*Мак Мед Прегл*ед 2018; 72(2): 99-105

ММП

Case report

AN ADULT PATIENT WITH AORTIC COARCTATION REPAIR, A COMPLEX MEDICAL ENIGMA AND CHALLENGE: CASE REPORT

ВОЗРАСЕН ПАЦИЕНТ СО ОПЕРИРАНА АОРТНА КОАРКТАЦИЈА, КОМПЛЕКСНА МЕДИЦИНСКА ЕНИГМА И ПРЕДИЗВИК, ПРИКАЗ НА СЛУЧАЈ

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Abstract

Introduction. Aortic coarctation (CoA) is considered not only a circumscript narrowing of the aorta, but a part of a generalized vascular disease. Complications include early CAD, heart failure, CVI, Ao aneurism/ dissection and early death (in the III-IV decade).
Case report. A 42-year-old woman, who has undergone surgical correction of the coarctation at the age of 20 months, complains of fatigue, vertigo, instability, intermittent claudication, frequent chest pains associated with BP above 130/80mmHg, tachycardia, extrasystoles, and headaches. She also complains of memory loss and inability to concentrate when her BP is lowered. Physical examination revealed a systolic murmur 2/6 (heard between the scapulas), left arm BP: 90/70mmHg, right arm BP: 130/80 mmHg. ECG: sinus rhythm, HR 85/bpm, QS form in V2-V5. CT angiography and heart ultrasound revealed restenosis with the narrowest part of the thoracic aorta being 10x12mm, with max gradient of 33mmHg and a mean gradient 18,3mmHg. Medical history notable for hypertension, hyperlipidemia, paroxysmal supraventricular tachycardia (HR of 180/min); SVES; paroxysmal atrial fibriloflutter (rapid ventricular conduction, HR of 180/min), generalized atherosclerosis, angina pectoris (positive treadmill test), circulatory insufficiency of the left upper extremity and bilateral lower extremities (ABI right 0,75; ABI left 0,90), hypoplastic left vertebral artery with grade IV Steal Sy, TIA with dysarthria and patent foramen ovale showed by TEE. Coronarography revealed no significant stenosis of the coronary and carotid arteries, the left subclavian artery and left vertebral artery 100% occluded. The patient is not a candidate for cardiovascular surgery or a vascular intervention due to the high probability of complications. Medications: Propafenone 300 mg t.i.d, Rivaroxaban 20 mg once a day, Rosuvastatin 20 mg once a day, Cilostazol 100 mg b.i.d.
Conclusion. Our aim was to highlight the complexity of this entity-coarctation of aorta, with it's variety of presentation in the clinical setings, especially in the postoperative course that significantly decrease patient's quality of life. This represents challenge on medical tretman in adult patient with operated aortic coarctation.

Key words: Aortic recoarctation, adult patient

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Апстракт

Вовед. Аортната коарктација (CoA) се смета дека не е само циркуларно стеснување на аорта, туку е дел од генерализирано васкуларно заболување. Компликациите вклучуваат рана КАБ, срцева слабост, ЦВИ, Ао аневризма/дисекција и прерана смрт (во III-IV декада).
Приказ на случај. 42 годишна жена, која имала хируршка корекција на аортна коарктација на возраст од 20 месеци, се жали на замор, вртоглавица, нестабилност, интермитентна клаудикација, чести градни болки при крвен притисок (КП) над 130/80 mmHg, тахикардија,екстрасистоли и главоболки. Таа, исто така, се жали на губење меморија и неспособност да се концентрира, кога КП е намален. Физикалниот преглед открива систолен шум 2/6 (интерскапуларно), КП на лева рака: 90/70 mmHg, десна рака: 130/80 mmHg. ЕКГ: синус ритам, СФ 85/мин, QSформа во V2-V5. КТ ангиографија и срцев ултразвук откриваат рестеноза на најтесниот дел на торакална аорта 10x12 mm, со максимален градиент 33mmHg и среден градиент 18,3 mmHg. Медицинската историја укажува на постоење хипертензија, хиперлипидемија, пароксизмална суправентрикуларна тахикардија (со СФ од 180/мин); предкоморни предвремени удари; пароксизмален претkоморен фибрило-флатер (со брзо коморно спроведување, со СФ од 180/мин), генерализирана атеросклероза, ангина пекторис (позитивен treadmill test),

циркулаторна инсуфициенција на левиот горен екстремитет и двата долни екстремитета (АБИ десно 0,75; АБИ лево 0,90), хипопластична лева вертебрална артерија со степен IV Steal Sy лево, ТИА со дизартрија и отворен foramen ovale прикажан на ТЕЕ. Коронарографијата открива дека нема сигнификантни стенози на коронарните и каротидни артерии, како и дека левата артерија супклавија и левата вертебрална артерија се 100% оклудирани. Пациентката не е кандидат за кардиоваскуларна хирургија или за васкуларна интервенција, заради голема можност за компликации.

Терапија. Тбл. Propafenone 300 mg двапати дневно, Тбл. Rivaroxaban 20 mg еднаш дневно, Тбл. Rosuvastatin 20 mg еднаш дневно, Тбл. Cilostazol 100 mg двапати дневно.

Заклучок. Наша цел беше да се потенцира комлексноста на клиничките наоди во постоперативниот тек на аортна коарктација, кои значајно го намалуваат квалитетот на животот на пациентот. Тоа, воедно, претставува предизвик во лекувањето на оперирана коарктација на аорта кај возрасен пациент.

Клучни зборови: аортна рекоарктација, возрасен пациент.

Introduction

According to Guidelines for the management of GUCH (2010) [1], aortic coarcation (CoA) is considered as part of a generalized arteriopathy, and not only as a circumscript narrowing of the aorta. Coarctation is the third most prevalent form of congenital heart disease [2,3]. CoA accounts for 5-8% of all congenital heart defects. The prevalence of isolated forms is about 3 per 10000 live births. There is a morphological spectrum of abnormalities, ranging from a discrete stenosis distal to the left subclavian artery to a hypoplastic aortic arch and isthmus, or long tubular stenosis of the descending thoracic aorta.

Coarctation can be considered a primary (native) phenomenon, or a recurrent event, secondary to previous repair. Although there are many parallels in the management of native and recurrent coarctation, the pathophysiological processes responsible for secondary coarctation are different, and this may affect the approach and outcomes of management. Furthermore, the outcome data following repair suggest that coarctation is far from cured in a significant proportion of cases. Restenosis is a potential consequence of any type of repair, and late hypertension is relatively common, even in the absence of residual or recurrent coarctation.

We can find (re)coarctation across the very wide age range and in variety of presentation, that is why our goal was to show a case report with operated aortic coarctation, but with very limited quality of live.

Case report

The patient is a 42-year-old female, who has undergone a surgical repair of the CoA at the age of 20 months in Ljubljana (1976) (sec.Clagett). She has a BSA of 1,9m^2 and hyperlipidemia. In the last two years, more notably in the last year, she complains of fatigue, vertigo, instability, difficulty with walking and prolonged standing, intermittent claudication at 200 m and numbness in the bilateral lower extremities.

She has frequent chest pains associated with BP above 130/80 mmHg, dyspnea, tachycardia, extrasystoles, headaches and left ocular palsy. She also complains of memory loss and inability to concentrate when her BP is lowered with a subjective feeling of drowsiness and nausea, which interfere greatly with her day to day activities.

She had her first hypertensive episode during her first pregnancy 17 years ago, with a BP of 180/120mmHg. She was hospitalized due to preeclampsia, associated with proteinuria and leg edema. She was prescribed antihypertensive medicine. The kidney ultrasound showed no abnormalities. The BP Holter showed poorly regulated hypertension with maximal values of 185/125 mmHg and an average BP of 150/95mg. In 01/2016 she suffered a transient ischemic attack with dysarthria and a BP of 170/105 mmHg. She was prescribed amlodipine, nebivolol and enalapril, but she states that she felt unwell with the medications.

Physical examination revealed a systolic murmur 2/6 (heard between the scapulas), left arm BP: 90/70 mmHg, right arm BP: 130/80 mmHg. Systolic BP left leg (a. tibialis post.) 85 mmHg, systolic BP right leg (a. tibialis post.) 90 mmHg. ECG: sinus rhythm, HR 85/bpm, QS form in V2-V5, with low-voltage R waves in all standard and precordial leads.

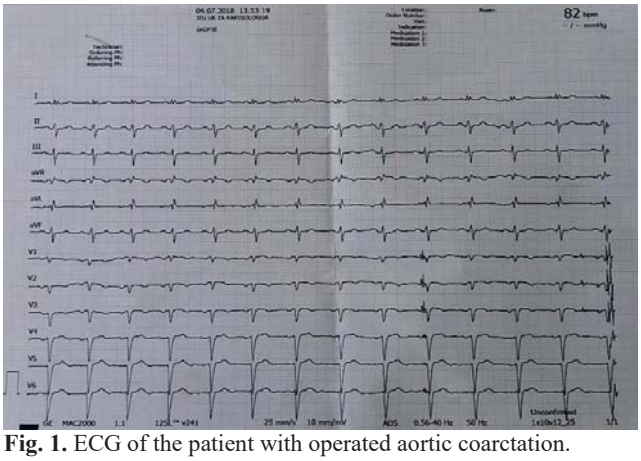

Fig. 1. ECG of the patient with operated aortic coarctation.

The rhythm holter showed frequent episodes of PSVT with a HR of 180/min; frequent SVES, singles, in pairs or often in continuous runs; paroxysmal atrial fibriloflutter with rapid ventricular conduction, HR of 180/min.

The exercise test was highly indicative of CAD, with a short duration of just 3 mins, only 30% of the car-

diovascular capacity was reached, with a horizontal ST depression in the inferior leads, maximal HR of 166/min, BP did not rise accordingly.

The heart ultrasound showed normal global systolic left ventricular function, with hypokinesis of the apical and basal segment of the inferior wall. The GLS was -14,8%. The left atrium was enlarged. There was sclerosis of the aortic valve with fusion of the right coronary cusp and the noncoronary cusp, pointing to a functional bicuspid valve. There was mild aortic and mitral regurgitation noted. The narrowest part of the thoracic Ao was 11-12mm. The flow speed was increased, with a maximal gradient of 33,7mmHg and a mean gradient of 18,3mmg, with a high likelihood of restenosis. The IAS was thinner at the level of fossa ovalis.

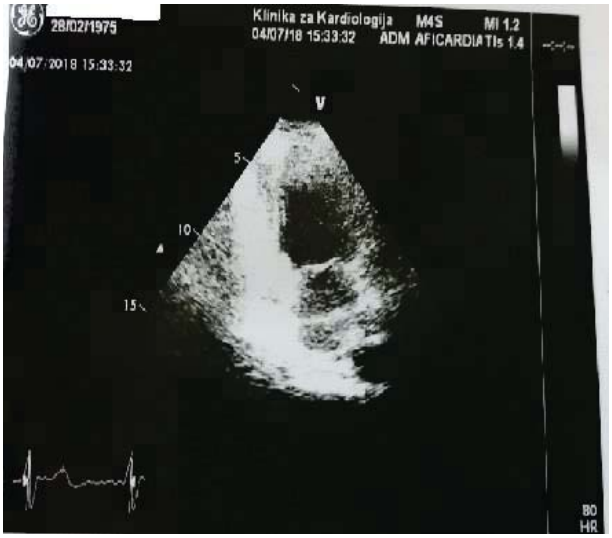

Fig. 2. Hypokinesia of the inferior wall

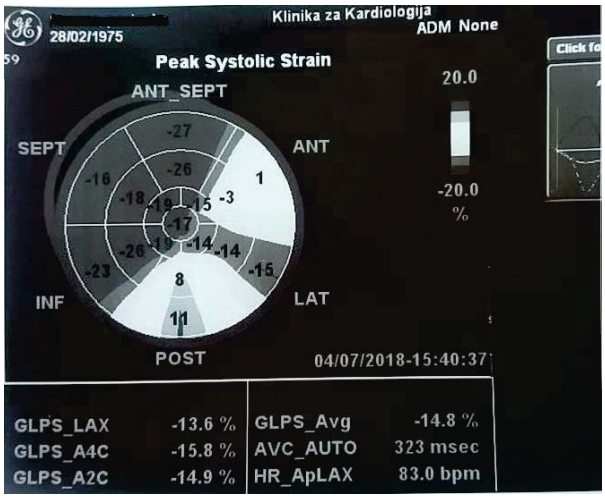

Fig. 3. Reduced Global Longitudinal Strain -14,8% (2-CH view)

CT angiography revealed that the Ao descendens is narrower (15-16 mm) and tortuous distal to the origin of the left CCA, with restenosis on the narrowest part of the thoracic aorta-10x12 mm and a dilatation distally to the narrowing-22 mm. The ascendant aorta is 30 mm, and the arch 20 mm, both with borderline dimensions, hypoplastic. The left subclavian artery cannot be visualized from the standard points of view, but can be seen from the level of the left vertebral artery, appearing grossly hypoplastic and fragile, with retrograde filling from the left ECA. The left vertebral artery is also hypoplastic and fragile, with a diameter of 1mm. A prominent right vertebral artery with a diameter of 4mm.

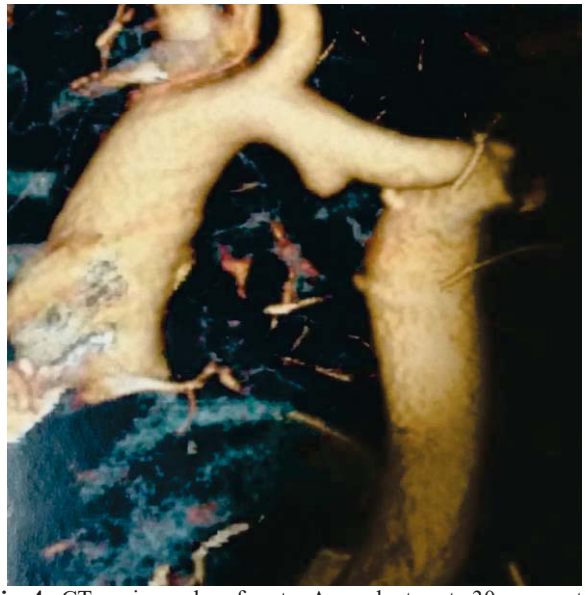

Fig. 4. CT angiography of aorta: Ascendant aorta 30mm, aortic arch 20mm, both hypoplastic
Ao descendens narrower (15-16 mm) distal to the origin of the left CCA, restenosis on the narrowest part of the thoracic aorta-10x12 mm, dilatation distally to the narrowing -22 mm. Left arteria subclavia missing.

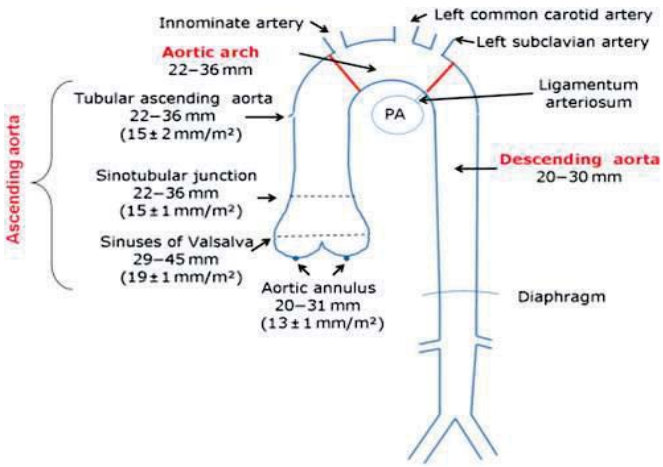

Fig. 5. Normal values of the aorta

Carotid Doppler: shows a hypoplastic and fragile left vertebral artery, with a diameter of 1mm, grade IV steal phenomena is noted. The right vertebral artery is dominant, with a diameter of 4mm with anterograde filling, tortuous. Mild atherosclerotic lesions on both carotid arteries. CCA with a thickened IMT.

Doppler of the upper and lower extremities: circulatory insufficiency of the left upper extremity (abnormal signals of the left brachial artery) and bilateral lower extremities (ABI right 0,69; ABI left 0,90), supporting the intermittent claudication.
CT of the peripheral blood vessels: showed very fragile arteries of the bilateral lower extremities.
Transesophageal echocardiography: revealed patent foramen ovale.
Coronarography: No significant stenosis of the coronary and carotid arteries. The left subclavian artery and left vertebral artery are 100% occluded.The patient is not a candidate for cardiovascular surgery or a vascular intervention due to the high probability of complications.
Neurological examination: Vertigo, with abnormal conduction through the peripheral auditory pathways and a positive Romberg test.
The orthopedic surgeon concluded that the difficulty standing and walking are not of spondylogenic or neurogenic origin.
In the course of the treatment, due to hypermenorrhea, we discontinued the baby aspirin. Since the diagnosis of AFF episodes, we put the patient on Rivaroxaban 20 mg once a day. The patient was also prescribed Propafenone 300 mg t.i.d. for rhythm control (the patient has stated that she feels unwell when on β-blockers). Additionally, she was prescribed Rosuvastatin 20mg once a day and Cilostazol 100 mg b.i.d. She was recommended regular follow ups for management of the hypertension and other CV risk factors, reassessing of the aortic restenosis and monitoring for the complications such as aortic dilatation and dissection and early onset of CAD.

Discusion

CoA is typically located at the insertion site of the ductus arteriosus, but it often varies. The most important notion is, if the ductus arterious is opened or closed, and it's location-proximally or distally of the coarctation. With preductal coarctation, the narrowing is proximal to the ductus arteriosus, it typically presents in infancy (infantile form) and if severe, usually presents in the first three weeks of life. In ductal coarctation the narrowing occurs at the insertion of the ductus arteriosus and usually appears when the ductus arteriosus closes. In postductal coarctation (adult form) the narrowing is distal to the insertion of the ductus arteriosus. This latter form is most common in adults and may be diagnosed incidentally for the presence of a cardiac murmur, hypertension, headache and lower limb muscle weakness.
In most cases, the coarctation is located distal to the origin of the left subclavian artery, thus the patients experience the typical symptoms with high BP in the upper limbs and low BP in the lower limbs. In certain instances, the coarctation may involve the left subclavian artery or lie proximal to it. This rare occurrence of a presubclavian coarctation was first described by Theron Clagett (1957), and the surgical protocol for the repair of this type of coarctation, is named after him. In his research paper, out of the 223 patients he included with surgical repair of coarctation at the Mayo Clinic, only six had presubclavian coarctation [4]. In these 6 patients it was surgically warranted that the left subclavian artery was removed along with the ligamentum arteriosum and the coarctation. With the exception of only one patient who had a patent ductus arteriosus and a right-left shunt and expired shortly after surgery, the other 5 patients had a good outcome from the surgery. Due to the presubclavian localization of the coarctation, our patient underwent the same surgery at the age of 20 months.
Aortic coarctation is part of a complex vascular disease. 'Cystic medial necrosis' (medial degeneration) with early elastic fibre fragmentation and fibrosis was found in the ascending and descending aorta, resulting in an increased stiffness of the aorta and carotid arteries [5,6]. CoA associated functional anomalies, include lowered baroreceptor activity, reduced arterial reactivity and compliance, and increased arterial stiffness in the vasculature. It is likely that these changes contribute to the pathophysiology of hypertension [7].
Seifert BL. and al. rated the stiffness index of the proximal descending aorta (precoarctation) and its relation to Doppler-derived pressure gradients obtained by continuous wave Doppler, and invasive catheter pressure gradients. They found that increasing the stiffness of the precoarctation segment also increased the degree of acceleration of flow velocity toward the coarctation, so the pressures and gradients in this segment increased also. Continuous wave Doppler instantaneous pressure gradients overestimated the catheter instantaneous pressure gradients [8].
DeGroff CG. and al. show that the degree of antegrade diastolic flow (diastolic runoff) noted on spectral Doppler tracings is dependent on lesion severity, saying that the presence of this spectral Doppler pattern is as much related to the severity of coarctation as it is with changes in aortic compliance. They developed three computational numeric models of coarctation with high, low, and no wall compliance. Flow simulations run representing high and low flow states. In both the low and high-flow states, the degree of diastolic runoff increased with increasing vessel compliance. Increased aortic compliance brings greater dilatation of the precoarctation aorta in systole, resulting in a persistence of stored upstream energy. This stored energy, released downstream in diastole, as the precoarctation aortic walls contract, leads to increased degrees of diastolic runoff [9].
CoA hemodinamicaly contributes to significant after load on the LV, manifested by increased wall stress, compensatory left ventricular hypertrophy, the development of arterial collaterals and finaly LV dysfunction.

Clinical features include upper body systolic hypertension, lower body hypotension, a blood pressure gradient between upper and lower extremities (>20 mmHg indicates significant CoA), radio femoral pulse delay. Cardiac catheterization with manometry (a peak-to-peak gradient >20 mmHg indicates a haemodynamically significant CoA in the absence of well-developed collaterals), and angiocardiography is still the gold standard for CoA evaluation at many centres before and after operative or interventional treatment.

Whereas blood pressure usually normalizes for a time after successful repair, one third of CoA patients develop hypertension (HTN) by adolescence and 90% by middle age. The pathogenesis of the later onset HTN remains poorly understood. Possible explanation may lie with the mechanical obstruction caused by the restenosis, the structural changes in the walls of the central and peripheral blood vessels, the lowered baroreceptor activity, abnormal function of the RAA system, higher catecholamine levels, essential hypertension, hypoplasia of the aortic arch and the occurrence of HTN during physical activity. The likelihood of HTN is higher if the patient was older and had HTN prior to surgery.

According to Guidelines beta-adrenergic receptor blockers have been established for HTN terapy in CoA preoperatively and postoperatively. If no residual arch obstruction exists, ACE inhibitors or angiotensin II antagonists may be added if hypertension persists despite beta-blocker therapy.

What concerns of treatment, aortic coarctation can be repaired surgically or percutaneously (catheter interventional treatment). The decision should be made according to the anatomy and location of the coarctation, age of the patient, presence of other cardiac lesions, and other anatomic determinants (extensive collaterals or aortic calcification). In native CoA with appropriate anatomy, stenting has become the treatment of first choice in adults in many centres. For adults with recurring or residual CoA, angioplasty with or without stent implantation has been shown to be effective in experienced hands if anatomy is appropriate. The operative techniques are still used and are necesery in many situations. Re-CoA repair in adults can be complicated, and ascending-to-descending aorta conduits may be preferable in cases of difficult anatomy. Although the surgical risk in simple CoA may currently be <1%, it increases significantly beyond the age of 30-40 years. Associated problems that may require intervention have to be considered: aneurysm of the ascending aorta with a diameter >50 mm [>27.5 mm/m2 body surface area] or rapid progression; aneurysm at the previous CoA site; aneurysms of the circle of Willis or associated significant aortic valve stenosis or regurgitation [1]. Acording to the Guidelines [1] indications for intervention in coarctation of the aorta as class I C is: All patients with a non-invasive pressure difference >20 mmHg between upper and lower limbs, regardless of symptoms but with upper limb hypertension (>140/90 mmHg in adults), pathological blood pressure response during exercise, or significant LVH should have intervention.

Vimalarani A. and al (2018) reported an 56 year old adult patient, with surgically corrected coarctation with Dacron tube graft (16 mm x 20 mm) at 21 years of age. He was admitted for angina pectoris, hypertension, and exertional dyspnea, so coronary angiogram revealed left anterior descending artery and diagonal disease, which were stented. Because of the severe stenosis at the proximal and distal anastomosis of the Dacron tube graft, they deployed covered stent inside the Dacron graft. The use of covered stents has expanded for native and recurrent CoA, because they can prevent or deal with the complications of aneurysm formation and stent fractures, or tortuous lesions [10]

Despite apparently successful repair of the obstruction, however, individuals with a history of CoA demonstrate excess morbidity and premature mortality (in the III-IV decade) associated with hypertension (HTN), cerebrovascular accident, coronary arterydisease, heart failure and aortic dissection/rupture. These adverse outcomes are independent of the severity of the original obstruction, type of treatment or restenosis. Presbitero *et al*., showed that patients with repaired coarctations still died, on average, at a much earlier age than the general population [11]. Since then, researchers have been trying to examine the cause of this excess mortality. Multiple studies have shown the main cause of death in patients with corrected CoA is coronary artery disease (CAD) [12,13] saying that CoA is associated with accelerated or premature CAD despite repair.

Roifman *et al*. (14) identified 756 individuals diagnosed with CoA and 6471 with ventriculoseptal defect (1983-2005). They compared the rate of cardiovascular diagnoses in age-matched CoA and ventriculoseptal defect cohorts (median age 30 years). The CoA group had significantly greater rates of HTN (45% vs 16%), CHF (15% vs 7%), peripheral vascular disease (13 vs. 2.7%), and stroke (5.5% vs 2.6%; $P<0.0001$ for all) and hyperlipidemia (4.0 vs. 2.4%, p=0.01). CoA patients also had higher CAD (4.9% vs3.5%), but this was not statistically significant after adjusting for the greater prevalence of CAD risk factors: HTN, hyperlipidemia, and male sex in the CoA group. The authors conclude that CoA is not an independent risk factor for CAD. We also saw that prevalence of cardiovascular comorbidities remains so high in CoA patients. So it is emphasized the need for treatment of cardiovascular risk factors such as HTN and dyslipidemia in CoA patients to prevent the late complications, but is not entirely clear that standard risk factor treatment is effective in reducing the occurrence of CAD and stroke in CoA. The 4.9% prevalence of CAD in this analysis (2005) is very similar to historical observations of

5.1%, reviewed by Verheugt *et al*. [14] The 5.5% prevalence of cerebrovascular disease in this study is actually greater than earlier estimates [15]. So we can't conclude that conventional treatment prevents coronary and cerebrovascular disease in CoA patients.

Dendramis G. and al describe a case of a 63-year-old man, admitted for acute coronary syndrome. During the cardiac catheterization with right femoral artery access and aortography they accidentally found significant coarctation at the level of the thoracic aorta. With a transradial right approach they treated the culprit lesion critical stenosis (80%) of the proximal left anterior descending artery and subocclusion of the distal circumflex artery. He pointed that it is possible that CoA can go unnoticed for many years and can be diagnosed accidentally after the onset of its complications [16].

The incidence of CAD in CoA patients, makes a relation to postulated vascular reactivity abnormalities in CoA. Several studies have shown that CoA patients may have higher rates of persistent endothelial dysfunction, increased levels of pro-inflammatory cytokines and vascular stiffness and these intrinsic vascular abnormalities may persist even after repair, so they can potentially predispose to the development of CAD regardless of repair.

Raneem F. and al (2018), reported of total transcatheter approach including stenting of severe coarctation of the aorta (CoA) located 16 mm distal to LSA, transcatheter aortic valve replacement (TAVR) for severe aortic bicuspid valve stenosis, and percutaneous coronary intervention (PCI) to treat significant coronary artery disease (significant proximal left anterior descending (LAD) stenosis) in a high risk elderly patient. They report a 70-year-old female, with significant comorbidities: uncontrolled hypertension and acute decompensated heart failure on admission, type 2 diabetes mellitus, chronic obstructive pulmonary disease, and severe calcifications of the ascending aorta. The procedures were successfully performed and the patient was asymptomatic at follow-up [17].

In the recent years there is a progress in elucidating the genetic origins of CoA and related cardiovascular deseases as a key to identifying individuals at risk for complications.

There are findings that the combination of CoA and bicuspid aortic valve (BAV) ocured in male sex more frequently. Girls and women with a single X chromosome (Turner syndrome) demonstrate prevalence of hypoplastic left heart estimated at 10%, aortic coarctation at 12%, and BAV at 30% [18].

Tagariello A. and al reported mutations in the Y-chromosome allele of transducin ß–like protein 1 (*TBL1Y*) in 2/83 study subjects with CoA [19]. This gene is located in a Yp region and variation in this locus correlates with atherogenic lipid profiles in men [20]. Roifman et al report in his study a significantly higher prevalence of hyperlipidemia in CoA versus ventriculoseptal defect patients. These recent developments indicate that further studies focused on the sex chromosome short arms, could be productive in illuminating the genetic male predisposition to both CoA and CAD.

Conclusion

Our aim was to highlight the complexity of this entity -coarctation of aorta, with its variety in clinical presentation, especially in the postoperative course. Even with a good postoperative outcome, most patients' still have a decrease in the quality of life, making the future medical treatment of these patients a significant challenge.

Conflict of interest statement. None declared.

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