

Arterial hypertension and endovascular treatment of adults with coarctation of the aorta: a single-center experience

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Introduction Coarctation of the aorta (CoA) is a common cause of secondary arterial hypertension in young adults.^{1,2} However, in many cases, antihypertensive therapy is initiated without excluding this condition, and hypertension is very likely to persist. We aimed to analyze the diagnostic pathway and medical therapy of hypertension in adult patients undergoing endovascular stenting of CoA.

Methods We investigated 24 consecutive adults (men, 78.1%) with CoA referred for a transcatheter intervention at our institution between May 2013 and April 2018. Medical history was obtained at baseline, with special attention paid to the age at which hypertension was first noted and the age at final diagnosis of CoA. Detailed information on antihypertensive therapy was collected at baseline, at discharge, and then by phone after a mean (SD) period of 34 (17) months (range, 2–63 months).

Blood pressure (BP) was measured at baseline and after stenting, using an Omron oscillometric device (Omron Healthcare, Kyoto, Japan). Hypertension was defined in accordance with the European Society of Cardiology guidelines.¹

Endovascular procedures were carried out under general anesthesia in a hybrid operating room. Invasive measurement of aortic BP was performed above and below the coarctation directly before and after stenting. Peak systolic pressure gradient defined as a difference in peak systolic BP measured across the lesion was calculated. Stents were delivered using the femoral

approach. Bare metal stents were used in 2 patients (8.3%) (LD Max, EV3, Plymouth, Minnesota, United States and Cheatham Platinum, NuMED, Inc., Hopkinton, New York, United States), and covered stents were used in the remaining 22 patients (83.7%) (Cheatham Platinum, NuMED, Inc.).

Written informed consent was obtained from all patients before the intervention. In accordance with national ethics regulations, approval for further analysis was not required as this was a retrospective study with anonymized patient data.

Statistical analysis Statistical analysis was performed using SPSS 17.0 (SPSS Inc., Chicago, Illinois, United States). Normally distributed continuous variables were compared with the paired-sample *t* test, and categorical variables, with the Wilcoxon signed-rank test. A *P* value of less than 0.05 was considered significant.

Results and conclusions The median age at procedure was 36 years (range, 18–77 years). All patients underwent successful stent implantation, with a significant reduction in peak systolic pressure gradient (TABLE 1). The maximal residual pressure gradient was 6 mm Hg. The median hospitalization time was 4 days (lower and upper quartiles, 3 and 5 days, respectively). No early procedure-related complications, such as neurologic deficit, stent migration, balloon rupture, or aortic wall injury, were observed.

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TABLE 1 Invasive and noninvasive blood pressure measurement as well as use of antihypertensive drugs before stent implantation (baseline), after the procedure (discharge), and at follow-up

Parameter	Baseline	Discharge	Follow-up
Invasive blood pressure measurement			
No. of patients	24	24	NA
Ascending aorta SBP, mm Hg	115.5 (31.7)	111.7(24.5)	
	$P = 0.55$ (95% CI, -9.2 to 16.8) ^a		
Descending aorta SBP, mm Hg	81.0 (23.3)	110.4(23.6)	NA
	$P < 0.001$ (95% CI, -42.4 to -16.4) ^a		
Peak systolic pressure gradient, mm Hg	40.1 (15.9)	1.3 (2.2)	NA
	$P < 0.001$ (95% CI, 32.1-45.4) ^a		
Noninvasive blood pressure measurement (upper extremity)			
No. of patients	24	23	NA
SBP, mm Hg	155.8 (20.0)	131.1(17.2)	
	$P < 0.001$ (95% CI, 16.7-32.6) ^a		
DBP, mm Hg	84.2 (11.2)	78.6 (10.1)	NA
	$P = 0.04$ (95% CI, 0.2-11.1) ^a		
Antihypertensive drugs			
No. of patients	24	23	23
At least 1 drug, n (%)	23 (95.8)	17 (73.9)	15 (65.2)
	$P = 0.025$ ($Z = -2.24$) ^a		NA
	$P = 0.008$ ($Z = -2.65$) ^b		
At least 3 drugs, n (%)	19 (79.2)	7 (30.4)	7 (30.4)
	$P = 0.001$ ($Z = -3.46$) ^b		
Average number of drugs per patient	3.1 (1.3)	1.9 (1.8)	1.9 (1.7)
	$P = 0.01$ (95% CI, -2.1 to -0.3) ^a		NA
	$P = 0.009$ (95% CI, -2.1 to -0.3) ^b		

Data are presented as mean (SD) unless indicated otherwise.

a comparison of baseline with discharge data; **b** comparison of baseline with follow-up data

Abbreviations: SBP, systolic blood pressure; DBP, diastolic blood pressure; NA, not applicable

One patient died 14 days after the procedure from decompensated acute heart failure caused by de novo aortic valve stenosis. However, this was not considered a complication of stenting. In 1 of the 2 patients treated with bare metal stents, aortic aneurysm formation was revealed during the follow-up. A successful implantation of a covered stent (CVRDCP8Z39, NuMED, Inc.) into the previously implanted bare metal stent (CP8Z45, NuMED, Inc.) was performed 11 months after the index procedure.

At baseline, only 1 patient (4.2%) did not take any antihypertensive drugs, while the majority (79.2%) were treated with at least 3 drugs. A significant decrease in both systolic and diastolic BP was observed after the procedure (TABLE 1). Medical treatment was reduced or discontinued

when possible: 6 patients (26.1%) were discharged without any antihypertensive medication, 10 (52.2%) were prescribed 1 or 2 antihypertensive drugs, and 7 (30.4%) were prescribed at least 3 drugs. The mean number of drugs per patient dropped from 3.1 to 1.9 (TABLE 1).

At follow-up, 15 patients (65.2%) continued their medication, but only 7 (30.4%) required 3 drugs or more. The mean number of drugs per patient was similar to that at discharge (TABLE 1).

Coarctation of the aorta was diagnosed in adolescence or adulthood in 20 patients (83.3%). Among the 4 patients diagnosed in infancy, 2 were operated on before the age of 3 years and currently presented due to recoarctation. In the case of the remaining 2 patients, surgery was deferred at the request of their caregivers, and, eventually, percutaneous intervention was performed at the age of 35 and 27 years, respectively. In this subgroup, the first clinical manifestation of CoA was predominantly hypertension (in 19 patients), while cardiac murmur was reported as the first recognized symptom in 1 patient. The mean (SD) age at detection of these abnormalities was 17.1 (8.8) years (range, 1-36 years), while the mean (SD) age at diagnosis of CoA was 33.5 (14.9) years (range, 15-60). These calculations did not include 1 patient who died, as complete information could not be obtained. The mean (SD) delay in diagnosis was 16.4 (11.1) years (maximum 37 years).

Importantly, the majority of patients did not undergo proper physical examination either before or during medical treatment (continued for nearly 11 years on average, maximally 25 years). Coarctation of the aorta can often be diagnosed only on physical examination. A discrepancy between upper and lower extremity pulses, and, more importantly, a difference in BP between upper and lower limb of more than 20/10 mm Hg, are highly suggestive findings.^{1,2} Unfortunately, pulse assessment and 4-limb BP measurement, although quick and easy to perform, seem to be neglected by many physicians. In fact, all patients from our group claimed to have been prescribed medication without prior evaluation of femoral pulses. Four-limb pressure measurement was performed before referral to a tertiary care hospital only in 2 patients.

Published data confirm that correction of CoA leads to BP reduction.³⁻⁵ De-escalation or discontinuation of antihypertensive therapy may be achieved in 63% to 84% of patients after stenting.⁵⁻⁸ These data are in accordance with our study, where reduction in the number of drugs was observed in 60.1% of patients at discharge and 69.6% at follow-up. Residual hypertension may be due to arterial remodeling resulting from diffuse vasculopathy involving, among others, the transforming growth factor- β signaling pathway.^{3,9}

Endovascular stenting has become an accepted therapeutic option in adults with CoA.^{6,8,10}

We believe that apart from reporting satisfactory results in terms of safety, efficacy, and resolution of hypertension, our study highlights the need for careful physical examination. Palpation of brachial and femoral pulses as well as BP measurement in the upper and lower extremities should constitute an integral part of routine medical checkup in patients presenting with hypertension to avoid unnecessary medication and late complications of long-lasting unrecognized CoA.

The limitations of our single-center study include selection bias, since we analyzed a relatively small number of patients treated in a tertiary cardiac center for adults. Furthermore, follow-up was short due to the patients' expected life span, and the follow-up data were based on phone contact. Finally, a standardized method of BP measurement, preferably 24-hour ambulatory BP measurement, should be used to objectively confirm the efficacy of medication.

ARTICLE INFORMATION

CONFLICT OF INTEREST None declared.

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REFERENCES

- 1 Williams B, Mancia G, Spiering W, et al. 2018 ESC/ESH Guidelines for the management of arterial hypertension. *Kardiol Pol.* 2019; 77: 71-159.
- 2 Rimoldi SF, Scherrer U, Messerli FH. Secondary arterial hypertension: when, who, and how to screen? *Eur Heart J.* 2014; 35: 1245-1254.
- 3 Chen SS, Donald AE, Storry C, et al. Impact of aortic stenting on peripheral vascular function and daytime systolic blood pressure in adult coarctation. *Heart.* 2008; 94: 919-924.
- 4 Babu-Narayan SV, Mohiaddin RH, Cannell TM, et al. Cardiovascular changes after transcatheter endovascular stenting of adult aortic coarctation. *Int J Cardiol.* 2011; 149: 157-63.
- 5 Musto C, Cifarelli A, Pucci E, et al. Endovascular treatment of aortic coarctation: long-term effects on hypertension. *Int J Cardiol.* 2008; 130: 420-425.
- 6 Fawzy ME, Awad M, Hassan W. Long-term outcome (up to 15 years) of balloon angioplasty of discrete native coarctation of the aorta in adolescents and adults. *J Am Coll Cardiol.* 2004; 43: 1062-1067.
- 7 Schröder R, Bussmann WD, Jacobi V, et al. Long term effects of balloon coarctation angioplasty on arterial blood pressure in adolescent and adult patients catheter. *Cardiovasc Diagn.* 1995; 36: 220-225.
- 8 Chang ZP, Jiang SL, Xu ZY. Use of covered Cheatham-Platinum stent as the primary modality in the treatment of native coarctation of the aorta. *Chin Med J (Engl).* 2012; 125: 1005-1009.
- 9 Brili S, Antonopoulos AS, Oikonomou E, et al. Impairment of arterial elastic properties and elevated circulating levels of transforming growth factor-beta in subjects with repaired coarctation of aorta. *Int J Cardiol.* 2016; 207: 282-283.
- 10 Sulik-Gajda S, Fiszer R, Białkowski J, et al. Implantation of stents for post-surgical recoarctation of the aorta in adolescents and adults. *Kardiol Pol.* 2017; 75: 983-989.