CARDIAC RISK ASSESSMENT BEFORE CAROTID ENDARTERECTOMY

HUSSIEN M.M. RABEE, MD, FRCSI

Preoperative cardiac assessment is an essential step to identify the patients at risk, optimize any dysfunction, anticipate perioperative and postoperative problems and plan special management. Carotid endarterectomy (CEA) has become one of the most commonly performed vascular procedures in Western countries. The awareness of the potential beneficial role and hazards of CEA is not proportionate to the magnitude of this problem in our countries, not only among patients, but also among medical disciplines. This report is a retrospective analysis of the prevalence of coronary artery diseases among 442 patients who were referred to the Division of Vascular Surgery at the King Khalid University Hospital in Riyadh, Saudi Arabia with suspicion of carotid artery disease. Eighty-two patients proved to have significant carotid artery stenosis and had thorough preoperative cardiac assessment by a senior cardiologist. All cases had clinical assessment and ECG, 66 cases had echocardiogram examination, 44 had Dipyridamole Thallium-scan and 12 had coronary angiogram. Sixty-eight patients underwent 76 carotid endarterectomy. Four of them had MI and only one case died during the perioperative period. This study shows that cardiac screening studies have a potential role in candidates for carotid surgery in influencing the decision to operate and intensity of perioperative monitoring and care. We believe that the teamwork should involve vascular surgeons, cardiologist and anesthetist to manage such critical patients properly.

CAROTID ARTERY DISEASE AS A SOURCE OF STROKE, whether by embolization from an atherosclerotic plaque or by severe reduction of extracranial or intracranial blood flow, is fairly common in the Western World. I Symptomatic significant carotid artery stenosis (> 70%) is the main indication of carotid endarterectomy (CEA) which has become one of the most commonly performed vascular procedures in Western countries.2,3 In view of the modernization and change of lifestyle and dietary pattern in the Middle East area during the last two to three decades, there is no reason why such serious carotid diseases should not be equally common.4,5 Preoperative cardiac assessment is essential step to identify the patients at risk, optimize any dysfunction, anticipate perioperative and postoperative problems and plan special management.6 All treatments included in vascular surgery may carry unwanted or unacceptable outcomes for the individual patient and family, the surgeon and the hospital, especially if the patients are not well prepared prior to surgery.7 In determining the appropriateness of cardiac assessment for carotid surgery patients, the questions that need to be asked include the following: what is the incidence of coronary disease in carotid surgery patients? How much does this disease contribute to early and late mortality following carotid surgery? Can operative mortality, and longevity, be improved by a systemic approach to cardiac assessment including selective therapeutic intervention for coronary disease if discovered?8 This report presents the experience of the Vascular Surgery Division in King Khalid University Hospital, Riyadh Saudi Arabia, in cardiac risk assessment before carotid endarterectomy (CEA).

Materials and Methods

During the period between May 1995 and May 1999, a total of 442 patients were referred to the Division of Vascular Surgery at the King Khalid University Hospital in Riyadh, Saudi Arabia with suspicion of carotid artery disease. There were 261 males and 181 females. The age ranged from 20 to 94 with a median age of 55 years. All cases underwent thorough history taking and clinical examination. Carotid Duplex studies were performed in all cases with a real-time B-mode ultrasound imager (Aloca 680, Japan), using a 7.5 MHz probe with an integrated 5 MHz pulsed...
Doppler and included longitudinal and transverse views of the common carotid carotid artery, carotid bifurcation and proximal internal and internal carotid arteries. The images generated were photographed on Polaroid film and recorded on videotapes for later analysis. Peak systolic velocity was recorded and the degree of carotid artery stenosis were estimated. Aortic arch and bilateral selective carotid artery arteriography were done in 93 patients (Figure I). Ninety cases (82 patients) were found to have significant carotid artery disease (> 70% stenosis). All 82 patients had thorough preoperative cardiac assessment by a senior cardiologist. The basic scheme is graphically depicted in the form of an algorithm in Figure 2. This protocol included the use of one of the clinical scoring systems (Goldman, Destskey's score or Eagle's marker) and ECG in order to categorize the patients into three groups: low, intermediate and high risk for surgery. Those with no clinical markers (low risk) could undergo CEA, without further screening, and with standard monitoring.

The intermediate and the high risk groups would first undergo echocardiogram to rule out a cardiac source for emboli and estimate the ejection fraction. The high risk group were usually referred directly for cardiac catheterization and/or coronary angiography. The group with intermediate risk group would undergo Dipyridamole Thallium scan (DT). On the base of the clinical scoring, ejection fraction and the DT scan results, the patients in this intermediate group would be either referred to CEA with intensive monitoring or undergo coronary angiography. For those who had been found to have significant coronary artery disease, they would undergo coronary revascularization first or simultaneously if the carotid artery disease were hemodynamically significant (ie, bilaterally >60%). The worst symptomatic side will be done first. The last group of patients found to have significant uncorrectable coronary artery disease might be offered the option of conservative treatment.

Results

Eighty-two patients underwent preoperative cardiac assessment according to the mentioned protocol. Sixty-eight of them had 76 CEA by consultant vascular surgeons (bilateral in 8 patients), 4 cases refused CEA and 10 cases were found to have significant uncorrectable coronary artery disease. Fifty-two were males, 16 were females and their ages ranged from 53 to 79 with a mean age of 63 years. All patients were found to be on regular low-dose aspirin for the management of symptomatic carotid artery stenosis and all of them received intravenously 5000 units of heparin during CEA before clamping of the carotid arteries. Risk factors for atherosclerosis (Table I), shows that 62 patients were hypertensive (75%), 56 were diabetic (68%), history of ischemic heart disease (IHD) and smoking were detected in 52 (64%), and 18 patients associated with peripheral vascular disease (22%). Clinical evaluation and ECG were done in all patients, echocardiogram in 66 patients, dipyridamole thallium (DT) scan in 44 patients and coronary angiogram in 12 patients (Table 2). Combined coronary bypass grafting (CABG) and CEA were performed in 7 patients, 3 of them were done simultaneously and staged in 4 patients (Table 3). Admission to the surgical intensive care unit (SICU) were done in 65 cases after CEA and to high
Clinical scoring

Goldman CRI > 12
Desky CRI > 15
Eagle Criteria
(Age > 70, DM, Angina, Q waves on ECG, Ventricular arrhythmia)

Low Risk

Intermediate Risk

High Risk

Echocardiogram

Dipyramidole Thallium Scan

DTSCAN

Low Risk

CEA

With Intensive monitoring

High Risk

Coronary Angiogram

Figure 2. Pre-operative cardiac assessment algorithm

dependency unit (HDU) in II cases (Figure 3). Seventy-five cases were done under general anaesthesia and one case was done under local anesthesia (Figure 4). There was 4 cases who experienced postoperative chest pain and ECG changes suggesting myocardial ischemia. However, there was no reported cases of MI except only one case of perioperative mortality (1.3%) which was a case of staged CEA and CABG and died 3 days after CABG.

Discussion
There is a significant incidence of coronary artery disease in carotid surgery patients. It was found that the prevalence of "severe" disease (defined as more than 70% narrowing of one or
RISK ASSESSMENT BEFORE CEA
(secondary to adrenergic release), may precipitate

Intraoperative myocardial ischemia which can be
detected by ECG and transoesophageal
echocardiography.16

Operations in the
carotid bifurcation
were originally,

Table 1. Risk factors for atherosclerosis (n = 82)

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypertension</td>
<td>62</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>56</td>
</tr>
<tr>
<td>Ischemic heart Disease</td>
<td>52</td>
</tr>
<tr>
<td>Smoking</td>
<td>52</td>
</tr>
<tr>
<td>Peripheral Vascular Disease</td>
<td>18</td>
</tr>
</tbody>
</table>

Table 2. Risk factors for atherosclerosis (n = 82)

<table>
<thead>
<tr>
<th>Test</th>
<th>No. of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical scoring ECG</td>
<td>All</td>
</tr>
<tr>
<td>Echocardiogram DT scan</td>
<td>All</td>
</tr>
<tr>
<td>Coronary angiogram</td>
<td>66</td>
</tr>
</tbody>
</table>

Table 3. The surgical management for significant carotid artery disease
(n=76)

<table>
<thead>
<tr>
<th>Procedure</th>
<th>No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEA alone</td>
<td>69</td>
</tr>
<tr>
<td>CEA &amp; CABG</td>
<td>4</td>
</tr>
<tr>
<td>Staged</td>
<td>3</td>
</tr>
<tr>
<td>Simultaneously</td>
<td>76</td>
</tr>
<tr>
<td>TOTAL</td>
<td>56</td>
</tr>
</tbody>
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Figure 3. Early post-CEA monitoring.
Figure 4. Type of anesthesia during CEA.

more coronary arteries) was 32% in cerebral vascular
disease patients. 10 The most common cause of
perioperative mortality after carotid endarterectomy
are due to cardiac problems including myocardial
ischemia with infarction and/or arrhythmia.11 The
incidence of perioperative myocardial infarction with
major carotid surgery varies from 0% to 5% in
different series.12 Riles et al. found that 5% of those
suspected of having coronary artery disease suffered
perioperative myocardial infarction despite the use of
local anesthesia.13 Hertzer et al. have clearly shown
that 14% of patients with no clinical indications of
coronary artery disease had severe correctable

It is well accepted that carotid endarterectomy is
superior to medical management for symptomatic
stenosis with 70% or more reduction in diameter. In
another group of patients in which symptomatic
stenosis is between 50% and 70%,3 the decision to
operate may well be influenced by the presence and
severity of associated coronary disease. 14 A cardiac
source for transient ischemic attacks or stroke should
not be overlooked. It is not uncommon to detect a
mitral thrombus being frequently found at the site of
myocardial infarction and atrial fibrillation.8 Add to
this mitral prolapse, cardiomyopathy, and
thrombogenic vegetations on diseased valves. IS
Finally, the hemodynamic changes in the form of
hypotension, carotid sinus reflex and hypertension
are often still, performed with the patient under local or cervical block anesthesia. Local anesthesia has the advantage of allowing the surgeon to evaluate the patient's cerebral tolerance to trial carotid clamping. General anesthesia has three major advantages. First, the anesthesiologist has better control over the patient's airway and ventilatory mechanics. Second, halogenated anesthetic agents have been shown to increase cerebral blood flow and at the same time, decrease cerebral metabolic demand. This combined effect may increase tolerance to temporary carotid artery clamping. Finally, the sleeping, anesthetized patient can undergo comfortably whatever exacting procedure is required without disturbing the operating field and the surgical team.

The appropriate surgical management of the patient with coexistent coronary and carotid disease remains problematic. The incidence of significant carotid stenosis among patients undergoing myocardial revascularization has been reported to be between 6% and 16% and as many as 49% of patients with extracranial cerebrovascular disease will have coronary artery disease, as manifested by angina pectoris or previous myocardial infarction. In 1972, Bernhard et al. reported the first group of patients who underwent simultaneous carotid endarterectomy and coronary artery bypass procedures. They demonstrated a significant reduction in deaths resulting from cardiac disease compared with patients having coronary disease undergoing only carotid endarterectomy. Despite a growing experience during the past decade, the performance of simultaneous carotid endarterectomy and coronary artery bypass surgery remains controversial. Considerable disagreement still exists regarding the indications for the combined procedure, the proper intraoperative sequence of procedures and details of management and the risks of performing carotid endarterectomy at the time of myocardial revascularization. Cardiopulmonary bypass is often associated with an initial period of hypotension. Therefore, the presence of an uncorrected significant carotid stenosis may predispose to cerebral hypoperfusion during this period of cardiopulmonary bypass and during the immediate postoperative period when intermittent arrhythmias and depressed cardiac output are most likely to occur.

The study of Brener et al., during which over 4000 consecutive CABG patients were prospectively screened for asymptomatic carotid stenosis, and the report of Hertzler et al., which is the only randomized prospective study of simultaneous carotid and coronary surgery, have clearly demonstrated that major carotid occlusive disease significantly increases stroke risk during the course of CABG. Brener et al. recorded a 9.2% incidence of TIA/stroke when asymptomatic carotid disease was present in CABG patients, as compared to a 1.9% risk in patients without carotid stenosis. Hertzler's report from Cleveland Clinic detailed a stroke rate of 8.9% in 275 CABG patients with angiography study documenting carotid stenosis 70% compared with an institutional stroke rate of 1.3% for CABG.

Prospective studies relating the risk of stroke to carotid stenosis during coronary surgery are not available. However, in a retrospective study, Kartchner and McRac noted a 17% incidence of stroke among 234 patients undergoing major cardiovascular surgery if preoperative oculoplethysmography yielded positive findings suggesting significant carotid disease. The incidence of stroke was only 1% among those whose preoperative oculoplethysmographic findings were negative. In another study the incidence of stroke following coronary bypass was 12.2% among those patients with significant carotid disease determined noninvasively vs 2.0% in those with negative carotid studies. It is logical, therefore, to treat significant carotid stenosis prior to the onset of cardiopulmonary bypass and eliminate one potential source of perioperative stroke, if the endarterectomy can be performed safely. It has been suggested that the staged approach is appropriate for the patient with a truly stable angina. However, it has been demonstrated repeatedly that the performance of a carotid endarterectomy may convert stable angina pectoris into an unstable condition which requires emergency bypass surgery. Performing carotid endarterectomy with pump standby, as advocated by some, has limited appeal since these cardiac complications frequently do not develop until 24 to 48 hours postoperatively. Simultaneous carotid endarterectomy and myocardial revascularization have evolved as a logical approach to the patient with significant disease in both systems. Numerous reports during the past 10 years have confirmed the relative safety of this combined surgical approach.

Since myocardial infarction and stroke are two of the leading causes of death, it is not surprising that coexistent disease in the coronary and carotid circulations is frequently seen in patients with symptoms referable to one system or the other.
in both systems may convey serious risks to the patient when corrective surgery is performed on one system or the other. Although the incidence of neurologic complications following open heart surgery has been dramatically reduced in recent years, stroke remains a devastating complication and occurs in at least 2% to 7% of patients undergoing coronary bypass surgery. The potential causes of perioperative stroke include air emboli, embolization of atheromatous debris or thrombus from the aortic cannulation site, aortic dissection, or low cardiac output, in addition to extracranial cerebrovascular occlusive disease.

There are several end-points for gauging the effectiveness of such an approach to cardiac surveillance in patients with vascular disease. An effective approach should decrease cardiac morbidity and mortality, including nonfatal cardiac events. It should be both sensitive and specific, and should be cost-effective in terms of yield, cost, and time required, based on the likelihood that a significant percentage of patients who are candidates for vascular surgery and who have significant coronary disease may not be able to successfully complete a treadmill study. The approach outlined here should be useful when the presence of significant coronary disease changes the management plan of a large cohort of candidates for arterial surgery. It will be necessary to evaluate the merits of this approach and to determine the actual percentage ending up in each diagnostic pathway. It is important to determine not only the percentage of patients requiring screening tests, but the number of patients in whom the tests changed the original management plan.

From the previous data, it is clear that cardiac screening studies have a potential role in candidates for carotid surgery in influencing the decision to operate as well as the intensity of perioperative monitoring and care. Cardiac assessment may include the use of different clinical parameters and scoring, ECG, echocardiography, dipyridamole-thallium scanning and coronary angiography. We believe that the teamwork should involve vascular surgeons, cardiologists and anesthetists to manage such critical patients properly.

Acknowledgment

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References

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