

## REVIEW

## Cardiac surgery in the elderly from the point of cardiologist Evaluation of risk and outcome

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**Prolongation of life expectancy, increasing incidence of coronary artery disease, advances in surgical techniques and in care of elderly patients are reasons of elevating the number of prospective candidates in this age group for cardiac surgery. Although advanced age is considered as a risk factor for any form of surgical treatment and is usually associated with higher postoperative morbidity and mortality rates. The paper submitted clarifies numerous problem areas concerning this topic in the group of patients over 65 years. The factors affecting decision-making for surgical treatment are analyzed. The specific problems concerning this age group: significant disease severity, more comorbid illnesses are discussed. Some specifics of cardiac surgery (coronary artery bypass grafting and/or valve surgery) are dealt with. An increased attention should be devoted to mental and metabolic state and general physical condition (level of fitness and activity). High level of activity and intellectual functions, re-socialization efforts following surgery and adequate social background of the patient also play an important role. According to these facts individualized approach in indication for surgery is emphasized. (Ref. 45.)**

**Key words:** cardiac surgery, elderly patients.

Because of the increasing number of elderly patients in the general population, as well as the increasing incidence of coronary artery disease, which is the leading cause (73 %) of death in these patients (Riečanský et al, 2000), cardiac surgery is performed in the elderly with increasing frequency. General advances in surgical techniques, in myocardial protection and perioperative management enhanced the safety of surgical treatment of heart diseases making morbidity and mortality in this age group, acceptable. These are the reasons of elevating the number of prospective candidates for cardiac surgery. Advanced age is considered a risk factor for any form of surgical treatment and is usually associated with higher postoperative morbidity and mortality rates (Páčovský, 1994; Tsai et Matloff 1990; He et al, 1994; Avery et al, 2001). With the increasing age the physiologic reserve of all the systems and of the whole organism decrease, pathology of the underlying diseases along with multiorgan diseases become more pronounced. Polymorbidity is a frequent phenomenon in these patients. The analysis of large groups showed that only 7—9 % of patients had no comorbidity in this age group (Avery et al, 2001; Alexander et al, 2000).

The main aim of geriatric medicine is not only life prolongation but in particular, improved quality of life. The question as to whether heart operation will really lead to improved quality of the patient's life still plays an important role in the decision making process about radical management of the disease. Therefore, prior to surgery, it is mandatory to evaluate both somatic and psychic functions of the elderly. The paper submitted clarifies numerous problem areas. The factors affecting decision-making for surgical treatment, are analyzed, specifics of single cardiac surgery in seniors are dealt with and a brief characteristics of a risk patient is presented.

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### Factors affecting indication to operation

The indications to cardiac surgery in older patients (over 65 years) coincide with those in younger age groups. Preoperative examinations and perioperative management are also comparable. However, an increased attention should be devoted to mental and metabolic state of the patient as related to his/her general physical condition, such as level of fitness and activity, nutritional state, mental orientation. High level of activity and intellectual functions, viability, re-socialization efforts of the patient after the operation, are considered a significant positive factors. Adequate social background of the patient also plays an important role. On the other hand, limited physical activity, passive attitude towards illness, senility or disillusion may become a contraindication for surgical management (Páčovský, 1994; Tsai et Matloff 1990; He et al, 1994; Avery et al, 2001).

The risk of cardiac surgery must be well balanced by both relative and absolute benefits for the patient. Preoperative examination involves a detailed history accentuating current or prior problems with pharmacologic treatment. The information on stress and physical strain, particularly in ischemic heart diseases, is of great significance. Reluctance in explicit indication from the aspect of the underlying diseases on one hand, or urgent cardiac surgery on the other hand, are the most frequently influenced by *extracardiac diseases*.

*Central nervous system (CNS).* Cerebrovascular insufficiency varying from mental confusion up to hemispherical infarction is the most common and most devastating complication after cardiac surgery in patients aged over 65 years. The incidence of postoperative stroke is reported to range from 2 to 9 % (Alexander et al, 2000; Tumanet a spol., 1992; Lakata et al, 1997). Patients with cerebrovascular accident before operation are more sensitive. Preoperatively the data on transient ischemic attacks, previous history of cerebrovascular strokes with or without residual consequences, play an important role. In this case meticulous neurological examination including CT of the brain must be performed. Ultrasound diagnostics of the carotic system is an obligatory preoperative examination. In case of hemodynamic significant stenosis of carotic (extracranial) arteries, angiography must be performed. This procedure will determine the necessity of surgical treatment. The time frame between the heart and carotid operation depends on the severity of the cardiac finding. Reconstruction of the carotic stenosis usually follows the management of coronary or valvular diseases (Lakata et al, 1997; Fischer, 1999). Simultaneous operation is performed only in a case of bilateral and severe damage in the carotic arteries. If surgery is not contraindicated by a consulting neurologist in patients with demonstrated CNS disease, higher perfusion pressures are recommended during cardiopulmonary bypass and a considerable stress is laid upon ventilatory and circulatory support in postoperative period (Tuman et al, 1992; Fischer, 1999).

*Cardiovascular system and hemodynamics* of the patient. Adequate evaluation of preoperative hemodynamics of the pa-

tient is obligatory in postoperative management, i.e.: fluid replacement, pulmonary function support, use of vasoactive substances and circulatory support. History and time interval since previous myocardial infarction play a significant role in anticipating operation risk, in decision-making as to when and whether to operate the patient and in the very strategy of surgical treatment. Risk factors in elderly people include cardiac surgery shortly after acute myocardial infarction (MI), hemodynamic instability requiring inotropic agents, reduced ejection fraction, NYHA functional class IV. limitation, branch blockade on ECG and hemodynamically significant mitral regurgitation (Avery et al, 2001; Freeman et al, 1991; Craver et al, 1999). Coronary finding itself is of lesser importance and stenosis of left main coronary artery has had no impact upon early postoperative survival (Tsai et Matloff, 1990; Čoček et al, 2001; Katz et al, 1995). In this phase severity of myocardial ischemia, rhythm disorders and appropriate pharmacologic therapy are of great importance. Combination of antiarrhythmics with betablockers in preoperative period is hazardous in elderly people as it may lead to hypotension during cardiopulmonary bypass. Calcium blockers must be administered until surgical intervention, since their rapid withdrawal may have an adverse effect on coronary vascular resistance. In postoperative period hypertensive seniors may show unstable blood pressure that may be a manifestation of bleeding, renal dysfunction or cerebrovascular insufficiency.

*Pulmonary system.* Normal physiologic ageing process causes changes in pulmonary function parameters — static volumes and expiration flow-rates diminish, normal oxygenation is being impaired making elderly people more vulnerable and sensitive to numerous negative perioperative factors (Šimková et al, 1990). Cardiac surgery markedly affects respiratory mechanics and dramatically decreases pulmonary volumes whose restoration may last for several weeks (Šimková et Krištúfek, 1998). Old age is typical of slow onset of chest physiotherapy, mobilization and inability of coughing or conscious suppressing of cough due to pain, reduced mucociliary clearing ability connected with the secretion stagnation in the respiratory tract, with subsequent formation of atelectases and evolving infection. Two- or three-fold increase in pulmonary postoperative complications is reported in the elderly patients (Manning 1989; Šimková et Riečanský, 1992). A more frequent incidence of complications is associated with previous cardiac decompensation, concurrent valvular heart disease (Šimková et Riečanský, 1992; Šimková et al, 2000) and concomitant bronchopulmonary diseases, i.e. situations when preoperative discrimination of pulmonary functions occurs. Accordingly, functional examination of the lungs prior to the operation is a prerequisite (Šimková, 2001). It serves not only to establish and assess current functional state of the patient and risk stratification, but to plan effective postoperative ventilation, as well. According to the functional finding bronchodilators and corticoids especially in the inhaled form, are applied. The cultivation finding is decisive in applying targeted antibiotic treatment and intensified chest physiotherapy. A possible complication in elders is stomach content aspiration. Nasogastric probe is intro-

duced during patient's ventilation and state of confusion (Baumgartner et al, 1994).

*Gastrointestinal system.* Postoperative stress ulcer and hemorrhage in gastrointestinal tract after cardiac surgery are observed in a small number of patients (Tsai et Matloff, 1990; Baumgartner et al, 1994). A potential risk is previous ulcer history, accordingly in these cases control gastrofibroscopy is mandatory. Acute ulcer is a contraindication for open-heart surgery. In a case of healed ulcer pre- and postoperative intensive antiulcer treatment is initiated. Cardiac surgery must be preceded by objective assessment of nutritional state of elders, which is usually suboptimal and induced by cardiac cachexia. Optimizing of nutrition preoperatively is necessary, as it has been shown that morbidity of these patients is connected with hypoalbuminemia (Tsai et al, 1994; Rich et al, 1985). In postoperative period the gastrointestinal tract function is usually limited. Old patients frequently suffer from nausea, anorexia, gastroplegia, vomitus and ileus. If a probe is introduced the patient develops diarrhoea. In such cases circumspect parenteral nutrition must be administered to avoid risk of volume load and prevent evolving infection. Fluid retention develops in old patients more rapidly and their response to it is more sensitive. An unfavourable nutritional state may result in deteriorated healing of the scar (Tsai et Matloff, 1990; Tsai et al, 1994). Surgeon must pay a great attention to the operation wound suture. In our department continuous intradermal vertical suture is used.

*Renal system — renal function.* Renal function physiologically drops with the increasing age. Sophisticated and demanding examinations with application of contrast agent or diuretic treatment may affect internal environment. Cardiopulmonary bypass surgery places further demands on renal function. Due to these reasons meticulous examination of renal functions along with intensive monitoring of water-mineral metabolism, are of paramount importance. Adequate hydration prevents perioperative renal dysfunction. If creatinine clearance drops below 50 % of the reference value, preoperative management of the patient consists in ultrafiltration. During cardiopulmonary bypass diuresis is followed up and adequate perfusion pressure and osmolality are provided. If need be, mannitol and diuretics are administered. After the operation such a patient is dialyzed. Renal failure as a postoperative cardiac surgery complication has been reported in 2—13 % (Alexander et al, 2000).

*Diabetes mellitus.* A large number of old people has latent diabetes mellitus. The detection of glycidic metabolism disorder is a usual consequence of operative and postoperative stress. Diabetics often show nutritional and volume problems, such as increased sensitivity to infection as well as slow and complicated operation wound healing. Postoperative course of diabetics may also be complicated by pain perception disorder. Preoperative management must encompass optimal diabetes compensation that will facilitate postoperative course.

*Malignancy.* Preoperative examination seems to reveal in elderly people so far undiagnosed neoplasm (Tsai et al, 1994; Chocron et al, 1996). Suspected cases are those related with inappreciable loss of body weight, hemoptysis, anemia, rectal hemorrhage and painless lymphadenopathy. Patients in remission after successful treatment of e.g. leukemia or lymphoma are potential candidates for cardiac surgery (Tsai et Matloff, 1990; Wegner et al, 1987). The ratio open heart surgery risk versus improved quality of life in patients with history of malignant disease is being very carefully considered.

*Hemocoagulation problems.* Liver function disorder is quite common in cardiac decompensation. In these cases an increased susceptibility to bleeding during surgery and increased sensitivity to anticoagulant treatment after surgery, are observed. The elderly patient requires a special care of hemocoagulation profile. Thrombocyte count, INR and PTT are routinely followed up. Aspirin is withdrawn at least a week before surgery, other antithrombotic agents, such as dipyridamole and nonsteroid antirheumatics minimally 72 hours before planned surgery. If this measure cannot be made (e.g. in acute surgery) fresh frozen plasma is administered. Reoperation due to bleeding is always an emergency connected with large volume shift and represents a serious additional risk of infections, respiratory failure and accounts for high percentage of deaths (17 %). In postoperative period 22 % and less of hematocrit is considered the indication for transfusion, whereas, in a group of elderly patients it climbs up to 30 % (Tsai et Matloff, 1990; Baumgartner et al, 1994).

The high risk of scheduled operation for extracardiac causes consists mainly in the presence of cardiovascular risk factors, such as diabetes mellitus, cerebrovascular diseases, peripheral vascular diseases, concomitant chronic obstructive pulmonary disease (COPD) and chronic renal insufficiency. In this context risk factors, such as smoking or hypertension, present hepatic damage, malignancy or implanted pacemaker seem to be of minor importance (Weisfeldt et al, 1990; Jones et al, 1996).

### Cardiac surgery in patients over 65 years

The most frequent indications to cardiac surgery include coronary artery diseases followed by valvular diseases and a combination of coronary and valvular surgery. Other indications, such as aortic aneurysm and/or dissection, tumours and pericardial disease appear in old patients in a lesser extent.

*Coronary artery bypass graft surgery.* According to our experiences coronary artery bypass graft surgery in adequate anatomic conditions, failure of targeted conservative treatment strategies, and unsuitable finding for percutaneous transluminal coronary angioplasty (PTCA) is a suitable and proper therapeutic method also in patients over 65 years. However, these patients show somewhat higher incidence of perioperative and postoperative complications (Tsai et al, 1991; Frelich et al, 2001). Emergent procedure especially for instabile angina pectoris re-

sults in high early mortality (23 %), which is 4-fold greater than in elective surgery (Alexander et al, 2000).

Strategy and technique of bypass grafting do not differ in old patients. The efforts always aim at complete revascularization, i.e. bypass of all the arteries with significant stenosis or closure. Aorta ascendens is the usual site for the arterial return. With regard to the calcified plaques and intimal atheromatic changes, it is very important to select proper drainage site. In traumatic cannulation atheromatic mass move and aortic dissection may appear (Tsai et al, 1994). Equally careful procedure is being made in aortic cross-clamp and ventricular catheters. Due to the incidence of a more diffuse atherosclerotic damage of coronary artery the least affected site is chosen for the suture. The risk of dissection of atheromatic intima and media from adventitia is imminent. Similarly as in anastomoses also in aorta, dislocation of atheromatic masses into the vascular lumen must be avoided. In partial aortic clamp the damage of aortic integrity from the margins of the clamp has to be prevented. Venous graft in the elderly may also lead to elasticity loss with subsequent separation of the intima from media and adventitia. Literature data report early complication after coronary artery bypass graft surgery in as much as 28—32 % of cases: i.e. postoperative bleeding (5 %), sternum dehiscence (3 %), renal failure (6 %), cerebrovascular stroke (3 %), sepsis (2 %), perioperative myocardial infarction — MI (10 %), pulmonary complications (8 %) (Tsai et al, 1990, 1994, 1991). Minor complications, such as mental disorders, pericarditis, lesser subendocardial perioperative MI, irrelevant scar infections are observed in as much as 36 % of cases. In these patients hospital stay is usually prolonged.

*Miniinvasive surgery* without use of cardiopulmonary bypass is a method that enables to decrease the incidence of complications by eliminating disadvantages of sternotomy and extracorporeal circulation. It is perspective in elders as well, in particular those with risk factors for open-heart surgery (Jones et al, 1996; Tsai et al, 1991; Frelich et al 2001; Fiore et al, 1989).

*Valve replacement surgery.* The most serious problem in valvular surgery of elderly patients is difficult weaning from cardiopulmonary bypass (Čoček et al, 2001; Fremes et al, 1989; Horneffer et al, 1987; Guler et al, 2000). Patients with normal function of replaced valve prosthesis may also show decreased ventricular compliance and ability to respond to stress (caused by increased cardiac output). In weaning the patient from cardiopulmonary bypass afterload reduction is appropriate after valve replacement or reconstruction. If it shows insufficient, inotropic agents and vasopressors or intraaortic balloon contrapulsation must be applied (after mitral valve replacement). In elderly patients valve reconstruction is being preferred. However, it may be considered solely in mitral and tricuspid regurgitation or in noncalcified stenosis of these valves. Otherwise, valve prosthesis replacement is accomplished. Life expectancy of patients of this age group is below 15 years, hence with regard to possible severe complications of anticoagulant treatment, implantation of biologic valve prosthesis requiring no permanent anticoagulation, is

recommended in elderly patients (Fremes et al, 1989; Horneffer et al, 1987).

*Aortal valve replacement.* In valvular surgery of patients aged over 65 prevails aortic valve replacement (Bessone et al, 1988). Degenerative process of leaflets seems to be the etiologic factor in the majority of cases. Literature data report higher operative mortality in younger subjects, ranging from 4 to 20 % (Fremes et al, 1989). The mortality has an increasing trend in current demands for coronary surgery. Furthermore, mortality is affected by cardiac state, duration of cardiopulmonary bypass, small body surface, use of small prosthesis (Fremes et al, 1989; Čerbák, 2000; Craver et Goldstein, 1984; Bloomstein et al, 2001).

*Mitral valve replacement.* The incidence of rheumatic mitral valve diseases is observed in 4 % of necropsies of old subjects (Grossi et al, 2000). Therefore, mitral valve surgery is dominated by the patients with rheumatic valve diseases. Another important pathologic process causing mitral regurgitation in older subjects is myxomatous valve degeneration and ischemic damage of subvalvular apparatus. The highest mortality and morbidity in seniors is attributed to mitral valve replacement (17 %) with rising trends when combined with myocardial revascularization (28 % or 33 %) (Avery et al, 2001; Alexander et al, 2000). Difficult postoperative course is also related to secondary pulmonary vascular disease with severe irreversible pulmonary hypertension (Šimková et Urbanová, 2001). High, three-fold greater mortality is observed in urgent surgery (Tsai et Matloff, 1990; Alexander et al, 2000). Rupture of the posterior atrioventricular sulcus in calcified mitral annulus is a major complication. Many authors prefer valvular reconstruction to its replacement in elderly subjects. This procedure shows lower morbidity and mortality (4—5 %) and has numerous advantages (Bolling et al, 1996; Kawahito et al, 2000). It also creates more favourable conditions for adjustment, saving or restoring the left ventricular function. It requires no anticoagulation therapy and reconstruction effect is of long-term character. Some authors report very good results of mitral valve reconstruction and concurrent myocardial revascularization (Bolling et al, 1996). The alternative approach consists in employing bioprosthesis with restoring of subvalvular apparatus. However, in this case reoperation for prosthesis degeneration is impending with the lapse of time.

*Double or triple valve replacement.* Over the past decade operative mortality of patients after double valve replacement has decreased with regard to improved myocardial protection and advances in perioperative care. Early mortality in double replacement and coronary artery bypass is acceptable — about 12 %, late — within 40 months is 28 % (Tsai et al, 1994). Cardiac disorders in combination with anticoagulant treatment are the leading causes of mortality rates.

*Combination of valve replacement and surgical myocardial revascularization.* This intervention is required by as much as 40 % of geriatric patients. With the increased duration of the

intervention along with the cardiopulmonary bypass, which is an independent risk factor of early mortality, the number of complications increases, as well (Čerbák, 2000; Bolling et al, 1996).

Other reasons for cardiac surgery in elderly patients are rare. The most frequent causes involve acute *aortic dissection*, extramural hematoma or chest *aortic aneurysm*, i.e. states complicating long-lasting hypertension. Surgical treatment of dissection is always an emergency connected with higher mortality (9–30 %) as compared to lower age groups (Bloomstein et al, 2001). Aorta ascendens intramural hematoma due to high risk of classic dissection, is an inevitable indication to surgical treatment (Fruitman et al, 1999). Long-term results are satisfactory (Chňu-pa et al, 2000).

**Cardiostimulation in surgical treatment.** Cardiostimulation in patients aged over 65 years is widely used presenting excellent therapeutic outcomes (Tsai et Matloff, 1990; Chocron et al, 1996). Postoperative overdrive of pacemaker facilitates to control arrhythmia and maximal cardiac output. This method enables to replace chronic antiarrhythmic treatment with its adverse effects. In numerous cases implantation of permanent pacemaker as a treatment mode is suitable, because temporary stimulation restricts mobilization in seniors, thereby supporting the development of pneumonia, thrombophlebitis, voiding disorders, psychic decompensation and other complications associated with bedridden patients. The implantation of transvenous electrodes in local anesthesia appears to be an appropriate mode. Permanent pacemaker is indicated in complete atrioventricular blockade, in persistent sinus bradycardia, sick sinus syndrome, in cerebrovascular insufficiency due to low cardiac output and in some cases of acute MI (Baumgartner et al, 1994). Aggressive and definitive approach facilitates adjustment of effective circulatory function. An increased cardiac output improves the function of other organs.

In general high risk patients include:

1. candidates of emergent surgery with no toleration of any delay necessary for patient's management (25 % mortality rate) (Alexander et al, 2000),
2. with hemodynamic instability prior to the operation and cardiac decompensation (12 % mortality rate) (Tsai et Matloff, 1990),
3. with need of myocardial revascularization and mitral valve replacement (16–50 % mortality rate) (Avery et al, 2001; Chocron et al 1996),
4. candidates for double or triple valve replacement (30–60 % mortality rate) (Tsai et Matloff, 1990; Tsai et al, 1994),
5. with previous history of cardiac surgery,
6. with chronic obstructive pulmonary disease (Weisfeldt et al, 1990; Šimková et al, 2001; Fischer et al, 1996), with renal insufficiency (He et al, 1994).

Patients over 65 years represent a heterogenous group, varying in emotional, physical, cognitive function, in severity of the disease. Indication criteria in cardiac surgery in this age group

equals to those in younger patient groups. Preoperative examinations and perioperative management are also comparable. A special attention should be devoted to mental and metabolic state of an elderly patient in connection with his general physical condition. It is very important for the patient to actively cooperate with the doctor and nursing personnel (mainly in postoperative period), since the incidence of postoperative complications as well as mortality is higher in geriatric patients. Patients — candidates for urgent/emergent surgery and double valve replacement or polymorbid patients seem to be at high risk. In this group minimally invasive surgery might save lives of many other people. In general, we can state that outlook at surgical intervention in patients over 65 years calls for an individual selection that consists in anticipated life expectancy, in assessing cardiac state of the patient and severity of noncardiac diseases with the aim of enhancing the patient's quality of life.

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