Dear Colleagues,

This International Symposium, already celebrating its XVIIIth edition, is set to offer you the most relevant clinical evidence in Vascular and Endovascular fields, aiming, for the fourth consecutive year, to broadcast a series of selected live cases, a National pioneering approach driving this event.

With our Faculty, we jointly created a teaching experience, under new Legal ambiance, proudly endorsed once again by the LINC and SITE initiatives, recognized by our Medical College and University, accredited by the UEMS and also compliant with Eucomed Medtech rules. The full support and commitment of the Hospital Administration Council, Autonomous Surgical Management Unit and Vascular Surgical Department was essential to improve all the logistics and organization, allowing for our Hospital based initiative to be valued and shared by the vascular community.

Living times of financial constraints implies rationalization of human and technical resources, the probing question is how to adapt our medical attitude to this new social and economic paradigm. The answer is not only education, knowledge, and salient experience sharing. It obliges a proper assessment of the clinical decisions and therapeutic devices choice, taking into consideration the state of the art knowledge and the capabilities of our group.

The changing pattern in Vascular Medicine, with endovascular procedures being part of the actual portfolio treatment options in the majority of the situations, incorporating new materials and techniques, is assumed in this Symposium as a platform in which the sponsoring companies can have their fundamental partnership role highlighted and properly included.

I have to mention that this event continues to be, for us, a crucial opportunity to interact with the most skilled surgeons, upgrade the Department expertise, treat our patients with better results and justify future reference Centre ambitions. It also has to be emphasized the post graduate learning intention of the Symposium in which the involvement of our residents must be truly underlined, preparing and organizing the meeting, namely Marina Neto, João Neves, Joel Sousa and Pedro Pinto.

From the most complex aortic cases treatment to PAOD, carotid and venous disease management, all topics have been carefully selected for this interactive meeting.

I am most grateful for your presence and participation, your kindness and availability to be part of it, and please consider this event as a joint solid project, to sound your voice and reflect your experiences.

Enjoy the meeting and our beautiful city of Porto. Recently awarded as the best travel Europe destination (2017). You will certainly become part of our History.

Of the Symposium, and so of the City.

José Fernando Teixeira
Symposium President
President
Dr. José Fernando Teixeira

Secretary General
Prof. Doutor Sérgio Sampaio

Honorary Presidents
Prof. Doutor António Braga
Dra. Fernanda Viana
Prof. Doutor Roncon de Albuquerque

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Dra. Marina Neto
Dr. Joel Ferreira Sousa
Dr. José Pedro Pinto

Live cases and Handbook
Dr. João Rocha Neves
Dra. Marina Neto
Dr. Joel Ferreira Sousa
Dr. José Pedro Pinto

Short cases committee
Dr. Joel Sousa

UEMS application
Dr. Joel Sousa

Web Supervisor
Dr. João Neves

Logistics coordination
Dr. Pedro Henrique Almeida
Dr. José Almeida Lopes
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7TH APRIL FRIDAY MORNING

Sessions

Aortic Dissection
Chairpersons: Rui Almeida, Paulo Pinho
Moderators: Adelino Leite Moreira, Duarte Medeiros, João Silva e Castro, Álvaro Laranjeira Santos

AAA Carlos Vaquero
SFA PAD – TASC D
Michael Piorkowski
Comment: Joana Carvalho and Augusto Rocha e Silva

Iliac PAD – TASC C
Nilo Mosquera
SFA in-stent restenosis
Ignacio Lojo
SFA lesion
Nilo Mosquera
(supplemental case – tbc)
Comment: Manolo Martinez and Miguel Lobo

Type IV Aneurysm
Fernandez Noya
AAA
Fernandez Noya
Comment: Miguel Lobo and Manolo Martinez

09H00  Non-parallel grafts options in the arch
Carlos Vaquero

TEVAR treated Type B Aortic Dissection natural history
Frank Vermassen

Petticoat technique: rationale, technical options
Vincent Riambau

Medically treated Type B Aortic Dissection natural history
Rosa Moreno

10H30  COFFEE BREAK

11H00  Planning to treat an uncomplicated Type B Aortic Dissection. Which factors are important?
Vincent Riambau

Chimney variations in the arch. How to make them work
Mario Lachat

Conference
Chairperson: Luis Mota Capitão
New challenges, new solutions for thoracoabdominal aortic pathologies
Dinis da Gama

12H00  Opening Session

13H00  LUNCH

14H30  COFFEE BREAK

Live Cases

AAA Carlos Vaquero
SFA PAD – TASC D
Michael Piorkowski
Comment: Joana Carvalho and Augusto Rocha e Silva

Iliac PAD – TASC C
Nilo Mosquera
SFA in-stent restenosis
Ignacio Lojo
SFA lesion
Nilo Mosquera
(supplemental case – tbc)
Comment: Manolo Martinez and Miguel Lobo

Type IV Aneurysm
Fernandez Noya
AAA
Fernandez Noya
Comment: Miguel Lobo and Manolo Martinez

TBC – to be confirmed
Sessions

Aneurysms
Chairpersons: J. Fernandes e Fernandes, Daniel Menezes
Moderators: Rui Machado, Rocha e Silva, Oscar Gonçalves, Frederico Bastos Gonçalves

14H30  Failed EVAR/EVAS. Is postponing open conversion only delaying failure? Eric Verhoeven

GREAT Registry: Latest clinical evidence in a real world registry Eric Verhoeven

Inflammatory AAA. Open, endo, when? Fernandez Noya

Renal and visceral debranching – still an option, really? Mario Lachat

Bridging stent grafts selection in EVAR. Critical issue Nilo Mosquera

Renal visceral complications during and after taaa repair Piotr Kasprzak

16H30  Low Profile Endoprosthesis: 5 years results Nilo Mosquera

16H30  COFFEE BREAK

17H00  Nexus graft. A different concept for the arch David Planer

Endoanchoring in tevar Piotr Kasprzak

Conference
Chairperson: Mário Macedo
New challenges, new solutions; endovascular solutions for aortic disease J. Fernandes e Fernandes

17H30  Carotid
Chairpersons: Roncon de Albuquerque, Luís Mendes Pedro
Moderators: Pedro Brandão, Gonçalo Cabral, José Carlos Vidoedo, Pereira Albino

17H30  Immediate post intracranial thrombolysis carotid stenosis management Antonio Moreno

CEA and CABG: before, at the same time or never? Marta Moura

Are the indications for carotid surgery with or without CABG the same? Laura Capoccia

18H30  Urgent vs emergent management of symptomatic carotid artery stenosis João Rocha Neves

Live Cases

Thoracic aneurysm and Juxtarenal AAA
Eric Verhoeven

Comment: Piotr Kasprzak and Frank Vermassen

Thoracic Pseudo-Aneurysm
Vincent Riambau

Comment: Álvaro Laranjeira and David Planer
### Live Cases

<table>
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<tr>
<th>Time</th>
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<th>Presenter(s)</th>
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<td>09H00</td>
<td>Juxtarenal AAA</td>
<td>Nilo Mosquera</td>
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<td>Comment: Gaspar Mestres and Ana Sofia Ferreira</td>
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<td>10H30</td>
<td>Chronic deep venous disease</td>
<td>Marzia Lugli</td>
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<td>Comment: Ignacio Lojo and Paulo Dias</td>
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<td>10H30</td>
<td>AAA with conic hostile neck</td>
<td>Omar Andres</td>
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<td>14H30</td>
<td>Drug eluting vascular stent vs Plain old balloon angioplasty</td>
<td>Nilo Mosquera</td>
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<td>Single vs multivessel revascularization</td>
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<td>11H00</td>
<td>Deep venous arterialization</td>
<td>Michael Piorkowski</td>
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<td>11H00</td>
<td>Interwoven nitinol stent vs bare metal stent vs drug eluting balloon</td>
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<td>11H00</td>
<td>Drug eluting peripheral stent vs Plain old balloon angioplasty vs bare metal stent</td>
<td>Augusto Ministro</td>
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<td>11H00</td>
<td>The importance of conformability in the treatment of complex obstructive lesions in CLI patients</td>
<td>Fernandez Noya</td>
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<td>13H00</td>
<td>Deb with Paclitaxel, advantages. Sustainable?</td>
<td>Gaspar Mestres</td>
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<td>13H00</td>
<td>Optimization of CO2-angiography in patients with kidney impairment</td>
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<td>14H30</td>
<td>Short Case Session</td>
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<td>14H30</td>
<td>Conference</td>
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8TH APRIL SATURDAY AFTERNOON

Sessions

Veins
Chairpersons: Albuquerque de Matos, Maria José Ferreira
Moderators: Paulo Correia, Amilcar Mesquita, Manuel Fonseca

14H30  When should we risk treating thrombosis extending into the IVC
       Niels Baeckgard

17H00  Outcome evaluation after deep vein interventions.
       Marzia Lugli

17H00  Sizing venous stents
       Marzia Lugli

17H30  COFFEE BREAK

17H30  Extended treatment of venous thromboembolism: new evidence
       Paulo Dias

17H30  Large vein obstructions. Is there a specific way / tool to cross them?
       Ignacio Lojo

18H30  How to measure thrombus age/symptom duration before CDT?
       Niels Baeckgard

18H30  r-VTE: from clinical trials to real world clinical practice. What outcomes should we assess?
       Pereira Albino

18H30  Closing Session

Live Cases

BTK PAD
Marco Manzi

Comment: Gabriel Anacleto and Luís Silvestre

Type Ia endoleak after EVAS
Ignacio Lojo

Comment: Rui Machado and Luís Silvestre
Non-parallel grafts options in the arch in aortic dissection

Introduction
Aortic dissection is the most common acute aortic syndrome, and it often requires urgent surgery. The open surgery of total arch replacement is gold standard technique, for patients with acute type A aortic dissection. Anastomoses of the graft to the left subclavian artery and descending aorta are often difficult, and the arch vessel anastomosis is frequently performed at the dissected site. Over the last decade, various strategies have been employed to decrease the risk of total arch replacement. Open total arch replacement and ascending aortic replacement with a “frozen” elephant trunk technique have been developed and advocated. Others have advocated the placement of an antegrade stent-graft into the proximal descending aorta during open type A dissection repair.

Thoracic endovascular aortic repair (TEVAR) has demonstrated good short- and mid-term results for a variety of thoracic aortic pathologies. Endovascular intervention is the preferred treatment option in the aortic dissection of the acute complicated group, but in the acute uncomplicated group, endovascular treatment is debatable. In patients with chronic presentations, endovascular treatment is gaining acceptance. However, due to the need for recurrent reinterventions, open surgery in this group remains the most common practice in good surgical candidates. These considerations make the reconstruction of supra-arch branch vessels necessary for favourable outcomes.

The management of diseases involving the aortic arch and the descending thoracic aorta remain a challenge in cardiovascular surgery. Open surgical approach is the standard method of treatment, which makes use of cardiopulmonary bypass, hypothermic circulatory arrest, and cerebral perfusion. Despite the significant improvement in outcomes, the standard approach continues to be associated with a 15% to 20% mortality rate.

Endovascular supra-arch branch preservation was successfully attempted using fenestrated, scalloped or branched stent grafts. This hybrid approach, of conventional arch replacement with downstream placement of a stent-graft through an open arch, has stimulated the development of novel grafts such as the E-vita prosthesis, which is composed of a Dacron segment for replacement of the ascending aorta and arch, together with a stent graft segment, which is positioned in the proximal descending thoracic aorta. TEVAR combined with graft bypass (hybrid procedure) has gained a widespread implementation and extended endovascular treatment options.

Thus, it is not a suitable option for high-risk surgical patients. Hybrid aortic arch repair has become widely adopted in clinical practice because it is a less invasive technique that combines aortic debranching and thoracic aortic endovascular repair (TEVAR). This approach limits the need to perform a median sternotomy, single-lung ventilation, cardiopulmonary bypass, and aortic cross-clamp. Moreover, the debranching method provides a healthy and adequate landing zone for the stent graft. This technique, however, is associated with its own complications and risks, such as endoleak, paraplegia, stroke, and risk of acute ascending aortic dissection. In particular, it is commonly reported that acute aortic dissection can occur in a retrograde fashion shortly after surgery.

Our experience
Material and Methods
To analyze the feasibility, safety and effectiveness of endograft exclusion of acute and chronic descending thoracic aortic dissections (AD) (Standford type-B). We describe our clinical experiences and early and mid-term results with stent-grafting.

From January 2001 to February 2017, a total of 163 patients (134 males; mean 63 ± 12 years, range 47-78) with thoracic aortic dissection underwent TEVAR at University Hospital of Valladolid in Spain. Preoperative
computed tomography angiography measured the length (9.4 ± 3.3 mm) and diameter (27.1 ± 6.1 mm) of the landing zone. Thoracic aortic stent grafts were implanted through the femoral artery using a surgical (n = 145) or totally percutaneous method (n = 18). Type of endografts implanted was Valiant (Medtronic, USA) 148, TAG Gore 6 procedures, TX2 Zenith (Cook) 8 procedures, Endofit (Endomet) 1 procedure. All endograft implantations were performed under angiography supported by simultaneous transoesophageal-ultrasound imaging. All patients were followed up from 1–48 months (average, 24-months). A total of 223 aortic stent graft segments were used in aorta dissection endovascular surgery. The diameter of aortic stent grafts was 32.8 ± 3.2 mm (range 24–42 mm), and the length was 172.9 ± 29.0 mm (range 80–230 mm).

**Results**

The total technical success rate was 75.46%. Immediate postoperative endoleak was detected in 19 cases (19/163, 11.65%) on postoperative aortogram. In the hybrids procedures for aortic dissection treatment (n:43), 17 carotid–carotid by pass, 28 carotid–subclavian by-pass, 6 carotid–carotid subclavian by-pass, 3 transposition carotid–subclavian, 12 aortic branch trunk–braquiocephalic, subclavian and carotid arteries. The incidence rate of stroke in this group was 6,97% (3/43). During follow-up, 3 patients died. One died of abrupt haemoptosis of unclear reason. One died of a ruptured pseudoaneurysm secondary to surgical replacement of the thoraco-abdominal aorta for dissected aortic aneurysm 19 months after TEVAR. Procedural success was reported in 95.70% of patients. Major complications were reported in 6 patients, 2 retrograde dissection and 4 paraplegias (1 total recovery). Overall survival rates were 70.37% at 30-day. 2.7% of patients died over the follow-up period. The left-carotid–artery was occluded in 3, with extra-anatomic bypass associated. The left-subclavian–artery was occluded in 14 with no complaints of arm ischemia. 6 patients (13.95%) required 7 secondary interventions, for proximal or distal endoleaks in 8, continued perfusion of false lumen from distal re–entry sites in 6, continued perfusion of false lumen from left–subclavian–artery in 1 and surgical treatment in one retrograde dissection.

**Discussion**

The chimney technique is expected to prevent an endoleak by prolonging the proximal landing zone. Therefore, the chimney technique should not be recommended for aortic dissection with the tear or false lumen located at the greater curvature or for a true aneurysm with fusiform intumescence.

It is reported that retrograde type A aortic dissection is a rare but lethal complication after TEVAR. The incidence rate of retrograde type A aortic dissection after TEVAR was already 2.5%. One patient with acute type B aortic dissection in this group developed a type II endoleak after TEVAR, which can increase the shear stress on the aortic arch, strengthening interaction among the aortic stent graft, the chimney stent and the fragile aortic wall and causing retrograde type A aortic dissection 3.5 months after TEVAR. He was converted to open surgery and underwent total arch replacement combined with stented elephant trunk implantation.

Multiple factors contribute to endoleak development in the treatment of dissections. Aortic arch disease is a challenging clinical problem, especially in high–risk patients, in whom open repair can have
morbidity and mortality rates of 30% to 40% and 2% to 20%, respectively. Aortic arch chimney (AAC) stents used during thoracic endovascular aortic repair (TEVAR) are a less invasive treatment strategy than open repair, but the current literature is inconclusive about the role of this technology. The focus of this analysis is on our experience with TEVAR and AAC stents.

Endovascular stent graft placement has evolved into an effective treatment modality of various disease states of the aorta, particularly in the complex anatomic regions of the arch extending to DTA. This technology continues to evolve at a rapid pace, leading to its wide acceptance. The major advantage of this approach is the avoidance of DHCA. This technique requires suitable “landing zones” (minimum 2 cm of “normal” aortic segment) for secure stent graft fixation, which in our case was the ascending aortic prosthetic graft. Surgical bypass grafting of the supra-aortic trunks provides the extended proximal landing zone to facilitate optimal stent graft apposition. The stent graft deployment may be done synchronous with the debranching procedure including the option of antegrade deployment through a side graft attached to ascending aortic graft although many surgeons consider performing them in a staged manner to lessen the magnitude of physiological stress to the patient, as was done in the present case. Controversy exists over the management of left subclavian artery (LSA) in such cases. While a few authors have recommended safe intentional coverage without revascularization, others have shown higher incidence of neurological sequelae and arm ischemia if no bypass was given to LSA. Left subclavian artery revascularisation is recommended in specific instances if stenoses and abnormalities of the supra-aortic and intracranial arteries are present or entire descending thoracic aorta needs to be relined.

Conclusions

Endovascular treatment in Aortic Dissection is technically feasible. Although minimally invasive, major complication occurred in low cases of patients, with very low incidence of paraplegia. Acute and mid-term morbidity and mortality of this treatment appear to favourably compare with open surgical but further studies are necessary to compare endograft exclusion with medical treatment in Aortic Dissection. Hybrid techniques certainly constitute an effective strategy in patients who are elderly with significant comorbidities unfavourable for open surgical repair, although the long-term results in terms of reoperations or reinterventions are still awaited.

References


Frank Vermassen

Professional Career
1977-1984  Medical studies at the Ghent University - graduated as M.D. in 1984, maxima cum laude
1984-1990  Surgical training at the Ghent University Hospital, dept. of general, thoracic and cardiovascular surgery
1990 - 1991  Fellow at the department of cardio-thoracic and vascular surgery at the Sint-Antonius Hospital, Nieuwegein (the Netherlands)
12/1/1991  Recognition as specialist (consultant) in surgery
22/05/1991  Doctor in biomedical sciences (PhD): maxima cum laude - Ghent University
Title: Venous allografts for vascular reconstructions
1991 - 1995  Associate head of clinic at the department of general, thoracic and cardiovascular surgery, Ghent University Hospital
1995 - 2001  Head of clinic at the department of general, thoracic and cardiovascular surgery, Ghent University Hospital
Since 1997  Recognition as head of training in vascular surgery
Since 2001  Chief of the department of thoracic and vascular surgery, Ghent University Hospital
Since 10/2000  Professor at Ghent University
Since 09/2011  Chairman of the Division of Metabolic and Cardiovascular Diseases at Ghent university Hospital

TEVAR treated Type B Aortic Dissection natural history
Vincent Riambau

ESVS Past President
President SITE
President Endovascular Foundation
Director of VR Vascular Centre at TEKNON MEDICAL CENTER Barcelona
Professor and Chef of Vascular Surgery Division at CardioVascular Institute, Hospital Clinic, University of Barcelona

Petticoat technique: rationale, technical options

The aims of TEVAR for Aortic type B dissection are: closure the main entry tear, reduce the false lumen pressure, increase the true lumen pressure in order to achieve a false lumen thrombosis and late aortic remodelling, avoiding further aortic complications.

The Provisional Extension To Induce Complete Attachment (PETTICOAT), was introduced by C. Nienaber in 2008. He was looking for a better remodelling reaction after TEVAR. It consists in to prolong the cover thoracic stent-graft with a bare aortic stent crossing the visceral ostia. Stabilising the lamella, it was believed that the pressure in the false lumen would decrease, increasing the true lumen flow and inducing false lumen thrombosis and subsequent remodelling thereafter.

Results from the literature demonstrated an improvement in remodelling distally to the stent-graft. However, that improvement was less than expected. New modalities like the so-called Stabilize Petticoat is gaining popularity and could offer better remodelling effect than the simple self-expandable bare stent deployment. Nevertheless, still it is too early to assure the effectiveness of this Petticoat modality. Another modality is related to the deployment method. Some authors prefer to deploy first the bare stent and the stent-graft latter, proximally and with an overlapping with the previous one. It see to be safer in terms of prevention of SIDRs and quite effective regarding the false lumen thrombosis and the higher volume for the true lumen.

Another important issue that could be improved by the Petticoat technique is the maintenance of the end organ perfusion. Classical Petticoat technique is safe and useful for the mal-perfusion syndrome. Its Stabilise modality can offer even better results in these adverse scenarios.

In conclusion, Petticoat technique improves end-organ perfusion. However, there is no evidence of improved short and mid-term survival as well as positive remodelling of the false lumen in the distal aorta. At the moment, a widespread use of the PETTICOAT technique is not justified and it should be limited to cases complicated by dynamic mal-perfusion as a bailout adjunctive tool. STABILISE Concept is feasible and promotes better rates of aortic remodeling.
Medically Treated TBAD Natural History

Terminology
In light of contemporary concepts in aortic pathology we consider the pathology of acute aortic syndrome (AAS) described in 2001. It embraces a heterogeneous group of patients with a similar clinical profile that includes penetrating atherosclerotic aortic ulcer, intramural aortic haematoma, and the classic aortic dissection. AAS is characterised clinically by aortic pain in a patient with a coexisting history of hypertension.

Pathogenesis
Although no pathogenetic mechanism is common to all aortic dissections, classic aortic dissection frequently exhibits the presence of an intimomedial flap and an entrance tear. At pathology, aortic dissection is characterised by a separation of the aortic media of variable longitudinal and circumferential extension. The outer part of the aortic media will form with the adventitia the false channel outside wall, whereas the rest of the aortic media will constitute with the intimal layer to form the intimomedial flap.

Classification
It’s considered as “acute” when the diagnosis is made within two weeks of the initial symptoms. The definition of an acute dissection is even not uniform in that several pathologies, such as intramural hematoma and penetrating aortic ulcer that may evolve to a dissection. Acute dissection of the ascending aorta are considered as DeBakey I or II, or Stanford A, and if dissection of the aorta occurs in the descending aorta, DeBakey III or Stanford B.

Incidence
Around 5–10 per 100,000 inhabitants each year and probably raising in the near future.

Risk Factors
Hypertension, male gender, smoking and previous aortic wall diseases (connective tissue diseases) are the main risk factors.

Natural History
In AAS chest pain is characteristic and has been called “aortic pain”. The recognition of pain associated with these progressive aortic lesions is of paramount importance. A severely intense, acute, searing or tearing, throbbing, and migratory chest pain, denotes that the patient may have an AAS.

Moderate to severe hypertension is a universal risk factor for the development of AAS.
Aortic dissection also may cause symptoms that are commonly attributable to other acute conditions. For example, aortic dissection can mimic a heart attack, stroke, or acute abdominal conditions, or a patient may present with an ischemic limb. These vastly different conditions can produce very different symptoms, but all can be explained by compromised arterial inflow to some branch of the aorta due to aortic dissection.
Diagnosis
With the objective yet to confirm, classify and delimit the extent, differentiate true and false lumen, locate intimal tears, assess side branch involvement and detect extravasation. Then it is possible to make some determinations with: transoesophageal ultrasonography, CTA scan, MRI and angiography.

Medical Treatment
The initial target of medical treatment is pain relief and to reduce the systolic blood pressure. Basic medical treatment comprises β-blockers, diuretics, calcium-blockers, and angiotensin converting enzyme-inhibitors within the acute phased additional α-blockers, as well as nitroglycerine.

The primary aim of this approach is to obtain a systolic blood pressure between 100 and 120 mmHg, with the maintenance of an urinary output and prevention of malperfusion of the visceral organs.

Complicated TBAD was defined as the presence of one or more of the following conditions: resistant hypertension despite adequate medical therapy, persistent pain, end organ malperfusion, impending rupture, rupture or central/peripheral neurological complications.

In theses cases the endovascular and surgical treatment are usually performed. But in uncomplicated TBAD, the controversy between medical vs endovascular treatment is not currently resolved.

Discussion
We analysed the current state of evidence, considering Medically treated TBAD natural history, in order to select the best option, for the individual patient.
Planning to treat uncomplicated TBAD.
Which time limits are important?

It is very well known that the uncomplicated Type B Aortic Dissections (TBAD) are not so benign over the follow up. Up to 50% of the identified uncomplicated TBAD will develop aortic complications over the years. Different predictors on outcome for the natural history of the TBAD have been described in the literature.

Nowadays we can identify some morphological and functional unfavourable predictors factors and we have some moderate evidence about the benefit of TEVAR over the best medical treatment, especially when it is applied in subacute phase. However, no clear score or decision-making algorithm has been accepted by consensus in order to be applied in the real clinical practice.

The current knowledge we have has been reflected in the most recent European guidelines. We should consider TEVAR in uncomplicated TBAD when we identify the so-called “aorta at risk” (see Table 1).

Table 1

<table>
<thead>
<tr>
<th>Author</th>
<th>Significant predictor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loewe</td>
<td>Entry tear at the concavity of the distal aortic arch</td>
</tr>
<tr>
<td>Kato</td>
<td>Entry tear in thoracic aorta</td>
</tr>
<tr>
<td></td>
<td>Maximal aortic diameter ≥40 mm</td>
</tr>
<tr>
<td></td>
<td>Perfused FL</td>
</tr>
<tr>
<td>Weiss</td>
<td>Short distance between entry tear and LSA</td>
</tr>
<tr>
<td>Evangelista</td>
<td>Main entry tear size &gt;9 mm</td>
</tr>
<tr>
<td>Song</td>
<td>Initial FL diameter of the upper descending thoracic aorta ≥22 mm</td>
</tr>
<tr>
<td>Andaché</td>
<td>Dissection extending to the infrarenal aorta</td>
</tr>
<tr>
<td>Tsai</td>
<td>Partial thrombosis of the false lumen</td>
</tr>
<tr>
<td>Jo</td>
<td>Re-elevation of d-dimer levels</td>
</tr>
<tr>
<td>Karmonik</td>
<td>Increased wall shear stress (&gt;10 Pa) at the posterior wall of the false lumen adjacent to the entry tear</td>
</tr>
</tbody>
</table>

Modified from Capoccia L and Riambau V, Ann Vasc Surg 2013

In Summary,
• More than 50% of uncomplicated ATBAD become complicated
• Some predictors on outcome define Aorta at risk
• Aorta at risk would benefit most from early intervention (Subacute phase)
• This benefit should be proven to reach more evidence
Chimney variations in the arch. How to make them work
Visceral malperfusion in aortic dissection, is flap disruption still an option?

Visceral malperfusion is one of the most insidious and threatening complication of acute aortic dissection. Malperfusion syndrome is defined as reduced blood supply to vital organs, with subsequent ischemia and impairment of their function. The pathophysiology of malperfusion syndrome in aortic dissection is by a dynamic compression of the true lumen due to false lumen pressurization, or by a static mechanism due to extension of the intimal flap into the branch vessels and subsequent occlusion of the true lumen. Frequently, a combination of both mechanisms is at the basis of malperfusion syndrome onset.

Approximately 30% of patients with type A aortic dissection (TAAD) suffer from malperfusion syndrome, whereas the incidence in type B aortic dissection (TBAD) is approximately 20%. Correct management and timing of aortic repair in the setting of visceral malperfusion remains a subject of debate.

Prognosis of patients suffering from TBAD complicated by organ malperfusion is definitely worse than uncomplicated patients. International Registry of Acute Aortic Dissection (IRAD) described visceral ischemia in 7.1% of patients with TBAD with an in-hospital mortality rate of 30.8% in patients with visceral ischemia vs 9.1% in those without (OR = 3.33, P < 0.0001).

TBAD complicated by organ malperfusion was historically treated by open surgical repair, consisting of replacing the diseased aorta by a graft. This approach, although associated with a resolution of malperfusion in most of cases, carried a not negligible mortality rate. Surgical aortic fenestration is an alternative technique in which a hole is created in the dissection flap, thus creating a single lumen that resolves the malperfusion. Panneton et al reported the results of 7 patients who underwent elective aortic fenestration for TBAD. Two of them had fenestration in the descending thoracic aorta, and one had concomitant fenestration and thoracoabdominal graft replacement. No postoperative death occurred in this series.

During last decades, the endovascular techniques were introduced with the aim of reducing the morbidity associated with open operations.

Endovascular treatment of patients with TBAD complicated by organ malperfusion is based on the concept to promptly resolve visceral malperfusion, which represents the real life-threatening condition, and not necessarily this means to cover the aortic primary entry tear. Endovascular approach to malperfusion syndrome in patients with aortic dissection consists in an endovascular flap fenestration, with spot stenting of the branch vessel if static obstruction is present.

In case of large primary entry tear and collapsed of the true lumen at level of visceral aorta, this technique may be associated with proximal thoracic endovascular aortic repair (TEVAR), optionally followed by distal aortic extension with bare metal stent ("PETTICOAT technique"), in order to promote true lumen expansion and future remodeling.

Endovascular repair has emerged as the treatment of choice in those patients who present with TBAD complicated by malperfusion syndrome. By reducing flow into the false lumen with coverage of the primary entry tear, and the lack of adequate re-entry tears in TBAD with dynamic malperfusion, TEVAR promotes false lumen thrombosis and has been demonstrated to show favorable aortic remodeling in recent reports. However, TEVAR alone might not always relieve symptoms of organ malperfusion. The simultaneous occurrence of static obstruction should be investigated and treated, if necessary, by ancillary endovascular procedures.
References

New changes, new solutions for open repair of thoracoabdominal aortic pathology

Vascular Surgery, a branch of surgery devoted to the management of arterial diseases, was created and later expanded in clinical practice in the second half of the XXth century, following the pioneer discovery of the technique of endarterectomy by João Cid dos Santos, in Lisboa, in 1946. Several other techniques and methods were later introduced, thanks to the ingenuity and creativity of distinguished surgeons, including the use of venous conduits and prosthetic grafts, having increased and expanded their field of activity in the management of occlusive or aneurysmatic diseases, rendering vascular surgery, at the end of the century, an independent, reliable and peculiar speciality of contemporary medicine.

It was also in an era close to the term of the century that a new therapeutic approach was introduced by Juan Parody in 1991, the endovascular treatment of aortic aneurysms, that slowly and gradually gained popularity, credits and expansion, thanks to the efforts, investments and creativity of the health industry, together with the enthusiastic support of distinguished vascular surgeons.

Its progressive and growing expansion experienced in the last decades was in part due to its less invasive character, rendering the endovascular treatment an extremely attractive method, not only for patients, as well as for the young generations of vascular surgeons.

As a consequence of such modification of concepts and attitudes, the conventional vascular surgery (now named “open”) suffered a remarkable and progressive reduction of activity, becoming an almost “close to extinction” methodology for the management of occlusive and aneurysmatic diseases, in the present and modern times.

The assumption of this phenomenon has, however, raised some concerns, not only scientific-based as well as educational, due to the presently well recognized selectivity, limitations and contra-indications of the endovascular treatment, facing some features and challenges of aortic pathology.

These facts, associated to the poor long term results that some endografts exhibit along the years, has called the attention again for the past and for the real value, feasibility and durability of open repair in the management of complex and demanding aortic pathology, as the author intents to demonstrate, displaying some exemplar cases of its own experience.

(Marfan syndrome and large and extensive thoracoabdominal aortic dissecting aneurysms; large and ruptured thoracoabdominal aortic aneurysm; Takayasu’s aorto-arteritis; ruptured mycotic aneurysm of the thoracoabdominal aorta; coral reef aortic occlusive disease; congenital abdominal aortic coarctation).
Eric Verhoeven

- Vascular Surgeon
- Chief, Department of vascular and endovascular surgery, Klinikum Nürnberg, Germany

Eric Verhoeven was born in Belgium in 1960. During his youth, he lived and followed school in different countries including Germany and France. He received his MD degree at the University of Leuven (Belgium) in 1988, which was followed by a residency in General Surgery. After graduating in General Surgery (1994) he moved to The Netherlands for a fellowship in Vascular Surgery at the University Medical Center Groningen, and accepted a position as Consultant Vascular Surgeon one year later.

His major task and interest was to set up an endovascular programme in cooperation with the surrounding peripheral hospitals. This resulted in a large endovascular experience with more than 1500 endovascular cases in Groningen. Later, he focused on the endovascular treatment of ruptured aneurysms under local anaesthesia, and the treatment of complex aortic aneurysms with fenestrated and branched stent-grafts.

In 2005, he completed his PhD entitled “Endovascular Aneurysm Repair: Results and exploration of new frontiers” at the University of Groningen.

In November 2009, he accepted a position as chief of the department of Vascular and Endovascular Surgery in Nürnberg (Germany). His main interest here is also the fenestrated and branched programme, with a total experience of now more than 700 cases.

In January 2011, he was awarded a guest-professorship of Surgery at the University of Lisbon, Portugal.

In October 2011, he accepted a part-time Professorship in Vascular Surgery at the University of Leuven, Belgium.

He presented results of his work in numerous congresses with more than 600 official presentations, and has published over 200 articles and book chapters.

He is a reviewer for numerous journals and an editor for JEVT, EJVES, and the Polish Journal of Vascular Surgery.

He is married with Margo; together they have two sons (Daniel, 8, and Anthony, 7).

Other interests include a wide variety of sports and traveling. He speaks several languages (Dutch, French, German, English, Spanish and some Italian).

Failed EVAR/EVAS. Is postponing open conversion only delaying failure?

GREAT Registry: Latest clinical evidence in a real world registry
Inflammatory AAA. Open, endo, when?
Renal and visceral debranching – still an option, really?
Nilo Mosquera

School of Medicine and Surgery, USC (Santiago de Compostela University)

**Ph Dr Courses**: Surgery and Anesthesiology Advances Course.

**Research sufficiency titulation** reached in September 2004. USC.

**FELLOWSHIP**
MIR examination 2000 (Year 2001): Qualify Number 641/9122
Fellowship: **Angiology and Vascular Surgery. 2001-2006.**
General Surgery Department: 2001–2002
CHUS (Clinical and University Hospital of Santiago de Compostela)


**CURRENT POSITION**
AEA: Angiologist and Vascular Surgeon
Endovascular Therapy Area Director.
Angiology and vascular Surgery Department.
Complejo Hospitalario Universitario de Ourense. (CHUO)

**Bridging stent grafts selection in fEVAR. Critical issue**
Renal—visceral complications during and after TAAA repair

Endovascular repair of thoracoabdominal aortic aneurysms has increased in popularity in modern vascular practice, and several groups have demonstrated good perioperative and midterm outcomes even in patients with significant comorbidities.\(^1\)\(^,\)\(^2\)\(^,\)\(^3\) The use of fenestrated and branched endografts (F/B-EVAR) is however associated with additional technical challenges in comparison to standard endovascular repair of thoracic (TEVAR) or abdominal (EVAR) aneurysms, mainly due to the fact that renal and visceral vessels need to be secured with stent-grafts. This makes planning and execution of the procedure more complex and can result in reno-visceral complications during the procedure as well as during follow up (FU).

During planning, correct alignment of fenestrations with the target vessels is crucial to avoid stent-graft kinking and possible Target vessel occlusions. The use of fenestrations or branches in thoracoabdominal devices is dictated by specific patient anatomy, with fenestrations being applied mostly in cases of focally narrow aortic diameters and branches being applied in aortic diameters >25mm as well as in acute cases, due to the availability of off-the-shelf devices. Despite the fact that both configurations are associated with good patency rates, a recent retrospective multicenter study has demonstrated that endograft designs incorporating renal fenestrations rather than renal branches are associated with significantly lower occlusion rates\(^4\).

During the procedure, renal and/or visceral complications can arise due to incorrect deployment of the main stent-graft. This can result in inability to catheterize one or more target vessels, especially in the case of angulated anatomy or orifice stenosis of target vessels. Especially in the case of fenestrations it is important to utilize the device’s single- or doublediameter reducing ties and ensure that at least two target vessels are catheterized and fitted with the proper stent-grafts before complete deployment of the main stent-graft. In case of target vessel catheterization failure over the groin and the axillary artery, a retrograde approach through the distal segment of the target vessel can be considered as a bail-out measure\(^5\). Other intraoperative complications include target vessel dissection or perforation during catheterization maneuvers. These complications can be avoided with use of a standardized catheterization technique, applying a soft 0.035” wire for primary target vessel catheterization, followed by a stiff wire to facilitate stent-graft deployment into the target vessel. In case a dissection of a target vessel occurs, the best bail-out option is to extend the stent-graft deeper into the target vessel and realign with a self-expandable bare-metal stent. Finally, in the case of fenestrations, caution has to be taken, not to crush already deployed stent-grafts during flaring maneuvers. To avoid this, sequential stenting and flaring of target vessel stent-grafts is advised, beginning with the more caudally positioned target vessel\(^6\).

Post procedurally, mid-term outcome for renal and visceral arteries is dependent on several factors, such as preoperative anatomy, type of thoracoabdominal aneurysm (atherosclerotic/post dissection), target vessel diameter and angulation as well as medical therapy. Rigorous follow up is paramount, with the use of contrast-enhanced ultrasound and computed tomography angiography (CTA) to promptly recognize target vessel stenosis and possible endoleaks.

Strategies to treat complications include stent-graft extension deeper into the target vessel for the distal endoleaks and balloon angioplasty or relining, when necessary, for stenosis. The effect of stent-graft choice on renal and visceral outcome has recently been studied in a retrospective multi-center study\(^6\). There appears to be no difference in occlusion or reintervention rate for branch vessels mated with balloon-expandable compared with selfexpandable stents. Renal events however, appear to outnumber visceral events. In the case of target vessel occlusion, revascularization options include endovascular measures such as the use of local thrombolysis or relining with additional stent-grafts, as well as conventional open surgery with a bypass to the respective target vessel. In any
A short time interval between occlusion and revascularization time is the deciding factor for the reintervention outcome.

References

Nilo Mosquera

School of Medicine and Surgery, USC (Santiago de Compostela University)

**Ph Dr Courses**: Surgery and Anesthesiology Advances Course.

**Research sufficiency titulation** reached in September 2004. USC.

**FELLOWSHIP**
MIR examination 2000 (Year 2001): Qualify Number 641/9122
General Surgery Department: 2001–2002
CHUS (Clinical and University Hospital of Santiago de Compostela)


**CURRENT POSITION**
AEA: Angiologist and Vascular Surgeon
Endovascular Therapy Area Director.
Angiology and vascular Surgery Department.
Complexo Hospitalario Universitario de Ourense. (CHUO)

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Low Profile Endoprosthesis: 5 years results
Nexus graft: A different concept for the arch

Background
Conventional surgical or hybrid repair of aortic arch aneurysms carries substantial risk of mortality and morbidity. There are numerous unique challenges in endovascular solution for aortic arch pathologies. Currently, there are no approved endovascular dedicated devices for aortic arch repair. The Nexus™ (Endospan Ltd., Israel) aortic arch endograft system represent a novel concept for endovascular treatment of Zone 1 to 4 aortic arch pathologies. The specific challenges, solutions, midterm results and remaining challenges will be presented.

Methods
Nexus™ endograft system is a two module system. The main module is a branched endograft deployed over a brachio-iliac through & through guidewire from the innominate artery, across the aortic arch to the descending thoracic aorta. The second module is then deployed in the ascending aorta with a unique self-protruding sleeve for fixation and sealing between the two modules. Due to the geometric complexity and variability of the aortic arch, a unique pre-procedural planning and training are performed on a patient specific elastomeric 3D printed model.

As of March 2017, 25 patient were enrolled in the FIM study or compassionate use of the Nexus™ arch endograft. All patient were considered as high surgical risk or non-operable. Peri-procedural outcome and up to 2 years follow up will be presented.

Results
Successful implantation of the modular graft was achieved in 100% of patients. There was one patient with type Ia/III endoleak (4%). There were four cases (16%) of type Ib endoleak (from parallel graft gutters). There were 3 mortality cases (12%), of them, 2 cases within 30 days and one case 2.5 months post procedure. CVA rate was 12%, and LV perforation 4%. There was no graft migration or side branch occlusion.

Conclusion
The Nexus™ is a unique dedicated arch endovascular device. Midterm results of first 25 patient implanted shows promising safety and effectiveness profile compared to historical surgical cohorts. Compassionate use is optional worldwide.
Piotr Kasprzak

• Prof. Dr. med. Piotr M. Kasprzak is vascular and endovascular surgeon at the University Hospital in Regensburg, Germany, since 1995 and works as a head of the Department of Vascular Surgery. He graduated at the Medical University in Lodz, Poland, in 1974. He specialized in vascular surgery in 1980 – 1981 in Vienna (Prof. Dr. H. Denck). Between 1984 and 1995 he was Deputy Director in the Clinic of Vascular Surgery in Nuremberg (Head Prof. Dr. D. Raithel). His main interest are carotid pathology and aneurysmal disease as well as sonographic evaluation and follow-up.

EndoAnchor fixation in the thoracic aorta – primary use or repair

Complexity of thoracic stent graft implantation in an curved proximal aortic segment will increase the risk of stent graft non-alignment, migration and development of type I endoleaks probably leading to aneurysm expansion and secondary rupture. Especially in steeply angled aortic arch configurations proximal stent graft apposition in the aortic arch is frequently poor with relevant risk of stent graft infolding or collapse and fatal outcome in some patients.

The EndoAnchor stent graft fixation system, initially introduced for endoanchoring in the infrarenal aorta, can now also be used in the thoracic aorta having a longer working sheath with three different deflectable tip sizes for better device stability and steerability. The indications for EndoAnchor implantation in the thoracic aorta or the aortic arch are to some extent similar to the indications for EndoAnchor use in infrarenal aortic aneurysm with short infrarenal necks (hostile neck) to prevent complications as a primary procedure. In other cases as a secondary repair option to treat type I endoleak, migration (using additional cuff), stent graft non-alignment or stent graft infolding.

The multicenter experience with the use of EndoAnchors for primary use or prevention of complications in infrarenal aortic aneurysms was documented in the ANCHOR registry with good results. However, EndoAnchor implantation for stent graft fixation in the thoracic aorta and the aortic arch will additionally have to consider complex endovascular stent grafts with fenestration or branches for perfusion of supraaortic and visceral arteries with an increased risk of cerebrovascular or visceral embolic events leading to stroke or major renovisceral malperfusion.

Especially in the thoracic aorta and the aortic arch it is important to visualize the EndoAnchor system precisely before implantation of the anchors can be performed. The ring marked tip of the EndoAnchor application system has always to be oriented in a right angle position to the stentgraft and the aortic wall. In the aortic arch rotation and orientation of the introducer sheath and the tip of the EndoAncor system can be difficult and therefore, it is recommended to control the position of the tip of the implantation device in at least two different planes under fluoroscopy. According to the technical principle and the two-step release mechanism of the EndoAnchor implantation device the EndoAnchors are partially screwed into the aortic wall, when the position and direction of the anchors can be controlled again. This first implantation step still allows a backward retrieval of the EndoAnchor and within the same approach repositioning of the application device to achieve the best orientation for EndoAnchor release. It is important that the stent graft has close apposition to the aortic wall for secure fixation with the EndoAnchors based on their length of 4.5 mm. Usually a transfemoral approach is selected for insertion of the introducer sheath, although for stent graft fixation at the inner aortic curvature a left axillary access might be useful.

Based on our experience perioperative complications are very low without and no hemorrhage of damage to the aortic wall or the stent graft was observed. Stent graft fixation using EndoAnchors for non-alignment, type Ia endoleak, migration or partial infolding secondary repair or prevention of complications was effective, safe and durable during follow-up. However, in few patients EndoAnchor stent graft fixation did not prevent proximal aortic expansion proximal to the fixation site, as initially expected by technicians.

In summary, according to our experience and the data reported in the literature the Heli-FX Thoracic EndoAnchor System is a valuable option for primary preventive stent graft fixation and secondary repair of complications during or following endovascular thoracic aortic repair.

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J. Fernandes e Fernandes

• Department of Vascular Surgery, Hospital Santa Maria-CHLN, Faculty of Medicine University of Lisbon

New challenges, new endovascular solutions for aortic disease
Immediate post intracranial thrombolysis
carotid stenosis management

85% of stroke are ischemic; of these, 25% are of athero-thrombotic origin and proximal internal carotid artery stenosis or occlusion have the grater role.

The ischemic stroke has a high rate of recurrence: between 30–45% of patients who have suffered a stroke will have another one in the next five years.

A high rate of early proximal re-occlusion or severe residual stenosis was observed in tandem occlusion.

The immediate and long-term durability of carotid angioplasty alone is likely to be lower than with stenting.

Acute extracranial stenting combined with anterior circulation thrombectomy is a routine procedure, but is still controversial.

The risk of intracranial hemorrhage associated with early reperfusion might be increased because of hyperperfusion syndrome and the requirement of antplatelet agents after stent placement.
CEA and CABG: before, at the same time or never?

Introduction:
Cerebrovascular complications, as perioperative stroke, are among the most feared consequences after coronary artery bypass graft surgery (CABG). Patients with concomitant cerebrovascular and coronary heart disease represent a subset with advanced atherosclerosis in whom other areas of the arterial system are also involved.

Pathophysiology:
The main mechanisms of ischemic stroke associated with CABG surgery are cerebral hypoperfusion and atheroembolization, particularly from the aortic arch, implying that atherosclerosis of the ascending aorta may be a more important cause of perioperative stroke than carotid artery stenosis. However, the presence of a symptomatic carotid artery stenosis – bilateral 50 to 99% carotid stenosis or total carotid occlusion on one side combined with a 50 to 99% carotid stenosis on the other side, increases the risk of a perioperative stroke in patients undergoing CABG.

Timing of revascularization:
Operating on the carotid lesion first might increase the risk of myocardial infarction, while operating on the coronary lesion first might increase the risk of perioperative stroke.

a) Combined or synchronous procedure
Patients undergoing CABG who are selected for carotid revascularization, a combined procedure is suggested with carotid endarterectomy (CEA) plus CABG, rather than a staged procedure, for those who have severe left main coronary artery disease, diffuse coronary heart disease without satisfactory collaterals, or unstable angina.

b) Staged carotid revascularization before CABG
A staged carotid revascularization with CEA or carotid artery stenting (CAS) before CABG, rather than a combined procedure, is suggested for patients with chronic stable angina in the absence of a recent myocardial infarction. CAS immediately prior to CABG is not indicated due to the need of dual antiplatelet therapy.

c) CABG after stroke
Patients with a prior history of stroke or transient ischemic attack (TIA) have an increased risk of perioperative stroke with CABG, which may be as high as 8.5%. Timing of cardiac surgery after a stroke should include sufficient delay to allow identification of the cause of stroke, restoration of cerebral autoregulatory mechanisms, and remodeling of the parenchymal damage to minimize the risk of hemorrhagic transformation. Unless emergent cardiac surgery is warranted, we suggest a delay of at least a month, longer for strokes involving larger territories.

Prevention:
Preoperative evaluation for identification and potential treatment of preexisting stroke risk factors, including aortic atherosclerosis and carotid stenosis and medical therapy (aspirin, antithrombotic drugs, statins, and antihypertensives).

Conclusion:
There is no consensus regarding the effectiveness or staging of prophylactic carotid revascularization in patients scheduled for CABG. Data suggest that most perioperative strokes are not preventable by carotid revascularization.
References
Are the indications for carotid surgery with or without CABG the same?

Introduction

Indication to invasive carotid treatment can vary depending on the plaque characteristics and, of course, the characteristics of the patient.

The incidence of significant carotid stenosis in patients undergoing CABG ranges between 2.8% and 22%, and up to 40% of patients undergoing CEA could have significant concomitant coronary artery disease.

Development of the topic

According to the SAPPHIRE trial, high-risk patients with medical comorbidities present with one of the following features:
- congestive heart failure (New York Heart Association class III/IV) and/or a known severe left ventricular dysfunction;
- open heart surgery needed within 6 weeks;
- recent MI;
- unstable angina (Canadian Cardiovascular Society class III/IV);
- severe pulmonary disease.

As a rule, patients with mild or moderate coronary artery disease can be submitted to CEA with low-to-mild perioperative risk. Nevertheless, in high-risk patients with severe coronary artery disease and critical carotid stenosis, risks and benefits of invasive carotid revascularization should be carefully evaluated, so that the optimal surgical strategy remains debatable. If performing CEA before treating the coronary stenosis exposes the patient to an increased risk of acute coronary syndrome, and performing CABG before treating the carotid lesion could increase the risk of perioperative stroke, performing both operations simultaneously could expose the patient to a prohibitively high surgical stress.

It has to be recognized that the onset of stroke after CABG can be multifactorial (atherothrombotic debris from the aortic arch or carotid axes embolization, atrial fibrillation, low cardiac output, and hypercoagulation states), since in patients with carotid stenosis who undergo CABG, without intervention on the carotid arteries, only 40% of postoperative strokes are ipsilateral to the carotid lesion. Moreover, only a quarter of the strokes in patients with combined carotid and coronary surgery are exclusively ipsilateral to the carotid stenosis, while symptomatic patients or asymptomatic patients with significant bilateral stenoses or contralateral occlusion may be considered at higher risk of stroke during cardiac surgery.

According to the European Society of Cardiology (ESC) guidelines it could be considered reasonable to propose carotid revascularization in patients scheduled for non-emergency CABG with recent (6 months) TIA/stroke and symptomatic carotid stenosis, and in selected patients with high-grade, asymptomatic carotid stenosis, particularly in the case of bilateral stenosis. On the other hand, the European Vascular Surgery (ESVS) guidelines on carotid treatment published in 2009 clearly state that “Until data from randomised trials are available, the surgical approach to the patient with simultaneous severe coronary and carotid artery disease should be individualised, based on the specific risk profile of each patient (class C recommendation).”

Several single centers experiences have reported excellent results in both simultaneous and staged CEA/CAS and CABG. Depending on the team experience, patients with both significant carotid and coronary stenosis can be offered an invasive rather than a medical treatment. Anyway, the role of modern medical therapy should be properly acknowledged; in some experiences antiplatelet, anticoagulant, or statin therapies have been linked to improved
results in severe atherosclerotic patients in terms of stroke, myocardial infarction and death prevention.

Conclusions

To answer the question, unless high-quality evidence-based data are available on those patients different solutions should be offered to patients with concomitant significant carotid and coronary stenosis, depending on the experience of the vascular specialist and, above all, of the multispecialty team taking care about them in different hospitals, bearing in mind that surgical risk should always be kept to a minimum.
Urgent vs emergent management of symptomatic carotid artery stenosis

Introduction

Carotid endarterectomy (CEA) is recommended for moderate (50-69%) to severe (70-99%) ipsilateral carotid artery stenosis in patients with recent TIA or stroke within the past 6 months if the group perioperative morbidity and mortality risk estimated is <6% (1). The ECST and NASCET post-hoc analysis has shown the greatest benefit from intervention within the 2 days and the first 2 weeks after randomization.

Urgent CEA (uCEA), within 48 hours after the event, has been proposed recently under the concept that reperfusing brain areas could avoid cell death, improving neurologic outcomes. Single centre series have reported much more favourable outcomes when CEA was performed on this time-frame. Besides, since natural history data clearly show that patients are more exposed to recurrent ischemic events in the first few days after symptoms onset, uCEA might be a real option.

The subset of patients who are submitted to IVT probably benefit from eCEA since the reduction of stroke recurrence might be even higher and the opportunity for improvement is greater with earlier treatment. There are scant data as to thrombolysis followed by intervention has an increased risk of complications.

Meta-analysis of uCEA vs eCEA does not demonstrate increase of procedural risk in symptomatic patients comparing to eCEA in selected patients. Intervention until the 48 hours prevents more strokes and reduces hospital length of stay and costs attributed to more severe damage.

Early CEA after intravenous thrombolysis (IVT) seems safe in the 2 days – 2 weeks window in selected patients, although very few reports before the 48h time frame are available.

The approach to carotid endarterectomy patient selection should go along other developments in stroke area, leading to a patient specific optimum therapeutic window.

Bibliography


8TH APRIL
SPEAKEARS
LECTURES
Nilo Mosquera

**Medicine Doctor**, Course 1994–2000
School of Medicine and Surgery, USC (Santiago de Compostela University)

**Ph Dr Courses**: Surgery and Anesthesiology Advances Course.

**Research sufficiency titulation** reached in September 2004. USC.

**FELLOWSHIP**

**MiR examination 2000 (Year 2001)**: Qualify Number 641/9122
Fellowship: **Angiology and Vascular Surgery. 2001-2006.**
General Surgery Department. 2001–2002
CHUS (Clinical and University Hospital of Santiago de Compostela)


**CURRENT POSITION**

AEA: Angiologist and Vascular Surgeon
Endovascular Therapy Area Director.
Angiology and Vascular Surgery Department.
Complexo Hospitalario Universitario de Ourense. (CHUO)

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**Drug eluting vascular stent vs Plain old balloon angioplasty**
Marco Manzi

Current Position:
• January 2007 to present: Director of Interventional Radiology Unit, Foot & Ankle Clinic, Policlinico Abano Terme, Italy

Memberships
• Professional Board at Milan, 1986;
• Member of Interventional Radiology Section of the SIRM (Italian Society of Medical Radiology);
• Member of IESIR (Italian-European Society of Interventional Radiology);
• Member of CIRSE (Cardiovascular and Interventional Society of Europe);
• Honorary Member of IRSA (Interventional Radiology Society of Australasia);
• Member of ESIR (European Society of Radiology).

Didactical activities
• Since 2001 involved in distal revascularization Technical Courses and Workshops;
• Didactical pole of Master in Endovascular Therapies (Milan Bicocca University) for peripheral procedures since 2009;
• Proctoring and tutoring activity with procedures performed in Australia, China, South Korea, Russia, Saudi Arabia, Poland, Portugal, Germany, Japan, India, Malaysia;
• Since March 2012 Registration at Australian Medical Council E100309-4;
• Involved as Faculty invited speaker/live operator in many international congresses and meetings since 2008. Author and co-author of many scientific papers, most on CLI techniques.

Single vs multivessel revascularization
Michael Piorkowski
Consultant and senior interventionalist for angiology and cardiology

03/2014  Speciality board for Angiology
04/2012  Speciality board for Internal Medicine and Cardiology
04/2010–03/2014  Center for Vascular Medicine, Department of Internal Medicine I / Angiology and Cardiology, Park Hospital Leipzig
01/2009–03/2010  Internal Clinic II / Nephrology, Hematology and Oncology, Carl-Thiem-Clinic Cottbus
01/2006–12/2008  Clinic for Cardiology, Heart-Center Cottbus

Deep venous arterialization
Michael Piorkowski
Consultant and senior interventionalist for angiology and cardiology

03/2014  Speciality board for Angiology
04/2012  Speciality board for Internal Medicine and Cardiology
04/2010–03/2014  Center for Vascular Medicine, Department of Internal Medicine I / Angiology and Cardiology, Park Hospital Leipzig
01/2009–03/2010  Internal Clinic II / Nephrology, Hematology and Oncology, Carl-Thiem-Clinic Cottbus
01/2006–12/2008  Clinic for Cardiology, Heart-Center Cottbus

Interwoven nitinol stent vs bare metal stent vs drug eluting balloon
The endovascular management of symptomatic atherosclerotic superficial femoral artery disease is challenging and requires consideration of unique anatomic, hemodynamic, and biomechanical factors. Reduced durability and greater reintervention rates when compared to open surgery have long been the major caveats of endovascular therapy for femoropopliteal occlusive disease.

The use of bare metal stents (BMS) has become common practice to ensure technical success in cases of residual stenosis and flow-limiting dissection after balloon angioplasty (PTA) and to increase patency rates in long and calcified lesions, where results of PTA have traditionally been disappointing. However, mid- and long-term loss of patency remains a problem due to restenosis, which is thought to result from the combination of neointimal hyperplasia as a response to mechanical injury to the vessel wall and the increased biomechanical stress in the femoropopliteal territory[1]. Lessons learned in the field of coronary intervention have led to the development of drug-eluting stents (DES) for peripheral use, which combine the benefits of providing a scaffold against elastic recoil after PTA and delivering antiproliferative drugs to limit neointimal hyperplasia. Early studies of sirolimus- (SIROCCO and SIROCCO II trials) and everolimus-eluting (STRIDES trial) self-expanding nitinol stent platforms for the superficial femoral artery (SFA) demonstrated early efficacy followed by disappointing longer-term results leading to the abandonment of both peripheral DES programs.

Recently, the 5-year results of the Zilver PTX trial comparing a paclitaxel-eluting stent to PTA with provisional BMS have been published[1]. This study included 474 patients with femoropopliteal occlusive disease; of which 236 were randomized to receive primary DES and 238 were randomized to PTA. In the PTA group, 120 patients had residual stenosis and were secondarily randomized to receive a provisional BMS (59 patients) or DES (61 patients). The primary endpoints were event-free survival (EFS) and primary patency. EFS was a combined endpoint defined as freedom from death, amputation, clinically driven target lesion revascularization (TLR) and worsening of the Rutherford classification by 2 classes or to class 5 or 6. At 5 years, the primary DES group showed superiority in both EFS (81.4% vs. 70.1%, p<0.01) and primary patency (64.9% vs. 19.0%, p<0.01) compared to the PTA group. When scrutinizing the provisional stenting groups, patients who received a DES showed superior rates of freedom from TLR (84.9% vs. 71.6%, p=0.06) and primary patency (72.4% vs. 58.0%, p=0.03) at 5 years in comparison with provisional BMS. Interestingly enough, the primary patency rates of primary and provisional DES were not significantly different (72.4% vs. 64.9%, p=0.17).

The overall DES group showed significantly higher rates of freedom from clinically driven TLR (83.1% vs. 67.6%, p<0.01) and primary patency (66.4% vs. 43.4%, p<0.01) when compared to standard care (optimal PTA + PTA with provisional BMS). Analysis of clinical benefit defined as freedom from persistent or worsening symptoms of ischemia after the initial treatment, also showed superiority of the overall DES group over standard care (79.8% vs. 59.3%, p<0.01) and of provisional DES over provisional BMS (81.8% vs. 63.8%, p=0.02). The benefit of overall DES over standard care in terms of primary patency was consistent in several lesion and patient subgroups on univariate analysis, including lesion length > 7 cm, occlusion, diabetic patients and Rutherford class 4-6. The long-term safety of the Zilver PTX stent was also confirmed. Stent fracture rate was 0.9% at 1 year and 1.9% at 5 years. There were no reports of adverse reactions to paclitaxel.

The study is not without limitations: more than 90% of enrolled patients had intermittent claudication as indication for treatment and the mean length of treated lesions was around 6.6 cm (lesions up to 14 cm), 92% of which were confined to the SFA, leaving to question the performance of this technology in critical limb ischemia patients with more extensive and diffuse disease. There was also no comparative analysis with a primary BMS strategy.
Furthermore, it is important to note that although duplex ultrasound was performed on all stented patients out to 5 years, only a subgroup of the PTA patients underwent duplex ultrasound during longer-term follow-up.

To its credit, this study is the largest randomized clinical trial of DES implantation in the femoropopliteal territory and as such constitutes the strongest body of evidence to date in support of DES over standard endovascular therapy.

The results of the Zilver PTX randomized clinical trial are supplemented by a single-arm study and a Japanese Zilver-PTX registry involving a population much more aligned with real-world clinical practice.

In the single-arm study, 787 patients received primary DES. A TASC C/D (Trans-Atlantic Inter-Society Consensus [TASC II]) subset in this single-arm analysis was separately reviewed. This group had a substantial average lesion length of 22.6 cm, yet had a favorable 12-month primary patency of 77.6% [3][4].

The ZEPHYR registry sought to evaluate the performance of the Zilver PTX stent at 1 year and identify predictors of restenosis [5]. Among the 690 patients included, 32% were treated for critical limb ischemia. Mean lesion length was 17 cm and 45% were chronic total occlusions. These figures are a much better approximation to a real-world scenario and can provide a better understanding of how the Zilver PTX stent performs in the more challenging cases seen in clinical practice. The 1-year restenosis rate was 37%, which is perhaps not surprisingly higher than reported in the Zilver PTX trial. A major adverse limb event, defined as major amputation or any reintervention, occurred in 22% of patients at 1 year. Outcomes were somewhat sobering in this more complex population, although no definitive conclusion can be drawn due to lack of a comparative arm.

In a prospective, multicenter, post-market surveillance study of Zilver PTX including 907 patients, Yokoi et al. reported a 91.0% rate of freedom from TLR and a primary patency rate of 86.4% at 12-months [6]. The study population was also of considerable complexity, with 21.5% of patients treated for critical limb ischemia and an average lesion length of 14.7 cm, including 41.6% total occlusions and 18.6% in-stent restenosis.

These results show promise for DES in terms of increasing long-term clinical benefit and decreasing reintervention rates. Nevertheless, an optimal strategy for treating femoropopliteal occlusive disease remains to be determined. Recent clinical experience with drug-coated balloons (DCB) has yielded very positive results in terms of primary patency and freedom from TLR whilst avoiding stent placement. Head-to-head comparisons of DCB and DES are currently lacking and there is insufficient data to identify lesion- and patient-specific features to guide the choice of endovascular technique.

Current available evidence is supportive of the use of DES for femoropopliteal occlusive disease and may constitute a first step in elevating them to standard of care. Still, there are some questions to be answered before they can be considered the gold standard treatment.

References

The importance of conformability in the treatment of complex obstructive lesions in CLI patients
Gaspar Mestres, MD, PhD, FEBVS, is a vascular surgeon of the Vascular Surgery Division – Cardiovascular Diseases Institute, Hospital Clinic, University of Barcelona, Spain.

Dr. Gaspar Mestres was born in 1979 in Barcelona, Spain. He received his MD from the University of Barcelona in 2003, completed the internship and residency in Angiology and Vascular Surgery in Vall d’Hebron University Hospital (Autonomous University of Barcelona) in 2009, obtained the PhD in 2010 in the same university in endovascular aortic surgery research, and achieved the FEBVS in 2011. He is a staff member of the Vascular Surgery Division at the Hospital Clinic (Barcelona, Spain) since 2009, and Clinical Professor of the Faculty of Medicine (University of Barcelona) since 2011.

His current research focuses mainly on endovascular aortic surgery, particularly on late performance of aortic endografts, aortic anatomy modification after EVAR and TEVAR, uncommon complications of endografts, its applications in uncommon diseases or in off-label conditions, and in-vitro performance of endografts in off-label indications, as parallel stent or sandwich technique. He also focuses his medical assistance and research on endovascular peripheral artery disease treatment, and vascular access surgery: access creation and follow-up, pre and intraoperative ultrasound assessment, chronic vascular access flow measurements and dysfunction detection, identification of factors related to early postoperative vascular access thrombosis and imaging study of vascular access anastomosis, role of exercise in access maturation, endovascular treatment of access dysfunction and cardiac or peripheral vascular changes after fistula ligation.

Introduction

The treatment of peripheral artery disease is a challenge for most physicians, for the difficulty in revascularization and the complications during follow-up. Actually, in spite of the widespread preference for endovascular treatment for peripheral lesions, the rate of restenosis and occlusions during follow-up is a key point in decision-making and material selection. Because our goal should not only be a good final image after the revascularization procedure, but long term durability and limb salvage.

Since first peripheral artery angioplasty (Dotter, 1964), endovascular techniques have evolved in order to improve results: stents, drug coated stents, drug coated balloons (DCB), debulking and atherectomy devices, ... Among all these possibilities, the use of DCB offers interesting results. The objective of using DCB is to inhibit neointimal growth of vascular smooth muscle cells after angioplasty (PTA), by releasing different products (paclitaxel), thus preventing restenosis during follow-up. The stent-less technology of DCB offers a unique advantage by providing the same antiproliferative agent through more rapid transfer of drug with a presumably more homogeneous distribution on the luminal surface, as opposed to confined to struts on a scaffold platform (drug coated stents). Moreover, unlike stents, there is no durable or biodegradable polymer carrier or rigid metallic frame with a DCB, thereby avoiding a potential unfavorable chronic foreign body response that could contribute to in-stent restenosis.

The most commonly used drug for DCB is paclitaxel, which allows passive absorption through the cell membrane and a sustained effect within the treated vessel wall. The Lutonix (BARD, New Hope, MN) is a low dose drug coated balloon (using 2.0 paclitaxel mcg/mm2) using polysorbate and sorbitol as carrier excipients to deliver paclitaxel (to avoid inadequate paclitaxel detachment from the balloon). Other balloons can use higher concentration of paclitaxel (up to 3.5 mcg/mm2) and different carriers excipients (iopromide, PEG, urea, polysorbate/sorbitol, ...). Each combination of paclitaxel dose, carrier and balloon technology and design is of upmost importance to precisely deliver and penetrated the drug in the vessel, and obtain the better results during follow-up. Therefore, each DCB is unique and should be evaluated independently of paclitaxel dose.

Development of the topic

Since 2003, the use of DCB has been progressively used, and several series analyzing its results have been published, and since 2008, different DCB have been tested in randomized control trials. However, follow-up, treated lesions, patient and device selection have to be read carefully to understand and properly interpret the results. Thus,
these results cannot be compared directly, and each study has to be analyzed independently.

Referring to Lutonix DCB, several series and studies have been published, all of them reinforcing the usefulness of Lutonix balloon in different peripheral territories. The first randomized published trial was the Levant-I trial, an European trial that randomized (1:1) 101 patients with femoropopliteal disease (stenosis and occlusions), in patients with intermittent claudication (Rutherford 3 and 4), into DCB (Lutonix) or uncoated balloon. It demonstrated, a reduction in late lumen loss (at 6 months: 58% lower for the Lutonix group) and composite 24-months major adverse events (39% for Lutonix vs 46% for uncoated balloons).

After this initial safety and performance study, the Levant-II pivotal trial was performed, randomizing (2:1) more patients (476) with the same anatomical location and clinical severity, also to Lutonix DCB or uncoated balloon. It was a well-controlled prospective, multicenter, randomized trial. In general, it demonstrated better results using DCB than uncoated balloons (at 1 year: primary patency 65.2% vs 52.6%, freedom from primary safety events 83.9% vs 79.0%), and non-published data at 2 years follow-up reports the persistence of patency difference between both groups.

Extensive blinding steps were taken to reduce bias, including physician, technicians, core lab and patient blinding. Indeed, this study was designed to ensure blinding of the evaluating physician and ultrasound exams, at every phase of the study, so the investigators were always unaware of both the index treatment and the duplex ultrasound findings during follow-up, in order to reduce potential bias in decision-making to perform a repeat revascularization procedure (which occurred in other studies). In fact, in this study, among patients with loss of patency during follow-up, the percentage of patients requiring revascularization (reintervention) was similar in both groups (38% vs 37.5%), because physicians did not know the arm treatment and the need of reintervention was decided only based on clinical data. It is completely opposite to what occurred in other trials, where patients with restenosis in DCB arm had a significant tendency towards less reintervention rate than patients initially treated with uncoated balloons (probably to reduce the reintervention percentage in the DCB arm).

Another important characteristic of the Levant-II trial is the exclusion criteria of patients who where likely to require stents, resulting in a low rate of stent use, in comparison to the high rate in other studies. All this very precise terms in study design, improved the study bias but limited the significance of the results and produced general results that could differ from other registries.

The Levant-II trial also showed interesting post-hoc subgroup analysis. Firstly, the full wall apposition of the balloon to the artery ratio (>1.04:1) showed better results than undersized balloons (in this subgroup: 1 year primary patency was 79.9% vs 48.2%, 65.7% improvement!). Also, a reduced transit time <30 seconds, inflation time >120 seconds, final residual stenosis <20% and pressure >7 atmospheres, improved Lutonix results, and should probably be followed in general practice.

After these initial good results, the Lutonix Global SFA Registry was designed as a real world confirmation of the Levant-II results: a prospective multicenter open label patient registry. 691 patients where enrolled, with very promising results: freedom from target lesion restenosis was 94.2% at 12 months, and preliminary results report 89.2% at 24 months. In addition, excellent results where observed in patients with calcified lesions, occlusions, long lesions or female patients, in contrast to expected results in these worst prognosis subgroups.

Other single center studies have also shown a benefit using Lutonix, in comparison to other devices, in reducing distal particle embolization after femoral artery angioplasty (46.2% vs 0%), and published and non-published multicenter registries have seen promising results in below the knee (BTK) arteries (89.3% freedom from target lesions restenosis at 6 months after using Lutonix in BTK). In fact, there is an ongoing randomized clinical trial analyzing the utility of Lutonix in BTK lesions, and despite the good initial results, there still are no official reported results. This is a long-awaited study, because regardless of promising results in smaller trials using other DCB (Ideas trial, Debellum trial, Debate-BTK), larger trials have failed to demonstrate the efficacy of this technology in BTK vessels (using other DCB: In.Pact Deep). So we will look forward to the BTK Lutonix randomized controlled trial results.

Lutonix have also shown benefits in other areas. Ongoing non-published randomized controlled trials using Lutonix for in-stent restenosis have provisionally reported 28.6% improvement over PTA in sustained clinical benefit. And also in the treatment of arteriovenous fistula stenosis: an ongoing prospective global multicenter randomized trial, including 285 patients, has preliminary reported, at 8 months follow-up, 29.8% fewer interventions to maintain target lesion patency in DCB arm, and an increase from 49.4% to 61.6% in target lesion primary patency. Thus, the benefit of Lutonix DCB is not only limited to femoropopliteal area, but also to other areas where uncoated PTA has failed to maintain adequate short and mid-term patency.
Conclusions

Significant efficacy of Lutonix balloon angioplasty in the treatment of femoropopliteal artery disease has been consistently demonstrated, providing higher patency and lower reintervention rate than uncoated balloon angioplasty. These results seem to persist during follow-up, at least up to 2 years. Thus, we have to conclude that Lutonix advantages are indeed sustained during follow-up. Usefulness of this device in other areas (below the knee, arteriovenous fistula, in-stent restenosis ...) seems also promising.
Marco Manzi

Current Position:
• January 2007 to present: Director of Interventional Radiology Unit, Foot & Ankle Clinic, Policlinico Abano Terme, Italy

Memberships
• Professional Board at Milan, 1986;
• Member of Interventional Radiology Section of the SIRM (Italian Society of Medical Radiology);
• Member of IESIR (Italian-European Society of Interventional Radiology);
• Member of CIRSE (Cardiovascular and Interventional Society of Europe);
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• Involved as Faculty invited speaker/live operator in many international congresses and meetings since 2008. Author and co-author of many scientific papers, most on CLI techniques.

Optimization of CO₂-angiography in patients with kidney impairment
José Fragata

Professor José I. G. Fragata was born in Lisbon in 1953 and did his medical – surgical education in Portugal and in the United Kingdom, where he has followed all steps, from junior to consultanship. He got his MD in 1976, from the Faculty of Medicine, University of Lisbon, and has completed the State Board Exams in Cardiothoracic Surgery in 1986. In 1992 he obtained his PhD in Medicine and by 1993, his professor degree in Cardiothoracic Surgery, at the Nova Medical School, Universidade Nova.

In 1999 he became Fellow of the European Board of Thoracic and Cardiovascular Surgeons – “FETCS” and more recently, of the Society of Thoracic Surgeons (USA) and of the European Society of Cardiology – “FESC”.

In 2007 Professor José Fragata was appointed head of the Cardiothoracic Department at Santa Marta’s Hospital in Lisbon, and has, since, become Full Professor of Surgery at NOVA Medical School.

Professor José Fragata has a broad experience in surgery for all cardiac lesions, both in adults and children. Pediatric cardiac surgery is his sub-specialization. He has also accumulated relevant experience in thoracic transplantation - cardiac and pulmonary, being the head of our unique national lung transplantation program. During his long surgical career Professor Fragata was directly involved in over 10 000 cases, that he was responsible for operating and managing in Portugal, in the United Kingdom and the Middle East, where he has worked briefly as Chief Surgeon.

Professor José Fragata is Chief of Cardiac Surgery at Hospitais Cuf in Lisbon, one of the busiest and leading private practices in town. Within José de Mello Saúde he also holds responsibilities as Clinical Governance advisor.

He is member of a large number of Scientific Societies: Portuguese Medical Council, National Cardiology and Cardiothoracic Societies, EACTS, ECYCS, AEPC, STS, ESC, World Society of Pediatric and Congenital Heart Surgery (WSPCHS), being at the Council, and the European Congenital Heart Surgeons Association (ECHSA), on which he served as Secretary General for four years, becoming its President since 2014. Also, Professor José Fragata has contributed with over seventy scientific papers, in peer review, and seven books within the fields of Cardiothoracic Surgery, Medical Error, Patient Safety and Health Care Management. Professor José Fragata is presently the Director of INDEG’s Master Program for Healthcare Management.

Professor José Fragata belongs to the editorial board and, or, acts as regular reviewer to the following Journals: European Journal of Cardiothoracic Surgery, Asian Annals Thoracic Surgery, World Journal of Pediatric and Congenital Heart Surgery, Revista Portuguesa de Cardiologia.

Professor José Fragata is corresponding Member for the Portuguese Academy of Medicine and was elected member to the NOVA UNIVERSITY General Board Council. His beloved hobby is sailing with the family and friends.

New Challenges, new solutions for quality and performance in surgery
When should we risk treating thrombosis extending into the IVC?

Introduction

IVC thrombosis is definitely underdiagnosed. IVC thrombosis is a serious problem with significant mortality and morbidity compared to DVT in the lower extremities calculated to occur 1–2 per 100,000 annually equal sex attributed. The mortality is 2 fold more frequent and post-thrombotic syndrome (PTS) can follow in up to 90 % with venous claudication (45 %) and/or venous ulceration (30 %).  

Thrombosis in IVC is mostly associated with congenital IVC abnormalities, which occur in 0.5–1 % of the general population; this topic will not be touched further in this abstract. On the contrary, thrombosis in a normal calibrated IVC is rare and very seldom as an isolated entity. It can be caused due to extension from an existing iliac DVT, a vein tumor (leiomyosarcoma) and external disease with compression from abdominal pathology. Furthermore, a substantial number of un-retrieved IVC filters is more and more contributing to an increase. It is stated, that up to 25 % of IVC filters will occlude due the great rate of non-retrieved filters. The thrombus can be total, partially or appear as a free-floating thrombus.

Clinical signs

Symptoms are typically characterized by back pain and bilateral lower extremity symptoms with swelling and heaviness if the thrombus obstruct the IVC totally. Scrotal swelling seems almost to be a typical sign. Other serious symptoms are pulmonary involvement with dyspnea and sometimes oliguria due to migration to the renal veins. Partially thrombosed IVC will usually only affect one extremity. Chronic occlusions can result in large paraspinal/spinal collaterals, which in rare cases can give raise to lumbar radicular pain, sciatica and even cauda equine syndrome.

All these above mentioned symptoms call upon treatment more than anticoagulation and compression stockings, which has been the treatment of choice for many years.

Extension of DVT from the iliac veins

This is the most frequent cause of a thrombus formation in IVC. It has been published recently that more than 20 % of iliac vein thrombosis also extend into IVC. Unfortunately, information of precise extension is missing from this paper. However, based of only 2.4 % of 212 patients had bilateral symptoms it may be deduced that the IVC thrombus load was restricted and only extended partially into IVC. In another study with 189 patients only 18 patients (9.5 %) had thrombus extension into the IVC and 8 patients identified with IVC filter thrombosis. A total of 33 limbs (17 %) in the Copenhagen material had IVC involvement. In 18 of these cases, the configuration was a free-floating thrombus for which a retrievable filter was inserted. In the remaining cases, the thrombus was a minor 1–2 cm propagation from the iliac vein into the IVC like in the first mentioned paper. All these patients had only unilateral symptoms. However, the thrombus progression can go further and involve the contralateral limb at the iliocaval confluence without severe limb symptoms from this side and yet sometimes even asymptomatic. In our material, the bilateral limb DVT was due to caval atresia.

Diagnosis and diagnostic modality

The most typical sign of a fully obstructive IVC thrombosis is bilateral limb DVT with swelling from the groin. Ultrasonography in none-obese patients is the first line diagnostic method, to rule out whether a caval atresia, hypoplasia, normal calibrated or expanded IVC with thrombus is present. The combination of monophasic flow at
rest and non-increasing flow distally (if a vein is open) during the Valsalva maneuver can only predict an outflow obstruction, but not distinguish if an IVC thrombosis exists together with an iliac thrombosis, which has been addressed in a publication.

CTV is the method of choice for further evaluation if US is impossible or uncertain or to exclude abdominal pathology. In case of a “hidden or forgotten” IVC filter, this modality is superior compared with MRV, which in that case gives artefacts from the filter.

If an expansion of IVC is visualized, it might be suspected that the thrombosis is in connection with a vein tumor at this site, which is the most frequent location for a leiomyosarcoma. Thrombus in IVC aneurism is extremely rarely described, but can cause DVT.

Ultrasonography for unilateral limb DVT sometimes finds this minor IVC thrombosis. However, sometimes the IVC involvement will show up during the diagnostic procedure prior to the thrombolytic procedure. After guidewire recanalization of the thrombosed iliofemoral segment a free IVC placement has to be visualized. No visible contrast media or compromised flow configuration at this point indicates thrombosis. Further precise attachment of thrombus will appear during following venograms, when thrombus removal has begun with the lytic therapy.

**Treatment**

Even there are increasing number of publications about endovenous thrombus removal for iliofemoral DVT with positive outcome, the number of publications including IVC is limited as mentioned above. The most convincing paper is published recently. The thrombus extended massively into IVC in 46 patients out of 102 patients. The IVC involvement was restricted to the infrarenal part in 54.3 % and 50 % occurred with an indwelling thrombosed IVC filter. Bilateral limb DVT was seen in 25 patients. Pharmacomechanical thrombolysis was more frequently used in the caval thrombus group (97.8 % vs 82.1 %, p = 0.01). Primary patency at 2 years for the caval and noncaval group was 76.7 % and 78.0 % (p = 0.787). However, PTS occurrence was lower in caval group (11.5 % vs 34.3 %, p = 0.035). Interestingly, an IVC filter was inserted in 25 patients in the noncaval group and in 19 patients in the caval group; 8 filters were not retrieved. No IVC stent was inserted. The reason for better outcome in the caval group was probably less distal DVT involvement in this group of patients according to the authors, otherwise difficult to explain.

In our own experience from Copenhagen we have not experienced PE during CDT procedures with non free-floating IVC thrombosis material in 15 cases without filter. The thrombus material was dissolved by the lytic fluid. The filter was in the other cases inserted from the contralateral groin and not via the transjugular approach, which usually is preferred. The Norwegian CaVenT study did not include patients with IVC thrombosis or DVT extension from the iliac vein. Stenting is performed in the iliac vein or separately in IVC (few cases) if any residual stenosis remains.

**Conclusion**

Extension of pelvic vein thrombosis into IVC is relatively frequent in patients with iliofemoral DVT. The finding is not going to worry or change the set up in the different endovenous thrombolysis procedures, with can be simple CDT, ultrasound enhanced CDT or pharmacomechanical thrombolysis. It seems unnecessary to insert an IVC filter, except maybe in situations with a free-floating thrombus. It seems that the European attitude differs from the liberate use of filters in US. It has to be stressed, that removal of all thrombus material and stenting of remaining underlying obstruction is important to avoid recurrence and in order to minimize PTS. Massive obstructive IVC thrombosis with bilateral limb DVT calls for treatment from both sides. Stenting for any residual stenosis is mandatory even in the IVC. IVC thrombosis does not influence results negatively, which is the main message.

**References**

Marzia Lugli

• Deputy Chief of Vascular Surgery in the Department of Cardiac-Thoracic-Vascular Surgery at Hesperia Hospital Modena, Italy.
• She performed more than 6000 vascular surgery operation concerning arterial surgery (open or endovascular) and venous surgery (superficial and deep venous surgery – open or endovascular).
• Her equipe has been nominate among the ten Centres of world excellence in deep venous surgery.
• In particular Dr. Lugli has acquired extensive experience in venous diseases, with high level of competence in performing endovascular procedures for diagnosis, treatment of acute and chronic diseases, stenting implant.
• She directed the first Hands-On Courses in surgical and endovascular surgery on deep venous system.
• President, Moderator, Scientific Secretary or Invited Speaker in more than 150 International and National Congresses and Courses.
• Author of 60 published papers, co-author in 13 edited textbooks, author of 70 medical films.
• Chair of the Research, Education, Publications Committee of European Venous Forum Society.
• Peer-reviewer for 3 Journal dealing on vascular surgery.
• Member of 5 Scientific Societies.

Outcome evaluation after deep vein interventions.

Sizing venous stents
Anticoagulation is the mainstay of venous thromboembolism (VTE) treatment, preventing its recurrence. By recent guidelines, direct oral anticoagulants are now considered the first-choice anticoagulants in VTE non-cancer associated patients. These new agents are a great step forward, as they do not require routine laboratory monitoring or dose adjustment, have fewer interactions with other drugs or food and are associated with a lower risk of most forms of bleeding. These improved benefit-risk profile is well demonstrated by randomised trials and real-world evidence observational studies and renders this class of drugs attractive for long-term VTE prevention.

The impact of these advantages is reflected on clinical guidelines balancing between the risk of recurrent VTE and the risk of bleeding. Regarding the duration of anticoagulation therapy, the 10th edition of the ACCP antithrombotic guidelines (CHEST 2016) summarily recommends:

- proximal DVT or PE provoked by surgery or by a nonsurgical transient risk factor: 3 months (grades 1B)
- unprovoked proximal DVT or PE: extended therapy if bleeding risk is low/moderate (grade 2B) and 3 months if bleeding risk is high (grade 1B)
- DVT or PE associated with active cancer: extended therapy (grade 1B)
- aspirin is suggested in patients with an unprovoked proximal DVT or PE who are stopping anticoagulant therapy and do not have a contraindication to aspirin (Grade 2B)

Despite these recommendations, clinical strategies for extended anticoagulation remain uncertain and concerns about bleeding often leads to a reluctance to continue treatment.

We aim to present and interpret the new evidence for extended treatment of venous thromboembolism provided by the EINSTEIN CHOICE study, published March 2017, in The New England Journal of Medicine.

The goal of the Reduced-dosed Rivaroxaban in the Long-term Prevention of Recurrent Symptomatic Venous Thromboembolism (EINSTEIN CHOICE) trial was to assess the efficacy and safety of two doses of rivaroxaban with those of aspirin in patients with VTE who had completed 6 to 12 months of anticoagulation therapy and for whom there was equipoise regarding the need for continued anticoagulation. Secondary aims of the study were to determine whether the lower dose of rivaroxaban was as effective as the higher dose and whether it was associated with less bleeding.

Patients were randomly assigned to receive once-daily rivaroxaban at doses of 20 mg or 10 mg or aspirin. After a median of 351 days, symptomatic recurrent fatal or nonfatal venous thromboembolism or unexplained death occurred in 17 of the 1107 patients (1.5%) who were assigned to receive 20 mg of rivaroxaban in 13 of 1127 (1.2%) who were assigned to receive 10 mg of rivaroxaban, and in 50 of 1131 (4.4%) who were assigned to receive aspirin (hazard ratio [HR] for rivaroxaban 20 mg vs. aspirin: 0.34, 95% confidence interval [CI] 0.20–0.59; HR for rivaroxaban 10 mg vs. aspirin: 0.26, 95% CI 0.14–0.47). Major or clinically relevant non-major bleeding occurred in 3.3%, 2.4%, and 2.0% of the patients, respectively (p for rivaroxaban 20 mg vs aspirin = 0.14).

The results of this important trial indicate that among patients who had completed a 6- to 12-month course of anticoagulation for both provoked or unprovoked VTE, extending anticoagulation with either prophylaxis (10 mg) or treatment (20 mg) doses of rivaroxaban for one year is superior to aspirin in reducing recurrent VTE events, without increasing major bleeding. The findings of this trial are likely to influence clinical practice and future guidelines as it provide good-quality evidence to support the use of long-term, reduced-intensity anticoagulation therapy with rivaroxaban.
References


Large vein obstructions. Is there a specific way / tool to cross them?
Niels Baeckgard

- Associate vascular professor, emeritus, University of Copenhagen, Gentofte Hospital and Rigshospitalet

Vascular and general surgeon, consultant and associate professor (emeritus) at the University of Copenhagen. Area of interest for the last 20 years has been venous disease, especially treatment of acute deep vein thrombosis. President EVF 2009, co-director EVC in Maastricht since 2010. Former advisor for The Danish Board of Health. Has published more than 100 articles and book chapters. Being a part of several national and international guidelines.

Measuring thrombus age/symptom duration before catheter-directed thrombolysis

Immediately after a thrombus is established a remodeling process occurs including organization. Sometimes the thrombus is resolved without doing any harm, but often recanalized with some harm, either with thickening and stiff vein wall with or without valve destruction and finally some with permanent occlusion as the result after DVT. Thrombus age of maximum of 14 days is recommended for early thrombus removal in patients with iliofemoral venous thrombosis and referred to as an acute thrombus. This time limit is mentioned in many different guidelines. However, the basis on which this time limit is chosen seems a little weak. The classic US registry including over 200 patients for catheter-directed thrombolysis stratified symptom duration into less than 10 days and more than 10 days. The complete lysis was significantly better before 10 days (p < 0.01).

Animal experiment from the Mayo Clinic with rats have shown interesting results after temporary occlusion and permanent occlusion. Occlusion of 24 hours resulted in normalization of the vein wall in week 2, whereas a permanent occlusion revealed post-thrombotic vein wall thickening in week 3. This information might indicate a gap in which a thrombus removal has to be performed before vein damage occurs.1

Ultrasonography can help to determine the thrombus age. A publication has invented a term called the “clot stabilization”. In average of 11–12 days after thrombus onset, a lack of motion with the clot vein interface was observed. The interpretation of this observation indicates a solid adhesion to the vein wall with irreversible changes to the wall. This investigation from 1995 has never been repeated.2

Measuring the increasing echogenicity of the thrombus has been evaluated in term of a gray-scale median analysis (GSM). Computer analyzed calculations of shades of gray of all pixels on an image has calculated a cut-off value for an acute thrombus with GSM values up to 23.03 with 84.10 % specificity and 59.30 % sensitivity.3

MRV has also addressed the problem in terms to differentiate between acute, subacute and chronic thrombus. The used pre-determined characteristics to decide for acute, sub-acute and chronic DVT on MRV images, with high inter-observer agreement among experts (kappa value 0.9). An acute thrombosis had an average duration of complaints of 6.5 (2–13) days, 13 (8–18) days for sub-acute thrombosis and 22 (15–32) days for a chronic thrombus.4 Difference in lysis time was strongly connected to these groups.5

The objective signs cannot as such be used to determine the thrombus age. However, the patients are prone to remember the onset of pain, which often comes prior to swelling. We have recently in the Copenhagen experience with 191 patients with iliofemoral DVT treated with catheter-directed thrombolysis tested, among other factors, the symptom duration simply taken from the patient history. In a multivariate time independent Cox proportional hazard model this variable significantly showed better outcome with patent veins and normal valves after median 50 months of follow-up, when symptom duration was less than 2 weeks (p = 0.024).6

Conclusively, we have some different methods to evaluate the thrombus age. However, a simple history seems to be very accurate in order to determine the age of a thrombus. Thrombus age less than 2 weeks seems optimal for achieving the best results with catheter-directed thrombolysis for iliofemoral deep venous thrombosis.

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Unprovoked venous thromboembolism (VTE) is associated with a high risk of recurrence. Advances on anticoagulation with the approval of novel oral anticoagulants (NOACs) for treatment and prevention of VTE episodes have increased the treatment options and changed the treatment pattern. Long-term anticoagulant therapy is associated with an increased risk of bleeding and the decision on whether to stop or not the treatment is often controversial and based on physician’s clinical evaluation rather than on guidelines. Furthermore, data on extended anticoagulation with vitamin K antagonist (VKA), NOACs and aspirin, and recent data on sulodexide for prevention of recurrent VTE, underline the need for clear guidelines in order to optimize patients’ management and achieve risk reduction. Current guidelines are mainly driven by evidence based medicine, which usually don’t mirror the real world patient. Therefore, the assessment and evaluation of treatment success, failure and outcomes should balance data either from randomized and controlled trials, observational studies and real world data.