Incidence and risk factors of surgical site infection in prolapsed lumbar intervertebral disc surgery

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ABSTRACT

INTRODUCTION: Discectomy for prolapsed intervertebral disc is commonly done spine surgery and has a risk of Surgical Site Infection that leads to higher morbidity and healthcare costs. To develop strategies to reduce the risk for Surgical Site Infection, independent risk factors for it should be identified. We report incidence and risk factors for post-operative Surgical Site Infection among the cases operated in a tertiary level referral hospital.

METHODS: A prospective analytical study was carried on forty-six lumbar prolapsed intervertebral disc patients who met the inclusion criteria and were included in the study. Preoperative, per-operative, and postoperative risk factors of individual patients were gathered in a Performa. Patients were divided into two groups: with Surgical Site Infection and without Surgical Site Infection. Risk factors were analyzed between two groups.

RESULTS: There were 6 cases of postoperative Surgical Site Infection with an incidence of 13.04%; 3 deep infection and 3 superficial. Independent risk factors like Age ($p<0.073$), Sex ($p<1.00$), Hemoglobin ($p<0.794$), Alcohol use ($p<0.831$), Smoking ($p<0.305$), Preoperative Random Blood Sugar ($p<0.282$), Total leukocyte count ($p<0.232$), Albumin level ($p<0.628$), Body Mass Index ($p<0.604$), Duration of Surgery ($p<0.913$), Type of surgery and Type of postoperative bed were not found to be significant risk factors.

CONCLUSION: The overall incidence of Surgical Site Infection in lumbar Prolapsed intervertebral disc surgery is higher in our setting but we could not identify any independent risk factors. Unknown intra-operative factors that we did not include in the study seem to be the risk factors.

KEYWORDS: Incidence; Prolapsed intervertebral disc; Risk Factor; Spine Surgery; Surgical Site Infection.

INTRODUCTION

Surgical site infections (SSI) is defined as superficial, deep or organ space infections occurring within 30 days after surgery (or within one year of hardware implantation).[1] SSI following spine surgery is a dreaded complication leading to significant morbidity and cost to the patient.[2] The reported incidence of SSI following spine surgery ranges from 0.5 to 18.8%.[3] Discectomy and laminectomy have reported incidences of infection of less than 3%.[4] Several factors increase the risk of SSIs, including older age, chronic malnutrition, obesity, smoking, previous spinal surgery, poorly controlled diabetes, incontinence, steroid therapy, increased blood loss, intraoperative blood transfusion, intraoperative tissue damage, and wound seroma. Besides, prolonged preoperative hospitalization, previous radiation of the surgical field, preexisting neoplasm, multiple surgical levels, prolonged operation time, spinal dysraphism and morphine nerve paste used for postoperative pain control have also been reported as risk factors for spinal surgical site infections.[5] Discectomy for Prolapsed Intervertebral Disc(PIVD) is a common spine surgery performed in our setting. This study aimed to find the incidence of SSI after lumbar discectomy at our center and also identify various risk factors involved.

MATERIALS AND METHODS

A cross-sectional prospective analytical study was conducted from February 2016 to January 2017 in the Department of Orthopaedics and Trauma Surgery, Tribhuvan University Teaching Hospital in patients suffering from PIVD who underwent surgical intervention. A total of 46 patients were included using a convenience sampling method. Indications for surgery were- Patient suffering from PIVD of the lumbar region with features suggestive of Cauda Equina syndrome; VAS score persistently more than seven and/or claudication distance less than ten minutes after exhaustive conservative treatment. Cases with revision surgery and poly-trauma were excluded from the study.

Surgical site infection was defined according to The US Centers for Disease Control and Prevention definition.[6] Superficial SSI was defined as involving only the skin or subcutaneous tissue of the incision and not extending into the fascial and muscle layers and at least one of the following: 1) Purulent drainage, with or without laboratory confirmation, from the superficial incision. 2) Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision. 3) At least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat, and the superficial incision is deliberately opened by the surgeon, unless the site is culture-negative. 4) Diagnosis of superficial incisional SSI by the surgeon or attending physician.

Deep SSI is defined as involving deep soft tissues (e.g., fascial and muscle layers) of the incision and at least one of the following:

1) Purulent drainage from the deep incision but not from the organ/space component of the surgical site. 2) 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), localized pain, or tenderness, unless the site is culture-negative. 3) An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination. 4) Diagnosis of a deep incisional SSI by a surgeon or attending physician. SSI that involved both superficial and deep incision sites is considered deep incisional SSI. A high level of suspicion is of paramount importance in early diagnosis of post-surgical discitis (PSD). The clinical symptom of PSD is back pain with or without leg pain which may be subtle and the infection may become apparent only in its late stage. Inflammatory markers in blood tests (i.e. Erythrocyte sedimentation rate (ESR), C-reactive protein (CRP), and total leukocyte count) and imaging studies (X-ray and MRI) are useful diagnostic modalities. However, identification of the organism in tissue biopsy or blood cultures is confirmative.[7]

Onset time was defined as the period from initial surgery to SSI diagnosis and was classified as early infection (occurring within 30 days after surgery) or late infection (occurring > 30 days after surgery).[8] Age, Sex, Smoking, and Alcohol use were verbally assessed. Type of surgery, number of surgeons, and type of postoperative ward were noted. The operating duration was taken from surgical incision to wound closure and measured in hours according to the analog clock present in the operation theatre. Weight and Height were measured and, Body Mass Index

(BMI) was calculated. For the assessment of the nutritional status of the patient preoperative hemoglobin, albumin level, and total leukocyte count were recorded. Preoperative random blood sugar levels and renal function were checked. Preoperative morbidities if any, like hypertension, diabetes mellitus were optimized before the operation. Serological tests were done in all cases to exclude HIV, Hepatitis B, and Hepatitis C.

Ethical clearance was obtained from the Institutional Review Board (IRB) of the Institute of Medicine and informed consent obtained from each patient.

All the data analyses were performed using Microsoft Xcel office 2007 and SPSS (Statistical Package for the Social Sciences) version22. Both descriptive and inferential statistical analyses were done. Univariate analysis was used to assess the association of potential risk factors and SSI. Continuous data were described with mean ± SD or median (25–75% quartile) and Categorical data were described with a number (percentage). Student t-test or Mann–Whitney–Wilcoxon test was used for continuous variables and the chi-square test or Fisher exact test for categorical variables. A P value of < 0.05 was accepted as significant.

RESULTS

Out of the 46 patients studied 27 (58.69%) were males and 19 (41.30%) were females. The age of patients ranged from 14 to 70 years with the mean age being 39.91 years. Of them, 28 had PIVD at L4-L5 level, 14 had PIVD at the L5-S1 level, and the remaining 4 patients had PIVD at multiple levels. Out of the 46 operated cases, 39 with radiculopathy underwent Minimally Invasive Lumbar Open Discectomy (MILOD), and the remaining seven with cauda equina syndrome underwent laminectomy surgery. All cases improved symptomatically immediately after the operation. Demographic findings of patients with SSI and without SSI are listed in Table 1.

Table 1: Demographic characteristics of the SSI and Non-SSI groups

Characteristic	SSI group (n =6)	Non-SSI group (n =40)
Age (years), mean±SD	33.33±7.65	40.9±13.57
Male sex, n (%)	3 (50)	24 (60)
Body mass index (kg/m2)	25.14±3.17	24.37±3.59
Alcohol Use, n (%)	1 (16.66)	11 (27.5)
Smoking, n (%)	0	12 (30)
Hemoglobin level (mg/dl)	13.41±2.14	13.66±1.63
Total leucocyte count (/mm3)	9001±1638	8017.5±2390
Random Blood Sugar (mmol/L)	4.95±0.65	5.34±1.44
Albumin level (mg/dl)	40.33±4.54	39.2±8.35
Anatomic location of the surgery, n (%)		
L4-L5	5 (83.33)	23 (57.5)
L5-S1	1 (16.66)	13 (32.5)
Multiple levels (>1)	0	4 (10)
Type of Surgery, n (%)		
MIOLD	6 (100)	33 (82.5)
Decompression via Spinoplasty	0	7 (17.5)
Surgeons involved	3	3.1±0.49
Operative time (in hours)	1.37±0.37	1.39±0.40
Postoperative beds, General (%)	4 (67)	24 (60%)

Six cases (13.04%) developed postoperative SSI, three deep, and another three superficial infections. Five cases had an early infection while one deep SSI was a late type. Three deep SSI cases had postoperative discitis. Of the three superficial infection cases with discharge, swabs were sent for culture and sensitivity. One case had Staphylococcus aureus (sensitive to cephalosporin), the second had coagulase-negative Staphylococcus (sensitive to Doxycycline, Vancomycin, Teicoplanin) and in the other case, Acinetobacter Iwoffii was isolated, sensitive to Ampicillin and sulbactam. All three cases were treated with sensitive antibiotics and regular dressings. Three cases with post-operative discitis were treated with bed rest, pain management, and antibiotics. Antibiotics were started empirically with intravenous clindamycin for two weeks together with oral rifampicin and ciprofloxacin to be continued with oral clindamycin for a period of six weeks. Clinical improvement supported by negative laboratory inflammatory markers (ESR, CRP, and total leukocyte count) and radiological signs of healing were guiding to stop antibiotic treatment. All the discitis cases improved with the treatment protocol.

Univariate analysis was done for each risk factor. For the categorical variables chi-square test was done to analyze the degree of significance; gender ($p<1.000$), alcohol use ($p< 0.831$), and smoking ($p<0.305$) were found to be insignificant. Student t-test for continuous variables like age ($p<0.073$), hemoglobin ($p<0.794$), random blood sugar ($p<0.282$), albumin ($p<0.628$), total leucocyte count ($p<0.232$), BMI ($p<0.604$), duration of surgery ($p<0.913$) and the number of surgeons ($p<0.209$), all were also found to be statistically insignificant. Type of surgery and postoperative beds among the SSI and non-SSI cases were also not statistically significant.

DISCUSSION

Postoperative wound infections are the most grave but common complication following spinal surgery. The incidence documented in the literature ranges from 0.5% to 20%.[9,10] Infection rates vary greatly according to the type of index surgical intervention. Historically, lower-risk spinal surgeries include those that do not require instrumentation. Discectomy and laminectomy have reported incidences of infection of less than 3%.[4] In the United States, the National Nosocomial Infections Surveillance (NNIS) System, a Centers for Disease Control and Prevention (CDC) orchestrated voluntary performance-measurement system, has reported a 1.25% rate of surgical site infection following laminectomy and a 2.1% rate following laminectomy with non-instrumented fusion.[11] Peruzzi P et al,[12] Imae et al[13] and Kanth et al[14] experienced postoperative discitis in 0.66%, 0.57%, and 1.7% of their series from France, Japan and, Pakistan respectively. In our series, the discitis rate of 6.5% (3/46 cases) is higher than in the previous studies. The occurrence of frequent cases of SSI in PIVD cases prompted us to undertake this study. As the infection rate was alarmingly high, risk factors leading to the higher rate of infection needed to be studied to act to prevent SSI.

Various studies have shown variable risk factors responsible for the postoperative spinal infection. Instrumented procedures have a higher infection rate.[15,16] Our study showed a higher incidence of infections in cases of discectomy and laminectomy without instrumentation. Higher age is one of the risk factors for SSI.[17] However, a review article by Reina Yao et al concluded that there is mixed evidence of age being associated with SSI.[18] In this series, age as a continuous variable was associated with SSI but it is not statistically significant ($p<0.073$). Surprisingly, our SSI cases were younger (33.33 ± 7.65) compared to non-SSI cases (40.9 ± 13.57). The number of males and females among the study participants seems to be a reflection of the generalized population presenting with spinal disorder requiring surgery in our country. Though female sex is said to be one of the risk factors,13 gender is not a risk factor in our study which is in agreement with various studies.[4,5,15,16] Obesity is found to be an independent risk factor that increased the rate of SSI.[10,18-20] In obesity, the subcutaneous adipose layer can be quite thick. During the closure of the surgical wound, areas of dead space can easily be created. Local fat necrosis can occur and result in a localized wound problem superficial to the fascia. We did not find an association of BMI with SSI, similar to previous studies.[5,15] The use of alcohol and smoking both are known as a risk for SSI.[5,18] In our series none of our SSI cases were a smoker and only one patient used to drink alcohol occasionally. Though there are some reports denying diabetes mellitus as a risk factor for SSI,[5,21] it has been widely found to be an independent risk factor for SSI.[10,16,18,20] In a meta-analysis by Fei Q et al to find out risk factors for postoperative infection, diabetes was the most important predictor of SSI.[22] In our study, all six cases in the SSI group were non-diabetic with average preoperative random blood sugar level was 4.95±0.65, lower than the non-SSI group. This may be because of the younger age of SSI cases. However, in our center, we optimize blood sugar levels before surgery if the patient is diabetic. In our study, we have taken preoperative hemoglobin, albumin, and total leucocyte count as the marker of malnutrition. The average hemoglobin level, serum albumin level, and leucocyte count among the SSI cases was 13.41 mg/dl, 40.33 mg/dl, and 9001/mm2 respectively and were within normal range meaning that no one was malnourished. This result is not per the literature that suggests, malnutrition is associated with SSI.[18]

Intra-operative factors play a significant role in postoperative infection. Duration of surgery (> 3 hours) is one of the major risk factors for SSI.[5,13,16,20,22] In a retrospective literature review there was mixed evidence on the duration of surgery in association with SSI,[18] and in some reports, there was no significant relation of operating time with SSI.[15] In our study, average operating time in both groups was about 75 minutes (incision to the closure of the wound) and there was no significant relation with SSI. Though the number of SSI was more at the L4-5 level (83.33%) compared to non-SSI cases (57.5%) it was not statistically significant. There have been few studies done to find out the relation of the surgeon's experience and the number of scrub surgeons to SSI. One study, in scoliosis surgery, showed that the risk of SSI is more with a less experienced surgeon.[23] In regards to the effect of resident involvement, some studies looking at different aspects of this, have found an association with SSI.[21,24,25] However, Reina Yao et al in their retrospective review article, were not able to establish an association of SSI with resident/ fellow involvement and number of surgeons involved because of the mixed evidence.[18] All cases in our series were operated with the MILOD technique by a team of three members, one senior spine surgeon assisted by one young surgeon and one resident or by two residents. To find out any role of postoperative beds on SSI, we analyzed cases admitted in general bed or cabin. Similar to the findings of Apisarnthanarak et al we also found no significant association of type of post-op beds and occurrence of SSI.[21]

This study was prompted by several SSI cases in spine surgery in our hospital. We tried to mitigate most of the pre-operative risk factors that have already been established in the literature in our set up, none of the variables studied were significantly associated with SSI. There are numerous intra-operative factors, like operating room traffic, changes of scrub nurses, use of C-arm, and sterility of instruments which can be a risk factor for SSI that we did not study. These operative procedures were undertaken after the earthquake when different orthopedic cases were done in a similar setup. Also, the operating rooms in our hospital that time were shared with Neurosurgery and Uro surgery teams which could have led to such alarming results.

CONCLUSION

The finding of the study thus concludes that though the incidence of infection is higher in our study none of the risk factors we studied were significant. Thus a further meticulous study is needed to find out risk factors of SSI. There should be a dedicated spine surgery operating room to reduce the risk of SSI.

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