CIRSE 2022 – Barcelona
Monday, September 12, 2022

Join us for today's Film Interpretation Panel!

Combining an excellent learning opportunity with great fun and just a pinch of friendly rivalry, the Film Interpretation Quiz has been a fan-favourite for years. In this year's edition, quiz masters Alex Barnacle and Gerry O'Sullivan will ask brain-teasing questions on tricky cases to see which audience member has what it takes for the final round on stage.

Don't miss this chance to demonstrate your knowledge and take home the title of Quiz-master of the Year!

Thyroid embolisation

Saim Yilmaz

Thyroid diseases have become one of the main areas of interest for interventional radiology in recent years. Benign thyroid nodules have been successfully treated by chemical ablation with ethanol, and by thermal ablation with laser, radiofrequency or microwave [1,2]. In the literature, numerous studies have shown that percutaneous ablation (PA) produces marked shrinkage of the thyroid nodules with very few side effects [1-5]. At six months, a 50-80% volume reduction of the treated nodule is generally seen, and the results are durable over time [3,4]. Ideal patients for percutaneous ablation are those with a single or a few thyroid nodules of small to medium size. It is generally accepted that percutaneous ablation is less effective in nodules with a volume of >30 ml compared to smaller ones. If the nodules are numerous, very large or extend into the thoracic cavity, then the procedure will be more technically challenging, time consuming and probably less effective [4,5].

In such cases of nodules and in diffuse toxic goiter (Graves disease) where PA is not a good option, thyroid artery embolisation (TAE) may be a viable alternative [6,7]. In Graves disease, the first line of treatment is medical therapy, which successfully controls the disease in more than 70% of the cases [6]. However, some patients do not respond or are not suitable for medical therapy. In these patients, radioactive iodine (RAI) treatment and surgery are generally recommended. However, RAI exposes the thyroid to a high dose of radiation and frequently results in permanent hypothyroidism. In the case of surgery, the patient loses the thyroid gland and is exposed to the risks of hypoparathyroidism and recurrent laryngeal nerve palsy [8,9]. The most important advantages of TAE over the conventional RAI and surgery are the absence of surgical complications, high dose radiation exposure and hypothyroidism [6,7,10].

TAE is performed via a common femoral artery approach under local anesthesia and conscious sedation. After the thyroid arteries are selectively catheterized, PVA particles or similar are injected via a coaxial microcatheter until stagnation is achieved. Depending on the underlying pathology and location of the lesions, 2,3 or 4 thyroid arteries can be embolised [6,10]. Because of the proximity of the thyroideal arteries to the carotid and vertebral arteries, TAE should be performed by interventional radiologists who have a certain level of experience in neurovascular procedures. Adequate anticoagulation and extreme caution against reflux of embolic particles are essential [11].

If appropriate measures are taken, the risks of TAE are few and generally mild. After the procedure, most patients experience mild to moderate neck pain that lasts for several days and temporary hyperthyroidism for several

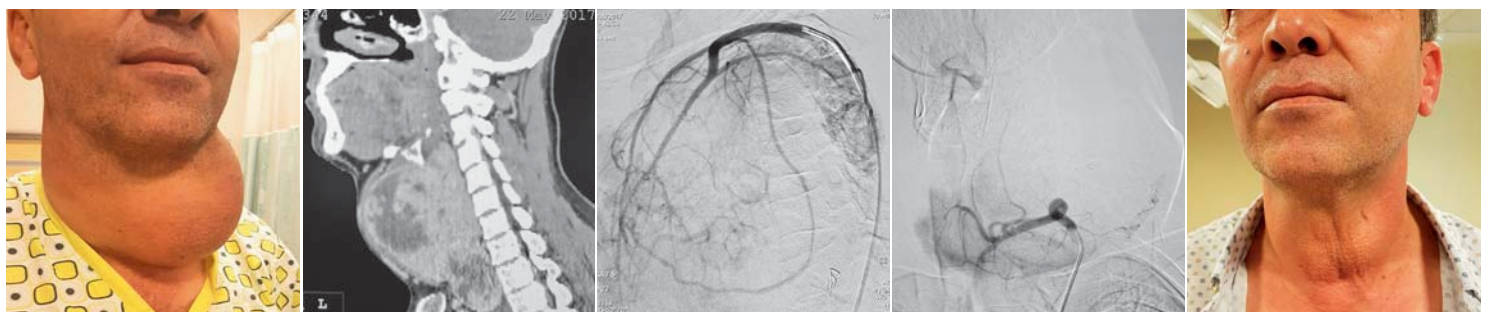

Figure 1: A 48-year-old male with nocturnal dyspnea and snoring, preoperative photography shows a large cervical goiter (FIG 1A). On the preoperative sagittal reformatted CT image, the goiter is composed of several nodules that contain cystic areas (FIG 1B). The patient underwent TAE. On angiography, the nodules were fed by the left superior thyroideal artery (FIG 1C) and left inferior thyroideal artery (FIG 1D). These arteries were embolised with PVA particles. One year after the embolisation, a neck photography shows a remarkable size reduction of the goiter (FIG 1E). The patient is asymptomatic and very satisfied with the cosmetic improvement.

Don't miss it !

Show me the evidence
Monday, September 11, 15:15-16:00
Auditorium 1

Saim Yilmaz
Varisson Radiology and IR Center
Antalya-Istanbul/TR

Dr. Yilmaz is the founder and chief interventional radiologist of the Varisson Radiology and IR Center. He was educated at Istanbul University Medical School and became a radiology professor at Akdeniz University Medical School. For the last 30 years, he has worked as a dedicated interventional radiologist in many fields including peripheral arterial interventions, neurovascular interventions, varicose veins treatments, embolisations, and oncologic interventions. He authored more than 80 scientific papers in peer-reviewed journals that received more than 700 citations and had seven scientific awards in interventional radiology. He pioneered several interventions in Turkey including subintimal angioplasty, endovenous laser ablation, uterine, varicocele and thyroid embolisations and percutaneous cryoablation. His main areas of interest are interventional oncology, thyroid interventions and embolotherapy.

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weeks. Although TSH drops and thyroid hormones become high, symptoms are not severe and patients typically become euthyroid in one to two months after the procedure [6,10].

In the past, TAE has been successfully used in the treatment of Graves disease at some centres in Asia and Europe [6,7,10]. Embolisation had a success rate of around 80% in Graves disease, and in all the embolised patients, there was also a marked volume reduction in the thyroid gland. Interestingly, this "secondary effect" did not receive enough attention and thyroid embolisation has not been used for this purpose, except for some case reports [12,13]. In 2021, our group published an article on TAE for nodular goiter [10]. In this study, 56 patients with a giant solitary nodule or multiple thyroid nodules underwent TAE. At the six months follow up, there was a statistically significant reduction in the volumes of the nodules, thyroid gland and the degree of retrosternal goiter extention ($p<0.001$). The health-related quality of life (HRQoL) scores also significantly improved after TAE ($p<0.001$). In patients with hyperthyroidism, thyroid hormones returned to normal in 86% of the cases [10,11]. These results and the data in previously published articles suggest that TAE may be an attractive alternative to conventional surgery and RAI in the treatment of diffuse or nodular toxic or nontoxic goiters with Bethesda 2-3 fine needle biopsy results. These findings should be taken into consideration when offering the treatment options to patients with goiter.

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Don't miss it !
The different sides of an IR
IR Trainee Session
Monday, September 12, 10:00-11:00
Room 114

Why all the different faces of IR should stay and work together

Raman Uberoi (EBIR)

Raman Uberoi
John Radcliff Hospital
Oxford/GB

Raman Uberoi is an interventional radiologist consultant for the Oxford University Hospitals. He was the clinical director of John Radcliffe Hospital from 2003 to 2012. He was the president of BSIR from 2015 to 2017 and the Royal Society of Medicine Radiology from 2016 to 2018. Dr. Uberoi is the senior editor for Clinical Radiology, British Journal of Radiology, and the deputy editor of CVIR; he has published over 150 articles. Currently he is the Chairperson of the Curriculum Revision Task Force and the EBIR Examination Council.

Interventional radiology (IR) has become a key specialty, integral to the management of virtually every patient group. During the COVID-19 pandemic, interventional radiology demonstrated its vital role in saving lives and improving outcomes, providing 24/7 onsite services. Interventional radiology has developed rapidly in the last 50 years from being considered a crazy and way-out concept to becoming the leader in cutting edge and innovative treatments. This fledgeling discipline has challenged the medical establishment to rethink how we manage patients, enhancing and, in many instances, replacing established treatments. As IRs, we have developed from within radiology, but have evolved to become radically different from our imaging colleagues. The process of evolution is constant and we need to think about where we are heading and how to shape our future, beginning by first reflecting on where we are now, how we got here and where we need to progress in the future.

IR developed from a significant unmet need to treat patients less invasively, more safely and for a broader range of pathologies. In 1923, angiography was first successively used in man, initially requiring a surgical cut-down. Then in 1953, Sven-Ivar Seldinger pioneered the Seldinger technique, which allowed for the first time, major procedures to be undertaken percutaneously [1]. In 1955, Goodwin published the first description of percutaneous nephrostomy [2]. This was followed by Charles Dotter, who undertook the first percutaneous angioplasty for critical ischemia and effectively founded interventional radiology. In 1973, percutaneous angioplasty leapt forward with the emergence of double-lumen balloon catheters leading to percutaneous coronary angioplasty in 1977. Stenting, though proposed in 1969, came of age in the 1990s using metal stents, and more recently, temporary stents, stent-grafts and biological stents increasing the range of pathologies we can treat. Transcatheter embolisation also became a key core IR procedure with the first case in 1965. With improvements in embolic agents and catheter technology IRs could reach and treat a much greater range of diseases, supported by imaging technologies such as higher resolution fluoroscopy, Ultrasound, fast CT and MRI scanning. These technologies established the concept of minimally invasive percutaneous image-guided treatments. In the mid-1970s, Gerard Debrun developed a detachable latex balloon catheter for the treatment of carotid-cavernous fistulae and giant intracavernous aneurysms [3] and the subdiscipline of neuro-intervention was born. In 1990, the invention of the Guglielmi detachable coils by Guido Guglielmi revolutionised the treatment of intracranial aneurysms [4], and this became established as the first-line technique for intracranial aneurysms following the highly successful results of the International Subarachnoid Aneurysm Trial in 2005 [5]. These successes paved the way for an explosion of developments in IR treatments for benign and malignant diseases. Inevitably the increasingly huge range and complexity of these procedures meant IRs have started to branch out into different subdisciplines such as vascular, non-vascular, neuro, venous, urology, paediatric and oncology IR, and this list continues to expand.

All these disciplines have a common past but also a shared future and we need to think carefully about how we provide services in the future and the training of the next generation of IRs. The core skills required are the same for all IR subdisciplines. Still, the number of IRs in each discipline can be small, limiting the ability of IRs to provide procedures 24/7, as recently evidenced by the role out of stroke thrombectomy. It is no good being able to provide an excellent service during the day and then for this to become someone else's problem overnight and weekends. IRs need to take responsibility for delivering these services by working collaboratively and sharing the workload across subdisciplines. When there is a vacuum, other specialities will feel empowered to take over our techniques, picking and choosing the areas they wish to practice. Charles Dotter early on recognised the need to take clinical responsibility with direct access to patients, a message we have failed to heed. The results of this can be seen, with the loss of coronary angioplasty and, in many countries, endovascular treatments.

Although imaging remains at the core of IR, the way IRs utilise imaging has radically changed. Undertaking emergency life-saving procedures, palliative or curative treatments such as tumour ablation, angioplasty, coiling of aneurysms, and stroke thrombectomy require clinical knowledge and skills. These are common to all IR disciplines but fundamentally different from those currently taught in many radiology programs. To achieve the best possible results, IRs have to be skilled technically to deliver interventions effectively and safely, but they also need to play an integral part in the patient's overall clinical care including patient counselling, selection, post-procedural management and dealing with complications. For IRs to exercise safe and effective clinical care, core skills have to be nurtured during training as for any other clinical specialists [6]. Clinical competency should include exposure to out-patient clinics, ward work, drug management, follow-up, shared responsibility with other specialists, and data collection for national registries within a structured governance practice. With the natural evolution of clinical radiology, IRs in all the subdisciplines have become more akin to imaged guided surgeons with direct clinical responsibility for patients. The training and assessment processes need to reflect this; however, national exams and assessments often focus predominantly on imaging and diagnostic skills.

Many countries have already started to change the models for IR training and provision of clinical care [7]. In the US, IR has become a specialty within radiology since 2012 [8]. A white paper has been developed in Australia to consider the creation of an IR specialty with an appropriate curriculum and a similar process is underway in Ireland, Egypt and India. The assessment process took an enormous leap forward with the creation of the European board of interventional radiology examination (EBIR) by CIRSE in 2010. This is now a well-established, internationally recognised examination accrediting IRs. The EBIR has also recently been adopted by the German and Dutch exam boards as part of their assessment or re-accreditation process. Similarly, a national assessment process for IRs has been established in Greece to reflect modern IR training accreditation needs. These are all positive steps and we have a tremendous opportunity to work together across the IR disciplines to shape our future.

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Three-year outcomes of a single branch, off-the-shelf endovascular solution for treating aortic arch pathologies

Andrew Holden

Don't miss it !
Aortic interventions
Monday, September 12, 17:30-18:30
Room 113

Andrew Holden
Auckland City Hospital
Auckland/NZ

Professor Andrew Holden is the director of the Northern Region Interventional Radiology Service for the Auckland City Hospital in Auckland, New Zealand.

Aneurysms, dissections and penetrating ulcers involving the aortic arch represent some of the most challenging pathologies to deal with. For many years, aortic arch pathology remained the preserve of the cardiothoracic surgeons, with only a few, highly skilled endovascular enthusiasts involved. Even in the hands of expert cardiothoracic teams, conventional aortic arch replacement is associated with a high mortality (14.5%) [1]. Alternatives such as frozen elephant trunk (FET) have helped to reduce mortality, but a recent review of 3154 FET cases found a 4.7% spinal cord ischemia and a 7.6% permanent stroke rate [2]. Neurological complications after aortic arch repair are one of the most profound sources of post-operative morbidity, with paraplegia being devastating for patients. Many of these complications arise due to low flow states that occur during aortic clamping or hypothermic circulatory arrest.

Endovascular approaches to the aortic arch have become increasingly used as they avoid prolonged distal aortic occlusion and are associated with lower rates of spinal cord ischaemia (1.1%) [3]. Unfortunately, many of the current endovascular devices continue to report stroke rates in excess of 10%, and in some cases up to 20% [4-6]. These high stroke rates may be due to vessel trauma caused by the need to cannulate cerebral arteries, directly puncture the carotid arteries and the associated passage of wires and sheaths.

The NEXUS™ Aortic Arch Stent Graft System has been designed specifically to manage aortic pathologies in the uniquely challenging environment posed by the arch. The two-piece, curved stent graft system conforms naturally to the shape of the arch and by having a long seal area in the ascending aorta (Zone 0) maximizes the all-important proximal seal in this dynamic anatomy.

The single branch of the NEXUS system is deployed over a femoro-right subclavian wire into the innominate artery, avoiding the need for carotid manipulation and trauma during implantation and so has the potential to lower strokes rates (Figure 1 and Product Animation NEXUS™ – YouTube). Surgical debranching to provide LCCA/LSCA flow is performed by some teams a few days prior to the stent insertion, whilst others choose to undertake the case in a single sitting. The system has dual-flush ports to maximise air bubble removal, which are associated with silent brain infarction [7].

The mid-term outcomes from the initial Nexus experience have recently become available. This was a multi-centre study with prospective data collection. All the cases were complex with the proximal landing zone in all cases in Zone 0. During the early cases, parallel graft insertion was performed to provide LCCA/LSCA flow but it became apparent that technique was associated with gutter leaks and a switch to surgical debranching occurred [8]. Where possible, the patients were evaluated through to three years.

The cohort of patients included 18 patients in the first-in-man study and a further 10 who were treated as compassionate cases. Aneurysmal disease was the primary pathology in two thirds of the cases, with the remainder being a mixture of dissections and penetrating ulcers. The group were relatively high risk, with >90% of them being ASA3+, a mean age of 72 years, one third having significant COPD and over half with a previous sternotomy. Given that this cohort represented the learning curve for a number of physicians, the procedures were fairly simple with a mean operating time of 185 minutes, and two-thirds of cases being completed percutaneously. The median length of hospital stay was 8.5 days, with a remarkably short ICU stay of only one day. ICU and hospital stay was excellent given the comorbid nature of the patients and would not have been achievable with open surgery.

Importantly, the composite freedom from mortality/disabling stroke or paraplegia rate at 30 days was an encouraging 92.9%. Device durability was excellent over the three years of follow up with no late strokes or paraplegias (Figure 2). The causes of longer-term mortality are shown in Figure 2. There were no type 1a endoleaks throughout the study period and only a single type 1b leak (3.8%) was present at three-year scanning. The brachiocephalic trunk branch remained patent in 100% of cases at three-year follow up.

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Figure 1: Key deployment steps of the NEXUS™ Aortic Arch Stent Graft System

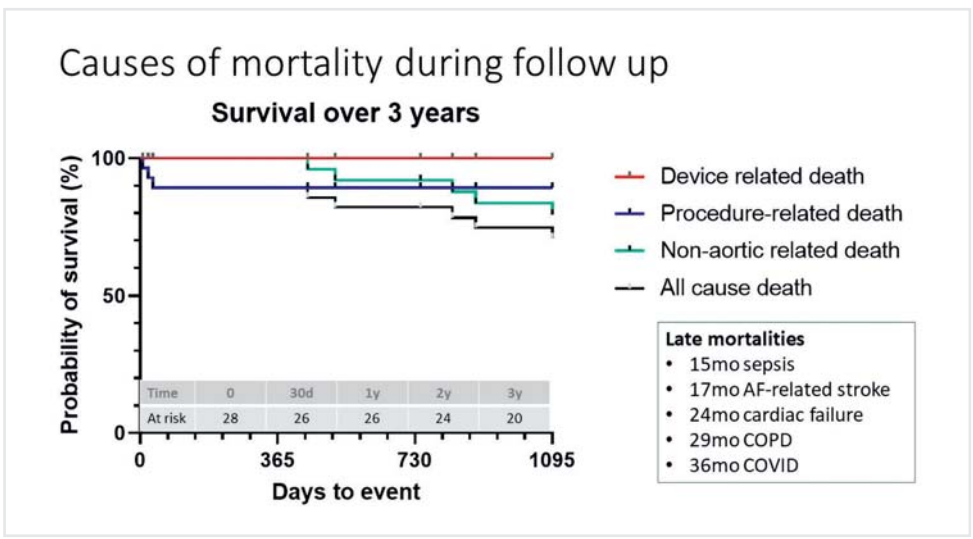

Figure 2: Causes of mortality during follow up

Figure 3: Clinical case of an aortic arch aneurysm successfully treated by the NEXUS™ Aortic Arch Stent Graft System

Don't miss it !
Venous nightmares
Monday, September 12, 16:15-17:15
Room 112

Venous nightmares

Andrew Wigham

Andrew Wigham
Oxford University Hospitals
Oxford/GB

Dr. Andrew Wigham is an interventional radiologist at Oxford University Hospitals NHS Trust. He trained in IR at the Royal Free Hospital in London before being appointed in Oxford. His main interest is in the treatment of deep and superficial venous disease, and he established the deep venous programme in Oxford shortly after his appointment. He was involved in the design of the BSIR National Registry for acute DVT and is currently centre PI for several venous stent trials.

The treatment of both chronic and acute venous disease continues to expand rapidly with the development of multiple new exciting technologies. New thrombectomy devices and dedicated venous stents mean patients can be treated more efficiently with lower procedural risks and potentially improved long-term outcomes. However, the key to successful long-term results remains decision-making including patient selection, accurate assessment of thrombus clearance, in-flow assessment, and knowing when to stent and when not to stent.

This case in the 'Venous nightmares' session will demonstrate the importance of correct decision-making at each stage of the treatment process. The patient had suffered a left ilio-femoral DVT several years previously which had been managed conservatively. The patient had not been referred or considered for endovascular intervention. He subsequently developed severe PTS with leg ulceration. MRV confirmed occlusion of the left iliac veins and catheter venography was performed to assess the in-flow vessels prior to iliac recanalization and stenting (Fig. 1). This was thought to be adequate to support iliac vein stenting.

The patient underwent iliac recanalization and stenting of the iliac veins down to the femoral / profunda confluence (Fig. 2). The stents occluded early requiring CDT to clear. Subsequently, there were three more episodes of stent occlusion. Adequate anti-coagulation was confirmed, and no stent compromise was identified – with poor in-flow deemed the cause for the repeated occlusions. At this stage, the decision was made to extend the stent into the profunda vein (Fig. 3). This started a cycle of symptom improvement, followed by stent fracture or stenosis (Fig. 4) resulting in stent extension more inferiorly into the profunda (Fig. 5), ultimately leading to profunda occlusion which was not salvageable (Fig. 6). The patient's symptoms returned with recurrent ulceration and limited further endovascular options.

Whilst this case does not illustrate an acute, dramatic complication of venous intervention, it does demonstrate how important the combination of sound technique, decision-making, and robust follow-up are in achieving good long-term outcomes. There are several points in this patient's treatment where different decisions may have improved outcomes, although it should be remembered that techniques and historical treatment algorithms do not necessarily reflect contemporary best practise.

The first point to address is the initial decision not to treat this patient acutely with thrombectomy and stenting. At that time, they were not referred for consideration of intervention and even now many patients do not see a doctor with expertise in venous intervention. Up to 50% of patients with proximal DVT will develop PTS [1] and this patient was one of the 10% of iliofemoral DVT patients [2] who go on to develop severe post-thrombotic syndrome (PTS) with ulceration. PTS prediction remains more art than science. Predictive factors for PTS include proximal DVT, increasing age, obesity, recurrent DVT, sub-therapeutic anti-coagulation, and residual thrombus and symptoms beyond 4 weeks [3]. The difficulty with a number of these factors is that by the time they are apparent, the effective window for endovascular treatment has passed. Of note, several of the new thrombectomy devices can effectively remove thrombus beyond the traditional two-week window and this allows patients who present late to be treated effectively. Additionally, in equivocal cases a short period of conservative management can be trialled, safe in the knowledge that effective treatment is possible out to 4 and possibly 6 weeks if required [4].

The next decision which can be questioned is the adequacy of the in-flow prior to iliac recanalization and stenting. The initial diagnostic venogram was thought to demonstrate adequate in-flow. (Fig. 1). A classification system proposed by Jalaie's group [5]. defines the extent of veno-occlusive disease; grade 1 representing focal compression such as May-Thurner, through to grade 5 with post-thrombotic / occlusive changes involving the entire iliac segment, extending into the common femoral, profunda, and femoral veins. It is proposed that patients with grade 5 disease are not suitable for endovascular reconstruction, and grade 4 patients need in-flow optimisation whether endovascular or surgical. Our patient's disease severity was at least grade 4. Sub-optimal in-flow in chronic venous disease is known to be predictive of stent failure [6].

Accurate assessment is challenging and comes with experience. The quandary that we often find ourselves in is that patients with the most severe in-flow disease have the most severe symptoms. In patients with impaired in-flow and severe symptoms, we have now moved to using endovascular techniques to optimise in-flow, such as the 'ACCESS PTS' technique [7], utilising a combination of thrombolysis infusion and venoplasty. If adequate in-flow is obtained, we then proceed to recanalization and stenting. It is vital that the patients are invested in the process and understand the need for follow-up and possible re-interventions. If the in-flow is very poor, then we will turn patients down. Another key point is that in-flow damage occurs as a result of the acute event, and whilst waiting to see if patients develop PTS before treating may seem a sensible option, often by the time intervention is considered, the in-flow damage has occurred.
Finally; stenting into the in-flow vessels. Whilst there are small cohorts demonstrating reasonable results [8], it is not a durable solution and should only be performed as a last resort. Importantly, profunda occlusion may precipitate symptom deterioration. Our case highlights the common course of stenting into in-flow vessels; a reasonable venographic result and short-term clinical improvement followed by stent stenosis, occlusion or fracture and symptom recurrence.

As our experience and understanding of venous disease have progressed, our approach to this patient would be different now. We have established a centralised electronic referral pathway within our vascular network to ensure all acute iliofemoral DVTs are referred and reviewed for consideration of intervention. Given the diseased in-flow, we would now use endovascular techniques to improve this before potentially proceeding to stenting. Finally, we would probably have avoided stenting into the profunda vein.

In summary, this case highlights the continued evolution of our understanding of venous disease. It highlights the importance of decision-making and the need to provide ongoing follow-up and care to these often-complex patients. Talks such as the venous nightmares session enable frank and honest discussions with colleagues from across Europe to learn from each other mistakes, exchange new ideas and continue to improve the quality of care we provide to our venous patients.

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Figure 1: Initial diagnostic venogram demonstrating severe post-thrombotic change affecting the iliac segment extending into the CFV. The upper femoral vein is occluded with stenosis of the upper profunda vein.

Figure 2: Venogram following venous recanalization and stenting down to the femoral/ profunda confluence.

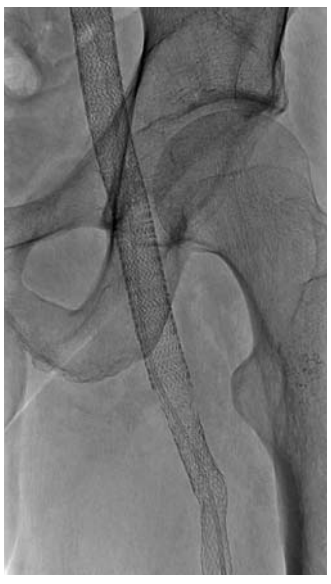

Figure 3: Stent extension into the profunda vein.

Figure 4: Venogram showing in-stent stenosis of the iliac and profunda stents with a tight stenosis at the lower aspect of the profunda stent.

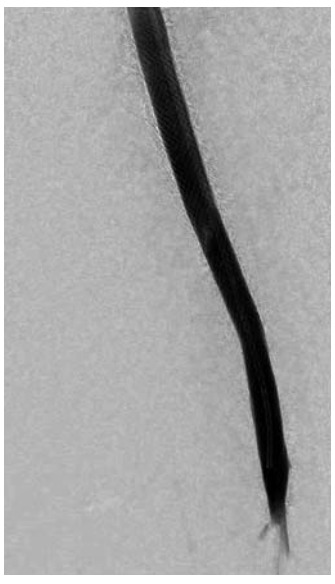

Figure 5: Stent extended further into the profunda vein.

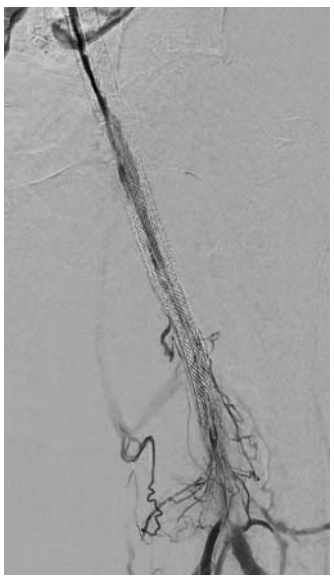

Figure 6: Venogram demonstrating occluded iliac and profunda stents.

Embolisation with non-adhesive liquid embolic agent

Joo Young Chun, Robert Morgan

Don't miss it !
Treating complex visceral aneurysms
Monday, September 12, 17:30-18:30
Room 112

Complex visceral artery aneurysms (VAA) may not be treatable with conventional techniques such as covered stenting or coil embolisation. These may exhibit a wide neck, arise at a major bifurcation or the parent artery must be preserved. In such cases, balloon-assisted embolisation with a non-adhesive liquid embolic agent may be a useful technique. These EVOH-based agents include Onyx™ (Medtronic, USA), Squid (Emboflu, Switzerland) and Precipitating Hydrophobic Injectable Liquid (PHIL) (Microvention, Terumo, Japan), developed primarily for use in intracranial aneurysms and vascular malformations. Onyx is the most widely used and discussed in more detail.

Onyx™ (Medtronic) is a cohesive liquid embolic agent, composed of ethylene-vinyl alcohol (EVOH) copolymer dissolved in dimethyl sulfoxide (DMSO) with suspended micronized tantalum powder. When the DMSO solvent diffuses away, Onyx forms a spongy elastic embolus. Onyx™ is supplied in ready-to-use vials and several formulations are available that differ in the concentration of copolymer and tantalum content (Figure 1). Onyx 34 (EVOH 8%) is more viscous and allows for more controlled injection in higher flow targets, whereas Onyx 18 (EVOH 6%) will travel more distally and penetrate deeper into the target lesion. Onyx 34L has a lower tantalum concentration resulting in less streak artefact on CT. Onyx is delivered through a microcatheter under fluoroscopic control.

There are several practical considerations when using Onyx™. Vials need to be shaken for at least 20 minutes and until they are ready to be drawn up for injection (Figure 2). A separate clean trolley and clean gloves are advised to prevent inadvertent polymerisation. The microcatheter should be DMSO compatible. The dead space of the microcatheter is filled with DMSO prior to injecting Onyx slowly (<0.3mL/min) under fluoroscopic guidance during injection.

Complex visceral aneurysms may be treated with Onyx using a balloon-assisted technique (Figure 3). A DMSO-compatible microcatheter is positioned with its tip in the centre of the aneurysm. Then a compliant balloon is placed across the neck of the aneurysm to isolate it from the parent vessel. The microcatheter is primed with DMSO to fill its dead space and Onyx is injected via the microcatheter until a sufficient volume (usually 0.2 ml) has been introduced, so Onyx reaches the end of the catheter. Onyx is then injected slowly with the occlusion balloon inflated.

Onyx accumulates around the tip of the microcatheter and forms a nidus that stays attached to the catheter. Occasional intermittent balloon deflation is performed to perfuse the end organ. The aneurysm is progressively filled until Onyx flows to the margins of the balloon and occludes the neck of the aneurysm flush with the arterial wall. Following angiographic confirmation of complete aneurysm exclusion, a ten-minute pause is taken to allow complete solidification of the polymer. The balloon is then reinflated and the microcatheter is removed by gentle traction.

Advantages of Onyx over an adhesive agent such as N-butyl-cyanoacrylate (NBCA) include no risk of the catheter becoming permanently adherent to the aneurysm wall. Embolisation with Onyx is less painful than NBCA as polymerisation is not exothermic and does not cause an inflammatory reaction. Onyx does not adhere to the arterial wall and therefore does not interfere with subsequent surgical repair.

On the other hand, widespread use of Onyx is prohibited by its high cost. In addition, it produces significant streak artefact on follow-up CT, often rendering them non-diagnostic for the purposes of aneurysm assessment. The authors have also experienced aneurysm reperfusion eight years after successful embolization with Onyx requiring re-intervention. Similar cases of Onyx resorption with recanalization of intracranial AVMs have also been reported.

Joo Young Chun
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Joo Young Chun is a consultant interventional radiologist at St George's University Hospital in London with a special interest in arterial intervention. She is a member of many committes including the CIRSE Standards of Practice committee, BSIR Education and Research Committee, and EBIR Examination Council. She is an associate editor for CVIR Endovascular and a RCR FRCR 2B examiner.

Robert Morgan
St George's University Hospitals
London/GB

Robert Morgan is a professor of interventional radiology at St George's University Hospital in London, as well as the Deputy Editor-in-Chief of CVIR Endovascular, and former President of CIRSE.

Figure 1: Onyx preparations

Figure 2: Shaking Onyx prior to use

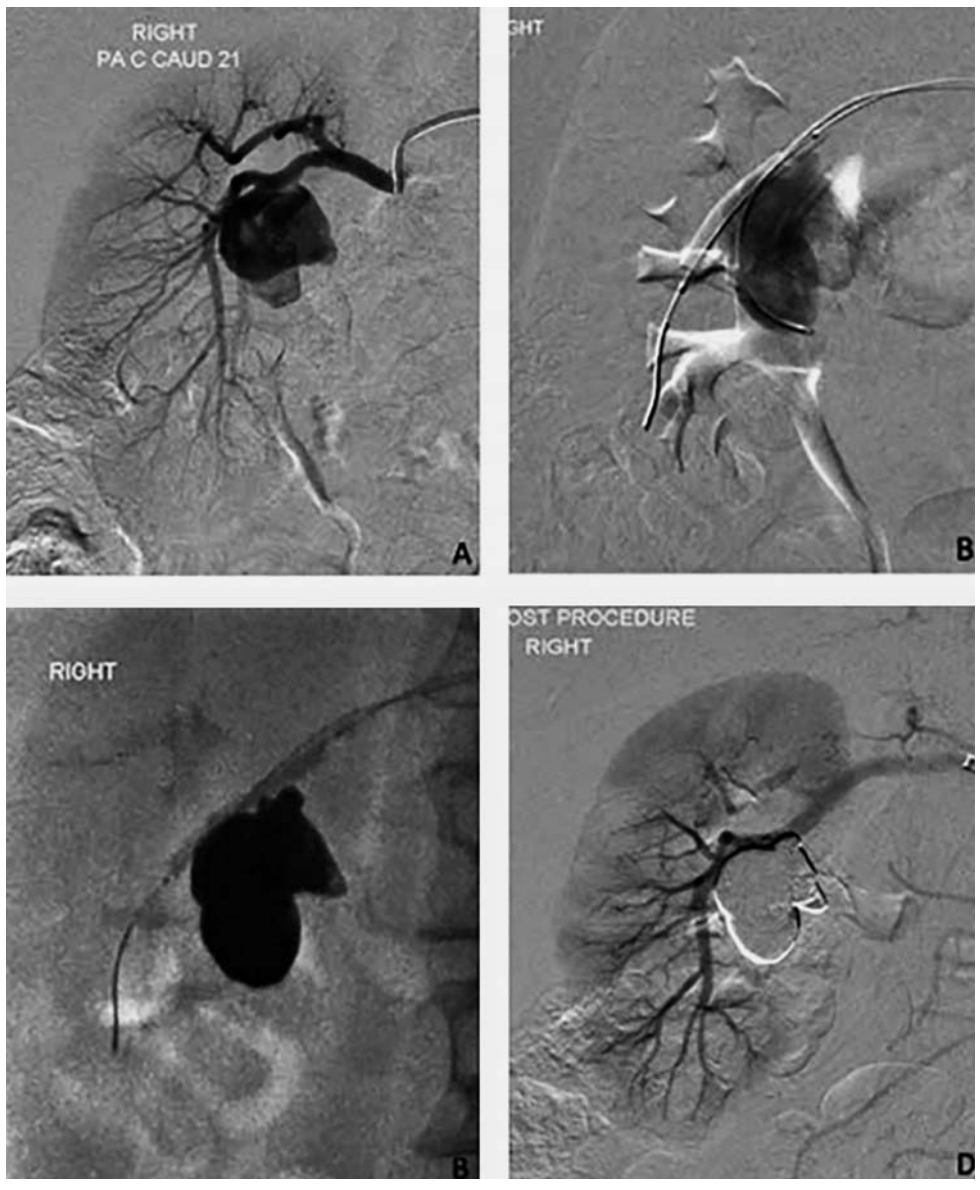

Figure 3: (A) Selective renal angiogram shows a 3cm fusiform aneurysm with a wide neck arising from main lower pole artery (B) Microcatheter within the aneurysm and a 3 x 40mm balloon inflated across the aneurysm neck excluding the aneurysm from parent artery (C) Onyx injected slowly into aneurysm via microcatheter (D) Completion angiogram shows complete aneurysm embolisation with no loss of renal parenchyma.

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Don't miss it !
Pancreatic cancer management
Monday, September 12, 10:00-11:00
Room 117

Irreversible electroporation in pancreatic cancer

Jose Maria Abadal

Jose Maria Abadal
Hospital Universitario Severo Ochoa, Madrid

Jose Maria Abadal has been a consultant vascular and interventional radiologist since 2000 and chief of department of radiology at Hospital Severo Ochoa University Hospital (Madrid). He is currently the Vicepresident of the Spanish Society of Vascular and Interventional Radiology (SERVEI). His interest includes Interventional Oncology, ESKD endovascular treatments and EVAR/PAD. He is a highly regarded teacher at University and Director of the "Endoschool of Interventional Radiology" for 14 years.

In addition to a strong interest in research, he is a regularly invited speaker at international conferences and a member of the CIRSE 2022 Scientific Programme Committee.

Pancreatic duct adenocarcinoma (PDAC) represents Europe's third cause of cancer-related death. Still, five-year survival rates are below 7% for locally advanced pancreatic cancer (LAPC) and 3% for metastatic cancer. Factors that contribute to this poor outcome are advanced disease, poor performance status at diagnosis, and limited therapeutic options and response. Irreversible electroporation (IRE) is a non-thermal ablation technique that uses short high-voltage electric pulses which induce cell apoptosis by creating nanopores in tumoural cell membranes. The main advantage over other thermal ablation techniques is that there is no "heat-sink effect" and thermal damage to vessels and ducts due to their elastin and collagen composition.

IRE has two typical indications. First, it can be performed in locally advanced pancreatic cancer (LAPC), considered non-resectable due to vascular encasement (stage III). It can also be used in surgical candidates with borderline tumours to increase the chance of R0 resection margin (Stage IIB). Tumour diameter should be less than 3-4 cm. After histological confirmation of pancreatic cancer, patients undergo neoadjuvant chemotherapy for at least three to four weeks. Stable tumour or volume decrease and low aggressive biology predict a better IRE response.

IRE can be performed through open surgery (or laparoscopically) with intraoperative US guidance or percutaneously under CT guidance (less frequently under US guidance). A high degree of expertise is needed for planning and performing the procedure. The most crucial step is placing multiple needles parallel to obtain full coverage of the lesion in this complex and delicate anatomic region. Two to six electrodes are inserted, and 100 pulses of 1500v/cm and 90µs are delivered between pairs of needles, synchronized with the "r" wave of the EKG to prevent cardiac arrhythmias. Needle pullback is frequently needed for overlapping ablations.

In the open approach, needles are normally placed caudo-cranially along the SMA axis (Fig.1). When the percutaneous technique is used, needles are placed normally using the CT axial plane (Fig.2). Transhepatic and transgastric routes are often used. Special care is taken to avoid puncture of the vessels and duodenum/bowel wall. Robotic stereotaxic needle placement aids needle positioning and shortens the procedure.

IRE is considered a high-risk intervention with complications of up to 36% and a mortality rate of 2%. The most severe complications are vessel thrombosis, bowel perforation, bleeding and severe pancreatitis. Tumour response is evaluated with CT. It may be challenging, as IRE tumour ablation may not resemble the typical necrosis imaging findings that occur with thermal ablation. Pseudotumoural growth can be seen for up to six weeks, secondary to swelling. Tumour response can be assessed after three months by combining signs of tumour growth, pathological enhancement, indirect signs of vascular/biliary compression, and tumour markers.

The main goal of IRE is to increase overall survival (OS) without affecting the quality of life of patients with LAPC. There are several studies that have demonstrated a median OS above 17 months, almost duplicating the current standard of care with chemotherapy alone. Besides local tumour ablation, evidence is emerging on IRE's role in inducing systemic immunomodulation in a low immunogenic tumour like PDAC. IRE triggers an important antigen release and T cell activation that can be used combined with immunotherapy drugs as an added pathway to treat local and distant tumours.

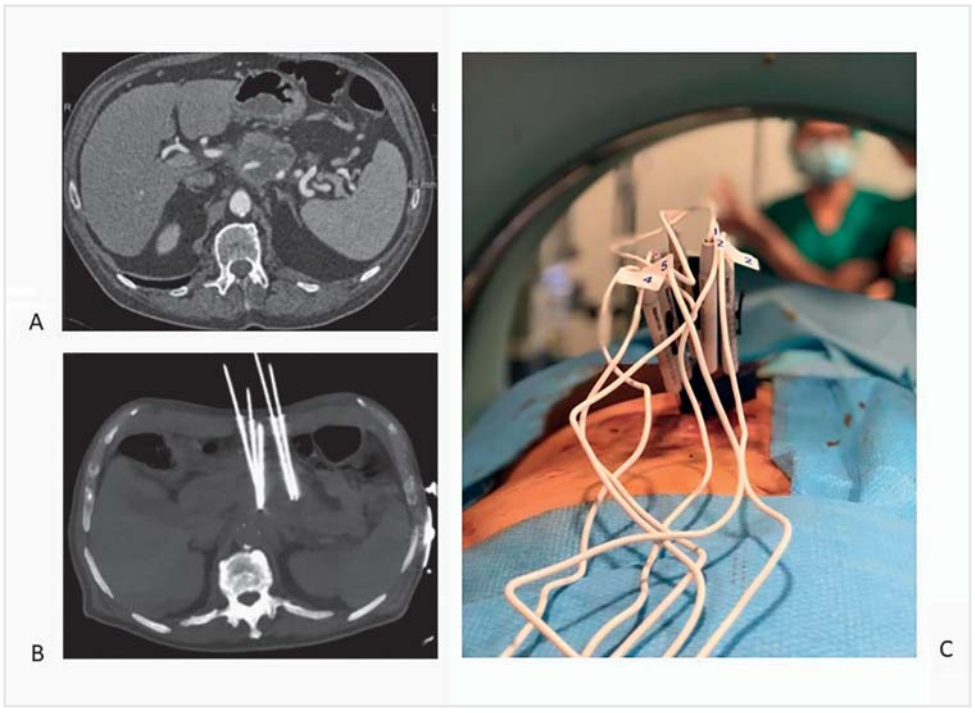

Figure 1: Open Approach IRE. (a) Needle planning along SMA, SMV axis, to cover the lesion. (b) Surgical field with 19G needle electrodes, 20mm parallel distance and 15 mm active tip exposure. (c) Direct visualization of needle advance using a T-shaped US transducer.

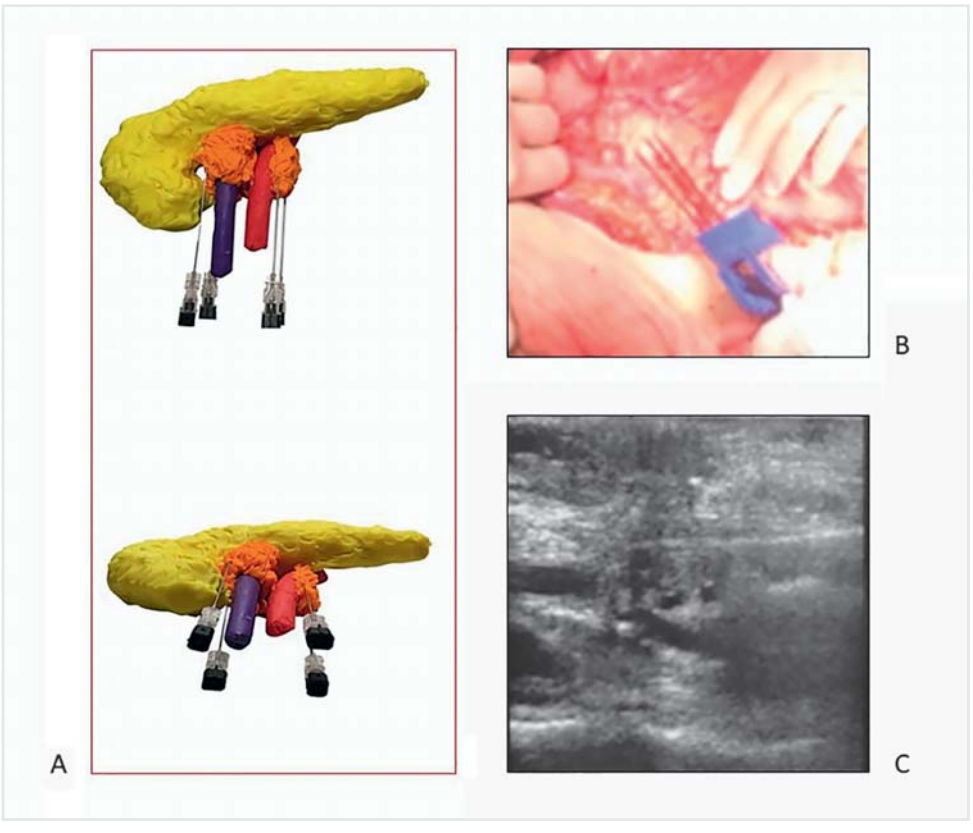

Figure 2: Percutaneous CT guided IRE. (a) LAPC with encasement of the celiac trunk. (b) Five parallel electrodes placed orthogonal to the patient. Pullback was needle to cover the lesion. Patient was under general anesthesia, and needle insertion is performed in apnea (c) Gantry view of electrodes, adequately fixed and taken care of CT table movements to prevent needle dislodgment.

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Access and crossing techniques for heavily calcified lesions

Mariano Palena

Don't miss it !
Challenges and opportunities in the treatment of severe vascular calcification
Monday, September 12, 17:30-18:30
Room 117

Nowadays, infra-inguinal angioplasty represents the most frequent choice of revascularisation in patients with peripheral artery disease [1]. Lower limb arterial revascularisation can be crucial for limb salvage, wound healing, and improvement of patients' quality of life, especially when chronic limb-threatening ischemia (CLTI) is sustained by heavily calcified lesions. The operator's access and crossing technique choices are fundamental to achieving successful treatment.

The common femoral artery (CFA) is the preferred puncture site, both for retrograde (RA) and antegrade access (AA) due to its suitable caliber for endovascular devices, its superficial path facilitating puncture, and its anatomical position simplifying hemostasis with compression [2]. Ultrasound-guided puncture of the CFA is easy and has a lower rate of complications when compared to fluoroscopy [3]. Moreover, in the case of a patient's hostile anatomy (eg. high CFA bifurcation, obesity, prior inguinal surgery), this technique allows to safely visualize the superficial femoral artery (SFA) and use it as an alternative access [3]. Once the CFA is suitable for access, our group always performs AA when possible.

In literature, AA has been reported to have similar access site complications to RA [4] and can be successfully used if the patient presents heavily calcified aortic bifurcation, tortuous iliac anatomy, or previous aorto-iliac interventions (either endovascular or open). In addition, for infrainguinal angioplasty, AA guarantees optimal device control due to the smaller length and curvature of both wire and catheter between the sheath and the target lesion [3,5]. As a result, it allows for easier guidewire manipulation and better catheter support. On the other hand, RA markedly changes the device's resulting force by crossing the aortic bifurcation, resulting in less pushability, torqueability, and device support [6]. Moreover, we always recommend the use of a closure device instead of manual compression, due to its safety and lack of complications (access site haematoma or haematoma requiring intervention) [4].

Arterial revascularisation for above (ATK) and below the knee (BTK) artery occlusion can be a determining factor during the endovascular procedure, especially in patients with chronic limb-threatening ischemia (CLTI). One of the most important issues operators face regarding endovascular revascularisation failure is certainly heavily calcified peripheral artery disease (PAD) vascular lesions. According to the literature, almost 25% of the procedures performed in seriously calcified chronic total occlusions (CTOs) do not result in technical success [7]. Moreover, heavily calcified arterial burden represents a predictor of poor clinical outcome following procedures [8].

Various techniques with different devices were developed for crossing severely calcified lesions, but this topic continues to be extremely compelling. Firstly, a crucial element is the choice of the guidewire, as most failures are associated with a failure of the guidewire crossing. In general, a wire can be advanced mainly in three ways, namely by the sliding technique, the drilling technique, and the penetrating technique. All of these methods work on the principle of wire escalation, exchanging a wire with lower tip load for one with a higher tip load in order to increase penetrability.

Another key concept is the recanalisation approach. Outside the traditional endoluminal approach, an alternative crossing technique was firstly described in 1994 with percutaneous intentional extraluminal recanalization (PIER) consisting in entering the subintimal space proximal to CTO, going beyond the occlusion, creating by angioplasty a subintimal channel, then exiting downstream in the true lumen [9]. This approach has ensured low morbidity and mortality compared to surgical revascularization along with cost reduction [10]. Another crossing procedural method, especially when re-entry into the true lumen by antegrade subintimal recanalisation is unsuccessful or when there is a limited target artery re-entry zone, is represented by the subintimal arterial flossing with antegrade-retrograde intervention (SAFARI). This technique firstly described in 2004 uses a retrograde access which is usually obtained by the popliteal, proximal or distal anterior tibial artery (ATA), the dorsalis pedis (DP), the distal posterior tibial artery (PTA), in selected cases by the peroneal artery (PA) and even through the more distal first dorsal metatarsal artery or the plantar arch directly; all of them performed in order to gain access to patient's distal artery, successfully cross the lesion and obtain the target vessel recanalization [11,12,13]. In 2006, a new concept for CTO recanalization using a controlled antegrade and retrograde subintimal tracking technique (CART) [14] was first introduced. This method combines the simultaneous use of bidirectional access, then a subintimal dissection is created antegradely with a guidewire and retrogradely with a ballon with the aim to limit the extension of the subintimal dissection in the CTO portion and afterwards, by deflating the retrograde ballon, the antegrade guidewire is inserted to reach the distal real lumen. Lately, a variation of the technique has been applied with the reverse-CART involving antegrade ballon inflation followed by retrograde guidewire crossing into proximal real lumen using the dissection created by the antegrade balloon [15]. Recently, the evolution of crossing techniques, mostly in the BTK district, has lead to the development of new methods by external plaque modification. The first one was the PIERCE technique in which, after the guidewire crossing, the severely calcified plaque was punctured from the outside of the vessels using a 19 to 16-G puncture needle [16]. The second one represents an extension of the PIERCE technique, the so-called direct extravascular calcium interruption arterial procedure (DECIAP) in which the calcified plaque can be crushed and therefore modified through a small surgical incision using surgical tools in order to allow balloon passage or treat persistent recoil [17].

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Dr. Mariano Palena is currently a Consultant Interventional Radiologist at Policlinico Abano Terme, Italy. From 2010-2019, he was co-director of the Interventional Radiology Unit at the Abano Terme HOSPITAL/IT, a regional center of reference and excellence in the Veneto region.
From 2019-2022, he directed the Endovascular Surgery Unit at Maria Cecilia Hospital – Cotignola/IT, a center dedicated to diabetic foot care. Dr. Palena obtained his medical degree from the University of Bologna where he also completed his postgraduate studies and specialization.
He has written and published more than 50 original and review articles, book chapters, and abstracts. Among them are some articles describing new advanced and extreme techniques for the revascularisation of the vessels of the legs and feet, developed and first described by Dr. Palena's working group. He is actively engaged in advanced clinical research in the endovascular treatment of lower limb arterial disease and the treatment of the diabetic foot. In particular, Dr. Palena's interest focuses on the treatment of chronic arterial occlusions of the femoral, tibial and foot arteries.

For this article's references, please scan the QR code on the right.

Don't miss it !
Vertebral augmentation workshop
Monday, September 12, 12:45-14:15
Room 132

Vertebral augmentation hands-on device training

Paul Lohle, Kai Wilhelm

Paul Lohle
Elisabeth Tweesteden Ziekenhuis (ETZ), Tilburg/NL

Paul N.M. Lohle, MD PhD, completed his medical studies at the Groningen University in the Netherlands before starting his training in radiology & interventional radiology at the Westeinde Hospital in The Hague. Today, Paul works as an IR in a large community teaching hospital in Tilburg, in the south of the Netherlands.

For more than 15 years, Paul has been in charge of radiological teaching and training of the residents in his department, as well as the interns and IR fellows in his hospital. He is particularly skilled in embolisation (GI -, trauma -, pulmonary bleeders & fibroid-, adenomyosis-, prostate embolisation) including vascular interventions such as stroke treatment, AV-shunts, GI ischaemia and critical limb ischaemia. He is the principle investigator of the VERTOS 1,2,3,4,5 trials and the initiator of the QUESTA and SpleniQ trial. He is an active member of CIRSE and a CIRSE fellow.

Dr. Paul N.M. Lohle is often an invited speaker at international conferences, such as CIRSE and has authored or contributed to numerous CIRSE Academy courses, especially on UAE (fibroid and adenomyosis) and PV (percutaneous vertebroplasty) and is currently on the CIRSE 2022 Scientific Programme Committee.

Kai Wilhelm
Johanniter GmbH, Bonn/DE

Prof. Kai Wilhelm is chairman of the department of radiology of the Johanniter GmbH Bonn, Germany. He did his training and continuing education in radiology and neuroradiology at the University hospital in Bonn including Internships at the Department of Radiology and Neuroradiology of the Geneva University Hospital in Switzerland. His main clinical and scientific interests are vascular and nonvascular interventions. He is an active member of the DeGIR, DRG, DGNR, ESR and CIRSE fellow and the recipient of several honors and awards. In 2002 he received a CIRSE Educational Grant and 2008 a CIRSE Fellowship Grant. Prof. Wilhelm is CVIR editorial board member in the field of musculoskeletal Interventions.

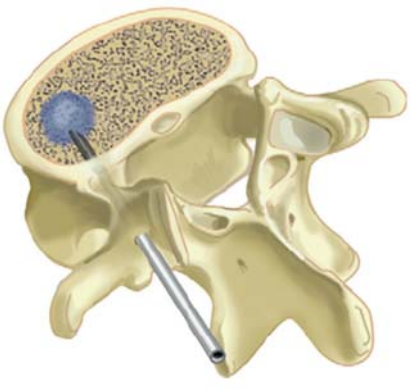
For this article's references, please scan the QR code on the right.

Introduction

Every day interventional radiologists are approached by patients to resolve their vertebral pathologies. In recent years, considerable technological progress has been made as a consequence of the extraordinary outcomes of minimally invasive techniques, which have helped countless patients to achieve pain relief and avoid many of the complications associated with open surgery.

Every self-respecting interventional radiologist should know, understand, and if possible learn how to apply this vertebroplasty cementation technique for extra good care of his patients. It's not difficult, you'll learn it quickly during the Hands-On Workshop here at CIRSE 2022! Come to this workshop and we will teach you the simple skills in 15-30 minutes, so that you can successfully apply it in your own hospital.

Workshop: hands-on!



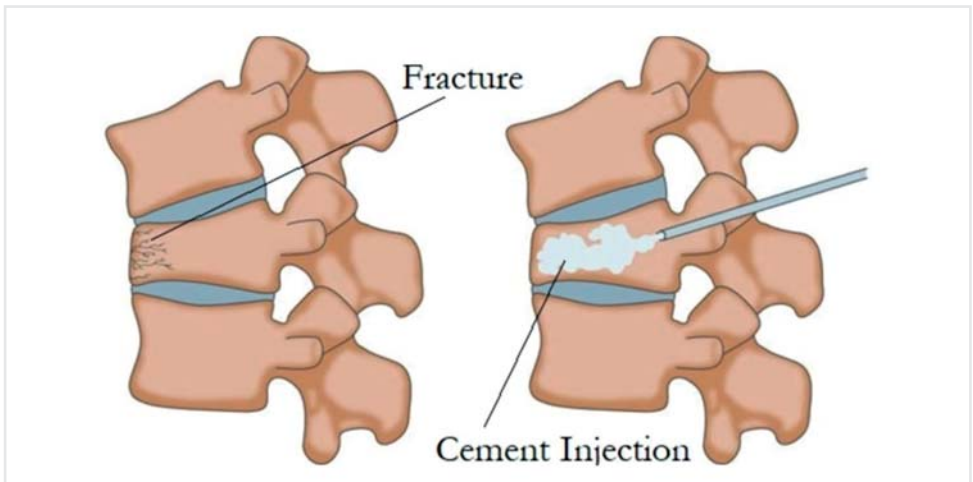
This workshop gives an insight into the principles and techniques of vertebral augmentation and restoration. It consists of a short theoretical introduction followed by hands-on demonstration and participation by the attendants. All participants have the opportunity to practice needle placement, cement preparation and injection on plastic spine models under fluoroscopic guidance.

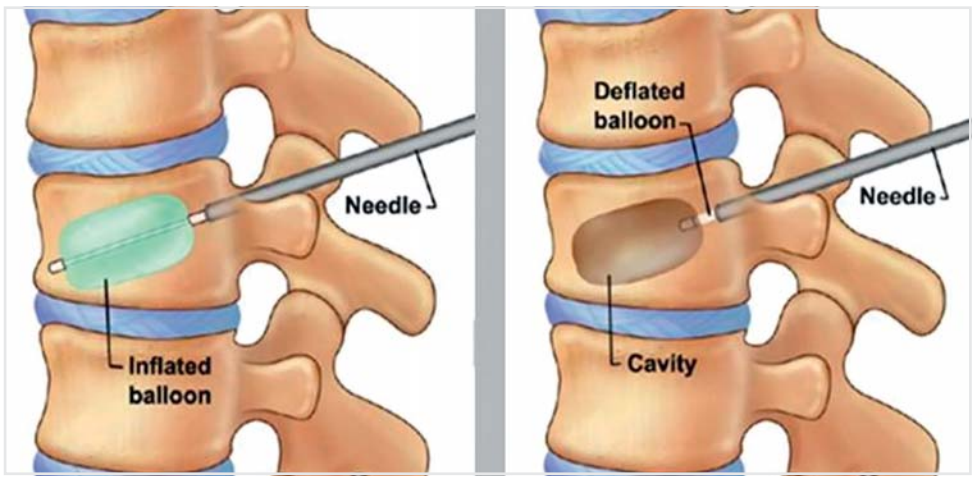
Learning objectives

- To understand the basic principles of the percutaneous vertebral augmentation procedures
- To become familiar with the currently available techniques
- To practise needle placement on a spine model under fluoroscopic guidance
- To learn and practise cement preparation and delivery under fluoroscopic guidance
- To learn how to perform kyphoplasty

Percutaneous vertebroplasty (PV) is a non-vascular interventional radiology procedure for the treatment of painful vertebral fractures, most commonly due to vertebral collapse fractures caused by osteoporosis (woman>man), in Morbus Kahler, plasmocytoma, and lytic or blastic vertebral metastases.

PV is a procedure in which a special cement is injected into a fractured vertebral body with the goal of relieving spinal pain and restoring mobility of the patient. Percutaneous vertebral augmentation techniques are image-guided procedures used to consolidate vertebral compression fractures (VCFs), treat pain, and where possible, achieve vertebra height-restoration. PV involves the injection of radio-opaque cement into a collapsed vertebra. It is effective for treating certain types of painful VCFs and some painful benign and malignant vertebral lesions that fail to respond to conservative therapies.





Kyphoplasty (KP), a form of cementation/ vertebroplasty, attempts to restore vertebra body height by inflating high-pressure balloons prior to cement injection.

Vertebral body stenting and the other supplemental implant techniques include the placement of expandable scaffolds, inserted before the cement injection, in order to impede the secondary height-loss encountered with kyphoplasty after balloon deflation.

In addition to the classic cementation technique, we teach you to work with other devices such as Spine Jack, KIVA, other forms of kyphoplasty, vertebral augmentation and restoration.

Evidence with historical awareness of vertebroplasty through time

Vertebroplasty has been introduced by the French, thanks to the work of the interventional neuro-radiologist (Professor Hervé Deramond) in early '90s. The technique became worldwide accepted, because of many study reports with excellent clinical success rate ± 90%: pain reduction, improvement of function, both on short and long term. Professional societies endorsed the use of PV.

However in 2009, Buchbinder and Kallmes sham RCT trials, demonstrated no short-term benefit of PV when compared with controls. VERTOS 4 sham RCT trial, could not demonstrate a significant difference in pain reduction after PV compared to sham.

What VERTOS 4 did proof however, was:

1) vertebroplasty prevents further height loss of cemented vertebral bodies compared to more severe height loss after sham intervention, and
2) vertebroplasty does not increase the risk of new vertebral fractures in adjacent or at remote levels.

Cementation provides an important advantage in the prevention of morbidity associated with loss of sagittal balance. A single wedge-shaped fracture at the thoracolumbar level can cause a 15-20° of spinal kyphosis. Spinal kyphosis induces sagittal imbalance of spine, induces increased risk of falling with increased risk of new vertebral compression fractures.

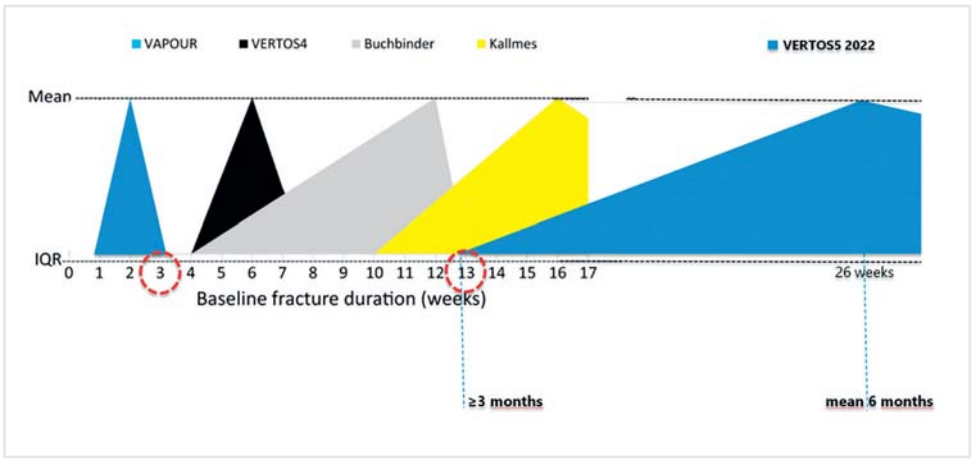
Thus, spinal kyphosis is a serious factor in:

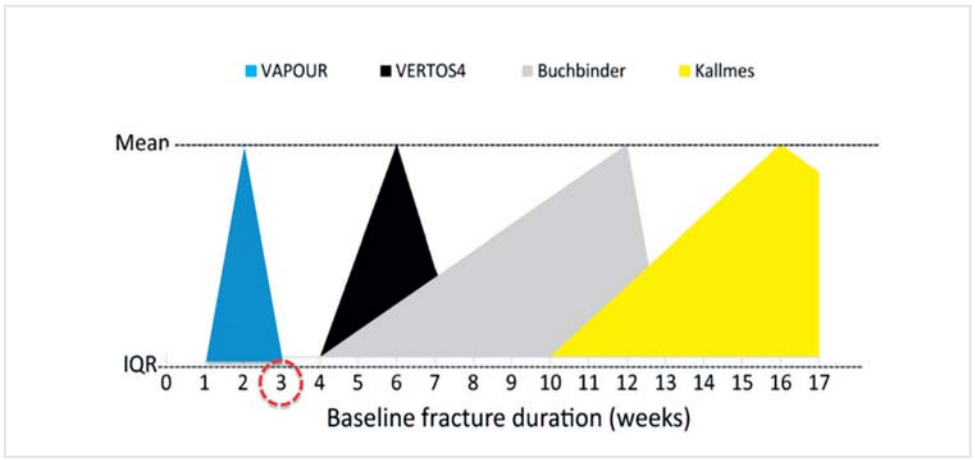
1) patients' morbidity,
2) decreased functional capacity and decreased respiratory capacity, and
3) increased risk of mortality.

The United States Medicare system came out with figures, which were analyzed showing that in patients with osteoporotic vertebral compression fractures the mortality risk was 4% **higher** between the years 2010-2014 (no more reimbursement by Health Insurance Companies in certain states of the US) compared to the period 2005-2009 during which the vertebroplasty procedure was reimbursement in the US. Cementation cohorts had a 7-19% (vertebroplasty and kyphoplasty) **lower** 10yr mortality risk than the non-surgical management cohort.

An important publication came out in 2016 by William Clark; his VAPOUR sham randomized controlled trial demonstrated a sound and clear benefit of PV regarding pain relief when compared to sham intervention, with a significant difference in pain reduction after PV compared to sham. The positive findings of VAPOUR contrast with the three other former sham RCT trials. These conflicting results gave rise to discussions and controversies about PV worldwide!!

These differing outcomes from blinded RCTs have created controversies for the role of vertebroplasty in managing patients with **acute painful osteoporotic VCFs.** Cochrane review of PV failed to acknowledge any positive evidence for PV even with the VAPOUR trial. The recent American Society of Bone and Mineral Research taskforce report also based





their finding on Cochrane review. Other analyses have drawn different conclusions, confirming the positive evidence for PV in patients with acute fractures and severe pain.

The positive findings of VAPOUR may be partly explained by performing vertebroplasty much earlier with most patients (±80%) having fractures of 3 week duration or less, which is a key enrolment difference from the 3 former blinded RCTs (see figure below).

By far, most vertebroplasty studies focussed on early osteoporotic vertebral compression fractues (oVCFs), including the 4 blinded (sham) RCTs all 4 mainly focussing on (sub) acute oVCFs. There is only 1 study by Chen et al. focussing purely on c**hronic painful oVCFs 3 months or older.**

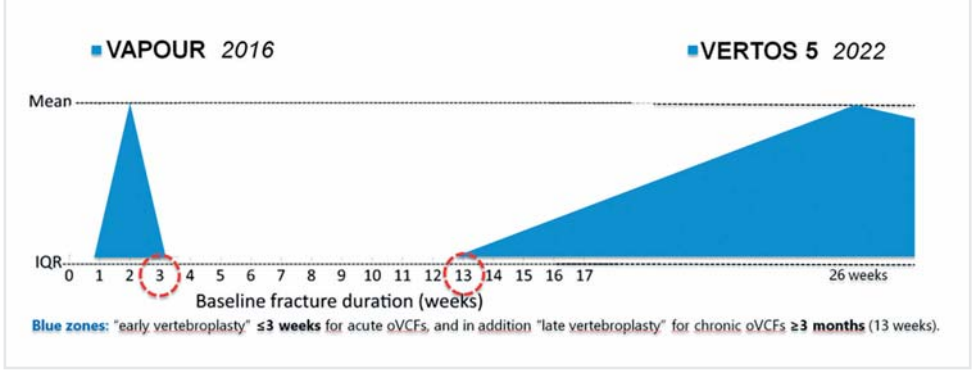
In line with the study results from Chen et al. the recent VERTOS 5 trial (sham RCT on chronic oVCFs, including vertebral fracture 3 months or older) demonstrated:

1) significant more pain relief after vertebroplasty than sham intervention.
2) significant difference in quality of life in favour of vertebroplasty at 12 months follow up compared to sham.

In other words, VERTOS 5 is the world's first blinded RCT on purely chronic painful oVCFs showing PV superiority over sham (Level Ia evidence). In pain treatment of chronic oVCFs (≥3mo) PV provides 1) sustained and progressive greater pain relief and 2) better health-related quality of life improvement than sham intervention during 12 mo fu.

Given the results of several studies that found no added value in vertebroplasty, it is worth considering offering vertebroplasty particularly for the acute fracture before 3 weeks (conclusion VAPOUR trial) or for chronic fractures after 3 months (conclusion Chen's trial and VERTOS 5 trial). The discussions will continue for the time being... to be continued.

Be that as it may, you are most welcome to join this Hands-On Workshop here at CIRSE 2022 and we will teach you the simple skills in 15-30 minutes, so that you can successfully apply this vertebroplasty procedure in your own hospital.



Pulmonary tumours: what are the indications?

Andrea Veltri

Don't miss it !
Pulmonary tumours: where do we stand
Monday, September 12, 08:30-09:30
Room 115

On one hand, a fundamental course on lung ablation covering the question "Where do we stand?" is necessary, as this kind of treatment for primary and metastatic pulmonary tumors is less known and practiced than image-guided ablative therapies (IGTA) of liver and kidney. On the other hand, however, this topic seems to be repetitive over the years, as its development is still slow and difficult.

It is well known that local treatment of SCLC is anecdotal and in terms of NSCLC the pretherapeutic clinical and radiological assessment is configured as the management of the pulmonary node, when it is incidental or found during a cancer screening. In both cases there are consolidated guidelines [1-3]. These guidelines begin with the stratification of the risk of the incidental nodules in the patient or from the positive test (LDCT) in the cancer screening, pass from CT without and with contrast (CECT). Following the initial guidelines, dimensional and/or volumetric monitoring of the smaller nodes is done and metabolic imaging (FDG-PET) is used. Later, biopsy typing (TTNB) of the larger ones or in case of growth should be done. The final radiological diagnosis should be discussed together with the multidisciplinary board (MTB) where the best therapeutic option will be decided.

The MTB meeting is also the ideal place to discuss the treatment decisions in case of oligometastatic disease (OMD) involving the lung, where IGTA can be one of the options. In this case, the pre-therapeutic radiological assessment is often limited to imaging for staging or restaging a known tumour, demonstrating OMD of colorectal cancer (CRC) or oligoprogression of treated NSCLC. The pre-treatment assessment, in most cases, consists of a chest CECT scan associated with the abdominal study. Sometimes PET-CT completes the pre-treatment assessment where the presence of other extra-thoracic or abdominal metastases can be relevant. It can also better demonstrate viable tissue in metastases already treated with systemic or local therapy (e.g. previous SBRT).

To date, the guidelines of the leading oncological scientific societies (ESMO, NCCN) relegate IGTA for NSCLC Stage IA (peripheral T1abc, N0) as an option for inoperable patients not receiving SBRT or definitive RT, but this indication is questionable. Few prospective trials and many retrospective studies demonstrate the non-inferiority of IGTA compared to SBRT [5, e.g.], but the number of treated patients included in studies is very unbalanced in favor of SBRT, so much so that oncologists will believe that the results of RT are more evident than those of IGTA. The logical consequence is that larger and randomised prospective trials are needed to insert the IGTA closest to RT in the algorithm for stage IA medically inoperable NSCLC, as requested from the NCCN by the SIO as early as 2019.

In case of OMD, IGTA are considered one of the therapies in the "toolbox "of the instruments for local ablative treatment. In the treatment of OMD, the MTB discusses possible patient choices (including surgery, IGTA, SBRT and embolisation techniques) based on clinical condition, resectability, molecular profile, etc. [6-7]. International guidelines are available especially for CRC and NSCLC, but in clinical practice they are often translated to other neoplasms, especially gastrointestinal. For lung metastases there is also a growing body of literature, mainly based on observational studies, but prospective, randomised trials are still needed to directly compare therapeutic options and better define the indications of percutaneous IGTA of pulmonary tumours [8].

Contraindications to lung IGTA for both primary and metastatic tumours are well summarised in the CIRSE Standards of Practice on Thermal Ablation of Primary and Secondary Lung Tumours [4]. This includes: the presence of nodal and distant metastases (except for oligometastatic disease); untreatable coagulopathies; an ECOG performance status >2; a life expectancy of less than one year; an end-stage lung disease and/or respiratory failure; lesions located <1 cm from hilum, large vessel, main bronchi, trachea or esophagus (if adjunctive techniques to space them out are not applicable).

Indications and contraindications to pulmonary IGTA depend on the evidence, which in the literature is not yet robust enough to lead to strong recommendations in the guidelines of the main oncological scientific societies.

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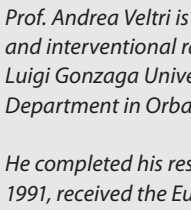

Andrea Veltri
University of Turin
Orbassano/IT

Prof. Andrea Veltri is head of the diagnostic and interventional radiology unit at the San Luigi Gonzaga University Hospital-Oncology Department in Orbassano (TO), Italy.

He completed his residency in Torino (IT) in 1991, received the European Diploma of Clinical Ultrasonography in 1993 and attended a brief fellowship at the Radiology Department of the University of Pittsburgh Medical Center (Pennsylvania, USA) in 1994. Since 2006 he is a professor of radiology at University of Turin Medical School and Radiology Residency Program.

Since the 1990s, he has been dealing with image-guided ablative therapies of tumours, first of the liver, then later the other organs addressed by the newborn discipline of interventional oncology.

He is active member of the Italian Society of Diagnostic and Interventional Radiology (SIRM), European Society of Radiology (ESR) and Cardiovascular and Interventional Radiology Society of Europe (CIRSE, member and fellow). For many years he has been in the faculty of the annual congress of CIRSE, ECIO, and the Mediterranean Interventional Oncology-Live, which has been held in Rome since 2015.

Catch the workshop !

Tips and tricks in FEVAR/BEVAR planning and interventions workshop
Monday, September 12, 17:30-18:30
Auditorium 2

Tips and tricks in FEVAR/BEVAR planning and interventions

Ondina Bernstein

Ondina Bernstein
St Mary's Hospital
London/GB

Dr. Ondina Bernstein is a consultant interventional radiologist and head of interventional radiology at St Mary's Hospital, Imperial College Healthcare in London. She completed a clinical and research fellowship in University Health Network and Mount Sinai Hospital in Toronto and undertakes vascular and oncology interventional radiology. She is on the specialty training board and curriculum committee at the Royal College of Radiologists.

The endovascular treatment options for juxta-renal and thoraco-abdominal aortic aneurysms have improved substantially in recent years with an increasing number of both off-the-shelf and custom-made endo grafts available. The clinical condition of patients and their anatomy need to be critically assessed on a case-by-case basis to decide on the best treatment for the patient. Despite the advances in endo graft technology, the success of the implantation and clinical outcomes depend on correctly sized and planned endo grafts. CT angiograms with a minimum slice thickness of 1mm are reformatted on planning software, prior to the manufacture of a customised endo graft.

The landing zones are assessed to decide the type of endo graft required to achieve a seal both proximally and distally. Fenestrated endovascular repair (FEVAR) is generally utilised for juxta-renal aortic aneurysms and branched endovascular repair (BEVAR) for thoraco-abdominal aortic aneurysms. BEVAR requires a minimum diameter of the aorta at the level of the visceral arteries, depending on the device used.

Access is planned to ensure that the delivery system of the endo graft can be inserted. In general, the common femoral and iliac arteries should be a minimum of 7-8mm in diameter. Angioplasty or an iliac conduit are adjunctive procedures that may be required or an open repair could be considered instead. The most common intraoperative adverse events are access complications and target artery complications. [1]

FEVAR for juxta-renal aneurysms may have fenestrations for two, three, four or even five visceral arteries. With increasing experience and follow-up, there has been a move to targeting more visceral arteries for a better proximal seal. Endo graft design differs between manufacturers. Cook Zenith® FEVAR and t-Branch® endo grafts commonly have two sealing stents proximal to the fenestrations/ branches, but by optimising the sealing zone and improving durability, the risk of spinal cord ischaemia increases. Some centres advocate the use of prophylactic spinal drains for all cases, while other centres take a more selective approach. If full coverage of the descending thoracic aorta is required, staged procedures can reduce the risk of paraplegia.

The visceral arteries are scrutinised to plan the "landing zones" of the target arteries and balloon expandable bridging stent graft sizes. The coeliac axis, superior mesenteric artery (SMA), and main right and left renal arteries are targeted. If there is a further large renal artery, a stent graft could be customised to include five fenestrations, but generally smaller accessory renal arteries are covered. This results in a higher rate of renal infarcts but no significant reduction of eGFR on follow-up or type II endoleaks related to the renal artery. [2] The commonly used bridging stent grafts start at 5mm diameter, so renal arteries with a diameter of less than 4mm are unlikely to achieve a durable result free from occlusion. Indeed, renal artery stents are the most likely visceral target to occlude during follow-up, with a higher rate following BEVAR than FEVAR.

Challenging target artery anatomy also includes ostial stenoses and a decision can be made to pre-stent problematic stenoses. Pragmatic decisions of achieving a seal versus not covering an early branch of a target visceral artery are made. Figure 1 demonstrates a chronic dissection flap that extends into the left renal artery. Extension of the bridging stent to the renal artery bifurcation was required to achieve a seal and a branch did not need to be covered.

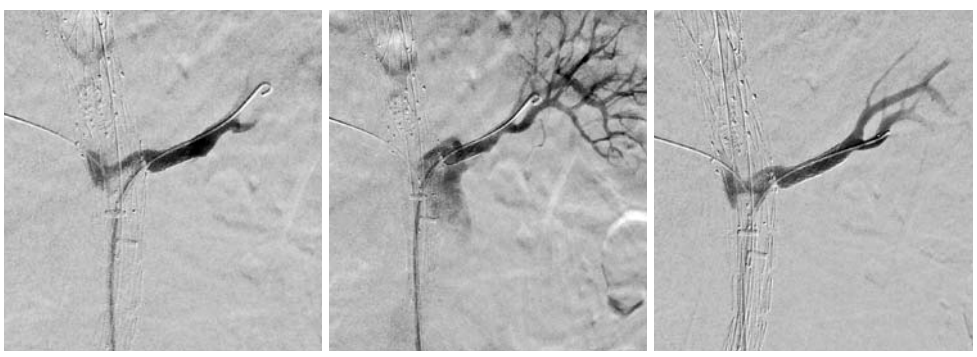

Figure 1a, b, c: Demonstrates a chronic dissection flap that extends into the left renal artery. Extension of the bridging stent to the renal artery bifurcation was required to achieve a seal and a branch did not need to be covered.

The angulation of the target artery should be taken account of at the planning stage so that vessels can be efficiently cannulated.

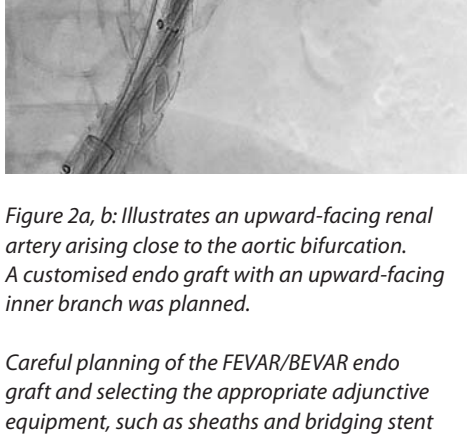

Figure 2a, b: Illustrates an upward-facing renal artery arising close to the aortic bifurcation. A customised endo graft with an upward-facing inner branch was planned.

Careful planning of the FEVAR/BEVAR endo graft and selecting the appropriate adjunctive equipment, such as sheaths and bridging stent grafts, can facilitate successful outcomes in challenging anatomy.

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6. Juszczak M, Murray A, Koutsoumpelis A, Vezzosi M, Mascaro J, Claridge M, Adam D. Elective Fenestrated and Branched Endovascular Thoraco-abdominal Aortic Repair with Supracoeliac Sealing Zones and without Prophylactic Cerebrospinal Fluid Drainage: Early and Medium-term Outcomes. Eur J Vasc Endovasc Surg (2019) 57, 639-48

Don't miss this session !

CIRSE meets EANM
Intra-arterial delivery of radionuclide – new frontiers
Monday, September 12, 11:30-12:30
Room 113

CIRSE meets EANM

Don't miss today's CIRSE meets the European Association for Nuclear Medicine session featuring an expert panel comprised of experts from both societies.

To kick off the session, Dr. Garin will give an overview of the evolution of dosimetry in TARE for HCC from the nuclear medicine perspective. After that, we will hear the results of the RASER study investigating radiation segmentectomy for early HCC in curative intent. Dr. Lam will speak on intra-arterial liver-directed peptide receptor radionuclide therapy (PRRT) in metastatic neuroendocrine tumours as well as targeting primary brain tumours via the same method. To conclude the session, Dr. Weber will give an outlook on what could be the future developments in intra-arterial delivery of radionuclide therapy.

A must-see session for anyone working in the field of radiation therapy!

Update on venous stents

Gerard O'Sullivan, EBIR

So – what's the big deal about venous stents anyway?

Veins are just like arteries – they carry blood; arteries from the heart; veins to the heart – they are just pipes – right?

Well, you may have noticed a fair bit of noise about venous stents over the past few years. Is this just industry-generated or is there something more to this?

Early in my career I started off purely "arterial" and have now ended up nearly entirely "venous". My exposure to venous disease started with central venous access, then arterio-venous haemodialysis maintenance, then IVC filter insertion and retrieval.
Along the way I started performing venous thrombectomy, then superior vena cava management; venous sampling, and latterly deep venous reconstruction and pelvic venous disease.

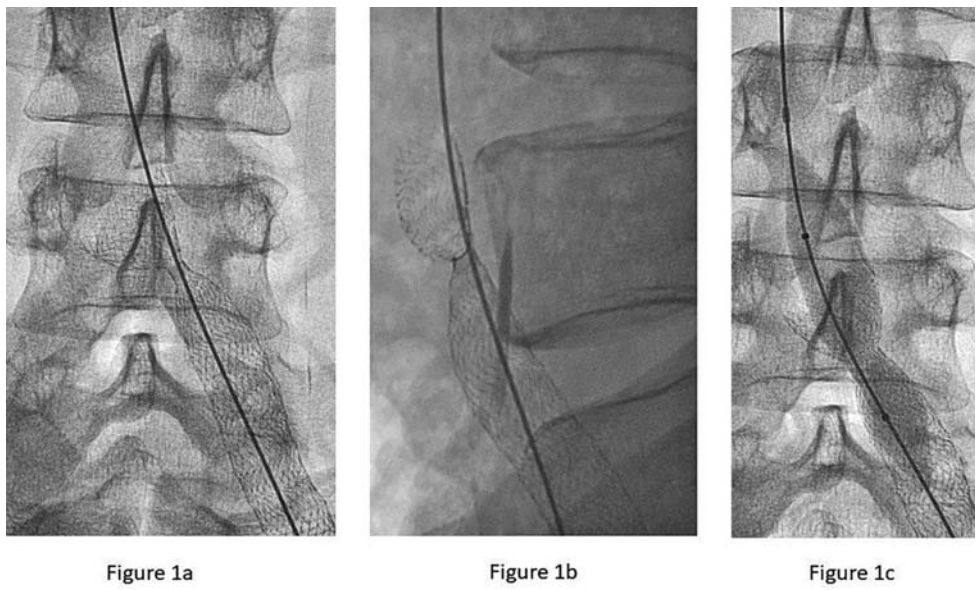


Figure 1: Super tight May-Thurner lesion (a) AP and (b) lateral views. (c) Repeat PTA to 14 mm at 20 atm required.

Venous stents are integral to almost the entire gamut of venous intervention.

Some of the principles you have learnt from arterial intervention certainly apply – good pre-operative imaging, proper planning, safe access; crossing the obstruction, and then appropriate use of balloons and stents. But the imaging is probably different; the site of access is almost certainly different; and the techniques for venous angioplasty and stenting also differ somewhat compared with those of arteries.

Stents have been used in veins since the beginning of the endovascular revolution. The BSCI Wallstent, which was designed in the early 1980s, is the longest established and worldwide probably still the most widely used stent, but since 2011 a whole range of new "venous-dedicated" stents have become available. They are constructed of different materials, have different features, are deployed differently, and come in different lengths and diameters.

The purpose of my lecture today is to acquaint you with some of these newer features, and to familiarise you with the ever-increasing number and variety of stents available.
My co-lecturers and I may also provide a glimpse of what is around the corner.
We will also discuss the recent venous stent withdrawals, why they occurred, and what we have learnt going forward.

Don't miss it !
Chronic venous disease
Monday, September 12, 08:30-09:30
Room 112

Gerard O'Sullivan
(EBIR)
University Hospital Galway
Galway/IE

Prof. Gerry O'Sullivan is a consultant interventional radiologist at the University Hospital Galway, Ireland. Previously, he held a consultant radiologist position at Rush University Medical Center in Chicago, USA. He specialises in vascular procedures and is particularly well known for his expertise in the venous field, especially DVT. Besides his work on deep venous disease therapies, he is also collaborating on several novel medical device developments. Prof. O'Sullivan has served as CIRSE Membership Committee Chairperson and has just been voted SPC Deputy-Chairperson. His tenure will begin after CIRSE 2022.

Follow him on Twitter @lahinchman!

For this article's references, please scan the QR code on the right.

Interview with Online outgoing Education Committee Chairperson Prof. Stefan Müller-Hülsbeck

Stefan Müller-Hülsbeck
Online Education Committee Chairperson

The past three years have made online education more relevant than ever. What did the OEC focus on?

Müller-Hülsbeck: CIRSE's online education (OE) stands on a strong base with three columns – the CIRSE Library, the CIRSE Academy and the CIRSE Webinars. Creating and evaluating sophisticated content suitable for these diverse platforms requires a highly motivated team. The OEC is comprised of members representing all facets of IR and the OEC team from the CIRSE office, which covers most of the editorial and administrative workload in order to create content which is highly appreciated by CIRSE members and non-members alike.

Looking a little bit deeper into the CIRSE Library, the user will find congress content from all CIRSE conferences from the last five years, including the annual CIRSE meeting, ECIO, ET, and IROS. With a newly improved and expanded search function, the CIRSE Library is an excellent tool to gather the most recent information from general to specific dedicated topics in IR.

The CIRSE Academy will soon cover the entirety of the European Curriculum and Syllabus for Interventional Radiology, which allows EBIR hopefuls a remarkably straightforward preparation path for the European Board of Interventional Radiology exam simply by going through the different Academy modules, which are CME accredited by the UEMS. Putting this content together over the last three years was rewarding but extremely challenging, as each module has to undergo a well-defined review process before final accreditation, which guarantees top-level, non-commercial content.

The CIRSE Webinars are our newest online offering, and these were created more or less to fill the demand that arose from the pandemic. It was important to be visible and ensure that education could continue virtually during times of restrictions, and in early 2020 when everything was uncertain it was the quickest way to provide important information, initially related to COVID, to our members. After we realised what a success these initial webinars were, we initiated a more regular release of webinars covering different fields in IR.

As one might imagine, everyone involved in online educational activities has been quite busy during the last months and years!

What were the biggest challenges you faced when adapting to the pandemic?

Müller-Hülsbeck: Within a few short weeks, we suddenly had to find a way to fill the gap in information and scientific exchange due to a multitude of abrupt limitations: no travel, no meetings, no interactive exchanges in person. Suddenly we had to adapt to virtual meeting formats, pre-recorded presentations, virtual presentations in a live format, problems with unstable internet connections, moderating sessions in virtual meeting rooms without having our counterparts next to us. Nevertheless, we adapted to it, and we were able to provide successful virtual meetings, like the CIRSE 2020 and 2021 Summits, operated by staff in Vienna with physicians streaming and participating from around the world.

This phase made it inescapably clear that online education is more important than ever before and will play a major role in the future, so that different time zones, travel, and any other logistical considerations are no longer a barrier for our members to gain information from CIRSE.

What do you consider the committee's biggest achievement in the past three years?

Müller-Hülsbeck: It is a huge accomplishment that the Academy now offers courses covering most parts of the European Curriculum and Syllabus for Interventional Radiology. This push forward to cover the entirety of the document is not yet complete, but we have made excellent strides in the realisation of this goal and it will be achieved in the near future. It's not possible to overstate the level of dedication by the committee that has gone into this project.

I think the improvements to the CIRSE Library are also of note; in addition to becoming more visually appealing, the Library is now more user friendly than ever before.

What other new initiatives were introduced?

Müller-Hülsbeck: The Library now includes a brand-new highlights section featuring exclusive content which aims to provide maximum educational value that can be reviewed in just a few minutes, with experts talking viewers through interesting cases in their specialisation. The scope of content available in the Library has expanded exponentially, so, alongside our featured content and topic packages, it's a way for us to make sure that users can find something fresh, curated, and educationally useful right on the home page.

CIRSE: What is your long-term vision? Where would you see the future of CIRSE's online educational programmes in five or ten years from now?

Müller-Hülsbeck: I hope that CIRSE's online education platforms will be the leading tools providing the latest scientific and educational content for all physicians working with IR worldwide. As mentioned earlier, OE should be a major component of any IR-related exam preparation; at the moment for the EBIR exam, but in the future, it could be used for any specialty or subspecialty exam in IR, either in Europe or internationally. The future of CIRSE's online educational programmes, alongside CIRSE's many other activities, will strengthen IR and position CIRSE as the leading ambassador spreading IR throughout the world.

CVIR Endovascular's Author Spotlight

At CVIR Endovascular, we have come up with a new initiative to put our authors in the spotlight, giving them an opportunity to provide insight into what drives their research, discuss important issues in IR, and share tips and tricks with other practitioners. The series premiered in February 2022, and new videos are added twice per month. All videos are announced on CVIR Endovascular's social media channels and available to watch on the CVIR Endovascular YouTube playlist as well as on the Author Spotlight page on our site!

Some of our most recent videos featured corresponding authors:

Dr. Keith Quencer gave an overview of adrenal vein sampling, assessing different techniques and the need for a standardised protocol for the procedure.

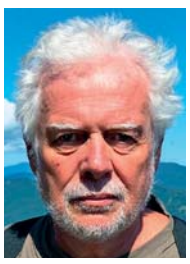
Prof. Colin Cantwell discussed hemodynamically unstable patients with acute abdominal hemorrhage with a preceding negative CTA and a potential connection between bleeding site and false CT findings

Dr. Keith Pereira spoke to us about how superior hypogastric nerve blocking can offer many women pain relief and even same-day discharge after UFE.

Dr. Takuya Haraguchi gave us the background on the novel "fracking" technique, utilising hydraulic pressure to crack deep calcified plaque in his step-by-step guide.

Dr. Mohammed Shamseldin outlined the innovative approach of using a technique more commonly used in neuroradiology using a cerebral stent retriever to remove a foreign body instead of surgical removal.

Five years of CVIR Endovascular – Interview with Editor-in-Chief Prof. Jim Reekers



5 YEARS ANNIVERSARY

It's been five years since CVIR Endovascular was launched and opened for submissions. Since then, the journal has seen a steady increase of submissions from 13 in 2017 to 160 in 2021. Not only the number of authors has increased throughout the year, but also the number of readers.
This can be seen in the increase in article downloads, from 13,200 in 2018 to more than 184,000 in 2021. Thank you to all authors, readers, reviewers and editorial board member for contributing to CVIR Endovascular's development!

As we celebrate the journal's fifth anniversary, we sat down with CVIR Endovascular's Editor-in-Chief Prof. Jim Reekers to talk about the journal.

You have been the Editor-in-Chief since the beginning of CVIR Endovascular. In your view, how has the journal evolved over the last five years, what contributions would you say has it made to the field of IR?

Reekers: I think we were able to obtain a steady position as one of the important platforms to publish scientific IR papers. We are more and more becoming the portal for many vascular IR papers. The goals we set for ourselves when we started to create a new open access journal have all been accomplished. However, I do think that there is room for further growth and improvement. CVIR Endovascular has made a strong statement to focus on quality rather than impact factor alone, as seen by a steady increase in the rejection rate.

What has been your favourite experience of being the Editor-in-Chief of CVIR Endovascular so far?

Reekers: There are many experiences which make me happy as an editor, but to see that so many young IRs find their way to our journal, both as readers but also as writers of scientific papers, gives me much joy and pride. In a few years from now, all journals will be open access and I think it is important that we already have established a prominent position as an open access journal. It also makes me proud to see that our number of submissions is still growing every year.

What sets CVIR Endovascular apart from other journals?

Reekers: I think the most important thing is that open access means that not only the subscribers of a journal, but the whole world is able to read our published papers. This means there is a much wider dissemination of our IR work and science. With more than 100,000 downloads every year we contribute enormously to the IR community. Another important factor is that we have a young group of reviewers and a young editorial board that represents the future of IR. CVIR Endovascular has a strong focus on practical papers, which I think is still the foundation of IR today and IR in the future. Case reports are therefore an indispensable part of what we do every day; being creative, innovative and pushing boundaries.

Do you have any advice or recommendations for future authors of the journal?

Reekers: The most important advice I can give is to read ALL the instructions for authors first, before you start writing for CVIR Endovascular. And don't hesitate to contact the editorial office (at info@cvirendovascular.org) if you have any questions!

If you had to name one vision for CVIR Endovascular's future that you hold above all others, what would it be?

Reekers: I really hope that in the near future all scientific papers will become available through a scientific streaming service, like the ones that already exist for music. That would be a huge step for free dissemination of all science. For the time being, I hope we will become a reference manual for all IR questions.

Visit **www.cvirendovascular.org** for more information about the journal!

CVIR the global home of IR!

CVIR

Check out the recently published commentaries on locoregional challenges and perspectives for IR practice from around the globe.

The article series was put together by Dr. Tiago Bilhim, CVIR Section Editor.

Locoregional Perspectives/ Challenges for Interventional Radiology Practice in the UK

by Raman Uberoi & Robert Morgan

Interventional Radiology: Tradition or Evolution?

by Sara Protto & Niko Sillanpää

EBIR-Helping to Foster Global IR

by Colin Nice

Locoregional Challenges for Interventional Radiology Practice: Specialty *de facto* but not *de jure*

by Jose Urbano

IR in Japan

by Toshihiro Iguchi & Koichiro Yamakado

Locoregional Challenges for Interventional Radiology Practice: USA

by John A. Kaufman

Old IR Challenges: It's Time for Common Views and Actions!

by Roberto L. Cazzato, Julien Garnon & Afshin Gangi

Challenges of Interventional Radiology in Brazil!

by Vinícius Adami Vayego Fornazari and Joaquim Motta

Perspectives/Challenges on IR Practice in India

by Sanjiv Sharma & Kartik P. Ganga

Locoregional Challenges for Interventional Radiology Practice in The Middle East/North Africa

by Karim A. Abd El Tawab & Mohammad Arabi

Locoregional Challenges for Interventional Radiology Practice: Australia

by Warren Clements

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STUDENT CORNER

ETF in the spotlight
Boglarka Tot – Women in IR; radiation protection

Boglarka Tod
Norrlands University Hospital
Umeå/SE
ETF Subcommittee member

CIRSE: Is it dangerous to be an IR nowadays?

Tot: The aspect of radiation exposure is something both men and women need to consider when choosing to pursue a career in IR. There is limited evidence regarding the potentially harmful effects of low-dose radiation exposure, but the doses of course need to be reduced as much as possible. Today, this is achieved very well with modern angiosuites and appropriate radiation protection equipment, which need to be used properly. We also work closely with medical physicists who are continually optimising the equipment. They also track all radiation exposure as detected by the dosimeters and follow up thoroughly on the rare occasion that elevated doses are detected. So, in the modern IR setting I think young women can feel safe to choose it as their career.

CIRSE: What is your message to young women who are interested in pursuing a career in IR?

Tot: My message to young women considering a career in IR is clear and simple: If you are interested in pursuing a career in IR, you should definitely do it!

Do not miss! – STUDENTS ON STAGE
Monday, September 12, 15:30-16:30, News on Stage Area

Recommended sessions of the day

Pulmonary tumours: where do we stand
08:30-09:30, Room 115

Acute mesenteric ischaemia - time is gut!
08:30-09:30, Room 116

Management of acute PE
10:00-11:00, Room Auditorium 1

How best to treat aorto-iliac occlusive disease
10:00-11:00, Room 112

Hands-on device and simulation training sessions

TIS-EMEA: Tools to perform a good access for peripheral intervention,
11:00-12:00, TIS-EMEA/TERUMO Learning Centre

Cordis: Getting started with radial access. Meet the expert
12:00-12:30, Cordis Learning Centre

Embolisation: materials and tools – coils & plugs
16:15-17:15, Room 134

TACE
17:00-18:00, Simulator Gallery

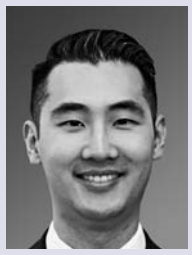
Tumour ablation – MWA
17:30-18:30, Room 111

ETF Short Talks

ETF Short Talks: Trainees and research
News on Stage, 17:30-18:30

be inspIRed...

Students in the Spotlight



Kevin Wang
Morsani College of Medicine
Florida/US

CIRSE: Can you tell us a little bit about yourself?

Wang: I am a currently a 4th year medical student with the University of South Florida, Morsani College of Medicine in the United States.

CIRSE: Why did you decide to study medicine and why are you interested in IR?

Wang: Being able to help others and making a difference in another person's life is what makes me fulfilled. This naturally led me to consider and decide to study medicine. I am specifically interested in IR's innovative nature, immediate impact on a patient's quality of life, and variety in procedures. There is always new technology and interventions; IR as a field that is just getting started.

CIRSE: How did you hear about CIRSE?

Wang: I heard about CIRSE from my mentor at Tampa General Hospital Dr. Jamil Shaikh. Dr. Shaikh recommended CIRSE as a great learning opportunity to not only present our work, but to immerse myself in IR and network as well.

CIRSE: What do you think is the best feature of the CIRSE Student Programme?

Wang: For me, it is the Mentoring Event. Having the opportunity to meet with potential mentors is an invaluable opportunity to learn more about different career paths within IR, the mentors' experiences, and to receive guidance on any questions one might have about IR.

CIRSE: What career path are you considering? What are your next steps?

Wang: I will be applying for residency in interventional radiology this upcoming application cycle. A future career path I am considering after residency is paediatric interventional radiology, as I enjoy working with neonates, children, and adolescents.

Richard Wu
Emory School of Medicine
Atlanta/US

CIRSE: Can you tell us a little bit about yourself?

Wu: I am from a town called Grand Rapids, Michigan and primarily grew up in that area. I eventually attended college at the University of Michigan in Ann Arbor, where I stayed after to do research on a community health intervention for peripheral artery disease. I then moved to Atlanta, Georgia for medical school at Emory University

CIRSE: Why did you decide to study medicine and why are you interested in IR?

Wu: I decided to study medicine because I realised the influence that physicians can have on their community, and I wanted to use that to provide healthcare to underserved populations. I became interested in IR during my third year of medical school when I was able to shadow some procedures on my clinical rotations. I had not known about the field, but was fascinated by the ability of IRs to do minimally invasive procedures anywhere throughout the body and knew this was the specialty I wanted to go into.

CIRSE: How did you hear about CIRSE?

Wu: I heard about CIRSE through my research mentor, Dr. Bercu, who graciously encouraged me and supported me in putting together a few abstracts for the conference.

CIRSE: What do you think is the best feature of the CIRSE Student Programme?

Wu: I am looking forward to seeing all that the CIRSE Student Programme entails when I arrive in Barcelona, but the Mentoring Event sounds like a valuable opportunity to connect with more experienced IRs and receive advice from them on moving forward.

CIRSE: What career path are you considering? What are your next steps?

Wu: I am unsure of what type of IR I want to practice in the future - one of the things that drew me to the field was the variety and breadth and I would like the option to practice many different kinds of IR procedures. I also hope to be in an environment where I can come up with innovative healthcare solutions, such as bringing IR interventions to those with limited access. My next steps will be applying to residency and starting that new phase of my training in the upcoming summer.

CIRSE student membership

If you would like to keep learning about interventional radiology after the congress and benefit from free congress registration for all CIRSE congresses, apply for the CIRSE student membership today! All students attending CIRSE 2022 have the chance to receive CIRSE student membership for free.

What are the main benefits?

- Free access to CIRSE's official journal CVIR
- Free streaming of all lectures from previous CIRSE congresses via the CIRSE Library
- Fast track registration for all CIRSE events

Apply for CIRSE student membership at
cirse.org/students/cirse-student-membership!

CIRSE student internship programme

CIRSE has established contacts to several IR departments of medical institutions throughout Europe who are willing to offer an internship to medical students to gain a first insight into what it would be like to work as an interventional radiologist.

If you would like to learn more about interventional radiology in practice, apply for an internship at one of our institutions for free!

Visit **cirse.org/students** to find out more!

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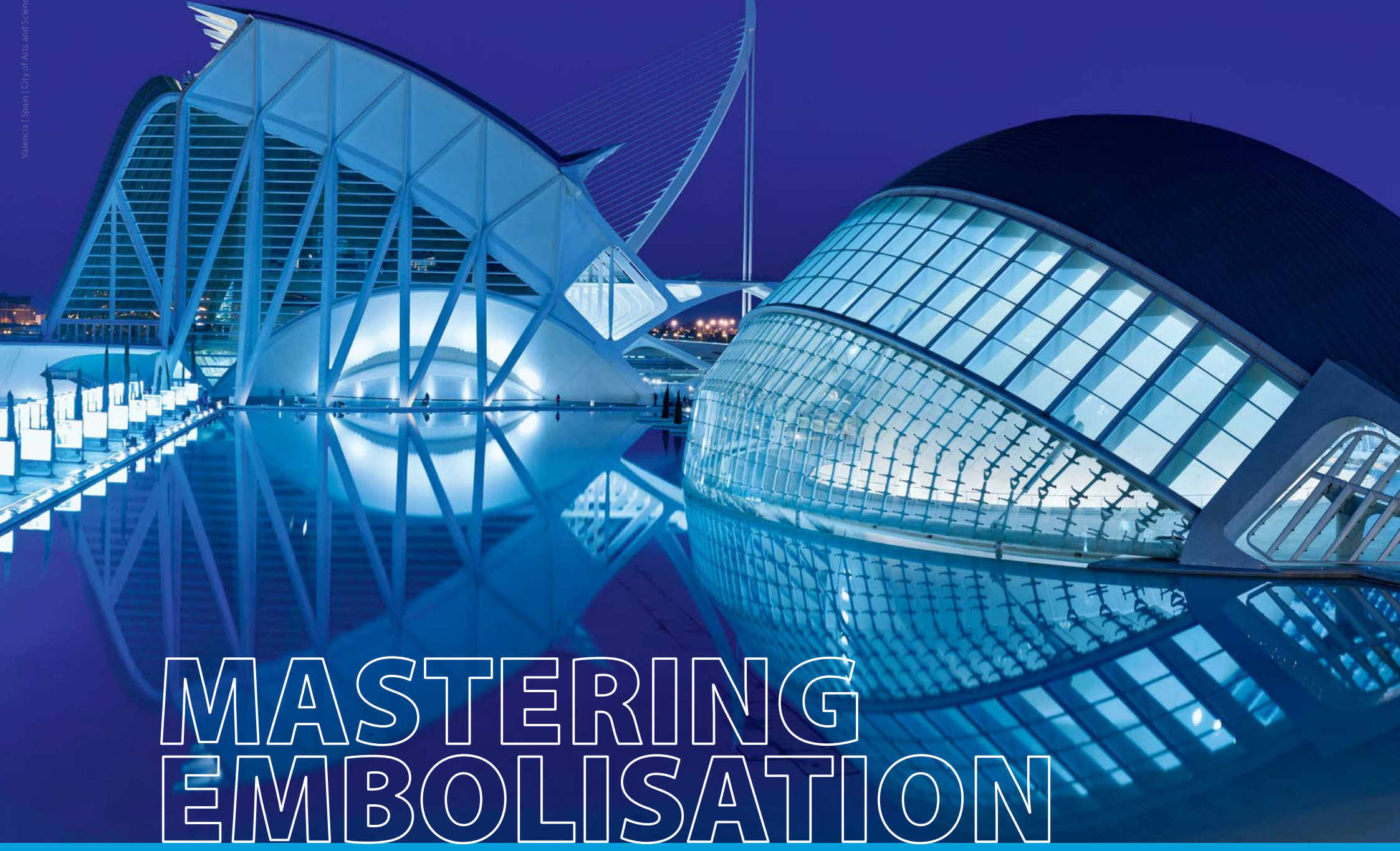

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