

The Role of Cardiac Surgery in Treatment of Chronic Heart Failure

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Summary

Chronic heart failure has become a significant health problem. Cardiac surgery has an important role in the treatment of patients with heart failure. There are traditional surgical techniques in cardiac surgery – coronary revascularization, valve surgery, ventricular reconstructive surgery as well as new surgical techniques – cardiac support device (CorCap), mechanical circulatory support and resynchronization therapy. Cardiac surgery has a definitive role in the treatment algorithm for chronic heart failure.

Key words

Cardiac surgery • Coronary revascularization • Valve surgery • Heart failure

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Introduction

It is a well known fact that chronic heart failure has become a significant health problem in recent years. With the increasing number of patients, the economic aspect of treatment for these patients has become a major burden on health care in many countries. One of the reasons, why so many patients have progressed to chronic failure is improvement in care of patients with acute myocardial infarction. In the past any patient suffering from myocardial infarction had a 50 % chance of dying. In present, in countries with developed cardiology services mortality reduced to a slim 5 %. All these patients surviving acute coronary event, gradually

advance to a stage of chronic heart failure.

Recent developments in the field of invasive cardiology overshadowed the role of surgery in the treatment of patients with coronary artery disease. There have even been voices stating that the days of cardiac surgery are numbered. I do not share this view. Cardiac surgery has an important role in the treatment of patients with heart failure. With traditional as well as new surgical techniques cardiac surgery has a lot to offer in terms of improvement of quality of life of these patients. In my opinion invasive cardiology and cardiac surgery should not be seen as competitors. They should rather be viewed as two methods that mutually complement each other to ultimately benefit the patient.

Coronary revascularization

The most important question one has to ask before performing direct surgical bypass is if ischemic myocardium improves its function after revascularization. Diagnostic tests that are able to identify stunned and hibernating myocardium include: positron emission tomography, dobutamine echocardiography and magnetic resonance imaging. In our department, the last method proved to be the most reliable in distinguishing viable from non-viable myocardium. Patients planned for surgery must be in compensated heart failure, their ejection fraction must be at least 20 % and they must have viable myocardium. The surgical technique of aortocoronary reconstruction for heart failure is the same as bypass performed for the ischemic disease. The operation should be carried out only by an experienced surgeon since any small technical or tactical mistake can have catastrophic consequences (Florian *et al.* 2004).

Valve surgery

One of the main features of chronic heart failure is a dilatation of left ventricle. As a direct consequence of left ventricular remodeling there is a progressive dilatation of mitral annulus with dislocation of papillary muscles. That is why mitral valve is the most common valve operated on in patients with heart failure. There are two types of surgery: valve repair or replacement. Mitral annulus, leaflets and subvalvular apparatus are all amenable to surgical repair. The aim of the operation is the preservation of mitral valve together with subvalvular apparatus and normalization of their function. In patients with atrial fibrillation, MAZE procedure is done in order to restore sinus rhythm.

Besides patients who are scheduled for mitral valve surgery there is a group of patients with previously unrecognized and untreated aortic valve disease. These patients pose a specific surgical dilemma and indication for aortic valve surgery is less clear. With the dysfunctional left ventricle, the transvalvular aortic gradient is usually low and the surgeon has to weight all the pros and cons of surgical treatment. Even if the patient survives the surgery, there may be minimal symptomatic relief and no improvement of quality of life. On the contrary, the patient may have been better off with the heart transplant.

Ventricular reconstructive surgery

There is a good body of evidence that resection of left ventricular aneurysm leads to symptomatic improvement in patients with heart failure. The new surgical procedure called left ventricular restoration uses Laplace principle to improve the function of dilated failing hearts (Athanasuleas *et al.* 2001). Laplace law stipulates that tension of the wall is directly proportional to the pressure difference across the wall and the radius of the cylinder and inversely proportional to the thickness of the wall. Therefore to create the same pressure during ejection of blood from the dilated left ventricle with increased radius, much larger wall tension has to be developed by cardiac muscle. Surgical reduction of left ventricular diameter causes fall in tension of the ventricular wall and ultimately leads to a decrease in oxygen consumption. The same concept also applies to resection of akinetic segments with normal wall thickness. The operation starts with opening of the left ventricle through dyskinetic or akinetic infarcted scar.

Ventriculectomy is followed by applying the purse string suture at the transitional zone (Fontan stitch). The exact diameter of left ventricle is derived from the body surface area and the measurement is performed with the use of specially constructed balloons. Ventriculectomy is then closed with Dacron patch.

New techniques

In recent years there has been a totally innovative approach to surgical treatment of failing myocardium by implanting a mesh wrap around the heart. CorCap – Cardiac Support Device is designed to alleviate the pressure produced by oversized, dilated hearts by external compression thereby preventing and reversing the progression of heart failure. From the technical point of view the implantation is fairly simple and does not require the use of extracorporeal circulation. It can be complemented with reduction mitral annuloplasty or/and cardiac resynchronization therapy.

Another surgical option, which has become immensely popular in the last decade, is implantation of mechanical circulatory support. They are defined as blood pumps, which are able to take over function of a native failing hearts in patients with chronic heart failure. Device is implanted to support either one ventricle (usually left ventricle) or both ventricles. Depending on the flow generated by the pump there are two types of devices: pulsatile and non-pulsatile. Our experience has shown that non-pulsatile devices are fully capable of adequate end organ perfusion. Assist device can be implanted with the view of bridging the patient to transplantation or as a destination therapy. Many patients have been successfully supported for many years. They are able to live near normal lives with very few limitations (they can shower, but they can not go swimming). Many of them are even able to continue with their former job (Netuka and Malý 2008).

Future perspectives

New advances in treatment of heart failure would not be possible without research. Surgeons have traditionally been hailed for their manual skills. Academic work and research are usually not one of common surgeon's forties.

I believe the times have changed. I can not imagine a fully competent cardiac surgeon without academic skills. We actively encourage research work.

Our department has been part of Centre for Cardiovascular Research since its foundation in 2000. Surgeons in training are thus able to gain competencies in academic work and on the other hand the academics can experience first hand the implementation of their research into clinical practice.

Manually skilled surgeons, trained in micro surgery, can apply various experimental methods into their surgical practice. They can make a good use of all laboratory equipment based in experimental cardiology department. In Langendorf model of isolated rat heart they carry out the whole range of clinical experiments. The results of these experiments lead to entirely new treatment methods. I would like to give you one example:

There is a growing population of patients who underwent surgery for congenital cyanotic heart disease in their early childhood and later present with symptoms and signs of ischemic heart disease. The management of these patients is in no way straightforward. Is there any difference in their myocardium in comparison to the rest of the population? It has been proven in experiment, that perinatal hypoxia enhances the tolerance of the adult myocardium to the lack of oxygen. This improved tolerance is dependent not only on the duration and type

of perinatal hypoxia but also on the gender of the patient (Netuka *et al.* 2006, Szárszoi *et al.* 2008). There is growing body of evidence, that there are significant differences between male and female myocardium. Published evidence suggests that female patients operated on for pure aortic stenosis with hypertrophied myocardium better tolerate the perioperative ischemia than their male counterparts. Due to the improvement in myocardial preservation techniques, there was no difference in mortality between the two groups, but female patients had less need for temporal pacing. Considering the fact, that conduction system is more sensitive to ischemia than the rest of myocardium, the incidence of post operative pacing was significantly higher in male patients (Bešík *et al.* 2009).

In conclusion, I would like to express my belief, that cardiac surgery has a definitive role in the treatment algorithm for chronic heart failure. Surgery plays a valuable part not only in clinical setting, but also provides a vital contribution to research of cardiovascular diseases.

Conflict of Interest

There is no conflict of interest.

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