An Emergent Large Vessel Occlusion Screening Protocol for Acute Stroke: A Quality Improvement Initiative

CE 1.5 ANCC Contact Hours

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ABSTRACT

Background: Nurses play an integral role in triaging stroke patients. The purpose of this quality improvement initiative was to determine the efficacy of using an emergent large vessel occlusion (ELVO) screening protocol in the emergency department by nursing staff to improve identification of eligible patients as compared with current practice, improving time to endovascular treatment. **Methods:** Retrospective chart review was used to identify 76 patients admitted to a large urban stroke center. Of these, 36 presented during a 4-month period before the implementation of the Stroke Vision, Aphasia, Neglect (Stroke VAN) tool for assessing ELVO risk; 40 patients were admitted during the 4 months after implementation of Stroke VAN. **Results:** The mean door-to-computed tomography angiography scan times were reduced from 119 to 49 minutes ($P < .0001$) for all patients and reduced from 77 to 27 minutes in a subset of VAN-positive patients. **Conclusion:** Implementation of the VAN screening tool to assess for ELVO was associated with decreased door-to-computed tomography angiography times and more rapid identification of endovascular eligible patients with ischemic stroke.

Keywords: acute ischemic stroke, ELVO, emergent large vessel occlusion, endovascular

Acute stroke is a neurological emergency. Time to treatment is critical, and without emergent intervention, the consequences can be detrimental. Literature supports quick assessment of and treatment for patients presenting with stroke symptoms to improve functional outcomes after a stroke.[1–3] Stroke facilities are expected to comply with American Stroke Association (ASA) benchmark times for treatment of acute ischemic stroke (AIS), which includes time to intravenous (IV) recombinant tissue plasminogen activator (rtPA) within 60 minutes of patient arrival.[2]

Over the past few years, further advances have been made in the treatment of acute stroke. Although IV-rtPA remains the standard of care for all eligible patients presenting with clinical symptoms of AIS,[1,2] recent studies have demonstrated superiority of endovascular treatment of emergent large vessel occlusion (ELVO) through mechanical removal of the thrombus over thrombolysis with IV-rtPA alone.[4–8] Minimizing delays in identification and promptly treating patients who may benefit from cerebral revascularization with stent retriever devices is essential. Delays in reperfusion strategies, including IV-rtPA and/or endovascular treatment, are well documented as being associated with worse functional outcomes,[1,2] citing time to reperfusion as an independent predictor of good outcomes in patients with acute stroke symptoms.[3]

With release of the 2015 ASA updated AIS guidelines confirming benefit of endovascular treatment in AIS,[1] there is increasing emphasis on healthcare providers to quickly identify those patients presenting with ELVO. At the time of this project, there were no validated or recommended clinical practice guidelines or stroke assessment tools endorsed by the ASA to specifically screen for ELVO. More specifically, nurses are among the first responders to patients presenting with stroke symptoms, and there are no recommendations on how nurses should screen patients for ELVO. The guideline specifies that the patient must exhibit neurological deficits from a medium to large vessel occlusion.[1] Without training to specifically assess for these symptoms, patients may not be triaged appropriately. The release of these updated guidelines in addition to the growing body of research supporting endovascular treatment in acute stroke indicated the need for our institution to review our current stroke protocol.

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To improve triage and minimize delays in care, a multidisciplinary task force was formed consisting of the neurointerventionalist, stroke nurse practitioner, stroke coordinator, emergency department (ED) manager, ED nurses and physicians, ED clinical educator, and radiology department. The task force performed a thorough review of the institution's current stroke protocol that consisted of performing a noncontrast computed tomography (NCCT) of the head and a neurological assessment by the neurologist who made the decision of whether or not IV-rtPA was indicated. If there is a concern for ELVO, the patient would then return to the CT scanner and undergo vessel imaging. The radiologist would notify the ED provider with any abnormal results, who would then contact the neurointerventionalist and activate the endovascular team. Unfortunately, this process could take 60 minutes or longer with delayed door-to-endovascular times, with many cases falling outside benchmark times for endovascular reperfusion therapy of 90 minutes.[9] In addition, this practice was not supported by current recommendations. The ASA guidelines no longer recommend waiting to evaluate response to IV thrombolytic therapy before considering endovascular treatment;[1] this should happen during initial evaluation.

After a thorough review of the current process, the task force identified a need to update the current stroke protocol to include screening patients for ELVO. The task force set 2 primary goals for patients presenting with suspected stroke: (1) decrease time to identification of ELVO and (2) notify the neurointerventionalist with patients presenting with symptoms of ELVO upon presentation to the ED.

The purpose of this quality improvement (QI) initiative was to determine the efficacy of using an evidence-based ELVO acute stroke screening protocol in the ED by nursing staff to improve identification of those eligible patients as compared with current practice and therefore improve time to endovascular treatment.

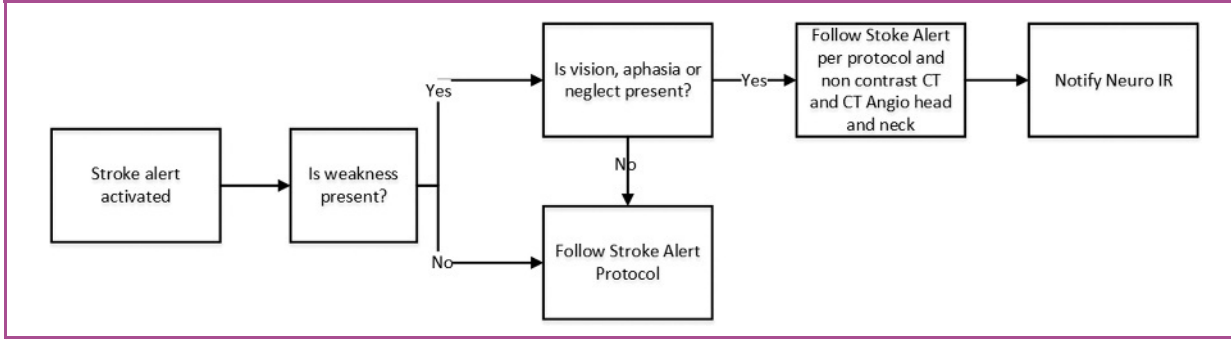
Neuro Interventional Radiology notification times were reduced from 192 to 27 minutes.

Methodology

Approval was obtained from the local institutional review board. The Division of Neurointerventional Surgery at a large southwest urban medical center implemented the QI initiative. This medical center is a designated Joint Commission Primary Stroke Center with endovascular capabilities to treat ELVO. In 2015, this medical center provided care for 559 ischemic strokes and 105 hemorrhagic strokes, qualifying this medical center as one of the busiest stroke programs in the state. A convenience sample of patients presenting as stroke codes served as the sample for this QI project. Inclusion criteria consisted of every stroke code in the ED that had a NCCT and computed tomography angiography (CTA) of the head and neck performed as part of the stroke code with a National Institute of Health Stroke Scale (NIHSS) score documented.

The evidence-based ELVO acute stroke screening protocol (Fig 1) was developed by the neurointerventionalist with collaboration from the task force and implemented on every stroke code presenting to the ED. Patients were initially screened using Stroke Vision, Aphasia, Neglect (Stroke VAN),[10] a validated ELVO screening tool with 100% interobserver reliability.[10] This scale was designed to focus the neurological assessment on symptoms of ELVO by testing specific vascular territories able to be treated with a stent retriever device and less emphasis on a scoring system.[10] The pilot study found Stroke VAN to be a quick and accurate tool to screen for ELVO,

FIGURE 1 Stroke Alert Process



reporting 100% sensitivity and 90% specificity for a diagnosis of ELVO in patients presenting with acute stroke.[10] This resulted in earlier activation of the endovascular team and decreased time to endovascular treatment.[10]

The basis of Stroke VAN is to assess for motor weakness. The patient raises both arms up in the air for 10 seconds. If no weakness is present, the patient is considered VAN negative and the examination is complete. If weakness is present, testing for visual deficits, aphasia, and neglect is performed. If the patient exhibits weakness in addition to a cortical symptom (visual deficits, aphasia, and/or neglect), then the patient is considered VAN positive. The VAN-positive patient is automatically triaged to an NCCT and CTA of the head and neck immediately after the NCCT with emergent notification to the neurointerventionalist who would review the images. If it was determined that the patient could benefit from endovascular treatment, the endovascular team was activated. For patients considered VAN negative, there was no need to notify the neurointerventionalist unless a posterior circulation stroke was suspected, namely, confused or comatose patients with dizziness, focal findings, or no other obvious reason for their altered mental status.[4] After the Stroke VAN assessment, the patient is then assessed using the NIHSS.

After the protocol was developed, the task force developed a formal education plan for all nursing staff in the ED who triage stroke codes. The 2-hour training session included discussing basic neuroanatomy, performing a Stroke VAN assessment, reviewing clinical trials supporting endovascular treatment, and differentiating symptoms of small versus large vessel occlusion. Emphasis was placed on how to implement the updated protocol and triaging those patients who presented with symptoms of ELVO (VAN positive). Stroke VAN was compared with other ELVO assessment tools including Cincinnati Prehospital Acute Stroke Severity Scale,[11] Field Assessment Stroke Triage for Emergency Destination,[12] Los Angeles Motor Scale,[13] and Rapid Arterial oCclusion Evaluation Scale.[14] Endovascular case studies were reviewed. Numerous sessions were offered over a 2-month period until all nurses directly involved in the care of patients during a stroke code were trained. There was an open forum for questions after the training session. Prerecorded lectures are now available at www.StrokeVAN.com.[15]

Education focused on performing a Stroke VAN assessment (Table 1), with specific emphasis on how to assess gaze, visual fields, motor testing, aphasia, extinction, and inattention.[10] Visual fields are assessed using finger counting or visual threat and, if present, making note of which side the field cut is present on, as well as having the patient look to the right and then left, evaluating for uneven eyes or gaze palsy. To assess for expressive aphasia (the ability to speak), the patient will repeat a sentence such as "today is a sunny day" or "no ifs ands or buts" and name 2 objects. To assess for receptive aphasia (the ability to understand), the patient is asked to follow simple commands such as close eyes and make a fist. In this scale, neglect can be counted as present if there is forced gaze or an inability to track to 1 side or the other.

The Division of Neurointerventional Surgery maintains an institutional level database of all endovascular

TABLE 1. Stroke VAN Assessment

Is arm weakness present? (extend arms with palms up for 10 s)		
Yes. Continue VAN assessment		
No. VAN negative. Exam done.		
Vision	Test peripheral vision. (hold 2 fingers on the left, 1 on the right)	Yes/No
	Observe for uneven eyes/cross-eyed	
Aphasia	Name 2 objects.	Yes/No
	Repeat "today is a sunny day"	
	Follow 2 commands (close eyes, make fist)	
Neglect	Forced gaze or inability to track (ask patient to follow your finger to the right and then left with their eyes)	Yes/No
	Unable to feel both sides at the same time (close eyes, touch both arms)	
	Ignoring 1 side	
VAN positive: weakness plus one or all of the V, A, or N (vision, aphasia, neglect)		
VAN negative: no weakness or no evidence of V, A, or N		

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patients who have underwent acute stroke thrombectomy. This database contains data including preprocedure NIHSS and time of NCCT and CTA of the head and neck that are abstracted from the electronic medical records and entered into the internal database. The protocol was implemented over a 4-month period, followed by a retrospective chart review including a group of patients presenting as a stroke code for the preceding 4-month period. The chart review process was performed by the stroke nurse practitioner. Data were reviewed from both the electronic medical records and the standardized data collection tool. Data reviewed included time of stroke alert notification, time of NCCT and CTA of the head and neck, NIHSS score, and time of notification to the neurointerventionalist. Stroke alerts during the period of January 1, 2015, to April 30, 2015, before initiation of the intervention were categorized as pre-VAN. Stroke alerts from May 1, 2015, to August 31, 2015, after implementation of intervention were categorized as post-VAN. Those in the pre-VAN group were retrospectively evaluated as VAN positive or negative using the NIHSS and clinical examination. Patients in the post-VAN group were evaluated with Stroke VAN at the time of presentation to the ED. Follow-up with the trained ED nurses was conducted in an open forum during staff meetings by the ED manager and stroke coordinator.

Results

A convenience sample of 76 patients met the inclusion criteria in the 4 months before the intervention (n = 36) and 4 months after the intervention (n = 40). The statistical analysis used an unpaired *t* test, 2-tailed, with a 95% confidence interval. All target outcomes improved significantly from before to after the process implementation, including a significant reduction in the mean arrival to CTA pre-VAN of 119 minutes (±59 minutes) versus post-VAN of 48 minutes (±47 minutes) (t_{74} = 5.793, $P < .0001$) for all stroke alerts. This improvement was also evident in the VAN-positive group (77 [±43] vs 27 [±23] minutes, $P < .05$).

Mean completion of CTA to radiology reading was 97 minutes; with the new protocol in place, the neurointerventionalist was notified immediately upon a patient testing VAN positive. Therefore, time to notification of the neurointerventionalist for patients with ELVO symptoms was dramatically reduced (192 to 27 minutes, $P = .0020$). None of the patients who presented as a stroke alert and were VAN negative had an ELVO, which is consistent with what was found during the pilot study.[10]

After this QI project, our standard of care now includes that any VAN-positive patient will immediately receive an NCCT and CTA of the head and neck and notification to the neurointerventionalist who will immediately review the images and evaluate for intervention. Stroke VAN is now performed on every stroke code that is activated in the field and ED and on the inpatient side.

Discussion

Adhering to the recommended benchmark times proves difficult without the use of an ELVO screening tool. The aim of this QI initiative was to determine the efficacy of using an evidence-based large vessel occlusion screening protocol in the ED by nursing staff to improve identification of ELVO and improve time to endovascular treatment.

The major finding was the significant improvement in time to identification of patients exhibiting signs of ELVO when triaged by nursing staff using the Stroke VAN screening tool. In addition to improving time to identification of those eligible patients, this tool was found to accurately identify patients with an ELVO. The results suggest that Stroke VAN, when performed by nurses as part of a standardized protocol, is efficacious in triaging patients for ELVO. Because of this QI initiative, Stroke VAN is the initial neurological assessment performed during all stroke codes at our institution resulting in an improved standard of care for patients presenting with suspected stroke.

This QI initiative can provide a framework for other hospitals, specifically in hospitals such as ours where advanced resources are not available 24-7. Stroke VAN can easily be initiated in any ED. This is a nurse-driven assessment tool. There is no need to calculate or interpret a score, and the assessment can be completed in 60 seconds or less,[4] which is important in busy, high-volume medical centers. Stroke VAN tests the same cortical components as the NIHSS so anyone who is NIHSS certified has the training to complete a Stroke VAN assessment. This tool is not meant to replace the NIHSS but only meant to enhance identification of those patients experiencing an ELVO.

Mandatory training is now included in the orientation process for all nurses hired into the ED, neuroscience floor, and intensive care units. Training is offered both in classroom settings and through prerecorded lectures that are available at www.strokevan.com,[15] followed by a posttest. In addition, training is now offered to the local emergency medical services with a future goal of performing Stroke VAN in the field and routing the patient to a facility that offers endovascular treatment of ELVO.

Implications for Nurses

The success of this QI project implementing a systematic evidence-based ELVO screening protocol is

owed to the ED nurses. The ED nurses are now able to efficiently triage eligible patients, autonomously contact the neurointerventionalist, and facilitate treatment within the recommended time windows. This protocol allows nurses the ability to advocate for their patients with suspected stroke. As a result, the nurses have improved their knowledge on localizing symptoms to large versus small vessel occlusion and increased their awareness of the treatment options available.

Throughout this process, the nurses were very clear on 1 thing: simple is better. When a stroke code is activated, the nursing staff is responsible for not only assessing the stroke symptoms but also quickly ruling out stroke mimics, including measuring vital signs, assessing blood glucose, facilitating an emergency CT scan, placing intravascular access, and drawing stat labs. These are all done within the first few minutes of activating a stroke code. They are already performing a full NIHSS and calculating that score, stating no time to do an additional scale that also requires calculations. This is not the case with many other proposed ELVO scales including the Cincinnati Prehospital Acute Stroke Severity Scale,[11] Field Assessment Stroke Triage for Emergency Destination,[12] Los Angeles Motor Scale,[13] and Rapid Arterial oCclusion Evaluation Scale.[14] During follow-up, many of the comments from nursing staff focused on the ease of performing this scale; noting how easy the mnemonic VAN is to remember cuing them on how to perform the scale by assessing for those 3 cortical symptoms.

Conclusion

Use of an evidence-based ELVO screening protocol by nursing staff in the ED improved identification of those patients eligible for endovascular treatment. Whether the first responder is a novice nurse, a neuroscience nurse, or an experienced stroke neurologist, Stroke VAN is easy to perform and simple to understand. Early diagnosis and treatment of ELVO has the potential to improve functional outcomes, decrease neurological morbidity and mortality, and, overall, offer patients a chance at quality of life.

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