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Research Article

INCIDENCE AND PREDICTORS OF SURGICAL SITE INFECTION IN MAJOR ABDOMINAL SURGERIES AT A TERTIARY CARE CENTER IN DELHI

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ABSTRACT

Objective: Surgical site infections (SSIs) are the third commonly stated nosocomial infections, with the prevalence rate of 14–16%. In India, the prevalence of SSIs in elective surgeries ranged from 3.83% to 39% and in cases of emergency surgeries, the prevalence ranged from 12.41% to 26.4%. This study was aimed to measure the occurrence of SSIs amid subjects experiencing major abdominal surgeries at tertiary care center in Delhi and to assess the predictors related to occurrence of SSIs in these subjects.

Methods: In this cross sectional study, data was collected over a period of one year at the Department of Surgery, Super Specialty Hospital in New Delhi, from January 2017 to January 2018. All major gastrointestinal surgeries were considered. Sociodemographic details, clinical history, and surgical details were taken.

Results: Out of total 626 patients, 42 (6.7%) developed SSIs. The positive predictors of SSIs in our study were male gender, American Society of Anesthesiology grade of 2 and above, wound class of two and above, longer duration of surgery, emergency surgery, open surgery, laparoscopic converted to open surgery, presence of comorbidities, presence of hypoalbuminemia, and hypoproteinemia.

Conclusion: SSIs seems to be a common source of perioperative morbidity and mortality, leading to increased hospital stay and cost of treatment. Proper planning and accordingly managing such case by case scenarios can lead to decreased incidence of SSIs and help reducing burden to the health system.

Keywords: Surgical site infection, Abdominal surgery, American society of anesthesiology, Surgical site infections, Hypoalbuminemia, Hypoproteinemia.

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INTRODUCTION

A center for disease control and prevention (CDC) refers surgical site infections (SSIs) to be “An infection that occurs after surgery in the part of the body where the surgery took place” [1]. The collective incidence of SSIs in elective clean and clean-contaminated surgeries in most of the developing countries reported as 6% [2]. The pooled incidence of SSI in lower- and middle-income countries in all wound categories is 11.8% [3]. In India, the occurrence of SSIs in elective surgeries ranged from 3.83% [4] to 39% [5]. In cases of emergency surgeries, the prevalence of SSI ranged from 12.41% [6] to 26.4% [7]. SSIs are the third commonly described nosocomial infections, accounts up to 14–16% [6]. The major predictors of SSIs are comorbidity, addiction such as smoking, pre-operative blood picture, antimicrobial prophylaxis, American Society of Anesthesiology (ASA) class, duration of surgery, post-operative antibiotics, and surgical wound classification [8]. The SSIs pose an economic burden on health system costs by prolonging the duration of hospital stay and advancing the treatment plan [9,10]. Care for cases with SSIs was predictable to cost on typical an additional 3422 US$ per case [11]. In case of abdominal surgeries, the chances of developing SSI are higher [12] resulting in amplified hospital stay, re-operations, readmissions, restriction of quality of life, and loss of daily wages, this further causes economic and social tragedy [13].

Due to this, we conducted a study aimed to measure the incidence of SSIs between cases undertaking major abdominal surgeries at tertiary care center in Delhi and to assess the predictors related to occurrence of SSI in these subjects.

METHODS

A cross-sectional research carried at the Department of Gastrointestinal and Bariatric Surgery, BLK Super Specialty Hospital, New Delhi. The data were collected over a period of 1 year, from January 2017 to January 2018. Patients, who had undergone gastrointestinal surgical procedures such as esophagectomies, gastric resections, pancreaticobiliary procedures, enteric, and colorectal resections as well as hernia repairs, either by conventional or laparoscopic methods, were included in the study. Both elective and emergency surgeries were encompassed into the research. Data regarding demographic status and detailed patient history were taken and examination and related investigations were done preoperatively. All the patients received preoperative antibiotics. Surgical details were noted such as elective/emergency, laparoscopic/open/conversion, duration of procedure, intraoperative findings, and contamination during surgery (wound class). Patient was observed for SSI in the IPD till patient was discharged and after that patient was followed in OPD at least till 30th post-operative day. Patients, in whom mesh was used, were followed for 1 year. The categorization of SSI was done based on CDC definition into superficial incisional, deep incisional, and organ or space SSIs [14]. Superficial incisional SSI is infection of the skin and subcutaneous tissues while deep incisional SSI is involvement of the fascial and muscle layers and organ or space SSI is involvement of any part of the anatomy other than the incision that is opened or manipulated during surgery.

The data were collected using a semi-structured performa and data entry was done in Excel. Data were screened for outliers; data analysis was done with SPSS. The categorical variables were expressed in proportion and percentages, the continuous variables were expressed in mean and standard deviation. The measures of association were measured by Odd’s ratio, the mean was compared by independent T test, and data were associated by Chi-square test followed by Fisher’s test. $p<0.05$ was considered statistically significant.

Table 1: Distribution and association of categorical variables with surgical site infection in study participants

Parameter	SSI present (n=42), frequency (%)	SSI absent (n=584), frequency (%)	χ^2 value, degree of freedom	p-value	OR
Sex (female)	13 (31.0)	306 (52.4)	7.21, 1	0.00	1
Male	29 (69.0)	278 (47.6)			2.455 (1.251–4.818)
ASA grade (1)	9 (21.4)	231 (39.6)	95.80, 3	0.00	1
ASA grade (2)	13 (31.0)	296 (50.7)			5.38 (2.36–12.23)
ASA grade (3)	13 (31.0)	55 (9.4)			6.06 (2.46–14.91)
ASA grade (4)	7 (16.7)	2 (0.3)			89.83 (16.3–495.08)
Wound class (1)	2 (4.8)	84 (14.4)	71.98, 3	0.00	1
Wound class (2)	19 (45.2)	451 (77.2)			1.76 (0.40–7.73)
Wound class (3)	4 (9.5)	15 (2.6)			11.2 (1.88–66.68)
Wound class (4)	17 (40.5)	34 (5.8)			21 (4.60–95.86)
Elective	18 (42.9)	527 (90.2)	78.08, 1	0.00	1
Emergency	24 (57.1)	57 (9.8)			12.327 (6.312–24.077)
Laparoscopic surgery (L)	7 (16.7)	467 (80)	86.68, 2	0.00	1
Open surgery (O)	24 (57.1)	87 (14.9)			18.40 (7.691–44.038)
Laparoscopic converted to open (LO)	11 (26.2)	30 (5.1)			24.46 (8.84–67.63)
Comorbidity (absent)	28 (66.7)	391 (67.0)	0.01, 1	0.89	1
Comorbidity (present)	14 (33.3)	193 (33.0)			1.013 (0.521–1.968)
Hypoproteinemia (present)	13 (31)	105 (18)	4.31, 1	0.03	2.04 (1.028–4.067)
Hypoproteinemia (absent)	29 (69)	479 (82)			1
Hypoalbuminemia (present)	7 (16.7)	33 (5.7)	7.94, 1	0.00	3.339 (1.379–8.085)
Hypoalbuminemia (absent)	35 (83.3)	551 (94.3)			1

ASA: American Society of Anesthesiologists, OR: Odds ratio, SSI: Surgical site infection

RESULTS

Six hundred and twenty-six subjects undergone major abdominal surgeries were recruited into the present study. Out of them, 42 (6.7%) patients developed SSI. In our study, male gender were seems to the positive predictors of SSI, ASA grade of 2 and above, wound class of two and above, emergency surgery, open surgery, laparoscopic converted to open surgery, presence of comorbidities and presence of hypoalbuminemia and hypoproteinemia. The odds of getting SSIs increased with increasing grade of ASA and wound class. The associations of gender, ASA grade, wound class, and type of surgery were found to have statistically significant relation with SSI status of patients (p<0.05) (Table 1).

The mean age of subjects with SSI was 49.59 (17) years, without SSI was 49.12 (15.35) years. No statistically significant difference among mean age in both groups was observed.

Mean duration of surgery in patients with SSI was 206.33 (103.73) min and without SSI was 99.72 (79.71) min. Mean duration of surgery (p=0.00) showed a statistically significant difference among both groups (Fig. 1).

The mean (SD) pre-operative protein in patients with SSI was 6.93 (1.03) g/l and without SSI was 7.33 (0.64) g/l. Statistical significant difference in mean preoperative protein values in both groups (p=0.00) was observed. Similarly, the mean (S.D) pre-operative albumin in patients with SSI was 3.84 (0.62) g/l and without SSI was 4.05 (0.39) g/l. The mean pre-operative albumin values among both groups (p=0.00) was also found to be statistically significant (Fig. 2).

In the present study, overall occurrence of SSI as 6.7, half of which were superficial incisional SSI, 31% were organ or space SSI and rest 19% were deep incisional SSI (Table 2).

The binomial regression analysis model when computed for the presence or absence of SSI in study participants yielded four models in forward LR model in SPSS. The final model constituted emergency surgery, ASA score of 3 and above, operative time of more than 90 min, open surgery, and lap to open converted surgery to be predictors of SSIs in our study. Nagelkerke R Square value for this model was 0.41 and significance was 0.00 (Table 3). The findings of regression model further supported the Table 1 findings.

Table 2: Incidence of surgical site infection

SSI	Frequency	Percentage (out of total SSI)	Percentage (out of total patients)
Deep	8	19.0	1.27
Organ or space	13	31.0	2.07
Superficial	21	50.0	3.3
Total	42	100.0	6.7

SSI: Surgical site infection

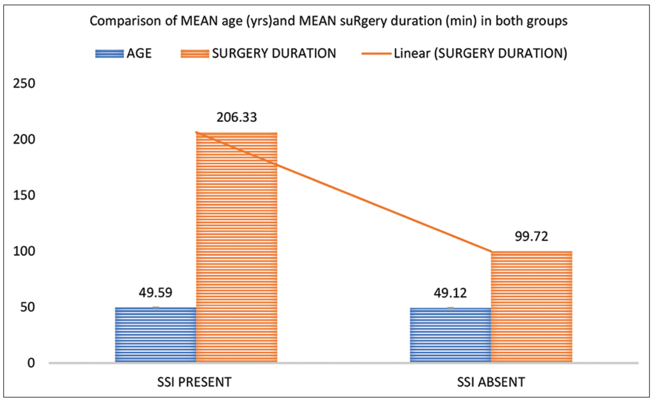

Fig. 1: Bar diagram comparing mean age and duration of surgery in patients with and without surgical site infections

DISCUSSION

The present study involved total 626 patients undergoing major abdominal surgeries. The overall incidence of SSI was found to be 6.7% which was in line with the findings by other Indian studies like Shahane *et al.* [15] –6% and Sharan *et al.* [16] –7%. Few other Indian studies have stated higher incidence of SSI like Patel *et al.* [17] –12.68%, Mekhla *et al.* [5] –39%, and Singh and Yadalwar [7] –26.4%. This rise in incidence was secondary to the fact that they included emergency surgeries only [7] and rural setting [5]. The previous studies have also shown lower incidence of SSI like Saravanakumar and Devi [6] –4.34%, Chada *et al.* [4] –3.83%, and Carvalho *et al.* [18] –3.4%, which were due to inclusion of clean or clean contaminated surgeries only [4,6]. SSI incidence was higher compared to the researches performed in

Table 3: Regression analysis for prediction of surgical site infection in study participants

Prediction of surgical site infections	OR	95% CI for OR		Nagelkerke R square Significance
		Lower	Upper	
Model 1				
Type of surgery (emergency)	12.805	6.495	25.247	0.210 0.000
Model 2				
Type of surgery (emergency)	6.376	3.036	13.394	0.360
Laparoscopic surgery				0.000
Open surgery	10.318	4.112	25.890	
Laparoscopic to open conversion	0.629	0.255	1.555	
Model 3				
Type of surgery (emergency)	4.108	1.799	9.382	0.398
ASA score (≥3)	4.135	1.796	9.521	0.000
Laparoscopic surgery				
Open surgery	8.750	3.351	22.850	
Laparoscopic to open conversion	0.563	0.218	1.451	
Model 4				
Type of surgery (emergency)	4.273	1.820	10.030	0.416
ASA score (≥3)	3.947	1.687	9.239	0.002
Operative time (≥90 min)	3.200	1.127	9.088	
Laparoscopic surgery				
Open surgery	5.274	1.851	15.029	
Laparoscopic to open conversion	0.645	0.249	1.671	

ASA: American Society of Anesthesiologists, OR: Odds ratio, CI: Confidence interval

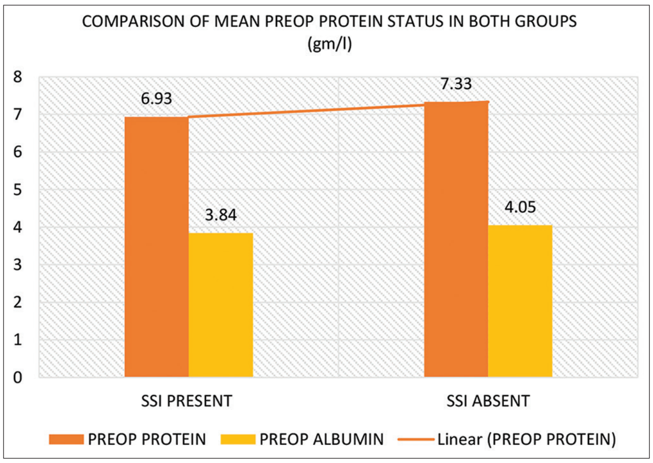

Fig. 2: Bar diagram comparing mean pre-operative protein and pre-operative albumin in patients with and without surgical site infections

established nations, namely, USA, 1.9% [19] and Italy, 2.6% [20]. This can be because developed nations have systematic SSI surveillance programs; well SSI related trained staff, better educated, and aware patients. It is actually the interaction between the bacterial, patient, and local wound factors which regulate the progress of SSI and therefore, it is challenging to know the actual relationship of a particular factor to the progress of SSI.

In our study, ASA grade emerged as a significant predictor of SSI. In other studies too, ASA grade had been significant predictor [21]. The odds ratio of SSI increased progressively with increase in ASA grade in other studies as well [5,12,17,21]. The ASA is believed to be overall reflection of health of an individual, thus predicting SSI. Wound class has been a significant predictor for SSI. The odds ratio of SSI increased with each class of wound in our study and other studies [8,12,15,16]. Albumin is a assessable sign of protein-energy malnutrition and has been connected with poor tissue healing, conceded immune response, and impaired collagen synthesis at operating sites [22,23]. Hypoalbuminemia has formerly been connected with an amplified threat of post-operative wound difficulties in numerous operations [24]. A reduction in albumin from 46 to 21 g/L is linked with an proliferation of morbidity from 10 to 65% [25]. In our study, hypoalbuminemia and hypoproteinemia has been connected with amplified threat of SSI. The awareness of the implications of low pre-operative serum albumin and consideration of nutritional intervention or improved antibiotic prophylaxis in malnourished subjects have shown some enhancement in preventing SSI in such cases [26].

In this study, mean duration of surgery was 99 min in patients who had SSI and 206 min in patients who did not have SSI. The mean duration in SSI group of patients was more than twice as compared to Non-SSI group. Higher surgical duration has been found to be associated with high SSI incidences as evidenced by previous literature [20] −1.6 h versus 2.1 h and in other studies, for every hour of extent of surgery, 34% rise in the chance of SSI expansion (p<0.001) [27,28]. Surgery duration associates with further threat influences predisposing to SSI, namely, ASA index, advising that subjects with advanced ASA grade tend to have lengthier surgery period [29]. The prospect of SSI amplified with aggregate time increments; for example, a 13%, 17%, and 37% increase in SSI for every 15 min, 30 min, and 60 min of surgery, correspondingly [30]. In our study, the duration of surgery was a significant predictor in regression models at cutoff value of 180 min. Pre-morbid illnesses, namely, diabetes and hypoalbuminemia, have been shown to have great risk of emerging SSI in the earlier studies; this was further confirmed in our study [12,26,31]. The incidence of SSI was found to be higher in open surgeries as compared to laparoscopic surgeries in our study similar to findings of other studies [16,32].

Limitations

Factors such as BMI and addiction status were not included in our studies which are significant predictors of SSI. Post-operative laboratory results were also not considered in this study.

CONCLUSION

SSIs are a common cause of perioperative morbidity and mortality, leading to increased hospital stay and cost of treatment. Factors such as presence of comorbidity, emergency surgery, higher ASA grade, dirty wounds, higher duration of surgery, and open surgical procedures are important and significant predictors of SSI. Proper planning and accordingly managing such case by case scenarios can lead to decreased incidence of SSI and help reducing burden to the health system.

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AUTHORSHIP CONTRIBUTIONS

Dr. Rayees Ahmad Bhat and Dr. Syed Altamash – Design and Data collection of data, journal selection, and literature analysis for the manuscript. Dr. Ruchi Pandey and Dr. Rayees Ahmad Bhat – Analysis and interpretation, literature search, manuscript writing, and submission to the journal.

CONFLICTS OF INTEREST

Nil.

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Nil.

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