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Coronary Artery Bypass Grafting In Young Patients: A Retrospective Review at Queen Alia Heart Institute

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Abstract **Original Research Article**

Background: Coronary artery bypass grafting (CABG) is the 'Gold Standard' for patients with multiple vessel coronary artery disease (CAD). Younger patients presenting with coronary artery disease requiring surgery may represent a distinct subgroup with the main goal for coronary revascularization being long term patency of the performed grafts to improve outcome. ***Objective:*** The aim of this study was to check if young patients need surgery urgently for operative revascularization or electively. Also, check the potential advances regarding long-term patency using combined venous and arterial revascularization, and finally the overall mortality in young group of patients after CABG. ***Methods:*** Between January 2018 to January 2022, 526 patients below the age of 50 years underwent Coronary Artery Bypass Grafting CABG for coronary artery disease CAD in Queen Alia Heart Institute QAHI, We retrospectively analyzed the perioperative data and evaluated patients' outcome. ***Results:*** In 25% of the patients, CABG was performed as an emergency procedure for STEMI or NSTEMI within 36 hours. Another 27% of the patients were operated urgently for unstable angina or myocardial infarction within the last weeks and only 48% of the patients were purely elective cases. We performed only venous bypass grafts in 12%, and combined venous and arterial revascularization in 88%. Patients received 2.8 ± 1 bypass grafts overall. Overall in-hospital mortality in this cohort was low with 1% ($n = 1$). ***Conclusions:*** The majority of the young patients below the age of 50 years present urgently for operative revascularization. Besides, the potential advances regarding long-term patency using total arterial revascularization, only about half of the young patients are feasible for this approach. Overall, early outcome in this group is excellent with mortality below one percent.

Keywords: CABG, QAHI, STEMI and NSTEMI.

INTRODUCTION

Coronary artery bypass grafting (CABG) remains the Gold standard for excessive coronary artery disease involving three vessels or the left main stem [1]. CABG is more durable than percutaneous coronary intervention, especially when using arterial grafts only [2-4]. There is abundant literature regarding risks of elderly patients undergoing cardiac surgery [5-7]. However, reports about younger patients undergoing CABG are sparse. D'Errigo *et al*., recently reported the multicenter data concerning patients below 50 years of age receiving CABG with a mortality rate of 0.9% overall [8]. However, no details about the used grafts were given in that study. A low postoperative mortality rate has also been reported by Khawaja *et al*., [9] in patients aged <50 years treated by percutaneous coronary intervention (0.86%). However, percutaneous coronary interventions were performed in 41% of cases in patients with single vessel coronary artery disease, which is significantly different from surgical series [8].

Patients who would benefit most from prolonged patency of total artery revascularization are the young patients. In this study we therefore sought to further evaluate patients under the age of 50 years receiving coronary artery bypass grafting.

PATIENTS AND METHODS

We reviewed the electronic medical records of 562 patients below the age of 50 years receiving CABG between January 2018 to January 2022 at Queen Alia Heart Institute (QAHI). The Ethics Committee of King Hussein Medical Centre, Amman Jordan approved this study. Informed consent was obtained from the patient for the publication

Operative technique:

A full median sternotomy was performed. We used cardiopulmonary support in all cases.

Total arterial revascularization (TAR):

*A*fter a full median sternotomy the LITA was harvested in no touch technique with minimal trauma as pedicled graft and treated with papaverine solution prior to use. RA was harvested from the non-dominant arm. We performed duplex sonography to assure open palmar arches. The T-graft was performed prior to initiating CPB between the RA and the LITA using an 8–0 prolene suture. CBP was initiated after completion of the T graft.

Combined venous and arterial revascularization:

We usually used the LITA and the saphenous vein as grafts. The LITA was most frequently anastomosed to the LAD or D1, whereas the saphenous vein was used for up to three sequential anastomoses. The venous only revascularization was achieved using the saphenous vein as aortocoronary bypass anastomosed to the acending aorta as standardized.

CPB was instituted with cannulation of the ascending aorta and a single two-stage right atrial cannulation. Standard bypass management included membrane oxygenators, arterial line filters, and non-pulsatile flow with a mean arterial pressure greater than 50 mm Hg. The myocardium was protected by using intermittent antegrade cold blood cardioplegia or crystalloid solution. Anticoagulation was achieved using 300 U/kg of heparin. If required, heparin was supplemented to maintain the activated clotting time above 450 s and was fully reversed with protamine at the end of the procedure. Patients received intravenous nitroglycerin infusions for the first 24 h if feasible. Inotropic agents were chosen by the haemodynamic state. Other routine medications included daily aspirin (300mg Aspirin i.v. 6 hour postoperatively unless bleeding occurred, 100mg Aspirin p.o. the first postoperative day) and resumption of cholesterol-lowering agents and β-blockers unless contraindicated beginning during the early postoperative course.

Statistical Analysis

Statistical analysis was performed using SPSS 22 package (SPSS Inc, Chicago, Il, USA). The data were shown as mean ± SD. Comparison of groups was performed using unpaired t-test or ANOVA with statistical significance assumed for p values <0.05.

RESULTS

A total of 526 CABG cases in patients below the age of 50 years were performed. Twenty five percent (n = 132) of the operations were emergencies, Twenty seven percent (n = 142) of the patients were operated urgently and only 48% (n = 252) of the patients were elective cases. 152 patients recently had a myocardial infarction (<30 days) of which 118 patients presented with myocardial infarction under 12 hours prior to the operation.

Median age was 46.98 (range from: 24–49), 81% (n = 426) of the patients were male. Patients usually presented with multiple risk factors. Arterial hypertension was present in 77%, nicotine abuse in 79% and hyperlipidaemia in 71% of patients. Obesity was present in 34% of cases, and diabetes mellitus in 25% of cases. The overall pre-operative left ventricular ejection fraction (LV-EF) was 55.5% (±13.8%). However, 12% of patients presented with a poor LV-EF below 35%. 236 Patients had already undergone PTCA/Stent implantation before they were admitted to cardiac surgery.

The patient received a coronary angiogram after admission to the hospital which showed a 3 vessel disease. 66% (n = 347) of patients were symptomatic prior to the operation (NSTEMI, STEMI and unstable angina). For further pre-operative details, please refer to Table 1.

Table 1: Patient's characteristics

Age, years	46.98 (range from 24-49)
Sex, male (%)	426 (81)
Arterial Hypertension (%)	405 (77)
Nicotine abuse (%)	416 (79)
Hyperlipidemia (%)	373 (71)
Obesity (%)	179 (34)
Diabetes mellitus (%)	132 (25)
Left ventricular ejection fraction in % (± SD)	55.5 (±13.8%)
Poor LV-EF in % (35% or below)	12%
Emergency (%)	132 (25)
Urgent (%)	142 (27)

Elective (%)	252 (48)
Non-ST-elevation acute coronary syndrome (%)	105 (20)
Recent STEMI (%)	105 (20)
Unstable angina (%)	137 (26)
Stable angina (%)	179 (34)
Previous PTCA/Stent (%)	236 (45)

Cardiopulmonary bypass and clamp times were 203.96 ± 58.51 min 88.70 ± 39.97 min and 49.95 ± 22.63 min, respectively. ICU stay and overall hospital stay were 2.23 ± 3.54 days and 8.64 ± 4.57 days respectively (See Table 2). In-hospital and 30 day mortality was 0.9% (n = 1).

Table 2: Operative data

Operation time min (± SD)	203.96 (±58.51)
Cardiopulmonary bypass times min (± SD)	88.71 (±39.97)
Clamp times min (± SD)	45.95 (±22.63)
Venous bypass grafts (exclusivly)	63 (12)
Total arterial revascularization	274 (52)
Arterial and venous revascularization	179 (34)
Number of performed bypass grafts n (± SD)	2.87 (±0.92)

The left internal thoracic artery (LITA) was used in 463 cases (88%) and anastomosed to the LAD. The radial artery (RA) as a T-graft was used in 51 cases and as a free graft in two cases. In total, the RA was used in 53 cases (10%).

In case of a total arterial revascularisation, combined venous and arterial revascularisation and venous revascularisation only, 2.6 (±0.89), 3.19 (±0.93) and 2.75 (±1.39) bypass grafts were anastomosed, respectively.

We performed venous bypass grafts in 12% (n = 63), total arterial revascularisation (using mainly the left internal thoracic artery with the radial artery as T-graft) in 52% (n = 274) of all cases and combined venous and arterial revascularization in 34% (n = 179).

Total arterial revascularisation was performed in 68% of elective cases. Urgent cases received total arterial revascularisation in 57% of cases. However, the emergent cases were suitable for total arterial revascularisation in 17% of cases. Accordingly, combined venous and arterial revascularisations in elective, urgent and emergency operations were 26%, 37% and 50%, respectively.

Postoperative course included one patient with a peri-operative stroke.42 patients needed prolonged ventilatory support (>48 h) and 26 patients developed a transient kidney insufficiency postoperatively. 10 patients needed a revision of their bypass grafts after suffering from postoperative myocardial infarction, and 11 patients needed revision due to symptomatic bleeding with either a haematothorax (n = 6) or pericardial tamponade (n = 5) see Table 4.

Table 4: Postoperative course

Re-Thoracotomy (%)	26 (5)
Bleeding (%)	11 (2)
Respiratory insufficiency (%)	42 (8)
Postoperative renal insufficiency (%)	26 (5)
Stroke (%)	5 (1)
In hospital death (%)	5 (1)
Revision of bypass grafts (%)	10 (2)

DISCUSSION

Despite all advances in prevention and diagnostics, as well as general awareness for cardiovascular disease in the elderly, our patient collective with young patients below 50 years of age often present in urgent or emergency settings. We have to assume that especially in these young patients with multiple risk factors; diagnosis of a coronary artery disease is delayed because of inadequate awareness. Clinical presentation of our patients collective was rather heterogeonus which makes a direct, propensity matched comparison very difficult. Especially the high frequency of extra hospital reanimated patients and patients with iatrogenic complications during PCI, makes a comparison to previous published studies for CABG difficult.

Although the recent long-term results from the SYNTAX [1], ASCERT [9], and FREEDOM [10] trials showed significantly better survival rates after CABG

than after PCI, CABG rates are declining over the past years, while PCI rates increase accordingly [11]. Nonetheless, CABG remains the Gold Standard for patients with coronary artery disease including those with diabetes and/or complex left main or three-vessel disease [1, 9].

The technique of CABG has not changed significantly over the past years. However, the use of bypass material remains under intense discussion. The use of one internal thoracic artery as graft, most often the LITA anastomosed to the LAD combined with venous conduits represents the standard therapy for patients undergoing CABG [12].

Failure rates of up to 12% of saphenous vein grafts within the first week after operation have been described. Therefore alternative grafts such as bilateral internal thoracic artery or radial artery grafts are more frequently used.

The long-term results from recent trials suggest favorable radial artery graft patency rates over saphenous vein grafts [13, 14]. Accordingly, several large observational studies have confirmed excellent graft patency and have reported superior long-term survival rates [15], also after applying propensity matching [4, 16] for patients receiving the radial artery as bypass grafts. However, concerns regarding vessel spasm, graft atherosclerosis, and unfavorable results from a number of studies exist. We do however; believe in the use of the radial artery as our standard graft in patients with no contraindications against this approach.

While these young patients would benefit most from a total arterial revascularization given its superior long term patency rates [4, 13-16], this approach is frequently not possible. In our series, 57% of urgent and 17% of emergency cases received a TAR in the subgroup analysis.

In our case series, 12% of patients present with a left ventricular ejection fraction of 35% or lower. This underlines the fact that especially this patient collective is administered to the hospital in a later stage of their disease.

However, the possible long-term advantage of a TAR is diminished by the fact that the life expectancy of these ill patients is severely diminished. Although, the options for a patient requiring CABG are small (TAR, venous and arterial revascularization, venous revascularization only) the decision making process is rather complex. In general we agree that absolute contraindications for a TAR are: cardiogenic shock, expected high doses of postoperative catecholamines and a life expectancy of less then 10 years.

In general our low postoperative mortality rate is similar to that reported by Khawaja *et al.*, [17]. Available data about the postoperative morbidity of young CABG patients report 94% of patients aged <50 years undergoing CABG recovering without any major events and 96% of patients being discharged to home [8].

CONCLUSIONS

Findings prove that surgical revascularization for coronary artery disease can be performed with very low mortality in young patients. However, presentation of patients with high rates of emergency and urgent cases often hinder the favourable approach of total arterial revascularization.

LIMITATIONS

A limitation of this study is the lack of data on long-term outcome. Comparative studies evaluating the immediate and late outcome studies are needed to further refine the strategy of revascularization in young patients receiving CABG.

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