Volume 7 Issue 1 January 2025 ISSN 2732-7175

Hellenic Society of Vascular and Endovascular Surgery

Hellenic Journal of Vascular and Endovascular Surgery

HOT TOPICS

Customary paradigm in anesthetic management of carotid endarterectomy patients shifts after pandemic: experiences of an advanced practice centre
Ankara, Turkey

Retrospective study of patients with asymptomatic, incidentally discovered, thoracic aortic pseudoaneurysm treated in a single institution
Crete, Greece

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Volume 7 • Issue 1 • 2025

Hellenic Journal of Vascular and Endovascular Surgery

Volume 7 • Issue 1 • 2025

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Hellenic Journal of Vascular and Endovascular Surgery

Contents

EDITORIAL

Newer biomarkers in tailoring treatment of venous thromboembolism; the paradigm of soluble fibrin-monomer complex

Constantine Antonopoulos

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With significant clinical, financial, and social costs, deep vein thrombosis (DVT) and its potentially lethal sequela, pulmonary embolism (PE), continue to be major global health issues. The silent progression, recurrence risk, and chronic complications like post-thrombotic syndrome (PTS) of DVT continue to pose a challenge to clinicians despite advancements in diagnostic procedures and therapeutic agents. Anticoagulants, including more recent direct oral anticoagulants (DOACs) like dabigatran etexilate and rivaroxaban, as well as more conventional ones like warfarin, are at the forefront of contemporary therapeutic management. Simultaneously, laboratory biomarkers—specifically, soluble fibrin-monomer complexes (SFMC) and D-dimer—have become both potential indicators of therapeutic response and diagnostic tools. This editorial seeks to provide an insightful and clinically meaningful discussion of the interactions between these markers and various anticoagulant regimens.

D-dimer has a well-established clinical utility. It has been appropriated into diagnostic algorithms for suspected thromboembolic events because it is a degradation product of cross-linked fibrin and its elevation indicates recent or ongoing fibrinolysis. It is especially helpful in conjunction with age-adjusted thresholds and pre-test probability scoring systems such as the Wells score. The non-specificity of D-dimer, however, restricts its use as a stand-alone diagnostic or prognostic tool. Elevated levels can be caused by trauma, infection, inflammation, and even aging. In contrast, SFMC captures the early phases of coagulation prior to the emergence of a fully formed thrombus, making it a more direct indicator of thrombin activity and fibrin formation. Because of this, SFMC might provide a clearer view of the thrombogenic process and the reaction to anticoagulation treatment.

Important information to further investigate this relationship is provided by a recent comparative study of 98 patients treated with dabigatran etexilate, rivaroxaban, or warfarin. D-dimer and SFMC levels were serially measured over a ten-day period while patients were grouped according to their treatment regimen. Despite being observational, the study's design identifies important trends that guide future research directions and clinical decision-making.

The study's temporal trend in SFMC levels was among its most illuminating conclusions. At baseline, all three groups—warfarin (WG), rivaroxaban (RG), and dabigatran (DG)—showed elevated SFMC, which is indicative of persistent coagulation activity linked to acute DVT. However, compared to those on warfarin, patients on rivaroxaban and dabigatran exhibited a more noticeable drop in SFMC levels by the fifth day of treatment. All groups' SFMC values had stabilized by day ten. Because of their targeted mechanisms of thrombin or factor Xa inhibition, rapid onset of action, and predictable pharmacokinetics, DOACs may have a faster antithrombotic effect, according to this pattern. Therapy stabilization, on the other hand, may be delayed by warfarin's delayed action, which calls for bridging with low molecular weight heparin and careful INR monitoring.

There are significant clinical ramifications to these SFMC trends. First of all, they highlight SFMC's potential as an early, sensitive biomarker for therapeutic efficacy in the treatment of DVT. In contrast to D-dimer, which tracks coagulation events by reflecting fibrin breakdown, SFMC records the active phase of fibrin formation. A sharp drop in SFMC during anticoagulation might be a sign of successful thrombogenesis suppression, which could eventually guide real-time treatment modifications or recurrence risk stratification.

The study's D-dimer trends provide a supplementary, albeit slightly more ambiguous, image. Contrary to expectations, there were no discernible differences between the therapies; by day five, D-dimer levels in all groups had increased significantly, and by day ten, they had only slightly decreased. As anticoagulation starts to break up pre-existing thrombi, there may be an increase in fibrinolytic activity, which could explain this paradoxical rise in the early stages of treatment. The interpretation of D-dimer as a short-term efficacy marker is complicated by this physiological response, even though it is consistent across all treatment modalities. Although D-dimer is helpful for initial diagnosis and may be useful for ruling out recurrence, its value in tracking short-term therapeutic response is less clear-cut than that of SFMC, as indicated by the limited decrease by day ten.

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ISSN 2732-7175 / 2025 Hellenic Society of Vascular and Endovascular Surgery Published by Rotonda Publications

The inherent difficulties in managing warfarin are another important finding from the study. Due to its long clinical history and low cost, warfarin is still used worldwide, despite its numerous practical issues. Warfarin's effects are influenced by dietary interactions, drug-drug interactions, and interindividual variability, making it notoriously difficult to achieve and maintain therapeutic INR levels. A sizable percentage of patients in the study had dose titrations longer than seven days, underscoring the gradual and erratic onset of the full anticoagulant effect. The WG cohort's SFMC levels normalized more slowly as a result of this delay, which also supports the growing preference for DOACs, particularly in outpatient and resource-constrained settings where frequent monitoring is impractical.

The inherent difficulties in managing warfarin are another important finding from the study. Due to its long clinical history and low cost, warfarin is still used worldwide, despite its numerous practical issues. Warfarin's effects are influenced by dietary interactions, drug-drug interactions, and interindividual variability, making it notoriously difficult to achieve and maintain therapeutic INR levels. A sizable percentage of patients in the study had dose titrations longer than seven days, underscoring the gradual and erratic onset of the full anticoagulant effect. The WG cohort's SFMC levels normalized more slowly as a result of this delay, which also supports the growing preference for DOACs, particularly in outpatient and resource-constrained settings where frequent monitoring is impractical.

From a more general clinical standpoint, the results are consistent with a changing paradigm where anticoagulation for DVT is becoming more customized, not only according to risk profiles and comorbidities but also in response to biochemical feedback. In this regard, SFMC may be seen as a potential "theranostic" tool that helps to customize the length and severity of therapy by acting as both a diagnostic and therapeutic tool. Individuals who exhibit quick SFMC normalization may be eligible for shorter treatment periods, which would lower their risk of bleeding and improve their quality of life. On the other hand, consistently high SFMC may call for more aggressive treatment or closer observation.

In addition to the clinical and scientific aspects, there are also economic ramifications. DVT is a systemic burden on healthcare systems in addition to being a personal health concern for patients. Post-thrombotic complications cause substantial lost productivity and necessitate long-term care. Significant cost savings could result from a biomarker-driven approach that speeds up diagnosis, improves treatment, and lowers recurrence. The study's conclusions about the effectiveness of DOACs—particularly dabigatran and rivaroxaban—in quickly reducing coagulation activity support the case for their wider use, even in settings where cost is a concern. Although the initial costs of the medication are higher than those of warfarin, these costs may be offset by the decrease in complications, hospital stays, and monitoring needs.

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Customary paradigm in anesthetic management of carotid endarterectomy patients shifts after pandemic: experiences of an advanced practice centre

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Abstract:

Purpose: During the COVID-19 pandemic, aerosol-generating procedures posed significant infection risks to operating room (OR) staff. This study evaluated the shift from regional anesthesia (RA; cervical plexus block) to general anesthesia (GA) with rapid sequence intubation (RSI) for carotid endarterectomy (CEA) patients to minimize viral transmission while maintaining patient safety.

Materials and Methods: A retrospective analysis of 69 CEA patients (May 2019-May 2021) was conducted: 32 received RA (pre-pandemic) and 37 received GA (during pandemic). Data included demographics, comorbidities, anesthesia type, ICU/hospital stay, and complications. RA involved ultrasound-guided cervical plexus block, while GA employed RSI with videolaryngoscopy and strict aerosol precautions. Statistical analysis compared outcomes between groups.

Results: No significant differences existed in age, gender, or ICU/hospital stay between groups. GA patients had higher ASA scores (*p*<0.001), while RA patients had more cerebrovascular events. RA-associated complications (dysphagia, coughing, respiratory distress) raised aerosolization risks, prompting the GA transition. No COVID-19 transmission occurred among staff during GA procedures.

Conclusion: Despite RA's historical preference for CEA, GA with RSI proved safer for OR staff during the pandemic without compromising patient outcomes. This paradigm shift highlights the importance of adapting anesthetic practices to public health emergencies while balancing procedural risks. Institutional protocols should prioritize staff safety during aerosol-generating procedures without sacrificing patient care.

Keywords: Carotid endarterectomy, COVID-19, general anesthesia, regional anesthesia, aerosol-generating procedures, rapid sequence intubation.

INTRODUCTION

Anesthesiologists, and operating room (OR) staff are exposed to infectious droplets and aerosols during airway management. In ORs, anesthesiologists have to take strict precautions to lessen aerosol-generating procedures for avoidance of infection spread to other patients and healthcare workers[1]. General anesthesia (GA) and rapid sequence induction (RSI) are both recommended to reduce airborne and droplet transmission through the patient's mouth and nose in COVID-19 outbreak[2,3].

Carotid endarterectomy (CEA) has been accepted as a "gold standard" treatment option in symptomatic patients since 1970[4]. However, these patients have so many comorbidities and are commonly prone to intraoperative hemodynamic deterioations[5-9]. Thus, personalized anesthetic management is required[6,10]. The choice of anesthetic technique for these patients has been widely debated over years, mainly owing to the advantages and disadvantages of GA and/or regional anesthesia (RA). Although both techniques have common aims, there is no consensus on anesthetic choice for CEA. It usually depends on decisions and comfort of the instuitution.

Our center is a center where RA has been used to be the first-choice of anesthetic management in CEA patients for years. However, complications related to cervical plexus block such as anxiety, paroxysmal coughing, shortness of breath, airway obstruction, dysphagia and also a possible need for emergent oratracheal intubation in these patients, caused a change in our customized anesthetic approach in COVID-19 outbreak. Although, endotracheal intubation is a high risk procedure even under elective conditions, during COVID-19 outbreak, we still preferred GA rather than RA, in CEA patients at our center during this period.

We aimed to guide cardiovascular teams in managing CEA patients in the favour of both patients and medical staff to preserve public health efforts to mitigate and avoid infection spread in this pandemic.

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doi: 10.59037/9myr9152
ISSN 2732-7175 / 2025 Hellenic Society of Vascular and Endovascular Surgery Published by Rotonda Publications

MATERIALS AND METHODS

After the approval of Clinical Research Ethics Committee from the Faculty of Medicine of Başkent University (KA22/396), 69 patients who underwent CEA operation at Başkent University Ankara Hospital between May 2019 and May 2021 were retrospectively evaluated according to the chronological order. As a result of COVID-19 outbreak, 37 patients between February 2020-May 2021 had GA, while 32 patients between May 2019-January 2020 had cervical plexus block. By screening the patient files, demographic data of patients (age, gender, body mass index (BMI)), comorbidities, type of anesthesia and operation, length of intensive care unit (ICU) and hospital stay and complications observed, were recorded. Exclusion criteria included synchronous carotid endarterectomy with coronary artery bypass or valve surgery.

Anesthesia management

No premedication was given to patients. All patients had intravenous (iv) access established. Routine monitorization included electrocardiography, pulse oximetry, invasive blood pressure measured from the contralateral radial artery.

In RA Group, oxygen (2 L/min) was administered nasally. Cervical plexus block was performed by a senior anesthesiologist, with the patient in the supine position and the head turned slightly away. Routinely, sternocleidomastoid muscle (SCM), cricoid cartilage and mastoid process were first identified. Then the puncture side on the disinfected skin of the lateral neck was covered by sterile covers. The common carotid artery, internal jugular vein and vagus nerve at the level of the 6th cervical vertebra (C6) behind SCM were identified by the transducer of the ultrasound. Under ultrasound visualization, the needle was firts advanced into the carotid sheath from the posterior border and then to the anterior border of the SCM transversally. Close to the carotid artery 20 mL local anesthetic (LA) solution (5 mL 0.5% bupivacaine and 5 mL 2% prilocaine) was administered perivascularly, in two equal doses. By sensorial testing in the appropriate nerve distribution we let the surgeons to start the surgery. No any other sedating agent was administered. If inadequate analgesia and discomfort were detected, local anesthetic (lidocaine 1%) administration was tried. For neurologic and motor function assessment, the patients were asked to squeeze the stress ball that was placed into the contralateral hand as well as some questions to answer.

After COVID-19 outbreak, the accustomed cervical plexus block practice was changed to GA practice. The patients were monitored by cerebral oximetry using near infrared spectrophotometry (NIRS) before anesthesia induction to record the baseline values and continuous NIRS monitorization was applied throughout the operations. Anesthesia was administered without premedication to the patients by using different hypnotic agents according to the preferences of the anesthesiologist. Intravenous lidocaine (1 mg kg^{-1}) was used to suppress the hemodynamic responses before anesthesia induction. Then a single dose of fentanyl (2 µg kg^{-1}) was administered. Rocuronium bromide (0.6 mg kg^{-1}) was used as a muscle relaxant. Oratracheal intubation was performed in all patients. Mechanical ventilation with 4-6 mL kg^{-1} tidal volume and a breathing frequency of 12-16 min^{-1} was performed and the end-tidal CO_2 concentration was maintained at 30-35 mmHg. For anesthesia maintenance either sevoflurane (0.8-1.1%) or desflurane (5-6%) was administered through an oxygen/air mixture (FiO_2=50%). At the end, inhalational anesthetic agent was turned off, and sugammadex was applied to every patient for endotracheal extubation and emergence.The neurological examination of the patients were performed in ORs before ICU administration.

During the follow-up in the operation, hypovolemia, arterial hypotension were corrected using iv crystalloids and then, if necessary, by bolus norepinephrine (5 mg) and/or norepinephrine (0.03-0.06 µg kg^{-1} dk^{-1}) infusions. If arterial hypertension occured bolus nitroglycerine was administered.

All the patients were transported to ICU and followed up as required.

Statistical analysis

Data analysis was performed using IBM SPSS Statistics *ver.* 25.0 software (IBM Corporation, Armonk, NY, US). Kolmogorov-Smirnov test was used to investigate whether the normal distribution assumption was met. Categorical data were expressed as numbers (n) and percentage (%) while quantitative data were given as mean ± SD and median (min-max). The mean difference in ages between groups was compared Student's t test. On the other hand, the Mann Whitney U test was applied for the comparisons of quantitative data which the assumption of normality was failed. Categorical data were evaluated Continuity corrected χ^2 or Fisher's exact test, where applicable. A p value less than 0.05 was considered statistically significant.

RESULTS

Between May 2019 and May 2021, 69 patients (25 females, 44 males) who underwent endarterectomy intervention due to carotid artery stenosis were retrospectively analyzed. From January 2020, 37 patients (female/male: 14/23) had general anesthesia (Group GA) with orotracheal intubation. The ones before January 2020 had deep and superficial cervical plexus block (Group RA). There was no difference in mean age and female to male distibution of the patients between the groups (p=0.322 ve p=0.962). ASA physical status scores were significantly higher in Group GA (p<0.001), while there was no difference among the comorbidities between the groups. A history of cerebrovascular event (CVE) and transient ischemic attack (TIA) was more frequently seen in Group RA (Table 1). The length of stay in ICU and hospital was similar between the groups (Table 2).

DISCUSSION

Our study is not the first study to show how COVID-19 outbreak has resulted in significant changes for customized approach to selection, planning, and practice of anesthesia as well as the practices of other fields in medicine. Başkent Uni-

Table 1. Demographic characteristics of patients

	Group GA (n=37)	Group RA (n=32)	p-value
Age (years)	70.8±8.8	72.8±8.2	0.322†
Gender			0.962‡
Female	14 (37.8%)	11 (34.4%)	
Male	23 (62.2%)	21 (65.6%)	
ASA			**<0.001¶**
II	0 (0.0%)	8 (25.0%)	
III	37 (100.0%)	24 (75.0%)	
Comorbidity			
HT	30 (81.1%)	26 (81.3%)	>0.999‡
CAD	23 (62.2%)	22 (68.8%)	0.749‡
AF	5 (13.5%)	3 (9.4%)	0.716¶
DM	16 (43.2%)	11 (34.4%)	0.613‡
COLD	5 (13.5%)	3 (9.4%)	0.716¶
TIA	0 (0.0%)	8 (25.0%)	**<0.001¶**
CVE	2 (5.4%)	12 (37.5%)	**0.003‡**
Smoking	17 (45.9%)	9 (28.1%)	0.203‡

† Student's t testi, ‡ Continuity corrected Chi-square test χ^2 test, ¶ Fisher's exact test

HT: hypertension, CAD: coronary artery disease, AF: atrial fibrillation, DM: Diabetes Mellitus, COLD: chronic obstructive lung disease, TIA: transient ischemic attack, CVE: cerebrovascular event

Table 2. Clinical data of the patients

	Group GA (n=37)	Group RA (n=32)	p-value
Length of stay at ICU (days)	1 (1-12)	1 (1-13)	0.678†
Length of stay at hospital (days)	6 (1-32)	4 (2-44)	0.056†
Bleeding	1 (2.7%)	1 (3.1%)	>0.999‡
Complications			
no complication	31 (83.8%)	26 (81.3%)	>0.999¶
dysphagia	1 (2.7%)	2 (6.3%)	0.593‡
dysphonia	2 (5.4%)	0 (0.0%)	0.495‡
hematoma	2 (5.4%)	2 (6.3%)	>0.999‡
seizure	1 (2.7%)	1 (3.1%)	>0.999‡
cardiac arrest	1 (2.7%)	1 (3.1%)	>0.999‡
Revision required	1 (2.7%)	1 (3.1%)	>0.999‡
MI	0 (0.0%)	1 (3.1%)	0.464‡
Mortality	1 (2.7%)	0 (0.0%)	>0.999‡

† Mann Whitney U testi, ¶ Fisher's exact test, ‡ Continuity corrected Chi-square test χ^2 test,

versity Hospital Cardiovascular Surgery and Anesthesiology Departments had together achieved 483 CEA operations under deep and superficial cervical plexus block from 2003 to January 2020[11]. However; we had to change our accustomed anesthesia practice to GA after COVID-19 outbreak.

Deep cervical plexus block is a good and safe anesthetic technique for assessment of neurological and motor functions in these patients. However possible complications like discomfort at swallowing, paroxysmal coughing, shortness of breath, airway obstruction and need for emergent oratracheal intubation might lead to environmental contamination by generation of aerosols, and droplets. Considering the current evidence on the risks of COVID-19 transmission in the operating rooms, we suggested implementing radical changes and modifications to the anesthetic planning and perioperative management, even our cardiac team is experienced in RA for years.

Previously, there have been multiple reports describing CEA operations being performed under cervical plexus block[12-15]. In late 1900's Stoneham et al, reported that CEA might be performed successfully under either deep or superficial cervical plexus block combined with sedation and local infiltration by the surgeon[13]. However, they declared that the incidence of paralysis of phrenic nerve due to this block was unknown. They didn't report any complications related to RA in that paper, probably as they assumed the incidences very

low[13]. Habitually; most of the reports have been still reviewing the surgical outcome without paying attention to the incidence of intra-operative neurological, hemodynamic and respiratory detoriations. These are the complications faced by the anesthesiologists. Actually, monitorized anesthetic care of CEA patients under RA is a challenge for anesthesiologists. Especially, deep cervical blocks are associated with high rates of serious complications in comparison to superficial/intermediate ones[16]. The peripheral nerve blocks in neck region have a potential risk for puncture-related complications due to many blood vessels and nerves, nearby. Besides, anesthesia of recurrent laryngeal, vagus, hypoglossal, and phrenic nerves are all potential adverse effects. Opperer et al. emphasized the impact of depth of cervical plexus blocks on the blockade of hemi-diaphragmatic motion due to the phrenic nerve's pulsy[17]. The authors couldn't demonstrate clinically significant dysfunctions although there appears to be differences in FEV_1 and FVC before and after the deep cervical blocks. In our patient group, we used to encounter transient respiratory complications, like breathing difficulties, dyspnea, cough, decreases in oxygen saturation and dysphagia. Unfortunately, these procedures became the most aerosol generating procedures in COVID-19 outbreak. This increased the possibility of exposure of the medical staff to these droplets in the operating room. As the anesthesia technique was underestimated as RA, even in COVID-19 outbreak, the OR staff could be in lack of care and thus didn't use personal protective equipments (PPE) properly. Consequently, in contrary of what was expected, we had the patients intubated by the most experienced anesthesiologist in the team with RSI and videolaryngoscopy using an intubation box or transparent shield. To avoid repeated interventions, a guidewire was placed in the intubation tube, the tip was clamped, and we performed intubation following iv administration of a muscle relaxant to prevent any kind of airway irritation reflex. After reaching the appropriate depth, the cuff was inflated and connected to the breathing circuit, and the clamp was removed. The location of the endotracheal tube was confirmed by capnography.

In the literature, most aforementioned RA preferences during COVID-19 outbreak were for emergent orthopedics, urological and/or obstetrics cases[18,19]. These RA managements were all far away from the airway. It was the same in our country. Topcu et al, reported a significantly higher use of RA as the primary anesthetic technique than in the pre-pandemic period[20,21]. However, there are differences among the hospitals, such that our hospital is a private university hospital referred mainly for organ transplantation and extreme aged patients for cardiac surgeries. Thus we didn't have usual traumatic or non-traumatic surgical emergencies like the ones at state hospitals in our region. Most symptomatic carotid disease patients were referrals from the state hospitals. ASA III patients were more in number, probably the patients in better conditions didn't prefer to go to hospitals. However, patients with TIA or stroke were less in number due to possible overall decreases in diagnosis during COVID-19 outbreak.

Indeed, COVID-19 outbreak has affected the practice of medicine in many ways. The shift in the customary paradigm at our center is one of these examples. We believe strict adherence to our department's protective measures led to our optimal results.

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Retrospective study of patients with asymptomatic, incidentally discovered, thoracic aortic pseudoaneurysm treated in a single institution

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Abstract:

Introduction: Spontaneous thoracic aortic rupture can result in disastrous complications. Rarely, such an event can be asymptomatic and in these cases it may escape diagnosis, posing an immediate threat to patient's life.

Methods: We conducted a single-center retrospective analysis of all patients treated with thoracic aortic endovascular repair [TEVAR] for various pathologies, between 01/2019 - 01/2024. The subgroup of patients with incidentally found pseudoaneurysms of the thoracic aorta were identified and further analyzed. Demographic information, procedural details and follow-up data of these cases were collected.

Results: Initially, 40 patients were identified, among which only three fulfilled the criteria for an incidental finding of a spontaneous, concealed, asymptomatic rupture of the descending thoracic aorta, presenting as a pseudoaneurysm which was revealed in computed tomography [CT], performed for other medical reasons. All patients were treated, in an emergency setting, with TEVAR. Branched endografts and chimneys were used in 2 out of 3 cases. In one case, a proximal extension with a branched endograft was necessary to treat a type IA endoleak after an initial implantation of standard TEVAR. There was one in-hospital mortality due to unrelated medical reasons.

Conclusion: Asymptomatic presentation of thoracic aortic pseudoaneurysm is possible and in these patients prompt endovascular repair can reduce the risk for serious complications or death.

INTRODUCTION

Spontaneous rupture of the thoracic aorta is a devastating event[1]. Most commonly it presents with hemodynamic collapse of the patient, requiring immediate treatment. However, concealed, asymptomatic rupture can be challenging to diagnose, as it may present with atypical symptoms or be completely asymptomatic and be identified as an incidental radiological finding days, weeks or even months after the event.[1,2] This clinical entity poses a unique threat for the patient, as he is unaware of the pathology and the potential complications can be life-threatening. The first 24h mortality of patients with contained rupture of a thoracic aortic aneurysm is around 80%[2].

As stated by the ACC/AHA 2022 Guidelines, a pseudoaneurysm of the thoracic aorta following a blunt traumatic thoracic aortic injury [BTTAI] is classified as Grade 3 BTTAI and should be managed urgently, as they are at a high risk of progression and rupture[3]. However, in the present study incidental finding of non-traumatic thoracic aortic pseudoaneurysm was our focus. To our knowledge, data are very limited regarding pathophysiology, natural history, and prognosis of this clinical entity and consequently robust diagnostic and therapeutic algorithms are not currently available.

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doi: 10.59037/2h8reh94
ISSN 2732-7175 / 2025 Hellenic Society of Vascular and Endovascular Surgery Published by Rotonda Publications

MATERIALS AND METHODS

Study design:

We conducted a retrospective observational study of all patients treated with TEVAR, in our department, between 01/2019 - 01/2024, according to the STROBE statement for observational studies.[4] Our study population consisted of patients treated for an asymptomatic, incidentally found thoracic aorta pseudoaneurysm.

Inclusion criteria:

All patients with thoracic aortic pathology undergoing interventional treatment throughout the study period were identified. This included patients with thoracic aortic aneurysm or pseudoaneurysm, thoracoabdominal aneurysms, patients with acute aortic syndromes that involved the thoracic aorta [aortic dissection - AD, intramural hematoma - IMH, penetrating aortic ulcer - PAU or thoracic aorta rupture] and also patients with acute thoracic aortic injuries after blunt or penetrating trauma.

After the initial screening, only patients with an incidental finding of a thoracic aortic pseudoaneurysm, were analyzed.

Exclusion criteria:

Patients with aortic pathology that did not involve the descending thoracic aorta were excluded [for example, pathology including the ascending aorta, abdominal aorta and iliac arteries]. Additionally, patients with thoracic aortic pathologies that were managed conservatively were also excluded.

Endpoints

Information that were collected included patients' demographic characteristics [age, gender, ethnicity], comorbidities and past medical history, clinical presentation, the modalities that were used for the diagnosis, the lesions' characteristics [meaning its' diameter, neck length, aortic branches involved] and type of treatment, including treatment technical characteristics. Endpoints included technical and clinical success, need for re-intervention, length of hospital stay and/or need for stay in the ICU, patients' mortality and morbidity and follow-up outcomes.

RESULTS

Study population

After searching our database, 43 patients were at first identified. Fifteen patients were treated for thoracoabdominal aortic aneurysm, 17 patients presented with thoracic aortic dissection treated either in the acute or subacute phase and 8 patients presented contained aortic rupture after trauma and were subjected to endovascular repair. Finally, 3 patients fulfilled the criteria for an asymptomatic, incidentally found, thoracic aortic pseudoaneurysm, who were treated with TEVAR. The above-mentioned results are also depicted in the flow-diagram presented in Figure 1.

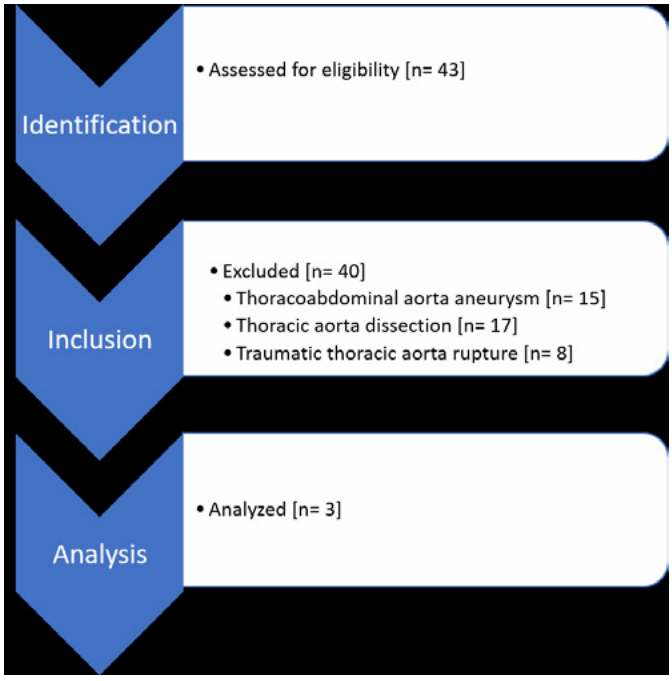

Figure 1: Flow chart summarizing selection of the study population.

Overall results

All patients were treated <24h after initial diagnosis. One patient was treated with Chimney TEVAR, while the remaining two were initially treated with standard TEVAR, with LSA coverage in order to achieve an adequate proximal seal. In one of those cases this was not successful and the deployment of an additional branched device was required to treat a Type IA endoleak. Post-procedurally all patients were admitted to the ICU. Two patients were discharged in good general condition, while one patient died after several weeks of hospitalization due to unrelated medical reasons. The results regarding patient information and procedural data are summarized in Table 1. Endpoints of the analysis are summarized in **Table 2**. In the following section a detailed report of these cases is provided.

Case 1

The first patient is a 78 years old male who was hospitalized two months ago for fever of unknown origin, which was finally attributed to lung infiltrations. During his hospitalization he underwent chest x-ray, where a radiopaque saccular mass in the left mediastinum was depicted, and which wasn't present in a previous x-ray from the patient's history six months ago (Figure 2). However, at that time, this finding wasn't further assessed. After his discharge, he was advised to undergo a CT scan, in order to review the aforementioned lung infiltrations. In the CT scan a pseudoaneurysm of the thoracic aorta was identified, measuring 60mm of maximum diameter. Then, he was referred to our department where he underwent CT angiography [CTA] and a concealed rupture of the thoracic aorta, originating proximal to the origin of the left subclavian artery [LSCA] was diagnosed. Specifically, a ruptured penetrating aortic ulcer [PAU] was identified as the probable cause of rupture (Figure 3). He was at first admitted to our department and then was treated, urgently, with chimney - TEVAR [Ch-TEVAR] under general anaesthesia. A TEVAR endograft Terumo RelayPro 34/30 154mm was deployed with the proximal extent in the Z2 zone, just proximal to the origin of the LSCA and distal extent to T5 zone, while two balloon expandable covered stents Atrium Advanta V12 [BE] 12x61mm were deployed in the LSCA, with the chimney technique, in order to preserve LSCA patency (Figure 4). The patient had a high-grade left internal carotid artery stenosis, measured around 90%, so assuring that the left vertebral artery remained patent was important in order to preserve brain perfusion. In the completion angiography adequate coverage of the rupture point was verified, while the LSCA & left vertebral artery remained patent, without endoleak or active extravasation. The patient was transferred post-operatively to the ICU, awake, for further monitoring where he remained for 24h and then was transferred to the Vascular Surgery Unit in good general condition, fully mobilized. During his hospitalization he developed contrast-induced acute kidney injury [CI-AKI], with a peak cre-

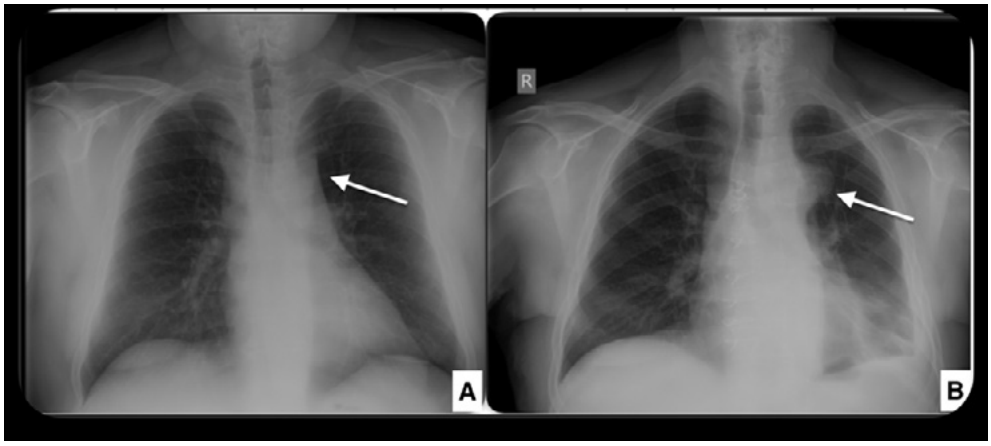

Figure 2: X-ray of the 1st patient at the time of presentation (B) and 6-months ago (A). White arrow indicates a mediastinal mass which was not apparent in the 1st examination.

Figure 3: CT angiography of the 1st patient with the white arrow indicating the pseudoaneurysm of the thoracic aorta.

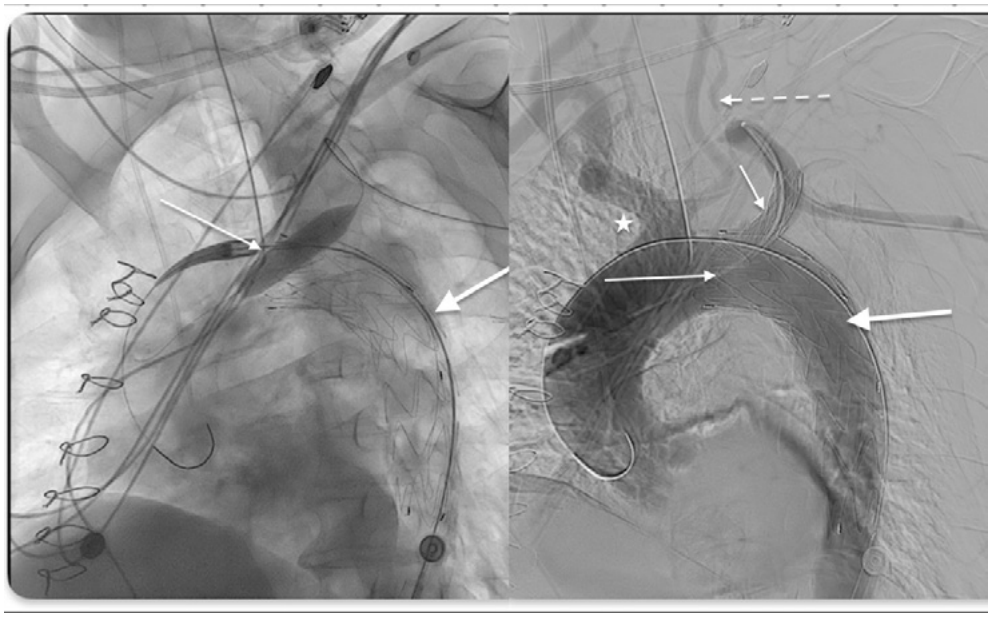

Figure 4: Intra-operative images of the 1st patient. In the left panel the main endograft (thick white arrow) and the ballon expandable chimney stent in the LSCA (thin white arrow) can be seen. In the right panel an intraoperative angiography indicates successful sealing with patent main graft and chimney graft (thin white arrows). Additionally, the left vertebral artery (dashed arrow) and the common origin of the brachiocephalic truck and the left common carotid artery (star) are depicted.

atinine level of 1.67mg/dl, which prolonged his stay for five days. The fourth postoperative day the patient underwent a CTA, for post-operative monitoring, where a gutter endoleak between the main endograft and the Chimney graft, to the saccular pseudoaneurysm, was identified, without clinically significant growth of the aneurysm diameter. A third scan was performed during the eighth postoperative day, for investigation of an episode of shortness of breath, where spontaneous occlusion of the endoleak was observed, without growth of the pseudoaneurysm sac. He was discharged the ninth post-op day, with baseline renal function restored. The patient has successfully completed short-term follow-up, at one month after the discharge, where in the CTA both no endoleak and sac regression were identified. He has yet to complete however one year follow-up.

Case 2

The second patient was a 73 years old male with a history of lung lymphoma with multiple chemo- and radiation-therapy sessions, who was at that time hospitalized in the Hematology department for dyspnea, cough and hoarseness of voice investigation. He underwent non contrast thorax-CT, for possible respiratory tract infection. However, in the CT scan, a pseudoaneurysm of the descending thoracic aorta was identified. Following the above-mentioned finding, the patient underwent CTA, where a concealed rupture of the thoracic aorta, originating distal to the origin of the LSCA was diagnosed, with a pseudoaneurysm measuring 85mm of maximum diameter **(Figure 5)**. He was then admitted to our department and treated, urgently, based on the proposed guidelines, with the deployment of a TEVAR endograft TTerumo Relay-Pro 32/32x160mm with proximal extent in the Z2 zone just proximal to the LSCA and with distal extent to T5 zone. In the completion angiography a Type IA endoleak was depicted (Figure 6), and therefore the patient underwent a 2nd procedure 24h later, with the insertion of a proximal extension of the endograft with the deployment of a Castor Endograft Endovastec Lombard 36/30x200mm, branch 10x25mm@10mm (C363010-2002510), with a branch to the left common carotid artery [LCCA]. During the deployment, the endograft slightly migrated proximally, causing severe stenosis of the orifice of the brachiocephalic artery [BCA]. Immediately, the right common carotid artery [RCCA] was dissected and cannulated and a balloon expandable covered stent Atrium V12 12x61mm was deployed in the BCA, with the chimney technique (Figure 7). In the completion angiography no endoleak was identified, with good patency of the BCA and LCCA. Postoperatively, he had a prolonged stay at the ICU, which lasted for six days, due to severe face and larynx swelling which didn't allow extubation. Moreover, the patient acutely developed severe heart failure, with a left ventricle ejection fraction [LVEF] 15% and had multiple episodes of acute respiratory distress syndrome [ARDS] which were finally attributed to bronchiolitis. The patient was transferred to the Pulmonology department for further treatment, on the forty-ninth post-op day. However, he passed away ten days later, due to aplastic anemia and acute respiratory failure.

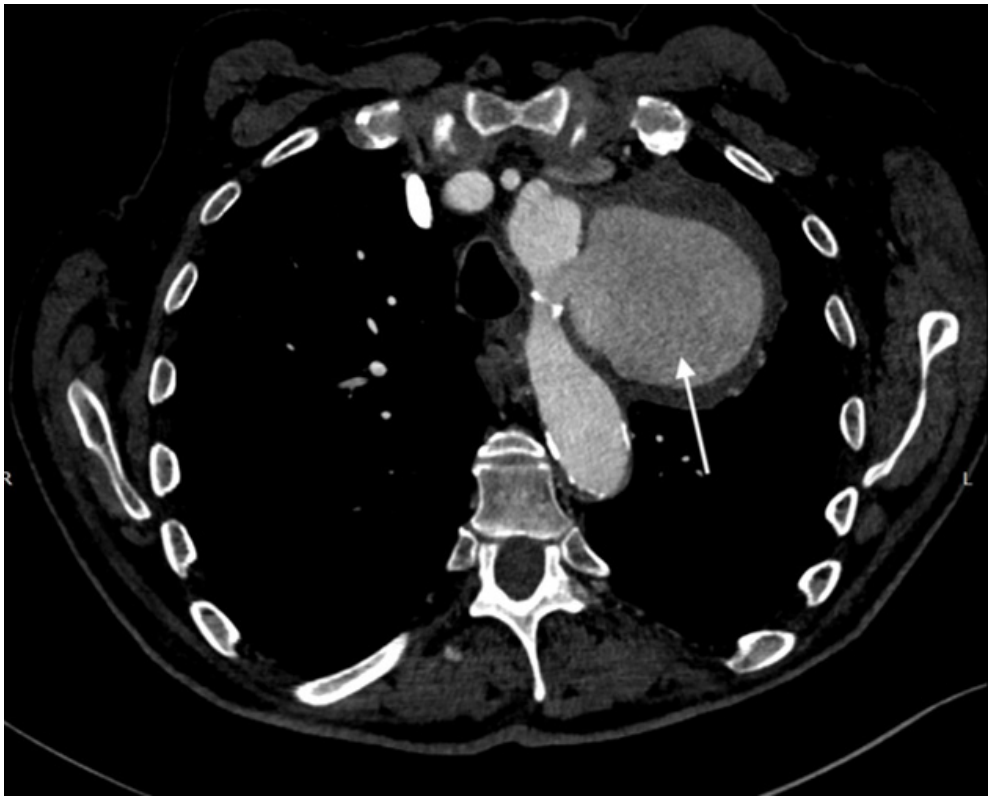

Figure 5: CT angiography of the 2nd patient with the white arrow indicating the pseudoaneurysm of the thoracic aorta.

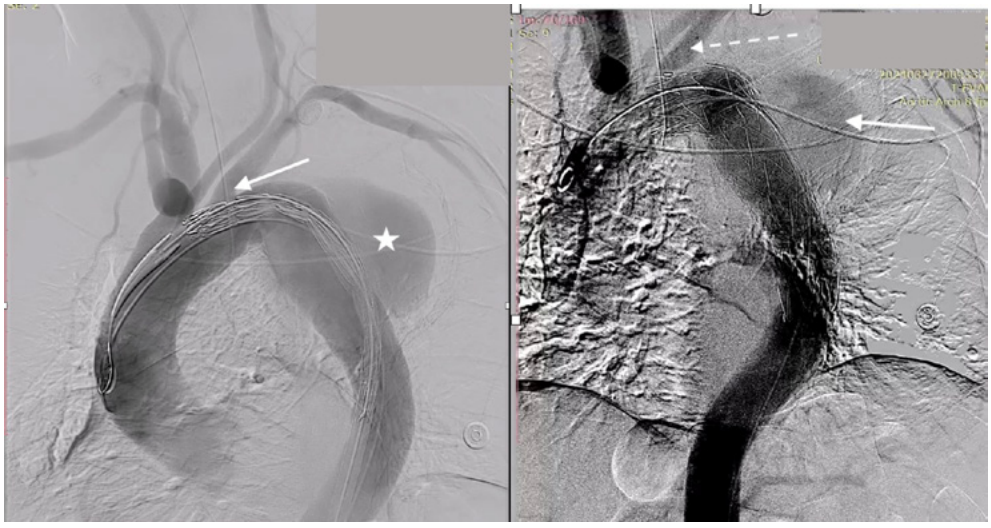

Figure 6: In the left side an intraoperative angiography shows the endograft before its deployment proximal to the origin of the LSCA (white arrow) and the sac of the pseudoaneurysm (star). In the right side, postoperative CT angiography indicates continuous perfusion of the pseudoaneurysm sac due to Type IA endoleak (white arrow) despite successful deployment of the endograft at the level of the LSCA (dashed arrow).

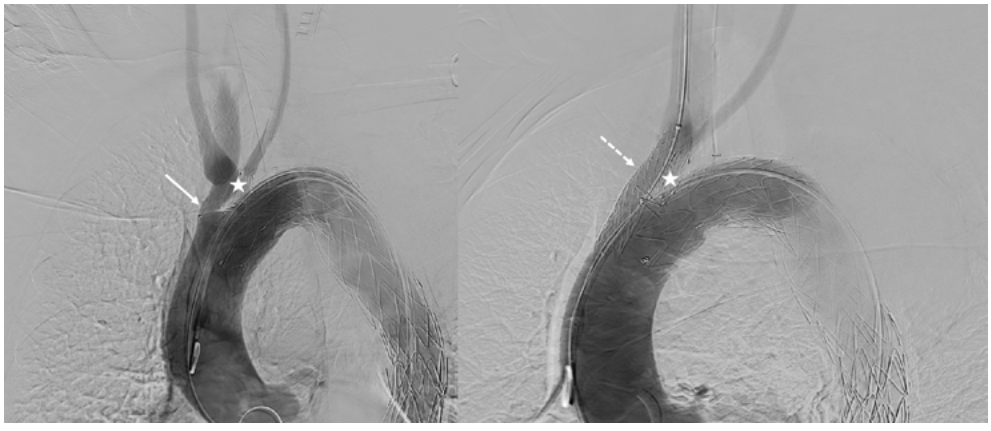

Figure 7: Intraoperative images of the 2nd patient during the deployment of the branched endograft. In the left side the proximal part of the endograft partially covers the origin of the brachiocephalic artery (white arrow). As bailout, a chimney graft was deployed in the brachiocephalic artery through the right common carotid artery, as shown in the right image (dashed arrow). Star indicates the branch inside the left common carotid.

Case 3

The third patient is a 44 years old female, with a history of Adamantiades - Behcet's disease [ABD], under therapy with colchicine and methotrexate, who was hospitalized at that time in the Pulmonology department, for thoracic pain, migrating to the back and possible upper respiratory tract infection. During her hospitalization she underwent a non-contrast thorax-CT. Just as the above-mentioned cased, the CT showed a periaortic hematoma in junction with the descending thoracic aorta, which was described as a potential concealed rupture of the thoracic aorta forming a saccular pseudoaneurysm measuring 60mm of maximum diameter. Then, she underwent CTA, where a concealed rupture of the thoracic aorta, originating distal to the origin of the LSCA was identified **(Figure 8)**. She was then transferred to our department for further treatment. She underwent urgent TEVAR, under general anaesthesia. A TEVAR endograft Terumo Relay PRO 28x130mm, with proximal extent to the Z2 zone, just proximal to the LSCA and distal extent to T5 zone, was deployed. In the completion angiography, adequate coverage of the rupture point was verified, while LSCA & left vertebral artery remained patent, without endoleak or active extravasation. Her postoperative course was uncomplicated and was fit for discharge at the fourteenth post-op day. The patient has to-date completed successfully three-year follow up, where complete sac regression was identified in the most recent CTA.

DISCUSSION

After conducting a detailed search of all the patients treated in our department, for pathology regarding the thoracic aorta, during the last five years, we identified 3 patients that fulfilled the aforementioned criteria and who formed our target-group.

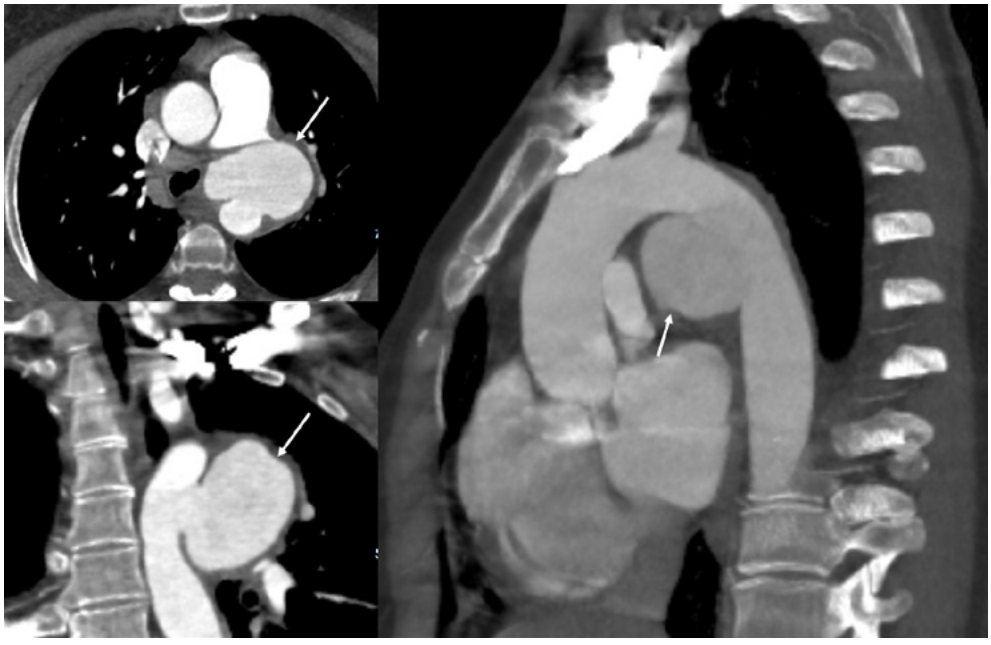

Figure 8: CT angiography of the 3rd patient with the white arrow indicating the pseudoaneurysm of the thoracic aorta.

The first patient [patient #1] suffered a concealed spontaneous rupture of the descending thoracic aorta, due to a ruptured penetrating aortic ulcer [rPAU], at the level of origin of the LSCA, causing the formation of a saccular pseudoaneurysm. PAUs most commonly present with symptoms imitating aortic dissection, a tearing-sensation chest pain, migrating to the back or the shoulder, with concomitant pleural effusions, identified in up to 30% of ruptures, whether more atypical symptoms include cardiac and pulse rhythm abnormality, signs of stroke, vascular insufficiency and end-organ infarction[5, 6]. There is scarce information in the literature regarding spontaneous, asymptomatic, ruptured PAU.

He had a medical history of arterial hypertension, dyslipidemia, coronary artery disease, COPD, AMI, inactive gastrointestinal cancer and he was an active, heavy smoker (110packs/year), making him high risk for developing PAU, as it's described in the literature[7, 8]. The first imaging modality that he underwent was a chest x-Ray, where a saccular radiopaque mass was depicted, which was later identified as a hematoma. Most commonly the chest radiograph findings of a PAU are unremarkable[5], or pleural effusions or widened mediastinum may be present[9]. However, in this case, there was a chest x-Ray to compare, six months ago, where this exact finding was absent and that could have raised clinical suspicion, but was misidentified and not assessed clinically by the treating physicians at that time.

The second patient [patient #2] had a medical history of lymphoma that was in regression when he was referred to our department. Based on the literature, there is an association between aortic aneurysm and developing malignancy, and vice versa, especially pulmonary and hematology malignancies[10]. Also, there is suspicion that radiation therapy and chemotherapeutic drugs, such as antimetabolites, have been associated with altered aneurysm growth and thus need increased aneurysm surveillance. However, increased risk of aortic rupture, in patients with active malignancy, with or without synchronous chemotherapy or radiation therapy, has not been documented[10].

The patient complained about dyspnea, hoarseness of voice and cough. At first, the aforementioned symptoms were attributed to possible respiratory tract infection [RTI] and that's the reason he underwent a CT scan. However, after diagnosing the large pseudoaneurysm sac a possible explanation would be that the sac was applying pressure on the left bronchi / lung, causing dyspnea and cough, as well on the left recurrent laryngeal nerve [RLN] causing hoarseness. RTI was ruled out since there were no inflammatory markers and no imaging findings supporting this diagnosis.

There are no known contraindications for deploying a thoracic endograft in a patient with synchronous active malignancy, and as described by Danial P. et al, TEVAR for patients with T4 lung cancer with aortic evasion, before open resection of the tumor, had excellent results, with no late thoracic endograft-related complications observed, during the follow-up[11]. As no active infection was officially diagnosed and the patient's anatomy was suitable for endovascular treatment, he was treated, as proposed in current the guidelines, with TEVAR[3].

The third patient [patient #3] had a history of Adamantiades-Behcet's disease. ABD is an idiopathic, systemic inflammatory vasculitis, which presents clinically with recurrent oral and genital ulcers and ocular involvement. Vascular involvement has been described in up to 7-38% of the cases. Pathology of the aorta has been described in about 1.5-2.7% of the cases and most commonly involves pseudoaneurysm or saccular aneurysm of the abdominal aorta[12]. Due to significantly increased risk of rupture in these patients, attributed to inflammatory processes and fibrotic reactions in the sur-

rounding tissues, treatment is indicated regardless of the aneurysm size. However, in this case, no aneurysmal dilation of the thoracic aorta was identified. The treatment modalities of an aortic aneurysm in a patient with ABD involves conservative management, consisting of corticosteroid and immunosuppressants, open surgical and endovascular repair[12]. Conservative treatment was not a feasible solution for a ruptured thoracic aorta. Open surgical treatment has a high risk for complications and is technically challenging[12]. 30-day mortality for open and endovascular repair is around 33% and 19%, respectively[13]. The patient was a good candidate for endovascular repair, as it was anatomic feasible and there was no active infection, therefore she was treated, as suggested by the guidelines, with TEVAR[13, 14].

The initial clinical suspicion for all the patients was set when they underwent a non-contrast thorax CT, where a pseudoaneurysm of the thoracic aorta was identified. Especially for patient #1, non-contrast CT could depict hyperdensity in PAU, indicating intimal hematoma with an increased risk of rupture[15]. CTA is the preferred imaging modality for identifying a PAU, as it is seen as a contrast-filled outpouching or crater-like morphology, with irregular margins and extending beyond the expected boundaries of the aorta[5, 6, 8].

Then, they all were referred to our department, where they urgently underwent CTA, which is the gold standard for conclusive diagnosis and planning the treatment, in cases that thoracic aorta rupture is suspected[16]. Pseudoaneurysm of the descending thoracic aorta was diagnosed. In patient #1 a ruptured type B PAU, originating just proximal to the origin of the LSCA was depicted, whether in patients #2 and #3 the rupture point was identified distal to LSCA orifice. Aortic pseudoaneurysm is defined as a leakage of blood from the aorta, forming a contained hematoma, with persistent communication between the originating artery and the hematoma. It is actually a contained rupture of the aorta, and thus, urgent treatment is indicated. Aortic pseudoaneurysms are proposed to be treated with TEVAR, with excellent technical success rates around 100% and low rate of device-related complications, around 2.4%[17].

All patients were treated successfully, based on the proposed guidelines, with TEVAR[3]. Regarding the revascularization of the LSCA, when the patient is being operated electively it is suggested to maintain the patency either with endovascular techniques or by open surgical revascularization, whether in emergency cases it is common practice to cover the orifice of the LSCA if needed, in order to achieve the minimum length of proximal landing zone required for the endograft deployment[3]. Exception to the above is when there is an internal mammary artery to coronary artery bypass or a clearly dominant left vertebral artery, where, even in an emergency setting, patency of LSCA has to be preserved[13]. In patient #1, due to severe >90% stenosis of the left common or internal carotid artery, and a clearly dominant left vertebral artery, we considered it important to preserve patency of the vertebral artery in order to avoid cerebral hypoperfusion. The severe comorbidities deemed the patient as extremely high risk for open surgery [carotid-subclavian artery bypass], chimney grafting of the left subclavian artery was chosen instead, with the pitfall of not complete sealing of the rupture point and persistent endoleak. Despite the aforementioned risk, the two endografts were successfully deployed, without endoleak or extravasation identified in the completion angiography. Regarding patients #2 and #3, there weren't any special considerations to preserve patency of the LSCA, so this was covered.

Post-TEVAR type IA EL was identified in two of the three patients [patient #1 and #2]. Endoleak can be identified in up to 9-38% of patients undergoing TEVAR, with the most common type being Type I EL, around 8.4% of the patients[18]. As it is well established, all type IA EL, once identified, should be aggressively treated, since it represents high-pressure endoleak that can potentially cause sac expansion, rupture and death[19]. In-between the treatment modalities of type IA EL are proximal extension with aortic cuff placement, placement of a large-caliber balloon expandable stent in the proximal extent of the endograft in order to further promote sealing, deployment of a custom-made or off-the-shelf branched device, use of endo-anchor fixation system and transcatheter embolization of the leaking site[20]. However, some ELs can resolve spontaneously. Moreover, EL can be classified as slow or fast, regarding the time needed to visualize the aneurysmal sac, during aortography, as proposed by De León Ayala IA et al[19]. These authors concluded that the majority of slow IA EL cases spontaneously occluded in the 6 months follow up, with no recurrence reported in the one-year follow up. In patient #1, despite the fact that no endoleak was present in the completion angiography, in post-operative CTA, a gutter type IA EL with filamentous perfusion of the pseudoaneurysm sac, without clinically significant growth of its diameter was depicted. Four days after the first post-op CTA, a second scan was performed, in order to screen for acute onset of dyspnea and to exclude pulmonary embolism [PE], where spontaneous occlusion of the endoleak was revealed with no further growth of the aneurysm sac. Therefore, no further treatment was indicated. Patient #2 developed a fast EL IA and therefore further treatment was indicated. In the literature, spontaneous occlusion of type I endoleaks is not usually anticipated[21]. Accordingly, the endoleak in patient #2 was treated successfully, endovascularly, without further impact on overall survival of the patient[21].

Patient #1 developed acute-on-chronic kidney disease, as defined by the 2011 ESUR Contrast Media Safety Committee guidelines[22], although all the proposed guidelines regarding hydration therapy as a preventive measure were followed[23, 24]. However, with proper management he restored renal function to his baseline creatinine [1.60mg/dl].

Patient #2, who underwent staged endovascular aortic arch debranching, with LSA coverage and TEVAR, developed post-op, acute severe heart failure [HF], with a LVEF of 15% and recurrent episodes of ARDS without any indication of an acute coronary syndrome. Among the common complications after complete endovascular debranching of the aortic arch are retrograde dissection, stroke, graft stenosis or occlusion, spinal cord ischemia and type IA EL[25]. It is worth mentioning that in a previous heart U/S the LVEF was 40%. As stated in

the literature, after the deployment of TEVAR, an increase of arterial stiffness is noted, with multiple effects in the heart, central hemodynamics and heart systole[26,27]. However, such acute and severe HF was an unexpected complication in the present case, and burdened heavily his post-op course.

CONCLUSION

Spontaneous, asymptomatic rupture of the thoracic aorta, is a rare vascular condition. Patients with different medical background may present with such lesions. On the absence of robust evidence regarding the clinical course of these cases, prompt endovascular treatment even if this means operating under suboptimal conditions without waiting until complete preoperative work-up is completed, may be appropriate in order to treat these patients and avoid serious adverse events.

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Impeding rupture of a giant aortic root; surgical tips and tricks

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Abstract:

We present an interesting and rare case of a 58-year-old man with a giant aortic root of 10 cm diameter along with the literature data; and tips and tricks in the surgical treatment.

Keywords: giant aortic root, huge aortic root, aortic aneurysm, aortic surgery, aortic rupture, impeding rupture of aortic root, aortic aneurysm.

INTRODUCTION

Thoracic aortic aneurysm (TAA) in general is a silent disease which may have devastating complications. It is classified by the segment of the aorta involved. It is usually seen in men but all in all it is not a common disease - the incidence is estimated to be 6 to 10 cases per 100,000 patient-years[1,2]. Etiology of the disease is multifactorial. Most aneurysms are degenerative and factors such as atherosclerosis and hypertension are highly associated[3,4] while many cases are caused by a wide range of disorders classified as aortitis. Syndromic TAA is a subcategory related to several connective tissue disorders such as Marfan, Ehlers-Danlos etc[5]. We herein report a case of giant aortic root measured 10 cm in its maximum diameter which was successfully treated with open surgical repair.

CASE

A 58-year-old man was presented in the emergency department with chest pain and persistent hypertension. In the echocardiography performed, the following was reported: severe aortic valve regurgitation, left ventricle end diastolic diameter of 7 cm, left ventricle ejection fraction less than 30% and a huge aortic root estimated more than 11 cm. Due to chest pain and these serious findings the patient underwent chest computed tomography with intravenous contrast, confirming the giant aortic root and the huge left ventricle without any aortic dissection acute or chronic [Figure]. During this workup blood pressure was measured at 220 mmHg despite intravenous infusion of nitroglycerine, calcium channel antagonists, and esmolol.

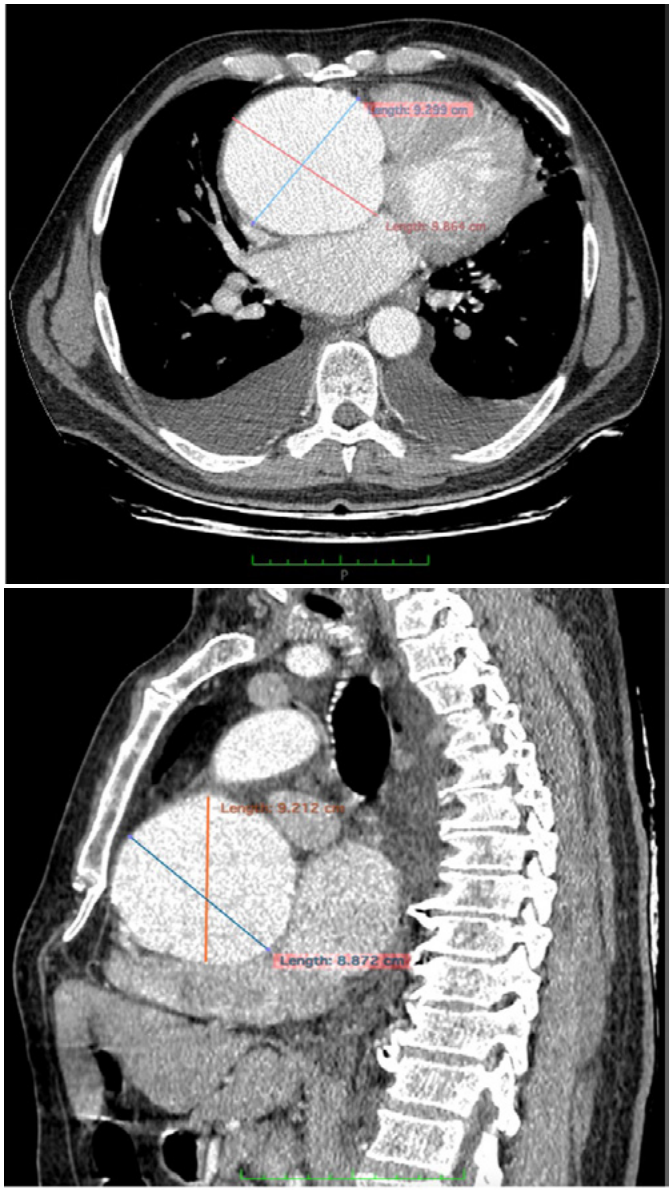

Figure: Chest computed tomography with intravenous contrast, confirming the giant aortic root and the huge left ventricle without any aortic dissection acute or chronic.

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doi: 10.59037/nb6s8188
ISSN 2732-7175 / 2025 Hellenic Society of Vascular and Endovascular Surgery Published by Rotonda Publications

Chest pain was attributed to the pressure of the root to the surrounding tissues and in the impending rupture of the root. Due to these findings and the clinical presentation this case was considered as emergent and we decided to operate immediately.

After general anesthesia a typical right axillary artery cannulation was performed. A synthetic graft of 10 mm diameter was anastomosed to the subclavian artery in order to connect the arterial line of the extracorporeal circulation. Fully heparinization was done in order to be ready in case of any event like root rupture. Median sternotomy was performed and fibrosis and adhesions were recognized around the heart and aorta. Meticulous lysis of adhesions helped us to harvest the right atrium for the venous cannulation and then, we harvested the whole aortic root. Retrograde cardioplegia infusion was impossible due to adhesions. Antegrade through root vent was also impossible due to aortic root regurgitation. Thus, after clamping the ascending aorta; aortotomy was performed and cardioplegia was infused directly in the coronary ostium.

The aortic root was excised and the buttons of both coronary arteries were prepared appropriately with mobilization in order to approximate the graft of the upcoming Bentall procedure. After appropriate sizing a valved Valsalva graft with mechanical aortic valve of 27mm and 30mm ascending aorta graft (Carboseal Valsalva graft) was used. Then, a typical Bentall procedure was performed. The early postoperative course was uneventful and the patient was discharged in the fifth postoperative day. The patient at 3 months reports enhanced performance status and follow-up imaging demonstrated improved LV function and properly working aortic valve. 9 month-follow up revealed no surprises as the patient is fully active and new laboratory and ultrasound workup demonstrated no abnormalities.

DISCUSSION

Open surgical repair is considered to be the gold standard for managing thoracic ascending aortic aneurysms and dissection. Aortic root involvement necessitates coronary artery re-implantation and maybe aortic valve replacement or repair. In case both ascending aorta and valve are diseased, valve replacement is necessary and modified Bentall procedure is most commonly used[6, 7].

In case of a giant root, some tips and tricks are useful for patient safety. Axillary artery cannulation is performed before sternotomy in order to be safe in case of root rupture. If needed, in some cases, venous cannulation through femoral vein may be also performed before sternotomy and start cooling of the patient. Fully heparinization of the patient is done early, before sternotomy, to be ready for extracorporeal circulation immediately. The two buttons of the coronary arteries are in a certain distance and their approximation anastomosis to the synthetic graft may require extended mobilization of both coronaries or elongation with the interposition of a synthetic graft of 8 mm in diameter.

Nowadays, aortic valve repair in case of regurgitation is considered to be a safe alternative. Valve-sparing aortic root replacement is recommended for patients without significant aortic valvular disease. So, in these cases, aortic valve repair may be performed and only substitute the root, the ascending aorta and anastomose the coronary buttons to the graft. This way the Bentall procedure and the mechanical valve may be avoided. In case of valve repair, if the aortic annulus is extremely dilated, repair may be difficult and the long-term results, doubtful. Techniques with ring implantation are applied.(8) However, in our case factors such as severe aortic valve regurgitation and poor LV function led us to decide that valve replacement was the optimal choice for the patient. At the end of the procedure intraoperative transesophageal echocardiography is mandatory to evaluate the competence of the repaired valve.

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An urgent axillopopliteal bypass to treat a bleeding infected anastomotic groin pseudoaneurysm

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INTRODUCTION

A 59-year-old-male transferred from a local hospital with a bleeding sinus at his left groin, controlled with external bandaging. He underwent at another hospital a femorofemoral bypass due to left leg claudication, five years ago, an aortobifemoral bypass 3 years ago, a graft extension of the left limb to profunda, 1 year ago, for thrombotic complications. Postoperatively, a left groin infection was treated with debridement leading to a draining sinus. Eventually, a massive bleeding occurred through this sinus, six months later. The patient transferred to our hospital and expeditiously to the operating theater after a computed tomography angiography (fig 1). The sinus was excised and a ruptured pseudoaneurysm was found. Segments of the existing thrombosed grafts were removed and the orifices of the deep profunda femoris artery were sutured from within, as they were the source of bleeding. The wound was packed with iodinated gausses and isolated with adhesive drape. The skin was sterilized again, and the patient underwent an axillary-popliteal bypass. Cultures isolated Acinetobacter baumannii. He received Daptomycin 500mg o.d. (replaced eventually with Vancomycin 1gr b.i.d due to raising creatine phosphokinase levels) and minocycline 100mg b.i.d. He had an uneventful recovery, discharged on 33rd postoperative day under ciprofloxacin 500mg b.i.d., minocycline 100mg b.i.d., *rivaroxaban 20mg o.d.* and acetylsalicylic acid 100 mg o.d. He remains asymptomatic, with palpable pedal pulses, 1 year later (fig 2).

The axillopopliteal bypass is usually reserved as a last resort, when previous revascularization options for atherosclerotic disease have failed. Previous graft infection and onco-vascular surgical resections with scaring and/or post-radiation arteritis are other current indications. Nowadays, there is an absence of publications as most series were published more than 25 years ago. Patency and limb salvage vary at about 60-80% at 1 year and patency rates at about 40% at 3 to 5 years. Due to high co-morbidity, mortality is reported to be up to 30-50 % at 1 year. Currently, the use of ringed instead of

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doi: 10.59037/qsnsds09
ISSN 2732-7175 / 2025 Hellenic Society of Vascular and Endovascular Surgery Published by Rotonda Publications

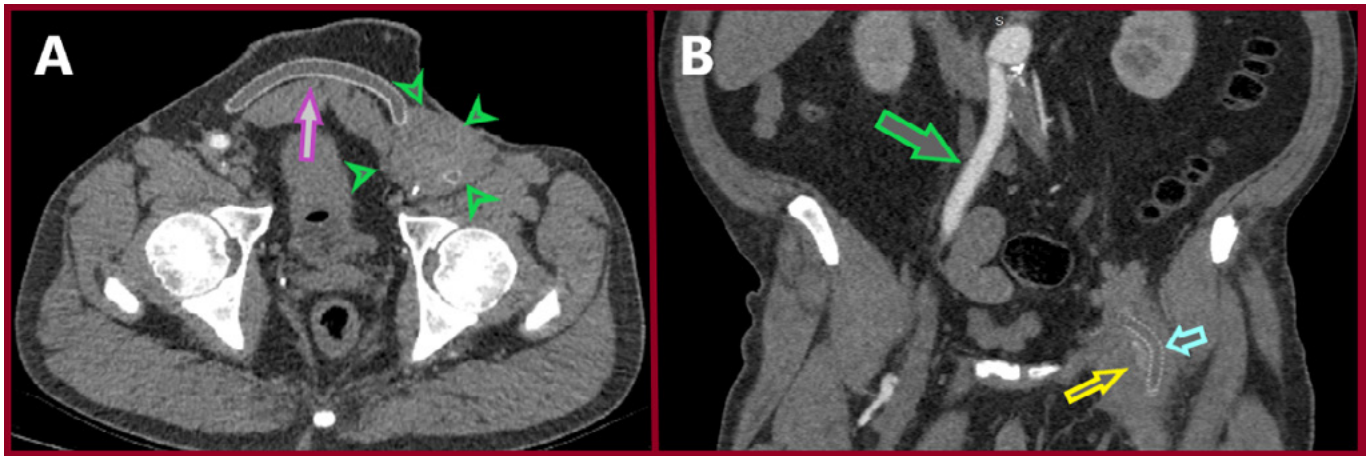

Figure 1: A computed tomography angiography revealed an aortofemoral left limb and femorofemoral bypass thrombosis and a patent right limb of an aortobifemoral bypass. A blood pooling was apparent in the left groin, arising from the orifices of the profunda femoral artery. Signs of Leriche syndrome are apparent in the aortoiliac system (A: green arrowheads: anastomotic pseudoaneurysm with a bleeding sinus, purple arrow: thrombosed femorofemoral bypass. B:green arrow: blood pooling due to anastomotic hemorrhage).

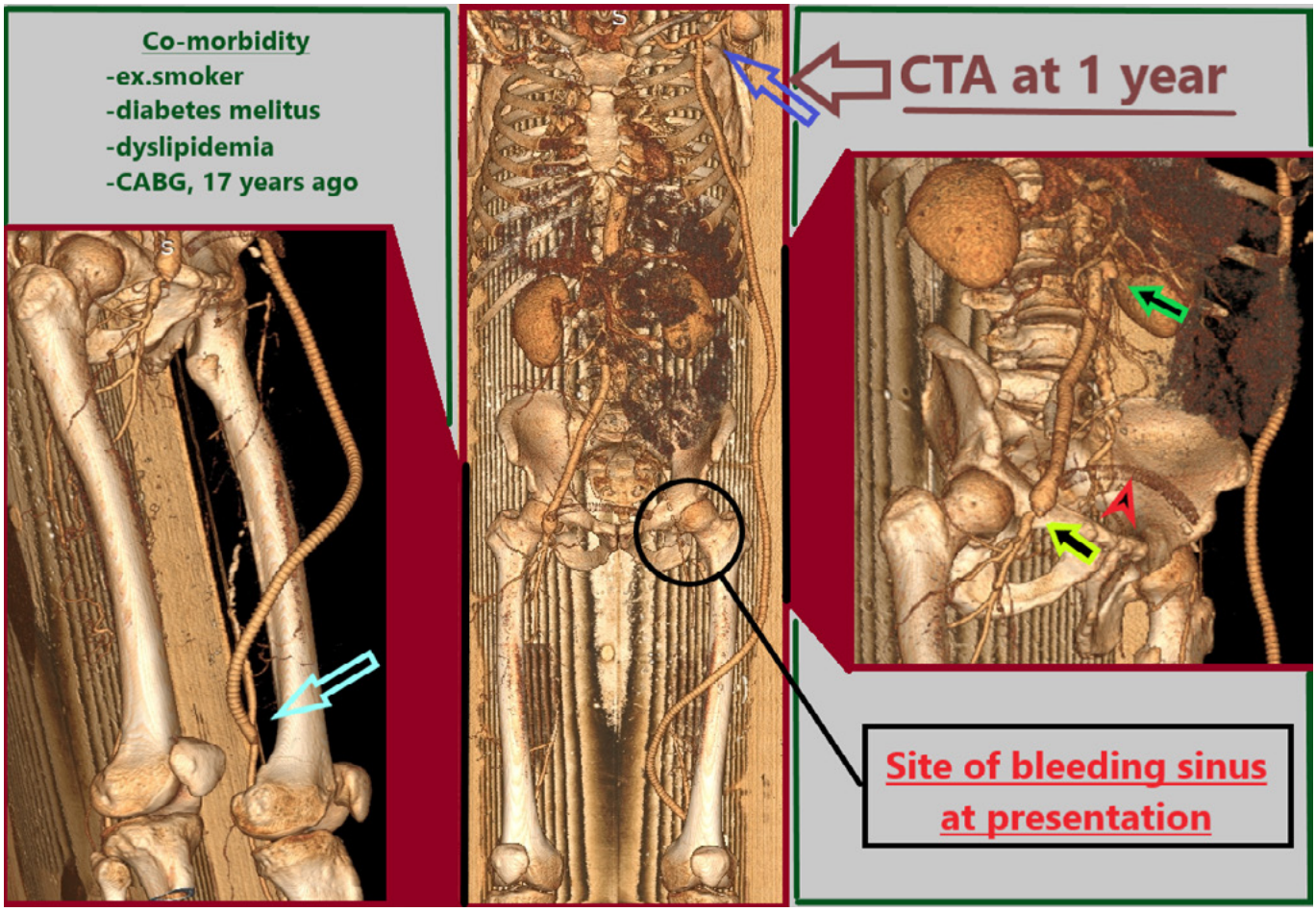

Figure 2: The route of the axillopopliteal graft. Two grafts 70cmx8mm Ringed PTFE (W.L. Gore & associates) were used, which were interconnected in an end-to-end fashion, after completion of the proximal and distal anastomoses (The graft had a lateral route but at the mid-thigh it crossed the anterior femoral area and connected end to side with the first part of the popliteal artery), (Blue arrow: proximal anastomosis, light blue arrow: distal anastomosis, green arrow: stump of the thrombosed left aortofemoral limb, light green arrow: patent right aortofemoral anastomosis, red arrowhead: thrombosed femorofemoral bypass).

unsupported PTFE grafts, 8mm in diameter (vs 6mm in older trials), and the modern antithrombotic treatment (anticoagulation plus antiplatelets based on the Voyager-Pad trial) may give better results.

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Rupture of the infrarenal aorta during the 1st postoperative day after emergent endovascular treatment of acute Type B aortic dissection

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Abstract:

Acute Type B Aortic Dissection (ATBAD) is a vascular emergency requiring prompt diagnosis and treatment to avoid serious complications. Complicated cases are treated invasively, preferably by endovascular means.

We present a 60-year old woman who was admitted due to ATBAD, with the primary entry tear located just distal to the level of the Left Subclavian Artery (LSA) origin. She was initially treated conservatively, however on the 2nd day due to refractory pain she was subjected to emergency TEVAR with LSA coverage.

The procedure was uneventful. During the 1st postoperative day the patient complained for back pain and underwent a new CT indicating successful endograft deployment without remarkable changes from the distal thoracic and abdominal aorta compared to the preoperative imaging. During the same night the patient became hemodynamically unstable and died. Post-mortem CT indicated infra-renal aortic rupture.

ATBAD may result in mortality even if prompt treatment has been undertaken.

INTRODUCTION

Acute aortic syndromes are disorders of thoracic and abdominal aorta, that require urgent evaluation and treatment, with acute aortic dissection (AD) being the most frequent and most lethal in-between them[1]. Uncomplicated Acute Type B Aortic Dissections (ATBAD) initially undergo conservative management with close monitoring in an intensive care unit (ICU) setting, aiming to lower blood pressure and heart rhythm, relieve pain and allow for an uneventful recovery during the acute phase[2, 3]. On the contrary, complicated cases (rupture, malperfusion, aortic enlargement) undergo immediate endovascular repair. Similarly, patients with uncontrolled hypertension or refractory pain, are considered an intermediate risk category and are candidates for emergent treatment. The primary goal of endovascular repair is primary entry tear coverage, to lower false lumen pressure, allow true lumen expansion and promote positive aortic remodeling[2]. Nevertheless, reentry tears may continue to perfuse the false lumen leading to its expansion.

CASE REPORT

We present a 60-year old female patient who was admitted from the emergency department due to ATBAD. CT angiography (CTA) indicated ATBAD with the primary entry tear located just distal to the Left Subclavian Artery (LSA) origin, extending distally to the aortic bifurcation and the left common iliac artery (Figure 1). Additionally intramural hematoma, with multiple ulcerations were noted, extending from the level of the LSA to the thoracoabdominal aorta, where a second entry point was also identified, at the level of the celiac artery (CA) origin, on the posterior aortic wall (at 180o with regard to the CA origin) . The CA, superior mesenteric artery and renal arteries were originating from the true lumen (TL), whereas the inferior mesenteric artery from the false lumen, which however was patent. The patient was transferred to the ICU, where the arterial pressure was normalized and the pain was controlled, with intravenous administered antihypertensive and analgesic treatment. During the 2nd hospital day, the patient complained about pain recurrence and underwent repeat-CTA without remarkable changes, including expansion of the dissection, rupture of the aorta or malperfusion to the abdominal viscera or the limbs. Because of uncontrolled and refractory pain she was subjected to emergency TEVAR with LSA coverage during the same day (Gore TAG 34x100mm, W.L.Gore and Associates, Inc.) (Figure 2).

The procedure was uneventful. During the 1st postoperative day the patient was transferred to the ward in good general condition, with per os controlled pain and blood pressure. In the afternoon of the same day she complained for back pain and underwent a new (3rd) CT angiography, which indicated successful endograft deployment and unremarkable changes in the distal thoracic and the abdominal aorta, compared to the preoperative imaging. During the same night the patient became hemodynamically unstable and died. Post-mortem CT examination indicated rupture of the infra-renal aorta and a large retroperitoneal hematoma (Figure 3).

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doi: 10.59037/y66n1973
ISSN 2732-7175 / 2025 Hellenic Society of Vascular and Endovascular Surgery Published by Rotonda Publications

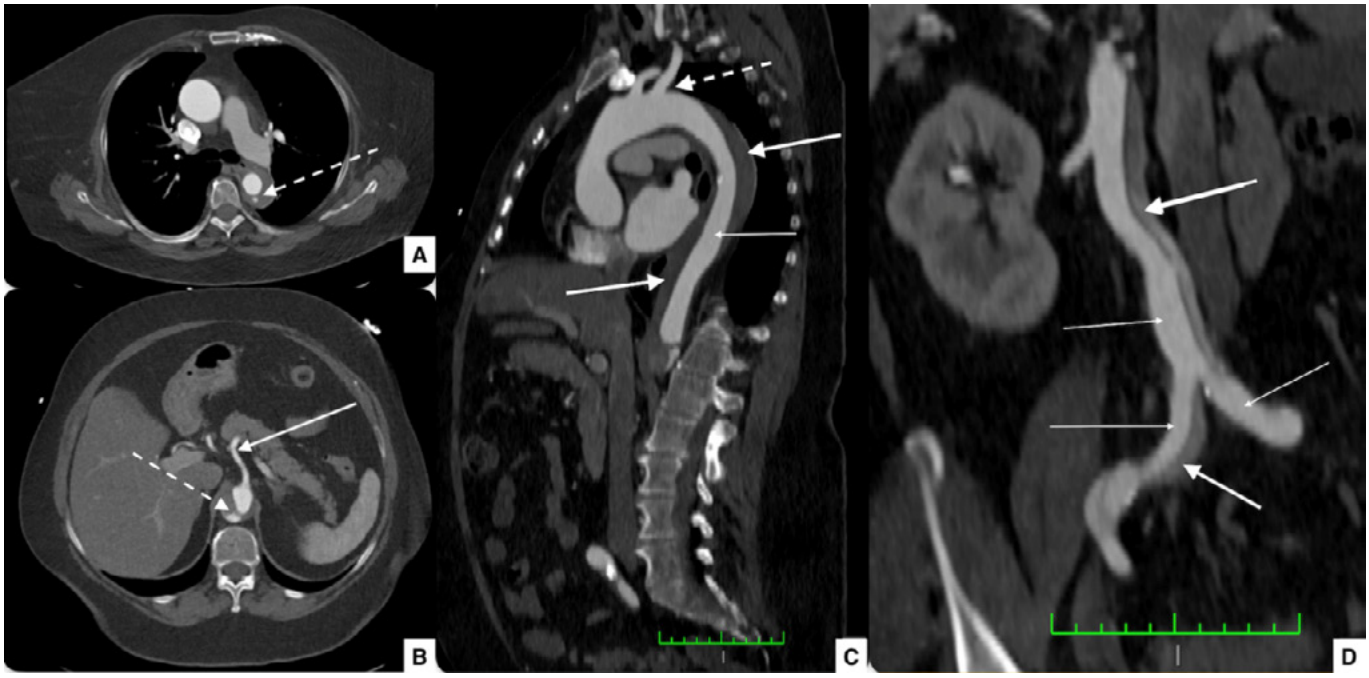

Figure 1: Pre-operative CTA. A: Axial image indicating proximal entry tear (dashed arrow) and intramural hematoma. B: Axial image indicating a second entry tear (dashed arrow) at the level of the celiac artery origin (solid arrow). C: Sagittal image indicating the false lumen and intramural hematoma (thick white arrows), the true lumen (thin white arrow) and the level of the primary first entry tear (dashed arrow), just distal to the origin of LSCA. D: Coronal views of the aorta (thick arrow indicating the false lumen/intramural hematoma, thin arrows indicating the true lumen).

Figure 2: Intraprocedural image showing deployment of the thoracic endograft. Thick white arrow indicates the brachiocephalic artery, thin white arrow indicates the left common carotid artery, dashed arrow depicts the origin of the left subclavian artery having been covered by the endograft, and star depicting the thoracic endograft

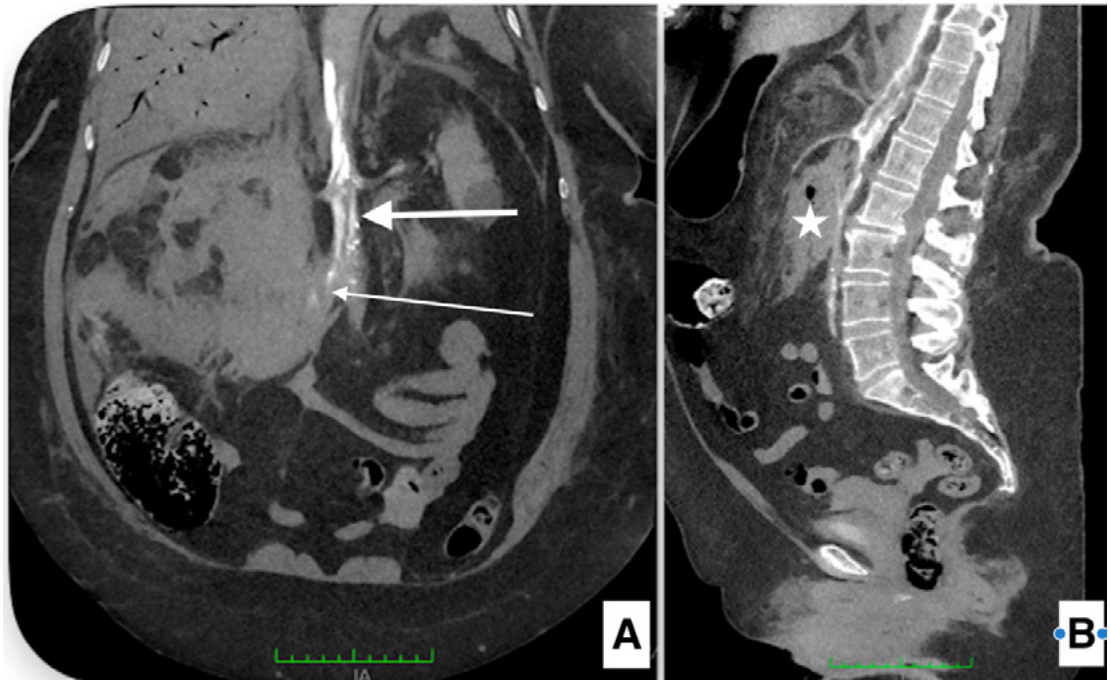

Figure 3: Post-mortem CTA. A: thick white arrow indicating the infrarenal abdominal aorta and thin white arrow depicting the point of aortic rupture. B: white star depicting the large retroperitoneal hematoma.

DISCUSSION

ATBAD results in a 13% in-hospital mortality according to a previous publication from the IRAD registry and most of these deaths occur during the first week after the acute event[4, 5, 6]. This was the case with the patient reported here as well, who died in the 1st postoperative day, 3-days after the initial symptoms. In our case, the patient had, at first, an uncomplicated ATBAD and thus was treated with intravenous administered β-blockers, vasodilators and morphine. However, due to recurrent and refractory back pain the dissection was characterized as complicated and emergent surgical treatment was decided.

Refractory pain is considered a high risk index after ATBAD, which usually sets the indication for invasive treatment. The term refractory has not been clearly defined in the literature, but it is usually considered when it is not possible to control pain during a >12 hours time period, despite maximal medical therapy[7]. These patients are in an excess risk for mortality, especially when they are managed medically. Specifically, patients with refractory pain and/or uncontrolled arterial hypertension, have been shown to present a 35% in-hospital mortality rate, compared to 1.5% of patients in the low risk group, when treated conservatively. Although overall (regardless of the mode of treatment) mortality rate is again significantly higher among patients with these high risk variables compared to patients without (17.5% vs 4%), the difference is not so wide, thus suggesting that invasive management should be considered for these patients[5]. Moreover, periaortic hematoma has been previously identified as a significant predictor of a poor prognosis, conferring a relative risk around 3 for death after ATBAD, which was present in our patient[6].

Current therapeutic protocols regarding invasive management of ATBAD indicate that the procedure aims to cover the primary entry tear in order to induce positive aortic remodeling[2]. In our case this was achieved by deploying the endograft just distal to the origin of the left common carotid artery, proximal to the origin of the LSA. This is considered appropriate in cases of acute aortic pathologies, if no specific contraindications exist[8]. Adequate coverage of the primary entry tear, and successful deployment of the endograft, just distal to the origin of the left common carotid artery was indicated in the post-operative CTA. A 2nd entry tear just opposite the origin of the CA, which was feeding the false lumen, had been noted in all 3 CT scans of the patient, but watchful waiting of this lesion was considered appropriate. If one would decide to cover this as well, not only >35cm of aortic coverage would be required, with a subsequent risk for neurologic complications, but also the origin of the CA would have been covered, while the distal sealing zone till the origin of the SMA would be around 15mm. These factors, along with the fact that the postoperative CTA indicated successful endograft deployment and unremarkable changes in the abdominal aorta contributed to the decision not to undertake a 2nd invasive procedure in this patient.

Among the complications after TEVAR for ATBAD are stroke, spinal cord ischemia, retrograde type A dissection, chronic post-TEVAR aortic dilatation, angulation, migration or collapse of the stent graft, false aneurysm formation, graft erosion, stent-frame fracture and rupture of the aorta[2]. Perioperative aortic rupture after TEVAR can be classified as procedure-related, device-related or due to progression of the disease, as analyzed in Table 1[9]. From the current literature, a low rate of death after endovascular treatment has been reported, that mainly occurs due to aortic rupture (2/3 of cases),

most of which are located in the aortic arch, after retrograde Type A dissections[9]. We are not aware of previous reports on cases presenting infrarenal aortic rupture.

CONCLUSION

Acute type B aortic dissection is a vascular emergency requiring urgent treatment. Complicated cases are preferably treated by endovascular means, but even in the presence of a successful and timely invasive procedure, there is a potential for serious complications which may result in patient's death. To our knowledge only scarce data have been reported regarding abdominal aortic rupture after endovascular treatment of ATBAD.

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Spontaneous aneurysm of the right external jugular vein

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Abstract:

External jugular vein aneurysms (EJVAs) are rare vascular anomalies, typically presenting as asymptomatic, soft, and compressible neck masses that become more prominent with increased intrathoracic pressure. This report details the case of a 69-year-old woman with a progressively enlarging right-sided cervical mass, accentuated by laughing. Imaging via Doppler ultrasound confirmed a pseudoaneurysm of the right external jugular vein, characterized by a parietal breach and a compressible venous sac. Surgical resection with end-to-end anastomosis was successfully performed, with an uneventful postoperative course. EJVAs may be congenital or acquired, with risk factors including venous insufficiency, aging, and prior trauma, although many cases remain idiopathic. Diagnosis relies on clinical examination and imaging, with Doppler ultrasound as a primary tool. Treatment is typically surgical, mainly for aesthetic reasons, though endovascular options exist. This case underscores the importance of considering EJVA in the differential diagnosis of lateral neck masses and highlights the role of imaging in guiding management.

INTRODUCTION

Venous aneurysms are relatively rare lesions that have been reported throughout the venous system.[1,2] They occur most often in the lower limbs, followed by the face, neck, abdomen, and thorax.[1,2] Cervical aneurysms are even rarer and generally involve the internal jugular vein.[1,2] External jugular vein aneurysms (EJVAs) are rare and often pose an aesthetic concern.[1,3] We report a case of spontaneous aneurysm of the external jugular vein and describe the circumstances of its discovery and therapeutic management in a 69-year-old female patient.

OBSERVATION

A 69-year-old female patient presented with a visible mass on the right side of the neck, which had gradually increased in size and drew attention from those around her, as it typically became more prominent when she laughed.

Her medical history included chronic venous insufficiency. There was no history of catheterization of the internal or external jugular veins, and no prior cervical trauma. She had been followed for varicose veins and had undergone sclerotherapy.

Physical examination of the cervical region revealed a mass at the base of the neck, located on the right side and slightly lateral to the neck vessels, measuring approximately 2 cm in diameter (Figure 1). The mass expanded with respiratory movements. It was soft, compressible, non-fluctuant, non-pulsatile, and without a thrill. The overlying skin was neither erythematous nor inflamed. No other masses or lymphadenopathy were detected elsewhere in the neck. Auscultation revealed no murmur.

Ultrasonography with color Doppler of the neck vessels revealed the following:

- **Right side**: The common carotid artery, its bifurcation, and both the internal and external carotid arteries were patent and without abnormality. The right thyroid lobe appeared normal. The right subclavian artery and the vertebral artery in segments V0 and V1 were also normal. The internal jugular vein was unremarkable. A venous mass, visible externally, was supplied by the external jugular vein. A clearly visible breach in the wall of the external jugular vein allowed communication with a venous pocket located laterally in the neck. Color Dop-

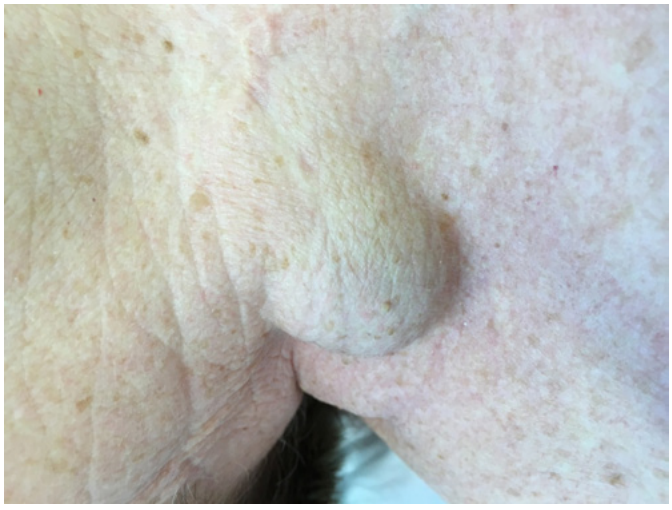

Figure 1: Right cervical mass.

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doi: 10.59037/gee8v787
ISSN 2732-7175 / 2025 Hellenic Society of Vascular and Endovascular Surgery Published by Rotonda Publications

pler imaging provided precise visualization of this parietal breach and demonstrated filling of the venous sac with each respiratory movement and during intrathoracic pressure exertion. The venous pocket measured 1.5 cm in thickness and 3 cm in diameter, was fully compressible, and showed no signs of thrombosis. These findings were consistent with a true false aneurysm of the right external jugular vein.

- **Left side**: The supra-aortic trunks and jugular veins were normal.

The patient underwent surgical resection of the aneurysm with end-to-end anastomosis under general anesthesia (Figures 2 and 3). Postoperative recovery was uneventful, and the patient was discharged on postoperative day 4.

DISCUSSION

Venous aneurysms are rare compared to arterial aneurysms.[1] Over a span of 21 years, only five cases of venous aneurysms were reported, of which only two were external jugular vein aneurysms (EJVA).[1,2] The most common site for cervical venous aneurysms is the internal jugular vein.[1,3,4]

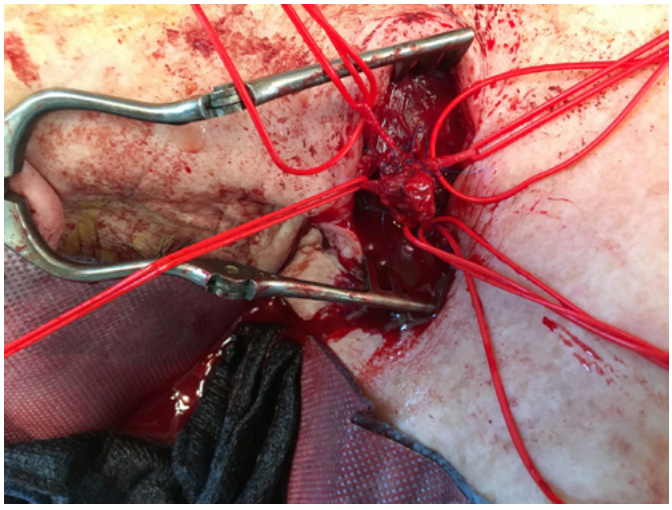

Figure 2: Intraoperative image

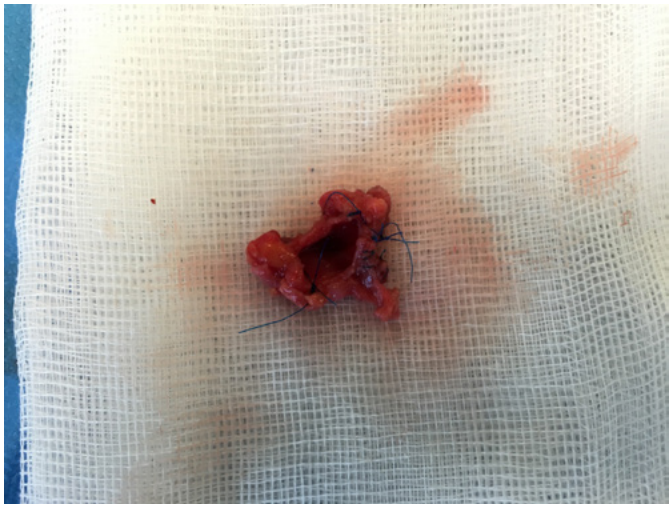

Figure 3: Aneurysm sac

Several differential diagnoses have been proposed for a lateral cervical mass, including upper mediastinal tumors and cysts, external laryngeal diverticulum, and venous aneurysms.[3,4] Venous aneurysms can be either congenital or acquired. Among the acquired forms, risk factors include recent trauma, aging, cardiovascular disease, inflammation, venous insufficiency, and arteriovenous fistulas[3,5] In some cases, no clear etiology is identified.[5,6]

In our case, there was no history of recent trauma or catheterization of the cervical veins. The patient was 69 years old and under follow-up for chronic venous insufficiency. Notably, cases of cervical venous aneurysms involving the internal jugular vein have even been reported in infants as young as 3 and 6 months old.[7]

EJVA typically presents as a unilateral, asymptomatic, oval mass that is non-pulsatile and silent on auscultation. Its most distinctive feature is the increase in size during laughter, shouting, or Valsalva maneuvers. However, clinical examination alone often cannot distinguish it from aneurysms of the internal jugular vein. Diagnostic approaches remain debated. While Doppler ultrasound is often sufficient for diagnosis, computed tomography offers superior spatial and temporal resolution and is better suited for detecting vascular anomalies.[8]

Surgical management of venous aneurysms of the neck and face is not as systematic as for other venous aneurysms, which are typically operated on to prevent complications such as pulmonary embolism, hemorrhagic rupture, or compression. In the case of cervical and facial venous aneurysms, surgery is usually performed for cosmetic reasons.[1,3,4]

Regarding therapeutic options, two approaches are available: open surgery, which is the most commonly performed,[9,11] and endovascular surgery.[8] Open surgical techniques include ligation, tangential venorrhaphy with or without aneurysm resection, and venous bypass.[9-11]

Endovascular surgery offers aesthetic advantages, especially for aneurysms in the cervical or facial regions. It can be performed on an outpatient basis and under local anesthesia. The procedure involves catheterizing the aneurysm via a femoral approach and embolizing it.[8]

CONCLUSION

External jugular vein aneurysms are extremely rare and typically present as cosmetic concerns. They may be congenital or acquired, with no identifiable cause in some cases. Surgical treatment, most often via open techniques, is the standard approach, with endovascular procedures used in select cases.

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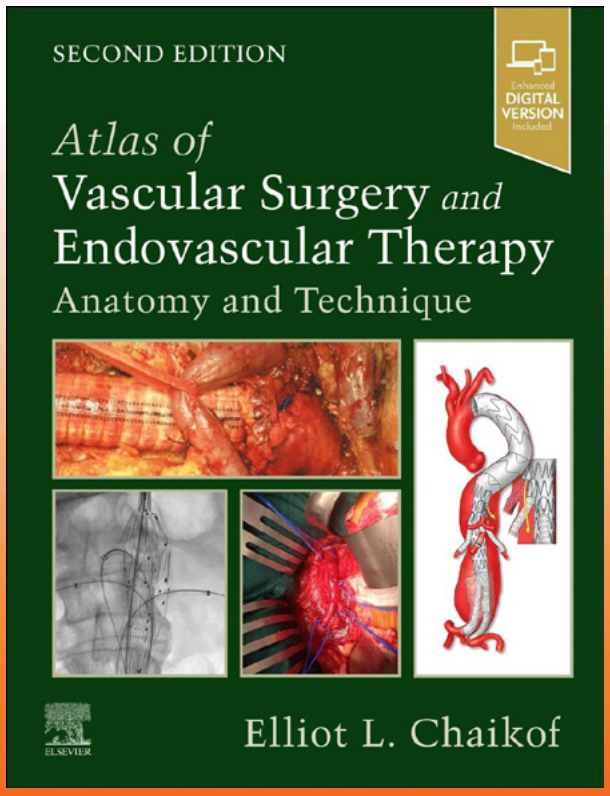

ISBN: 9780323566940

PRICE: ~~300€~~ **260€**

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