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Comparison of conventional electrocautery vs Plasmablade™ for internal thoracic artery harvesting

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ABSTRACT

Objectives: In this study, we aim to investigate whether internal thoracic artery harvesting with the PlasmaBlade™ is more effective and safer than electrocautery in preserving the integrity of the intima and pedicle of the internal thoracic artery.

Patients and methods: Between January 2014 and March 2014, a total of 40 patients were randomized to undergo internal thoracic artery harvesting with the PlasmaBlade™ (group 1; n=20) or electrocautery (group 2; n=20). Internal thoracic artery sections (intima and pedicle) were stained with hematoxylin-eosin, van Gieson's and Masson's trichrome stains. Their integrity was morphologically assessed using the light microscopy.

Results: Histological examination showed that endothelium was well preserved and endothelial injury scores were significantly lower in group 1, compared to group 2 (p=0.020). Bleeding scores for the vessel wall and the pedicle were also significantly lower in group 1, compared to group 2 (p=0.020). The mean injury zone width was significantly shorter in group 1 (0.335 mm and 0.730 mm in group 1 and 2, respectively) (p=0.000).

Conclusion: The PlasmaBlade™ is safer and more effective in preserving the integrity of the intima and pedicle of the internal thoracic artery than electrocautery for internal thoracic artery harvesting in coronary artery bypass grafting. A well-preserved endothelial function may provide higher graft patency rates.

Keywords: Coronary artery bypass surgery; electrocautery; graft harvesting; internal thoracic artery.

After Kolesov performed the first internal thoracic artery (ITA) - left anterior descending artery (LAD) anastomosis,[1] ITA was recognized as the most optimal conduit for coronary artery bypass grafting (CABG). Thanks to its positive effects on early and long-term patency rates and high cardiac survival rates, it has been explicitly suggested by many authors.[2] Despite the developments in transcatheter methods and new generation drug eluting stents, it is still incomparable with other alternative methods in terms of the patency rates of LAD-ITA anastomosis.[3]

Internal thoracic artery has a unique molecular and cellular resistance against atherosclerosis.[4,5] However, endothelial injury during harvesting may activate the coagulation cascade, thereby, leading to early graft thrombosis.[2] Furthermore, the endothelial injury may facilitate the atherosclerotic process, and, as a result, it may cause graft stenosis or occlusion in the long-term.[2] Therefore, the internal elastic lamina must be intact for a high-rate long-term ITA patency.

Internal thoracic artery harvesting with electrocautery has become a standard procedure since first described in 1967.[1] To further increase the utilization of this artery, a variety of topical and systemic vasodilator agents have been proposed and less invasive ITA harvesting techniques have been developed.[4-6]

The PlasmaBlade™ (PEAK Surgical, Inc., Palo Alto, CA, USA) which was developed to cause minimal thermal damage during tissue cutting and coagulation has been introduced as a novel surgical device with pulsed-plasma technology.[7-11]

In this study, we aim to investigate whether ITA harvesting with the PlasmaBlade™ is more effective and safer than conventional electrocautery in preserving the integrity of the intima and pedicle of the ITA.

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PATIENTS AND METHODS

Between January 2014 and March 2014, a total of 40 patients who were hospitalized for CABG were randomized to undergo ITA harvesting with the PlasmaBlade™ (group 1; n=20) or electrocautery (group 2; n=20). The socio-demographic and basic characteristics in respect of accompanying diseases are provided in Table 1.

The primary objective of our study was to find out whether Plasmablade is superior to electrocautery in means of preventing endothelial and perivascular connective tissue injury by histopathologic examination of the ITA samples under light microscope. The study protocol was approved by the Ankara Atatürk Training and Research Hospital Ethics Committee. A written informed consent was obtained from each patient. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Surgical technique

Internal thoracic artery graft harvesting was initiated with placing the ITA retractor following the median sternotomy. Endothoracic fascia was opened throughout the ITA. The conventional cautery (Valleylab™ Force FX™ monopolar electrocautery, Covidien; Mansfield, Mass) was used at a low-power (diatermy coagulation 20 W). In the other group, the PlasmaBlade™ was used. A special care was taken to avoid dissection, avulsion, or spasm during excision. The subclavian vein was exposed proximally to the ITA and the proximal branches of the ITA were divided. It was distally released up to 1 cm proximal to the bifurcation together with the accompanying satellite veins and fatty tissues. Homeostasis was implemented using hemostatic titanium clips on the ITA branches (SLS-Clip™ System Vitalitec International Inc., Plymouth, Massachusetts, USA). The branches were divided approximately 2 mm distal from the origin of the ITA. Following systemic heparinization for minimum three minutes, the graft was separated from the thoracic wall. The ITA segment was removed from the distal section of the ITA prior to use of the papaverine solution. Then, the papaverine solution is sprayed onto the graft and the ITA was kept in a warm papaverine and physiological saline-impregnated gauze. In our clinic, the bifurcation is kept in place to protect the sternal blood flow and collateral circulation. Approximately 1 cm long distal segment, the ITA is not used prior to bifurcation. The study specimens were obtained removing a 1 cm long ITA tissue proximal to this segment.

Pathological examination

The specimens were fixed in the solution containing 10% buffered formaldehyde. All specimens were sectioned, stained with hematoxylin-eosin (H-E), Masson's trichrome (MTK), and elastic van Gieson (EVG) stains and were examined under the light microscopy (Leica DM6000 B, Leica Microsystems Inc., Buffalo Grove, IL, USA). The specimens stained with MTK were examined to identify the extent of the thermal injury on the collagen in the vascular wall, while the specimens stained with EVG were analyzed to determine the impact of the thermal injury on elastine in the ITA wall. The specimens stained with H-E underwent histological examination.

Endothelial injury, congestion, free bleeding, and the width of the injury zone were evaluated in the histopathological examination under the light microscopy. Scoring systems which were described in previous studies were used.[12,13]

During the histopathological examination, endothelial injury was scored to be 0= no injury, 1= mild injury (slight desquamation in the endothelium, minimal exposure in the basal lamina), 2= moderate injury (intimal or endothelial contusion), and 3= severe injury (endothelial separation), regarding the endothelial cell loss, exposed basal lamina, and intimal and medial edema.

Congestion was scored to be 1, in case of congestion in 30% of the vascular structures; to be 2, in case of congestion in 60% of the vascular structures, and to be 3, in case of 90% or higher congestion of vascular structures.

Free bleeding was scored to be 1, in case of bleeding in less than 10% of the perivascular soft tissue to be 2, if it involves 20-50%, and to be 3, if it is more than 50%.

The width of the injury zone was examined to compare the impact of collateral thermal injury which the PlasmaBlade™ and conventional cautery caused in the soft tissues during dissection.

Statistical analysis

Based on the results of the preliminary power analyses, the obligatory sampling width required for the comparison of the endothelial injury between the groups was calculated as 40 with 20 patients in each

Table 1
The baseline and demographic characteristics of patients

	Group 1			Grup 2			
	n	%	Mean±SD	n	%	Mean±SD	*p*
Age (years)			60.40±7.94			61.30±8.05	0.724
Sex							0.342
Male	16	80.0		19	95.0		
Female	4	20.0		1	5.0		
Diabetes	11	55.0		7	35.0		0.341
Hypertension	11	55.0		10	50.0		1.000
COPD	1	5.0		1	5.0		1.000
Hyperlipidemia	9	45.0		9	45.0		1.000
ESRD	2	10.0		2	10.0		1.000
Cigarette smoking	11	55.0		10	50.0		1.000

SD: Standard deviation; COPD: Chronic obstructive pulmonary disease; ESRD: End stage renal disease.

group. In such case, the expected value for the power of the test was found to be approximately 81.31%.

Statistical analysis was carried out using SPSS for Windows version 15.0 software program (SPSS Inc., Chicago, IL, USA). The demographic data were expressed in mean ± standard deviation. The Mann-Whitney U test and Spearman's correlation analysis were performed. A *p* value of <0.05 was considered statistically significant.

RESULTS

The baseline and demographic characteristics of the patients are shown in Table 1.

The bleeding status was compared under four categories between two groups, as described above. The first, second, and third-degree bleeding were found to be 50%, 30%, and 20% in group 1 respectively. In group 2, the patients with no bleeding, first, second, and third-degree bleeding were found to be 5%, 10%, 25%, and 60%, respectively.

Using the Pearson's chi-square test, the patients with no bleeding were combined with the patients with first-degree bleeding in a single category and the patients were re-examined under three categories (Table 2). In group 1, less severe bleeding was seen, indicating a statistical significance (Fisher's exact test=7,860 and p=0.020) (Figure 1).

The mean width of the injury zone was 0.335 mm and 0.730 mm in group 1 and group 2, respectively (Figure 2). In group 1, the width of the injury zone was significantly lower (Student's t test=4.902 and p=0.000) (Table 3). Desquamation was also seen in the collagen tissue due to collateral thermal injury in the MTK stained ITA samples harvested with electrocautery (Figure 3).

Table 2
Bleeding scores of patients

	Bleeding				
	0 to 1	2	3	*Total*	*p*
Group 1					
Number	10	6	4	20	0.020
Percentage	50.0	30.0	20.0	100.0	
Group 2					
Number	3	5	12	20	
Percentage	15.0	25.0	60.0	100.0	
Total					
Number	13	11	16	40	
Percentage	32.5	27.5	40.0	100.0	

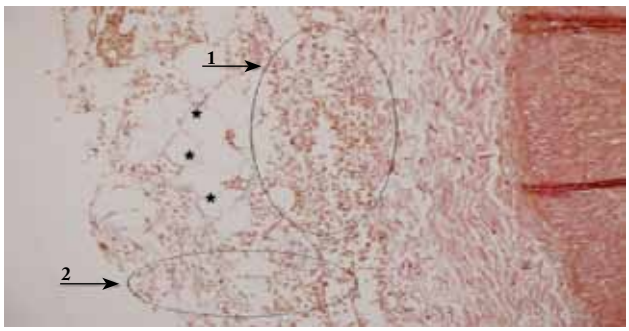

Figure 1. Normal fat cells (★), perivascular free bleeding (1) and minimal thermal injury (2) on the internal thoracic artery wall harvested with the PlasmaBlade™ (stained with elastic van Gieson, magnification x 20).

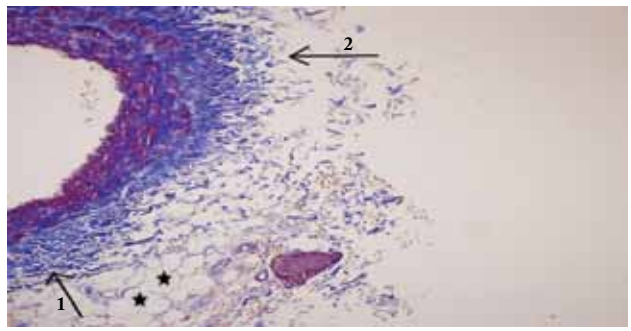

Figure 2. Regular collagen (1) and normal fat cell (★) and significant collagen disintegration (2) induced by thermal injury harvested with conventional electrocautery (stained with Masson's trichrome, magnification x 20).

No endothelial injury was observed in 95% (n=19) of the patients in group 1 and in 60% of the patients (n=12) in group 2 (p=0.020). In both groups, there was no second or third-degree endothelial injury (Table 4). Collateral heat did not cause damage to the collagen tissue in MTK stained ITA samples harvested with the PlasmaBlade™ (Figure 4).

When the congestion scores were reviewed, first-degree congestion was found in 45%, second-degree congestion in 50%, and third-degree in 5% of the patients in group 1, while these were found to be 20%, 65%, and 15% in group 2, respectively. The congestion scores of both groups are presented in Table 5.

The congestion was examined under three categories. Using the Fisher chi-square, the categories were combined to have two categories. However, there was no statistically significant difference in the congestion scores between the groups (p=0.605).

DISCUSSION

Since CABG was first brought into daily practice, several attempts have been made to develop an ideal graft. However, the superiority of the arterial grafts into the venous grafts was proven: the ITA was introduced in 1960s, and since then, it has been the optimal conduit of choice.[2,4,6,14-16] The ITA has higher long-term patency rates, compared to other grafts.[13-15] While the typical atherosclerotic changes and intimal hyperplasia can develop faster in the venous grafts, they are seen much rarely and later with the ITA grafts.[17-21]

Currently, one of the most commonly used techniques in the ITA harvesting is pedicled preparation of the conduit with the surrounding soft tissue, satellite veins, and endothoracic fascia.[2-4,14] This method facilitates harvesting and reduces the possibility of vascular injury.[4] In addition, sustainability of venous and lymphatic drainage ensures the protection of vasa vasorum and continued activity of the conduit.[4,5] Since the very first cases for CABG, it has been prepared using electrocautery.[22] The main goal of using electrosurgery is to ensure a clean and clear incision and coagulation with minimum collateral heat injury.[23,24] The PlasmaBlade™ tissue dissection devices are introduced as novel surgical devices with pulsed-plasma technology to avoid adverse effects of conventional electrocautery.[23,24] It has been developed to induce minimal thermal damage during the tissue dissection and coagulation and the device is called as PEAK® Surgery System together with PULSAR® Generator.[23-25] Most electrosurgical cutting tools use

Table 3
The width of injury zone of patients

	Number	Mean±SD (mm)	Mean±SE	*p*
Group 1	20	0.3350±0.25603	0.05725	0.000
Group 2	20	0.7300±0.25361	0.05671	

SD: Standard deviation; SE: Standard error.

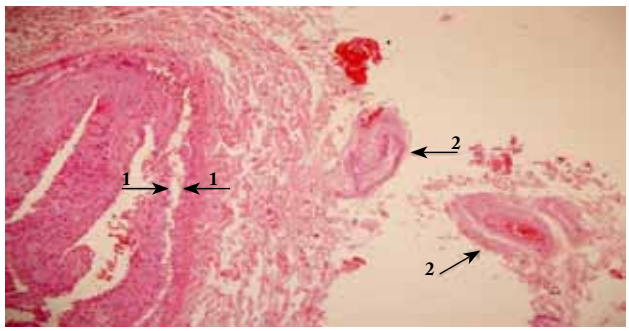

Figure 3. Disintegration of the internal thoracic artery wall (1) and cautery artefacts in small arterioles (2) induced by thermal injury harvested with conventional electrocautery (stained with hematoxylin-eosin, magnification x 10).

continuous radio-frequency (RF) waveforms which thermally vaporize the soft tissue through heating and via an electric arc.[23-25] This results in cutting and coagulation which leaves a wide zone of collateral thermal tissue damage. As the PlasmaBlade™ device receives RF energy in short pulses via a highly insulated cutting electrode, it has an ability to cut at a much lower mean temperature than conventional electrosurgery.[4]

Furthermore, the basic operating principle of this system is that it creates a vapor cloud with the device end contacting with the tissue. The ionization of the water molecules in the vapor cloud creates a specific environment for the dissection. It has been shown that the dissection is performed at a lower temperature (approximately 45 °C) with a lower power, a lower voltage, and a lower current due to the ionization of the water molecules.[23,24] The mean temperature for the conventional cautery is 250 to 350 °C.[23,24] Unlike conventional electrocautery systems, this device does not provide a fixed voltage. Its pulsed-voltage values ranging between +300 and -100 within nanoseconds ensure maximum ionization of the water molecules. As the device end is covered with a glass-based silicon agent, the active region becomes narrow and only the crescent-shaped region which is approximately 0.5 mm thick at the tip is active.[7-11] As the impedance of the tissue decreases within this specifically created environment, less tissue necrosis and thermal damage occur and such a dissection is obtained closer to that performed with a scalpel.[23-25]

A variety of preclinical and clinical studies were carried out in different surgical zones while and after developing the peak surgery system.[23] The studies were initially started with *in vivo* and *ex vivo* preclinical testing on animals and, then, clinical studies were performed.[23] It has been shown through these studies that such a dissection which has a scalpel precision and causes hardly any thermal damages at lower power levels can be performed using the PEAK surgery system and that the system has a hemostasis capability equal to the conventional electrocautery at higher power levels.[23]

No matter how much lower the power is kept in conventional electrocautery during ITA harvesting, the resulting collateral heat may cause damage to both the surrounding tissue and the ITA itself. The traction induced by the perivascular hematoma and electrocautery burn creates a local turbulent flow in the artery. Such turbulent flow may accelerate atherosclerosis due to the endothelial damage as previously reported in the literature and pose an adverse effect on the graft patency.[5] In our study, severe bleeding areas in the perivascular tissue were found significantly higher in the electrocautery group.

Table 4
The extent of endothelial damage of patients

	Endothelial damage			
	0	1	*Total*	*p*
Group 1				
Number	19	1	20	0.020
Percentage	95.0	5.0	100.0	
Group 2				
Number	12	8	20	
Percentage	60.0	40.0	100.0	
Total				
Number	31	9	40	
Percentage	77.5	22.5	100.0	

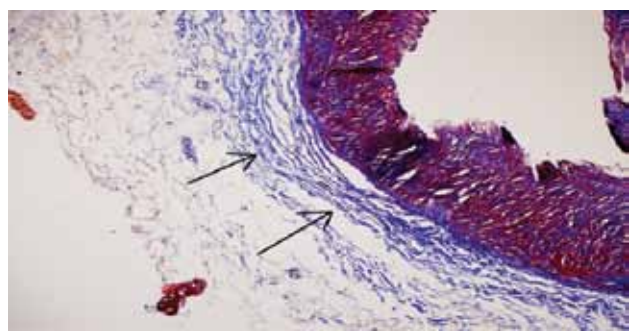

Figure 4. Normal collagen in the internal thoracic artery wall not affected by thermal injury harvested with the PlasmaBlade™ (stained with Masson's trichrome, magnification x 20).

Table 5
Congestion scores of patients

	Congestion				
	1	2	3	*Total*	*p*
Group 1					
Number	9	10	1	20	
Percentage	45.0	50.0	5.0	100.0	
Group 2					
Number	4	13	3	20	
Percentage	20.0	65.0	15.0	100.0	0.605
Total					
Number	13	23	4	40	
Percentage	32.5	57.5	10.0	100.0	

Therefore, we believe that less perivascular bleeding in the pedicle with the PlasmaBlade™ system may reduce the turbulent flow and increase the patency rates.

It has been shown that an intact elastic lamina following the ITA harvesting may prevent atherosclerosis. In our study, the width of the injury zone was found to be significantly lower in the patients treated with the PlasmaBlade™ rather than electrocautery. Thus, it suggests that the PlasmaBlade™ may reduce collateral thermal injuries, and accordingly, increase the graft patency rates.

In another study, Lehtola et al.[26] demonstrated that an endothelial injury and mural thrombosis developed, when the tip of the electrocautery contacted with the ITA wall or the hemostatic metallic clips, which might be a reason for early and late graft failures. In this study, histopathological examination of the electrocautery group revealed thermal damage-induced extensive cautery artefacts in the arterioles of the ITA.

Several preclinical studies have shown that the PlasmaBlade™ requires less than half of the energy produced in the conventional electrocautery devices to achieve similar dissection and coagulation results due to the advance level insulation of its electrode configuration, and its pulsed electric wave forms.[23] This ensures that the temperature during the procedure is less than half of the temperature of the conventional devices, thereby, providing a decrease in the heat transfer by more than a half and a decrease by 50 to 90% in the depth of the thermal injury of the surrounding tissues.[23] Similarly, in our study, the width of the injury zone and severe perivascular bleeding were significantly lower in the PlasmaBlade™ group than the conventional electrocautery group.

Moreover, postoperative sensorial abnormalities on the thoracic wall (i.e. hypoesthesia, hyperalgesia, and allodynia) are associated with the utilization of electrocautery, which may adversely affect the wound healing.[27] It is well-known that the surgical smoke impairs the image quality and the cautery smoke increases the risk of cancer.[28] In addition, the requirement for the cautery tip to be frequently cleaned may be challenging; however, more importantly, burn injuries have been reported in case of improper grounding.[28] In the literature, the advantages of the PlasmaBlade™ have been published.[23] Nonetheless, the ability of the PlasmaBlade™ to provide surgical hemostasis and its effects on postoperative bleeding and blood product utilization should be further evaluated in clinical studies. The major concern of bilateral ITA harvesting is the sternal wound infections, particularly in diabetic patients. Therefore, it should also be investigated whether the Plasmablade™ would make a difference in wound infections.

In conclusion, our study results suggest that the PlasmaBlade™ is safer and more effective in preserving the integrity of the intima and pedicle of the internal thoracic artery than electrocautery for internal thoracic artery harvesting in coronary artery bypass grafting. No matter how much easier electrocautery makes internal thoracic artery harvesting, therefore, novel technologies such as PlasmaBlade™ are needed to be developed to minimize side effects. A well-preserved endothelial function may provide higher graft patency rates.

Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

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Cardiovascular Surgery and Interventions

Case Report Open Access

A simple technique for reimplantation of an anomalous origin of the left coronary artery from the pulmonary artery in an adult

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ABSTRACT

An anomalous origin of the left coronary artery from the pulmonary artery (ALCAPA), which may cause the left coronary artery to grow with an anomalous origin from the pulmonary artery, is a rare disease associated with sudden cardiac death and ventricular arrhythmias in adults. Herein, we report a 43-year-old female case of ALCAPA syndrome as assessed by cardiac computed tomography angiography with three-dimensional reconstruction and echocardiography which was corrected by a simple surgical technique. We present this case due to its unusual presentation in an adult.

Keywords: ALCAPA; coronary artery; correction; surgery.

The anomalous origin of the left coronary artery from the pulmonary artery (ALCAPA), which was first described in 1866, is a rare congenital cardiac malformation affecting one of every 300,000 live births.[1] The first clinical description, in conjunction with autopsy findings, was described by Bland et al.[2] in 1933 and the rare congenital anomaly is also called as the Bland-White-Garland syndrome in the literature.

There are two types of ALCAPA syndrome: adult type characterized by well-established collaterals and infantile type characterized by no collaterals. Nearly 90% of infants who experience myocardial infarction and congestive heart failure die within the first year of life.[3] In the adult type, which is seen only 10 to 15% of patients, it may be an important cause of sudden cardiac death and ventricular arrhythmias.[3]

Herein, we present an unusual case of ALCAPA in an adult which was corrected by a simple surgical technique.

CASE REPORT

A 43-year-old woman was referred to our hospital with clinical continuous heart murmur. She had no previous history of cardiac diseases. On admission, she complained about palpitation during heavy exercises.

Physical examination revealed continuous murmur in the left side of the sternum. Chest X-ray showed cardiomegaly and transthoracic echocardiography demonstrated a normal right ventricle with a mildly dilated left ventricle. Left ventricular ejection fraction, measured in M mode, was 65%. No septal defects were found. Color Doppler imaging revealed only mild mitral regurgitation, which was likely to originate from the ventral side of the aorta with prominent laminar diastolic flow compatible with coronary artery flow. Conventional angiography demonstrated no coronary artery stenosis. A written informed consent was obtained from the patient.

Cardiac computed tomography angiography with three-dimensional reconstruction (Figure 1) and echocardiography demonstrated an anomalous origin of the left coronary artery (LCA) from the posterior pulmonary sinus of the main pulmonary artery (PA) with diffusely enlarged and tortuous coronary arteries.

Surgical technique

The heart was approached through median sternotomy. Cardiopulmonary bypass was established with standard aortic and bicaval venous cannulation. Moderate hypothermia (26 °C) was used. After both great arteries were clamped, cold blood cardioplegia

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was injected directly into the ascending aorta as well as into the PA. After both great arteries were detached and the PA was transected above the level of commissures, the anomalous LCA ostium was identified arising from the lateral aspect of the posterior-facing sinus. The anomalous LCA with a button of PA was excised. Despite significant mobilization, critical tension on the anomalous LCA persisted, as the distance between it and the aorta was much higher than anticipated. The PA is re-anastomosed at the side of the transection. The aortic cross-clamp was off. We prepared a 5 cm saphenous vein graft for the proximal portion of the saphenous vein anastomosis into the coronary button. We passed the saphenous vein graft through transverse sinus to the lateral aspect of the aorta. We put side-clamp and performed proximal anastomosis of the saphenous vein graft (Figure 2). The postoperative period was uneventful and the patient was discharged in the fifth postoperative day with anticoagulant regimen.

At the final follow-up visit, she was in New York Heart Association class 1. The postoperative left ventricular ejection fraction was around 60%.

DISCUSSION

A variety of surgical approaches have been proposed in adults with ALCAPA, including ligation of the LCA,

Figure 1. Cardiac computed tomography angiography with three-dimensional reconstruction showing the origins of coronary arteries. The left coronary artery originates from the pulmonary artery.

reimplantation of the LCA to the aorta, creation of an aorta pulmonary window with an intrapulmonary buffle (Takeuchi procedure), and a combination of LCA ligation and coronary artery bypass grafting.[4,5]

Recently, the first case of a giant aneurysm formation after Takeuchi procedure was reported.[6] In this case, a saphenous vein graft into the LCA was performed. The reported complications of Takeuchi repair include the development of PA stenosis at the intrapulmonary baffle, baffle leak, decreased left ventricular function, and mitral regurgitation.[6] Thus, late complications of the Takeuchi procedure are common.

In 1974, Neches et al.[7] were the first to describe the direct reimplantation of the anomalous LCA into the aorta by transferring it with a button of PA. However, direct reimplantation of the LCA may be technically more challenging and hazardous in adults due to its distant, less elastic, and friable nature of the coronary arteries.[8] Creative methods such as direct transfer, tubular reconstruction, and in situ transfer can be used in adults, regardless of the site of the LCA orifice.[9]

It is well known that ALCAPA in elderly is not suitable for direct reimplantation, unless the orifice of the LCA really close to the inner curvature of the aorta, which is extremely small in the minority of patients.[8] In this case, reimplantation of the LCA into the aorta was considered unfeasible due to the distance between the insertion site of the LCA on the PA and the aorta. The main advantage of this method is that the graft run in the anatomical groove behind the PA through transverse sinus.

Figure 2. Surgical technique of direct implantation of left coronary artery with a saphenous vein graft.
a: Saphenous vein graft; b: Aorta; c: Right coronary artery.

As we are aware of that the saphenous vein may not be fully patent like the internal thoracic artery in coronary artery bypass grafting, we used the possibly largest conduit - a saphenous vein graft - to match the size of the LCA in our case.

In conclusion, this technique provides tension-free venous graft for the transfer of anomalous origin of the left coronary artery from the pulmonary artery into the aorta, when the anomalous left coronary artery ostium is located at a distance from the aorta in adults.

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Cardiovascular Surgery and Interventions

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Plasmapheresis, intravenous immunoglobulin and fondaparinux treatment in heparin-induced thrombocytopenia after aortic and mitral valve replacement

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ABSTRACT

Heparin-induced thrombocytopenia is a complication associated with increased early mortality and major morbidity rates after open heart surgery. Herein, we present a case of heparin-induced thrombocytopenia with major hemodynamic deterioration following elective aortic and mitral valve replacement who was successfully treated with plasmapheresis, intravenous immunoglobulin, and fondaparinux.

Keywords: Heparin-induced thrombocytopenia; intravenous immunoglobulin; plasmapheresis; valve replacement.

Heparin-induced thrombocytopenia (HIT) is an uncommon complication with increased early mortality and major morbidity rates after open heart surgery.[1] Various treatment strategies, including intraoperative plasmapheresis, have been suggested in the treatment of HIT.[2] However, tailoring a treatment and management strategy for patients with postoperative HIT can be more challenging.

Herein, we present a case of HIT with major hemodynamic deterioration following elective aortic and mitral valve replacement who was successfully treated with plasmapheresis, intravenous immunoglobulin, and fondaparinux.

CASE REPORT

A 49-year-old female patient who was diagnosed with advanced mitral and aortic insufficiency was hospitalized for an elective procedure. Her medical history showed insulin-dependent diabetes, bipolar disorder with related medications, and prior use of immune suppressives and oral corticosteroids for rheumatoid arthritis. Angiography revealed normal coronary arteries. Preoperative laboratory values were as follows: urea 40 mg/dL, creatinine 0.97 mg/dL, hematocrit 40.6%, hemoglobin 13.1 g/dL, and platelets 311,000/μL. A written informed consent was obtained from the patient.

The patient underwent elective aortic and mitral valve replacement (21 mm and 29 mm, respectively; CarboMedics Inc, Austin, Texas, USA). Aortic cross-clamp time was 247 minutes, while total perfusion time was 282 minutes. Longer duration of cross-clamping was mainly due to challenging mitral exploration. In the operating room, the patient received a replacement of four units of erythrocyte suspension and three units of fresh frozen plasma solution. She was transferred to the intensive care unit (ICU) in stable condition under 10 μg/kg dobutamine, 4 μg/kg dopamine, and nitroglycerin with a temporary pacemaker in place due to bradycardia.

The patient developed signs of low output at sixth hours after surgery. Inotropic support was increased. Mechanical valve functions appeared to be normal on echocardiography. No localized bleeding or hematoma was identified. The patient underwent revision surgery. On her return to the ICU, the patient was oliguric to anuric with serum urea 57 mg/dL and creatinine 2.02 mg/dL. She underwent hemodialysis on the first postoperative day. In the ICU period, 450 mL fluid was drained on the day of surgery, 250 mL fluid was drained in the first postoperative day and 100 mL fluid was drained in the third postoperative day. Total amount of blood drainage from the chest tube was 800 mL. On the day of surgery, the patient was monitored in the ICU by routine blood gas parameters,

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hematocrit, hemoglobin levels, and drainage volumes. Neither concentrated erythrocyte suspension nor the fresh blood was necessary. Only two units of fresh frozen plasma were replaced. In the first and second postoperative days, one unit concentrated erythrocyte suspension was administered on each day.

The platelet count of the patient who was intubated and on daily hemodialysis with unfractionated heparin went into a rapid, progressive fall in the following days. Within the first four consecutive postoperative days, the platelet count was 48,000, 36,000, 16,000 and 10,000/μL, respectively. Diffuse ecchymotic rashes developed in the third or fourth day. These rashes were more prominent in the arms, neck around the catheter sites, and chest areas, which covered a relatively large area. Overall condition of the patient became worse. Blood hypoxia, aspiration of bloody fluid from the tracheal tube, hypotension, and ventricular tachycardia episodes were noted. Her clinical and laboratory findings under unfractionated heparin treatment made us suspect possible HIT condition due to dramatic fall in the platelet count, which was unable to be explained by any other means except the lack of massive bleeding or transfusions. Unfractionated heparin treatment was interrupted and substituted by low-molecular-weight heparin, fondaparinux (Arixtra® GlaxoSmithKline, Philadelphia, PA, USA), 2.5 mg subcutaneous administration at once. Upon the persisting hemodynamic deterioration, the patient was subjected to an emergency plasmapheresis (Prisma® TPE System, Gambro, IL, USA) in the fourth postoperative day. Plasmapheresis was repeated on the next day (in the fifth postoperative day). As recommended by the hematology consultant, intravenous immunoglobuline-IVIG (Pentaglobin® Biotest Pharma GmbH Dreieich Germany) was also administered as 50 mL on the sixth and seventh postoperative days. Following the treatment, the patient was hemodynamically stabilized with reduced hypoxia. The platelet count gradually increased, reaching 57,000, 66,000 and 71,000/μL in the sixth, seventh, and eighth postoperative days, respectively. The heparin-PF4 (platelet factor 4) antibody was found to be positive (STic Expert® HIT Diagnostica Stago SAS, Asnières sur Seine France) as assessed by the rapid lateral flow immunoassay (LFIA) method at a private laboratory.[3,4]

Renal functions also returned to normal after eight hemodialysis sessions. Fondaparinux treatment continued for a total of 17 days. Oral anticoagulant treatment, which was initiated when tracheostomy was practiced, continued afterwards. No bleeding complicated the fondaparinux treatment. Mechanical valve functions remained normal as confirmed by echocardiography. The tracheostomy cannula was removed in the 25th postoperative day. A slight, circumscribed, cutaneous, and subcutaneous seropurulent discharge from the sternal incision wound healed progressively with wound care and systemic antibiotherapy. The platelet count on the day preceding discharge from the hospital was 233.000/μL.

The patient was discharged in a stable condition in the 42nd postoperative day.

DISCUSSION

Heparin-induced thrombocytopenia occurs in 0.2 to 2% of cases of open heart surgery.[1,5,6] Suspecting HIT is the first step in diagnosis of the disease in cardiac surgical patients.[7] Taking into account for the other causes that may lead to drop in platelets, clinican should suspect for HIT in the findings which are unexplained thrombocytopenia, venous or arterial thrombosis in the presence of thrombocytopenia, necrotic skin lesions at heparin injection sites and acute anaphylactoid reactions after IV boluses of heparin.[7] Unlike cases with previous history of HIT, it can be more challenging to diagnose and establish a standard protocol for those with postoperative worsening of hemodynamic parameters.

In our case, HIT diagnosis was based on the clinical and laboratory findings. The 4Ts scoring system[8] was used in the clinical evaluation. The patient had a low-risk score of three, platelet nadir <10,000, 1 point; non-necrotizing widespread skin lesions, 1 point; and possible other causes of thrombocytopenia (rheumatoid arthritis), 1 point. The anti-PF4/heparine antibody was positive. Although pretest scores were low, clinical and routine laboratory findings with confirmed antibody positivity suggested HIT.

In addition, several conditions may cause or aggravate thrombocytopenia including extended total perfusion time, dialysis treatment, and history of rheumatoid arthritis requiring immunosuppressive treatment as in our patient. However, the decrease in the platelet counts during postoperative period was beyond expectations in our case who was on heparin treatment. The preoperative platelet count was 310,000/μL, whereas it was 48,000, 36,000, 16,000, and 10,000/μL in the

first, second, third, and fourth postoperative days, respectively. Simultaneously, ecchymotic eruptions appeared in the arms and neck around the catheter sites, which disseminated to the legs, chest, and abdomen over the next days. The patient's response to the treatment also supported the diagnosis of HIT. Following the discontinuation of heparin treatment, low-molecular-weight heparin treatment was initiated. Also, after plasmapheresis and intravenous immunoglobulin treatment, hemodynamic, laboratory, and clinical findings showed a rapid improvement. The amount of drainage was negligible and no massive blood transfusion was required. The thrombocyte count was 10,000/μL in the fourth postoperative day. However, after low-molecular-weight heparin was initiated, it increased to 57,000, 66,000, and 71,000 in the sixth, seventh, and eighth postoperative days, respectively. The clinical presentation of the patient and her responsiveness to the treatment, altogether, suggested HIT. Based on the anti-PF4/heparine antibody positivity, the condition was confirmed as HIT.

In the literature, some authors advocate that HIT diagnosis should not be eliminated in patients with low 4Ts scores[9,10] In a study in which surgical ICU patients were analyzed, the rate of HIT positivity was 8.6% in patients with a 4T score between 0 and 3, while the rate of HIT negativity was 57% among those with a score higher than 3[11] These results may raise a question on the reliability of the 4Ts scoring system.[11] Although both pretests and laboratory findings have some limitations, it is rare that both fail simultaneously.[9] In all patients with clinically suspected HIT, the detection of the anti-PF4/heparine antibody is required.[12]

In our case, we administered plasmapheresis in the fourth postoperative day, as the clinical worsening was apparent. Plasmapheresis was repeated on the following day. Treatment was followed by improved hemodynamic parameters and arrest of bleeding. In general, plasmapheresis recommendations for HIT following open heart surgery involve the postoperative period.[13] There is, however, no established treatment protocol. In a study, 11 patients with history of HIT underwent intraoperative plasmapheresis to reduce the antibody load.[2] Plasmapheresis was followed by the placement, under cardiopulmonary bypass, of a permanent left ventricular assist device in a patient with hemodynamic instability and acute viral myocarditis was reported in another case.[14] Therefore, we believe that the postoperative administration of plasmapheresis might play a critical role for the improved status of our case.

Furthermore, unfractionated heparin was substituted by fondaparinux in the fourth postoperative day due to worsened hemodynamic status and HIT-targeted treatment was, then, initiated. The platelet count increased within 17 days of treatment and no bleeding occurred. Bedside echocardiography showed no valvular problems. Current guidelines also indicate that fondaparinux may be used as an alternative agent in HIT treatment.[15] Fondaparinux doesn't enhance the platelet activation effect of HIT sera and could be used as a treatment for HIT.[16] In addition, a successful therapeutic use of fondaparinux was previously reported in a HIT case following the implantation of a left ventricular assist device.[17] We, therefore, suggest that fondaparinux may be used as an alternative intravenous anticoagulation agent in cases of HIT following mechanical valve replacement.

After consulting to a hematologist, we administered intravenous immunoglobulin in the sixth and seventh postoperative days. Intravenous immunoglobulin is often considered to be safe and effective, when used in open heart surgery cases with immune dysfunction accompanied by thrombocytopenia.[18] Similarly, we believe that the administration of intravenous immunoglobulin following plasmapheresis might contribute to the improved clinical status of our case.

In conclusion, the substitution of fondaparinux for unfractionated heparin and treatment with plasmapheresis and intravenous immunoglobulin may improve clinical and laboratory findings. Considering the long-term anticoagulant efficacy of fondaparinux and possible merits of plasmapheresis and intravenous immunoglobulin, the treatment which we used may be applicable for those with heparin-induced thrombocytopenia accompanied by compromised hemodynamics following mechanical heart valve replacement.

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Cardiovascular Surgery and Interventions

Case Report Open Access

Refractory anemia and myxoma after radiofrequency ablation: a case report

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ABSTRACT

Recently, atrial fibrillation has been widely treated by percutaneous radiofrequency ablation. Local alteration in milieu due to myocardial inflammation after the procedure may cause well-known complications, such as perforation and thromboembolism. Herein, we present a case of myxoma with a sudden onset of symptoms with refractory anemia diagnosed one year after radiofrequency ablation procedure.

Keywords: Anemia; inflammation; myxoma; radiofrequency catheter ablation.

Percutaneous radiofrequency ablation (RFA) is preferred treatment for drug-resistant, permanent or paroxysmal atrial fibrillation (AF).[1] Related complications, mainly thromboembolism, are seen about 1 to 5% of cases.[2] Myxomas are the most common primary neoplasms of the heart and they typically occur in the left atrium (LA) with attachment to the interatrial septum.[3] Dyspnea, thromboembolism, and constitutional symptoms are the classical triad of myxomas.[3] In the literature, such cases are rarely reported to occur after cardiac injuries.[4] Herein, we present a case of atypical left atrial myxoma with a sudden onset of symptoms with refractory anemia diagnosed one year after RFA procedure.

CASE REPORT

A 55-year-old female patient followed for chronic refractory anemia for the past eight months was consulted by a hematologist for the giant left atrial mass which was detected by computed tomographic pulmonary angiography with suspected pulmonary thromboembolism (Figure 1). Her medical history revealed percutaneous RFA after several attacks of AF. Preoperative echocardiographic findings were normal. She was lost in the follow-up period after palpitation-free three months. Four months after the procedure, she was diagnosed with refractory anemia as confirmed by the further tests including proinflammatory cytokines and bone marrow aspiration. Plasma interleukin-6 (IL-6) increased from 46 pg/mL to 210 pg/mL within eight months. A written informed consent was obtained from the patient.

The transthoracic echocardiography showed a giant myxoma filling the LA which was protruding through the mitral valve into the left ventricle during diastole (Figure 2). The rhythm was new-onset AF and hemoglobin level was 7.4 mg/dL preoperatively. She was operated within two days of admission. After transseptal exploration of LA, we excised the myxoma with its pedicle attached to the superior margin of the left superior pulmonary vein. She was discharged on the sixth postoperative day with an uneventful recovery. Her hemoglobin level was 11.8 mg/dL and IL-6 level was within normal range at three months.

DISCUSSION

Percutaneous RFA has been widely used as the first-line therapy for symptomatic patients with AF.[1] Serious complications, including thromboembolic events, are likely to be seen in 1 to 5% of RFA cases.[2] Left atrial masses after the procedure should be considered in the differential diagnosis of thrombi, infective endocarditis, and myxomas.[4] Prothrombotic markers with other inflammatory mediators typically increase within first week and most thromboembolic events occur within two weeks after RFA.[5] Therefore,

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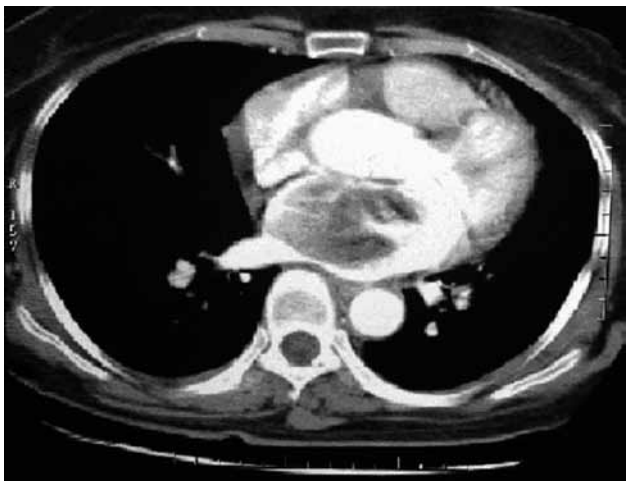

Figure 1. Computed tomographic image of the left atrial mass filling the left atrium.

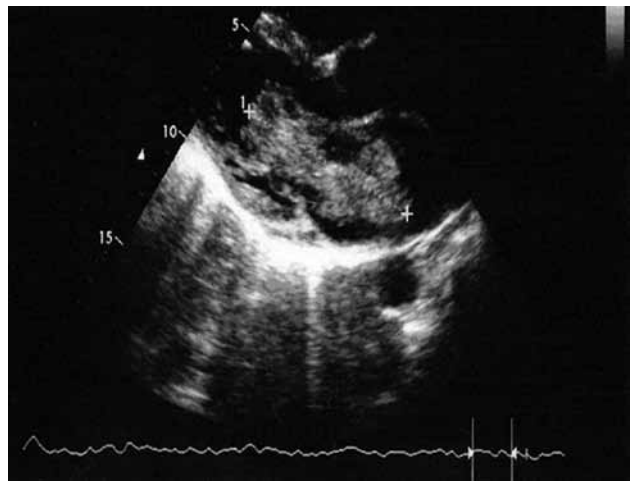

Figure 2. Echocardiographic view of a myxoma protruding into the left ventricle.

procedure-related late thrombus formation in cardiac chambers is not expected, unless AF recurs.

In addition, RFA produces myocardial necrosis to prevent signal transmission through the accessory pathways and, precisely, pulmonary vein isolation is the main target.[1] Some inflammatory cytokines have been studied to determine RFA-induced myocardial injuries and baseline procedural high-sensitivity CRP values are proposed to be independently predictive of AF recurrences.[5] Myxomas have been also reported to be seen after instances causing endocardial injuries, including percutaneous mitral balloon valvuloplasty and repair of atrial septal defects.[3] However, based on a very few number of cases in the literature, it is difficult to establish a conclusion that whether myxomas are related to inflammatory responses to RFA or are coincidences. To the best of our knowledge, the appearance of an atrial myxoma after RFA has been reported only twice.[4,6] In our case, its atypical site of attachment close to the left superior pulmonary vein and rapid growing process make us more suspicious on its coincident nature with RFA-related myocardial changes.

Furthermore, dyspnea is thought to occur when the tumor mass intermittently obstructs the flow across the atrioventricular valves and its severity correlates the size of the myxoma.[7] Although possible effect of the tumor size on hemolysis seems to be reasonable, the evidences related to mechanical red blood cell injuries are still unclear. In a study, Kanda et al.[8] reported an increased expression of IL-6 in 12 of 15 myxomas (80%). Moreover, increased IL-6 in a wide range of patients was found to be inversely related to the hematopoietic activity.[9] As a result, the authors concluded that; IL-6 level plays a major role for the development of anemia'. Interleukin-6 measurement for the diagnosis of myxomas would provide us improved interpretation on the inverse relationship between increased expression of IL-6 and anemia.

In conclusion, although further cases are required to elucidate the relationship between myxoma development and local inflammation of endocardium after radiofrequency ablation, it should be kept in mind that myxomas may cause anemia via interleukin 6 production.

Declaration of conflicting interests

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Cardiovascular Surgery and Interventions

Case Report Open Access

A rare presentation of repair of aortic coarctation-related complication and its hybrid repair

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ABSTRACT

A 50-year-old male patient who had coarctation surgery history was admitted to our hospital with complaints of hematemesis and melena. Computed tomography showed extravasation of the distal anastomosis of the descending aorta and periesophageal and left thoracic hematoma. A hybrid surgery with new graft interposition between supraceliac abdominal aorta and the distal part of the prior graft was performed in combination with thoracic endovascular aortic repair. Aorta coarctation surgery may have high complication risk. Hybrid treatment of such complications reduces the mortality and morbidity risk.

Keywords: Aortic coarctation; aortic rupture; hybrid repair.

Aorta coarctation surgery accounts for 10% aneurysm formation arising from the suture lines during follow-up.[1] In this study, we present a rare case of pseudoaneurysm after early postoperative period and its hybrid repair.

CASE REPORT

A 50-year-old male patient was admitted to our hospital with complaints of hematemesis and melena. The patient was hospitalized by the internal medicine specialist with the diagnosis of gastrointestinal bleeding. The patient's history revealed coarctation of aorta. Subclavian flap aortoplasty was performed 10 years ago and 10 mm polytetrafluoroethylene (PTFE) graft interposition from the ascending aorta to the descending aorta passing the posterior pericardia was performed four months ago. The patient was referred to our clinic with the history of aortic coarctation surgery which might be a suspicious cause of the gastrointestinal bleeding. Computed tomography showed that there was extravasation of the distal anastomosis of the descending aorta and hematoma which extended around esophagus and left thorax (Figure 1).

A written informed consent was obtained from the patient and he was operated in the hybrid operating room. Redo sternotomy and supraumblical midline laparotomy were performed. Mediastinum and abdominal aorta were explored. The patient was heparinized and 10 mm PTFE graft which was anastomosed between the ascending to the descending aorta was explored from the mediastinum. A hole was created into the diaphragm and a new 10 mm PTFE

Figure 1. Preoperative computed tomography image showing the polytetrafluoroethylene graft anastomosed to the descending aorta (white arrow), pseudoaneurysm, mediastinal and left thoracic hematoma (black arrow), periesophageal hematoma and nasogastric catheter (arrowhead).

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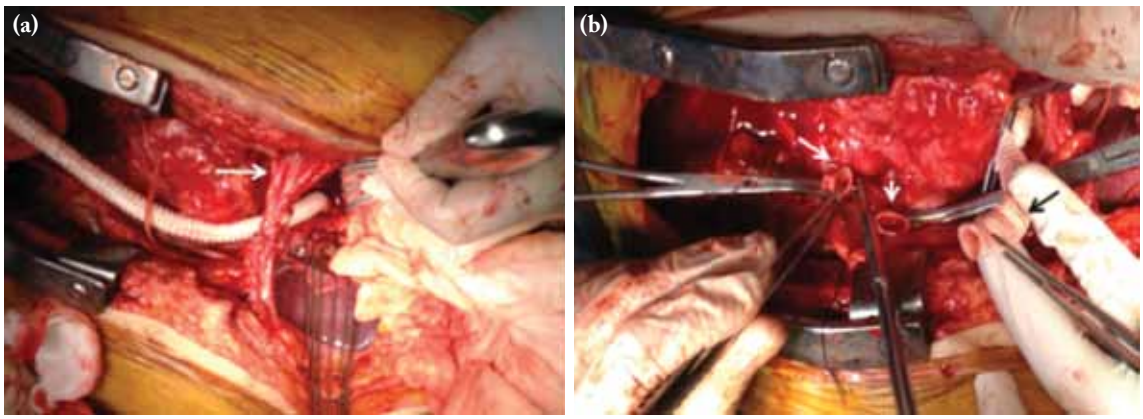

Figure 2. **(a)** A new polytetrafluoroethylene graft anastomosed to the supraceliac abdominal aorta, diaphragm (arrow). **(b)** Anastomosis of the new graft's proximal side (black arrow) to the old graft's distal side (white arrow), old graft's clamped distal side (arrowhead).

graft was passed through the hole. Side clamp applied to the abdominal aorta and distal anastomosis was performed to the abdominal aorta from the superior of the celiac artery level. We preferred abdominal aorta anastomosis to minimize high complication risks due to hematoma on thoracic level and, therefore, we used redo sternotomy instead of thoracotomy which is associated with a lower complication risk compared to the redo sternotomy in uncomplicated patients. Old graft was clamped and divided from the proximal of the descending aortic anastomosis. The proximal end of the new graft was anastomosed to the distal end of the old graft (Figure 2). The distal end of the old graft was ligated. The right common femoral artery was explored and aortography was performed with the right common femoral arterial cannulation. There was extravasation of the thoracic aorta anastomosis. Thoracic endovascular aortic repair

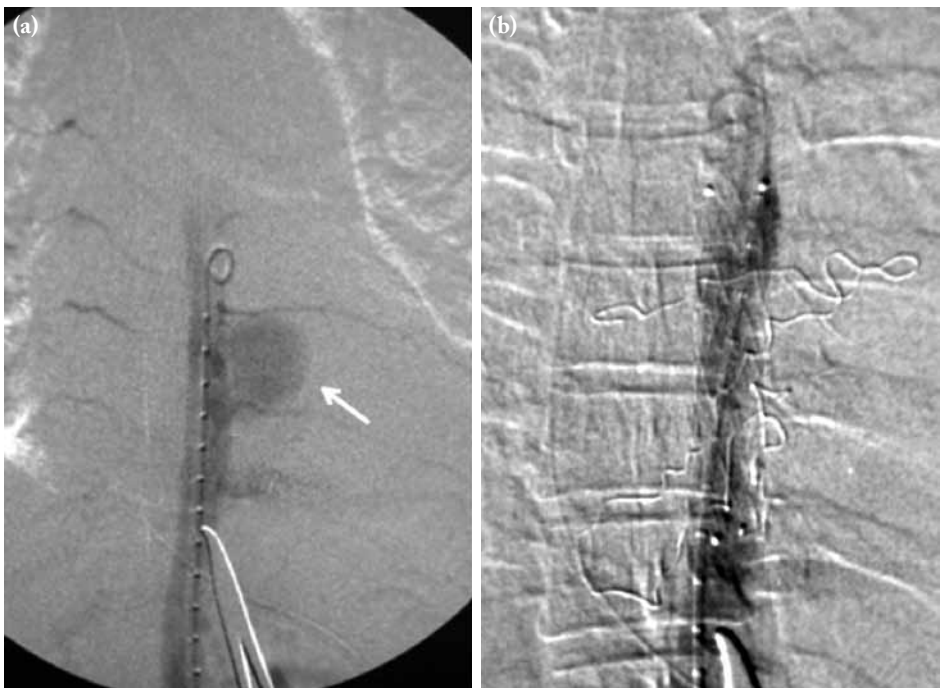

Figure 3. **(a)** An angiographic image of the descending aorta and pseudoaneurysm (arrow). **(b)** An angiographic image of the descending aorta after thoracic endovascular aortic repair.

(TEVAR) was performed through the right femoral arterial intervention using 10 mm/70 cm endovascular graft (Vascutek/Terumo, Inchinnan, Scotland, UK.) (Figure 3). The patient was taken to the intensive care unit after the operation was completed. In the pre- and early postoperative period, we inserted nasogastric catheter to monitor hematemesis. There was no bloody drainage. In the postoperative first week, no new melena formation was seen. The patient was discharged 10 days after the operation.

DISCUSSION

Aorta coarctation is a congenital vascular anomaly which is mostly seen on aortic isthmus.[2] Its prevalence is 0.4% of live births.[2] There are many techniques for repairing this anomaly such as subclavian flap aortoplasty, Dacron-patch aortoplasty, tube graft interposition, and ascending to descending aorta end-to-end graft anastomosis, although most are associated with complications.[3] Pseudoaneurysm formation which is seen 17% after subclavian flap aortoplasty, 5% to 28% after Dacron-patch aortoplasty, 6% after tube graft repair, and 3% after end-to-end anastomosis is a high mortality complication and mostly develops on the descending aortic anastomosis due to the weak thoracic aortic structure. This complication has high rupture capacity and has to be treated regardless of its size.[3]

In this case, the patient underwent subclavian flap aortoplasty 10 years ago and the ascending to descending aorta end-to-end graft anastomosis four months ago. Subclavian flap aortoplasty did not cause any pseudoaneurysm for 10 years; however, end-to-end graft anastomosis caused spontaneous pseudoaneurysm formation and left thoracic hematoma in four months. Pseudoaneurysm formation should be checked with routine imaging controls. Due to potential late complications, patients who are treated surgically should be regularly followed in an imaging study, regardless of the fact that young or old and new or a long time passed from the initial surgery.[3] In this case, our patient was admitted with gastrointestinal bleeding due to periaortic and thoracic hematoma. Although pseudoaneurysm and hematoma rarely cause esophageal fistula and gastrointestinal bleeding,[4] we should keep in mind that history of aortic coarctation surgery may complicate with gastrointestinal bleeding.

Emergent open surgically repair of the descending aorta has the highest mortality risk compared to endovascular treatment.[5] Today, thoracic endovascular aortic repair is a safe and easy method for all types of diseases of the thoracic aorta, such as aortic aneurysms, hematomas, blunt aortic ruptures, and aortic surgery complications, whether in emergency or elective setting.[5] Thoracic endovascular aortic repair has lower mortality (9%) and paraplegia rates (3%) compared to open surgery and it is suggested that TEVAR should be the standard therapy for thoracic aortic diseases.[5] The patients who are treated with TEVAR should be also followed with imaging techniques due to the recurrence risk of TEVAR and first disease. In our patient, we preferred TEVAR for pseudoaneurysm treatment and this method provided us a safe and rapid repair of the aorta in a patient who had third operation of the descending aorta.

In conclusion, aortic coarctation surgery may have a high mortality complication risk in early and late postoperative period. The patients have to be followed through imaging studies on a regular basis. Thoracic endovascular aortic repair is a low mortality, morbidity, and first choose method for descending aortic pathologies, such as aortic coarctation patients operated more than one.

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Cardiovascular Surgery and Interventions

Case Report Open Access

Coronary artery bypass grafting in inflammatory bowel disease: two case reports

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ABSTRACT

The administration of coronary artery bypass grafting for coronary artery disease with inflammatory bowel disease has been rarely reported. Patients with inflammatory bowel disease have an increased risk for thrombotic events. Also, inflammatory bowel disease is seen in the protein-losing enteropathy and development of heparin resistance is associated with a deficiency of antithrombin III. In this article, we present two cases with ulcerative colitis and Crohn's disease who underwent off-pump coronary artery bypass grafting.

Keywords: Beating heart; Crohn's disease; inflammatory bowel disease; ulcerative colitis.

Inflammatory bowel disease (IBD) is an inflammatory condition which predominately affects the gastrointestinal tract; however it can also affect any organ outside the gastrointestinal system.[1] Crohn's disease (CD) and ulcerative colitis (UC) are the two major forms of IBD. Clinically, IBD is characterized by multiple relapses and remissions with an unknown etiology. However, several evidences suggest that gut tissue injury is the result of an abnormal immune response and involves multiple non immune cellular systems, including intestinal microvascular endothelial cells.[1] Patients with IBD have also an increased risk for coagulation disorders, such as protein-losing enteropathy, and development of heparin resistance is associated with a deficiency of antithrombin-III (AT-III). Thus, we believe that the off-pump (beating heart) coronary artery bypass grafting (CABG) is more appropriate for coroner bypass surgery in these patients. In this article, we report two IBD cases who underwent CABG surgery with off-pump technique.

CASE REPORT

Case 1– A 71-year-old male patient was admitted to our cardiology department with a complaint of acute chest pain. The patient underwent coronary angiography which revealed total occlusion of the left anterior descending (LAD) artery, 80% stenosis in the first diagonal branch (D1), and 80% proximal stenosis of the right coronary artery (RCA). The patient was referred to our clinic for CABG surgery. A year earlier, the patient was diagnosed with CD. The patient was under follow-up and recently the CD disease was in remission. Physical examination and routine laboratory test results were normal. The patient was consulted to the gastroenterology department. Surgery was advised to the patient. He was informed about the procedure and a written informed consent was taken for surgery. With off-pump technique, a three-vessel CABG surgery was performed: left internal mammary artery (LIMA) to the LAD and saphenous vein as a graft to the D1 and RCA arteries. Thoracic drainage fluid in the postoperative period was 420 mL. No postoperative complication was seen and the patient was discharged uneventfully.

Case 2– A 71-year-old male patient was admitted to our emergency department with acute myocardial infarction. The patient was referred to the cardiology department for coronary angiography. Coronary angiography demonstrated triple-vessel disease and the patient was referred to our clinic for CABG surgery. The patient had a diagnosis of UC 10 years ago. The patient was under follow-up and recently the UC disease was in remission. Physical examination and routine laboratory test results were normal. Coronary angiography revealed 90% stenosis of the LAD artery, 80% stenosis in the first obtuse margin branch (OM1), and total occlusion of the RCA. The patient was

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consulted to the gastroenterology department. Surgery was advised to the patient. He was informed about the procedure and a written informed consent was taken for surgery. With off-pump technique, a three-vessel CABG surgery was performed: LIMA to the LAD and saphenous vein as a graft to OM1 and RCA arteries. Thoracic drainage in the postoperative period was 350 mL. No postoperative complication was seen and the patient was discharged uneventfully.

DISCUSSION

Inflammatory bowel disease encompasses two different but interrelated disorders: UC and CD. Ulcerative colitis is characterized by superficial inflammation which begins in the rectum and extends proximally along the colon.[2] Crohn's disease is characterized by transmural patchy inflammation and can involve any region of the gastrointestinal tract from the mouth to the anus.[2] Inflammation has a fundamental role in the development and progression of endothelial dysfunction. Endothelial dysfunction has been shown to be associated with reduced nitric oxide and increased oxidative stress and it has been described in patients with different inflammatory conditions.[3]

Recently, it has become increasingly evident that chronic systemic inflammation plays a critical role in the pathogenesis of atherosclerosis and many studies have suggested a positive correlation between IBD and the occurrence of ischemic heart disease (IHD). Multiple inflammatory mediators such as C-reactive protein, interleukin-6, tumor necrosis factor-alpha (TNF-α), matrix metalloproteinases-2 and 9 are associated with the increased incidence of IHD. In addition, some subclinical atherosclerosis markers such as increased carotid artery intimal medial thickness, increased arterial stiffness, and increased carotid-femoral pulse wave velocity and insulin resistance are higher in prevalence in patients with IBD independent of traditional IHD risk factors, which may suggest a rapid progression of atherosclerosis in this population.[4]

Conventional CABG performed using cardioplegic arrest and cardiopulmonary bypass is well-defined in the literature. On-pump CABG is associated with higher cardiac, pulmonary, renal, neurological, bleeding, and other systemic complications. Thus, off-pump CABG has gained an increased interest since 1990s as a strategy to prevent complications in high-risk patients, particularly. The main merit of off-pump CABG is the elimination of the many inflammatory insults associated with the use of the extracorporeal circuit and the ischemia-reperfusion injury associated with cardioplegic arrest and non-physiological flow.[5]

Heparin resistance is defined as activated clotting time <400 second after full-dose heparinization for open heart surgery.[6] Antithrombin-III and alpha1-antitrypsin are the main inhibitors of the coagulation system. The plasma levels of these proteins decrease in protein-losing enteropathy, such as IBD. The loss of these two main coagulation system inhibitors can, thus, lead to thrombotic complications in patients with IBD.[6] We believe that off-pump CABG is a more appropriate option for these patients, as on-pump CABG requires anticoagulation due to extracorporeal circulation which necessitates high-dose heparin. Herein, both of our patients were operated with off-pump technique successfully.

In conclusion, patients with chronic inflammatory bowel disease are at high risk for cardiovascular morbidity and mortality. Management of these patients undergoing open heart surgery can be more troublesome associated with coagulation disorders and these patients are also at high risk for on-pump technique. Therefore, we believe that beating heart technique is a more appropriate option for this patient population.

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Cardiovascular Surgery and Interventions

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Surgical approach to internal iliac arteries in repair for bilateral iliac aneurysms

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ABSTRACT

Bilateral iliac artery aneurysms are rare pathologies. Although patients are often asymptomatic, they are associated with high morbidity and mortality rates due to the risk of rupture in symptomatic patients. Currently, the treatment of iliac artery aneurysms is feasible using endovascular and open surgical techniques. When aneurysm involves the ostium of internal iliac artery, anastomosis of this artery to the interposed graft is recommended. Nevertheless, in some surgical conditions, anastomosis to the interpositioned graft may be impossible. Herein, we present a 76-year-old male case who underwent open surgery for bilateral iliac aneurysmectomy and graft interposition. In this case, surgical ligation of bilateral internal iliac arteries was performed due to the weakness and fragility of the vessel wall.

Keywords: Aneurysm; bilateral internal iliac artery; surgical repair; ligation.

Aneurysmatic dilatation of the iliac artery is more common in patients with advanced age.[1] It usually involves only one side with bilateral lesions being extremely uncommon and difficult to diagnose.[1] Patients presenting with rupture as the first sign of clinically asymptomatic iliac artery aneurysm comprise 33 to 38% of the cases,[1,2] thereby, indicating the high mortality and morbidity associated with this condition. Early detection of asymptomatic iliac artery aneurysms with advanced imaging modalities bears a clinical significance.[1-3] Potential therapeutic strategies include endovascular interventions or open surgery.[1-3] In patients with bilateral iliac artery aneurysms, internal iliac artery should be preserved or re-implanted.[1-3] Bilateral interruption of the blood flow in the iliac arteries has been reported to result in pelvic ischemia, impotence, or pelvic claudication.[1-3] Also, injury to collateral circulation may represent another potential cause of increased morbidity. On the other hand, failure to establish blood flow in both internal iliac arteries may lead to pelvic ischemia. Despite this fact, in the presence of thin-walled or lacerated vessels precluding anastomosis, surgical ligation may be considered.

Herein, we present a 76-year-old male case who underwent open surgery for bilateral iliac aneurysmectomy and graft interposition. In this case, surgical ligation of bilateral internal iliac arteries was performed due to the weakness and fragility of the vessel wall.

CASE REPORT

A 76-year-old male patient presented to our outpatient unit with complaints of abdominal pain emerging after 50 meters of walking for the past three months. The pain was limited to the left lower quadrant and the patient had no family history of a diagnosis of aneurysms or sudden death in family members. At the time of presentation, his heart rate was 68 bpm, blood pressure was 140/74 mmHg, and body temperature was 36.4 °C with nonspecific biochemistry results. On chest X-ray, the cardiothoracic index was below 2.5. Electrocardiogram showed sinus rhythm with no findings suggestive of cardiac ischemia or other pathology. Physical examination showed that femoral and distal peripheral pulses were bilaterally palpable. Abdominal ultrasound showed bilateral dilatation in the iliac arteries in the abdominal ultrasound. Computed tomography was used to evaluate the intra-abdominal pathology. Contrast-enhanced abdominal tomography showed bilateral aneurysmal dilatation of the common iliac arteries. The diameters of the abdominal aorta, right common iliac artery, and the left common iliac artery were 2.1x2.0, 6.2x5.9, and 4.3x3.8 cm, respectively (Figure 1). No endovascular

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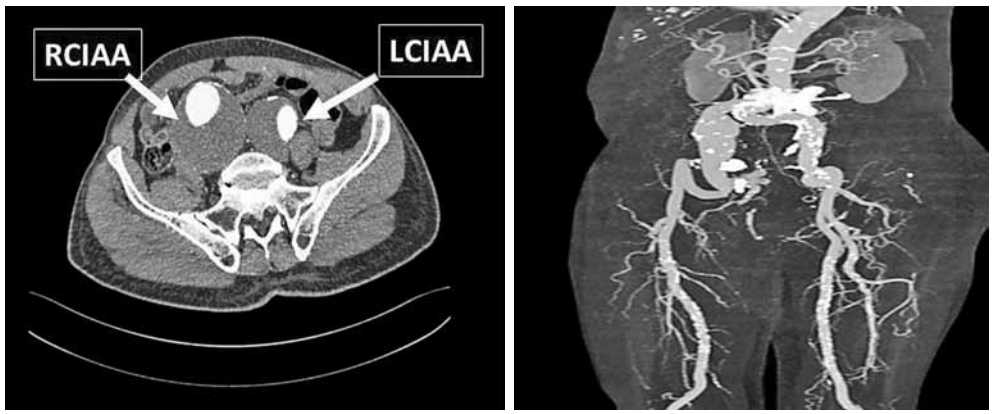

Figure 1. Bilateral iliac artery aneurysms as shown by the contrast enhanced tomographic images. Note the extensive collateral circulation on the right side. RCIAA: Right common iliac artery aneurysm; LCIAA: Left common iliac artery aneurysm.

procedures were performed due to the aneurysmatic involvement of the internal iliac arteries. The patient was asked to provide a written informed consent for surgery, after information was provided to him on the risk of mortality and free rupture into the abdominal cavity. A written informed consent was obtained from the patient.

Under general anesthesia, the abdominal cavity was accessed through a median laparotomy and the distal abdominal aorta as well as the iliac arteries were explored (Figure 2). Aneurysmatic dilatation was also observed macroscopically and, then, bilateral iliac artery aneurysmectomy was performed by placing clamps on the aorta and distal external iliac arteries. At this stage, the vessel wall in the proximal segments of both internal iliac arteries was observed to be tiny and fragile. Also, adequate retrograde blood flow was present in the internal iliac arteries. No re-implantation was performed in the internal iliac arteries, which were too fragile and lacerated. An end-to-end anastomosis with a 16:8 Dacron Y graft between the proximal graft and the distal abdominal aorta was accomplished, while the distal anastomoses

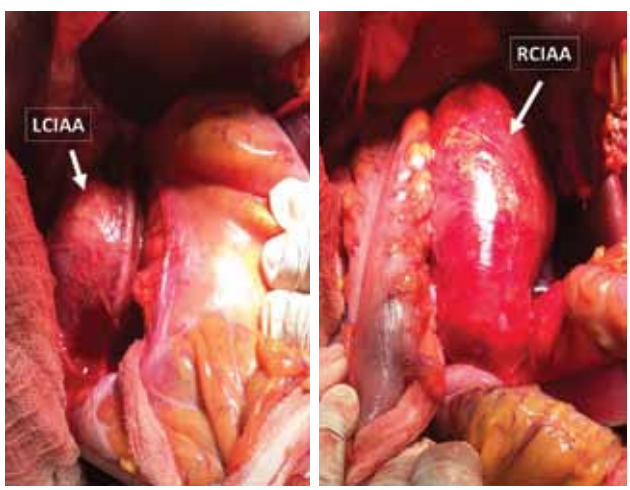

Figure 2. Macroscopic appearance of the bilateral iliac artery aneurysms in the surgical field. RCIAA: Right common iliac artery aneurysm; LCIAA: Left common iliac artery aneurysm.

Figure 3. The tube graft placed between the distal abdominal aorta and both external iliac arteries. The arrow with the white interrupted line shows the site of ligation on the right internal iliac artery. REIA: Right external iliac artery aneurysm; LEIA: Left external iliac artery aneurysm.

were performed with end-to-end anastomoses in both distal external iliac arteries (Figure 3). Both internal iliac arteries were ligated. Following hemostasis, the abdominal layers were closed in accordance with the normal anatomy. After a one-day stay in the intensive care unit postoperatively, he was transferred to the patient ward.

Postoperatively no pelvic, visceral, or distal ischemia occurred, and the patient was discharged with complete cure in the sixth postoperative day with hypertensive treatment.

DISCUSSION

As seen in our case with abdominal aortic aneurysms, the aneurysms of iliac arteries frequently develop on the background of existing atherosclerosis.[1-3] Other etiological factors include infections, injuries, arteritis, connective tissue disorders such as Marfan's syndrome, and pregnancy.[1-3] Although mostly asymptomatic, aneurysms of the iliac arteries may lead to neurological, urological, or gastrointestinal symptoms due to the compression effect on the adjacent organs.[1-3] Also, hematuria due to uretero-iliac aneurysmal fistula, or hydronephrosis secondary to ureter compression may develop in the urinary system.[1-3] Other symptoms due to a compression effect on the gastrointestinal system include constipation, abdominal distension, ileus, or melena.[1] Neurological manifestations may include lumbosacral plexus entrapment and consequent back pain, pain projecting anteriorly in the thigh, and pain and paresthesia in the legs.[1]

The primary goal of treatment in bilateral iliac artery aneurysms be it surgical or endovascular, is to eliminate the risk of rupture.[1] Surgical approach involves accomplishment of graft interposition through aneurysmectomy, as well as the use of graft material. Particular attention should be paid to avoid injury to the internal iliac arteries during this procedure. The absence of reimplantation of the internal iliac arteries in open surgical techniques and the use of coil embolization in endovascular approaches may result in decreased penile and gluteal blood flow, which have been reported to be associated with pelvic ischemia, impotence, or pelvic claudication.[4]

Current management strategies for iliac artery aneurysms include open surgery or endovascular interventions. Conventional surgery remains the gold standard approach in the management of aneurysms involving the common iliac artery.[1-5] On the other hand, endovascular interventions may be preferred in appropriately selected patients, as they are associated with a less invasive course of management.[4-7] For instance, endovascular procedures may be preferred in aneurysms located in poorly accessible anatomical sites, or in patients with a history of previous abdominal surgery or concomitant conditions. Also, successful results have been reported for endovascular grafting and coil embolization in the distal branches of the internal iliac arteries as alternative management modalities.[4-7] However, whether endovascular interventions would eventually replace open surgery still remains unclear, due to the lack of data on long-term outcomes with this management strategy.[6-8]

Review of literature revealed no large patient series undergoing bilateral internal artery ligation. In the light of common practice, a recommendation is made to perform an end-to-end anastomosis between the internal iliac arteries and the graft placed in the position of the common iliac artery.[1] However, in cases with fragile and tiny vessel walls or in those with traumatic lacerations of the arteries precluding a surgical anastomosis, ligation may be undertaken. In such cases, the adequacy of the collateral branches and retrograde blood flow should be ascertained. Also, in the presence of visceral ischemia, possible revascularization should always be considered. In our patient, no re-implantation of the internal iliac artery was performed due to degenerative changes in the walls of the internal iliac artery potentially complicating surgery and also on the basis of the presence of adequate retrograde blood flow. Implantation may be opted out, when mesenteric arterial blood flow is normal and pelvic collateral blood flow is adequate, or when the patient has strong retrograde blood flow in the internal iliac artery. However, in such cases, a particular emphasis should be placed on the close monitoring of the patient with regard to potential pelvic ischemia. Our case had no such morbidity during the follow-up.

In conclusion, the recommended approach involves the re-implantation of the internal iliac arteries. Preservation of the pelvic collateral blood flow should be a priority in all patients. When the superior and inferior mesenteric blood flow is normal or retrograde blood flow is strong, a decision to not to perform reimplantation of the internal iliac artery may be justified, when surgery seems infeasible. However, it should be kept in mind that the latter approach requires close patient monitoring.

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Cardiovascular Surgery and Interventions

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A rare case of hypertrophic obstructive cardiomyopathy with mitral valve stenosis

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ABSTRACT

A 50-year-old male was referred with a 10 day history of tachypnea and dyspnea. Transthoracic echocardiography showed serious fibrotic mitral stenosis and a mean gradient of 18 mmHg. The interventricular septum was hypertrophic with a width of 2.1 cm. A standard septal myectomy and mitral valve replacement were performed. Hypertrophic obstructive cardiomyopathy is mostly associated with mitral insufficiency rather than mitral stenosis. Surgery can be life-saving in acute deterioration in patients with coexisting hypertrophic obstructive cardiomyopathy and mitral valve pathology.

Keywords: Hypertrophic obstructive cardiomyopathy; mitral stenosis; mitral valve replacement; septal myectomy.

Hypertrophic obstructive cardiomyopathy (HOCM) is a cause of sudden cardiac death in young patients.[1] Intraventricular anatomical and contractile features are the determinants of the clinical course and management modality in most of the cases. Herein, we discuss an unusual case of HOCM and mitral stenosis (MS).

CASE REPORT

A 50-year-old male was referred to our hospital with a 10-day history of tachypnea and dyspnea. Physical examination revealed widespread crepitations at the base of the lungs, particularly. His blood pressure was 100/70 mmHg. Electrocardiography revealed atrial flutter with a rate of 150 bpm. Transthoracic echocardiography (TTE) demonstrated serious fibrotic MS with a valve area of 1.2 cm^2 and a mean gradient of 18 mmHg. The interventricular septum was hypertrophic with a width of 2.1 cm (Figure 1). The pressure gradient of the left ventricular outflow tract (LVOT) was 76 mmHg and the ejection fraction was 60%. The preoperative TTE did not reveal an abnormal anterior motion of the anterior leaflet. Coronary angiography showed clinically insignificant coronary plaques. Physical examination and a chest X-ray revealed signs of pulmonary edema and increased cardiothoracic ratio. A decision was made to operate on an emergency basis. A written informed consent was obtained from the patient.

Transesophageal echocardiography probe was placed. Sternotomy was followed by bicaval cannulation. Cardiopulmonary bypass (CPB) was initiated. After cross-clamping, an oblique aortotomy was made towards the non-coronary sinus. The first incision was made to the subannular region at the level of the right and the left leaflet commissures. The second incision was made to the subannular region at the level of the right coronary ostium. These two incisions were adjoined with the third incision which was made 5 mm below the annulus. The myectomy was performed with a thickness of 1 cm and a length of 3-4 cm towards the apex. The myectomy was decided to be sufficient, when the trunk and the base of the papillary muscles became visible. As the mitral valve leaflets were severely thickened and fibrosed with a narrow valve orifice, the mitral valve replacement was performed. Transesophageal echocardiography revealed the pressure gradient of the LVOT as 15 mmHg and no systolic anterior motion (SAM) of the mitral valve was detected. The postoperative course was uneventful. He was followed in the intensive care unit (ICU) for two days and discharged in the eight postoperative day.

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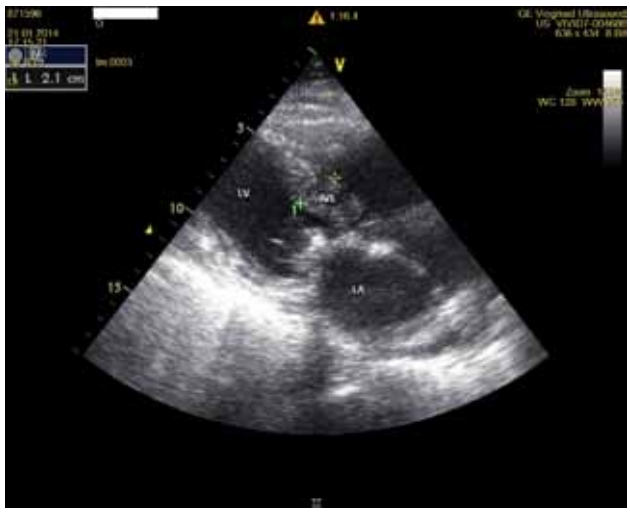

Figure 1. A preoperative transthoracic echocardiographic image showing an interventricular septum thickness of 2.1 cm.

DISCUSSION

Asymmetrical septal hypertrophy is the most common cause of HOCM which results in SAM of the anterior leaflet of the mitral valve.[2] This abnormal movement of the mitral apparatus may also cause mitral insufficiency and contributes to the worsening of the left ventricular function.[3] Patients may be asymptomatic, until the hypertrophy becomes prominent and causes geometrical impairment of the left ventricle.[1] Sudden cardiac death may be even the presenting symptom in some of the cases.[1]

The unusual presentation of our case is what makes this case interesting. Hypertrophic obstructive cardiomyopathy is mostly associated with mitral insufficiency rather than MS.[3] The preoperative TTE did not reveal an abnormal anterior motion of the anterior leaflet nor did we observe any regurgitation intraoperatively. There was a severe pressure gradient caused by the MS. The MS may have decreased the already low left ventricular filling even further. The clinical deterioration and pulmonary edema seen in our case, despite medical treatment, was due to the sum of the pathophysiological effects of HOCM and MS; HOCM increased the left ventricular end-diastolic pressure with outflow obstruction resulting in back pressure on the lungs, while MS caused dyspnea due to the restricted left ventricular inflow, thereby, resulting in left atrial pressure and back pressure on the pulmonary circulation.

Pharmacological therapy with beta-blockers, calcium channel blockers, and disopyramide is often beneficial for patients with mild symptoms.[4] However, for patients refractory to the pharmacological therapy, more invasive therapeutic procedures can be life-saving.

In addition, alcohol-induced septal ablation (ASA) is an interventional treatment modality which aims to decrease the septal muscle mass.[5] Long-term follow-up results are comparable with surgical myectomy.[5] Alcohol-induced septal ablation can also achieve significant reduction of the LVOT obstruction gradient and symptomatic relief.[5] However, complications such as complete heart block are more common after ASA than surgical myectomy.[5] In daily practice, it is mostly performed in older patients with high surgical risk and in those without any intracardiac disease and not requiring open surgery.[5]

Furthermore, surgery yields the best long-term results with good mortality and morbidity rates.[6] Septal myectomy is the conventional procedure in most of the cases.[7] Almost always, sufficient myectomy is achieved, if the papillary muscles are easily visible. Nevertheless, in some patients, myectomy may be insufficient in creating a wide outflow tract. In such cases, mitral valve replacement is the treatment of choice to relieve the LVOT obstruction.[7] In this case, mitral valve replacement was performed, as the mitral valve was not appropriate for repair. We believe that replacement of the valve also contributed to the abolition of the LVOT gradient.[8]

In conclusion, in most cases, hypertrophic obstructive cardiomyopathy does not consist of a single anatomical pathology and it can manifest itself with an unusual clinical presentation, as in our case. Therefore, the approach to each case should be individualized and treatment decisions should be made by expert surgeons. Surgery is a more favorable approach for hypertrophic obstructive cardiomyopathy and can be life-saving in acute deterioration in patients with coexisting hypertrophic obstructive cardiomyopathy and mitral valve pathology.

Declaration of conflicting interests

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Cardiovascular Surgery and Interventions

Case Report Open Access

Right anterior thoracotomy approach for isolated aortic valve replacement with sutured aortic valve prosthesis

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ABSTRACT

Minimally invasive aortic valve surgery is associated with less bleeding, shorter duration of mechanical ventilation, and reduced intensive care unit and hospital stays. Herein, we present a 85-year-old male case with minimal invasive sutured aortic valve replacement via right anterior thoracotomy. We also discuss the advantages of this method.

Keywords: Aortic valve prosthesis; minimally invasive surgery; right anterior thoracotomy.

Minimally invasive aortic valve replacement (AVR) performed through a right anterior thoracotomy (RAT) or upper hemisternotomy (UHS) is becoming a favored approach. Advantages of less bleeding and faster recovery due to the incision technique made the right anterior thoracotomy a preferable approach. We present a patient with minimal invasive sutured AVR via right anterior thoracotomy.

CASE REPORT

A 85-year-old male patient was admitted to our hospital with complaints of angina and dyspnea on exertion. His body mass index was 19 kg/m^2. Cardiac examination revealed a regular heart rate and rhythm with no rubs or heaves. A 3/6 late-peaking systolic murmur at the right second intercostal border was radiating to the carotid arteries and encroached on the second heart sound. Auscultation revealed normal lung sounds bilaterally and pulmonary function test results were normal. On preoperative assessment, there was no contraindication for single lung ventilation. After physical examination with suspected of valvular pathology, transthoracic echocardiography was performed. It showed severe aortic valve stenosis characterized by an aortic valve area of 0.8 cm^2, a mean aortic valve gradient of 45 mmHg, and a maximal aortic velocity of 4 m/sec. For further examination, thoracic computed tomography was performed without contrast enhancement to evaluate the aortic calcifications, as well as the relationship among the aortic valve, sternum, and intercostal spaces. It demonstrated noncalcified ascending aorta with a diameter of 43 mm. The distance of annulus and ascending aorta to the right anterior thoracotomy incision were evaluated. Coronary angiography scans were normal and carotid Duplex ultrasound showed insignificant stenotic plaques. A written informed consent was obtained from the patient for surgery.

The patient underwent surgery with right anterior thoracotomy incision. After anesthesia induction, he was intubated with a double-lumen endotracheal tube for single lung ventilation and had intraoperative transesophageal echocardiography. On supine position, the external defibrillator pads were placed, and the skin incision and peripheral cannulation was performed. By peripheral cannulation via femoral artery and vein, a right anterior thoracotomy with a 5 cm skin incision from the third intercostal space near the sternal border was performed. The right internal thoracic artery and veins were ligated. A soft tissue retractor was inserted into the incision. Pericardial fat was excised and pericardiotomy was performed 4 cm anterior to the right phrenic nerve. The pericardium was retracted by passing sutures through the chest wall away from the incision. The operative field was insufflated with carbon dioxide. A 23 mm Medtronic Hancock bioprosthetic valve

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(Medtronic, Minneapolis, MN, USA) was implanted (Figure 1). Cross-clamp and cardiopulmonary bypass times were 83 min and 108 min, respectively. Postoperative course was uneventful.

DISCUSSION

In 1996, Cosgrove and Sabik[1] introduced the first right parasternal approach to reduce the morbidity from valvular heart operations. Then, techniques encompassed a wide variety of incisions. Today, the RAT and UHS are the primarily minimal invasive AVR approaches.

Improved cosmesis, less pain and narcotic use, and rapid recovery have been reported, which offer more comfort to both patients and surgeons. Several studies address ministernotomy, while outcomes of minimally invasive valve replacement via RAT have not been well-defined, yet. Establishing the more comfortable way of operation for aortic valve surgery requires a coordinated effort by the surgeon, anesthesiologist, perfusionist, and nurses. Upper hemisternotomy may be applied by less experienced minimal invasive AVR surgeons. However, stability of the manubrium is the weaker chain of the operation. The sternotomy is re-approximated using steel wires. Right anterior thoracotomy avoids sternotomy, while the integrity of the sternum minimizes the postoperative discomfort with a limited skin incision.[1] Although, the surgical site is smaller and the aortic valve sits deeper within the wound. Exposure is facilitated by minimizing cannulation techniques within the incision, coupled with strategic placement of pericardial sutures.[2] Most studies show that RAT is a safe procedure associated with low mortality and postoperative complications. The in-hospital mortality of 1.5% is lower than the recent mortality rate reported in the Society of Thoracic Surgeons Database.[3] Although cross-clamp and cardiopulmonary bypass times were longer than in the standard approach, the low incidence of postoperative stroke, renal failure, atrial fibrillation, and blood transfusions, as well as the short postoperative recovery, are consistent with other minimally invasive approaches, highlighting the safety of this procedure.[4] In addition, due to the psychological and cosmetic results, it is a preferable method.[5]

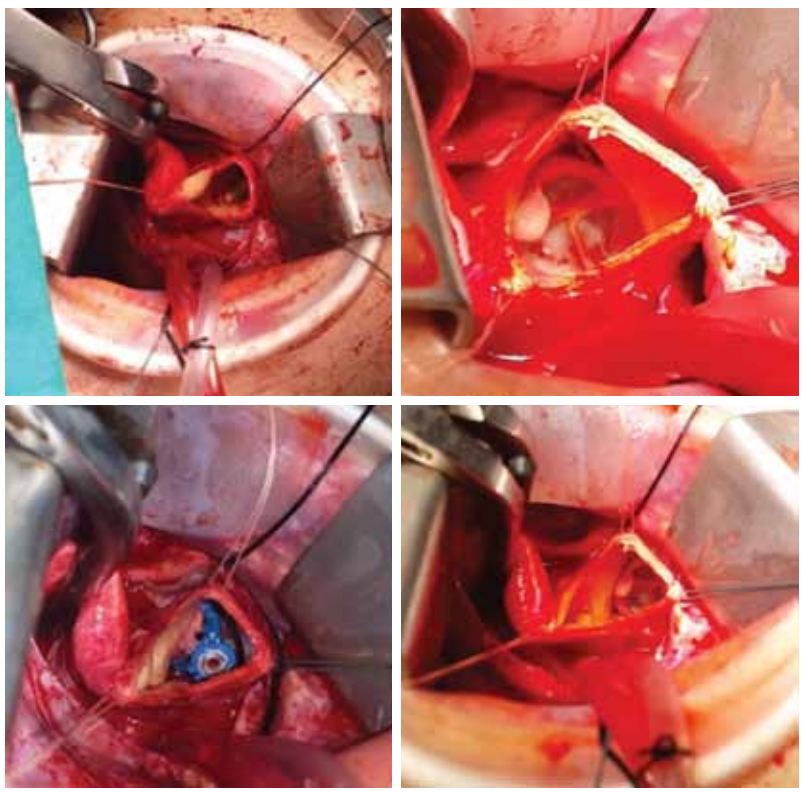

Figure 1. Sutured aortic bioprothesis valve replacement via right anterior thoracotomy approach.

In conclusion, minimally invasive aortic valve replacement via a right anterior thoracotomy is a safe and effective method.

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Cardiovascular Surgery and Interventions

Case Report Open Access

Surgical removal of a cardiac hydatid cyst in the interventricular septum causing complete atrioventricular block

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ABSTRACT

Hydatid cysts are caused by the larva of *Echinococcus* which is usually seen in the lungs and liver. It is uncommon in the heart and rarely seen in the interventricular septum. Cardiac hydatid cysts are often asymptomatic; however, they sometimes may cause impaired cardiac conduction system and syncope. Herein, we report a 20-year-old female case with a cardiac hydatid cyst nested in the interventricular septum causing complete atrioventricular block.

Keywords: Atrioventricular block; cardiac hydatid cyst; echinococcosis, hydatidosis.

Hydatid cysts are parasitic diseases caused by the larva of *Echinococcus*.[1] It usually located in the liver and lungs and cardiac involvement is extremely rare, accounting for 0.5 to 2% of the cases.[2] The left ventricle wall is the most common involvement site; however, hydatid cysts can be found in the heart as well.[3] Also, it may be less frequently seen in the pericardium, right ventricle, and interventricular septum. Herein, we report a 20-year-old female case with a cardiac hydatid cyst nested in the interventricular septum causing complete atrioventricular (AV) block.

CASE REPORT

A 20-year-old female patient was admitted to our Cardiology outpatient clinic with complaints of malaise and dizziness. She had no previous hydatid disease history. Atrioventricular block was found in the electrocardiography. There were no abnormal findings in her physical examination. On transesophageal (TEE) and transthoracic echocardiography (TTE), a 2x2.4 cm cystic mass was detected in the interventricular septum. As the hydatid cystic disease is endemic in Turkey, the patient was referred to our clinic for surgical treatment with the initial diagnosis of cardiac hydatid cyst. The mass was measured as 2.5x2.8 cm using the thoracic computed tomography (CT) (Figure 1). Serological test results for *Echinococcus* infestation were negative. Complete blood count showed mild eosinophilia without any other abnormal findings. The patient was scheduled for surgery. A written informed consent was obtained from the patient.

Under general anesthesia and proper monitorization, a median sternotomy was performed. Following the aortic and bicaval venous cannulations, cardiopulmonary bypass (CPB) was established. The aorta was cross-clamped and the heart was arrested with antegrade cardioplegic solution. A right ventriculotomy was done adjacent to the interventricular septum. The hydatid cyst was exposed (Figure 2). Approximately 5 mL of turbid fluid was aspirated with a syringe from the cyst and, then, it was filled with 3% sodium chloride solution. After five minutes of exposure to the hypertonic solution, the cyst was re-emptied. The cystic material was totally removed through cystotomy and the remaining cavity was closed with 3/0 polypropylene sutures. No ventricular septal defect was detected. The right ventriculotomy was closed with primary suturing using the Teflon felt strips and no patch was used for the closure. An epicardial pacemaker was implanted during the operation due to the complete AV block. Samples of the cystic fluid and the cystic material were sent for pathological and histological examination. The patient was transferred to the

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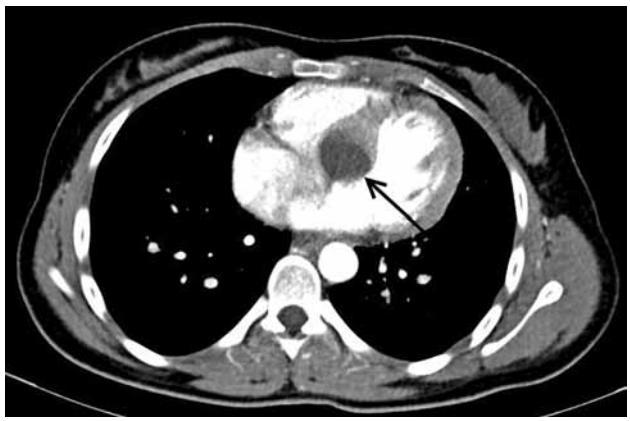

Figure 1. Thoracic computed tomography of the cyst in the interventricular septum (arrow).

Cardiology clinic in the seventh postoperative day for permanent pacemaker implantation. We administered oral albendazole therapy in the postoperative period and the patient was discharged with oral albendazole prescription.

DISCUSSION

The main cause of hydatid cysts in human is *Echinococcus granulosus* and human is the intermediate host in its life cycle.[4] Most of its embryos can be eliminated by the host immune system; however, they sometimes can survive and evolve to the cystic state.[5] The cysts usually grow very slowly (1 cm/year).[5] The larvae can reach the heart via the coronary circulation; however, cardiac hydatid cysts are uncommon due to the contraction ability of the heart (0.5 to 2% of the cases).[6] An adventitial pericystic layer was formed around the cyst, when it is placed in the myocardium as a reaction against it.

In addition, these cysts may cause several symptoms according to the location. Most of the cardiac hydatid cysts are asymptomatic. Most common clinical manifestations are precordial chest pain and coughing. Also fever, hemoptysis, arrhythmia, and cardiac conduction disorders, dyspnea, syncope, acute myocardial infarction, valvular disorders, pericarditis can be seen. A ruptured cardiac hydatid cyst may also cause more serious complications such as pericardial tamponade, pulmonary or systemic embolization, pulmonary hypertension, and anaphylactic reactions.[2] Ulgen et al.[7] reported a case who died from recurrent cerebral embolization of a ruptured cardiac hydatid cyst. In our case, the patient had malaise, dizziness, and

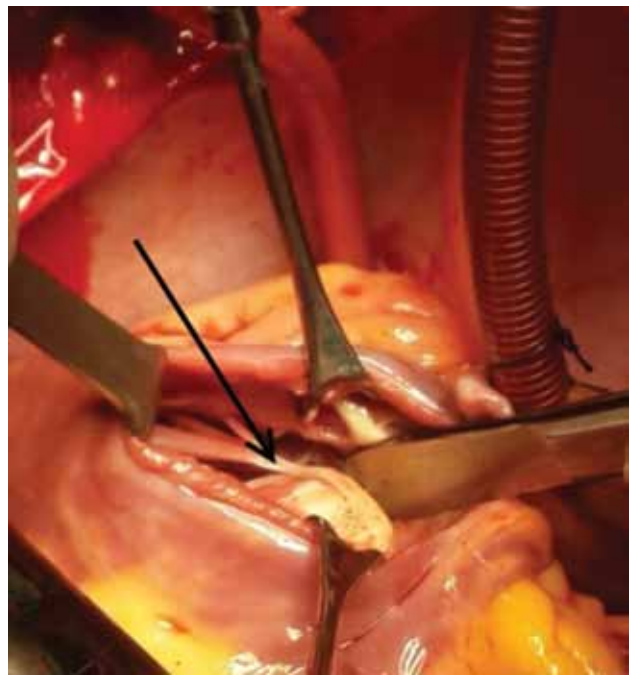

Figure 2. The cyst was exposed by right ventriculotomy (arrow).

complete AV block probably due to the mass effect of the cyst and compression of the conduction pathway of the heart. A similar case reported by Ipek et al.[8] with a cardiac hydatid cyst located in the interventricular septum which was revealed by a complete heart block which was removed under CPB. In our case, the AV block did not recover and, therefore, a permanent pacemaker was implanted postoperatively.

The diagnosis of cardiac echinococcosis is mainly based on the combination of clinical suspicion, cardiac imaging, and serological tests. Echocardiography is the most common method for the diagnosis of cardiac hydatid cyst. Also, CT imaging can be used in the differential diagnosis and can determine the size and exact location of the cyst in the heart. Serological test results for echinoccocosis were negative in our case; however, histological and pathological examinations of the intraoperative specimens confirmed the diagnosis of a hydatid cyst.

The most favored method for the treatment of cardiac hydatid cysts is surgical treatment under CPB. The cyst content should be removed carefully and it should be sterilized with hypertonic saline solution to prevent recurrence. It has been reported that nearly 10% of all hydatid cysts tend to recur

after surgery.[9] Albendazole alone or in combination with praziquantel can be used as prophylaxis. We also administered oral albendazole therapy in the postoperative period and the patient was discharged with albendazole prescription.

In conclusion, cardiac hydatid cysts may cause serious complications, such as anaphylactic reactions and sudden death in case of ruptures, particularly. It can easily be diagnosed with transthoracic echocardiography. The surgical treatment yields favorable results. Therefore, we recommend the surgical treatment of this pathology as soon as possible.

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Cardiovascular Surgery and Interventions

Interesting Image Open Access

An unusual iatrogenic cervical arteriovenous fistula: treatment of a rare vascular complication

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Cervical arteriovenous fistulas may be rarely seen as complications of venous catheterization due to cardiac operations.[1,2] A 22-year-old girl underwent coronary artery bypass grafting due to a single-coronary artery-related coronary stenosis. On one month follow-up, there was a thrill on the anterior right cervical area. Computed tomography angiography revealed fistulization between the right proximal vertebral artery and right internal jugular vein, which probably resulted from jugular venous catheterization (Figure 1). We closed the fistula by inserting a stent into the vertebral artery. Postoperative computed tomography angiography revealed no fistula (Figure 2). Percutaneous interventions and surgical procedures are available for the closure of arteriovenous fistulas.

Figure 1. The black arrow showing the vertebral artery and the white arrow showing the internal jugular vein.

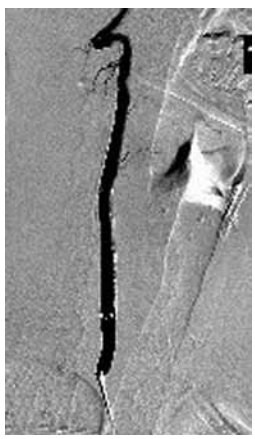

Figure 2. Postoperative computed tomography angiography showing no fistulization.

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Cardiovascular Surgery and Interventions

Interesting Image Open Access

An image of single coronary artery in a four-month-old child undergoing ventricular septal defect repair surgery

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Single coronary artery is an extremely rare congenital anomaly in which there is only one coronary artery arising from the aorta by a single ostium, giving branches. Since these anomalies are usually asymptomatic, interventions are limited.[1,2]

A four-month-old child underwent surgery for an 8 mm isolated perimembranous ventricular septal defect. He also had coronary artery origin anomaly detected by catheterization preoperatively (Figure 1). Preoperative evaluation showed no other pathology (Figure 2). All coronary branches were given by the single coronary artery without any kinking or compression (Figure 3). A written informed consent was obtained from the patient and ventricular septal defect was repaired. The operation was completed successfully.

A single coronary artery is a rare coronary artery origin anomaly which can be often associated with other congenital cardiac defects, such as ventricular septal defect. This anomaly is usually in benign nature and seldomly requires surgical intervention.

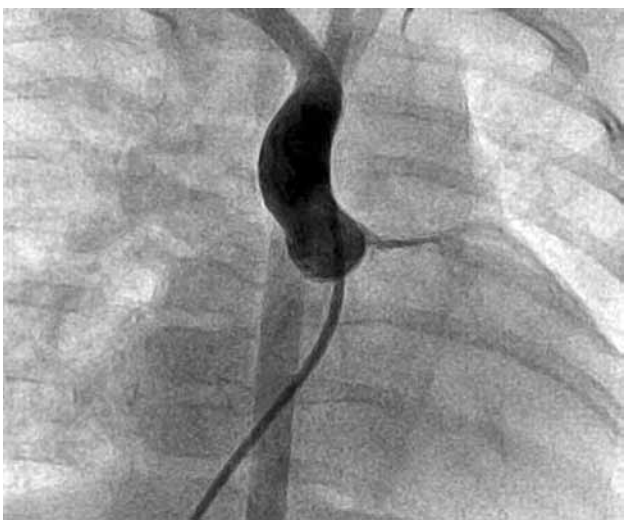

Figure 1. Preoperative angiography showing a single coronary artery.

Figure 2. Preoperative radiography shows cardiomegaly.

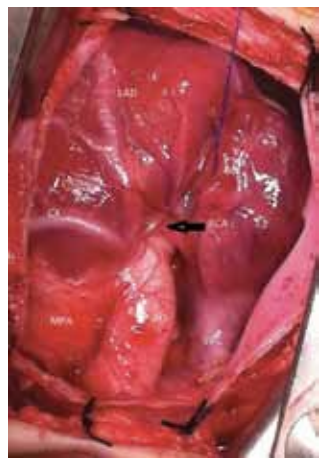

Figure 3. An intraoperative view of the single coronary artery and its coronary branches.
LAD: Left anterior descending; RCA: Right coronary artery; CX: Circumflex; AO: Aorta; MPA: Main pulmonary artery; SVC: Superior vena cava.

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Cardiovascular Surgery and Interventions

How to do it? Open Access

Transesophageal echocardiography may verify true lumen of a dissected aorta

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ABSTRACT

Thoracic endovascular aortic repair is used to treat complicated type B dissections. A 62-year-old male patient was admitted to our cardiovascular surgery clinic with chest pain. Contrast thoracic tomography showed chronic type B dissection, proximal advance of type B aortic dissection beginning distally to the origin of the left subclavian artery. Endovascular intervention was planned. Transesophageal echocardiography was used to verify the true and false lumens during procedure. In conclusion, angiographic examination may not be sufficient to differentiate the true and the false lumens of the aorta. Therefore, transesophageal echocardiography may be used to verify the true lumen of the thoracic descending aorta.

Keywords: Aortic dissection; echocardiography; endovascular intervention.

Thoracic endovascular aortic repair (TEVAR) has been a novel treatment modality for the descending thoracic aortic aneurysms and dissections in the past decade.[1] In nearly all cases, angiographic assessment is enough to verify true lumen during TEVAR.[1] However, if not available, there are some other methods.[2,3] Herein, we report a rare case in whom the true lumen was verified with transesophageal echocardiography (TEE) during TEVAR.

CASE REPORT

A 62-year-old male patient with a preexisting type B aortic dissection for three years was admitted to our cardiovascular surgery clinic with chest pain.

Contrast computed tomography of the chest showed proximal advance of type B aortic dissection beginning distally to the origin of the left subclavian artery. In this case, TEVAR was planned. During TEVAR, TEE examination was used to verify true and false lumens (Figure 1).

In TEE examination, the beginning of the dissection was detected. The distal part of the arcus aorta was assessed by Doppler ultrasound (Figures 1a and 1b). The descending aorta was also visualized by Doppler ultrasound (Figures 1c and 1d).

The intra- and postoperative period were uneventful. The patient was discharged on the third postoperative day without any additional problem. A written informed consent was obtained from the patient.

DISCUSSION

Although echocardiography, either transesophageal or transthoracic, is not considered as the gold standard for the diagnosis of aortic pathologies, such conditions can be detected during first-line echocardiography in the majority of the cases. By transthoracic echocardiography (TTE), ascending aorta can be best visualized in parasternal long axis view.[4] Arcus aorta and proximal part of the descending aorta can be visualized in TTE suprasternal view. The sensitivity of TEE in the diagnosis of aortic dissection was 97 to 99%; however, the specificity of TEE alone is as low as 77 to 85%.[4] Keren et al.[5] described the high sensitivity of biplane or multiplane TEE for the detection of ascending aortic pathologies on 112 emergency patients with an ascending aortic dissection.

Altogether, it is obvious that TTE can visualize ascending aortic pathologies. However, it is not favorable for the practitioners to diagnose or even predict a descending aortic pathology with TTE.

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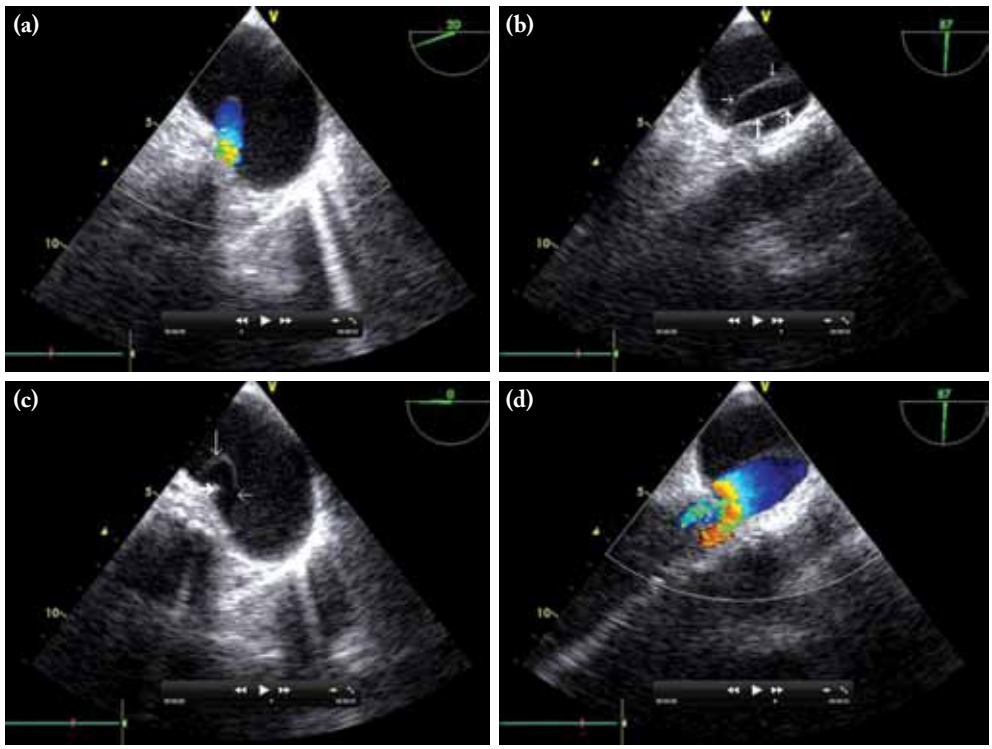

Figure 1. Perioperative transesophageal echocardiography examination. **(a)** Blood flow in true lumen of the distal part of the arcus aorta is seen. **(b)** In the distal part of the arcus aorta, true lumen is marked with regular arrows and the guidewire can be seen in the true lumen marked with a bold arrow. **(c)** In the descending aorta, true lumen is marked with regular arrows and the guidewire can be seen in the true lumen marked with two bold arrows. **(d)** Blood flow in the true lumen of the ascending aorta is seen.

On the other hand, TEE can be helpful for the diagnosis of descending aortic pathologies.

During TEVAR procedures, angiography can be always enough for the visualization of the lumens and verifications of true lumens.[2,3] However, in some complicated cases, it is possible to place the guidewire in the false lumen instead of the true one.[2] Follis et al.[2] reported a case with the deployment of the endovascular graft in the false lumen of type B dissection in which the authors compulsorily switched to open surgery. Ugurlucan et al.[3] in their e-comment addressing Follis et al.'s[2] case, highlighted their angiographic method to facilitate the correct positioning of the stent graft during endovascular repair of type B dissection. In their previous case reports, Ugurlucan et al.[1] suggested a method to facilitate the grafts in the correct position of the true lumen. They advanced a guidewire under fluoroscopic guidance from a brachial artery toward the femoral artery and prepared for stent graft deployment. However, this technique requires an additional surgery or puncture, posing additional time and risk.

In conclusion, we suggest that it is also possible to verify true and false lumens of the aorta using a less invasive technique and to facilitate the proper deployment of the stent graft without risk for an additional invasive procedure.

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