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Hellenic Society of Vascular and Endovascular Surgery

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Temporary Arterial Shunting During Evacuation Stages in Combat Trauma
Kharkiv, Ukraine

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Athens, Greece

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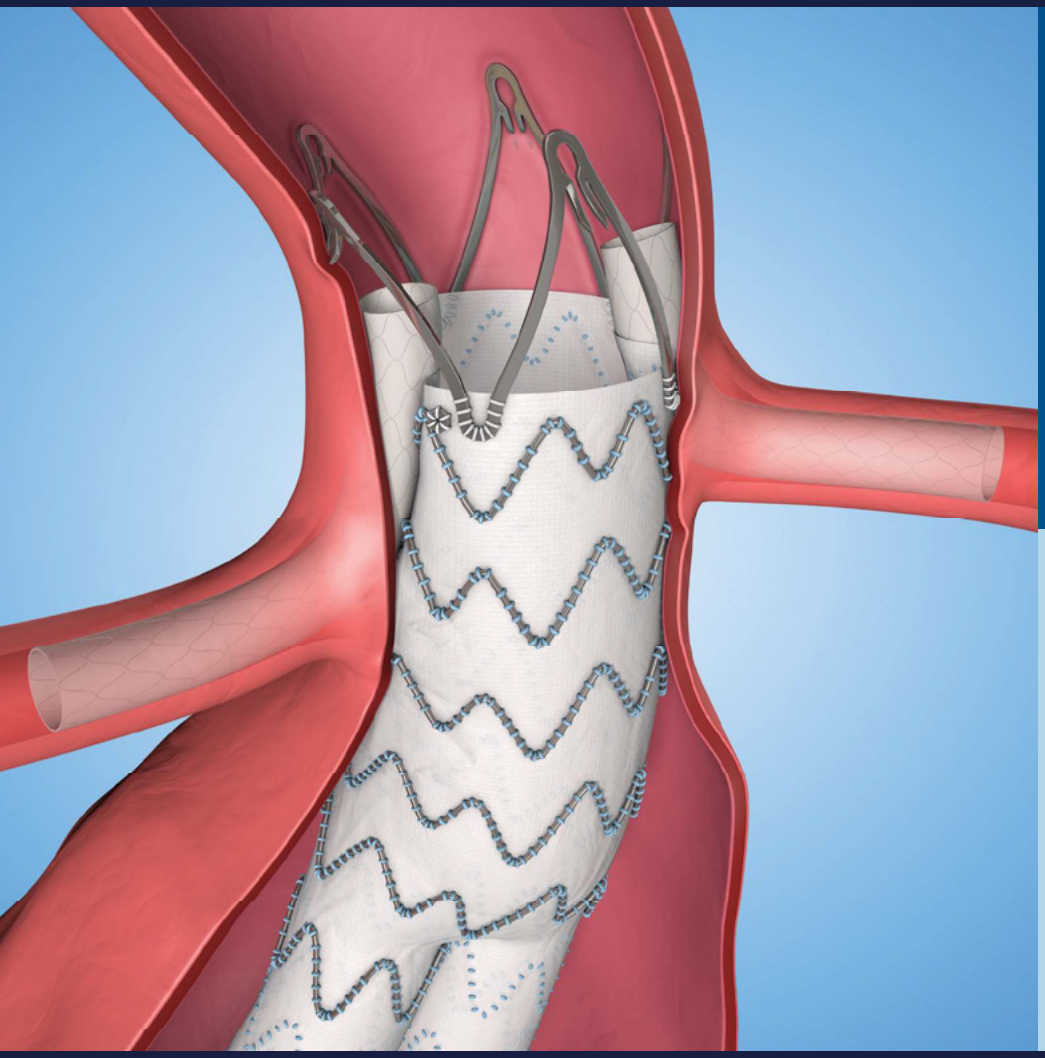

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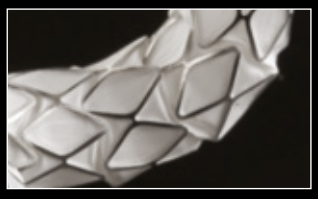

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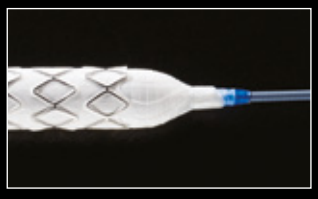

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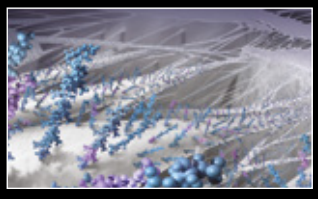

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EDITORIAL

Ven(o)us Rising

Efthymios Avgerinos, MD

Assoc. Professor of Vascular Surgery, 2nd Department of Vascular Surgery, University of Athens
Associate Editor Hellenic Journal of Vascular and Endovascular Surgery
Incoming President Hellenic Society of Phlebology

Venus Rising from the Sea ***"Venus Anadyomene"*** was one of the iconic representations of the goddess Venus (Aphrodite), made famous in a much-admired painting by Apelles of Kos, now lost, but later revived greatly in the Italian Renaissance through Botticelli's famous painting "*The Birth of Venus*".

Venous is Rising indeed. I enjoy using this parallelism to emphasize the rebirth of "Venous" that had been left behind. We're all experiencing the Renaissance of Veins, Superficial and Deep!

Venous diseases are much more prevalent (compared to arterial) yet have been neglected either because they were considered as less important or because treatments options were poor and inexistent. Times have changed, quality of life now matters, evidence and knowledge is piling, and Phlebology is turning to an exciting new field, attracting interest by several specialists. More importantly, modern phlebology offers minimally invasive treatment alternatives to conditions previously considered "anticoagulation alone is enough" or "incurable".

Advancements in Phlebology started 20 years ago with the introduction of endovenous ablation techniques for superficial venous diseases but over the past 10 years we're seeing an unprecedented introduction of novel technologies addressing deep venous pathologies: acute deep venous thrombosis (DVT) and pulmonary embolism, post-thrombotic syndrome, pelvic venous disease, venous compression syndromes and venous malformations.[1,2] Thrombectomy, debulking and crossing devices, dedicated venous stents and intravascular ultrasound are transforming the current landscape of deep venous intervention. More importantly large trials are underway and will soon give some answers towards better patient selection. Following the ATTRACT trial (on acute DVT)[3], The NIH sponsored C-TRACT[4] and PE-TRACT[5] randomized trials are addressing the effect of iliofemoral venous stenting in patients with post-thrombotic syndrome and the effect of endovascular thrombectomy in patients with intermediate high risk pulmonary embolism. The industry sponsored trial DEFIANCE[6] is actively enrolling acute DVT patients randomized to anticoagulation or mechanical thrombectomy and the EMBOLIZE[7] trial is enrolling patient with pelvic venous disease to conservative management or ovarian vein embolization. Within the next 2 years we will be able to better understand the role and benefits of these interventions to a subset of patients who were previously untreated (or maltreated).

Where do Vascular Surgeons stand? Too busy treating mainly arterial "more urgent" pathologies? Poor results due to poor knowledge? Not many patients referred to us because nobody knows we have novel treatments to offer or because other specialties are taking over.

Vascular Surgeons need to answer the call, stay updated with the latest techniques, research findings, and guidelines to provide the best care for our patients. Continued collaboration and rebranding of our skills will be essential to streamline referrals and create integrated care pathways that address the multifaceted nature of deep venous disease. Towards this direction the Hellenic Journal of Vascular and Endovascular Surgery in collaboration with the Hellenic Society of Vascular and Endovascular Surgery and the Hellenic Society of Phlebology, in 2025 will inaugurate, a dedicated Venous Section.

It is much needed and we're seeking our national and international experts' and readers' support to make it grow proportionally to the Rising Ven(o)us.

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Temporary Arterial Shunting During Evacuation Stages in Combat Trauma

Valeriy Boyko[1,2], Vitalii Prasol[1,2], Petro Zamiatin[1,2], Denys Zamiatin[1], Oleksandr Prasol[2], Yurii Bunin[3], Sergii Vasyliuk[4], Vitaliia Atamaniuk[4]

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Abstract:

Introduction. Combat-related injuries to major blood vessels represent one of the most challenging aspects of military trauma surgery. Critical factors for successful outcomes include the organized and timely transport of wounded individuals to specialized vascular centers, as well as the prompt provision of highly specialized surgical care.

Materials and Methods. In a specialized medical center, we analyzed the feasibility of reconstructive surgery in 192 soldiers with blast injuries to the upper or lower limbs, accompanied by major vascular damage. These patients were evacuated from a combat support hospital at varying intervals, with 143 arriving within 24 hours and 49 beyond 24 hours. Eighty-seven (45.31%) of the injured arrived with hemostatic tourniquets or ligated arteries, while 105 (54.68%) had undergone temporary external shunting of the major artery.

Results. The overall amputation rate was 34.89%, with 23.77% of amputations occurring when evacuation took place within 24 hours, compared to 67.34% when evacuation exceeded 24 hours (OR 0.15 [0.07–0.37], p = 0.001). Wounded soldiers evacuated to the specialized center within 24 hours had an 85% higher chance of limb salvage. This chance increased to 94% for soldiers with a functioning shunt (OR 0.06 [0.01–0.54], p = 0.004) and to 85% for those with a non-functioning shunt (OR 0.15 [0.04–0.64], p = 0.012). For those with hemostatic tourniquets, the odds ratios were 0.37 (0.17–0.84, p = 0.027) and 0.44 (0.18–1.12, p = 0.133), respectively.

Conclusion. The use of temporary shunting to restore limb perfusion in combat settings is an effective method for reducing the risk of amputation. Optimal outcomes are achieved when wounded soldiers are evacuated to specialized medical centers within 24 hours.

Keywords: blast injury, limb, artery, vein, temporary external shunt, amputation.

INTRODUCTION

The challenges of treating vascular injuries in combat trauma are exacerbated by difficulties in providing self-aid, initial pre-hospital care, and complex evacuation under active combat conditions. The modern firearms used in the war in Ukraine often cause complex limb injuries, involving damage to bones, muscles, nerves, arteries, and veins. Blast injuries account for a significant portion of major vascular damage.

Combat-related injuries to major blood vessels are one of the most challenging areas in military trauma surgery. Critical factors for successful treatment outcomes include the well-organized and timely transport of wounded personnel to specialized vascular units and the prompt provision of highly specialized surgical care[1, 2].

During the evacuation stages of soldiers with vascular injuries of the limbs to combat support hospitals (typically located within 5-10 km of the combat zone), surgeons must always consider the option of external shunting. In such cases, combat medics have the option to use either linear or looped temporary vascular shunts. Linear shunts are inserted into the vessel lumen and follow its path without bending (the most commonly available sizes are 8, 10, 12, and 14 Fr linear internal shunts)[3, 4]. Looped shunts are inserted in a looped configuration. Prior to 2022 in Ukraine, these shunts were primarily used for carotid artery temporary shunting; however, they are also well-suited for use in major limb arteries[5, 6].

The use of temporary shunting of peripheral arteries to maintain distal vascular perfusion is rare in civilian surgical practice but is gaining popularity in the treatment of military trauma. A report from the Regional Vascular Surgery Unit of The Royal Victoria Hospital, Belfast, demonstrated that early intraluminal artery/vein shunting to restore arterial inflow and venous outflow in patients with complex lower limb vascular injuries reduced the incidence of adverse events, includ-

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ing contractures, ischemic nerve paralysis, and amputations[7].

The experience with temporary shunting for peripheral vascular injuries during Operation Iraqi Freedom showed that this approach provides a simple and effective means of restoring limb perfusion in soldiers with blast limb injuries, even if the shunt becomes thrombosed during evacuation[8].

The challenge of using commercially branded shunts for temporary limb perfusion in conditions where a large number of wounded soldiers are admitted to a combat support hospital lies in their availability. In Ukraine, there are logistical and financial issues regarding their supply in field hospital operating rooms. Considering the extensive experience of Ukrainian surgeons in providing specialized care to such soldiers, specialists at the V.T. Zaytsev Institute of General and Emergency Surgery of the National Academy of Medical Sciences of Ukraine have undertaken an effort to develop and test an original looped shunt for temporary limb perfusion.

MATERIALS

In a specialized medical center, we conducted an analysis of the feasibility of reconstructive surgery in 192 soldiers with blast injuries to the upper or lower limbs involving major vascular damage. These patients were evacuated from a combat support hospital at varying intervals, with 143 arriving within 24 hours and 49 beyond 24 hours. Eighty-seven (45.31%) of the injured arrived at the specialized medical center with hemostatic tourniquets applied or the injured artery ligated, while 105 (54.68%) had undergone temporary external shunting of the major artery (Table 1).

Upon admission to the specialized vascular surgery center, blood flow through the shunt was absent in 36 out of the 105 cases (34.28%). The primary endpoint for analyzing the effectiveness of external arterial shunting in the combat support hospital was the amputation rate in the specialized hospital.

The statistical analysis involved calculating the odds ratio (OR), a key measure used to numerically express the extent to which the presence or absence of a certain outcome is associated with the presence or absence of a specific factor in a given statistical group. The confidence interval (CI) was set at 95%, determined as ±1.96 of the standard error.

RESULTS

Major arterial injuries represent one of the most critical aspects of surgery. Soldiers with major vascular injuries caused by blast trauma often die within hours of being wounded, especially in cases of injuries to large vessels in the chest or abdominal cavity. Most patients hospitalized in specialized medical centers typically have limb vessel injuries. This is likely due to the fact that temporary hemostasis methods for limb vessel injuries are more accessible during combat action. If a soldier can quickly recognize a limb vascular injury and apply a tourniquet, their chances of survival and later receiving specialized vascular surgical care increase significantly.

The custom loop shunt (CLH), proposed by the vascular surgeons at the V.T. Zaytsev Institute of General and Emergency Surgery of the National Academy of Medical Sciences of Ukraine, is shown in Figure 1. The CLH was fixed within the injured vessel using tourniquets (Figure 2).

Table 1. Methods of hemorrhage control for limb vessel injuries in battle-injured soldiers during evacuation to specialized centers

Shunt variant	Shunt patency	Shunt failure	Total
Javid™ shunt or similar linear shunts	17/28 (60.71 %)	11/28 (39.28 %)	28/192 (14.58 %)
Sundt™ Carotid Endarterectomy Shunts	11/21 (52.38 %)	10/21 (47.61 %)	21/192 (10.93 %)
Custom loop shunt (CLH)	37/56 (66.07 %)	19/56 (33.92 %)	56/192 (29.16 %)
Without a shunt (hemostatic tourniquet)	-	-	61/192 (31.77 %)
Without a shunt (vessel ligation)	-	-	26/192 (13.54 %)
Total	65/105 (61.90 %)	40/105 (38.09 %)	192 (100 %)

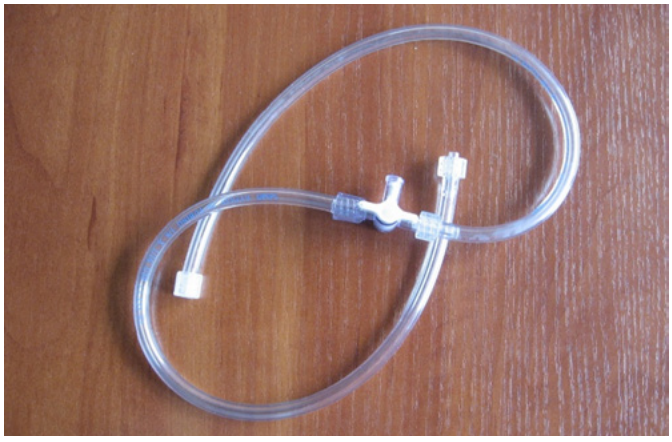

Figure 1. CLH V.T. Zaytsev Institute of General and Emergency Surgery of the National Academy of Medical Sciences of Ukraine.

Figure 2. Schematic of CLH fixation within an injured vessel using tourniquets.

Temporary arterial shunting was performed not only to ensure arterial perfusion during evacuation but also in patients with blast-related bone trauma and uncompensated limb ischemia. In such cases, temporary arterial shunting was conducted prior to orthopedic fixation. The ends of the shunt were inserted into the distal and proximal ends of the artery and secured with atraumatic rubber tourniquets. Afterward, orthopedic fixation of the bone fragments was performed, with blood flow through the shunt being monitored. We believe that in such situations, looped shunts (e.g., Sundt™ or CLH) are preferable over linear shunts, as they allow for safe repositioning and fixation of bone fragments.

The loop was positioned outside the wound and secured with a dressing. Medics responsible for the evacuation of wounded soldiers were provided with instructions regarding the shunt, with a caution not to manipulate the dressing unless properly trained in vascular surgery.

The success of temporary shunting was not dependent on the type of shunt used (combat field surgeons applied whichever shunt was available) or the presence or absence of systemic anticoagulation therapy. Soldiers were often evacuated to specialized hospitals by trucks that were not equipped for in-transit medical support. The temporary shunt was secured with non-absorbable sutures for the duration of the evacuation.

The amputation rate was influenced not only by the method of hemorrhage control but also by the time spent on evacuation, which is difficult to predict under conditions of active combat and mass casualty scenarios.

Overall, the amputation rate was 34.89%, with 23.77% of amputations occurring when evacuation was under 24 hours and 67.34% when evacuation exceeded 24 hours (OR 0.15 [0.07-0.37], p=0.001). Wounded soldiers evacuated to a specialized center within 24 hours had an 85% higher chance of limb salvage (Table 2). This chance increased to 94% in soldiers with a functioning shunt (OR 0.06 [0.01-0.54], p=0.004) and to 85% with a non-functioning shunt (OR 0.15 [0.04-0.64], p=0.012). For soldiers with a hemostatic tourniquet or ligated vessel, the odds ratios were 0.37 (0.17-0.84, p=0.027) and 0.44 (0.18-1.12, p=0.133), respectively.

Temporary vascular shunting should be considered as a method to restore blood flow rather than vessel ligation in cases of limb vessel injuries, including proximal vein segments. The primary advantage of this technique is the early restoration of blood flow, which prevents the adverse effects of arterial ischemia and venous hypertension.

We recommend that combat field surgeons follow these guidelines for managing limb vessel injuries in soldiers (Table 3).

Table 2. The impact of evacuation time and hemorrhage control techniques on the rate of limb amputations

Hemorrhage control	Total	Evac. < 24 h (n-143)	Evac. > 24 h (n-49)	p	OR (CI), 95 %
Shunt patency (n-65)	6/65 (9.23 %)	1/143 (0.69 %)	5/49 (10.20 %)	0.004	0.06 (0.01-0.54)
Shunt failure (n-40)	9/40 (22.5 %)	3/143 (2.09 %)	6/49 (12.24 %)	0.012	0.15 (0.04-0.64)
Hemostatic tourniquet (n-61)	30/61 (49.18 %)	17/143 (11.88 %)	13/49 (26.53 %)	0.027	0.37 (0.17-0.84)
Vessel ligation (n-26)	22/26 (84.61 %)	13/143 (9.09 %)	9/49 (18.36 %)	0.133	0.44 (0,18-1.12)
Total	67/192 (34.89 %)	34/143 (23.77 %)	33/49 (67.34 %)	0.001	0.15 (0.07-0.37)

Table 3. Guidelines for the management of limb vascular injuries in a field hospital setting (V.T. Zaytsev Institute of General and Emergency Surgery of the National Academy of Medical Sciences of Ukraine)

Tactical option	Indications
Without arterial bypass (hemostatic tourniquet or vessel ligation)	1. Hemodynamic instability in the injured soldier. 2. Complex blast injury of the limb with comminution of bone fractures. 3. Traumatic amputation of one or more limbs. 4. Limited resources and mass influx of casualties (tactical indications).
External arterial shunting (linear/ loop shunts)	1. Associated gunshot or non-gunshot bone fractures with extensive soft tissue damage (temporary arterial shunting is performed prior to orthopedic fixation of fractures). The soldier should be evacuated to a specialized center as quickly as possible. 2. For temporary perfusion, if reconstructive surgery of arterial injury is feasible in the field hospital. 3. In case of carotid artery injury. The soldier should undergo reconstructive surgery in the field hospital or be evacuated to a specialized center as quickly as possible (preferably, evacuation should be carried out by helicopter or specialized medical transport equipped for resuscitation).
Venous ligation	In case of associated (or isolated) injury to any major vein.
Temporary shunting or simple venous reconstruction	1. Hemodynamically stable injured soldier. 2. Injured major venous trunk of the limb (e.g., common femoral vein, popliteal vein). 3. Absence of other severe associated limb injuries. 4. Availability of resources and absence of mass influx of casualties requiring other urgent surgical intervention (tactical indications).

DISCUSSION

The outcomes of treating soldiers with blast injuries and damage to major vessels depend on several factors, including the specifics of the wound (whether the limb is preserved or completely amputated), the type of vessel (arterial or venous), the nature of the vessel injury (closed or open), vessel diameter, vessel rupture or wall damage, blood loss volume, the stage of shock, the distance of the injury from medical stabilization points or the hospital, the time and conditions of evacuation, and the accuracy of medical care provided at all stages of treatment[9, 10].

All these factors influence the severity of acute limb ischemia and the condition of the wounded soldier. The most important factor is the evacuation time, which directly affects the likelihood of limb amputation[11, 12].

Most general surgeons assigned to work in combat support hospitals in the combat zone have limited experience in vascular surgery. Therefore, they undergo training beforehand, which includes general principles for managing vascular injuries and stabilizing patients with severe blood loss. A combat surgeon should be familiar with surgical access to blood vessels, principles of distal and proximal vascular control, proper surgical management of blast-induced vessel injuries, and options for temporary shunting or vessel repair for further evacuation to specialized medical centers. Based on our experience, the most challenging aspect of this training is selecting the proper surgical access to the major vessels of the limb.

Since the injuries occur in physically healthy young individuals with no atherosclerotic plaques in the vessels, establishing a temporary shunt is a relatively straightforward technical procedure. However, in the context of injured muscles and bones with significant intermuscular hematomas, absence of normal anatomical landmarks, lack of a palpable pulse along the vessel, and access to only basic diagnostic methods (radiography or ultrasound of the limb), identifying and gaining surgical access to the damaged vessel can be difficult even for experienced vascular surgeons[10].

Hemorrhage control through vessel ligation is employed in cases where there is an immediate risk of death from bleeding. However, before ligating the vessel, the possibility of using temporary shunting or reconstructive procedures should always be considered. To make a final decision, ultrasound monitoring of limb perfusion should be performed. It should be noted that this is not always feasible when there is a mass influx of wounded soldiers during intensified combat operations near the front line where the combat support hospital is located. Vessel ligation may be allowed as a “damage control” procedure, or in cases of damage to small-caliber, distally located arteries or veins[10, 11].

Shunting is a quick procedure, but compared to a full reconstructive surgery on the damaged vessel, it extends the time window for saving the limb in certain clinical situations. Although temporary shunting is most effective when applied to large proximal vessels (axillary/brachial or femoral-popliteal arteries) within 3-4 hours, this technique should not be overlooked when treating distal small vessel injuries (distal brachial artery/forearm artery or leg arteries).

CONCLUSIONS

1. The use of temporary shunting to restore limb perfusion in combat conditions is an effective method that reduces the risk of amputations. Its efficacy is particularly high when soldiers are evacuated to specialized medical centers within 24 hours.

2. The development and application of the original loop shunt (CLH) in Ukraine for temporary shunting have shown better results compared to linear shunts, providing higher vessel patency and reducing complication rates.

3. In combat conditions, the organization of quality evacuation and the preparation of surgeons in vascular control techniques are critical factors for preserving injured limbs. Adherence to vascular control recommendations in field settings significantly enhances the effectiveness of treatment.

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How I did it:
In situ fenestration of the Nexus aortic arch endograft with reentry catheter in urgent cases non-eligible for total supraaortic debranching

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Abstract:

Objective: To describe a novel technique for in-situ fenestration (ISF) of the Nexus aortic arch device using the BeBack re-entry catheter in patients contraindicated for total supraaortic debranching.

Methods: ISF was performed in four high-risk patients with aortic arch aneurysms, including post-type A dissections, mega-aorta syndrome, and symptomatic endoleaks. Contraindications for total debranching included prior neck surgeries, radiation therapy, and complex anatomy. The procedure involved controlled fenestration of the Nexus graft, deployment of bridging stent-grafts, and restoration of left subclavian artery perfusion.

Results: Technical success was achieved in all cases, with no major adverse events. Follow-up imaging confirmed the absence of target vessel instability or endoleak in two patients at two years, with ongoing stable outcomes for others.

Conclusions: ISF with the BeBack catheter is a safe and effective alternative for urgent aortic arch repair in patients ineligible for total debranching. Larger studies are warranted to validate these findings.

INTRODUCTION

The endovascular repair of aortic arch aneurysms has emerged as a safe and effective treatment strategy for selected patients, offering a minimally invasive alternative to open surgery, particularly for high-risk individuals[1]. Over the years, several custom-made devices with varying design concepts-such as outer and inner branches, two or three inner branches, and large fenestrations-have been developed to address this complex anatomical region[2, 3]. However, a direct comparison of these devices' effectiveness has yet to be undertaken, leaving the selection largely dependent on the user's experience and expertise.

For urgent cases requiring treatment up to zone 0 of the aortic arch, the Nexus device (Endospan, Herzlia, Israel) remains the only off-the-shelf endograft specifically designed for this purpose[4]. While the single-branch design is advantageous for rapid deployment, it necessitates a total supraaortic debranching, typically involving a bypass connecting the right carotid, left carotid, and left subclavian arteries. However, in our clinical experience, certain patients present anatomical or clinical challenges that make total supraaortic debranching infeasible or contraindicated.

To address these limitations, we developed and standardized an in-situ fenestration technique for the Nexus device using a reentry catheter. This approach avoids total aortic debranching while maintaining perfusion to critical vessels. Herein, we present the details of this novel technique.

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DESCRIPTION OF THE TECHNIQUE

Patient Preparation

All patients were treated under general anesthesia, with both the bypass and endovascular repair performed during the same session. After sterile preparation of the surgical field, the left common femoral vein was accessed to insert a central venous catheter for anesthetic monitoring.

Bypass Creation

A left common carotid-to-left subclavian artery bypass was performed using a thin-walled 8mm ring-armored polytetrafluoroethylene (PTFE) graft (Artivion, NW Kennesaw, USA), following the standard technique as described elsewhere[5]. The wound was partially closed to allow further access for subsequent procedural steps.

Access Preparation for Nexus Graft Implantation

1. Right/left Common Femoral Artery: A surgical cut-down was performed to expose the right or left common femoral artery and bifurcation for device introduction. Ultrasound-guided puncture of the retrograde common femoral vein facilitated the placement of a temporary pacemaker in the right ventricle.

2. Right Brachial Artery: Ultrasound-guided puncture was performed, and a 7F short sheath was introduced for guidewire access.

3. Left Axillary Artery: The left axillary artery was surgically exposed, and a 7F sheath was introduced to facilitate the in-situ fenestration.

Nexus Graft Deployment

A through-and-through guidewire was established between the surgically exposed right or left common femoral artery and the right brachial artery. A pigtail catheter was placed in the proximal ascending aorta for the initial angiogram. A 24F, 65cm Dryseal sheath (W.L. Gore, Arizona, USA) was advanced to the proximal descending aorta and the aortic arch component of the Nexus device was deployed under fluoroscopic guidance[4]. A double-curved Lunderquist guidewire (COOK Medical, Bloomington, USA) was carefully advanced into the left ventricle and the ascending graft was introduced and deployed using rapid pacing. Finally, a kissing balloon technique was applied at the docking site using an Expand balloon (Artivion, NW Kennesaw, USA) and a 12mm balloon catheter through the through-and-through wire for the branch of the brachiocephalic artery.

In-Situ Fenestration

Step 1: A Rosen wire (COOK Medical, USA) was introduced through the pigtail catheter in the left brachial artery and positioned outside the ascending aorta graft. The 7F sheath in the left axillary artery was replaced with an 8F, 45 cm Flexor sheath or a 12F Flexor sheath (COOK Medical, USA), depending on the size of the bridging stent-graft. The sheath was delivered at the level of the origin of the left subclavian artery.

Step 2: Using a Spartacore guidewire (Boston Scientific, Massachusetts, USA) and the BeBack re-entry catheter (Bentley, Hechingen, Germany), the in-situ fenestration was performed as follows: The tip of the BeBack catheter was confirmed in left and right oblique fluoroscopic views to ensure accurate positioning (at 12 o' clock in the right oblique view). The needle was safely advanced through the polyester graft, and the guidewire was navigated into the descending aorta by rotating the needle (**Figure 1**). The fenestration was sequentially dilated with a 3x40 mm Nanocross Elite balloon catheter (Medtronic, Santa Rosa, USA), followed by a 5x60 mm Sterling balloon catheter (Boston Scientific, Massachusetts, USA). Finally, an 8mm VBX stent-graft (W.L. Gore, Arizona, USA) was deployed through the fenestration, and a 10x20 mm balloon catheter was used to flare the stent-graft at the level of the Nexus graft. The completion angiogram confirmed proper perfusion and positioning, and if necessary, the VBX stent was extended using a Viabahn stent-graft

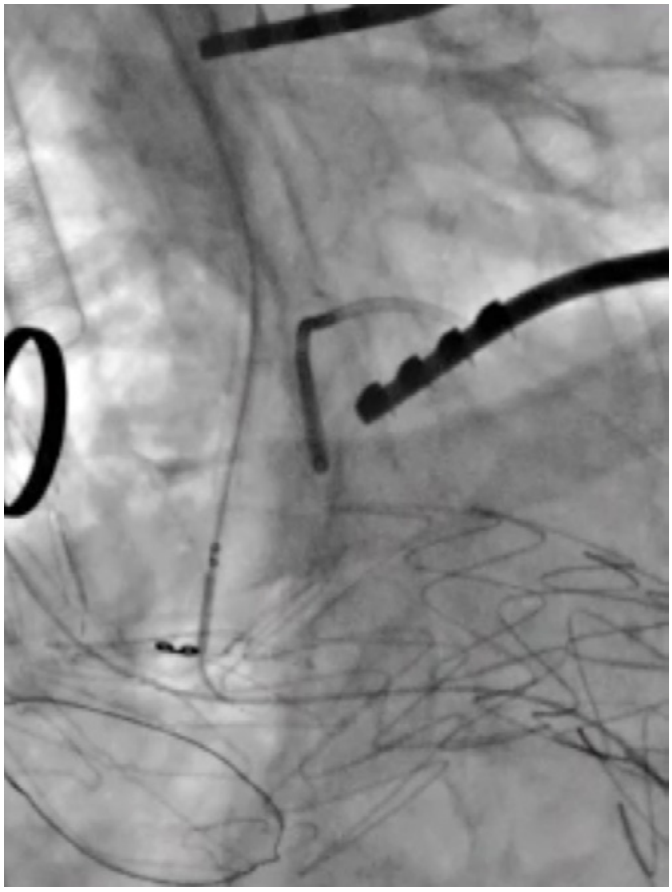

Figure 1: Fluoroscopic image of the BeBack catheter penetrating the arch component of the Nexus One endograft.

CASE PRESENTATION

The described technique was performed in four patients undergoing urgent repair of aortic arch aneurysms. All patients provided informed consent prior to the procedure.

Patient Cases and Rationale for In-Situ Fenestration

Case 1: The first patient presented with a post-type A dissection thoracoabdominal aortic aneurysm, complicated by uncontrolled arterial hypertension due to a collapse of the true lumen at the level of the proximal descending aorta.

Case 2: The second patient had an extensive symptomatic type Ia endoleak following previous endovascular thoracoabdominal aortic repair. Additionally, the patient exhibited further aneurysmal degeneration of the aortic arch. Notably, the patient had undergone surgical repair of the ascending aorta seven years earlier for aneurysmal disease.

Case 3*:* The third patient presented with a symptomatic 7.8 cm post-type A dissection aneurysm of the proximal descending aorta. The aneurysm was characterized by a rapid enlargement of the false lumen (>2 cm within 6 months), necessitating urgent intervention.

Case 4*:* The fourth patient developed mega aorta syndrome, presenting with: A symptomatic 8 cm thoracoabdominal aortic aneurysm. A concurrent 5.5 cm aneurysm of the aortic arch. The patient had previously undergone ascending

aortic repair. Given the complexity of the disease, a staged approach was initiated, starting with aortic arch repair using the Nexus endograft. This strategy aimed to reduce procedural time compared to performing a total endovascular repair with custom-made devices.

Table 1 summarizes the specific reasons for selecting in-situ fenestration in these patients and lists the bridging stent-grafts utilized in each case. Factors influencing this decision included the need to avoid total supraaortic debranching, previous surgical interventions, and the urgency of repair.

Outcomes

The procedure demonstrated 100% technical success (**Figure 2**). None of the patients experienced any major adverse cardiovascular events postoperatively. Two of the four patients have completed one-year, and two patients two-year follow-up with computed tomography angiography (CTA) confirming the absence of target vessel instability or other complications (**Figure 3**).

Table 1. Main indications for in situ fenestration (ISF) and type of bridging stent-grafts (BSGs) used in each patient.

Patient	Indications for ISF	Type of BSGs
Patient 1	Previous thyroidectomy with left vocal paresis	8mm VBX stent-graft
Patient 2	Previous neck radiation due to tongue cancer	8mm VBX stent-graft with Viabahn extension
Patient 3	Large asymptomatic goiter	8mm VBX stent-graft
Patient 4	Previous surgical repair of a right common carotid artery aneurysm	8mm VBX stent-graft with Viabahn extension

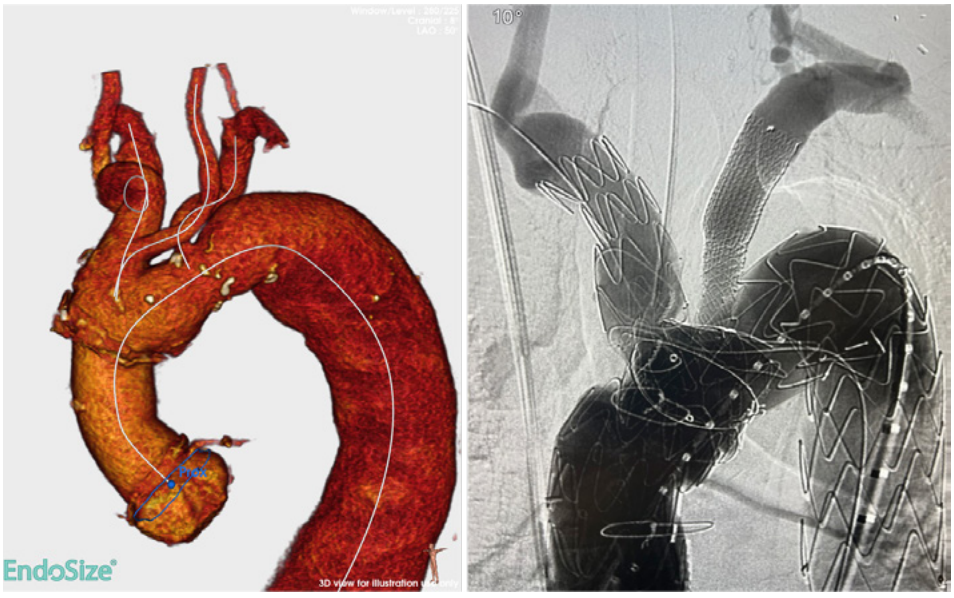

Figure 2. Preoperative computed tomography angiography and intraoperative diagnostic angiogram after successful Nexus One implantation and in situ fenestration.

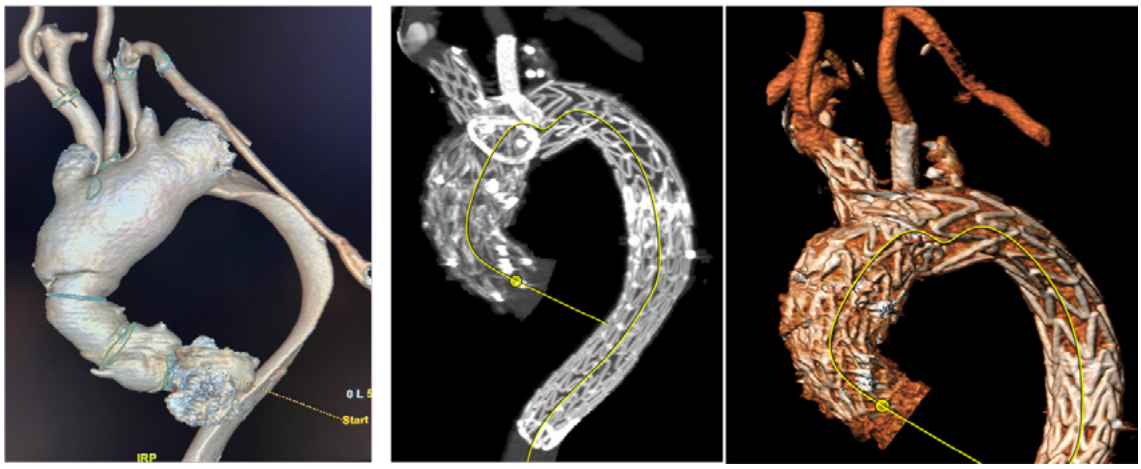

Figure 3. Pre- and postoperative (at 2 years) computed tomography angiography with 3D reconstruction.

DISCUSSION

This study presents the first description of in-situ fenestration of the single-branch Nexus One® aortic arch endograft using the BeBack re-entry catheter. This novel approach provides a significant advantage by avoiding total aortic arch debranching, a procedure that is not only technically demanding but also contraindicated in certain patient populations. Performing both the bypass and the endovascular repair of the aortic arch during a single session is particularly critical in urgent cases where time efficiency is essential.

In our experience, absolute and relative contraindications to total arch debranching include previous carotid endarterectomy, history of surgical procedures involving the esophagus or neck (e.g., oncological surgery, prior radiation therapy), conditions such as dysphagia, previous tracheotomy, or vocal cord paresis, presence of previous carotid artery stenting and severe gastroesophageal reflux disease. For these patients, in-situ fenestration provides an effective and less invasive alternative for restoring supra-aortic vessel perfusion.

Comparison to Existing Fenestration Techniques

The in-situ fenestration of thoracic endografts has been previously described applying laser-assisted graft penetration[6], dedicated needles for PTFE thoracic endografts[7] and recently, a technique using electro-cautery with a 0.018 wire has been reported[8].

To our knowledge, this is the first report utilizing the BeBack catheter as a fenestration tool specifically for the Nexus endograft. At present, there is no comparison studies between the different techniques. In our personal opinion, this device offers several technical advantages compared to other techniques. First the catheter is a combined support and re-entry catheter available in two sizes (2.4F and 4F), featuring a front-facing needle. Due to the low profile, the device provides enhanced flexibility, particularly in challenging aortic arch anatomies such as Type III arches[9]; in the same context, any accidental fenestration of the Dacron graft can be left uncovered without concern for endoleak or graft fatigue, as the material self-seals[10,11]. Secondly, the catheter allows precise control of the needle direction, enabling safe and accurate navigation of the guidewire into either the ascending or descending aorta, depending on the arch anatomy[10,11]. Finally, unlike laser-assisted techniques that burn the Dacron fibers, the BeBack catheter splits the fibers (**Figure 4**). This may preserve the structural integrity of the graft and enhance the long-term stability of the connection with the bridging stent-graft[12]. The latter remains a hypothesis and requires further in vitro confirmation.

On the other hand, the technique does present certain challenges: (1) Fenestration Positioning: Accurately locating the fenestration site can be difficult. Based on the design of the Nexus device, the optimal site is in the “valley” immediately distal to the single branch[13]. This location offers adequate space for deploying the bridging stent-graft and improves visibility, as it typically corresponds to the cranial position (12:00 o’ clock) in the aortic arch. (2) Sheath Delivery: After fenestration, the 7F sheath must be advanced through the fenestration to allow for the safe deployment of the balloon-expandable stent-graft. To minimize the risk of graft dislocation or migration, the thoracic endograft is maintained under tension via the integrated suture of the single branch[14]. (3) “Swallowing Technique”: To advance the sheath, the 5mm 0.014 balloon catheter is acutely deflated (the “swallowing technique”), avoiding the use of a sheath dilator that may mismatch with the 0.014 wire[15]. This maneuver ensures smooth and controlled sheath delivery through the fenestration.

CONCLUSIONS

This study introduces a novel technique for in-situ fenestration of the Nexus aortic arch device, providing an alternative solution for patients who are ineligible for total supraaortic debranching. The technique offers significant clinical advantages, including the ability to perform both bypass and endovascular repair during a single session, which is particularly critical in urgent cases. Our initial experience in four patients demonstrates that the approach is both feasible and safe, achieving 100% technical success with no major adverse cardiovascular events. Early follow-up imaging confirmed stable outcomes, with no evidence of target vessel instability or en-

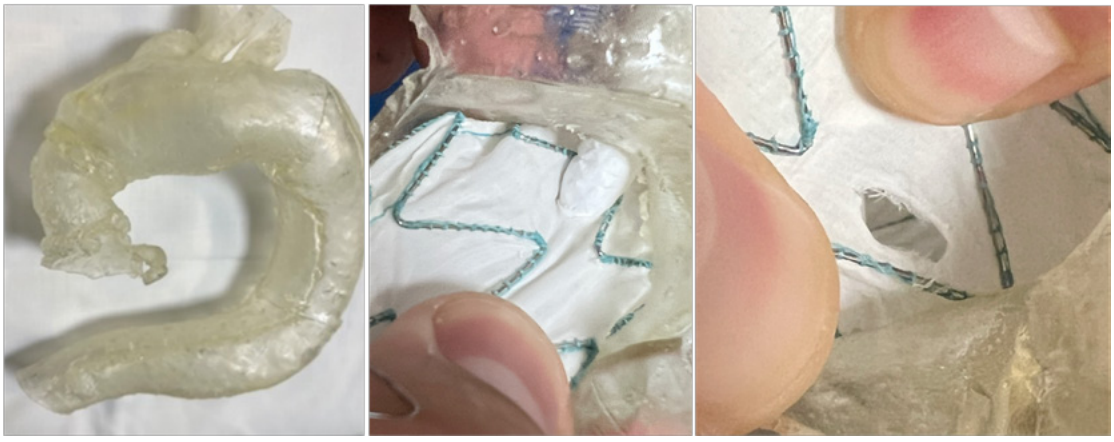

Figure 4: Demonstration of the bridging stent-graft (8mm, VBX) and the polyester graft after in vitro performance of an in situ fenestration in a Nexus One endograft

doleak. However, while these results are promising, further evaluation in larger patient cohorts with long-term follow-up is necessary to validate the technique's durability, clinical outcomes, and broader applicability. Such studies are already planned to address these questions and refine the technique further.

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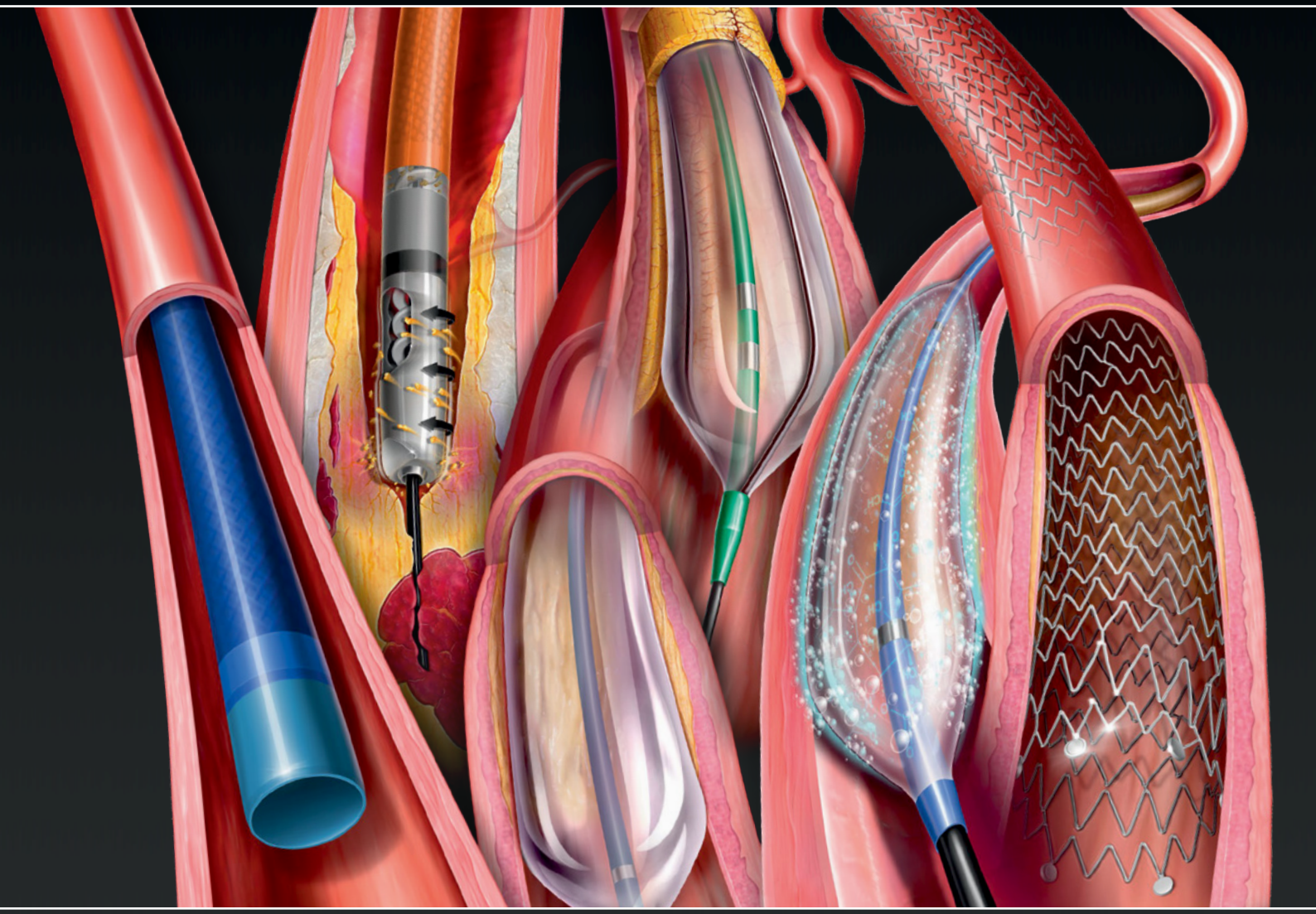

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Acute DeBakey Type II Aortic Dissection on Chronic Ascending Aortic Aneurysm

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Abstract:

DeBakey Type II acute aortic dissection in the setting of chronic ascending aortic aneurysm constitutes one of the rarest occurring subtypes of acute ascending aortic dissections and remains significantly underreported in literature. This work describes a case of a 73-year-old male patient who presented with a chronic ascending aortic aneurysm which further advanced into acute DeBakey Type II aortic dissection while in the hospital setting awaiting surgery. The patient successfully underwent open hemi – arch replacement, was successfully extubated the first post – op day and was uneventfully discharged a few days later. This report describes the occurrence of DeBakey Type II aortic dissection on chronic ascending aortic aneurysm and highlights the importance of vigilance regarding uncommon complications in aneurysm patients as well as the need for further research on the above-mentioned pathology.

Key Words: Bilateral Pneumothorax, DeBakey Type II Aortic Dissection, Acute Aortic Dissection, Chronic Ascending Aortic Aneurysm, DeBakey Type II, Acute Aortic Syndrome

INTRODUCTION

Acute aortic syndromes (AAS) encompass a group of aortic wall conditions manifesting clinically with sudden onset and intense tearing chest and/or back pain with radiation to the lower abdomen and pelvis[1]. The most common AAS is acute aortic dissection (AAD). AAD is a cardiovascular emergency associated with high rates of morbidity and mortality requiring prompt surgical management to sustain life[1].

AAD can be classified using the Stanford and DeBakey systems[2,3]. Stanford type A aortic dissections involve the ascending aorta and originate anywhere from the aortic root to the origin of the brachiocephalic trunk. This dissection pattern has been associated with rapidly occurring and lethal complications[2]. Aortic dissections developing anywhere throughout the length of the aorta except for the ascending aortic part are classified as Stanford type B[2]. The DeBakey system typifies lesions according to the location of the initiating intimal tear and the pattern of extension[1]. In DeBakey type I, the dissection originates in the ascending aorta and propagates distally to the descending aorta. In DeBakey type II, only the ascending aorta is involved while in DeBakey type III the dissection originates in the descending aorta and propagates distally[1,3]. From the acute onset of aortic wall injury, pathological responses and remodeling occurs which classifies aortic dissection as acute up to 2 weeks from onset, subacute from 2 weeks to 3 months, and chronic after 3 months[4,5].

Computed Tomography (CT) is pivotal in diagnosing, surveilling, and planning the appropriate intervention for aortic dissections[6]. Prognosis depends on many factors, which consist of preoperative, operative, postoperative, and patient specific factors. Pivotal predisposing risk factors include both acquired and genetic conditions that weaken the layers of the aortic wall. Vulnerable patients include those with; male sex, hypertension, atherosclerosis, previous cardiovascular surgery, an underlying aneurysm, connective tissue diseases such as Marfan syndrome, vascular type of Ehlers-Danlos syndrome, Loey's-Dietz syndrome, congenital bicuspid aortic valve, inflammatory vasculitis such as giant cell arteritis and Takayasu arteritis.

DeBakey Type II dissection is a well - documented phenomenon affecting the ascending aorta either acutely or in a chronic manner. In this case report, though, a rare occurrence of DeBakey Type II dissection occurs due to a pre-existing chronic aortic aneurysm.

CASE REPORT

A 73-year-old man was admitted to a tertiary hospital in Athens, Greece for scheduled open surgical repair of an ascending aortic aneurysm. The patient presented with acute chest

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pain and the initial CT imaging on admission revealed an ascending aorta aneurysm with a diameter of 7.03 cm and an aortic root size of 3.9cm (**Figure 1**). Echocardiography showed moderate aortic and mitral valve insufficiency. The patient's past medical history was significant for surgical inguinal hernia repair, catheter ablation treatment for atrial fibrillation, and hypertension. Family history was insignificant. In addition, the patient reported daily alcohol intake but no tobacco or recreational drug use. Medication history was significant for olmesartan, medoxomil, and amlodipine for hypertension control, flecainide for rate control due to atrial fibrillation and apixaban for anti - coagulation. Lastly, clinical examination and laboratory tests were not significant for any irregular findings and coronary angiography did not reveal additional issues.

However, during the pre-operative CT angiography that was performed, an aortic dissection extending from the proximal ascending aorta to the brachiocephalic trunk (DeBakey-Type II) was detected on the grounds of the pre - existing ascending aortic aneurysm (**Figure 2**)**.** As of that, the patient management plan was altered and the final pre - operative diagnosis was documented as DeBakey Type II aortic dissection.

The operation was performed with the patient under general anesthesia in the supine position. A median sternotomy provided access to the thoracic cavity and cardiopulmonary bypass was established through cannulation of the left common femoral artery and the superior vena cava (SVC) and right atrium. Deep hypothermia (18°C) was employed to provide robust organ and cerebral protection during circulatory arrest, as the anatomical complexity of this case necessitated this approach to achieve enhanced cerebral protection since the repair duration might be prolonged due to technically difficult restoration. Retrograde cardioplegia administration and retrograde cerebral perfusion (RCP) through the SVC were initiated to ensure adequate cerebral protection due to the dissection's involvement of the brachiocephalic trunk. The decision to use SVC and atrial cannulation was made specifically to facilitate

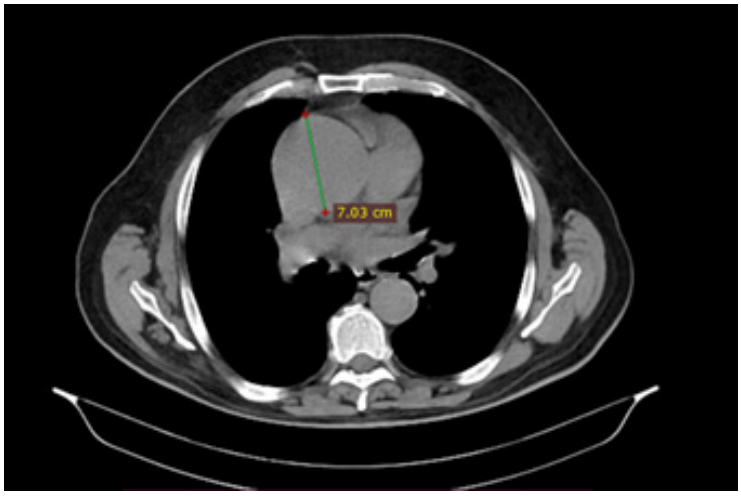

Fig 1 Initial CT (Computed Tomography) scan on admission showcasing an ascending aorta diameter of 7.03 cm (green line).

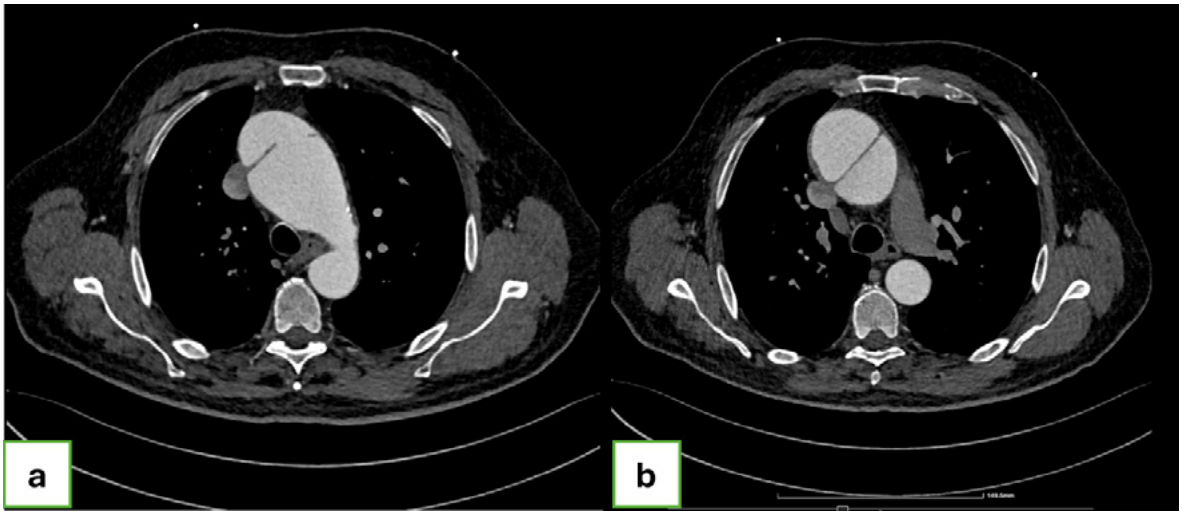

Fig 2 a) Pre - operative CT (Computed Tomography) scan showcasing the dissection of the ascending aorta extending to the origin of the brachiocephalic trunk. b) Preoperative CT (Computed Tomography) scan showcasing the dissection of the ascending aorta.

RCP. While a single two-stage cannula through the right atrium to the inferior vena cava might suffice in routine cases, the complexity of this patient's dissection required additional measures to mitigate the risk of cerebral ischemia.

As seen in **Figure 2**, the dissection included the ascending aorta and the brachiocephalic trunk. Thus, the decision was made to proceed to a hemi - arch aortic replacement using a synthetic graft. For that purpose, a branched graft (Intergard Woven, 34mm, Medtronic Inc. Sacramento, CA) was selected, and replacement of the proximal arch and the dissected segment of the innominate artery was initially achieved. Following that, the graft was anastomosed with the proximal aorta and further reinforcement and hemostasis was achieved through felt placement. Lasty, the cross - clamp was released. The Bi Bartolomeo catheter was not utilized due to the surgical team's preference for the selected graft and cannulation technique, which are part of the institution's standardized protocol. This approach has consistently demonstrated favorable outcomes in similar cases.

Gradual rewarming of the patient was achieved with concurrent physiological return of cardiovascular circulation. Lastly, a biventricular pacemaker and two chest tubes allowing pleural drainage were implanted, and the patient was weaned off cardiopulmonary bypass. Deep hypothermic circulatory arrest and retrograde cerebral perfusion time was approximately 30 minutes.

The patient was transferred to the ICU following the end of the operation. In the first post - operative day the patient was extubated successfully, and oxygen saturation remained within the normal limits. The only significant abnormality was metabolic alkalosis due to base excess during the first post - operative day with a pH value of 7.409 and $HCO3^-$ concentration of 27.4 mmol/L but it was corrected with the administration of spironolactone soon after. During the second post-operative day, the patient was transferred to the regular surgical floor and was later discharged on post-operative day six with significantly improved clinical presentation. Discharge medication included aspirin of 100mg twice daily, omeprazole 20mg twice daily, bisoprolol fumarate 2,5mg once daily, and paracetamol 1g as needed. He was scheduled for an early follow-up visit 10 days after discharge.

DISCUSSION

This case highlights a rare presentation of an acute DeBakey Type II aortic dissection occurring on a pre-existing chronic ascending aortic aneurysm. The unique properties of the ascending aorta's mobility, combined with hemodynamic forces, play a significant role in the predisposition to acute aortic syndromes (AAS) in this anatomical region. The transition from the mobile segments of the ascending aorta to the immobile descending aorta at the isthmus is particularly vulnerable to deceleration injuries and spontaneous dissections, further potentiating the incidence of complications such as aortic dissection in the ascending aorta[1].

Diagnostic imaging, particularly computed tomography (CT), is essential in identifying the type, location, and extent of aortic dissections[6]. In this case, CT angiography was instrumental in detecting the dissection, confirming the involvement of the ascending aorta and brachiocephalic trunk, and guiding the decision for surgical intervention. The DISSECTION mnemonic - standing for: Dissection or other AAS, Intimal tear, Size of aorta and false lumen, Segment(s) of aorta involved, Extent and termination, Complications, Thrombus in false lumen, Inspect False/True lumen, Other factors to consider, and Notify the provider - has been proposed as a comprehensive tool to assess critical aspects of the dissection, including the intimal tear, the size of the aorta, and complications such as thrombus formation or rupture, all of which can inform prognosis and management[6].

Aortic dissection associated with chronic aneurysms presents additional challenges. Literature suggests that 5% to 20% of aortic dissections are linked to arteriosclerotic aneurysms, with this incidence rising due to the aging population[7]. In particular, the overlap of an aortic aneurysm and dissection increases the risk of rupture if not addressed, underscoring the importance of timely surgical management[7]. In this case, the surgical approach of hemi-arch replacement, using a synthetic graft, effectively treated both the aneurysm and dissection, demonstrating a successful outcome despite the complexities of the condition.

This report also underscores the scarcity of documented cases of DeBakey Type II aortic dissection occurring on a pre-existing aneurysm, highlighting the need for further research. While there is ample literature comparing DeBakey Type I and II dissections, few studies focus on the intersection of chronic aneurysms and acute dissections. This case adds to the limited data, suggesting that the presence of an aneurysm may complicate both the clinical presentation and surgical management, necessitating individualized treatment plans based on the patient's comorbidities, dissection pattern, and overall prognosis.

CONCLUSION

This case illustrates the critical importance of considering acute aortic dissection in patients with known aneurysms, even in the absence of classic risk factors such as trauma. Prompt diagnosis and intervention, guided by comprehensive imaging and individualized surgical planning, are essential for successful outcomes. Further research is warranted to explore the optimal management of acute aortic dissection in the context of chronic aneurysms, with the goal of improving both short- and long-term patient outcomes.

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BOOK OF ABSTRACTS

ENDOVASCULAR THROMBECTOMY FOR ACUTE ILIOFEMORAL DEEP VENOUS THROMBOSIS

N. Hasemaki[1], Ef. Avgerinos[2], An. Skotsimara[1], M. Tsotsios[1], N. Melachroinopoulos[1], S. Georgopoulos[1], Ath. Katsargyris[1], Ch.Klonaris[1]

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Background: Ilio-femoral deep vein thrombosis has a high rate of long-term morbidity, mainly in the form of postthrombotic syndrome. Endovascular interventions of acute deep vein thrombosis using thrombolysis and mechanical thrombectomy have received increased focus in the literature as a safe and effective therapeutic modality in selected patients.

Aim: To report the use of endovascular thrombectomy in the management of acute iliofemoral venous thrombosis in young patients.

Methods: From October 2022 to January 2024, 6 patients were treated in our department for acute iliofemoral deep vein thrombosis. All patients were treated with endovascular mechanical thrombectomy using the ClotTriever Thrombectomy System (Inari Medical, Irvine, CA, USA) or the Aspirex Mechanical Aspiration Thrombectomy System (BD, Franklin Lakes, NJ, USA).

Results: Four patients were female (66.7%) and the mean age was 33 years (range 24-39). All patients presented within 1 week of symptom onset, whereas an identifiable provoking factors was present in 5 cases (83.3%). May-Thurner syndrome was present in two patients (33.3%). Endovascular mechanical thrombectomy was carried out via popliteal vein access in all cases, wheres as ClotTriever Thrombectomy System was used in 5 cases (83.3%). Technical success was 100%, and venous stenting was performed in 4 cases (66.7%) due to residual stenosis. There were no bleeding events or repeat venous procedures. The median postprocedure hospital stay was 2 days and all patients reported complete symptom relief at postprocedure day one.

Conclusions: Endovascular mechanocal thrombectomy is an effective and safe treatment for selected patients with acute iliofemoral thrombosis. Nonetheless, further research is warranted to determine mid-term and long-term outcomes.

GENETIC AND BIOCHEMICAL THROMBOPHILIC MARKERS IN PATIENTS WITH HRONIC VENOUS DISEASE (VENOUSVARICOSEVEINS) AND VENOUS ULCERS

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Aim: The aim of this study is to investigate the correlation of biochemical and thrombophilic markers (such as antithrombin, protein C and S deficiency rate, factor V Leiden involvement rate and G20210A prothrombin mutation) with the severity of clinical presentation of CVD, especially those patients with chronic and relapsing limb ulcers.

Methods: The study was performed in 200 individuals with chronic venous disease (varicose veins and / or venous ulcers) and in a corresponding number of control individuals free(100volunteers) of the above or other clinical symptoms referring to a latent venous or thrombophilic pathology, corresponding to sex and age. The classification was made according to the CEAP system developed under the auspices of the American Venous Forum. Doppler color ultrasound and / or duplex ultrasonography was performed to evaluate the effectiveness of the venous system. The ankle-branchial index calculated to determine the effectiveness of the arterial system.

Results: In a first sample of 30 people (15 men and 15 women) in ages from 50 to 70 years with moderate or severe degree chronic venous disease of the lower extremities shows an increase of the factor MTHFR(C677), increase of heterozygous types of Factor V Leiden and a slight rise in Factor V.Willebrand. Also appears a very small rise of IgG and IgM antibodies as well as a slight increase protein C. A specific increase in the CRP index does not occur as well as the WBC.

Conclusions: The polypeptide tissue antigen TPA appears to contribute to the development of chronic venous insufficiency lower extremity disease but not homocysteine (HCY). In this the small sample of patients does not show a particular rise α1 antitrypsin, plasminogen-PLG, Factor IX and Factor XI as well as protein S.

Young Vascular Surgeons Forum - EVST

USE OF ROTATIONAL ATHERECTOMY-ASSISTED BALLOON ANGIOPLASTY IN THE TREATMENT OF ISOLATED BELLOW-THE-KNEE ATHEROSCLEROTIC LESIONS IN PATIENTS WITH CHRONIC LIMB THREATENING ISCHEMIA

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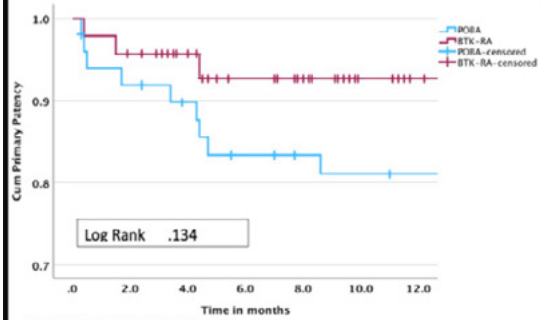
Aim: Aim of the study is to evaluate the safety and effectiveness of rotational atherectomy-assisted balloon angioplasty (BTK-RA) for the treatment of isolated below the knee (BTK) atherosclerotic lesions and to compare the outcomes to plain old balloon angioplasty (POBA).

Methods: Between January 2020 and September 2023, 96 consecutive patients with chronic limb threatening ischemia (CTLI) and isolated BTK-lesions underwent POBA (group A) or BTK-RA (group B). The primary outcome measures were: periprocedural technical success, primary patency, postoperative increase of the ankle branchial index(ABI), target lesion revascularization (TLR), limb salvage, minor amputation and death. Both techniques had similar technical success, operative time, intraprocedural complications and bailout stent implantations independent on the operator's experience.

Results: Group B had significantly higher primary patency rates (93.5% vs 72.0% respectively, p=.006), lower in hospital stay (2.0 - 3.0 vs 4.0 - 6.0 days respectively, p<0.001) and higher postoperative ABI (0.8 - 0.2 vs 0.7 - 0.1 respectively, p=.008), compared to group A, respectively. Significant differences (POBA n: 20, 40%, BTK-RA n=3, 6.5%) were found in minor amputation rates between the 2 groups (p<0.001), while the respective limb salvage rates were similar in both groups (94.0% vs 97.8%, p=.35).

Conclusion: The use of BTK-RA for the treatment of BTK-lesions in patients with CTLI showed significant clinical advantages in comparison to POBA.

Figure 1A: Cumulative patency in 12 months



Survival analysis at 12-month follow up

	0	2	4	6	8	10	12
Total							
Cum Survival (%)		99	98	98	98	97	69
At risk	96	94	93	90	88	87	50
Std error	0.01	0.01	0.01	0.01	0.01	0.02	0.06
Group 1							
Cum Survival (%)		90	83	83	81	81	60
At risk	50	44	42	37	36	35	20
Std error	0.04	0.04	0.05	0.05	0.06	0.06	0.09
Group 2							
Cum Survival (%)		96	92	92	92	92	92
At risk	46	39	30	22	14	7	3
Std error	0.03	0.03	0.04	0.04	0.04	0.04	0.04

Figure 1B: Procedural and follow up results

	Total N=96	Group 1 N=50	Group 2 N= 46	p-value
Experienced surgeon[1]	60 (62%)	35 (70%)	25 (54%)	.114
Op duration (minutes)[2]	59-30	64-30	58-23	.878
Antegrade punction[1]	83 (86%)	43 (86%)	40 (86%)	.891
Technical success[1]	88 (91.7%)	44 (88%)	44 (95.7%)	.175
Assisted technical success[1]	96 (100.0%)	50 (100.0%)	46 (100.0%)	n/a[3]
Bailout stenting[1]	8 (8%)	6 (12%)	2 (4%)	.175
Peripheral embolization[1]	0 (0.0%)	0 (0.0%)	0 (0.0%)	n/a[3]
Access site complications[1]	1 (1%)	0 (0%)	1 (2%)	.295
Hospital stay (days)[2]	2.5-5	4-6	2-3	**<.001**
Postoperative ABI[2]	0.8-0.2	0.7-0.1	0.8-0.2	**.008**
Postoperative ABI >0.8[1]	38 (48%)	16 (35%)	22 (67%)	**.005**
30 days MACE[1]	1 (1%)	1 (2%)	0 (0)	.335
Mortality[1]	2 (2%)	2 (4%)	0 (0%)	.170
Primary patency[1]	79 (82%)	36 (72%)	43 (93%)	**.006**
Reintervention (TLR)[1]	13 (76%)[3]	12 (85%)[3]	1 (3 %)[3]	.052
Minor Amputation[1]	23 (24%)	20 (40%)	3 (6%)	**<0.01**
Limb salvage[1]	92 (96%)	47 (94%)	45 (98%)	.349

[1] N (%)
[2] Median-IQR
[3] Incidence calculated at patients with failed primary patency, not in the entire cohort.

TREATMENT LENGTH, DEVICE SELECTION AND EXTERNAL ILIAC ARTERY EXTENSION ARE ASSOCIATED WITH INCREASED AORTIC STIFFNESS AFTER ENDOVASCULAR AORTIC REPAIR: A PROSPECTIVE, SINGLE-ARM STUDY

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Background-Aim: Aortic stiffness is a strong independent factor of adverse cardiovascular outcomes. Implantation of stent endografts during endovascular aortic repair(EVAR) increases aortic rigidity, as available commercial endoprostheses are composed of stiffer materials compared to native aortic wall. The aim of this study is to investigate the correlation between endograft properties and aortic stiffness increase.

Methods: This is a prospective, observational and single-arm study. Patients with infrarenal abdominal aortic aneurysms, managed electively with aortobiiliac endografts are consecutively enrolled in our study. Changes in aortic stiffness are calculated by pulse wave velocity(PWV) measurements. Primary endpoint is the correlation of various endograft properties and PWV increase. Statistical analysis is performed by software SPSSv28.0.

Results: 38 patients fulfilling the inclusion criteria were enrolled in this preliminary stage of the study. Patients received Dacron polyester, ePTFE with suprarenal fixation(ePTFESF) and with infrarenal fixation(ePTFEIF) endografts. PWV was significantly increased postoperatively in the total number of patients (10.6 to 11.9 m/s; p<.001), but also in each type of endograft separately. A statistically significant and positive correlation (r=.870; p<.001) of PWV increase and endograft length was found. The observed correlation remained statistically significant in all three endograft categories; Dacron (r=.985; p<.001), ePTFESF (*r*=.969; p<.001) and ePTFEIF (r=.931; p=.001). Multiple regression analysis showed a statistically significant effect of both endograft type and endograft length on PWV increase, which was higher for ePTFESF endografts comparing to ePTFEIF endografts (p=.038) and the universally observed positive correlation was stronger in the ePTFESF group comparing to the ePTFEIF group (p<.001).

Conclusions: Endoprostheses with infrarenal fixation should be preferred in EVAR. Minimum sealing lengths according to instructions for use should be used, avoiding unnecessary extension of iliac limbs to common iliac bifurcations or even to external iliac arteries.

Improvement of endograft properties could minimize the aortic stiffness leading to prevention of adverse cardiovascular events.

AORTIC VASCULAR GRAFT AND ENDOGRAFT INFECTION - OUTCOME ANALYSIS IN A DUAL CENTER COHORT

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Background: Aortic graft infection (AGI) is a serious complication of open and endovascular aortic surgery with significant morbidity and mortality. There is still a low level of evidence regarding diagnostic certainty, comparison of surgical and conservative therapy and procedural outcomes. The aim of this study is a dual center cohort analysis with presentation of the results of both treatment alternatives including a quantitative and qualitative PET-CT analysis for a possible improved risk stratification.

Methods: All Patients with AGI (1/2013 - 12/21) from two university centers were included in a prospective database. Patient characteristics, details of initial surgery, characteristics of surgical treatment and complications during inpatient and follow-up were collected retrospectively. All available PET-CTs were evaluated qualitatively using a visual grading scale and quantitatively using the maximum uptake method. The primary endpoints were mortality during hospitalization and reintervention-free survival at 6 months. Secondary endpoints include survival and complication rates, particularly in the comparison of surgical procedures and the comparison with the conservatively treated group.

Results: 76 patients were treated surgically and 17 conservatively. The diagnosis of AGI was made after 36±49 months. A fistula was present 32 times. Reconstruction was performed with a silver prosthesis (21.3%), hand-sewn bovine pericardium (61.3%) or deep vein (17.3%). With a hospital stay of 45±37 days and 17±34 days in the ICU, the surgical and medical complication rates were 61.8% and 65.8% respectively. In 23.7% of cases there were aortic complications. In-hospital mortality was 19.4%, re-intervention-free survival at 6 months was 50%. The reconstruction material showed no influence on hospital mortality (p=0.18).

Conclusions: Perioperative morbidity and mortality in surgical treatment of AGI remain high. This study shows comparable short- and medium-term mortality in conservatively treated patients, albeit with a small number of patients. Due to the complexity of AGI, a prospective national registry should be established.

MECHANICAL THROMBECTOMY FOR ILIAC LIMB GRAFT OCCLUSION AFTER ENDOVASCULAR ANEURYSM REPAIR USING ROTAREX™S ATHEROTHROMBECTOMY SYSTEM

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Background: Iliac limb graft occlusion is one of the most frequent adverse events after endovascular aortic aneurysm repair (EVAR). Multiple studies, identified limb occlusion as the third most common cause of reintervention post-EVAR, after endoleaks and graft migration, with incidence ranging between 0% and 10.6%. Until recently, over-the-wire thrombectomy anf crossover femoral-femoral graft were most commonly performed for the treatment of symptomatic iliac limb thrombosis.

Aim: To report the use of the Rotarex™S atherothrombectomy system in symptomatic acute, subacute, or chronic graft limb thrombosis following EVAR.

Methods: Seven male patients (mean age 70.6 years) presented with iliac limb graft occlusion after EVAR. Median time to occlusion was 56 weeks (1-364 weeks), whereas all occlusions were unilateral. The presenting symptom was intermittent claudication (n = 4) and acute limb ischaemia (n = 3). Mechanical thrombectomy was performed using the 10F Rotarex Rotational Excisional Atherectomy System (Becton, Dickinson and Company, Franklin Lakes, USA) with stenting/relining of the affected limb.

Results: Technical success was 85.7% (6/7 cases). In one case with iliac limb angulation, the Rotarex wire was cut during the procedure and retrieved with snare device, and the lliac limb was then recanalised with limb stenting/relining. After the successful thrombectomy in the remaining cases, limb graft stenting/relining was performed in all cases (n = 6) and outflow stenting due to external iliac artery stenosis was permorded in 3 cases. Post-operatively, novel oral anticoagulant therapy and antiplatelet therapy was administrated in all cases. Median length of stay was 2 days. Over a median follow-up period of 12 months (4-24 months), there was no event of limb reocclusion.

Conclusions: Rotational mechanical thrombectomy for iliac limb occlusion after EVAR appears to be both safe and effective. However, it is of utmust important to recognise defects contributing to graft occlusion and treat them within the same procedure.

SINGLE CENTER EXPERIENCE WITH THE USE OF BOVINE PERICARDIUM GRAFT TO TREAT AORTIC INFECTIONS

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Background-Aim: An aortic graft or endograft infection is a severe complication that can occur after open or endovascular reconstructive surgery (EVAR) for an abdominal aortic aneurysm and is associated with high morbidity and mortality. Infection of the native aortic wall, leading to a mycotic aneurysm may also have a disastrous course. We describe our single-center experience with the use of home-made bovine pericardium grafts to treat aortic infections.

Methods: Between October 2019 and February 2024, 14 patients [13 males, median age 70.07 ± 9.4 years, range 57-81] underwent surgery with a home-made bovine pericardium graft to treat an aortic infection. The cause was conventional graft infection in 6 cases, mycotic aneurysm in 4 cases, abdominal endograft infection after previous EVAR in 3 cases, and after thoracic endovascular repair in 1 case. In all cases, graft infection was documented by a combination of clinical findings, laboratory tests, imaging, and microbiologic tests.

Results: Mean interval time between initial surgery and graft/endograft infection was 9.63±9.2 years (range 0.3 - 32 years). Two mycotic aneurysms presented with aneurysm rupture. Fever and abdominal or lumbar pain (57%) was evident in 8 patients, while 2 patients presented with a low-grade infection. A fistula was present in 4 cases (3 aorto-enteric and 1 aorto-bronchial). A positive pathogen detection was confirmed in 11 patients. Transabdominal approach was selected in 11 cases, a retroperitoneal in 2, and a thoracoabdominal in 1 case. All patients received an in situ replacement using a hand-sewn graft made of a bovine pericardium sheet. The overall in-hospital mortality was 28.6%. At a mean follow-up of 12±13.99 months, no recurrence of infection was observed.

Conclusions: Bovine pericardium grafts are associated with low graft-related complications and, therefore, provide a valuable and encouraging option for in situ replacement following aortic infection.

ePP06

INFRAINGUINAL ENDOVASCULAR TREATMENT OF PERIPHERAL ARTERIAL OCCLUSIVE DISEASE IN DIABETIC PATIENTS

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Introduction: Periferal arterial occlusive disease (PAOD) manifests as claudication, ischemic rest pain or tissue loss. The incidence of PAOD is increasing due to the rising prevalence of diabetes and obesity in the general population. The aim of this study is to analyse the outcomes of infrainguinal endovascular treatment of PAOD in patients with diabetes.

Methods: This is a retrospective analysis of patient data from 2018 to 2022 with first time infrainguinal endovascular treatment for PAOD. The primary outcome was to compare amputation free survival between diabetic and non-diabetic group. Endovascular procedures comprised of plain balloon angioplasty with selective use of plain or drug eluting stents.

Results: Study included 228 patients, 157 (68,9%) males and 71 (31,1%) females. Most prevalent comorbidities were congestive heart failure (30,3%) and previous myocardial infraction (14,5%). Claudications was present in 50,9%, rest pain in 15,4% and wound was present in 33,8%. Among 228 procedures the target lesion was the femoropopliteal in 128 (56,1%) and in infrapopliteal segment in 100 (43,9%). Diabetes was present in 158 (69,3%) patients, of whom 52 (32,9%) were women. The mean follow up was 8 months. The mean hospital stay was 3 days. Major amputation occurred in 20,2% in the diabetic group and in 2% in non-diabetic group (OR 12,66 95% CI 1,65 - 97,29; p=0,002). The mean time to major amputation in non-diabetic group was significantly longer (p = 0,016). In the diabetic group men had significantly longer amputation free time (p = 0,004) than women. There were 12 (0,5%) deaths and non of them were due to the revascularisation procedure.

Conclusion: This study shown that the diabetic group displayed a considerably higher rate of major amputations, emphasizing the critical importance of early intervention and close monitoring for diabetic PAOD patients.

ePP09

PERCUTANEOUS ENDOVASCULAR REPAIR OF ABDOMINAL AORTIC ANEURYSMS; A SINGLE-CENTER EXPERIENCE

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Background - Aim: Recently, percutaneous endovascular abdominal aortic aneurysm repair (pEVAR) has gained its role in abdominal aortic aneurysm (AAA) treatment. The aim of the study is to report the increase of pEVAR in a tertiary center through years and its impact on clinical outcome.

Methods: A single-center, observational, retrospective study of prospectively collected data was conducted. All patients who underwent elective pEVAR (using the Proglide device) and EVAR with femoral cutdown access between 2017 and 2024 were included [2017-2019 early pEVAR experience (253 patients); 2020-2024 late experience (340 patients)]. Baseline characteristics, intra- and peri-operative data were collected. The main outcomes measured were the rate of pEVAR application, the need for blood transfusion and hospital stay.

Results: A total of 593 patients were treated by endovascular means (20.5% pEVAR vs 79.5% EVAR). Mean age was similar between groups (pEVAR 72.8±4.5 vs EVAR 72.3±7; p=0.68). The mean number of Proglide closure devices used for right and left access was 232 and 205 respectively. There was no difference in terms of type of anaesthesia [pEVAR: local 7% and 93% general anaesthesia (GA) vs EVAR: local 9% and 91% GA, p=0.38].The mean operation time was lower for pEVAR (111±40) vs EVAR 129±45 (p=0.000), while the need for transfusion was similar between groups [pEVAR: 20/122 (16.4%) vs EVAR: 70/434 (16%) p=0.65]. The average hospital stay was significantly lower for patients who underwent pEVAR (1.35±0.8) vs EVAR 3.23±2 (p=0.000). Only 1 death occurred in EVAR group. In the initial period pEVAR was used only in 10% of cases, while it was increased significantly in the later experience to 28.2%.

Conclusions: pEVAR is a growing trend in the treatment of AAA, and compared with femoral cutdown access, it can be considered safe and effective, reducing the operation time and hospital stay.

ePP10

CAROTID SUBCLAVIAN ANASTOMOSIS AS A FIRST STEP IN HYBRID TREATMENT OF AORTIC ARCH AND PROXIMAL DESCENDING THORACIC AORTIC INJURY

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Background: The hybrid approach to the treatment of the pathology of the thoracic aorta allows us to significantly expand the possibilities of the isolated TEVAR. An extra-anatomical left CCA-LSA bypass prior to the placement of an endoprosthesis in zone 2, would be sufficient for a save blood flow at the LSA.

Methods: From 2014 to 2024 at the National M.Amosov ICVS of the NAMS of Ukraine, 253 patient with aortic aneurysms were treated by TEVAR; 111 (43,8%) patients of them were operated with the hybrid approach, 56 (22,1%) of them received carotid-subclavian anastomosis, as a first stage. The causes of aortic injury were: descending aortic aneurysm without dissection - 12; 38 patients had an aortic dissection (4 - acute, 6 - subacute, 28 - chronic), PAU (n = 2), postcoarctation aortic aneurysm (n = 3), enlargement residual aorta after previous ascending aortic grafting (causing TAAD) (n = 1). If patients admitted emergency: first TEVAR operation were performed (only two cases). In all cases, a carotid-subclavian shunt was performed from a 5-6 cm supraclavicular access. The middle thirds of the left carotid and left subclavian arteries were connected with the armed d=6mm PTFE grafts, no need to cross the neck muscles.

Results: Mortality among 56 operated on patients consist 1.7% (one patient). There were several complications: endoleak type I or II (3 and 1); bleeding (>200 ml) treated surgically (n-1), treated conservative (n-2): thrombosis of the anastomosis and reoperation (n-1), dissection of the LSA (n-2), trauma of the recurrent laryngeal nerve (n-1), stroke (1). No one case of SCI. In the remote period, one patient died after 3 months from an unknown reason.

Conclusions: Carotid-subclavian bypass for revascularization of the subclavian artery performed in the setting of TEVAR is durable, safe method for expand endograft landing zone to Ishimaru 2 zone.

ePP12

THE FIRST EXPERIENCE OF FROZEN ELEPHANT TRUNK OPERATION IN HIGH VOLUME UKRANIAN AORTIC CENTER

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Background: Ongoing development of cardiovascular technologies has made it possible to carry out simultaneous replacement of the ascending, arch and descending thoracic aorta (frozen elephant trunk operation), constantly improving the results and reducing the number of complications during such difficult surgery. In the case of conventional, planned operation, an alternative may be a hybrid, staged approach. In acute conditions, aneurysm ruptures, bleeding, uncontrolled aneurysm expansion - time and opportunities for two-stage correction are limited. Despite the risks, the only possible way to save the patient's life can be one-stage urgent operation.

Methods: During the last decade, the department surgical treatment of aortic pathology the National M.Amosov Institute of Cardiovascular Surgery of the NAMS of Ukraine, performs up to 250 operations for aortic pathology every year, including about 100 patients with acute aortic syndromes, 2/3 of which are aortic dissection type A. From 2020 to 2024, 25 patient with thoracic aortic pathologies were treated with one stage replacement ascending, arch and descending thoracic aortic - frozen elephant trunk operation (FET); Patients age were 36 - 68 y.o, mean - 54,2; 18 (72,0%) patients are male. Concomitant CAD needs CABG took place in 6 (24,0%), COPD - 8 (32,0%), CRF - 5 (20,0%), DM - 5 (20,0%), pulmonary hypertension (more than 70 mm of mercury) - 3 (12,0%), severe mitral insufficiency - 2 (8,0%). Part of the patients, 12 (48,0%), had cardiac operation previously; for the third of them, more than two operation with bypass took place in early; 10 pts (40,0%) operated due different aortic lesions in the ascending part of aorta (supracoronal grafting - 8, Bental`s operation - 2); and one case after aortic valve replacement and coronary bypass surgery, respectively. The causes of aortic injury among all patients were: acute type A aortic dissection - 1 (4,0%); chronic type A aortic dissection - 12 (48,0%), 8 of them - enlargement residual aorta after previous ascending aortic grafting (causing TAAD); non A non B aortic dissection - 5 (20,0%), chronic type B aortic dissection - 2 (8,0%); blunt aortic injury (BAI) - 2 (8,0%), TAAA - 3 (12.0%). Simultaneously of the FET procedure, we performed Jacoub operation - 2, CABG - 6 (1-3 venous autografts), mitral valve plasty - 2, tricuspidal valve plication - 4. All operation we profound with 25^{o}C hypothermia and antegrade cerebral perfusion for all three cerebral vessels. For all operation we used E-Vita Hybrid stent graft system (E-Vita Open Plus - 14, E-Vita Open Neo - 11). Three operations we operated on urgently, all another were planned surgery.

Results: Hospital mortality among 25 operated with FET operation patients consist 8,0% (two patient), which correlates with results reported by colleagues with significant experience in such intervention. The reasons of death were stroke and severe pulmonary insufficiency respectively. In two patients we received neurological complication - permanent paraplegia and transient stroke. Renal failure needed temporary dialysis - 3. Bleeding, needed re-thoracotomy - only 1 case. Prolonged ventilation (more 2 p o days) took place in 4 pts.

Conclusions: Frozen elephant trunk operation allowed treatment of complex patients with extensive thoracic aortic diseases with satisfactory short- and mid-term results. Acute and chronic, especially non-A non-B type of aortic dissections represent interesting subsets for FET procedure.

ePP13

DETERMINANTS OF RECURRENCE RATE DURING MIDTERM FOLLOW-UP OF PATIENTS AFTER ENDOVENOUS LASER ABLATION OF PRIMARY LOWER LIMB VARICOSE VEINS

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Background: The goal of this prospective cohort study was to study the different determinants impacting primary varicose vein recurrence rates and patterns after endo venous laser ablation (EVLA) for primary lower limb varicose veins.

Patients and Methods: 127 symptomatic patients (127 limbs) with great saphenous vein reflux (>0.5 seconds), GSV diameter> 3mm and pre-operative incompetent perforators were followed up within two years for recurrence after EVLA.

Outcomes: Recurrence was defined clinically by venous clinical severity score (VCSS) and CEAP classification and radiologically by patterns of reflux on duplex ultrasound examination. Assessment was done at 1, 6, 12 and 24 months after the procedure.

Results: Two-year life table analysis showed varicose vein recurrence in 9 (7.1%) of limbs. Varicose vein recurrence was mostly seen owed to due to BMI more than 30.5 kg/m2 in 77.8 % (p <0.001, 95% CI 1.105 to 1.590) of recurrence patients, refluxing anterior accessory saphenous vein in 77.8% of patients (p <0.001, 95% CI 3.2 to 1669.1) and postoperative incompetent perforators in 77.8% of patients (p <0.001, 95% CI 2.7 to 69.3). Age, gender and pre-operative GSV diameter ≥5.5 mm were statistically insignificant in determination of recurrence.

Conclusion: BMI, refluxing anterior accessory saphenous vein and postoperative incompetent perforators are the most important determinants of recurrence after EVLA with a statistically significant impact in comparison with age, gender and preoperative dilated GSV diameter ≥5.5 mm.

ePP16

COVERED ENDOVASCULAR RECONSTRUCTION OF ILIAC BIFURCATION (CERIB TECHNIQUE); SHORT-TERM AND 1-YEAR OUTCOMES

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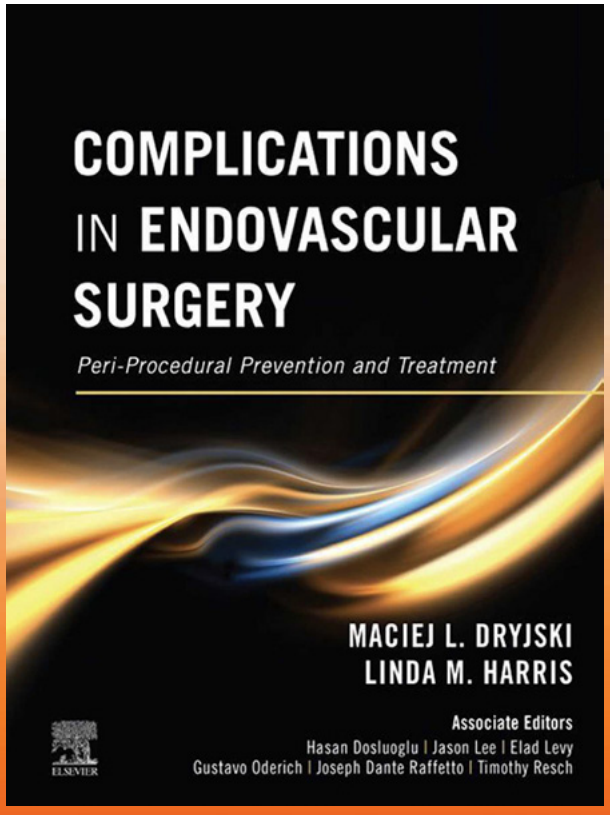
Introduction: Successful distal zone seal with internal iliac artery salvage is crucial during EVAR. The aim of this study is to present 1-year outcomes of the CERIB technique, an "off-the-shelf" endovascular option for distal landing zone seal at the external iliac artery (EIA), while maintaining blood flow to the IIA.

Methods: This is a single center, retrospective analysis of prospectively collected data of patients undergoing EVAR for intact AAA or previous failed-EVAR (December 2022 - March 2024). Primary outcomes included technical success and primary patency at maximum follow-up. Secondary outcomes were endoleak rate (EL) associated with the iliac reconstruction and reintervention rate.

Results: A total of 25 patients (96% males, mean age: 72 ± 7.1 years old) with 31 iliac bifurcations treated were included. Treatment indications included a CIA aneurysm (67.7% - 21/31 iliac bifurcations), short-CIA (16.1% - 5/31), narrow lumen CIA (9.6% - 3/31) and EL Ib (6.4% - 2/31). Aortic platforms deployed included the COOK Alpha (9 limbs), GORE C3 (6 limbs), MEDTRONIC Endurant IIS (7 limbs), ENDOLOGIX Ovation Alto (1 limb), ARTIVION E-tegra (3 limbs) and the COOK T-branch platform (5 limbs). Technical success rate was 100%. Primary patency rate at 30-days (31/31 iliac bifurcations), 6-months (22/22) and 1-year (11/11) was 100%. No death was reported for all patients at maximum follow-up. CERIB related EL rate was 3% (1/31 iliac bifurcations), with one case of gutter EL. Reintervention rate was 6.4% (2/31) during the follow-up; including one case of proximal stent extension and relining due to gutter EL and one case of EIA relining due to an asymptomatic stenosis.

Conclusion: CERIB technique showed excellent short-term and 1-year outcomes in terms of freedom from endoleak and patency rates. CERIB technique may be used as an alternative to iliac branch devices for IIA salvage during EVAR. Long-term surveillance is warranted.



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