From the Society for Vascular Surgery

Preoperative frailty Risk Analysis Index to stratify patients undergoing carotid endarterectomy

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Objective: **Rapid and objective preoperative assessment of patients undergoing carotid endarterectomy (CEA) remains problematic. Preoperative variables correlate with increased morbidity and mortality, yet no easily implemented tool exists to stratify patients. We determined the relationship between our fully implemented frailty-based bedside Risk Analysis Index (RAI) and complications after CEA.**

Methods: **Patients undergoing CEA in the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) database from 2005 to 2011 were included. Variables of frailty RAI were matched to preoperative NSQIP variables, and outcomes including stroke, mortality, myocardial infarction (MI), and length of stay were analyzed. We further analyzed patients who were symptomatic and asymptomatic before CEA.**

Results: **With use of the NSQIP database, 44,832 patients undergoing CEA were analyzed (17,696 [39.5%] symptomatic; 27,136 [60.5%] asymptomatic). Increasing frailty RAI score correlated with increasing stroke, death, and MI ($P < .0001$) as well as with length of stay. RAI demonstrated increasing risk of stroke and death on the basis of risk stratification (low risk [0-10], 2.1%; high risk [>10], 5.0%). Among patients undergoing CEA, 88% scored low (<10) on the RAI. In symptomatic patients, the risk of stroke and death for patients with a score of ≤10 is 2.9%, whereas if the RAI score is 11 to 15, it is 5.0%; 16 to 20, 6.9%; and >21, 8.6%. In asymptomatic patients, the risk of stroke and death for patients with a score of ≤10 is 1.6%, whereas if the RAI score is 11 to 15, it is 2.9%; 16 to 20, 5.2%; and >21, 6.2%.**

Conclusions: **Frailty is a predictor of increased stroke, mortality, MI, and length of stay after CEA. An easily implemented RAI holds the potential to identify a limited subset of patients who are at higher risk for postoperative complications and may not benefit from CEA. (J Vasc Surg 2015;61:683-9.)**

Randomized controlled trials have demonstrated significant reduction in stroke with carotid endarterectomy (CEA) compared with medical treatment alone for patients with symptomatic[1-3] and asymptomatic[4-6] carotid stenosis. Guidelines have been established defining appropriate candidates and acceptable outcomes for CEA.[7] Despite clear benefit of CEA in these trials, CEA, particularly in asymptomatic patients, is under increased scrutiny.

Practicing in a cost-constrained environment where the value of operative intervention is dictated by outcomes, attempts to further improve the outcomes of CEA are paramount.[8] Research and quality improvement activities have focused on multivariate regression analyses in an effort to identify preoperative risk factors predictive of poor postoperative outcomes of CEA. Although individual physiologic characteristics alone have been identified, there has been no validated and implemented assessment tool to risk stratify preoperative patients. In addition, the analyses available have not incorporated frailty and geriatric risk factors, such as cognitive, functional, social, and nutritional measures, despite these being recognized as strong predictors of postoperative outcomes.[9]

Frailty is a syndrome that reflects decreased physiologic reserves and an accumulation of comorbid conditions.[10,11] In simpler terms, frailty is the objective assessment for what many have come to know as the "eyeball test." Research has validated multiple assessments that are able to identify frail patients. It is now well established that frailty is a strong predictor of complications and mortality in surgical patients.[12] Unfortunately, initial studies using these time-intensive assessment tools preclude implementation in a busy clinical setting.

Knowing the significance of frailty and outcomes, we implemented, as part of a quality improvement project, an easily performed frailty screening process in the clinical setting. We developed the Risk Analysis Index (RAI), which is a simplification of the Porock

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SEX, AGE AND CANCER

1. Sex — Female = 0/ Male = 5 _____
2. Age _____

Score with Cancer _____
Score without Cancer _____

Age (years)	Score with cancer	Score without cancer
<69	20	2
70-74	19	3
75-79	18	4
80-84	17	5
85-89	15	6
90-94	14	7
95-99	14	8
>100	13	9

MEDICAL CO-MORBIDITIES

3. Weight loss in past 3 months (>10 lbs) — No = 0/ Yes = 5 _____
4. Renal Failure — No = 0/ Yes = 6 _____
5. Congestive heart failure — No = 0/ Yes = 4 _____
6. Poor appetite — No = 0/ Yes = 4 _____
7. Shortness of breath at rest — No = 0/ Yes = 8 _____

RESIDENCE, COGNITION AND ACTIVITIES OF DAILY LIVING

8. Residence other than independent living — No = 0/ Yes = 8 _____
   If yes, circle location: Skilled Nursing Facility/Assisted Living/Nursing Home
   If yes, circle if admission was in last 30 days — No/ Yes
9. Deterioration of cognitive skills over the last 3 months — No / Yes
10. Activities of Daily Living

Score with Cognitive Decline (-2 - 21) _____
Score without Cognitive Decline (0 – 16) _____
TOTAL SCORE _____
PERCENT _____

Score	Mobility	Eating	Toilet Use	Personal Hygiene
0	Independent	Independent	Independent	Independent
1	Supervised	Supervised	Supervised	Supervised
2	Limited assistance	Limited assistance	Limited assistance	Limited assistance
3	Extensive assistance	Extensive assistance	Extensive assistance	Extensive assistance
4	Total dependence	Total dependence	Total dependence	Total dependence

ADL Score	ADL Score with Cognitive Decline
0	ADL score -2
1-2	ADL score -1
3-4	ADL score -0
5-7	ADL score +1
8-9	ADL score +2
10-11	ADL score +3
12-13	ADL score +4
14-16	ADL score +5

Points = Percent	Points = Percent
0-5 = 4%	36-40 = 47%
6-10 = 4%	41-45 = 58%
11-15 = 7%	46-50 = 69%
16-20 = 11%	56-60 = 89%
21-25 = 17%	61-65 = 90%
26-30 = 27%	66-70 = 93%
31-35 = 36%	71-75 = 100%

Fig 1. Risk Analysis Index (RAI) form. *ADL*, Activities of daily living.

6-month mortality index (Fig 1). It was validated retrospectively and prospectively in unpublished quality data at our institution and demonstrated a correlation with increased RAI score and postoperative complications. It is now used as a screening mechanism to identify high-risk surgical patients at our institution.[13-15] With this evidence, we applied our RAI to patients undergoing CEA in a large prospective national database.