To start with, could you please remind us of the basic features of Peripheral Artery Disease.

Peripheral artery disease is a common manifestation of atherosclerosis; the number of cases of PAD progressively rises with age, typically beginning after age 40. The prevalence of PAD (defined by an abnormal value of the ankle-brachial index [ABI] \( \leq 0.90 \)) is around 5% in patients between the ages of 60 and 69, 15% in patients age 70 and older and rises to 20–25% for those over 80. With the aging of the global population, it is anticipated that PAD will become increasingly common in the future. Indeed, a recent analysis found an increase of 23.5% in the prevalence of PAD between 2000 and 2010. Today, it is estimated that more than 200 million individuals suffer from PAD worldwide. Insufficient blood supply to the leg due to the narrowing and occlusion of arteries can cause exercise-induced ischemic leg pain, known as intermittent claudication. Importantly, many people with PAD report no or atypical symptoms, including even some patients with at least moderately severe disease. Of course, the patient’s general level of activity also influences the intensity of symptoms. Critical limb ischemia, the most severe form of PAD, affects 1-2% of patients with symptomatic PAD and manifests as ischemic rest pain and/or tissue loss including skin ulceration or gangrene. Patients are at immediate risk of limb loss and revascularization is urgently needed.

Importantly, both symptomatic and asymptomatic PAD are indicators of generalized atherosclerosis; the total risk of cardiovascular events including myocardial infarction and cardiovascular death is increased. The contribution to the etiology of PAD of key modifiable risk factors such as smoking, diabetes, hypertension,
Peripheral Artery Disease

Dyslipidemia and the metabolic syndrome has been confirmed in many studies. While these major risk factors for PAD are similar to those for coronary and cerebrovascular disease, there are some differences in their relative importance. For example, smoking and diabetes show a particularly strong association with PAD. Due to the high CV morbidity and mortality, close and intense management of CV risk factors is of utmost importance in PAD.

Despite the availability of screening tools, overall there has been a general lack of attention to PAD, its contribution to adverse health outcomes and various treatment options. There is clearly a need to provide PAD patients with appropriate disease management to improve survival and quality of life as well as to reduce the socioeconomic impact of the disease. For symptomatic patients, various endovascular treatment options have been rapidly developed over the last decade and an ‘endovascular first’ strategy is now being increasingly advocated for all peripheral vascular territories including the iliac, femoropopliteal and below-the-knee arteries.

**Q** In Leipzig, how many patients do you see and how are you equipped to handle them?

In our Department of Angiology at the University Hospital Leipzig we treat around 5000 patients each year providing screening, diagnosis, prevention and treatment services for vascular disease. We offer extensive non-invasive vascular testing and imaging and perform around 2500 peripheral interventions as well as around 200 endovascular aortic repair procedures each year. We provide coverage 24 hours a day, 7 days a week for the treatment of emergencies such as ruptured aortic aneurysms, acute limb ischemia and acute venous thromboembolism. While we predominantly serve the Leipzig region with its population of around 1 million, about 40% of patients are referred to us from across Germany and even internationally for complex interventions.

Our department comprises a 40-bed vascular ward with highly skilled nurses trained in wound management, an outpatient clinic and three dedicated cath labs equipped with the Philips AlluraClarity technology, which is supported by a prep and recovery unit. A vascular hybrid OR is right now under construction and will be opened next year. As we are a leading center in vascular research with active involvement in various clinical trials we also have a dedicated study team that runs an additional outpatient clinic for follow up visits within clinical trials. Our medical staff consists of angiologists and we work in close collaboration with vascular surgeons and the Department of Radiology at the University Hospital Leipzig.

**Q** How in practice are percutaneous endovascular procedures planned and carried out in your institution?

Apart from emergency cases, patients are generally admitted to our ward the day before the procedure for pre-operative assessment. Due to organizational and reimbursement issues we do not perform interventions on an outpatient basis. Apart from particular individual cases, peripheral interventions are usually performed under local anesthesia.

For femoropopliteal interventions we really have moved forward over the last years with the use of drug-coated balloons (DCB) as primary treatment strategy while stent implantation has more and more become a bail out option in case of severe flow limiting dissection or acute recoil. Several randomized controlled trials in the field, such as InPACT SFA, Levant 2 and ILLUMINATE EU/US demonstrated excellent patency rates of DCB in short and medium-length femoropopliteal lesions and our own data also support their use in long lesions. However, long-term outcome still has to be clarified by addressing the question of whether DCBs are just delaying rather than preventing restenosis. In our institution,

**Q** and what are typical treatment and associated outcomes?

In our department we offer a wide range of endovascular procedures for PAD, aortic and peripheral aneurysmatic disease as well as acute and chronic venous disease. Thus, revascularizations of arterial and venous chronic total occlusions, carotid and visceral interventions and complex endovascular aortic repair are frequently performed. In the cath labs, we are equipped with state-of-the-art infrastructure including several atherectomy devices (Phoenix, Rotarex, Jetstream, Laser, HawkOne), CO2 angiography, intravascular ultrasound, re-entry devices (Pioneer, Outback) and a wide portfolio of balloons, stents and stent grafts.

With the aging of the global population, it is anticipated that PAD will become increasingly common in the future; a recent analysis found an increase in prevalence of PAD of 23.5% between 2000 and 2010. Today, it is estimated that >200 million individuals suffer from PAD worldwide.
we are also increasingly adopting the combination of laser or mechanical debulking devices and DCB treatment in order to achieve optimal results without the need for a permanent implant, even in complex lesions.

After the interventions and before discharge from hospital, all patients undergo non-invasive testing including duplex ultrasound and ABI measurements. Patients are either routinely scheduled for follow-up visits at our institution after 6 months and yearly thereafter or are monitored by a local vascular specialist/center. As outcome measures we focus on both anatomic end points such as duplex ultrasound-assessed binary restenosis, which has traditionally been used in many trials, as well as functional end points such as walking performance and hemodynamic measurements.

In particular, for endovascular repair of complex aortic aneurysms we also rely on live image guidance such as fluoroscopy or IVUS to help us to substantially shorten procedure times as well as to reduce radiation exposure.

Q: What about likely future developments in the field?

There are many exciting developments ahead. For example, it will be interesting to find out if drug-eluting balloons can improve outcomes after below-the-knee interventions. Laser and mechanical debulking strategies have the potential to become an important tool for complex lesions but we need more trials in this area. Of course, stents will still play a major role in peripheral interventions and their design will no doubt be further improved. At the moment, the concept of bioabsorbable stents is no longer being actively pursued but maybe in the future new technologies will be developed in this area. In the light of ever-growing healthcare expenditure constraints, studies on the cost-effectiveness of novel and more costly treatments will be necessary.

Q: Is the issue of scattered ionizing radiation still a concern among interventionalists?

Yes, definitely. In the literature we find increasing evidence linking occupational radiation exposure to various adverse health effects, including cataracts, thyroid disease, reproductive health effects, and malignancy. In our department at the University Hospital Leipzig we are focused on reducing exposure by adopting three key principles: (1) minimize time (less time = less exposure), (2) increase distance (as the distance from the radiation source doubles, the exposure drops by 25%), and (3) use extensive shielding (lead aprons, glasses, and shields). To reduce radiation it is necessary to follow basic practices such as collimation, utilization of filters, decreased frame rate, and minimized use of magnification, steep angulations, and digital subtraction angiography. Likewise, the use of lead shielding below the table, hanging and portable shields, and reducing the air gap between the image intensifier and the patient are also helpful. We are happy to now use the Allura Clarity system as we have seen substantial X-ray dose reductions compared to prior systems.

Q: Finally, every year Leipzig is host to the major international conference, the Leipzig Interventional Course (LINC). What were the main messages/developments coming out of this year’s LINC?

LINC 2018 was indeed once again packed with cutting-edge lectures, exciting live case presentations and animated discussions bringing together vascular experts from all over the world and different specialties. For femoropopliteal interventions we saw several presentations highlighting the benefits of DCB including the compelling 2 year results of the Stellarex DCB in the randomized ILLUMENATE EU trial and ILLUMENATE Global registry. The local delivery of anti-proliferative drugs using the Bullfrog Micro-Infusion device might have the potential to improve outcomes after below-the-knee revascularizations, where long term success is still limited by high restenosis rates. As for technical advances, the retrograde puncture and recanalization in case of antegrade failure, which we adopted and refined early on in Leipzig, has really become a routine tool in the hand of experienced interventionalists. Over the next years we will also see more data coming out on the role of endovascular interventions for common femoral artery stenosis, which has long been considered a “last frontier” of open surgery. Another exciting area is venous stenting where we learned a lot with respect to optimal patient selection and choice of dedicated devices in both acute and chronic venous thrombosis. The field of EVAR is also developing rapidly, for example now offering new solutions and devices for patients with hostile neck anatomy.