Advancing Diagnosis of Acute Stroke
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SCHOOL OF MEDICINE

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- NIH/NINDS – research and salary support
- Sense Diagnostics, Inc. – Founder and Equity Holder
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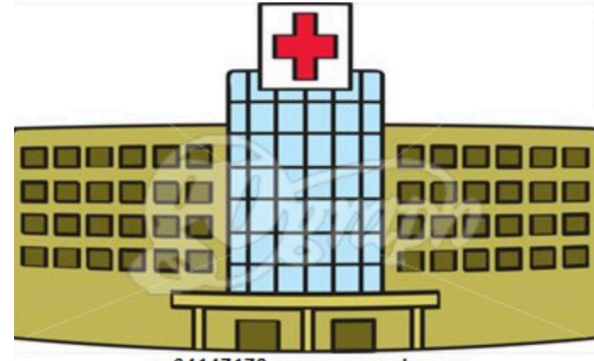- Nico Corp – Clinical Trial DSMB Member

Outline

- Community/lay public stroke recognition and use of emergency medical services (EMS)

- EMS stroke recognition and prehospital stroke triage

- Emergency Department (ED) misdiagnosis of stroke

- Special Consideration – Under-resourced environments, disparities in care

- Approaches to Improve Stroke Diagnosis

- Summary/Recommendations

Recognition of Stroke and Use of EMS

- In a 2014 National Health Interview Survey, stroke awareness was 66% and was lowest for Hispanics, blacks and the western United States

- 50-60% of all US stroke patients utilize 911/EMS

- Racial/ethnic minorities are less likely to use EMS – consistent with lower stroke recognition

Ojiket et al. J Neurol Neurophysiol. 2016
Adeoye O et al. Am J Emerg Med. 2009
Mikulík,R et al. Cerebrovasc Dis. 2011
Tataris K et al. West J Emerg Med. 2014

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One Model for Stroke Triage

Is it a stroke?
Prehospital Stroke Scale

"Severe Stroke" Triage

Ideal Model for Stroke Triage

SEVERE STROKES

Non-Severe Strokes

Prehospital Setting:
1) Stroke?
2) Severe Stroke?
3) Stroke Center for your network?

EMS Stroke Recognition and Prehospital Triage

- Limitations in accuracy of prehospital stroke screening tools contribute to triage delays
  - Dispatch suspicion of stroke – PPV 34%
  - EMS providers – miss up to 30%

De Luca et al. BMC Health Serv Res. 2013
Brandler et al. Neurology 2014.

Triage of Severe Stroke

Comparison of eight prehospital stroke scales to detect intracranial large-vessel occlusion in suspected stroke (PRESTO): a prospective observational study

Martijne H C Duvekot, Esmee Venema, Anouk D Rozeman, Walid Moudrous, Frédérique H Vermeij, Marileen Biekart, Hester F Lingsma, Lisette Maasland, Annemarie D Wijnhoud, Laus J M M Mulder, Kees C L Alblas, Roeland P J van Eijkelenburg, Bianca I Buijck, Jeannette Bakker, Aarnout S Plaisier, Jan-Hein Hensen, Geert J Lycklama à Nijeholt, Pieter Jan van Doormaal, Adriaan C G M van Es, Aad van der Lugt, Henk Kerkhoff, Diederik W J Dippel, Bob Roozenbeek, on behalf of the PRESTO investigators*

Summary

Background Due to the time-sensitive effect of endovascular treatment, rapid prehospital identification of large-vessel occlusion in individuals with suspected stroke is essential to optimise outcome. Interhospital transfers are an important cause of delay of endovascular treatment. Prehospital stroke scales have been proposed to select patients with large-vessel occlusion for direct transport to an endovascular-capable intervention centre. We aimed to prospectively validate eight prehospital stroke scales in the field.

PRESTO Summary

- 1039 people with paramedic suspected stroke

- 120 (12%) diagnosed with LVO

- RACE performed best (AUC 0.83)
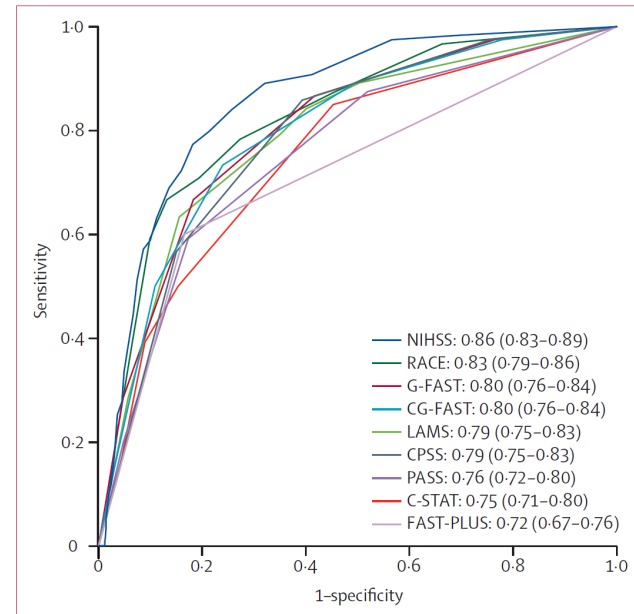
Lancet Neurol 2021

Figure 2: ROC curves for prehospital stroke scales and the NIHSS as assessed by the clinician

Data are area under the ROC curve (95% CI). CG-FAST=Conveniently-Grasped Field Assessment Stroke Triage. CPSS=Cincinnati Prehospital Stroke Scale. C-STAT=Cincinnati Stroke Triage Assessment Tool. FAST-PLUS=Face-Arm-Speech-Time plus severe arm or leg motor deficit. G-FAST=Gaze-Face-Arm-Speech-Time. LAMS=Los Angeles Motor Scale. NIHSS=National Institutes of Health Stroke Scale. PASS=Prehospital Acute Stroke Severity. RACE=Rapid Arterial oCclusion Evaluation. ROC=receiver operating characteristic.

PRESTO Considerations

- PPV (overtriage)
  - **RACE 0.4 (60%)**
  - G-FAST 0.32 (68%)
  - CG-FAST 0.38 (62%)
  - LAMS 0.35 (65%)
  - CPSS 0.33 (67%)
  - PASS 0.31 (69%)
  - CSTAT 0.30 (70%)
  - FAST Plus 0.32 (68%)

- NPV (undertriage)
  - RACE 0.95 (5%)
  - G-FAST 0.95 (5%)
  - CG-FAST 0.95 (5%)
  - LAMS 0.95 (5%)
  - CPSS 0.94 (6%)
  - PASS 0.94 (6%)
  - CSTAT 0.93 (7%)
  - FAST Plus 0.94 (6%)

Overtriage – delays in thrombolysis

ED Misdiagnosis of (Ischemic) Stroke

- 14% of ischemic stroke cases misdiagnosed in the ED
  - Younger age and decreased level of consciousness associated with misdiagnosis
  - Only 1% of misdiagnosed cases may have been eligible for thrombolysis

Madsen et al. Acad Emerg Med. 2016.

Special Consideration – Under-resourced Environments and Disparities in Care

- United States/Higher Income Disparities
  - Race/ethnicity, sex, age, geography, and socioeconomic status

- Low/Middle Income Disparities
  - Race/ethnicity, sex, age, geography, and socioeconomic status
  - But worse – access and availability of care

Elkind et al. Stroke. 2020.

Approaches to Improve Stroke Diagnosis

- Clinical screening tools

- Blood biomarkers

- Devices

- Imaging

Summary/Recommendations

- There's a need for:
  - Effective training/education campaigns to improve public awareness of stroke

  - Clinical assessment tools, devices and/or biomarkers to improve EMS stroke recognition and facilitate prehospital stroke triage

  - Clinical assessment tools, devices, biomarkers and/or imaging to improve ischemic stroke diagnosis in the ED

- All approaches should account for disparities in access to and availability of care