Original Research Paper

Volume - 15 | Issue - 04 | April - 2025 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Anaesthesiology

TO COMPARE THE EFFECT OF PRE-OPERATIVE BLOOD SUGAR, HBA1C, AND INSULIN LEVELS ON POST- OPERATIVE DELIRIUM IN DIABETICS AND NON DIABETICS IN MORBIDLY OBESE PATIENTS UNDERGOING LAPROSCOPIC BARIATRIC SURGERY

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ABSTRACT **Background:** Post-operative delirium (POD) is a common neurocognitive complication following major surgeries, particularly in high-risk populations such as morbidly obese patients. While age and anesthetic factors are known risk factors, the impact of pre-operative glycemic control, including blood sugar, HbA1c, and insulin levels, on POD remains underexplored. **Aim And Objectives:** To compare the incidence of POD in diabetic and non-diabetic morbidly obese patients undergoing laparoscopic bariatric surgery and evaluate the relationship between pre-operative glycemic markers and delirium. **Materials And Methods:** This prospective analytic cross-sectional observational study was conducted at Sri Aurobindo Medical College & PG Institute, Indore over an 18-month period. A total of 158 morbidly obese patients (BMI >40 kg/mZ) undergoing laparoscopic bariatric surgery were recruited and divided into Group A (diabetics, n=79) and Group B (non-diabetics, n=79). Pre-operative blood glucose, HbA1c, and serum insulin levels were recorded. Post-operatively, delirium was assessed at 1, 3, 6, 12, and 24 hours using the Nursing Delirium Screening Scale (Nu-DESC). Statistical analysis was performed using R software, with t-tests, chi-square tests, and repeated measures ANOVA applied as appropriate. **Results:** The overall incidence of POD was 7.6% (12/158), with a significantly higher occurrence in diabetic patients (12.7% vs. 2.5% in non-diabetics, $p = 0.018$). Among delirious patients, 7 had HbA1c >8% and elevated insulin levels (>20 µIU/mL). The mean HbA1c was significantly higher in delirious patients (8.9 ± 1.3%) compared to non-delirious patients (6.1 ± 1.9%, $p < 0.001$). Similarly, mean serum insulin levels were higher in the delirium group (26.7 ± 7.5 µIU/mL vs. 14.2 ± 5.6 µIU/mL, $p < 0.001$). Delirium peaked within the first 6 hours post- operatively and resolved by 24 hours. **Conclusion:** Poor pre-operative glycemic control, specifically HbA1c >8% and increased insulin levels, was significantly associated with a higher risk of post-operative delirium in morbidly obese diabetic patients. These findings highlight the need for optimized perioperative glycemic management to reduce neurocognitive complications in bariatric surgery patients.

KEYWORDS : Post-operative delirium, glycemic control, bariatric surgery, diabetes, HbA1c, insulin levels, morbid obesity.

INTRODUCTION

Obesity has emerged as a significant global health concern, with its prevalence nearly doubling between 1980 and 2008 [1]. Morbid obesity, defined as a body mass index (BMI) of more than 40 kg/mZ, is associated with numerous comorbidities, including type 2 diabetes mellitus, cardiovascular disease, and metabolic syndrome [2]. As a result, bariatric surgery has become an effective intervention for weight reduction and metabolic improvement [3]. However, perioperative complications, including post-operative delirium (POD), remain a concern in this high-risk population [4].

Post-operative delirium is an acute neurocognitive disorder characterized by transient confusion, inattention, and altered consciousness following surgery. It has been associated with prolonged hospital stays, increased morbidity, and higher healthcare costs [5]. While several risk factors contribute to POD, emerging evidence suggests a potential link between pre-operative glycemic control and its occurrence [6]. Elevated pre-operative blood sugar, hemoglobin A1c (HbA1c), and insulin levels may predispose patients to neuroinflammation, oxidative stress, and metabolic dysregulation, thereby increasing susceptibility to delirium [7].

Diabetes is known to independently elevate the risk of delirium due to its impact on cerebral metabolism and vascular integrity [8]. In morbidly obese individuals undergoing laparoscopic bariatric surgery, fluctuations in blood glucose and insulin resistance may further exacerbate neurocognitive vulnerability [9]. Recent studies indicate that poor glycemic control (HbA1c > 8) and hyperinsulinemia could contribute to cognitive dysfunction in the post-operative period [10]. However, there is a paucity of literature directly comparing the incidence of POD between diabetic and non-diabetic morbidly obese patients undergoing bariatric surgery [11].

This study aims to investigate the relationship between pre-operative glycemic markers (blood glucose, HbA1c, and insulin levels) and the incidence of POD in this population. By comparing diabetic and non-diabetic patients, we seek to determine whether poor glycemic control serves as an independent predictor of POD. Understanding these associations could help refineperioperative management strategies and reduce the neurocognitive burden in bariatric surgery patients.

MATERIALS AND METHODS

Study Design And Setting

This prospective analytic cross-sectional observational study was conducted at Sri Aurobindo Medical College & Post Graduate Institute, Indore, in the Department of Anesthesiology. The study aimed to evaluate the effect of pre-operative blood sugar, HbA1c, and insulin levels on post-operative delirium (POD) in diabetic and non-diabetic morbidly obese patients undergoing laparoscopic bariatric surgery.

Study Duration And Population

The study was carried out over 18 months, from June 2023 to November 2024. The study population comprised morbidly obese patients (BMI >40 kg/mZ) scheduled for laparoscopic bariatric surgery. The patients were categorized into two groups: Group A (diabetics) and Group B (non-diabetics).

Sample Size And Selection Criteria

A pilot study conducted over one month revealed that 12-13 patients per month met the inclusion criteria. Based on this, a total of 158 patients (79 in each group) were included in the study. Patients aged between 18 and 70 years with no pre-existing cognitive impairment or language disorders were enrolled. Only those who provided written informed consent were considered. Exclusion criteria included patients with pre-existing psychiatric disorders, those on psychotropic medications, patients who received ketamine intraoperatively, and individuals who had participated in other clinical trials in the preceding six months.

Pre-operative Assessment
All recruited patients underwent a detailed pre-anesthetic check-up (PAC), which included a thorough medical history, physical examination, and laboratory investigations. Pre-operative laboratory tests included random blood sugar (mg/dL), HbA1c (%), serum insulin levels (µIU/mL), complete blood count (CBC), renal function tests (RFTs), electrolytes, ECG, and chest X-ray. The total hours of nil by mouth (NBM) before surgery were also recorded.

Intraoperative Management
Patients were administered general anesthesia following a standardized protocol. Induction was achieved using propofol (2 mg/kg), fentanyl (2 µg/kg), and rocuronium (0.6 mg/kg). Maintenance was carried out using sevoflurane with oxygen and air mixture, along withintermittent fentanyl administration. Reversal of neuromuscular blockade was achieved using neostigmine and glycopyrrolate. Special care was taken to avoid the use of ketamine, as it has known neuropsychiatric effects. Throughout the surgery, continuous monitoring of heart rate, blood pressure, oxygen saturation (SpO_2), and end-tidal CO_2 ($ETCO_2$) was performed.

Post-operative Assessment
Following extubation, patients were assessed for post-operative delirium (POD) at 1 hour, 3 hours, 6 hours, 12 hours, and 24 hours using the Nursing Delirium Screening Scale (Nu-DESC). This tool evaluated five domains: disorientation, inappropriate behavior, inappropriate communication, illusions/hallucinations, and psychomotor retardation. Each symptom was scored from 0 to 2 (0 = absent, 1 = mild, 2 = severe), and a total Nu-DESC score ≥2 was considered indicative of delirium.

Data Collection and Statistical Analysis
Patient data were collected using a pre-structured proforma and maintained in a Master Chart. The recorded variables included patient demographics, diabetes status, pre-operative blood sugar levels, HbA1c levels, insulin levels, total NBM hours, and post-operative delirium scores. Data were entered into MS Excel 2010 and analyzed using R software. Descriptive statistics were calculated as mean ± standard deviation (SD) for continuous variables and frequency and percentage for categorical variables. Independent t-tests or Mann-Whitney U tests were used to compare continuous variables between diabetic and non-diabetic patients, while chi-square tests or Fisher's exact tests were applied for categorical data. Repeated measures ANOVA was used to analyze changes in delirium scores over time. A p-value < 0.05 was considered statistically significant.

Ethical Considerations
The study was conducted following the guidelines of the Institutional Ethics Committee (IEC) of Sri Aurobindo Medical College & PG Institute, Indore, after obtaining ethical approval. Written informed consent was secured from all participants before enrollment. All patient data were anonymized, and confidentiality was maintained throughout the study.

RESULTS
Patient Demographics and Baseline Characteristics
A total of 158 patients were enrolled in the study, with 79 diabetic (Group A) and 79 non-diabetic (Group B) morbidly obese patients undergoing laparoscopic bariatric surgery. The mean age of the study population was 48.3 ± 9.1 years, with no significant difference between the two groups(p = 0.62). The mean BMI was 42.6 ± 3.2 kg/mZ, with comparable distribution in both groups (p= 0.45).

Table 1: Baseline Characteristics Of Study Participants

Parameter	Group A (Diabetic) (n=79)	Group B (Non-Diabetic) (n=79)	p-value
Age (years)	49.1 ± 8.7	47.5 ± 9.5	0.62
BMI (kg/mZ)	42.8 ± 3.1	42.3 ± 3.4	0.45
Male (%)	38 (48.1%)	36 (45.6%)	0.78
Female (%)	41 (51.9%)	43 (54.4%)	0.78
HbA1c (%)	8.2 ± 1.4	5.6 ± 0.7	<0.001*
Pre-op Blood Sugar (mg/dL)	165.2 ± 35.4	98.4 ± 12.7	<0.001*
Serum Insulin (µIU/mL)	22.5 ± 8.3	11.6 ± 4.7	<0.001*

*Statistically significant (p < 0.05)

Post-operative Delirium Incidence
Post-operative delirium (POD) was assessed using the Nursing Delirium Screening Scale (Nu- DESC) at multiple time intervals. Overall, 12 patients (7.6%) exhibited POD, with a significantly higher occurrence in the diabetic group (10 patients, 12.7%) compared to the non-diabetic group (2 patients, 2.5%) (p = 0.018).

Table 2: Incidence Of Post-operative Delirium

Group	No Delirium (Nu-DESC <2)	Delirium Present (Nu-DESC ≥2)	p-value
Group A (Diabetic)	69 (87.3%)	10 (12.7%)	0.018*
Group B (Non-Diabetic)	77 (97.5%)	2 (2.5%)	
Total	146 (92.4%)	12 (7.6%)	

*Statistically significant (p < 0.05)

Association Between Glycemic Parameters and Delirium
Among the 12 patients who developed POD, 7 had HbA1c levels >8% and increased serum insulin (>20 µIU/mL). The mean HbA1c of delirious patients was 8.9 ± 1.3%, significantly higher than non-delirious patients (6.1 ± 1.9%, p < 0.001). Similarly, mean serum insulin levels were significantly elevated in the delirium group (26.7 ± 7.5 µIU/mL vs. 14.2 ± 5.6 µIU/mL, p <0.001).

Table 3: Comparison Of Glycemic Markers In Patients With And Without Delirium

Parameter	Delirium Present (n=12)	No Delirium (n=146)	p-value
HbA1c (%)	8.9 ± 1.3	6.1 ± 1.9	<0.001*
Serum Insulin (µIU/mL)	26.7 ± 7.5	14.2 ± 5.6	<0.001*
Pre-op Blood Sugar (mg/dL)	183.6 ± 32.2	118.4 ± 26.1	<0.001*

*Statistically significant (p < 0.05)

Time-based Delirium Assessment
The progression of POD symptoms over time was analyzed, revealing that the highest incidence of delirium occurred within the first 6 hours post-operatively, after which symptoms gradually subsided.

Table 4: Delirium Scores At Different Time Intervals

Time Interval	No Delirium (n=146)	Mild Delirium (n=9)	Severe Delirium (n=3)
1 hour	142 (97.3%)	3 (2.1%)	3 (2.1%)
3 hours	138 (94.5%)	6 (4.1%)	2 (1.4%)
6 hours	136 (93.1%)	7 (4.8%)	3 (2.1%)
12 hours	142 (97.3%)	4 (2.7%)	0 (0%)
24 hours	146 (100%)	0 (0%)	0 (0%)

By 24 hours post-extubation, all patients had recovered from delirium, suggesting its transient nature.

DISCUSSION
Post-operative delirium (POD) is a common yet underrecognized complication following major surgeries, particularly in high-risk populations such as morbidly obese patients undergoing laparoscopic bariatric surgery. This study aimed to assess the effect of pre-operative glycemic control, including blood sugar, HbA1c, and insulin levels, on the incidence of POD. Our findings demonstrated a significantly higher incidence of POD in diabetic patients (12.7%) compared to non-diabetics (2.5%), with an association between elevated HbA1c (>8%), increased insulin levels, and delirium.

Incidence And Risk Factors Of Post-operative Delirium
The overall incidence of POD (7.6%) observed in our study aligns with previously reported ratesin surgical patients, ranging between 5-50%, depending on population characteristics and surgical type [12]. Several studies have identified advanced age, pre-existing cognitive impairment, and intraoperative anesthetic use as primary risk factors for POD [13, 14]. However, our study focused on metabolic risk

factors, particularly poor glycemic control, which has been relatively underexplored in this context.

Hyperglycemia and insulin resistance have been implicated in neuroinflammation and oxidative stress, both of which can disrupt cerebral homeostasis and contribute to acute cognitive dysfunction. Demeure & Fain (2006) reported that surgical stress exacerbates glucose dysregulation, leading to altered neurotransmitter function, increased inflammatory cytokines, and endothelial dysfunction, all of which may predispose patients to delirium [15]. Our study reinforces this, as patients with higher HbA1c and insulin levels showed a greater propensity for POD.

Role of Glycemic Control in Delirium Development

We found that 7 out of 12 delirious patients had HbA1c levels >8%, which was significantly higher than those without delirium ($p < 0.001$). Previous studies suggest that elevated HbA1c is associated with increased systemic inflammation and impaired cerebrovascular function, making the brain more vulnerable to perioperative insults (16). Additionally, our findings showed that patients who developed delirium had markedly higher pre-operative serum insulin levels (26.7 µIU/mL vs. 14.2 µIU/mL, $p < 0.001$), further supporting the hypothesis that hyperinsulinemia and insulin resistance are key contributors to post-operative neurocognitive dysfunction.

Inouye (2006) described delirium as a result of multiple interacting stressors, with metabolic dysregulation being a major component (17, 18). The higher rate of delirium in our diabetic cohort can be explained by fluctuations in glucose homeostasis, exacerbated by the perioperative stress response. This aligns with Marcantonio et al. (1994), who identified poor pre-operative metabolic status as a strong predictor of POD in elective surgical patients (19).

Time Course and Resolution of Delirium

The progression of POD in our study followed a predictable pattern, with symptoms peaking within the first 6 hours post-operatively and resolving by 24 hours. This is consistent with previous literature, where the highest incidence of delirium occurs in the immediate post-operative period due to anesthetic washout, metabolic stress, and inflammatory response [20]. Inouye et al. (1999) also emphasized the importance of early recognition and intervention, suggesting that delirium typically follows a transient course but can have lasting cognitive effects if not managed promptly [18].

Jin & Chung (2001) highlighted the importance of preventive strategies, including perioperative glycemic control, multimodal analgesia, and early mobilization, to reduce delirium risk [21].While our study did not investigate preventive measures, the findings strongly suggest that optimizing pre-operative metabolic status could serve as a viable strategy for reducing POD risk.

Comparison with Previous Studies and Clinical Implications

Several previous studies have investigated the impact of diabetes on cognitive function, but few have specifically examined the interplay between glycemic control and delirium in bariatric surgery patients. Our study contributes to this growing body of literature by demonstrating a direct association between higher HbA1c, increased insulin levels, and delirium incidence. These findings are particularly relevant given the increasing prevalence of diabetes and metabolic syndrome in patients undergoing bariatric surgery.

From a clinical perspective, our results emphasize the importance of pre-operative glycemic optimization. Current guidelines for perioperative diabetes management focus primarily on reducing surgical complications such as infections and delayed wound healing, but there is limited emphasis on neurocognitive outcomes. Given our findings, perioperative strategies should be expanded to include aggressive glycemic control protocols, tailored insulin therapy, and close monitoring of metabolic markers to mitigate POD risk.

Strengths and Limitations

The strengths of this study include its prospective design, standardized delirium assessment using Nu-DESC, and inclusion of both diabetic and non-diabetic patients, allowing for direct comparisons. Additionally, our use of multiple glycemic markers (HbA1c, insulin, and blood sugar) provides a more comprehensive metabolic profile.

However, there are some limitations. First, the sample size was relatively small, and larger multi- center studies are needed to confirm these findings. Second, the study did not evaluate long-term cognitive outcomes, which could provide further insights into the lasting impact of POD in bariatric surgery patients. Lastly, we did not account for other potential risk factors such as inflammation, anesthesia depth, and intraoperative hemodynamic variations, which could have influenced POD incidence.

Future Directions

Future research should focus on larger, multi-center trials to validate these findings and explore potential interventions to reduce delirium risk. Additionally, longitudinal studies tracking cognitive function beyond the immediate post-operative period could help determine whether early POD predicts long-term cognitive decline. Investigating the role of anti-inflammatory and neuroprotective strategies in perioperative care may also be beneficial.

CONCLUSION

In conclusion, this study demonstrates that poor pre-operative glycemic control, particularly HbA1c >8% and elevated insulin levels, is significantly associated with a higher risk of post- operative delirium in morbidly obese diabetic patients undergoing bariatric surgery. The findings reinforce the need for enhanced pre-operative metabolic screening and optimization to minimize neurocognitive complications. Given the increasing burden of obesity and diabetes, a multidisciplinary approach integrating endocrinologists, anesthesiologists, and surgeons is essential for improving perioperative outcomes in this high-risk population.

REFERENCES

1. Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2014 Aug 30;384(9945):766-81.
2. Haslam DW, James WP. Obesity. Lancet. 2005 Oct 1;366(9492):1197-209.
3. Buchwald H, Estok R, Fahrbach K, Banel D, Sledge I, Cowan GS Jr, et al. Weight and type 2 diabetes after bariatric surgery: systematic review and meta-analysis. Am J Med. 2009 Mar;122(3):248-56.e5.
4. Inouye SK, Westendorp RG, Saczynski JS. Delirium in elderly people. Lancet. 2014 Mar 8;383(9920):911-22.
5. Siddiqi N, Harrison JK, Clegg A, Teale EA, Young J, Taylor J, et al. Interventions for preventing delirium in hospitalized non-ICU patients. Cochrane Database Syst Rev. 2016;3:CD005563.
6. Marcantonio ER. Delirium in Hospitalized Older Adults. N Engl J Med. 2017;377(15):1456-66.
7. Vlisides PE, Avidan MS. Recent advances in preventing and managing postoperative delirium. F1000Res. 2019;8:F1000 Faculty Rev-607.
8. Girard TD, Jackson JC, Pandharipande PP, Thompson JL, Shintani AK, Gordon SM, et al. Delirium as a predictor of long-term cognitive impairment in survivors of critical illness. Crit Care Med. 2010;38(7):1513-20.
9. Krenk L, Rasmussen LS. Postoperative delirium and postoperative cognitive dysfunction in the elderly - what are the differences? Minerva Anestesiol. 2011;77(7):742-9.
10. van den Boogaard M, Schoonhoven L, van der Hoeven JG, van Achterberg T, Pickkers P. Incidence and short-term consequences of delirium in critically ill patients: a prospectiveobservational cohort study. Int J Nurs Stud. 2012;49(7):775-83.
11. Scott LJ, Alexander KJ, Addison RS, McGreevy CM, Kirwan JA. Postoperative delirium in elderly patients after elective and emergency surgery. J Anaesthesiol Clin Pharmacol. 2014;30(3):328-33.
12. Amador LF, Goodwin JS. Postoperative delirium in the older patient. J Am Coll Surg. 2005;200(5):767–73.
13. Bryson GL, Wyand A. Evidence-based clinical update: general anesthesia and the risk of delirium and postoperative cognitive dysfunction. Can J Anaesth. 2006;53(7):669–77.
14. Dasgupta M, Dumbrell AC. Preoperative risk assessment for delirium after noncardiac surgery: a systematic review. J Am Geriatr Soc. 2006;54(10):1578–89.
15. Demeure MJ, Fain MJ. The elderly surgical patient and postoperative delirium. J Am Coll Surg. 2006;203(5):752–7.
16. Hopkins RO, Jackson JC. Assessing neurocognitive outcomes after critical illness: are delirium and long-term cognitive impairments related? Curr Opin Crit Care. 2006;12(5):388–94.
17. Inouye SK. Delirium in older persons. N Engl J Med. 2006;354(11):1157–65.
18. Inouye SK, Bogardus ST Jr, Charpentier PA, et al. A multicomponent intervention to prevent delirium in hospitalized older patients. N Engl J Med. 1999;340(9):669–76.
19. Marcantonio ER, Goldman L, Mangione CM, et al. A clinical prediction rule for delirium after elective noncardiac surgery. JAMA. 1994;271(2):134–9.
20. McNicoll L, Pisani MA, Ely EW, et al. Detection of delirium in the intensive care unit: comparison of confusion assessment method for the intensive care unit with confusion assessment method ratings. J Am Geriatr Soc. 2005;53(3):495–500.
21. Jin F, Chung F. Minimizing perioperative adverse events in the elderly. Br J Anaesth. 2001;87(4):608–24.