

Abstract

Introduction: Cardiovascular surgery is a relatively young but progressively evolving field in medicine. More specifically, in the past decades, cardiac surgery achieved significant advances in understanding the causes, progression and treatments of ischemic heart disease (IHD). The IHD is the most common coronary disease, and it ranks first in morbidity and mortality in the developed world. It justifies the need for significant fundamental research as well as its study in clinical practice. It now includes specialized cardiovascular centres with the complex specialized treatments. A group of interventional cardiologists capable of performing routine examinations of the coronary veins using selective angiography has been established. They can eventually also perform percutaneous coronary interventions with direct stent implants. Thus the advances have been made in comprehensive indication of the patients towards their optimal treatments under the regime of a cardio-team. Such team comprises of a cardio-surgeon, interventional cardiologist, echocardiography specialist and the attending physician who is usually the cardiologist.

The IHD treatments involve preventive cardiology with the regime measures and checks, pharmacotherapy, interventional cardiology and cardiac surgery to spa treatment and rehabilitation.

This work focuses on cardiac surgery treatments of IHD, and in particular, on opportunities of relatively less known removal of artery graft and its use in coronary reconstruction. The motivation to seek new artery grafts for coronary artery bypass (CABG) is to improve its lifetime, make it more easily obtainable, and to minimize traumatization of patients. Another motivation is a relative lack of suitable autologous artery grafts in some patients, mainly those younger ones. The reasons can be especially a previous surgery, tissue injury, thrombosis, stenosis, atypical progression, gracility as well as preference of the surgeon (and sometime also of the patient), and there may be many other causes. Aortocoronary bypass often complements more complex types of surgical treatment which incorporates both the surgery on the heart valves as well as the surgery on the ascending aorta including the aortic root. For this purpose, the aorta from pigs is also used for research, and to obtain the material for practicing the basic suturing techniques by beginning surgeons. The research aims to determine novel preserving procedures for treatment of the valve leaflets to improve their life time. Moreover, the hemodynamic flow measurement of aorta, its tissue and its elasticity are of interest. It is also useful to predict these results in humans. The material is also considered for the replacements of aortal valves with the stent and stentless valves, and the replacements of the aortic root. The practice of suturing techniques is achieved by creating an anastomosis of the ascending aorta, central anastomosis bypass and implantation of the aortic valve replacement.

Aims: The target of this work is to assess critically the meaning, advantages and limitation of current alternative artery grafts and assess their needs for cardiac surgery. We attempt to explain the fundamental principles of surgical coronary artery revascularization, and identify the opportunities for removal of rare autologous artery grafts – descending branch of lateral circumflex femoral artery (DBLCFA) – not only in our conditions. Our intention is to determine the length and radius of this artery (DBLCFA), and provide the description of its anatomic variability, surgical availability and its tendency to atherosclerosis. Next we introduce practical use of this artery for artery grafts during reconstruction of the coronary bypass. A supplementary task is to describe arterial channels for the tissue supply of aorta in pigs.

Methodology and materials: The first part considers anatomic-surgical availability of artery (DBLCFA) – 35 sample collections in total. The second part is concerned with imaging of native artery (DBLCFA) using CT angiography (CTA) in order to determine its size, variability, contribution to the collateral circulation, and its tendency to atherosclerosis in a sample of 100 patients. In the third part, we study histology of collected samples with emphasis to evaluate the atherosclerotic damage. There were 20 samples from the deceased who underwent an autopsy studied in total with 15 samples removed from the artery and used in myocardial revascularization. The last part then includes practical case studies of using DBLCFA as an artery graft for coronary reconstruction and validating its short-term patency. In the supplement, we documented the vasa vasorum density in individual segments of thoracic and abdominal aorta in pigs using total 123 samples from 25 pigs.

Results: Examining the collected samples and the CTA, we can decide for each patient their suitability for artery removal. We proved there is an easy surgical access with minimum traumatization of the surrounding tissue. In the last part, we observed anatomical stability with minimal variability which does not impede the artery removal, and also sufficient useful length and radius corresponding to the coronary bloodstream while having minimum tendency to atherosclerosis. Furthermore, we demonstrated the possibility of practical use of DBLCFA as a fully adequate alternative artery graft which can be considered in myocardial revascularization. We also demonstrated the excellent short-term patency of DBLCFA when used as a composite graft. In the supplement, we determined the density of vasa vasorum in individual layers and segments of the aorta in pigs.

Discussion: Increasing the number of opportunities to select the autologous graft for revascularization cardiac surgery is very useful. Among more traditional and now commonly used artery grafts are internal thoracic artery (ITA) from both sides in combination with great saphenous vein (GSV) and radial artery (RA). However, their use is limited by unavailability or impossibility of these grafts removal, for many reasons stated above. Additional motivation for seeking new artery grafts is the preference for using artery grafts in younger patients due to a good long-term throughput. The artery grafts are preferred especially to bypass the left coronary artery. In bypassing the right coronary artery, the medium to long-term throughput does not differ significantly between the arterial and venous grafts. It is likely caused by higher tendency of the right coronary artery and its blood stream to a steal phenomenon. In addition, we have to take into account the significance and possibly the number of stenosis, and localization of the coronary vein closures. It is also important to evaluate the presence and extent of the collateral system. The overall throughput of the coronary bloodstream can be found by a selective coronary angiography. However, the size and quality of the coronary blood vessel tissues will not become obvious until the direct examination by the cardiac surgeon. At this point, the surgeon has to have enough experience to decide whether the artery bypass is needed and what graft will be used. The decision risk is obviously greater in sequential than in composite coronary bypass, since during the obstruction of one anastomosis usually leads to thrombosis of the whole corresponding coronary reconstruction.

Conclusions: DBLCFA was found to be useful alternative autologous arterial graft which was directly verified during coronary reconstruction. The CTA study confirmed the size and its anatomic stability. The minimum tendency to atherosclerosis was observed even in patients with significant sclerotic damage of the pelvic arteries using CTA, and also histologically confirmed on collected samples. This graft has been already used by some clinical institutions in the world, and in some cases, it is being used regularly. Hence, the main contribution of this work is investigating the opportunity of using DBLCFA as a high quality arterial graft in the specific conditions in our country. However, the limitations of this graft is its relatively short length which constrains its use mainly as a supplement of other commonly used grafts, especially with left internal thoracic artery (LITA). In summary, our study confirmed the initial expectations that DBLCFA can be used as an easily accessible and usable arterial graft. In the part dealing with the blood supply of the aortic tissue in pigs, we used quantitative mapping of the occurrences of the vasa vasorum to make contributions to interpretations of the atherosclerotic changes, inflammatory angiogenesis, and experimental creation and influencing the abdominal cavity aorta in pigs as an experimental method in the vascular surgery.

