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Hellenic Society of Vascular and Endovascular Surgery

Hellenic Journal of Vascular and Endovascular Surgery

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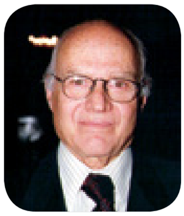

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Matsagkas MI, Kouvelos G, Spanos K, Athanasoulas A, Giannoukas A. Double fixation for abdominal aortic aneurysm repair using AFX body and Endurant proximal aortic cuff: mid-term results. Interact Cardiovasc Thorac Surg. 2017;25:1-5.

Giannoukas AD, Chabok M, Spanos K, Nicolaides A. Screening for Asymptomatic Carotid Plaques with Ultrasound. Eur J Vasc Endovasc Surg. 2016;52:309-12.

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EDITORIAL

Successful use of chimney EVAR in ruptured cases is possible only in case of considering and accepting important preoperative standards

Konstantinos P. Donas, MD, PhD, Gergana T. Taneva, MD, Nizar Abu-Bakr, MD, PhD Stefano Fazzini, MD

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The report from the Department of Vascular Surgery of the University of Larissa in the last issue of HJVES, demonstrate the feasibility of emergent endovascular repair in 3 ruptured pararenal aneurysms by the use of chimney grafts.[1] The technical success was 100%. The patients treated immediately and the results showed promising performance of this alternative approach.

The PERformance of the chImney technique for the treatment of Complex aortic pathoLogiES (PERICLES registry) gathered a total of 13 US and European centers proving comparable mid-term results to the fenestrated/branched technologies and supporting chimney EVAR (ch-EVAR) validity as an off-the-shelf and immediately available alternative.[2] In 2019 the European Society for Vascular Surgery included the use of parallel grafts as an alternative in the emergency setting, bail-out technique or when fenestrated devices are not available or contraindicated.[3]

However, use of ch-EVAR is demanding and can be associated with early or late failures. Especially, in case of ruptured pathologies due to the perioperative stress for urgent treatment there is a high risk to have suboptimal experience and outcomes. Consequently, we aim by this editorial to highlight important preoperative standards to minimize the risk of early and late failures.

PREOPERATIVE STANDARDS

Etiological factors for persistent gutter-related type IA endoleaks

The presumed Achilles heel of ch-EVAR is the concern regarding gutter endoleaks between the chimney stent and aortic main body stent-graft. The PERICLES registry collaborators identified two key factors associated with persistent gutter endoleak.[2] One was the degree of aortic stent-graft oversizing, and the other one was related to insufficient length of the new proximal seal zone. There is a clear recommendation of 30% aortic stent-graft oversizing and total seal length of at least 20mm.[2] These recommendations should be always take under consideration during preoperative planning and sizing.

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Placement of the chimney graft

Occlusion of a chimney graft can be the most devastating ch-EVAR complication. An occluded renal chimney graft is frequently asymptomatic or presented with mild non-specific symptoms. Stent rescue is technically challenging due to the presence of suprarenal stents, which constitute a barrier between the sheath and the occluded device. Moreover, the presence of the pins of the suprarenal stent can have potentially an interaction with the balloon of the chimney graft leading to inadvertent trapping and interaction of the sheath from the pins.

Consequently, there is a need to protect during placement the balloon of the chimney graft removing the balloon only within the sheath. We are aiming to have the sheath at the upper level of the suprarenal stent but always below the pins.

Use of chimney grafts in angulated renal arteries

The additional deployment of flexible nitinol stent aims to improve the transition of the chimney graft in angulated artery. Scali S et al[4] showed that relining of the stainless-steel rigid balloon expandable chimney grafts with the placement of nitinol stents in angulated renal arteries minimizing the risk of kinking and consequent stenosis and/or occlusion. Consequently, selection of shorter chimney grafts avoiding involving the angulated segment of the renal arteries can be a good alternative.

Risk of stroke

A noteworthy criticism of ch-EVAR for treatment of juxtarenal aneurysms is the risk of stroke related to the need to use upper extremity access. To address this concern, in an additional analysis of the PERICLES registry, Bosiers and colleagues reported a clinically relevant cerebrovascular event rate of 1.9%.[5] Not surprisingly, the use of bilateral upper extremity access was found to be an independent predictor factor associated with a 2.8-fold increased risk for postoperative stroke.[5] This important finding led to the recommendation not only for the monitoring of the ACT having prolonged time for the elective cases but also for using a single arm access point (e.g. left upper extremity) with double punction of the axillary artery for double ch-EVAR procedures. In this context, evaluation of the left subclavian artery and the thoracic aorta should be performed preoperatively. In case of presence of excessive soft thrombotic plaques, ch-EVAR should be avoided due to the high risk of diffuse embolization and trush in several organs.

In summary, the use of chimney grafts is no longer a matter of faith but a fact. The evidence in the literature supports its complementary role for the treatment of juxtarenal aneurysms and in agreement with that the ongoing ENCHANT Study as a fully prospective multicentre trial of ch-EVAR (clinicaltrials.gov identifier: NCT03320252) will provide further evidence bringing the technique to a higher level of evidence (B) than f-EVAR (C). Consequently, if we do not want to keep looking at the tree but the forest, we have nowadays evidence to support the use of this approach as first treatment option in several challenging clinical entities. However, good outcomes are the result only in case of consideration and acceptance of important preoperative standards, as described here, highlighting the potential risk of also devastating complications.

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SPECIAL ARTICLE

Vascular Surgery in the era of COVID-19 pandemic

Konstantinos Spanos, MD, MSc, PhD, Athanasios D. Giannoukas, MD, MSc, PhD, FEBVS, Miltiadis Matsagkas, MD, PhD, FEBVS

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Since the first case of COronaVIrus Disease (COVID-19) that was identified on the 17th of November of 2019 in Wuhan of China, a pandemic across the words has spread. COVID-19 is caused by Severe Acute Respiratory Syndrome CoronaVirus-2 (SARS-CoV-2), a single-stranded RNA encapsulated corona virus which is highly contagious and spreads predominantly by either droplets (larger particles) or direct contact with patients (or fomites) rather than 'airborne spread' of smaller particles.[1]

Patients that are in greater risk are people >80 years old, and people with underlying medical problems such as cardiovascular disease, diabetes, chronic respiratory disease, and cancer. Currently, there are no specific vaccines or treatments for COVID-19. However, there are many ongoing clinical trials evaluating various potential treatments.[1]

As the COVID-19 pandemic continues to explode, hospital systems are scrambling to intensify their measures for protecting patients and health care workers from the virus. The vascular surgery communities around the world are trying to prioritize the management of patients according to their individual needs, but also accept that the hospital circumstances have changed and this may have an impact on clinical decision-making. Principles include reducing unnecessary exposure to hospitals, deferring less urgent cases and reducing hospitalization, dependency on ICU and blood transfusion.

The Hellenic Society of Vascular and Endovascular Surgery (HSVES) has recently issued some recommendations for the current situation with the COVID-19 pandemia.[2] Thus, for patients positive for COVID-19 or high clinical suspicion, conservative treatment is recommended where possible and safe for the patient. In case of intervention (endovascular or open) then the use of personal protective equipment is necessary as well as the observance of all precautions to preserve the health of the medical - nursing team.

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Table 1 shows the recommendations[2] of the HSVES regarding patients that need treatment and a surgery should not be deferred.

Category	Recommendation on what to treat
Aortic disease	Symptomatic or Rupture- EVAR with local is first choice
	Mycotic or Graft infection
	Asymptomatic aneurysm >65mm- except if it possible to delay surgery
	Acute aortic dissection
	Aorto-enteric fistula
Carotid disease	Symptomatic
Popliteal aneurysm	>2.5cm
Peripheral arterial disease	Acute limb ischemia or critical limb ischemia
Access	AV graft or AV fistula thrombosis or infection
	Central Venous Catheter
Vein disease	Acute iliac-femoral thrombosis
Amputation	Ischemia- Infection- Sepsis
Uncontrolled bleeding	Embolization- surgery

Table 1. shows the recommendations[2] of Hellenic Society of Vascular and Endovascular Surgery regarding patients that need treatment and a surgery should not be deferred. EVAR: endovascular aortic aneurysm repair; AV: arteriovenous.

The Hellenic Surgical Society has also published some general recommendations and from the perspective of Vascular surgery they defined the following clinical entities as urgent[3]:

- Hemorrhage or peritonitis from blunt or penetrated trauma
- Abdominal aortic rupture
- Acute arterial occlusion

Regarding the elective procedures they recommend interventional treatment only for:

- Arterial occlusion with ischemia limb lesions
- Symptomatic carotid disease

They also recommend some general principles:

- COVID-19 test of each patient that is going to be treated even for acute cases if this is possible and available.
- Chest X ray or computed tomography (CT) scan 24 hours before surgery

- All patients should wear their mask
- The operation should be done as fast as possible, with an experienced operator and the least number of surgeons.
- If possible do not operate during the night
- If conservative treatment is an option please prefer that or any minimal invasive treatment

Other strong and prestigious Vascular and Surgical Societies have already published their own guides.

The Vascular Society of Great Britain and Ireland has suggested that most arterial surgery is either urgent or emergency in nature and should continue at present where possible.[4] When possible, only urgent outpatients should be seen, and virtual clinics should be considered. On discharge, many vascular patients will either need no outpatient follow (but be given a telephone number to ring if in trouble) or can be reviewed in remote outpatient clinics.

Regarding the elective cases, guidelines recommend that elective arterial surgery and venous surgery should be deferred. Asymptomatic carotid surgery and surgery for claudication should be deferred. The size threshold for abdominal aortic aneurysm (AAA) surgery needs to weigh up risk of rupture in the next few months with risk of intervention and resource limitation. Thus, a diameter of >7cm or imminent rupture AAA is currently recommended.

Regarding the urgent cases, ruptured aneurysms should ideally be treated by endovascular aortic aneurysm repair (EVAR) whenever possible to reduce dependence on the High Dependency Unit and reduce length of stay. Open surgery should only be considered when EVAR is inappropriate or unavailable and in cases where there is a good chance of success. Intensive care unit (ICU) capacity will need to be considered prior to intervention. Patients with critical leg ischemia, which means legs immediately threatened, should undergo urgent intervention. There may be situations where primary amputation may be more appropriate than complex revascularisations, multiple debridements and potential prolonged hospital stay. Crescendo TIAs would normally need urgent surgery. If there are severe resource limitations, aggressive best medical therapy would be more appropriate for recently symptomatic carotids.

They also pointed that this situation might have an impact on Clinical training and education. Remote or virtual meetings will become important. The next sitting of the final Fellowship has been already cancelled.

Additionally, the Royal College of Surgeons of England have made clear their main principles for the management of this situation.[5]

1. Adapting surgical services
   - Triage of non-emergency surgery
   - Clinical networks
   - Rotas
   - Virtual outpatient clinics
2. Working in an extended scope of practice
   - Working beyond one's regular scope of practice as part of a team
   - Retired surgeons and trainees
3. Caring for patients at the end of life
4. Protecting the workforce
   - Infection prevention
   - Ensuring surgeons' and surgical teams' well-being

The American College of Surgery[6] has also published their recommendations on the management of vascular surgery patients. Thus the procedures that should not be postponed are:

- Ruptured or symptomatic TAAA or AAA
- Aneurysm associated infection or Prosthetic graft infection
- AAA or thoraco-abdominal AAA (TAAA) >6.5cm (postpone if possible)
- Symptomatic peripheral aneurysm
- Symptomatic non-aortic intra-abdominal aneurysm
- Acute aortic dissection with rupture or malperfusion
- Aorto-enteric fistula (AEF) with septic/hemorrhagic shock, or signs of impending rupture
- Symptomatic acute mesenteric occlusive disease
- ○ Infected arterial prosthesis without overt sepsis, or hemorrhagic shock, or impending rupture
- ○ Symptomatic Carotid Stenosis: carotid endarterectomy (CEA) and transcarotid artery revascularization (TCAR)
- ○ Thrombosed or nonfunctional dialysis access or infected or ulcer or patient needing an access
- ○ Acute limb ischemia or Limb Ischemia: Progressive tissue loss, acute limb ischemia, wet gangrene, ascending cellulitis or Fasciotomy for compartment syndrome
- □ Traumatic injury with hemorrhage and/or ischemia
- □ Acute iliofemoral deep vein thrombosis (DVT) with phlegmasia
- □ Amputations for infection/necrosis
- □ Surgery/Embolization for uncontrolled bleeding in unstable patients

In particular regarding the management of stroke, the American Heart Association/ American Stroke Association (AHA/ASA) Stroke Council Leadership have released the Temporary Emergency Guidance to United States Stroke Centers during the COVID- 19 Pandemic.[7]

Thus, they believe that all stroke teams should endeavor to adhere to all published guidelines regarding patient selection for therapy; treatment times; and post-recanalization monitoring. Across the wide variety of health care delivery systems in their country, full compliance with all guidelines cannot happen at all times in every locality. They stated that "The global spread of the 2019 novel coronavirus has profoundly affected the way we conduct our healthcare practices”.[8]

In our region the 1st COVID-19 case (in Thessaly, Greece) was reported on 10.03.20, almost two weeks after 1st COVID-19 case in the country (26.02.20). Currently (06.04.20), the COVID total cases are 1,735 in Greece (93 ICU; 73 deaths), while in Thessaly only 22 cases have been reported (3 ICU; no death)

On the 9th of March, we have stopped our outpatient clinic, while on the 11th of March the elective operations were also stopped in our Hospital. All patients that need treatment that could not be postponed and will be electively operated are tested 48h before operation for COVID-19, while the imminent urgent and emergency patients are tested just before the operation, to know the result even after the operation, in order to take the right precautions. No COVID-19 patient needed a Vascular procedure so far. Table 2 shows the patients’ management of our Department from 06.03.20 to 06.04.20. It is profound that all numbers of patients that have been examined and treated either electively or urgently have been significantly decreased during this period.

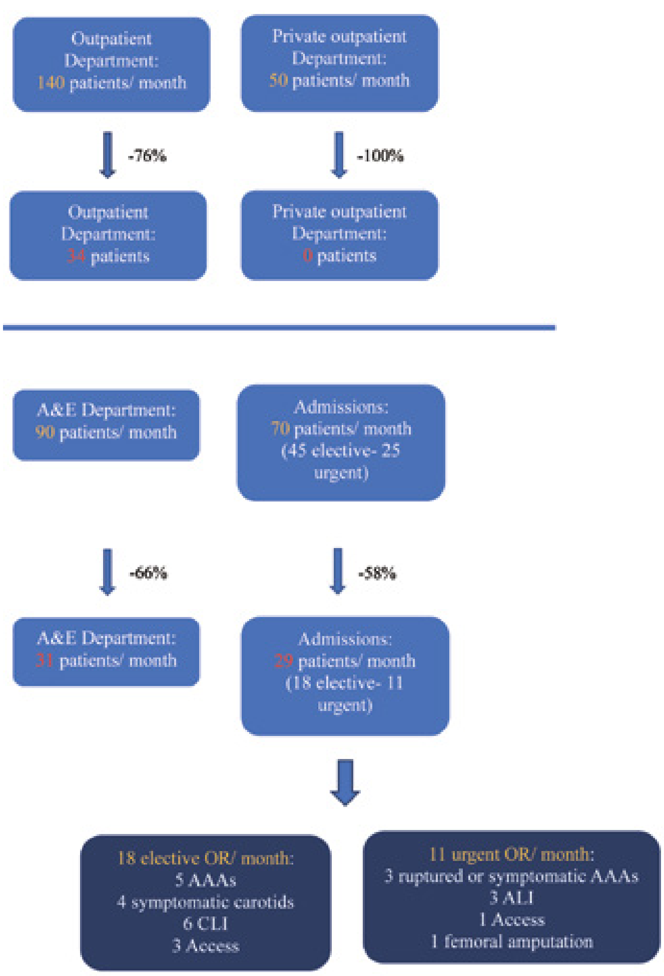

Table 2. shows the patients’ management of our Department from 06.03.20 to 06.04.20. A&E: accident and emergency; OR: operation; AAA: abdominal aortic aneurysm; CLI: critical limb ischemia.

Currently, only the on-call Doctors are in the Hospital in order to protect the rest of the medical staff from COVID-19 infection. The indications for patients treatment are mainly AAA >60mm (local anesthesia with MAC if possible), symptomatic carotid disease and CLI. We are trying to treat at least 2-3 cases per week in a semi-elective base.

We should bear in mind that during such a difficult period the recommendations are defined by the following parameters:

- the need for surgery in order to save the patient that is in imminent danger for his life.
- the burden of the medical logistics system from surgery or non-surgical treatment of diseases (conservative treatment) - consumption of blood and derivative units, need for long-term surgery, surgery hospital stay for many days, need for treatment in the ICU.
- the risk of exposure to COVID-19 infection in both the patient and the medical and nursing staff.

In general, conditions should be assessed on a daily basis based on the pandemic data and the needs of the Health System, locally and nationally, with a sense of responsibility.

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INVITED COMMENTARY

COVID-19 in Vascular Surgery

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In this issue, Spanos *et al.*[1] have described how the sudden onset of the COrona Virus Disease (COVID-19) pandemic in China and the global spread of the Severe Acute Respiratory Syndrome Corona Virus 2 (SARS-CoV-2) have affected the provision of vascular surgery. This pandemic found the majority of the health systems unprepared, despite the alarming warnings coming from infection specialists since the epidemic of the original SARS virus in 2002-2004.

In order to cope with the expected wave of severely ill patients to be admitted in the hospitals, governments adopted different strategies, from total lockdowns to free propagation of the virus in the community aiming in achieving "herd immunity". Along the course of the pandemic and while data from other affected countries started to pile, strategies have been completely altered or modified, something that is described by Spanos et *al.*[1] in his work.

Most strategies agreed in a number of points. All available resources should be used mainly in treating COVID-19 patients, other cases should be deferred in time if possible, medical personnel should be protected and rotated, and screening of suspected patients should be performed. Despite the simplicity of these points, the reality of the pandemic proved the contrary. Thus, alike the different approaches governments had, every health institution, medical association or specialty college published respective guidelines on what cases can be deferred, what should be considered urgency and emergency, and how clinics should be run.

Most COVID-19 vascular surgery guidelines seem to agree on what patients should be treated immediately; acute limb ischemia, vascular trauma and aortic aneurysm rupture. [2,3] As it was described in Spanos et al.,[1] these principles are reflected in the recommendations that were presented by Hellenic Society of Vascular and Endovascular Surgery (HSVES). All other cases can be deferred for later, although there is no global consensus on the timing of these deferrals. Carotid disease seems to be the most ambiguous in terms of the procedure timing, a situation described by Spanos et *al* in their manuscript.

Some institutions have suggested that even emergency or urgent cases should be treated in ways that minimize the procedure time, the hospital stay, the need for blood products and occupancy of Intensive Care Units (ICU) or High Dependency Units (HDU). Therefore, procedures should be performed by experienced physicians to minimize the time, while the least possible staff should be present in the operation theatre to minimize personnel exposure. In some cases, treatment should be more aggressive in order to minimize length of stay, the need of readmission and follow-up clinic visits; a good example for this is diabetic foot/gangrene and surgical debridement. In cases where both open and endovascular techniques can be performed (e.g. ruptured aneurysms), the endovascular procedure should be preferred in order to minimize the procedure time, the use of blood products and the length of stay. It is interesting to note that the COVID-19 guidelines oppose guidelines issued by the same or other institutions; Royal College of Surgeons' guidance opposes the initial NICE guidelines regarding EVAR.[4] A number of centers in Greece cannot strictly adhere to these principles, mainly because there is no emergency endovascular service. Minimizing theatre personnel and rotation of teams are already in place in most vascular units in Greece, as mentioned by Spanos *et al.*

Clinics cannot be run in the usual manner, since social distancing is either imposed or suggested. The UK National Health System has already introduced virtual vascular outpatient clinics where bidirectional audio and video connection between the patient and the physician is established.[5] The Athens Medical Association has introduced a service called "Doctor Next 2 Me", which allows any patient can connect to a physician through a smart phone or a computer.[6] Although this service has attracted attention from the public, it focuses on COVID-19 related consultations. It is a promising technology and could be used for virtual vascular consultations in the future.

Apart from the clinical aspect, the pandemic also affects other parts of vascular surgery. Education and training also suffer from the imposed social distancing and travel bans. The European Society for Vascular Surgery (ESVS) is already considering an online only Annual Meeting, while other vascular meetings are already either cancelled or postponed. The

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HSVES annual and the LIVE meetings are already postponed, while other local meetings are affected, too.

Vascular training is also affected, as number of patients has decreased due to the abovementioned guidelines. Societies are researching online tools to continue providing training. The necessity of online solutions is such that ESVS is considering reintroducing vascular e-learning,[7] only a couple years after shutting down a promising e-learning project. HSVES has already taken advantage of novel tools and has held its first *imeeting*, receiving very positive feedback. It remains to see to what extent online activities can substitute or replace activities that previously required the physical presence of a vascular surgeon or a trainee.

This short review of the current management of patients with vascular disease,[1] shows that it is rather clear that the pandemic will alter all clinical, educational and training activities of vascular surgeons around the globe. The Hellenic vascular community has reacted promptly to this changing environment and has put significant efforts to address the difficulties risen from the new situation.

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The use of mannitol as a neuroprotective factor in cases of hyper-perfusion syndrome after carotid revascularization: a proposed clinical protocol

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INTRODUCTION

Hyper-perfusion syndrome (HPS) is an early post-operative complication in patients treated for high grade carotid stenosis managed with either of carotid revascularization modalities.[1] The development of new neurological symptoms, 6 to 12 hours after the procedure, should set the suspicion of HPS, which may be presented in 1% of patients undergoing endarterectomy (CEA).[1] Post-operative high blood pressure, headache, atypical migraine and focal seizures may be associated with (HPS) and aggressive hypertension control is proposed in these cases[1].

Scarce data exist in the current literature concerning the role of mannitol immediately after carotid revascularization, carotid artery stenting or endarterectomy, in patients presenting hyper-perfusion syndrome.[2] In the acute phase of cerebral ischemia, due to embolus or hyper-perfusion, “neuroprotective” measures as well as the management of cerebral edema have been poorly evaluated and analyzed.[3] In any case, a multidisciplinary team work is mandatory in these complicated cases.[3]

Based on the current literature and our center’s experience, an empirical protocol concerning the use of mannitol in patients treated for high grade carotid stenosis, or those presenting neurological deterioration immediately after carotid revascularization, has been developed and presented.

PROTOCOL

Patient selection

As the role of mannitol is not clarified in the current literature, all patients may not profit from an aggressive management or such a strategy may be harmful in cases with post-operative hypotension. Patients that seem to benefit from mannitol neuroprotection may be separated in 4 subgroups:

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1) Symptomatic patients with high grade carotid stenosis >80%

2) Asymptomatic high grade carotid stenosis, >90%, or near occlusion lesions

3) Patients combining high grade, symptomatic or asymptomatic carotid stenosis >80% with contralateral high grade carotid stenosis, >90%, or near occlusion lesions or occluded internal carotid artery

4) Patients with confusion or neurological deterioration after the accomplishment of the procedure

Use of mannitol

In cases targeting to the prevention of HPS, 75ml of intravenous (iv) mannitol are administrated within 30 minutes, intra-operatively about 10 minutes before declamping in cases of CEA or as far as the internal carotid artery (ICA) is catheterized, in carotid stenting (CAS). In patients presenting with neurologic deterioration after extubation, and the HPS is suspected, the primary dose of mannitol (75ml) is administrated immediately. By protocol, in our department, all patients receive 120mg dexamethasone iv after carotid clamping or after the catheterization of internal carotid artery in cases of carotid artery stenting. All patients are evaluated with cerebral oximetry intra-operatively. After the initial administration, the patient receives 3 additional dosages of 50ml mannitol with a 6-hour interval and 30-minute duration during the initial 24 post-operative hours, irrespectively of his/her neurological status.

Intra-operative blood pressure control

The intra-operative anesthetic blood pressure management initiates with the identification of the “normal” for the patient blood pressure target, which is estimated according to patient’s baseline values. Invasive blood pressure monitoring is considered mandatory; since allows the anesthesiologist to act in a timely manner to unanticipated blood pressure swings and titrate effectively the vasopressors.[4] Anesthesiologists prefer phenylephrine, ephedrine or norepinephrine to achieve optimal values. During intra-operative monitoring, the hemodynamic goal is the blood pressure not to fluctuate more than 10-20% of the baseline values. Especially, during carotid clamping in CEA, the target mean arterial pressure (MAP) is approximately 20% above baseline; to optimize collateral cerebral blood flow to the brain.[5, 6] Nevertheless, this is a general guidance, and the data from the chosen neuro-monitoring method should help with the appropriate adjustments. Thus, the best hemodynamic management relies on an individualized approach according to patient characteristics and needs.

Post-operative monitoring and medical management

The underlying carotid pathology as well as the use of mannitol, order the need for close monitoring of vital signs in the ward. Blood pressure target is between 110-140mmHg. Calcium channel inhibitors are used as a first line treatment for addressing hypertension (eg. Nifedipine 10mg). Persistent hypertension is confronted with angiotensin receptor blockers (eg Ramipril 5mg) or intra-venous glycerin trinitrate, initially with 5ml/h and adjusting according to blood pressure measurements.

As mannitol may provoke important dehydration, an input-output equilibration is mandatory. All patients are hydrating receiving 80ml per hour normal saline and urine output is re-evaluated per hour, while hydration is adjusted to patient's needs accordingly. In asymptomatic or totally recovered patients, liquid consumption initiates 6 or 12 hours after the accomplishment of the procedure or the full stabilization of the patient accordingly.

In terms of antithrombotic agents, all CEA patients continue their pre-operative antiplatelet therapy (aspirin 100mg or clopidogrel 75mg once daily). All CAS cases receive double antiplatelet therapy pre-operatively and for the first 30-days post-operatively.

Patients with neurologic symptoms after intervention

In such cases, an imminent duplex ultrasound evaluates the patency of the internal carotid artery while persistent symptomatology sets the need for urgent computed tomography angiography of the brain and neck. If there is no sign of technical failure of the revascularization or intra-cranial occlusion, the patient is closely monitored for vital signs, urine output and per hour neurological clinical evaluation for the next 24 hours at least. If the patient shows neurological improvement with attenuation of symptoms, monitoring becomes less intensive until she/he, is fully stabilized. In any case, patients with symptoms undergo cerebral CT within the 48 post-operative hours. In such cases iv mannitol, if not started before, administered in the recovery room at a dose of 75-100ml depending in patient's body mass index and continued thereafter in doses of 50ml in 30min infusions every 6 hours, up to 48 hours in total, depending on patient's neurologic condition. In some cases of HPS the neurological symptoms may begin a few hours after the intervention in an otherwise well-recovered patient, having fluctuating course, which is much affected from the systolic blood pressure (BP) of the patient. The patient is usually neurologically stable in the BP range of 110-150 mmHg, while deteriorates when BP is above or below these values, obviously for different hemodynamic reasons.

DISCUSSION

HPS is a rare complication after carotid revascularization, estimated around 1% for CEA and CAS patients, equally distributed.[1, 7] However, it is a devastating complication, difficult to distinguish from new onset cerebral event (stroke or transient ischemic attack (TIA), while its presence maybe also underdiagnosed and thus, misreported in the literature. Furthermore, symptomatic patients may be at higher risk to evolve HPS.[7] This fact may be explained by the edema around the location of the previous ischemic lesion which may mimic neurological deficits associated with the underlying infarct. Current guidelines discuss extensively HPS. However, no recommendations are included concerning patients' evaluation and management, except that aggressive blood pressure control seems to affect the incidence of HPS and hemorrhagic stroke after revascularization and that it may be associated with less morbidity comparing with new ischemic events.[1, 8]

The main mechanism associated to HPS and the evolution of cerebral edema is vasogenic while cytotoxicity plays an additional role compared to ischemic lesions where cellular apoptosis and cytotoxicity predominate over vascular mechanisms. In cases of acute ischemic events, mannitol is not generally administrated and may be associated with adverse events and higher mortality.[9-11] In cases of vasogenic edema, protein and water communicate between the vascular and interstitial compartment due to hydrostatic forces.[12] During cerebral injury, inflammation and ischemia contribute to endothelial injury and increase the permeability of blood-brain border via an increased expression of mediating factors.[12] Current experience with the use of mannitol in case of cerebral edema arises mainly from neurological sources. Anti-edema therapy may significantly decrease the mortality in a wide spectrum of cerebral conditions.[12] Especially, osmotherapy, which has been extensively evaluated in previous decades, is the cornerstone of pharmacologic therapy and includes mannitol and hypertonic saline.[13] Mannitol uses a double path mechanism; the rapid reduction of intra-cerebral pressure due to the dehydration of white matter and the alterations associated with the cerebral blood volume.[14, 15] Nevertheless, only null data exists in the vascular surgery literature.[2] However, mannitol has been used in cases of HPS after carotid revascularization with encouraging results.[2]

As this grey zone has not been clarified for the moment, newer and controversial data arise from the experimental world. Carotid bodies seem to be activated by acute saline overload rather than mannitol.[16] Such an acute phenomenon affects and increases sympathetic activity and probably affects cerebral hemodynamics and microcirculation.[16] At the same time, an osmolality elevation triggers a complex neurohumoral response which includes sympathoexcitation and hypertension. Hypertonic saline and mannitol seem to participate in this mechanism.[17] In rat models, mannitol seems to reduce brain ischemia-reperfusion injury while the combination of mannitol and dexamethasone is even more effective.[18] According to our experience, this combination seems to protect or even reverse HPS evoked by carotid revascularization. The evolution of medicine and biology may explain unknown mechanisms of the cerebral function, circulation and autoregulation in the future. Novel factors may be added to the management of brain edema associated to ischemic/reperfusion damage.[19, 20]

Based on the above mention knowledge, as well as our personal long experience with carotid interventions, we propose a quite simple protocol of mannitol administration during and after such intervention, as an effort to reduce or even minimize HPS. Patients with high-grade carotid stenosis, asymptomatic but mainly symptomatic, as well as those with significant contralateral disease, may benefit the most from such a protective protocol. In any case, it has to be understood that any evidence or even particular data are not reported in the literature so far.

CONCLUSION

Mannitol may be a helpful supplementary measure in patients at high risk for HPS. We hereby propose an intra and post-operative protocol, as an effort to reduce HPS in selected patients that undergo carotid revascularization. Of course intra-operative monitoring and strict post-operative surveillance are mandatory for an uneventful hospitalization. Dedicated studies are needed in this field to extract firm conclusions.

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Isolated dissections of the visceral arteries. Management and outcomes

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Abstract:

Background: The wide application of computer tomography angiography (CTA) in the diagnostic evaluation of abdominal pathologies identifies an increasing number of isolated dissections of mesenteric arteries (IMAD). Despite the recent ESVS guidelines, IMAD management is still controversial. The aim of this retrospective study was to assess all cases diagnosed with IMAD, symptomatic and asymptomatic, in two tertiary vascular centers and present the therapeutic strategies used.

Methods: This is a two-center retrospective analysis of patients who presented IMAD from 2013-2019. All patients were assessed with CTA at presentation and follow up. Patients received conservative treatment initially, while some of them who remained symptomatic underwent a subsequent endovascular intervention.

Results: Fourteen patients presented with IMAD; 11 symptomatic and 3 asymptomatic. CTA revealed a dissection of the celiac trunk (2 symptomatic) or the superior mesenteric artery (SMA) (12 patients; 9 symptomatic). All symptomatic patients were initially treated conservatively with food restriction and antithrombotic therapy. Two patients with SMA dissection, who clinically deteriorated, underwent endovascular intervention using stents. One patient suffered a mild ischemic colitis that was managed conservatively with a complete recovery. The rest of the symptomatic patients were discharged showing clinical improvement. A short-term anticoagulant therapy was prescribed (1 month) with a long-term single antiplatelet therapy thereafter. Asymptomatic patients initiated single antiplatelet therapy and remained under close surveillance. During follow-up (range 6-60 months), all patients remained asymptomatic and serial imaging confirmed the stabilization or improvement of the dissection.

Conclusion: IMAD should be considered in the differential diagnosis of acute abdominal pain. CTA is the preferred method for diagnosis and follow-up. Conservative treatment seems to be a safe and efficient option, while an endovascular procedure could be attempted in persistent symptomatology.

INTRODUCTION

Isolated mesenteric artery dissections (IMAD), including the superior mesenteric artery and celiac trunk, are uncommon arterial lesions, with low incidence in the general population.[1,2] It may be asymptomatic or associated with acute abdominal pain, which is the commonest symptom, and/or mesenteric ischemia.[1,2] During the last decades, the widespread use of new imaging modalities as computed tomography and magnetic resonance imaging has permitted the immediate diagnosis of the disease in symptomatic patients, while asymptomatic dissections have been detected incidentally during investigation of other pathologies.[1]

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Different management approaches have been described for the treatment of IMAD, including open surgery, stenting and conservative management.[2] Asymptomatic and patients with mild symptoms may be successfully treated with conservative measures while persistent or worsen abdominal pain may require an interventional approach.[2] However, and despite the quite recent ESVS guidelines, at the moment, there is no consensus on the optimal therapy for IMAD, as all existing evidence stems from case series studies.[1]

The aim of this retrospective study was to assess all cases diagnosed with IMAD, symptomatic and asymptomatic, in two tertiary vascular centers and present the therapeutic strategies used.

METHODS

Patients' characteristics and imaging

Between September 2013 and August 2019, 14 patients were diagnosed with IMAD in two tertiary centers and were analyzed retrospectively. Demographics, clinical evaluation, anatomical characteristics, location of the dissection (SMA or CT), medical management, and patients' outcomes were recorded prospectively. Patients divided in symptomatic and asymptomatic according to the presence of clinical symptoms and signs at the time of evaluation. All patients were assessed with computed tomography angiography (CTA) of the abdominal aorta down to the femoral arteries at presentation and follow-up in order to verify the diagnosis and course of the lesion. All patients underwent food restriction until symptoms' relief and clinical stabilization. In case of symptoms' deterioration, despite the conservative management, endovascular treatment was attempted as the first treatment option, keeping as back-up treatment the conventional open surgery. Sizing and planning for any endovascular procedures were performed using a workstation with 3Mensio dedicated reconstruction software (Medical Imaging B.V., Bilthoven, Netherlands).

Medical management

In patients with asymptomatic IMAD, conservative management was the initial and definitive approach. In all patients, where dissection was diagnosed through medical imaging and referenced no present symptoms (considered as chronic dissections), antiplatelet treatment with aspirin 100mg per day initiated along with antihypertensive control medication and statin therapy. In cases were symptoms were present at diagnosis, treatment with low molecular weight heparin (LMWH) or unfractionated heparin (UFH) initiated, according to the severity of symptoms and the possible need for further intervention. Conservative treatment continued until symptoms were resolved. Patients with deterioration of symptoms that were not responding to medical treatment were considered for endovascular intervention.

Technical details

Patients that underwent an endovascular intervention were treated in an adequately equipped operating room using a mobile digital angiographic system (Philips BV Pulsera, Philips Medical Systems, Netherlands) or an angiographic suite (Allura Xper FD 20, Philips, Netherlands). Access was achieved with open exposure or ultrasound-guided percutaneous puncture according to surgeon's preference and patient's anatomical characteristics. An upper access site from the left brachial artery or a standard femoral access was decided according to patient's anatomy.

A hydrophilic 0.035'' or/and 0.014'' and 0.018'' guidewire was inserted to the true lumen of the dissected vessel and it was exchanged with a standard PTFE-coated guidewire after access. After the insertion of a 7mm x 45 or 65cm sheath (Arrow, Teleflex, USA) into the artery, a diagnostic arteriography was accomplished. A covered stent graft (Be-Graft, Bentley, Innomed, Germany or Viabahn, Gore, USA) was, then, adjusted and deployed into the true lumen over a stiff guidewire. Covered stents were preferred to prevent distal embolization while balloon expandable stents were chosen in cases were a strict adjustment to the lesion was demanded. In case of long dissection, self-expanding bare metal stents were used to preserve patency. Final angiography was used to confirm adequate placement and patency intra-operatively.

Follow-up and post-operative imaging surveillance

In symptomatic patients, a LMWH was continued for the 1st month of follow-up, exchanged to single antiplatelet therapy with aspirin 100mg once per day as a long-term antithrombotic regimen. Patients treated with endovascular means underwent double antiplatelet therapy for 3 months and continued with single antiplatelet agent thereafter. All patients underwent clinical evaluation and CTA as the standard imaging method for the 30-day, 6-month and 1st-year of follow-up. Duplex ultrasonography was additionally used to evaluate the flow and any stent-graft malformation in patients treated endovascularly.

RESULTS

Fourteen patients were presented with IMAD; thirteen were males with a mean age 60.5 years (range 54-72 years). Patients' pre-operative comorbidities are presented in Table I. All patients had hypertension under treatment and were previous smokers. In the only female patient, a concomitant isolated dissection of the right common iliac artery was detected in CTA. Pulses were present in both femoral arteries and patient did not present symptoms of limb ischemia or intermittent claudication. Twelve patients were symptomatic and two asymptomatic. All patients underwent CTA which revealed a dissection of the mesenteric arteries. Two patients suffered from celiac trunk dissection and were both symptomatic (Figure 1) and the remaining, from superior mesenteric artery dissection (Figure 2). In this group, 9 presented symptoms at diagnosis and 3 were asymptomatic. The clinical presentation was acute diffused abdominal pain, with post-prandial exertion. In symptomatic cases, patients avoided food consumption while 2 patients referred excessive weight loss in a short time period. Clinical evaluation revealed abdominal tenderness and decreased bowel bruits. Episodes of vomits, nausea and diarrhea associated with episodes of constipation were also recorded (Table I).

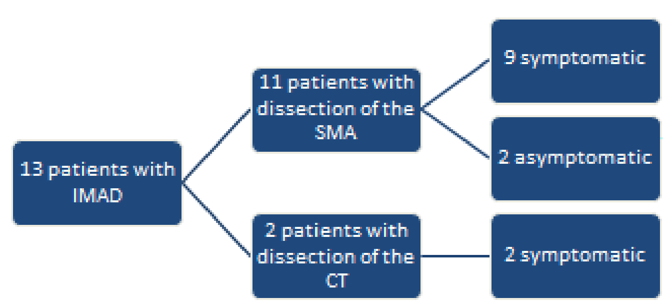

Figure 1. Distribution of isolated mesenteric artery dissection (IMAD) among patients. All dissections of the celiac trunk (CT) were symptomatic while 10 out of 12 patients with superior mesenteric artery (SMA) dissection presented symptoms.

As recorded previously, asymptomatic patients initiated single antithrombotic treatment with aspirin and statin therapy. A close control of blood pressure was also demanded. All asymptomatic patients remained under close surveillance. In symptomatic patients, food restriction was the initial measure along with subcutaneous LMWH or even UFH when clinical or laboratory deterioration was remarked. Statin therapy and hypertension control were also included in the standard conservative approach. Symptomatic patients were discharged showing clinical improvement. Hospitalization of symptomatic patients, that were conservatively treated, ranged between 5 to 9 days. A short-term anticoagulant therapy was prescribed (1 month) with a long-term single antiplatelet therapy (aspirin 100mg per day) to be continued thereafter.

Patient no	Age (years)	Sex	Abdominal symptoms	Accompanying symptoms	Comorbidities
1	50	M	Sudden severe periumbilical pain	Nausea	Hypertension Solitary kidney Smoking
2	67	M	Sudden moderate epigastric	Nausea Vomiting Anorexia	Hypertension Dyslipidemia Obesity Smoking
3	54	M	Sudden moderate periumbilical pain	Anorexia	Hypertension Dyslipidemia Smoking
4	56	M	Sudden moderate periumbilical pain	Nausea	Hypertension Dyslipidemia Smoking
5	69	M	Moderate diffused abdominal pain	Nausea	Hypertension Obesity Smoking
6	67	M	Sudden diffused pain	Nausea	Hypertension Smoking
7	52	M	None	None	Hypertension Diabetes Smoking
8	50	M	Post-prandial epigastric pain	Weight loss	Hypertension Smoking
9	69	M	None	None	Hypertension Smoking
10	63	M	Sudden abdominal pain with back irradiation	Anorexia	Hypertension Smoking
11	72	M	Sudden peri-umbilical pain Hematochezia	Diarrhea	Hypertension Smoking Abdominal aortic aneurysm
12	55	F	Mild sudden peri-umbilical pain	None	Hypertension Smoking
13	70	M	Mild diffused abdominal pain	Anorexia	Hypertension Dyslipidemia Smoking
14	54	M	Moderate post-prandial peri-umbilical pain	Weight loss	Hypertension Smoking

Table I. Patients' demographic characteristics and clinical presentation

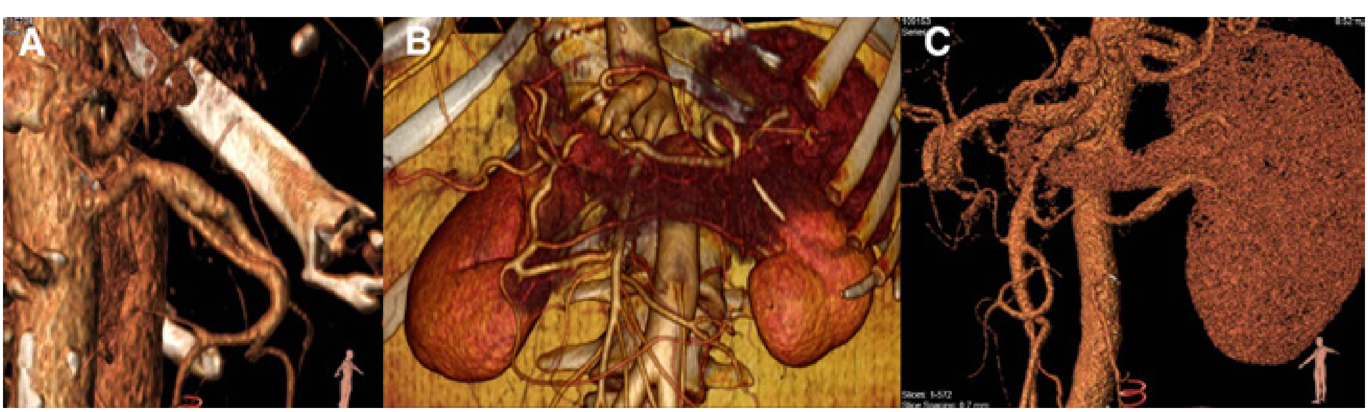

Figure 2. In Panel A, a dissection of the SMA was detected in the diagnostic CTA. This patient remained asymptomatic. In Panel B, a dissection of the CT was diagnosed. Both patients that suffered a CT dissection were symptomatic. In Panel C, another case of dissected SMA in a symptomatic patient was revealed. The patient suffered from hematochezia but recovered completely with conservative management.

Three patients deteriorated during hospitalization. In the first case, a 72-year old male patient presented ischemic colitis with episodes of hematochezia. UFH was preferred to this patient for a better control of anticoagulation and the flexibility of the medication in case of operation. The patient remained under close monitoring for 4 days when symptoms relief was achieved. He was discharged the 8^{th} day, in a good general condition under anticoagulant treatment with LMWH. We should refer that this patient suffered also from an abdominal aortic aneurysm which was treated electively 3 months after the episode of dissection. No sign of dissection of the aorta was recorded in the CTA.

Two patients that presented severe clinical deterioration despite conservative management as described above, with excessive abdominal pain, significant weight loss and inability to eat, probably due to insufficient collateral circulation, finally underwent endovascular intervention. Both cases were undertaken under local anesthesia with monitor assisted anesthesiological control. Systemic heparinization was administrated after sheath insertion (50-100IU/kg). In the first case, a left brachial artery access with open exposure was decided while an ultrasound guided percutaneous femoral access was chosen for the second patient. In the first case, a self-expanding covered stent 8mm x 50mm (Viabahn, Gore, USA) was deployed into the proximal SMA. A post-dilatation was performed using an 8mm balloon. Final angiography confirmed the false lumen occlusion and SMA patency (Figure 3). In the second patient, catheterization was challenging due to the total occlusion of the proximal SMA. A .018' guidewire was used to pass through the occluded segment, then carefully driven in the true lumen of the artery and finally, exchanged with a stiffer wire (Rosen, Cook, USA). A balloon expandable covered stent 8mm x 37mm (Be-Graft, Innomed, Germany) was deployed at the proximal part of the SMA. Angiography revealed a decreased lumen at the middle portion of the artery and a self-expanding bare metal stent 8mm x 60mm (E-luminexx, Bard, USA) had to be used to address this problem, while also preserving a large branch coming out from this part of the vessel (Figure 4). Completion angiography confirmed the adequate position of the stents and the patency of SMA. The operational time was 90 min while the mean contrast volume was 45ml. Overall technical success was 100%. Both patients were transferred post-operatively to the ward. Liquid consumption started the 1^{st} post-operative day and a complete diet was initiated the 2^{nd} one. Both patients were discharged the 4^{th} post-operative day and remained asymptomatic after operation with an immediate weight gain. A double antiplatelet therapy was initiated after the procedure and up to 3^{rd} month in order to preserve stent patency.

Figure 3. A patient with a symptomatic SMA dissection and persistent symptoms despite medical management underwent an endovascular approach, using a self-expanding stent. In panel A, diagnostic angiography confirmed the dissection intra-operatively while in panel B, the deployment of the stent graft was technically successful.

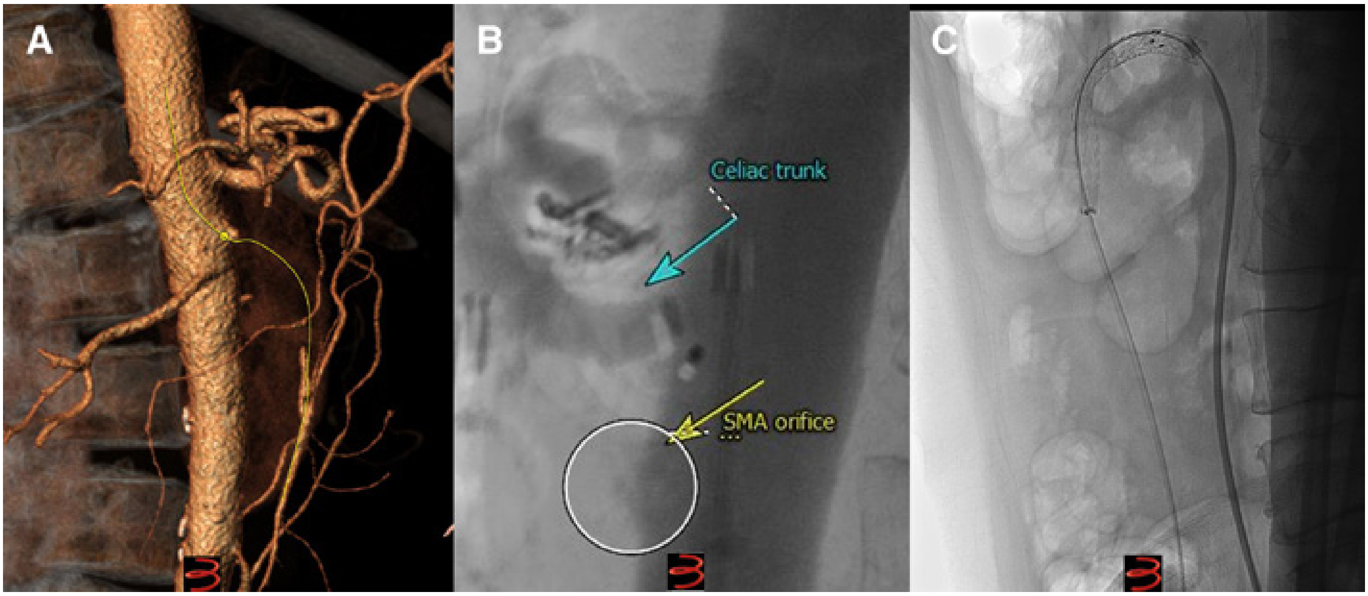

Figure 4. In the second case, technical issues were raised, as the SMA was completely occluded a few millimeters after its orifice (Panel A and B). The catheterization was achieved using a .018' guidewire. A balloon expandable stent was used proximally and a further stenting with a self-expanding stent was deployed in the middle portion of the SMA to preserve branch patency (Panel C)

Follow-up was ranging between 6 and 72 months. All patients remained asymptomatic and serial imaging confirmed the stabilization or improvement of the dissection. Patients that underwent intervention were also stable while a complete thrombosis of the false lumen achieved in both cases. The first patient completed 5 years of uneventful follow-up (Figure 5) while the second patient, 6 months (Figure 6).No re-intervention, colonic ischemia event, major cardiovascular adverse event or death was recorded. No stent compression, restenosis or migration was revealed in follow-up CTAs.

Figure 5. The first patient that underwent endovascular treatment, completed 5 years of uneventful follow-up. CTA revealed adequate stent position, SMA patency and dissection disappearance.

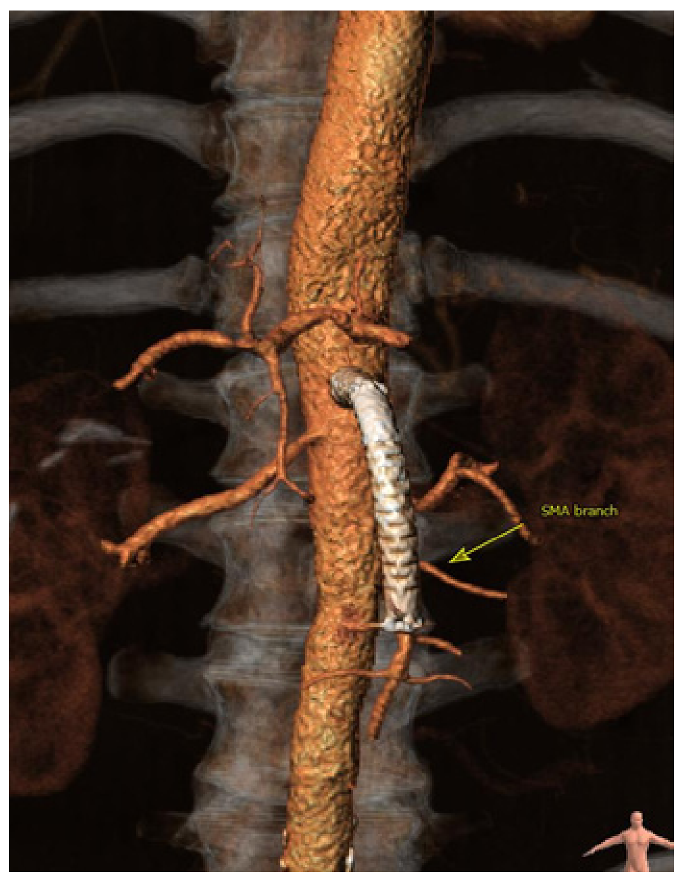

Figure 6. The second case that was treated using stent completed 6 months of follow-up. No complication was recorded. CTA revealed stent and SMA patency. The smaller branches of the SMA were successfully preserved (yellow arrow).

DISCUSSION

IMAD is a rare cause of acute abdominal pain. As in this study, the disease affects middle-age male patients.[1] In this analysis, mean age was estimated at 60.5 years ranging between 54-72 patients while 13 out of 14 patients were males. The incidence of the disease is estimated at 0.09% of all abdominal contrast-enhanced CTs and 0.68% of all CT scans accomplished for the evaluation of acute abdominal pain.[3] The prevalence of the disease is higher in Asian populations, especially from developed areas.[1,4] The majority of the literature is conducted in Far East countries, a fact reflecting the geographical distribution of the disease.[1,4] IMAD affects mainly middle age male patients while hypertension is the commonest comorbidity and the prevalence of diabetes may be lower in this group.[1,4] However, the specific etiology of the disease is not yet defined.[1] Acute abdominal pain is the commonest symptom and affects more than 90% of these patients.[4] In the European population, and furthermore in Greece, there no epidemiological data concerning IMAD and its specific characteristics.

As current information raise from case series and retrospective analyses, the best treatment option is not clear.1In the latest European Guidelines, the suggested management options have a level C of evidence.1 It has been proposed that asymptomatic patients should be treated conservatively with antiplatelet agent, statin and antihypertensive control.[1,5] These patients seem to have an uneventful follow-up with regression or stabilization of the dissection in 90% of them.[3] Conservative management may be successfully applied also in symptomatic patients, even without anticoagulation.[6,7,8] In this study, asymptomatic patients (21%) have been treated as indicated by the guidelines with single antiplatelet agent and statin. No development of symptoms or other complication has been recorded in this group. Along this line, the majority of symptomatic patients (10/13, 79%) had a regression of symptoms after the initiation of food restriction and anticoagulant regimen. Only one patient presented mild ischemic colitis with episodes of hematochezia. In this case, UFH was used, as an urgent colectomy could not be precluded initially. Finally, he responded to the medical management and was discharged a few days later. All symptomatic patients that did not undergo intervention were discharged with LMWH for the first month, which was then converted to single antiplatelet therapy.

In this study, two patients underwent endovascular treatment. Both patients had severe symptomatology and did not respond to the initial conservative management. Generally, the decision of endovascular intervention should evaluate the anatomic characteristics, patients' general status and symptomatology. Stenting of the diseased arteries may be challenging; however with satisfying results so far, affirming its safety and efficacy in highly symptomatic patients.[9] It is quite unusual to see any stent-related complications post-operatively after a successful intervention, while follow-up imaging in most cases revealed stent and artery patency with complete obliteration of the dissection.[9] Single or double antiplatelet therapy may be initiated after stent implantation in order to preserve patency.[9,10] In this study, double anti-platelet therapy was prescribed post-operatively. No hemorrhagic complication has been recorded in the literature so far.[10] In case of stent failure without signs of peritonitis or bowel ischemia, conservative medical treatment may be continued with acceptable outcomes and complete alleviation of symptoms.[11,12]

Access may be femoral or brachial.[13] In this study, one patient underwent femoral percutaneous access while the other brachial access with open exposure. Brachial artery access should be available in any case, as a failed catheterization via the femoral artery may be achieved through upper access.[13] Concerning the decision of stent type, the data are scarce. In the two patients treated with endovascular means, covered stents have been chosen in order to prevent distal embolization. Furthermore, no proximal branch was detected in CTAs, permitting the use of this type of stent. In the second patient, a decrease outflow due to the long dissected segment obligated the use of an additional stent. In this case, a bare metal stent was applied to preserve branch patency. Bare metal stents may have satisfying patency, even when more than one has to be used.[9] Thrombus protrusion into the bare metal stent cannot be precluded and may affect long-term patency.[13] There is no much information concerning the comparison of patency between balloon expandable and self-expanding stents. We have selected a balloon expandable stent in one case where the accurate position was mandatory to preserve branch patency. Self-expanding stents may be also reliable with good results as their conformability may better follow native vessels mobility.[12,14] Both balloon and self-expanding stent may be reliable in IMAD without difference in stent or false lumen patency, symptoms relief and progression of the disease.[15]

As endovascular management had satisfying results in this study, none of the patients underwent open surgical repair which may be an option in case of stent failure. Mesenteric bypass or patch-plasty may be an alternative when there is no stent availability or surgeon is not familiar with the endovascular procedures.[16] Conventional repair may be associated with good results affirming graft and artery patency while colonic ischemia events have not been recorded in the literature.[16] No late intervention or recurrences were noted.[16] All treatment approaches may have optimal results when patients' selection is careful. Successful dissection management may achieve 95-100% of complete recovery in this group of patients.[17]

Close follow-up may be mandatory in patients managed conservatively or not. The patients of this study had a follow-up ranging between 6 and 72 months. During surveillance, none of the patients presented recurrence of symptoms while CTAs revealed the complete resolution or stabilization of the lesion. No aneurysm formation or rupture has been recorded. Analogous data from the literature are in accordance to our results.[9,18] Among patients with IMAD, diameter enlargement may be recorded, reflecting the progression of the disease.[9] Routine surveillance may be important for re-evaluation of the status of dissection, as well as stent patency in operated patients.[9] Ultrasound may be used in appropriate cases in order to decrease radiation, contrast and cost during follow-up.[9]

CONCLUSION

IMAD should be considered in the differential diagnosis of acute abdominal pain. CTA is the preferred method for diagnosis and follow-up. Conservative treatment including adequate antithrombotic agents seems to be a safe and efficient option, while an endovascular procedure could be attempted in persistent symptomatology.

No conflict of interest.

Acknowledgements: None

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INVITED COMMENTARY

Isolated Dissections of Mesenteric Arteries. What we Know and What we Don't Know

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It has been well documented in the literature that isolated dissections of the mesenteric arteries (IMAD) have predominantly a benign course compared to other potentially catastrophic causes of acute mesenteric ischemia, such as embolism or acute thrombosis.[1] In the majority of asymptomatic cases, diagnosis of the dissection is an incidental finding.[1] We know that the disease is rare in Europe, but not so uncommon in East Asia.[2,3]

In this interesting and challenging paper, Nana et al.[4] reported on the experience of treating isolated visceral artery dissections in two Greek vascular centres. The authors analyzed the outcomes of 14 patients with the disease. Interestingly, 2 out of 11 symptomatic patients (18%), initially treated with optimal medical treatment, were clinically deteriorated and treated endovascularly with stenting. The authors concluded that conservative treatment seems to be a safe option, while an endovascular procedure could be attempted in patients with persistent symptomatology.[4] The results of this study come to confirm the existing guidelines. The current guidelines recommend conservative treatment with antiplatelet therapy and control of hypertension in patients with asymptomatic IMAD (Class IIa, Level C) and antiplatelet therapy or heparin until symptoms resolve (Class IIa, Level C) in patients with symptomatic IMAD.[5] Endovascular revascularization should be considered in patients with a symptomatic IMAD not responding to medical management and with a suspicion of bowel ischemia (Class IIa, Level C).[5]

Three interesting points have been raised by this study and should be highlighted:

1. Isolated dissections of the mesenteric arteries (IMAD) have predominantly a benign course. This is because in the majority of patients with IMAD, the dissection plane leads to a dissected compromised true lumen with incomplete vessel occlusion, that may produce intermittent symptoms of bowel malperfusion.[1] The majority of patients under optimal conservative treatment show an uncomplicated stable course with encouraging prognosis. Three metanalyses documented that initial conservative treatment appeared safe and effective in more than 80-90% of symptomatic patients.[1-3]
2. We know that a critical subgroup of symptomatic patients, initially treated with conservative treatment, will require conversion to either endovascular or open procedures due to consistency of symptoms or deterioration of clinical condition.[1] In a recent metanalysis, resolution of symptoms was observed in 100% for those treated with open procedure and 88.8% for those treated endovascularly, underlining the undoubted primary role of open reconstruction in certain cases.[1] The pooled rate of bowel ischemia in patients treated conservatively was 3.75%, showing that the disease has a sneaky character if left misdiagnosed or underestimated. If bowel infarction and sepsis occur, the mortality rate is 50 to 60%.[6] Current guidelines suggest that patients with a symptomatic IMAD and with a suspicion of bowel ischemia should be considered for endovascular revascularization [5] but doesn't elucidate and mention in which patients the open repair should be offered as a first or alternative option. Resection of the dissective membrane from the origin of the SMA with selective embolectomy of the arcade arteries and reconstruction with vein patch, remains an important option in cases of extended lesions of the SMA with distal embolism.[7,8]
3. What we also don't know so clearly is the identification of the predicting factors of the disease which will lead to symptoms and finally to bowel ischemia or aneurysmatic expansion and rupture. The vascular remodeling of the visceral artery is an important factor related to the short- and long-term clinical outcome. Various classifications have been proposed to describe the morphometric characteristics of the dissected segment of the superior mesenteric artery (SMA). The Sakamoto classification was the first one and more simple which attempted to analyze the presence of false luminal flow and true lumen paten-

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cy at the dissected segment.[9] The classification proposed by Yun added the type of complete thrombosis of the dissected SMA.[10] Some studies suggest that limited dissection with re-entry, corresponding to type I lesions according to the Sakamoto and Yun classifications, is the most favorable type and can be treated sufficiently with optimal medical therapy because it is not associated with changes in CT findings or presence of symptoms in follow up.[9,11] Clinical symptoms seem to be associated with the length of dissection and the degree of true lumen stenosis.[11] The "cul-de-sac" shaped false lumen (Type II according to Sakamoto and IIa according to Lun) without re-entry, has been associated with aneurysmal formation.[11] A patent false lumen and aneurysmal formation on an initial CT scan have been identified as negative factors that affect the favorable remodeling of the SMA.[12]

In conclusion, the level of evidence for the current guidelines is C and the clinical decision making recommendations come exclusively from observational studies. Grey zones exist and issues that we don't know regarding this sneaky disease need to be clarified with more evidence and data in future studies. The subgroup of patients that will be benefited from open repair as a first option should be defined. Identification of the prognostic factors that lead to a favorable SMA remodeling and clinical outcome is important. In case of an unfavorable SMA remodeling, a close follow-up protocol is necessary. The duration and frequency of follow-up with imaging and the antithrombotic therapy need to be also better defined.

No conflict of interest.

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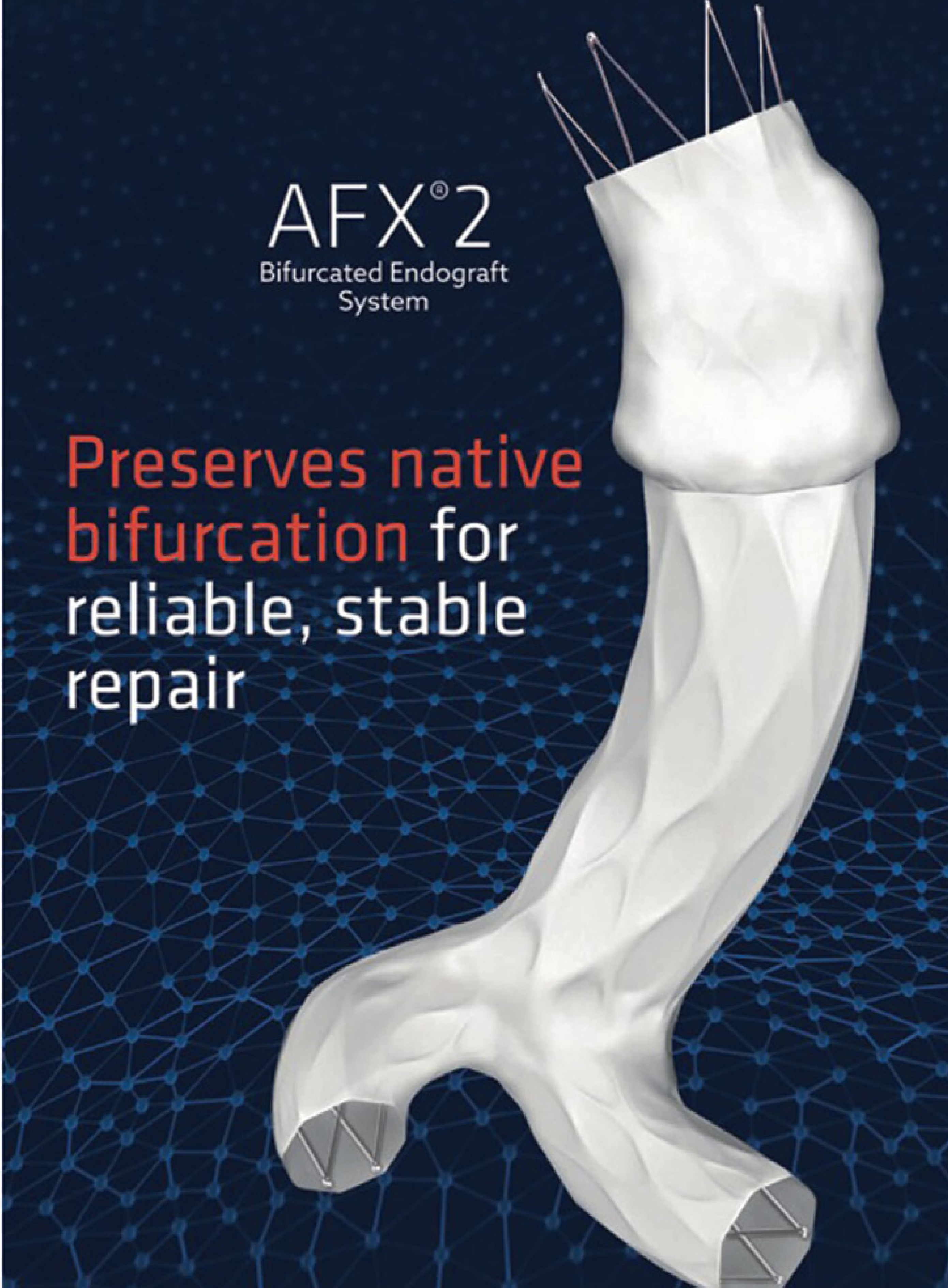
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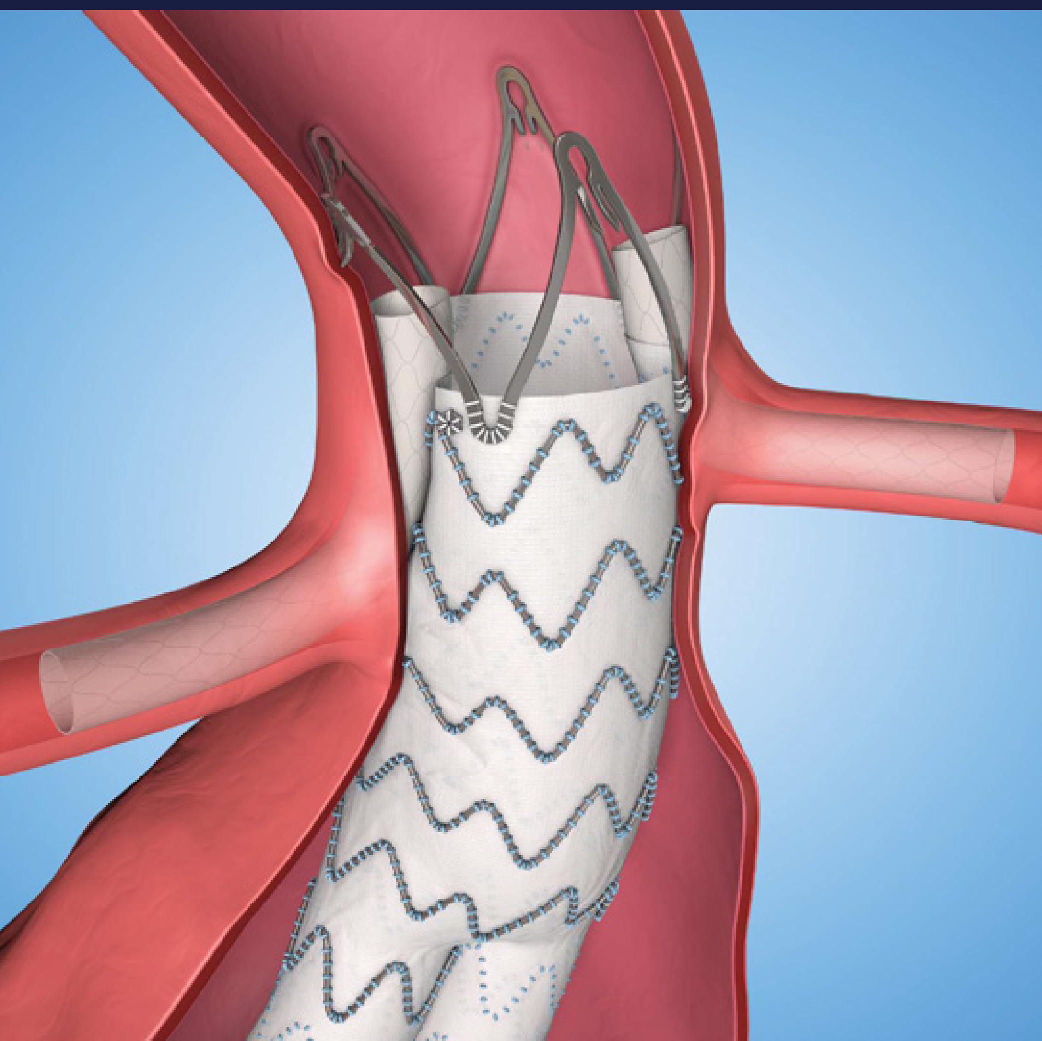

Quality of life in patients with lymphoedema: Initial results of a Greek Lymphoedema Centre

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Abstract:

Aim: The aim of our study was to assess the role of an intensive multidisciplinary lymphoedema treatment program on health related quality of life (HRQoL), using the Freiburg Life Quality Assessment - lymphoedema (FLQA-l) as the study instrument.

Materials and Method: A prospective study included 35 patients with unilateral secondary limb lymphoedema who were followed for 3-4 weeks of intensive lymphoedema treatment program delivered by the multidisciplinary team and then by long-term home-based management guidelines. Patients were assessed in the beginning, in the end of the intensive program, at 6 and 12 month after treatment. Assessment included limb circumference measurements, skin condition, limb mobility, clinical assesement, and FLQA-l.

Results: 35 consecutive patients with unilateral secondary limb lymphoedema (International Society of Lymphology - ISL lymphoedema staging II, late II and III) were treated. 15 patients had lower limb while 20 patients had upper limb lymphoedema. Common causes of secondary lymphoedema were breast oncological surgery (57%) and gynaecological oncological surgery (14%). An overall improvement in terms of limb circumference measurements was recorded immediately after treatment (p=0.000) and was maintained at 6 (p=0.01) and 12 (p=0.005) months-follow up. An overall improvement of QoL was recorded for patients immediately after treatment (p=0.005) and at 6 (p=0.047)months after treatment, but not at 12 (p=0.09) months of follow up. Patients with lower limb lymphoedema had a greater improvement in QoL than patients with upper limb lymphoedema immediately after the treatment (p=0.000) but at six months time the QoL was improved more in upper limb patients (p=0.003). Patients with mobility and skin problems report an improvement in QoL after six months of treatment (p=0.05). A correlation was recorded between limb improvement and QoL measurements, but was statistically important only immediately after treatment (p=0.018) and not at 6 (p=0.77) and 12 (p=0.29) months. Thus, while the limb measurements improve the QoL improves. In terms of subgroup analysis, only patients with lower limb lymphoedema had improved their QoL according to limb measurements. Sex did not play any role on the outcome of the correlation between QoL and limb measurements improvement. For patients with mobility problems a correlation between QoL grade and limb improvement measurements was recorded (P: 0.035 after treatment, P: 0.000 at 6 months and P: 0.028 at 12 months). Skin problems also exhibited a correlation between QoL and limb measurement improvement (P: 0.000 after treatment, P: 0.200 at 6 months and P: 0.031 at 12 months).

Conclusion: A multidisciplinary intensive treatment program may improve the limb circumference and the QoL in patients with lymphoedema. The clinical improvement is not necessarily followed by the same degree of improvement in QoL. In particular patients with skin or mobility problems have the greatest imprtovement in QoL.

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INTRODUCTION

Lymphoedema is a pathological condition in which malformed or non-functioning lymphatics render transport capacity unable to remove normal lymphatic load. This condition leads to a fluid and protein load in the interstitium space and to the characteristic clinical signs of lymphoedema.[1] The incidence of lymphoedema reported in different studies varies widely as a result of the diversity in cancer treatment and measurement methods.[2] It is estimated that lymphoedema impacts upon more than 120 million world-wide.[3] Current epidemiology is thought to underestimate the number of patients suffering from lymphoedema by at least one third.[4] In many countries the provision of care for patients with lymphoedema is inadequate often as a result of under-recognition of this chronic, debilating condition[4-6] that can have deleterious effects on patients' physical and psychosocial health.[4]

Several facets such as pain and discomfort, sleep and rest, activities of daily living, dependence on medication and treatment, working capacity and social support are significantly affected by lymphoedema.[7] Pain in lymphoedema is directly correlated with activity limitation, participation restriction and sub-optimal health-related quality of life.[8] The World Health Organization has declared health to be "a state of complete physical, mental and social well-being and not merely the absence of disease".[9,10] Without proper treatment lymphoedema can lead to severe swelling, fibrosis, skin changes and infections. Early identification and management are crucial. There are numerous treatment options available for alleviating the consequences of lymphoedema. Means and techniques used in the diagnosis, assessment and treatment of lymphoedema vary. Management guidelines have been given and International consensus documents have been issued by the International Society of Lymphology and the International Lymphoedema Framework concerning the diagnosis and treatment of lymphoedema.[11] Given the fact that there is no cure, lymphoedema needs life-long treatment and requires a multidisciplinary approach in an individualized program that will address the special needs of each patient.[12]

Physical functioning is the domain most affected among lymphoedema patients,[13] but quantitative studies show that patients with lymphoedema experience greater levels of functional impairment, poorer psychological adjustment, anxiety and depression than the general population.[5] Healthy people have a better QoL in all domains of life, as well as in the overall general QoL, when compared to patients with lymphoedema.[7] HRQoL must be an important outcome in the management of patients with lymphoedema,[4] even though it is difficult to estimate the impact of lymphoedema in many aspects of everyday life.

The aim of our study was to assess the role of an intensive multidisciplinary lymphoedema treatment program on HRQoL, using the Freiburg Life Quality Assessment - lymphoedema (FLQA-l) as the study instrument.

MATERIALS AND METHODS

Participants: Thirty-seven consecutive patients with unilateral limb lymphoedema requiring high complexity case management (International Society of Lymphology - ISL lymphoedema staging II, late II and III) were assessed, by the multidisciplinary lymphoedema treatment team of the University General Hospital of Larisa. The two patients with primary lymphoedema were excluded from the study. (Table 1) Fifteen patients had lower limb unilateral lymphoedema while twenty patients had upper limb lymphoedema. Of those patients with upper limb lymphoedema 50% had also breast lymphoedema. Causes of secondary lymphoedema were oncological surgery for breast cancer, gynaecological cancer, non Hodgkin lymphoma, melanoma, injury (extended skin laceration) and venous insufficiency resulting in phlebo-lymphoedema. In some cases obesity was present as secondary aggravating factor. (Table 1) The individual characteristics, such as sex, age, BMI, upper/lower limb lymphoedema, years since onset of lymphoedema, lymphoedema (ISL) stage, cellulitis/erysipelas episodes and other comorbidities were recorded.

Patients with unilateral limb lymphoedema were chosen because in those patients it is possible to assess the reduction of the percentage excess volume of the swollen limb in comparison with the unaffected limb. Currently, it is not possible to establish an assessment way, in cases of bilateral limb oedema, that would represent a percentage of reduction to normal and those cases were excluded from the research. Only ISL stage II, late II and III were included in the study because ISL stage 0 or I did not require intensive management program. (Table 1)

Variable	N%
Lymphoedema Characteristics	
Cause of lymphoedema	
Breast cancer	20 (57)
Gynaecological cancer	5 (14,3)
Melanoma	2 (5,7)
Non-Hodgkins lymphoma	2 (5,7)
Injury	2 (5,7)
Venous insufficiency	4 (11,4)
Limb affected	
Upper limb lymphoedema	20 (57)
Lower Limb lymphoedema	15 (43)
Side of lymphoedema (for arm)	
Dominant side	9 (42,8)
Non Dominant side	12 (57,2)
Years since onset of lymphoedema	
Stage of lymphoedema	
ISL Stage II	16 (45,7)
ISL Stage Late II	11 (31,5)
ISL Stage III	8 (22,8)
Cellulitis / Erysipelas	
1-2 episode	10 (28,6)
Recurrent episodes	3 (8,6)
Comorbidities	
Skin problems	12 (34,3)
Mobility problems	7 (20)
Presence of pain	1 (2,9)

Table 1.

Multidisciplinary Lymphoedema Treatment Porgram: All 35 patients followed 3-4 weeks of intensive lymphoedema treatment program delivered by the team of vascular surgeons, dermatologists, physiotherapists, psychologist, dietician and social worker. The program, according to the management guidelines of the International Lymphoedema Framework (Lymphoedema Framework, 2006)[4,5] consisted of daily skin care, multi-layer compression bandaging, manual lymphatic drainage (MLD) according to necessity, intermitted pneumatic compression and individualized exercise program given by the team's physiotherapists. Dietary advice by the team's dietician was given to all patients and individualized diet program was given to those in need for BMI reduction. During the program all patients had a session with the team's psychologist and they were given advice on how to cope with the changes in life that a long-term condition that can't be cured, such as lymphoedema requires. Self-management guidelines (information, advice, education) were given throughout the treatment sessions and during a special atomic session by the team's physiotherapists. After the completion of the intensive program compression garments were prescribed, as needed, to all the patients, but the final choice of garment (circular/flat knitted, ready to order/custom made) depended largely on availability (not all garment choices are available in the city of Larisa) and on the patient's financial situation (In Greece only a small percentage for lymphoedema compression garments is reimbursed).

Assessment methods/tools:

The translation was made from German to Greek by two official translators and the Greek text was translated back to German by two other official translators, in order to assess the consistency of the translation. The Greek version of the FLQA-l was used for the research without testing for its psychometric properties and this must be taken into account when interpreting the results of the study.

Assessment was performed in the first day of the program, at its completion (3rd-4th week) and at 6 and 12 months after the completion of the program. The percentage of oedema reduction of the swollen limb was assessed by the same person, by tape measurements using a spring-loaded tape measure. Limb circumference measurements were compared to the unaffected limb. 10 circumferential measurements were taken of both limbs, and the four points of greater differences were taken into account. Satisfactory improvement for limb circumference was considered to be a >50% reduction of the difference with the unaffected limb.

The impact of the multidisciplinary intensive program on the patient's Quality of Life was assessed by a translation in Greek language of the Freiburg Life Quality Assessment Scale-lymphoedema module. The FLQA-l was developed by Augustine et al.[14,15] on the basis of previously validated FLQA vein questionnaire and records the health related quality of life of patients with lymphoedema. The questionnaire consists of 92 items that refer to the following scales "Physical Complaints", "Everyday life", "Social life", "Emotional well-being", "Treatment", "Satisfaction" and "Profession/Household". Each scale contains six items. Every item is evaluated on a five-point scale from "never" to "always" or "not at all" to "very". The questionnaire has also 3 Visual Analogue Scales ranging from "zero = very bad" to "ten = very good" that refer to satisfaction with general health, lymphoedema status and quality of life. The data were entered into spreadsheet as numbers from 1 to 5 (in the visual-analogue scales from 0 to 10). According to Augustine et al.[14,15] the FLQA-l is a valid and reliable QoL questionnaire specific for lymphoedema. It has been proven to be feasible for QoL evaluations in outpatient and inpatient settings. According to the questionnaire scoring system a decrease of >25% was considered satisfactory improvement, a decrease of 12-25% was considered as moderate improvement and a decrease of 12% was considered as non improvement. Furthermore, an increase of 12% was considered as non deterioration, an increase between 12% and 25% was considered as moderate deterioration and an increase of >25% was considered as major deterioration.

The presence of skin changes and mobility difficulties were recorded for all patients.

STATISTICS

A mixed models approach was adopted to examine the effect of several health indices on the Quality of Life measurements at the four different time points. All main effects were examined as well as all 2nd degree interactions for each time point. The statistical significance was in all cases set at 0,05. The analysis was carried out with the use of Stata v.13.0.

RESULTS

Table 2 shows the demographics of the patients. An overall improvement in limb circumference measurements was recorded for patients with lymphoedema which was statistically important immediately after treatment and was maintained at six and 12 months-follow up (Fig 1 and Table 3).

Variable	N%
Demographic	
Sex	
Male	4 (11.4)
Female	31 (88.6)
Age (y)	
<60 yrs	13 (37,1)
>60 yrs	22 (62,9)
BMI	
Underweight (<18.50)	0
Normal range (18.50-24.99)	5 (14,3)
Pre-obese (25.000-29.99)	6 (17,1)
Obese class I (30-34.99)	9 (25,7)
Obese class II (35-39.99)	10 (28,6)
Obese class III (>40)	5 (14,3)

Table 2. Show the demographics of the patients.

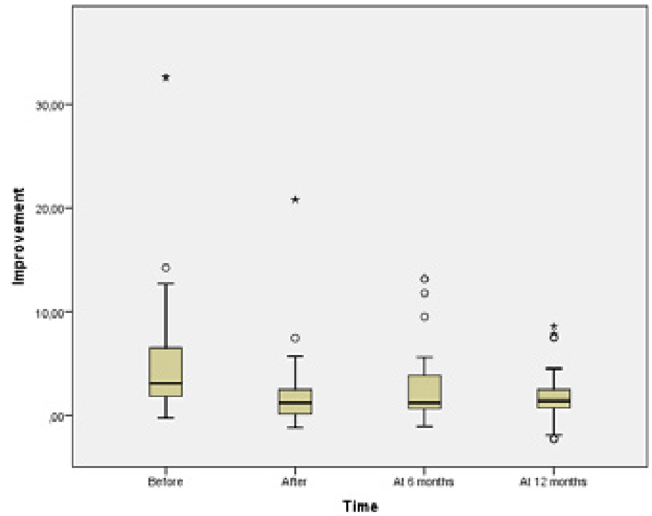

Figure 1. Improvement in limb size immediately after treatment and at 6 and 12 months after treatment. Improvement is calculated as the reduction in limb size differences between health and affected side. Statistically important improvement was recorded between before and after treatment and was maintained 12 months after treatment.

Pairwise Comparisons

Measure: MEASURE_1

(I) Improvement	(J) Improvement	Mean Difference (I-J)	Std. Error	Sig.b	95% Confidence Interval for Differenceb	
					Lower Bound	Upper Bound
1	2	3,047*	,500	,000	1,647	4,448
	3	2,811*	,820	,010	,515	5,108
	4	3,645*	,984	,005	,888	6,403

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

b. Adjustment for multiple comparisons: Bonferroni.

Table 3. Improvement in limb size immediately after treatment and at 6 and 12 months. Statistically important difference was recorded after treatment and at 6 and 12 months in comparison with before treatment.

An overall improvement of QoL was recorded for patients with lymphoedema undergoing the multidisciplinary intensive programme. Improvement in QoL was considered statistically important immediately after treatment and at 6 months after treatment, but not at 12 months (P: 0.005 after treatment, P: 0.047 at 6 months and P: 0.094 at 12 months) (Fig. 2 and Table 4). Patients with lower limb lymphoedema had a greater improvement in QoL than patients with upper limb lymphoedema immediately after the treatment but at six months time the QoL was improved more in upper limb patients. Patients with upper limb lymphoedema had statistically important improvement at six months assessment. At twelve months both upper and lower limb patients had lost part of the improvement in QoL (Fig. 3, Table 5.).

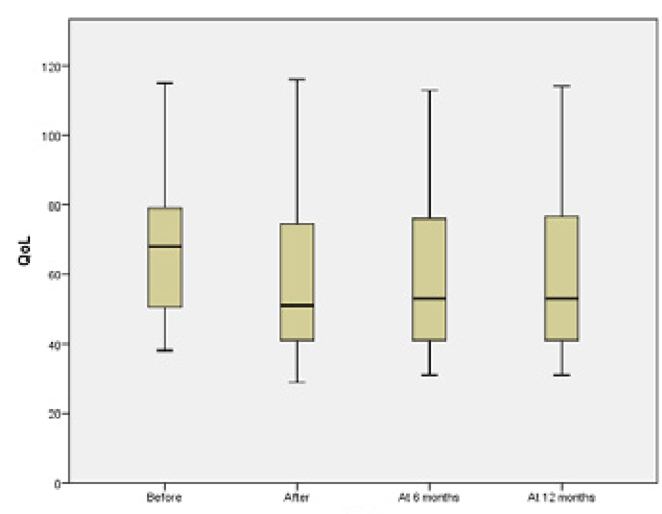

Figure 2. QoL of patients with lymphoedema before treatment, after treatment and at 6 and 12 months after treatment. Statistically important improvement was recorded between before and after treatment, was maintained at 6 months, but was lost at 12 months after treatment. A reduction in QoL scale score is considered as an improvement in QoL.

InQoL	Coef.	Std. Err.	z.	P>[z]	[95% Conf. Interval]	
Time						
After	-.3393669	.1215925	-2.79	0.005	-.5776839	-.1010499
At 6 months	-.228896	.1150945	-1.99	0.047	-.4544771	-.0033149
At 12 months	-.1975338	.1179216	-1.68	0.094	-.4286559	-.0335884

Table 4. Changes in QoL after treatment and at 6 and 12 months.

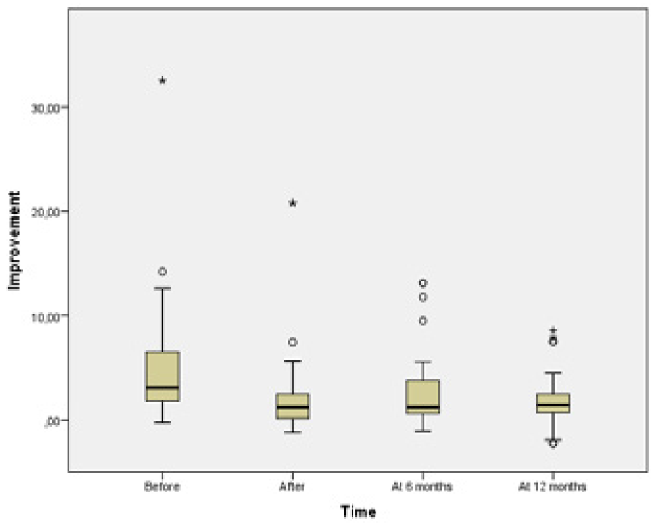

Figure 1. Improvement in limb size immediately after treatment and at 6 and 12 months after treatment. Improvement is calculated as the reduction in limb size differences between health and affected side. Statistically important improvement was recorded between before and after treatment and was maintained 12 months after treatment.

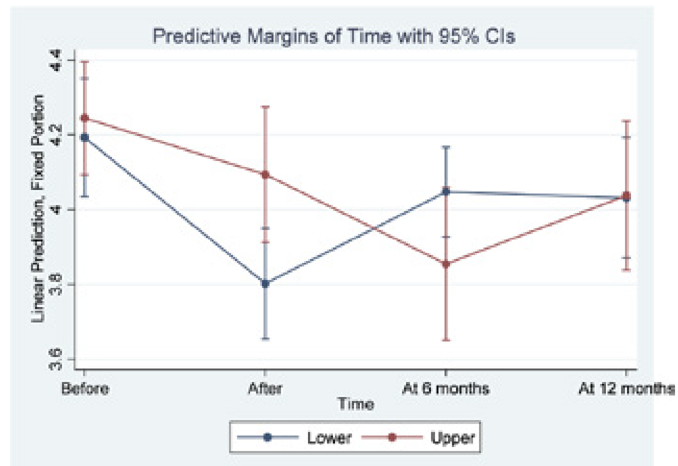

Figure 3. Changes in QoL immediately after treatment and at 6 and 12 months after treatment for patients with upper and lower limb lymphoedema.

	Delta-method		Unadjusted		Unadjusted	
	Contrast	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Upper Limb Lymphoedema						
Time						
After vs Before	-.1510366	.1203051	-1.26	0.209	-.3868302	.084757
At 6 months vs Before	-.3901491	.1296337	-3.01	0.003	-.6442264	-.1360718
At 12 months vs Before	-.2072778	.1277608	-1.62	0.105	-.4576843	.0431288
At 6 months vs After	-.2391125	.1395182	-1.71	0.087	-.5125632	.0343382
At 12 months vs After	-.0562412	.1377798	-0.41	0.683	-.3262846	.2138023
At 12 months vs At 6 months	.1828713	.1459961	1.25	0.210	-.1032757	.4690183
Lower Limb Lymphoedema						
Time						
After vs Before	-.3904738	.1105214	-3.53	0.000	-.6070918	-.1738558
At 6 months vs Before	-.1454329	.1011291	-1.44	0.150	-.3436423	.0527766
At 12 months vs Before	-.1605508	.1150396	-1.40	0.163	-.3860243	.0649227
At 6 months vs After	.245041	.0969852	2.53	0.012	.0549534	.4351286
At 12 months vs After	.229923	.1114143	2.06	0.039	.011555	.4482911
At 12 months vs At 6 months	-.0151179	.1021042	-0.15	0.882	-.2152385	.1850026

Table 5. Changes in QoL immediately after treatment and at 6 and 12 months after treatment for patients with upper and lower limb lymphoedema.

Men and women had an improvement in QoL immediately after the treatment, but a part of the improvement was lost at six and twelve months. Overall men had greater improvement in QoL than women but the changes in QoL followed the same pattern (Fig. 4, Table 6.).

The presence of mobility and skin problems is a positive predictive factor for QoL improvement. Patients with mobility and skin problems report an improvement in QoL after six months of treatment (p=0.05). On the contrary, patients with no skin and mobility problems report an aggravation in QoL immediately after the treatment which is improved later on (intact skin) or at six months time which does not improve at 12 months (normal mobility) (Fig. 5 and Fig 6).

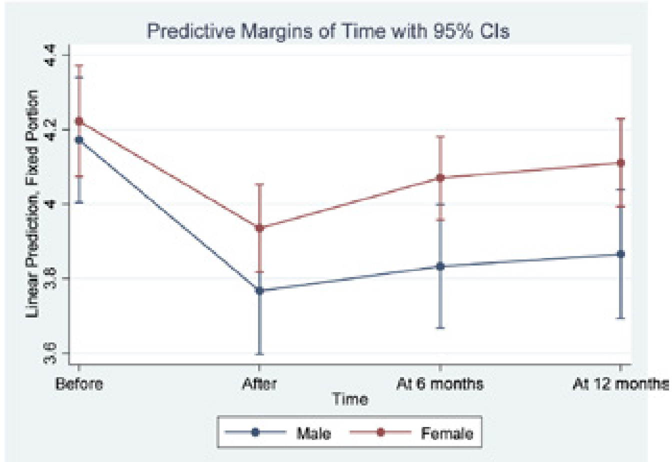

Figure 4. Changes in QoL immediately after treatment and at 6 and 12 months after treatment for men and women with limb lymphoedema.

	Delta-method		Unadjusted		Unadjusted	
	Contrast	Std. Err.	z	P>|z|	[95% Conf. Interval]	
Women with Lymphoedema						
Time						
After vs Before	-.2882223	.0970957	-2.97	0.003	-.4785263	-.0979183
At 6 months vs Before	-.1534115	.0950834	-1.61	0.107	-.3397715	.0329485
At 12 months vs Before	-.1117591	.0972161	-1.15	0.250	-.3022991	.0787808
At 6 months vs After	.1348108	.0826084	1.63	0.103	-.0270987	.2967203
At 12 months vs After	.1764632	.0850545	2.07	0.038	.0097595	.3431668
At 12 months vs At 6 months	.0416524	.0827499	0.50	0.615	-.1205344	.2038391
Men with Lymphoedema						
Time						
After vs Before	-.4057063	.1217578	-3.33	0.001	-.6443471	-.1670655
At 6 months vs Before	-.3391014	.120357	-2.82	0.005	-.5749968	-.1032061
At 12 months vs Before	-.3065959	.1230694	-2.49	0.013	-.5478075	-.0653843
At 6 months vs After	.0666049	.1208995	0.55	0.582	-.1703537	.3035635
At 12 months vs After	.0991104	.1236	0.80	0.423	-.1431411	.3413619
At 12 months vs At 6 months	.0325055	.1222203	0.27	0.790	-.2070419	.272052

Table 6. Changes in QoL immediately after treatment and at 6 and 12 months after treatment for men and women with limb lymphoedema.

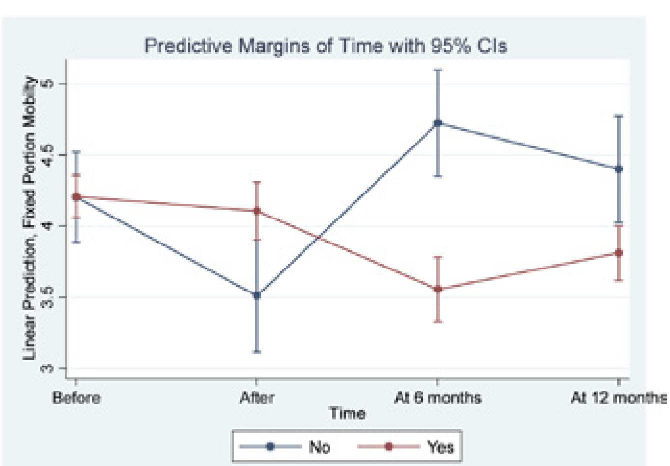

Figure 5. Changes in QoL immediately after treatment and at 6 and 12 months after treatment for patients with lymphoedema with or without mobility problems.

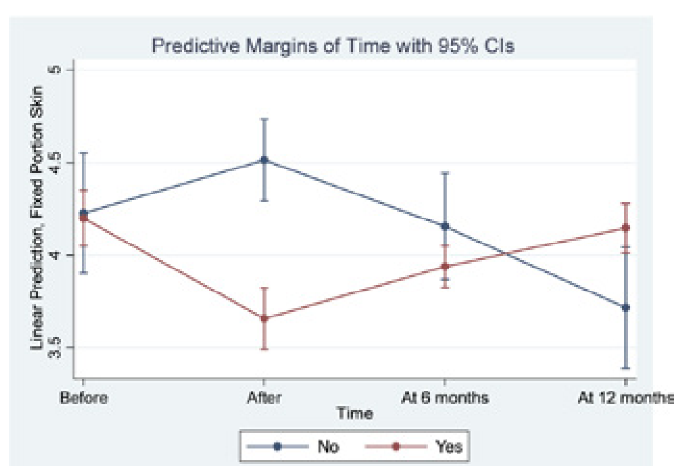

Figure 6. Changes in QoL immediately after treatment and at 6 and 12 months after treatment for patients with lymphoedema with or without skin problems.

Obesity and Stage of lymphoedema exhibited an oddly pattern as far as improvement in QoL is concerned. Normal weight patients did not exhibit any statistically important improvement in QoL. Pre-obese patients showed the biggest improvement in all obesity categories, only after six months time. Patients with obesity stage I, II and III exhibited statistical improvement immediately after treatment that was lost at six and twelve months. As far as lymphoedema stage is concerned, for Stage II and Late II QoL was improved after treatment and at six months interval but the improvement was not maintained at twelve months. Patients with Stage III lymphoedema exhibited an odd deterioration in QoL at six months. Nevertheless, because of the vast range in frequency between obesity and lymphoedema stages, the number of patients in each stage group was relatively small and the results of the statistical analysis cannot be considered safe.

lnQoL	Coef.	Std. Err.	z	P>[z]	[95% Conf. Interval]	
Time#c.lnimpro						
Before	-.3020605	.1833072	-1.65	0.099	-.6613359	.0572149
After	-.6569541	.2784292	-2.36	0.018	-1.202665	-.1112429
At 6 months	-.0913182	.3181644	-0.29	0.774	-.7149089	.5322725
At 12 months	-.3061883	.2905757	-1.05	0.292	-.8757063	.2633297
Position#Time#c.lnimpro						
Upper#Before	.821623	.1031141	0.80	0.426	-.1199376	.2842622
Upper#After	.4580403	.2041322	2.24	0.025	.05794486	.858132
Upper#At 6 months	-.3020028	.2004035	-1.51	0.132	-.6947865	.0907808
Upper#At 12 months	.0088085	.2405023	0.04	0.971	-.4625674	.4801844
Sex#Time#c.lnimpro						
Women#Before	.0798347	.0959249	0.83	0.405	-.1081746	.267844
Women#After	.2642657	.1392286	1.90	0.058	-.0086173	.5371487
Women#At 6 months	.371338	.1517504	2.45	0.014	.0739127	.6687633
Women#At 12 months	.3856971	.146109	2.64	0.008	.0993287	.6720654
Mobility#Time#c.lnimpro						
Positive#Before	.007618	.2900087	0.03	0.979	-.5607886	.5760245
Positive#After	.9362823	.4429898	2.11	0.035	.0680382	1.804526
Positive#At 6 months	-1.833727	.4538416	-4.04	0.000	-2.72324	-.9442139
Positive#At 12 months	-.9247247	.4195186	-2.20	0.028	-1.746966	-.1024835
Skin#Time#c.lnimpro						
Positive#Before	-.0419826	.2763509	-0.15	0.879	-.5836205	.4996552
Positive#After	-1.345101	.2641116	-5.09	0.000	-1.86275	-.8274517
Positive#At 6 months	-.3418686	.266753	-1.28	0.200	-.864695	.1809577
Positive#At 12 months	.6742579	.3123213	2.16	0.031	.0621195	1.286396

Table 7. Correlation between improvement in limb measurements and QoL immediately after treatment for patients with upper and lower limb lymphoedema, for men and women and for patients with and without mobility and skin problems.

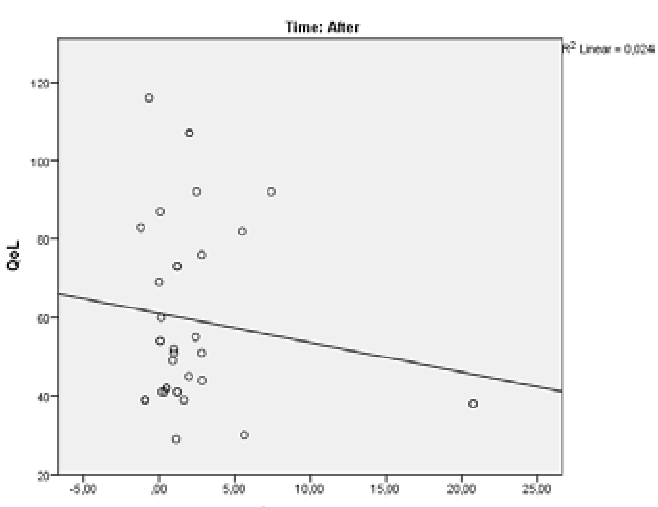

Figure 7. Correlation between improvement in limb measurements and QoL immediately after treatment

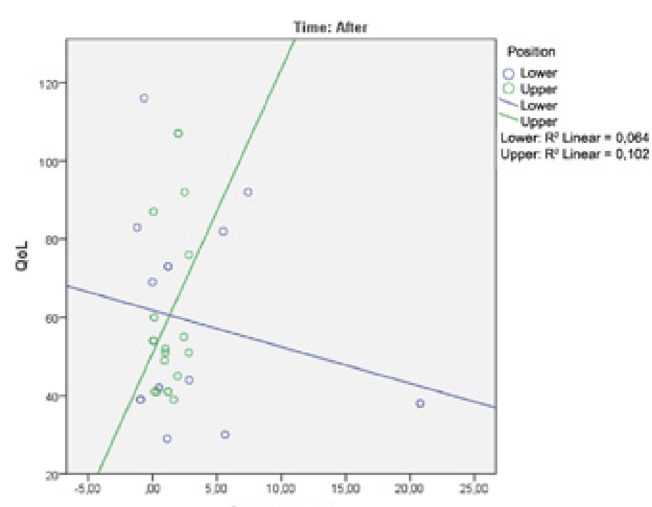

Figure 8. Correlation between improvement in limb measurements and QoL immediately after treatment for patients with upper and lower limb lymphoedema.

A correlation was recorded between limb improvement and QoL measurements, but was statistically important only immediately after treatment and not at 6 and 12 months (P: 0.018 after treatment, P: 0.774 at 6 months and P: 0.292 at 12 months) (Fig. 7 Table 7). Thus, while the limb measurements improve the QoL improves. An opposite correlation was found for the subgroup of patient with upper limb lymphoedema immediately after treatment (P: 0.025 after treatment, P: 0.132 at 6 months and P: 0.971 at 12 months) (Fig. 8, Table 7) meaning that improvement in limb circumference is not necessarily followed by improvement in QoL.

One the other hand a correlation between QoL and limb improvement for patients with lower lymphoedema was noted, but again only immediately after treatment (Fig. 8, Table 7). Women exhibited an opposite correlation between QoL grade and limb improvement measurements (P: 0.058 after treatment, P: 0.014 at 6 months and P: 0.008 at 12 months for women) (Fig. 9, Table 7) which actually matches the above mentioned results for the upper limb patients (upper limb patients were only women because of breast cancer treatment). Also for women it was recorded that even though big changes in limb improvement happened the changes in QoL that followed were small. For men because of the small number of participants the results cannot be taken into account.

The correlation between QoL and limb improvement for the different stages of obesity or different stages of lymphoedema also cannot be considered valid because of the small number of patients in each stage. For patients with mobility problems a correlation between QoL grade and limp improvement measurements was recorded (P: 0.035 after treatment, P: 0.000 at 6 months and P: 0.028 at 12 months) (Fig 10, Table 7). Skin problems also exhibited a correlation between QoL and limb measurement improvement (P: 0.000 after treatment, P: 0.2 at 6 months and P: 0.031 at 12 months) (Fig 11, Table 7).

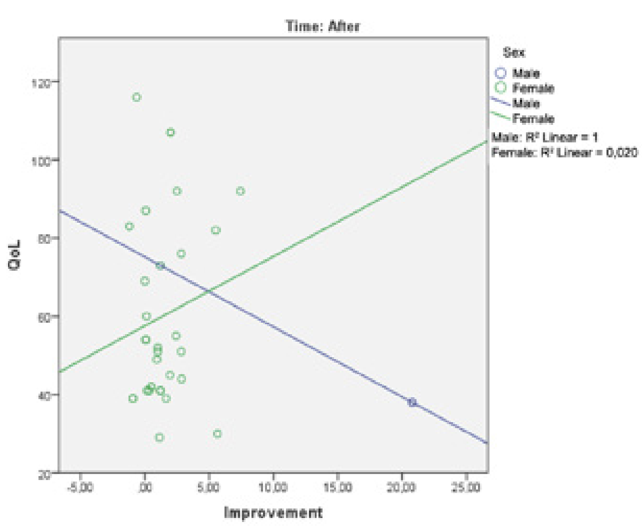

Figure 9. Correlation between improvement in limb measurements and QoL immediately after treatment for men and women with lymphoedema

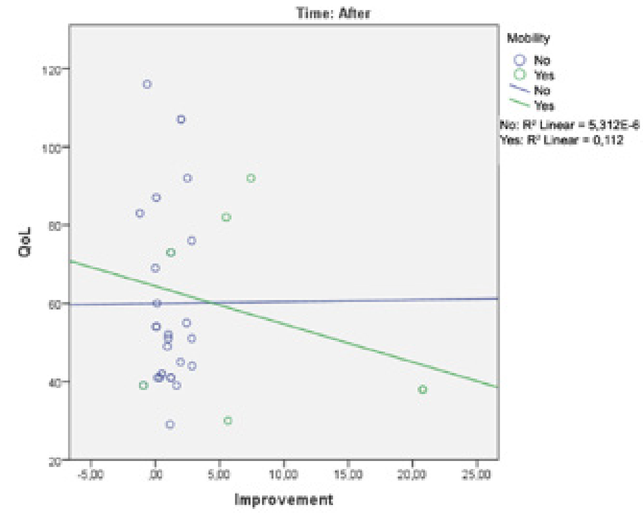

Figure 10. Correlation between improvement in limb measurements and QoL immediately after treatment for patients with lymphoedema with and without mobility problems

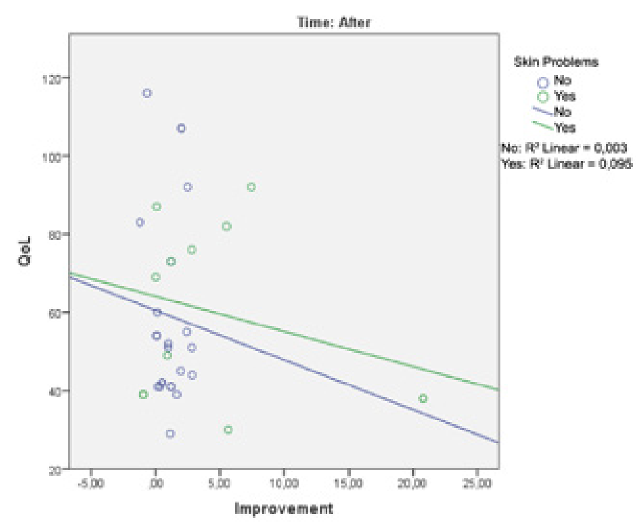

Figure 11. Correlation between improvement in limb measurements and QoL immediately after treatment for patients with lymphoedema with and without skin problems

DISCUSSION

Limb circumference or volume and joint mobility are common clinical outcomes for lymphoedema program.[16] Improvements in QoL (health perception, vitality and mental health) after rehabilitation have been reported for patients with arm lymphoedema.[17] It has been reported in the literature that Complex decongestive physiotherapy has a significant improvement on HRQoL specifically in gynaecological cancer patients with unilateral lymphoedema and that change in % excess volume is necessarily correlated with a change in physical functioning, social functioning, role-physical, bodily pain and general health and improvement in overall QoL.[18] On the other hand it was recently mentioned that the change in limb volume is not associated with a change in any of the HRQoL subscales they used.[19] In fact significant improvements are made in QoL following CDT, which are not necessarily correlated with limb volume reductio.[20] Increased limb volume is poorly related to the impact of lymphoedema on the patient[4,5] and in fact, circumference and mobility are only two of the factors affecting daily life and well-being in lymphoedema.[21] Total number of symptoms (pain, range of motion) may be more important than swelling while treating lymphoedema patients.[22,23] Also a number of factors that can affect HRQoL of lymphoedema patients have been identified. A significant correlation was found between an improvement in skin condition and an improvement in scores on the pain subscale of a QoL scale.[24] Other factors include, lack of lymphoedema awareness by health professionals, lack of information provided to patients, emotional responses such as shock, fear, annoyance, frustration and negative body image, high treatment cost in terms of time and disruption to lifestyle. Other factors leading to deficits in quality of life include the frequency of acute inflammatory episodes, the presence of pain, skin quality, lymphoedema in the dominant hand and reduced limb mobility.[4,5] The most distressing aspects of lymphoedema are local pain, embarrassment and limitations of physical activities.[25] It has been stated also that treatments should not be focusing only on decreasing arm volume without addressing other issues, such as pain because they may not result in improvements in activity, participation, or Health Related Quality of Life (HRQoL).[8]

In our study, improvement in limb circumference correlated with improvement in QoL in general, but when subgroups were taken into account it was noted that for women with upper limb lymphoedema the improvement in limb circumference was not necessarily followed by an improvement in QoL and in some cases the QoL exhibited deterioration. One explanation could be the fact that these patients are psychologically distressed and their QoL could have been affected by the breast cancer diagnosis treatment and prognosis, so the improvement in their limb appearance didn't have a great impact in their QoL. Another factor taken into account could be the necessity of wearing a long term maintenance material (glove and sleeve) that is still accompanied by the stigmatation of the disease at least in Greek society. On the other hand, it is stated that quality of life differs significantly for women with and without lymphoedema only when a subjective measurements is used, because subjective and objective tools investigate different aspects of lymphoedema.[26] It is possible that a subjective measure, such as the Lymphoedema and Breast Cancer Questionnaire (LBQO)[27] would have given different results.

Even though pain is considered a major correlation factor to QoL for lymphoedema patients, in our study only one of the patients reported pain related to lymphoedema and it could not be taken into account for the statistical analysis. The presence of mobility and skin problems was considered in our study important predictive factor that can influence the improvement of QoL after the treatment. On the contrary a number of patients who did not experience these problems and had intact skin and good mobility exhibited deterioration in their QoL and in our study it was translated that the treatment modules as well as the self-maintenance phase with the need of elastic garment and self bandaging for patients that have to cope only with limb volume could negatively affect their QoL. When assessing the effect of lymphoedema treatment, it is essential to determine whether the benefits to patient outweight the burden associated with treatment.[28] In our study, the number of patients whose QoL was affected negatively by the multidisciplinary program emphasizes the fact that for patients with no mobility and no skin problems, living with an unmanaged lymphoedema is easier than coping with daily lymphoedema self-management. Proper patient enrolment to an intensive program should address the patient's attitude towards self management. On the other hand, in this study BMI levels seemed to play a role in the QOL improvement in patients with lymphoedema. It has been previously described that increased BMI can affect negatively QOL.[29] Recently, it was shown that BMI was related to severe lemphoedema. The importance of an education care unit promoting personalized nutritional lifestyle and encouraging physical activity early in the management of cancer is of paramount importance.[30]

Considerations have to be taken into account concerning the assessment tool that was used in the study. HRQoL assessment of outcomes is made using patient-reported outcome (PRO) instruments or questionnaires, that quantify significant variables from the patient's perspective. The Nottingham Health Profile Part 1 (NHP-1) has been used for measurement of health-related quality of life of patients receiving conservative treatment for limb lymphoedema.[24] The SF-36 has been suggested to be appropriate for use with patients with lower limb lymphoedema.[31] The WHO 100-item QOL questionnaire (WHOQOL-100), which ascertains an individual's perception of QOL in the physical, psychological, level of independence, environmental and spiritual domains, as well as the general QOL has been administered in filarial lymphoedema patients.[7] A cancer specific questionnaire (EORTC-QLQ-C30) has been used for lymphoedema patient assessment.[32,33] The Dermatology Life Quality Index (DLQI)[34,35] and the modified version of Life Quality Index (LQI), focusing on the oedematous limb rather than the skin, have been administered to patients with Bancroftian filariasis.[25] Nevertheless, condition or disease specific measures might provide more sensitive assessment for specific populations, such as patients with lymphoedema.[36] The number of HRQoL specific for lymphoedema assessment instruments is limited. The Wesley Clinic Lymphoedema Scale (WCLS)[37] has no qualitative work and no formal psychometric analysis to confirm its' validity.[36] The Upper Limb Lymphoedema - 27 questionnarie (ULL-27)[38] has strong psychometric properties (Pusic et al, 2013) but its' use is limited for the upper limb. The Lymphoedema Quality of Life Inventory (LQOLI) is an instrument developed for patients with different types of lymphoedema. It is an instrument developed and tested in Australia but only published and translated and validated in Swedish.[39] At the beginning of our study, the FLQA-l was one of the few available instruments. It has showed good internal consistency (Cronabach's alpha was higher than 0.75 in all scales), has no floor and ceiling effects and satisfactory item selectivity. The test-retest reliability, sensitivity to change and convergent validity with other psychometric instruments has been reported as satisfactory.[24,25]

The main limitation of this study was the relatively small number of patients. The number of men patient in the study group was also small and it is difficult to draw conclusions. Additionally, weight loss or gain was not assessed. The different stages of obesity or different stages of lymphoedema also cannot be considered valid because of the small number of patients in each stage. Additionally, the majority of the patients did not strictly follow the dietary advice, while there was no official record of the diet scheme that each patient was presecribed.

CONCLUSION

A multidisciplinary intensive treatment program may improve the limb circumference and the QoL in patients with lymphoedema. The clinical improvement is not necessarily followed by the same degree of improvement in QoL. In particular patients with skin or mobility problems have the greatest imprtovement in QoL.

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Applied statistics in vascular surgery Part VI: Basic plots

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Abstract:
When working with data, it is essential to incorporate data visualization. By using appropriate illustrations, the researcher can greatly help the readers to better comprehend the statistical analysis. Among the most common types of graphs are bar graphs, histograms, box plots and error plots. A brief description of these basic statistical plots is presented.

INTRODUCTION

Descriptive statistics aims to summarize data involved in a study.[1] For example, a medical student collected data from 1,000 patients with infrarenal aortic aneurysm, who were treated with endovascular repair during a 10-year period. Of course, no one is going to read all this piece of data and if they did, they would not be able to capture any useful information from it. In that case, it becomes quite useful to use descriptive statistics and present key metrics such as mean, mode, median, range, variance, standard deviation, skewness and others, in order to provide a comprehensive way to summarize the available data.[2] Although this is the first step before proceeding with further analysis, numbers are not always perfectly conceivable by the readers. That is where graphs/plots can be of great use. They form a major component of almost all quantitative data analysis, by allowing researchers to provide a visual interpretation of complex data analysis and help readers to better comprehend the text and metrics.[3] Our aim in this paper is to present the most common plots used in vascular surgery literature.

WHICH GRAPH TO CHOOSE? BAR GRAPH VS HISTOGRAM

A good graph can convey information quickly and easily to the reader. The type of data often determines what graph is appropriate to use. One of the most widely used plots is the ***bar graph (also called bar chart)***. It consists of rectangular bars or columns (called bins) that represent the total amount of observations in the data for each category. Data can be displayed in vertical bars, horizontal bars, comparative bars, which show a comparison between values, or stacked bars, which contain multiple types of information.

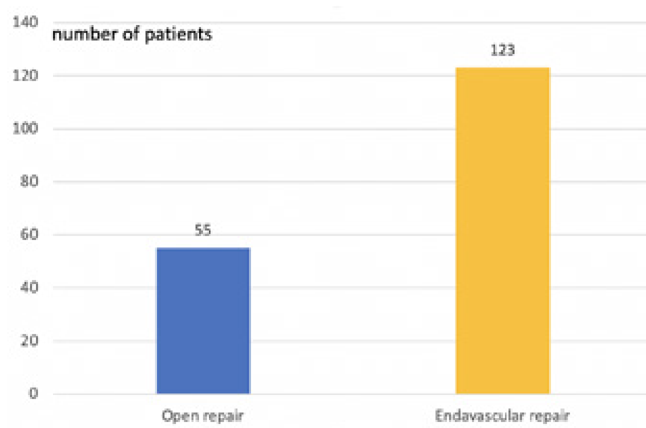

Figure 1. Example of a bar chart. Distribution of patients with abdominal aortic aneurysm according to treatment option

A simple bar graph (Figure 1) has two axes; one axis describes the types of categories being compared (eg. open vs endovascular repair of patients with abdominal aortic aneurysm) and the other has numerical values (eg 55 patients vs 123 patients, respectively) which represent the values of the data. The length of each bar is proportionate to the numerical value or percentage that it represents. A similar-looking graph is the ***histogram***. A histogram (Figure 2) represents the frequency distribution of continuous variables (eg. age of patients with abdominal aortic aneurysm, who were treated with endovascular repair) and it is displayed in such a way that there is no gap between the bars. Importantly, the researcher should know that histogram is used for displaying continuous data, whereas bar graphs display categorical data.[2]

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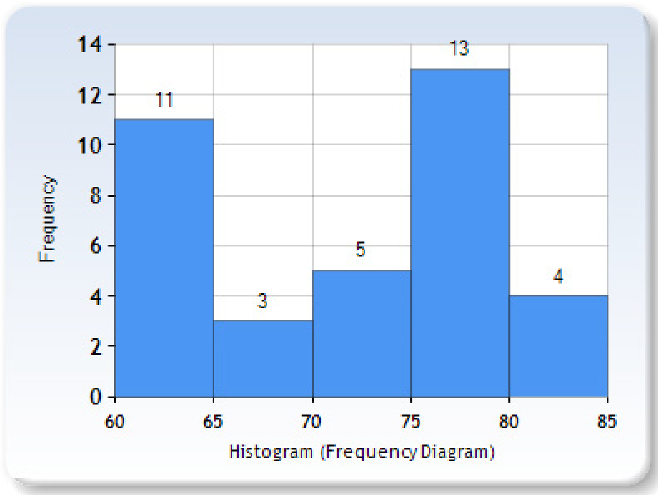

Figure 2. Example of histogram. Age (years) distribution for patients with abdominal aortic aneurysm, who were treated with endovascular repair.

WHEN WE NEED TO ADD ADDITIONAL INFORMATION IN A PLOT; THE BOX PLOT

Although the bar graphs and histograms can illustrate important information about the data being investigated, usually there is much more information about the variables that we may want to know, which cannot be found in a bar chart or a histogram. For example, we may know the age distribution of patients with abdominal aortic aneurysm, who were treated with endovascular repair, but we do not know whether or not the data are skewed, if there are outliers, how tightly the data are clustered around the mean.[4] In that case, the reader should look for a ***box plot*** (also called ***box-and-whisker plots***).

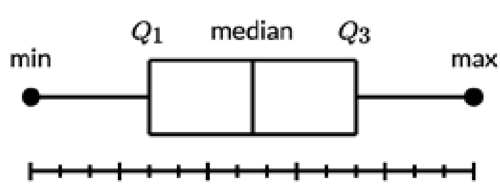

Figure 3. A typical box plot, with minimum (min) value, maximum (max) value, 25th percentile (Q1), 50th percentile (Q2 or median) and 75th percentile (Q3).

A box plot (Figure 3) contains five values: i) the 1st quartile, ii) the median, which is the value that divides the data in half and represents the 2nd quartile, iii) the 3rd quartile, iv) the minimum value and v) the maximum value of the data. Horizontal or vertical lines and a rectangular box are used to illustrate these five values. The one end of the box represents the 1st quartile (Q1, 25th percentile), the other end of the box represents the 3rd quartile (Q3, 75th percentile), while the median or 2nd quartile (Q2, 50th percentile) is represented by a line, somewhere between the ends of the rectangular box. One of the horizontal or vertical lines represent the minimum value, while the other represents the maximum value. The "whiskers" extend from the ends of the box to the smallest and largest data values.[3] Important information provided by the box plot is the graphical illustration of the median, which unlike the mean, it is unaffected by extreme values at one end or the other. Data are more or less symmetrically distributed about the median, if the median falls near the center of the box. In case the median falls near the bottom the data are positively skewed, while if the median is closer to the top of the box, data are negatively skewed. In the data of the example of Figure 2, a box plot (Figure 4) shows that data are not symmetrically skewed, while median is 71 years, with Q1=63 years and Q3=75 years. The difference between the Q3 and Q1 (75 - 63 = 12) is the inter-quartile range (IQR), which contains the middle 50% of the data and can provide an estimation of the dispersion of the data.

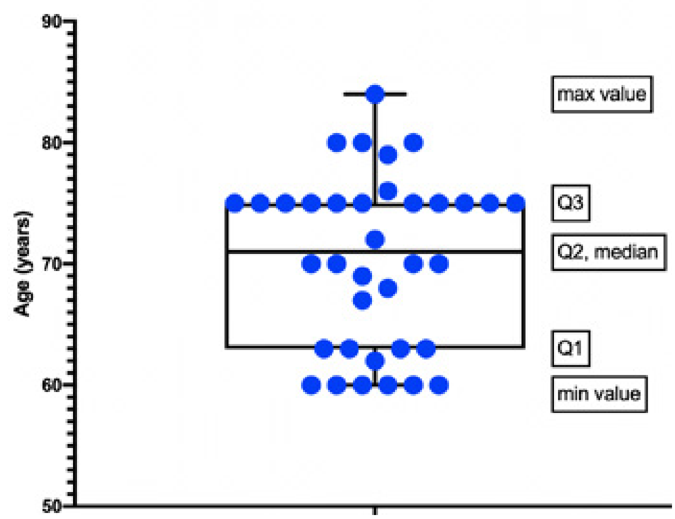

Figure 4. Box plot illustrating data of Figure 2.

ERROR PLOTS

Sometimes, measurement of uncertainty is of interest in medical research. Standard deviation (SD) provides information about how the data is distributed about the mean value and it is a good way to measure this uncertainty.[2,4] In this case, the ***error plot*** can graphically present mean with SD or other measures of uncertainty (eg. 95% confidence intervals or standard error). Figure 5 shows the error plot of data also illustrated in Figure 2. In this example, mean age of patients is 70.4 years, with SD of 7.0 years. Error plots can be applied to other graphs, such as bar graphs in order to provide an additional layer of detail on the presented data. Error Bars are illustrated as cap-tipped lines that extend from the center of the plotted data point and the length of the error lines helps indicate the measure of uncertainty (eg. SD; Figure 6).

Plots give a good, quick picture of the data. As one of the most influencing statisticians, John Tukey, said, "*the researcher should never begin analyzing data before he/she has visualized them in some way*".[2,3]

No conflict of interest.

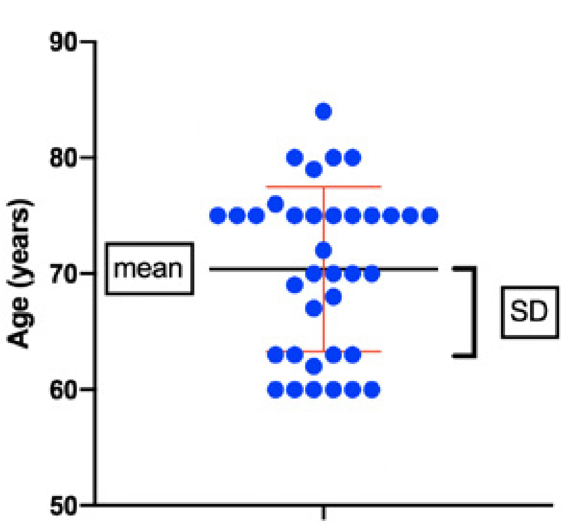

Figure 5. Error plot illustrating data of Figure 2

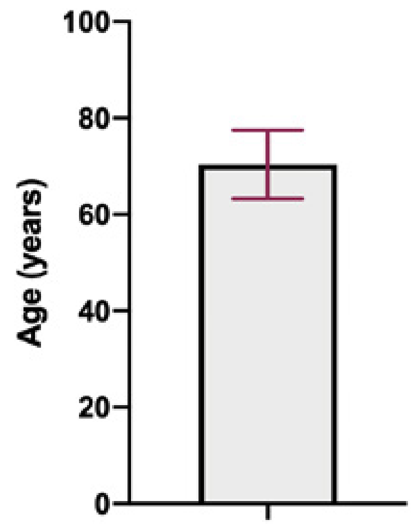

Figure 6. Error plot with bar chart illustrating data of Figure 2

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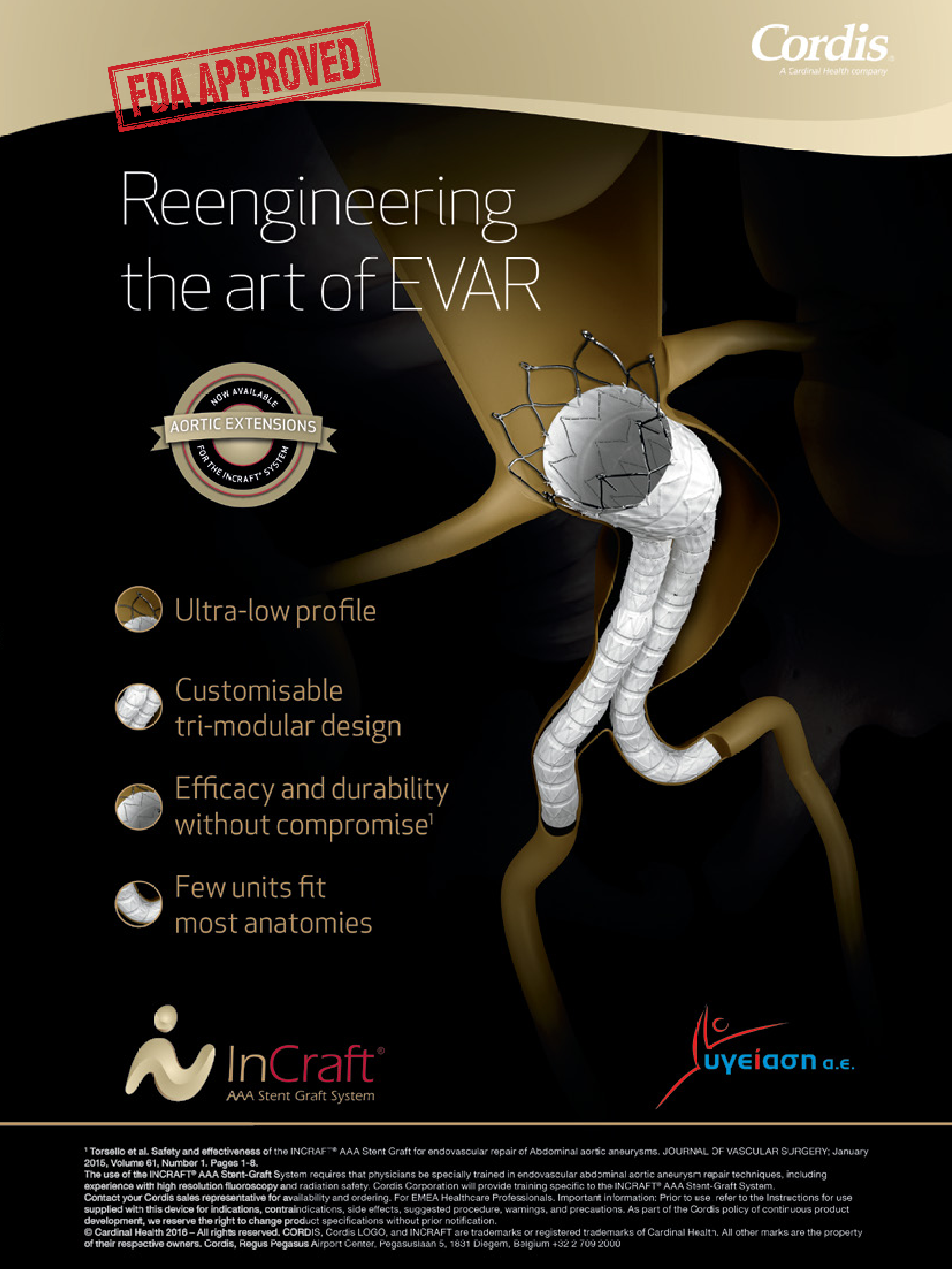

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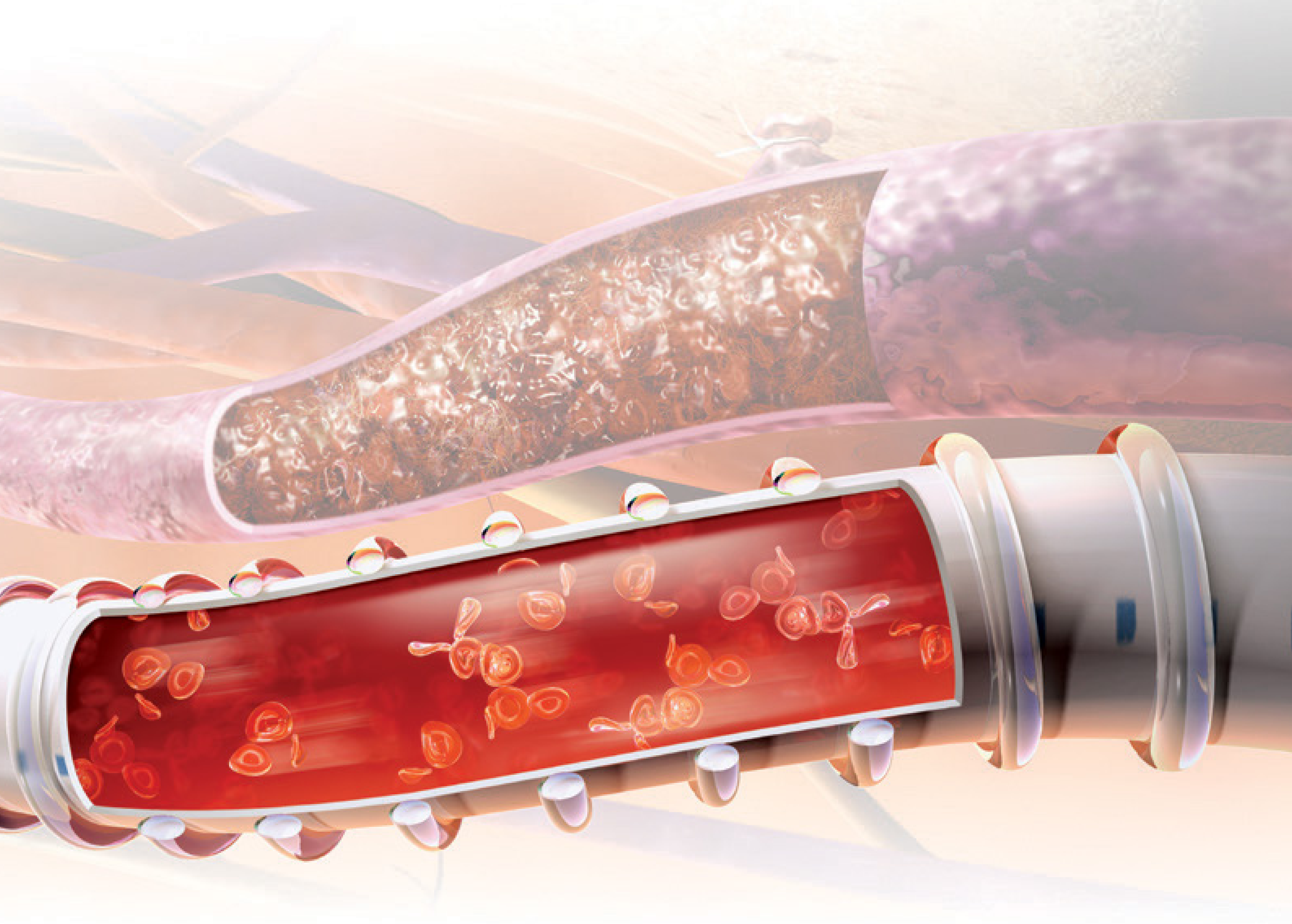

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Surgical management of Hypothenar Hammer Syndrome in a patient presented with a true aneurysm of the ulnar artery and hypoplastic deep arterial palmar arch

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Abstract:

Background: Hypothenar Hammer syndrome (HHS) is considered to be a rare entity resulted from repetitive or emerged blunt trauma and microinjury to the ulnar artery which lies in the Guyon's Canal. The vast majority of patients are involved in occupational activities or include athletes which have experienced continued microtraumas in a similar fashion. The aim of the current report is to present our experience of a patient with HSS and hypoplastic deep palmar arch operated to our department.

Case report: A 32 years old male patient, presented to our department with a pulsating mass on the palmar surface of his left hand. The patient reported a fall-related blunt trauma to the hypothenar eminence of his left hand two years ago. Allen's test was positive for the ulnar artery perfusion area, while both the color doppler ultrasound and magnetic resonance angiography revealed a 1,7cm aneurysm to the distal end of the artery. Given the above findings, we performed aneurysmectomy and an end to end anastomosis of the ulnar artery with successful immediate result. During the five-month follow-up there were no post-operative complications.

Conclusion: The anatomic peculiarity over the Guyon's canal leaves the ulnar artery and nerve essentially exposed to injury against the hook of the hamate. Repetitive microtrauma raises the risk for intimal injury and aneurysmal lesion formation which should be treated surgically to protect the perfusion of the arm from possible complications. The choice of treatment for HHS can be rather challenging regarding the plethora of clinical presentations of the disease. Nevertheless, in the presence of an aneurysmal lesion the gold standard remains aneurysmectomy with an end to end anastomosis.

INTRODUCTION

Hypothenar hammer syndrome (HHS) is a disease of uncommon occurrence. The silent nature of this condition and the broad spectrum of differential diagnosis including Berger's disease, Raynaulds disease and others, synthesizes a riddle hard to solve for most clinical practitioners. HHS was first described as a clinical entity by Guttani and Von Rosen in 1772[1]. Conn et al in 1970[2] suggested that repetitive trauma to the hypothenar eminence of the hand can lead to ulnar artery injury and "Hypothenar Hammer Syndrome" was proposed as the appropriate nomenclature for the disease. Most prone to the disease are males over females in their 40's occupied in manual labor[3,]. The frequent use of their dominant hand in a striking manner similar to a hammer, results in recurrent microtrauma over Guyon's Canal and subsequent injury to the ulnar artery[4] which can lead to vasospasm and thrombosis of the artery or the formation of a pseudoaneurysm. In rare cases those injuries may happen after an isolated blunt trauma and concern the emergence of a true aneurysm.

The aim of this report is to present our experience of a patient with a fusiform aneurysm of his left ulnar artery, resulted after blunt trauma of the arm and hypoplastic deep palmar arch operated to our department.

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CASE REPORT

A 32 years-old male patient presented to our department with a pulsative mass on the palmar surface of his left hand. The patient reported a fall-related blunt trauma to the hypothenar eminence of his left hand two years ago. Localized pain which alleviated with the use of nonsteroidal anti-inflammatory drugs (NSAIDs) was the only symptom at the time of presentation, while the patient stated a progressive increase in the size of the mass. His past medical history was free, whilst he stated to be an active smoker. Allen's test was positive and revealed remaining perfusion of the pulsatile radial artery. So, we proceeded in further investigation with color doppler ultrasound and magnetic resonance angiography. Both examinations revealed a 1,7cm true aneurysm to the distal end of his left ulnar artery with hypoplastic deep palmar artery arch (Fig. 1A,B and 2A,B). Given the above findings and the possibility of complications due to the presence of the aneurysm, surgical intervention was decided.

Under local anesthesia a small curvilinear incision over the pulsating mass was performed. After surgical exploration and dissection of the surrounding tissues, control of the proximal and distal necks of the aneurysm was possible using vessel loops (Fig. 3A,B). After blockage of the arterial inflow, a longitudinal incision to the aneurysmal sac was performed with the remaining length of the artery allowing for the creation of an end to end anastomosis. Anastomosis was performed using a supporting angiocath with a 7.0 prolene suture. The procedure was uneventful with evident patency to the proximal and distal part of the artery post-operatively.

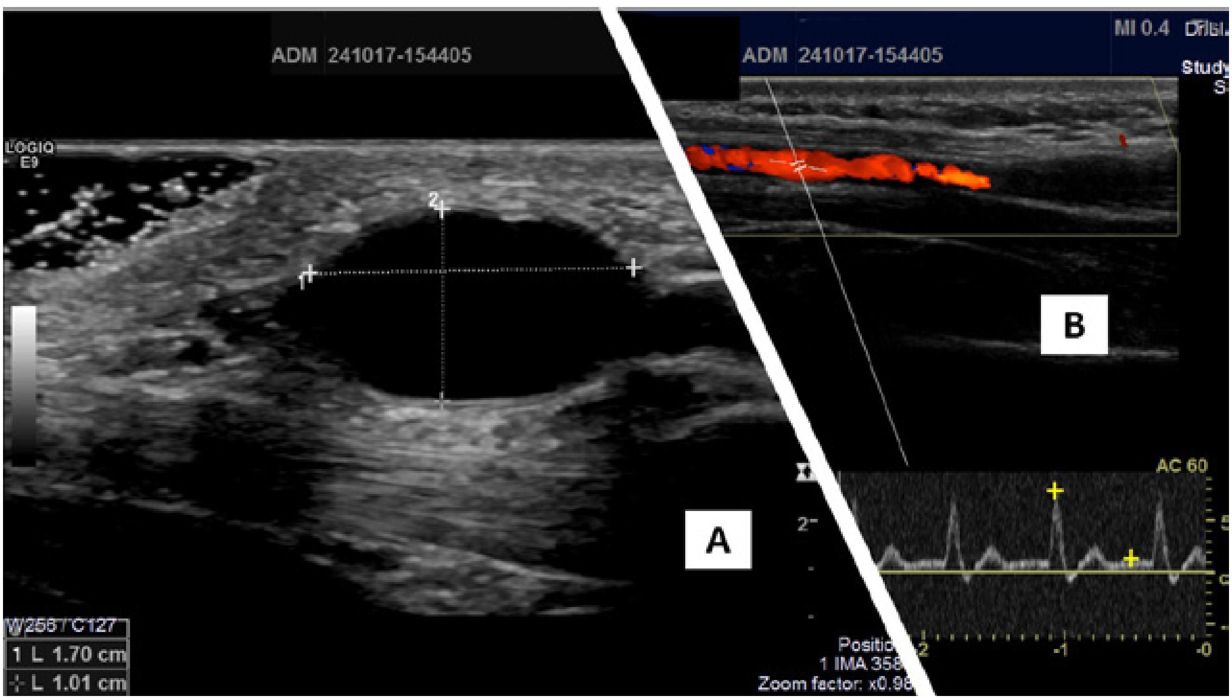

Figure 1. A. Preoperative imaging of the 1,7cm ulnar artery aneurysm using color doppler ultrasound with B. normal waveforms.

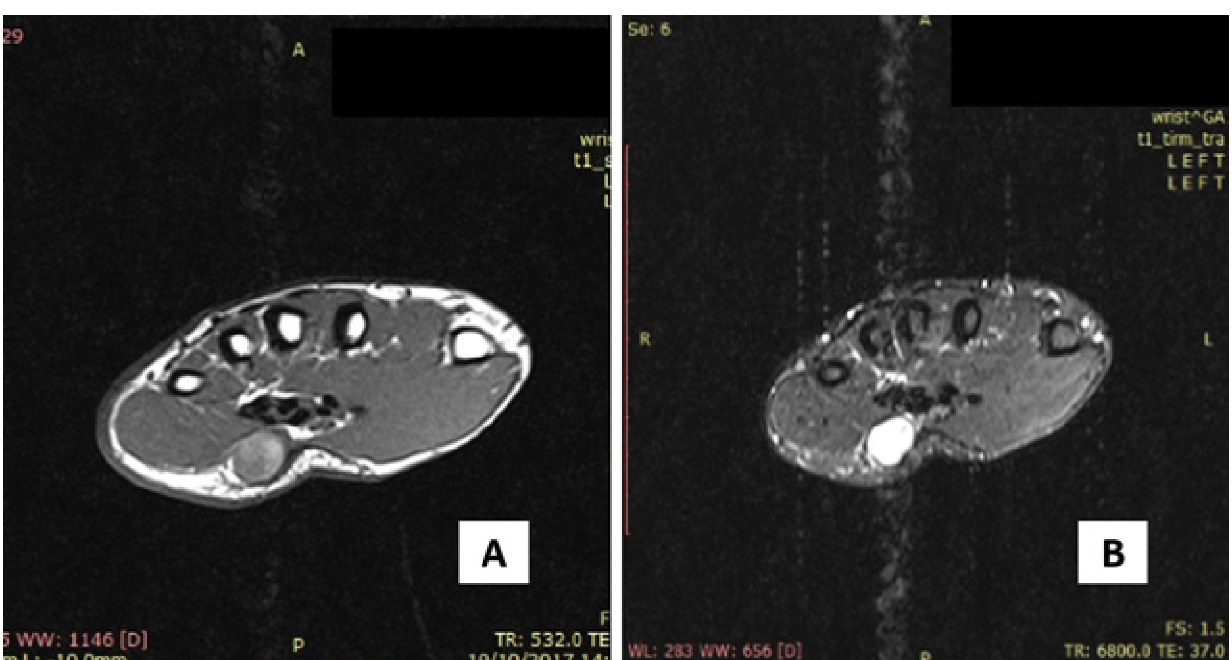

Figure 2. Preoperative magnetic resonance imaging angiography of the 1,7cm ulnar aneurysm in transversal view at A. T1 and B. T2

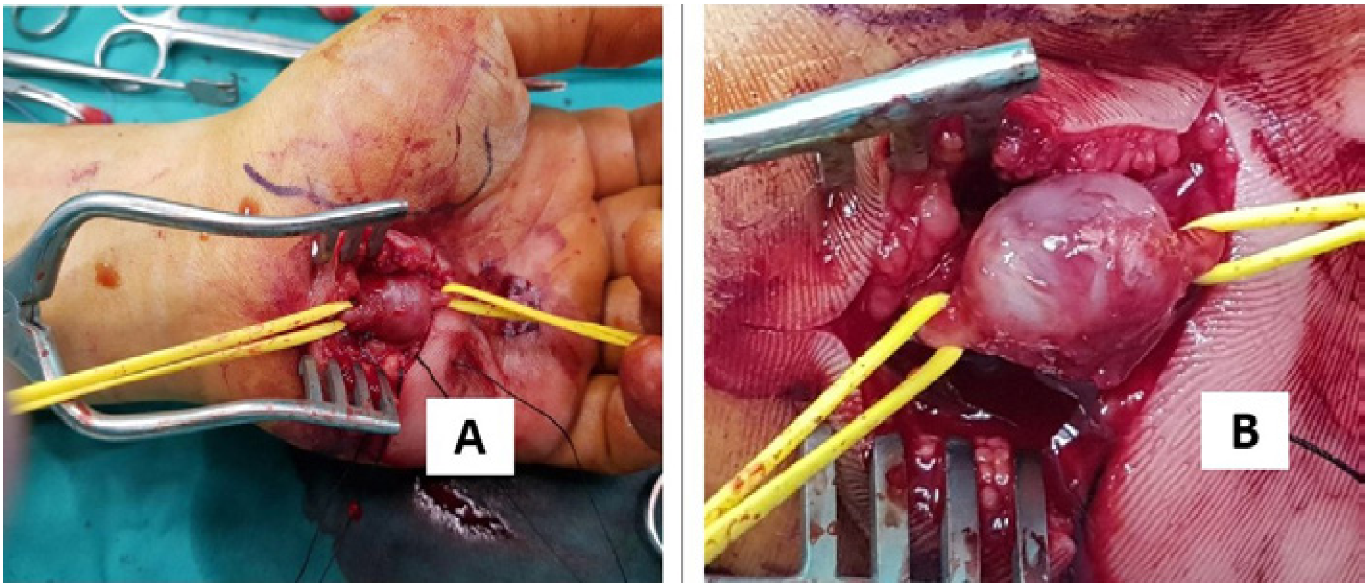

Figure 3. A. After exploration of the left hypothenar area, control of the ulnar artery proximally and distally using vessel loops and B. focusing on the fusiform aneurysmal sac before aneurysmectomy.

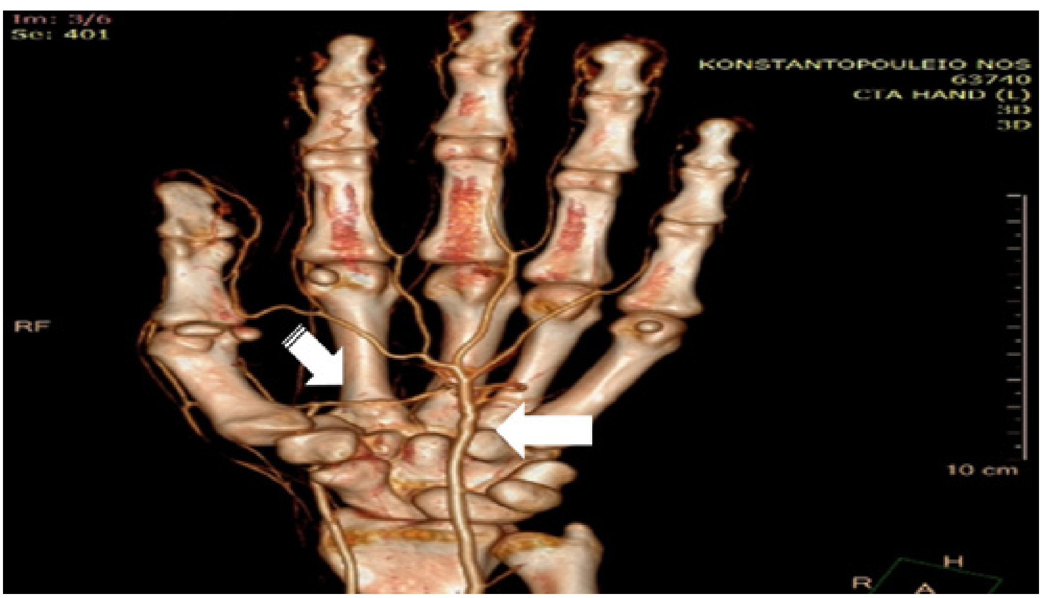

Figure 4. Postoperative CT angiography demonstrating patency of the anastomosis (white arrow) and the hypoplastic deep palmar arch (toothed white arrow).

In the first follow-up five months thereafter, the patient does not report any neurologic or vascular complications. Computer tomography angiography (CTA) showed patency of the anastomosis and good perfusion of the hand from the hypoplastic deep palmar arch (Fig. 4).

DISCUSSION

The pathophysiology of hypothenar hammer syndrome (HHS) is known to be correlated with the anatomy of the hand. The ulnar artery and nerve pass through the ulnar canal (Guyon's canal) before entering the hand. At that point the nerve and artery are merely protected by skin, subcutaneous tissue and the palmar aponeurosis while laterally it borders with the hook of the hamate[4]. The above anatomic peculiarity leaves the artery exposed to trauma over the boney structure of the hamate. Repetitive microtrauma over the Guyon's canal causes intimal injury with subsequent thrombus formation and consequently the formation of an aneurysm. Rarely the process of the disease involves a single blunt trauma to the hypothenar eminence. In asymptomatic patients with a patent aneurysm surgical approach is evidence based for the prevention of thrombosis, emboli and possible decompression of the ulnar nerve[5] . If untreated HHS can lead to ischemia, necrosis and gangrene as the superficial palmar branch is formed predominantly by the ulnar artery and limited contribution from the radial artery. Furthermore in 37% of cases a trans palmar arciform continuation of the ulnar artery with a full complement of common volar digital branches is the sole source of blood supply to the fingers[6]. Ferris et al. demonstrated the possible underlying presence of ulnar artery fibromuscular dysplasia[7]. In his study, histologic examination of 19 resected ulnar arteries was performed. Hyperplastic proliferation of the intima or media and disruption of the internal elastic lamina were evident, typical signs of fibromuscular dysplasia. The rarity of the disease with fewer than 150 cases reported globally poses an obstacle in formatting clear therapeutic regimes.

Many treatments have been described ranging from conservative management (calcium channel blockers, antiplatelets or anticoagulation, and pentoxifylline to reduce blood viscosity[8]) to surgical[9] or even endovascular procedures[10]. Our decision for the presented case was based on the local extension of the disease and the need to preserve blood supply of the extremity with the end to end anastomosis to be proven efficient without any post-operative complications.

CONCLUSION

The presence of aneurysmal disease to the distal portion of the ulnar artery in the context of the hypothenar hammer syndrome is of utmost clinical significance. Therefore, prompt diagnosis and early treatment of the disease is vital to prevent the survival and functionality of the affected extremity.

No conflict of interest.

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VASCULAR IMAGE

Carotid Artery Donut Sign

Polyzois Tsantrizos, MD, MSc[1], Spyros Papadoulas, MD, PhD[1], Konstantinos Nikolakopoulos MD, MSc, PhD[1], Peter Zampakis, MD, PhD[2], Stavros K Kakkos, MD, PhD, MSc, PhD, DIC, RVT[3]

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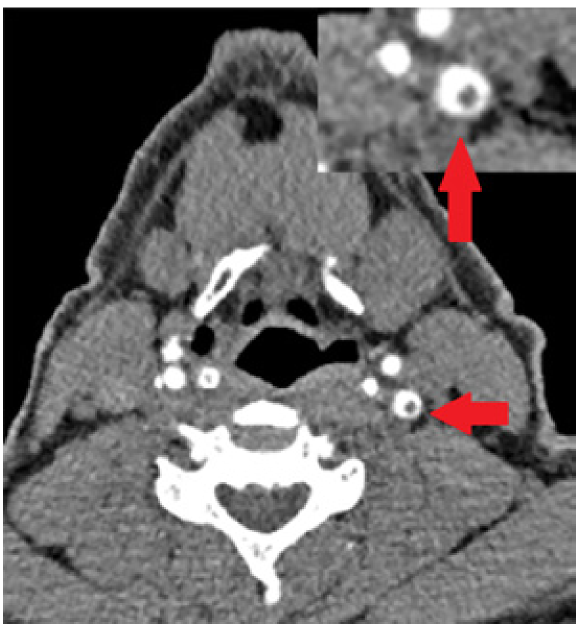

Figure 1.

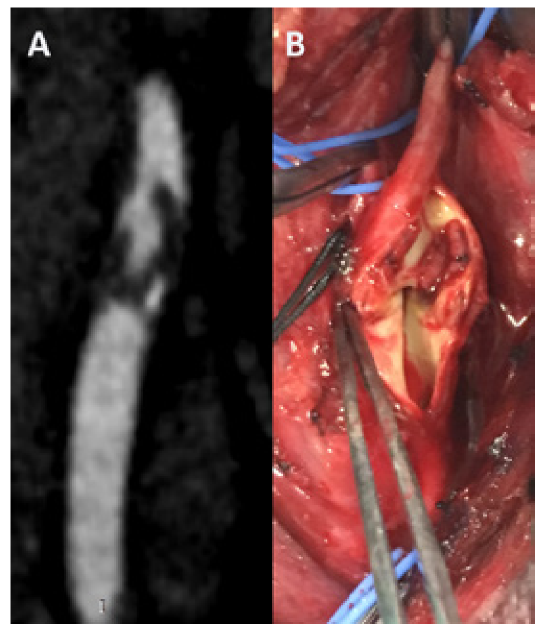

Figure 2.

A 58-year-old right-handed male, heavy smoker with a past medical history of hypertension, diabetes mellitus and dyslipidemia, was admitted to the Neurology Department with three transient ischemic attacks manifested as right arm hemiparesis and motor aphasia. These episodes were brief in duration and occurred within a period of a few hours. Duplex ultrasound revealed an atherosclerotic plaque with an overlying thrombus producing a 70% stenosis of the left internal carotid artery. Magnetic resonance scanning of the brain demonstrated recent infracts scattered throughout the left hemisphere. Computed tomography angiography showed a 80% stenosis with free floating thrombus: in axial images thrombus produced a specific finding, previously reported as 'donut sign',[1] being a result of the central filling defect surrounded by normal lumen opacification (Fig. 1, arrow), see also Fig. 2, panel A. Confirmed on urgent surgery (Fig. 2, panel B), a typical carotid thrombendarterectomy was performed with primary repair of the arteriotomy site. Postoperative course was uneventful, and patient was discharged on the second postoperative day. Treatment alternatives include medical treatment with anticoagulation, urgent carotid endarterectomy, and medical management with deferred surgery if the tail of the thrombus extends considerably high in the internal carotid artery beyond the reach of surgery.[2]

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VASCULAR IMAGE

Anomalous anatomy results in a major bleed following dialysis catheter placement: bleeding control and reconstruction of the common femoral vein with a single anastomosis

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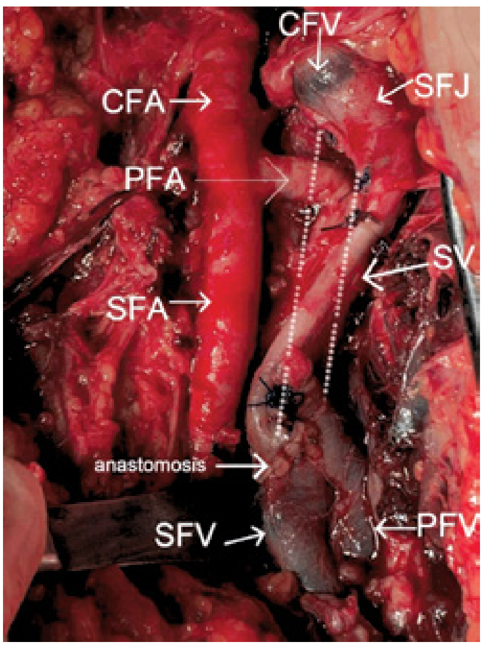

CFA: common femoral artery SFA: superficial femoral artery PFA: profiund demoral artery

CFV: common femoral vein SFV: superficial femoral vein PFV: profiund demoral vein

SV: saphenous vein SFJQ saphenofemoral junction

dot-line: original course of the ligated and divided comon femoral vein

A 75 year-old female patient was admitted with acute renal failure. Following an attempt to place a dialysis catheter in the right femoral vein, the patient developed a large groin and thigh hematoma and became hemodynamically unstable despite application of pressure and appropriate fluid resuscitation. The catheterisation attempt was done by the treating nephrologist without ultra-sound guidance.

The patient was rushed to the operating theater. Vessel control was obtained, and a large tear was noticed in the profunda femoris artery (PFA). The PFA was arising from the medial aspect of the common femoral artery (CFA). Usually, the disposition and course of the vessel is posterolateral to the CFA.

The common femoral vein (CFV) had to be divided and ligated just proximal to its bifurcation to access the injured PFA. A bolus of IV heparin was administered (80 units/kg) after the PFA repair. An end to end reconstruction of the CFV was not possible because of significant length loss. Thus, we decided to restore the CFV continuity using an in-situ saphenous vein graft. The saphenofemoral junction was preserved and the saphenous vein was mobilized and anastomosed with the distal CFV stump. This was a successful single anastomosis reconstruction the CFV.

This case highlights that anatomical landmarks are not enough to guide central venous access. The anomalous medial position of the PFA, just posterior to the common femoral vein (CFV), lead in our case to the accidental cannulation and subsequent dilation of the PFA with a 12F sheath. Recommendations for the use of ultra-sound guidance[1] need to be followed to avoid such disastrous complications.

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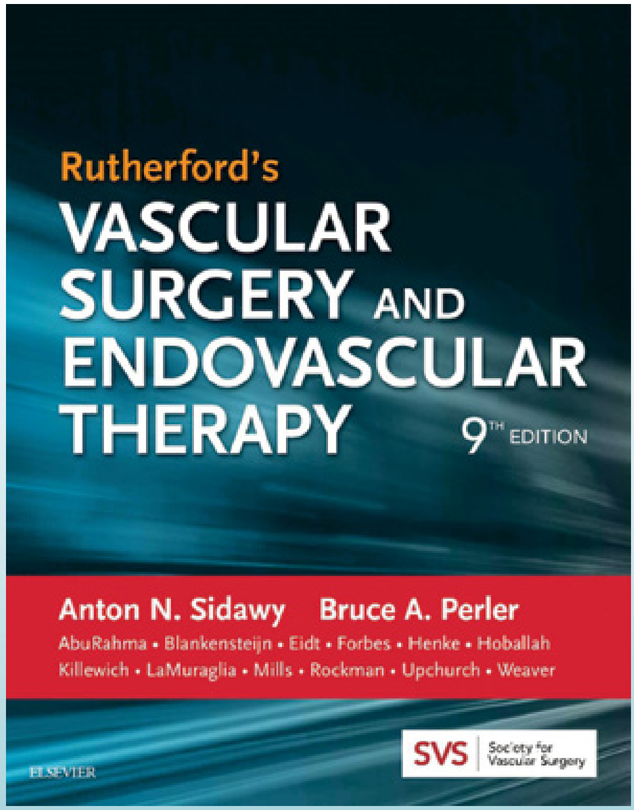

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