TÜBİTAK

Original Article

Turk J Med Sci
2010; 40 (5): 739-744
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E-mail: medsci@tubitak.gov.tr
doi:10.3906/sag-0906-45

Analysis of periprocedural medical complications during carotid angioplasty and stent placement

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Aim: To evaluate periprocedural medical complications during carotid angioplasty and stent placement.

Materials and methods: Data of all patients who underwent carotid artery stenting and were admitted to the postanesthesia care unit between January and December 2006 were retrospectively evaluated. All patients received conscious sedation, constant monitoring, and 0.5 mg atropine before balloon inflation. Risk factors and intra- and postprocedural complications were recorded.

Results: Twenty-two patients were treated for asymptomatic carotid stenosis and 25 patients for symptomatic carotid stenosis. Of the symptomatic patients 3 presented with retinal symptoms, 15 with a hemispheric transient ischemic attack, and 7 with a minor stroke. During the procedure 19.1% patients had complications and during Postanesthesia Care Unit stay 45% had complications. None of the patients had a urinary tract or chest infection or developed symptoms of a hyperperfusion syndrome. In the 30-day postprocedural follow-up, one patient died due to pulmonary thromboembolism.

Conclusion: Our results suggest that the overall incidence of complications after carotid artery stent placement was high. Therefore, patients with higher preoperative risk factors should be monitored closely.

Key words: Carotid artery, angioplasty, stenting, complications, anesthesia

Karotis anjiyoplasti ve stent yerleştirilmesinin periprosedüral döneminde medikal komplikasyonların analizi

Amaç: Bu retrospektif çalışmanın amacı karotis anjiyoplasti ve stent yerleştirilmesi sırasında gelişen tıbbi komplikasyonların değerlendirilmesidir.

Yöntem ve gereç: Ocak-Aralık 2006 tarihleri arasında karotis arter stentlenmesi işlemi geçirerek anestezi sonrası yoğun bakıma kabul edilen bütün hastaların verileri değerlendirildi. Bütün hastalara bilinçli sedasyon, sürekli monitörizasyon ve balon şişirilmeden önce 0,5 mg atropin uygulandı. Risk faktörleri, işlem sırası ve sonrası komplikasyonlar kaydedildi.

Bulgular: Yirmi iki hasta asemptomatik, 25 hasta ise semptomatik karotis stenozu için tedavi edildi. Semptomatik hastalardan 3 tanesi retinal semptomlarla, 15 tanesi hemisferik transient iskemik atak ile, 7 tanesi ise minör inme ile başvurmuştu. İşlem sırasında hastaların % 19,1'inde, Anestezi sonrası yoğun bakım izlemi sırasında ise hastaların % 45'inde komplikasyon izlendi. Hiçbir hastada idrar yolu veya akciğer enfeksiyonu görülmedi ve hiç hiperperfüzyon sendromu izlenmedi. 30 günlük işlem sonrası izlem sırasında bir hasta pulmoner tromboembolizm ile kaybedildi.

Sonuç: Bizim sonuçlarımıza göre, karotis anjioplasti ve stent yerleştirilmesi sonrası komplikasyon oranları yüksektir. Bu nedenle, preoperatif risk faktörleri yüksek olan hastalar yakın monitörize edilmelidir.

Anahtar sözcükler: Karotis arter, anjiyoplasti, stentleme, komplikasyonlar, anestezi

Received: 26.07.2009 – Accepted: 01.03.2010

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Introduction

Carotid artery stent (CAS) placement is an investigational technique for carotid artery revascularization, and reports suggest that this procedure has promising short- and intermediate-term results (1). There has been growing interest in and application of carotid artery stenting (2). Moreover, CAS has emerged as a potential therapeutic alternative to carotid endarterectomy (CEA) for the treatment of severe symptomatic or asymptomatic carotid stenosis. In several case series and trials it is suggested that CAS can be performed with acceptable procedure-related neurologic complication rates compared with CEA (3,4).

To date, most investigators have examined neurologic complications. Aside from the frequency of neurologic deficits, the benefit of either CEA or CAS is also highly dependent on the risk of medical complications such as myocardial infarction or hemodynamic complications. In Gröschel et al.'s study the medical complication rate was 15% (5). Although most of these nonneurologic complications resolved completely, some patients had life-threatening or serious cardiovascular disorders. Hemodynamic instability, most likely due to stretching of the carotid sinus and manipulation in the vicinity of the adventitial baroreceptors, occurs frequently after CAS and has been shown to correlate with increased hospital complications and long-term risk of death (6-10).

All these data enhance the importance of identification of potential risk factors for medical complications after CAS, and will become a key feature for future patient selection and patient counseling. Therefore, we evaluated periprocedural medical complications during carotid angioplasty and stent placement.

Materials and methods

Patient population: We retrospectively reviewed the database of all patients who underwent CAS and were admitted to the Postanesthesia Care Unit after the procedure at our institution from January 2006 to December 2006. Institutional Review Board approval was obtained before the study. It is the policy of our hospital that all patients with a symptomatic or asymptomatic carotid stenosis receive identical and standardized medical as well as neurologic evaluations. In all patients the diagnosis of carotid artery stenosis was made by carotid duplex ultrasound scanning and/or CT-MR angiography.

Medical treatment: The routine antiplatelet therapy with clopidogrel and acetyl salicylic acid was initiated before the procedure. Clopidogrel was continued for 6 weeks and aspirin given indefinitely.

Carotid angioplasty and stenting procedure: All procedures were performed with the patient under conscious sedation with continuous control of heart rate, blood pressure, and SpO_2. For the sedation midazolam 0.05 mg/kg was administered intravenously. The sedation levels of the patients were assessed by the Ramsay sedation scores. A score of 2 or 3 was targeted. When the drug doses were not enough to reach targeted sedation scores, midazolam (0.02 mg/kg iv) was repeated. Before balloon inflation, 0.5 mg atropine was administered intravenously in each patient as a prophylaxis against potential reflex bradycardia or asystole. All patients received oxygen by a nasal cannula (5 L/min) to reach at least 95% oxygen saturation. Procedures started with a diagnostic angiogram of the aortic arch followed by selective catheterization of aortic arch vessels in double projection. In all patients, self-expandable stents and filter-type embolic protection devices were used during the CAS procedures. At the end of the procedure the arterial puncture site was closed by an Angio-seal vascular closure device (Opakim, ST. JUDE MEDICAL).

After the stent procedure, all patients were transferred to the Postanesthesia Care Unit for overnight observation. Heart rate and oxygen saturation were monitored continuously and 2 electrocardiograms (ECG) were obtained immediately after CAS and on day 1. Noninvasive blood pressure monitoring was performed every 5 min until the end of the procedure. Cardiac enzymes were routinely collected from every patient. A physician evaluated any episode of neurologic change. Postprocedural symptomatic hypotension was treated with an intravenous infusion of dopamine or ephedrine, postprocedural hypertension was usually treated with intravenous esmolol, and symptomatic sinus bradycardia was treated with intravenous

atropine. Patients with asymptomatic hypotension were advised to have bed rest and receive intravenous fluids or both as a prophylactic measure.

Data collection: All patients' data were collected from a database retrospectively including preprocedural, intraprocedural, and follow-up information.

Patients with symptomatic internal carotid artery stenosis were recorded. A carotid stenosis that had not caused any stroke or TIA in the previous 6 months was considered asymptomatic. The following cerebrovascular risk factors were recorded in all patients: hypertension, diabetes mellitus, hyperlipidemia, smoking, coronary artery disease, previous myocardial infarction, history of previous coronary bypass surgery, and cardiac failure. Hypertension was defined as occurring when systolic blood pressure was ≥140 mmHg, diastolic blood pressure was ≥90 mmHg, or antihypertensive drugs were used. Diabetes was defined as previously diagnosed insulin-dependent or non-insulin dependent diabetes mellitus, and hyperlipidemia as cholesterol levels 220 mg/dL or in the presence of lipid-lowering drugs.

The following medical complications during CAS were recorded: symptomatic hypertension (symptoms due to systolic blood pressure ≥180 mmHg or diastolic blood pressure ≥100 mmHg requiring intravenous medication), symptomatic hypotension not associated with bleeding or cardiac failure (symptoms due to systolic blood pressure ≤90 mmHg requiring administration of vasopressor agent), and bradycardia (persisting mean heart rate < 50 beats/min). After CAS, myocardial ischemia as determined by ECG and cardiac enzymes, cardiac arrhythmias that required antiarrhythmic medication or a pacemaker, congestive heart failure, angina pectoris, symptomatic hypertension, symptomatic hypotension not associated with bleeding or cardiac failure, renal failure (doubling of preinterventional urea and/or creatinine), and also access-site related complications were recorded.

Statistical analysis: Continuous values are expressed as mean ± SD and nominal variables as counts and percentages. All statistical analyses were performed with SPSS (version 11.5) (SPSS, Inc, Chicago, IL, USA).

Results

The study population consists of 47 CAS patients (34 men, 13 women; mean age 62 ± 10) of which 22 patients (47%) were treated for asymptomatic carotid stenosis and 25 patients (53%) for symptomatic carotid stenosis. Of the symptomatic patients, 3 (25%) had presented with retinal symptoms, 15 (60%) with a hemispheric TIA, and 7 (28%) with a minor stroke. The demographic and clinical characteristics of the patients are shown in Table 1.

Table 2 summarizes the medical complication rates during the procedure and at the PACU. During the procedure 9 (19.1%) patients had complications. Three patients experienced bradycardia with balloon inflation. Hypotension occurred in 2 patients. Three patients experienced hypotension and bradycardia at the same time. Volume expansion or dopamine or ephedrine doses were titrated to maintain systolic blood pressure at 90 mmHg. One patient had hypertension.

During the PACU stay medical complications occurred in approximately 45% of all patients. Twenty-one patients had 1 complication and 2 patients had more than 1.

Three patients (6.4%) had cardiac (2 patients MI, 1 patient arrhythmia), 10 patients (21.3%) had hemodynamic (6 patients hypotension, 4 patients hypertension), 9 patients (19.2%) had vascular-access problems (6 patients bleeding, 3 patients hematoma), and 2 patients (4.3%) had other complications (1 patient urticaria, 1 patient hematuria). None of the vascular-access complications required surgical correction. No patients had a urinary tract or chest infection.

In the 30-day postprocedural follow-up one patient died due to pulmonary thromboembolism. First he suffered a subarachnoid hemorrhage and underwent surgery. Then he had a deep venous thrombosis and pulmonary thromboembolism and died.

Neurological complications were not investigated during the study.

Table 1. Baseline characteristics of study patients (N = 47).

Demographics	
Mean age (years)	62 ± 10
Male	34 (72.3%)
Female	13 (27.7%)
Presenting symptom	
Asymptomatic	22 (47%)
Symptomatic	25 (53%)
Retinal symptoms	3 (25%)
TIA	15 (60%)
Previous stroke	7 (28%)
Preoperative risk factors	
Hypertension	27 (57.4%)
Diabetes mellitus	11 (23.4%)
Smoking	24 (51.1%)
Coronary artery disease	19 (40.4%)
Hyperlipidemia	12 (25,5%)
Previous myocardial infarction	4 (8.5%)
History of previous coronary artery bypass surgery	8 (17%)
Cardiac failure	4 (8.5%)

Table 2. Intraoperative and postoperative complications.

Complication	**Number of patients (%)**
Intraoperative	
Bradycardia	3 (6.4)
Hypotension	2 (4.3)
Hypertension	1 (2.1)
Bradycardia + Hypotension	3 (6.4)
Postoperative	
Cardiac	
Myocardial Infarction	2 (4.3)
Arrhythmia	1 (2.1)
Hemodynamic	
Hypotension	6 (12.8)
Hypertension	4 (8.5)
Access-site related	
Bleeding	6 (12.8)
Hematoma	3 (6.4)
Other	
Urticaria	1 (2.1)
Hematuria	1 (2.1)

Discussion

In this study, we analyzed our database of patients to determine the overall incidence of preprocedural risk factors and intraprocedural and postprocedural medical complications. In the study by Gröschel et al. (5) the postprocedural complication rate was 15% of all patients. In our study this rate was 45%. Even after access-site related and other complications (such as urticaria and hematuria) were excluded from analysis, the medical complication rate was 25%. This may be due to 2 reasons: first, life-threatening or fatal nonneurologic events were common in this series; this result indicates that the overall incidence of medical complications after CAS was high. Secondly, preoperative risk factors such as coronary artery disease, history of previous coronary bypass surgery, and heart failure were higher in our study population.

Hemodynamic instability, in particular symptomatic hypotension, was the most frequent medical complication (12.8%). This complication is probably mediated through a dysfunction of adventitial baroreceptors in arterial segments that are dilated and covered with intravascular stents (10). Stent insertion likely leads to more prolonged effects on hemodynamics because the devices provide continuous tension on the carotid sinus. Our result was similar to these previous studies.

Dangas et al. (6) observed post-CAS hypotension in 25 (19%) of 133 patients (11). In the study by Qureshi et al. (10), transient hypotensive episodes after CAS occurred in 22.4% of all patients. Compared with these studies, the lower incidence of hypotensive episodes in Gröschel et al.'s (5) study (4.9%) could be because they only included patients who had symptoms requiring treatment with vasopressor agents.

Hypertension was less frequent (8.5%) than hypotension, but in previous studies it occurred in up to 40% of all CAS patients (10). Another favorable finding in our study is that no patients developed typical symptoms of a hyperperfusion syndrome, which is a very important and potentially life-threatening complication.

Previous CAS studies reported that intra- and postprocedural bradycardia occurred in up to 71% of all CAS patients but this was an uncommon medical complication in our series (6.4%) (11). In fact, no patient required treatment with a temporary venous pacemaker. It is easily perceivable that this finding can at least partially be attributed to advances in technique and equipment for CAS, especially the routine use of self-expanding stents and of atropine during CAS, as well as the cautious application of balloon postdilatation.

Two patients (4.3%) in our study developed nonfatal myocardial infarctions post-CAS, indicating that this potentially severe medical complication might occur more frequently than suggested by several previous CAS series and trials (12,13). This might be related to the single center nature of our study and patient profile of our study (high risk patients for MI: coronary artery disease (40.4%), previous myocardial infarction (8.5%)). In conjunction with our findings, 3.4% of all CAS patients had a non-Q-wave myocardial infarction in the recently published 'Stenting and Angioplasty with Protection in Patients at High Risk for Endarterectomy'; (SAPPHIRE) trial (4).

Our study had some limitations: it was a nonrandomized study. This study was a single center experience, and we should be cautious in extending these results to other centers. Moreover, we were unable to perform subgroup analysis because of the small sample size.

Carotid artery stenting is a technique that is gaining widespread usage and acceptance in the world. As with all newly spreading technologies, its optimal usage and potential dangers are slowly becoming apparent. Our series suggests that patients may present with different dangers and problems for the anesthesiologist. Therefore, patients with higher preoperative risk factors should be monitored closely.

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