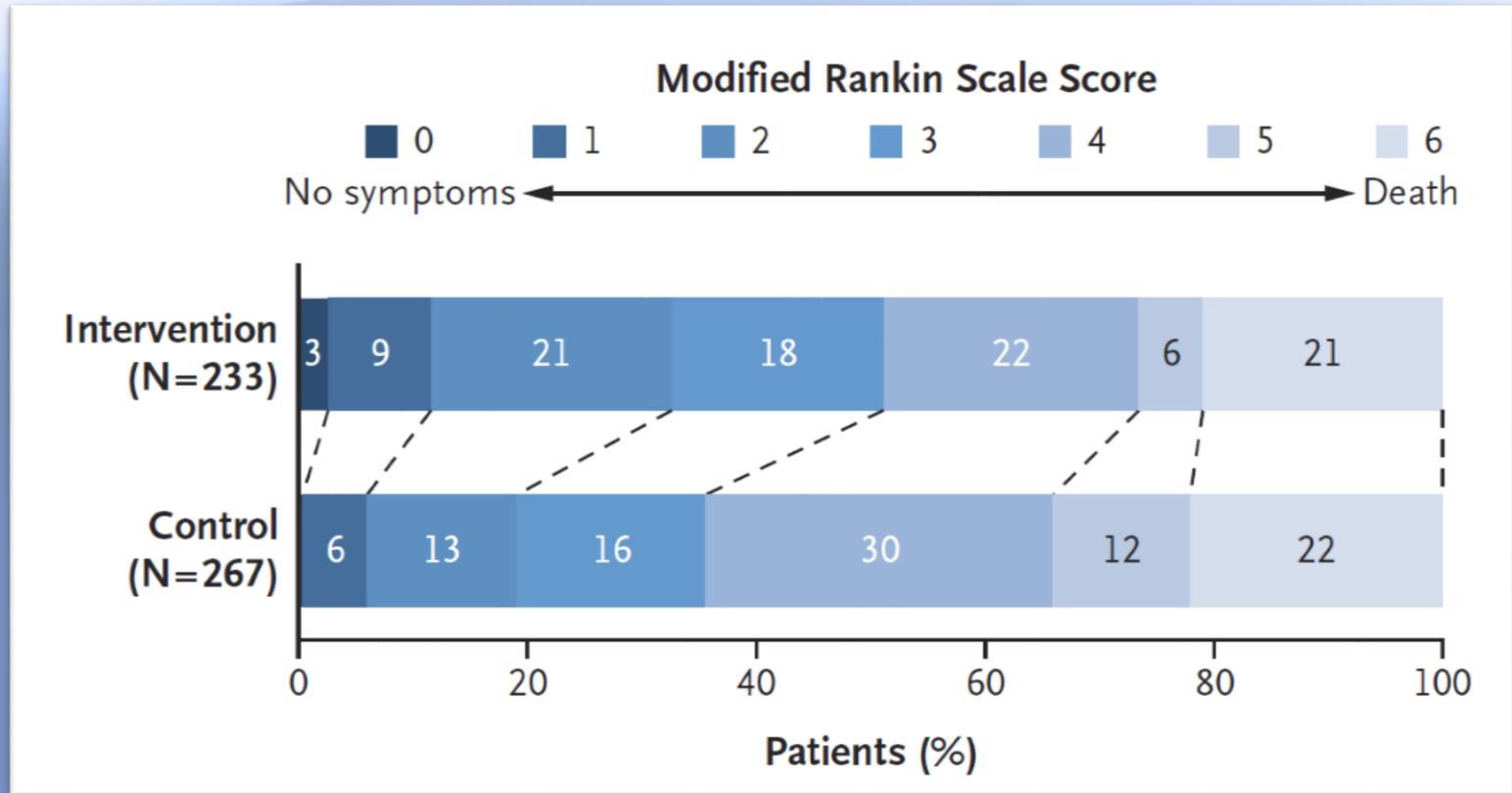


MR CLEAN

- Multicenter Randomized Clinical trial of Endovascular treatment for Acute ischemic stroke in the Netherlands)
- Mechanical thrombectomy shown to be effective in large vessel occlusion
- Improved rate of good outcome (mRS 0-2) by 71% over medical management alone with iv tPA (32.6% versus 19.1% achieving mRS 0-2 respectively)



MR CLEAN



MR CLEAN



- Benefit was seen in all age groups including elderly (80+)
- No difference in serious adverse events (hemorrhage or mortality)
- The Dutch government did not pay for intervention unless enrolled in the trial (no cherry picking)
- All patient had proven arterial occlusion
- Used the stent retrievers which have greater recanalization success compared to previous generation IA therapy



ORIGINAL ARTICLE

A Randomized Trial of Intraarterial Treatment for Acute Ischemic Stroke

O.A. Berkhemer, P.S.S. Fransen, D. Beumer, L.A. van den Berg, H.F. Lingsma, A.J. Yoo, W.J. Schonewille, J.A. Vos, P.J. Nederkoorn, M.J.H. Wermer, M.A.A. van Walderveen, J. Staals, J. Hofmeijer, J.A. van Oostayen, G.J. Lycklama à Nijeholt, J. Boiten, P.A. Brouwer, B.J. Emmer, S.F. de Bruijn, L.C. van Dijk, L.J. Kappelle, R.H. Lo, E.J. van Dijk, J. de Vries, P.L.M. de Kort, W.J.J. van Rooij, J.S.P. van den Berg, B.A.A.M. van Hasselt, L.A.M. Aerden, R.J. Dallinga, M.C. Visser, J.C.J. Bot, P.C. Vroomen, O. Eshghi, T.H.C.M.L. Schreuder, R.J.J. Heijboer, K. Keizer, A.V. Tielbeek, H.M. den Hertog, D.G. Gerrits, R.M. van den Berg-Vos, G.B. Karas, E.W. Steyerberg, H.Z. Flach, H.A. Marquering, M.E.S. Sprengers, S.F.M. Jenniskens, L.F.M. Beenen, R. van den Berg, P.J. Koudstaal, W.H. van Zwam, Y.B.W.E.M. Roos, A. van der Lugt, R.J. van Oostenbrugge, C.B.L.M. Majoie, and D.W.J. Dippel, for the MR CLEAN Investigators*

Endovascular Therapy for Ischemic Stroke with Perfusion-Imaging Selection

B.C.V. Campbell, P.J. Mitchell, T.J. Kleinig, H.M. Dewey, L. Churilov, N. Yassi, B. Yan, R.J. Dowling, M.W. Parsons, T.J. Oxley, T.Y. Wu, M. Brooks, M.A. Simpson, F. Miteff, C.R. Levi, M. Krause, T.J. Harrington, K.C. Faulder, B.S. Steinfort, M. Priglinger, T. Ang, R. Scroop, P.A. Barber, B. McGuinness, T. Wijeratne, T.G. Phan, W. Chong, R.V. Chandra, C.F. Bladin, M. Badve, H. Rice, L. de Villiers, H. Ma, P.M. Desmond, G.A. Donnan, and S.M. Davis, for the EXTEND-IA Investigators*

Thrombectomy within 8 Hours after Symptom Onset in Ischemic Stroke

T.G. Jovin, A. Chamorro, E. Cobo, M.A. de Miquel, C.A. Molina, A. Rovira, L. San Román, J. Serena, S. Abilleira, M. Ribó, M. Millán, X. Urra, P. Cardona, E. López-Cancio, A. Tomasello, C. Castaño, J. Blasco, L. Aja, L. Dorado, H. Quesada, M. Rubiera, M. Hernández-Pérez, M. Goyal, A.M. Demchuk, R. von Kummer, M. Gallofré, and A. Dávalos, for the REVASCAT Trial Investigators*

Randomized Assessment of Rapid Endovascular Treatment of Ischemic Stroke

M. Goyal, A.M. Demchuk, B.K. Menon, M. Eesa, J.L. Rempel, J. Thornton, D. Roy, T.G. Jovin, R.A. Willinsky, B.L. Sapkota, D. Dowlathshahi, D.F. Frei, N.R. Kamal, W.J. Montanera, A.Y. Poppe, K.J. Ryckborst, F.L. Silver, A. Shuaib, D. Tampieri, D. Williams, O.Y. Bang, B.W. Baxter, P.A. Burns, H. Choe, J.-H. Heo, C.A. Holmstedt, B. Jankowitz, M. Kelly, G. Linares, J.L. Mandzia, J. Shankar, S.-I. Sohn, R.H. Swartz, P.A. Barber, S.B. Coutts, E.E. Smith, W.F. Morrish, A. Weill, S. Subramaniam, A.P. Mitha, J.H. Wong, M.W. Lowerison, T.T. Sajobi, and M.D. Hill for the ESCAPE Trial Investigators*

Stent-Retriever Thrombectomy after Intravenous t-PA vs. t-PA Alone in Stroke

Jeffrey L. Saver, M.D., Mayank Goyal, M.D., Alain Bonafe, M.D., Hans-Christoph Diener, M.D., Ph.D., Elad I. Levy, M.D., Vitor M. Pereira, M.D., Gregory W. Albers, M.D., Christophe Cognard, M.D., David J. Cohen, M.D., Werner Hacke, M.D., Ph.D., Olav Jansen, M.D., Ph.D., Tudor G. Jovin, M.D., Heinrich P. Mattle, M.D., Raul G. Nogueira, M.D., Adnan H. Siddiqui, M.D., Ph.D., Dileep R. Yavagal, M.D., Blaise W. Baxter, M.D., Thomas G. Devlin, M.D., Ph.D., Demetrius K. Lopes, M.D., Vivek K. Reddy, M.D., Richard du Mesnil de Rochemont, M.D., Oliver C. Singer, M.D., and Reza Jahan, M.D., for the SWIFT PRIME Investigators*

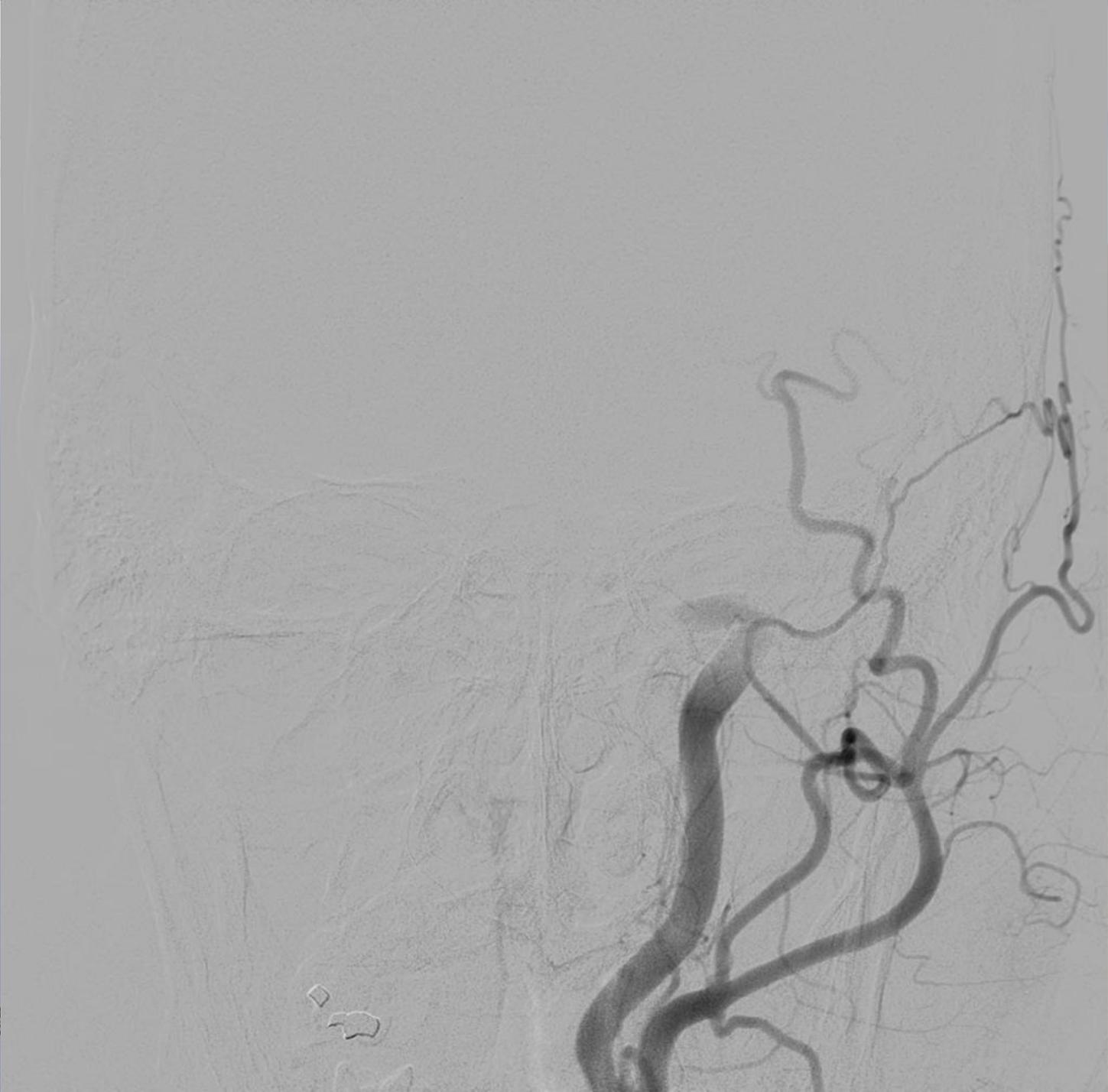
5 Positive trial published in NEJM in 2015

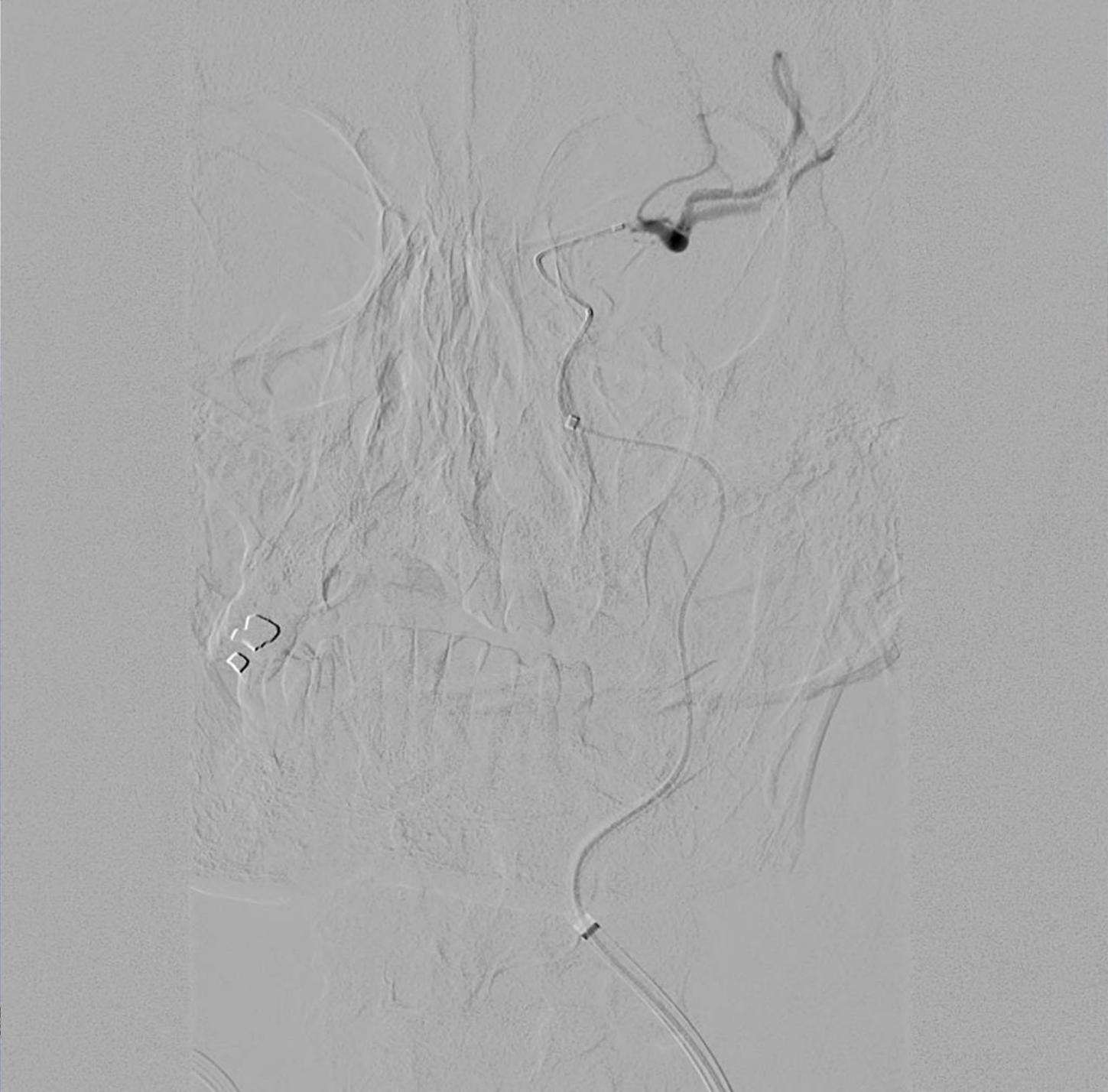


Mechanical Thrombectomy

- NNT: 2.5-7
- 14-40/100 endovascularly treated patients will benefit
- And safe compared to standard of care (5 NEJM trial safety)

Endpoint	Endovascular (n = 634)	Control (n = 652)
sICH	29/634 4.6%	28/652 4.3%
PH1 and PH2	37/634 5.8%	35/652 5.4%
SAH	17/634 2.7%	5/652 0.8%
90d Mortality	97/634 15.3%	122/652 18.7%











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Neuss, Germany



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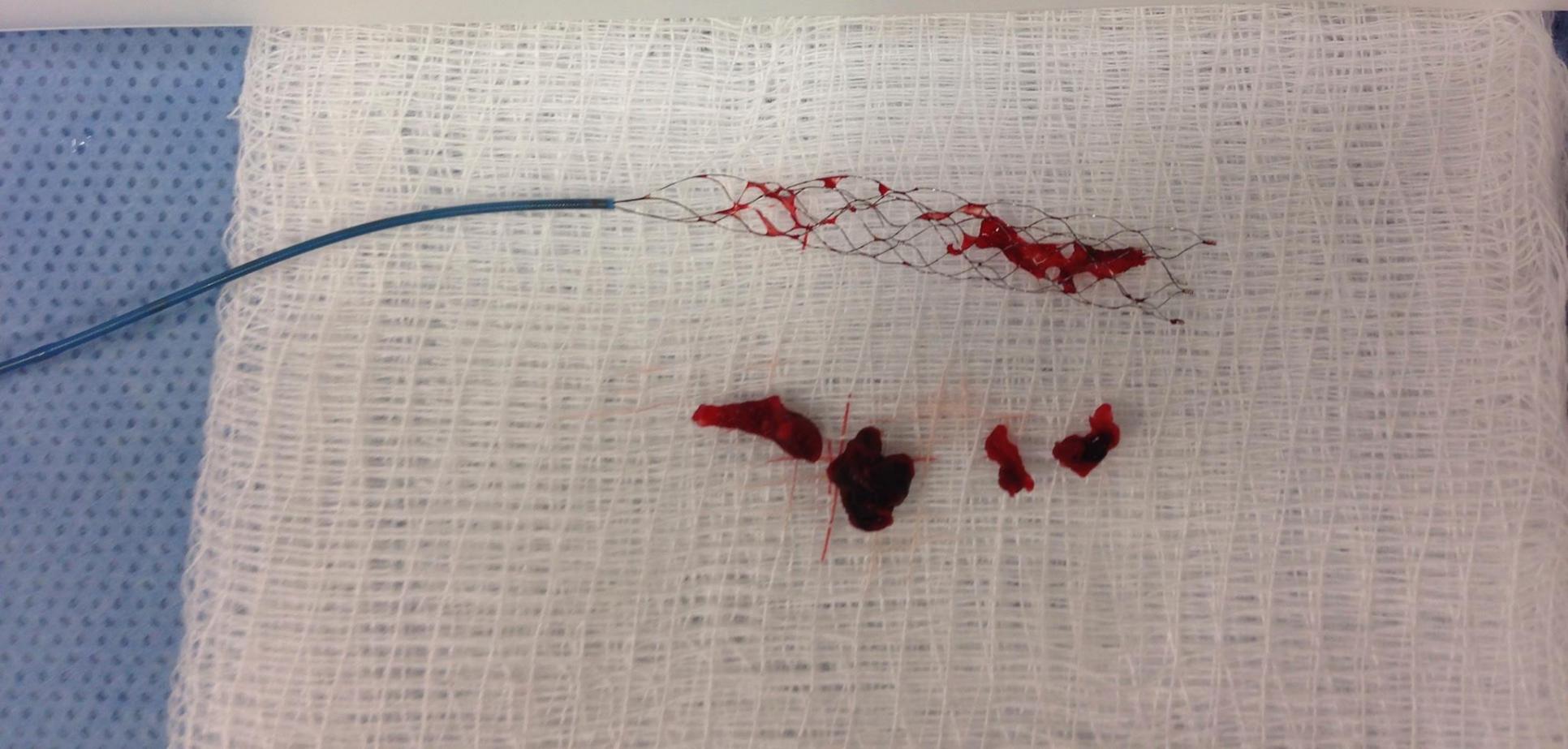
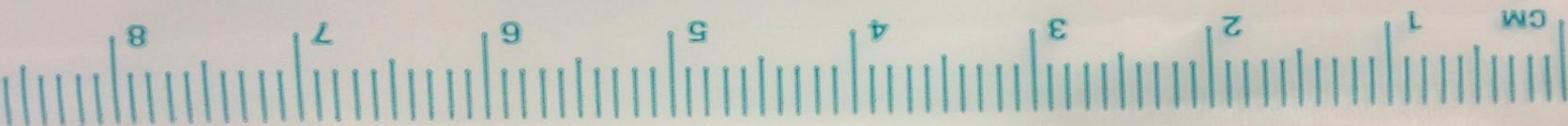
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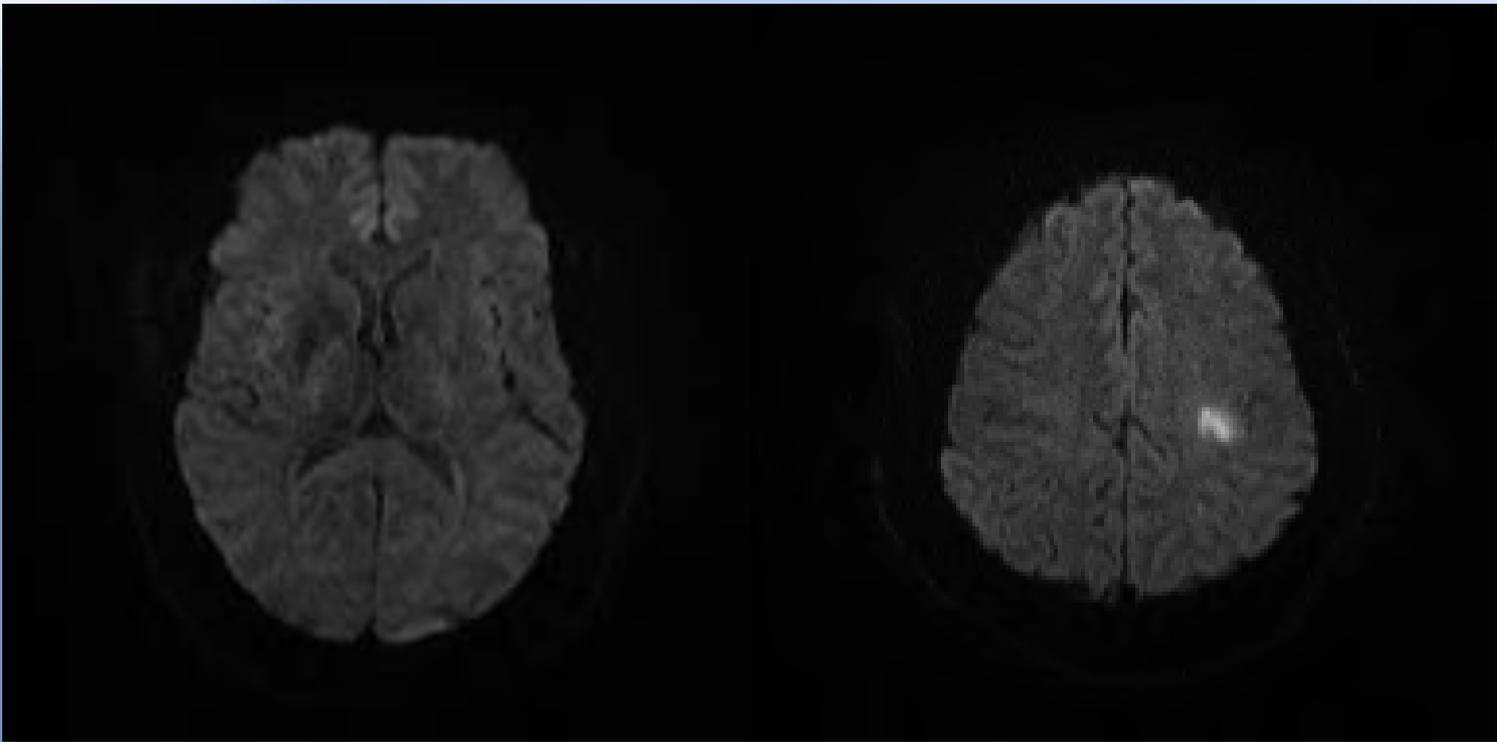


Attention, see
instructions
for use



Sterile unless
package is
damaged or open





Case 1

- Patient had complete recovery of her right hemiparesis and aphasia and discharged on anticoagulation for long-term management of her atrial fibrillation.
- NIHSS 28 dropped to 0 by discharge.



AHA/ASA Guideline

2015 AHA/ASA Focused Update of the 2013 Guidelines for the Early Management of Patients With Acute Ischemic Stroke Regarding Endovascular Treatment

A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

The American Academy of Neurology affirms the value of this guideline as an educational tool for neurologists.

Endorsed by the American Association of Neurological Surgeons (AANS); Congress of Neurological Surgeons (CNS); AANS/CNS Cerebrovascular Section; American Society of Neuroradiology; and Society of Vascular and Interventional Neurology

William J. Powers, MD, FAHA, Chair; Colin P. Derdeyn, MD, FAHA, Vice Chair;

José Biller, MD, FAHA; Christopher S. Coffey, PhD; Brian L. Hoh, MD, FAHA;

Edward C. Jauch, MD, MS, FAHA; Karen C. Johnston, MD, MSc;

S. Claiborne Johnston, MD, PhD, FAHA; Alexander A. Khalessi, MD, MS, FAHA;

Chelsea S. Kidwell, MD, FAHA; James F. Meschia, MD, FAHA;

Bruce Ovbiagele, MD, MSc, MAS, FAHA; Dileep R. Yavagal, MD, MBBS; on behalf of the

American Heart Association Stroke Council



Recommendations

Endovascular Interventions

1. Patients eligible for intravenous r-tPA should receive intravenous r-tPA even if endovascular treatments are being considered (*Class I; Level of Evidence A*). (Unchanged from the 2013 guideline)
2. Patients should receive endovascular therapy with a stent retriever if they meet all the following criteria (*Class I; Level of Evidence A*). (New recommendation):

Recommendations

- (a) prestroke mRS score 0 to 1,
- (b) acute ischemic stroke receiving intravenous r-tPA within 4.5 hours of onset according to guidelines from professional medical societies,
- (c) causative occlusion of the internal carotid artery or proximal MCA (M1),
- (d) age ≥ 18 years,
- (e) NIHSS score of ≥ 6 ,
- (f) ASPECTS of ≥ 6 , and
- (g) treatment can be initiated (groin puncture) within 6 hours of symptom onset

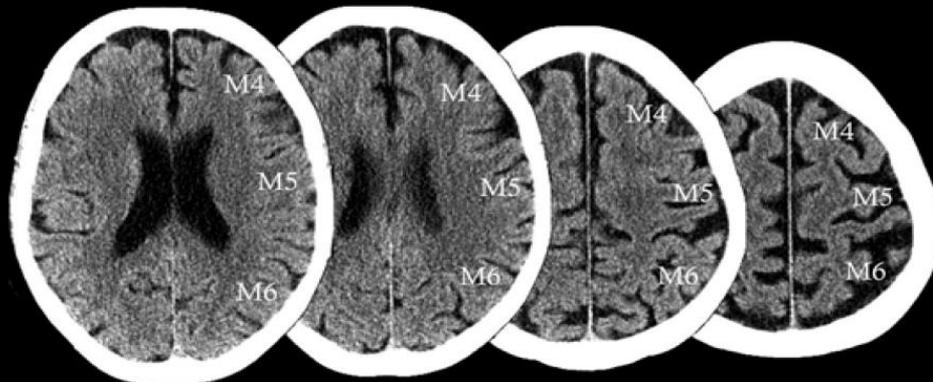
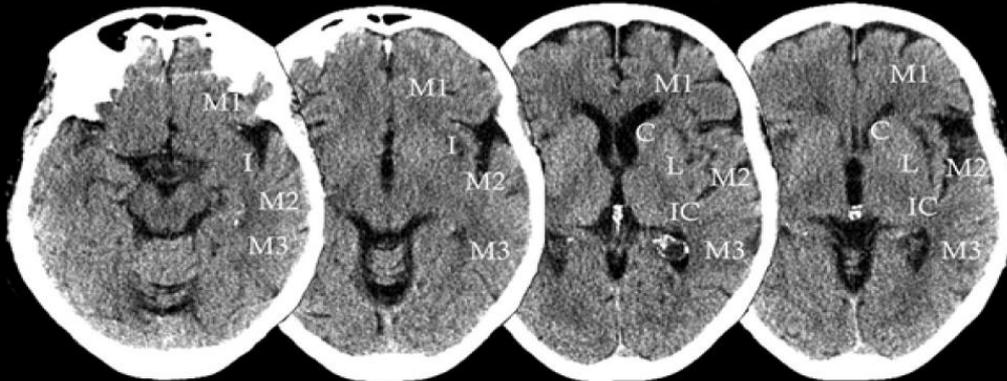
Recommendations

If endovascular therapy is contemplated, a noninvasive intracranial vascular study is strongly recommended during the initial imaging evaluation of the acute stroke patient but should not delay intravenous r-tPA if indicated. For patients who qualify for intravenous r-tPA according to guidelines from professional medical societies, initiating intravenous r-tPA before noninvasive vascular imaging is recommended for patients who have not had noninvasive vascular imaging as part of their initial imaging assessment for stroke. Noninvasive intracranial vascular imaging should then be obtained as quickly as possible (*Class I; Level of Evidence A*). (New recommendation)



ASPECT Score

Ganglionic Level



Supraganglionic Level

Examine all the images at the ganglionic and supra-ganglionic levels.

Take off 1 pt from 10 for every region that is affected

ASPECTS

8-10
core.

Small

6-7
core.

Moderate

0-5
core.

Large

CTA Collateral



Recommendations

Systems of Stroke Care

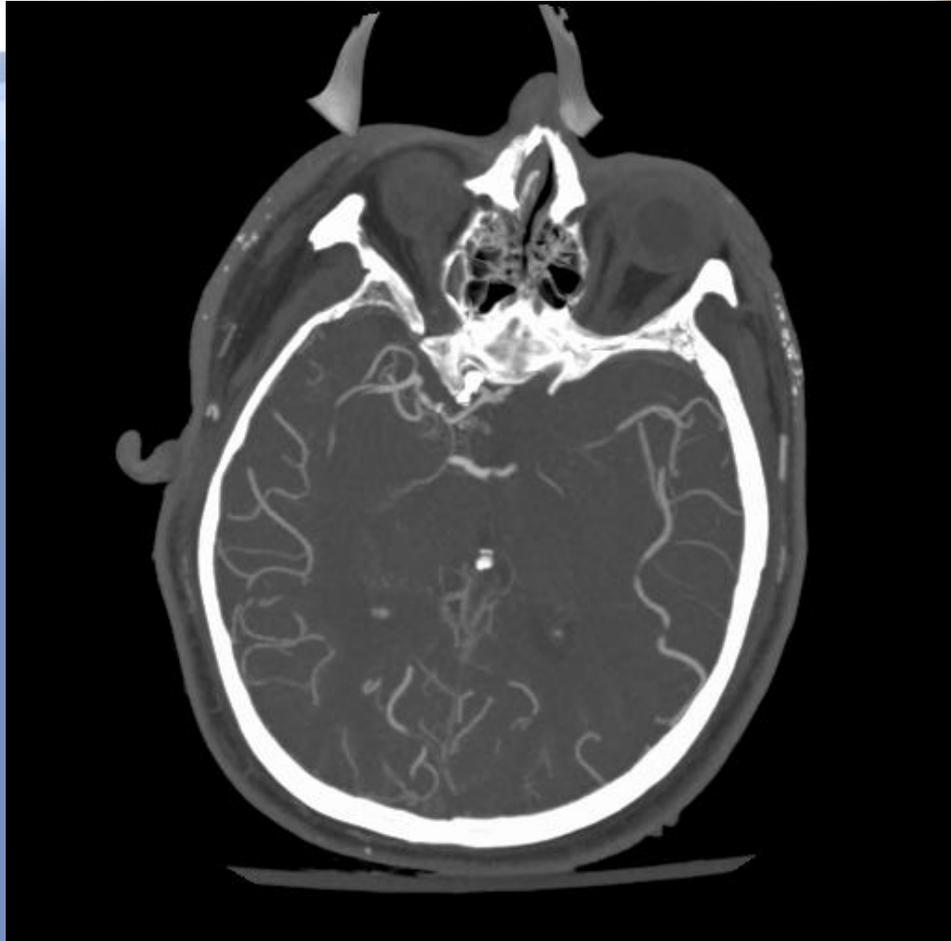
1. Patients should be transported rapidly to the closest available certified primary stroke center or comprehensive stroke center or, if no such centers exist, the most appropriate institution that provides emergency stroke care as described in the 2013 guidelines (*Class I; Level of Evidence A*). In some instances, this may involve air medical transport and hospital bypass. (Unchanged from the 2013 guideline)
2. Regional systems of stroke care should be developed. These should consist of consisting of:
 - (a) Healthcare facilities that provide initial emergency care including administration of intravenous r-tPA, including primary stroke centers, comprehensive stroke centers, and other facilities.
 - (b) Centers capable of performing endovascular stroke treatment with comprehensive periprocedural care, including comprehensive stroke centers and other healthcare facilities, to which rapid transport can be arranged when appropriate (*Class I; Level of Evidence A*). (Revised from the 2013 guideline)



Case 2

- 64 year-old male who ran out of anticoagulant for atrial fibrillation
- Witnessed fall at work
- Patient is aphasic with right hemiparesis

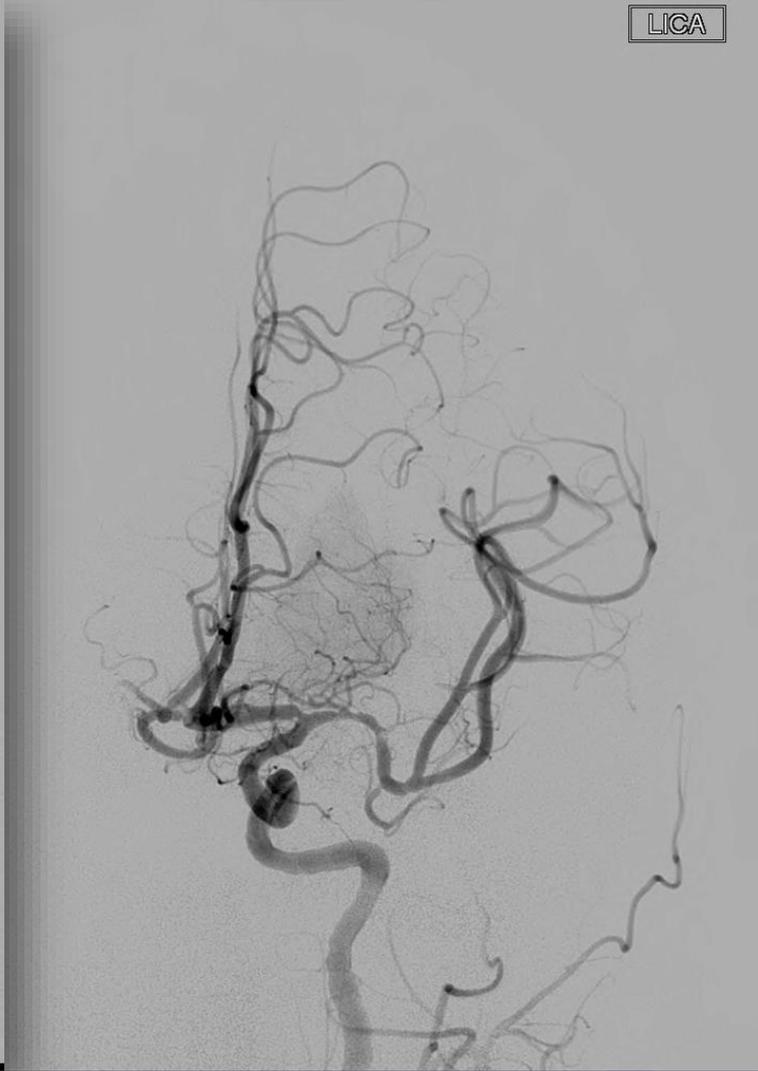


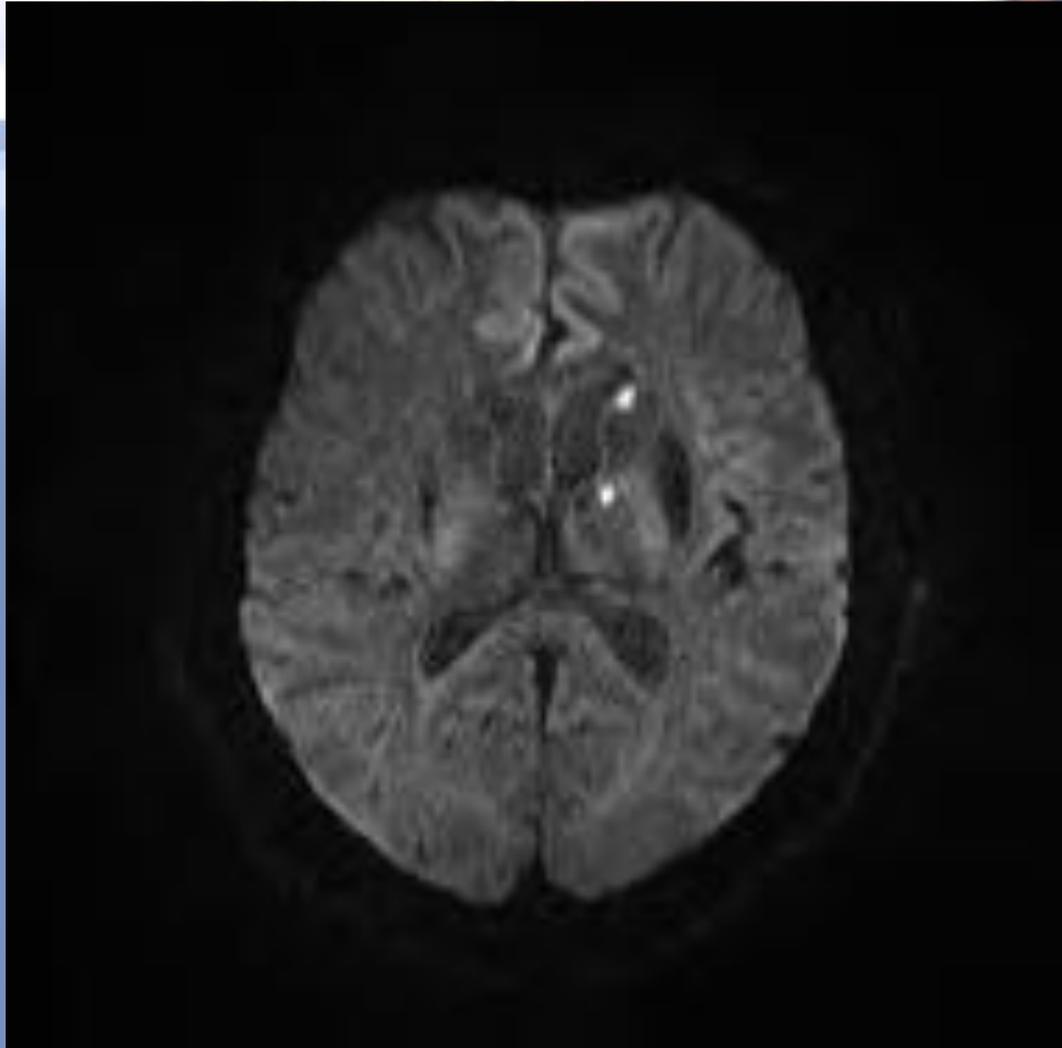






LICA



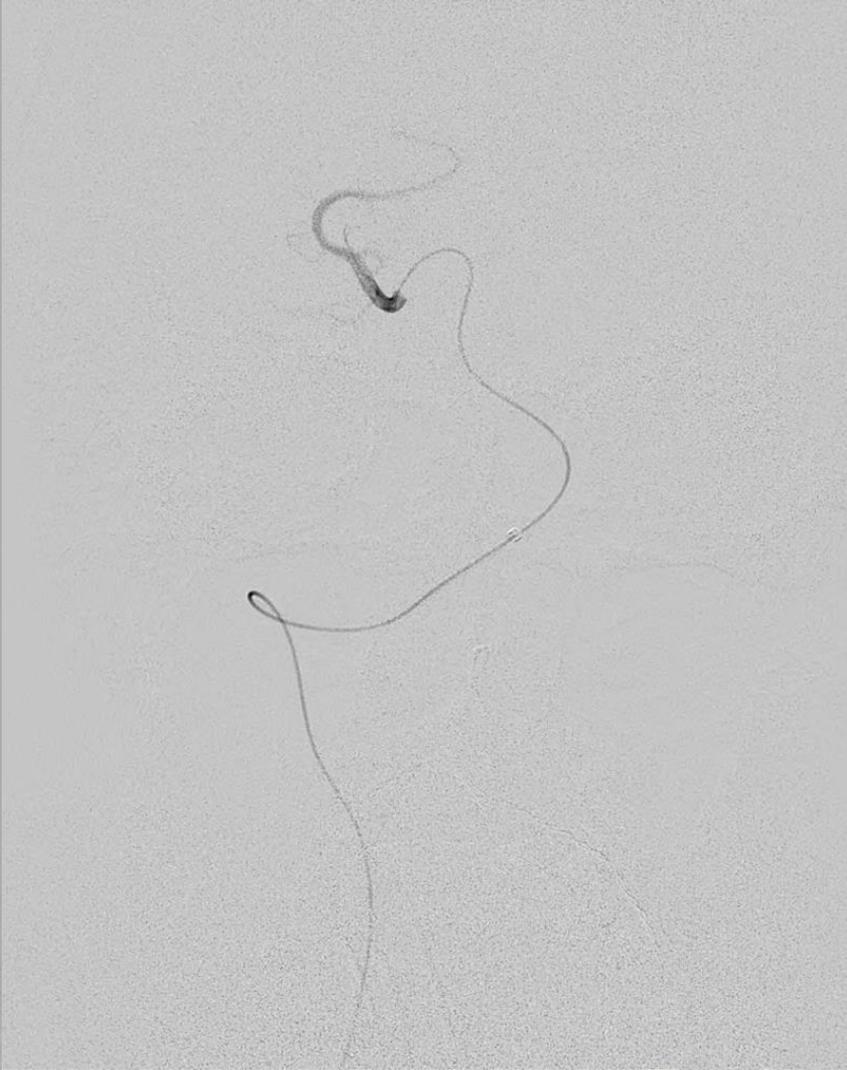


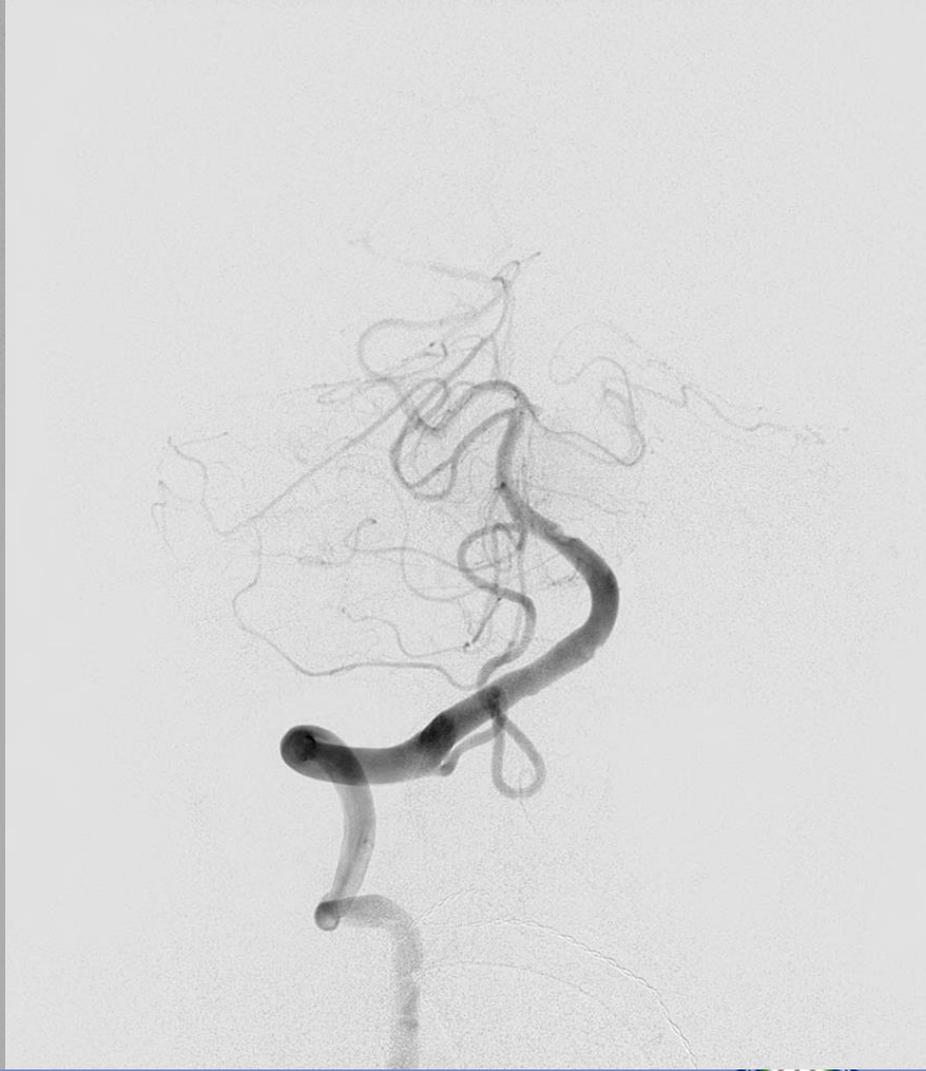
Case 3

- 60 year old male tourist with loss of consciousness on the bus
- Despite IV tPA, patient posturing
- Transferred from outside hospital







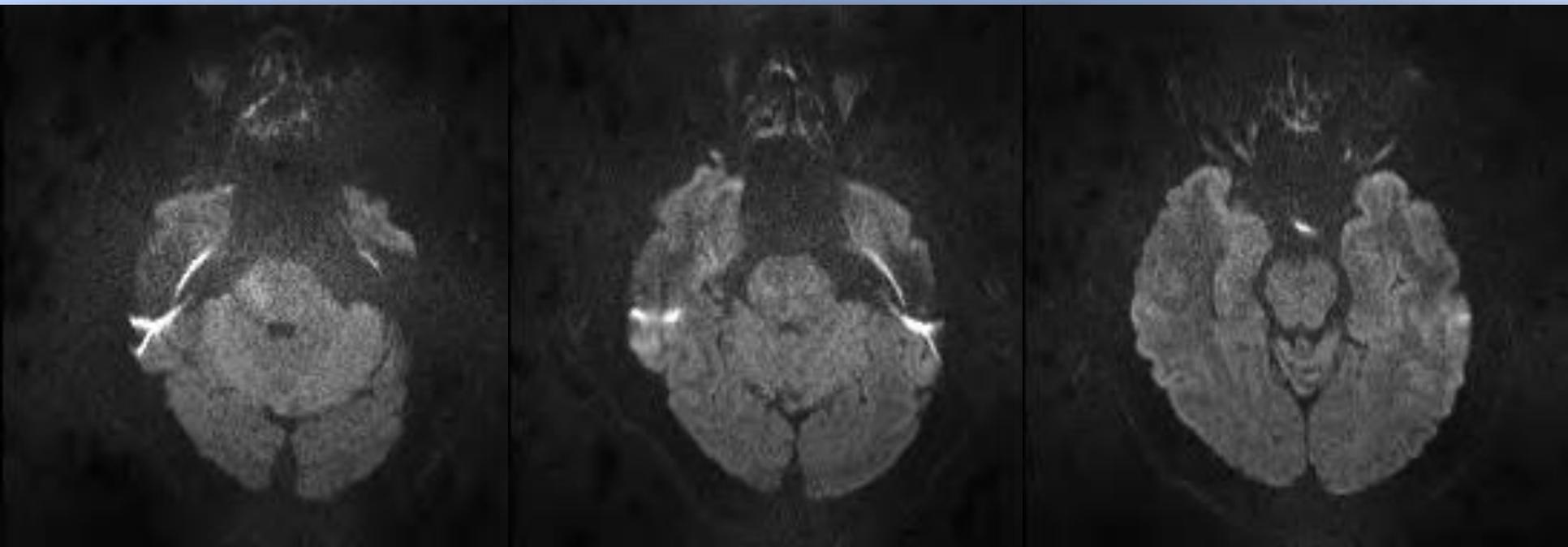




POST PLASTY

5X2 POWERFLEX







Thank You!

