Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v2023i1.429
*Biol. Clin. Sci. Res. J., Volume, **2023**: 429*
Original Research Article

POSTOPERATIVE COMPLICATIONS IN DIABETIC INDIVIDUALS HAVING ORTHOPEDIC AND GENERAL SURGERY

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(Received, 25th February 2023, Revised 14th June 2023, Published 30th September 2023)

Abstract: *It is not fully understood why diabetic patients tend to have worse clinical outcomes following surgery. A recent study aimed to identify the variables that contribute to negative outcomes in diabetic patients who undergo planned orthopedic or general surgery. The study analyzed data from the Al Nafees Medical College and Hospital Islamabad and included 500 patients with diabetes who underwent surgery between February 2022 to August 2022. Of these patients, 48 percent had orthopedic surgery, while 52 percent had general surgery. The average age of the patients was 64.6 ±11.82, and the average length of diabetes diagnosis was 8.91±7.64. After the surgery, 40 patients (8%) experienced negative outcomes, including delayed extubation in 17 patients (42.5%), circulatory disorder in 4 patients (10.0%), respiratory abnormalities in 6 patients (15.0%), non-healing of the incision in 5 patients (12.5%), infections at other sites in 4 patients (10.0%), other complications in 3 patients (7.5%), and death in 1 patient (2.5%). The study used multivariable logistic regression to identify the factors associated with postoperative negative outcomes. The results revealed that patients who were over 65 years old had a higher chance of negative outcomes [odds ratio (OR)=2.33, 95% confidence interval (CI): (1.26,3.88)]. Other factors that contributed to negative outcomes were impaired kidney function (OR=2.53, 95% CI: 1.33-6.58), diabetes complications (OR=2.63, 95% CI: (1.56, 4.68), male sex (OR=2.24; 95% CI: (1.34, 3.48), and general surgery (OR=1.68; 1.61, 5.46; 95% CI: (1.61, 5.46). In conclusion, higher age, male sex, high postoperative blood glucose levels, diabetic-related complications, impaired kidney function, and the type of surgical procedure contributed to postoperative negative outcomes in diabetic patients who undergo planned surgery.*

Keywords: Postoperative Complications, Diabetes Mellitus, Orthopedic Surgery, General Surgery, Surgical Wound Infection, Inflammation.

Introduction

Over the last three decades, the number of people worldwide suffering from diabetes has risen significantly, with 70% of those affected residing in developing nation (Atlas, 2015). Among these nations, Pakistan has seen the greatest increase in diabetic patients. By 2030, it is estimated that developing countries will have 69% more adults with diabetes than developed nations (20%) (Wild et al., 2004). Due to high levels of blood glucose, abnormal metabolism, and other factors, diabetic individuals are more prone to developing coronary artery disease, cerebrovascular disease, and cancers, among other ailments. Additionally, their life expectancy is nine years shorter than that of people without diabetes (Bragg et al., 2017) . Moreover, diabetic patients are more likely to experience complications after surgery, which is concerning as more than half of them are expected to undergo surgery in their lifetime (Sudhakaran and Surani). Postoperative complications lead to longer hospital stays, increased financial burden, and higher rates of mortality (Frisch et al., 2010; Kotagal et al., 2015; Sebranek et al., 2013). High glycemic fluctuation and low blood sugar and hyperglycemia can worsen their condition and increase the risk of complications following surgery (Kotagal et al., 2015). High initial glucose levels are also associated with a significantly lower overall probability of survival in post-operative patients (Wang et al., 2019). Furthermore, hyperglycemia can lead to surgical infections (Clarke, 1970), endothelial cell dysfunction (Maruyama and Sato, 2017), brain ischemia (Donatelli et al., 2007), and inadequate wound healing (Hommel et al., 2017). Patients with diabetes are more likely to have high blood glucose levels due to the stress of trauma, surgical blood loss, and anesthesia (Kotagal et al., 2015)5. The release of chemicals such as steroids can exacerbate insulin resistance, worsen glucose metabolism abnormalities, and cause acid-base and water-electrolyte imbalances (Palermo et al., 2016). Research suggests that controlling blood glucose levels and choosing a better treatment plan before major cardiovascular (Lee et al., 2014) and orthopedic procedures (Wukich, 2015) can significantly reduce the risk of glucose metabolism problems and complications following surgery, leading to better surgical outcomes. It is unclear which medical conditions in diabetic patients may lead to adverse events and how they affect surgical outcomes. However, high blood pressure (M Dodson et al., 2014), liver disorders, (Wang et al., 2019) low hemoglobin levels (Scrascia et al., 2014), and poor nutrition (Wang et al., 2019) are known risk factors for negative outcomes in surgical patients with diabetes. Therefore, the aim of this study is to identify the risk factors for postoperative complications in individuals with diabetes following orthopedic or general surgery.

Methodology

[Citation Abbasi, S.H., Asim, A., Sarfraz, M., Bashir, M.A., Kanwal, S., Imtiaz, H. (2023). Postoperative complications in diabetic individuals having orthopedic and general surgery. *Biol. Clin. Sci. Res. J.*, **2023***: 429.* doi: https://doi.org/10.54112/bcsrj.v2023i1.429]

This retrospective study was conducted at a single center. Between February 2022 to August 2022, all patients who had diabetes (type 1 or type 2) and underwent elective orthopedic or general surgery at the Al Nafees Medical College and Hospital Islamabad. The hospital's ethics committee approved the study, and because it was retrospective, informed consent was not obtained. Patients diagnosed with diabetes according to WHO guidelines who had elective orthopedic or general surgical procedures were included in the study. Patients who underwent outpatient procedures were excluded. Diabetic patients were identified according to WHO guidelines, and hyperglycemia was defined as a fasting plasma glucose level below 6 mmol/L or random plasma glucose level below 7.8 mmol/L. Minor surgeries were procedures with low technical complexity, a straightforward approach, and minimal risk, while major surgeries were complex and high-risk procedures.

The hospital's record management system provided baseline information about the patients. The following data were collected for each participant: gender, age, body mass index (BMI), illness, and adverse effects of diabetes, diabetic comorbidities, and nutritional assistance before and after surgery, chemical markers, and venous blood sugar levels. Blood glucose data were taken from medical records, and the average of multiple measurements was used for evaluation. Preoperative fasting venous blood glucose and postoperative fasting venous blood glucose levels were compared.

Surgical negative outcomes were defined as mortality, postoperative wound infections, inflammation at other sites, admission to the intensive care unit (ICU), or other serious problems that resulted in breathing and cardiovascular abnormalities. A significant increase or decrease in blood pressure was used to characterize circulatory problems, as well as arrhythmias that required treatment with vasoactive or regulated antiarrhythmic drugs. Late extubation due to postoperative respiratory insufficiency and/or weak respiratory muscles was referred to as "respiratory irregularities."

Diabetic complications included diabetic eye disease, diabetic kidney disease, diabetic nerve damage, and diabetic foot. High blood pressure, ischemic heart disease, and vascular diseases of the brain were listed as diabetes comorbidities. Irregular kidney function was considered when the creatinine level exceeded 110 mmol/L.

Data analysis was performed using SPSS 25. Continuous variables were expressed as means ± standard deviations, and categorical indicators were expressed as frequencies (%). The Student t-test was used for normally distributed continuous variables, while the Mann-Whitney test was used for non-normally distributed continuous variables. The Chi-square test was used to assess the frequencies of categorical variables. Adjusted odds ratios (ORs) were used to analyze the effects of clinical and demographic data on the incidence rates of postoperative adverse events in diabetic patients. A significance level of $P < 0.05$ was used for statistical analysis.

Results

The following are the baseline characteristics of the general patient population, as listed in Table 1: The study included 500 diabetic individuals who underwent surgery. Out of these, 266 were male (53.2%) and 234 were female (46.8%). The average age of the participants was 64.6 ± 11.82 years, while the average time elapsed since their diabetes diagnosis was 8.91 ± 7.64 years. The average BMI was 26.80 ± 3.69 kg/m2. Among the patients, 20.4% had diabetic complications, with vascular issues being the most prevalent (98.0%), followed by diabetic nephropathy (0.7%), diabetic retinopathy (0.6%), diabetic neuropathy (0.6%), and diabetic foot (1.2%). Additionally, 48.3% of the patients had hypertension, 11.78% had coronary heart disease, and 6.7% had cerebrovascular disorders. Finally, 69.6% of the patients had diabetic comorbidities.

Table 2 displays the perioperative data. In 240 (48.0%) patients, the surgery was orthopedic; in 260 (52.0%), it was general. A mean of 13.7±11.1 days were spent in the hospital.

Postoperative complications affected 40 patients (8.0%), including 17 (42.5%) who experienced delayed extubation due to surgically induced respiratory distress and/or respiratory muscle weakness (Table 3). 4 (10.1%) individuals had circulatory issues, 6 (15.0%) had respiratory and circulatory problems, 5 (12.5%) had wounds that didn't heal, 4 (10.1%) had infections at other places, and 3 (7.5%) had further complications.

In Table 4, univariable analyses that contrast preoperative and postoperative variables between patient groups with and without post-operative adverse events are shown. Between the groups with and without postoperative adverse events, seven characteristics significantly varied: age greater than 65 years [OR=2.57, 95% CI: (1.77, 3.76), P.<.001], sex (OR=2.23, 95% CI: (1.49, 2.87), P<.001, diabetic comorbidities (OR=2.62, 95% CI: (1.64, 3.63), P<.001, diabetic complications (OR=3.75, 95% CI: (2.63, 5.71), P<.001), abnormal kidney function (OR= 2.43, 95% CI: 1.76–6.49, P=.001, general surgery (OR= 1.79, 95% CI: 1.53, 5.87, P=.063). In Table 3, multivariable analysis is displayed. Age more than 65 (OR=2.33 95% CI: (1.26,3.88), P=.0007), male sex (OR=2.24, 95% CI: (1.34, 3.48), P=.002), , diabetic complications (OR=2.63, 95% CI: (1.56, 4.68)P=.003), Diabetic comorbidities(OR=1.68, 95% CI: ((0.65, 2.70)P=.442), and general surgery (OR=1.68, 95% CI: (1.61, 5.46), P=.063) were linked to the development of postoperative adverse events.

Table 1: Patient demographic data

Variables	Overall	Adverse effect	No adverse effect	P value
No. %	500	118 (7.7%)	382(92.3)	-
Age (y, mean± SD)	64.6±11.82	68.32±11.20	62.99±10.65	<0.001
Male, n (%)	266 (53.2%)	32 (6.4%)	234(93.6)	<0.001
Weight (kg, mean± SD)	72.81±13.60	68.81±12.86	73.00±12.47	0.83
BMI (kg/m2 , mean± SD)	26.80±3.69	25.67±3.76	25.81±3.89	0.24

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Diabetes mellitus				**0.13**
Type 1, n (%)	8 (1.6%)	1 (0.2%)	7(99.8)	
Type 2, n (%)	492(98.4)	47 (9.4%)	445(90.6)	
Disease course (years, mean± SD)	8.91±7.64	9.51±6.75	8.25±6.41	0.247
Diabetic complications, n (%)	102 (20.4%)	22 (4.4%)	80 (16.0%)	<.001
Diabetic comorbidities, n (%)	348 (69.6%)	37 (7.4%)	311(62.2)	<.001
Smoke, n (%)	110 (22.0%)	11 (2.2%)	99(19.8)	0.013
Systolic blood pressure, mean± SD	136.72±17.96	138.05±20.07	137.05±20.07	0.478
Diastolic blood pressure, mean± SD	79.37±10.57	79.40±12.04	78.47±10.36	0.587
FPG (preoperative), mean± SD	6.87±2.36	6.71±1.83	6.8±2.21	0.145
FPG (post-operative), mean± SD	9.20±3.52	9.64±3.76	9.06±3.12	0.247
Creatinine, mmol/L, mean± SD	68.16±20.49	97.49±28.35	71.28±37.46	0.0017
BUN, mmol/L, mean± SD	5.60±2.59	6.89±4.75	5.71±1.86	0.547

Table 2: Peri Operative data of patients

Variable	overall	With adverse event	Without adverse event	P value
No. %	500	40(8.0%)	460(92%)	
Surgery type, n (%)				**<0.001**
General surgery	260(52.0 %))	30 (6.0%)	230 (46%)	
Orthopedic surgery	240 (48.0 %))	14 (14%)	226 (45.2%)	
Anesthesia, n (%)				**0.0674**
Local anesthesia	30 (6.0%)	1(0.2%)	29(5.8%)	
General anesthesia	393 (78.6%)	34 (6.8%)	359 (71.8%)	
Epidural anesthesia	22 (4.4%)	3(0.6%)	19 (3.8%)	
Nerve block	23 (4.6%)	2 (0.4%)	21 (4.2%)	
Brachial plexus block	29 (5.8%)	0 (0%)	29 (5.8%)	
Lumbar plexus block	3 (0.6%)	0 (0%)	3(0.6%)	
Hospital stay, mean± SD	14.65±12.05	27.82±26.96	13.43±8.53	**0.003**

Table 3: post-operative complications among diabetic patients

Variable	Total N=40
Delayed extubation	17(42.5%)
Circulatory Disorders	4(10.0%)
Respiratory abnormalities	6(15.0%)
Non healing of the wound	5(12.5%)
Other sites infection	4(10.0%)
Other complications	3(7.5%)
Death	1(2.5%)

Table 4: Analysis of the perioperative and postoperative complications in diabetes patients using both single and multiple variables

Variables	Uni variable analyses		Multivariable analysis	
	OR value (95% CI)	P	OR value (95% CI)	P-Value
Age, y, >65 vs 65	2.57 (1.77, 3.76)	<.001	2.33 (1.26,3.88)	0.007
Sex: male vs female	2.23 (1.49, 2.87)	<.001	2.24 (1.34, 3.48)	0.002
Body mass index (BMI) ≥28 kg/m2 : yes vs no	0.99 (0.67, 1.49)	.576	_	_
Preoperative fasting venous blood glucose, mmol/L	0.83 (0.75, 1.03)	.183	_	_
Postoperative fasting venous blood glucose, mmol/L	1.24 (0.88, 1.70)	.278	_	_
Diabetic complications: yes vs no	3.75 (2.63, 5.71)	<.001	2.63 (1.56, 4.68)	0.003
Diabetic comorbidities: yes vs no	2.62 (1.64, 3.63)	<.001	1.68 (0.65, 2.70)	0.442
General surgery vs orthopedic surgery	1.79 (1.53, 5.87)	.013	1.68 (1.61, 5.46)	0.063

Discussion

The purpose of this research was to retrospectively examine information related to diabetes patients who underwent general or orthopedic surgery. The goal was to identify potential risk factors for postoperative complications. Our findings revealed that diabetes patients are more likely to experience postoperative complications than other patients. The research concluded that several factors could increase the risk of postoperative complications, such as being older,

male, having impaired kidney function, undergoing general surgery, having issues from diabetes, or having higher peripheral glucose levels in the blood after surgery.

Our research discovered that fasting blood glucose levels before and after surgery did not affect the development of adverse effects following surgery. However, we found that multiple indices of blood glucose variability can cause serious oxidative harm, inflammatory reaction, vascular damage, and abnormal metabolic processes, resulting in negative outcomes in diabetic patients (Candido, 2013; Subramaniam et al., 2014). Intraoperative hyperglycemia in diabetic individuals can cause postoperative infections, coronary complications, and other negative effects (Dronge et al., 2006; Frisch et al., 2010; Subramaniam et al., 2014; Wang et al., 2019).

Our study showed that the total frequency of postoperative complications in this cohort was 8.0%. Delayed extubation due to postoperative pulmonary and/or heart problems and the use of vasoactive substances were the primary causes of harmful events. General surgery was correlated with postoperative adverse outcomes in individuals with diabetes compared to elective orthopedic surgery (Bamba et al., 2016; Coan et al., 2013; Kotagal et al., 2015). Orthopedic surgery also had surgical risk in the presence of diabetes, but the risk could be lower than with general surgery (Akiboye and Rayman, 2017; Shohat et al., 2018).

Our research emphasized the importance of a thorough preoperative evaluation for diabetic patients, especially for those undergoing elective intermediate/major procedures that do not involve cardiovascular or cerebral surgery. This study has some drawbacks due to its retrospective design, but it provided clinical proof of the postoperative glycemic range in patients undergoing elective orthopedic and/or general procedures.

Conclusion

In conclusion, after undergoing intermediate-to-major elective orthopedic and general surgery, 8% of patients with diabetes experienced postoperative adverse effects. The top risk factors leading to negative consequences in these individuals were aging, male gender, increased postoperative blood glucose, diabetic complications, impaired kidney function, and general surgery (as opposed to orthopedic surgery).

Declarations

Data Availability statement

All data generated or analyzed during the study are included in the manuscript.

Ethics approval and consent to participate.

Approved by the department Concerned.

Consent for publication

Approved

Funding

Not applicable

Conflict of interest

The authors declared an absence of conflict of interest.

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