Development and validation of a score to predict life expectancy after carotid endarterectomy in asymptomatic patients

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ABSTRACT

Objective: Recent improvement of best medical treatment for carotid stenosis has sparked a debate on the role of surgery identification of patients who may benefit from carotid endarterectomy (CEA) is crucial to avoid overtreatment. An expected 5-year postoperative survival is one of the main selection criteria. The aim of this study was the development of a score for predicting survival of asymptomatic patients after CEA.

Methods: Our score was derived from a retrospective analysis of 648 consecutive asymptomatic patients from a single hospital. External validation of the score was then performed on a second cohort of 334 asymptomatic patients from two different hospitals in the same area. Factors associated with reduced postoperative survival within the derivation cohort (DC) were identified and tested for statistical significance. Each selected factor was assigned a score proportional to its β coefficient: 1 point for chronic obstructive pulmonary disease, diabetes mellitus, coronary artery disease, and lack of statin treatment; 4 points for age 70 to 79 years and creatinine concentration ≥1.5 mg/dL; 8 points for age ≥80 years and dialysis. The DC was divided into four groups based on individual scores: group 1, 0 to 3 points; group 2, 4 to 7 points; group 3, 8 to 11 points; and group 4, ≥12 points. Group-specific survival curves were calculated. The validation cohort (VC) was stratified according to the score. Survival of each of the four risk groups within the VC was compared with its analogue from the DC.

Results: Median follow-up of the DC and VC was, respectively, 56 and 65 months. Intercohort comparison of 5-year survival was 84.7% ± 1.7% vs 85.2% ± 2% ($P = .41$). Group-specific 5-year survival within the DC was 97% ± 1.5% (group 1), 88.4% ± 2.2% (group 2), 69.6% ± 4.7% (group 3), and 48.1% ± 13.5% (group 4; $P < .0001$). Five-year survival within the VC was 95.5% ± 2% (group 1), 89.5% ± 2.7% (group 2), 65% ± 6.1% (group 3), and 44.8% ± 14.1% (group 4; $P < .0001$). Intercohort comparison of group-specific survival curves showed close similarity throughout the groups.

Conclusions: Our score is a simple clinical tool that allows a quick and reliable prediction of survival in asymptomatic patients who are candidates for CEA. This selective approach is crucial to avoid unnecessary surgery on patients who are less likely to survive long enough to experience the benefits of this preventive procedure. (J Vasc Surg 2017;■:1-8.)

The benefit of carotid endarterectomy (CEA) for the prevention of stroke in patients with severe carotid stenosis was shown in the mid-1990s[1] and later corroborated by larger trials.[2] More recently, the appropriateness of CEA for asymptomatic patients has become a matter of controversy. Results of randomized trials comparing best medical treatment (BMT) alone with BMT plus CEA are now being questioned because BMT has improved its effectiveness through the years.[3,4] As a result, there is now a lack of univocal consensus on this

subject; some surgeons have completely ceased to routinely offer surgical treatment to asymptomatic patients.

Contemporary guidelines stress the importance of selection of patients for the treatment of asymptomatic carotid disease. A target of 3 to 5 years of postoperative life expectancy[5,6] is specifically recommended.

Although there are probably other factors that identify subgroups of patients who will likely profit the most from an aggressive approach (high-risk plaques, patients with hypercoagulable status), we believe that a "selective approach" to asymptomatic stenosis, consisting of offering surgery to those patients who will survive long enough to benefit from surgery, is the easiest way to avoid unnecessary treatments.

The aim of our study was to provide clinicians with a score that could help them stratify patients by their survival likelihood to select the best candidates for CEA for asymptomatic carotid stenosis.

METHODS

We derived our score for postoperative long-term mortality from a retrospective cohort of consecutive

asymptomatic patients treated in one hospital (Ospedale San Carlo Borromeo, Milan, Italy) and validated the strength of its prediction model on a different cohort of asymptomatic patients collected from two different hospitals in the same area (Spedali Civili, Brescia, Italy; and IRCCS Policlinico San Donato, San Donato Milanese, Italy).

This study is in agreement with the principles outlined in the Declaration of Helsinki. Patients gave informed consent for use of personal data to the hospital at which they received medical care, according the Italian state laws; no Institutional Review Board approval or informed consent of the patients was required because this research was a retrospective analysis.

Patients without an ipsilateral or nonhemispheric neurologic event during the previous 6 months were defined as asymptomatic.

Patients who underwent surgery for restenosis and concomitant CEA and coronary artery bypass grafting were excluded from this study. In case of bilateral CEA, survival was calculated from the first procedure. In our division, CEA is always the first treatment option unless there is evidence of a major medical contraindication (congestive heart failure class III/IV, left ventricular ejection fraction <30%, unstable angina, recent myocardial infarction [MI], chronic obstructive pulmonary disease [COPD] with forced expiratory volume in the first second of expiration <30%) or presence of anatomic risk factors (high lesions, tandem intracranial lesions, presence of a tracheostomy, prior irradiation or surgery to the neck, recurrent stenosis, contralateral laryngeal palsy). Contralateral carotid occlusion is not considered an absolute contraindication.

A database of asymptomatic patients who underwent CEA from January 2002 to September 2013 at Ospedale San Carlo Borromeo was used as the primary source for data collection. This database included demographics, comorbidities, medications, and treatment details.

The presence of hypertension, diabetes mellitus (DM), dyslipidemia, and pulmonary disease was recorded in case of a previous specific diagnosis or if the patient was under specific treatment. Kidney function was directly tested during preoperative assessment. Coronary artery disease (CAD) was recorded if the patients had suffered MI or angina or underwent a coronary revascularization with either percutaneous transluminal coronary angioplasty or coronary artery bypass grafting.

Postoperative long-term survival was assessed for each patient. Hospital records of outpatient visits, diagnostic procedures, and rehospitalizations were queried. For patients without recent admission to the hospital, survival was assessed through telephone calls.

Score derivation. Long-term postoperative survival was estimated using the Kaplan-Meier method. Hazard

ARTICLE HIGHLIGHTS

· **Type of Research:** Retrospective cohort study
· **Take Home Message:** Based on data of 648 operations, the authors developed a scoring system to predict 5-year survival in patients with asymptomatic carotid artery disease. The scores, based on six factors (age, coronary artery disease, renal function, diabetes mellitus, chronic obstructive pulmonary disease, and statin therapy), were validated on a separate cohort of 334 patients.
· **Recommendation**: The authors recommend using their scoring system to calculate the probability of survival for 5 years in asymptomatic patients with carotid stenosis who may be candidates for carotid intervention.

ratios (HRs) were calculated for several potential risk factors using Cox regression models. For deriving our score, we selected those parameters that showed a statistically significant correlation with survival and those parameters that, despite not reaching significance, have an undisputed clinical relevance for survival. For each of these parameters, we calculated the β coefficient associated with each univariate HR. Comparison among different β coefficients allowed us to "weight" the relative importance of different parameters and therefore to assign an individual score to each of them.

A cumulative score was calculated for each patient, allowing us to stratify them. We therefore arbitrarily divided them into four "risk groups" according to their score. Group-specific survival curves were calculated and differences were tested by log-rank test and Wilcoxon test. A *P* value of .05 was considered significant.

Score validation. We validated the score obtained on a different population of asymptomatic patients who underwent CEA in two different medical centers. The two hospitals share the same indications for treating carotid stenosis with the first one (see earlier). The validation cohort (VC) resulted from merging of two series of consecutive patients operated on in both centers before 2010 (5-year follow-up minimum). Data collection was limited to the parameters of our scoring system to be able to assign a score to each patient. Similar to the derivation cohort (DC), long-term survival was assessed through existing records and, in case of no further contact, through telephone calls.

No technical aspect of perioperative management was standardized; anesthesia, type of intraoperative brain monitoring, and type of intraoperative control may have differed among centers. Surgical technique was always left to the surgeon's preference.