Predicting Cerebral Large Vessel Occlusion through Non-invasive Cerebral Oximetry

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RACE Scale

"A RACE scale ≥5 had sensitivity 0.85, specificity 0.68, positive predictive value 0.42, and negative predictive value 0.94 for detecting LVO."

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Design and validation of a prehospital stroke scale to predict large arterial occlusion: the rapid arterial occlusion evaluation scale.

Pérez de la Ossa N[1], Carrera D, Gorchs M, Querol M, Millán M, Gomis M, Dorado L, López-Cancio E, Hernández-Pérez M, Chicharro V, Escalada X, Jiménez X, Dávalos A.

Author information

Abstract

BACKGROUND AND PURPOSE: We aimed to develop and validate a simple prehospital stroke scale to predict the presence of large vessel occlusion (LVO) in patients with acute stroke.

METHODS: The Rapid Arterial oCclusion Evaluation (RACE) scale was designed based on the National Institutes of Health Stroke Scale (NIHSS) items with a higher predictive value of LVO on a retrospective cohort of 654 patients with acute ischemic stroke: facial palsy (scored 0-2), arm motor function (0-2), leg motor function (0-2), gaze (0-1), and aphasia or agnosia (0-2). Thereafter, the RACE scale was validated prospectively in the field by trained medical emergency technicians in 357 consecutive patients transferred by Emergency Medical Services to our Comprehensive Stroke Center. Neurologists evaluated stroke severity at admission and LVO was diagnosed by transcranial duplex, computed tomography, or MR angiography. Receiver operating curve, sensitivity, specificity, and global accuracy of the RACE scale were analyzed to evaluate its predictive value for LVO.

RESULTS: In the prospective cohort, the RACE scale showed a strong correlation with NIHSS (r=0.76; P<0.001). LVO was detected in 76 of 357 patients (21%). Receiver operating curves showed a similar capacity to predict LVO of the RACE scale compared with the NIHSS (area under the curve 0.82 and 0.85, respectively). A RACE scale≥5 had sensitivity 0.85, specificity 0.68, positive predictive value 0.42, and negative predictive value 0.94 for detecting LVO.

CONCLUSIONS: The RACE scale is a simple tool that can accurately assess stroke severity and identify patients with acute stroke with large artery occlusion at prehospital setting by medical emergency technicians.

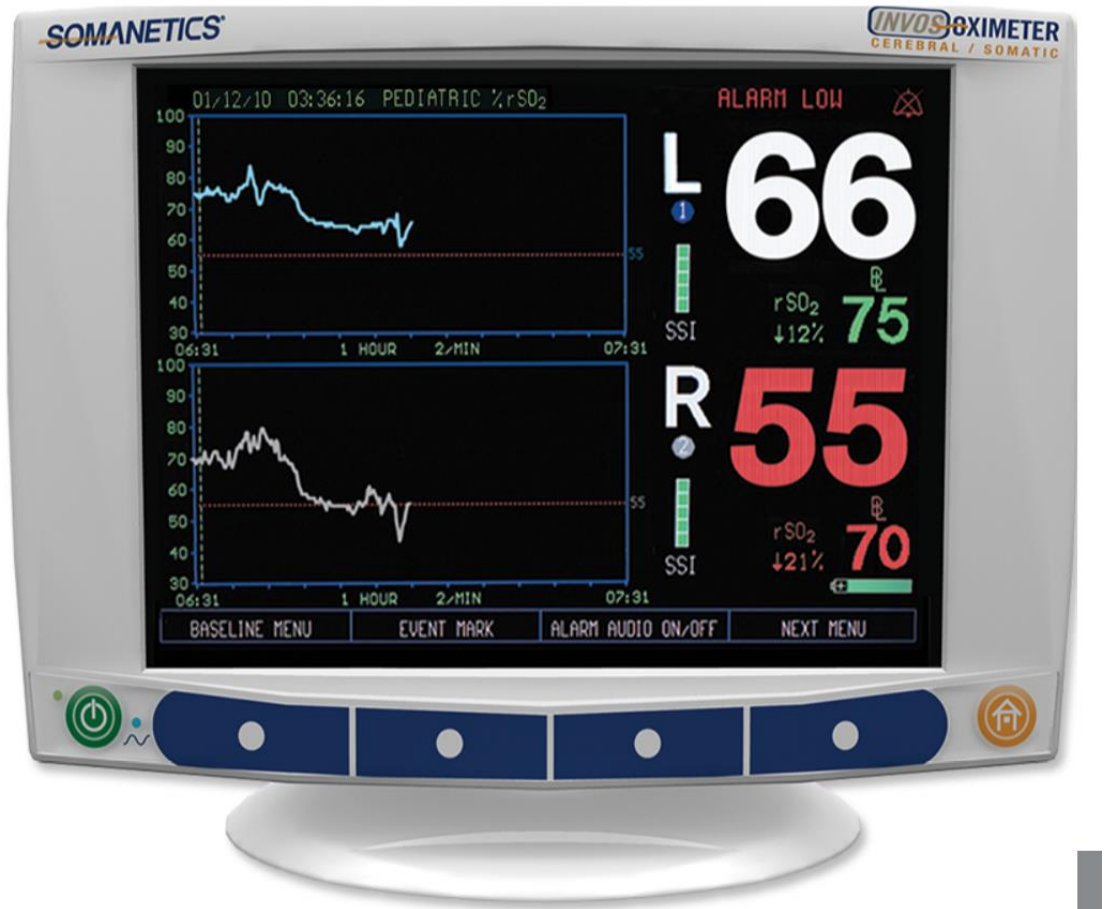
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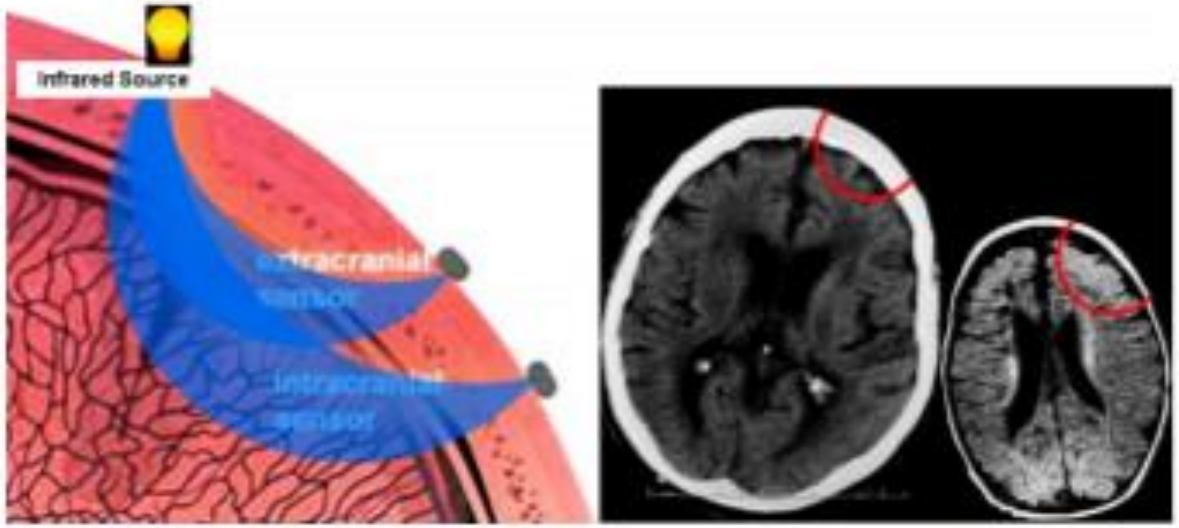
Figure 2: INVOS™ Detector Orientation



Each INVOS optode uses the proprietary orientation of two infrared detectors to measure light reflected transcranially from a neighboring source. Detector orientation ensures that the parabolic photon paths to both detectors traverse brain tissue.

Brain Oxygen Balance Monitoring with Near-infrared Spectroscopy (NIRS)

Intracranial regional hemoglobin oxygen saturation (rSO_2) measurement by NIRS is possible because the human skull is translucent to infrared light. As with other forms of clinical oximetry, saturation determination relies on multiple wavelengths of light to discriminate between the unique absorption spectra of oxyhemoglobin and deoxyhemoglobin.

A selection of clinical studies using INVOS™ technology intraoperatively in broad cardiac surgery patient populations

Cerebral desaturation during high-risk cardiac surgery is common and can be successfully identified using INVOS™ monitoring technology and reversed, reducing desaturation load during surgery

Monitoring with INVOS™ technology and intervention is associated with reduced permanent stroke rates, need for mechanical ventilation, and length of hospital stay

Inclusion of INVOS™ monitoring technology into a blood conservation protocol is associated with fewer blood transfusions and fewer units of blood transfused

A selection of clinical studies using INVOS™ technology intraoperatively in broad cardiac surgery patient populations

Brassard P, Pelletier C, Martin M, Gagné N, Poirier P, Ainslie PN, Caouette M, Bussières JS. Influence of norepinephrine and phenylephrine on frontal lobe oxygenation during cardiopulmonary bypass in patients with diabetes. *J Cardiothorac Vasc Anesth.* 2014;28(3):608-17.

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A selection of clinical studies using INVOS™ technology intraoperatively in carotid endarterectomy surgery

INVOS™ monitoring technology can be used to identify patients at risk for cerebral ischemia during CEA

Monitoring with INVOS™ technology can be considered as a sensitive, specific, and practical method compared to EEG to predict cerebral ischemia during CEA

INVOS™ technology may be an effective monitoring method compared to EEG to inform shunt selection during CEA

INVOS™ monitoring technology paired with an interventional algorithm can inform the need for shunt placement during CEA

A selection of clinical studies using INVOS™ technology intraoperatively in carotid endarterectomy surgery

Pennekamp CWA, Immink RV, den Ruijter HM, Kappelle LJ, Bots ML, Buhre WF, Moll FL, de Borst GJ. Near-infrared spectroscopy to indicate selective shunt use during carotid endarterectomy. *Eur J Vasc Endovasc Surg.* 2013;46(4):397-403.

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ORIGINAL ARTICLE

Noninvasive cerebral oximetry during endovascular therapy for acute ischemic stroke: an observational study

Christian Hametner[1], Predrag Stanarcevic[2], Sibylle Stampfl[3], Stefan Rohde[4], Roland Veltkamp[5] and Julian Bösel[1]

Implementing endovascular stroke care often impedes neurologic assessment in patients who need sedation or general anesthesia. Cerebral near-infrared spectroscopy (NIRS) may help physicians monitor cerebral tissue viability, but data in hyperacute stroke patients receiving endovascular treatment are sparse. In this observational study, the NIRS index regional oxygen saturation (rSO_2) was measured noninvasively before, during, and after endovascular therapy via bilateral forehead NIRS optodes. During the study period, 63 patients were monitored with NIRS; 43 qualified for analysis. Before recanalization, 10 distinct rSO_2 decreases occurred in 11 patients with respect to time to intubation. During recanalization, two kinds of unilateral rSO_2 changes occurred in the affected hemisphere: small peaks throughout the treatment ($n=14$, 32.6%) and sustained increases immediately after recanalization ($n=2$, 4.7%). Lower area under the curve 10% below baseline was associated with better reperfusion status (thrombolysis in cerebral infarction $\geq$ 2b, $P=0.009$). At the end of the intervention, lower interhemispheric rSO_2 difference predicted death within 90 days ($P=0.037$). After the intervention, higher rSO_2 variability predicted poor outcome (modified Rankin scale $>$ 3, $P=0.032$). Our findings suggest that bi-channel rSO_2-NIRS has potential for guiding neuroanesthesia and predicting outcome. To better monitor local revascularization, an improved stroke-specific set-up in future studies is necessary.

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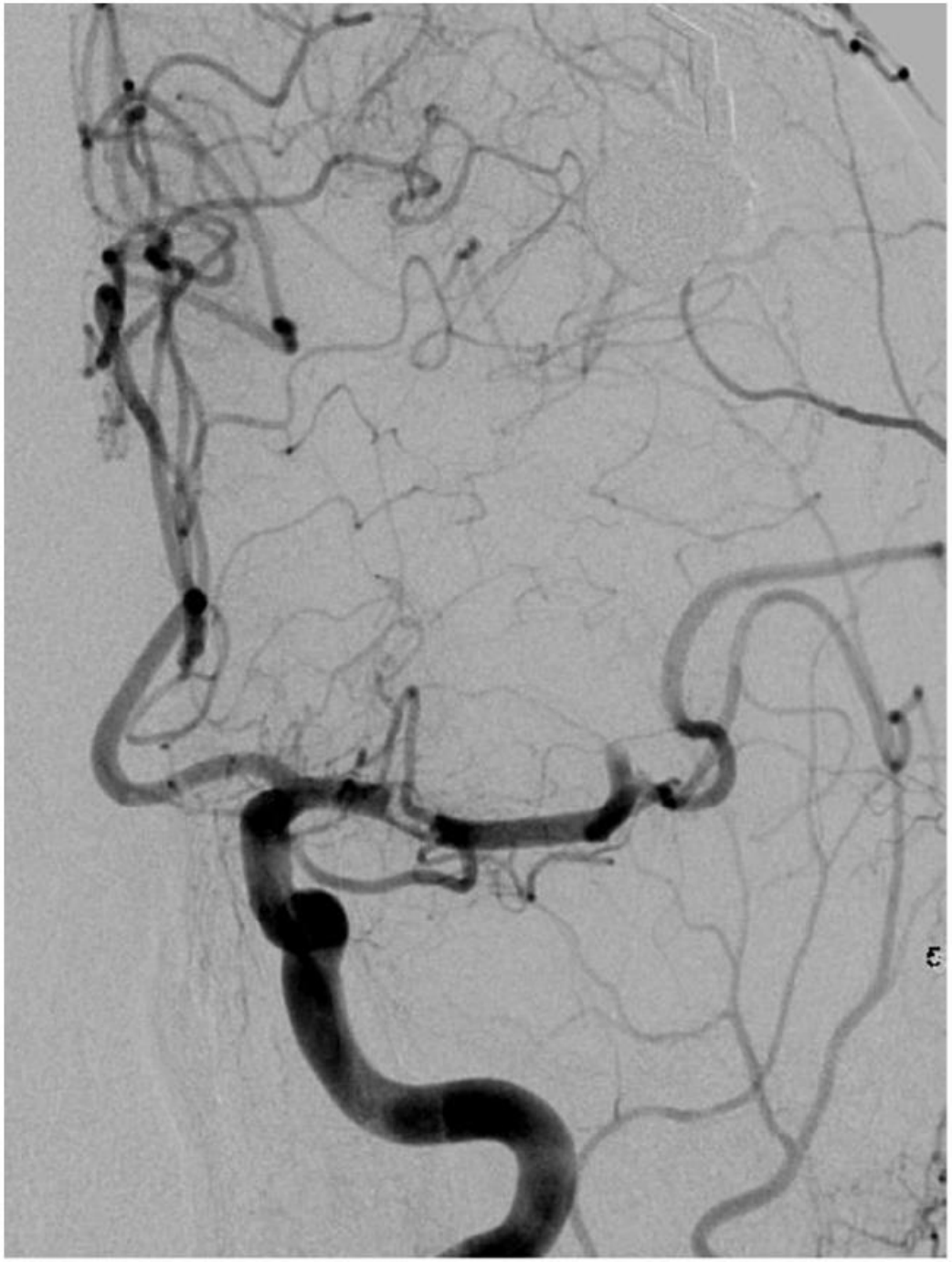
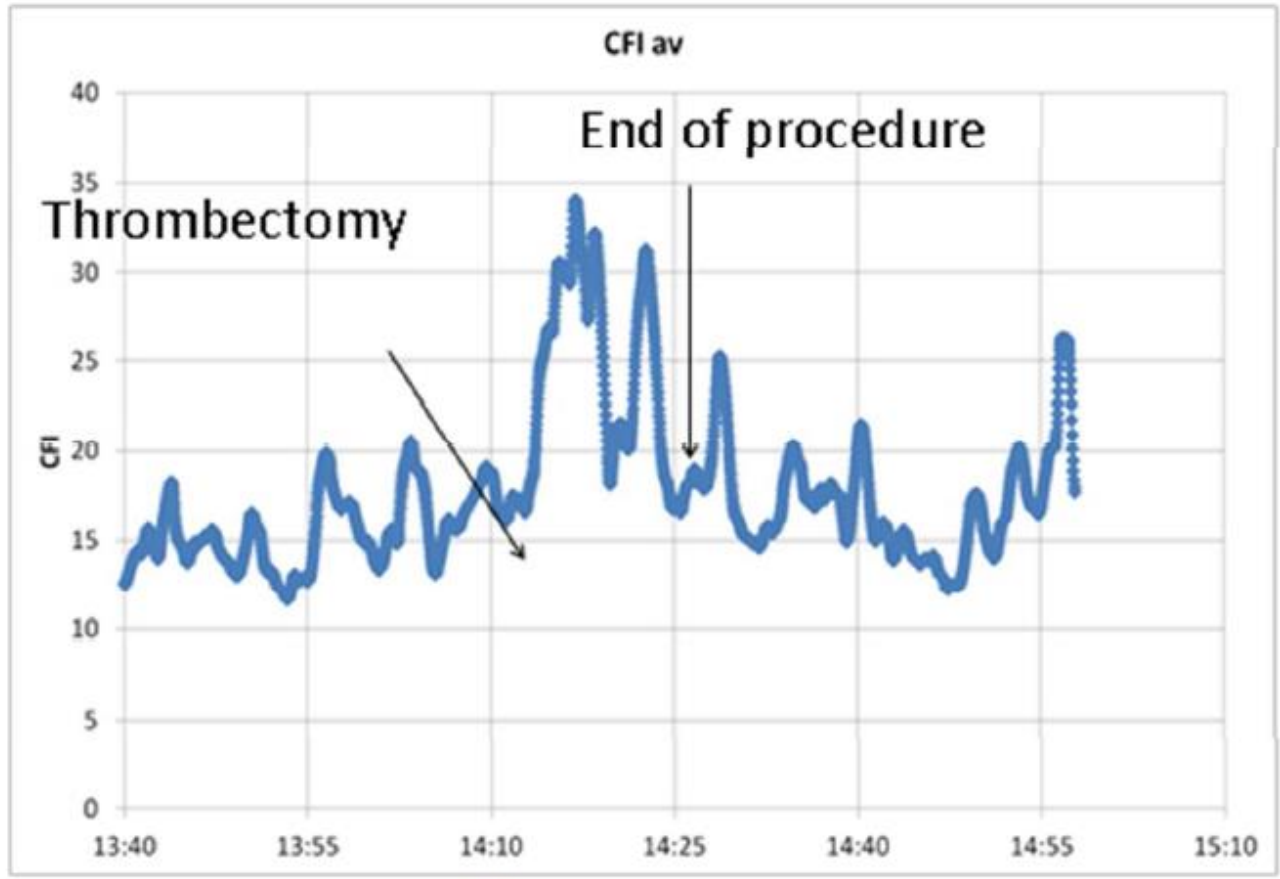
Keywords: acute ischemic stroke; medial cerebral artery occlusion; near-infrared spectroscopy; perfusion; regional oxygen saturation; thrombectomy

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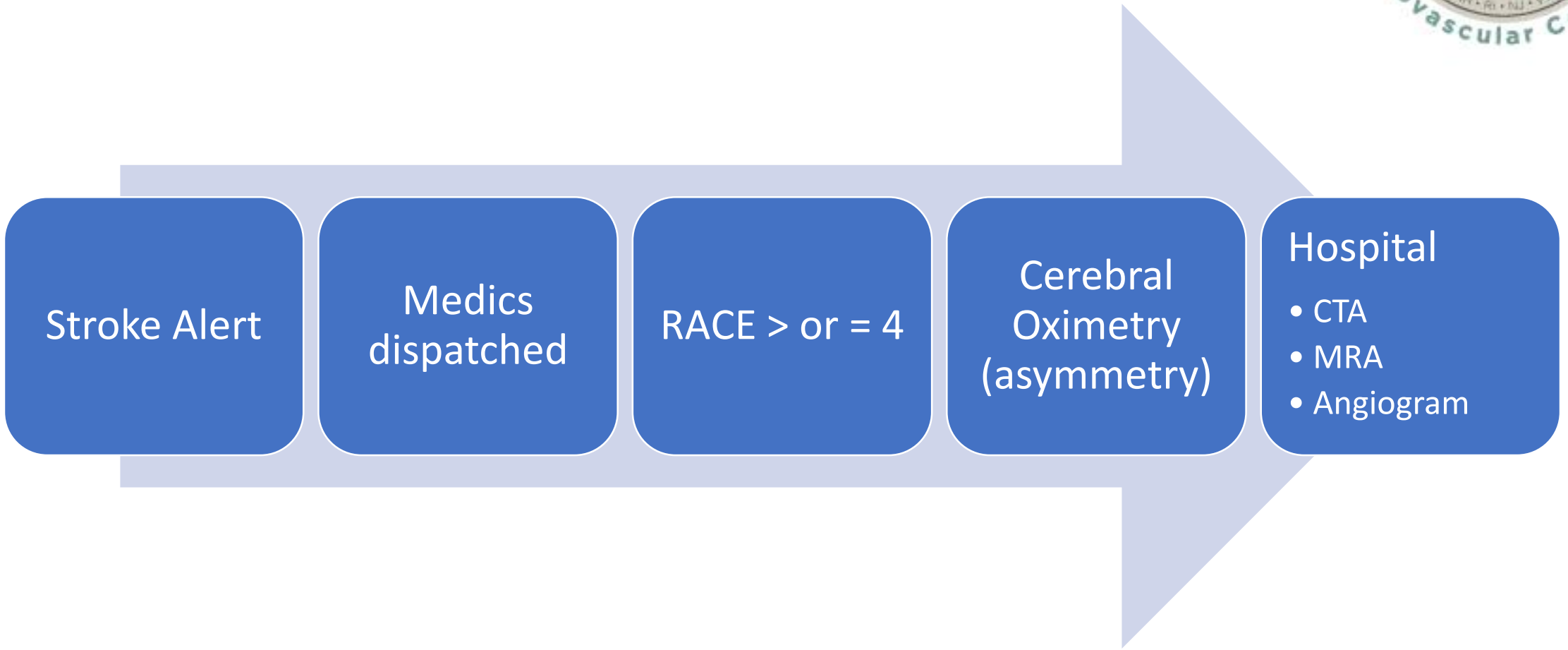
Protocol


Stroke Alert
Medics dispatched
RACE > or = 4
Cerebral Oximetry (asymmetry)
Hospital
• CTA
• MRA
• Angiogram

Objective

- To determine the value or degree of asymmetry of NCO with highest sensitivity and specificity for prediction of LVO
- Beginning with RACE > 4 so sensitivity and specificity in this select population
- Improve on sensitivity and specificity of RACE > 4

Pie in the Sky

- Utilize more than one machine at time for faster patient enrollment
- Include surrounding community hospitals
- Include patients irrespective of RACE scale as sensitivity for LVO is 85%