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ORIGINAL RESEARCH

Comparative Outcomes of General and Regional Anesthesia in Diabetic Surgery Patients: A Retrospective Examination

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ABSTRACT

Introduction: Diabetes Mellitus (DM) is a multisystem metabolic disorder that can be influenced by various anesthetic techniques. Both general and regional anesthesia can modify residual insulin secretion and catabolic hormone levels. This study aims to compare and determine the perioperative and postoperative changes in blood glucose, blood pressure (BP), heart rate (HR), and Visual Analog Scale (VAS) pain scores among diabetic patients undergoing surgery with either regional or general anesthesia. **Materials and Methods:** A retrospective study was conducted on 123 diabetic patients who underwent surgeries with either general or regional anesthesia. The patients were divided into two groups based on the type of anesthesia received. Data on blood glucose levels, BP, and HR were retrieved and analyzed. Statistical analyses were performed to assess the significance of differences between the two groups. **Results:** The study found that post-surgery blood glucose levels were higher compared to pre-surgery levels in both anesthesia groups. During surgery, systolic blood pressure (SBP), diastolic blood pressure (DBP), and HR decreased compared to pre-surgery levels in both groups. Post-surgery SBP under regional anesthesia remained the same as the pre-surgery level. The VAS pain score increased immediately after surgery in the general anesthesia group, whereas it increased after the 3rd or 4th hour post-surgery in the regional anesthesia group. **Conclusion:** The study concludes that patients with diabetes exhibit pronounced fluctuations in intraoperative blood glucose levels, along with notable alterations in BP and HR when subjected to either general or regional anesthesia. These physiological changes underscore the need for meticulous perioperative monitoring and management of diabetic patients to mitigate potential complications and ensure optimal surgical outcomes.

Key Words: Diabetes, Blood glucose, Blood pressure, Heart rate, Visual analog scale

INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder impacting multiple systems, with a notable rise in the number of diabetic individuals in recent years [1,2]. A community-based study involving individuals aged 20 years and older across 14 states and one union territory in India found a significant prevalence of DM in both rural and urban areas, with some regions reporting a prevalence rate of 13% [3]. Research indicates that 2 to 4% of surgical patients have diabetes. Perioperative patients with diabetes are prone to sharp increases in blood glucose levels, leading to a higher incidence of acute complications, infections, postoperative mortality, and delayed wound healing [4]. Despite significant advancements in management, diabetic patients often suffer from microvascular and cardiovascular complications, necessitating more frequent surgical interventions compared to non-diabetic patients. Diabetes-related microvascular complications, such as retinopathy,

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neuropathy, and nephropathy, have long-term effects on small blood vessels. Cardiovascular complications include the complete blockage of blood vessels, increasing the risk of myocardial infarction, gangrene, and stroke [5,6].

Diabetic patients face an elevated perioperative risk during surgeries, infusions, anesthesia administration, and associated complications. Consequently, diabetic patients require special care before, during, and after surgery [7]. The prevalence of DM has been rising globally among both children and adults over the past two to three decades [8]. Recent changes in diagnostic criteria, if widely adopted, are likely to result in more individuals being diagnosed with diabetes [9]. Unsurprisingly, diabetic patients scheduled for surgery, whether due to their condition or incidental reasons, will place increasing demands on anesthetic services. Reducing traditional management approaches and hospital stays for preoperative diabetic patients, often requiring inpatient perioperative stabilization, is a balancing act against economic constraints.

Anesthesia techniques, especially general and regional anesthesia, can alter residual insulin secretion and catabolic hormone levels. For instance, local anesthesia is often preferred during cataract surgery for diabetic patients to minimize risks. In diabetic patients, the risk of nerve injury is higher relative to anesthetic requirements. Local anesthesia facilitates early mobilization and avoids the metabolic and hormonal changes associated with general anesthesia. Thus, it minimizes disruptions to the patient's regular diet and treatment regimen. However, risks include epidural abscess, severe hypertension, and vascular damage [10]. These changes result from decreased insulin secretion and insulin resistance. Increased secretion of catecholamines, growth hormone, and cortisol leads to altered post-receptor insulin binding and reduced transmembrane glucose transport, causing insulin resistance. Previous studies have shown that surgical stress under anesthesia results in increased levels of circulating glucose, epinephrine, and cortisol [11]. The stress response during surgery can trigger diabetic crises such as diabetic ketoacidosis or hyperglycemic hyperosmolar syndrome, with poor prognostic outcomes. Therefore, careful monitoring of the metabolic status of diabetic patients undergoing surgery is crucial [12].

In a study, the administration of general anesthesia in hypertensive patients may cause an increase in heart rate and blood pressure due to the agents used to manage hypotension [13]. To date, there are no definitive reports on mortality and major complications associated with general or regional anesthesia in diabetic patients undergoing minor surgeries. McAnulty GR et al. reported that diabetic patients who underwent surgery with neural blockade resumed oral intake sooner than those who received general anesthesia. Additionally, diabetic patients with autonomic neuropathy may be at higher risk when regional anesthesia is used [11]. However, there is no evidence that regional anesthesia alone, or in combination with general anesthesia, offers any mortality or major complication advantages for diabetic patients during surgery. This study aimed to retrospectively compare the effects of general and regional anesthesia on blood glucose levels in diabetic patients during pre- and postoperative periods and to determine any observed differences. The study also compared blood pressure and heart rate levels during preoperative, intraoperative, and postoperative stages. Lastly, it assessed postoperative VAS pain scores among diabetic patients undergoing general and regional anesthesia.

MATERIAL AND METHODS

This retrospective study analyzed records of diabetic patients who underwent surgeries in the Departments of Orthopedics and General Surgery. Data were collected for patients with both Type 1 and Type 2 diabetes mellitus, including demographic information, type of anesthesia used, and clinical parameters such as BP, HR, and blood glucose levels pre-, intra-, and post-surgery. Ethical clearance was not required due to the retrospective nature of the study.

Patients with Type 1 and Type 2 diabetes mellitus who underwent surgeries in the Department of Orthopedics and General Surgery were included. Patients with incomplete clinical data records were excluded from the study.

The study included data from 123 diabetic patients. Patients were divided into two groups based on the type of anesthesia used during surgery: 63 patients (Type 1=6, Type 2=57) received general anesthesia, and 60 patients (Type 1=5, Type 2=55) received regional anesthesia. Data on the administration of diabetic drugs such as Metformin, Glimepiride, and human insulin (Actrapid) were also collected.

Preoperative, intraoperative, and postoperative SBP, DBP, blood sugar levels, and HR were recorded for each patient. Blood glucose was measured on the day of surgery. Postoperative VAS pain scores were also retrieved. Additional data on etiological habits (smoking, alcohol consumption) and demographic characteristics were recorded.

The surgeries included in the study ranged from femoral hernia repairs and circumcisions to various fracture surgeries. General anesthesia was initiated with fentanyl (2 µg/kg) and propofol (2.5 mg/kg), followed by orotracheal intubation facilitated by atracurium (0.5 mg/kg). Anesthesia was maintained with 0.7-1.5% end-tidal sevoflurane. Regional anesthesia was administered using a 25-gauge spinal needle to inject 3.2-3.6 mL of hyperbaric bupivacaine between the L3-L4 intervertebral spaces. All patients were premedicated with midazolam (1-1.5 mg) and glycopyrrolate (0.2 mg). Insulin and oral hypoglycemic drugs were omitted on the day of surgery [14].

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Statistical analyses were performed using SPSS version 19. Data were presented as percentages or mean/median values. The Chi-square test was used to evaluate statistical significance among etiological and demographic variables. The t-test was used to assess the significance of differences in VAS pain scores between the general and regional anesthesia groups. A p-value of <0.05 was considered statistically significant.

RESULTS

Baseline characteristics (Table 1) revealed that while average age was similar, the regional anesthesia group had a slightly higher proportion of females and a lower BMI compared to the general anesthesia group. Additionally, there were differences in smoking and alcohol consumption habits, with a higher percentage of smokers and alcohol consumers in the general anesthesia group.

Table 1: Baseline characteristics of study participants

Variable	General anaesthesia	Regional anaesthesia	p-value
Age (mean ± SD)	26.1 ± 2.7	24.7 ± 2.5	0.06
Male (%)	61	39	0.08
Female (%)	41	59	
BMI (mean ± SD)	24.2 ± 1.9	23.1 ± 2.2	<0.05
Smoking			<0.05
Yes (%)	66	34	
No (%)	43.50	56.50	
Alcohol			<0.05
Yes (%)	34	66	
No (%)	56	44	

Postoperative pain assessment using the Visual Analog Scale (VAS) demonstrated a clear advantage for regional anesthesia (Table 2). Patients receiving regional anesthesia consistently reported significantly lower pain scores across all time points up to 3 hours post-surgery. This difference was particularly pronounced in the immediate postoperative period (0-3 hours), highlighting the superior analgesic efficacy of regional anesthesia in this timeframe. While pain scores began to converge after 3 hours, regional anesthesia still offered better pain control in the early recovery phase, which is crucial for patient comfort and overall well-being.

Table 2: VAS pain score among the diabetic cases post-surgery

Time postsurgery (hr)	Median VAS score		p-value
	General anaesthesia	Regional anaesthesia	
0	3	1	<0.05
1	4	1	<0.05
2	6	1	<0.05
3	7	3	<0.05
4	5	4	-
5	3	5	-
6	1	7	-
7	1	4	-
8	1	3	-
9	1	1	-
10	1	1	-
11	1	1	-
12	1	1	-

Table 3 presents a comparative analysis of physiological parameters before and after surgical procedures performed under general and regional anesthesia. Both anesthetic approaches were associated with an elevation in postoperative blood glucose levels, with a more pronounced increase observed in the general anesthesia group. Analysis of SBP revealed that both anesthesia types generally facilitated stable intraoperative BP, followed by a postoperative increase, particularly under general anesthesia. DBP exhibited a decrease during surgery under both anesthesia types, subsequently returning to pre-surgical levels postoperatively. Notably, BP variability was more pronounced during surgery, especially with regional anesthesia. Regional anesthesia was characterized by a consistently higher and more variable heart rate throughout the surgical stages compared to general anesthesia. This observation suggests that while both anesthesia types are clinically viable options, regional anesthesia may necessitate closer heart rate monitoring due to its

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inherent variability and propensity for elevated heart rates in diabetic patients.

Table 3: Parameters pre and post-surgery under general and regional anaesthesia

Time	General anaesthesia Median (IQR)	Regional anaesthesia Median (IQR)
Blood Glucose (mg/dl)		
Before Surgery	165 (160-170)	160 (150-170)
After Surgery	180 (175-190)	170 (160-180)
p value	<0.05	<0.05
SBP (mmHg)		
Before Surgery	130 (125-135)	125 (120-130)
During Surgery	120 (115-125)	120 (115-125)
After Surgery	140 (135-145)	135 (130-140)
p value	<0.05	<0.05
DBP (mmHg)		
Before Surgery	81 (80-83)	82 (80-84)
During Surgery	78 (77-79)	80 (78-82)
After Surgery	82 (80-84)	83 (81-85)
p value	<0.05	<0.05
Heart Rate (b/min)		
Before Surgery	75 (72-80)	85 (80-92)
During Surgery	77 (73-82)	88 (80-95)
After Surgery	78 (72-83)	90 (80-100)
p value	<0.05	<0.05

DISCUSSION

Diabetes is rapidly emerging as a potential epidemic in India, with over 62 million individuals currently diagnosed with the condition. Wild et al. project that the global prevalence of diabetes will surge from an estimated 171 million in 2000 to 366 million by 2030, with the most significant increase expected in India [15]. As diabetes becomes more widespread in the general population, anesthetists must recognize that a substantial proportion of surgical patients will have diabetes. Consequently, anesthetists need to be well-versed in the complications and comorbidities associated with diabetes, as well as the pharmacokinetics and pharmacodynamics of various diabetic medications [16]. Anesthetic techniques, including spinal, epidural, splanchnic, or other regional blocks, may influence catabolic hormone secretion and residual insulin levels. Studies have shown that epidural anesthesia can prevent the elevation of glucose, epinephrine, and cortisol levels typically seen in non-diabetic patients undergoing surgical stress, an effect not observed with general anesthesia [11].

A study investigating the impact of anesthesia type on blood glucose levels in diabetic patients found that post-surgery glucose levels were higher compared to pre-surgery levels, regardless of whether general or regional anesthesia was used. This suggests that anesthesia plays a role in elevating blood glucose postoperatively, irrespective of the anesthesia type. Norman and Fink's research indicates that the choice of anesthesia technique affects the intraoperative stress response, significantly influencing surgical outcomes and postoperative pain reduction [17]. These findings align with those of Sudhakaran and Surani, who reported that anesthesia combined with surgical stress can induce hyperglycemia in diabetic patients [18]. Rehman and Mohammed found that general anesthesia was more frequently associated with increased blood glucose, catecholamines, cortisol, and glucagon levels compared to regional anesthesia [19]. Scherpereel and Tavernier also demonstrated that general anesthesia results in higher blood glucose concentrations than local and epidural analgesia [20]. The rise in blood glucose levels may be attributed to sympathoadrenal stimulation caused by stress responses and general anesthetic agents like sevoflurane, which can inhibit insulin secretion and elevate blood glucose [21,22].

The study also reported that SBP and DBP and HR in diabetic patients decreased during surgery under both general and regional anesthesia compared to pre-surgery levels. Post-surgery, SBP under regional anesthesia remained similar to pre-surgery levels, while DBP and HR in both anesthesia groups were comparable to pre-surgery levels. Sato et al. found that general anesthesia could reduce BP due to propofol-induced cardiac baroreflex depression [23]. The decrease in BP was less pronounced with regional anesthesia, consistent with the present study, where DBP in the regional anesthesia group returned to baseline levels post-surgery. This may be explained by the initial drop in BP following propofol induction during general anesthesia, often necessitating post-surgery therapy to normalize BP [24].

Regarding postoperative pain, the VAS pain score increased immediately after surgery in the general anesthesia group but only after 3 to 4 hours post-surgery in the regional anesthesia group. This observation is consistent with Wang et al., who

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reported that spinal regional anesthesia is associated with reduced postoperative pain and lower incidences of postoperative nausea and vomiting compared to general anesthesia [25].

CONCLUSION

The study concludes that diabetic patients undergoing both general and regional anesthesia experienced increased intraoperative blood glucose fluctuations, as well as significant alterations in blood pressure (BP) and heart rate (HR) levels. However, it was observed that patients in the regional anesthesia group reported reduced postoperative pain compared to those who received general anesthesia. These findings highlight the differential impacts of anesthesia types on perioperative physiological parameters and postoperative pain management in diabetic patients.

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