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Surgical Site Infection Following Open Posterior Spine Surgery: Which is the Most Affected?

Açık Posterior Omurga Cerrahisi Sonrası Cerrahi Alan Enfeksiyonu: En Çok Etkilenen Hangisi?

Azharuddin Azharuddin[1], Harapan Harapan[2], Jonny Karunia Fajar[2]

[1]Syiah Kuala University Faculty of Medicine, Department of Orthopedic and Traumatology, Consultant of Spine Surgery, Banda Aceh, Indonesia
[2]Syiah Kuala University Faculty of Medicine, Medical Research Unit, Banda Aceh, Indonesia

ABSTRACT

Objective: Surgical site infection (SSI) is an important cause of surgical wound healing disorders. Although SSI is uncommon in open posterior spine surgery, it is potentially correlated with serious morbidity, increased resource utilization and mortality. To evaluate the association between several spinal disorders treated with open posterior spine surgery and the risk of SSI.

Materials and Methods: A retrospective study was conducted in Dr. Zainoel Abidin General Hospital included data during January 2012 to December 2015. The data of the spinal disorders treated with open posterior spine surgery and the risk of SSI were extracted from medical record. A chi-square was employed to assess the association between spinal disorders treated with open posterior spine surgery and the incidence of SSI.

Results: A total of seven (2.4%) SSIs of 289 patients treated with open posterior spine surgery were analyzed. Spinal tuberculosis was associated with 5.9 fold increased the risk of SSI [odds ratio 95% confidence interval= 5.99 (1.14-31.51), p=0.034]. While, other spinal disorders including spinal stenosis (p=0.311), spine fracture (p=0.759), herniated nucleus pulposus (p=0.484), spinal dislocations (p=0.806), spondylolisthesis (p=0.925), spinal tumor (p=0.491), and scoliosis (p=0.707) had no significant association with the risk of SSI.

Conclusion: In our population, spinal tuberculosis is indicated to be correlated with the risk of SSI.

Keywords: Surgical site infection, open posterior spine surgery, spinal disorders, spinal tuberculosis, risk factor

ÖZ

Amaç: Cerrahi alan enfeksiyonu (CAE), cerrahi yara iyileşme bozukluklarının önemli bir nedenidir. CAE, açık posterior omurga cerrahisinde nadir olmakla birlikte; ciddi morbidite, artan kaynak kullanımı ve mortalite ile potansiyel olarak ilişkilidir. Açık posterior omurga cerrahisi ile tedavi edilen çeşitli omurga bozuklukları ve CAE riski arasındaki ilişkiyi değerlendirmektir.

Gereç ve Yöntemler: Ocak 2012-Aralık 2015 tarihleri arasında, Dr. Zainoel Abidin Kamu Hastanesi'nde elde edilen veriler ile retrospektif bir çalışma yürütüldü. Açık posterior omurga cerrahisi ile tedavi edilen omurga bozuklukları ve CAE riski verileri tıbbi kayıtlardan toplandı; tedavi edilen omurga bozuklukları ve CAE insidansı arasındaki ilişki ki-kare testi ile değerlendirildi.

Bulgular: Açık posterior omurga cerrahisi ile tedavi edilen toplam 289 hastadan 7 (%2,4) CAE'li hasta incelendi. Spinal tüberküloz, CAE riskinin 5,9 kat artmasıyla ilişkiliydi [odds oranı %95, güven aralığı= 5,99 (1,14-31,51), p=0,034]. Spinal stenoz (p=0,311), omurga kırığı (p=0,759), fıtıklaşmış nukleus pulposus (p=0,484), omurga çıkıkları (p=0,806), spondilolistezis (p=0,925), omurga tümörü (p=0,491) ve skolyoz (p=0,707) gibi diğer omurga hastalıkları CAE riski ile anlamlı ilişki göstermemiştir.

Sonuç: Popülasyonumuzda spinal tüberkülozun CAE riski ile ilişkili olduğu gösterilmiştir.

Anahtar kelimeler: Cerrahi alan enfeksiyonu, açık posterior omurga cerrahisi, omurga bozuklukları, spinal tüberküloz, risk faktörü

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Address for Correspondence / Yazışma Adresi: Jonny Karunia Fajar, Syiah Kuala University Faculty of Medicine, Medical Research Unit, Banda Aceh, Indonesia
E-mail / E-posta: gembyok@gmail.com **ORCID-ID:** orcid.org/0000-0002-0309-5813

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INTRODUCTION

Surgical site infection (SSI), formerly called surgical wound infections (1), are infections occurring up to 30 days after surgery (or up to one year after surgery in patients receiving implants) and affecting either the incision or deep tissue at the operation site (2,3). However, the widely used SSI definition refers to the SSI classification consisting of superficial incisional, deep incisional, and organ/space SSI (4). The incidence of SSI in all cases of surgery is vary, ranging from 0.8% in US to 16.4% in Japan (3) and for spinal surgery is ranging from 0.22% to 9.4% (5-10). SSIs were associated with an increased in treatment costs about more than fourfold (11) or US$ 15,800 to 43,900 per admission (12) or US$ 10 billion per year (3) due to prolonged hospitalization, additional diagnostic tests, therapeutic antibiotic treatment, and additional surgery procedures (4,8). In addition, studies also found that SSI was associated with an increased mortality rate, which was most often due to *Staphylococcus aureus* infection (13-15). Because SSIs are associated with a fatal consequence, efforts to reduce SSI are paramount and it is necessary to take precautions by being aware to several factors that have the potential to induced SSI.

SSI in spinal surgery can be superficial (above the fascia) or deep (below the fascia) such as spondylitis, discitis, spondylodiscitis, and epidural abscess (16). The incidence of SSIs in spinal surgery is rare, compared with other types of surgery (3). Although its incidence in spinal surgery is relatively infrequent event, SSIs are proven to be correlated with a high morbidity, mortality, increased additional cost and resource utilization (1). In addition, studies revealed that SSIs are also correlated with a long duration of surgery usually longer than three hours (17,18). Given the fact that the mean surgical time for spinal disorder is about four hours (19), therefore SSIs are potentially acquired among spinal disorder surgical procedures. Here, we reported the incidence of SSIs in patients with spinal disorders treated with open posterior spine surgery. The data are expected to be a clue for physicians to concern about several cases that have the potency for the risk of SSIs.

MATERIALS AND METHODS

Study Designs and Participants

This is a single-center retrospective study conducted in Dr. Zainoel Abidin General Hospital. The total population was all spinal disorder patients underwent open posterior spine surgery (289 patients - updated January 9th 2016) treated in Dr. Zainoel Abidin General Hospital during January 2012 to December 2015. A total sampling method was used in the study and 289 cases were identified.

Eligibility Criteria and Measures

Eligibility criteria consisted of predefined inclusion and exclusion criteria. Inclusion criteria for this study were (1) patients with spinal disorders treated with open posterior spine surgery (2) patients with SSI after open posterior spine surgery. The exclusion criteria in this study were incomplete medical record. Demographic and clinical data of the patients were retrieved from medical record. The explanatory variable in this study was spinal disorders while the response variable was the risk of SSI, which is defined as infections occurring up to 30 days after surgery and affecting either the incision or deep tissue at the operation site (2).

Statistical Analysis

Data of odds ratio (OR) and 95% confidence interval (95% CI) regarding the association between spinal disorders and the risk of SSI were analyzed using chi-square test with SPSS software. The value of $p<0.05$ was considered statistically significant.

RESULTS

Over the study time frame, there were 291 open posterior spine surgeries, two cases were excluded due to incomplete medical record, and therefore 289 cases were included in the analysis. Of these, seven (2.4%) patients were with SSI. Distribution of the age and gender of the patients with posterior spine surgeries and those with SSI are presented in Table 1. Most of the cases aged between 41-60 years

Table 1: Patients characteristics included in the study

Patients characteristics		n	%
Age	<11years	1	0.34
	11- 20 years	15	5.19
	21-40 years	117	40.48
	41-60 years	119	41.17
	>60 years	37	12.80
Total		289	100.00
Gender	Female	168	58.13
	Male	121	41.86
Total		289	100.00

Note n, amount of sample; %, percentages

Table 2: Summary odds ratios and 95% confidence interval regarding the association between spinal disorders treated with open posterior spine surgery and the risk of surgical site infection

No	Spinal disorders	Number of events		SSI		OR (95%CI)	p
		n	%	n	%		
1	Spinal stenosis	64	21.99	0	0.00	0.226 (0.013 - 4.008)	0.311
2	Spinal tuberculosis	88	30.24	5	71.42	5.994 (1.140 - 31.515)	0.034
3	Spine fracture	31	10.65	1	14.28	1.400 (0.163 - 12.026)	0.759
4	HNP	44	15.12	0	0.00	0.357 (0.020 - 6.369)	0.484
5	Spinal dislocation	12	4.12	0	0.00	1.443 (0.078 - 26.704)	0.806
6	Spondylolisthesis	15	5.15	0	0.00	1.151 (0.063 - 21.081)	0.925
7	Spinal tumor	6	2.06	0	0.00	2.836 (0.146 - 55.083)	0.491
8	Scoliosis	29	9.96	1	14.28	1.512 (0.176 - 13.014)	0.707
Total		289	100.00	7	100.00		

OR: Odds ratio, 95% CI: 95% Confidence interval, SSI: Surgical site infection, n: Amount of sample; %: percentages, p: Significance, HNP: Herniated nucleus pulposus

and 58.13% cases were female. The most frequent spinal disorders in this study was spinal tuberculosis accounted for 88 cases (30.24%) followed by spinal stenosis (21.99%) (Table 2).

SSIs were occurred in seven patients: five patients with spinal tuberculosis, one patient each with scoliosis and spine fracture. Our analysis showed that only spinal tuberculosis was significantly associated with the risk of SSI [OR 95% CI=5.994 (1.140 - 31.515), p=0.034]. Other spinal disorders had no significant association with the risk of SSI (Table 2). Our analysis showed that spinal tuberculosis had 5.9 fold increased the risk of SSI compared with other spinal disorders.

DISCUSSION

SSI is a devastating complication in spine surgeries associated with various problems such as increased treatment costs, high morbidity, and some cases with mortality (4,13). In this study, we reported the incidence of SSI in spinal disorder treated with open posterior surgery and we tried to correlate between variables. This is the first study in Indonesia regarding SSI following spine surgery. The first study was reported by Turnbull in Canada (20).

Age is one of the individual risk factors in spinal disorder. Increasing age is directly proportional to increased risk of spinal disorders (21). Our result revealed that age 41-66 years was the commonest group with spinal disorders (Table 1). Previous studies found that the mean age for spinal disorder ranges from 44.2±16.0 to 63±14 years (5-8,10,12,14,16,18,22-32). This indicates that our result was consistent with previous findings. Although the prevalence of spinal disorders increase with age, a study showed that the relation between age and spinal disorders was not linear, suggesting that multiple factors are involved (33).

The incidence of SSI following spine surgery is varied depend on surgical procedure. Data revealed that the incidence ranges from 0.5% to 18.8% (34-39). Moreover, twenty studies reported were identified from PubMed and EMBASE regarding the incidence of SSI following spine surgery. They reported the incidence vary, ranging from 0.2% to 16.1% (5-8,10,12,14,16,18,22-32). Our result showed that the incidence of SSI following spine surgery was 2.4%. We tried to calculate the average of our result combined with the 20 studies, and the average was 4.7%. This indicates that our result was consistent with previous data. Interestingly, SSI incidence in our centre is lower than the average global incidence of SSI.

Of 289 spine surgeries, our analysis reveals that only spinal tuberculosis was associated with increased the risk of SSI. Our result was different with several studies. Studies found that trauma and or degenerative in cervical (8,18,27,28,32), thoracic (12), and lumbar spine (6,7,10) were the commonest cases associated with SSI. This difference could not be clearly explained. However, among those studies, spinal tuberculosis was not included because no case was identified. Perhaps if they included spinal tuberculosis, it is likely that the results would be similar to those in our study. Extra-pulmonary tuberculosis especially spinal tuberculosis is most common in human immunodeficiency virus-seropositive patients (40). However, in our country, high incidence and prevalence of pulmonary tuberculosis is logical to consider that extra-pulmonary tuberculosis should be relative high (41). All this time, there have been no study reported SSI on spinal tuberculosis. Therefore, we

could not compare our results specifically. Nevertheless, it is well known that tuberculosis infection is one of the co-morbidities for SSI (27).

SSI by *Mycobacterium tuberculosis* is uncommon. However, several studies had reported *M. tuberculosis* associated SSI in patients with no history of tuberculosis (42-45). This indicated that the virulence of *M. tuberculosis*is very high. However, there may be other influential factors such as dormant, endemic areas, and others. In most cases, SSI by *M. tuberculosis* is caused by reactivation of dormant tuberculosis (46). In our study, spinal tuberculosis was the only case of infection. Therefore, the risk for SSI is higher in subjects with spinal tuberculosis than others. SSI by *M. tuberculosis* is an infection by *M. tuberculosis* in skin, soft tissue, and or organ (47). In the patients with an existing tuberculosis infection like in our study, SSI probably comes from primary sources. Influenced by several factors, it triggers to cause cutaneous and surgical wound infection.

Although the results of this study showed that spinal tuberculosis had the association with the increased risk of SSI. However, at present time, it is not possible to give recommendations for the use of specific management for spinal tuberculosis. Therefore, orthopedic organization is expected to review SSI in spinal disorder especially spinal tuberculosis. Thus, there would be the gold standard recommendations for the use of specific management to prevent SSI as recommended by World Health Organization (3).

This study had several limitations. First, in this study was not included data regarding the risk factors associated with SSI, i.e. intra-operative blood loss, operative time, inpatient stay prior to index operation, smoking, alcohol abuse, malnutrition, diabetes, and long-term steroid use like described by Olsen et al. (5). Second, false negative results could be occurred in this study due to the small sample size. Therefore, further studies with a larger sample size are required to determine the better association. Third, we did not evaluate the post-operative outcome. Fourth, we did not identify the microbial agent causing the SSIs. Lastly, this was retrospective study and therefore further study with cohort design is needed.

CONCLUSION

Spinal tuberculosis is indicated to be correlated with the risk of SSI. In addition, the study also showed that spinal tuberculosis is a case to be aware because it is potentially to trigger SSI.

Ethics Committee Approval: Our study was approved by the Institutional Review Board of Syiah Kuala University (no: 017/KE/FK/2015), and carried out in accordance with The Declaration of Helsinki.

Informed Consent: Because this was a retrospective study, the signed written informed consent was not required.

Authorship Contributions

Surgical and Medical Practices: A.A., Concept: A.A., J.K.F., Design: A.A., H.H., J.K.F., Data Collection or Processing: H.H., Analysis or Interpretation: H.H., Literature Search: H.H., J.K.F., Writing: A.A., H.H., J.K.F.

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