Journal of Clinical and Basic Cardiology

An Independent International Scientific Journal

Journal of Clinical and Basic Cardiology 1999; 2 (1), 53-60

Arterial myocardial revascularization in the 9th decade of life - own results and literature review

Mortasawi A, Albert A, Alexander T, Dalladaku F, Ennker IC
Ennker J, Hofmeister J, Rosendahl U, Schröder T

Indexed in
Chemical Abstracts
EMBASE/Excerpta Medica

Krause & Pachernegg GmbH · VERLAG für MEDIZIN und WIRTSCHAFT · A-3003 Gablitz/Austria

Arterial myocardial revascularization in the 9th decade of life – own results and literature review

A. Mortasawi[1], T. Schröder[1] , I. C. Ennker[1] , A. Albert[1], J. Hofmeister[1], F. Dalladaku[1], U. Rosendahl[1] , T. Alexander[2], J. Ennker[1]

Due to the fact that the entire population shows a progressively increasing portion of older people and due to the medical-technical progress it comes to an increase of the average age of patients undergoing heart surgery. In view of the limited life expectancy, the arterial revascularization in the 9th decade of life is faced with controversial discussions. We have analysed our patients in relation to this aspect. Between January 1st, 1995 and June 6th, 1998 103 patients in the 9th decade of life (44 women, 59 men, 80 to 88 years old, median: 82 years) underwent isolated myocardial revascularization surgery supported by a heart-lung machine. We performed 69 (67 %) elective, 24 (23 %) urgent and 10 (10 %) emergency surgeries. 14 patients (13.6 %) solely received venous bypasses (group I), 89 (86.4 %) additionally also received unilateral bypasses of the internal mammary artery (IMA) (group II).

4 patients died at our facility (3.9 %), 3 further patients died during the follow-up treatment in outlying hospitals, the hospital mortality rate in group I therefore presented a rate of 7.1 %, in group II 6.7 % and in total, a rate of 6.8 %. In 1997, the hospital mortality rate could be reduced to 2.4 % (1/42). The rate of stroke was 4.9 %, the rate of perioperative myocardial infarct was 3.9 %. There was no evidence of a dependency on IMA-application. The follow-up observation time ranged between 2 and 45 months (median: 15 months). The survival rate for patients in group I was after one year 82.5 %, after two years 71 %. The survival rate for patients in group II was after one year 89.7 %, after two years 81 %. The absence rate of angina after one year was 88 % in group I, and 93 % in group II. The differences were not significant. Whereas 94 % of the patients could preoperatively be related to class III or IV of the NYHA-classification, 89 % of the survivors belonged to class II. The myocardial revascularization with the internal mammary artery performed on patients in the 9th decade of life discloses – in relation to solely venous coronary bypasses – a comparably acceptable morbidity and mortality. The more prolonged follow-up observation period will clarify whether the arterial myocardial revascularization also represents itself as the superior method in this age category. *J Clin Basic Cardiol 1999; 2: 53–60.*

Key words: coronary artery bypass grafting; octogenarians; morbidity; mortality; survival

The part of the population in the Federal Republic of Germany which is 80 years of age or older shows an increasing tendency, it augmented from 1.9 % in 1970 to 4.1 % in 1994. This part reached a total of 4.0 % in 1995 in all of Germany (3,294,200 people) [1]. In 1996, a total of 87,372 patients in Germany underwent surgery with the heart-lung machine (HLM). 2383 of those (2.7 %) were 80 years of age or older [2].

Advantages of bypasses of the internal mammary artery (IMA) in comparison to venous grafts, especially in the long-term follow-up, were already documented many times in the eighties [3–14]. It has been assumed for a long time that IMA-bypasses on elderly patients are correlated with an increased morbidity and mortality. The reasons for this assumption included a prolonged duration of surgery, the opening of the pleural cavity, the risk of pulmonary dysfunction as well as impairment of the wound healing. In addition to this, there is a limited life expectancy, which leads to a controversial discussion of arterial revascularizations in this age category. We have therefore examined our patients regarding to these factors.

Patients and methods

6226 patients underwent surgery with the heart-lung machine during the time period from January 1995 to June 1998. 213 out of these (3.4 %) were 80 years of age or older. 103 patients (48 %) received an isolated myocardial revascularization. The collection of data started in March 1996, we therefore obtained a retrospective documentation of the information on the 30 patients operated on until then, and a prospective documentation on the patients undergoing surgery thereafter. We compared 14 patients who mainly received venous bypasses during the initial phase of our newly opened hospital (group I) with 89 patients who received an additional unilateral arterial revascularization (group II). There was a total of 44 women and 59 men between the age of 80 and 88 (median: 82 years). The grouping was done according to the Cleveland Clinic Severity Score for preoperative risk estimation [15].

Corresponding to the quality management in cardiac surgery performed in the Federal Republic of Germany (FRG) surgeries, cases which revealed no interruption of the period of hospitalization from the time of establishing the indication for surgery until the surgical intervention, were classified as urgent. Surgeries performed immediately after confirmation of the diagnosis (up to 48 hours), were classified as emergencies.

Data for morbidity and mortality were completed by contacting the original hospitals, the family physicians or by telephone interviews with the patients or with their family members. Apart from the 30-day-mortality, the hospital mortality (cases of death also after the 30th postoperative day, however, still during in-patient treatment) was determined. As of March 1996 survivors or their family physicians were contacted by telephone in 4–6-months intervals. A complete follow-up was possible on all survivors.

The statistical processing of data, as far as necessary prerequisites were fulfilled, was performed by Chi^2-test according to Pearson, Fisher-Yates-test, t-test for independent spot-checks and by Cox regression analysis. The survival rate was determined according to the Kaplan-Meier method.

From the [1]Department of Cardiothoracic and Vascular Surgery and the [2]Department of Anesthesiology, Heart Institute Lahr/Baden, Germany
Correspondence to: Dr. med. Amir Mortasawi, Klinik für Herz-, Thorax- und Gefäßchirurgie, Herzzentrum Lahr/Baden, Hohbergweg 2, D-77933 Lahr

Results

Table 1 summarizes the preoperative data of all patients. Table 2 shows the preoperative risk estimation according to the Cleveland Clinic Severity Score. There were no significant differences between group I and II.

Table 3 shows the intraoperative data. Significant differences were only found in the amount of distal anastomoses ($p < 0.01$). The number of the distal anastomoses was significantly higher with 3.3 ± 0.7 in the IMA-group in comparison with group I with 2.4 ± 0.8. A total of 3 patients (3 %) (one from group I and two from group II) required an intraoperative implantation of an intraaortic balloon pump due to low cardiac output. However, there were no complications. We performed 69 (67 %) elective, 24 (23 %) urgent and 10 (10 %) emergency surgeries. Elective interventions presented a mortality rate of 5.8 % (4/69), urgent interventions 4.2 % (1/24) and emergency surgeries 20 % (2/10). Both cases of death after emergency surgery happened in external hospitals on the 11th respectively 8th postoperative day, whereby the transfer from our hospital to the postoperative wards took place on the 4th respectively 5th postoperative day with stable circulatory conditions. Hospital mortality rate in group I presented a rate of 7.1 %, in group II 6.7 % and in total, a rate of 6.8 %. In 1997, the hospital mortality rate could be reduced to 2.4 % (1/42). There was no significant difference between the two groups. The death of an 81 year old patient (group II) was caused by a gastrointestinal haemorrhage. One group II patient died of circulatory arrest. Two female patients (group II) died due to a sequela of a cerebral infarction. 3 further patients (one from group I and two from group II) died in external hospitals during their follow-up treatment however none of the cases was definitively related to a cardiac process.

Table 4 shows the perioperative morbidity and mortality. 3 patients of group I (21 %), 16 of group II (18 %) and a total of 19 patients (18 %) had an entirely uncomplicated progress. The remainder of the patients disclosed cardiac, renal, pulmonary or neurological problems. There was, however, no significant difference between group I and II. Only one obese patient with a chronic obstructive pulmonary disease and postoperative cough attacks (group II) presented with an instability of the sternal osteosynthesis without signs of infection needed re-operation. There was no significant difference in the duration of the hospitalization between group I and II.

Follow-up was possible in all survivors. The follow-up observation period ranged between 2 and 45 months (median: 15 months). Survival rate for patients in group I was after one year 82.5 %, after two years 71 %. The survival rate for patients in group II was after one year 89.7 %, after two years 81 %. In 11 cases (61 %) death was of cardiac origin, in two cases (11 %) a sequela of a carcinoma. In one case (5,6 %) pneumonia was the cause of death, in one case an acute haemorrhage in the upper gastrointestinal tract, and in one case stroke. The cause of death in the two remaining cases could not be distinctly determined. Whereas 94 % of the patients could preoperatively be related to class III or IV of the NYHA-classification, 89 % of the survivors belonged to class II. Absence rate of angina after one year was 88 % in group I, and 93 % in group II. The differences were not significant. After one year, 87.3 % of the survivors did not require a repeated hospitalization because of cardiac complaints, this applied to 85.6 % after two years. Repeated myocardial infarctions were not observed. 73 % did not require any support in their daily activities, 21 % needed support. The remaining 6 % required care in a nursing home.

Table 1. Preoperative data

	Without IMA-bypass	With IMA-bypass	Total
Women	7/14 = 50 %	37/89 = 42 %	44/103 = 43 %
Men	7/14 = 50 %	52/89 = 58 %	59/103 = 57 %
Total	14/103 = 13.6 %	89/103 = 86.4 %	103
Age (median in years)	82 (80 to 86)	82 (80 to 88)	82 (80 to 88)
Body-Mass-Index (kg/m^2)	23.8±3.3	25.3±3.2	25.3±3.1
Creatinine ≥ 1,6 mg/dl	29 %	15 %	17 %
Dialysis	0	0	0
Chronic obstructive pulmonary disease	14 %	16 %	16 %
Hypertension	71 %	78 %	77 %
Diabetes mellitus	29 %	35 %	34 %
Carotid stenosis	21 %	24 %	23 %
History of stroke	7 %	8 %	8 %
Peripheral vascular disease	7 %	22 %	20 %
NYHA ≥ III	100 %	93 %	94 %
Unstable angina pectoris	43 %	55 %	53 %
Stenosis of the left main coronary artery	29 %	35 %	34 %
3-vessel disease	79 %	87 %	85 %
EF < 50 %	36 %	46 %	45 %
History of cardial decompensation	14 %	24 %	21 %
History of cardiopulmonary resuscitation	7 %	4 %	4 %
Myocardial infarction ≤ 2 weeks	14 %	8 %	9 %
Myocardial infarction ≥ 2 weeks	29 %	59 %	54 %

Table 2. Preoperative risk estimation according to the Cleveland Clinic Severity Score [15]

	Without IMA-bypass	With IMA-bypass	Total
≤ 5 points (predicted mortality ~ 3 %)	10 (72 %)	71 (79 %)	81 (78 %)
6 points (predicted mortality ~ 7 %)	1 (7 %)	6 (7 %)	7 (7 %)
7 bis 9 points (predicted mortality ~ 10 %)	2 (14 %)	7 (8 %)	9 (9 %)
≥ 10 points (predicted mortality ~ 22 %)	1 (7 %)	5 (6 %)	6 (6 %)

Table 3. Operative data

	Without IMA-bypass	With IMA-bypass	Total
Elective surgery	58 %	69 %	67 %
Urgent surgery	21 %	23 %	23 %
Emergency surgery	21 %	8 %	10 %
Mean cardiopulmonary bypass time (min)	83±26	85±27	88±26
Mean crossclamp time (min)	40±14	44±13	43±13
Mean number of distal anastomoses	2.4±0.8	3.3±0.7	3.2±0.8
Mean preoperative haemoglobin (g/dl)	13.0±1.5	13.5±1.3	13.4±1.4
Transfusion of packed red blood cells (units)	0.9±1.1	0.7±1.1	0.7±1.1
No blood transfusion	57 %	67 %	66 %
Intraaortic balloon pump	7 %	2 %	3 %

Table 4. Postoperative data

	Without IMA-bypass	With IMA-bypass	Total
Mean duration of the hospitalization in cardiac surgery (days)	6.9±4.5	9.1±7.2	8.9±6.9
Mean duration of the total hospitalization (days)	24.9±11.2	22.3±12.1	22.6±11.9
Mean length of stay in the intensive care unit (days)	6.0±7.4	5.4±7.0	5.4±7.1
Postoperative transfusion of packed red blood cells (units)	1.9±2.6	1.5±2.1	1.5±2.2
No postoperative blood transfusion	43 %	55 %	53 %
No blood transfusion during the in-hospital treatment	29 %	39 %	38 %
Uneventful postoperative course	21 %	18 %	18 %
Rethoracotomy because of haemorrhage	0	0	0
Mediastinitis	0	0	0
Instability of the sternal osteosynthesis	0	1 %	1 %
Reintubation	7 %	7 %	7 %
Tracheotomy	7 %	1 %	2 %
Pneumonia	7 %	11 %	11 %
Perioperative myocardial infarction	7 %	3 %	4 %
Atrial Fibrillation	64 %	49 %	51 %
Low output syndrome	7 %	3 %	4 %
Postoperative confusion	29 %	18 %	19 %
stroke	0	6 %	5 %
Postoperative renal insufficiency requiring haemofiltration	0	3 %	3 %
Gastrointestinal bleeding	0	1 %	1 %
30-day-mortality	7.1 %	5.6 %	5.8 %
Hospital mortality	7.1 %	6.7 %	6.8 %

Discussion

During the past years it has come to an increase of the people of 80 years of age or older in the entire population of the FRG. A similar development has also been registered in other high developed industrial countries [16–19]. According to the Federal Department of Statistics, 771,580 patients received inpatient treatment for the diagnosis of "ischaemic cardiac diseases" in 1995. 90,540 (11.7 %) out of these were aged ≥ 80 years. Under the same diagnosis there was a total of 28,460 deaths in the hospitals in 1995, 39 % of this amount were 80 years of age and older (11,230 patients). In the FRG an 80 year old woman has an average life expectancy of approximately 8 years and an 80 year old man approximately 6 years. As a result of the technical and medical progress, one can observe a raising of the age limit for invasive interventions. Of 32,786 patients who received surgery with the heart-lung machine (HLM) in 1989 in the FRG 3673 (11.2 %) were 70 years of age or older [20]. The portion of this age group in the total showed an increasing tendency in the following years and reached 23.6 % in 1994 (15,399 of a total of 65,347 patients) [21] and 24.4 % in 1995 (19,041 of 78,184) [22]. In 1996, 22,725 (26 %) of patients undergoing surgery with HLM were 70 to 79 years old and 2383 (2.7 %) 80 years of age and older [2]. This development is a result of an improved myocardial protection, of continued development of surgical techniques, of extracorporeal perfusion, of anesthesiological management as well as of postoperative treatment.

Elderly patients benefit more from bypass surgery than from a purely medicamentous therapy [23–27]. Numerous studies show that, in comparison with venous grafts, IMA-grafts reveal a superior patency rate and that they have a more favourable influence on the continued progress (less recurrent angina symptoms, myocardial infarctions and repeated surgeries as well as a higher survival rate) [5–7, 9–11, 14, 28–36], arterial revascularization, therefore, became a routine measure in younger patients. In 1996, 69 % of the patients in Germany (39,881 of 57,7679) received IMA-bypasses [37]. Application of an arterial graft in case of elderly patients was initially not favoured because of limited life expectance and because of apprehension, that IMA-bypasses could be accompanied by more non-cardiac complications in comparison with the venous grafts. With the increasing number of elderly patients undergoing bypass surgeries, 5-year survival rates could be recorded which were comparable with the survival rates of patients in the fifth and sixth decade of life. Comparable results with other age groups became obvious as far as recurrent angina symptoms and repeated myocardial infarctions were concerned, also in reference to the functional status [38]. It was also documented that patients in the 9th decade of life revealed 4–5 year life expectancy rates after successful bypass surgery which were comparable with life expectancy rates of the same age group of the total population, they therefore benefited from surgery [19]. Increasing experience of the surgeons with management of internal mammary artery and the fact that the increasing number of elderly patients needing surgery required the search for alternatives because of the quality of venous graft at a higher age level resulted in tendency to apply an arterial revascularization in elderly patients [35, 39–45].

Mortality

A series of studies has documented that coronary revascularization in elderly patients is associated with higher morbidity and mortality in comparison with younger collectives [17, 19, 35, 42, 44, 46–53], which could also be confirmed in our patients. While hospital mortality of isolated myocardial revascularization in the 9th decade of life was 6.8 %, the corresponding rate for the remaining, younger, age groups was 1.5 %. Increased mortality and morbidity is of multifactorial nature, and definitely not only a reflection of the aging process. Several authors have pointed out that elderly patients often suffer from a larger number of relevant accompanying diseases, and, in comparison with younger patients, generally undergo surgery in an advanced stage of their disease and with more pronounced symptoms [19, 24, 44, 46, 48, 53–55].

Curtis and colleagues [56] found no significant difference in the mortality of patients with and without IMA-bypasses (70–90 years of age). A positive influence of the IMA-application on early mortality below as well as above the age limit of 70 years was documented by Edwards and colleagues [57] in an extensive study of 38,578 patients with isolated myocardial revascularization. This positive influence was also pointed out by other authors [6, 41, 58, 59].

Several working groups have mentioned the dependence of mortality on the urgency of surgery [13, 24, 27, 39, 40, 45, 60–64]. If people of this age group, whose psychic and physical condition permits an operation, receive further diagnostic investigations for cardiac complaints at an earlier stage, this would allow a reduction of the amount of urgent and emergency interventions in favour of elective surgeries.

Table 5 summarizes the data of other working groups regarding mortality of isolated myocardial revascularization in patients aged 80 years and above. In multivariate statistical analysis the following factors were established as independent parameters for mortality of isolated myocardial revascularization in the 9th decade of life: restricted left ventricular function, NYHA IV, acute myocardial infarction, urgency of intervention, preoperative renal dysfunction, diabetes mellitus, application of IABP, sternal wound infection [19, 45, 55, 61–64, 77, 84]. The following are the corresponding parameters

for all cardiosurgical interventions in the 9th decade of life: urgency of surgery, acute myocardial infarction, prolonged cardiopulmonary bypass time, combination of myocardial revascularization and valve replacement, high preoperative left ventricular end-diastolic pressure, restricted left ventricular function, NYHA III and IV, renal insufficiency, chronic obstructive pulmonary disease, application of IABP, sternal wound infection, hyperlipidemia, diabetes mellitus, female gender [86].

Morbidity

Coronary surgery at higher age is associated with more extensive morbidity in comparison with younger collectives. Data on perioperative myocardial infarction in this age group in literature vary between 0 % and 13 % [19, 35, 44, 45, 62, 69, 74, 81, 84]. Several authors, however, found infarction rates comparable to rates reported for younger patients [44, 47, 87]. Literature revealed no evidence of an increase of perioperative myocardial infarction rate due to IMA-application in the 9th decade of life.

Data between 1.5 % and 8 % are found in literature for postoperative neurological events [19, 35, 44, 45, 61, 62, 70, 78, 81, 83, 84, 88]. It is known that with advancing age neurological deficits occur distinctly more frequent after myocardial revascularization [38, 46]. Tuman and colleagues [89] examined 2000 patients and found neurological events in 0.9 % of the patients younger than 65 years, in 3.6 % of patients between 65 and 74 years, and in 8.9 % of the patients older than 75 years. Progressive arteriosclerosis of aorta and of large vessels, reduction of global and regional cerebral perfusion as well as alteration of autoregulation of cerebral blood flow with increasing age may be some explanation [89].

With progressing age it comes to a reduction of compliance of lung as well as of thorax, of strength of respiratory musculature and of bronchociliary activity, which could therefore result in postoperative pulmonary dysfunctions. It is feared that IMA-preparation causes increased thoracic pain, pleural inflammations and consecutively leads to an impairment of the pulmonary situation. We found no evidence for a significant difference as far as duration of postoperative respiration, postoperatively developed respiratory insufficiency and of pneumonia in patients with and without IMA-bypass is concerned, which complies with the statements of Morris and colleagues [44]. In the other age groups, data on pulmonary complications fluctuate between 4 and 20 % [19, 35, 44, 45, 61, 62, 69, 70, 78, 81].

The examined patients disclosed no sternal infection. Other authors found relevant rates up to 2 % [18, 19, 44, 62, 78, 81, 90] and no dependence on the IMA-application [52, 91]. The data on disturbance of the sternal wound healing after IMA-application without consideration of age is not uniform [58, 88, 92–101]. The bilateral IMA-bypass appears to be associated with an increased risk of sternal infection, especially in association with diabetes, obesity and prolonged ventilation.

None of our patients required a repeated thoracotomy due to secondary haemorrhage. The data on postoperative haemorrhage in literature range between 1.8 % and 16 % [19, 35, 44, 55, 62, 69, 70, 78,

Table 5. Hospital mortality of isolated myocardial revascularization in patients aged 80 years and above

Ref.	Number of patients	Hospital mortality	Hospital mortality in relation to urgency of the surgery
[17]	24461	11.5 %	
[18]	25	0 %	
[19]	300	11 %	Elective: 9.6 % Urgent: 11 % Emergency: 33 %
[27]	16	12.5 %	No emergency: 0 % Emergency: 66.7 %
[35]	50	20 %	
[39]	Total: 61 With IMA: 23 (29.9 %)	8.2	
[40]	23 With IMA: 11 (47.8 %)	8.6	
[43]	48	8.3 %	
[44]	Total: 474 With IMA: 188 (39.7 %)	Total: 7.8 % Without IMA: 7 % With IMA: 9 %	
[45]	159 With IMA:52 (32.7 %)	10.7 % 30-days-mortality: 6.3 %	No emergency: 7.8 % Emergency: 22.6 %
[46]	84	5.9 %	
[55]	303 With IMA: 106 (35 %)	8.3 %	
[56]	68	14.7 %	
[59]	81-90 Years: 5184 > 90 Years: 45	4.7 % 11.1 %	
[60]	62	12.9 %	Elective: 5.6 % Emergency: 23.1 %
[61]	205	5.8 %	Elective: 2.2 % Urgent: 5.9 % Emergency: 28.6 %
[62]	100 With IMA: 10 (10 %)	12 %	Elective: 2.8 % Urgent: 13.5 % Emergency: 33.3 %
[63]	71	12.7 %	Elective: 2 % Emergency: 28 %
[64]	Total:100 With IMA: 7 (7 %)	Total: 8 % Without IMA: 7.5 % With IMA: 14.3 %	Elective: 0 % Urgent+Emergency: 13 %
[65]	295	6 %	
[66]	44	11.4 %	
[67]	29	10.3 %	
[68]	41	24.4 %	
[69]	45 (Only venous grafts)	11 %	
[70]	86 With IMA: 45 (52 %). 38 unilateral. 7 bilateral	13.9 30-days-mortality: 10.5 %	
[71]	28	7.1 %	
[72]	40	12.5 %	
[73]	28 (Only venous grafts)	7.1 %	
[74]	142 With IMA: 44 (31 %)	5.6 %	
[75]	151	3.3 %	
[76]	49	10 %	
[77]	98	6.1 %	
[78]	255	8.6 %	
[79]	58	3.4 %	
[80]	33	6.1 %	
[81]	157	7 %	
[82]	Total: 28 With IMA:11 (39 %)	0 %	
[83]	25	0 %	
[84]	154 With IMA:16 (10.4 %)	10.4 %	
[85]	26	4 %	Elective: 0 % Urgent: 5 %
Our results	Total: 103 With IMA:89 (86.4 %)	Total: 6.8 Without IMA: 7.1 % With IMA: 6.7 %	Elective: 5.8 % Urgent: 4.2 % Emergency: 20 %

81, 84]. Only Morris and colleagues [44] differentiated between patients with or without IMA-bypass and detected no significant difference.

51 % of our patients disclosed a transitory postoperative atrial fibrillation. Tasi and colleagues [81] quote a rate of 43.3 %, Mullany and colleagues [45] a rate of 35 %. The age-dependent rate of postoperative supraventricular arrhythmias is known from other studies [102]. Horneffer and colleagues [38] found a supraventricular arrhythmia after the myocardial revascularization in 8.8 % of patients younger than 55 years, in 28 % of patients between 55 and 69 and in 37 % of patients older than 70 years. Leitch and colleagues [103] detected a postoperative atrial fibrillation in 3.7 % of the patients younger than 40, and in 27.7 % of the patients above 70 years. A decreased number of the sinoatrial node cells as well as fibrosis and sclerosis of the conduction system is quoted as a possible cause [86]. Information in literature on the duration of hospitalization after isolated coronary surgery in the 9th decade of life fluctuates between 10 and 26 days [18, 19, 35, 44, 45, 55, 62, 70, 81, 84]. Morris and colleagues [44] detected a significant positive effect of the arterial revascularization on duration of the in-patient treatment (11.4 versus 13.9 days).

Functional status and survival rate

An improvement in the quality of life by improvement of symptoms and complaints is the primary aim of the myocardial revascularization. The aim is to allow the patients to live in the surroundings they are used to and to enable them to look after themselves essentially independently during everyday life. Several working groups have pointed out that patients in this age category also distinctly benefit from the operation. Whilst preoperatively 94 % of our patients could be correlated to group III and IV according to NYHA classification, 89 % of the survivors belonged to class II. Other authors have also detected a positive experience regarding functional status as well as angina symptoms [17, 19, 39, 40, 44, 45, 55, 60, 62, 64, 69, 70, 74, 84, 104].

It has not been determined whether bypass surgery in this age group results in an improvement of life expectancy. The previously published randomized studies with a comparison between medicamentous therapy and coronary surgery [105, 106] have excluded this age group. Presently ongoing randomized studies do not reveal an adequate amount of cases to sufficiently assess this age group [107–109]. It is expected that more recent and more extensive multicentric studies contribute to clarification of these problems [110]. Table 6 shows information on the survival rates after isolated myocardial revascularization after the 80th year of life. Morris and colleagues [44] discovered that a significant difference in favour of patients with IMA-bypass existed as of the 2nd year after surgery. The fact that this difference did not first appear after 4–5 years like in other age groups, was seen in relation to poorer quality of venous bypasses at a very high age level, which could become noticeable in an early stage of the progress. As far as the 5-year survival rate is concerned, Azariades and colleagues [111] found in patients older than 70 years a superiority of IMA-bypasses (89 %) in comparison with solely venous bypasses (78 %). Other teams [17, 38, 49], however, could not document an improvement of the survival rate by application of IMA with progressive age. Restrictively we do however have to mention that, in case of these working groups, the frequency of arterial grafts was comparably low.

PTCA versus bypass surgery

PTCA is also increasingly applied on elderly patients with clear risk. Refering older publications, we find mortality rates between 1.3 % and 15 %, and primary success rates range between 74 % and 96 %. Morbidity, especially neurological complications, is smaller in comparison with coronary surgery and mobilization as well as improvement of the functional status can be achieved faster. With comparable 5-year survival rates, patients who underwent surgery, however, have less angina recurrences and infarctions, and number of patients requiring a secondary intervention is also smaller. Apart from the residual stenoses after PTCA with rates up to 58 %, this could also be explained by the fact that a more extensive revascularization can be achieved by surgery. A prospective, randomized study is presently being carried out in the U.S.A. (Veterans Affairs Cooperative Study 385: Angina with ex-

Table 6. Survival rates after isolated myocardial revascularization in patients aged 80 years and older

Ref.	Number of patients	after 1 year	after 2 years	after 3 years	after 4 years	after 5 years
[19]	300				75 %	
[35]	50			60 %		
[44]	Total: 474		With IMA: 92 %	With IMA: 85 %	With IMA: 83 %	With IMA: 80 %
	188 (39.7 %) with IMA		Without IMA: 85 %	Without IMA: 78 %	Without IMA: 75 %	Without IMA: 70 %
[45]	159					80 %
	52 (32.7 %) with IMA					
[55]	303	82 %		72 %		
	106 (35 %) with IMA					
[61]	205	89 %		77 %		66 %
[62]	100					
	10 (10 %) with IMA		77 %		51 %	
[64]	100	87 %	80 %	77 %	73 %	
[69]	45 (Only venous grafts)	80 %	77 %	60 %		
[70]	86			64 %		
	45 (52 %) with IMA					
	38 unilateral, 7 bilateral					
[74]	142			87 %		
	44 (31 %) with IMA					
[81]	157	85 %				62 %
[83]	25	94 %				88 %
[84]	154					61 %
	16 (10.4 %) with IMA					
Our	Total: 103	Without IMA: 82.5 %	Without IMA: 71 %			
study	89 (86.4 %) with IMA	With IMA: 89.7 %	With IMA: 81 %			

tremely serious operative mortality evaluation: AWESOME). This study compares the results of PTCA and coronary surgery and does include patients older than 70 years. It is hoped that the results of this study will allow for a better assessment of these procedures [23, 54, 61, 76, 91, 112–125].

Final conclusions

Thanks to the general medical-technical advances, a myocardial revascularization can also be performed in the 9th decade of life as a safe and effective therapeutic measure. To achieve better results, patients of this age group with cardiac symptoms whose psychic and physical condition permits an operation should undergo further diagnostic investigations at a much earlier stage, this would allow reduction of the number of urgent and emergency interventions in favour of elective operations. Myocardial revascularization with the internal mammary artery on patients in the 9th decade of life discloses a comparable acceptable morbidity and mortality in relation to the purely venous coronary bypasses. The prolonged follow-up observation period will clarify whether the arterial myocardial revascularization will also present itself as the superior method in this age category.

Acknowledgements

We acknowledge the technical assistance of Mrs. G. Eichner.

References

1. Statistisches Bundesamt. Gustav Stresemann-Ring 11, Wiesbaden, 1997 .
2. Deutsche Gesellschaft für Thorax-, Herz- und Gefäßchirurgie: Leistungen der Deutschen Herzchirurgie 1996. Zur Pressekonferenz anläßlich der 26. Jahrestagung der Gesellschaft, Dresden, 1997.
3. Barner HB, Barnett MG. Fifteen- to twenty-one-year angiographic assessment of internal thoracic artery as a bypass conduit. Ann Thorac Surg 1994; 57: 1526–8.
4. Barner HB, Standeven JW, Reese J. Twelve-year experience with internal mammary artery for coronary artery bypass. J Thorac Cardiovasc Surg 1995; 90 668–75.
5. Cameron A, Kemp HG, Green GE. Bypass surgery with the internal mammary artery graft: 15 year follow-up. Circulation 1986; 74 (Suppl III): 30–6.
6. Cosgrove DM, Loop FD, Lytle BW, Goormastic M, Stewart RW, Gill CC, Golding LR. Does mammary artery grafting increase surgical risk? Circulation 1985; 72 (Suppl II): 170–4.
7. Grondin CM, Campeau L, Lesperance J. Comparison of late changes in internal mammary and saphenous vein grafts in two consecutive series of patients 10 years after operation. Circulation 1984; 70 (Suppl I): 208–12.
8. Ivert T, Huttunen K, Landou C, Björk VO. Angiographic studies of internal mammary artery grafts 11 years after coronary artery bypass grafting. J Thorac Cardiovasc Surg 1988; 96: 1–12.
9. Loop FD, Lytle BW, Cosgrove DM, Stewart RW, Goormastic M, Williams GW, Golding LAR, Gill CC, Taylor PC, Sheldon WC, Proudfit WL. Influence of the internal mammary artery grafts on 10 year survival and other cardiac events. N Engl J Med 1986; 314: 1–6.
10. Lytle BW, Loop FD, Cosgrove DM, Tarliff NB, Easley K, Taylor PC. Long-term (5 to 12 years) serial studies of internal mammary artery and saphenous vein coronary bypass grafts. J Thorac Cardiovasc Surg 1985; 89: 248–58.
11. Okies JE, Page US, Bigelow JC, Krause AH, Salomon NW. The left internal mammary artery: the graft of choice. Circulation 1984; 70 (Suppl I): 213–21.
12. Shelton ME, Forman MB, Virmani R, Bajaj A., Stoney WS, Atkinson JB. A comparison of morphologic and angiographic findings in long-term internal mammary artery and saphenous vein bypass grafts. J Am Coll Cardiol 1988; 11: 297–303.
13. Singh RN, Sosa JA, Green GE. Long-term fate of the internal mammary artery and saphenous vein grafts. J Thorac Cardiovasc Surg 1983; 86: 359–63.
14. Tector AJ, Schmahl TM, Janson B, Kallies JR, Johnson G. The internal mammary artery graft. Its longevity after coronary bypass. JAMA 1991; 246: 2181–4.
15. Higgins TL, Estafanous FG, Loop FD, Beck GJ, Blum JM, Paranandi L. Stratification of morbidity and mortality outcome by preoperative risk factors in coronary artery bypass patients. A clinical severity score. JAMA 1992; 267: 2344–8.
16. Gehlot AS, Santamaria JD, White AL, Ford WC, Ervine KL, Wilson AC. Current status of coronary artery bypass grafting in patients 70 years of age and older. Aust N Z J Surg 1995; 65: 177–81.
17. Peterson ED, Cowper PA, Jollis JG, Bebchuk JD, DeLong ER, Muhlbaier H, Mark DB, Pryor DB. Outcomes of coronary artery bypass graft surgery in 24461 patients aged 80 years or older. Circulation 1995; 92 (Suppl II): 85–91.
18. Sahar G, Raanani E, Brauner R, Vidne BA. Cardiac surgery in octogenarians. J Cardiovasc Surg 1994; 35 (Suppl I): 201–5.
19. Williams DB, Carillo RG, Traad EA, Wyatt CH, Grahowski R, Wittels SH, Ebra G. Determinants of operative mortality in octogenarians undergoing coronary bypass. Ann Thorac Surg 1995; 60: 1038–43.
20. Kalmar P, Irrgang E. Cardiac surgery in the Federal Republic of Germany during 1989. A report by the German Society for Thoracic and Cardiovascular Surgery. Thorac Cardiovasc Surgeon 1990; 38: 198–200.
21. Kalmar P, Irrgang E. Cardiac surgery in Germany during 1994. A report by the German Society for Thoracic and Cardiovascular Surgery. Thorac Cardiovasc Surgeon 1995; 43: 181–3.
22. Bruckenberger E. 8. Bericht des Krankenhausausschusses der Arbeitsgemeinschaft der Leitenden Medizinalbeamtinnen und Medizinalbeamten (AGLMB) zur Situation der Herzchirurgie 1995 in Deutschland. Niedersächsisches Sozialministerium, Hannover, 1996.
23. Elbaz M, Fourcade J, Carrie D, Jean M, Karouny E, Foures F, Bery E, Bounhoure JP, Puel J. Coronary artery disease in octogenarians: contribution of coronary angiography and the evaluation of therapeutic possibilities. Arch Mal Coeur 1995; 88: 1391–8.
24. Horvath KA, DiSesa VJ, Peigh PS, Couper GS, Collins JJ, Cohn LH. Favorable results of coronary bypass grafting in patients older than 75 years. J Thorac Cardiovasc Surg 1990; 99: 92–6.
25. Ko W, Gold LP, Lazzaro R, Zelano JA, Lang S, Isom OW, Krieger KH. Survival analysis of octogenarian patients with coronary artery disease managed by elective coronary artery bypass surgery versus conventional medical treatment. Circulation 1992; 86 (Suppl II): 191–7.
26. Krumholz HM, Forman DE, Kuntz RE, Baim DS, Wie JY: Coronary revascularisation after myocardial infarction in the very elderly: outcomes and long-term follow-up. Ann Intern Med 1993; 119: 1084–90.
27. Naunheim KS, Kern MJ, McBride LR, Pennington DG, Barner HB, Kanter KR, Fiore AC, Willman VL, Kaiser GC. Coronary artery bypass surgery in patients aged 80 years or older. Am J Cardiol 1987; 59: 804–7.
28. Acinapura AJ, Jacobowitz IJ, Kramer MD, Zisbrod Z, Cunningham JN. Internal mammary artery bypass: thirteen years of experience. Influence of angina and survival in 5125 patients. JCardiovasc Surg 1992; 33: 554–9.
29. Acinapura AJ, Rose DM, Jacobowitz IJ. Internal mammary artery bypass grafting: influence on recurrent angina and survival in 2,100 patients. Ann Thorac Surg 1989; 48: 186–91.
30. Barner HB, Swartz MT, Mudd TG, Tyras DH: Late patency of the internal mammary artery as a coronary bypass conduit. Ann Thorac Surg 1982; 34: 408–12.
31. Cameron A, Davis KB, Green G, Schaff HV. Coronary artery bypass surgery with internal thoracic artery graft – effect on survival over a 15-year period. N Engl J Med 1996; 334: 216–9.
32. Killen DA, Arnold M, McConahay DR, Wathanacharoen S, Reed WA. Fifteen-year results of coronary artery bypass for isolated left anterior descending coronary artery disease. Ann Thorac Surg 1989; 47: 595–9.
33. Morris JJ, Smith LR, Jones RH, Morris PB, Muhlbaier LH, Reves JG, Rankin JS. Influence of diabetes and mammary artery on survival after coronary bypass. Circulation 1991; 84 (Suppl III): 275–84.
34. Olearchyk AS, Magovern GJ. Internal mammary artery grafting. Clinical results, patency rates, and long-term survival in 833 patients. J Thorac Cardiovasc Surg 1986; 92: 1082–7.
35. Peigh PS, Swartz MT, Vaca KJ, Lohmann P, Naunheim KS. Effect of advancing age on cost and outcome of coronary artery bypass grafting. Ann Thorac Surg 1994; 58: 1362–7.
36. Zeff RH, Kongtahworn C, Iannone LA, Gordon DF, Brown TM, Phillips SJ, Skinner JR, Spector M. Internal mammary artery versus saphenous vein graft to the left anterior descending coronary artery: prospective randomized study with 10-years follow-up. Ann Thorac Surg 1988; 45: 533–6.
37. Kalmar P, Irrgang E. Cardiac surgery in Germany during 1996. A report by the German Society for Thoracic and Cardiovascular Surgery. Thorac Cardiovasc Surgeon 1997; 45: 134–7.
38. Horneffer PJ, Gardner TJ, Manolio TA, Hoff SJ, Rykiel MF, Pearson TA, Gott VL, Baumgartner WA, Borkon AM, Watkins L, Reitz BA. The effects of age on outcome after coronary bypass surgery. Circulation 1987; 76 (Suppl V): 6–12.
39. Deiwick M, Tandler R, Möllhof T, Kerber S, Rötker J, Roeder N, Sheld HH. Heart surgery in patients aged eighty years and above: determinations of morbidity and mortality. Thorac Cardiovasc Surgeon 1997; 45: 119–26.
40. Diegeler A, Autschbach R, Falk V, Walther T, Gummert J, Mohr FW, Dalichau H. Open heart surgery in the octogenarians – a study on long-term survival and quality of life. Thorac Cardiovasc Surgeon 1995; 43: 265–70.
41. Gardner TJ, Greene PS, Rykiel MF, Baumgartner WA, Cameron DE, Casale AS, Gott VL, Watkins Jr L, Reitz BA. Routine use of the left internal mammary artery graft in the elderly. Ann Thorac Surg 1990; 49: 188–94.
42. Katz NM, Hannan RL, Hopkins RA, Wallace RB. Cardiac operations in patients aged 70 years and over: mortality, length of stay, and hospital charge. Ann Thorac Surg 1995; 60: 96–101.
43. Klima U, Wimmer-Greinecker G, Mair R, Gross C, Peschl F, BrückeP. The octogenarians – a new challenge in cardiac surgery? Thorac Cardiovasc Surgeon 1994; 42: 212–7.
44. Morris RJ, Strong MD, Grunewald KE, Kuretu MLR, Samuels LE, Kresh JY, Brockman SK. Internal thoracic artery for coronary artery grafting in octogenarians. Ann Thorac Surg 1996; 62: 16–22.
45. Mullany CJ, Darling GE, Pluth JR, Orszulak TA, Schaff HV, Ilstrup DM, Gersh BJ. Early and late results after isolated coronary artery bypass surgery

in 159 patients aged 80 years and older. Circulation 1990; 82 (Suppl IV): 229–36.
46. Cane ME, Chen C, Bailey BM, Fernandez J, Laub GW, Anderson WA, McGrath LB. CABG in octogenarians: early and late events and actuarial survival in comparison with matched population. Ann Thorac Surg 1995; 60: 1033–7.
47. Grover FL, Johnson RR, Marshall G, Hammermeister KE, and Department of Veterans Affiars Cardiac Surgeons. Factors predictive of operative mortality among coronary artery bypass subsets. Ann Thorac Surg 1993; 56: 1296–1307.
48. Khan SS, Kupfer JM, Matloff JM, Tsai TP, Nessim S. Interaction of age and of pre-operative risk factors in predicting operative mortality for coronary bypass surgery. Circulation 1992; 86 (Suppl II): 186–90.
49. Kitamura M, Endo M, Yamaki F, Ohtsuka G, Nishida H, Koyanagi H. Long-term results of coronary artery bypass grafting in elderly Japanese patients. Ann Thorac Surg 1995; 60: 576–9.
50. Kupfer J, Khan S, Matloff JM, Tsai TP, Nessim S, Gray R. Heterogenous mortality rates of elderly patients undergoing coronary bypass surgery. Circulation 1992; 86 (Suppl I): 437.
51. Mohan R, Amsel BJ, Walter PJ. Coronary artery bypass grafting in the elderly: a review of studies on patients older than 64, 69 or 74 years. Cardiology 1992; 80: 215–25.
52. Salomon NW, Page US, Bigelow JC, Krause AH, Okies JE, Metzdorff MT. Coronary artery bypass grafting in elderly patients. J Thorac Cardiovasc Surg 1991; 101: 209–18.
53. Weintraub WS, Craver JM, Cohen CL, Jones EL, Guyton RA. Influence of age on results of coronary artery surgery. Circulation 1991; 84 (Suppl III): 226–35.
54. Görlach G, Stertman WA, Wolf M, Lohmann E, Hehrlein FW. Ursachen der erhöhten Mortalität der Koronarchirurgie im fortgeschrittenen Alter. Herz/Kreisl 1996; 28: 73–5.
55. Tsai TP, Chaux A, Matloff JM, Kass RM, Gray RJ, DeRoberties MA, Khan SS. Ten-year experience of cardiac surgery in patients aged 80 years and over. Ann Thorac Surg 1994; 58: 445–51.
56. Curtis JJ, Walls JT, Bole TM, Schmaltz RA, Demmy TL, Salam N. Coronary revascularization in the elderly: determinants of operative mortality. Ann Thorac Surg 1994; 58: 1069–72.
57. Edwards FH, Clark RE, Schwartz M. Impact of internal mammary artery conduits on operative mortality in coronary revascularization. Ann Thorac Surg 1994; 57: 27–32.
58. Grover FL, Johnson RR, Marshall G, Hammermeister KE, and Department of Veterans Affairs Cardiac Surgeons. Impact of mammary grafts on coronary bypass operative mortality and morbidity. Ann Thorac Surg 1994; 57: 559–69.
59. The Society of Thoracic Surgeons. Data analysis of The Society of Thoracic Surgeons. National cardiac surgery database. Summit Medical, Minnetonka, 1997.
60. Freemann WK, Schaff HV, O'Brien PC, Orszulak TA, Naessens JM, Tajik AJ. Cardiac surgery in the octogenarian: Perioperative outcome and clinical follow-up. J Am Coll Cardiol 1991; 18: 29–35.
61. Kaul TK, Fields BL, Wyatt DA, Jones CR, Khan DR. Angioplasty versus coronary artery bypass in octogenarians. Ann Thorac Surg 1994; 58: 1419–26.
62. Ko W, Krieger KH, Lazenby WD, Shin YT, Goldstein R, Lazzaro R, Isom OW. Isolated coronary artery bypass grafting in one hundred consecutive octogenarian patients. J Thorac Cardiovasc Surg 1991; 102: 532–8.
63. Naunheim KS, Dean PA, Fiore AC, McBride LR, Pennington DG, Kaiser GC, Willman VL, Barner HB. Cardiac surgery in the octogenarians. Eur J Cardio-Thorac Surg 1990; 4: 130–5.
64. Talwalkar NG, Damus PS, Durban LH, Hartstein ML, Taylor JR, Weisz D, Wisoff BG, Robinson NB. Outcome of isolated coronary artery bypass surgery in octogenarians. J Card Surg 1996; 11: 172–9.
65. Akins CW, Daggett WM, Vlahakes GJ, Hilgenberg AD, Torchiana DF, Madsen JC, Buckley MJ. Cardiac surgery in patients over 80 years age. Data presented during the 33rd annual meeting of The Society of Thoracic Surgeons, San Diego, California, 1997.
66. Bashour TT, Hanna ES, Myler RK, Mason DT, Ryan C, Feeney J, Iskikian J, Wald SH, Antonnini C, Malabed LL. Cardiac surgery in patients over the age of 80 years. Clin Cardiol 1990; 13: 267–70.
67. Braunstein EM, Bajwa TK, Andrei L, Maglio C, Richardson C, Shen YH, Schmidt DH. Early and late outcome of revascularization for unstable angina in octogenarians. J Am Coll Cardiol 1991; 17: 151A.
68. Edmunds LH, Stephenson LW, Edie RN, Ratcliffe MB. Open-heart surgery in octogenarians. N Engl J Med 1988; 319: 131–6.
69. Glock Y, Faik M, Laghzaoui A, Moali I, Roux D, Fournial G. Cardiac surgery in the ninth decade of life. Cardiovasc Surg 1996; 4: 241–5.
70. Glower DD, Christopher TD, Milano CA, White WD, Smith LR, Jones RH, Sabiston Jr DC. Performance status and outcome after coronary artery bypass grafting in persons aged 80 to 93 years. Am J Cardiol 1992; 70: 567–71.
71. Hall RJ, Elayda MA, Gray A, Mathur VS, Garcia E, De Castro CM, Massumi A, Cooley DA. Coronary artery bypass: long-term follow up of 22,284 consecutive patients. Circulation 1983; 68 (Suppl II): 20–6.
72. Kowalchuk GJ, Siu SC, McAuliffe LS, Maggs PR, Lewis SM. Coronary artery bypass surgery in octogenarians: early and late results. J Am Coll Cardiol 1990; 15: 35A.
73. Merril WH, Stewart JR, Frist WH, Hammon JW, Bender HW. Cardiac surgery in patients age 80 years or older. Ann Surg 1990; 211: 772–5.
74. Mick MJ, Simpfendorfer C, Arnold AZ, Piedmonte M, Lytle BW. Early and late results of coronary angioplasty and bypass in octogenarians. Am J Cardiol 1991; 68: 1316–20.
75. Murphy SF, Nickerson NJ, Kouchoukos NT. Functional outcome in the elderly after coronary artery surgery. Medsurg Nurs 1996; 5: 107–10.
76. Myler RK, Webb JG, Nguyen KP, Shaw RE, Anwar A, Schechtmann NS, Bashour TT, Stertzer SH, Zapolanski A. Coronary angioplasty in octogenarians. Comparisons to coronary bypass surgery. Cathet Cardiovasc Diagn 1991; 23: 3–9.
77. Pifarre R. Open heart surgery in the elderly: changing risk parameters. Ann Thorac Surg 1993; 56: S71–S73.
78. Ranger WR, Glover JL, Shannon FL, Sakwa MP, Bassett JS. Coronary artery bypass and valve replacement in octogenarians. Am Surg 1995; 62: 941–46.
79. Strain JF, Stelzer PE, Subramanian VA, Cohen NT, Gleim GW. CABG versus PTCA for octogenarians with three vessel disease. Circulation 1994; 90 (Suppl I): 333.
80. Tsai TP, Matloff JM, Gray RJ, Chaux A, Kass RM, Lee ME, Czer LSC. Cardiac surgery in the octogenarian. J Thorac Cardiovasc Surg1986; 91: 924–8.
81. Tsai TP, Nessim S, Kass RM, Chaux A, Gray RJ, Khan SS, Blanche C, Utley C, Matloff JM. Morbidity and mortality after coronary artery bypass in octogenarians. Ann Thorac Surg 1991; 51: 983–6.
82. Ura M, Sakata R, Umebayashi Y, Ueno T, Ueyama K, Arakaki K. Coronary artery bypass surgery in patients over 80 years. Nippon Kyobu Geka Gakkai Zasshi 1996; 44: 1124–9.
83. Utley JR, Leyland SA. Coronary artery bypass grafting in the octogenarian. J Thorac Cardiovasc Surg 1991; 101: 866–70.
84. Weintraub WS, Clements SD, Ware J, Craver JM, Cohen CL, Jones EL, Guyton RA. Coronary artery surgery in octogenarians. Am J Cadiol 1991; 68: 1530–4.
85. Yashar JJ, Yashar AG, Torres D, Hittner K. Favorable results of coronary artery bypass and/or valve replacement in octogenarians. Cardiovasc Surg 1993; 1: 68–71.
86. Vaska PL. Cardiac surgery in special populations, part 1: octogenarians, patients with neuropsychiatric disorders, and blacks. AACN Clinical Issues 1997; 8: 50–8.
87. Kennedy JW, Kaiser GC, Fisher LD, Maynard C, Fritz JK, Myers W, Mudd G, Ryan TJ, Coggin J. Multivariate discriminant analysis of the clinical and angiographic predictors of operative mortality from the Collaborative Study on Coronary Artery Surgery (CASS). J Thorac Cardiovasc Surg 1980; 80: 876–87.
88. Galbut DL, Traad EA, Dorman MJ, DeWitt PL, Larsen PB, Kurlansky PA, Button JH, Ally JM, Gentsch TO. Seventeen-year experience with bilateral internal mammary artery grafts. Ann Thorac Surg 1990; 49: 195–201.
89. Tuman KJ, McCarthy RJ, Najafi H, Ivankovich AD. Differential effects of advanced age on neurologic and cardiac risk of corornary artery operations. J Thorac Cardiovasc Surg 1992; 104: 1510–7.
90. Carrel T, Horber P, Turina MI. Operation for two-vessel coronary artery disease: midterm results of bilateral ITA grafting versus unilateral ITA and saphenous vein grafting. Ann Thorac Surg 1996; 62: 1289–94.
91. Morrison DA, Bies RD, Sacks J. Coronary angioplasty for elderly patients with "high risk" unstable angina: short-term outcomes and long-term survival. J Am Coll Cardiol 1997; 29: 339–44.
92. Berreklouw E, Schönberger JPAM, Bavinck JH, Verwaal VJ, Koldewijn EL, van der Linden F, van der Tweel I, Bredee JJ. Similar hospital morbidity with the use of one or two internal thoracic arteries. Ann Thorac Surg 1994; 57 1564–72.
93. Berreklouw E, Schönberger JPAM, Ercan H, Koldewijn EL, de Bock M, Verwaal VJ, van der Linden F, van der Tweel I, Bavinck JH, Bredee JJ. Does it make sense to use two internal thoracic arteries? Ann Thorac Surg 1995; 59 1456–63.
94. Dewar LRS, Jamieson WRE, Janusz MT. Unilateral versus bilateral mammary revascularization: survival and event-free performance. Circulation 1995; 92 (Suppl II): 8–13.
95. Galbut DL, Traad EA, Dorman MJ, DeWitt PL, Larsen PB, Kurlansky PA, Carillo RG, Gentsch TO, Ebra G. Coronary bypass grafting in the elderly. Single versus bilateral internal mammary artery grafts. J Thorac Cardiovasc Surg 1993; 106: 128–36.
96. Grossi EA, Esposito R, Harris LJ, Crooke GA, Galloway AC, Colvin SB, Culliford AT, Baumann FG, Yao K, Spencer FC. Sternal wound infections and use of internal mammary artery grafts. J Thorac Cardiovasc Surg 1991; 102: 342–7.
97. Kouchoukos NT, Wareing TH, Murphy SF, Pelate C, Marshall Jr WG. Risks of bilateral internal mammary artery bypass grafting. Ann Thorac Surg 1990; 49: 210–9.
98. Lytle BW, Cosgrove DM, Loop FD, Borsh J, Goormastic M, Taylor PC. Perioperative risk of bilateral internal mammary artery grafting: analysis of 500 cases from 1971 to 1984. Circulation 1986; 74 (Suppl III): 37–41.
99. Morris JJ, Smith LR, Glower DD, Muhlbaier LH, Reves JG, Wechsler AS, Rankin JS. Clinical evaluation of single versus multiple mammary artery bypass. Circulation 1990; 82 (Suppl IV): 214–23.
100. Saldanha RF, Raman J, Esmore DS, Spratt PM, Farnsworts AE, Chang VP, Shanahan MX. Myocardial revascularization in patients over seventy-five years. J Cardiovasc Surg 1988; 29: 624–8.
101. Wouters R, Wellens F, Vanermen H, De Geest R, Degrieck I, De Meerleer F. Sternitis and mediastinitis after coronary artery bypass grafting. Analysis of risk factors. Tex Heart Inst J 1994; 21: 183–8.
102. Fuller JA, Adams GG, Buxton B. Atrial fibrillation after coronary artery bypass grafting. Is it a disorder of the elderly? J Thorac Cardiovasc Surg 1989; 97: 821–5.

103. Leitch JW, Thomson D, Baird DK, Harris PJ. The importance of age as a predictor of atrial fibrillation and flutter after coronary artery bypass grafting. J Thorac Cardiovasc Surg 1990; 100: 338–42.
104. Little T, Milner MR, Lee K, Constantine J, Picahrd AD, Lindsay Jr J. Late outcome and quality of life following percutaneous transluminal coronary angioplasty in octogenarians. Cathet Cardiovasc Diagn 1993; 29: 261–6.
105. Varnauskas E, and The European Coronary Surgery Study Group. Twelve-year follow-up in the randomized European Coronary Surgery Study. N Engl J Med 1988; 319: 332–7.
106. The Veterans Administration Coronary Artery Bypass Surgery Cooperative Study Group. Eleven-year survival in the Veterans Administration randomized trial of coronary bypass surgery for stable angina. N Engl J Med 1984; 311: 1333–9.
107. Hamm CW, Ischinger T, Reimers J. Angioplasty versus bypass-surgery in patients with multivessel disease: reinterventions and complication during 6 months follow-up. N Engl J Med 1994; 331: 1037–43.
108. King III SB, Lembo NJ, Weintraub WS, Kosinski AS, Barnhart HX, Kutner MH, Alazraki NP, Guyton RA, Zhao X, Emory Angioplasty Versus Surgery Trial (EAST). A randomized trial comparing coronary angioplasty with coronary bypass surgery. N Engl J Med 1994; 331: 1044–50.
109. RITA Trial Participants. Coronary angioplasty versus coronary artery bypass surgery: the Randomized Intervention Treatment of Angina (RITA) Trial. Lancet 1993; 341: 573–80.
110. Vogel RA. HCFA's Cooperative Cardiovascular Project: a nationwide quality assessment of acute myocardial infarction. Clin Cardiol 1994; 17: 354–6.
111. Azariades M, Fessler CL, Floten HS, Starr A. Five-year results of coronary bypass grafting for patients older than 70 years: role of internal mammary artery. Ann Thorac Surg 1990; 50: 940–5.
112. Camenzind E, Meier B, Urban P, Dorsaz PA, Dosso JF, Rutishauser W. Coronary angioplasty in octogenarians. Schweiz Med Wochenschr 1993; 123: 970–6.
113. Forman DE, Berman AD, McCabe CH, Baim DS, Wei JY. PTCA in the elderly: the "young-old" versus the "old-old". J Am Geriatr Soc 1992; 40: 19–22.
114. Kaus T, Field B, Wyatt D, Jones C, Khan D. Angioplasty versus coronary artery bypass in octogenarians. Ann Thorac Surg 1994; 58: 1419–26.
115. Kowalchuk GJ, Siu SC, Lewis SM. Coronary artery disease in the octogenarian: angiographic spectrum and suitability for revascularization. Am J Cardiol 1990; 66: 1319–23.
116. Laster SB, Rutherford BD, Giorgi LV, Shimshak TM, McConahay DR, Johnson Jr WL, Huber KC, Ligon RW, Hartzler GO: Results of direct percutaneous transluminal coronary angioplasty in octogenarians. Am J Cardio 1996; 77: 10–3.
117. O'Keefe Jr JH, Sutton MB, McCallister BD, Vacek JL, Piehler JM, Ligon RW, Hartzler GO. Coronary angioplasty versus bypass surgery in patients above 70 years old matched for ventricular function. J Am Coll Cardiol 1994; 24: 425–30.
118. Pfisterer M. Koronarangioplastie versus aortokoronare Bypassoperation bei älteren Patienten. Schweiz Med Wochenschr 1995; 125: 2080–3.
119. Reynen K, Kunkel B, Gansser R, Bachmann K. Success and restenosis rate of PTCA in patients over 75 years of age. Z Kardiol 1992; 81: 157–63.
120. Salley RK, Robinson MC. Ischemic heart disease in the elderly: The role of coronary angioplasty and coronary artery bypass grafting. South Med J 1993; 86: 15–22.
121. Santana JO, Haft JI, La Marche NS, Goldstein JE. Coronary angioplasty in patients eighty years or older. Am Heart J 1992; 124: 13–8.
122. Somitsu Y, Yamaguchi T, Ishiki R, Ikari Y, Furuta Y, Hara K, Saeki F, Tamura T, Wanibuchi Y, Suma H. Outcome of coronary angioplasty and coronary artery bypass grafting in patients over 75 years old. J Cardiol 1994; 24: 271–7.
123. ten Berg JM, Bal ET, Tjon Joe Gin RM, Ernst JMPG, Mast EG, Ascoop CAPL, Defauw JJAW, Plokker HWM. Initial and long-term results of percutaneous transluminal coronary angioplasty in patients 75 years of age and older. Cathet Cardiovasc Diagn 1992; 26: 165–70.
124. U KM, Mantadilok V, Fatterparker AK, Bahr R. Single (culprit) vessel disease in octogenarians with acute myocardial infarction and unstable angina. Md Med J 1996; 45: 471–5.
125. Walter PJ, Mohan R. Coronary angioplasty versus coronary artery bypass surgery. Isr J Med Sci 1996; 32: 815–6.

Mitteilungen aus der Redaktion

Besuchen Sie unsere

zeitschriftenübergreifende Datenbank

☑ **Bilddatenbank** ☑ **Artikeldatenbank** ☑ **Fallberichte**

e-Journal-Abo

Beziehen Sie die elektronischen Ausgaben dieser Zeitschrift hier.

Die Lieferung umfasst 4–5 Ausgaben pro Jahr zzgl. allfälliger Sonderhefte.

Unsere e-Journale stehen als PDF-Datei zur Verfügung und sind auf den meisten der marktüblichen e-Book-Readern, Tablets sowie auf iPad funktionsfähig.

☑ **Bestellung e-Journal-Abo**