RESEARCH ARTICLE

COMPARATIVE STUDY OF LAPAROSCOPIC SURGERY AND OPEN SURGERY IN REGARDS TO SURGICAL-SITE INFECTIONS

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DOI: 10.5455/ijmsph.2013.2.125-128 Received Date: 10.11.2012 Accepted Date: 11.11.2012

ABSTRACT

Background: Surgical site infections (SSI) formerly termed surgical wound infection, are one of the most frequent post-operative infectious complication. Patients with SSI had longer and costlier hospitalization than patients who didn't have such infection. Laparoscopic surgery as a minimally invasive surgery have good outcome regarding SSI as compared to open procedure.

Aims & Objective: To compare infection rate after laparoscopic versus open surgery.

Material and Methods: A retrospective analysis of large number of cases in SMIMER Hospital was conducted. Patients who underwent laparoscopic (n=4500) or open (n=1500) appendicectomy, cholecystectomy, anti-reflux surgery, or gastric bypass from 2009 to 2012 were included in the analysis. The main outcome measure was inpatient diagnosis of SSI (Surgical Site Infection) after laparoscopic and open surgery.

Results: During 36 month of study period total of 6000 patient underwent one of four selected procedure. Overall, the incidence of SSI was significantly lower in laparoscopic (100 of 4500, 2.0%) than in open (150 of 1500, 10%) surgery ($P<0.01$). Largely, laparoscopic techniques offer a protective effect against SSI. Patient treated with laparoscopy were 76% less likely to experience SSI. Odds Ratio (OR), 0.30; 95% Confidence Interval (CI), 0.28-0.34.

Conclusion: Patient treated with laparoscopic procedure is less likely to experience SSI. After stratification by severity of illness, wound classification & admission status, laparoscopic techniques shows a protective effect against SSI.

KEY-WORDS: Laparoscopy; Open Surgery; Wound infection; Surgical Site Infection

Introduction

Among, Surgical patients, SSI is the most common nosocomial infection. Center for Disease Control and Prevention(CDC) set guidelines for prevention of Surgical Site Infection(SSI).[1] Although, most hospital acquired infections measures have focused on preventive antimicrobials, we theorize that certain surgical techniques, such as laparoscopy, will further decreases SSI by limiting the degree of trauma and contamination of surgical site. Elective, urgent and emergent admission status was studied for all procedure groups. In this study, using a large number of cases of SMIMER, We determined and compared the incidence of SSI between laparoscopic and open surgical procedures.

Materials and Methods

The UHC (University Health-system Consortium) is an administrative, clinical & financial database that provides benchmark measures on the use of comparative data analysis between academic institutions. The assignment of an illness severity level is based on combination of principal and secondary diagnoses to define different levels of severity and complexity of treatment. The four illness severity categories are minor, moderate, major & extreme. The morbidity rate was defined as "the presence of all procedure and non-procedure related complication diagnosed before hospital discharged". The in-hospital mortality rate was defined as "the percentage of the patient who died before discharged from the hospital". The risk-adjusted mortality ratio defined as "the proportion between the observed and expected mortality. And the length of stay was defined as "the period from the index procedure to hospital discharge". The diagnosis of SSI was based on presence of the procedure related surgical wound infection complication after laparoscopic and open surgery diagnosed before hospital discharge.

Study Cohort

We analyzed the SMIMER hospital discharged records of all patients 18 years of age or older who underwent one of the four commonly performed gastrointestinal procedures, namely, appendicectomy, cholecystectomy, anti-reflux surgery or roux-en-y gastric bypass. Hospital records were reviewed from 1st July 2009 to 30th June 2012. The analysis of four gastrointestinal procedures required the use of appropriate diagnosis and procedural codes as specified by "International classification of Diseases (ICD)". Age groups were defined as ages 18-45 years, 46-59 years, and older than 60 years. Elective and urgent/emergent admission status was studied for all procedure groups.

Outcome

The main study outcome was the overall incidence and individual rate of SSI after four laparoscopic and open surgical procedures as mention above. The Odds ratios (ORs) for the development of SSI after laparoscopic and open procedures were analyzed.

Statistical Analysis

We compared patient characteristic (gender, age group and severity class), length of hospital stay, thirty day re-admission, and overall and individual rate of SSI after laparoscopic and open surgery. The rate of SSI after laparoscopic and open surgery also was examined according to severity of illness, admission status and degree of wound contamination. Data are expressed as mean SD. Differences in patients' characteristics and SSIs between laparoscopic and open groups were analyzed using Fisher's exact test or Chi-square test. Univariate analysis was performed, and the 95% Confidence Interval (CI) of the Odd ratio were obtained. Continuous variables were compared using Student-t test. A p-value less than 0.01 were considered significant.

Results

During the study period, total of 7000 patients underwent one of four procedures: appendicectomy (n = 3520), cholecystectomy (n = 2250), anti-reflux surgery (n = 720) or gastric bypass (n = 1510). The great majority of patients had laparoscopic surgery (n=4500, 72%) whereas a lower number underwent open surgery (n = 1500, 28%). The distributions of laparoscopic and open techniques for all procedures were shown in Table-1. The number of females was significantly greater in laparoscopic group. Patient younger than the 64 year received laparoscopic procedures, whereas the group older than 64 year had open surgery more often. Most of laparoscopic procedures were performed on elective basis, whereas the open operations were performed on an urgent basis.

Table-1: Data for Patients who underwent for Laparoscopic and Open Surgery

Variable	Laparoscopic	Open	*p* Value
Total Cases	4500	1500	<0.01
Procedures (%)			
Appendicectomy	72.5	27.5	<0.01
Cholecystectomy	82.8	17.2	<0.01
Anti-reflux	70.5	23.5	<0.01
Gastric Bypass	60.3	39.7	<0.01
Gender			
Male	46.7	52.0	<0.01
Female	53.3	48.0	<0.01
Age (Years)			
18-45	32.1	30.0	<0.01
46-59	48.5	45.9	<0.01
≥ 60	02.4	14.1	<0.01
Admission Status (%)			
Elective	52.6	41.3	<0.01
Urgent	21.4	13.2	<0.01
Emergent	36.0	45.5	<0.01

In-Hospital Main Outcome

Laparoscopic surgery offered significantly lower overall morbidity including SSI; shorter hospital stay (Table-2). The risk-adjusted mortality ratio, although comparable between surgical techniques was lower for laparoscopic anti-reflux surgery, and higher for open cholecystectomy. Overall SSI was diagnosed during the index hospitalization for 250 patients of these patients, 100 (41.6%) of 4500 had laparoscopic and 150 (10%) of 1500 (p Value < 0.01) underwent open surgery. Laparoscopic appendicectomy, cholecystectomy, anti-reflux surgery or gastric bypass procedures all were associated with significantly lower rates of SSI than the corresponding open surgery.

Patients with minor and moderate severity of illness who experienced SSI had primarily open procedures, whereas those in the major/extreme

category who experienced SSI had laparoscopy. For all four procedures the length of hospital stay, although high with both techniques, was significantly shorter for laparoscopic than for the open operations. For all the procedure analyzed, the 30 day re-admission rates were significantly higher for open surgery groups than for the laparoscopic groups (Table-2).

Table-2: In Hospital Outcomes for Patient who underwent Laparoscopic and Open Surgeries

Variable	Laparoscopic	Open	*p* Value
Total Cases	4500	1500	<0.01
Overall Morbidity (%)			
Appendicectomy	08.0	10.5	<0.01
Cholecystectomy	08.4	24.2	<0.01
Anti-reflux	09.5	25.0	<0.01
Gastric Bypass	08.0	13.0	<0.01
Risk-Adjusted Mortality Ratio			
Appendicectomy	00.8	00.6	NA
Cholecystectomy	00.7	01.2	NA
Anti-reflux	00.2	00.6	NA
Gastric Bypass	00.7	00.8	NA
Length of Stay (Days)			
Appendicectomy	2.1 ± 2.3	4.0 ± 4.0	<0.01
Cholecystectomy	3.4 ± 3.5	7.5 ± 7.0	<0.01
Anti-reflux	3.0 ± 4.5	8.2 ± 9.8	<0.01
Gastric Bypass	2.8 ± 2.2	3.0 ± 3.5	<0.01
30 Day Re-Admission (%)			
Appendicectomy	02.5	03.8	<0.01
Cholecystectomy	02.0	04.2	<0.01
Anti-reflux	01.5	03.0	<0.01
Gastric Bypass	02.4	04.5	<0.01

NA - Not Applicable; Data are presented are mean ± SD and proportions (%); Risk-adjusted mortality ratio (observed to expected mortality). Laparoscopic versus open surgery groups (p<0.01, t-test or Fischer's exact test when applicable), over morbidity includes SSI.

Table-3: Outcome for Patient who Experience SSI Complications after Laparoscopic & Open Surgery

Variable	Laparoscopic	Open	*p* Value
Total Cases	100	150	<0.01
SSI (%)			
Appendicectomy	0.6	1.8	<0.01
Cholecystectomy	0.5	2.0	<0.01
Anti-reflux	0.4	1.6	<0.01
Gastric Bypass	0.4	1.2	<0.01
Length of Hospital Stay (days)			
Appendicectomy	9.8 ± 5.3	10.4 ± 7.3	<0.01
Cholecystectomy	10.6 ± 11.0	13.1 ± 8.0	<0.01
Anti-reflux	22.5 ± 56.7	26.1 ± 30	<0.01
Gastric Bypass	14.6 ± 11.2	18.1 ± 16	<0.01
Severity of Illness (%)			
Minor	15.3	15.8	<0.01
Moderate	45.1	52.2	<0.01
Major/Extreme	40.7	36.0	<0.01

Data are mean SD for the number of the cases and the proportion of total cases (%). SSI versus overall surgery groups (p<0.01, t-test or Fischer's exact test when applicable)

The SSI complication rates for individual procedures are shown in Table-3.

Odds for SSI

Overall, patients undergoing laparoscopic procedures had 76% less probability of experiencing SSI. The like-hood of experiencing SSI was 68% less for those who underwent a laparoscopic appendicectomy, 85% less for those who had a laparoscopic cholecystectomy, 86% less for those who had a laparoscopic anti-reflux surgery and 65% less for those who had a laparoscopic gastric bypass. In general, laparoscopy offered a protective effect against SSI for all the procedure analyzed. The main influence observed was with elective laparoscopic procedures (76% less probability of experiencing a SSI). When laparoscopy was used to treat perforated acute appendicitis with peritonitis or abdominal abscess, the patient had 60% less probability of experiencing a SSI than with open appendicectomy.

Discussion

The findings showed that laparoscopic surgery offered a protective effect against SSI compared with open operations. Surgical site infections (SSI) formerly termed surgical wound infection, are one of the most frequent post-operative infectious complication.[2] Among all surgical patients, SSI was the most common hospital acquired surgical infection.[3] When surgical patient with SSI died, the great majority of deaths were related to infection. Furthermore, SSI is associated with longer hospital stay and additional hospital costs.[4] In addition, patients with SSI had longer and costlier hospitalization than patients who didn't have such infection.[5,6] Similarly it was demonstrated previously from large nationwide data bases that for colon resections performed to manage benign and malignant diseases, laparoscopic colectomy had significantly lower incidence of SSI than open colectomy.[7-10]

The major differences between laparoscopic and open procedures are the method of access, the method of exposure, and the extent of operative trauma. Finding also have shown laparoscopy to be a physiologically superior operation compared

with open surgery because it causes less impairment of immediate post-operative pulmonary function, less systemic stress, improved immunologic response, and less local tissue trauma.[11-14] The contributing factors to the lower SSI rates for laparoscopic treated patients are believed to be shorter surgical incision, decrease tissue trauma and contamination, and elimination of mechanical retraction of abdominal wall. Although the laparoscopic approach is known to have high operating room costs, mainly due to laparoscopic equipment expenses, the total hospital costs are offset by a reduction in the length of hospital stay and decrease in number of costly complications. Although both approaches appear to be a safe, laparoscopic surgery was not only associated with shorter length of hospital stay and less overall morbidity, but additionally provide a protective effect against SSI for all procedures examined. However those with SSI had a shorter hospital stay if they had undergone for laparoscopic procedures. Nevertheless, the protective benefits of laparoscopy against SSI were shown to be maintained when patients were stratified by severity of illness and presence of peritonitis or abscess. It is plausible that groups considered "High Risk" and elderly that undergo urgent or emergent operations resulting in dirty wounds also may benefits from minimally invasive procedure.

Conclusion

Patient treated with laparoscopic procedure are less likely to experience SSI. After stratification by severity of illness, wound classification & admission status, laparoscopic techniques shows a protective effect against SSI.

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Cite this article as: Navadiya SK, Vaghani YL, Chauhan HD. Comparative study of Laparoscopic surgery and open surgery in regards to surgical-site infections. Int J Med Sci Public Health 2013; 2:125-128.
Source of Support: Nil
Conflict of interest: None declared