ESC Heart & Brain Workshop

The role of time on ischemic stroke progression

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Stroke Neurologist
Hospital Vall d'Hebron

Supported by Bayer, Bristol-Myers Squibb and Pfizer Alliance, Boehringer Ingelheim, Daiichi Sankyo Europe GmbH and Medtronic in the form of educational grants. The scientific programme has not been influenced in any way by its sponsors.

ESC Council Stroke

Declaration of Interest

Nothing to declare

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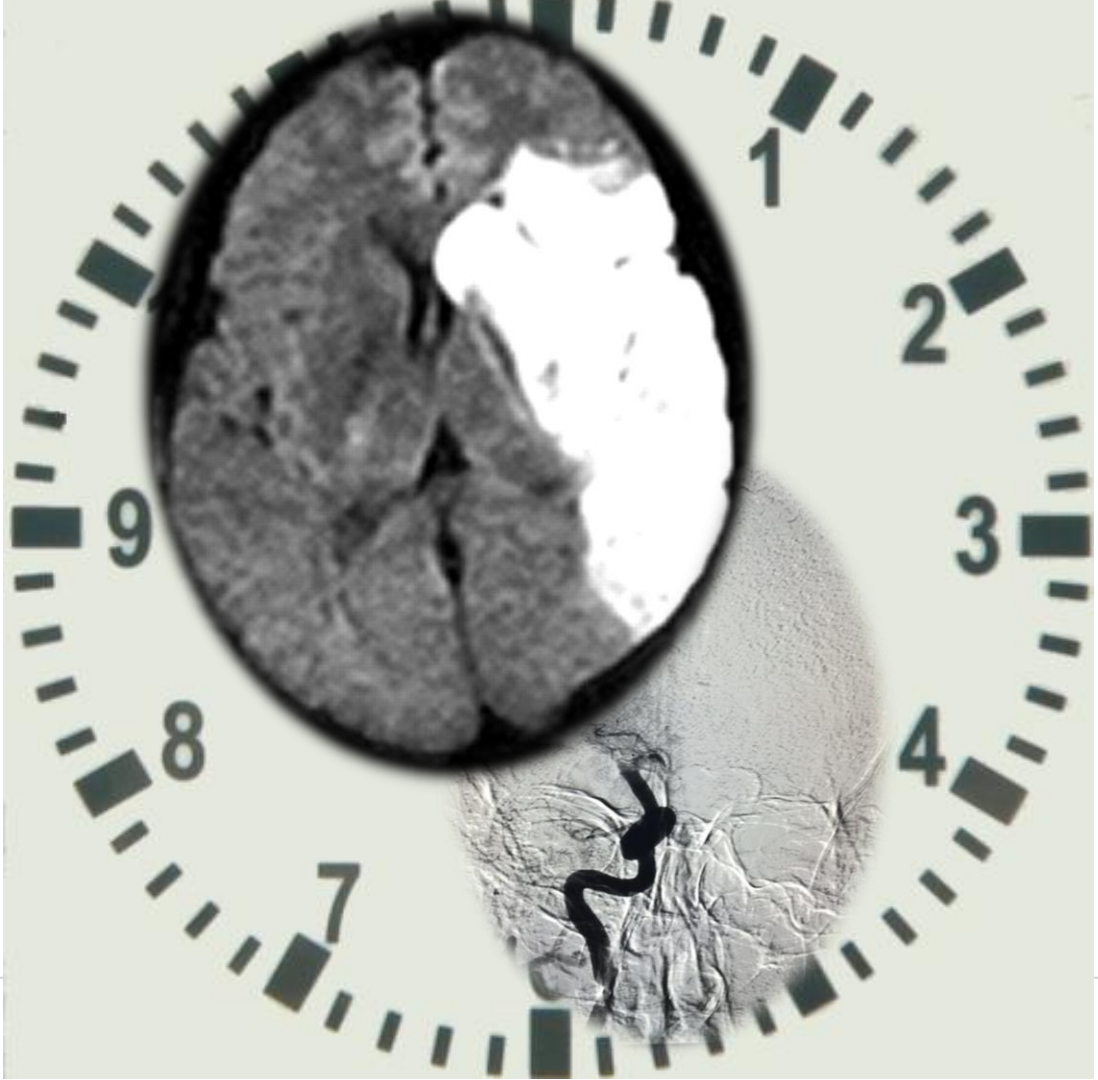
WITH A STROKE,
TIME LOST IS BRAIN LOST.



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Time Is Brain—Quantified

Jeffrey L. Saver, MD

Stroke.2006;37:263-266.

Average infart growth:
5.4 mL / h

BRAIN

Estimated Pace of Neural Circuitry Loss in Typical Large Vessel, Supratentorial Acute Ischemic Stroke

	Neurons Lost	Synapses Lost	Myelinated Fibers Lost	Accelerated Aging
Per Stroke	1.2 billion	8.3 trillion	7140 km/4470 miles	36 y
Per Hour	120 million	830 billion	714 km/447 miles	3.6 y
Per Minute	1.9 million	14 billion	12 km/7.5 miles	3.1 wk
Per Second	32 000	230 million	200 meters/218 yards	8.7 h

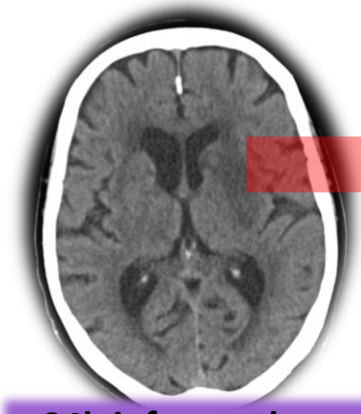
VOLUME INFARCT

TIME ONSET

ESC Council Stroke

Infarct Volume Is a Pivotal Biomarker After Intra-Arterial Stroke Therapy

Albert J. Yoo, MD*; Zeshan A. Chaudhry, MD*; Raul G. Nogueira, MD; Michael H. Lev, MD; Pamela W. Schaefer, MD; Lee H. Schwamm, MD; Joshua A. Hirsch, MD; R. Gilberto González, MD, PhD (*Stroke*. 2012;43:1323-1330.)

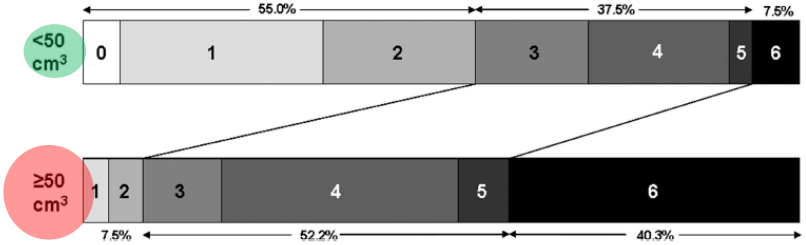


24h infarct volume

Table 2. Variables With Significant Correlation to 3-Month mRS (0–6)

	Rho	95% CI	Univariate *P*	Multivariate *P*
Final infarct volume, cm^3	0.592	0.453 to 0.703	<0.0001	<0.0001
Age, y	0.399	0.226 to 0.547	<0.0001	<0.0001
TICI score (0–3)	−0.512	−0.640 to −0.357	<0.0001	0.0006
Admission NIHSSS	0.284	0.100 to 0.450	0.004	NS
HTN	0.200	0.011 to 0.376	0.04	NS

mRS indicates modified Rankin Scale; TICI, Thrombolysis In Cerebral Infarction; NIHSSS, National Institutes of Health Stroke Scale score; HTN,



mRS at 3 months

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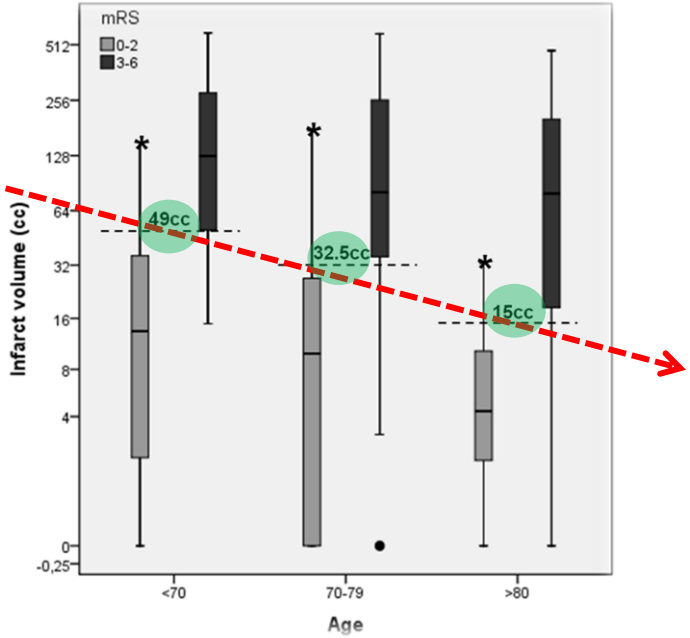
ORIGINAL RESEARCH

Age-adjusted infarct volume threshold for good outcome after endovascular treatment

Marc Ribo,[1] Alan Flores,[1] Eloy Mansilla,[1] Marta Rubiera,[1] Alejandro Tomasello,[2] Pilar Coscojuela,[2] Jorge Pagola,[1] David Rodriguez-Luna,[1] Marian Muchada,[1] José Alvarez-Sabín,[1] Carlos A Molina[1]

J NeuroIntervent Surg 2014;



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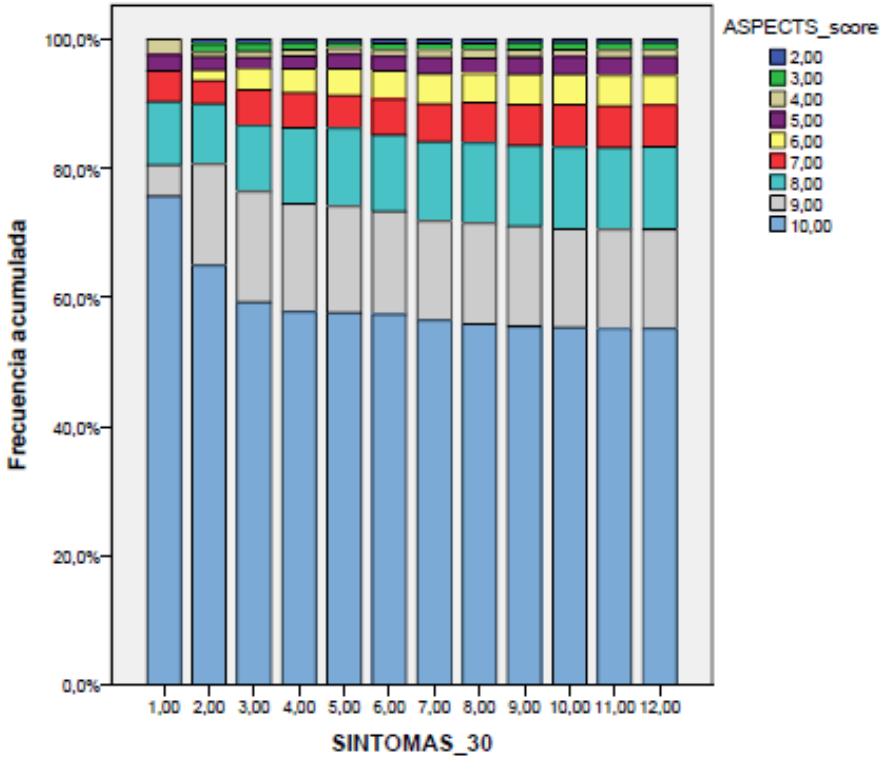
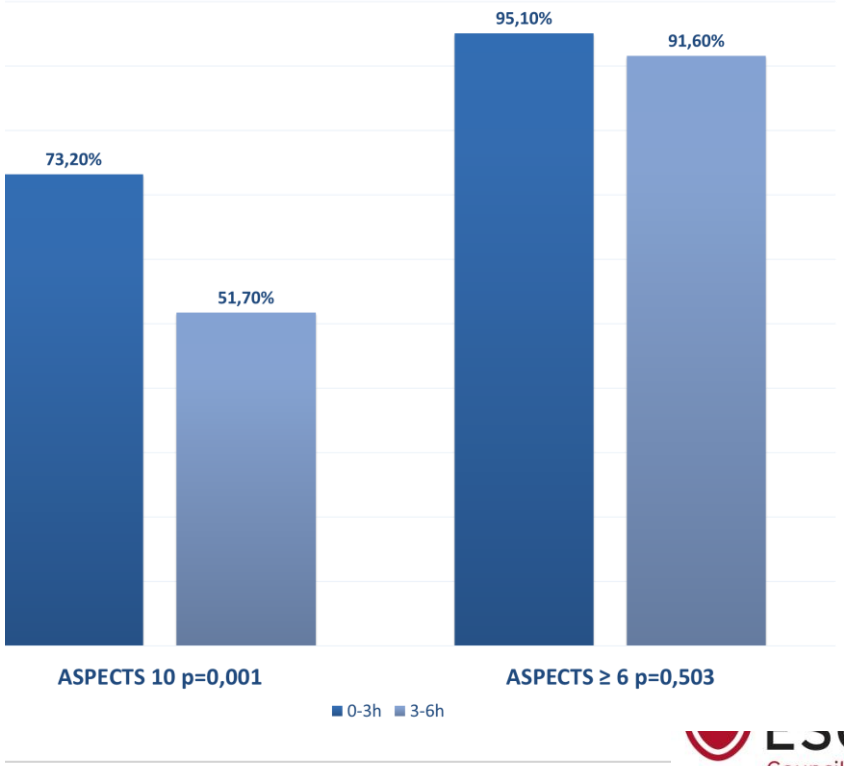
<6hours Code Stroke Catalunya 2016-2017





M. Requena, MD. Poster presentation. ISC 2018

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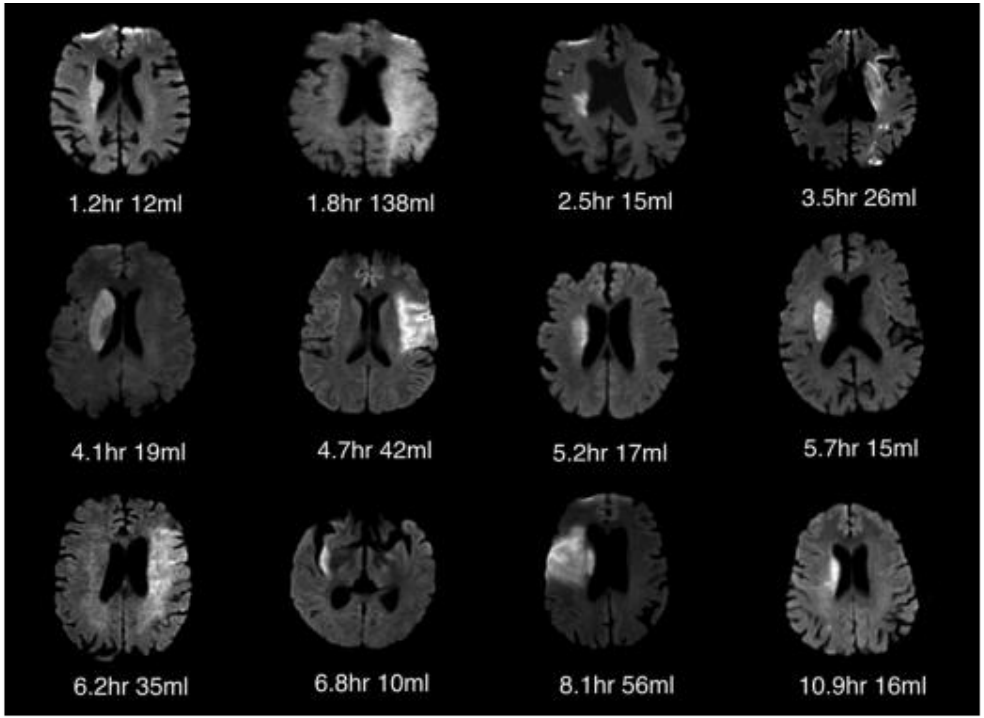
Time and Diffusion Lesion Size in Major Anterior Circulation Ischemic Strokes

Reza Hakimelahi, MD; Behroze A. Vachha, MD, PhD; William A. Copen, MD; Giacomo D.E. Papini, MD; Julian He, MD; Mahmoud M. Higazi, MD; Michael H. Lev, MD; Pamela W. Schaefer, MD; Albert J. Yoo, MD; Lee H. Schwamm, MD; R. Gilberto González, MD, PhD



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Time and Diffusion Lesion Size in Major Anterior Circulation Ischemic Strokes

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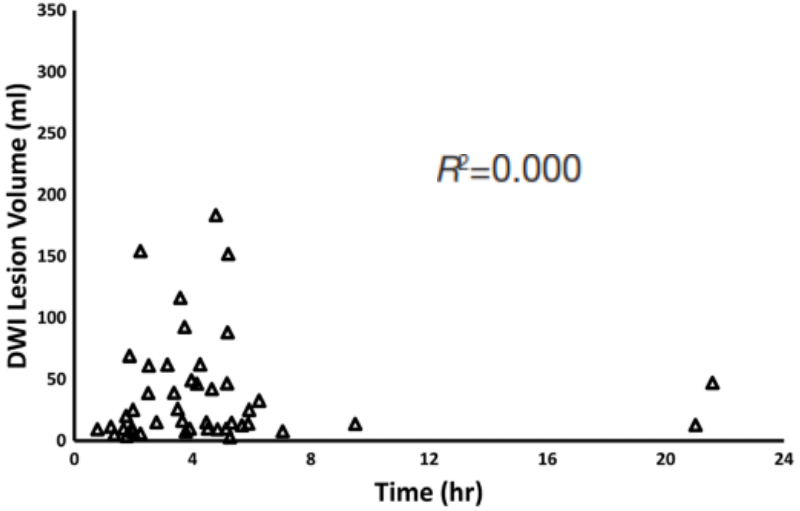

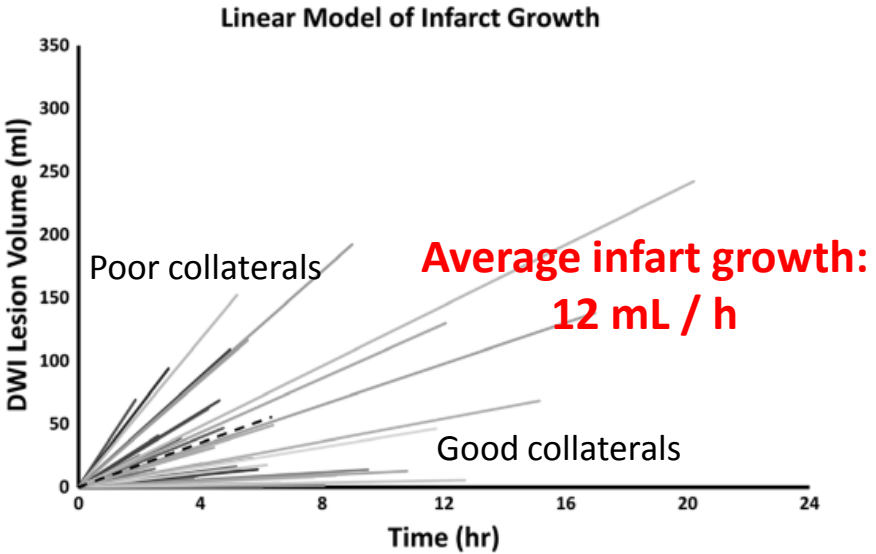

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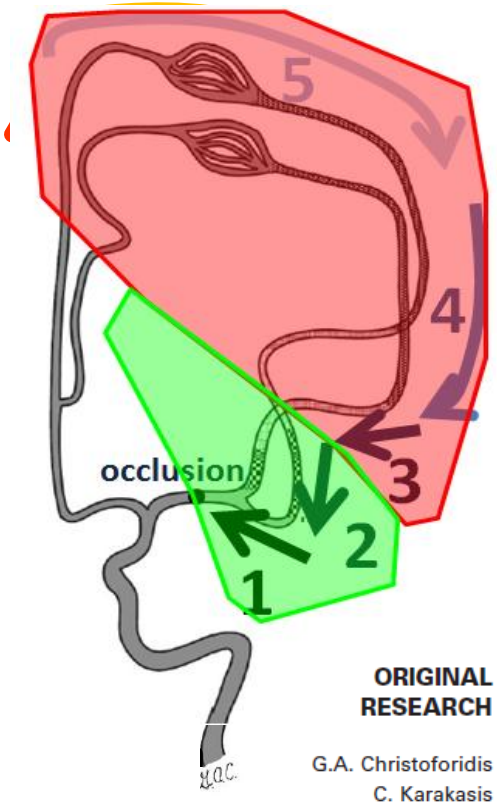
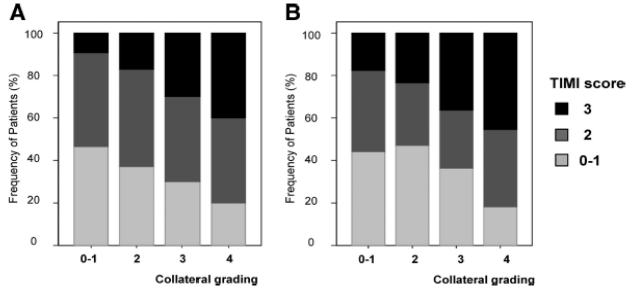


ORIGINAL RESEARCH

G.A. Christoforidis
C. Karakasis
Y. Mohammad
L.P. Caragine
M. Yang
A.P. Slivka

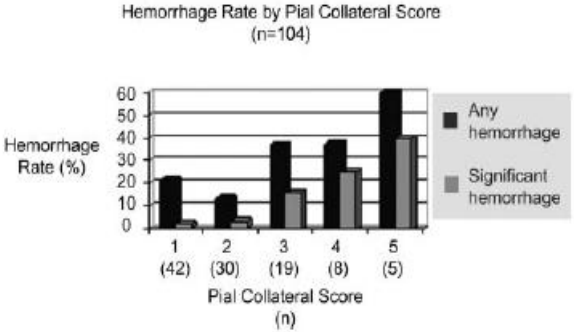
Collaborative Flow Predicts Response to Endovascular Therapy for Acute Ischemic Stroke

Oh Young Bang, MD; Jeffrey L. Saver, MD; Suk Jae Kim, MD; Gyeong-Moon Kim, MD; Chin-Sang Chung, MD; Bruce Ovbiagele, MD; Kwang Ho Lee, MD; David S. Liebeskind, MD



AJNR Am J Neuroradiol 30:165–70 | Jan 2009 |

Predictors of Hemorrhage Following Intra-Arterial Thrombolysis for Acute Ischemic Stroke: The Role of Pial Collateral Formation



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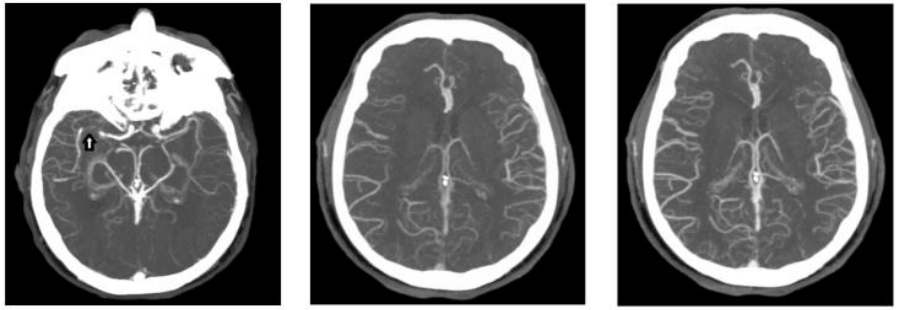
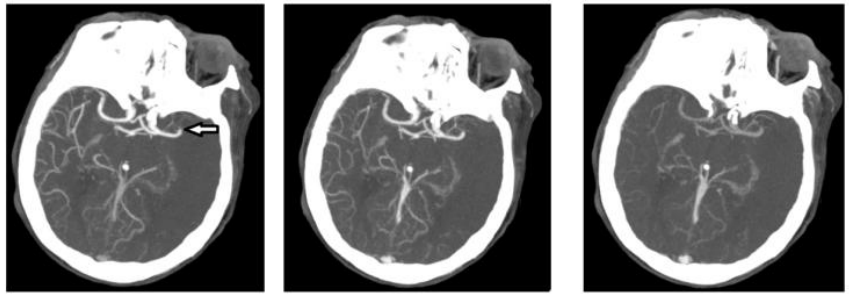
valuation



Good CC: Score 5

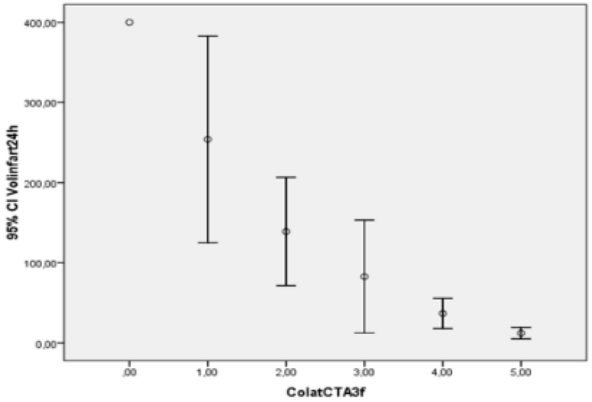
score 0 score 1 sc

Correlation with admission DWI lesion volume and poor outcome



Poor CC: Score 0

CC evaluation on mCTA



Variable	OR	IC up	IC lo	p
Age	1.02	0.97	1.07	0.32
NIHSS b	1.05	0.93	1.19	0.86
ASPECTS	1.05	0.57	1.96	0.38
Recanalization	7.13	1.67	30.37	0.01
mCTA good CC	4.80	1.26	18.32	0.02

Independent predictors of good functional outcome

Rubiera *et al. Poster presentation, ISC 2015*

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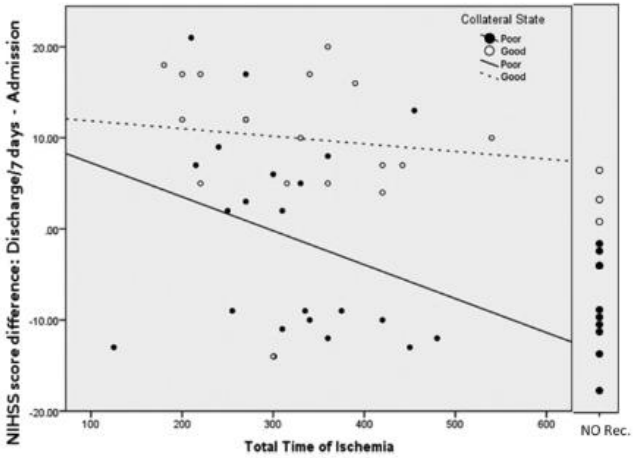
Extending the Time Window for Endovascular Procedures According to Collateral Pial Circulation

Marc Ribo, MD, PhD; Alan Flores, MD; Marta Rubiera, MD, PhD; Jorge Pagola, MD, PhD; Joao Sargento-Freitas, MD; David Rodriguez-Luna, MD; Pilar Coscojuela, MD; Olga Maisterra, MD; Socorro Piñeiro, MD; Francisco J. Romero, MD; Jose Alvarez-Sabin, MD, PhD; Carlos A. Molina, MD, PhD



Extending the Time Window for Endovascular Procedures

ESC Council Stroke

Dramatic Recovery in Acute Ischemic Stroke Is Associated With Arterial Recanalization Grade and Speed

Mikael Mazighi, MD, PhD; Elena Meseguer, MD; Julien Labreuche, BST; Jean-Michel Serfaty, MD; Jean-Pierre Laissy, MD; Philippa C. Lavallée, MD; Lucie Cabrejo, MD; Céline Guidoux, MD; Bertrand Lapergue, MD; Isabelle F. Klein, MD, PhD; Jean-Marc Olivot, MD, PhD; Aymeric Rouchaud, MD; Jean-Philippe Desilles, MD; Elisabeth Schouman-Claeys, MD; Pierre Amarenco, MD

[*Stroke*. 2012;43:2998-3002.

Table 2. Impact of Grade and Time to Recanalization on Dramatic Recovery Outcome Among Patients With Recanalization Monitored by Angiography

Recanalization Results	No.	DR, No. (%)	*P* Value	OR (95% CI)*	*P* Value*
All patients (n=128)					
TIMI grade flow					
2 (partial)	49	7 (14.3)	<0.001	1.00 (reference)	
3 (complete)	79	37 (46.8)		4.97 (1.98–12.51)	<0.001
Time to recanalization, tertiles					
>296 min	43	9 (20.9)	0.002†	1.00 (reference)	
226–296 min	43	13 (30.2)		1.75 (0.65–4.77)	
<226 min	42	22 (52.4)		3.85 (1.47–10.09)	0.006†

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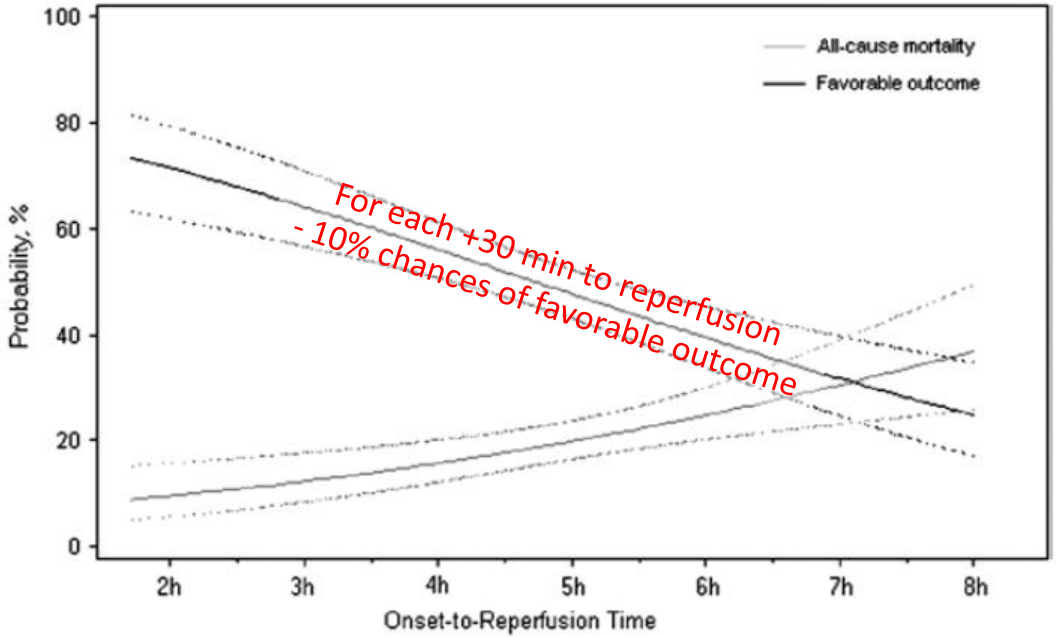
Impact of Onset-to-Reperfusion Time on Stroke Mortality

A Collaborative Pooled Analysis

Mikael Mazighi, MD, PhD; Saqib A. Chaudhry, MD; Marc Ribo, MD; Pooja Khatri, MD, MSc; David Skoloudik, MD; Maxim Mokin, MD; Julien Labreuche, BST; Elena Meseguer, MD; Sharon D. Yeatts, PhD; Adnan H. Siddiqui, MD; Joseph Broderick, MD; Carlos A. Molina, MD; Adnan I. Qureshi, MD; Pierre Amarenco, MD

(*Circulation*. 2013;127:1980-1985.)

480 patients with endovascular treatment & known time of reperfusion



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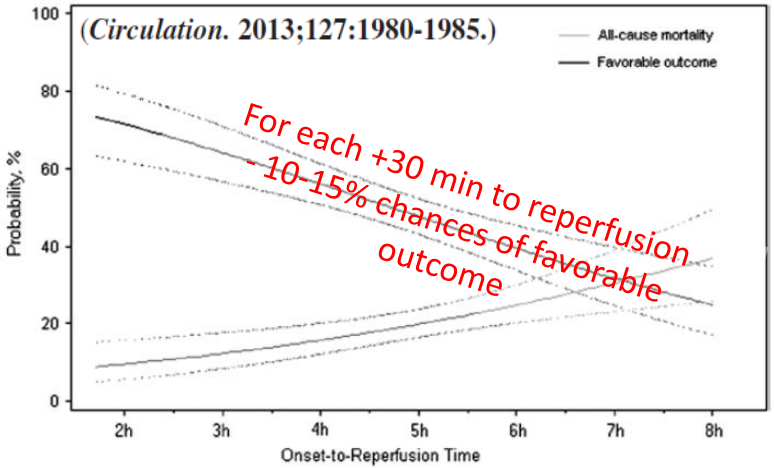
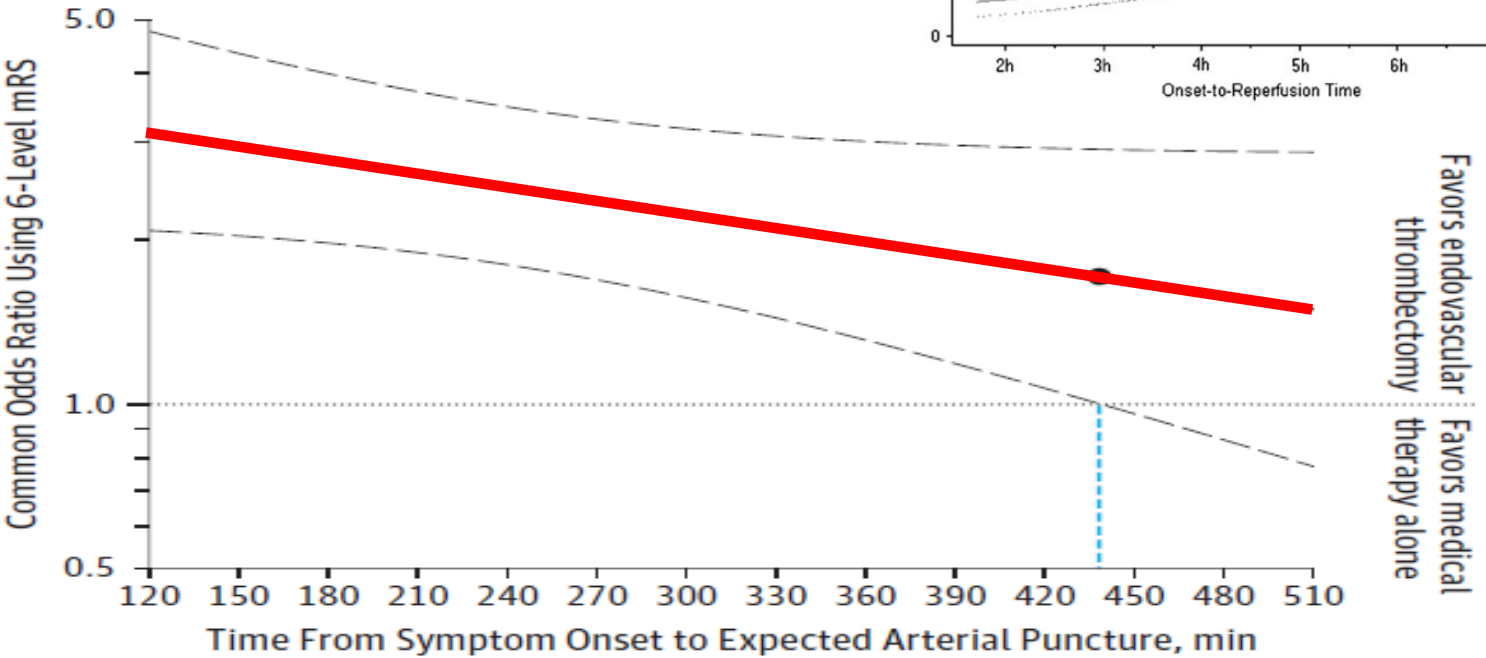
Time to Treatment With Endovascular Thrombectomy and Outcomes From Ischemic Stroke: A Meta-analysis

Jeffrey L. Sav
Bruce C. Cam
Thomas G. De
Adnan H. Sid
Puck S. Fransı
Frank L. Silver
Antoni Davalo

A Odds ratio for less disability at 3 mo in endova vs medical therapy alone groups by time to tre





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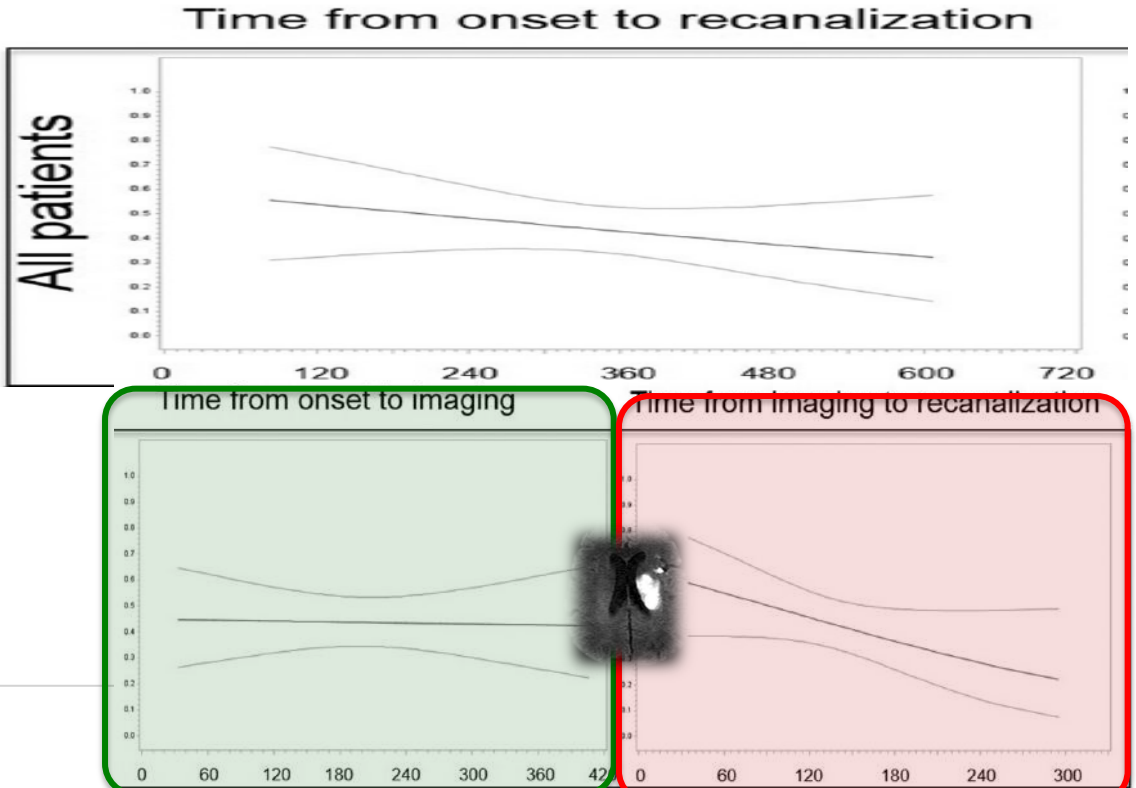
Association Between Time to Reperfusion and Outcome Is Primarily Driven by the Time From Imaging to Reperfusion

Marc Ribo, MD; Carlos A. Molina, MD; Erik Cobo, PhD; Neus Cerdà, PhD; Alejandro Tomasello, MD; Helena Quesada, MD; Maria Angeles De Miquel, MD; Mónica Millan, MD; Carlos Castaño, MD; Xabier Urra, MD; Luis Sanroman, MD, PhD; Antoni Dàvalos, MD; Tudor Jovin, MD; for the REVASCAT Trial Investigators*

Stroke. 2016;47:999-1004.



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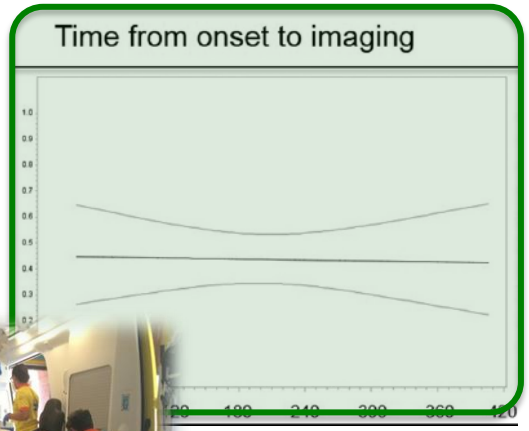

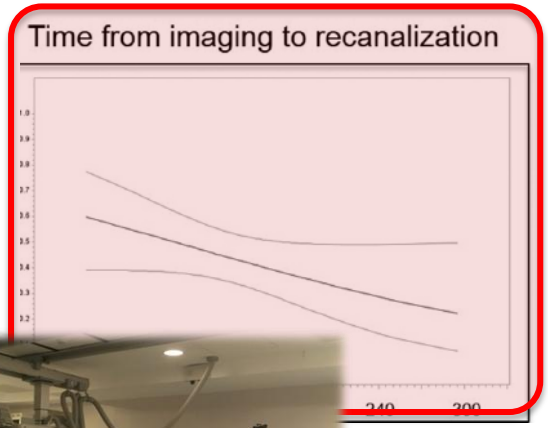

Number of candidates

Improve outcomes of treated patients

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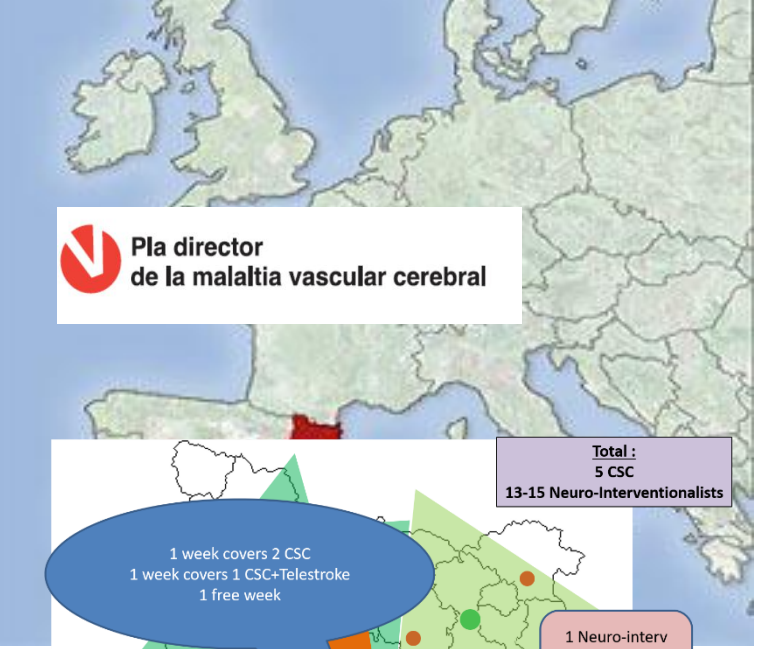

ER CODE

CT CODE

ANGIO CODE

Pre-notification
RACE>4 o NIHSS >10
< 6 hours

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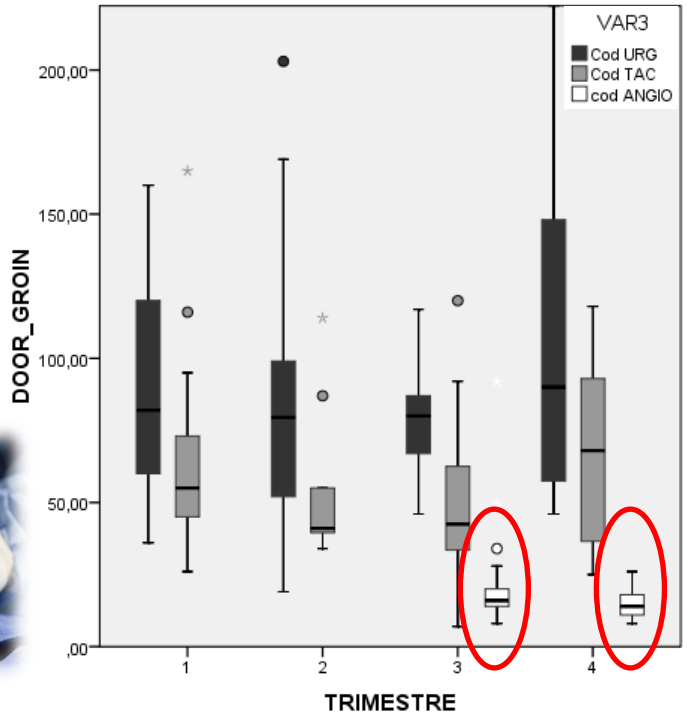
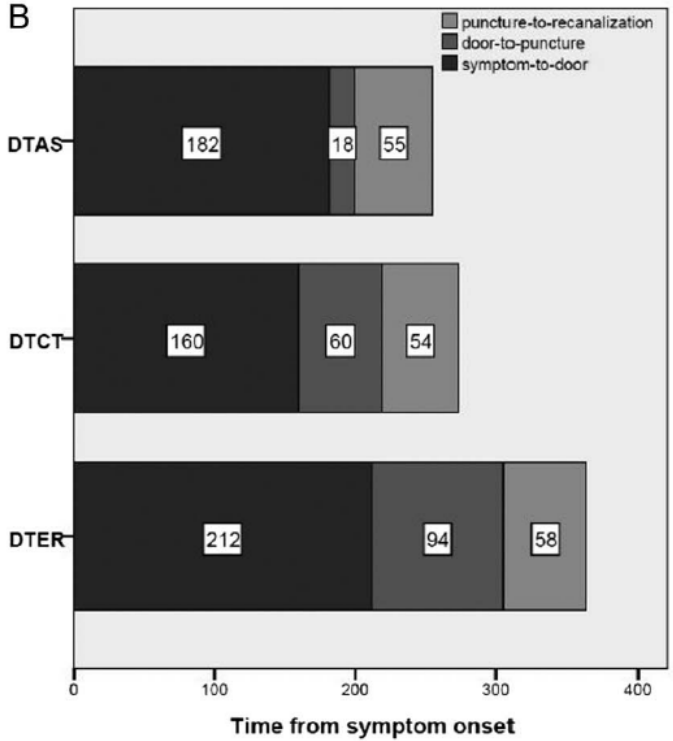
J NeuroIntervent Surg 2017

ORIGINAL RESEARCH

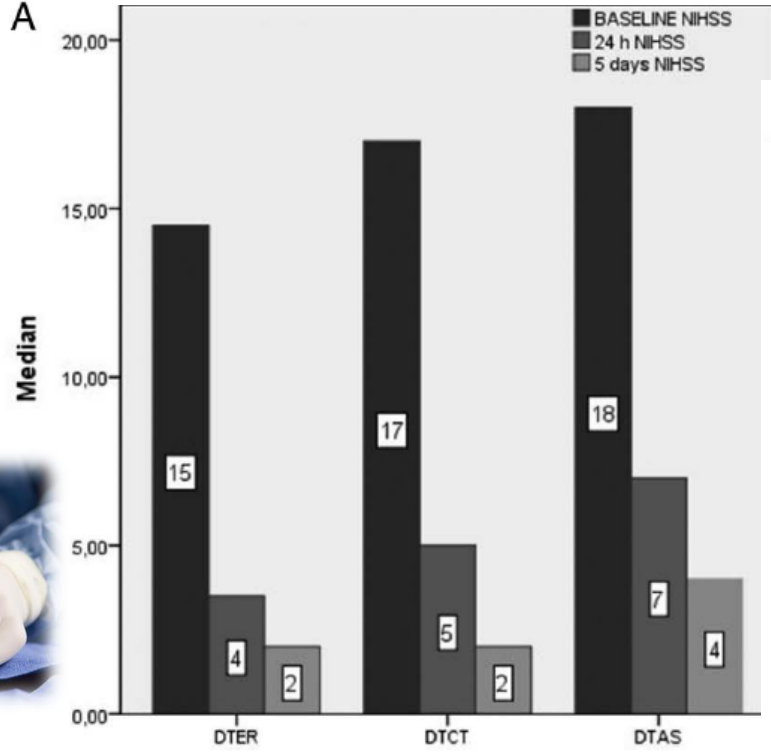
Direct transfer to angiosuite to reduce door-to-puncture time in thrombectomy for acute stroke

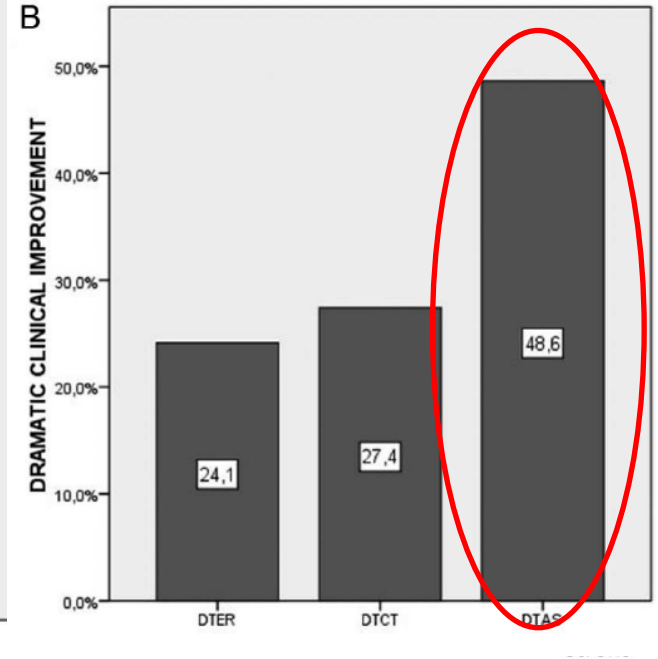




ORIGINAL RESEARCH

Direct transfer to angiosuite to reduce door-to-puncture time in thrombectomy for acute stroke





Interfacility Transfer Directly to the Neuroangiography Suite in Acute Ischemic Stroke Patients Undergoing Thrombectomy

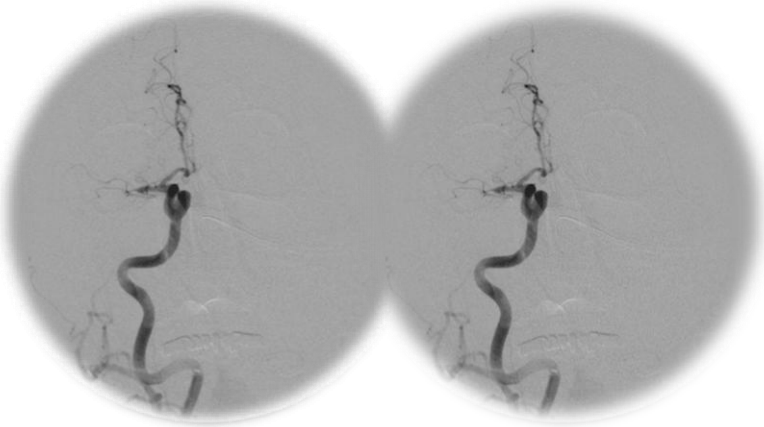
Ashutosh P. Jadhav, MD, PhD; Cynthia L. Kenmuir, MD, PhD; Amin Aghaebrahim, MD; Kaustubh Limaye, MD; Lawrence R. Wechsler, MD; Maxim D. Hammer, MD; Matthew T. Starr, MD; Bradley J. Molyneaux, MD, PhD; Marcelo Rocha, MD, PhD; Francis X. Guyette, MD; Christian Martin-Gill, MD; Andrew F. Ducruet, MD; Bradley A. Gross, MD; Brian T. Jankowitz, MD; Tudor G. Jovin, MD

Stroke. 2017;48:1884-1889.

Table 2. Outcome Times Stratified by Treatment

Variable	Transfer Location		*P* Value
	ED (n=150)	DAN (n=111)	
Door to angiosuite	67 (34–72)	10 (3–6)	0.001*
Door to puncture	81 (46–91)	22 (12–25)	0.001*
Door to recanalization	125 (81–146)	66 (39–84)	0.001*
Angiosuite to access	13 (8–17)	12 (8–14)	0.177
Access to recanalization	44 (27–53)	43 (20–61)	0.883
Angiosuite to recanalization	57 (37–74)	56 (29–73)	0.548
LSW to recanalization	429 (258–468)	348 (221–394)	0.052

Mean (interquartile range). DAN indicates directly admitted to the neuroangiography suite; ED, emergency department; and LSW, last seen well.
*Statistical significance at $P<0.05$.

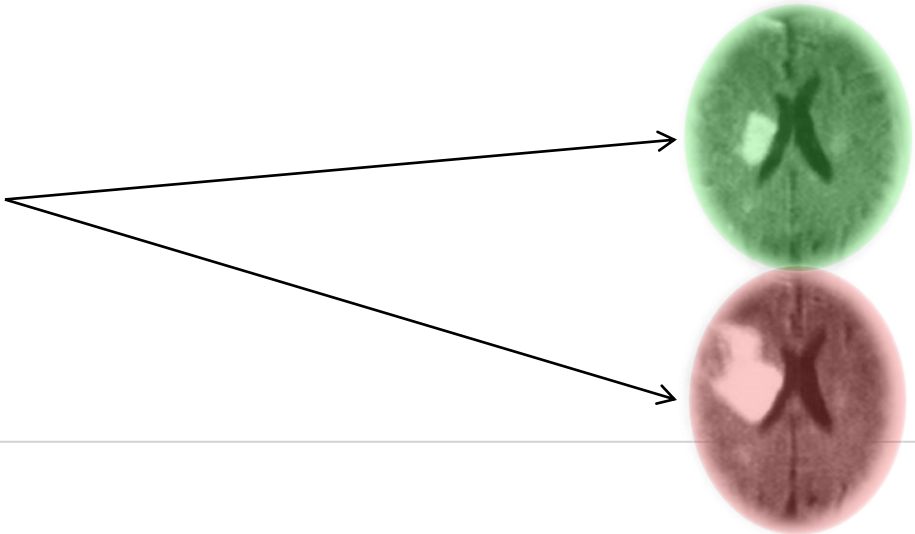


30 min.

60 min.

90 min.

Initial
DWI



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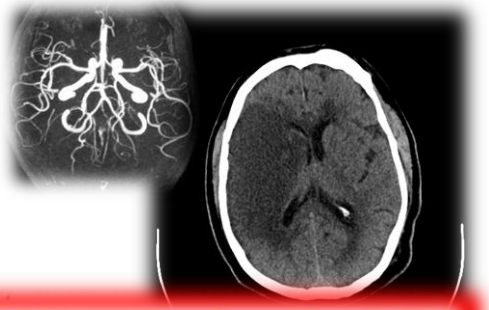
ESC Council Stroke

ORIGINAL RESEARCH

Infarct growth despite full reperfusion in endovascular therapy for acute ischemic stroke

Diogo C Haussen,[1] Raul G Nogueira,[1] Mohamed Samy Elhammady,[2] Dileep R Yavagal,[2] Mohammad Ali Aziz-Sultan,[3] Jeremiah N Johnson,[2] Brandon G Gaynor,[2] Shyian Jen,[1] Seena Dehkharghani,[1] Eric C Peterson[2]



Overall, 35% of patients had SIG.

Table 2 Procedural variables

	SIG (n=21)	No SIG (n=39)	p Value
Time last normal to groin puncture (h)	6.8±2.7	6.9±3.3	0.83
Duration of procedure (h)	1.4±0.7	1.25±0.6	0.20
Occlusion site			
Cervical ICA only	4 (19%)	2 (5	
ICA-T	2 (10%)	5 (1	
MCA M1	11 (52%)	25 (	
MCA M2	4 (19%)	7 (1	
Tandem	2 (10%)	5 (1	
Angiogram collaterals*			
0–1	4 (22%)	5 (1	
2	7 (39%)	15 (	
3	6 (33%)	7 (2	
4	1 (6%)	2 (7	
Devices			
First-generation devices	15 (71%)	21 (	
Stent-retrievers	5 (23%)	19 (	
IA t-PA	10 (47%)	16 (	

*47 patients.
IA t-PA, intra-arterial tissue plasminogen activator; ICA, internal carotid artery; ICA-T, ICA terminus; MCA, middle cerebral artery; SIG, significant infarct growth.

Table 4 Multivariate analysis for predictors of significant infarct growth

	OR	95% CI	p Value
Race	0.31	0.11 to 0.89	0.03
Diabetes	1.58	0.37 to 6.72	0.53
IV t-PA	0.19	0.04 to 0.90	0.03
Stent-retriever	0.17	0.03 to 0.89	0.03
mRS ≤2 at 3 months	0.15	0.02 to 0.80	0.02

IV t-PA, intravenous tissue plasminogen activator; mRS, modified Rankin Scale.

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Predictors of Infarct Growth after Endovascular Therapy for Acute Ischemic Stroke

Shumei Man, MD, PhD, Junya Aoki, MD, PhD, Muhammad S. Hussain, MD, Dolora Wisco, MD, Yohei Tateishi, MD, PhD, Gabor Toth, MD, Ferdinand K. Hui, MD, and Ken Uchino, MD

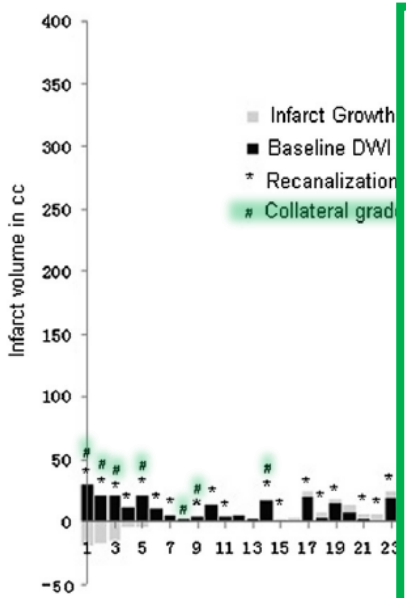


Table 4. *Logistic regression of predictors for DWI no-growth versus other three groups combined*

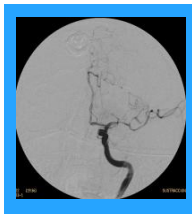
	Odds ratio	Confidence interval	*P* value
Age	1.07/unit	.95-1.27	.317
Admission glucose	1.00/unit	.98-1.03	.768
On statin	.29	.01-5.50	.395
Initial NIHSS	1.17/unit	.94-1.58	.063
IV tPA	.38	.04-2.78	.197
ICA occlusion	.29	.05-2.31	.294
Good collaterals	4.02	1.14-19.08	.030
Initial DWI volume	.90/unit	.73-.99	.032
Time to recanalization	1.00/unit	.99-1.00	.281
TICI 2b and above	16.91	1.69-477.0	.002

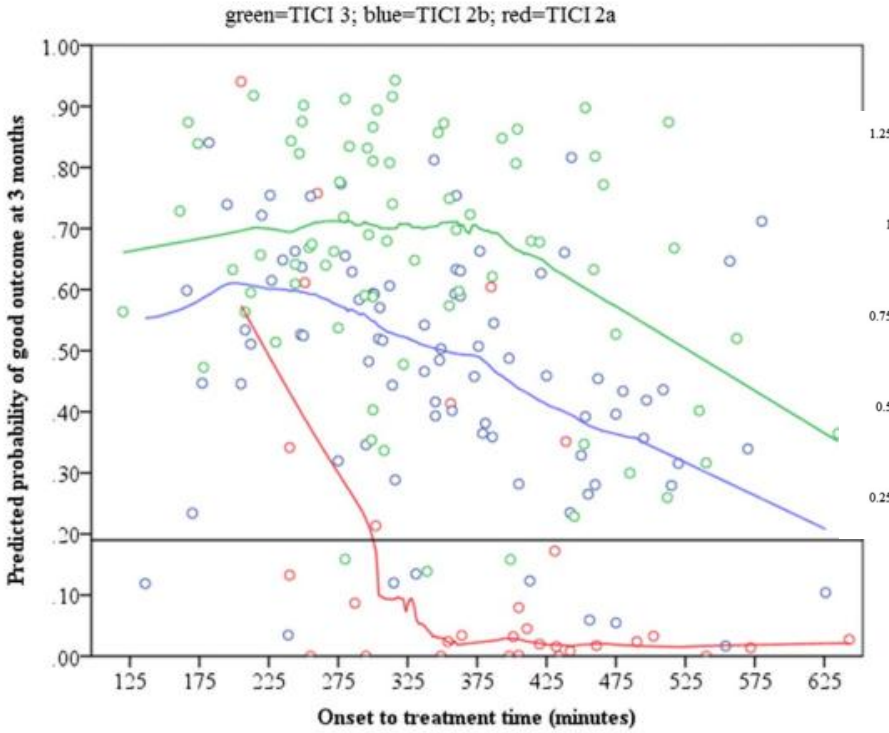
ESC Council Stroke

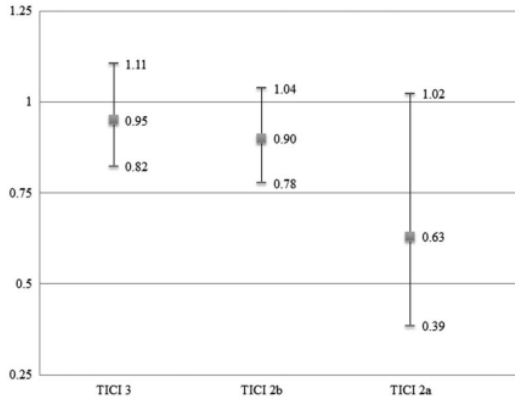
ORIGINAL RESEARCH

Prabhakaran S, *et al*. *J NeuroIntervent Surg* 2016

Complete reperfusion mitigates influence of treatment time on outcomes after acute stroke







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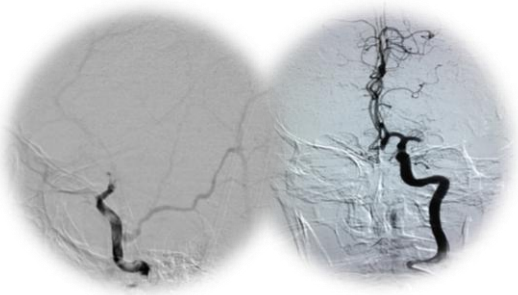
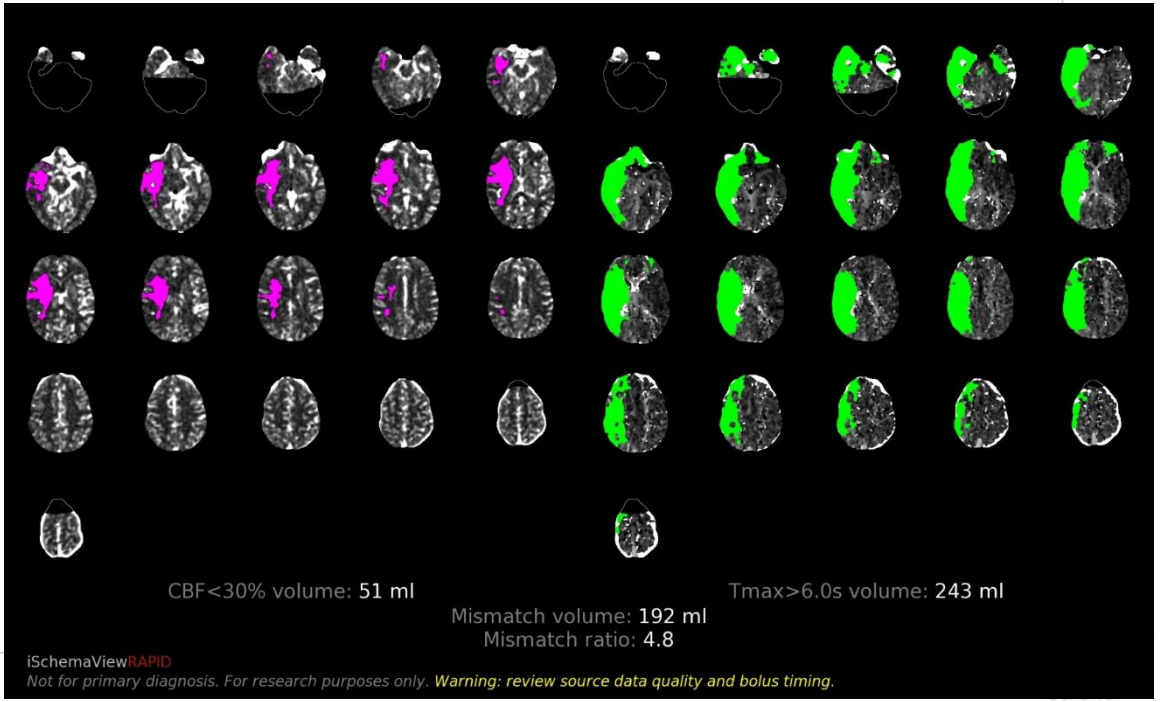
The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

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

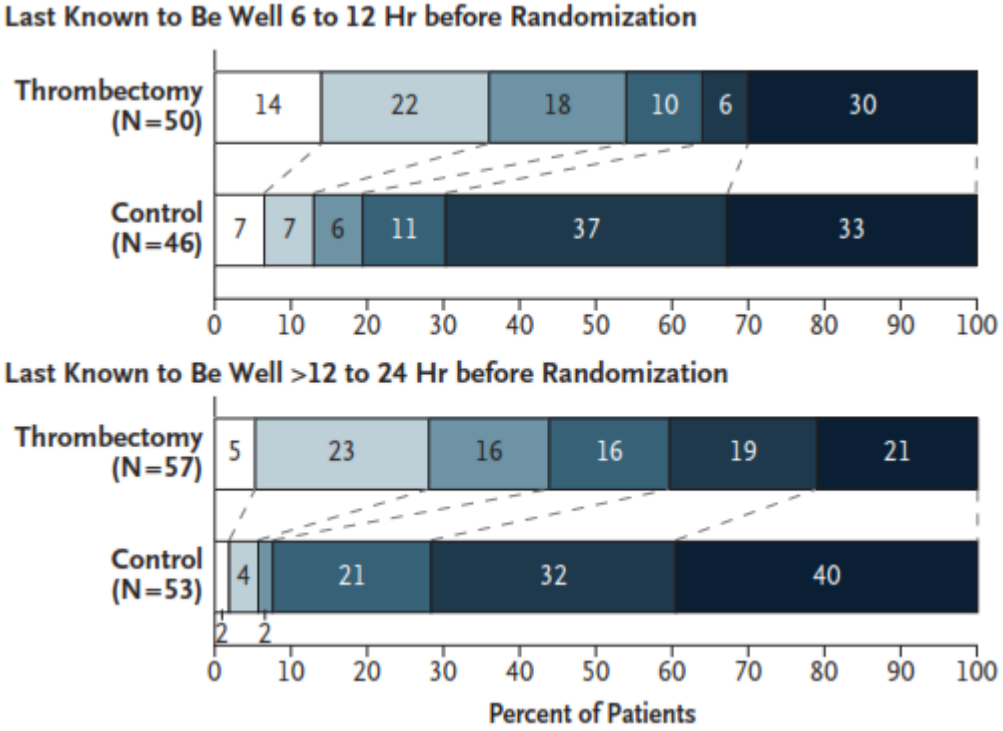




60y, NIHSS 20, M1 occ

ORIGINAL ARTICLE

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



Type of stroke onset		0.21
On awakening	>0.99	
Witnessed stroke	0.99	
Unwitnessed stroke	0.93	
Interval between time that patient wa		0.22
known to be well and randomizatio		
6 to 12 hr	>0.99	
>12 to 24 hr	>0.99	
Time from first observation of sympto		0.70
to randomization		
0 to 6 hr	>0.99	
>6 hr	>0.99	

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