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A COMPARATIVE ANALYSIS ILLUSTRATING THE INCIDENCE AND PATTERN OF INFECTION RATE IN ELECTIVE SURGICAL PROCEDURES AMONG DIABETIC AND NON-DIABETIC PATIENTS IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Objective: To compare the incidence and pattern of infection rate in elective surgical procedures among diabetic and non-diabetic patients in a tertiary care hospital. **Study Design:** Relative cross sectional study. **Place and duration of study:** Combined Military Hospital Rawalpindi, Pakistan from July 2022 to December 2022. **Patients and Methods:** This study had 80 patients, comprising 40 diabetics (group A) and 40 non-diabetics (group B), who were scheduled for elective surgery. Individuals in both groups were monitored 4 weeks post-surgery to assess for the existence of postoperative infection, and the responsible organism was reported. The data was evaluated using SPSS version 22. **Results:** In our study, mean age of our participants was 45.51 ± 9.77 years. 47 (58.75%) participants were men while 33 (41.25%) were women. Median HbA1C% was 6.20% (4.10% – 8.60%). Difference amongst groups regarding mean age ($p < 0.001$) and median HbA1C% ($p < 0.001$) was statistically important while in terms of gender distribution ($p = 0.820$) and mean BMI ($p = 0.241$) was insignificant statistically. In diabetics, incidence of post-operative infection was 18 (45.00%) while in non-diabetics it was 9 (22.50%), ($p = 0.033$). "*Staphylococcus aureus*" and "*Acinetobacter*" were most commonly isolated organisms. **Conclusion:** Diabetics have a significantly greater likelihood of developing a postoperative infection.

KEYWORDS: Diabetes, Elective Surgery, Infection, Wound.

INTRODUCTION

In Pakistan, as well as across the globe, a significantly large proportion of population is affected by diabetes which is a multi-system endocrine disease.[1] This disease is on the rise due to a number of factors, including growing urbanization, unhealthy diets, and improper food management. The condition has deleterious consequences on a wide range of structural and biological processes throughout the body.[2] The percentage of the global population with diabetes is projected to double till the year 2030, meaning an increased demand for diabetes care.[3] Nearly half of people with diabetes are expected to need surgical treatment at some point in the course of their lives, which is worrisome because they have a higher risk of complications following the procedure like poor process of healing of the surgical wound, infections, needing a second operation or transfusion of blood, and staying in the hospital longer than necessary.[4]

Many patients still experience a variety of complications after surgery, including infection after surgery, despite numerous improvements in operative strategies, surgical approaches, and equipment utilized when carrying out operations.[5] Infections following surgery are more common in people with diabetes because the disease increases the generation of agents with inflammation-promoting and antioxidant qualities, which in turn create

an immune-deficient setting through high blood sugar levels and encourage the dissemination of infectious agents.[6,7] Despite this, there remains some debate over the possibility that diabetes has a substantial impact on the incidence of post-surgical infection with some studies exhibiting a significant difference in frequency of infection between diabetics and non-diabetics while other studies reporting a non-significant variance amongst the diabetics and non-diabetics in terms of post-operative infection.[8]

To address and bridge these discrepancies in the previous literature, we decided to research this subject matter of comparing the incidence of post-operative infection after elective surgical procedure, and its pattern, in patients who had diabetes versus those patients who were non-diabetics. Results of this study will not only provide an important insight regarding the burden of infection after surgery in our local population but will also help us to identify the prevalent microorganisms being involved in the pathogenesis of these infections which will help formulate a local directory for infectious agents and most appropriate empirical therapies to counter their infectious process.

METHODOLOGY

We held this comparative cross sectional study at General Surgery unit of "Combined Military Hospital Rawalpindi, Pakistan" from Jul-Dec 2022 after gaining approval from the ethical review board of "Combined Military Hospital Rawalpindi, Pakistan", (ERB number: 401). Sample size of 80 (40 diabetics and 40 non-diabetics) was computed utilizing WHO sample size calculator by assuming level of significance 5%, power 90%, anticipated post-operative infection rate in in diabetics and non-diabetics of 66.66% and 31.16%[9] using following formula [10]:

$$n = \frac{\left\{ z_{1-\alpha/2}\sqrt{2\bar{P}(1-\bar{P})} + z_{1-\beta}\sqrt{P_1(1-P_1)+P_2(1-P_2)} \right\}^2}{(P_1 - P_2)^2}$$

Inclusion criteria: We included patients who underwent elective surgery having age above 18 years, who either had male or female gender and were either diabetics or non-diabetics.

Exclusion criteria: We excluded patients who had to have emergency operations, those with coagulation disorders, those who were no fit to undergo surgery under anesthesia and those who any other comorbidity other than diabetes including high blood pressure, malnutrition, thyroid disorders, smoking, tobacco chewing or morbid obesity.

We selected patients by using "non-probability consecutive sampling" technique/ it was made sure that before making any person part of our study, he or she was completely explained the purpose of study and an informed consent in verbal and written form was obtained from the potential participant of the study. To define diabetes, we used the criteria of "American Diabetes Association (ADA)" that defines diabetes as "having an HbA1C% of 6.5% or more"[11] while absence of diabetes was also defined based on a criteria set by "American Diabetes Association (ADA)" as per which "a person who has HbA1C% values less than 5.7% is considered as a non-diabetic individual".[12]

Once selected, baseline descriptions of all the study individuals involved, like age (in years), gender, body mass index (BMI) along with HbA1C% were documented. Surgical procedures were carried by a set of two expert surgical teams who were blind to the diabetic status of the patient. After surgery all the study participants in both the groups were provided with same post-surgery care with intravenous antibiotics "injection ceftriaxone 1g twice daily for 5 days and injection metronidazole 500mg thrice daily for 5 days" and analgesics "injection paracetamol 1g thrice daily and injection ketorolac 30mg as required". Patients were discharged after completion of recovery period and were given a plan of follow up. They were instructed to provide their follow up on the telephone in case of any signs and symptoms of infection throughout the two weeks as well as at the end of two weeks they were directed to visit in person when they were physically examined for presence of post-surgical infection for which we set an operational definition as follows: "presence of pus or any discharge with swelling and erythema at the surgical wound site and/or ≥ 2 signs of acute systemic infection including pain, fever, raised white blood cell count (> 11000/mm^3) on CBC".[13] In case of presence of infection, a wound swab sample (in case of discharge/pus) or blood culture sample (in case of signs of systemic infection) was obtained to document the culprit organism. In case of infection adequate treatment was ensured with either parenteral antibiotics or wound cleaning or both, depending upon the patient's condition.

"Data was analyzed by using Statistical Package for Social Sciences (SPSS) 22.00. Normality of data was checked by Shapiro-Wilk test which showed that age and BMI were normally distributed while HbA1C% was non-normal data. Quantitative data (age, BMI and HbA1C %) was represented using mean with standard deviation and the median (IQR). Qualitative data (gender, presence of post-operative infection and its pattern) was represented by using percentage and frequency. Chi square test (for comparison of qualitative variables), Student t-test (for comparison of normally quantitative variables) and Mann-Whittney U-test (for non-normal quantitative data) were applied and a p-value of ≤ 0.05 was taken as statistically significant".

RESULTS

We made 80 individuals (40 individuals with diabetes and 40 non-diabetic individuals) part of our study. In our study, mean age of our participants was 45.51 ± 9.77 years. In our study, 47 (58.75%) individuals were men

while 33 (41.25%) were women. Mean BMI of all study participants was 31.48 ± 4.30 kg/m2. Median HbA1C% of our study participants was 6.20% (4.10% – 8.60%). Baseline attributes of all included individuals are presented in table I:

Table I: Baseline characteristics.

Sr. No.	Characteristics	Value (n = 80)
1	Mean age	45.51 ± 9.77 years
2	**Gender** - Men - Women	 47 (58.75%) 33 (41.25%)
3	Mean BMI	31.48 ± 4.30 kg/m^2
4	Median HbA1C%	6.20% (4.10% – 8.60%)

We also compared all these baseline characteristics of patients in diabetics group (group A) and non-diabetics group (group B). We found that difference amongst groups regarding mean age ($p < 0.001$) and median HbA1C% ($p < 0.001$) was statistically substantial while in terms of gender distribution ($p = 0.820$) and mean BMI ($p = 0.241$) was insignificant statistically. This relationship of baseline attributes amongst the two groups is presented in table II below:

Table II: Comparison of Baseline Attributes amongst Groups (n = 80).

Characteristic	Group A (n = 40)		Group B (n = 40)		p-value
Mean age	49.93 ± 7.09 years		41.10 ± 10.16 years		< 0.001
Gender	Male	Female	Male	Female	0.820
	23 (57.50%)	17 (42.50%)	24 (60.00%)	16 (40.00%)	
Mean BMI	30.92 ± 5.41 kg/m^2		32.05 ± 2.74 kg/m^2		0.241
Median HbA1C%	7.85% (6.80% - 8.60%)		5.00% (4.10% - 5.60%)		< 0.001

Composite incidence of post-operative infection in our study was 27 (33.75%). In diabetics (n = 40), incidence of post-operative infection was 18 (45.00%) while in non-diabetics (n = 40) it was 9 (22.50%), ($p = 0.033$). This comparison of frequency of post-operative infection two weeks after surgery between the two groups is given below in table III.

Table III: Comparison of incidence of post-operative infection (n = 80).

Parameter	Group A (n = 40)	Group B (n = 40)	p-value
Post-operative infection	18 (45.00%)	9 (22.50%)	0.033

In our study, we also studied the pattern of post-surgery infection and found the presence of various organism as follows in table IV:

Table IV: Pattern of post-operative infection (n = 27).

Organism	Frequency [n (%)]
Staphylococcus aureus	7 (25.93%)
Acinetobacter	7 (25.93%)
Klebsiella	6 (22.22%)
Escherichia coli	3 (11.11%)
Enterobacter	2 (7.41%)
Pseudomonas	2 (7.41%)

Antibiotic susceptibility and resistance pattern was also documented in our study and is exhibited below in table V:

Table V: Antibiotic susceptibility pattern (n = 27).

Drug	Sensitive [n (%)]	Resistant [n (%)]
Moxifloxacin	14 (51.85%)	13 (48.15%)
Clindamycin	9 (33.33%)	18 (66.67%)
Ceftriaxone	2 (7.41%)	25 (92.59%)
Co-amoxiclav	1 (3.70%)	26 (96.30%)
Gentamicin	14 (51.85%)	13 (48.15%)

Linezolid	20 (74.07%)	7 (25.93%)
Meropenem	17 (62.96%)	10 (37.04%)
Amikacin	18 (66.67%)	9 (33.33%)
Piperacillin - tazobactam	20 (74.07%)	7 (25.93%)
Vancomycin	11 (40.74%)	16 (59.26%)

DISCUSSION

Diabetes is notoriously known to impair the basic process of healing by having direct effect of human physiology, which was first observed in the rats model.[14] This is possibly caused by a number of factors, like ineffective response of immune system against pathogenic organisms in people with diabetes that might occur because of chronically high blood sugar levels that culminates in reduced white blood cell mobilization and movement which influences the anti-infective adaptation as well as declines the phagocytosis that leads to reduced clearing of the infectious pathogens.[15] Similar was the case in our study as we found that the incidence of infection was significantly greater amongst individuals who belonged to diabetic group in comparison with those in non-diabetic group of our study. This finding of our study was endorsed by a study done by Qamar *et al.*[16] who also found that there was significantly high frequency of infection after elective and clean surgery among patients who have diabetes as compared to non-diabetic counterparts.

However, we observed a slight disagreement from the findings of our study in some other researches in which it was found that effect of diabetes on the incidence of infection rate between diabetics and non-diabetics.[17,18] Based on the results of our study, it is logical to draw an inference that occurrence of diabetes mellitus accentuates propensity of evolving an infection, especially in the early period after an operation. This inference is supported by various studies that have been conducted in the past, results of which suggest that having diabetes means a higher chance of developing an infection during the post-operative period.[19,20] In terms of pattern of infection we found that most common culprit microbes that were found in our study population were "*Staphylococcus aureus*" and "*Acinetobacter*" on culture samples. Previous studies have also found that these organisms in addition to a few other bacteria are commonly found on culture samples of patients with post-surgical infections.[21,22] One of a worrying finding of our study was a significant proportion of resistance to various modern and broad spectrum antibiotics. Antibiotics are the mainstay treatment of infections and growing prevalence of resistance is a major concern that should be handled hands on. This growing resistance to antibiotics has been in the discussions for many years and researchers are continuously working to counter this problem.[23]

Nevertheless, our study shown that individuals with diabetes have a far greater predisposition than those without diabetes to develop an infection after surgery. However, we also discovered papers with conflicting findings, for which we urge that additional research be done in order to determine the relationship between having diabetes and a higher risk of getting post-operative infection.

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CONCLUSION

In conclusion, diabetics have a significantly greater likelihood of developing a postoperative infection. Additionally, owing to growing resistance of antibiotics globally, and especially our region, it should be made a standard practice to have culture and sensitivity in all patients to give targeted and appropriate antibiotic therapy.

ETHICAL COMMITTEE APPROVAL

Ethical committee of Combined Military Hospital, Rawalpindi gave the approval for this study.

CONFLICTS OF INTEREST

None.

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