Original Article

Comparative Study of Surgical Site Infection between Laparoscopic Appendectomy and Open Appendectomy

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Abstract

Surgical site infection (SSI) is defined as infection at surgical site within 01 month after surgery (or within a year in case of implant). Surgical-site infection requires microbial contamination of the surgical wound to occur. LA provides considerable benefits over OA, including a shorter length of hospital stay, less postoperative pain, earlier postoperative recovery, and a lower complication rate. This was a prospective observational study conducted inpatient department of Chittagong Medical College Hospital and private hospitals and clinics in Chittagong city. The patients were interviewed face to face by the researcher for the purpose of collection of data and were examined by the researcher for certain signs recorded in the fixed protocol. Collected data was classified, edited, coded and entered into the computer for statistical analysis by using SPSS-22. Out of 200 cases mean age was found 33.76 ± 23.35 years in OA group and 32.21 ± 16.51 years in LA group. Male was found 58% in OA group and 53% in LA group. Female was found 42% and 47% in OA and LA group respectively. Mean operative time was found 41.2±8.5 minutes in OA group and 49.3±8.9 minutes in LA group. Alternate pathology were more frequently detected in LA due to wide area of vision. Superficial incisional SSI was found 10% in OA group and 5% in LA group. Deep incisional SSI was found 2% in OA group and 2% in LA group. Organ/space SSI was 2% and 3% in OA group and LA group respectively. Staphylococcus aureus is the commonest organism isolated form the surgical wounds from 41.34% followed by Pseudomonas 21.26%, no growth 11.1%, E.coli 9.6%, others 9.4%, Klebsiella 7.0%. Laparoscopic appendectomy was better than open appendectomy with respect to wound infection rate, postoperative pain, postoperative hospital stay and return to normal activities.

Key Words: Surgical site infection- SSI, Laparoscopic appendectomy- LA, open appendectomy- OA.

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Introduction

The microorganisms may originate from either endogenous or exogenous sources. Infection only occurs if the number and virulence of the bacteria or fungi overwhelm natural host defense mechanisms unless foreign material is present in the surgical site (ie, suture, mesh)[1]. According to the CDC (Centers for Disease Control) definition surgical sites infection splits into 3 groups: superficial incisional SSI, deep incisional SSI and organ-space SSIs- depending on the site and extend of infection. By definition, superficial incisional SSI involves only the skin and subcutaneous tissue and occurs within 30 days after the operation. Purulent drainage, positive fluid, or tissue cultures, pain or tenderness,

localized swelling, redness, or heat are characteristic. Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision. At least one of the following signs or symptoms of infection: pain or tenderness, localised swelling, redness, or heat and superficial incision are deliberately opened by surgeon, unless incision is culture-negative. Diagnosis of superficial incisional SSI made by a surgeon or attending physician. The following are not considered superficial SSIs: Stitch abscesses (minimal inflammation and discharge confined to the points of suture penetration). Incisional SSIs that extend into the fascial and muscle layers[2]. Deep Incisional Surgical Site Infection: Infection occurs within 30 days after the operation if no implant is left in place or within one year if implant is in place and the infection appears to be related to the operation and infection involves deep soft tissue (e.g. fascia, muscle) of the incision and at least one of the following: Purulent drainage from the deep incision but not from the organ/space component of the surgical site. A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (>38˚C), localised pain or tenderness, unless incision is culture-negative. An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination. Diagnosis of deep incisional SSI made by a surgeon or attending physician[2].

Organ/ Space Surgical Site Infection: Infection occurs within 30 days after the operation if no implant is left in place or within one year if implant is in place and the infection appears to be related to the operation and infection involves any part of the anatomy (e.g., organs and spaces) other than the incision which was opened or manipulated during an operation and 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 that is found on direct examination, during reoperation, or by histopathologic or radiologic examination. Diagnosis of organ/ space SSI made by a surgeon or attending physician[2]. Surgical site infection is a major cause of morbidity and mortality inspite of development in surgical care. It imposes substantial burden on health care resources[3]. SSI depends on site and type of an operation. Hospital variation is also there[4]. Acute appendicitis is one of the most common abdominal emergency and accounts for approximately 1% of all surgical operations[5]. The surgical treatment of appendicitis is one of the great public health advancement of the last 150 years[4]. The treatment of acute appendicitis remained essentially unchanged since its first description by Charles MC Burney in 1889[7]. Appendectomy by Mc Burney's incision remained the procedure of choice for nearly a century until 1983, when Curt Semn offered an alternative "laparoscopic appendectomy". Minimally invasive surgery is a breakthrough in this context. For example laparoscopic appendectomy and open appendectomy SSI rate 0.6% and 3.9% respectively in Korea. This is due to less invasive procedure, early mobilization and less hospital stay.[6] Several studies have shown the advantages of laparoscopic surgery in terms of shorter hospital stay, rapid postoperative recovery, and better pain control[8-10]. However, there have been concerns about the risk of infectious complications, particularly the development of intra abdominal abscess and superficial wound infection. This risk is significantly increased in cases of perforated appendicitis[11,12].

Materials and Methods

This prospective observational study was carried out in Chittagong Medical College Hospital and some Private Hospitals and Clinics in Chittagong City. Total 200 cases (100 laparoscopic appendectomy and 100 open appendectomy) were selected conveniently during January 2015 to June 2016. Post operative follow up (indoor and outdoor) of all cases were ensured for one month, Post operative cases of appendectomy between 18-16 years of age group agreed to participate in the study. Non diabetic and free from possible confounders and serious illness, are included in the study and post operative appendectomy patient beyond 18-60 years age group, not agreed to participate in the study, diabetic and other serious illness which may act as a confounder was excluded in this study. After getting consent from the participants, standard questionnaire were used to identify the surgical site infection complain and collect demographic information. The patients were interviewed face to face by the researcher for the purpose of collection of data. Then the patients were examined by the researcher for certain signs and those were recorded in the check-list. Investigations were done for supporting the diagnoses. According to the participants' understanding level, sometimes the questions was described in the native language so that the patients can understand the questions perfectly and answer accurately. No randomization was carried out. The choice between open and laparoscopic approach was decided by the operating surgeon after discussion with the patient. All patients got prophylactic antibiotics at induction (cefuroxime 1.5 g and metronidazole 500 mg).

All patients got a 5-day course of antibiotics in post operative period. Patients were discharged after 24-72 hours post operatively or as wishes of the patient. Follow up were done in the OPD or over telephone after 2 weeks, 1month, for more remote patients. Follow up was for any post-operative complications and to assess quality of life. Statistical analyses were carried out by using the Statistical Package for Social Sciences version 21.0 for Windows (SPSS Inc.,

Chicago, Illinois, USA). The mean values were calculated for continuous variables. The quantitative observations were indicated by frequencies and percentages. Chi-Square test was used to analyze the categorical variables, shown with cross tabulation. Student t-test was used for continuous variables. P values <0.05 was considered as statistically significant. Informed written consent was taken from the patient or patient's guardian after duly informing the procedure of treatment, anticipated result, possible advantages, disadvantages and complications considering all ethical issues. Confidentiality was maintained both verbally and documentary by using separate locker and computer password. Protocol was approved by ethical committee of Chittagong Medical College, Chittagong.

Results

Table I shows characteristics of the patients. It observed that mean age was found 33.76 ± 23.35 years in OA group and 32.21 ± 16.51 years in LA group. Male was found 58% in OA group and 53% in LA group. Female was found 42% and 47% in OA and LA group respectively. Mean BMI was found 21.86±4.27 kg/m^2 in OA group and 22.50±3.98 kg/m^2 in LA group. The mean BMI difference was statistically significant (p<0.05) between two groups. Majority patients had multiple attack in both groups, which was 68% in OA group and 70% in LA group. Mean leucocyte count was found 14.87±6.7 ×10^3/μL in OA group and 13.26±4.9 ×10^3/ μL in LA group. The mean age, number of attack and mean leucocyte count were not statistically significant (p>0.05) between two groups.

Table-I: Patient characteristics

Characteristic	Study group		P-value
	OA (n = 100)	LA (n = 100)	
Age (yr)	33.76 ± 23.35 23.35	32.21 ± 16.51 16.51	$^a0.08^{ns}$
Gender			
* Male	58%	53%	$^b0.57^{ns}$
* Female	42%	47%	
BMI (kg/m^2)	21.86 ± 4.27	22.50 ± 3.98	$^a0.044^{s}$
Number of attack			
* Single	32%	30%	$^b0.759^{ns}$
* Multiple	68%	70%	
Leucocyte count (×103/μL)	14.87±6.7	13.26±4.9	$^a0.831^{ns}$

Values are presented as mean ± SD, no. of cases (%) or %. OA, open appendectomy; LA, laparoscopic appendectomy; BMI, body mass index. s=significant; ns=not significant [a]P value reached from unpaired t-test [b]P value reached from Chi square test

P value reached from Chi square test Regarding appendix pathology, 35.0% patients had hyperemic in OA group and 38.0% in LA group, 45.0% patients had suppurative in OA group and 43.0% in LA group, 8.0% patients had gangrenous in OA group and 11.0% in LA group, 12.0% patients had perforated/ abscess in OA group and 8.0% in LA group. The difference was not statistically significant (p>0.05) between two groups. (Table-II)

Table-II: Appendix pathology

	Study group		P-value
	OA (n = 100)	LA (n = 100)	
*Appendix pathology			
Hyperemic	35.0%	38.0%	
Suppurative	45.0%	43.0%	0.695^{ns}
Zangrenous	8.0%	11.0%	
Perforated/ abscess	12.0%	8.0%	

ns=not significant

Table-III shows postoperative recovery and complications. It was observed that mean operative time was found 41.2±8.5 minutes in OA group and 49.3±8.9 minutes in LA group. Port site bleeding was found 2% in LA group. Subcutaneous Emphysema was 1% in LA group. Port site infection was found 14% in OA group and 10% in LA group. Incisional/port site hernia was 4% in OA group and 2% in LA group. Mean operative time was statistically significant (p<0.05) between two groups.

Table-III: Per operative and postoperative clinical outcome (n=200)

	OA (n = 100)	LA (n = 100)	P-value
Operation time (min)	41.2 ± 8.5	49.3 ± 8.9	$^a0.001^{s}$
Port site bleeding	0	2%	$^b0.155^{ns}$
Subcutaneous Emphysema	0	1%	$^b0.316^{ns}$
Port site infection	14%	10%	$^b0.384^{ns}$
Incisional/port site hernia	4%	2%	$^b0.632^{ns}$

Values are presented as mean±SD or no. of cases (%). OA= open appendectomy; LA= laparoscopic appendectomy. s=significant; ns=not significant [a]P value reached from unpaired t-test [b]P value reached from Chi square test

Table IV shows surgical-site infections in overall appendicitis.

Table-IV: Surgical-site infections in overall appendicits

	OA (n = 100)	LA (n = 100)	P-value
Superficial incisional	10%	5%	0.179^{ns}
Deep incisional	2%	2%	1.000^{ns}
Organ/space	2%	3%	0.650^{ns}
Overall SSI	14%	10%	0.384

Values are presented as no. of cases (%). OA= open appendectomy, LA= aparoscopic appendectomy; SSI= surgical-site infection. s=significant; ns=not significant P value reached from Chi square test.

It was observed that superficial incisional was found 10% in OA group and 5% in LA group. Deep incisional was found 2% in OA group and 2% in LA group. Organ/space was 2% and 3% in OA group and LA group respectively. Overall SSI was 14% in OA group and 10% in LA group. The difference were not statistically significant (>0.05) between two groups.

Atypical myobacteirial infection was found 1(10.0%) in LA group but not found in OA group. The difference was not statistically significant (p>0.05) between two groups. (Table-V)

Table-V: Diagnosis of atypical mycobacterial infection in SSI

	OA (n = 14)	LA (n = 10)	P-value
Atypical mycobacterial infection	0	1(10%)	0.226^{ns}

ns=not significant P value reached from Chi square test

Port site infection was found in 10 patients of laparoscopic appendectomy, among them 7 (70.0%) patients had umbilical port, 2 (20.0%) had right iliac port and 1 (10.0%) had left iliac port site infection. (Table-VI)

Table-VI: Frequency of different port site infection in laparoscopic appendectomy (n=10)

Port site infection	Frequency	Percentage
Umbilical port	7	70.0
Right iliac port	2	20.0
Left iliac port	1	10.0

Staphylococcus aureus is the most commonest organism isolated form the surgical wounds from 41.34% followed by Pseudomonas 21.26%, no growth 11.1%, E.coli 9.6%, others 9.4%, Klebsiella 7.0% (Figure-I).

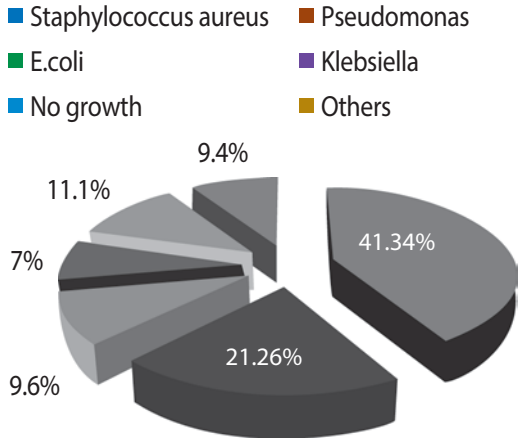

Figure-I: Organisms isolated from SSI wounds

Discussion

This prospective observational study was carried out in Chittagong Medical College Hospital and Private Hospitals and Clinics in Chittagong City. Total 200 cases (100 laparoscopic appendectomy and 100 open appendectomy) were selected conveniently during January 2015 to June 2016. Post operative follow up (indoor and outdoor) of all cases were ensured for one month. In this study it was observed that mean age was found 33.76 ± 23.35 years in OA group and 32.21 ± 16.51 years in LA group. The mean age difference was not statistically significant (p>0.05) between two groups. In study of Biondi et al.[13] showed the mean age was found 29.66±15.13 years in OA group and 27.75±14.24 years in LA group. The mean age difference was not statistically significant (p>0.05) between two groups. In study of Rahman et al.[14] showed the mean age was found 31.5±6.1 years open group and 29.8±5.2 years in laparoscopic group. The difference was not statistically significant (p>0.05) between two groups. In study of Suh et al.[4] also supported our results they showed the mean age was found 34.96±23.35 years OA group and 31.11±16.51 years in LA group. The mean age difference was statistically significant (p<0.05) between two groups. In study of Kargar et al.[15] also observed the LA and OA groups participants' mean age was 26.94±9.51 and 25.36±8.92, respectively (P=0.394). In this study it was observed that male was found 58% in OA group and 53% in LA group. Female was found 42% and 47% in OA and LA group respectively. Male female ratio was 1.4:1 in group OA group and 1.12:1 in LA group. The difference was not statistically significant (p>0.05) between two groups. Similar results were found Biondi et al.[13] they showed male was found 59.3% in OA group and 42.7% in LA group. Female was 40.7% and 57.3% in OA and LA group respectively. In study of Islam et al. showed in the laparoscopic group 123 (39%) were adult male, 176 (56%) were adult female. In study of Rahman et al.[14] observed Male:female was found 32:21 in open group and 17:29 in laparoscopic group. In Kargar et al.[15] study showed twenty three men (46%) and twenty seven women (54%) underwent LA while 28 men (86%) and 22 women (22%) were operated by OA technique. No statistically significant difference was observed in male to female ratio (P=0.212). Regarding body mass index (BMI) it was observed that mean BMI was found 21.86±4.27 kg/m^2 in OA group and 22.50±3.98 kg/m^2 in LA group. The mean BMI difference was statistically significant (p<0.05) between two groups. In Amiri and Ansari[16]. study showed that the average body mass index (BMI) was higher in the laparoscopic group (LA 26 kg/m^2; open appendectomy (OA); 22 kg/m^2). In study of Suh et al.[4] howed the mean BMI was found 21.86±4.27 kg/m^2 in OA group and 22.50±3.98 kg/m^2 in LA group. The mean BMI difference was statistically significant (p<0.05) between two groups. In this present study it was observed that majority patients had multiple attack in both groups, which was 68% in OA group and 70% in LA group. The difference was not statistically significant (p>0.05) between two groups. Similar results was found

Rahman et al.[14] single attack was found 18 (32.1%) in open group and 14 (30.4%) in LA group. Multiple attack was 38 (67.9%) in open group and 32 (69.6%) in LA group. The difference was not statistically significant (p>0.05) between two groups. In this study it was observed that mean leucocyte count was found 14.87±6.7 $\times 10^3/\mu L$ in OA group and 13.26±4.9 $\times 10^3/\mu L$ in LA group. The mean leucocyte count was not statistically significant (p>0.05) between two groups. In study of Katkhouda et al.[17] showed the mean WBC was found 15.4$\times 10^3/\mu L$ in open appendectomy group and 15.4 $\times 10^3/\mu L$ in laparoscopic appendectomy group. The difference was not statistically significant (p>0.3058) between two groups. Regarding appendix pathology, 35.0% patients had hyperemic in OA group and 38.0% in LA group, 45.0% patients had suppurative in OA group and 43.0% in LA group, 8.0% patients had gangrenous in OA group and 11.0% in LA group, 12.0% patients had perforated/abscess in OA group and 8.0% in LA group. The difference was not statistically significant (p>0.05) between two groups. In study of Lasheen et al.[18] observed that the severity of appendicitis was similar in both groups (27 catarrhal appendicitis 45%, 20 suppurative appendicitis 33.3% and 13 perforated appendicitis 21.7%). In the study of Suh et al.[4] showed hyperemic was found 16.7% in OA group and 17.0% in LA group. Suppurative was 39.0% in OA group and 42.5% in LA group. Gangrenous was 8.6% in OA group and 11.6% in LA group. Perforated/abscess was 35.7% in OA group and 28.9% in LA group. In this study it was observed that mean operative time was found 41.2±8.5 minutes in OA group and 49.3±8.9 minutes in LA group. Mean operation time was statistically significant (p<0.05) between two groups. Similar observation was found in different studies Kargar et al.[15] study showed the average skin to skin operation time was 34.4± 8.42 min in LA hand and 41.7± 8.84 in OA hand (P=0001). In study of Lasheen et al.[18] showed the mean operative time in group A was 55.7 minutes (range, 27 to 90) and in group B 57 minutes (range, 25 to 95), P = 0.0231. In study of Biondi et al.[13] showed the mean ± standard deviation (SD) operative time of 54.9 ± 14.7 min for the LA group was longer than the mean operative time of 31.36 ± 11.43 min for open appendectomy (P <0.0001). In another study of Islam et al.[19] showed the operating time in LA was 33±5.8 minutes and in OA was 37±7.5 minute (OR-0.79, CI-95%). In my study it was observed that port site infection occur in two groups, which was 14% in OA group and 10% in LA group. Incisional/port site hernia was found 4% in OA group and 2% in LA group. In study of Rahman et al.[14] showed in LA group one patient developed mild surgical emphysema, resolved spontaneously. Wound or port site infection is significantly higher in open group (p=0.019). Mortality rate was "0" in both groups. Two patient in the LA group required conversion to open operation. In Lasheen et al.[18] study observed that port wound infection was recorded in one patient of group A (1.7%) and 8 patients (13.3%) in group B, P = 0.007, which was managed by drainage and daily dressing as outpatient. In Suh et al.[4] study also observed readmission within 30 days of surgery was observed in 2 cases (0.6%) in the LA group and 9 cases (2.1%) in the OA group, but the difference was not statistically significant. Regarding surgical-site infections in overall appendicitis. It was observed that superficial incisional was found 10% in OA group and 5% in LA group. Deep incisional was found 2% in OA group and 2% in LA group. Organ/space was 2% and 3% in OA group and LA group respectively. Overall SSI was 14% in OA group and 10% in LA group. The difference were not statistically significant (>0.05) between two groups. Suh et al.[4] study showed the overall SSI rate was not different between the two groups (2.8% for the OA group vs. 4.6% for the LA group, respectively, P=0.204), but the superficial SSI rate was significantly lower in the LA group (3.2% vs. 0.6%, P = 0.016). In addition, the difference in the superficial SSI rate was more significant in severe forms of appendicitis, such as suppurative, gangrenous or perforated appendicitis. However, in the Suh et al.[4] study, the overall SSI rate was not significantly different between the two groups, and the superficial SSI rate was rather significantly lower in the LA group. The difference in the superficial SSI rate was more evident in severe forms of appendicitis, such as suppurative, gangrenous, or perforated appendicitis. SSI may occur anywhere from the skin to the organ/ space in both the LA and OA groups. However, the superficial SSI, which only involves the skin or subcutaneous tissue, is rare in the LA group because of the unique nature of the laparoscopic procedure. In this study it was observed that superficial incisional was found 10 (71.4%) in OA group and 5(50.0%) in LA group. Deep incisional was found 2 (14.3%) in OA group and 2 (20.0%) in LA group. Organ/space was 2 (14.3%) and 3 (30.0%) in OA group and LA group respectively. Overall SSI was 14 (100%) in OA group and 10 (100%) in LA group. The superficial incisional was statistically significant (<0.05) between two groups. In this study it was observed that atypical myobacteirial infection was found 1 (10.0%) in LA group but not found in OA group. The difference was not statistically significant (p>0.05) between two groups. Port site infection was found 10 patients laparoscopic appendectomy among them 7 (70.0%) patients had umbilical port, 2 (20.0%) had right iliac port and 1 (10.0%) had left iliac port site infection. In a study done by Karthik et al. found most common ports involved were umbilical port sites (47%). In present study Staphylococcus aureus is the most commonest organism isolated form the surgical wounds from 41.34% followed by Pseudomonas 21.26%, no growth 11.1%, E.coli 9.6%, others 9.4%, Klebsiella 7.0%. Ananda et al. found in their study Staphylococcus aureus 42.85%, Pseudomonas 19.64%, no growth 12.5%, E.coli 10.7%, Klebsiella 5.4% and others 8.9%. This was similar in this present study.

In conclusion, laparoscopic appendectomy was better than open appendectomy with respect to superficial wound infection rate, postoperative pain, postoperative hospital stay and return to normal activities.

Recommendations

Further studies can be undertaken with large number of patients in a single Hospital with a specific surgical team in a optimum operation theatre Environment.

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