

Native aortic coarctation stenting in patients ≥ 46 years old

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Abstract

Introduction: Stent implantation is an effective therapy for aortic coarctation (CoA) in adolescents and adults.

Aim: To present a unique group of patients with native coarctation of the aorta older than or equal to 46 years treated with bare metal or covered stents.

Material and methods: Since 2002 we have performed stent implantations by applying bare metal stents or covered stents using femoral access in 24 patients aged 46 and older.

Results: We used the Mullins technique in all cases, implanting different stents: Palmaz, Cheatham-Platinum (CP), covered CP or Andrastents XL/XXL. Twenty-one procedures were elective and 3 were urgent. Eighteen bare metal stents (2 stents in one patient) and 7 covered stents were used. All procedures were effective (CoA gradient reduced < 20 mm Hg), despite 2 migrations of bare metal stents. Mean gradient was reduced from 50.6 ± 15.3 to 6.8 ± 6.5 mm Hg ($p < 0.001$) and mean lumen diameter of stenosed aorta increased from 5.5 ± 2.5 to 14.9 ± 5.2 mm ($p < 0.001$). One special case is discussed – a 49-year-old man with end staged heart failure and severe CoA, who underwent a rescue procedure with a bare metal stent. One serious complication – stroke of the central nervous system – was observed in a 53-year-old woman during covered stent implantation (symptoms resolved during rehabilitation process).

Conclusions: Stent implantation of native coarctation of the aorta is also a safe procedure in the eldest patients and is associated with persistent relief of aortic obstruction.

Key words: aortic coarctation, bare metal stent, peripheral intervention.

Introduction

Coarctation of the aorta (CoA) is a common congenital defect, which, although normally detected and surgically repaired in early childhood, may also be diagnosed in adulthood, usually in the context of investigation for hypertension. According to Campbell [1] in the natural history of native coarctation of the aorta 75% of patients died before they reached the age of 46. Cardiovascular specialists generally agree that percutaneous balloon angioplasty, with or without stent implantation, is the preferred treatment for recurrent postsurgical CoA. However, percutaneous treatment for non-operated aortic coarctation in adults remains more controversial [2]. The European Society of Cardiology guidelines for the management of adult congenital heart diseases recommended intervention in all patients with a non-invasive pressure difference > 20 mm Hg between the upper and lower limbs accompanied by upper limb hypertension ($> 140/90$ mm Hg),

pathological pressure blood response during exercise or significant left ventricular hypertrophy, regardless of symptoms (class IC indication) [3].

Aim

Here we present a unique group of patients with native coarctation of the aorta older than or equal to 46 years treated with bare metal or covered stents.

Material and methods

Retrospective analysis of native CoA in 24 patient ≥ 46 years old treated with stenting between July 2002 and April 2017 was performed. This group of patients was selected from our 132 cases, where CoA was dilated with stent implantation [4]. The study was approved by our Institution Scientific Board, and informed consent was obtained from all patients. Diagnosis of CoA was based on a combination of clinical signs (system-

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ic hypertension) as well as invasive gradient more than 20 mm Hg. In the majority of the patients collateral circulation was present. Different stents were applied in this period depending on availability (bare metal: Palmaz, Cheatham Platinum (CP), Andrastents XL/XXL and covered with polytetrafluoroethylene CP stents). Characteristics of those stents have been described elsewhere [5, 6]. The stents were implanted retrogradely with the standard technique. In the majority of cases a one-stage procedure was performed. The decision to use a covered

stent was operator dependent and was mainly made in patients older than 50 years of age, with aortic calcification and presence of critical CoA. All procedures but one were done under intravenous sedation and local anaesthesia. In one patient with a critical condition (described in detail elsewhere [7]) the procedure was performed after intubation and general anaesthesia. In all patients 0.5–2 years after the procedures angio-computed tomography or angiography was done to document the results of stent implantation as well as to exclude aortic aneu-

Table I. Clinical and procedural characteristics of patients ≥ 46 years old with native CoA treated with stents

Patient	Date	Age [years]	Sex	Comorbidities and NYHA class	Gradient [mm Hg]		Diameter [mm]		Stent	Fluoro	Indications	Other
					Before procedure	After procedure	Before procedure	After procedure				
1	07.2002	52	M	IV (MI)	30	4	3	12	4114	21	Urgent	–
2	05.2003	46	F	II	60	10	3	14	5014	11	Elective	Migr.
3	06.2003	51	M	II (BAV)	73	19	2	16	4014	45	Elective	Migr.
4	10.2003	46	F	I (Small VSD)	59	2	6	18	4014	7	Elective	Redil.
5	07.2004	55	F	IV (AS, AI, MI)	55	2	8	16	5014	3	Urgent	–
6	03.2006	53	F	II (native aneur)	20	8	9	14	CVCP45	9	Elective	Stroke
7	06.2006	57	F	II (right arch)	58	15	10	16	CP39	7	Elective	–
8	08.2006	54	M	II	59	19	4	13	CP45	5	Elective	Redil.
9	06.2007	46	M	III (BAV, AS, AI)	57	7	5	14	CP39	7	Elective	–
10	07.2008	57	M	II, tongue carc	46	7	7	10	CVCP39	7	Elective	–
11	02.2010	51	F	II (BAV)	30	3	6	11	ASXXL39	7	Elective	–
12	05.2010	47	M	I/II	60	1	5	19	ASXXL39	13	Elective	–
13	07.2011	55	M		63	2	4	17	CVCP39	8	Elective	–
14	07.2011	49	M	IV (IM, sepsis, HF)	23	2	8	14	ASXL48	4	Rescu	–
15	01.2012	53	M	III	73	12	3	10	ASXXL48	7	Elective	Redil.
16	02.2012	56	M	II (AVR, DDDR)	56	0	7	14	ASXXL43	10	Elective	–
17	02.2012	48	F	III	57	1	3	16	CVCP39	8	Elective	Redil.
18	04.2012	60	F	II (BAV HR)	45	0	7	18	CVCP45	9	Elective	–
19	05.2012	52	M	II	32	14	10	16	CP39	5	Elective	–
20	05.2014	53	M	II	67	10	5	15	ASXXL39 ASXL35	13	Elective	–
21	08.2015	58	M	II (BAV, AS)	49	6	3	17	CVCP39	7	Elective	–
22	11.2016	58	M	II	61	19	2	15	ASXXL43	10	Elective	–
23	03.2017	46	F	I	30	0	9	18	ASXXL43	5	Elective	–
24	04.2017	48	M	II	52	0	4	14	CVCP45	15	Elective	–

AI – aortic valve incompetence, AS – aortic valve stenosis, AS XL/XXL – Andrastent type XL or XXL, AVR – aortic valve replacement, BAV – bicuspid aortic valve, CVCP – covered CP stent, Diameter – diameter of stenosed segment, DDDR – after pacemaker implantation, Gradient – transaortic gradient, Fluoro – time of fluoroscopy, MI – mitral incompetence, Migr. – Migration of the stent during procedure, M/F – male/female, native aneur. – native aneurysm of aorta, Redil. – redilatation of the stent in subsequent catheterization, right arch – right arch of the aorta, tongue carc – carcinoma of the tongue after surgical removal, VSD – ventricular septal defect, 4014/5014 – Palmaz stent diameter 4014 or 5014.

rysm formation. Serious adverse events were considered to be (among others) death related to the procedure, aneurysm formation (including in follow-up), and stroke.

Results

There were no procedural deaths (including in follow-up), serious adverse events (less one described below) or surgical intervention. The study group included 24 patients (9 females). Mean age of patients was 52.1 ± 4.4 (8 of them were older than 55 years). Regarding clinical history, none of our patients had data of previous endocarditis, aortic rupture/aneurysm or intracranial hemorrhage. Clinical and procedural characteristics



Figure 1. Tight aortic coarctation with collateral vessels (angio-CT scan)

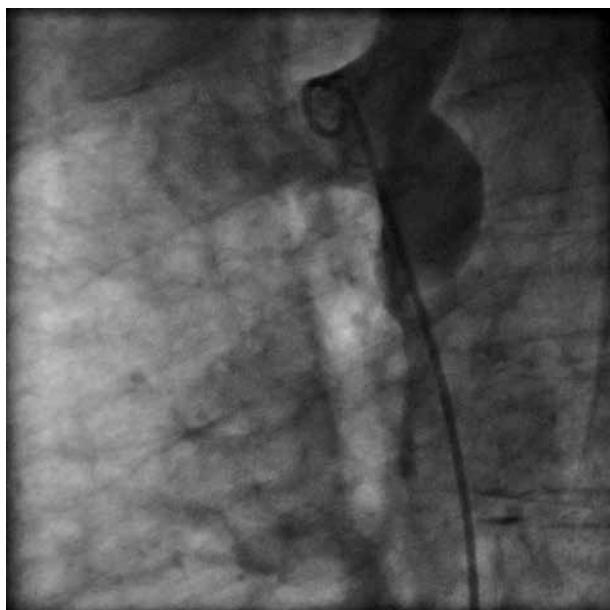


Figure 2. Aortic coarctation in LAO 90 view in cardiac catheterization (same patient)

of patients ≥ 46 years old with native CoA treated with stents are presented in Table I.

The clinical course of 6 of our patients (25%) before the procedure included serious heart failure (NYHA III/IV class). In all patients with heart failure after stent implantation clinical improvement was observed. Taking into consideration all the group of patients treated with stents (132) 50% had a reduced amount of antihypertensive medicines after procedures [4]. All stent implantations were successful except two cases (at the beginning of our series), when stent migrations occurred. All procedures were also effective (with residual gradient < 20 mm Hg) – even those 2 when migration of the stent occurred (stents were dilated in the lower part of the aorta). During the procedure and the follow-up aneurysm formations were not observed in any case. Three urgent procedures were performed. The history of one of those – patient 14 (Table I), described in detail elsewhere – is very instructive [7]. At the age of 45 years he was diagnosed with native CoA (confirmed by angio-computed tomography examination as critical CoA) but he refused any invasive treatment. Four years later he was admitted to another hospital for sepsis, ulcer on the right leg, and low ejection fraction (15% on echocardiography). He was transferred to our hospital where circulatory arrest occurred 4 times. Practically during resuscitation, rescue stent implantation of a bare metal stent was performed with a good clinical result and slow patient recovery. He will commence a 5.5-year follow-up, but severe mitral incompetency persists and his ejection fraction is 25%. This case indicates the necessity of CoA treatment immediately when diagnosis is established.

We have applied 7 covered stents and 18 bare metal stents. Figures 1–3 present images of angio computed



Figure 3. Covered CP stent implanted in aortic coarctation (same patient)

tomography and aortography before and after covered CP stent implantation.

The most important complication occurred in a 53-year-old woman (patient 6 Table I). Additionally to critical CoA she had aneurysm formation (ampulla after spontaneously closed patent ductus arteriosus?). Immediately after covered stent placement (occluding the entrance to this aneurysm) left hemiparesis occurred. On fluoroscopy, some calcification in the aortic arch was visible; we suspected that such rupture of the atherosclerotic plaque could be the reason for this complication. The rehabilitation of her stroke was uneventful. Planned re-intervention was performed in 4 of our patients when a staged procedure was undertaken (balloon redilatation of the stent).

Discussion

The observations presented here confirm the data of others [8–10] that stent implantation is an effective method of treatment of CoA. Our results indicate that it is also successful in older patients with native CoA. We have found both kinds of stents – bare metal and covered ones – very useful. The majority of adult cases are nowadays commonly treated by stenting of the CoA as the first-choice therapy [3]. Metal scaffolding may reduce the incidence of acute elastic recoil as well as late stenosis due to a more complete elimination of gradient in high velocity arterial system flow. Our experience indicated that aneurysm formation after stent implantation in the native CoA was absent. Sohrabi *et al.* [9] found more frequent incidence of aneurysm formation in covered than uncovered stents (presented proximally to the stent). This probably occurred in cases when a radial approach was required to cross stenotic segments with the aid of a Terumo guidewire. They suggested that manipulation with that guidewire in the pre-CoA region was responsible for this complication. In their randomized trial comparing application of covered and bare metal CP stents in 120 native CoA patients, effectiveness of both stents was high and similar. On the other hand, it was suggested that the incidence of rupture, dissection, and aortic aneurysm formation (not presented in our series) was greater with bare metal stent application and in cases of adults with strongly reduced aortic distensibility before and after the position of the CoA, including with distorted and angulated forms of CoA [8]. The latter was provoked by unequal radial forces during stent expansion. Another risk factor of these complications was long recoarctation or previous aneurysm (native, postoperative or after balloon angioplasty). Covered CP stents have some disadvantages as they require a 1–2 Fr larger sheath and increase the risk of obstruction of aortic branches. In our material, we have 6 patients with severe heart failure (in NYHA functional class III or IV). In all the procedure was effective. In our series, we have applied different bare

metal stents – Palmaz (now retracted), Cheatham Platinum and Andrastent XL/XXL. None of our stents were fractured in follow-up. However, one must note that stent fracture and progression of the fracture can occur when Cheatham Platinum stents are applied [10]. In contrast, in our recently published series of Andrastents used in CoA this complication was not observed [6].

According to Campbell [1], congestive heart failure in 304 necropsies of CoA patients was the cause of death in 25.5% and occurred at a mean age of 39 years. Spontaneous aortic rupture occurred in 21%, bacterial endocarditis in 18% and intracranial hemorrhage in 11.5% of them. These findings obviously support the need for early diagnosis and treatment of CoA. One serious complication occurred in our series – stroke in a 55-year-old woman with native aneurysm of CoA (remnant of closed spontaneously ductus arteriosus?) treated with a covered stent. She had some calcifications present in the aortic arch. This case suggests the potential usefulness of application of arterial filters in carotid arteries (similar as in stenting of stenosis of carotid arteries).

International guidelines for adults with congenital heart diseases recommend treatment of any significant CoA. In the natural history of native CoA 75% of patients died before they reached 46 years old [1]. In this paper, we present a unique group of patients older than 46 years treated with stent implantation.

A quarter of our patients had signs of heart failure. In the majority of them bare metal stents were used and this treatment was safe and effective. Serious complications during the procedure in our group included 2 stent migrations and one stroke, but no aneurysm formation occurred even in follow-up.

Conclusions

Stent implantation in older adult patients is a feasible, safe procedure both with bare metal and covered stents. The treatment of native CoA should be done as soon as the diagnosis is established to prevent development of heart failure.

Conflict of interest

The authors declare no conflict of interest.

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