Transfemoral endovascular treatment of proximal common carotid artery lesions: A single-center experience on 153 lesions

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Purpose: **To assess primary success and safety of percutaneous transluminal angioplasty (PTA) and/or stenting of ostial/proximal common carotid artery lesions (pCCA) and to compare its 30-day stroke/mortality level with the literature data for surgical options.**
Methods: **A total of 147 patients (153 stenoses, 6 recurrent) (71 female; 121 left) with significant diameter stenosis (>70% in symptomatic, n = 46; >85% in asymptomatic, n = 101 patients) of pCCA treated between 1994 and 2006 were retrospectively reviewed. With the exception of one, all procedures were performed using a transfemoral approach. A stent was implanted in 108 (70.5%) of cases. Stents were not available in the early years of our experience, but gradually became a routine practice. Embolic protection devices were used in 16 cases. Follow-up included neurological examination, carotid duplex scan, and office/telephone interview.**
Results: **Primary technical success was 98.7% (151/153 stenoses). There were no deaths. Periprocedural (<48 hours) neurological complications included 3/153 (2.0%) ipsilateral major strokes and 4/153 (2.6%) TIAs (including one contralateral TIA). There were 8/153 (5.2%) access site hematomas, 1/153 (0.7%) bradycardia, and 1/153 (0.7%) acute left ventricular failure with respiratory distress. Follow-up was achieved in 115/147 patients (78.2%) undergoing 120 procedures for a mean of 24.7 months and revealed one additional contralateral TIA and one additional minor stroke in an asymptomatic patient. In patients with follow-up, the 30-day procedural death/all-stroke rate was 3/120 (2.5%) The cumulative primary patency rate in the 115 patients with follow-up was 97.9% ± 2.1% at 1 year, 82.0% ± 7.1% at 4-years, and 73.5% ± 12.7% at 7 years. The cumulative secondary patency rate was 100% at 1 year, 88.0% ± 7.0% at 4 years, and 88.0% ± 11% at 7 years. Log-rank test showed no statistical difference (P = .82) in primary cumulative patency between PTA alone (n = 34) or PTA/stent (n = 86).**
Conclusion: **Transfemoral PTA/stenting appears to be appropriate treatment option for ostial/proximal common carotid artery significant stenoses. This study should also draw attention to the lack of data on natural history or effect of best medical treatment alone for these lesions, making evidence-based decision currently impossible for treatment of symptomatic or asymptomatic ostial and proximal common carotid artery significant stenoses. (J Vasc Surg 2008;48: 80-7.)**

Angioplasty of the supra-aortic arteries began in the 1980s. Initially, there was a fear of possible cerebral embolization,[1-3] which later prompted the introduction of cerebral protection devices. Subsequently, the endovascular treatment of significant (>70% luminal diameter stenoses) at the carotid bifurcation and proximal internal carotid artery in preventing stroke has been increasingly accepted.[4-7] In contrast, despite the region of the original proximal common carotid artery (CCA) being the second most common location for stenosis in the extra cranial carotid territory (1% to 2% of all carotid artery cerebral ischemia),[8] there are only a few reports involving small series of patients concerning the success rates and safety of angioplasty and or stenting of the origin of the proximal common carotid artery (pCCA). Thus, the effectiveness of this treatment in preventing stroke and guidelines for pCCA endovascular treatment are yet to be determined. The purpose of our study was to assess the primary success and safety of pCCA intervention in a single-center, retrospective study on 153 lesions in 147 patients over the past 13 years.

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MATERIALS AND METHODS

Patients. Between January 1, 1994 and December 31, 2006, 153 percutaneous transluminal angioplasties (PTA) (including six repeat PTA [rePTA]/stenting procedures done in the follow-up period) were performed on 147 consecutive patients with significant proximal common carotid artery (pCCA) stenosis. Eighty-four percent of the lesions were ostial stenoses, 14% proximal stenoses, and 2% combined. Proximal CCA stenosis was diagnosed by catheter angiography following an initial duplex screening. Inclusion criteria for endovascular treatment were ≥70% luminal diameter stenosis in patients with ipsilateral ischemic neurologic symptoms or ’85% stenosis in asymptomatic patients. Contraindications included suspected vessel

thrombus, severe calcification, or extreme tortuosity. The decision for treatment was made by consensus between the interventional radiologist, the vascular surgeon, and/or the neurologist. Informed consent of patients was obtained before the procedure in all patients.

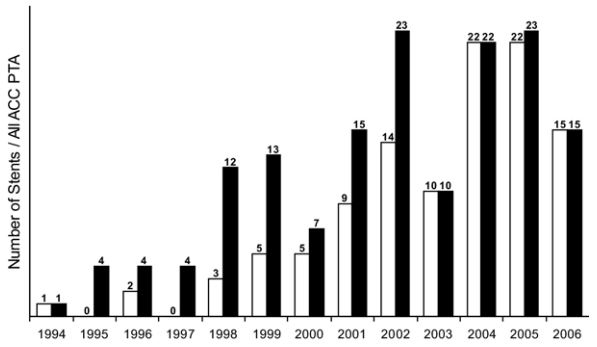
The average diameter stenosis was 81.5%. Patient age ranged from 21 to 83 years (mean = 60.6 years). The group included 76 men and 71 women. The majority of patients had atherosclerotic lesions, 10 patients had stenoses due to irradiation, and one had Takayasu arteritis. There were 104 patients who were hypertensive, 30 with diabetes, 59 with hyperlipidemia, and 34 smokers. Lower limb arterial stenoses were found in 40 patients, while 35 patients had coronary atherosclerosis. There were 32 common carotid artery interventions performed on the right and 121 on the left.

Forty-six patients were symptomatic and 101 patients were asymptomatic, including 57 patients with contralateral carotid or vertebrobasilar symptoms and 44 patients with no neurological symptoms. Presenting symptoms in the symptomatic group were amaurosis fugax on the ipsilateral side (n = 9), hemispheric symptoms (n = 27), and aphasia in (n = 10) patients. In the asymptomatic group, contralateral amaurosis fugax (n = 6), dysarthria (n = 2), contralateral lateralizing symptoms (n = 25), subclavian steal (n = 9), drop attack (n = 2), and aphasia from the contralateral side (n = 13) occurred. Greater than 50% stenoses and/or occlusions in other supra-aortic arteries were diagnosed in 124/153 (81,0%) of the cases. We additionally treated 3 innominate artery stenoses, 13 ipsilateral internal carotid artery stenoses, 1 contralateral external carotid artery stenosis, and 3 contralateral subclavian artery stenoses in one stage together with pCCA PTA.

Procedure. Before the intervention, anticoagulation and platelet aggregation inhibition was achieved by 70 U per kg heparin i.a., and 125 mg/d aspirin p.o. Sodium pentosan polysulphate (100 mg), which has both anticoagulative and mild fibrinolytic as well as endothelium protective effects, was also used at our institution until 2004.[1-3]

Angioplasty was carried out via femoral artery puncture in all but one case. In this case, femoral puncture was not possible due to occlusion of the femoral artery on both sides (Leriche syndrome), and therefore, the site of entry was the axillary artery. Over the 13 years, details of the technique have changed with the availability of new devices. Additionally, some of the variations in technical details were lesion and operator dependent. Typically, a polytetrafluoroethylene (PTFE) coated guidewire was used to introduce a pigtail catheter (Cordis Corp, Miami, Fla) to perform arch aortography. A 7F introducer guide (typically MPA 1, Cordis Corp) was then advanced to the aortic arch. The pCCA lesion was negotiated using a selective cerebral catheter (Headhunter or JB2, Cordis Corp, Miami, Fla) and a 0.035 inch guidewire (Terumo angled, Terumo Corp, Tokyo, Japan). The size of the angioplasty balloons were chosen based on the diameter of the CCA beyond the lesion (7-9 mm), with a length appropriate to the lesion (20 or 40 mm) (Wanda, Boston Scientific, Galway, Ireland). The balloon was inflated for approximately 10 to 20 seconds until satisfactory dilatation with abolition of the "waisting" of the balloon was achieved (6-10 atm). In case of technical difficulties in traversing the curved stenotic origin of the CCA, occasionally a 0.014 inch guidewire was used to traverse the stenosis and predilatation with a percutaneous transluminar angioplasty (PTCA) balloon (4.0 × 20 mm, Maverick, Cordis) was performed, after which the larger balloon catheter or stent introduction device was easily advanced through the stenosis. Finally, completion angiography of the treated lesion and the intracranial circulation of the treated carotid artery in two projections were performed.

Table I. Number of stents and total interventions annually



A stent was implanted in 108 cases: Palmaz/Genesis (Cordis) 61, Smart (Cordis) 4, AVE Bridge (Medtronic, Minneapolis, Minn) 6, Wallstent (Boston Scientific, Natick, Mass) 15, Cordis Precise Nitinol (Cordis) 11, Corinthian (Cordis) 1, Nexstent (Boston Scientific) 1, Radix (Biomedica Sorin Vienna, Austria) 1, Smart Nitinol (Cordis) 1, Wavemax (Abbott Medical, Abbott Park, Ill) 2, Xact (Abbott Medical) 1, while in 4 cases from the early years no data referring to the stent type was found. Table I shows the number of stents used and the number of total interventions annually. An embolic protection device was used in 16 cases (filter wire EZ 190 cm, Boston Scientific): 13 in the left carotid artery (3 ostial and 10 proximal stenoses), and 3 in the right carotid (3 proximal stenoses). In 13 cases, neuroprotection was used because of simultaneous internal carotid artery stenting. Until 2002, protection devices were not available at our institution.

Patients were continued on acetylsalicylic acid (100 mg daily per p.o.) indefinitely after the PTA, provided that there was no contraindication. Thirty-six patients were on dual antiplatelet therapy (three patients on acetylsalicylic acid + clopidogrel [75 mg per os] and four patients on acetylsalicylic acid + ticlopidine per os [250 mg b.i.d.]). Patients were usually discharged 1 day after the PTA and were asked to come back for a follow-up examination at 1, 3, 6, 12 months, and every 6 months thereafter. Patients were advised to come back immediately in case of observing new symptoms. Patients were strongly advised not to

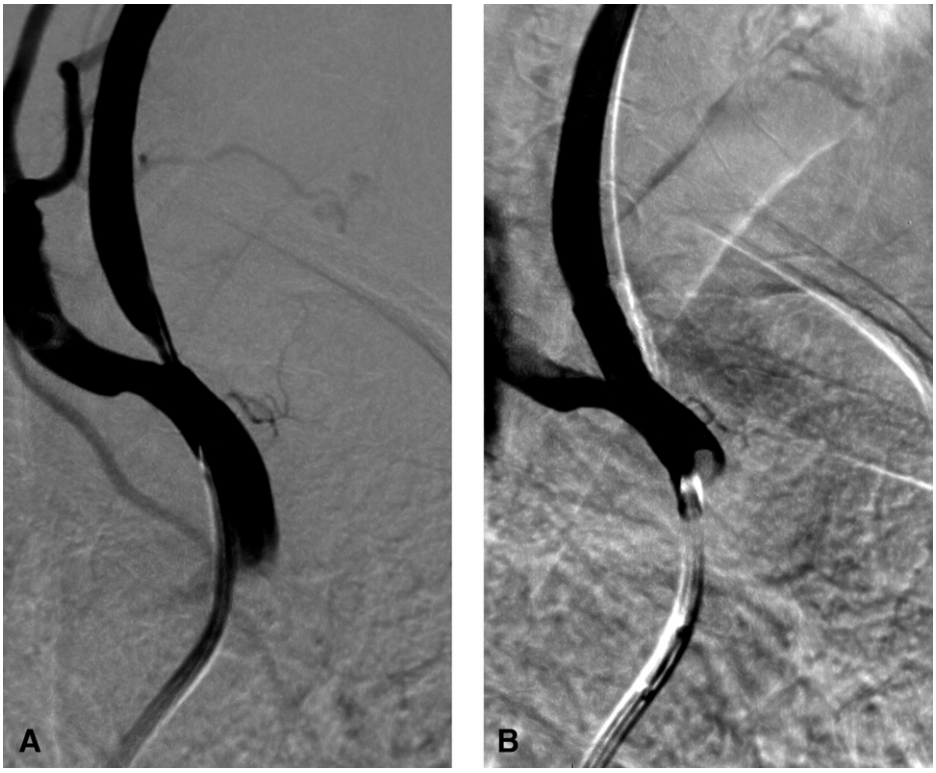


Fig 1. A and **B,** Successful PTA of the right proximal common carotid artery of a 51-year-old female, asymptomatic patient. Patient had follow-up duplex scan following previous internal carotid endarterectomy. Duplex scan diagnosed 90% stenosis (PSV 450 cm/s) on the proximal part of right CCA. The patient remained neurologically negative throughout the follow-up period. The last follow-up duplex scan at 17 months showed patent CCA with no indication of restenosis.

smoke and have their serum cholesterol levels and blood pressure tested regularly by their family physician or by us.

Follow-up. One hundred fifteen out of 147 patients (78.2%) (undergoing 120/153 [78.4%] successful procedures) had follow-up visits that included carotid duplex scanning and a neurological examination. Clinical follow-up was performed up to 7 years, and mean follow-up time was 24.7 months. Follow-up was carried out by an independent neurologist and results obtained through reviewing the medical records and clinical notes of the patients. New relevant neurological symptoms, such as occurrence of stroke or death were assessed as complications of the procedure.

Definitions. Transient ischemic attack (TIA) was defined as a temporary focal cerebral or retinal deficit that resolved within 24 hours, while stroke was defined as a new neurological deficit that persisted for a period of more than 24 hours. Technical success was defined as less than 30% residual diameter stenosis on the completion angiogram. A two- or threefold increase in value of peak systolic velocity by carotid duplex examination referred to a 50% or 70% diameter stenosis, respectively. Since direct visualization by carotid duplex during follow-up was not always possible, we refer to the patency rate rather restenosis-free patency rate in our analysis.

Statistical analysis. The Kaplan-Meier method was employed to calculate cumulative primary and secondary patency rates (SPSS, Chicago, Ill), and the log rank test was used to compare cumulative patency rates between PTA and PTA/stent groups. The occurrence of TIA, any stroke, or death was monitored during in-hospital stay (24 to 48 hours) (periprocedural), at 30 days (perioperative), and through the time to the most recent follow-up. This study had Institutional Review Board approval.

RESULTS

Primary success. The initial technical success rate was 98.7% (151 of 153 lesions in 147 patients). In two cases, the angioplasty was not successful: in one case it was impossible to pass the lesion with the guidewire, while in the second occasion, the procedure was stopped before the dilatation was done because of ipsilateral TIA (the patient did not undergo a second attempt at endovascular therapy). Examples of successful common carotid artery PTA are shown on Figs 1 and 2.

Complications. There were no procedure related deaths. Eight neurological complications (5.2%) occurred during the in-hospital stay: 3/153 (2%) ipsilateral major strokes during the procedure, 3/153 (2.0%) ipsilateral, 1/153 (0.7%) contralateral TIAs within 4 hours of the

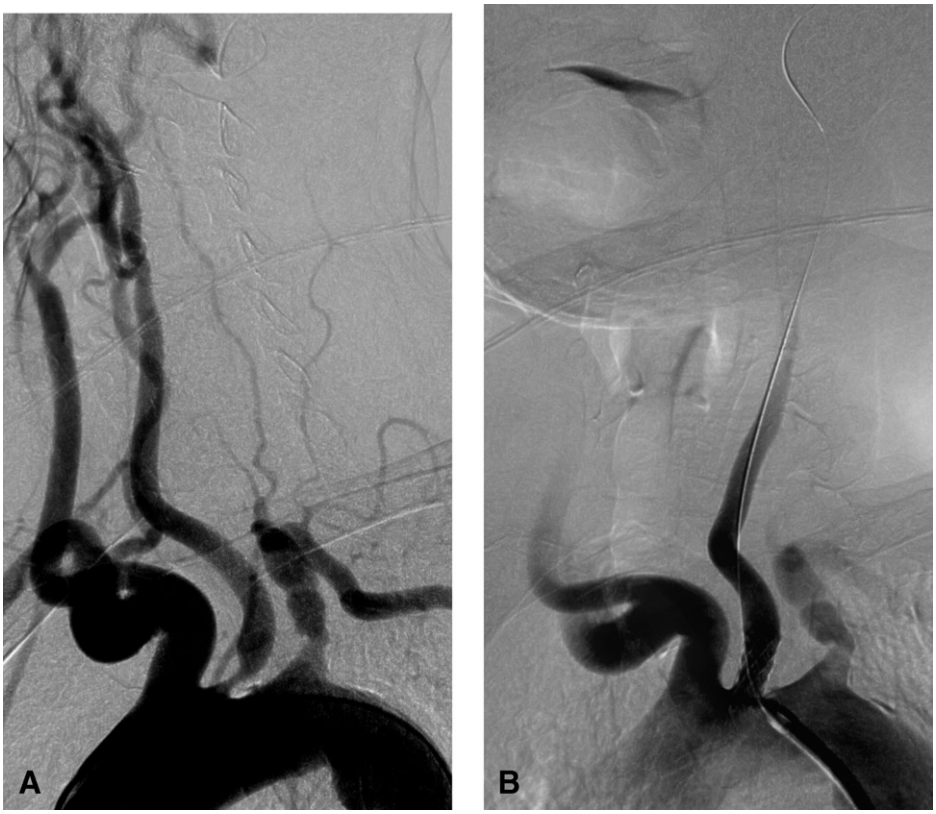


Fig 2. Successful PTA and stent (8 × 18 mm Genesis, Cordis Corp, Miami, Fla) deployment in the left ostial lesion of common carotid of a 76-year-old asymptomatic female patient. Follow-up duplex scan showed no restenosis after 18 months follow-up. **A,** Angiography revealed 80% stenosis at the origin of the left CCA. **B,** Control angiography after stent implantation. Follow-up duplex screening showed no restenosis at 18 months.

procedure, and 1/153 (0.7%) dizziness. Eight of 153 (5.2%) access site bleedings (four of them required surgical treatment), 1/153(0.7%) acute left ventricular failure with respiratory distress, and 1/153 (0.7%) bradycardia were also noted. The periprocedural death/all-stroke rate was 2.0% (3/153). The 30-day death/all-stroke rate was 2.5% (3/120; see follow-up). The first patient who suffered a major stroke developed right sided hemiplegia and dysarthria after stent implantation (Smartstent, Cordis) in the left proximal common carotid artery. We observed only mild recovery of that neurological status. The patient had symptoms (TIA) before the intervention. Carotid duplex scan 18 months after the procedure showed the common carotid artery to be patent without significant stenosis. Seventy-one months after the stent implantation, the symptoms were resolved. The second patient who suffered a major stroke had previously had right upper limb hemiparesis and aphasia. Angiography revealed left common carotid and left internal carotid artery occlusion and an 80% stenosis at the origin of the right common carotid artery; the right external carotid artery was also occluded. Both vertebral arteries had significant stenosis at their origin. PTA/stent implantation (Wallstent, Boston Scientific) of the right CCA and left vertebral artery was done. During the procedure, the right sided hemiparesis and aphasia deteriorated significantly. Within a week, aphasia improved, while the right upper limb hemiparesis remained unchanged. Thirty-five days later, the patient died due to cardiac insufficiency and pneumonia. The third patient developed hemiparesis on the left side after angioplasty without stent implantation and later we lost contact with her due to the patient's low level of compliance.

Clinical follow-up. One hundred fifteen out of 147 (78.2%) patients, representing 120/153 (78.4%) successful procedures were available for follow-up evaluation. Eleven unrelated deaths (gastrointestinal and hepatic malignity) occurred 35 days to 52 months following the procedure.

Carotid ultrasound. More than 50% diameter restenosis was detected in 11/115(9.6%) patients: 51% to 69% diameter restenoses n = 2; 70% to 99% stenoses n = 6; occlusion n = 3. Eight patients (7.0%) had angiography due to different indications (see below).

Selective carotid and arch angiography. Angiography revealed one 50% to 69% stenosis, and there was no indication for rePTA in this patient. Seventy percent to 99% restenosis was detected in seven patients (in one patient, CDS underestimated the degree of stenosis). Successful rePTA was done in six cases; one patient refused the offered

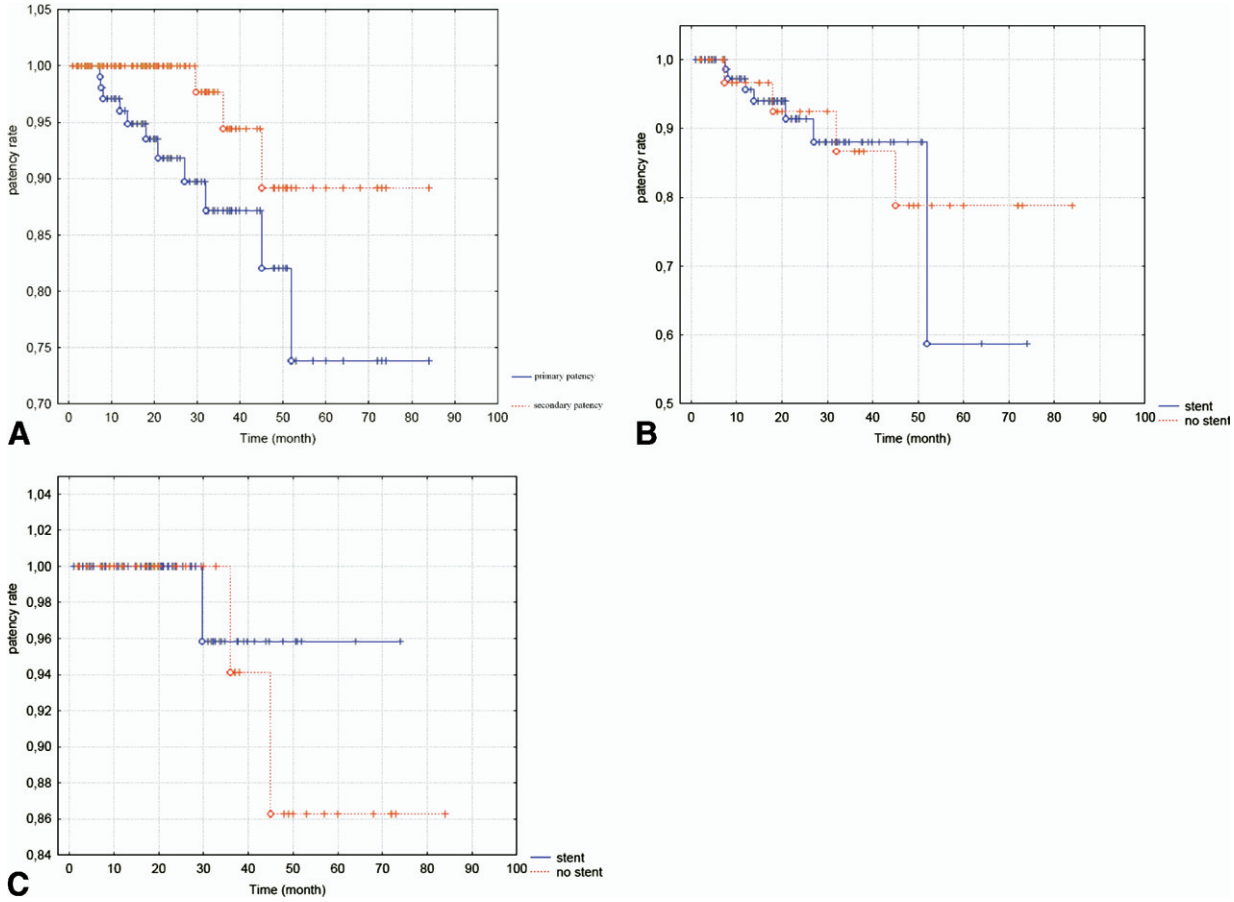


Fig 3. A, Kaplan-Meier analysis of cumulative patency rate for 120 proximal common carotid artery interventions, excluding initial failures. Since the direct visualization of the proximal part of the common carotid arteries by carotid duplex scan was not always possible during follow-up, we refer to "patency rate" rather than "restenosis-free patency rate" in our analysis. **B,** Kaplan-Meier curves of primary cumulative patency rate for 34 proximal common carotid artery angioplasty and 86 proximal common carotid artery stent implantation. Log rank test was used to compare primary cumulative patency rate between PTA and PTA/stent groups. (P = .825). **C,** Kaplan-Meier curves of secondary cumulative patency rate for angioplasty and stent implantation. Log rank test was used to compare secondary cumulative patency rate between PTA and PTA/stent groups (P = .680).

intervention. Follow-up of rePTA patients revealed restenosis in 3 cases at 14, 16, and 18 months following rePTA. Two of these were 50% to 69% secondary restenosis with no indication for further intervention. One patient was offered endovascular therapy; this patient did not consent to the procedure by the end of the follow-up period.

Neurological examination. Two asymptomatic patients showed new neurological symptoms: one contralateral TIA (19 months postprocedure) and one minor stroke (52 months postprocedure). The cumulative primary patency rate was 97.9% ± 2.1% at 1 year, 82.0% ± 7.1% at 4 years, and 73.5% ± 12.7% at 84 months. The cumulative secondary patency rate was 100% at 1 year, 88.0% ± 7.0% at 4 years, and 88.0% ± 7.0% at 84 months (Fig 3, *A*). The mean primary and secondary patency times were 23.9 and 24.9 months, respectively. In the PTA-only group, the primary patency rate was 97.2% ± 3.6% at 1 year, 86.5% ± 11% at 4 years, and 79.1% ± 11% at 84 months. In the PTA + stent group, the primary patency rate was 96.0% ± 2.5% at 1 year and 88.2% ± 5.3% at 4 years and 58.1% ± 12% at 74 months In the PTA + stent group, longest follow-up was 74 months (Fig 3, *B*). Log-rank test showed no statistical difference in primary (P = .825) (Fig 3, *B*) and in secondary (P = .680) (Fig 3, *C*) cumulative freedom from restenosis between PTA alone (n = 34) or PTA/stent (n = 84).

DISCUSSION

Before the era of endovascular therapy, surgical treatment was the only option in the management of occlusive disease of pCCA. Surgical revascularization of pCCA and other supra-aortic trunk lesions is an effective and durable treatment; however, the mortality/morbidity rate associated with the transthoracic approach can be as high as 16%

Table II. Surgical revascuarization of supraaortic trunk lesions

Author	*Year*	*No. of patients; cases*	*Trial type*	*Primary success rate*	*Indication*
Berguer et al[10]	1999	173;182	Retrosp	100%	>75% stenosis; 82% of patients symptomatic: cerebrovascular ischemia (66%), hand ischemia (13%), LIMA steal that lead to angina or congestive heart failure after LIMA CABG (3%)
Berguer et al[9]	1998	98;100	Retrosp	100%	87% symptomatic: cerebrovascular ischemia in 83%; upper extremity ischemia 4%

Table III. Endovascular treatment of pCCA lesions

Author	*Year*	*No. of patients; cases*	*Trial type*	*PTA only/ PTA + stent*	*Primary success rate*	*Indication*
Percutaneous PTA/stent						
Chio et al[11]	2003	37;42	Prosp	0/42	95,00%	>50% stenosis
Current study	2007	147;153	Retrosp	45/108	98,60%	31.2% of patients symptomatic; 68.7% asymptomatic
Surgical and retrograde PTA/stent						
Peterson et al[13]	2006	9;9	Retrosp	0/9	100,00%	80% of patients symptomatic (>90% sten)
Payne et al[14]	2006	8;8	Retrosp	8/0	100,00%	Severe inflow disease
Allie et al[15]	2004	23;23	Prosp	0/23	97,00%	Various
Grego et al[16]	2003	10;10	Retrosp	0/10	87,50%	12.5% TIA; 37.5% non focal cerebral symptoms
Macierewicz et al[17]	2000	6;6	Retrosp	0/6	100,00%	67% asymptomatic; 33% cerebral ischemia
Arko et al[18]	2000	8;8	Retrosp	0/8	100,00%	62.5% TIA; 7.8% non disabling stroke; 7.8% amaurosis
Levien et al[19]	1998	20;20	Retrosp	0/20	97,00%	43% TIA; 20.5% amaurosis; 6.8% retinal emboli; 29.7% asymptom
Sullivan et al[20]	1998	11;11	Prosp	0/11	92,90%	42.8% TIA; 57.1% asymptomatic
Queral et al[21]	1996	6;6	Prosp	0/6	92.3%	16.6% amaurosis; 83.3% TIAs
Motarjeme[22]	1996	8;8	Retrosp	8/0	93%	u

(Table II).[9] The introduction of extra-anatomic repair reduced the mortality rate of surgical repair of pCCA to 4.3% (Table II).[10] Nevertheless, having introduced the balloon dilation method at our department in the early eighties, the operative reconstructions of CCA was minimized to the cases of CCA occlusions or multiple lesions of the supra-aortic vessels. In addition, surgery is indicated in the case of unsuccessful endovascular therapy.

Data on endovascular treatment of pCCA lesions are scarce. There is only one other study on transfemoral elective stenting of 42 proximal common carotid artery lesions (Table III).[11] In that study, the periprocedural neurological complications rate was 4.7% (two minor strokes) with an additional death due to retroperitoneal hemorrhage within 24 hours of the procedure, leading to a 7.1% 30-day all stroke/death rate. However, the authors claimed that all 30-day procedure-related neurological events and deaths occurred in the first 2 years of the 5-year period studied, and expected further reductions in periprocedural events with experience and improved techniques, such as use of protection devices.[11] The neurological complication rate in the current study was lower (3/115, 2.6%); however, our study is retrospective, and follow-up was not available for all patients due to the long time-span (13 years) of treatment.

An alternative option for treatment of pCCA lesions is synchronous carotid endarterectomy and retrograde endovascular treatment of the common carotid artery stenosis (combined treatment) (Table III). There are numerous reports concerning this approach (n = 10), but all concern small patient cohorts (range 6-23), therefore, any conclusion from these studies are limited.

Carotid bifurcation stenting is routinely done under dual antiplatelet therapy. In contrast, dual antiplatelet ther-

Table II. Continued.

Postprocedural antiplatelet therapy	*Non neurol compl*	*Neurol compl periprocedural*	*30 days all stroke/death*	*Restenosis rate*	*Follow-up month*
unknown	Asymptomatic graft occl.: 2%; AMI: 3%; Pulm compl: 5%; graft infection: 1%	Death: 0,5%; Stroke: 3,8%	4,30%	Primary: 5 years: 9%, 10 years: 18%	mean 53+−5 months
single	2 asymptomatic graft occlusions, 3 nonfatal MI, 7 significant pulmonary complications, 3 sternal wound infections, 1 recurrent laryngeal nerve injury	Death: 8%, Stroke: 8%	16%	Primary: 5 years: 6%, 10 years: 12%	mean 51+−4,8 months

Table III. Continued.

Postprocedural antiplatelet therapy	*Non neurol compl*	*Neurol compl periprocedural (No. of cases)*	*30 days all stroke/death*	*Restenosis*	*Follow-up month*
u	2.7% retroperitoneal hemorrhage	2 minor strokes	3/42 (7.1%)	Primary 24 months: 5.1%	mean 24
Double	5.2%	3 major strokes; 4 TIAs	3/104 (2.8%)	Primary 12 months: 4.2%; at 48 months: 19,7%	mean 24.9
Double	0,00%	0	0	Primary 12 months: 0,00%	mean 12
Aspirin only	0,00%	0	0	Primary 24 months: 12.5%	mean 24
u	0,00%	0	0	Primary 12 months: 8.6%	mean 34
Aspirin only	0,00%	0	0	0.00%	U
Aspirin only	0,00%	0	0	Primary 18 months: 16.6%	median 20
Double	25% wound hematomas	1 hypoglossal palsy	0	Primary 23 months: 0.0%	mean 23.6
Aspirin only	4.5% hematoma	0	0	Primary 12 months: 9%	U
Aspirin only	3.4% hematoma; 1.1% AV fistula; 1.1% pseudoaneurysm	1 major stroke	2/14 (14.2%)	Primary 14,3 months: 16.0%	mean 14.3
Aspirin only	0	0	0	Primary 48 months: 15%	mean 27
Aspirin only	0	1 major stroke	1/8 (12.5%)	Primary 12 months: 0%	mean 60

apy was not routinely used in many of the published studies of pCCA endovascular procedures, including this report. However, use of dual antiplatelet therapy and protection devices, when technically possible, may further reduce the number of neurological complications associated with pCCA endovascular treatment.

The principal advantage of stent placement in the treatment of carotid artery stenoses is its impact on immediate outcome. The stent serves to limit embolization of atherosclerotic debris liberated during the PTA procedure. In addition, it reduces elastic recoil and prevents propagation of intimal dissections created during the procedure. However, there is no evidence that stenting is superior to angioplasty alone for proximal CCA lesions; current practice, however, includes primary stenting in most cases for the reasons discussed above (Table I).

Restenosis, although an issue in essentially all vascular interventions, has not been a major problem in lesions involving the carotid bifurcation or the adjacent internal carotid artery. In a recent review, a 5.5% incidence of restenosis at 12 months and 3% of repeat angioplasty for restenosis with a mean follow-up time of 26 months was described.[12] Our restenosis and rePTA rates for the pCCA are in a similar range. Additionally, stent placement has not changed the restenosis rate significantly in our study (Fig 3, *B* and *C*).

A main limitation of this study is its retrospective nature. In addition, due to the long period studied (1994-2006), the population was not homogeneous as to whether or not stents, protection devices, and/or dual antiplatelet therapy were used. For the same reason, follow-up is missing for 22% of the patients; however, procedural and in-hospital clinical outcomes were available for all 153 treatments. The number of restenoses, especially those below 70%, may also be underestimated due to the limitations of duplex scan examinations in direct visualization of CCA

origins. The lack of significant differences in the restenosis-free patency rate in our study between angioplasty alone and angioplasty stenting may also be due to the relatively small sample size and the overall excellent patency rate.

CONCLUSION

In conclusion, this is one of the two studies published on transfemoral angioplasty of ostial and proximal common carotid artery stenosis. The primary technical success rate is high (98.7%) with a 2.5% 30-day all stroke/death rate. These results should help vascular surgeons and interventional radiologists to consider risk versus benefit when deciding treatment options for ostial and proximal common carotid artery significant stenoses. This study should also draw attention to the lack of data on natural history or effect of best medical treatment alone for these lesions, making evidence-based decision making currently impossible for treatment of symptomatic or asymptomatic ostial and proximal common carotid artery significant stenoses.

AUTHOR CONTRIBUTIONS

Conception and design: TMP, JH, ZS, BN, DV, VB, AM, KH
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Writing the article: TMP, JH, ZS, BN, DV, VB, AM, KH
Critical revision of the article: TMP, JH, ZS, BN, DV, VB, AM, KH
Final approval of the article: TMP, JH, ZS, BN, DV, VB, AM, KH
Statistical analysis: TMP, JH
Obtained funding: TMP, BN, BV, HK, AM
Overall responsibility: TMP

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