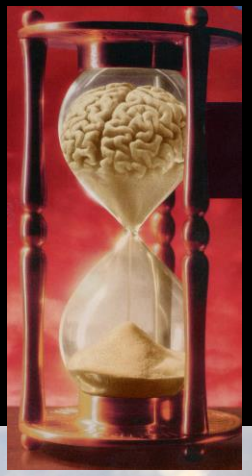
Endovascular Treatment of Stroke, Present and Future



Ajay K. Wakhloo, MD PhD FAHA

Professor of Radiology, Neurology and Neurosurgery,

Division Neuroimaging and Intervention & The New England Center for Stroke Research
Departments of Radiology, Neurology and Neurosurgery,

University of Massachusetts Medical School

UMASS

NEW ENGLAND CENTER FOR STROKE RESEARCH

DISCLOSURES

- Stryker Neurovascular (Consultant)
- Codman J&J (Consultant)
- InNeuroco (Stockholder, CMO)
- Pulsar (Bridge loan)
- Medtronic (Stockholder)
- Philips (MAB, Research Grant, Equipment support)
- Postgraduate Course Harvard Medical School (Speaker)
- Baptist Hospital, Miami, Florida (Speaker)
- NIH (R01 NS45753-01A1; 1R21EB007767-02;
- 5R01 NS045753-02; 1R21NS061132-01A1; 1R01NS091552-01A1)

Stroke in USA

- Stroke is the third cause of death and leading cause of disability in the United States
- 800,000 new or recurrent stroke per year
    - Approximately 87% ischemic
    - 40% due to large vessel occlusions
- Every 45 seconds someone in the U.S. has a stroke
- 160,000 fatal per year
- Stroke cost estimated at $62.7 billion in 2007
- iv t-PA only approved treatment of acute ischemic stroke within 3 h after symptom onset and approved in the US, Canada, Australia, and European Union
- April 1998 – March 1999 out of 14,295 inpatient with acute stroke, only 1.7% received t-PA (National Project of the US Centers for Medicare and Medicaid Service)
- 5-year recurrence rate for stroke 24-42%


The Economist
FEBRUARY 27TH–MARCH 4TH 2016
INDONESIA: A SPECIAL REPORT
Brexit: a threat to the West
Unjamming megacities
Why Apple is right
Hieronymus Bosch, painter of fear
Really?
LET'S MAKE AMERICA GREAT AGAIN

Successful Randomized Stroke Trials (2015)

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


Workflow and Intervention

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

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*

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 JANUARY 1, 2015 VOL. 372 NO. 1

A Randomized Trial of Intraarterial Treatment Ischemic Stroke

O.A. Berkhemer, P.S.S. Fransen, D. Beumer, L.A. van den Berg, H.F. Lingsma, A.J. Yoo, W.J. S P.J. Nederkoorn, M.J.H. Wermer, M.A.A. van Walderveen, J. Staals, J. Hofmeijer, J.A. G.J. Lycklama à Nijeholt, J. Boiten, P.A. Brouwer, B.J. Emmer, S.F. de Bruijn, L.C. van Dijk, 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 R.J. Dallinga, M.C. Visser, J.C.J. Bot, P.C. Vroomen, O. Eshghi, T.H.C.M.L. Schreuder, R.J. A.V. Tielbeek, H.M. den Hertog, D.G. Gerrits, R.M. van den Berg-Vos, G.B. Karas, E.W. S H.A. Marquering, M.E.S. Sprengers, S.F.M. Jenniskens, L.F.M. Beenen, R. van den Berg W.H. van Zwam, Y.B.W.E.M. Roos, A. van der Lugt, R.J. van Oostenbrugge, C.B.L.M. Majo for the MR CLEAN Investigators*

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

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. Dowlatshahi, 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*

Protocols

Solitaire™ with the Intention for Thrombectomy as Primary Endovascular Treatment for Acute Ischemic Stroke (SWIFT PRIME) trial: protocol for a randomized, controlled, multicenter study comparing the Solitaire revascularization device with IV tPA with IV tPA alone in acute ischemic stroke

Jeffrey L. Saver[1]*, Mayank Goyal[2,3], Alain Bonafe[4], Hans-Christoph Diener[5], Elad I. Levy[6], Vitor M. Pereira[7], Gregory W. Albers[8], Christophe Cognard[9], David J. Cohen[10], Werner Hacke[11], Olav Jansen[12], Tudor G. Jovin[13], Heinrich P. Mattle[14], Raul G. Nogueira[15], Adnan H. Siddiqui[16], Dileep R. Yavagal[17], Thomas G. Devlin[18], Demetrius K. Lopes[19], Vivek Reddy[13], Richard du Mesnil de Rochemont[20], Reza Jahan[21], and for the SWIFT PRIME Investigators

Stroke Program at UMASS

- Educatio

- Initial
- Arri
- Act
  Ne
  tech
- Asses
- Advance
- Advance to Th

ders)

ED, Stroke

y

, MRI)

A, Thrombectomy)

Goal: time to needle <30 min currently ~60min

Time matters

- Overall rate of successful revascularization in Solitaire-treated patients (mTICI 2b/3): 77% (236/306)
- Rate of independence significantly increased with improved mTICI (p=0.01 for trend)

mTICI	0-1	2a	2b	3
mRS 0-2 - n (%)	8/21 (38%)	25/49 (51%)	62/117 (53%)	77/119 (65%

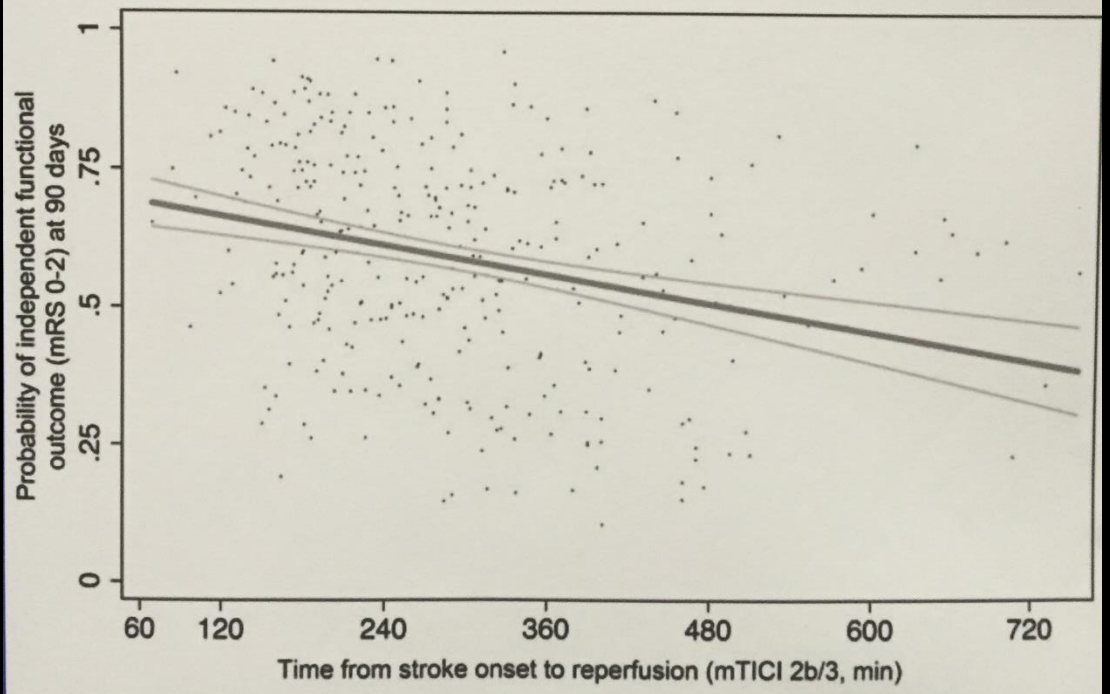


Figure 3: Rate of independence significantly decreased with increased time to reperfusion (OR 0.99 per minute, p=0.011) 1% decline in mRS 0-2 per 23 minute delay, p=0.01 for trend effect likely reduced by imaging selection for good collateral/mismatch imaging patterns

Development of Stroke Centers

Formation of a team at UMASS

> 60 people involvement at various levels including administration, MBAs, physicians, PA, NP, technologist

<u>Goal:</u>
Duplication of STEMI project UMASS

UMASS

Market Size and Development

J.P.Morgan

North America Equity Research
13 October 2015

Table 1: Stent Retriever Trials That Didn't Include Modern Endpoints or Patient Selection

	SWIFT 2012	TREVO 2012	STAR 2012	NASA Registry 2013
Number of Patients	89	88	202	354
TICI 2b/3 (Partial and Complete Revascularization)	76%	68%	85%	73%
Puncture to Revascularization	-	-	-	50 min
Symptomatic Intracranial Hemorrhage	8.6%	9.0%	7.5%	-
Modified Rankin Score ≤2 at 90 Days	36%	40%	55%	42%

Source: Turk et al. Journal of NeuroInterventional Surgery 2014

Table 2: Stent Retriever Trials with Modern Endpoints and Patient Selection Compared to MULTI MERCI

	MULTI MERCI 2005	MR CLEAN 2014	ESCAPE 2015	SWIFT PRIME 2015	EXTEND IA 2015
Device	Merci	Mostly Stent Retriever	Mostly Stent Retriever	Solitaire FR	Solitaire FR
% Stent Retrievers	100%	82%	86%	100%	100%
Number of Patients	81	233	165	98	35
Trial Completion	Completed	Completed	Stopped Early	Stopped Early	Stopped Early
Average ASPECTS Score	-	9 (7-10)	9 (8-10)	9 (7-10)	-
TICI 2b/3 (Partial and Complete Revascularization)	70%	59%	72%	88%	86%
TICI 3 (Complete Revascularization)	14%	24%	-	69%	48%
Puncture to Revascularization	91 min	-	33 min	29 min	43 min
Symptomatic Intracranial Hemorrhage	8.0%	7.7%	3.6%	1.0%	0.0%
Modified Rankin Score ≤2 at 90 Days	27%	33%	53%	60%	72%

Source: Smit et al. Stroke 2005; Berkhemer et al. *NEJM* 2015; Goyal et al. *NEJM* 2015; Jahan et al. *NEJM* 2015; Campbell et al. *NEJM* 2015

Table 5: J.P. Morgan US Stroke Market Model

	2014	2015E	2016E	2017E	2018E	2019E	2020E
US Stroke Patients	795,000	818,850	843,416	868,718	894,780	921,623	949,272
% Ischemic	87%	87%	87%	87%	87%	87%	87%
US Ischemic Stroke Patients	691,650	712,400	733,771	755,785	778,458	801,812	825,866
% Large Vessel Strokes	43%	43%	43%	43%	43%	43%	43%
US Large Vessel Strokes	297,410	306,332	315,522	324,987	334,737	344,779	355,122
% Treatable with Salvageable Tissue	50%	50%	50%	50%	50%	50%	50%
US Ischemic Stroke Patients with ELVO	148,705	153,166	157,761	162,494	167,369	172,390	177,561
% of US Ischemic ELVO Patients Treated	7.9%	11.5%	13.8%	17.3%	21.0%	25.0%	28.5%
US Ischemic ELVO Patients Treated	**11,750**	**17,616**	**21,695**	**28,033**	**35,150**	**43,100**	**50,608**

Table 6: J.P. Morgan European Stroke Market Model

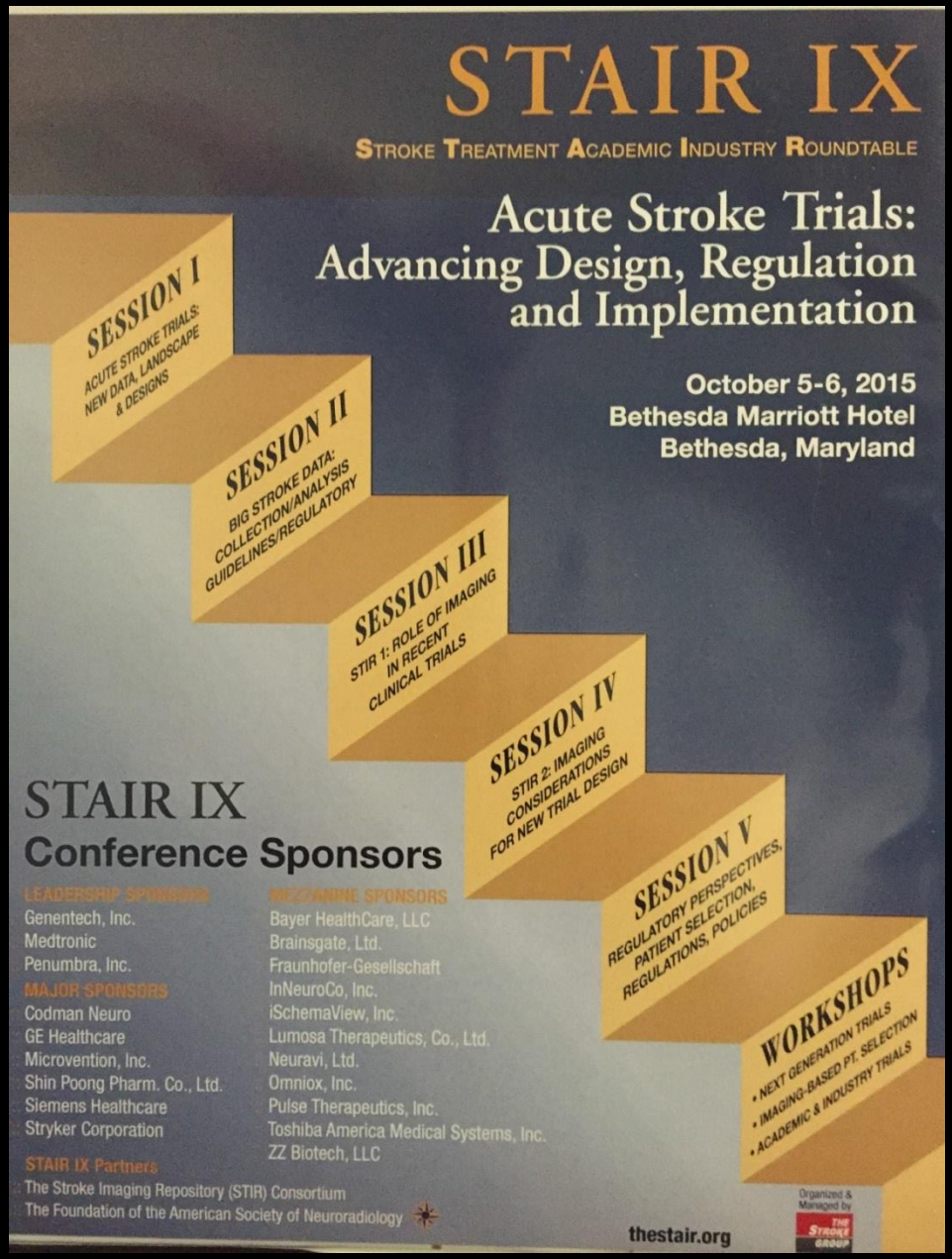
	2014	2015E	2016E	2017E	2018E	2019E	2020E
Total EU Stroke Patients	800,000	800,000	800,000	800,000	800,000	800,000	800,000
% Ischemic	85%	85%	85%	85%	85%	85%	85%
EU Ischemic Stroke Patients	680,000	680,000	680,000	680,000	680,000	680,000	680,000
% Large Vessel Strokes	40%	40%	40%	40%	40%	40%	40%
EU Large Vessel Strokes	272,000	272,000	272,000	272,000	272,000	272,000	272,000
% Treatable with Salvageable Tissue	50%	50%	50%	50%	50%	50%	50%
EU Ischemic Stroke Patients with ELVO	136,000	136,000	136,000	136,000	136,000	136,000	136,000
% of EU Ischemic ELVO Patients Treated	7.5%	15.0%	21.0%	27.5%	34.0%	41.0%	48.0%
EU Ischemic ELVO Patients Treated	**10,250**	**20,450**	**28,610**	**37,450**	**46,290**	**55,810**	**65,330**

Table 7: US Stroke Market Shares

	2014	2015E	2016E	2017E	2018E	2019E	2020E
US Aspiration Catheter Sales							
Penumbra	35.3	50.8	59.3	72.2	85.1	98.9	109.8
Other	2.5	6.0	10.9	18.6	29.1	41.4	55.3
Total US Sales	$37.8	$56.8	$70.1	$90.8	$114.2	$140.3	$165.1
Penumbra	94%	90%	85%	80%	75%	71%	67%
Other	6%	11%	16%	21%	26%	30%	34%
US Stent Retriever Sales							
Medtronic	41.0	60.0	69.4	81.1	91.9	101.4	106.8
Stryker	22.1	33.5	39.6	48.8	58.5	68.3	76.3
Penumbra	0.0	0.0	0.0	2.7	6.3	10.8	15.9
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total US Sales	$63.1	$93.5	$109.0	$132.6	$156.7	$180.5	$199.1
Medtronic	65%	64%	64%	61%	59%	56%	54%
Stryker	35%	36%	36%	37%	37%	38%	38%
Penumbra	0%	0%	0%	2%	4%	6%	8%
Other	0%	0%	0%	0%	0%	0%	0%
Total US Stroke Market							
Penumbra	35.3	50.8	59.3	74.9	91.3	109.7	125.7
Medtronic	41.0	60.0	69.4	81.1	91.9	101.4	106.8
Stryker	22.1	33.5	39.6	48.8	58.5	68.3	76.3
Other	2.5	6.0	10.9	18.6	29.1	41.4	55.3
US Stroke Market	**$100.9**	**$150.3**	**$179.1**	**$223.5**	**$270.8**	**$320.8**	**$364.1**
Penumbra	35%	34%	33%	34%	34%	34%	35%
Medtronic	41%	40%	39%	36%	34%	32%	29%
Stryker	22%	22%	22%	22%	22%	21%	21%
Other	2%	4%	6%	8%	11%	13%	15%

Table 8: OUS Stroke Market Shares

	2014	2015E	2016E	2017E	2018E	2019E	2020E
OUS Aspiration Catheter Sales							
Penumbra	32.0	46.3	55.4	63.9	72.4	80.0	86.9
Other	10.0	12.1	19.4	28.5	38.9	51.2	66.0
Total US Sales	$42.0	$58.5	$74.8	$92.4	$111.3	$131.2	$152.9
Penumbra	76%	79%	74%	69%	65%	61%	57%
Other	24%	21%	26%	31%	35%	39%	43%
OUS Stent Retriever Sales							
Medtronic	39.0	51.9	63.3	74.2	84.3	93.4	101.8
Stryker	22.1	33.5	42.3	51.3	60.0	68.7	77.2
Penumbra	0.0	0.4	1.4	2.8	4.4	6.2	8.3
Other	32.5	41.7	50.9	59.7	67.5	74.7	81.2
Total US Sales	$93.6	$127.5	$157.9	$188.0	$216.2	$243.1	$268.5
Medtronic	42%	41%	40%	39%	39%	38%	38%
Stryker	24%	26%	27%	27%	28%	28%	29%
Penumbra	0%	0%	1%	2%	2%	3%	3%
Other	35%	33%	32%	32%	31%	31%	30%
Total OUS Stroke Market							
Penumbra	32.0	46.7	56.8	66.8	76.7	86.2	95.1
Medtronic	39.0	51.9	63.3	74.2	84.3	93.4	101.8
Stryker	22.1	33.5	42.3	51.3	60.0	68.7	77.2
Other	42.5	53.9	70.3	88.1	106.4	125.9	147.2
OUS Stroke Market	**$135.6**	**$186.0**	**$232.7**	**$280.4**	**$327.4**	**$374.3**	**$421.3**
Penumbra	24%	25%	24%	24%	23%	23%	23%
Medtronic	29%	28%	27%	26%	26%	25%	24%
Stryker	16%	18%	18%	18%	18%	18%	18%
Other	31%	29%	30%	31%	32%	34%	35%



1. Consensus Statement on Imaging Selection and Outcomes in Acute Stroke Reperfusion Clinical Trials

Steven J. Warach, Marie Luby, Gregory W. Albers, et al. for the STAIR IX Consortium

2. STROKE TREATMENT ACADEMIC INDUSTRY ROUNDTABLE - The Next Generation of Endovascular Trials

Tudor G. Jovin[1], MD, Gregory W. Albers[2], MD, David S. Liebeskind[3], MD for the STAIR IX Consortium

In the MR CLEAN trial, the key imaging findings included a

1) clear benefit of endovascular therapy for NCCT ASPECTS scores of 5-10

2) good and moderate collateral score was also associated with a large benefit of endovascular therapy

3) Perfusion CT (PCT) mismatch (CBV and MTT thresholds) predicted functional outcome, the relative treatment effect in patients with and without mismatch was similar.

4) The use of an ischemic core volume >70mL on PCT criterion did identify a group of patients with very low rates of independent outcome (1/13 [8%])

Proposed imaging methods for patient selection

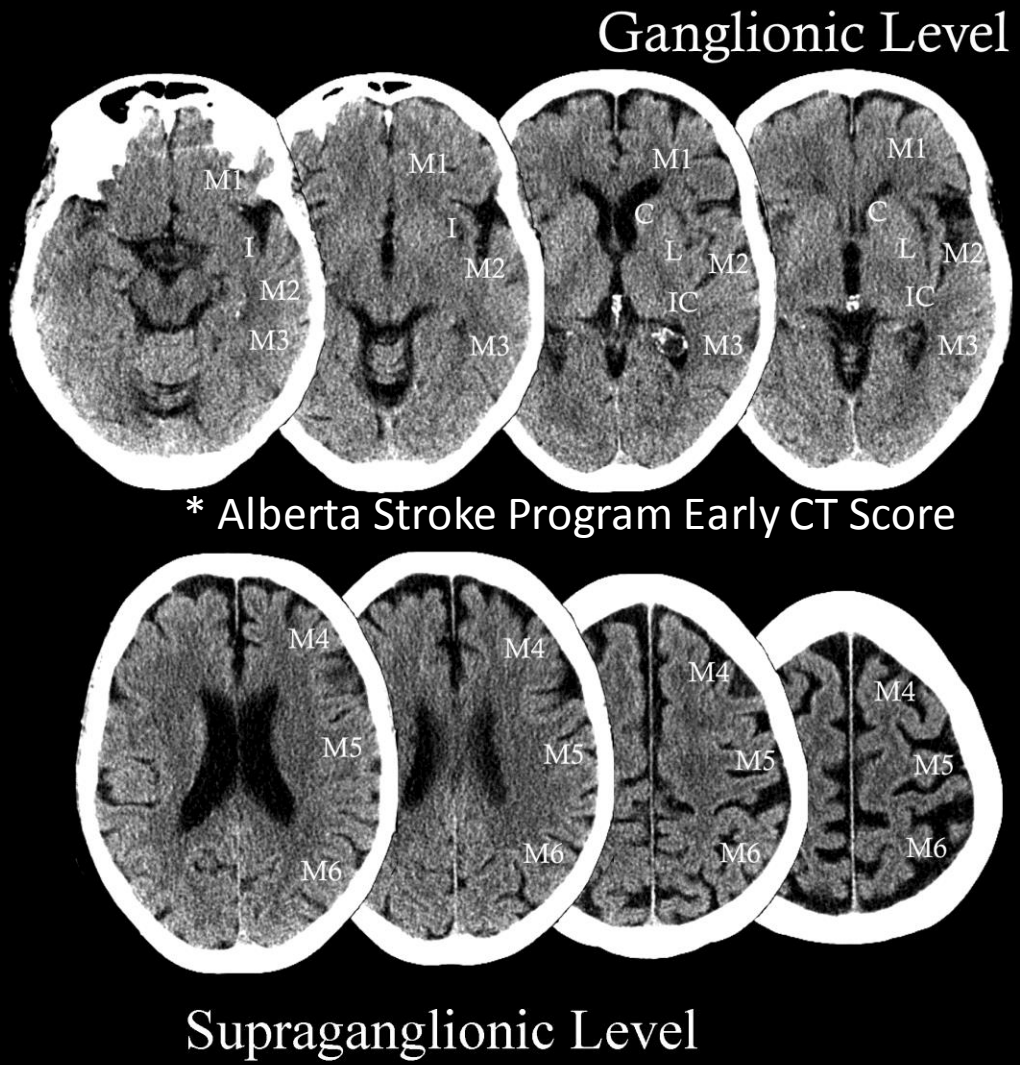
TRAIT	Proposed imaging methods
Artery occlusion	• CTA • MRA • Catheter angiography
Core	• ASPECTS on NCCT • Volume of severely decreased CBV or CBF from PCT • Volume of acute DWI lesion from MRI
Mismatch	• Volume of perfusion lesion (by PCT, MRP or ASL) to core volume
Cerebral collaterals	• CTA source images • Single- or multiphasic CTA • Contrast-enhanced MRA • Catheter angiography

I. Imaging Selection

1. Non contrast CT (NCCT) ASPECTS *

0-4 poor outcome
> 6 good outcome
>70 mL ischemic core volume predict low rate of independent outcome (<10% mRS 0-2)

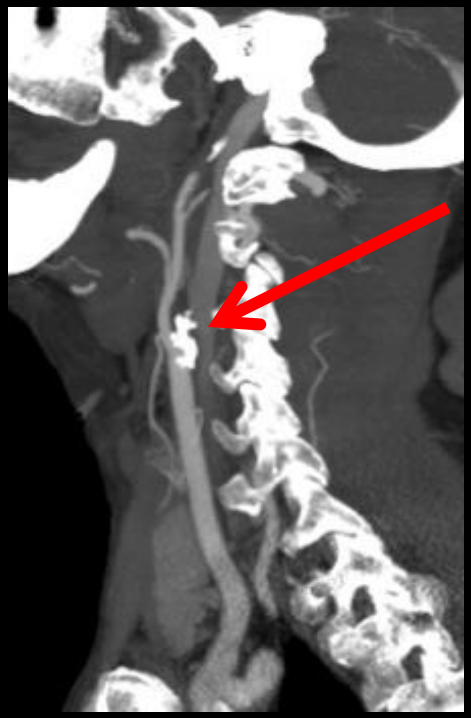
Orbito-meatal line
FOV 240mm
KV 140
mAS 450
Collimation 1x50
Slice thickness 5mm
Window setting cerebrum and bone



* Alberta Stroke Program Early CT Score

I. Imaging Selection

2. CT-Angiography (multiphase)



extracranial
R ICA occlusion

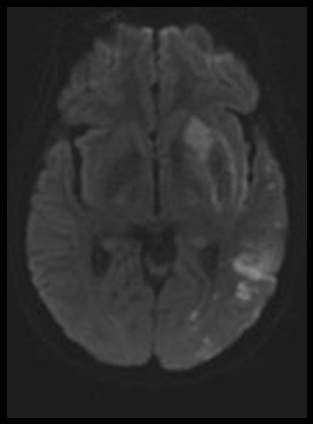
Extracranial

- occlusion (CAS)
- tortuosity
- selection of access products

Intracranial

- occlusion site
- occlusion length
- plaque characteristics
- collaterals
  - (poor, moderate, good)

3. Role of MRI/DWI/FLAIR



- posterior circulation
- delayed treatment (>6 hrs)
- CT questionable
- MRI availability

I. Imaging Selection

4. Role of collaterals

poor
moderate
excellent

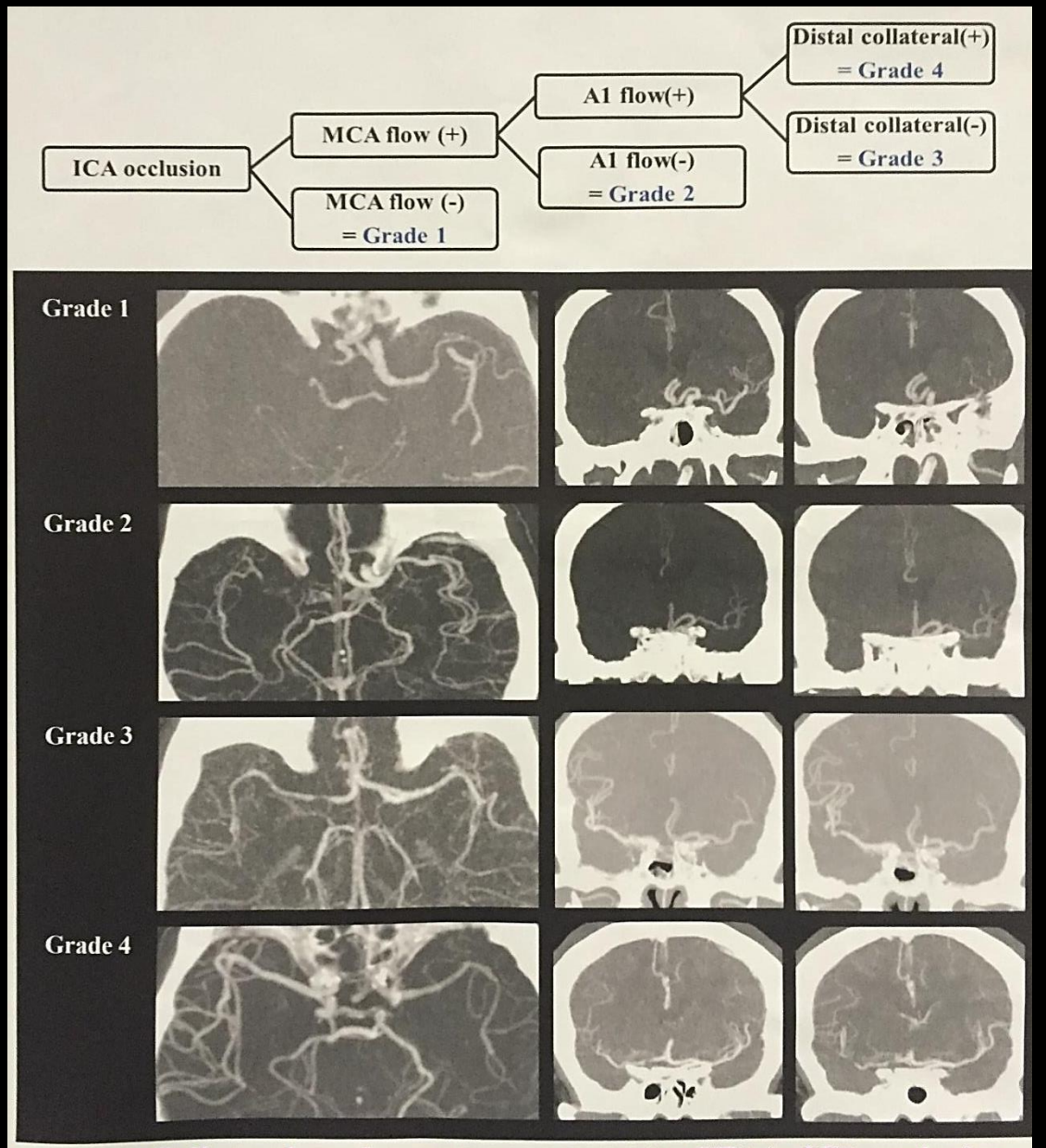


Figure1. Collateral grades system assessed by CTA in ICA occlusion

Paradigm shift related to Collaterals

- IMS 3: every 30 min delay in reperfusion is associated with a 10% relative reduction in probability of good clinical outcome (mRS 0-2, Khatri et al.)

- REVASCAT: 5% reduction for every 30 min delay (Tudor et al.)

New Trials to understand collaterals

- DEFUSE 3: N…e, randomized, multicent…nt trial, diffusio…match ratio >1.8, n… ml,
- DAWN: …ectomy device), v… T occl) core and clinical …n and consideration of …

Goal: understanding collaterals to differentiate "fast progressors" from "slow progressors" (20-30% of pat with ELVO???)

I. Imaging Selection

5. CT-Perfusion

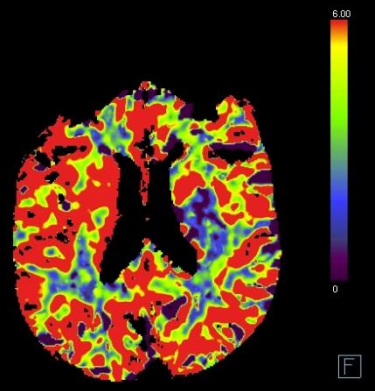
Cerebral Blood Volume (CBV)

Cerebral Blood Flow (CBF)

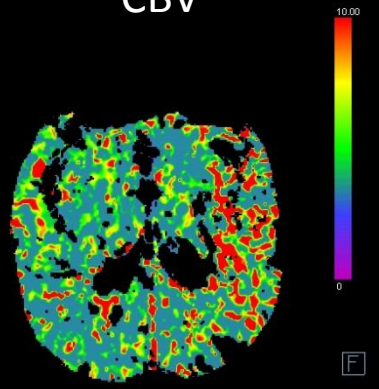
Mean Transit Time (MTT)

Time to Peak (TTP)

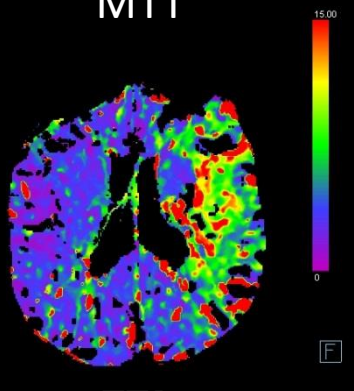
Time to Drain (TTD)



CBV



MTT

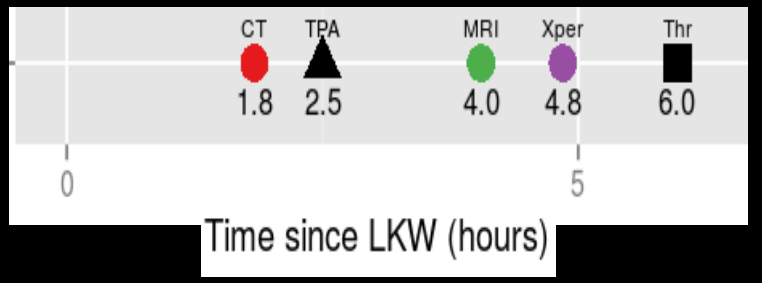


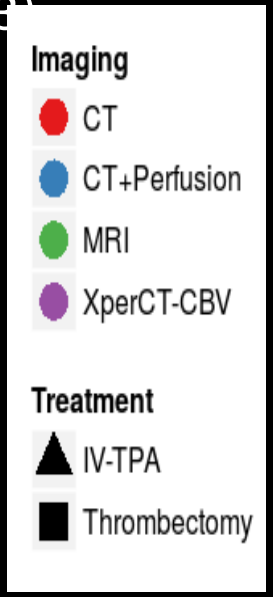
TTD

Stroke CBV

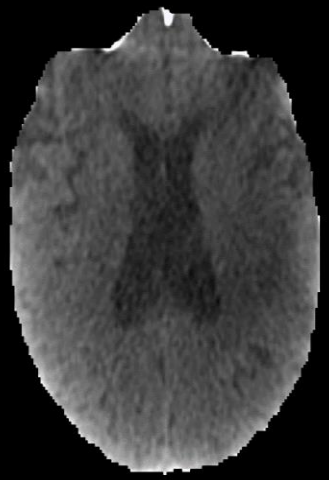
Case #11

Female, 78 y/o
NIHSS: 20
Left MCA mid-distal M2-segment
i.v. TPA
Thrombectomy/aspiration (TICI 3)

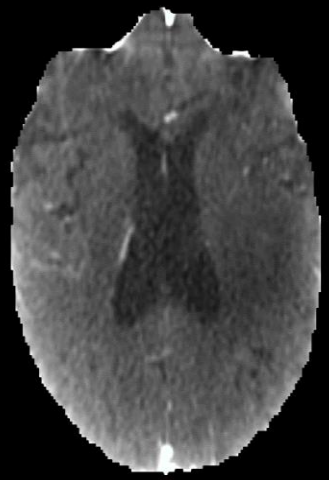




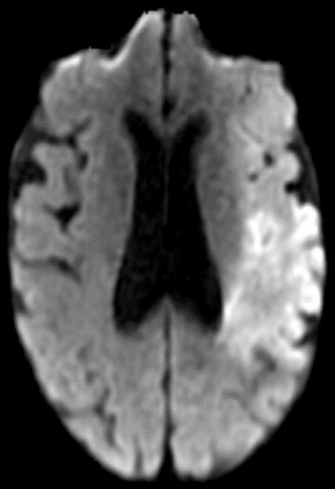
XperCT
no contrast



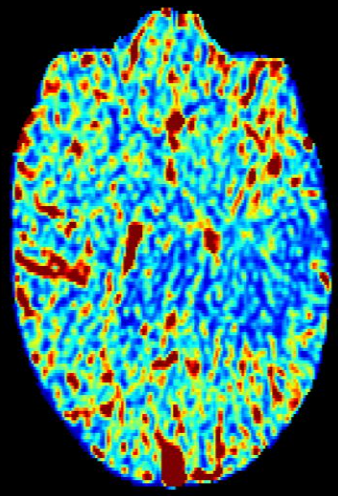
XperCT
with contrast



Pre-treatment MRI
DWI



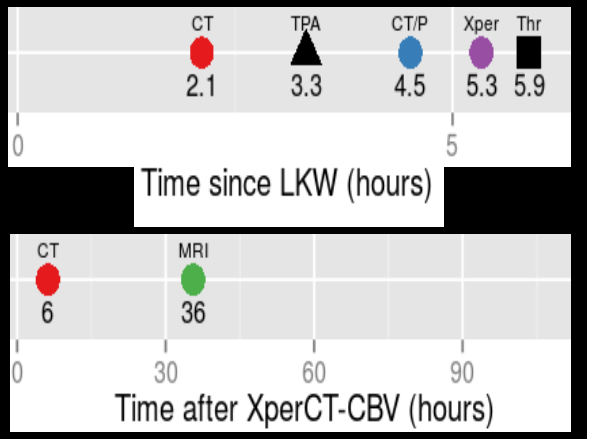
XperCT
CBV

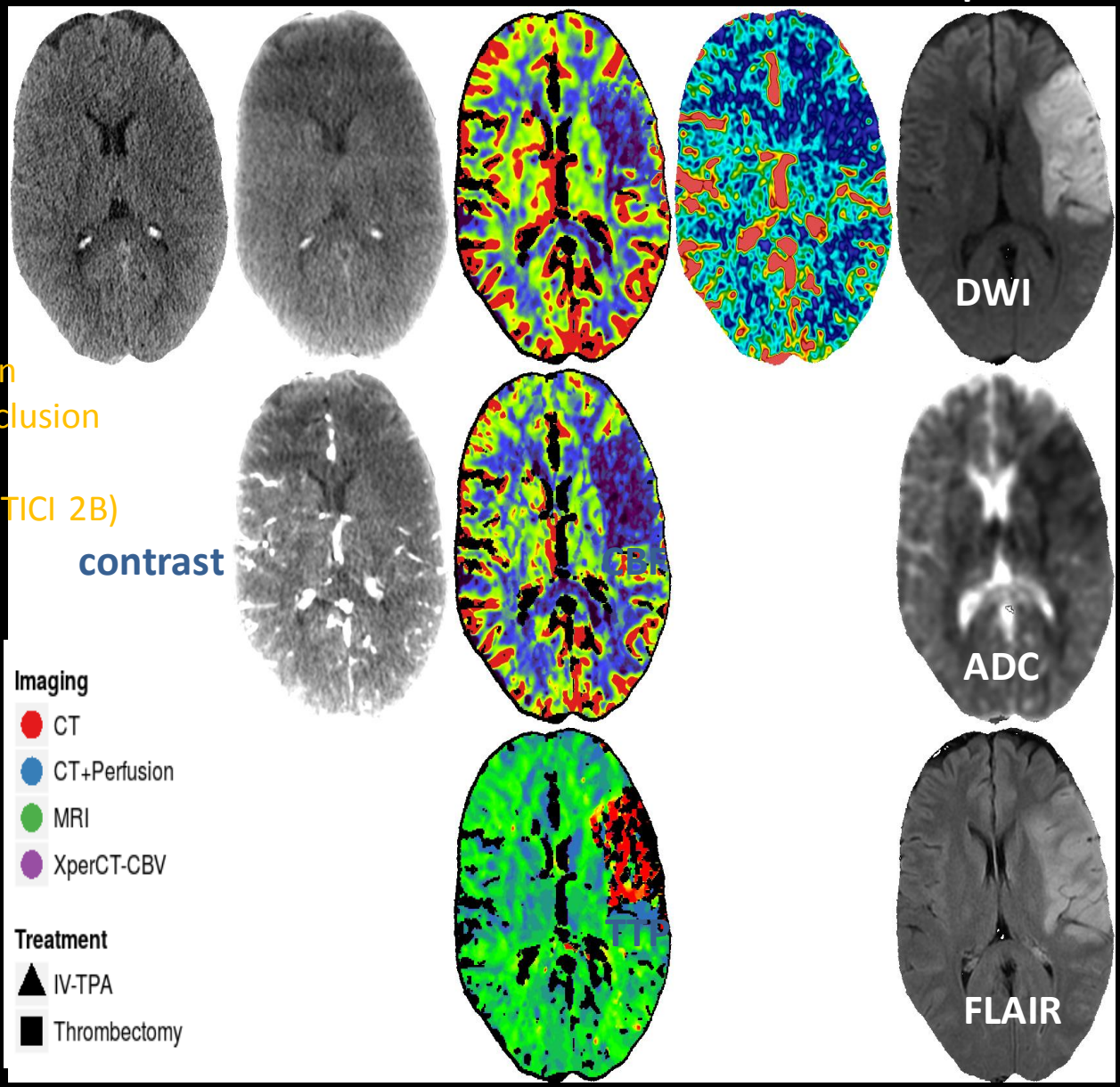


Stroke CBV

Case #21

Female, 37 y/o
NIHSS: 21
ASPECTS: 6-7/10
Mismatch CBV-CBF on CT Perfusion
Left M2/MCA superior division occlusion
i.v. TPA
2-pass thrombectomy/aspiration (TICI 2B)





II. Anesthesia

1. Conscious Sedation
Cooperative patients
Non-dominant hemisphere

2. MAC
Not cooperative patient
Dominant hemisphere
Posterior circulation

3. GA Intracranial
Not cooperative patient
Dominant hemisphere
Posterior circulation
Large infarct

Blood pressure control (systol > 160 mm Hg until revasc)

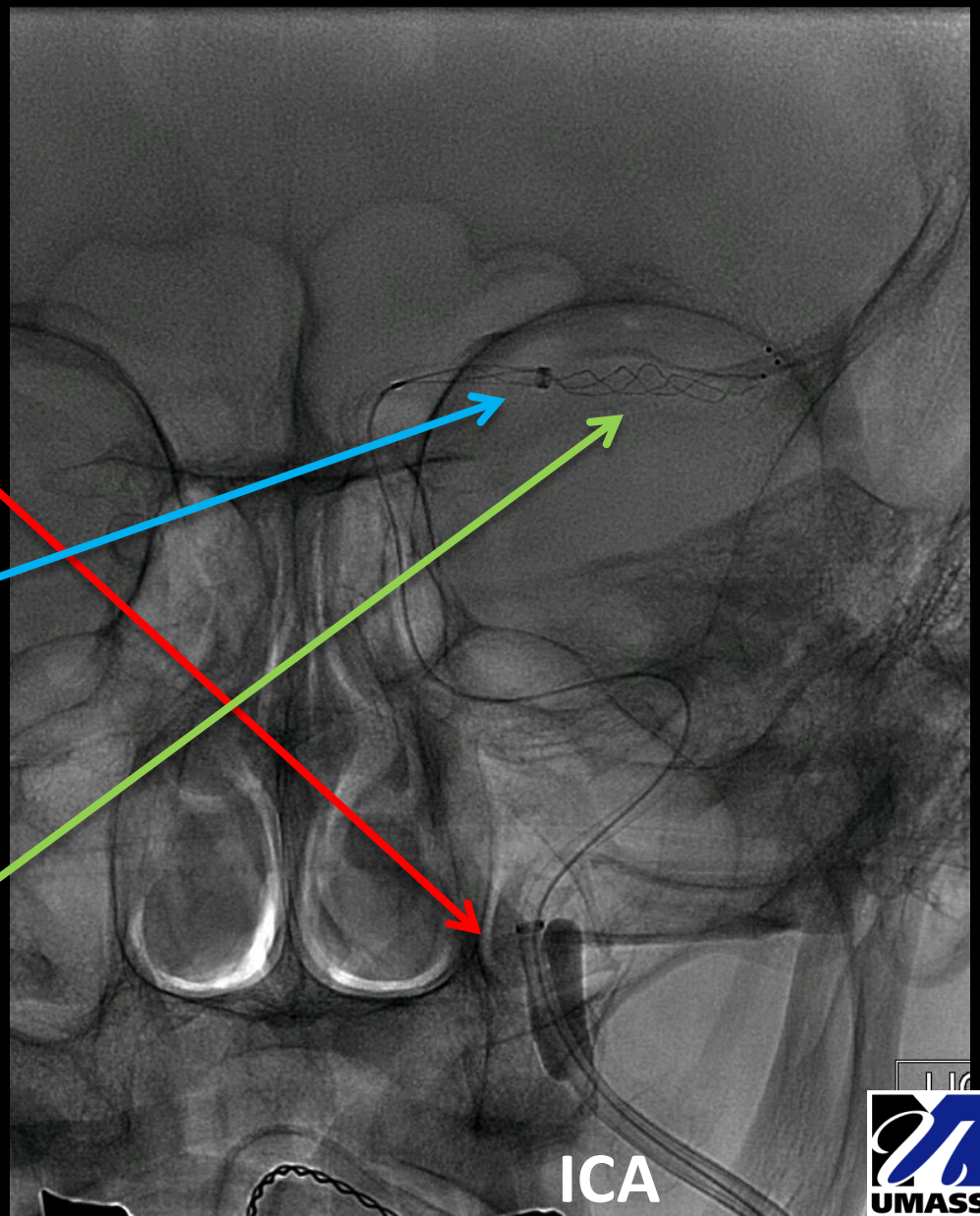
A-line generally not needed

Airways protection

NG tube for antiplatelets if needed

III. Technology and IV. Techniques

1. Femoral Access 8 F Sheath
2. 8 F Balloon Guide Catheter
3. 6 F Intermediate catheter for suction
4. Microcatheter over microwire
5. Thrombectomy device



II. Solitaire/Trevo mechanical Thrombectomy Device Selection

Stent-like clot retriever

RETRIEVABLE CLOSED CELL INTRACRANIAL STENT FOR FOREIGN BODY AND CLOT REMOVAL

Ajay K. Wakhloo, M.D., Ph.D.
Departments of Radiology, Neurosurgery, and Neurology, University of Massachusetts Medical School, Worcester, Massachusetts

Matthew J. Gounis, Ph.D.
Department of Radiology, University of Massachusetts Medical School, Worcester, Massachusetts

Reprint requests:
Ajay K. Wakhloo, M.D., Ph.D., Division of Neuroimaging and Intervention, Departments of Radiology, Neurology, and Neurological Surgery, University of Massachusetts Medical School, 55 Lake Avenue North, Worcester, MA 02481.
Email: wakhlooA@ummhc.org

OBJECTIVE: To assess the technical feasibility of using a retrievable, closed cell intracranial stent delivered through a microcatheter for safe removal of foreign bodies or clot.

METHODS: In vitro and in vivo testing were performed to demonstrate the feasibility of using retrievable intracranial stents for foreign body or clot removal. In vitro testing was performed in an anatomically correct silicone vascular replica by partially deploying the stent around a coil, then retracting the stent into the microcatheter to trap the coil. Withdrawal of the stent delivery system into the guide catheter resulted in coil removal. Subsequently, the technique was evaluated in a porcine model of intracranial aneurysms, wherein both fresh clot and herniated coils were extracted from the carotid arteries.

RESULTS: In these experimental procedures, both herniated coils and fresh clot were safely and easily removed from the in vitro and in vivo models. No periprocedural adverse events were observed.

CONCLUSION: These in vitro and in vivo studies suggest the potential use of retrievable stents for the removal of foreign bodies or clot from the intracranial circulation.

KEY WORDS: Aneurysm, Angiography, Clot, Coil, Endovascular treatment, Retrieval, Stent, Stroke

Neurosurgery 62[ONS Suppl 2]:ONS390–ONS394, 2008

DOI: 10.1227/01.NEU.0000313105.11167.8A

Stent-like systems dedicated to remove clots

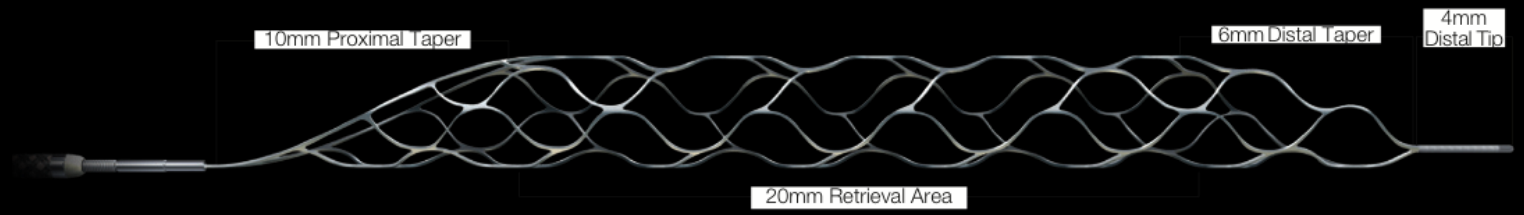


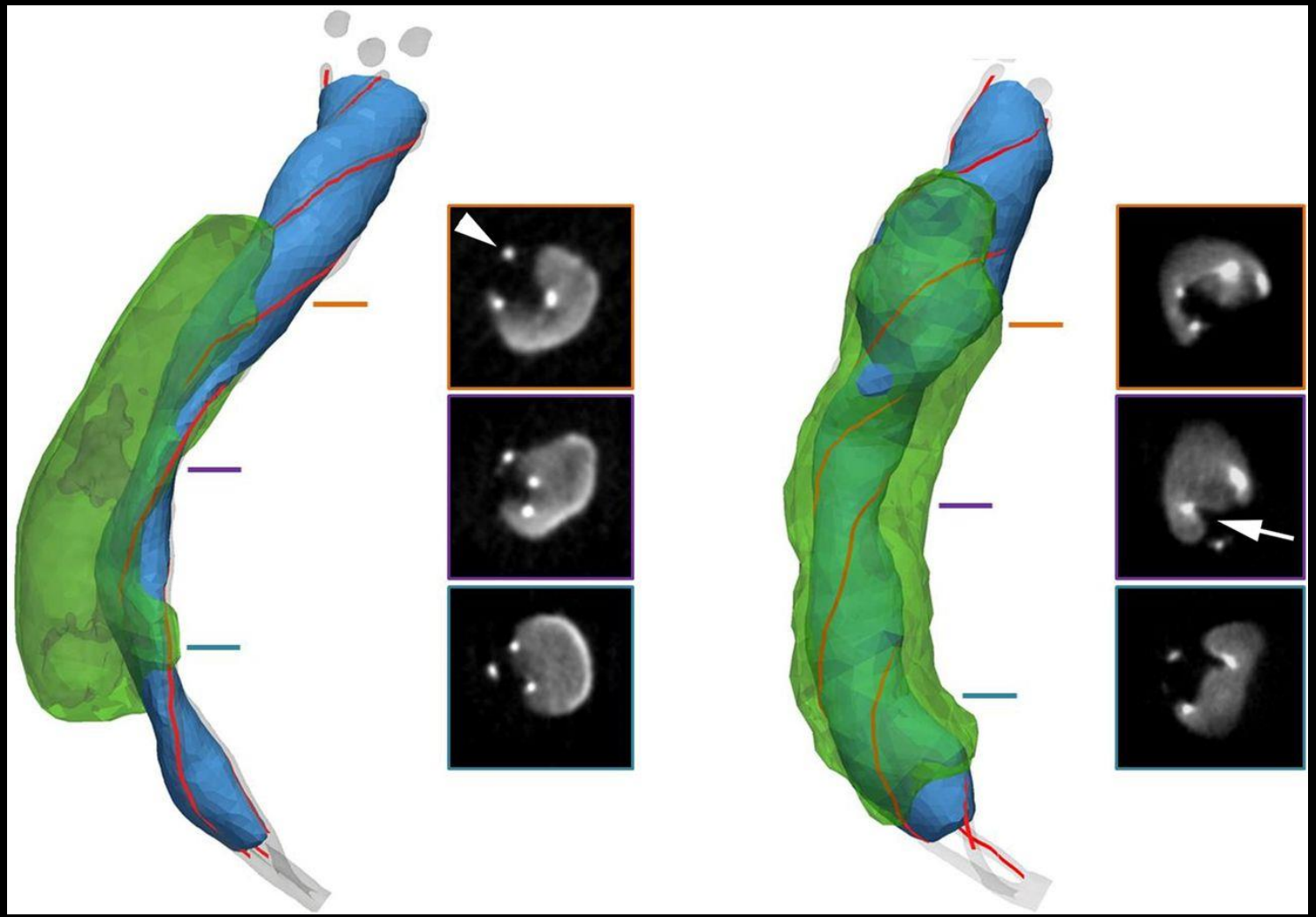
Image courtesy of Stryker Neurovascular
By Concentric Medical
Trevo ProVue Retriever Tip to Tail

Trevo® Retriever Design

Traditional Stent Design

Image courtesy of Stryker Neurovascular
By Concentric Medical®
Strut orientation comparison
90807477.AA

Representative cases in a hard clot model with different Trevo deployment techniques (left, straight unsheathing; right, initial unsheathing followed by pushing the device and spontaneous retraction of the microcatheter).



VasoCT
Clot Integration Factor

Related publications:

van der Marel et al., "Quantitative assessment of device-clot interaction for stent retriever thrombectomy", *J Neurointerv Surg* (2016; *in press*)

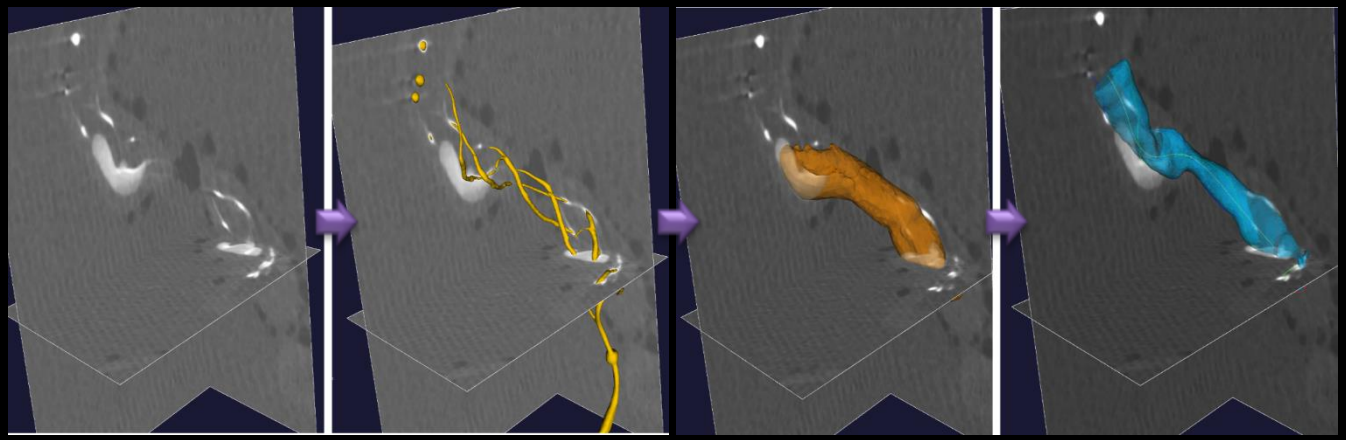
Conference presentations:

"Clot Integration Factor For In-Vitro Quantification Of Stent-Retriever Configuration Using Cone-beam CT"; *International Stroke Conference*; February 2016 (poster)

"Clot Integration Factor for in-vitro quantification of stent-retriever configuration using cone-beam CT"; *Summer Biomechanics, Bioengineering, and Biotransport Conference*; July 2016 (abstract submitted)

Three marker wires
Segmented clot
Intersection device-clot

$$\text{Clot Integration Factor} = \frac{\text{Volume of Clot} - \text{Device}}{\text{Volume of C}}$$

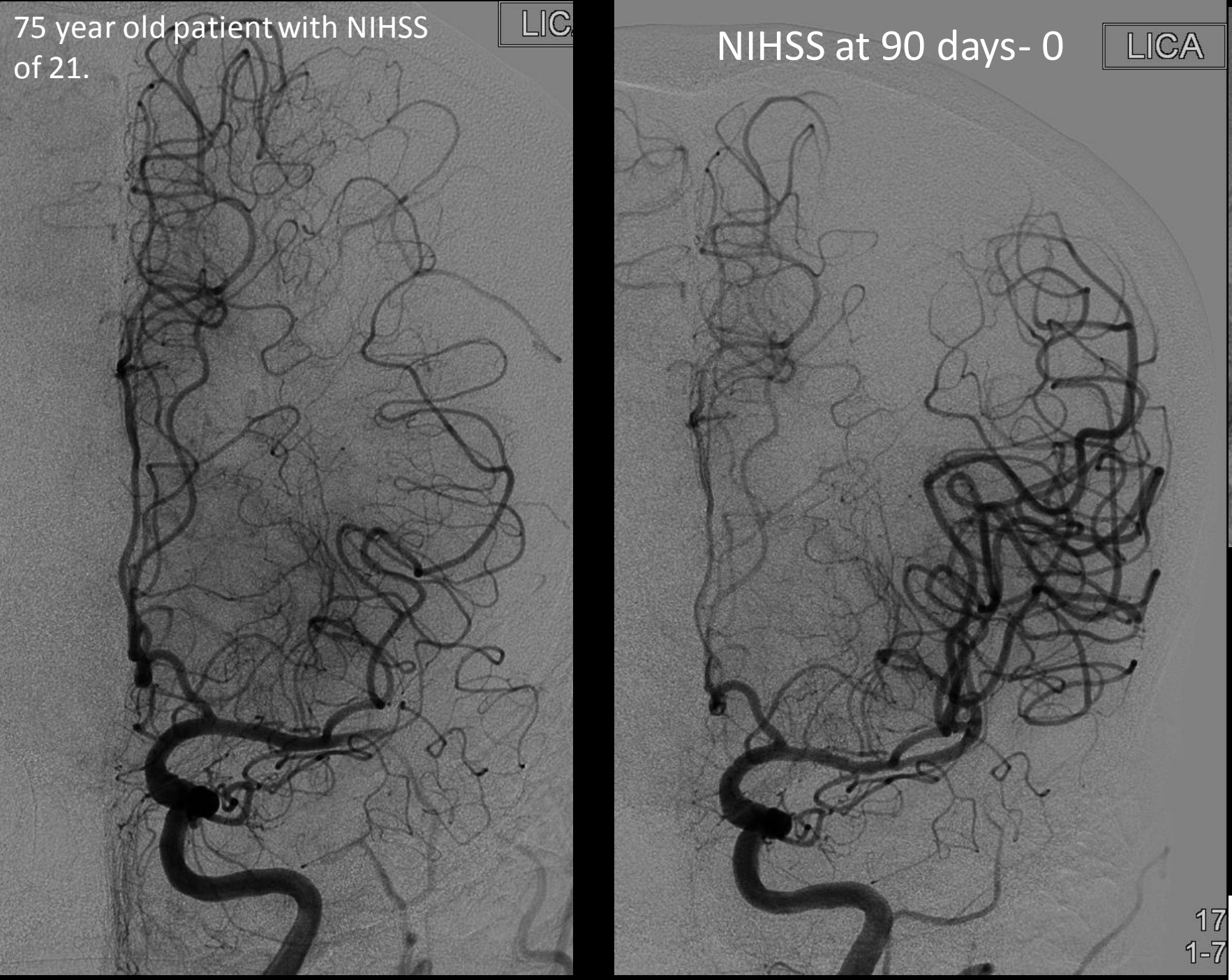


High-resolution reconstruction of cone-beam CT image

Extraction of visible marker wires

Segmentation of the contrast-enriched clot

Determination of the inner volume of the stent-retriever


75 year old patient with NIHSS of 21.
LIC
NIHSS at 90 days- 0
LICA
17
1-7
UMASS

Patient Selection

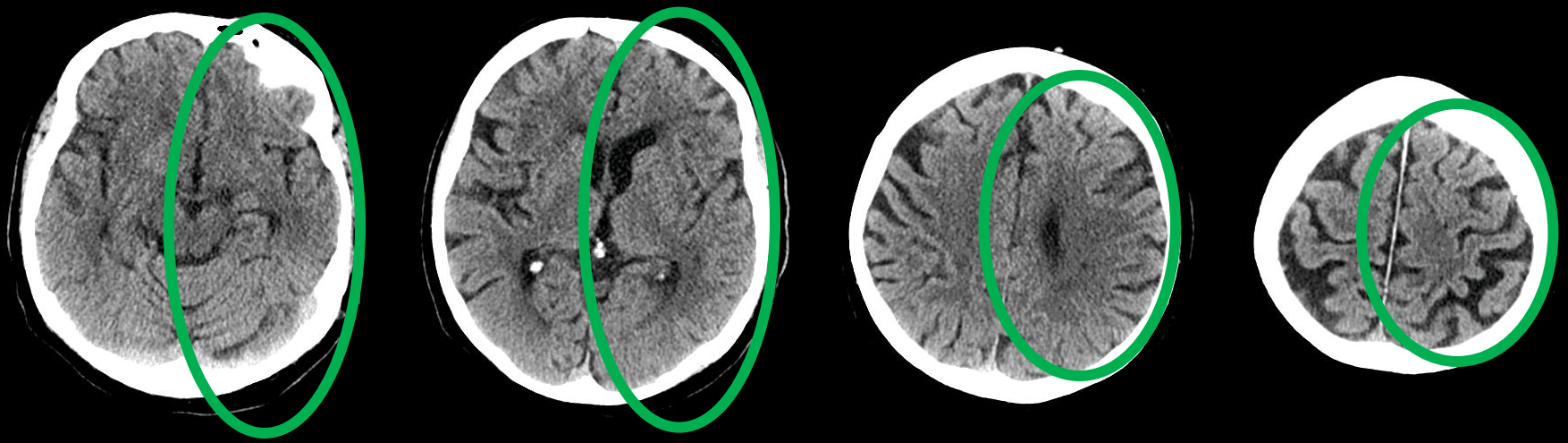
Two Subjects

Clinical Decision Making

Subject # D.S.

- 91 y o f
- Previous history of exertional dyspnea, HTN, HLD, DM, remote history of smoking mRS=1
- Acute onset of aphasia, right facial droop and right hemiparesis
- At ED new onset of A-Fib
- NIHSS 23

Imaging



ASPECTS >7

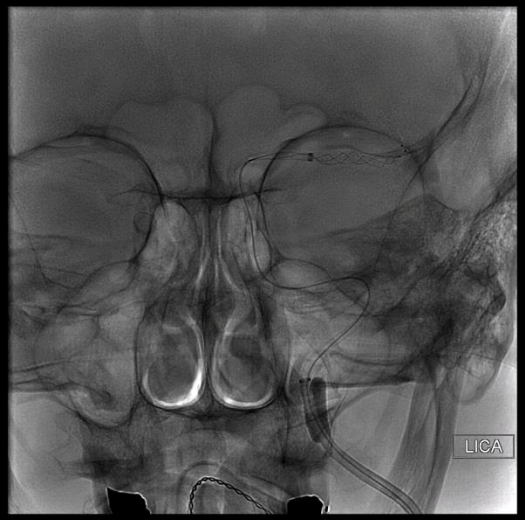
CTA left M1 occlusion

Modest collaterals

Treatment

8 F Femoral sheath
Flowgate 8 F BGC
ARC 6 F IC catheter
Trevo 4x20mm , 1 pass

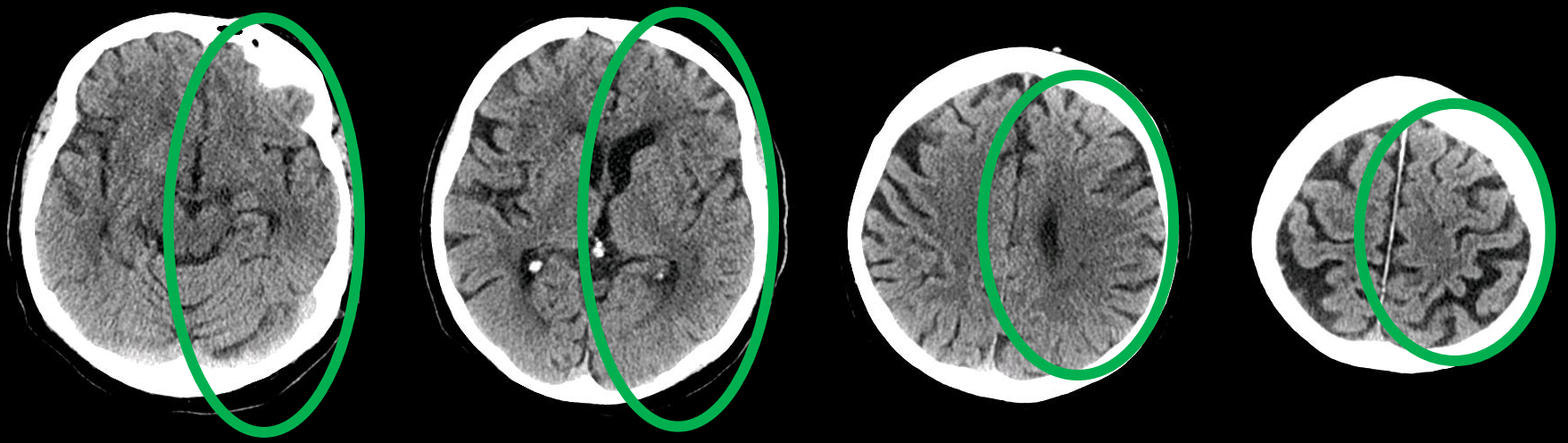
Treatment



8 F Femoral sheath
Flowgate 8 F BGC
ARC 6 IC catheter
Trevo 4x20mm , 1 pass
TICI 3

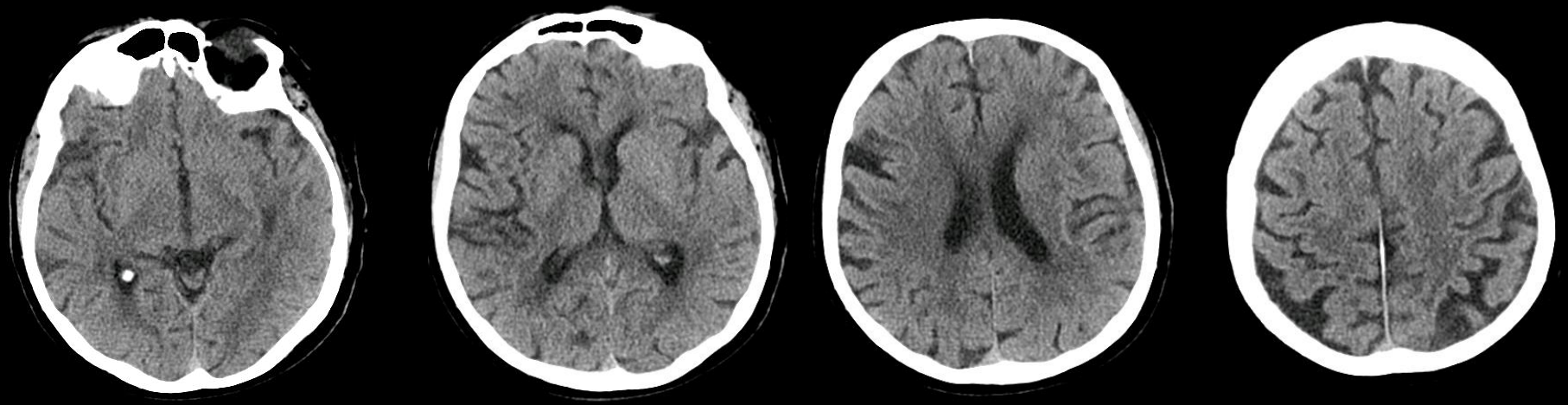
Outcome at 24 hrs: NIHSS 3

Imaging – Outcome following Thrombectomy



ASPECTS >7 pre treatment

Outcome at 24 hrs: NIHSS 3

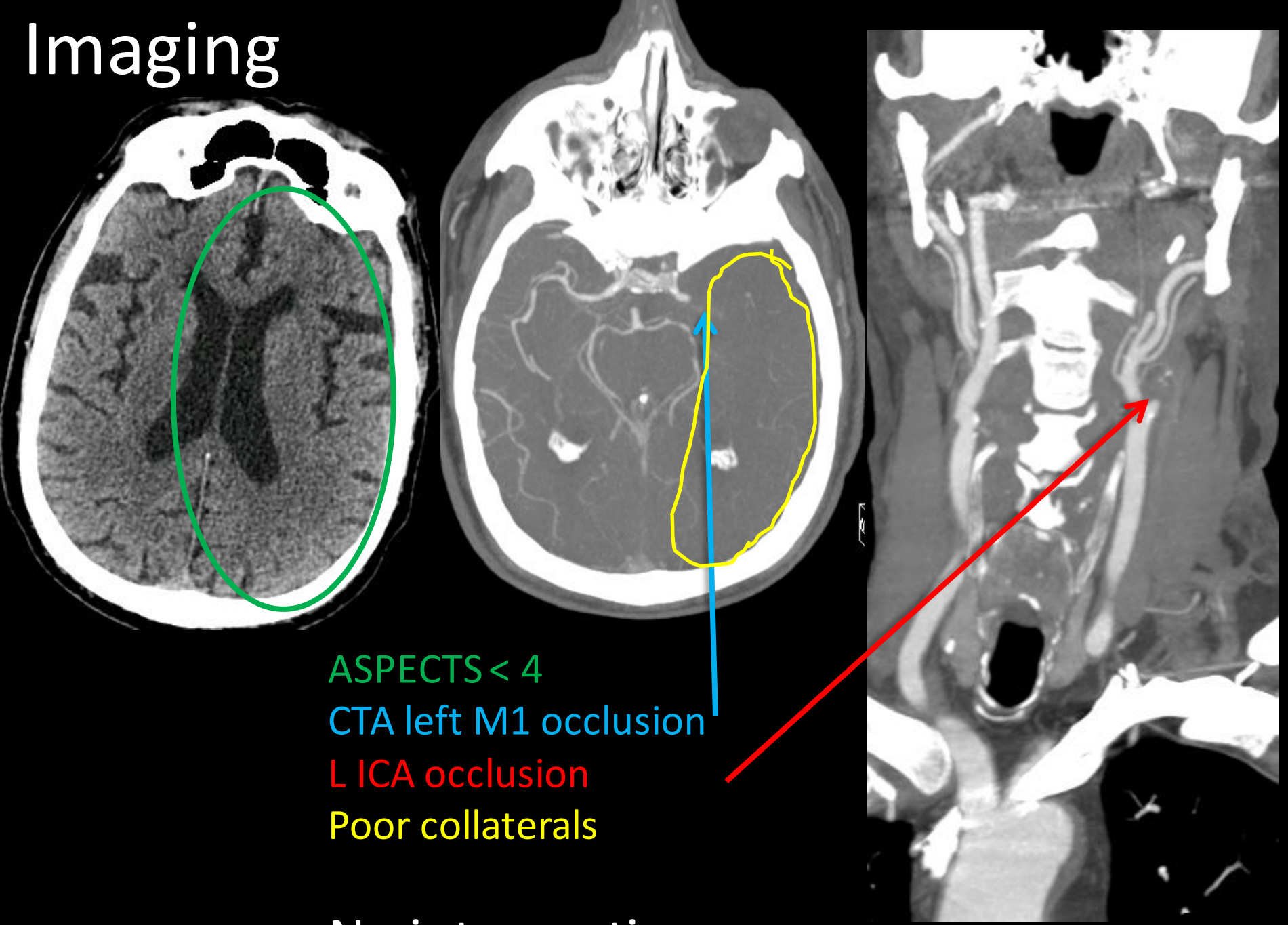


24-hr Follow-up Study

Subject # J.J.

- 83 y o m
- Early dementia mRS=1
- Acute onset of dysarthria, right facial droop and right hemiparesis
- At outside facility iv t-PA and transferred to UMASS
- NIHSS 28

Imaging



ASPECTS < 4

CTA left M1 occlusion

L ICA occlusion

Poor collaterals

No intervention

Evolution of Newer Endovascular Techniques we have adapted

Few Examples

ORIGINAL RESEARCH

Initial clinical experience with the ADAPT technique: A direct aspiration first pass technique for stroke thrombectomy

Aquilla S Turk,[1] Alex Spiotta,[2] Don Frei,[3] J Mocco,[4] Blaise Baxter,[5] David Fiorella,[6] Adnan Siddiqui,[7] Maxim Mokin,[7] Michael Dewan,[4] Henry Woo,[6] Raymond Turner,[2] Harris Hawk,[1] Amrendra Miranpuri,[1] Imran Chaudry[1]

Turk AS, *et al*. *J NeuroIntervent Surg* 2013;**0**:1–7. doi:10.1136/neurintsurg-2013-010713

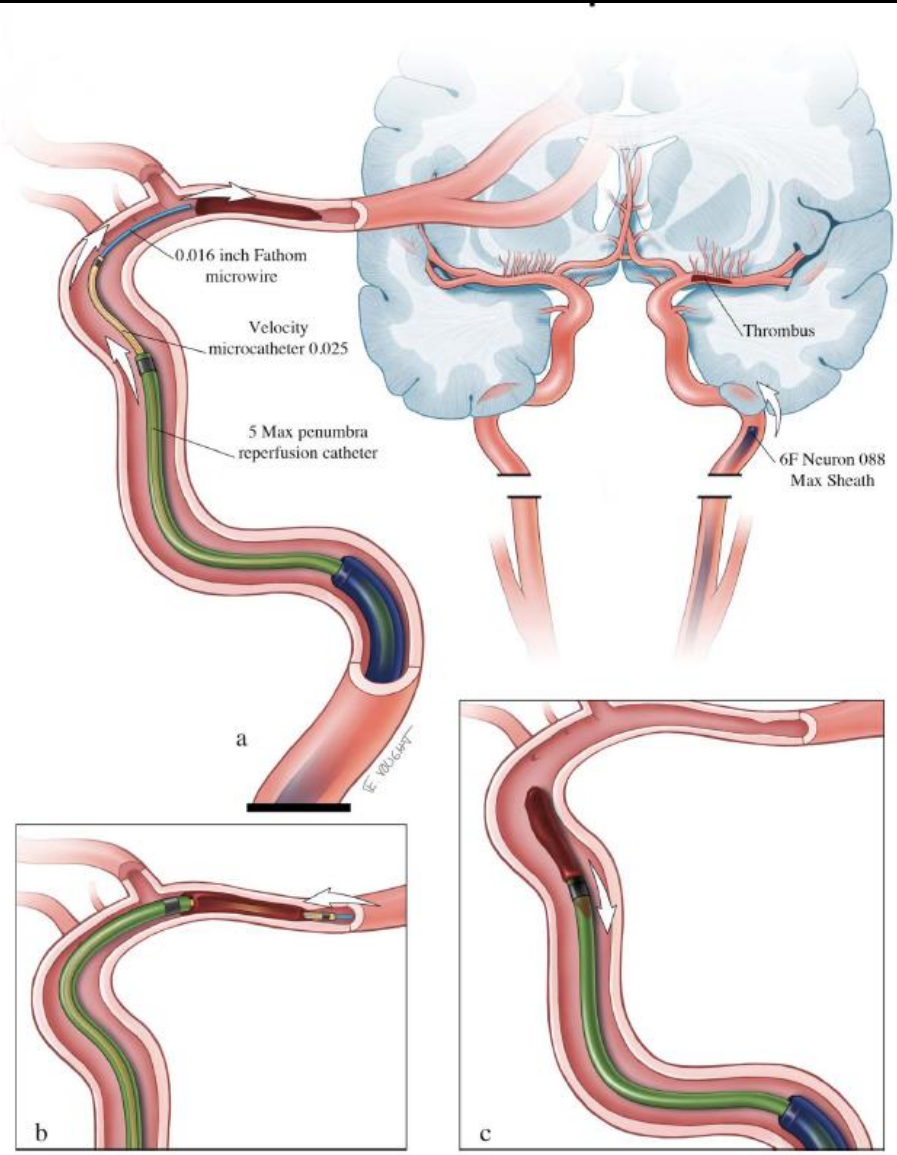
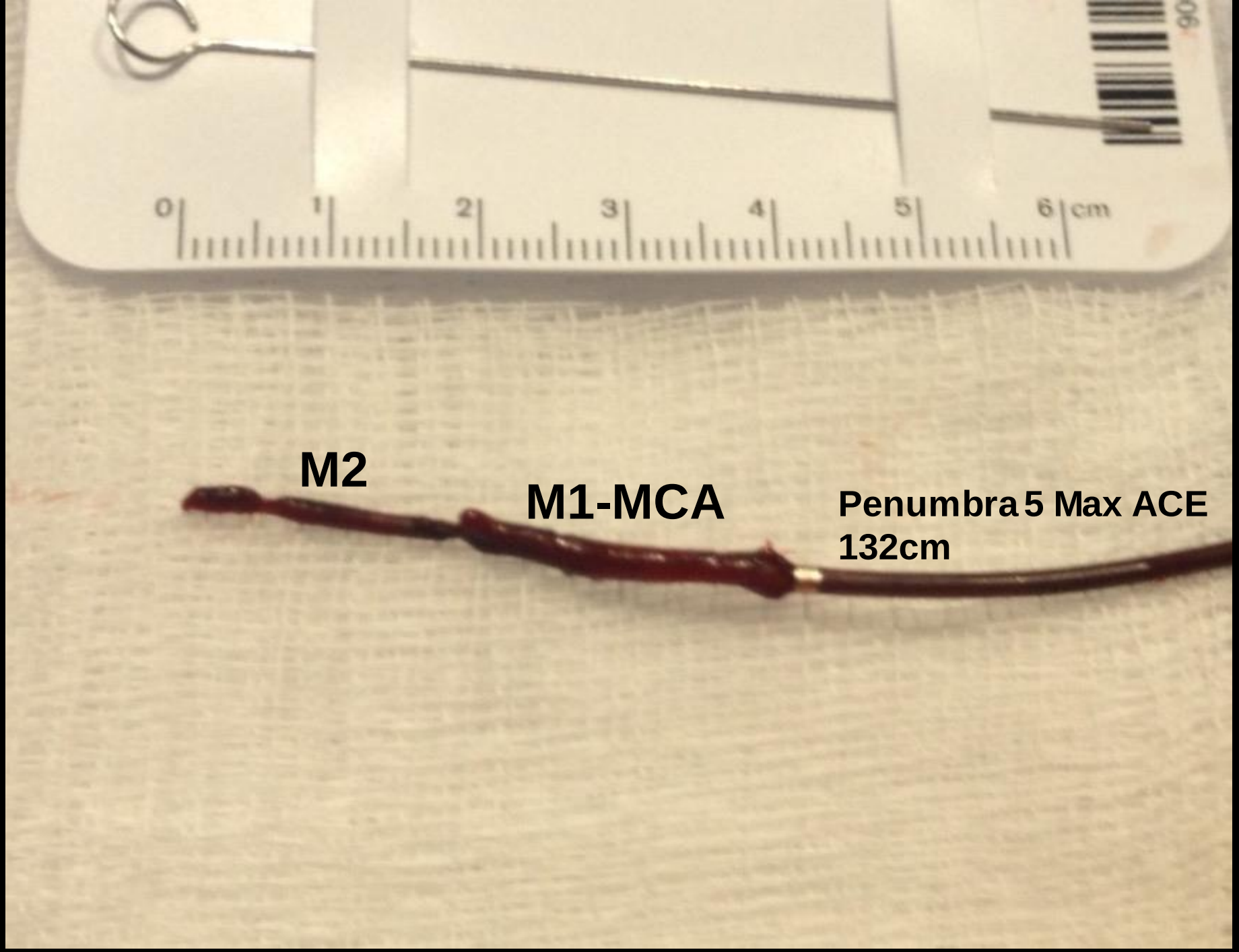


Figure 1 Illustration of the ADAPT technique in a middle cerebral artery clot. (A) The Neuron Max guide catheter is positioned as far distally as possible in the supplying internal carotid artery. Through this a 5 Max reperfusion catheter is advanced over a Velocity microcatheter with a 0.016 inch Fathom wire. (B) The Fathom wire and Velocity microcatheter are advanced through and distal to the thrombus to provide stable support for the 5Max to be advanced to the face of the thrombus. (C) Aspiration is applied to the 5 Max until aspiration becomes occlusive and the 5 Max is then removed while maintaining aspiration to ensure the clot remains engaged in the catheter tip.


M2
M1-MCA
Penumbra 5 Max ACE
132cm

ARTS (ACE-Retriever Technique for Stroke)

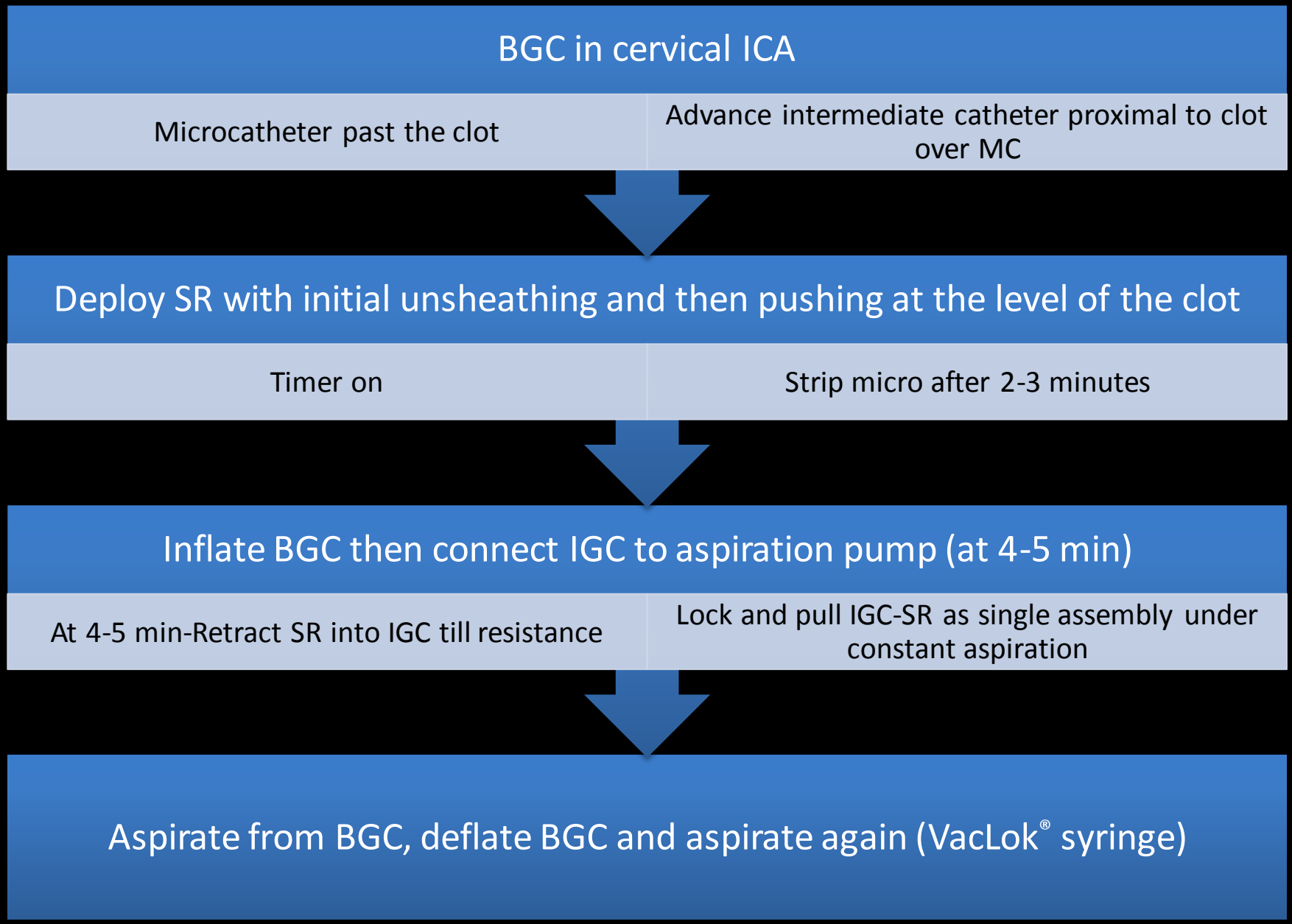
Initial Clinical Experience

Method

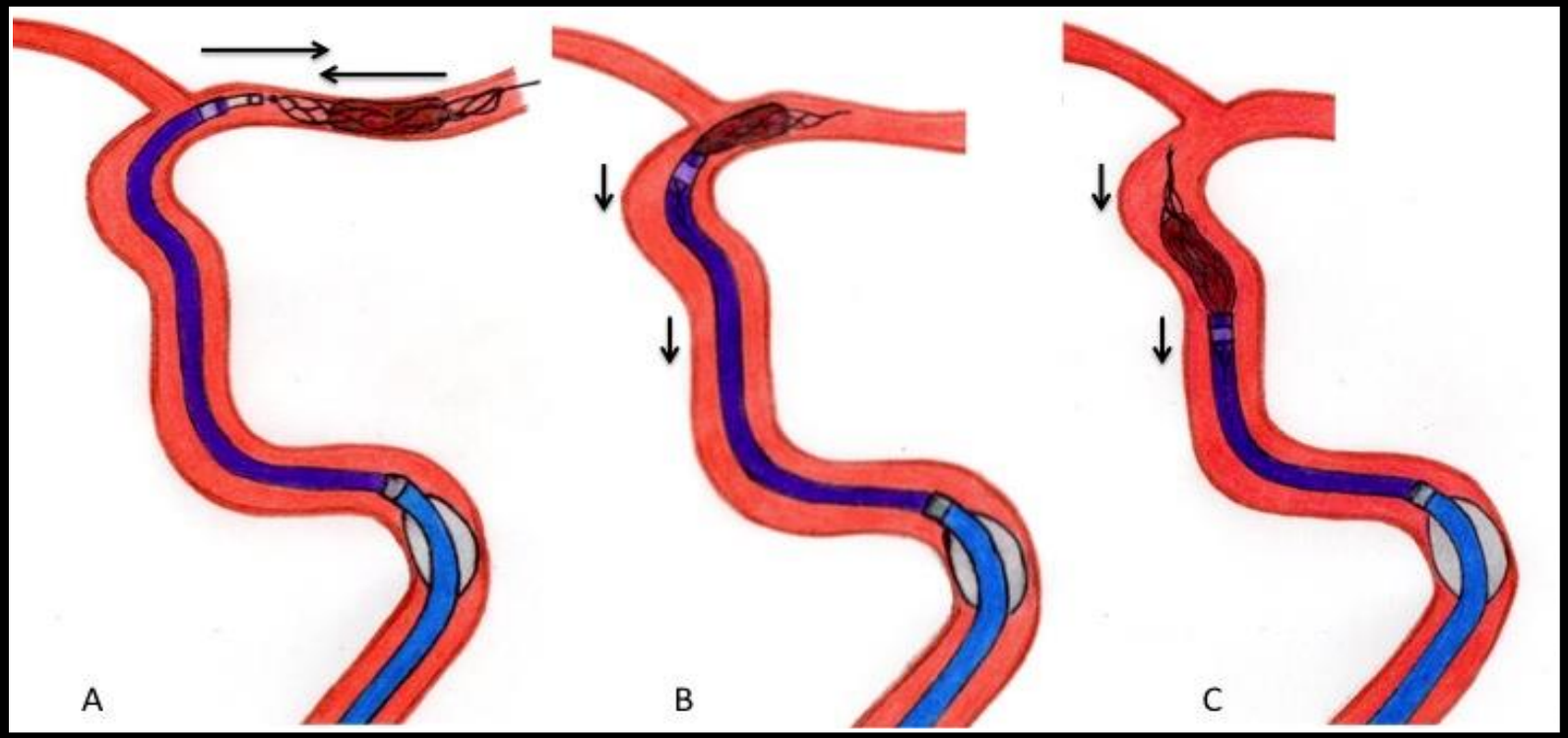
We report a retrospectively collected clinical data utilizing a new recanalization technique based on combined large lumen aspiration catheter and partially resheathed stent retrievers for thrombectomy (ARTS: ACE-Retriever Technique for Stroke)

Puri AS et al. SNIS 2015

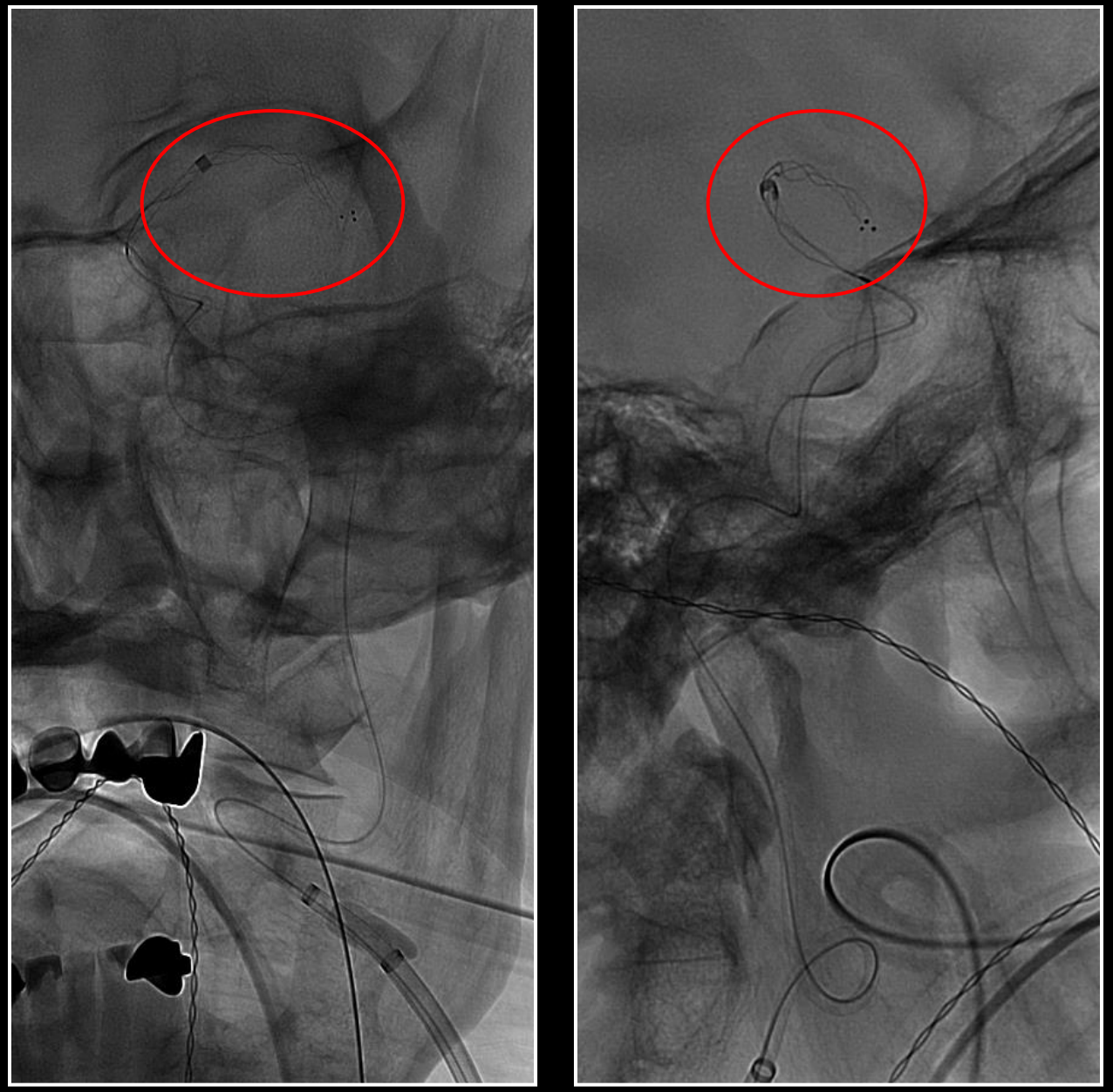
Chueh JY, Wakhloo AK, Gounis MJ. Effectiveness of mechanical endovascular thrombectomy in a model system of cerebrovascular occlusion. AJNR Am J Neuroradiol 2012;33:1998–2003


BGC in cervical ICA
Microcatheter past the clot
Advance intermediate catheter proximal to clot over MC
Deploy SR with initial unsheathing and then pushing at the level of the clot
Timer on
Strip micro after 2-3 minutes
Inflate BGC then connect IGC to aspiration pump (at 4-5 min)
At 4-5 min-Retract SR into IGC till resistance
Lock and pull IGC-SR as single assembly under constant aspiration
Aspirate from BGC, deflate BGC and aspirate again (VacLok® syringe)

ARTS & Balloon Guiding Catheter

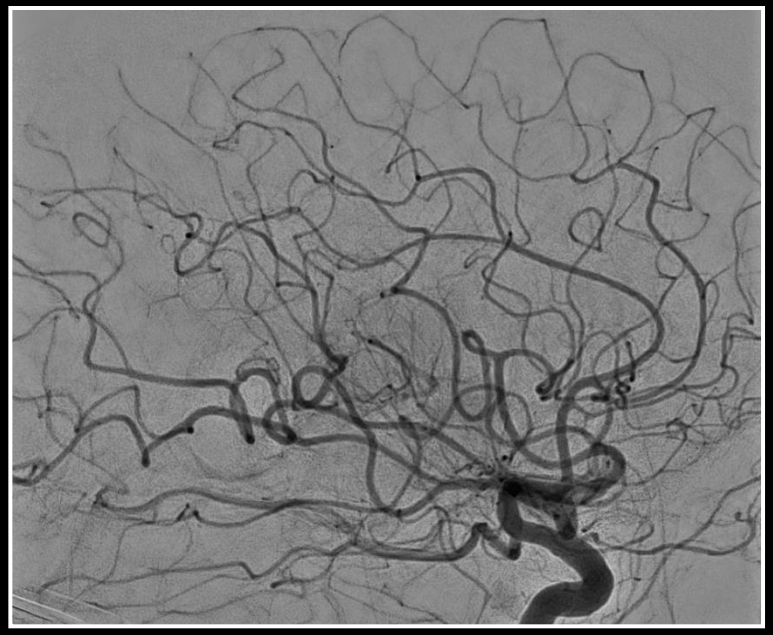


ARTS Illustration



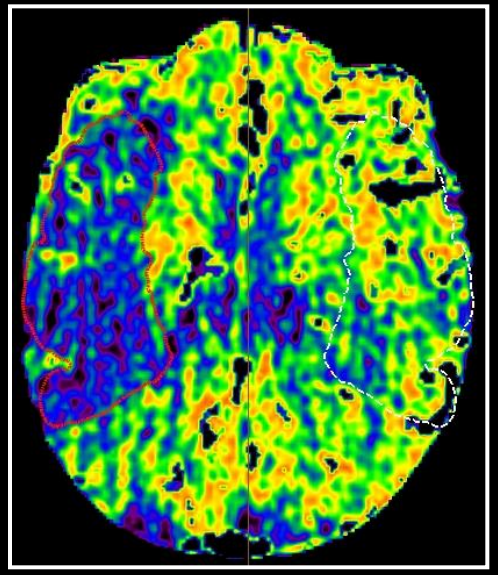
ARTS & Balloon Guiding Catheter

Post-ARTS Clot Removal

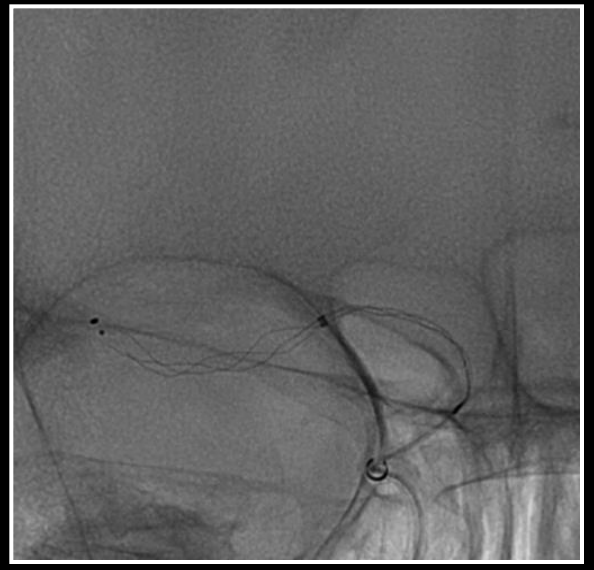


Post-procedural Angiography (TICI 3 recanalization)

Pre-procedural Angiogram (distal right MCA M1 occlusion)

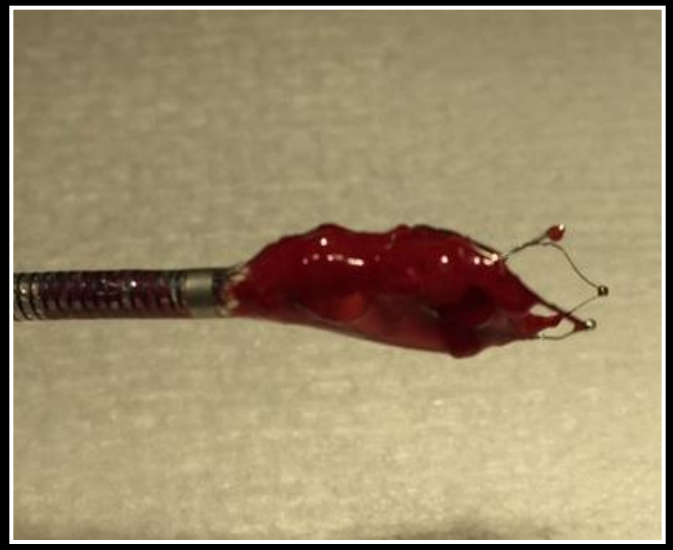


Cone Beam CT Perfusion



Mechanical Thrombectomy (AP)

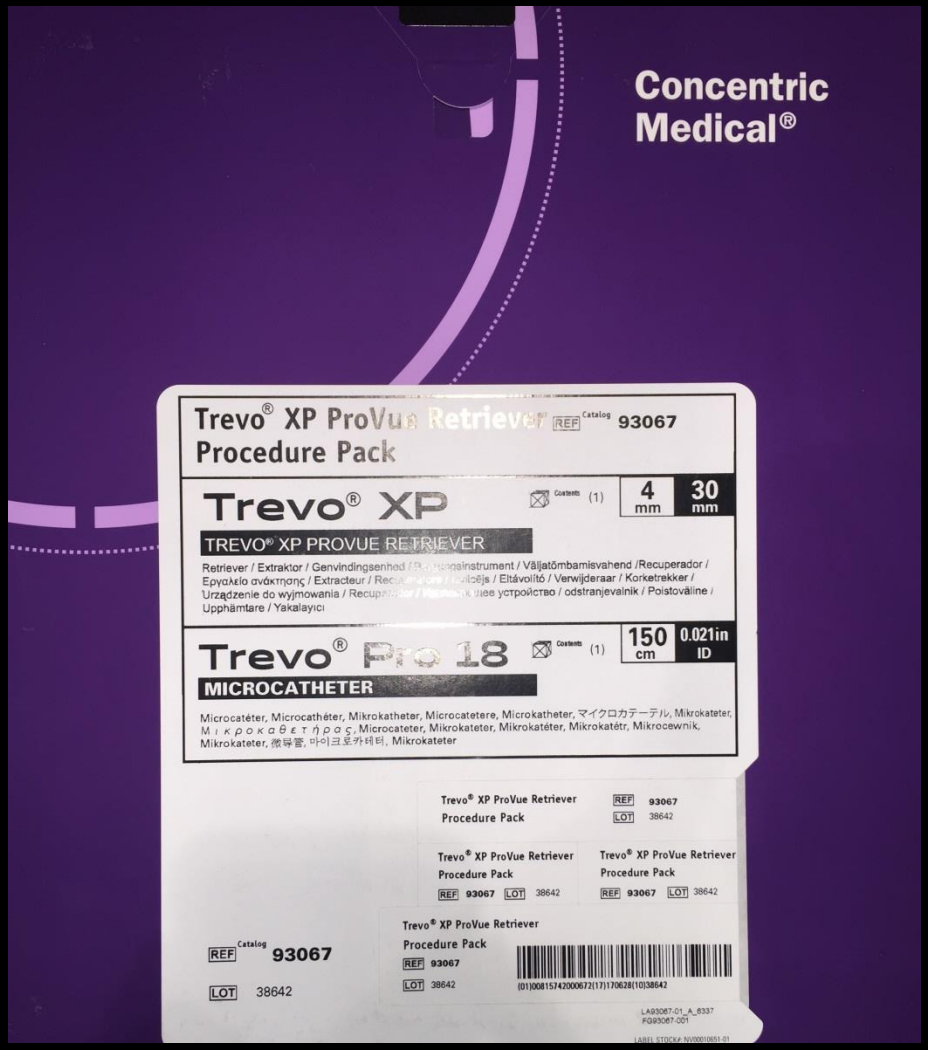
Mechanical Thrombectomy (LT)

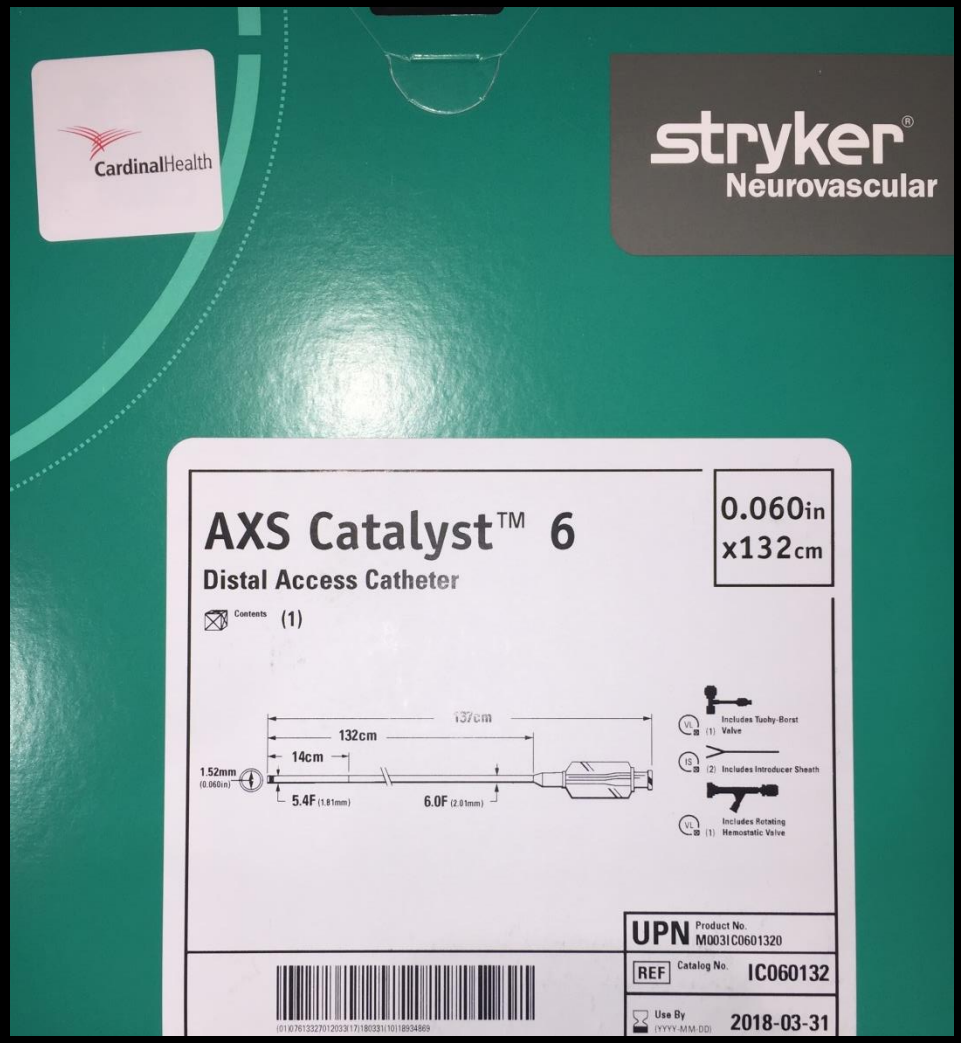


Post-ARTS Clot Removal

Post-procedural Angiogram (TICI 3 recanalization)

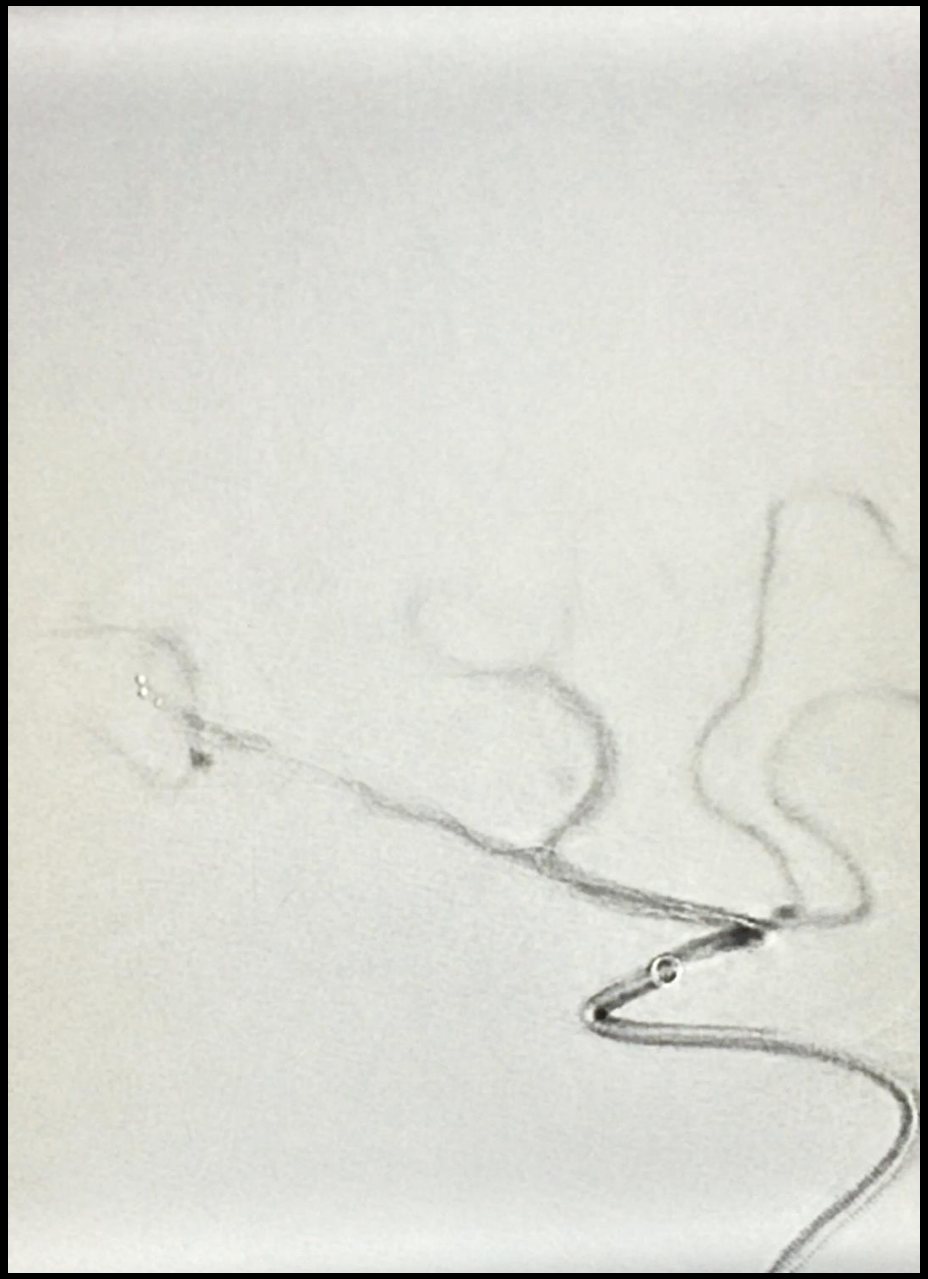
Distal M2/M2 occlusions



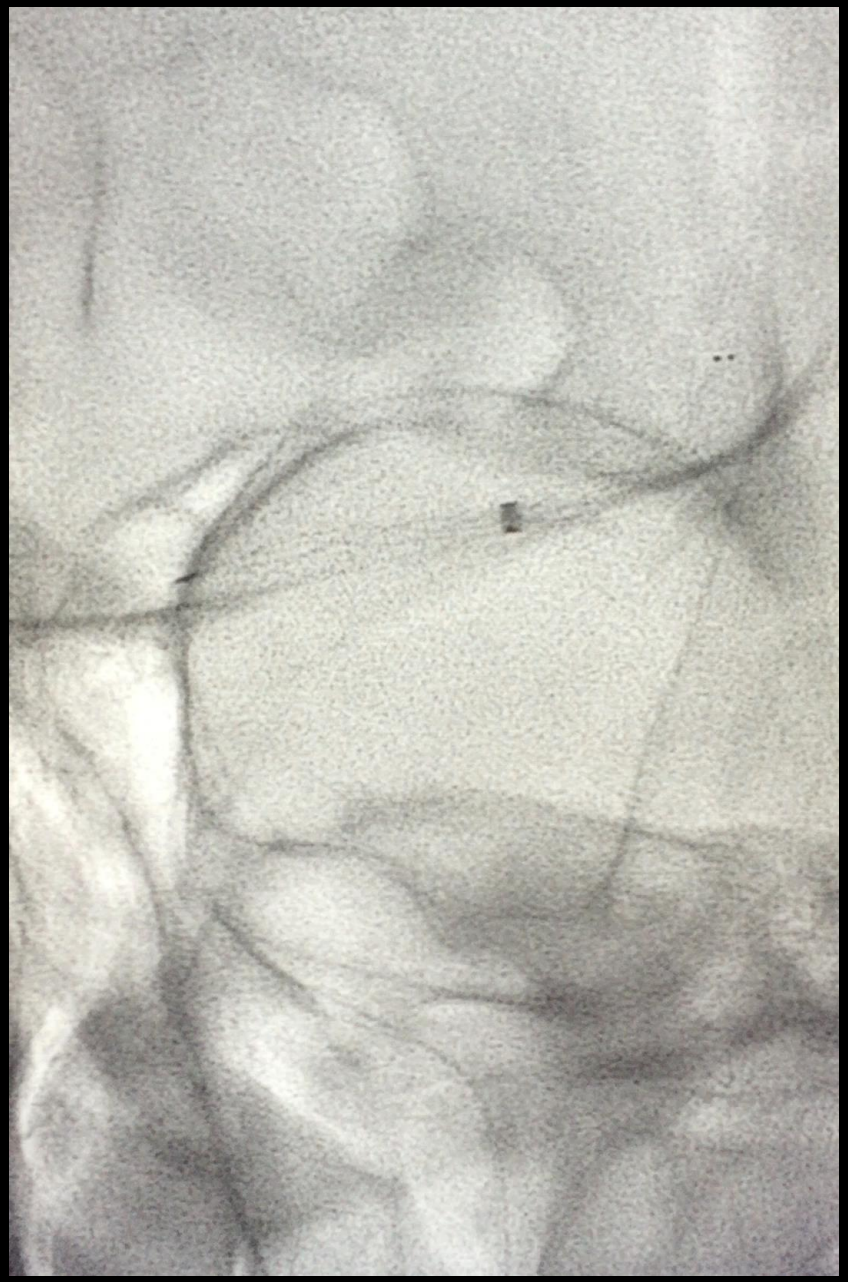


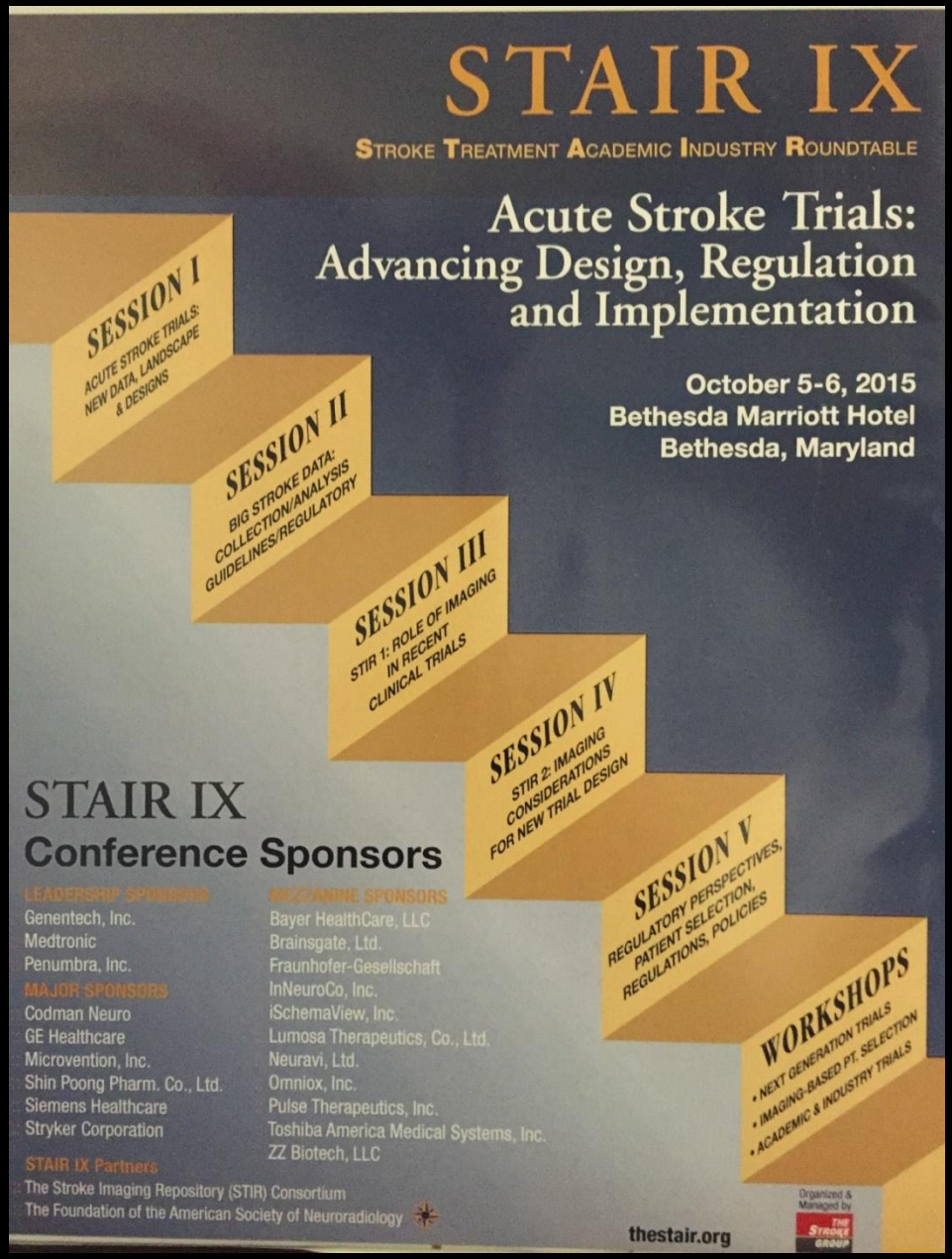
Distal M2/M2 occlusions

Distal M2/M2 occlusions



Distal M2/M2 occlusions





1. Consensus Statement on Imaging Selection and Outcomes in Acute Stroke Reperfusion Clinical Trials

Steven J. Warach, Marie Luby, Gregory W. Albers, et al. for the STAIR IX Consortium

2. STROKE TREATMENT ACADEMIC INDUSTRY ROUNDTABLE - The Next Generation of Endovascular Trials

Tudor G. Jovin[1], MD, Gregory W. Albers[2], MD, David S. Liebeskind[3], MD for the STAIR IX Consortium

Three key directions for advancing the field were identified

1) development of systems of care for ET in LVO stroke
2) development of therapeutic approaches adjunctive to ET and
3) expanding the patient population that may derive benefit from ET. beyond conventional time windows, in patients with large baseline ischemic core lesions and in other important subgroups

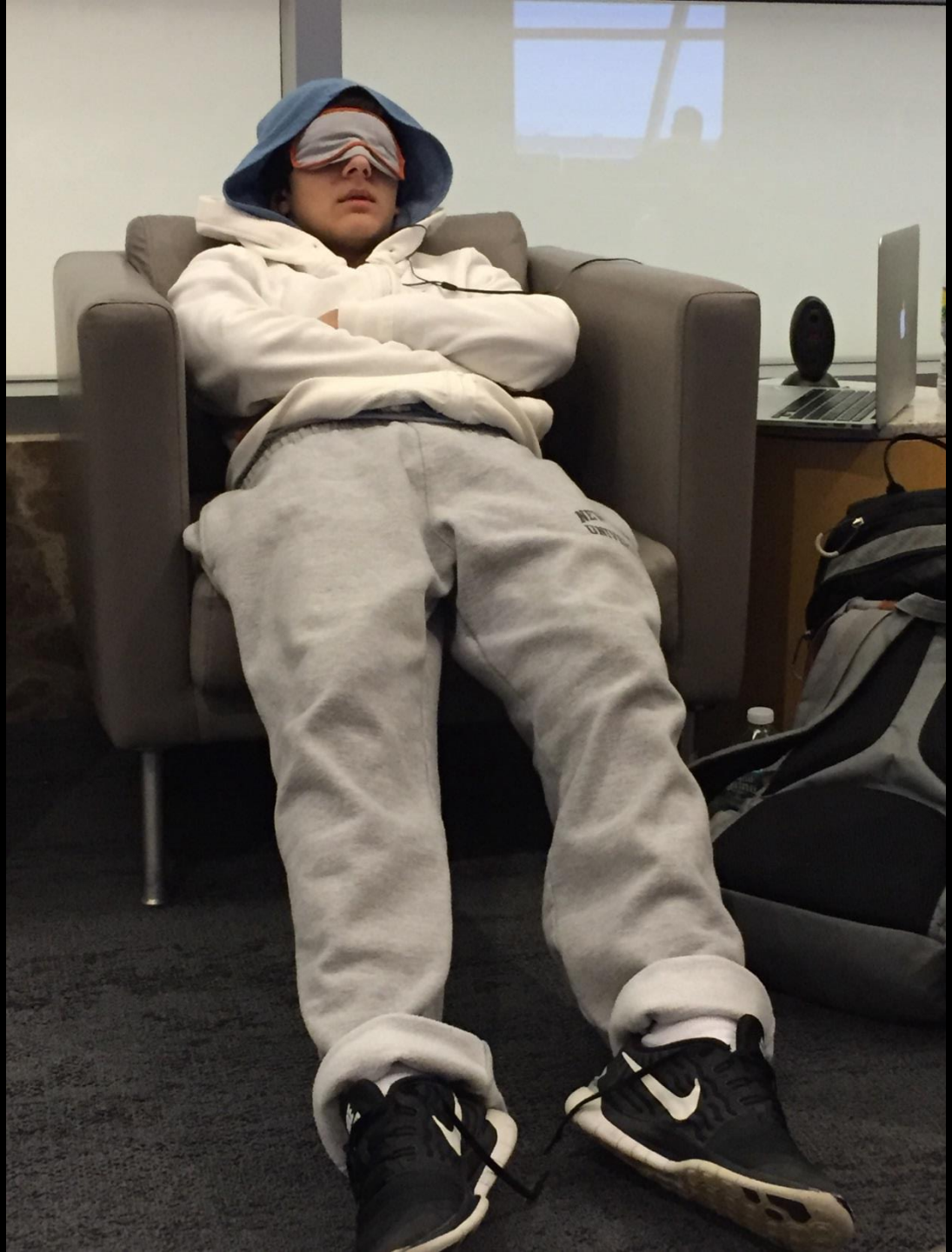
Methodological issues such as optimal trial design and outcome measures have also been addressed. Development of systems of care strategies should be geared both towards ensuring broad access to endovascular therapy for eligible patients and towards shortening time to reperfusion to the minimum possible. Adjunctive therapy development includes neuroprotective approaches, adjuvant microcirculatory/collateral enhancing strategies and peri-procedural management.

Unmet clinical needs from patient admission to rehab


Its starts with a good diet


and a glass of MALBEC
LINDOR


LIFE STYLE CHANGE: ACTIVITY



Needed Tools

- “Stroke bed” from Ambulance – ER – cath-lab-stroke unit
- Headrest
- Anesthesia unit
- Shunts EVD
- Decompression
- Clot removal (Apollo, Nokia)
- Larger bore suction catheters

Needed Tools

- “Stroke bed” from Ambulance – ER – cath-lab-stroke unit
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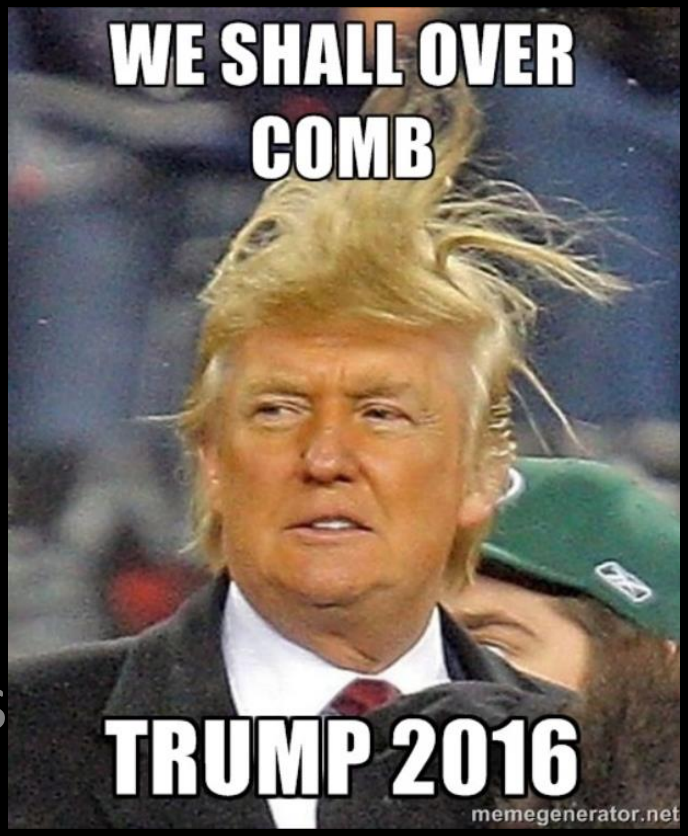
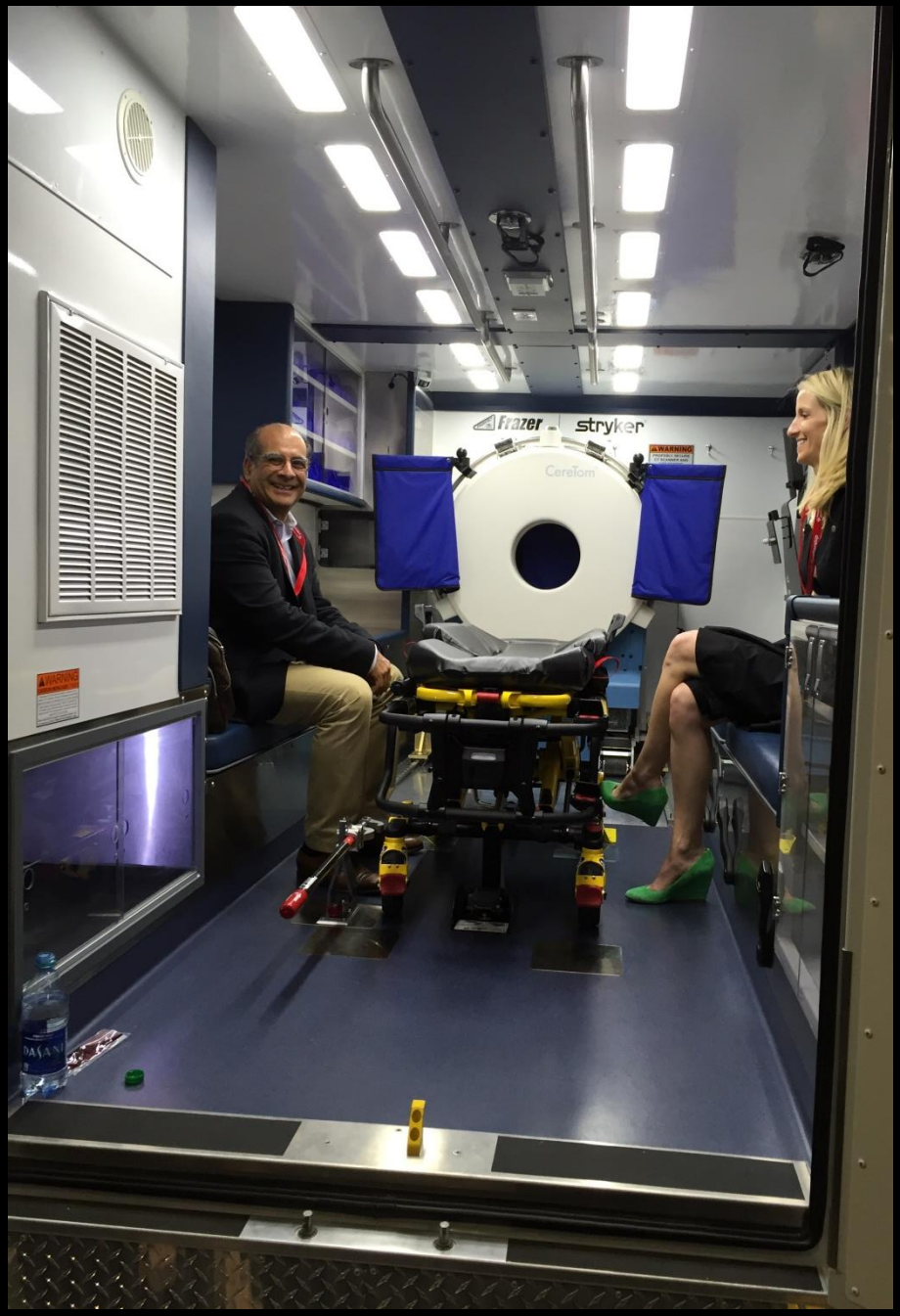



Mobile Stroke Unit
AMBUL
MS1
3
107


100
200
300
InTouch Health
Simulation Zone
Expert Theater
Mobile Stroke Unit
AMBULANCE
MS1
AMBULANCE



Ceretome

Siemens

STROKE MOBILE UNIT IN BUENOS AIRES

Cooling for Penumbra Freeze

Envisioned Stroke Workflow

2D Fluoro
+ Rotational
Angiography

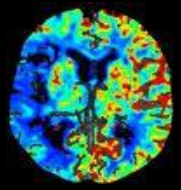
Xper CT

Hemorrhagic Stroke

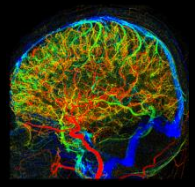
XperGuide For Ventricular Drainges

Xper CT

Ischemic Stroke



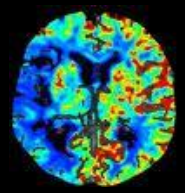
CBV



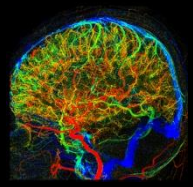
2D Perfusion

VasoCT

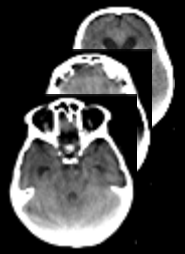
3D Roadmap on VasoCT



CBV



2D Perfusion



XperCT

Conclusions

- Historic times in Endovascular treatment of acute stroke
- Development of Stroke Center of Excellence and Education
- Quantification of Imaging for better patient selection – Define the infarct volume
- Better devices and techniques, better outcomes
- We need to be fasteER from symptom onset to recanalization (<60min), goal 30 min
- Hypothermia? Neuroprotection?
- Goal: Penumbra Freeze and patient transfer to Comprehensive Stroke Centers

Thank you for all the critical support and advancing STROKE