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IMPACT OF DIABETES ON THE PATIENTS UNDERGOING CORONARY ARTERY BYPASS GRAFTING

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Abstract: This study was designed to evaluate the impact of diabetes on functional capacity, level of physical activity, quality of life, dependency level and mortality risk in patients undergoing primary coronary artery bypass grafting. A total of 30 patients undergoing CABG procedure were assessed pre and postoperatively for their functional capacity by New York Heart Association classification and six-minute walk test, physical activity by Duke activity status index, dependency level by functional independency measurement, mortality risk by Society of thoracic surgeons, EuroSCORE II and CASUS and, quality of life preoperatively by Nottingham Health Profile questionnaire. Patients with a history of ≥10 years of diabetes were compared to the non-diabetics group. On analysis it was observed, that the diabetic group are older (68.67±7.52 years), hypertensive (87%), less obese, and have lesser ejection fraction than the non-diabetics. There was no significant difference between the group's functional capacity, quality of life and mortality risk, but the diabetic group showed a significantly higher postoperative risk to stroke (p=0.042) and longer hospital stay (p=0.006). Dependency level, functional capacity and total ICU stay was reported to be more affected in the diabetics. Both the groups showed an improved dyspnea and angina after the surgery. The dependency level in diabetics (p=0.00) and non-diabetics (p=0.003) was also observed to decrease significantly with the surgery. The study concluded that diabetes has an impact on the functional capacity, physical activity, angina, dependency level, and total hospital stay in the individuals following bypass surgery.

Keywords: Diabetes, Coronary artery bypass grafting, Functional capacity, Quality of life, Dependency level, Mortality risk

Introduction

Cardiovascular diseases (CVDs) are a leading cause of mortality internationally and the leading cause of both mortality and morbidity in India, with a prevalence rate of 11% (Namara et al., 2019; Chauhan et al., 2013).[1,2] Diabetes is an emerging worldwide epidemic and has been reported to have a positive significance on cardiovascular risk.[3] Studies have reported that the adults with diabetes have a higher prevalence rate of CVD than the adults without the diabetes (Einarson et al, 2018).[4] Since, cardiovascular diseases are the major cause of death and disability in diabetics, the adults with diabetes are expected to be at a greater health risk (Einarson et al, 2018; Santos et al, 2016).[4,5]

With the increasing incidence of cardiovascular diseases and its complications, the need for coronary artery bypass grafting (CABG) has also increased, making it as the most common cardiac surgery been performed worldwide (Santos et al, 2016; Melly et al, 2018).[5,6] Also, considered as the preferable revascularization treatment in the diabetes patients (Santos et al, 2016).[5] Previous studies have shown that the individuals undergoing CABG procedure tend to have a decrease functional capacity, poor quality of life and often present a state of anxiety and depression (Peric et al, 2008; Con, 1997).[7,8] As this procedure has seen to reduce the severity of angina and increase the survival chances, it is now been highly accepted by the cardiovascular disease patients. Thus, a comprehensive assessment of the risk factors associated with the CABG surgery is now been considered important (Diodato, 2014).[9]

The purpose of this study was to evaluate the impact of diabetes on the functional capacity, quality of life, physical activity, level of dependency and mortality risk in the patients undergoing coronary artery bypass grafting, in comparison to the non-diabetics. The study intends to evaluate the adverse effects of diabetes on various aspects of the individual's life, who are undergoing coronary artery bypass surgery.

Materials and Methods

The study is a cross-sectional study in which a total of 30 patients undergoing coronary artery bypass grafting were taken from the National Heart Institute Hospital, New Delhi. The study was executed only after the ethical approval received from the Jamia Hamdard Institutional Ethics Committee (JHIEC). Patients were made to sign the informed consent form, after which they were evaluated for the inclusion criteria such that their age was between 30-80 years and were admitted in the hospital for the elective coronary artery bypass grafting.[10] Patients were grouped under the diabetic group as "Group A" if they had a history of more than ten years of diabetes,[11] and under non-diabetic group as "Group B" if they reported no history of diabetes.

A preoperative evaluation was executed on the patients at the day of their admission, which included their demographic details, body mass index, medical and personal history of other comorbidities (Hypertension, COPD, thyroid, etc), Canadian Cardiovascular Society (CCS) classification of angina, functional class of dyspnoea according to New York Heart Association classification (NYHA), and ejection fraction (EF%) by

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echocardiography.[7,10,13] Left ventricular function was echocardiographically graded as normal if the ejection fraction was (EF %) ≥60%, mild dysfunction (EF 40%-59%), moderate dysfunction (EF 25%-39%) and severe (EF ≤25%).[13]

The Nottingham Health Profile (NHP) questionnaire was used to determine the quality of life in the patients, before their CABG procedure.[7] The NHP questionnaire is a generic scale that contains 38 subjective statements divided into six sections: physical mobility, social isolation, emotional reaction, energy, pain, and sleep. The scores of each section ranged from zero to 100, by adding the item weight, determined by the Thurstone method of paired compares to every positive answer.[7] A higher score indicated a higher level of dysfunction and worse quality of life.

The level of physical activity was estimated using the Duke Activity Status Index (DASI), which is a self-administered questionnaire consisting of 12 questions related to daily living activities. Each question is related to different aspect of patient's life, which if hampered can be easily evaluated. It has been validated as the "gold standard" of functional capacity measurement. [12,14] Each question has a scoring in "MET units", which determines the metabolic cost of the activity. The total METS level of each patient was objectively calculated preoperatively by this method.

The dependency level in the patients was calculated twice, pre and post CABG surgery, by Functional Independency Measurement (FIM) scale. It aims to assess the quantity of care that an individual requires to perform a series of motor tasks, and also includes the cognitive activities of daily living.[15] The cardiac mortality risk was assessed preoperatively using Society of Thoracic Surgeons (STS) risk score and EuroSCORE II (European System for Cardiac Operative Risk Evaluation), and postoperatively by Cardiac surgery score (CASUS). The STS risk was used to evaluate the operative mortality risks and long-term survival among patients who underwent isolated CABG.[16] EuroSCORE II was used for investigating the extent of risk factors which included peripheral vascular disease, carotid disease, neurological and cerebral dysfunction, COPD, pulmonary hypertension, recent myocardial infarction, stroke, and unstable angina.[11,12] The CASUS was used to estimate the mortality risk after surgery, as it considers the postoperative values and complications.[17]

After the surgery the patients were evaluated for their postoperative complications, symptoms via NYHA and CCS, and dependency level via FIM. The functional capacity of the patients was assessed prior to their discharge by the six-minute walk test, in which they were instructed to walk straight along a 15 m straight path, at the hospital corridor for six minutes.[18] The test was symptom limited, so the patients who complained of angina, severe dyspnoea, dizziness, or musculoskeletal pain were made to rest or stop as per their comfort. The heart rate, blood pressure and oxygen saturation were monitored both before and after the test. Both the groups were followed up for their total stay in ICU and in hospital, till their day of discharge.

The data was analysed using the SPSS 2.0 version. Descriptive statistics was used to find out the mean and standard deviation of the group's age, body mass index (BMI), hypertension (HTN) and left ventricular ejection fraction (LVEF%). The statistical analysis was then done between the groups by the independent sample t-test method and within the groups by the paired t-test. The confidence interval at 95% level was calculated to find the significance differences between and within the diabetics and non-diabetics patients on their functional capacity, physical activity, level of dependency, quality of life, cardiac mortality risk and days spent in ICU and hospital.

Results

The diabetic group undergoing coronary artery bypass grafting were observed to be older (68.67±7.52 years), more hypertensive (86.7%) and had lesser left ventricular ejection fraction (LVEF% 47.4±10%) than the non-diabetic group. Both the groups were observed to be obese and were mostly male.

Table I: Comparison between the groups on basis of their personal details

	Group A (mean±SD) or (n=15)	**Group B (mean±SD) or (n=15)**
Age (years)	68.67±7.52	56.87±5.23
BMI (kg/m^2)	25.46±3.74	26.79±3.74
Hypertension	86.7% (13)	60% (9)
LVEF (%)	47.4±10%	51.2±8%

Basal metabolic index (BMI), Left ventricular ejection fraction (LVEF)

The level of dyspnea measured by New York Heart Association (NYHA) classification and level of angina via Canadian Cardiovascular Society (CCS) scale showed no significant differences between the diabetic group and non-diabetic groups. Though the level of dyspnea was observed to be significantly improved with the surgery within the non-diabetic group (p=0.007), a significant improvement in angina grade within both the groups was also observed.

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Table II: The NYHA and CCS comparison between groups with the CABG surgery

	Group A (mean±SD)	Group B (mean±SD)	t value	p value
NYHA preoperatively	2.6±0.74	2.60±0.51	-0.232	0.818
NYHA post CABG	1.93±0.73	2.00±0.65	0.035	0.973
CCS preoperatively	2.29±0.69	2.31±0.87	0.342	0.735
CCS post CABG	1.59±0.51	1.56±0.51	0.331	0.743

New York Heart Association (NYHA), Coronary artery bypass grafting (CABG), Canadian Cardiovascular Society scale (CCS)

Table III: The NYHA and CCS comparison within the groups to the CABG surgery

	Pre-operative Mean±SD	Post-operative Mean±SD	t value	p value
NYHA Group A	2.6±0.74	1.93±0.73	1.989	0.068
NYHA Group B	2.60±0.51	2.00±0.65	3.093	0.007*
CCS Group A	2.29±0.69	1.59±0.51	4.243	0.001*
CCS Group B	2.31±0.87	1.56±0.51	3.503	0.003*

New York Heart Association (NYHA), Coronary artery bypass grafting (CABG), Canadian Cardiovascular Society scale (CCS)

*Significance in NYHA and CCS within the groups, with the surgery ($p<0.05$)

On measuring the quality of life by Nottingham Health Profile (NHP) questionnaire no significant difference was observed between the group's energy, pain, emotional reaction, sleep, social isolation and physical activity.

Table IV: Comparison of various aspects in quality of life between the groups#

	Group A (Mean±SD)	Group B (Mean±SD)	t value	p value
Energy (%)	45.65±45.01	41.6±42.52	0.119	0.906
Pain (%)	25.11±30.27	22.00±28.26	0.134	0.894
Emotional Reaction (%)	29.42±29.57	26.89±30.39	0.071	0.944
Sleep (%)	22.57±29.98	23.83±29.57	-0.15	0.882
Social Isolation (%)	25.62±33.82	13.56±23.23	1.14	0.264
Physical Activity (%)	34.37±32.55	24.03±30.77	0.786	0.439

#Quality of life showed no significant difference between the groups as $p>0.05$

The level of functional dependency assessed by Functional Independence Measurement scale (FIM) of the diabetics was reported to be significantly more affected with surgery than the non-diabetics ($p=0.037$). Both the groups showed a significant decrease in their dependency level with the surgery.

Table V: Comparison in dependency level between the groups, undergoing CABG surgery

	Group A (Mean±SD)	Group B (Mean±SD)	t value	p value
FIM preop	130.47±3.76	132.60±0.83	-1.564	0.129
FIM postop	113.07±31.77	126.80±6.93	-2.192	0.037*

Coronary artery bypass grafting (CABG), Functional independency measurement (FIM), Preoperatively (preop), Postoperatively (postop)

*Postoperative dependency level was observed to be significant between the groups ($p<0.05$)

Table VI: Comparison of FIM within each group, with the CABG surgery

	Preoperative	Postoperatively	t value	p value
FIM Group A	130.47±3.76	113.07±31.77	8.103	0*
FIM Group B	132.60±0.83	126.80±6.93	3.586	0.003*

Functional independency measurement (FIM), Coronary artery bypass grafting (CABG)

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*Functional dependency was observed to have significance with the CABG procedure, within both the groups ($p < 0.05$)

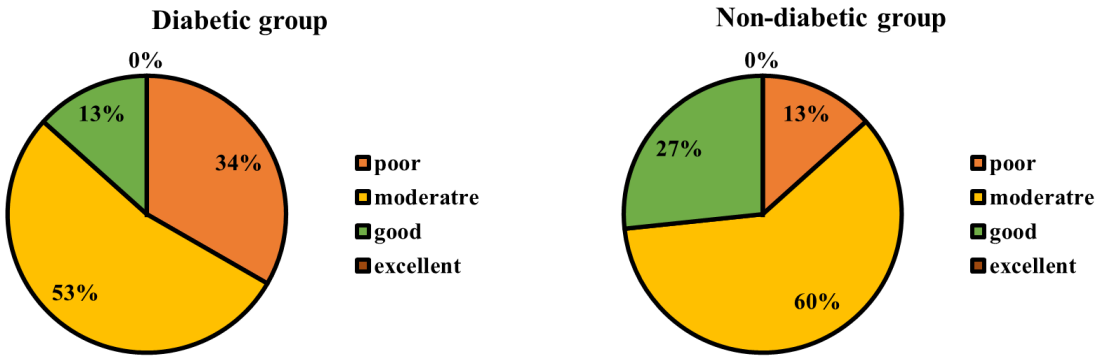
About 34% of diabetic patients reported a poorer physical activity than the non-diabetics (13%), when assessed by Duke Activity Scale Index (DASI), as shown below in the Figure 1. There was no statistical difference observed between the groups in their DASI scores and six-minute walk test.

Table VII: Comparison of functional capacity between the groups to the surgery

	Group A (Mean±SD)	Group B (Mean±SD)	t value	p value
6MWT (m)	110.56±48.89	163.05±53.76	-1.735	0.094
DASI	3.2±0.68	2.87±0.64	0.835	0.411

Six-minute walk test (6MWT), Duke activity status index (DASI)

*No significant difference between the groups as $p > 0.05$



a) b)

Figure 1: Grading of level of physical activity in both the groups, when assessed by Duke activity status index

The cardiac mortality risk pre and postoperatively, evaluated by Society of Thoracic Surgeons (STS), EuroSCORE II and CASUS showed no significant difference between the groups. Both the groups were observed to have no significance in their mortality risks, as presented in table VIII. On evaluating the postoperative complications, the diabetic group reported a greater significance for stroke postoperatively, than the non-diabetics (p=0.042) on the STS scoring as shown in table IX.

Table VIII: Comparison of mortality risks between the groups, undergoing CABG procedure

	Group A (Mean±SD)	Group B (Mean±SD)	t value	p value
EuroSCORE II (%)	1.11±1.29	1.04±1.26	0.45	0.656
CASUS	2.33±6.64	0.40±0.63	0.617	0.542

Coronary artery bypass grafting (CABG), European System for Cardiac Operative Risk Evaluation II (EuroSCORE II), Cardiac surgery score (CASUS)

Table IX: Comparison of risks to postoperative complications between the groups, undergoing CABG procedure

STS Scoring	Group A (Mean±SD)	Group B (Mean±SD)	t value	p value
Mortality	1.89±1.63	0.96±0.75	1.744	0.092
Renal failure	2.18±2.47	0.93±0.79	1.816	0.08
Stroke	1.91±0.82	1.28±0.72	2.135	0.042*
Prolonged ventilation	8.27±5.03	4.93±3.08	1.8	0.083
Deep sternal wound infection	0.16±0.07	0.12±0.04	1.93	0.064
Reoperation	2.78±0.86	2.13±0.95	0.207	0.837
Morbidity	12.41±7.33	8.02±4.25	1.586	0.124

Coronary artery bypass grafting (CABG), Society of Thoracic Surgeons (STS)

*Stroke was statistically significant between the groups ($p < 0.05$)

Both the groups were followed up for their total days spent in ICU and in hospital. The diabetic group showed a significantly longer stay at ICU and hospital, than their non-diabetic group (p=0.039 and p=0.006, respectively), as seen in table X.

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Table X: Comparison of days spent in ICU and hospital by the groups undergoing CABG procedure

	Group A (Mean±SD)	Group B (Mean±SD)	t value	p value
Number of days in ICU (days)	3.47±1.13	2.73±0.46	2.171	0.039*
Total days of hospitalization (days)	4.67±1.41	3.87±0.52	2.982	0.006*

*Total days spent in ICU and hospital was observed to have significant difference between the groups ($p<0.05$)

Discussion

In this study we evaluated that the patients undergoing coronary artery bypass surgery are old and are mostly male. On evaluating the groups, it was found that the diabetic group is older, has lesser ejection fraction and is mostly hypertensive than the non-diabetic group, with no significant difference in their BMI, as seen above in the table I. There were similar findings in the previous studies, [10, 19] stating that the diabetic patients undergoing CABG procedure are prevalent to be older, obese and have significantly lower left ventricular ejection fraction than the compared non-diabetic group, and have a greater percentage of history of hypertension. Studies have reported that the presence of diabetes and hypertension together accelerates the development of atherosclerosis which is higher than any other comorbid factor.

The level of dyspnea and angina was evaluated by NHYA and CCS, respectively. Functional capacity was assessed at baseline by six-minute walk test. The NYHA classification evaluated preoperatively and postoperatively on the CABG patients was found to have no significant difference between the groups. On evaluating within the groups, we observed that the severity of symptoms of patients in each group decreases after the cardiac surgery when compared to their preoperative values, with a significance difference observed in the non-diabetic group ($p=0.007$) as shown above in the table III. The result of our study is supported by the previous finding that after CABG, the presence of dyspnea is lesser during exhaustion, physical effort or any everyday activities.[7] Studies have also reported an improved NYHA classification after six months of CABG surgery, which was not conducted in our research. Though our study showed no difference in NYHA classification between the groups, evidences suggest that the impaired functional capacity and class III-IV angina is more in diabetes patient than the non-diabetics. [10,11]

In our study we observed that there is no significant difference between the diabetic and non-diabetic groups based on their functional capacity measured by 6MWT. The distance walked by both the groups were observed to be less than their predicted values, with the diabetes patients (110.56±48.89 m) having shorter six-minute walked distance than the non-diabetes group (163.05±53.76 m) with a mean difference of 52.49 meters, as shown above in the Table VII. The results were in line with the previous studies, conducted on patients with cardiac surgery, reporting that the absolute six minutes distance walked is shorter in diabetics than the non-diabetics and are lesser in women than men. [18,20] Coronary artery bypass grafting has been seen earlier to reduce the exercise capacity in the patients in their early postoperative course, which suggested the feasibility of six-minute walk test. [21] By providing reference values for their rehabilitation program, after the cardiac surgery.

The level of activity (the MET level), was evaluated by Duke Activity Scale index (DASI) among the patients undergoing CABG. When assessed on our patients, there was no significant relationship observed in the MET levels between the groups, but the diabetic group of our study were seen to be more involved with poorer physical activity than their non-diabetic group, as shown above in the Figure1. In a study conducted by Simpson et al, [22] it was reported that there is no statistical difference between the DASI score of diabetic and the non-diabetic patients when assessed after acute myocardial infarction. These similar findings suggest that a diagnosis of diabetes mellitus is not an independent determinant in functional activity level, after a cardiac event.

The level of dependency for the daily living activities in the patients was assessed by functional independency measurement (FIM) scale. On observation, it was evaluated that the postoperative FIM scores show significant difference between the diabetic and the non-diabetic groups (p value <0.05), as mentioned in the above table V. In our study, the FIM scores within the group was observed to decrease significantly after the CABG surgery, in both the diabetic and the non-diabetic group with the p value 0.000 and 0.003 respectively, as shown in the table VI. The results observed were similar to the previous study by Guimaraes M. et al, [23] indicating significant functional loss in the elderly patients undergoing coronary artery bypass surgery. Their study also evaluated that all the elderly patients undergoing CABG have reduced functional status significantly up to 6-months post-surgery, suggesting the use of FIM scale for the assessment of functional recovery over time after the cardiac surgery, which was limited in our study. [23]

In our study on evaluating the quality of life by NHP questionnaire in patients undergoing CABG surgery, the diabetic group was seen to have a greater range of pain, emotional reaction, social isolation, lack of energy level and decrease physical activity than their compared non-diabetic group. There was no significant difference observed in quality of life (QoL) between the groups preoperatively, as shown in the table IV. Previous studies have reported that QoL in diabetes patients worsens after CABG and that diabetes mellitus acts as an independent predictor of worsened quality of life in the physical mobility section. [7,24] Our study aimed to

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evaluate the difference in quality of life between the groups preoperatively and did not support within the group's QoL comparison, occurring with the cardiac surgery.

The mortality risk in patients undergoing CABG was assessed preoperatively by EuroScore II and postoperatively by CASUS. The STS scoring was used to assess the risks of postoperative complications in patients undergoing CABG surgery. In our patients, the mortality risk was seen to be higher in the diabetes patients, but no significant difference was found between the groups, as per the table VIII. The cardiac mortality risk determined preoperatively by EuroScore II and STS, in the study by Borde et al, [25] has satisfactory calibration power for the Indian patients, but have poor discriminatory power. The expected mortality rate and increase in postoperative morbidity in diabetic patients after CABG are more than the non-diabetic patients, as reported in previous researches. [5,26] In our STS scoring, the risks of postoperative complications were more likely to occur in diabetic group than their non-diabetics, with a statistical difference observed in stroke (p=0.042), as shown in table IX. Studies say that overall postoperative prevalence of stroke, in hospital deaths and occurrence of deep sternal wound infection is higher in diabetics. [5,11,13]

When the patients of our study were evaluated for their total number of ICU days and hospital days, it was observed that the diabetic group has more hospital days than the non-diabetic group. On evaluation, a positive significant difference was seen between the groups, in their number of ICU days (p=0.039) and the total hospital days (p=0.006) as tabulated above in table X. The results were similar to the findings reported in a previous study, in which the hours spent in the intensive care unit, length of hospital stay and total cost of CABG were all documented to be greater in diabetic patients than the non-diabetic patients.[5,13] Most of this difference observed in previous research was considered due to higher costs of clinical and laboratory testing, diagnostic imaging, pharmacy services, and nursing care.

In conclusion, diabetes mellitus can be considered as an independent risk factor for the impaired functional capacity, increased level of dependency and higher mortality risk in the individuals undergoing coronary artery bypass grafting. In present era of limited healthcare resources and increasing importance of economic aspects, patients with diabetes undergoing cardiac surgery interventions should receive special attention in their pre- as well as in the perioperative time. This may improve their perioperative outcomes and further reduce postoperative intensive care treatment time and cost. Diabetes should be brought into clinical use, early enough such as to detect and prevent its resulting adverse outcomes. Research and policies focusing on reducing diabetes and raising awareness about its preventive strategies, should be developed and implemented to check rising health care costs.

Limitations of the study

Our study is an observational study, conducted in one specific hospital by one surgical team, which reduces the variability of the test performance as observed in multimember studies. [5] All the patients of our study underwent the 6MWT only once after their cardiac surgery. According to Wu et al, [27] the effect of familiarization with this test is well known over first three sessions of the test, to establish a baseline. Due to time and staff limitations experienced in the present study, the patients were evaluated for the 6MWT only once, which might have depended their learning effect. This study involves only those patients who appeared the hospital for elective cardiac surgery, ignoring the urgent or emergent CABG procedures. The follow up from the patients was not taken in this study, which kept the postoperative adverse outcomes and the re-hospitalization cases unnoticed. A prospective study with a larger sample size and at multiple hospitals is advised to commence.

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References

1. Namara K., Alzubaidi H., Jackson J. Cardiovascular disease as a leading cause of death: how are pharmacists getting involved? Integr Pharm Res Pract. 2019; 8: 1–11.
2. Chauhan S., Aeri B. Prevalence of cardiovascular disease in India and its economic impact- A review. International Journal of Scientific and Research Publications, 2013; 3(10).
3. International Diabetes Federation. Diabetes and cardiovascular disease. Brussels: International Diabetes Federation 2016; 1–144.

ISSN: 0975-3583, 0976-2833 VOL 12, ISSUE 03, 2021

4. Einarson T.R., Acs A., Ludwig C., Panton U. Prevalence of cardiovascular disease in type 2 diabetes: a systematic literature review of scientific evidence from across the world in 2007–2017. Cardiovasc Diabetol 2018; 17:83.
5. Santos KA., Berto B., Sousa AG., Costa FA. Prognosis and complications of diabetic patients undergoing isolated coronary artery bypass surgery. Braz. J. Cardiovasc. Surg. 2016, 31(1).
6. Melly L., Torregrossa G., Lee T., Jansens JL., Puskas JD. Fifty years of coronary artery bypass grafting. J Thorac Dis. 2018; 10(3): 1960–1967.
7. Peric V, Borzanovic M, Stolic R, Jovanovic A, Sovtic S, Dimkovic S, et al. Predictors of worsening of patients' quality of life six months after coronary artery bypass surgery. J Card Surg 2008; 23:648-654.
8. AH. Con. Depression and social support as predictors of functional impairment and pain in men and women recovering from coronary artery bypass graft surgery (CABG). Thesis, Faculty of Education, Simon Fraser University, British Columbia, Canada, 1997.
9. Diodato M., Chedrawy EG. Coronary artery bypass graft surgery: the past, present, and future of myocardial revascularisation. Surgery Research and Practice 2014.
10. Thourani VH, Weintraub WS, Stein B, Gebhart SSP, Craver JM, Jones EL, et al. Influence of diabetes mellitus on early and late outcome after coronary artery bypass grafting. Ann Thorac Surg 1999; 67:1045–52
11. Lauruschkat AH, Arnrich B, Albert AA, Walter JA, Amann B, Rosendahl UP, et al. Prevalence and risks of undiagnosed diabetes mellitus in patients undergoing coronary artery bypass grafting. Circulation 2005; 112:2397-2402.
12. Cornelissen H., Arrowsmith JE. Preoperative assessment for cardiac surgery. Continuing Education in Anaesthesia, Critical Care & Pain 2006; 6(3).
13. Raza S, Sabik III JF, Ainkaran P, Blackstone EH. Coronary artery bypass grafting in diabetics: a growing healthcare cost crisis. The Journal of Thoracic and Cardiovascular Surgery 2015.
14. Khan S, Nagarwala R, Shyam A, Sancheti P. Validation of Duke Activity Status Index questionnaire to determine functional capacity in young healthy non exercising individuals. Physiother - J Indian Assoc Physiother 2019; 13:14-7.
15. Guimaraes MN, FilhoI CM. Functional status change in older adults undergoing coronary artery bypass surgery. Sao Paulo Med. J. 2011; 129 (2).
16. D'Agostino RS, MD, Jacobs JP, Badhwar V, Fernandez FG, Paone G, Wormuth DW. The society of thoracic surgeons' adult cardiac surgery database: 2018 update on outcomes and quality. Ann Thorac Surg 2018; 105:15–23.
17. Exarchopoulos T, Charitidou E, Dedeilias P, Charitos C, Routsi C. Scoring systems for outcome prediction in a cardiac surgical intensive care unit: a comparative study. Am J Crit Care 2015; 24:327-33.
18. Ingle L, Reddy P, Clark AL, Cleland JG. Diabetes lowers six-minute walk test performance in heart failure. JACC 2006; 47: 1904-17.
19. Li Z, Amsterdam EA, Young JN, Hoegh H, Armstrong EJ. Contemporary outcomes of coronary artery bypass grafting among patients with insulin-treated and non–insulin-treated diabetes. Ann Thorac Surg 2015.
20. Fiorina C., Vizzardi E., Lorusso R., Maggio M., Cicco GD, Nodari S, et al. The 6-min walking test early after cardiac surgery: reference values and the effects of rehabilitation programme. European Journal of Cardio-thoracic Surgery 2007; 32:724—729.
21. Demir R, Hatemi AC, Kucukoglu S., Yigit Z, Gurses HN. Evaluation of preoperative and postoperative exercise capacity by using six-minute walk test. European Respiratory Society Annual Congress 2012.
22. Simpson E., Pilote L. Quality of life after acute myocardial infarction: A comparison of diabetic versus non-diabetic acute myocardial infarction patients in Quebec acute care hospitals. Health and Quality of Life Outcomes 2005, 3:80.
23. Guimaraes NM, Cendoroglo MS, Almada-Filho CM. Course of functional status in elderly patients after coronary artery bypass surgery: 6-month follow up. Geriatr Gerontol Int 2016; 16: 737–746.
24. Rahimi A, Taghipour HR, Ebadi A, Pourebrahimi M. Comparing patients' quality of life before and after Coronary Artery Bypass Graft surgery (CABG). Iran J Crit Care Nurs. 2014;7(3):194-199.
25. Borde D, Gandhe U, Hargave N, Pandey K, Khullar V. The application of European system for cardiac operative risk evaluation II (EuroSCORE II) and Society of Thoracic Surgeons (STS) risk-score for risk stratification in Indian patients undergoing cardiac surgery. Ann Card Anaesth 2013; 16:163-6.
26. Szabo Z., Hakanson E., Svedjeholm R. Early postoperative outcome and medium-term survival in 540 diabetic and 2239 nondiabetic patients undergoing coronary artery bypass grafting. Ann Thorac Surg 2002; 74:712–9.
27. Wu G., Sanderson B., Bittner V. The 6-minute walking test: how important is the learning effect? Am Heart J. 2003; 146:129-133.