Large Vessel Occlusion (LVO) Screenings

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KANSAS INITIATIVE FOR STROKE SURVIVAL INC

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Recent March 2021 Article

Stroke

SPECIAL REPORT

Recommendations for Regional Stroke Destination Plans in Rural, Suburban, and Urban Communities From the Prehospital Stroke System of Care Consensus Conference

A Consensus Statement From the American Academy of Neurology, American Heart Association/American Stroke Association, American Society of Neuroradiology, National Association of EMS Physicians, National Association of State EMS Officials, Society of NeuroInterventional Surgery, and Society of Vascular and Interventional Neurology: Endorsed by the Neurocritical Care Society

Best Practices for EMS

Region should harmonize & adopt consistent stroke management **protocols**, evidence-based **stroke screening tools** and **severity scales** for identifying possible LVO

Stroke Management education (in conjunction with hospital partners and local EMS) should be done every year and integrated as a core care competency and should include information about interfacility transport (including of drip and ship patients)

EMS agencies should develop and utilize **stroke destination plans** based on hospital locations & capabilities, transport times, and patient acuity

EMS should develop uniform **prehospital stroke notification protocols** with receiving stroke hospitals and direct CT transport should be encouraged

Proposed times are meant to serve as starting points for local discussion and these should be determined in the future by specific performance data from stroke centers within the SSOC

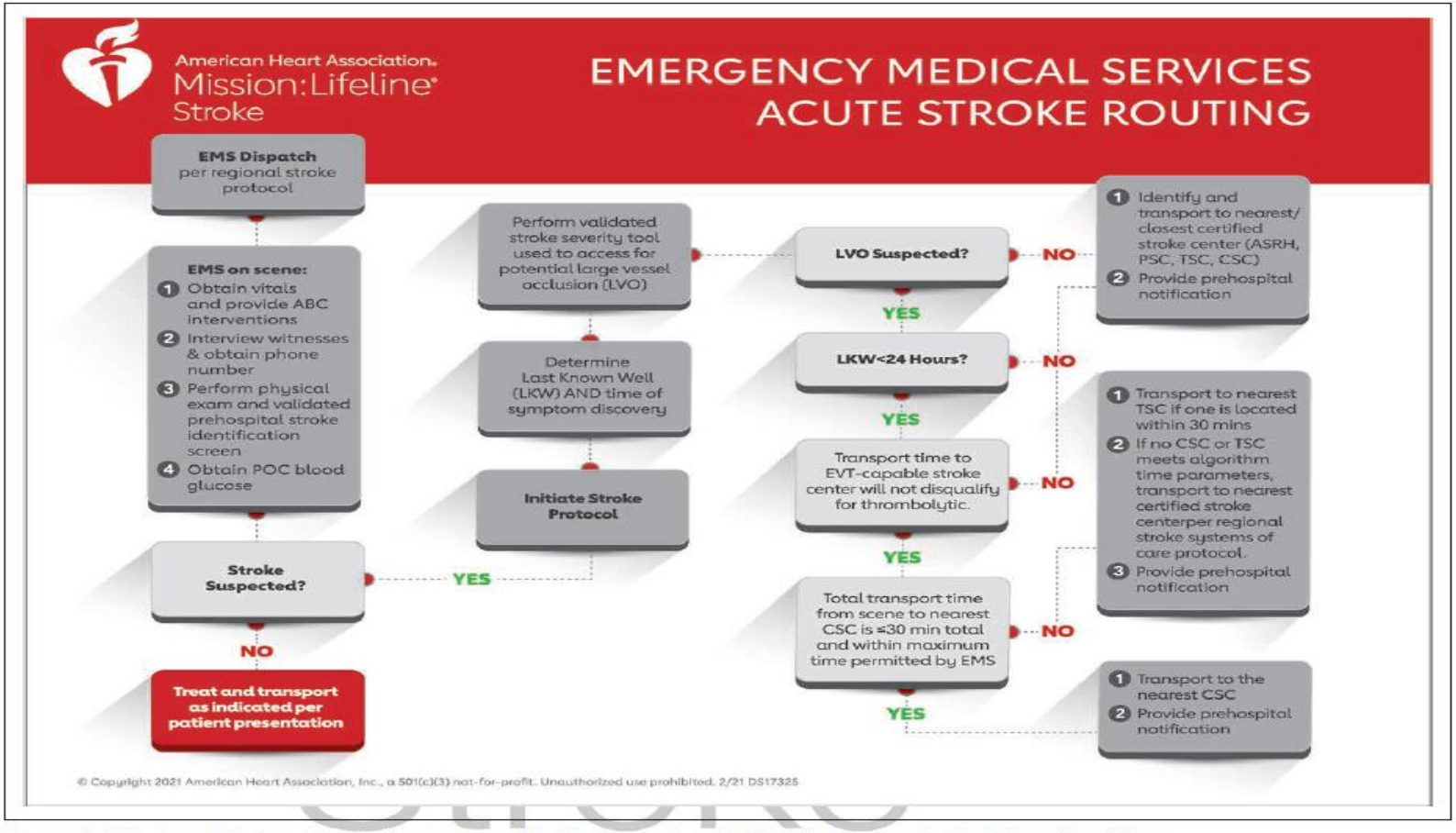
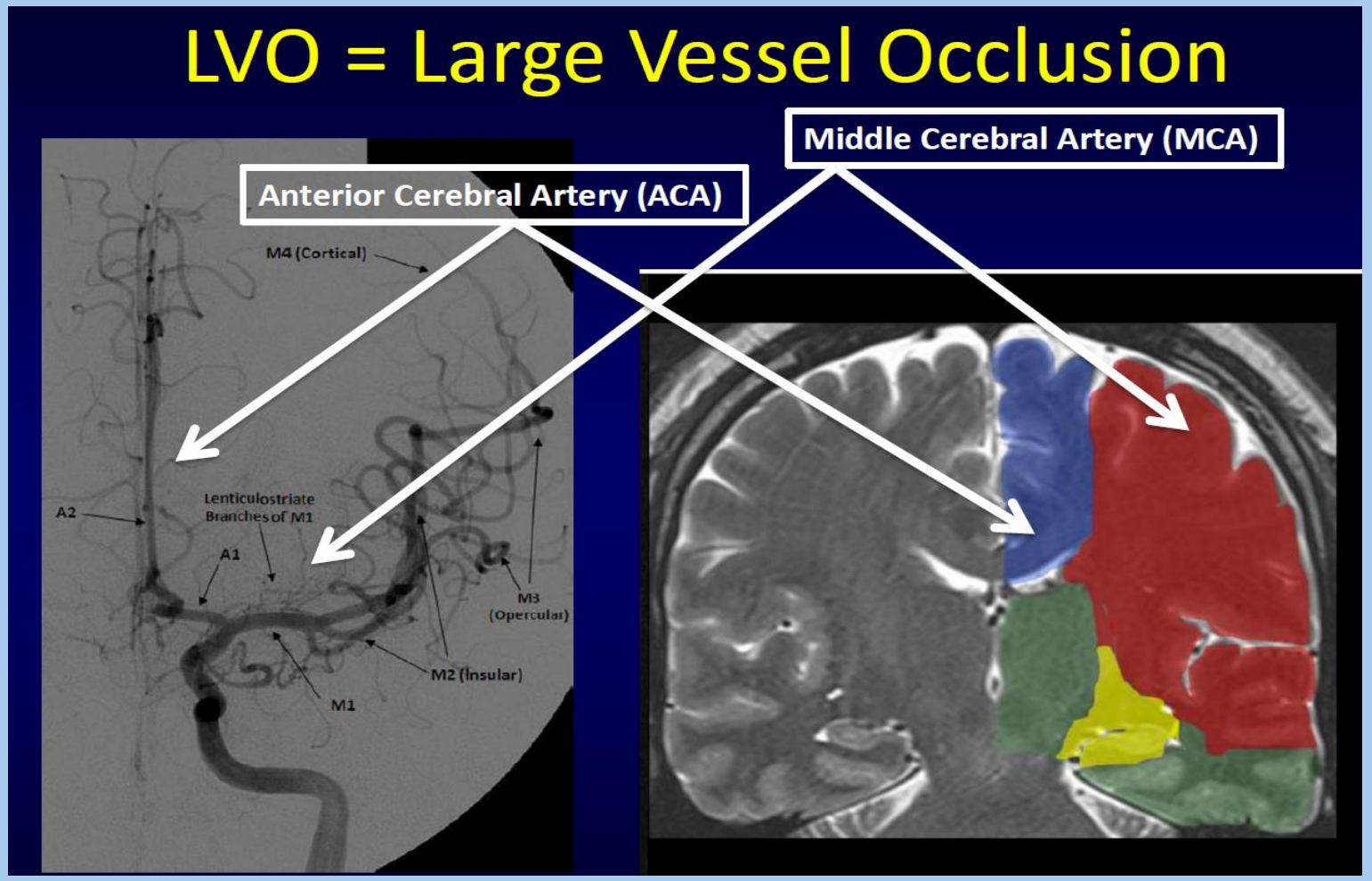


Figure 1. Mission: Lifeline Stroke Emergency Medical Services (EMS) Acute Stroke Routing Algorithm.
ABC indicates airway, breathing and circulation; ASRH, acute stroke-ready hospital; CSC, comprehensive stroke center; EVT, endovascular therapy; LKW, last known well; LVO, large vessel occlusion; POC, point of care; PSC, primary stroke center; and TSC, thrombectomy-capable stroke center. Reprinted from the American Heart Association with permission. Copyright ©2021.

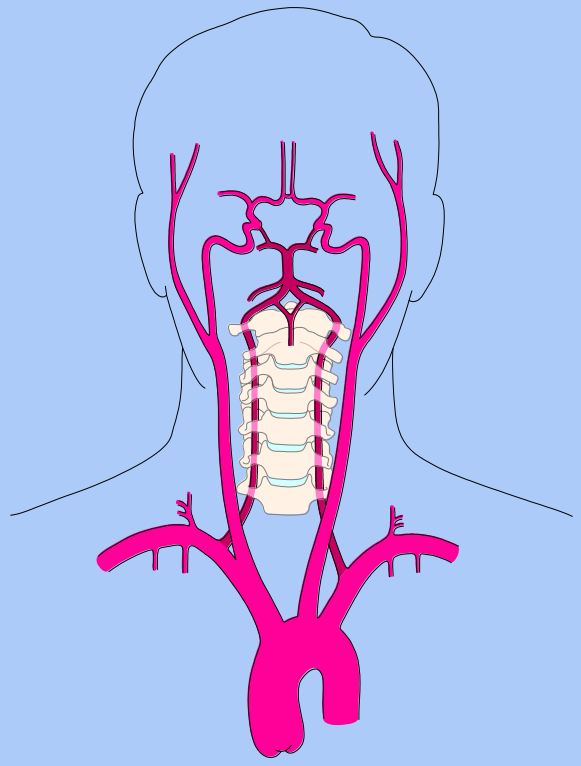
What is a LVO?


LVO = Large Vessel Occlusion
Middle Cerebral Artery (MCA)
Anterior Cerebral Artery (ACA)
M4 (Cortical)
A2
Lenticulostriate Branches of M1
A1
M3 (Opercular)
M2 (Insular)
M1

Large Vessel Ischemic Strokes

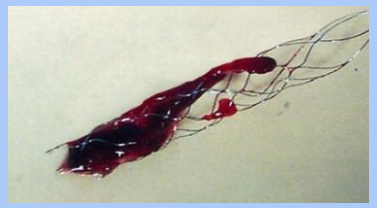
- 30-40% of Ischemic strokes are large vessel strokes
- If left untreated, prognosis is poor

Vessel	**Mortality**
ICA	53%
MCA	27%
Vert/Basilar	89-90%



Jansen O, et al.2. Furlan A et al. PROACT II Trial3. Brückmann Het al.

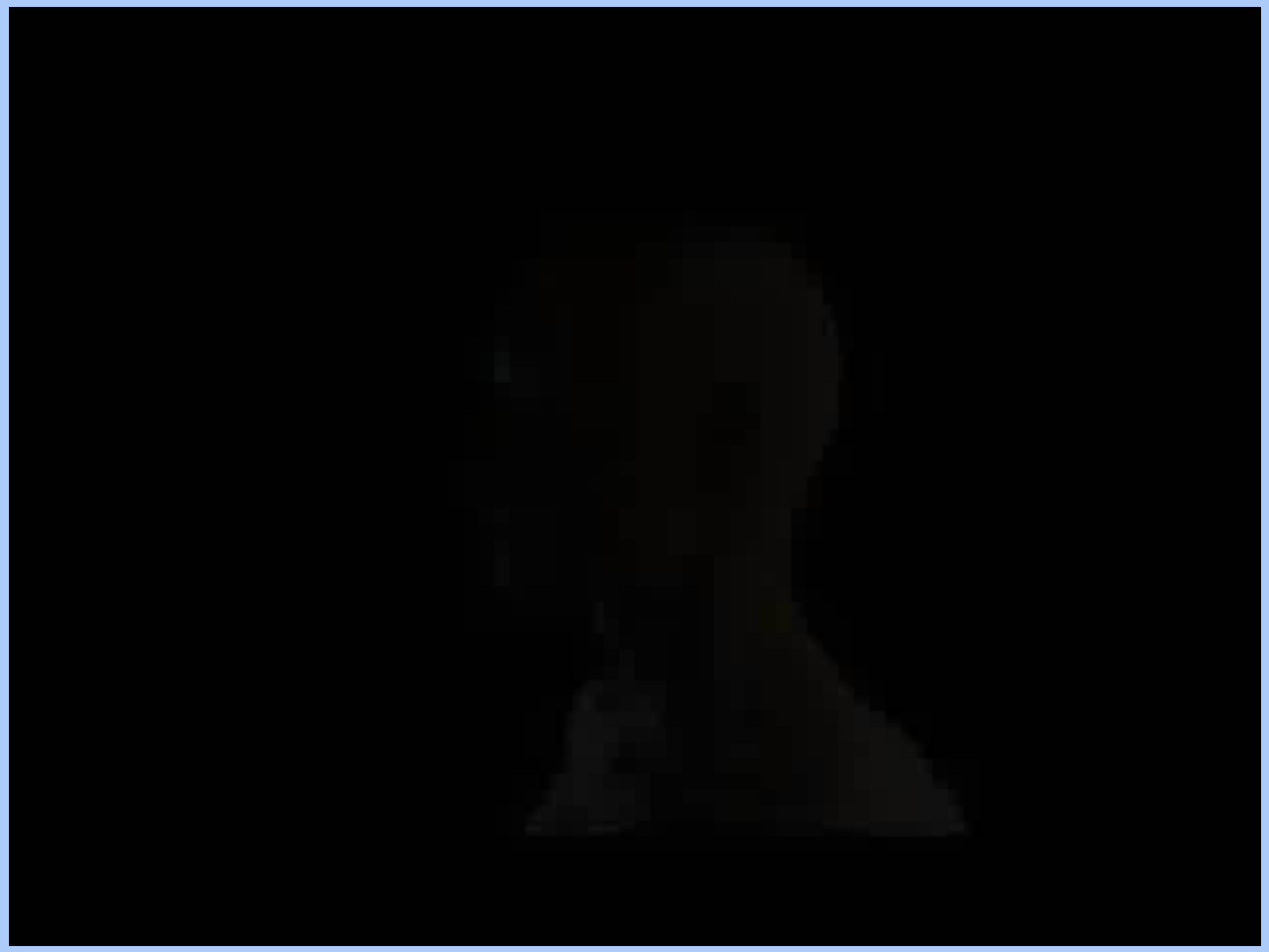
Endovascular Thrombectomy

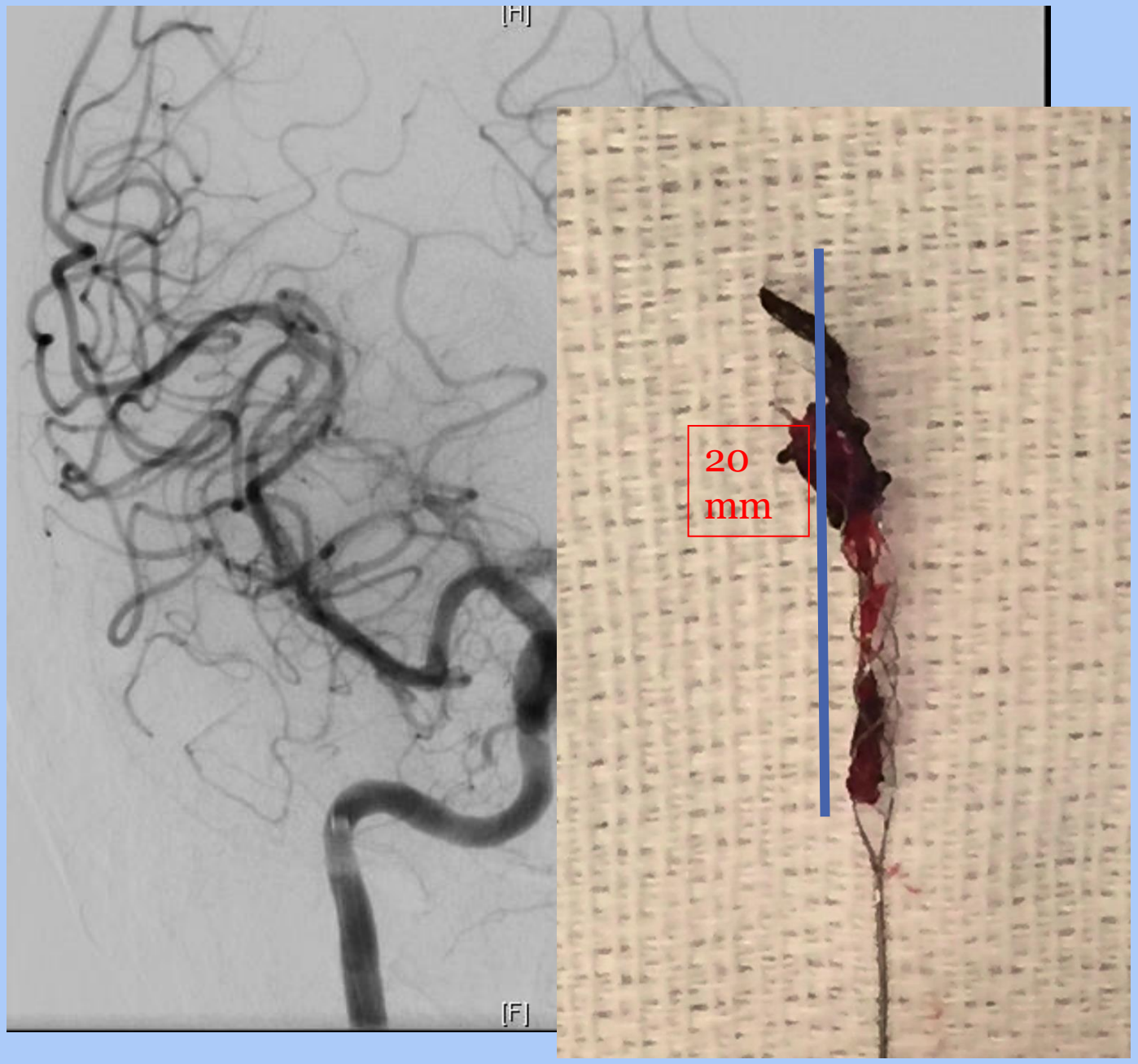


- Thrombectomy evolved during 2015 trials---these trials established this therapy as the standard of care
- Devices include: coil retrievers, aspiration/debulking systems, and stent retrievers
- Mechanical reperfusion may include:
  - Physical disruption of the clot and removal with device (thrombectomy)
  - Intra-arterial administration of tPA (directly into the clot)
  - Angioplasty
  - Placements of stents
- Time window for intra-arterial (IA) treatment varies depending on the location of the clot and what imaging shows:
  - Up to 24 hours; generally, a longer timeframe for posterior stroke

Aspiration Catheter

Stent Retriever

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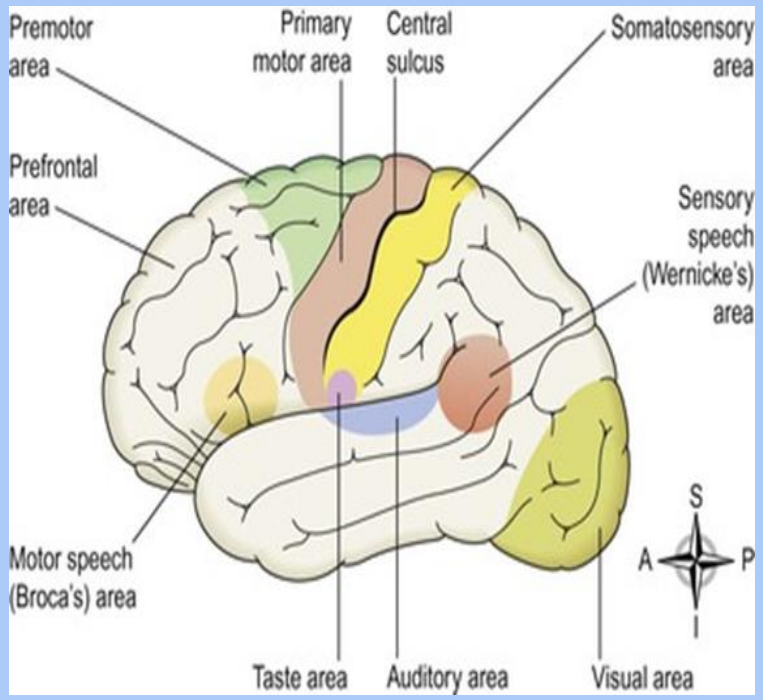
Large Vessel Occlusion (LVO) Screening Tools

- ✓ Multiple validated LVO screening tool
  - – These look for large vessel deficits (AKA ***cortical findings***)
    - Gaze, Aphasia, Paralysis, Neglect, Vision



How do you choose a scale?

- Keep it simple!
- Validated tool in pre-hospital setting
- High Accuracy
- High Interrater Reliability

"The specific scale chosen may be less important than the paradigm that *some* field severity score assessment should be done to screen for possible (E)LVO."

- Jayaraman et al. *J NeuroIntervent Surg*. 2016

Some Possible LVO Scales

- ✓ **CSTAT**
- ✓ **RACE (Rapid Arterial Occlusion Evaluation Scale)**
- ✓ **FAST-ED (Field Assessment Stroke Triage for Emergency Destination)**
- ✓ **Los Angeles Motor Scale (LAMS)**
- ✓ **Vision Aphasia Neglect (VAN)**

Comparing LVO Screening Tools

ORIGINAL RESEARCH

Stroke vision, aphasia, neglect (VAN) assessment—a novel emergent large vessel occlusion screening tool: pilot study and comparison with current clinical severity indices

Mohamed S Teleb,[1] Anna Ver Hage,[1] Jaqueline Carter,[1] Mahesh V Jayaraman,[2] Ryan A McTaggart[2]

Table 2 Comparison of aspect of the vision, aphasia, neglect emergent large vessel occlusion screening with other screening tools

Tool	RACE	LEGS	LAMS	Hemiparesis	VAN	3I-SS	CPSSS
Aspect tested							
Arm weakness	Yes	No	Yes	Yes	Yes	Yes	Yes
Face weakness	Yes	No	Yes	No	No	No	No
Leg weakness	Yes	Yes	No	Yes	No	Yes	No
Gaze	Yes	Yes	No	No	Yes	Yes	Yes
Visual field loss	Yes	Yes	No	No	Yes	No	No
Neglect	Yes	No	No	No	Yes	No	No
Aphasia/ speech	Yes	Yes	No	No	Yes	No	Yes

3I-SS, 3 item stroke scale; CPSSS, Cincinnati Prehospital Stroke Severity Scale; LAMS, Los Angeles Motor Scale; LEGS, legs, eyes, gaze, speech (Texas Stroke Intervention Prehospital Stroke Severity Scale); RACE, Rapid Arterial oCclusion Evaluation Scale; VAN, vision, aphasia, neglect.

Table 4 Emergent large vessel occlusion screening to comparisons

	RACE	LEGS	LAMS	Hemiparesis	VAN	3I-SS	CPSSS
Need to calculate score	Yes	Yes	Yes	No	No	Yes	Yes
No of tests	6	4	3	1	1–4	3	3–4
Length of exam 1–7 (7 is longest)	7	6	4	1	2	3	5
Positive predictive value (%)	42	60			74	74	
Sensitivity (%)	85	69	81	27–48 multiple etiologies analyzed	100	67	83
Negative predictive value (%)	94	86		Could not be calculated	100	89	
Specificity (%)	68	81	89		90	92	40
Type	Prospective	Prospective	Retro	Retro	Prospective	Prospective	Retro
Total No of patients analyzed	357	181	119	45	62	171	303

3I-SS, 3 item stroke scale; CPSSS, Cincinnati Prehospital Stroke Severity Scale; LAMS, Los Angeles Motor Scale; LEGS, legs, eyes, gaze, speech (Texas Stroke Intervention Prehospital Stroke Severity Scale); RACE, Rapid Arterial oCclusion Evaluation Scale; Retro, retrospective; VAN, vision, aphasia, neglect.

Conclusion: "The VAN screening tool accurately identified ELVO patients and outperformed a NIHSS ≥6 severity threshold and may best allow clinical teams to expedite care and mobilize resources for ELVO patients. A larger study to both validate this screening tool and compare with others is warranted"

Comparing LVO Screening Tools

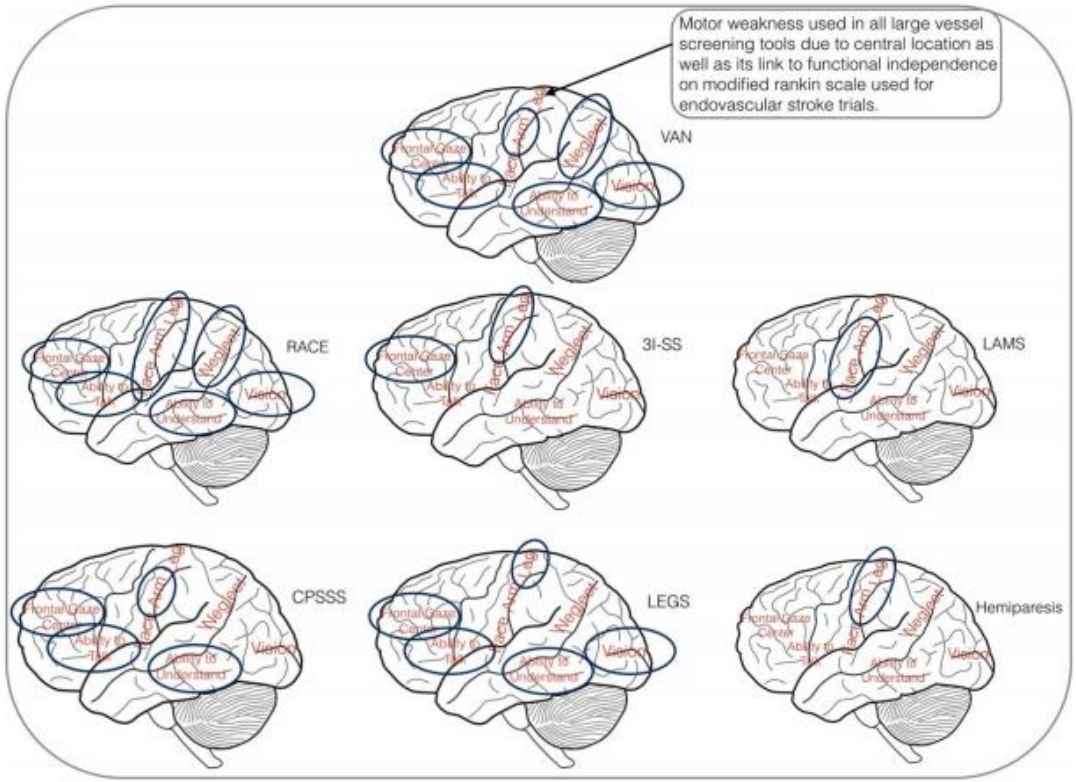


Figure 2 Large vessel occlusion screening tools—brain view. 3I-SS, 3 item stroke scale; CPSSS, Cincinnati Prehospital Stroke Severity Scale; LAMS, Los Angeles Motor Scale; LEGS, legs, eyes, gaze, speech (Texas Stroke Intervention Prehospital Stroke Severity Scale); RACE, Rapid Arterial oCclusion Evaluation Scale; VAN, vision, aphasia, neglect.

Teleb MS, *et al*. *J NeuroIntervent Surg* 2017;**9**:122–126. doi:10.1136/neurintsurg-2015-012131

Comparing LVO Screening Tools

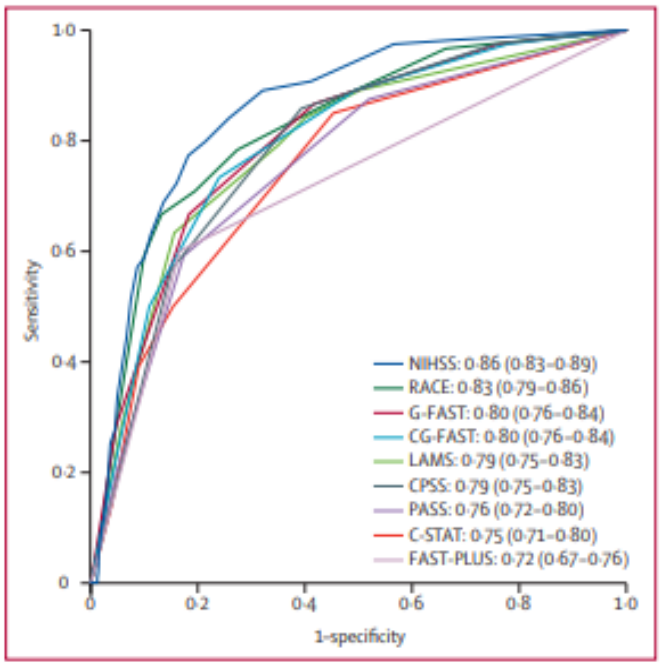


Figure 2: **ROC curves for prehospital stroke scales and the NIHSS as assessed by the clinician**

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.

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**

Conclusion: "Prehospital stroke scales detect aLVO with acceptable-to-good accuracy. RACE, G-FAST, and CG-FAST are the best performing prehospital stroke scales out of the eight scales tested and approach the performance of the clinician-assessed NIHSS. Further studies are needed to investigate whether use of these scales in regional transportation strategies can optimise outcomes of patients with ischaemic stroke"

The Cincinnati Prehospital Stroke Scale Compared to Stroke Severity Tools for Large Vessel Occlusion Stroke Prediction

Remle P. Crowe, PhD, NREMT, J. Brent Myers, MD, MPH, Antonio R. Fernandez, PhD, NRP, Scott Bourn, PhD, RN, Jason T. McMullan, MD, MS

- Conclusion: "CPSS demonstrated similar predictive performance characteristics compared to the RACE, LAMS and VAN for detecting LVO stroke. Prior to implementing a specific tool, EMS should evaluate ease of use and associated implementation costs"

Table 1. Patient characteristics stratified by prehospital stroke scale(s) documented

	Total N = 13,596	CPSS* 83% (N = 11,319)	RACE* 14% (N = 1,949)	LAMS* 7% (N = 880)	VAN* 4% (N = 506)
Age, years					
Median (IQR)	71 (58–82)	71 (58–82)	69 (58–80)	76 (65–85)	69 (57–81)
Sex					
Female	56% (7,481)	56% (6,248)	54% (1,041)	54% (456)	58% (277)
Male	44% (5,996)	44% (4,972)	46% (903)	46% (395)	42% (200)
Missing	119	99	5	29	29
Last Known Well					
<4.5 hrs	73% (6,611)	74% (5,666)	71% (1,025)	68% (425)	74% (210)
4.5 hrs – 6 hrs	3% (280)	3% (235)	3% (48)	3% (21)	5% (14)
>6 hrs – <24 hrs	15% (1,399)	14% (1,100)	19% (272)	21% (130)	14% (41)
>24 hrs	9% (819)	9% (694)	8% (110)	8% (50)	7% (20)
Missing (n)	4,487	3,624	494	254	214
Stroke Diagnosis					
Yes	31% (4,228)	30% (3,356)	41% (799)	44% (386)	48% (230)
No	69% (9,368)	70% (7,963)	59% (1,150)	56% (494)	52% (249)
LVO Diagnosis					
Yes	5% (694)	5% (546)	9% (167)	6% (52)	5% (24)
No	95% (12,902)	95% (10,773)	91% (1,782)	94% (828)	95% (455)

*Note: Multiple types of stroke screen could be documented per each encounter.

CSTAT
(Cincinnati Prehospital Stroke Severity Scale)

Cincinnati Pre-Hospital Stroke Severity Scale

Conjugate gaze deviation	☐ 2 points
Incorrectly answers Age *or* Month **and** Does not follow at least one command (close your eyes, open and close your hand)	☐ 1 point
Arm (right, left or both) falls to the bed within 10 seconds	☐ 1 point

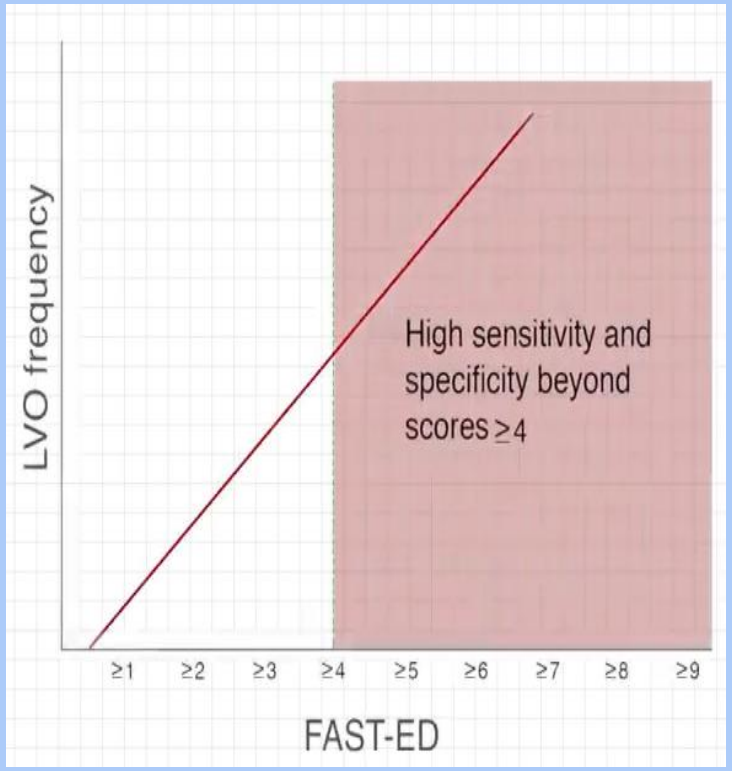
Score of **2 or more** = high likelihood of Large Vessel Occlusion (LVO) Stroke

RACE

Item	Instruction		RACE score	NIHSS score equivalence
Facial palsy	Ask the patient to show teeth	Absent (symmetrical movement)	0	0
		Mild (slightly asymmetrical)	1	1
		Moderate to severe (completely asymmetrical)	2	2-3
Arm motor function	Extending the arm of the patient 90 degrees (if sitting) or 45 degrees (if supine)	Normal to mild (limb upheld more than 10 seconds)	0	0-1
		Moderate (limb upheld less than 10 seconds)	1	2
		Severe (patient do not rise the arm against gravity)	2	3-4
Leg motor function	Extending the leg of the patient 30 degrees (in supine)	Normal to mild (limb upheld more than 5 seconds)	0	0-1
		Moderate (limb upheld less than 5 seconds)	1	2
		Severe (patient do not rise the leg against gravity)	2	3-4
Head and gaze deviation	Observe eyes and cephalic deviation to one side	Absent (eye movements to both sides were possible and no cephalic deviation was observed)	0	0
		Present (eyes and cephalic deviation to one side was observed)	1	1-2
Aphasia (if right hemiparesis)	Ask the patient two verbal orders - "close your eyes" - "make a fist"	Normal (performs both tasks correctly)	0	0
		Moderate (performs one task correctly)	1	1
		Severe (performs neither tasks)	2	2
Agnosia (if left hemiparesis)	Asking: - "Who is this arm" while showing him/her the paretic arm (asomatognosia) - "Can you move well this arm?" (anosognosia)	Normal (no asomatognosia nor anosognosia)	0	0
		Moderate (asomatognosia or anosognosia)	1	1
		Severe (both of them)	2	2
RACE Score total			0-9	

Field Assessment Stroke Triage for Emergency Destination

- Facial Palsy (0-1)
- Arm Weakness (0-2)
- Speech Changes (0-2)
- Time (no points)
- Eye Deviation (0-2)
- Denial/Neglect (0-2)
- Demo of FAST-ED

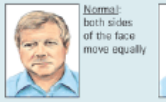


Field Use of FAST-ED

If Cincinnati Stroke Scale is POSITIVE (any one of the three tests shows abnormal findings), then assessment should include FAST-ED/Large Vessel Occlusion Screen. LVO Screen by Paramedic Only

Cincinnati Pre-hospital Stroke Scale

1. FACIAL DROOP: *Have patient show teeth or smile.*



Normal: both sides of the face move equally

Abnormal: one side of face does not move as well as the other side

2. ARM DRIFT: *Patient closes eyes & holds both arms out for 10 sec.*

Normal: both arms move the same or both arms do not move at all

Abnormal: one arm does not move or drifts down compared to the other

3. ABNORMAL SPEECH: *Have the patient say "you can't teach an old dog new tricks."*

Normal: patient uses correct words with no slurring. Abnormal: patient slurs words, uses the wrong words, or is unable to speak

Item	FAST-ED Score	Descriptions
Facial Weakness/Asymmetry		Ask the patient to smile or show teeth or gums
Normal or minor asymmetry	0	Facial movement is normal/symmetric or slightly asymmetrical
Complete asymmetry	1	Facial gesture when showing teeth or gums is completely asymmetrical
Arm weakness		Ask the patient to close eyes & hold both arms out with palms up for 10 sec.
No drift	0	Both arms remain up >10 sec. or slowly drift down equally
Drift or some effort against gravity	1	One arm drifts down in <10 sec. but has antigravity strength
No effort against gravity or no movement	2	Cannot maintain the arm against gravity and drops immediately
Speech Output		Check speech content & ask the patient to name 3 common items
Normal	0	Speech content normal AND names 2-3 items correctly (if speech is slurred but makes sense and naming is correct score as normal)
Abnormal	1	Speech content clearly abnormal OR names only 0-1 items correctly
Speech Comprehension		Ask the patient: "Show me two fingers"
Normal	0	Patient shows two fingers
Abnormal	1	Patient cannot understand/does not show two fingers
Eye deviation		Ask the patient to follow your finger while holding their head still
Absent	0	No deviation, eyes move to both sides equally
Partial	1	Patient has clear difficulty when looking to one side (left or right)
Forced Deviation	2	Eyes are deviated to one side and do not move to the other side (e.g. cannot follow finger)
Denial/Neglect		Ask the patient: "Are you weak anywhere?"
Normal	0	The patient recognizes that they are weak
Abnormal	1	The patient is weak but does NOT recognize they are weak
Denial/Neglect		While holding the patient's weak arm, ask the patient: "Whose arm is this?"
Normal	0	Patient recognizes the weak arm belongs to them
Abnormal	1	Patient does NOT recognize the weak arm belongs to them

FAST-ED indicates Field Assessment Stroke Triage for Emergency Destination. This is to be applied to adults (≥ 18 years old) with a positive Cincinnati Stroke Scale and is a screen for a Large Vessel Occlusion (LVO).

***FAST-ED/LVO screen should be performed by a paramedic**

Item	FAST-ED Score	Descriptions
Facial Weakness/Asymmetry		**Ask the patient to smile or show teeth or gums**
Normal or minor asymmetry	0	Facial movement is normal/symmetric or slightly asymmetrical
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Normal	0	Patient recognizes the weak arm belongs to them
Abnormal	1	Patient does NOT recognize the weak arm belongs to them

*A score of ≥ 4 is considered a positive LVO screen.

LAMS

- 3-item exam that takes 20-30 seconds to perform
  - Face
  - Arm
  - Grip
- ≥4 indicative of LVO

Los Angeles Motor Scale (LAMS)[22]		
Face	0	Both sides move normally
	1	One side is weak or flaccid
Arm	0	Both sides move normally
	1	One side is weak
	2	One side is flaccid/doesn't move
Grip	0	Both sides move normally
	1	One side is weak
	2	One side is flaccid/doesn't move
Total	0–5	

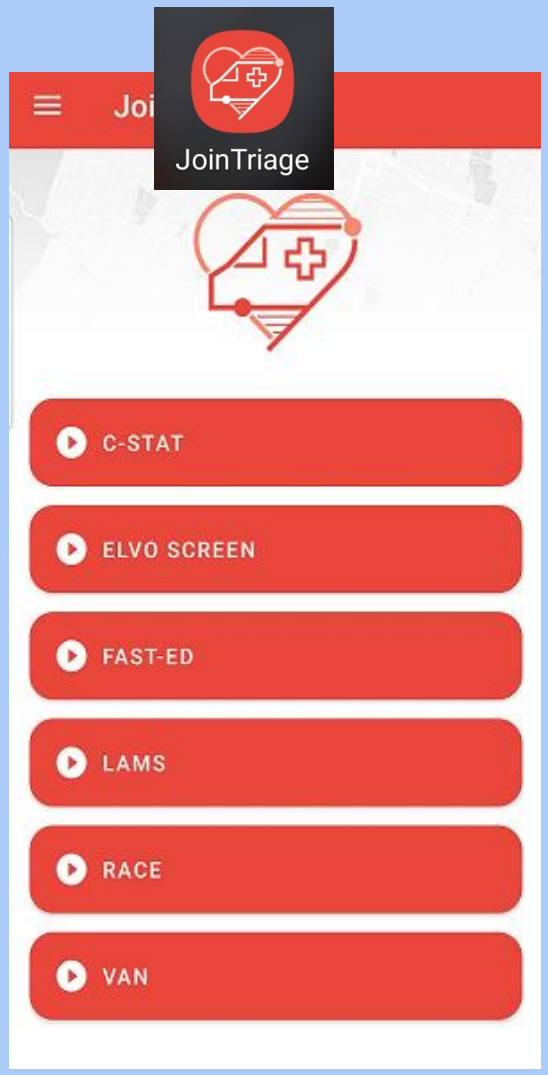
Vision, Aphasia, Neglect (VAN)

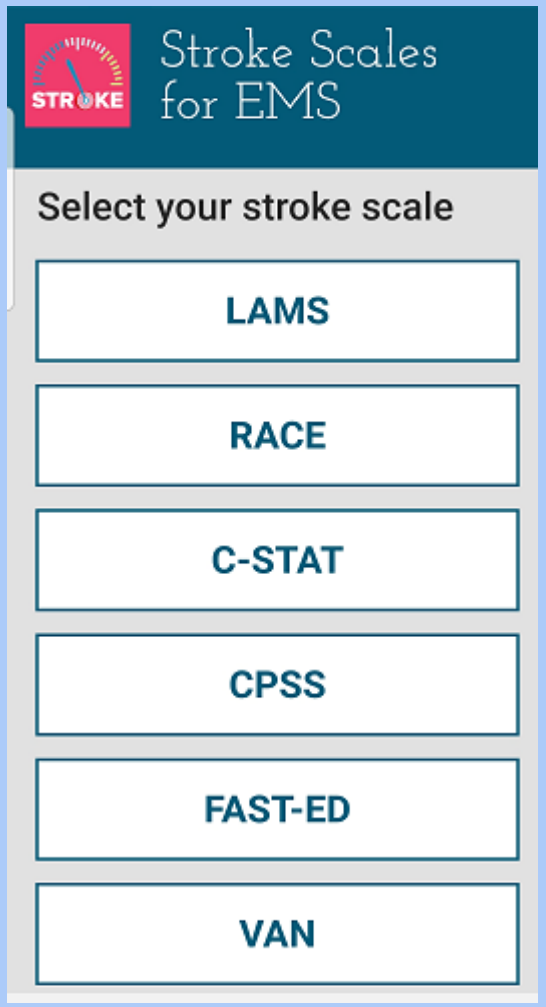
Table 1 Vision, aphasia, neglect emergent large vessel occlusion screening tool

Stroke VAN	
How weak is the patient? Raise both arms up	☐ Mild (minor drift) ☐ Moderate (severe drift—touches or nearly touches ground) ☐ Severe (flaccid or no antigravity) ☐ Patient shows no weakness. Patient is VAN negative
(exceptions are confused or comatose patients with dizziness, focal findings, or no reason for their altered mental status then basilar artery thrombus must be considered; CTA is warranted)	
Visual disturbance	☐ Field cut (which side) (4 quadrants) ☐ Double vision (ask patient to look to right then left; evaluate for uneven eyes) ☐ Blind new onset ☐ None
Aphasia	☐ Expressive (inability to speak or paraphasic errors); do not count slurring of words (repeat and name 2 objects) ☐ Receptive (not understanding or following commands) (close eyes, make fist) ☐ Mixed ☐ None
Neglect	☐ Forced gaze or inability to track to one side ☐ Unable to feel both sides at the same time, or unable to identify own arm ☐ Ignoring one side ☐ None

Patient must have weakness plus one or all of the V, A, or N to be VAN positive. VAN positive patients had 100% sensitivity, 90% specificity, positive predictive value 74%, and negative predictive value 100% for detecting large vessel occlusion.
CTA, CT angiography; VAN, vision, aphasia, and neglect.

Mobile Apps


JoinTriage
C-STAT
ELVO SCREEN
FAST-ED
LAMS
RACE
VAN


Stroke Scales for EMS
Select your stroke scale
LAMS
RACE
C-STAT
CPSS
FAST-ED
VAN

Kansas Initiative for Stroke Survival (KISS)

Website Resources

http://www.kissnetwork.us/

References

- Duvekot, MHC, Venema, E, Rozerman, W, et al. Comparison of eight prehospital stroke scales to detect intracranial large-vessel occlusion in suspected stroke (PRESTO): a prospective observational study. *Lancet Neurology,* 2021 (20), 213-212.

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Questions?