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Percutaneous Transluminal Angioplasty of Subclavian Artery Lesions

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ABSTRACT

Introduction: Percutaneous transluminal angioplasty (PTA) is one of the treatment options for stenotic and obstructive lesions of the subclavian artery. **Aim:** To evaluate initial and long-term results of percutaneous transluminal angioplasty of subclavian artery lesions. **Methods:** During period February 2016 to December 2017, 26 patients (12 men and 14 women) with significant subclavian artery stenosis and occlusion were admitted and underwent PTA. All patients were symptomatic. All PTA procedures were performed with the patient under local anesthesia, through the femoral artery (n=22), brachial artery (n=4), or combined route (n=6). In 7 patients, we performed direct stenting, while in the other 15 patients we performed predilatation before stent implantation. The follow-up protocol consisted of regular clinical examinations in 1, 3, 6 and 12 months post-procedural, and annually thereafter with duplex ultrasound monitoring. **Results:** Initial technical success was achieved in 22 of 26 procedures (84.61%), 100% in stenotic lesions and 55.5 % in total occlusions. Fourth of nine occlusions could not be recanalized by PTA. These patients were managed surgically. The 30-day mortality rate was 0% for the entire group. No patients required reintervention for recurrence of symptoms and the stents remain patent at period of 12 months post-procedural. **Conclusion:** The minimal invasive technique, the markedly lower complication rate, the high long-term patency, patient's comfort and the decreased hospital stay have made endovascular repair the primary choice of treatment in the majority of cases, especially in patients with stenotic lesions and high-risk patients. We consider PTA of subclavian artery stenotic/obstructive lesions should be the first therapeutic option.

Keywords: percutaneous transluminal angioplasty, subclavian artery lesions, subclavian steal phenomenon.

1. INTRODUCTION

The subclavian artery and brachiocephalic trunk are the most common upper extremity locations for atherosclerosis. Subclavian stenosis/occlusion can be responsible for vertebrobasilar insufficiency. The symptoms are quite variable, and can be as severe as embolization to the fingers, subclavian steal syndrome, or even ischemic events in the vertebrobasilar territory and coronary-subclavian steal, which can lead to myocardial ischemia (1, 2). Subclavian artery disease is usually focal, and the left side is affected in the majority of lesions (3).

Subclavian artery stenosis is much less common than lower-extremity disease with an overall occurrence of around 0.5% to 2%, but increases to 9% in the case of concomitant lower extremity artery disease (4). The most common presenting symptoms are vertebrobasilar insufficiency (18% to 62%) and upper extremity ischemia (13% to 69%), or both (15% to 56%) (4, 5).

For revascularization, both endovascular and surgical procedures are available. There are no randomized clinical trials comparing endovascular vs. open repair (4). The risk of severe complications, including vertebrobasilar stroke, is low with both approaches (5, 6). Percutaneous angioplasty with stenting for subclavian arterial stenosis is less invasive than open surgical repair, with a low rate of complications (7).

2. AIM

Aim of this article was to present our initial outcomes and experience from patients with stenotic/occlusive disease of subclavian artery treated percutaneous transluminal angioplasty.

3. METHODS

Between February 2016 and December 2017, 26 patients were evalu-

ated for symptoms of stenotic/obstructive lesions of the subclavian artery in the Clinic for Invasive Cardiology, University Clinical Center Tuzla. In this study, patients with subclavian artery atherosclerotic disease were included. Subclavian stenosis and occlusion were confirmed by duplex ultrasound and CT scan.

Detailed information on endovascular intervention was provided to all patients. An informed consent regarding all procedures was signed by all patients.

4. RESULTS

Twelve patients (46%) had clinical symptoms due to vertebrobasilar insufficiency or other neurological symptoms (vertigo, nausea, visual disturbances, ataxia, syncope). Six patients (23%) had disabling arm ischemia with sensation of cold and pallor in the fingers. Five patients (19%) had both symptoms.

Three patients had only mild arm claudication, without other complaints. Baseline characteristics are shown in Table 1.

	N	%	Mean±SD
Age (years)			61±09
Male	12	46.1	
Female	14	53.9	
Smoker	15	67.7	
Hypertension	10	38.4	
Diabetes mellitus	8	30.7	
Coronary artery disease	12	46.1	
Previous myocardial infarction	4	15.3	
Previous cerebrovascular accident	6	23	
Peripheral artery disease	5	19.2	
Hyperlipidemia	12	46.1	

Table 1. Baseline characteristic

Twenty-three lesions (88.46%) were located in that part of the subclavian artery proximal to the origin of the vertebral artery. The left subclavian artery was most frequently involved (92.30%), and all lesions were atherosclerotic.

All the patients were premedicated with aspirin 100 mg/day and continued indefinitely, and clopidogrel 150 mg b.i.d. the first day and continued 75 mg/day for 1 month; 5,000 units of heparin was given as a bolus during the procedure. The pre procedural protocol involved the evaluation of the target and supra aortic vessels by color duplex ultrasonography, arteriography, and CT scan.

For percutaneous transluminal angioplasty, a femoral approach was used in 22 patients, and a brachial approach in 4 patients. In 6 procedures, a combined femoral and brachial approach was used. For all transfemoral approaches, a short introduction sheath and a guiding catheter or a long sheath were used. After angiography of the aortic arch, selective catheterization of the subclavian artery was performed. The most common during our series was an 6 Fr or 7 Fr multipurpose guiding catheter placed at the ostium of the target lesion, which is crossed with an 0.035" steerable guidewire. Depending on operator preference and experience, it is possible to use several types of coronary guide wires (0.014" to 0.018") when the severity of the lesion does not permit crossing with the 0.035" wire technique.. When recanalization from the femoral approach was not possible, brachial artery access was established, and an attempt to recanalize from that side was performed.

Predilatation was performed with a 4 or 5-mm in diameter balloon. After percutaneous transluminal angioplasty was performed, an angiogram was obtained and the deployment of the stent followed. Mostly, we used balloon expandable stents. In 7 patients (31,8%), we performed direct stenting, mainly in lesions with favorable anatomic characteristics. The Peri-procedural anatomic characteristics along with the types and sizes of stents used are shown in Table 2.

	N	%
Artery treated	26	
Left subclavian	23	88.4
Right subclavian	3	11.6
Segment treated		
Proximal segment	24	92.3
Mid segment	2	7.7
Distal segment	0	0.0
Stent type		
Balloon expandable	20	76.9
Self-expandable	4	23.1
Stent diameter		
7mm	5	19.2
8mm	12	46.1
9mm	5	34.7

Table 2. Procedural data

Initial technical success was defined as angiographic residual stenosis less than 20%. Hemodynamic success was defined as normalization of upper-extremity blood pressure (compared with the physiologic contralateral arm) immediately after the procedure or improvement of the arterial pressure index by at least 0.15. Late success was considered as either an upper-extremity blood pressure equal to the contralateral extremity or decreased by less than 0.15 or the patient free of any symptoms. Clinical success was defined as complete resolution of presenting symptoms and clinical failure was defined as renewed clinical symptoms originating from recurrent obstruction of the subclavian artery. The other end point was death (PTA-related or non-PTA-related). The follow-up protocol consisted of regular clinical examinations in 1, 3, 6 and 12 months post-procedural, and annually thereafter with duplex ultrasound monitoring. If symptoms reoccurred and a greater than 50% recurrent stenosis, according to duplex ultrasound criteria, was diagnosed, angiography was performed.

Of the 26 patients treated, 17 (65%) were stenosis (>75%), and 9 (35%) total occlusions. Regarding the procedural outcomes, 22 out of 26 patients underwent technically successful revascularization of subclavian artery lesions using PTA. A typical example of

successful revascularization is shown in Figure 1. All of stenotic lesions were treated successfully. All of the 4 failures (3 left-sided, 1 right-sided) were due to occlusion of the proximal subclavian artery that was impossible to traverse with a guide wire. Both femoral and brachial approaches were attempted during these procedures, but the calcification was too severe to enable passage. These patients underwent subclavian-carotid bypass surgery. Those other 5 occlusive lesions were treated successfully.

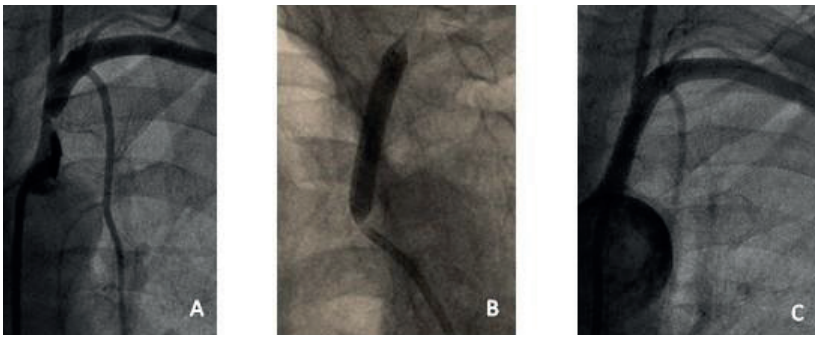

Figure 1. Stenosis of proximal subclavian artery before treatment (A), during stent implantation (B), and final result (C).

One of the 2 technically successful procedures was complicated by occurrence of a minor stroke in the contralateral right hemisphere. This ischemic event appeared one hour after the procedure. Three PTA-related dissections could be successfully over stented. Two patients, all with left-sided lesions groin hematoma without permanent sequel. In all 12 patients with pre-procedural vertebrobasilar insufficiency antegrade flow was confirmed at duplex scanning of the vertebral artery after the procedure.

Clinical follow-up was achieved in all patients according to our plan (1, 3, 6 and 12 months). No patient required any reintervention for recurrence of symptoms and the stents remained patent at 12 months period interval. Regarding survival, there were no in-hospital or early (within 30 days of the procedure) deaths.

5. DISCUSSION

Prevalence of subclavian stenosis is estimated to be 2% in the general population but increases to 9% in the case of concomitant lower extremity artery disease (4).

Surgical treatment of subclavian artery obstructive lesions, before the advent of percutaneous transluminal angioplasty, was considered standard therapy. The limitations of traditional surgical management of supra-aortic disease, and the good results achieved by the endovascular approach, have shifted treatment toward percutaneous interventions. According to ESC 2017 Guidelines, symptomatic stenosis or occlusion of the subclavian artery, acute ischemia threatening the extremitas, asymptomatic stenosis or occlusion in patients with subclavian steal phenomenon are indications for PTA (4).

The initial success rate in stenotic lesions of subclavian artery is 98 - 100%; however, the treatment of total occlusions is more difficult, with lower acute technical success [8, 9-12]. Our initial technical success rate of 84.7% in the entire patient group is at least comparable with that of other series (14, 15). The initial technical success rate for subclavian artery stenosis was 100% (17 out of 17), while for subclavian artery occlusions was 55.5 % (5 out of 9). The long-term results of endovascular treatment of stenotic lesions of subclavian artery are satisfactory, with one year primary patience rate of 100%. Subclavian artery total occlusions, obviously from the data being presented, have a much lower technical success rate than stenotic lesions. A review of the literature demonstrates success rates varying from of 46-76% (9-11). Rodriquez-Lopez et al (13) from the Arizona Heart Institute described a series of 17 patients with occluded subclavian and a 94% technical success. Results of the Pittsburgh Vascular Institute with total occlusions describe a technical success rate of approximately 75%. Our experiences with PTA of occlusive lesion of subclavian artery were 55% (14).

Occlusive lesions had a less favorable initial technical success rate compared with stenotic lesions. However, no patient with an occluded artery had any peri-procedural complication. Complications of any kind are certainly no more common than with open surgical procedures. Crossing the totally occluded artery is still the most important challenge in the endovascular treatment of the subclavian artery; however, this and other recent reports have demonstrated a better technical success rate than that seen in earlier series (7).

6. CONCLUSION

Results of our investigation of PTA and long-term results from other studies confirm that PTA of subclavian artery stenoses is a safe, highly effective procedure and should be considered the treatment of choice for symptomatic subclavian artery stenoses. It is reasonable to recommend percutaneous intervention as the initial treatment of all subclavian artery lesions.

- **Author's contribution:** E.J. and H.A. gave substantial contribution to the conception or design of the work and in the acquisition, analysis and interpretation of data for the work, E.J., I.I. and A.K. had role in drafting the work and revising it critically for important intellectual content. Each author gave final approval of the version to be published and they are agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.
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