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RELATIONSHIP OF PERIOPERATIVE HYPERGLYCEMIA AND POSTOPERATIVE INFECTION IN ELECTIVE ABDOMINAL SURGERY IN NON DIABETIC PATIENT

General Surgery

Nabal Kumar Mishra — Senior Resident, Department of Surgery, ESI PGIMSR & Hospital, Basaidarapur, New Delhi, India

Mansoor Banday — Senior Resident, Department of Surgery, ESI PGIMSR & Hospital, Basaidarapur, New Delhi, India

Atul Jain* — Senior Resident, Department of Surgery, ESI PGIMSR & Hospital, Basaidarapur, New Delhi, India.*Corresponding Author

Malwinder Singh — Senior Resident, Department of Surgery, ESI PGIMSR & Hospital, Basaidarapur, New Delhi, India

Tanweer Karim — Professor, Department of Surgery, ESI PGIMSR & Hospital, Basaidarapur, New Delhi, India

Subhajeet Dey — Professor, Department of Surgery, ESI PGIMSR & Hospital, Basaidarapur, New Delhi, India

ABSTRACT

BACKGROUND: Postoperative infections are common in surgical patients leading to increased morbidity and mortality. Patients are susceptible to stress-induced hyperglycemia following operation, independent of the diabetic status. Perioperative hyperglycemia in critically ill surgical patients increases the risk of postoperative infections and its consequences. Despite 30 million operations performed in United States and much more in India each year, the clear association between perioperative blood glucose (BG) level and postoperative infection (POI) remain ill-defined for the majority of surgery patients.

AIM: To identify the relationship of perioperative hyperglycemia and post-operative infection in elective abdominal surgery in non diabetic patients.

MATERIAL AND METHODS: This is a prospective, observational study of 150 patients who were non diabetic and underwent an elective abdominal surgery. The primary outcome of interest was POI, defined as the occurrence of 1 or more reports of pneumonia, wound infections, urinary tract infections, and sepsis in the first 30 days after surgery and one year after surgery in case of use of prosthesis. The primary predictor of interest was peri-operative hyperglycemia, defined as the RBS of >150mg/dl in the perioperative period (just prior to surgery and within 12 hr and within 24 hr after the skin closure). In the study 500 patient were screened for perioperative hyperglycemia out of which only 150(30%) patient had RBS>150mg/dl in perioperative period.

RESULTS AND CONCLUSIONS: There was significant change in RBS in the perioperative period. The overall incidence of POI in 150 cases of Elective Abdominal Surgeries was 7.33%. Wound infection was observed in 7 cases (4.66%) and 4 cases (2.66%) had respiratory complication.
Risk factors like old age, contaminated wound, higher ASA grade and increased duration of surgery are associated with increased POI.The most common complication was wound infection

KEYWORDS

Postoperative Infections, Perioperative Hyperglycemia, Surgical Site Infections

INTRODUCTION

Postoperative infections are common and often a costly surgical complication. Perioperative hyperglycemia in critically ill surgery patients increases the risk of postoperative infections and other complications.

Despite 30 million operations performed in United States and much more in India each year, the clear association between perioperative blood glucose (BG) level and postoperative infection (POI) (Table 1)[1,2] remain ill-defined for the majority of surgery patients.

Patients are susceptible to stress-induced hyperglycemia from surgical stress, independent of the diabetic status of the patient.

21 to 34% of patient who undergo operations have uncontrolled BG level (i.e. >150 mg/dl), particularly in the immediate postoperative period (<72hr).

Given the prevalence of stress hyperglycemia associated with surgical procedure, we hypothesized that perioperative hyperglycemia is associated with post operative infection (POI).

Table 1- Table showing different post operative infection & risk factors for POI

POST OPERATIVE INFECTION	RISK FACTORS FOR POST OP INFECTION	
	PATIENT FACTORS	OPERATIVE FACTORS
Surgical Site Infection (SSI)	Age	Duration of the surgical scrub
Postoperative Septicaemia	Nutritional status	Pre-operative shaving
Postoperative urinary tract infection	Diabetes	Pre-operative skin preparation
Postoperative chest infection	Smoking	Operative room ventilation
Post operative generalized peritonitis	Obesity	Antimicrobial prophylaxis
Postoperative pelvic abscess	Co-Existent infection at remote body site	Surgical technique
Postoperative subphrenic abscess	Altered immune response	Duration of the operation
Anastomotic leak	Length of the pre-operative stay	Surgical drains
Infection after implant surgery		Types of anesthesia
		Ventilator support

AIM OF THE STUDY

To identify the relationship of perioperative hyperglycemia and post-operative complication in elective abdominal surgery in non diabetic patients.

MATERIAL AND METHODS

A Prospective Observational study was done in the patients admitted to inpatient department of General Surgery in a tertiary care hospital undergoing Elective Abdominal Surgeries for a period of 2 years.

Inclusion criteria:

- Non diabetic patients who undergo elective abdominal surgery in our Hospital.
- Patients whose perioperative RBS is more than 150 mg/dl.

Exclusion criteria:
- A known diabetic patient.
- Emergency abdominal surgery.
- Surgery other then abdominal surgery.
- Perioperative RBS <_150 mg/dl.

METHODS

Patient Population, Case Selection, and Data Definitions

We performed a prospective, observational study of 150 patients who were not diabetic and underwent an elective abdominal surgery. (After proper consent from patients they were included in the study)

The primary outcome of interest was POI, defined as the occurrence of 1 or more infection in the first 30 days after surgery and one year after surgery in case of use of prosthesis. The primary predictor of interest was peri-operative hyperglycemia, defined as the RBS of >150mg/dl in the perioperative period (just prior to surgery and within 12 hr and within 24 hr after the skin closure). In the study 500 patient were screened for perioperative hyperglycemia out of which only 150(30%) patient had RBS>150mg/dl in perioperative period.

An elaborate study of these cases with regard to date of admission, history, clinical features, preoperative preparation, type of surgery, duration of surgery,type of anesthesia, postoperative infection, and postoperative management was done till patient was discharged from hospital, and then follow up on OPD basis for any signs of postoperative complication.

Postoperatively maximum of two blood sample were sent to access the blood glucose level, one within 12 hr of surgery and one within 24 hr of surgery

Case Definition:

A non diabetic patient who undergo elective abdominal surgery with perioperative RBS >150 mg/dl in any one of the perioperative blood sample. Diagnosis of postoperative infection was made on clinical rather than bacteriological basis initially.

"Infection was regarded as post operative Infection if it occurs within 30 days after the surgery and within one year in case of prosthetic use".

Definition and diagnostic criteria of SSI (surgical site infections) as per NNIS program[3] report

-Superficial incisional SSI
- Infection occurs at incision site within 30 days after surgery
- Infection involves only skin and subcutaneous tissue of the incision
- At least one of the following :
  - Purulent drainage from the superficial incision
  - Organism isolated from culture of fluid or tissue from the superficial incision
  - Surgeon deliberately opens wound and there is at least one sign or Symptom (pain, tenderness, localized swelling, redness or heat) unless the Wound culture is negative

Diagnosis of infection by a surgeon or attending physician

-Deep incisional SSI
- Infection occurs at the operative site.
- Within 30 days after surgery if no implant (non human derived foreign body that is permanently placed in the patient during surgery) is left in place.
- Within one year after surgery if an implant is left in place.
  - Infection appears related to surgery.
  - Infection involves deep soft tissue (muscle and facial layers)
  - At least one of the following.
- Purulent drainage from the deep incision but not from the organ/space component of the surgical site.
- Wound dehisces or is deliberately opened by the surgeon when patient has fever(>38^{0}C) and / or localized pain and or tenderness unless the wound culture is negative
- An abscess or other evidence of infection involving the deep incision seen on direct examination or by radiological examination

Diagnosis of deep incisional surgical site infection by surgeon or attending physician.

-Organ/Space SSI
- Infection occurs.
- within 30 days after surgery if no implant (non human derived foreign body that is permanently placed in the patient during surgery) is left in place
- within one year after surgery if an implant is left in place
- Infection appears related to surgery.
- Infection involves any part of anatomy other than the incision opened or manipulated during an operative procedure.
- At least one of the following.
- Purulent drainage from a drain that is placed through a stab wound into the organ/space.
- Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ / space.
- An abscess or other evidence of infection involving the organ/space seen on direct examination during surgery, by histopathological examination or by radiological examination.
- Diagnosis of an organ/space surgical site infection by surgeon or attending physician.

Statistical methods

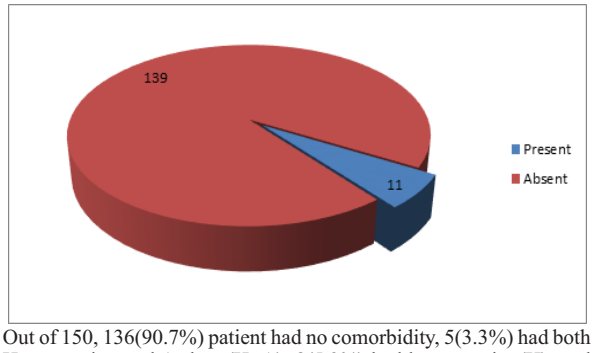
Descriptive analysis was done by measuring mean, standard deviation, proportions. Inferential statistics was done by using chi-square test, fishers exact test, independent t test. The graphs were made in Microsoft Excel software. P value <0.05 is considered as statistically significant. *Ethical committee approval taken.

RESULTS

Patient Population-

The study sample (N=150) had 103 male and 47 female patients. In the study sample 11 (7.33%) patients (GRAPH-1) had post-op infection (POI), whereas 139 patients had no post-op infection (NPOI) during their hospital stay and follow up period.

Figure 1: Pie Chart Showing Number Of Poi



Out of 150, 136(90.7%) patient had no comorbidity, 5(3.3%) had both Hypertension and Asthma(H+A), 8(5.3%) had hypertension(H), and 1(0.7%) had asthma, more POI(12.5%, p=.070) was observed in patient who had hypertension alone but was statistically insignificant.

Majority of cases were in the category of Inguinal Hernia (39.3%) then Ventral Hernia (19.3%) followed by Cholelithiasis(14.0%).(TABLE-2)

Table 2- FREQUENCIES (DISTRIBUTION) ON THE BASIS OF DIAGNOSIS

DIAGNOSIS	FREQUENCY	PERCENT
Inguinal Hernia	59	39.3
Ventral hernia	29	19.3
Cholelithiasis	21	14.0
Gastric Carcinoma	10	6.7
GOO	6	4.0
Rectal Carcinoma	4	2.7
Umbilical Sinus	1	0.7
Carcinoma GE Junction	3	2.0

Chronic Pancreatitis	2	1.3
Carcinoma Head Of Pancreas	2	1.3
PVD	1	0.7
Choledocholithiasis	2	1.3
Recurrent Subacute Intestinal Obstruction	1	0.7
Oesophageal Stricture	1	0.7
Soft Tissue Sarcoma Anterior Abdominal Wall	1	0.7
Hyperspleenism	1	0.7
Appendicitis	4	2.7
Omental Cyst	1	0.7
Inguinal Hernia + Cholelithiasis	1	0.7
Total	150	100.0

44(29.3%) cases were under ASA Grade-1, 87(58.0%) were under ASA Grade-2 and 19(12.7%) were under ASA Grade-3. 92 Cases (61.3%) were operated under Spinal Anesthesia (SA) and 58 Cases (38.7%) were operated under General Anesthesia (GA). In the category of SA two (2.2%) and in the category of GA nine (15.5%) cases had POI which is significant (p=0.002). Seven cases (12.1%) under GA had wound infection(WI) and two cases each (2.2 &3.4%) under SA and GA had respiratory tract infection(RTI) which is statistically significant.(p=0.002).

In our study (n=150), 121(80.7%) and 29(19.3%) were under the category of clean and clean-contaminated wound respectively. In the category of clean wound 5 Cases (4.1%) had POI and in the category of clean-contaminated 6 cases (20.7)had POI which was found to be significant in my study. (p=0.002)(TABLE 3)

Table 3-association Of Postop Infection With The Type Of Wound

			Wound		Total
			Clean	**Clean-contaminated**	
Post Operative Infection	-	Count	116	23	139
		Percentage within wound	95.9%	79.3%	92.7%
	+	Count	5	6	11
		Percentage within wound	4.1%	20.7%	7.3%
Total		Count	121	29	150
		Percentage within wound	100.0%	100.0%	100.0 %

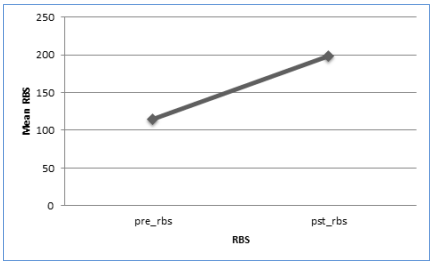
In our study it was observed that longer the duration of surgery more is the number of POI, however it was statistically insignificant (p=.003)

The mean preoperative RBS was 115.09 +-20.41 and postoperative RBS 198+-43.50 and the paired difference in mean between preoperative and postoperative RBS is -83.55+-20.21 which is significant (TABLE-4, GRAPH 2)

Table-4 A) Showing Mean Of Preoperative And Postoperative Rbs B) Mean Difference Between Preop And Post Operative Rbs

			PREOPERATIVE RBS	**POSTOPERATIVE RBS**
a	Mean		115.0867	198.6333
	N		150	150
	Std. Deviation		20.40823	43.50012
	Std. Error Mean		1.66632	3.55177
b	Paired Differences	Mean	-83.54667	
	t		-20.212	
	df		149	
	Sig. (2-tailed)		0.000	

Figure 2: Graph 2- Mean Of Preoperative And Postoperative Rbs



CHANGE IN RBS Vs POI- 11 cases had POI who had the mean difference in RBS of 104.45+-53.25 and the cases who had mean difference in RBS of 81.89+-50.24 did not have any POI, which is not significant in this study.(p=0.155)

CHANGE IN RBS VS TYPE OF POI- Cases who had mean difference in RBS of 109.85+-62.87 had more(7) of wound infection and cases who had mean difference in RBS of 95.0+-36.86 had more(4) of respiratory tract infection, but it is not significant in this study**. (p=0.328)**

POI Vs AGE- In this study the older age group had more complication as compared to the younger age group (12.5% in 70+, 8.7% in 51-70yr and 7.4% in 31-50 yr age group) but was not statistically significant (p=0.571).

DISCUSSION

INCIDENCE OF POI

The overall Incidence of POI in 150 cases of Elective Abdominal Surgeries was 7.33%. Wound infection was observed in 7 cases (4.66%) and 4 cases (2.66%) had respiratory infection.

The incidence rate of wound infection in this study is slightly higher than those reported in Western literature such as United Kingdom (3.1%), Holland (4.3%), etc.[2,4,5] but it can be attributed to the perioperative hyperglycemic status. Most of the studies carried out were done for incidence of wound infection and none has been done for overall incidence of POI.

WOUND TYPE

The incidence rate of POI differed by wound type, in our study maximum POI was noted in clean-contaminated wounds (20.7%). We had no contaminated case in our series, which is due to the fact that, this being predominantly a study of elective abdominal Surgery. The incidence of POI in clean wounds was 4.1% and clean contaminated wounds was 20.7% which is statistically significant (p=0.002).

In a study by SP Lilani and Associates in Grant Medical College and Sir J. J. Group of Hospitals, Byculla, Mumbai found that the overall infection rate was 8.95%. Surgical site infection rate was 3.03% in clean surgeries and 22.41% in clean-contaminated surgeries[7].

Our study correlates with Lul Raka et al series[6] and SP Lilani series, in incidence among clean contaminated cases and in our study it is found that clean-contaminated wounds are at higher risk of POI compared to clean wounds.

The incidence of wound infection in our study among clean cases (1.7%) was similar to the study by SP Lilani and colleagues in Grants Hospital, Mumbai and is well within the standard accepted range (1 – 5 %).[8]

AGE

In the present study it is observed that there is a gradual rise in Incidence of POI as age advances. The incidence showed a gradual rise from 0% in the <30 age groups to 7.4% in 31 – 50 age groups, up to 12.5% in >70 age groups, but the overall incidence in each age group did not differ significantly (p=0.57).

Cruse and Foord observed in their study that older patients are more likely to develop infection in clean wounds than younger patient.[9] As the age increases the number of associated co-morbidities also increases and there is also decrease in the immunity level which makes them more susceptible for POI.

DURATION OF SURGERY

It was observed that surgeries lasting longer than 60 min had a higher incidence of POI(22.2% to 23.1%) which was found to be statistically significant (p=0.003), compared to 4.9% in surgeries lasting less than 31 to 60 min. Similar results were present in study by Lul Raka et al in 2006.[8] Major abdominal Surgeries like Biliary tract surgeries and Gastrointestinal Surgeries usually lasts longer, compared to Abdominal wall Surgeries like Hernioplasty and henceforth the duration of exposure to microorganisms also increases which leads to substantial increase in incidence of wound infections.

In our study all the patient in whom the duration of surgery was expected to be longer was started with prophylactic chest

physiotherapy which might have had some bearing on the overall incidence of POI.

CHANGE IN RBS

It was observed that higher the change in RBS more is the POI. In our study the cases who had change in RBS with mean (104.45±53.25) had POI and those with mean RBS of (81.89±50.24) had no complication. We assess the association between Perioperative hyperglycemia with POI in a heterogonous non diabetic general surgical population who underwent elective abdominal surgery. Perioperative hyperglycemia is associated with an increased risk of postoperative infection. We present novel findings of a positive association between higher perioperative hyperglycemia and increased risk of POI after elective abdominal surgery that remained statistically insignificant, after adjustment of other known predictors of postoperative infection.

Randomized control trials in medical, cardiac, and neurosurgical populations have found reduced rates of bacteremia,[10] duration of antibiotic usage, infection rates and incidence of recurrent infections when patients have strict glycemic control. The Portland protocol provides parameters of BG control with a blood glucose goal of <150 mg/dl in diabetic patients undergoing cardiac surgery and has significantly reduced infections in the acute postoperative period.[11,12] Although multiple BG control protocols exist,[5,13] there is a paucity of clinical evidence on the effect of stress-induced hyperglycemia control on POI in diabetic and non diabetic patients undergoing general and vascular surgery.[14,15] The risk of POI in diabetic patients has been well described, and control of POG has been shown to dramatically reduce wound infection rates and mortality in diabetic patients. However, defined parameters for postoperative hyperglycemia in non diabetic patients has not been elucidated.

This study provides a unique contribution to understanding the association of perioperative hyperglycemia and postoperative outcomes in a general surgery patient who underwent elective abdominal surgery. Our study has some limitations like the less number of cases. Large number cases in the study group might have some significant association between perioperative hyperglycemia and POI. Although important variables that account for increased risk of infections were controlled for in our analysis, such as age, ASA etc. A randomized clinical trial comparing the effects of tight glucose control in patients who have undergone elective abdominal surgery is necessary to assess causation in the association of perioperative hyperglycemia and postoperative infection.

The use of a tight glucose control may also lead to a higher risk of hypoglycemia, a potential deleterious effect. In a clinical trial by Van den Berghe et al, 11.4% of those in the <110mg/dl group versus 1.8% of those with glucose control between 180 and 200 mg/dl had blood glucose <40 mg/dl. However, the mean value of hypoglycemia did not differ between the 2 groups (32 ± 7 mg/dl conventional group and 33 ± 5 mg/dl intensive group). Hypoglycemia sequel was similar for both groups, except for neurologic sequel, which was higher in the intensive glucose control group.[6]

To avoid hypoglycemia in the setting of tight glycemic control, quality improvement measures, such as adequate training of glucose management, the creation of designated teams may help.

CONCLUSION

Patients who had undergone elective abdominal surgery with perioperative hyperglycemia have had 7.33% POI. Clean contaminated wounds were found to have higher incidence of POI and longer the duration of surgery more is the POI. Further research is needed and other surgery should be included in the study to generalize the outcome, and the possible role of intensive glucose control in such patients to decrease the risk of postoperative complications. Postoperative glycemic control could be a simple, actionable intervention to decrease the risk of postoperative complications after elective abdominal surgery.

DECLARATIONS

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Conflict of interest: Nil
Ethical approval: Taken

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