

## Measuring Carotid Revascularization Quality

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Holy Grail: something that you want very much but that is very hard to get or achieve

—Merriam-Webster

Because US health care pivots from volume-based to value-based strategies, there is growing emphasis on optimizing quality, safety, and appropriate utilization. Accordingly, to improve, we must be able to measure our performance. In this issue of *Circulation: Cardiovascular Interventions*, Kuehnl et al provide a timely publication, from the German national database, that informs our quest for the Holy Grail of measureable quality and safety for internal carotid artery revascularization.<sup>1</sup>

### See Article by Kuehnl et al

The authors analyzed 182 033 procedures involving internal carotid artery revascularization, performed in Germany between 2009 and 2014. Because of mandatory reporting requirements, 99.1% of the data were available for analysis. They arbitrarily split the German hospitals into quintiles based on the case volumes for carotid endarterectomy (CEA; n=161 448) and carotid stenting (CAS; n=17 575) and then looked for correlations between hospital case volume and their safety end point, in-hospital death, and stroke.

Not surprisingly, their data, consistent with other observations,<sup>2</sup> confirmed an inverse relationship between hospital CEA case volume and inpatient death and stroke, but, similar to other reports,<sup>3</sup> failed to confirm an inverse safety relationship for CAS hospital volume. This is counterintuitive. A high-risk, complex procedure, such as CAS or CEA, should have an inverse safety relationship to both the case volume of the hospital (nursing experience, state-of-the-art equipment, and support services) and the individual operator's experience (technical expertise and clinical judgment).

The authors offer several reasonable explanations for their inability to confirm an inverse relationship between internal carotid artery revascularization safety and CAS hospital case volume, including the most likely reason—low CAS site volume ( $\approx 10\%$  of the CEA volume) and a relatively low number of stroke and death events (3.7%) in the CAS group. On an annualized basis, the ability to discriminate between sites

with 1 or 2 cases, 3 to 6 cases, 7 to 12 cases, 13 to 26 cases, and  $>27$  cases with an event rate of 3.7% is understandably difficult and subject to expected variation. Any differences observed among these low-volume groups would be likely because of chance.

It follows that low hospital CAS case volumes are an insensitive measure and would be expected to poorly discriminate performance among individual operators. Higher hospital case volumes result in programmatic strength, but do not specifically relate to individual operator experience or skill. A hospital performing 27 CAS per year could have one experienced operator performing 2 to 3 cases per month or 5 operators performing 1 case every other month or so. Although higher volumes are associated with better quality both institutionally and individually, there is no doubt that excellent outcomes can be obtained by lower volume providers.

It has been suggested that an institutional volume threshold of 79 CEA cases per year is necessary to achieve the highest quality outcomes.<sup>2</sup> An observed additional benefit of a high CEA volume hospital is that low-volume surgeons, working in that environment, achieve similar CEA quality and safety results to their higher volume counterparts. This argues for centralizing carotid revascularization in high-volume centers.<sup>2</sup>

Likewise, with CAS, both individual operator volume and site volume contribute to better quality and safety. A site volume threshold of 72 CAS per year is required to achieve a 30-day death and stroke rate below 3%, based on a regression model from the CAPTURE 2 registry (Carotid RX Acculink/RX Accunet Post-Approval Trial to Uncover Unanticipated or Rare Events).<sup>4</sup> In addition, a model has been developed to calculate a national benchmark for adjusted stroke rates after CAS.<sup>5</sup> Lower CAS complication rates may reflect collective institutional proficiency and experience, resulting in improved patient selection, device selection, and adjunctive medical management, along with group learning from case reviews.

Several reports have demonstrated that in addition to hospital or site volumes, individual operator experience contributes to the value equation by taking advantage of an individual operator's greater technical skill and clinical judgment.<sup>4-8</sup> In assessing individual operator performance, it seems that CAS volume and experience is more important than individual specialty.<sup>4,9,10</sup> During the initial roll-in phase of the CREST (Carotid Revascularization Endarterectomy Versus Stenting Trial), vascular surgeons were at a significant disadvantage (because of lower volume training) compared with other providers who brought with them more catheter-based endovascular experience<sup>11</sup> (Figure). However, early difference in outcomes related to operator specialty did not persist after the increased experience gained during the roll-in phase.<sup>12</sup>

Independent predictors of decreased 30-day death, stroke, and myocardial infarction are a shorter time interval between

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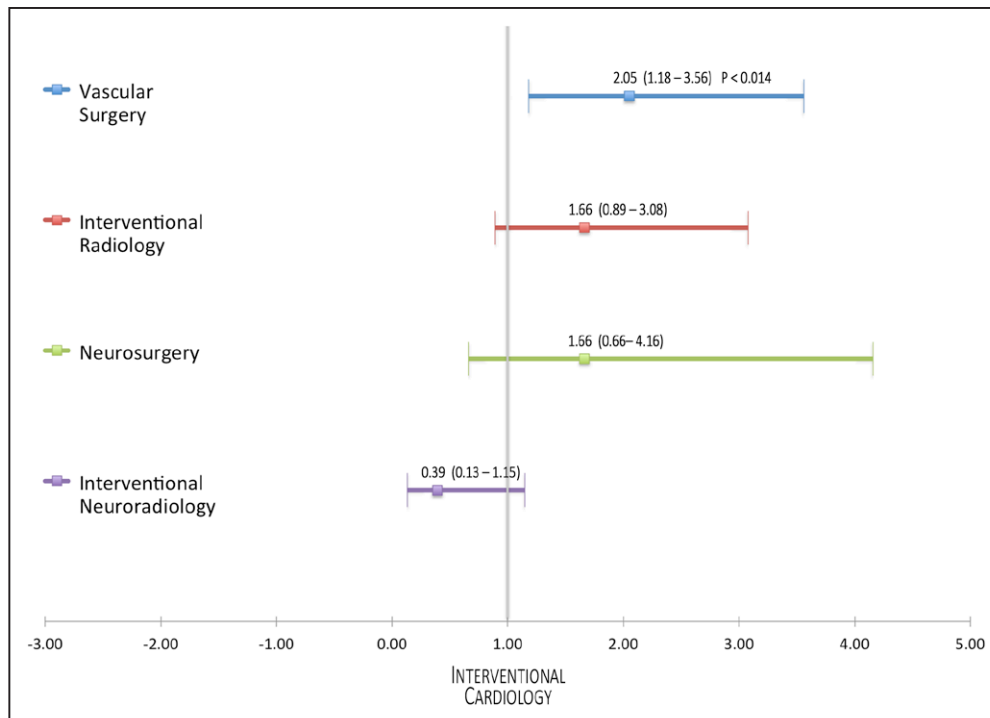
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**Figure.** Carotid stent outcomes (death, stroke, and heart attack) by operator specialty. Interventional cardiology, the largest group of operators, is used as the comparison group.<sup>11</sup>

CAS procedures (intensity of experience) and a shorter embolic protection device (EPD) dwell time reflecting technical proficiency and enhanced patient selection.<sup>6</sup>

Individual CAS operator performance can be characterized into 2 broad domains: technical skill (EPD dwell time) and clinical outcomes (30-day death, stroke, and myocardial infarction). Traditionally, we have relied on the clinical outcomes measure for quality and safety determinations, but the technical skill component, the EPD dwell time, is important because it correlates with operator experience. Greater operator experience enhances both the operator's endovascular technical skills and also informs better patient selection. It may be difficult to separate the effect of the intensity (interval between cases) and the cumulative (lifelong) nature of a CAS operator's experience, but both are important. CAS operator experience, represented by time-related variables, that is, time from the first CAS, the time to each subsequent CAS, and the time interval between CAS (intensity), correlate with operator technical skill as measured by the EPD dwell time.

One wonders if adding the individual operator metrics such as EPD dwell time and other individual operator experience measures to the current analysis would have helped stratify the lower volume centers and reveal the inverse volume to quality relationship we expect to find. If we are to achieve the Holy Grail of accurately determining the quality, safety, and appropriateness of internal carotid artery revascularization, we need better measurements. Going forward, these individual operator metrics should be added to carotid clinical registries to improve the fidelity of the measurement tool.

## Disclosures

None.

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