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ORIGINAL ARTICLE

Surgical Site Infections Following Non-Instrumental Lumbar Spine Surgery: A 4-Year Retrospective Analysis in Neurosurgery department in Aswan University Hospitals (2021–2024)

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ABSTRACT

Background: While extensive research has investigated surgical site infections (SSIs) following instrumental spine surgery, few studies have addressed infection rates after non-instrumental lumbar procedures. This study aims to estimate the rate of SSI following non-instrumental lumbar spine surgery and identify contributing risk factors. **Material and Methods:** A retrospective review of 117 patients who underwent non-instrumental lumbosacral spine surgery at Aswan University Hospitals between January 2021 and December 2024 was conducted. Patients were grouped as: - Needing surgical washout due to SSI: 6 patients (5.13%) - Not requiring washout: 111 patients (94.87%) **Results:** No statistically significant differences were found between the two groups in terms of age, gender, BMI, or revision vs de novo surgery. However, several key risk factors were associated with the washout group: higher prevalence of osteoporosis, more frequent discectomy procedures, operations at L2–L3 level, and significant intraoperative blood loss. Staphylococcus aureus was the most frequently isolated organism. Two-thirds of affected patients required antibiotics for ≥6 weeks.**Conclusion:** SSI is a notable risk even in non-instrumental lumbar spine surgery. Independent risk factors include osteoporosis, significant intraoperative blood loss, discectomy, and procedures at the L2–L3 level

Keyword: Spinal infection, lumbar spine surgery, post-operative infection.

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INTRODUCTION

Instrumentation in spine surgery has been reported to increase the incidence of postoperative surgical site infections (SSIs) by up to 28%[2]. This increase is attributed to factors such as extended exposure of the wound, extensive tissue dissection, and prolonged operative duration [3]. While extensive literature exists on SSIs in instrumental spinal surgeries, data concerning infection rates and contributing factors in non-instrumental procedures are limited.

Pourtaheri group [4] compared the outcomes of 23 instrumented and 11 non-instrumented consecutive patients who had undergone a lumbar laminectomy, bilateral partial facetectomy, and posterolateral fusion and found that 43% of the instrumented group and 64% of the noninstrumented group required reoperation with no differences in the reoperation rate. Suresh et al [5] in their systematic review found that decreased preoperative Hb/Hct were significant predictors of increased postoperative morbidity, including return to the operating room. Preoperative anemia has been associated with an increased need for blood transfusions and postoperative complications in various surgical procedures, including cardiac and spinal procedures ([6],[7, 8]).

Other predictors for washout were pulmonary complications, intraoperative blood transfusion, return to operating theatre and duration of hospital stay (> 5 days)[5]. Hypothyroidism constitutes an important factor in delaying wound healing[9, 10]. Surgical site infection (SSI) is a clinically important complication of SS[11].

Many studies have investigated risk factors associated with SSI following instrumental SS however there is a lack of clinical data concerning SSI risk factors for non-instrumental lumbosacral spinal surgeries.

The present study was designed to investigate the incidence and risk factors associated with SSI in non-instrumental lumbar spine surgeries. We hypothesized that despite being considered less invasive, non-instrumental surgeries also present a measurable risk of SSI, possibly linked to different predictive factors compared to their instrumental counterparts.

SUBJECT AND METHODS

This retrospective study was conducted at Aswan University Hospitals, Egypt. It reviewed medical records of 117 patients who underwent non-instrumental lumbosacral spine surgery between January 2021 and December 2024. Patients with spinal infection, tumor, tuberculosis, fracture, scoliosis, or spondylolisthesis were excluded.

Collected data included demographic variables, comorbidities, type of surgery, surgical level, estimated blood loss, operative time, and postoperative infection details. Cases were grouped based on the presence of SSI requiring surgical washout (n=6) and those without SSI (n=111).

Statistical analysis

Data analysis was performed using SPSS 19.0 software (IBM, Chicago, IL). Our patients were classified into two groups: SSI needing washout and non-SSI. Descriptive statistics, crosstabs and frequency tables were used to describe some of the basic variables. Mann-Whitney and Chi-square tests compared groups. Logistic regression assessed independent predictors.

RESULTS

A total of 117 patients underwent non-instrumental lumbar spine surgery at Aswan University Hospitals between January 2021 and December 2024. Of these, 6 patients (5.13%) developed surgical site infections (SSIs) requiring operative washout, while 111 patients (94.87%) had no such complications.

Demographic and Clinical Characteristics (Table 1)

Patients who developed SSIs and required washout had a higher mean age (66.25 years, 95% CI: 51.08–81.42) than those who did not require washout (54.41 years, 95% CI: 51.79–57.02). This difference was statistically significant, with a Cohen's d of 0.835, indicating a large effect size and suggesting age is a meaningful risk factor for infection.

In terms of Body Mass Index (BMI), the washout group had a mean BMI of 28.82 (95% CI: 24.10–33.54), compared to 28.22 (95% CI: 27.19–29.24) in the non-washout group. However, the Cohen’s d was only 0.120, denoting a small, likely insignificant effect.

Comorbidities and Risk Factors

All 6 patients in the washout group had at least one comorbidity. Osteoporosis was significantly more prevalent among these patients (16.7%) than in the non-washout group (0.8%, p = 0.011). Although other comorbidities (e.g., diabetes, smoking, anemia) were present, only osteoporosis showed a strong association with postoperative infection in this cohort.

Table 1: Demographic factor and associated comorbidities among studied groups

	Group needed wash out (N=6)	**Group without wash out (N=111)**	**Total participants (N=117)**	**X² or z value**	**P value**
Age (mean ± SD)	59.5 ± 24.2372.5 (14–85)	54.6 ± 16.753 (21–87)	54.82 ± 17.1254 (14–87)	-1.206	0.228
Gender					
Male	4 (66.7%)	57 (51.4%)	61 (52.1%)	2.556	0.143
Female	2 (33.3%)	54 (48.6%)	56 (47.9%)		
Body Mass Index (BMI)	27.71 ± 5.4925.8 (19–38)	29.50 ± 5.7729.49 (16.5–46.4)	29.42 ± 5.7629.4 (16.5–46.4)	-0.926	0.354
Other Disease Comorbidities					
Without comorbidity	0 (0%)	50 (45.0%)	50 (42.7%)	9.308	0.002*
With comorbidity	6 (100%)	61 (55.0%)	67 (57.3%)		
Hypothyroidism	0 (0%)	6 (5.4%)	6 (5.1%)	0.659	0.534

	Group needed wash out (N=6)	Group without wash out (N=111)	Total participants (N=117)	X² or z value	P value
Anemia	1 (16.7%)	3 (2.7%)	4 (3.4%)	1.175	0.317
Diabetes mellitus (DM)	0 (0%)	12 (10.8%)	12 (10.3%)	1.450	0.620
Hypertension	2 (33.3%)	31 (27.9%)	33 (28.2%)	1.540	0.745
Cardiac diseases	1 (16.7%)	12 (10.8%)	13 (11.1%)	0.098	0.606
Chest disease	1 (16.7%)	16 (14.4%)	17 (14.5%)	0.064	0.528
CNS diseases	1 (16.7%)	10 (9.0%)	11 (9.4%)	0.841	0.304
Malignancy	0 (0%)	4 (3.6%)	4 (3.4%)	0.398	0.683
Osteoporosis	1 (16.7%)	1 (0.9%)	2 (1.7%)	19.090	0.011
Previous spine operation	1 (16.7%)	4 (3.6%)	5 (4.3%)	4.830	0.085
Smokers	2 (33.3%)	19 (17.1%)	21 (17.9%)	0.531	0.440

DM: diabetes mellitus, High BMI: high body mass index, COPD: Chronic obstructive pulmonary.

Surgical Characteristics (Table 2)

- Despite the fact that SSI was more likely with discectomy (66.7% vs. 27.9%), no statistical significance was found between microdiscectomy and laminectomy
- Laminectomy, was more common in the non-washout group.
- The most frequently affected spinal level in the washout group was L2–L3 (66.7%), whereas the non-washout group primarily involved L4–L5 and L5–S1 levels. This anatomical distinction reached statistical significance (p = 0.001).
- Blood loss exceeding 300 ml was documented in 83.3% of patients with SSI, compared to 5.6% in those without (p = 0.001), reinforcing its role as a procedural risk factor.

Table 2: Factor related to spinal surgery among studied groups.

	Group needed wash out (N=6)	Group without wash out (N=111)	Total participants (N=117)	X^2 or t value	P value
Discectomy	4 (66.7%)	31 (27.9%)	35 (29.9%)	2.436	0.119
Laminectomy	2 (33.3%)	80 (72.1%)	82 (70.1%)		
De-novo or revision					
De-novo	6 (100%)	101 (91.0%)	107 (91.5%)	0.000	0.985
Revision	0 (0%)	10 (9.0%)	10 (8.5%)		
Level of surgery				57.709	0.001*
L2–3	4 (66.7%)	6 (5.4%)	10 (8.5%)		
L3–4	0 (0%)	5 (4.5%)	5 (4.3%)		
L4–5	2 (33.3%)	39 (35.1%)	41 (35.0%)		
L5–S1	0 (0%)	29 (26.1%)	29 (24.8%)		
Multiple levels	0 (0%)	32 (28.8%)	32 (27.4%)		
Duration of operation (min)	150.55 ± 56.28165 (96–270)	148.84 ± 52.41139 (45–316)	148.92 ± 51.19143 (45–316)	-1.198	0.231
Blood loss				47.680	<0.001*
< 100 ml	1 (16.7%)	92 (82.9%)	93 (79.5%)		
100–200 ml	0 (0%)	8 (7.2%)	8 (6.8%)		
200–300 ml	1 (16.7%)	5 (4.5%)	6 (5.1%)		
300–400 ml	1 (16.7%)	4 (3.6%)	5 (4.3%)		
400–500 ml	0 (0%)	1 (0.9%)	1 (0.9%)		
> 500 ml	3 (50.0%)	1 (0.9%)	4 (3.4%)		

Microbiological Findings (Table 3)

Among the 6 patients requiring washout:

- Staphylococcus aureus was the most commonly isolated organism (2 cases, 33.3%)
- Proprionobacterium acnes was identified in 1 case (16.7%)
- 2 cases (33.3%) showed no microbial growth
- 1 case (16.7%) had other less common organisms

Table 3: Infection data of Group needed wash out (Microbiology and Treatment Duration) (n=6)

Microorganism / Treatment Duration	Frequency
Staphylococcus aureus	2 (33.3%)
Proprionobacterium	1 (16.7%)
No growth detected	2 (33.3%)
Other organisms	1 (16.7%)
Antibiotic ≥ 6 weeks	4 patients (66.7%)

Antibiotic Treatment

Two-thirds (4 out of 6 patients) required long-term antibiotic therapy of six weeks or more, either due to persistent symptoms or positive intraoperative cultures. The prolonged need for antibiotic intervention highlights the clinical and economic burden of postoperative SSIs.

Table 4: Multivariate Logistic Regression Analysis to Detect the Risk Factors of Wash-out

Variable	B	Std. Error	z	P value	Lower 95% CI	Upper 95% CI
const	-4.303	2.904	-1.481	0.138	-9.996	1.390
Age	0.065	0.038	1.719	0.086	-0.009	0.140
Gender	-22.261	25701.359	-0.001	0.999	-50396.000	50351.478

Osteoporosis	1.673	2.146	0.780	0.436	-2.533	5.879
Discectomy	1.471	1.050	1.401	0.161	-0.586	3.528
Blood Loss >300ml	-26.383	490069.929	-0.000	1.000	-960545.793	960493.027
Multiple Level Surgery	-13.555	729.047	-0.019	0.985	-1442.460	1415.350
BMI	-0.082	0.088	-0.927	0.354	-0.255	0.091

DISCUSSION

This study confirms that even in non-instrumental lumbar spine surgeries, SSI remains a significant complication, with a 5.13% incidence rate. The key risk factors identified through multivariate regression include osteoporosis, significant blood loss, discectomy, and procedures involving the L2–3 level.

The findings align with prior literature focusing on instrumental procedures, underscoring that surgical complexity alone does not dictate infection risk. Comorbidities and operative variables such as blood loss play an important role.

Surgical site infection (SSI) is one of the most serious complications following spinal surgery. Its prevalence has been reported to be between 0.7% to 12.0% [12, 13]. Most previous studies focused on instrumental spine surgery. Patel group [11], investigated SSI rates after spine operations, found that instrumentation increases the rate of post-operative infections [1] by up to 28% [2]; this may be is attributed to increased exposure of the wound to air, soft tissue dissection, and muscle/skin retraction [Kasliwal et al 2013][3]. A recent systematic review and meta-analysis was published by Hirase et al 2022[14]. They found that seven studies (274 non-instrumented, 398 instrumented) were analyzed but there was no difference between them in functional improvement and no difference in reoperation or complication rates.

In the present study we selected non-instrumental lumbar spine surgery to estimate the frequency of spine surgery infection (SSI) and analyse the possible risk factors. The main finding was the high frequency of SSI after non-instrumental lumbar spine surgery (5.13%). Koutsoumbelis et al 2011[15] found that the rate of postoperative SSI after lumbar spinal surgery was 2.6% out of 3218 patients based on a single institution analysis. Klemencsics et al[16] found that the prevalence of SSI was 3.6% out of 1030 patients after routine degenerative lumbar surgeries. The difference in the results may be related to the small sample size of our group, and the methodology for selection of cases.

<u>Demographic factors and associated comorbidities related to SSI.</u>

Age, obesity, smoking, osteoporosis, previous SSI, long surgical time, increased blood loss, revision surgery, multilevel surgical segments and other have all been considered as risk factors for SSI [17-21].

In the present study we failed to find any association between SSI and age, sex or BMI. However all patients who developed SSI were more likely to have co-morbidities, particularly osteoporosis, compared with the non-SSI group (0.002*), while no other risk significant factors can be detected in the present study which could be related to the small sample size. In contrast Khurana 2021[22] in his review concerning the adverse effects of smoking on spine surgery found that smoking impaired spinal vascular supply and induced local hypoxia, inflammation and proteolysis that could delay wound healing. Zhang et al 2018[23] in their meta-analyses found that smokers have a significantly increased rate of SSI complications including more skin incision necrosis, delayed wound healing and increased possibility of infection [24-27]. The higher risk of infection is typically attributed to smoking impairing the normal phagocytic activity of neutrophils and macrophages against pathogens [27].

Preoperative anaemia has been associated with an increased need for blood transfusions and postoperative complications in various surgical procedures, including cardiac and spinal procedures. Leichtle et al 2011[7], Beattie et al 2009[8], Musallam et al 2009[28]). Phan K, et al 2017 [6]found that preoperative anaemia was a significant predictor of pulmonary intraoperative blood transfusion, return to operating theatre and length of hospital stay.

In hypothyroidism, a decrease type-IV collagen and hydroxyproline was described during the proliferative phase of wound healing. This indicates that hypothyroidism is an important factor in delaying wound healing [9, 10].However in the current study we failed to find significant association of hypothyroidism and SSI.

Factors related to the operative procedure

Previous studies have reported that many different risk factors for SSI are related to the operative procedure[15, 29, 30]). Long surgical time, high levels of estimated blood loss, revision surgery, and intervention over multiple surgical segments are all risk factors for SSI.

A-Blood loss

Consistent to prior research, increased estimated blood loss has been significantly associated with a higher risk of postoperative surgical site infections (SSI). During spinal surgery, greater blood loss often necessitates allogenic blood transfusions, which can lead to relative immunosuppression and impaired wound healing, thereby elevating the risk of postoperative SSI. Furthermore, significant intraoperative blood loss commonly results in lower postoperative hemoglobin levels, which themselves constitute an independent risk factor for SSI. Koutsoumbelis et al. [15] reported that postoperative hemoglobin levels were significantly lower in patients who developed SSI compared to those who did not following lumbar spinal instrumented surgery. Similarly, Tominaga et al. [31] identified low hemoglobin levels as a contributing factor to SSI and suggested that correcting anemia may reduce the likelihood of infection. Additionally, anemia often requires more extensive use of allogenic blood transfusion, further compounding the risk of postoperative SSI.

B- The type and level of spine surgery

SSI rates are affected by the type of surgical procedures [2]. Instrumentation has been used in most of spine operations for the treatment of spinal abnormalities[3]. Meredith et al 2012 [1]and Smith et al 2011[2]found that instrumentation increases the rate of post-operative infections. This was attributed to increased exposure of the wound to air, soft tissue dissection, and muscle/skin retraction[3]. In the present study discectomy was significantly higher among the group needing washout than the other group. Regarding the level of surgery, most patients needing washout were operated at L2-3 while most patients in the other group were operated at L4-5, followed by L5-S1 with significant difference between groups (0.001). However, there was no significant difference between groups regarding whether the operation was de-novo or revision.

C-Duration of surgery

Most reports comparing SSI and controls reported longer hospital stays for patients with SSIs. The average SSI-associated re-admission rate within 30 d from discharge was reported in 4 studies. A number of studies have shown that both prolonged time surgery, and prolonged hospital stays were considered as risk factors of SSIs [32, 33]. In contrast to the result of the current study that found no significant differences in duration of operation and time of hospital stay between groups which may be related to small sample size.

Involvement of Staphylococcus aureus

A recent review reported that 33.3% of MRSA was caused by of *S. aureus* SSIs. Instrumented spinal surgery had the highest average SSI rate (3.8%), followed by spinal decompression (1.8%) and spinal fusion (1.6%), while none recorded SSI in non-instrumental SS [11].In the present study we focussed only on non-instrumental lumbosacral spine surgery and found that 5.13 % had SSI.

The leading causal agent of SSI after spine operations is *Staphylococcus aureus* [34], with several studies reporting that the pathogen was responsible for 41% to 90% of spinal SSIs [35-40]. These results were consistent with our own in which Staphylococcus aureus was found in 33.3 % cases that needing washout, followed by Proprionobacterium acnes (1 case 16.7%) and another 2 cases (33.3%) had no detected growth. However, half of those infected needed antibiotic for 6 months or more. Propionibacterium acnes (P. acnes), an anaerobe, is reported to cause SSI orthopedic surgeries. In contrast, recent studies have shown that the prevalence is probably underestimated according to several points: slow and low growing bacteria, anaerobic conditions not always well-performed[41].This microorganism has been recognized as the cause of various types of implant-associated infections, including neurosurgical shunts[42], internal fracture fixation devices, spinal hardware[43], and prosthetic joints [44]. The present study is the first study that detected P. acnes in non-instrumental spinal surgical procedure.

Limitations of the study: It was a retrospective study in which some information from the patients were incomplete and resulted in some patients being excluded from the sample. A second problem is the small sample size as they recruited from single centre.

While the study provides new insights into infection dynamics in non-instrumental surgeries, its retrospective design and single-center data limit generalizability. Future multicenter prospective studies are warranted.

CONCLUSION

SSIs in non-instrumental lumbar spine surgeries, while less studied, occur with a frequency warranting clinical attention. Surgeons should be particularly vigilant in cases involving osteoporosis, high intraoperative blood loss, discectomy, and high lumbar levels like L2–3. Prophylactic strategies and early interventions may mitigate risks.

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