ELVO: an operational definition

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INTRODUCTION

Recent landmark randomized controlled trial data1–7 have initiated a global transformational change in acute stroke therapy for ischemic stroke patients with large vessel occlusion. With endovascular thrombectomy established as the new standard of care for patients with large vessel occlusions, increased attention has turned towards service delivery to as many eligible patients as possible. The SNIS, in concert with other regional, national and international societies, has focused on this agenda.8,9 As both the need for and availability of endovascular thrombectomy grows, the terminology describing eligible patients requires uniformity. An operational definition of the clinical scenario in which a stroke patient has an urgent need for endovascular thrombectomy becomes increasingly important.10,11 A standardized nomenclature that uses consistently defined terms will facilitate continuous quality improvement as the field grows and understanding is advanced.12

Endovascular thrombectomy is a therapy specifically directed towards proximal cerebral vascular occlusions. Earlier studies with equivocal results for the benefit of this therapy13–15 were noteworthy for the absence of confirmation of pre-procedure vascular status. Recent positive trials were characterized by the requirement that vascular occlusion be documented as a requisite for patient enrollment in the trials.1–7 However, across these recent landmark trials there was significant variability in the definition of large vessel occlusion (table 1). The purpose of this document is to provide a standardized operational definition.

ORIGINS OF ‘ELVO’

The term ‘Emergent Large Vessel Occlusion’ or ‘ELVO’ was coined by the SNIS in 2015. It was felt that an acronym (like STEMI) would provide a rallying point for care providers and patients. The choice of language was to emphasize the time-critical nature of large vessel strokes. However, despite the term appearing in the peer reviewed literature and in multiple other contexts, no formal definition of ELVO has been crafted. It was presumed that ELVO referenced internal carotid and M1 occlusions given data available at the time, and use of the term proliferated through societal guidelines and papers.16,17 Thus, while the informal introduction of this term has been successful, as the field continues to advance there is an increasing imperative for a formal operationalized definition of ELVO.

COMPONENTS OF AN EFFECTIVE DEFINITION

An ideal definition for a medical term possesses the following characteristics:
1. Concise
2. Flexible and readily adaptable to clinical advances
3. Encompassing
4. Easily applicable
5. Readily translatable into clinical practice

The definition of the therapeutic target for large vessel stroke care is particularly challenged by the rapid pace of change in the field of stroke care.

OPERATIONAL DEFINITION OF ELVO

Considering the ideal characteristics above, we propose the use of the following definition for ELVO:

An acute vascular occlusion that impairs cerebral perfusion, results in significant clinical deficit, and is accessible for endovascular thrombectomy.

Applying our ideal criteria above:
1. Concise: the definition concisely covers the concepts of vascular occlusion, neurological deficit, and therapeutic options.
2. Flexible and readily adaptable to clinical advances: the definition includes internal carotid artery (ICA), middle cerebral artery (MCA) M1 and proximal M2, distal vertebral and the basilar trunk vessels. However, as device technology and our evidence evolves, this may include distal M2, M3, A1, A2 segments and P1 and P2 posterior cerebral artery branches in the future. Specific criteria for measured vessel diameter are absent from the definition for this reason. Current trial data have not evaluated these distal smaller vessels and therefore do not currently support distal vessel thrombectomy.
3. Encompassing: the definition encompasses both anterior and posterior circulation, and extracranial and intracranial vasculature. ‘Emergent’ captures the time sensitivity of large vessel stroke. Use of the term ‘significant clinical deficit’ incorporates patients with syndromes that may not generate typical deficits but still cause considerable disability, such as isolated aphasia or dense hemianopia.
4. Easily applicable: the definition is easy to understand and apply.
5. Readily translatable into clinical practice: this allows clinical application in diverse patient populations with flexibility to account for patient variation (eg, with direct or indirect collaterals, variable MCA anatomical definitions, or variant/anomalous branch anatomy).

IMPLICATIONS OF A WIDELY ACCEPTED DEFINITION

Application of a widely accepted definition has several consequences that improve stroke care and has a precedent in the cardiology sphere.18 Assigning the term ELVO should bring a particular value to the patient. The resources spent on diagnosis, monitoring, and tracking an ELVO diagnosis must additionally carry societal value to justify such efforts. The diagnosis forms the basis for therapeutic direction for the individual patient, while the aggregate of ELVO patients forms the basis for healthcare policy and resource allocation.19

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A definition provides an opportunity for reinforcing public, legislative, and emergency service education that ELVO is a distinct subtype of stroke. This in turn impacts multiple downstream considerations, including early identification of patients in the community, streamlining transport to a treatment capable facility,20,21 and legal positions for treatment.

A clear definition encourages the use of vessel imaging at regional centers. To identify ELVO, vascular imaging (likely CT angiography (CTA) at most referral centers) is required, and use of CTA can identify ELVO, vascular imaging (likely standardized, and goal-directed response for the public and healthcare workers, analogous to that generated by ‘Trauma Call’ or ‘Code Blue’. This encourages efficient and rapid mobilization of staff and resources.

Finally, the term ELVO and its associated definition creates terminology to streamline communication between health providers. This allows standardization of data collection models and enables comparison and benchmarking of outcomes.

**DISSEMINATION OF THE DEFINITION**

Stroke care is in the midst of a major therapeutic shift. This shift requires engagement of a broad target audience, encompassing emergency medical services, hospital personnel at all levels, administrators, legislators and, importantly, the public. The current developments in treatment of stroke provide a unique opportunity for reorganization of systems of care, and the term ELVO should be outward facing. This should be true for all branding and community-based initiatives as well as directed medical initiatives. The SNIS would request and encourage other professional societies—particularly the American Heart and Stroke Society, the European Stroke Organization, the Stroke Alliance for Europe, the Asia Pacific Stroke Organization, the World Stroke Organization and other international bodies involved in stroke care—to unite in efforts to adopt a unified operational definition for ELVO for the benefit of stroke patients worldwide.

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**Competing interests** None declared.

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Table 1 Definition of the term large vessel occlusion in recent literature evaluating endovascular therapy

<table>
<thead>
<tr>
<th>Study</th>
<th>Year of publication</th>
<th>Only anterior circulation</th>
<th>Definition of large vessel occlusion in publication</th>
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<tbody>
<tr>
<td>MR CLEAN2</td>
<td>2015</td>
<td>Yes</td>
<td>Occlusion of the distal intracranial internal carotid artery (ICA), middle cerebral artery (MCA, M1 or M2 segments), or anterior cerebral artery (A1 or A2 segments)</td>
</tr>
<tr>
<td>EXTEND-IA2</td>
<td>2015</td>
<td>Yes</td>
<td>Occlusion of the ICA or the first or second segment of the MCA</td>
</tr>
<tr>
<td>SWIFT PRIME2</td>
<td>2015</td>
<td>Yes</td>
<td>Occlusion of the intracranial ICA, the first segment of the MCA</td>
</tr>
<tr>
<td>ESCAPE3</td>
<td>2015</td>
<td>Yes</td>
<td>Occlusion of the MCA trunk and its immediate branches, with or without intracranial occlusion of the ICA</td>
</tr>
<tr>
<td>REVASCAT4</td>
<td>2015</td>
<td>Yes</td>
<td>Occlusion of the intracranial ICA (distal ICA or T occlusions), M1 or tandem occlusions</td>
</tr>
<tr>
<td>THRACE6</td>
<td>2016</td>
<td>No</td>
<td>Occlusion of the intracranial ICA, the M1 segment of the MCA, or the superior third of the basilar artery</td>
</tr>
<tr>
<td>DAWN7</td>
<td>2017</td>
<td>Yes</td>
<td>Occlusion of the intracranial ICA, first segment of the MCA, or both</td>
</tr>
<tr>
<td>DEFUSE 3610</td>
<td>2018</td>
<td>Yes</td>
<td>Occlusion of the ICA or MCA-M1 segment</td>
</tr>
</tbody>
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18 Anon. Myocardial infarction redefined—a consensus document of The Joint European Society of Cardiology/ American College of Cardiology for the

References


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