Objective  Carotid angioplasty and stenting (CAS) has been suggested to be the procedure of choice in patients with high risk cardiovascular profile. Unfortunately, such patients are often aged with several comorbidities, such as a high prevalence of coronary artery disease, peripheral artery disease and hostile anatomy that complicate the CAS performance. We sought to evaluate the results of CAS in elderly patients, outlining the encountered challenges and the eventual proposed global cardiovascular management.

Methods  We retrospectively searched the database for patients > 65-year-old who were referred to Cardiovascular Diagnosis and Endoluminal Interventions, Rovigo General Hospital, over a 24-month period (December 2007–November 2009) for CAS. Coronary angiography and peripheral screening were performed in all patients. All eventual challenges and related solutions were analyzed.

Results  Totally, 160 patients were enrolled. Among which, 50 patients (31.2%, mean age 80 ± 6.4 years) underwent CAS over a 24-month period: 24 patients (48%) had concurrent coronary artery disease (three-vessel in 7 patients, bivessel in 8 patients, single vessel in 5 patients and left main in 4 patients); 13 patients (26%) had peripheral artery disease at the site of arterial access; 15 patients had type III aortic arch (30%), 7 patients severe tortuosity of the common carotid artery (14%), and 8 angulated takeoff of carotid or internal artery (16%). Concurrent percutaneous coronary intervention was performed in 14 patients, including 3 patients with left main disease. Concurrent peripheral intervention was performed in 7 patients (all with bilateral common or external critical disease) due to the impossibility to gain another access. Successful carotid cannulation was achieved in all patients with hostile neck. Two-wire technique has been used in 17 patients, three-wire technique in 9 patients, and four-wire technique in 4 patients.

Conclusion  Elderly patients submitted to CAS represent a complex and challenging subgroup in which often cardiac and peripheral technical expertise is required to gain success of the procedure: interventional cardiologists are probably the preferred performers in such complex patients (J Geriatr Cardiol 2010; 7:3-6).

Key words  carotid artery; angioplasty; stent; catheterization; elderly

Introduction

Carotid artery stenting (CAS) has been shown to be as effective as carotid endoatherectomy (CEA) for treatment of carotid artery stenosis and current literature suggests a superiority of CAS over CEA in high risk patients.1 Unfortunately, high-risk patients are often old, affected by more severe systemic atherosclerosis and have more difficult anatomy compared to standard general patients. In this population, the percutaneous approach to the carotid artery disease can be difficult due to concomitant coronary artery disease or peripheral artery disease at the arterial access site,2 and hostile anatomy of the aortic arch including tortuosity or angulated takeoff of the epiaortic vessels.3 In this study, we sought to retrospectively evaluate the results of CAS in elderly patients, outlining the encountered challenges and the eventual proposed management.

Methods

Subjects  We retrospectively searched the database for patients > 75-year-old who were referred to Cardiovascular Diagnosis and Endoluminal Interventions, Rovigo General Hospital, Rovigo, Italy, over a 24-month period (December 2007–November 2009) for CAS following current indications.1 Following our institutional protocol, elderly patients were investigated by non invasive aortic arch by means of computed tomography or magnetic resonance imaging, and at the time of carotid procedure with intraoperative aortic arch angiography. Patients symptomatic also for coronary artery disease were investigated with preoperative stress test or, if not clinically possible at the time of CAS, with coro-
nary angiography.

**Radiological equipment**

The radiological equipment was a flat panel 20 cm × 20 cm INNOVA 2100 (General Electrics). The contrast medium was Ultravist 370 (Schering) injected by an automatic acist syringe (Acist Medical System Inc. MN USA).

**PCI**

In asymptomatic or unknown coronary artery disease patients, concurrent PCI was performed only in presence of a stenosis of more than 90% of the left anterior descending coronary artery or left main, remanding the other anatomical lesions to medical follow-up and eventual staged ad hoc revascularization (surgical or percutaneous).

**Peripheral vessel angioplasty**

Asymptomatic peripheral artery disease at the site or arterial access was treated only if alternate access was not feasible, remanding all other cases to medical follow-up and evaluation for potential staged revascularization (surgical or percutaneous).

**Multi-wire technique**

Hostile neck were approached with multi-wire technique that included as a first step after the aortic arch angiography the cannulation of the common carotid artery with a 5 F diagnostic mammary artery catheter. With the aid of the road map technique and injection of a 6 ml of contrast medium, the operator attempted to advance a 0.035” soft guidewire (Terumo) within the external carotid artery. Then, the catheter was exchanged with an 8F MPA guiding catheter. If the first attempt to advance an 8F MAP guiding catheter to the distal common carotid artery failed, a second up to three additional Terumo soft guide-wires were advanced within the external carotid artery in order to obtain advancement of the guiding catheter to the external carotid artery and the accomplishment of the carotid angioplasty.

**CAS procedure**

All the procedures include the use of neuroprotection filter, such as the FilterWire EZ (Boston Scientific Corp, Mountain View, CA, USA) or the SpideRX (EV3, Plymouth, MN, USA) and stenting with open or close self-expandable stents, such as the Carotid Wallstent ( Boston Scientific International S.A., Nataterre Cedex, France) or Acculink Carotid stent (Abbot Vascular; Santa Clara, CA, USA).

**Statistical analysis**

Chi-square and t-student tests were used to compare frequencies and continuous variables between elderly and standard population of patients submitted to CAS. Statistical analysis was performed using a statistical software package (SAS for Windows, version 8.2; SAS Institute; Cary, NC). A probability value of < 0.05 was considered to be statistically significant.

**Results**

**Demographic and clinical data of the subjects**

Table 1 shows demographic and clinical data of the subjects enrolled in this study. Among which, 50 patients (31.2%, mean age 80 ± 6.4 years) underwent CAS over a 24-month period: 24 patients (48%) had concurrent coronary artery disease (three-vessel in 7 patients, bivessel in 8 patients, single vessel in 5 patients and left main disease in 4 patients); 13 patients (26%) and peripheral artery disease at the site of arterial access; 15 patients and type III aortic arch (30%), 7 patients severe tortuosity of the common carotid artery (14%), 8 angulated takeoff of carotid or internal artery (16%) (Table 1).

**Concurrent PCI results**

Concurrent percutaneous coronary interventions was performed in 14 patients, although they were asymptomatic: 11 patients underwent PTCA of left anterior descending coronary artery for a stenosis of more than 90%, and 3 patients underwent PTCA of left main (two for a more than 90% ostial stenosis of the left main and one for a stenosis of more than 80% of distal left main). Eight patients were referred for surgical revascularization and 2 for medical therapy.

**Concurrent peripheral interventions**

Concurrent peripheral intervention was performed in 7
patients (all with bilateral common or external critical disease) due to the impossibility to gain alternate access. Homolateral stenting of the common (4 patients) or external (3 patients) iliac artery was performed before CAS procedure in order to obtain retrograde arterial catheterization. In 6 patients, the common femoral artery was critically diseased and contralateral approach was used referring the patients for medical follow-up.

**Hostile neck management**

Successful carotid cannulation was achieved in all patients with hostile neck. Two-wire techniques has been used in 17 patients, three-wire technique in 9 patients, and four-wire technique in 4 patients (Fig. 1).

**Comparison to standard population**

Fluoroscopy time was obviously higher in elderly patients compared to the rest of patients (40.2 ± 10.1 min vs 25.8 ± 8.9 min, P < 0.01). Periprocedural complication rates did not differ significantly between elderly patients and the rest patients (Table 2).

**Discussion**

In symptomatic patients with moderate to severe carotid stenosis (≥50%) and high perioperative risk, carotid artery stenting is suggested as a potential alternative to CEA. Data from randomized trial showed that CAS is not inferior to CEA in the treatment of high-surgical risk patients.1

Significant concurrent asymptomatic coronary artery and peripheral artery disease is something not rarely reported in patients with carotid artery disease,6,7 whereas aortic arch anatomy and great vessels configuration influence the procedure complexity:8,9 all they play an important role in determining the success of CAS.

This study suggests that asymptomatic significant peripheral and coronary artery disease and hostile neck anatomy are frequent findings in elderly patients undergoing endovascular treatment of carotid stenosis and are the most challenging obstacle to a safe and effective CAS.

![Fig. 1 A case of 78-year-old lady. The case had previously stenting of the right internal carotid artery, and a type II aortic arch and tortuosity of the origin of the left internal carotid artery were apparent on the aortic angiography (A). The guiding catheter could not be advanced over a single Terumo guidewire and up to four guide-wire were necessary to advance the catheter safely and in stable position within the common carotid artery (B) in order to achieve a complete satisfactory stenting of the lesion (C).](image)

**Table 2 Comparison of procedural and follow-up data**

<table>
<thead>
<tr>
<th>Item</th>
<th>Elderly patients (n=50)</th>
<th>Standard population(n=90)</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carotid Wallstent and Filterwire EZ (n, %)</td>
<td>32 (64)</td>
<td>66 (60)</td>
<td>NS</td>
</tr>
<tr>
<td>Acculink and SpideRX (n, %)</td>
<td>18 (36)</td>
<td>44 (40)</td>
<td>NS</td>
</tr>
<tr>
<td>Fluoroscopy time (min)</td>
<td>40.2 ± 10.1</td>
<td>25.8 ± 8.9</td>
<td>0.01</td>
</tr>
<tr>
<td>Successful internal carotid artery cannulation</td>
<td>50 (100)</td>
<td>90 (100)</td>
<td>NS</td>
</tr>
<tr>
<td>Perioperative minor stroke (n)</td>
<td>1</td>
<td>1</td>
<td>NS</td>
</tr>
<tr>
<td>Bleeding at the access site (n)</td>
<td>3*</td>
<td>2*</td>
<td>NS</td>
</tr>
<tr>
<td>Perioperative major stroke (n)</td>
<td>1</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td>Perioperative ACS (n)</td>
<td>0</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td>Aortic/carotid dissection (n)</td>
<td>0</td>
<td>0</td>
<td>NS</td>
</tr>
<tr>
<td>Death (n)</td>
<td>1*</td>
<td>0</td>
<td>NS</td>
</tr>
</tbody>
</table>

*Not requiring blood transfusion; †The patient developed a hyperperfusion syndrome two hours after the procedure.
procedure. In particular, the main issue seems to be the unfavorable anatomy that may be associated with more complications during CAS, but some authors found no significant difference in adverse events between elderly patients (>80 years old) in which hostile anatomy is more frequent, and middle age population. It is clear that in such population, CAS, that is often the only therapeutic alternative because of the surgical risk due to age or comorbidities, should be performed by expert operators.

In conclusion, while CEA continues to be the procedure recommended in most of carotid artery stenosis cases, CAS can offer true benefits in high surgical risk patients. Such patients are often elderly with different asymptomatic but significant vascular comorbidities and hostile neck anatomy, and consequently the global vascular management and technical skillness usually became mandatory. Cardiology background and skillness make the interventional cardiologist probably the most complete invasive professionals for CAS procedures in such complex patients.

References