ORIGINAL RESEARCH PAPER

General Surgery

AN OBSERVATIONAL STUDY TO CORRELATE SURGICAL SITE INFECTION WITH PERIOPERATIVE HYPERGLYCEMIA

KEY WORDS:
Hyperglycemia, Surgical Site infection , Infection , Diabetes , post-operative infection, type 2 diabetes mellitus.

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ABSTRACT

Surgical Site Infection (SSI) is a common postoperative complication that a surgeon has to face which causes increase in length of stay in hospital and morbidity of the patient and causes poor surgical outcome. It has been seen that any surgery/ illness causes stress hyperglycemia and this peri operative hyperglycemia is associated with poor post operative outcomes including SSI. This study is done to ascertain the correlation between peri operative hyperglycemia to the subsequent risk of SSI and to know the incidence of perioperative hyperglycemia as well as SSI in the demographic region of eastern Uttar Pradesh. A total of 100 patients were enrolled in this study who underwent different surgical procedures. Patients were monitored for perioperative blood sugar, preoperatively; intraoperatively at the time of skin closure; 6 hours postoperatively; 24 hours postoperatively and 48 hours postoperatively as per the protocol. Perioperative hyperglycemia was defined when more than one value of blood glucose level was raised (RBS >140 mg/dL and FBS > 125 mg/dL). The patients were followed up to 30 days post operatively to check for occurrence of SSI. **Conclusion:** This study shows that perioperative hyperglycemia is a better indicator of post operative SSI as compared to intra operative or post operative stress hyperglycemia. Hence, patients with perioperative hyperglycemia need vigilance and early intervention to prevent SSI.

INTRODUCTION:

Surgical site infection (SSI) post-operatively is a nightmare to all surgeons. Despite tremendous advances in the asepsis, surgical techniques, modern operating room environment, antibiotic prophylaxis etc., SSIs remain an important clinical problem affecting every department of surgery and is among top five most common hospital acquired infections seen at hospitals.(1) In 1992, the US Centers for Disease Control (CDC) revised its definition of wound infection to include that of surgical site infections (SSI), and created operationalization criteria used in prospective surveillance studies. Surgical site infection (SSI) is defined as an infection that occurs within 30 days after operation [or up to 1 year if an implant (device left in place at the end of a procedure; e. g., prosthetic heart valve, pacemaker leads or any implants placed for fracture fixation), and the observed combination between incisional skin layer spaces and deep tissues at operative sites(2). This infection can be a superficial or deep incisional, over an organ and body means/site of the surgery.(3–5)

These infections are most frequently related to exogenous or endogenous microorganisms that come into the operative wound during surgery. In India, the rate of SSI is said to be from 5.9% — 55.5%.(4,5)

Clinically, it is often met with the phenomenon of perioperative hyperglycemia. There is emerging evidence that hyperglycemia may be significant contributor to the etiology of post operative infections (POI),(6–10) a prevalent and often costly surgical complication.

It is known that the incidence of surgical and other nosocomial infections are higher among patients with diabetes mellitus. The exact mechanism by which diabetes leads to SSI is not known, but it has been postulated that hyperglycemia (which can be considered as a marker of worse glucose control in diabetic patients over the long term) may contribute to higher infection rates among diabetics.(11,12)

Intensive insulin therapy (IIT) has been shown to lower infection rates following neurosurgery, making it a potentially effective method for controlling blood glucose and preventing postoperative infections (POI). However, improper administration of IIT can lead to hypoglycemia, which is associated with serious neurological complications and poses a significant risk with tight glucose management.(13–15) While clinical evidence is needed to establish the effectiveness of IIT for strict blood glucose control in preventing POI, the ideal target range for blood glucose levels, particularly during surgery, remains uncertain. Enhanced control of blood glucose fluctuations could improve survival rates(16,17) and reduce morbidity in surgical patients, yet the relationship between perioperative blood glucose levels and the occurrence of POI is largely unclear due to insufficient evidence.(18,19) Further research is required to determine the optimal blood glucose levels for surgical patients and to address these questions.(12,20)

MATERIAL AND METHOD :

The study was conducted in the Department of General Surgery at Dr. KNS Memorial Institute of Medical Sciences, Barabanki.

Inclusion Criteria:

1. Patients who underwent major and minor elective and emergency surgery in the Department of General Surgery at Dr. KNS Memorial Institute of Medical Sciences, Barabanki.
2. Both sexes (male and female).
3. Age of more than 10 years.

Exclusion Criteria:

1. Patients having prior serious illness (example- cancer patient).
2. Patients having evidence of systemic infection (septicaemia).
3. Patients having dirty/infected class of surgical site.

4. Patients who refused to give consent.
5. HIV, HCV, HBsAg positive patients.

Method Of Data Collection:
Random blood sugar (RBS) – measured by glucometer
FBS/RBS value was repeated in laboratory if glucometer reading is ≥140mg/dL

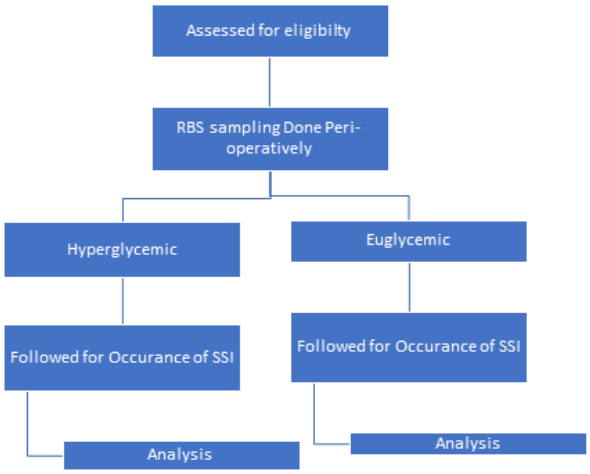
Blood Sample:
1. Capillary blood sample was taken from the upper limb by finger prick in which intravenous infusion was not being given – for glucometer reading.
2. Intravenous blood sample was taken from limb in which intravenous infusion was not being given – for laboratory reading.

Random Blood Sugar (RBS) Was Taken:
1. **Pre-operatively –** just before the surgery, in the ward, before shifting the patient to the operation theatre.
2. **Intra-operatively –** just before the skin closure.
3. **Post-operatively –**

a. After 6 hours
b. After 24 hours
c. After 48 hours

Perioperative hyperglycemia was defined when more than 1 value of:
1. Random blood sugar (RBS) ≥ 140mg/dL 111 or
2. Fasting blood sugar (FBS) ≥ 126mg/dL

Sequence Of Events:



Surgical Site Infection was diagnosed if any one of the following criteria is fulfilled :
1. Serous or non-purulent discharge from the wound,
2. Pus discharge from the wound,
3. Serous or non-purulent discharge from the wound with signs of inflammation (edema, redness, warmth, raised local temperature, fever > 38°C, tenderness, induration)
4. Wound deliberately opened up by the surgeon due to localized collection (serous/purulent).

RESULTS:
The current study is a quantitative, prospective, observational, and longitudinal investigation conducted in the Department of General Surgery at Dr. KNS Memorial Institute of Medical Sciences in Barabanki, India. Its objective is to examine the relationship between perioperative hyperglycemia and the risk of postoperative surgical site infections through a prospective observational approach.

A total of 100 patients who underwent various surgical procedures were included and followed for 30 days postoperatively. Patients' random blood sugar levels were monitored according to the protocol outlined in the materials and methods section, and the study population was divided into two groups:

Group 1 (n= 85) = patients who did not develop perioperative hyperglycemia
Group 2 (n= 15) = patients who developed perioperative hyperglycemia

In our study 85 (85%) patients did not develop perioperative hyperglycemia and were allocated as Group I and 15 (15%) patients developed perioperative hyperglycemia and were allocated as Group II.

Table 1 : Distribution of patients according to group Groups

Distribution of patients according to group Groups	No of patients
Group I	85 (85%)
Group II	15 (15%)

Table 2: Distribution of patients in two groups according to mean RBS (mg/dL) level at various times Time interval

Distribution of patients in two groups according to mean RBS (mg/dL) level at various times Time interval	Group I (n=85) (mg/dL)	Group II (n=15) (mg/dL)	Significance of difference	
			"t"	"p"
PRE-OP RBS (F)	98.37±9.52	115.56±15.29	-2.145	0.002
INTRA OP RBS	106.11±8.52	156.23±18.25	-5.301	<0.001
6 HRS RBS	103.75±9.41	129.00±14.41	-8.123	<0.001
24 HRS RBS	106.78±8.14	130.23±12.14	-3.215	<0.001
48 HRS RBS	103.93±9.87	121.66±11.28	-4.621	<0.001

The Above Table 2 shows that mean pre op RBS in group I was 98.37±9.52 mg/dL and in group II was 115.56±15.29 mg/dL, mean intra op RBS in group I was 106.11±8.52 mg/dL and in group B was 156.23±18.25 mg/dL, mean RBS 6 hours postoperatively in group I was 103.75±9.41 mg/dL and in group II was 129.00±14.41 mg/dL, mean RBS 24 hours postoperatively in group I was 106.78±8.14 mg/dL and in group II was 130.23±12.14 mg/dL, mean RBS 48 hours postoperatively was 103.93±9.87 mg/dL in group I and in group II was 121.66±11.28 mg/dL. There was significant difference in pre op RBS (p=0.002) in both the groups and the intra op, 6 hours, 24 hours, and 48 hours postoperative RBS were also significantly higher in group II with p value <0.001, which was highly significant.

Table 3 : Incidence of Peri operative hyperglycemia Peri operative hyperglycemia

Incidence of Peri operative hyperglycemia Peri operative hyperglycemia	No. of patients (n=100)	r value	p value
Yes	15 (15%)	0.694	0.029
No	85 (85%)		

The Above table 3 show that out of 100 patients who underwent surgery, 15 (15%) patients developed peri-operative hyperglycemia whereas 85 (85%) patients did not develop peri-operative hyperglycemia.

Table 4 : Correlation between peri-operative hyperglycemia to the subsequent SSI post-operatively Perioperative Hyperglycemia

Correlation between peri-operative hyperglycemia to the subsequent SSI post-operatively Perioperative Hyperglycemia	SSI developed	SSI not developed
Yes (15)	4(26.66%)	11(73.33%)

No (85)	4(4.7%)	81(95.29%)
Odds ratio	7.36	
P value	0.018	

CONCLUSION:

On the basis of the observations made during the study and their analysis, the following conclusions have been drawn from the present study:

1. A total of 100 patients were enrolled in the study out of which 15 patients developed perioperative hyperglycemia, thus showing the **incidence of perioperative hyperglycemia** to be 15%.
2. Overall **incidence of SSI** was found to be 8% (8/100) in the Department of General Surgery.
3. The **incidence of SSI in patients with perioperative hyperglycemia** was found to be significantly higher than perioperatively euglycemic patients (26.66% vs 4.7%).
4. This study shows that perioperative hyperglycemia (> 1 incidence of raised blood glucose perioperatively) is a better indicator of post operative SSI as compared to transient intra operative or post operative stress hyperglycemia.
5. To conclude, patients with perioperative hyperglycemia are vulnerable to develop SSI and hence such patients need vigilance and early intervention to prevent SSI.

Limitation

The limitation of our study was, that patients were from a single hospital, and the results, therefore, need to be verified by larger, prospective, multiple-hospital studies. The study being an observational study, a randomized controlled trial is required to ascertain the optimal perioperative blood glucose levels and to analyse the effects and benefits of intensive glucose control in preventing SSI.

Aim: To study the correlation between peri-operative hyperglycemia to the subsequent risk of post-operative surgical site infection through a prospective observational quantitative study.

Objective:

1. To know the incidence of stress hyperglycemia in patients who are euglycemic pre operatively.
2. To study the effect of peri-operative hyperglycemia on post-operative surgical site infections.

REFERENCES:

1. Anderson DJ, Podgorny K, Berríos-Torres SI, Bratzler DW, Dellinger EP, Greene L, et al. Strategies to Prevent Surgical Site Infections in Acute Care Hospitals: 2014 Update. Infect Control Hosp Epidemiol. 2014 Jun 1;35(6):605–27.
2. Kamat US, Fereirra AMA, Kulkarni MS, Motghare DD. A prospective study of surgical site infections in a teaching hospital in Goa. Indian J Surg. 2008 Jun;70(3):120–4.
3. Al-Niaimi AN, Ahmed M, Burish N, Chackmakchy SA, Seo S, Rose S, et al. Intensive postoperative glucose control reduces the surgical site infection rates in gynecologic oncology patients. Gynecologic Oncology. 2015 Jan;136(1):71–6.
4. Martin ET, Kaye KS, Knott C, Nguyen H, Santarossa M, Evans R, et al. Diabetes and Risk of Surgical Site Infection: A Systematic Review and Meta-analysis. Infect Control Hosp Epidemiol. 2016 Jan;37(1):88–99.
5. Golden SH, Peart-Vigilance C, Kao WH, Brancati FL. Perioperative glycemic control and the risk of infectious complications in a cohort of adults with diabetes. Diabetes Care. 1999 Sep 1;22(9):1408–14.
6. Pomposelli JJ, Baxter JK, Babineau TJ, Pomfret EA, Driscoll DF, Forse RA, et al. Early Postoperative Glucose Control Predicts Nosocomial Infection Rate in Diabetic Patients. J Parenter Enteral Nutr. 1998 Mar;22(2):77–81.
7. Latham R, Lancaster AD, Covington JF, Pirolo JS, Thomas CS. The Association of Diabetes and Glucose Control With Surgical-Site Infections Among Cardiothoracic Surgery Patients. Infect Control Hosp Epidemiol. 2001 Oct;22(10):607–12.
8. Zerr, Mba KJ, Furnary, Md AP, Grunkemeier, PhD GL, Bookin, Md S, Kanhere, Md V, Starr, Md A. Glucose Control Lowers the Risk of Wound Infection in Diabetics After Open Heart Operations. The Annals of Thoracic Surgery. 1997 Feb;63(2):356–61.
9. Hruska LA, Smith JM, Hendy MP, Fritz VL, McAdams S. Continuous Insulin Infusion Reduces Infectious Complications in Diabetics Following Coronary Surgery. J Cardiac Surgery. 2005 Sep;20(5):403–7.
10. Shah BR, Hux JE. Quantifying the Risk of Infectious Diseases for People With Diabetes. Diabetes Care. 2003 Feb 1;26(2):510–3.
11. Shilling AM, Raphael J. Diabetes, Hyperglycemia, and Infections. Best Practice & Research Clinical Anaesthesiology. 2008 Sep;22(3):519–35.
12. McManus LM, Bloodworth RC, Prihoda TJ, Blodgett JL, Pinckard RN. Agonist-dependent failure of neutrophil function in diabetes correlates with extent of hyperglycemia. J Leukoc Biol. 2001 Sep;70(3):395–404.
13. Sima AAF, O'Neill SJ, Naimark D, Yagihashi S, Klass D. Bacterial Phagocytosis and Intracellular Killing by Alveolar Macrophages in BB Rats. Diabetes. 1988 May 1;37(5):544–9.
14. Mowat AG, Baum J. Chemotaxis of Polymorphonuclear Leukocytes from Patients with Diabetes Mellitus. N Engl J Med. 1971 Mar 25;284(12):621–7.
15. Nolan CM, Beaty HN, Bagdade JD. Further Characterization of the Impaired Bactericidal Function of Granulocytes in Patients with Poorly Controlled Diabetes. Diabetes. 1978 Sep 1;27(9):889–94.
16. Bagdade JD, Root RK, Bulger RJ. Impaired Leukocyte Function in Patients with Poorly Controlled Diabetes. Diabetes. 1974 Jan 1;23(1):9–15.
17. Bagdade JD, Stewart M, Walters E. Impaired Granulocyte Adherence: A Reversible Defect in Host Defense in Patients with Poorly Controlled Diabetes. Diabetes. 1978 Jun 1;27(6):677–81.
18. Van Den Berghe G, Wouters P, Weekers F, Verwaest C, Bruyninckx F, Schetz M, et al. Intensive Insulin Therapy in Critically Ill Patients. N Engl J Med. 2001 Nov 8;345(19):1359–67.
19. Noordzij PG, Boersma E, Schreiner F, Kertai MD, Feringa HHH, Dunkelgrun M, et al. Increased preoperative glucose levels are associated with perioperative mortality in patients undergoing noncardiac, nonvascular surgery. eur j endocrinol. 2007 Jan;156(1):137–42.
20. Sperry JL, Frankel HL, Vanek SL, Nathens AB, Moore EE, Maier RV, et al. Early Hyperglycemia Predicts Multiple Organ Failure and Mortality but Not Infection. Journal of Trauma: Injury, Infection & Critical Care. 2007 Sep;63(3):487–94.