Original Article

# A cross sectional study of risk factors for surgical site infections after laparoscopic and open cholecystectomy in a tertiary care hospital in North East India

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## Abstract

**Background:** Surgical site infection (SSI) after cholecystectomy unduly delays patients' early return to normal activities and also leaves behind relatively disfigured cosmetic scars at the port sites. This prospective study was undertaken to assess the various risk factors leading to SSI in patients undergoing cholecystectomy, both by laparoscopic and open techniques in this part of India for which no data is available at present. **Material and Methods:** A total of 1507 cholecystectomies (1184 by laparoscopy and 323 by open technique) during a 6 year period. The various risk factors studied were gender, age, BMI, DM, chronic anaemia, COPD, timing of surgery (elective or emergent), influence of surgeon (operated by resident surgeon or faculty), intraoperative bile spillage, etc., Odd's ratio was calculated to see the influence of the factors on SSI and statistical significance was tested by Chi-square test. **Results:** The overall rate of infection was 3.12% (1.94% in laparoscopy and 7.43% in the open technique). Intraoperative bile spillage, increasing age, increased duration of surgery, laparoscopic cholecystectomy done by resident surgeons, increased intraoperative blood loss, emergent operations done for acute cholecystitis, etc., were associated with higher rates of SSI. **Conclusion:** Meticulous operative techniques avoiding bile spillage and blood loss during cholecystectomy may reduce the chances of developing SSI.

**Keywords:** Laparoscopic cholecystectomy, open cholecystectomy, risk factors, surgical site infection

## Introduction

Laparoscopic cholecystectomy (LC) which is the gold standard treatment for symptomatic gallstone diseases[1] has the added advantage of lesser surgical site infections (SSI) than open cholecystectomy (OC).[2] Besides OC, other risk factors for increased surgical site infections after cholecystectomy included older age of the patients, male gender, longer duration of surgical procedures, patients undergoing multiple surgical procedures, patients with more acute illness undergoing emergent surgeries, etc.[2-5] The overall rate of infections after cholecystectomy varied from 1% to 14%.[2,6] The present study was undertaken to study the various risk factors causing postoperative SSI in patients from North Eastern part of India.

## Material and Methods

This cross-sectional study was carried out in NEIGRIHMS, Shillong from April 2014 to March 2020. All consenting patients were included in the study. A total of 1507 cholecystectomies were performed during the period; 1184 by laparoscopy and 323 by open technique. Prophylactic Ceftraixone injection of 1 gram strength was given to all patients 30 minutes prior to incision.

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The role of the following risk factors were studied for SSI: gender, age, intra-operative bile spillage, intraoperative stone spillage, duration of surgery, diabetes mellitus, chronic obstructive pulmonary disease (COPD), chronic smoker, body mass index (BMI), chronic anaemia, alcoholism, operation done by residents vs faculty, intraoperative blood loss, emergency vs elective, etc., The factors were studied separately for LC and OC.

The descriptive statistics for continuous variables have been shown in percentages and as means with standard deviations.

Chi-square test was used to analyse the influence of the various factors on the number of infections in LC and OC separately. Odd's ratio was calculated to analyse the amount of influence one or the other factor were causing the SSIs. Statistical significance was kept at 95% with *P* value ≤ 0.05 taken as significant. Ethical approval was obtained from the ethics committee on 25th March 2014.

## Results

Out of 1507 cholecystectomies, SSI was detected in 47 (3.12%) patients; 23 (1.94%) in the laparoscopy group and 24 (7.43%) in the open technique. In the LC group, SSI was observed in the epigastric port in 38 (80.85%) patients, umbilical port in 6 (12.77%) and 3 (6.38%) in the lateral ports.

There were a total of 387 males and 1120 female patients in the ratio of 1:4 approximately [Table 1]. The incidence of infection in both males and females was comparable in both LC and OC groups. Most of the patients (~60%) belonged to age group 25-44 years of age [Table 2]. More number of infections was observed in older patients who underwent OC.

Most of the study population had BMI in the normal range. Only 123 (8.16%) patients belonged to the obese group [Table 3].

The time taken for surgery was significantly longer in both LC and OC in those patients who subsequently developed postoperative infections as shown in Table 4.

Bile spillage had had significant influence on patients with SSI in both laparoscopic and open cholecystectomy groups [Table 5]. In the LC group patients having bile spillage had 4.357 times more chances of developing postoperative SSI (p value 0.001). In the OC group, patients having bile spillage had 2.828 times more chances of having SSI than those patients not having bile spillage during operation (p value 0.03).

Stone spillage, diabetes mellitus, COPD, chronic smoking, chronic anaemia, alcoholism did not have any significant influence on SSI [Table 5].

Blood loss was found to be higher in both LC and OC group of patients who later on developed postoperative SSI. But it was found to be statistically significant (p value 0.02) in OC group.

Postoperative SSI was significantly higher (p value 0.001) in those LC done by resident surgeons, but the SSI was similar in OC group when operated by resident surgeons or by faculty.

**Table 1: Patient characteristics**

| Parameter | No infection (1460) | | Infection + (47) | |
|---|---|---|---|---|
| | Lap (1161) | Open (299) | Lap (23) | Open (24) |
| Gender | | | | |
| Male (387) | 289 | 87 | 4 (1.37%) | 7 (7.44%) |
| Female (1120) | 872 | 212 | 19 (2.13%) | 17 (7.42%) |
| Surgeon | | | | |
| Faculty (1078) | 978 | 78 | 16 (1.61%) | 6 (7.14%) |
| Residents (429) | 183 | 221 | 7 (3.68%) | 18 (7.53) |
| Timing of surgery | | | | |
| Routine (1419) | 1130 | 258 | 18 (1.57%) | 13 (4.80%) |
| Emergency (88) | 31 | 41 | 5 (13.89%) | 11 (21.15%) |

**Table 2: Age group distribution**

| Parameter | No infection (1460) | | Infection + (47) | |
|---|---|---|---|---|
| | Lap (1161) | Open (299) | Lap (23) | Open (24) |
| 15-24 (122) | 97 | 23 | 1 (1.02%) | 1 (4.17%) |
| 25-34 (411) | 346 | 61 | 3 (0.86%) | 1 (1.61%) |
| 35-44 (492) | 414 | 68 | 7 (1.66%) | 3 (4.23%) |
| 45-54 (301) | 208 | 76 | 9 (4.15%) | 8 (9.52%) |
| 55-64 (144) | 85 | 48 | 2 (2.30%) | 9 (15.79%) |
| 65-74 (37) | 11 | 23 | 1 (8.33%) | 2 (8.00%) |

**Table 3: BMI* distribution**

| Parameter | | No infection (1460) | | Infection + (47) | |
|---|---|---|---|---|---|
| | | Lap (1161) | Open (299) | Lap (23) | Open (24) |
| 18.4-22.9 (699) | Male (136) | 113 | 21 | 1 (0.88%) | 1 (4.55%) |
| | Female (563) | 473 | 79 | 8 (1.66%) | 3 (3.66%) |
| 23-24.9 (685) | Male (198) | 144 | 48 | 2 (1.37%) | 4 (7.69%) |
| | Female (487) | 366 | 102 | 9 (2.40%) | 10 (8.93%) |
| 25-29.9 (123) | Male (53) | 32 | 18 | 1 (3.03%) | 2 (10.00%) |
| | Female (70) | 33 | 31 | 2 (5.71%) | 4 (11.43%) |

*By Asian Criteria for BMI cut-offs (18.4-22.9:Normal; 23-24.9: Pre-obese; 25- 29.9: Obese)

**Table 4: Incidence of various risk factors**

| Parameter | No infection (1460) | | Infection + (47) | |
|---|---|---|---|---|
| | Lap (1161) | Open (299) | Lap (23) | Open (24) |
| Bile spillage | 87 | 38 | 6 | 7 |
| Stone spillage | 56 | 29 | 2 | 5 |
| Duration of surgery | 38.24±12.32 | 42.52±8.46 | 57.41±9.16 | 59.34±11.27 |
| Diabetes mellitus | 59 | 31 | 3 | 4 |
| COPD | 34 | 57 | 1 | 3 |
| Chronic smoker | 46 | 48 | 2 | 4 |
| Chronic anaemia | 47 | 17 | 2 | 1 |
| Alcohol | 71 | 13 | 2 | 1 |
| Blood loss | 54 | 27 | 3 | 6 |

**Table 5: Statistical results**

| Parameter | Approach | Odd's ratio | 95% CI | *P* |
|---|---|---|---|---|
| Bile spillage | Laparoscopic | 4.357 | 1.675-11.33 | 0.001 |
| | Open | 2.828 | 1.101-7.266 | 0.03 |
| Stone spillage | Laparoscopic | 1.879 | 0.430-8.214 | 0.36 |
| | Open | 2.45 | 0.852-7.050 | 0.09 |
| D M | Laparoscopic | 2.802 | 0.810-9.695 | 0.11 |
| | Open | 1.729 | 0.555-5.385 | 0.27 |
| COPD | Laparoscopic | 1.507 | 0.197-11.50 | 0.41 |
| | Open | 0.607 | 0.175-2.103 | 0.3 |
| Chronic smoker | Laparoscopic | 2.308 | 0.526-10.14 | 0.27 |
| | Open | 1.046 | 0.342-3.196 | 0.42 |
| Chronic anaemia | Laparoscopic | 2.257 | 0.514-9.910 | 0.28 |
| | Open | 0.721 | 0.091-5.664 | 0.44 |
| Alcohol | Laparoscopic | 1.462 | 0.336-6.359 | 0.47 |
| | Open | 0.916 | 0.115-7.308 | 0.33 |
| Blood loss | Laparoscopic | 3.075 | 0.887-10.67 | 0.09 |
| | Open | 3.358 | 1.229-9.173 | 0.02 |
| Resident vs faculty | Laparoscopic | 5.155 | 2.063-12.88 | 0.001 |
| | Open | 1.059 | 0.406-2.763 | 0.45 |
| Emergency vs elective | Laparoscopic | 10.13 | 3.533-29.02 | 0.001 |
| | Open | 5.325 | 2.235-12.68 | 0.001 |
| Males vs females | Laparoscopic | 0.635 | 0.214-1.882 | 0.28 |
| | Open | 1.242 | 0.510-3.026 | 0.40 |
| BMI >25 vs <25 | Laparoscopic | 2.529 | 0.733-8.731 | 0.14 |
| | Open | 1.701 | 0.643-4.501 | 0.21 |
| Age >55 vs <55 | Laparoscopic | 1.664 | 0.486-5.700 | 0.33 |
| | Open | 2.717 | 1.166-6.331 | 0.02 |

SSI was significantly higher in both LC and OC when the operations were done in emergent setting, as most of the surgeries in emergent setting are done by resident surgeons.

No increased incidence of SSI was noted in the present study in male patients or in patients with BMI >25.

Patients older than 55 years of age were found to have more incidence of SSI in the OC group which was statistically significant (p value 0.02), but no difference was observed in the LC group.

## Discussion

The overall infection rate in this study was 3.12% (1.94% in LC and 7.43% in OC) similar to 3.57% (2.6% in LC and 8.9% in OC) by Brill A *et al.*[7] Makadia JM *et al.*[8] reported overall infection rate of 4.3% (1.3% in LC and 66.7% in OC).

Intraoperative spillage of bile was a significant contributing factor for SSI in both LC and OC group. Makdia JM *et al.*[8] and Jawien M *et al.*[9] also reported higher incidence of SSI in patients having intraoperative bile spillage. However Smith JP *et al.*[10] found no increased incidence of SSI after intraoperative bile spillage.

Emergent operations done for acute cholecystitis was associated with higher infection rates in both LC and OC groups in the present study similar to the reports by den Hoed *et al.*[6] and Chuang SC *et al.*[11] D Warren *et al.*[12] also found higher infection rates in his cohorts after LC for acute cholecystitis but not for OC, whereas Hussain and Khan[13] from Saudi Arabia found no difference in infection rates for SSI for both acute and chronic cholecystitis (1.7% vs 1.3% respectively). Smith JP *et al.*[10] also found no increased incidence of SSI after LC.

D Warren *et al.*[12] in their study 66566 cholecystectomies found that male gender, obese patients, chronic anaemia, diabetes mellitus, patients having smoking related diseases, drug abuse and malnutrition had increased risk of developing SSI. In the present study, none of the above factors have been found to be significantly associated with SSI [Table 5]. Scott JD *et al.*,[14] Usuba T *et al.*[15] and Smith JP *et al.*[10] also found that obesity had no role to play in SSI after LC similar to the present study. Smith JP *et al.*[10] also concluded that diabetes mellitus does not increase SSI in patients undergoing LC.

Increasing age (>55 years) was associated with more SSI which was statistically significant in the OC group (p value 0.02). Similar results were observed by Richards *et al.*[2] and Brill *et al.*[7] However den Hoed *et al.*[6] and Smith JP *et al.*[10] did not find age to be a significant risk factor for SSI.

Epigastric port site was most commonly affected (80.85%) of cases as most of the specimens were extracted through that port. Similar result was found by Mumtaz KH Al-Naser[16] where he found 80% of his LC patients had infections in the epigastric port.

Increased mean operation time was associated with higher rate of SSI in the present study similar to the results obtained by Jawien *et al.*,[9] Richards *et al.*[2] and Chuang SC *et al.*[15]

Increased intraoperative loss of blood was associated with increased incidence of SSI more so in OC. However, Makadia JM *et al.*[8] found no association between increased intraoperative blood loss and increased SSI.

The rate of SSI in LC group operated by resident surgeons was significantly higher in the present study (Odd's ratio-5.155 and *P* value 0.001). However, Böckler D *et al.*[17] found no difference in postoperative complication rates of SSI after LC whether operated by resident surgeons or by senior surgeons.

Most of the patients in this part of North East India had normal BMI, but surprisingly the incidence of cholelithiasis is quite high; as every second general surgical operation performed here is due to gallstone-related diseases.

## Conclusion

Surgical site infections after cholecystectomy in the present study was 3.12% with lesser incidence of SSI after LC than OC. Intraoperative spillage of bile due to gallbladder perforation, increased age, longer duration of surgery, increased intraoperative

blood loss, emergent operation for acute cholecystitis and LC operated by resident surgeons were found to be associated with more incidence of SSI. Prophylactic antibiotic was given in all patients. A careful surgical dissection thereby preventing bile spillage will go a long way in preventing SSI in patients undergoing cholecystectomy. Especially surgeons from rural areas will benefit from this information.

## Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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## Conflicts of interest

There are no conflicts of interest.

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