THE CURRENT STATUS AND PERSPECTIVES OF VASCULAR SURGERY

Piotr Andziak
Department of General and Vascular Surgery, Central Clinical Hospital of the Ministry of Internal Affairs, Warsaw, Poland; Department of General and Vascular Surgery Medical University of Warsaw, Poland

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Summary

This chapter presents the current status and perspectives of vascular surgery. It describes the main problems of the diagnosis and treatment of arterial and venous disease.

1. Introduction

Vascular surgery, as well as other branches of surgery (oncological surgery, gastroenterological surgery, endocrinological surgery), stems from general surgery. The process took several decades, resulting in final separation of the branch. In most countries it is now a separate specialization with its own scientific societies.

What led to the separation of this branch of surgery? Certainly, among numerous factors that contributed to it, the crucial ones are: the differences concerning pathophysiology, recognition and treatment of arterial and venous diseases, differences in surgical techniques and the immensity of knowledge about both basic and clinical sciences concerned with this particular sphere.

Vascular surgery is the surgery of peripheral arteries and peripheral veins. Apart from being closely connected to each other, the blood vessel systems differ significantly in terms of physiology and related diseases.

Consequently the treatment methods, including surgical interventions, differ as well. Led by those obvious differences, a new medical specialization called phlebology, has evolved. Phlebology involves examining the causes of venous diseases, recognition and treatment of the diseases both in a conservative and a surgical way.

Modern surgery of veins and arteries was established in the 40's and 50's of the XXth century. Thus, compared to other surgery branches, it is relatively new. In spite of that, or in consequence , it is constantly being changed and improved and the last 30 years have brought a number of revolutionary changes.

The progress occurred in almost every aspect that allows us to recognize and treat venous and arterial diseases. A particularly dynamic development refers to diagnostics, especially vascular imaging. Modern subtraction arteriography still remains as the golden standard for diagnosing the pathology of peripheral arteries.

Duplex ultrasonography is a non-invasive, inexpensive, easily accessible and repeatable method of arterial and, particularly, venous imaging, which in many cases affects diagnosis. Owing to spectacular improvements in this method, as well as in the capability of using a contrast (gadolinum) during the examination, duplex ultrasonography has replaced angiography in numerous fields.

An additional advantage of the method is the possibility of simultaneous visualization of vein or artery morphology and analysis of blood flow in the segment of vessel being examined. Moreover, duplex ultrasonography allows evaluation of the patency and blood flow in arteries and veins difficult to visualize using other methods (e.g. portal vein system, visceral arteries).

CT angiography, a minimally invasive vein and artery imaging method that is becoming more and more precise, allows us to avoid more invasive methods (e.g. while diagnosing the pathologies of major veins or evaluating aortic aneurysms). Magnetic resonance angiography, a noninvasive method of imaging arteries and veins, proved to be useful in certain areas of artery and peripheral veins diagnostics.

Another factor that contributed to a dynamic advance in vascular surgery is the improvements in anesthesiology and intensive care. Owing to these improvements, patients who several years ago would have been disqualified from operation due to other serious concomitant diseases (cardiopulmonary diseases), can now be qualified to operation and safely operated upon.

The research-based establishment and standardization of indications and contraindications for vascular operations should be considered as a crucial element in the improvement of results of surgical therapy in arterial and venous diseases.

Figure 1. Vascular prosthesis: straight and bifurcated
(Source: Noszczyk W.: Miażdżyca i inne choroby tętnic obwodowych. Wydawnictwo Lekarskie PZWL, Warszawa 2005.)

However, without a major technical and technological advance, the dynamic development of vascular surgery would have never been possible. The progress affected all aspects of vascular surgery, especially the vascular prosthesis, vascular suture and operative technique. At present, we use the patient's own veins, or prosthesis made of artificial materials, for arterial bypass grafting (bypassing an obliterated or stenosed segment) (image). The prosthesis is usually made of polyester or polytetrafluoroethylene. Two types of prosthesis are in use – straight and bifurcated (in shape of an upturned 'Y' letter) (Figure1). The walls of a prosthesis are often curved, rarely plain, strengthened and reinforced with external rings. They are produced using weaving and knitting techniques. A knitted prosthesis is usually covered with a seal material (collagen, albumin).

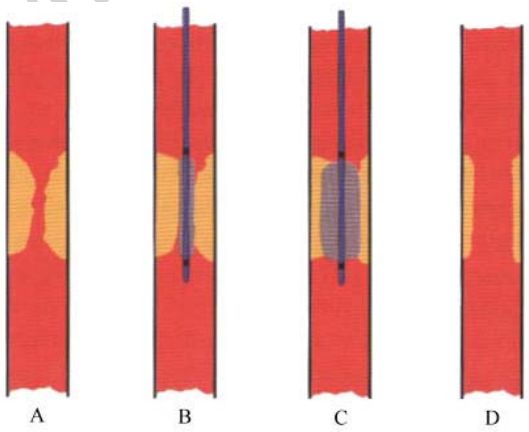

Figure 2 Percutaneous transluminal angioplasty
(Source: Noszczyk W.: Miażdżyca i inne choroby tętnic obwodowych. Wydawnictwo Lekarskie PZWL, Warszawa 2005.)

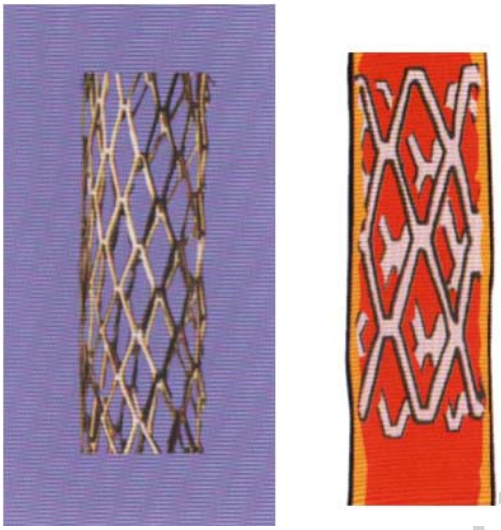

Figure 3. Stents
(Source: Noszczyk W.: Miażdżyca i inne choroby tętnic obwodowych. Wydawnictwo Lekarskie PZWL, Warszawa 2005.)

We have witnessed the rise and dynamic development of endovascular surgery that uses the latest achievements of technology such as percutaneous balloon angioplasty, stents and stent-grafts . Percutaneous balloon angioplasty (Figure2) in most cases involves the femoral artery puncture or incision. Surgical intervention of expanding the stenosis requires an elastic catheter with a high-pressure balloon. Balloon angioplasty enables the widening of the stenosis in arteries branching from an arterial arch, in carotid, renal, mesenteric and celiac trunk and lower limb arteries. Currently balloon angioplasty is in most cases supplemented with insertion of a stent into the treated artery. Stents (Figure3) are metal prostheses made of thin wire net of varied plait. Unexpanded stents are inserted into an artery by means of elastic catheters. Commonly used is the self expanding stent which, once released from the inserting catheter, adjusts its diameter to the diameter of the artery. Stents are applicable in the treatment of stenosis of the arteries rather than of veins . They form a kind of scaffold that prevents an elastic reaction of the wall in the balloon-expanded site, they reduce the vascular wall unevenness caused by angioplasty, and prevent recurrent stenoses . In particular cases, including closing an arteriovenous fistula or peripheral arterial aneurysm, we use stents covered with protheses. This particular kind of stent is leak-proof and allows us to exclude a planned part of an artery from circulation. A great number of thoracic and abdominal aorta diseases can now be treated with endovascular techniques using stent-grafts. A stent-graft (Figure4) is a vascular prosthesis attached to a metal scaffolding and folded in order to fit in the elastic catheter. The prosthesis can be straight or bifurcated. The diameter of the catheter is small enough to enable insertion of a stent-graft into the lumen of the aorta through a femoral artery puncture or incision. Once inserted into the aorta and placed in a desirable location, the catheter is removed while the stent-graft remains in place -excluding the aneurysm, dissected or injured part of aorta. This method is suitable for excluding aneurysms, dissections and injuries of the aorta. The endovascular operation is a significant supplement to surgical intervention, but it can also contend with it, especially when it comes to treating arteries and veins that are difficult to reach or patients who cannot be subject to a classical (open) operation due mainly to cardiological risk. An endovascular operation can only be conducted with the use of

fluoroscopy (stationary or mobile). The disadvantage of this method is the high cost of stents, stent-grafts and necessary equipment.

Figure4. Stent-graft
(Source: Noszczyk W.: Miażdżyca i inne choroby tętnic obwodowych. Wydawnictwo Lekarskie PZWL, Warszawa 2005.)

Progress in artery and vein surgery is strongly related to rapid advance in basic research, which is allowing us to better understand the mechanisms that cause diseases and complications. The comprehensive and dynamic growth in clinical pharmacology has also had a profound impact on the high level of vascular surgery today. Medications (anticoagulants, thrombolytic and antiplatelet drugs, antibiotics, etc.) that become more and more effective, strongly influence both the early and long-term results of the treatment.

Many outcomes and achievements of vascular surgery, especially those concerning arterial and venous anastomosis techniques, prove to be applicable in various other fields of surgery, for example in organ transplantation (liver, kidneys, pancreas, intestines).

Because indications and contraindications for operation, techniques and types of operations differ greatly depending on the segment of artery and vein system they concern, they need to be discussed in detail, below.

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Biographical Sketch

Andziak P.M. MD, PhD, Professor of Surgery, Head of Department of General and Vascular Surgery, Central Clinical Hospital of the Ministry of Internal Affairs, Warsaw, Poland; Professor of Surgery in Department of General, Oncological and Vascular Surgery Medical University of Warsaw, Poland, President of Polish Society for Vascular Surgery, member of European Society for Vascular Surgery, member of Polish Surgical Association, editor-in-chef of the Polish Journal of Surgery. His interests include vascular surgery and all kinds of endovascular procedures (stenting, stentgrafting).