Everything the Intensivist Needs to Know About Stroke

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I have no conflicts of interest

Outline

Discuss changing Epidemiology

- Review the workup of stroke in the ED/Floor/ICU
- Determine imaging to use(which type is best)
- Review standard in catheter based treatment
- Discuss the use of Duel antiplatelet therapy
- Cardiac Holter monitoring

Key Points:

- Time has very limited function in determining a stroke and cerebral imaging allows for a more accurate diagnosis, determine mechanism of the event and helps with early treatment and prognosis.

- Next best steps: Utilize duel antiplatelet therapies for 21 days after stroke when ABCD2 score is ≥ 4 and NIH ≤ 3 then monotherapy with antiplatelets and consider longer Holter monitoring as outpatients to improve the diagnosis of A Fib that would require anticoagulation.

Stroke in the US

- 795 000 people experience a new or recurrent stroke.
  - Approximately 610 000 of these are first attacks, and 185 000 are recurrent attacks.
- 137 000 stroke deaths annually in the United States.
- Leading cause of serious, long-term disability
- Third leading cause of death in the U.S.; second leading cause worldwide
- Second-leading cause of hospital admission among older adults

Stroke. 2011;42:849-877

Case Vignette

- A 54-year-old man presents 2 hours after sudden weakness in his left.
- His symptoms lasted for 30 minutes.
- He has hypertension and hyperlipidemia, for which he takes an angiotensin-receptor blocker and a statin, and he is a smoker with a 30 pack-year history.
- On examination, the blood pressure is 156/96 mm Hg.
- How should this patient be further evaluated and treated?

Amarenco P. N Engl J Med 2020;382:1933-1941

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Best cerebral imaging choices for this case:

A. CT of the brain
B. CT brain/CTA of brain and neck
C. MRI of the brain
D. MRI brain/MRA of brain and neck

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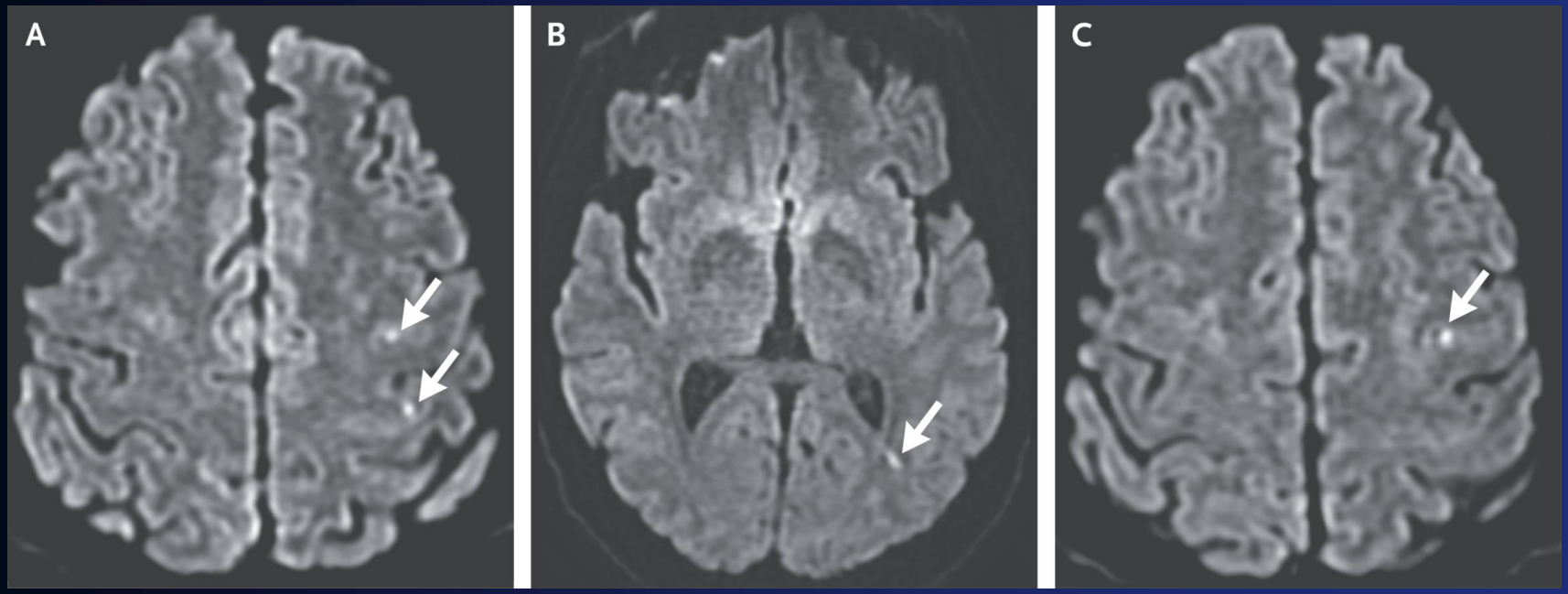
Neuroimaging Evaluation.



Amarenco P. N Engl J Med 2020;382:1933-1941

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Which is the best assessment scales to perform

A. Glasgow Coma Score
B. NIH Stroke Scale Score
C. ABCD2 score
D. The FAST Exam (Face, Arm, Speech, Time)

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Conclusions and Recommendations

- The patient described in the vignette presented with symptoms consistent with a motor TIA.
- I would have recommended that he take 300 mg of aspirin if possible.
- Without having self-administered aspirin, I would have administered the aspirin as well as 300 mg of clopidogrel.
- In a prompt assessment of diffusion-weighted imaging on brain MRI, the finding of a bright spot in the right hemisphere would confirm ischemia.
- I would then prescribe clopidogrel at a dose of 75 mg plus aspirin at a dose of 75 mg for 21 days, followed by long-term aspirin monotherapy (75 mg).

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Conclusions and Recommendations

- If ipsilateral right carotid stenosis were detected on imaging of the extracranial and intracranial vasculature, I would recommend prompt carotid endarterectomy.
- I would also perform a cardiac evaluation including 3-week ECG monitoring to detect paroxysmal atrial fibrillation that would warrant long-term oral anticoagulation instead of antiplatelet therapy, particularly in the absence of severe carotid stenosis or another potential direct cause of TIA.
- I would review with the patient his increased risk of stroke and provide guidance regarding control of risk factors, including smoking cessation and lifestyle changes.

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New Definition of TIA

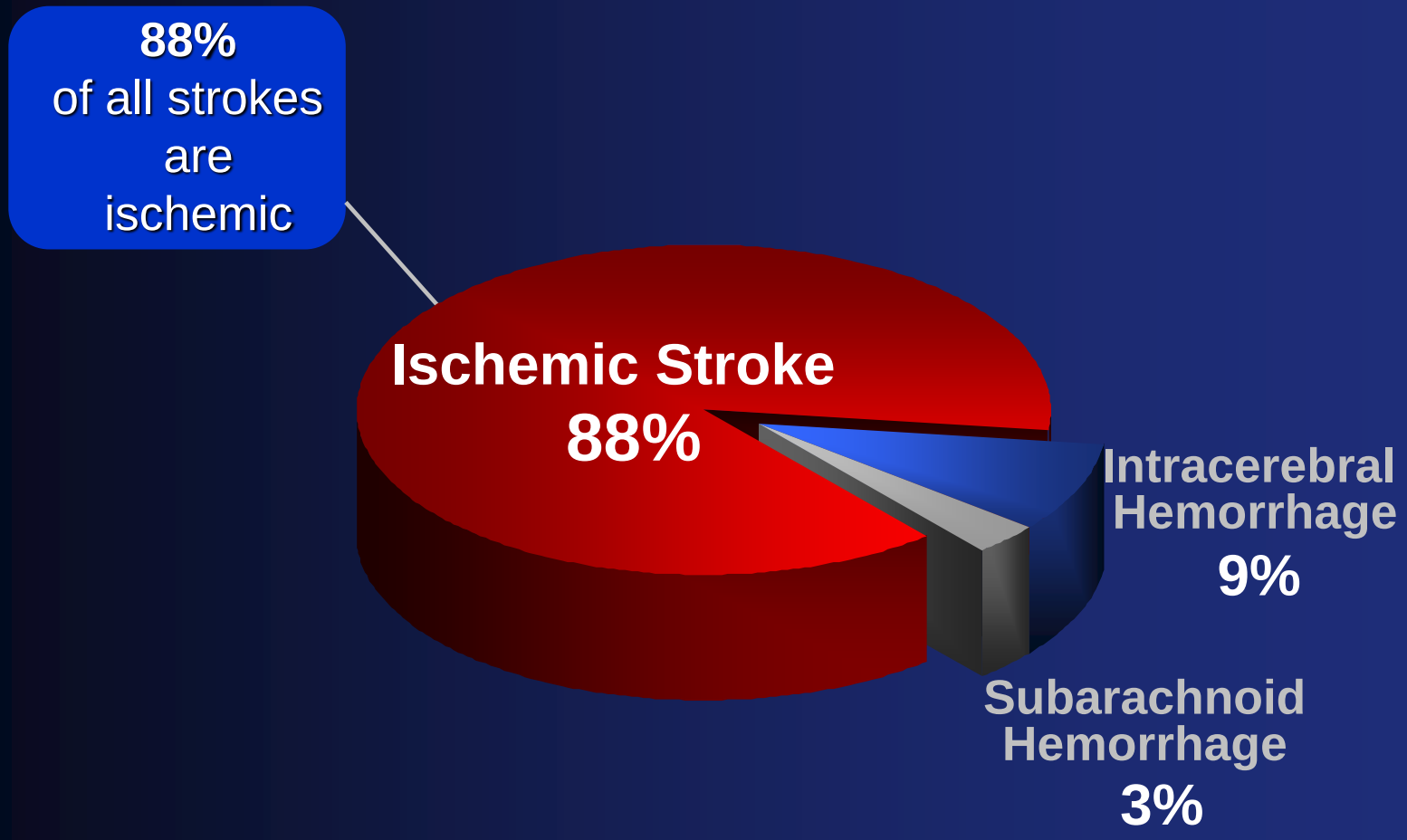
TIA is a brief episode of neurologic dysfunction caused by focal brain or retinal ischemia, with clinical symptoms typically lasting *less than one hour*, and *without evidence of acute infarction*

N Engl J Med, Vol. 337, Nov 21, 2002, 1713-1717.

Stroke, Vol 37, 2006, 577-617.

Stroke. 2009;40:2276.

Prevalence of Ischemic Stroke



American Heart Association. *Heart Disease and Stroke Statistics—2005 Update*. 2005.

ABCD^2 of TIA

- **Patients with TIA score points for each of the following factors:**
  - Age 60 years (1 point)
  - Blood pressure 140/90 mm Hg on first evaluation (1 point)
  - Clinical symptoms of focal weakness with the spell (2 points) or speech impairment without weakness (1point)
  - Duration 60 minutes (2 points) or 10 to 59 minutes (1 point)
  - Diabetes (1 point).
  - 2-day risk of stroke:
    - 0% for scores of 0 -1
    - 1.3% for 2 -3
    - 3, 4.1% for 4-5
    - 8.1% for 6-7

Stroke. 2009;40:2276.

Working up Stroke

- Neuroimaging evaluation within 24 hours of symptom onset.
  - MRI, including DWI, is the preferred brain diagnostic imaging modality.
- Noninvasive imaging of the cervicocephalic vessels should be performed routinely as part of the evaluation
- Noninvasive testing of the intracranial vasculature reliably excludes the presence of intracranial stenosis
- Patients with suspected TIA should be evaluated as soon as possible after an event
- ECG/ECHO/Holter

Stroke. 2009;40:2276

Common Causes – Not a single disease

- Atherothrombosis
  - Large-vessel
    - Extracranial
      - Aortic
      - Cervical ICA
      - Cervical CCA
    - Intracranial
      - ICA
      - MCA
      - Vertebral artery
      - Basilar artery
  - Small vessel
    - Lacunar
- Cardiac source
  - Atrial fibrillation
  - Dilated cardiomyopathy
- Nonatherosclerotic arteriopathies, eg:
  - Vasculitis
  - Migraine
- Prothrombotic disorders

Helgason CM et al. *Circulation*. 1997;96:701-707.

CT vs MRI in acute stroke

- **CT is widely available and fast**
  - **Noncontrast CT, CT angiography and CT perfusion can be performed in under 15 minutes**
  - **Superior to MRA in evaluating the vessels**
    - Less artefacts and better quantification of lesions
- **MRI stroke protocol takes longer**
  - **Conventional MRI, DWI, MRA and PWI**
  - **No radiation**
  - **Can be performed without contrast**
    - Arterial spin labelling, time-of-flight
- **The two modalities are equally useful for evaluating acute stroke**
  - **Equivalent depiction of the penumbra**

Imaging approach to acute stroke

- **Four P's**
  - **Parenchyma**
    - Assess early signs of acute stroke
    - Rule out haemorrhage
  - **Pipes**
    - Assess extracranial circulation (carotid & vertebral) and intracranial circulation for evidence of intravascular thrombus
  - **Perfusion**
    - Assess Cerebral blood volume (CBV), Cerebral blood flow (CBF) and Mean transit time (MTT)
  - **Penumbra**
    - Assess tissue at risk of dying if ischemia continues without recanalization of intravascular thrombus

Evaluation of Tissue Status: Noncontrast Head CT

Advantages

- Almost universally available
- Rapid
- High sensitivity for detection of hemorrhage (100% ICH, 90% SAH)

Disadvantages

- Often normal in hyperacute phase
- Insensitive to lacunar and posterior fossa strokes

Evaluation of Tissue Status: Multimodal MRI (including DWI)

Advantages

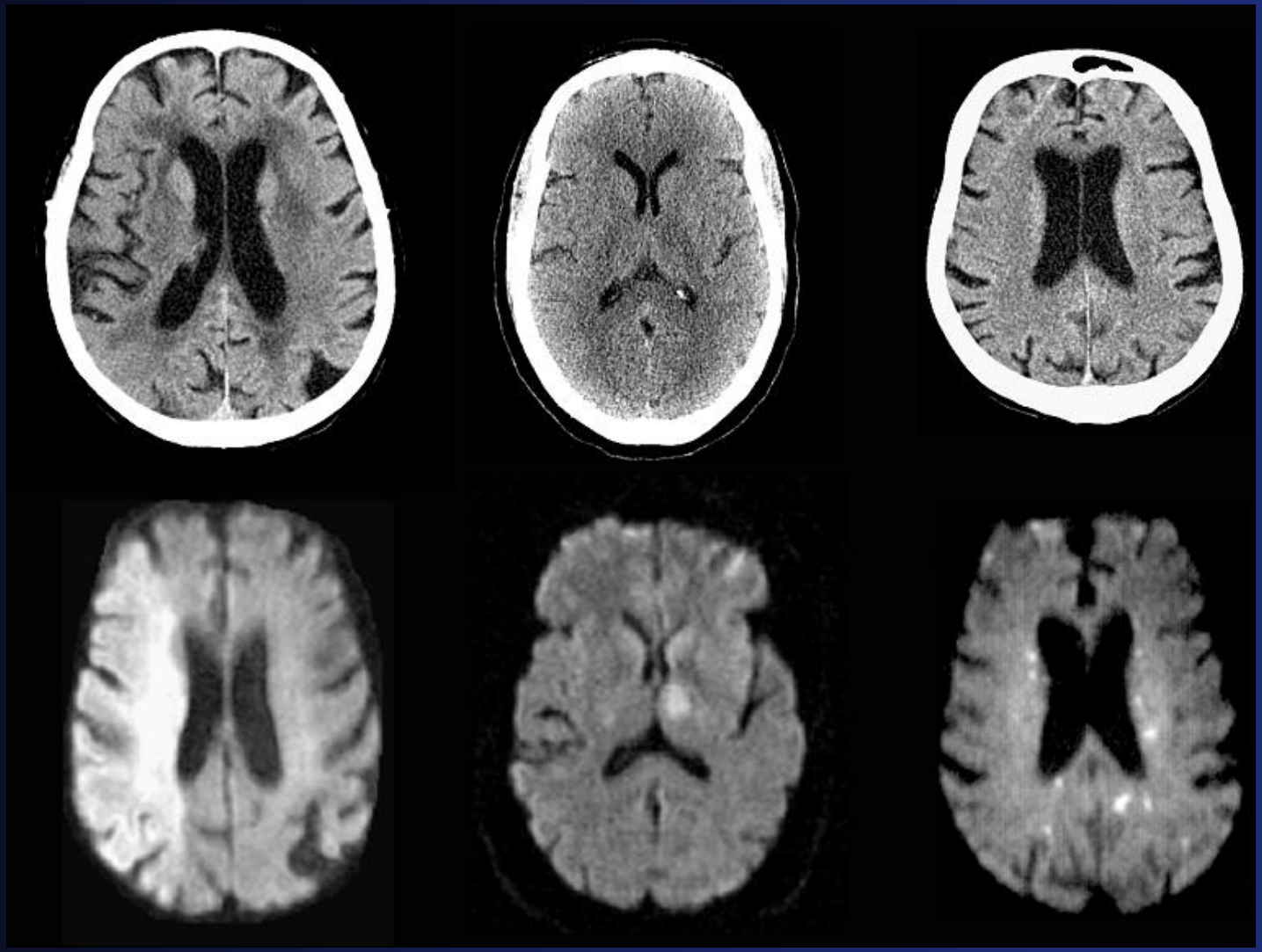
- More sensitive to acute ischemia
- More sensitive to posterior fossa lesions
- More sensitive to small vessel, lacunar lesions

- Disadvantages
  - Not universally available
  - Longer scanning time
  - Patient contraindications (e.g. pacemaker)

MRI - Tissue Status: Ischemia

CT

DWI



Evaluation of Vessel Status

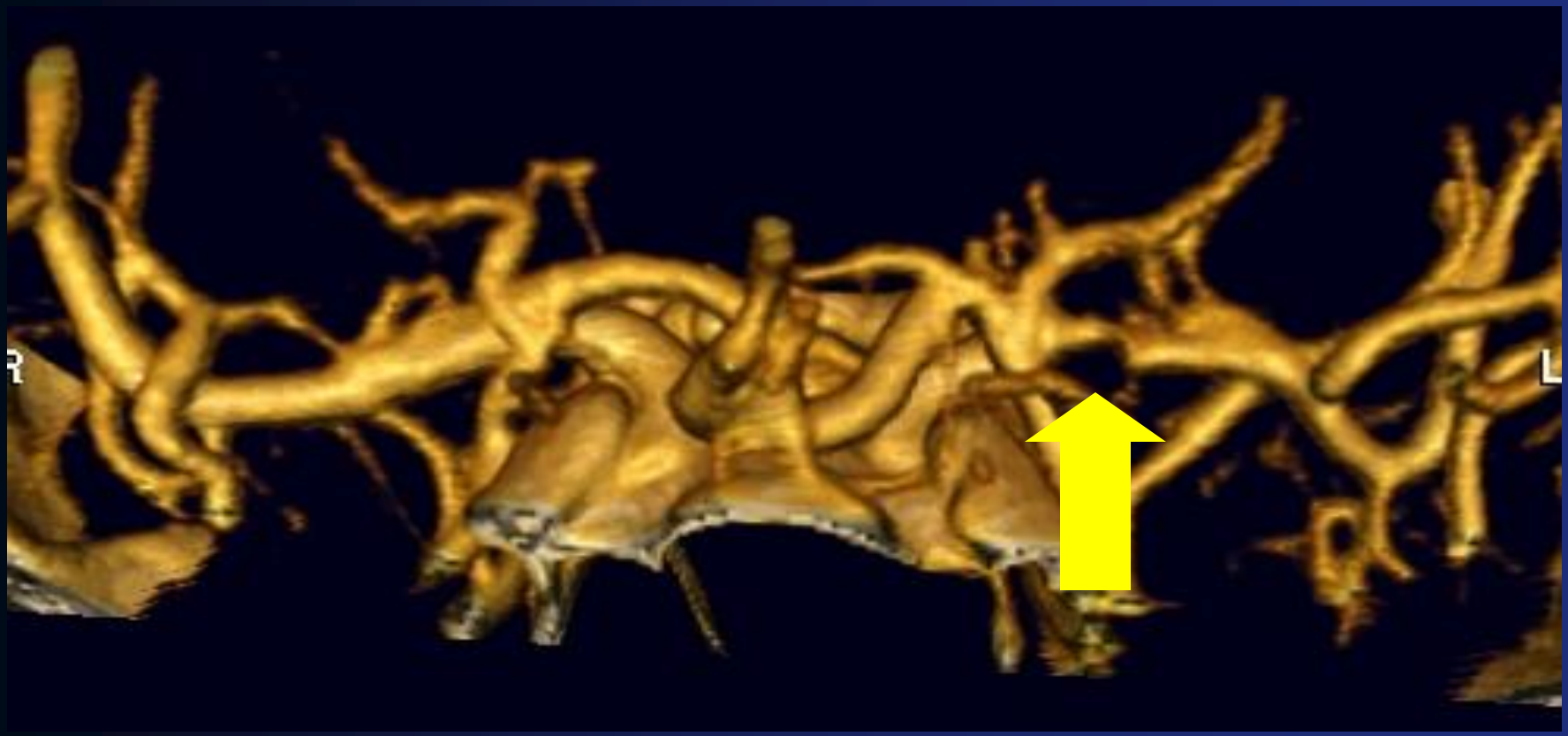
1. CT Angiography
2. MR Angiography
3. Ultrasound Techniques
4. Catheter Angiography

CT Angiography

- Requires injection of intravenous contrast agent
- New generation helical scanners allow rapid evaluation of aortic arch, neck, and intracranial vessels with 1 injection
- 80-100% accuracy compared with catheter angiography
- Disadvantages: iodinated contrast agent, radiation exposure

CTA: Carotid Stenosis

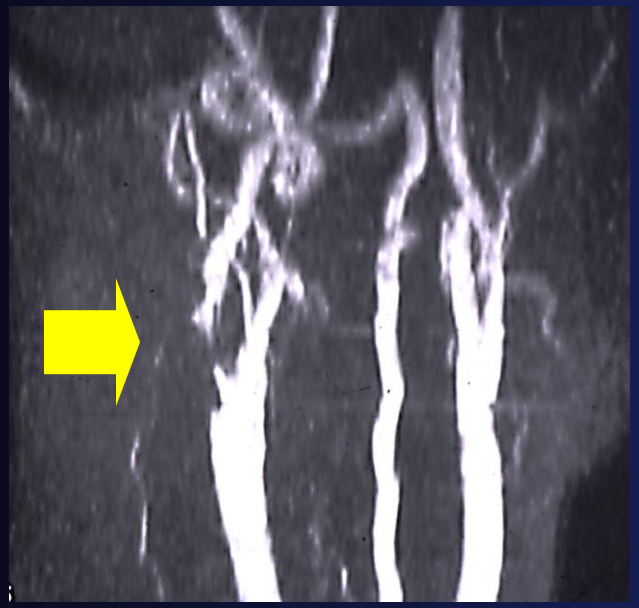
CTA: MCA Stenosis



MR Angiography

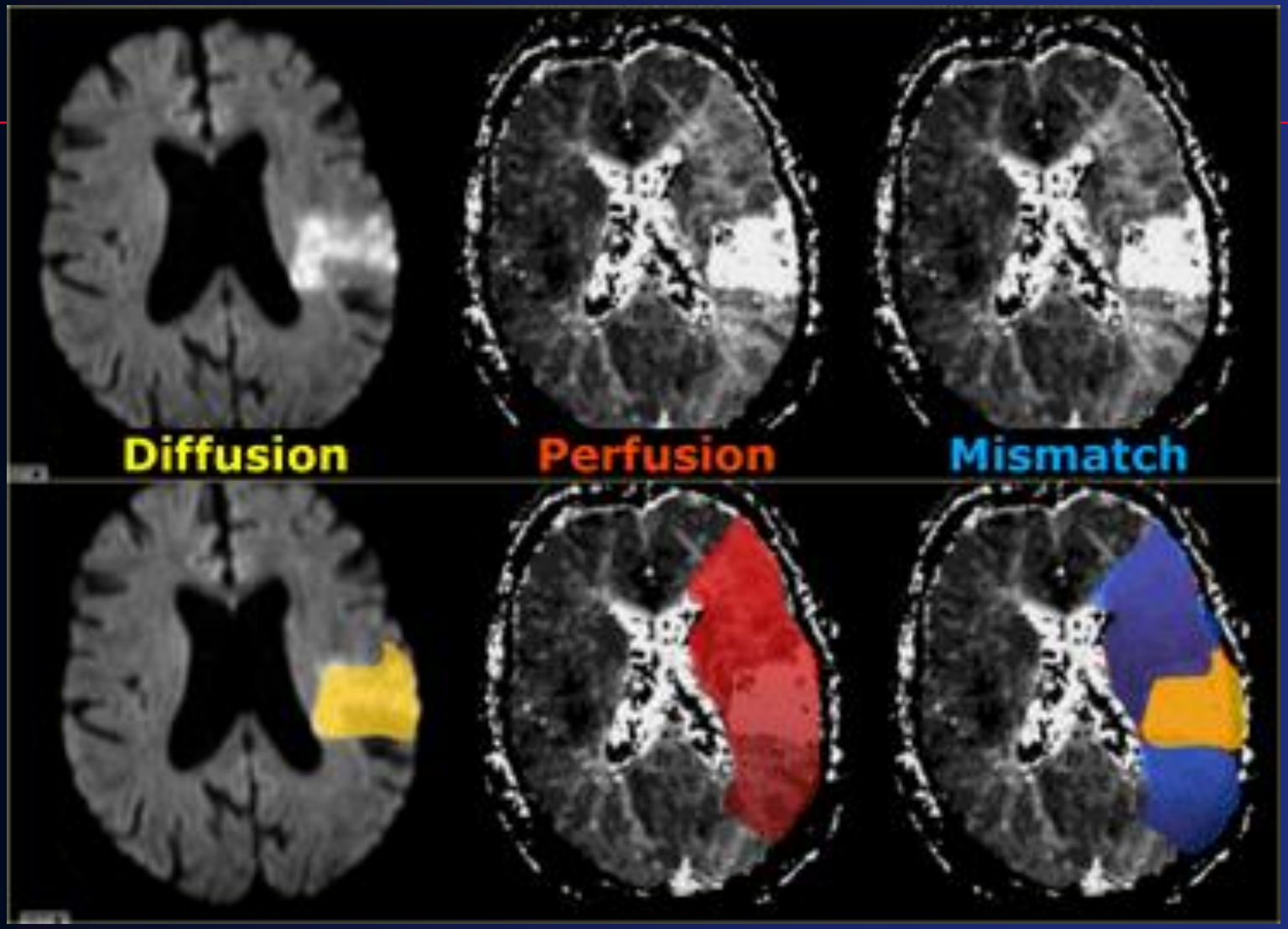
- Noninvasive means to evaluate neck and intracranial vessels
- Time of flight technique may overestimate stenoses
- Not reliable in identifying distal or branch intracranial occlusions
- Sensitivity and specificity 70-100% compared to catheter angiography
- Power-injector, contrast-enhanced techniques – increased sensitivity
- Subject to limitations of standard MRI

MR Angiography



Neck MRA: Right Carotid Stenosis

Intracranial MRA: Left ICA Occlusion


Diffusion
Perfusion
Mismatch

Whics scan to order?

- In ICU and symptomatic CT/CTA
- In ICU and asymptomatic MRI/MRA

- When there is a consideration of thrombolysis IV/IA Either

- IV TPA < 4.5 hours CT is min.

IV tPA, the "Gold Standard"

- Systemic "Clot Buster"
- FDA Approved for the treatment of AIS in 1996
- Only 8% of ischemic stroke patients are eligible for IV tPA
  - Narrow time window
  - Risk of cerebral and systemic hemorrhage
  - Achieves early reperfusion in only 13-50% of large vessel occlusions

National Institute of Neurological Disorders and Stroke rt-PA Stroke Study Group. Tissue plasminogen activator for acute ischemic stroke. N Engl J Med. 1995;333:1581-1587. Kleindorfer DO, Broderick JP, et al. Emergency department arrival times after acute ischemic stroke during the 1990s. Neurocrit Care. 2007;7(1):31-5. del Zoppo GJ, Poeck K, Pessin MS, et al. Recombinant tissue plasminogen activator in acute thrombotic and embolic stroke. Ann Neurol 1992;32:78-86. **6.** Bhatia R, Hill MD, Shobha N, et al. Low rates of acute recanalization with intravenous recombinant tissue plasminogen activator in ischemic stroke: realworld experience and a call for action. Stroke 2010;41:2254-8.

35-40% of Ischemic Strokes are Considered "Large Vessel"

- This subset of ischemic stroke comprises blockages in the:
  - Internal Carotid Artery (ICA)
  - Middle Cerebral Artery (MCA)
  - Vertebral / Basilar Artery

- Patient prognosis with these types of stroke is poor

Vessel	Mortality Rate
ICA	53%[1]
MCA	27%[2]
Basilar Artery	89-90%[3]

1. Jansen O, et al.
2. Furlan A et al. PROACT II Trial
3. Brückmann H et al.

Turning Point

The Era of Stent-Retrievers

Technological advances

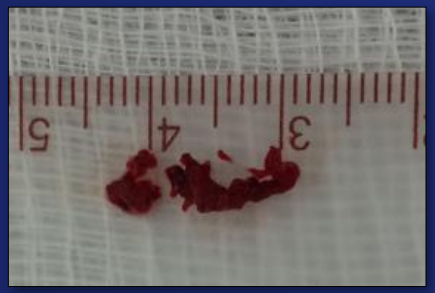
- Stent-retriever technology for safe, reliable performance

- Significant improvement in revascularization and patient outcomes vs older technology, proven in randomized clinical trials*

Goal of Ischemic Stroke Treatment

Before Intervention

After Successful Intervention



Original Article

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

Raul G. Nogueira, M.D., Ashutosh P. Jadhav, M.D., Ph.D., Diogo C. Haussen, M.D., Alain Bonafe, M.D., Ronald F. Budzik, M.D., Parita Bhuva, M.D., Dileep R. Yavagal, M.D., Marc Ribo, M.D., Christophe Cognard, M.D., Ricardo A. Hanel, M.D., Cathy A. Sila, M.D., Ameer E. Hassan, D.O., Monica Millan, M.D., Elad I. Levy, M.D., Peter Mitchell, M.D., Michael Chen, M.D., Joey D. English, M.D., Qaisar A. Shah, M.D., Frank L. Silver, M.D., Vitor M. Pereira, M.D., Brijesh P. Mehta, M.D., Blaise W. Baxter, M.D., Michael G. Abraham, M.D., Pedro Cardona, M.D., Erol Veznedaroglu, M.D., Frank R. Hellinger, M.D., Lei Feng, M.D., Jawad F. Kirmani, M.D., Demetrius K. Lopes, M.D., Brian T. Jankowitz, M.D., Michael R. Frankel, M.D., Vincent Costalat, M.D., Nirav A. Vora, M.D., Albert J. Yoo, M.D., Ph.D., Amer M. Malik, M.D., Anthony J. Furlan, M.D., Marta Rubiera, M.D., Amin Aghaebrahim, M.D., Jean-Marc Olivot, M.D., Wondwossen G. Tekle, M.D., Ryan Shields, M.Sc., Todd Graves, Ph.D., Roger J. Lewis, M.D., Ph.D., Wade S. Smith, M.D., Ph.D., David S. Liebeskind, M.D., Jeffrey L. Saver, M.D., Tudor G. Jovin, M.D., for the DAWN Trial Investigators

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- Always look for a vascular stenosis
- If you see a lesion: Consider transferring for thrombectomy or observation
- How can I figure out which patients might benefit? Advanced Imaging
- What is the time window of potential benefit of thrombectomy for appropriate patients? 24 hours has been proven

Telestroke

- AAN and ASA are supporters of bipartisan legislation which was recently introduced in Congress, the *Furthering Access to Stroke Telemedicine (FAST) Act* (H.R. 2799).

- This bipartisan bill expands access to stroke telemedicine (also called "telestroke") treatment in Medicare. Similar legislation (S.1465) has been introduced in the Senate.

ASA Treatment Guidelines: Ischemic Stroke Not Eligible for Thrombolytic Therapy

BP Level (mm Hg)	**Treatment**
SBP **<220** OR DBP **<120**	No treatment unless end-organ involvement
SBP **>220** OR DBP **<121-140**	**Nicardipine** or **labetalol** to 10% -15% ↓ in BP
DBP **>140**	**Nitroprusside** to 10% -15% ↓ in BP

ASA = American Stroke Association; IS = ischemic stroke; SBP = systolic blood pressure; DBP = diastolic blood pressure.

Adams HP, et al. *Stroke*. 2007;38:1655-1711.

ASA Treatment Guidelines: Ischemic Stroke Eligible for Thrombolytic Therapy

BP Level (mm Hg)	Treatment
Pretreatment SBP >**185** or DBP >**110**	**Labetalol** (may repeat once), **nitropaste, or nicardipine** If BP not reduced and maintained, do **not** administer rt-PA
During and after rt-PA	
SBP **180-230** OR DBP **105-120**	**Labetalol**
SBP >**230** OR DBP **121-140**	**Nicardipine** or **labetalol** If BP not controlled, consider nitroprusside

rt-PA = recombinant tissue plasminogen activator.

Adams HP, et al. *Stroke*. 2007;38:1655-1711.

Blood Pressure and Stroke What to Conclude

- All studies support detection and aggressive treatment of blood pressure for both primary and secondary prevention
- Reduction of stroke by 35%-40% possible[1]
- Thiazide-type diuretic recommended as first therapeutic agent[1]
- ACEI and ARBs are more effective in reducing progression of renal disease and are recommended as first-choice medications for patients with diabetes

1. Chobanian AV et al, and the National High Blood Pressure Education Program Coordinating Committee. *JAMA*. 2003;289:2560-2572.
2. Stroke, Vol 37, 2006, 577-617.
3. Schrader J. *Stroke*. 2003;34:1199-1703.

Noncardioembolic ischemic stroke or TIA

- Antiplatelet therapy is indicated in preference to oral anticoagulation to reduce the risk of recurrent ischemic stroke and other cardiovascular events while minimizing the risk of bleeding

Recent minor (NIHSS score ≤3) noncardioembolic Ischemic stroke or high-risk TIA (ABCD2 score ≥4)

- Duel antiplatelet therapy (aspirin plus clopidogrel) should be initiated early (ideally within 12–24 hours of symptom onset and at least within 7 days of onset) and continued for 21 to 90 days, followed by single antiplatelet therapy, to reduce the risk of recurrent ischemic stroke.

Already taking aspirin at the time of noncardioembolic ischemic stroke or TIA

- **The effectiveness of increasing the dose of aspirin or changing to another antiplatelet medication is not well established**

Noncardioembolic ischemic stroke or TIA

- The continuous use of duel antiplatelet therapy (aspirin plus clopidogrel) for >90 days or the use of triple antiplatelet therapy is associated with excess risk of hemorrhage

ACC/AHA Guidelines for the Treatment of Blood Cholesterol in Primary Prevention

- Recommendations based on the 10 year risk for cardiovascular disease
- Shifts away from specific cholesterol goals
- Estimated risk dictates intensity of statin Rx: high risk mandates high intensity statin Rx
- Atorvastatin 10 mg is moderate intensity statin Rx and 40 to 80 mg is high intensity
- 10-year risk calculator

Work-up of TIA and Ischemic Stroke

All Patients

- Brain Imaging
- Neurovascular imaging
- Blood glucose
- Serum electrolytes
- CBC w/ Platelets
- PT/PTT/INR
- 12 lead EKG/ROMI
- Holter monitoring
- TTE/TEE
- Supplemental O_2
- Fever reduction
- Lipids

Selected Patients

- Hepatic functions
- Toxicology
- Blood alcohol level
- Pregnancy
- Hypercoagulable w/u
- EEG
- LP

Original Article

Atrial Fibrillation in Patients with Cryptogenic Stroke

David J. Gladstone, M.D., Ph.D., Melanie Spring, M.D., Paul Dorian, M.D., Val Panzov, M.D., Kevin E. Thorpe, M.Math., Judith Hall, M.Sc., Haris Vaid, B.Sc., Martin O'Donnell, M.B., Ph.D., Andreas Laupacis, M.D., Robert Côté, M.D., Mukul Sharma, M.D., John A. Blakely, M.D., Ashfaq Shuaib, M.D., Vladimir Hachinski, M.D., D.Sc., Shelagh B. Coutts, M.B., Ch.B., M.D., Demetrios J. Sahlas, M.D., Phil Teal, M.D., Samuel Yip, M.D., J. David Spence, M.D., Brian Buck, M.D., Steve Verreault, M.D., Leanne K. Casaubon, M.D., Andrew Penn, M.D., Daniel Selchen, M.D., Albert Jin, M.D., David Howse, M.D., Manu Mehdiratta, M.D., Karl Boyle, M.B., B.Ch., Richard Aviv, M.B., Ch.B., Moira K. Kapral, M.D., Muhammad Mamdani, Pharm.D., M.P.H., for the EMBRACE Investigators and Coordinators

N Engl J Med
Volume 370(26):2467-2477
June 26, 2014

Study Overview

- In this study, patients with cryptogenic stroke who were randomly assigned to undergo intensive ECG monitoring for 30 days had a higher incidence of detected atrial fibrillation (16%) than those assigned to receive standard 24-hour monitoring (3%).

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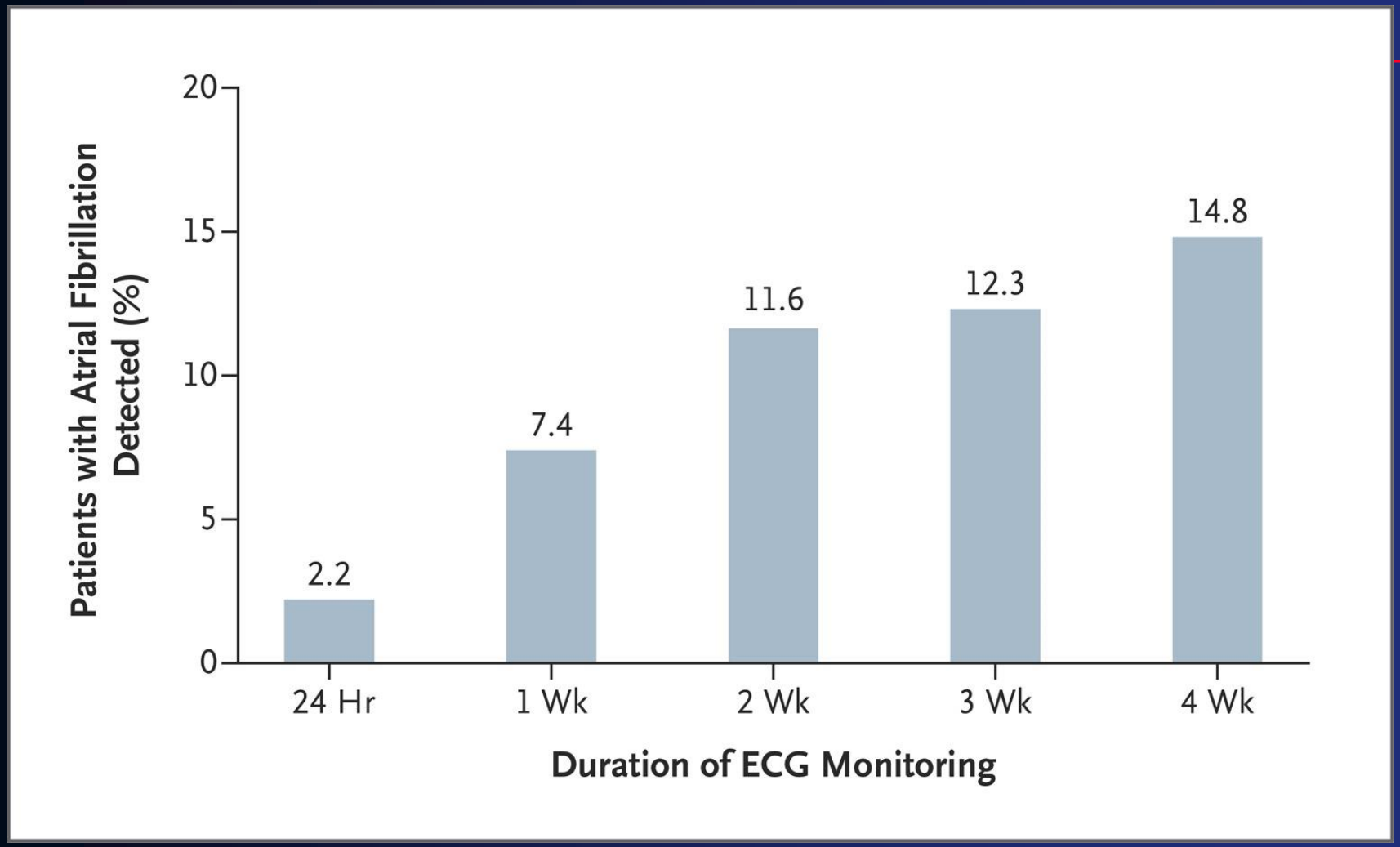
Incremental Yield of Prolonged ECG Monitoring for the Detection of Atrial Fibrillation in Patients with Cryptogenic Stroke or TIA.



Gladstone DJ et al. N Engl J Med 2014;370:2467-2477

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Conclusions

- Among patients with a recent cryptogenic stroke or TIA who were 55 years of age or older, paroxysmal atrial fibrillation was common.

- Noninvasive ambulatory ECG monitoring for a target of 30 days significantly improved the detection of atrial fibrillation by a factor of more than five and nearly doubled the rate of anticoagulant treatment, as compared with the standard practice of short-duration ECG monitoring.

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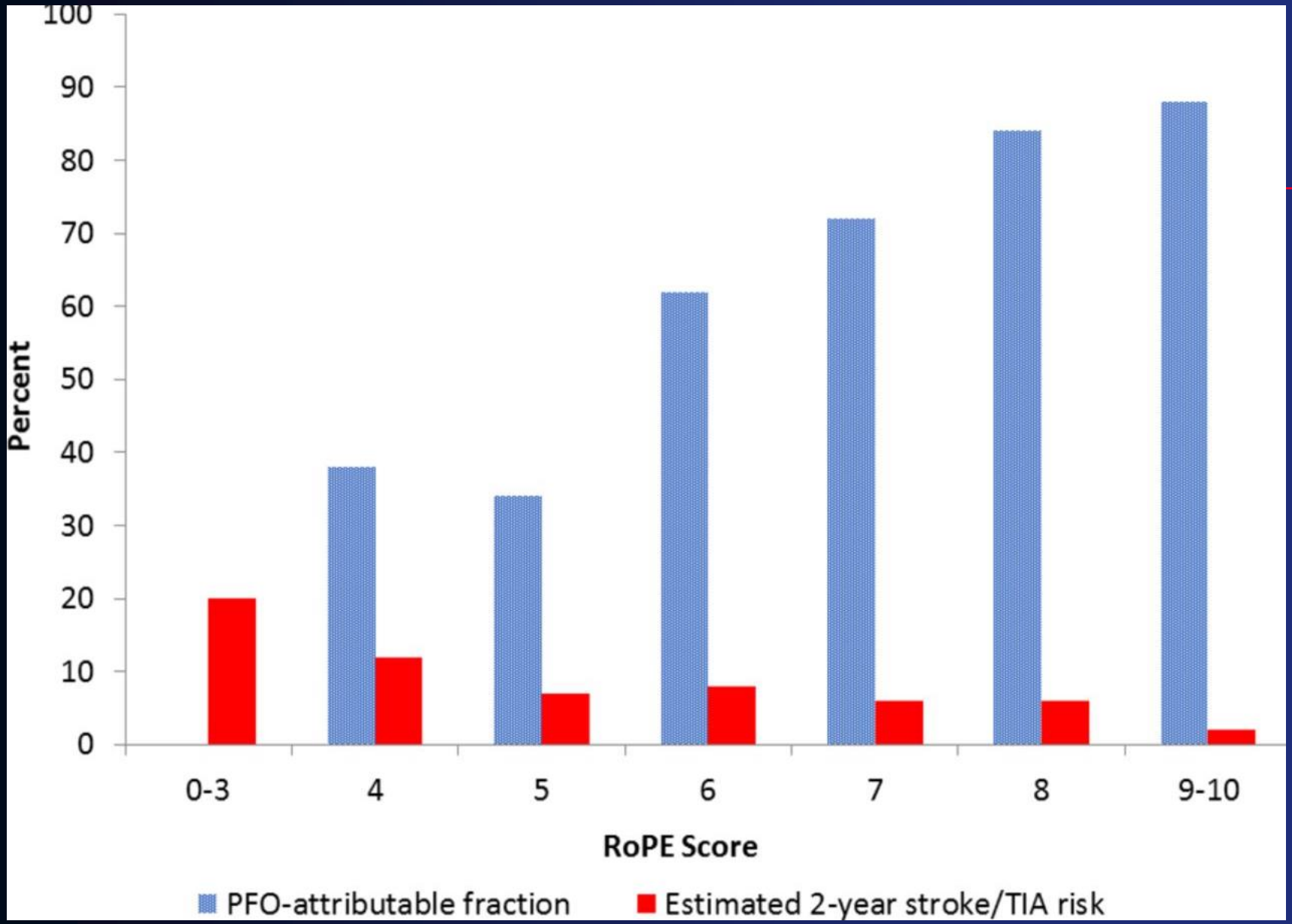
TABLE 1. RoPE SCORE CALCULATOR	
Patient Characteristic	**Points**
No history of hypertension	+1
No history of diabetes	+1
No history of stroke or TIA	+1
Nonsmoker	+1
Cortical infarct on imaging	+1
Age (y)	
18–29	+5
30–39	+4
40–49	+3
50–59	+2
69–69	+1
≥ 70	+0
Total RoPE score	0–10



Yuan K, Kasner SE
Patent foramen ovale and cryptogenic stroke: diagnosis and updates in secondary stroke prevention
Stroke and Vascular Neurology 2018;**3:**doi: 10.1136/svn-2018-000173

Key Points:

- Time has very limited function in determining a stroke and cerebral imaging allows for a more accurate diagnosis, determine mechanism of the event and helps with early treatment and prognosis.

- Next best steps: Utilize duel antiplatelet therapies for 21 days after stroke when ABCD2 score is ≥ 4 and NIH ≤ 3 then monotherapy with antiplatelets and consider longer Holter monitoring as outpatients to improve the diagnosis of A Fib that would require anticoagulation.

Summary

- Workup of stroke in the ED/Floor/ICU
- Imaging (which type is best)
- New time standard in catheter-based treatment
- Duel antiplatelet therapy
- Cardiac Holter monitoring

Reference:

- **2018 Guidelines for the Early Management of Patients With Acute Ischemic Stroke: A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association**
  - Stroke. 2018;49:e46–e99. DOI: 10.1161/STR.0000000000000158.)

- **2021 Guideline for the Prevention of Stroke in Patients With Stroke and Transient Ischemic Attack: A Guideline From the American Heart Association/American Stroke Association**

- **Originally published**24 May 2021

- https://doi.org/10.1161/STR.0000000000000375Stroke. 2021;52:e364–e467

Thank you for your Attention