

Post-operative antibiotic prophylaxis in spine surgery patients with thoracolumbar drains: A meta analysis

Terry C. Xia^{a,*}, Gersham J. Rainone^a, Cody J. Woodhouse^b, Dallas E. Kramer^b, Alexander C. Whiting^b

^a Drexel University College of Medicine, Philadelphia, PA, USA

^b Department of Neurosurgery, Allegheny Health Network, Pittsburgh, PA, USA

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STRUCTURED ABSTRACT

Objective: Closed-suction drains are commonly placed after thoracolumbar surgery to reduce the risk of post-operative hematoma and neurologic deterioration, and may stay in place for a longer period of time if output remains high. Prolonged maintenance of surgical site drains, however, is associated with an increased risk of surgical site infection (SSI). The present study aims to examine the literature regarding extended duration (≥ 24 h) prophylactic antibiotic use in patients undergoing posterior thoracolumbar surgery with closed-suction drainage.

Methods: This systematic review was conducted according to the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) guidelines. Relevant studies reporting the use of 24-h post-operative antibiotics compared with extended duration post-operative antibiotics in patients undergoing posterior thoracolumbar surgery with closed-suction drainage were identified from a PubMed database query.

Results: Six studies were included for statistical analysis, encompassing 1003 patients that received 24 h of post-operative antibiotics and 984 patients that received ≥ 24 h of post-operative antibiotics. The SSI rate was 5.16 % for the shorter duration group (24 h) and 4.44 % ($p = 0.7865$) for the longer duration group (≥ 24 h).

Conclusions: There is no significant difference in rates of SSI in patients receiving 24 h of post-operative antibiotics compared with patients receiving ≥ 24 h of post-operative antibiotics. Shorter durations of post-operative antibiotics in patients with thoracolumbar drains have similar outcomes compared to patients receiving longer courses of antibiotics. Shorter durations of antibiotics could potentially help lead to lower overall cost and length of stay for these patients.

1. Introduction

Post-operative surgical site infections (SSIs) are a common cause of morbidity and mortality in spine surgery.^{1,2} Subfascial drains are often placed after thoracolumbar procedures to assist with wound healing, reduce wound discharge, prevent formation and expansion of hematomas, prevent post-operative seroma formation, and reduce SSI occurrence.³ The use of drains after spinal surgery, however, has remained relatively controversial, and is often based on surgeon preference rather than scientific evidence.^{1,4,5} Further investigations are needed to understand the relationship between the duration of post-operative antibiotics in the setting of drains and their relationship to post-procedure SSIs. Current common practice involves the discontinuation of prophylactic antibiotics at 24 h post-operative. Recent

literature has explored numerous variables and their effects on the rate of SSI in patients undergoing spinal surgery, especially the timing of antibiotics administered post-operatively.^{6,7} Shorter courses of post-operative antibiotics have been demonstrated to be as effective at preventing SSIs as longer durations, including in patients with thoracolumbar drains placed during the procedure.^{6,7}

Effective recommendations with regards to spinal surgery patients undergoing posterior thoracolumbar surgery with closed-suction drainage are needed, with potential utility in helping to decrease healthcare costs, length of stay, adverse effects of antibiotics and overall risk of SSIs. We present a meta-analysis of the highest quality studies available involving prophylactic antibiotic use post-operatively in thoracolumbar spinal surgery patients with drains, that helps to clarify the relationships between duration of post-operative antibiotics in the

* Corresponding author. Drexel University College of Medicine, USA.

E-mail address: tcx23@drexel.edu (T.C. Xia).

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setting of drains and SSIs.

2. Methods

The primary objective of the study is to determine if SSI rate differs in patients undergoing thoracolumbar spinal surgery if placed on post-operative antibiotics during the entirety of subfascial drain compared to common practice (24 h) post-operative antibiotics. All case reports, small case series, and systematic reviews were excluded.

The electronic PubMed database was searched for MESH terms: “spine” “surgery” “drain” “antibiotic”, resulting in 556 published papers that were identified. Inclusion criteria for papers included in the study were as follows.

1. Patients underwent thoracolumbar surgery
2. Paper included description, including length, of post-operative drain use
3. Paper included two cohorts, one with common practice 24-h post-operative course of antibiotics compared to antibiotics during length of drain
4. SSI rates were reported in both cohorts

For these 556 papers that were identified. There was one duplicate record and was thus removed. The title of each paper was assessed by two authors (T.X. and G.R.) to gauge relevance with regards to the overall study goal. 498 papers were excluded based on title alone. Two authors (T.X. and G.R.) read through the entirety of the remaining 57 abstracts. 38 did not meet inclusion criteria.

The remaining 19 papers were read in their entirety by two of the

authors. Each paper was examined in detail for inclusion criteria. Any papers in which there was a question about whether the data met inclusion criteria were brought to a third author (C.W.) who would serve as the final decision maker for inclusion in our study. Out of the 19 papers, six in total met inclusion criteria and compared 24 h vs an extended period (drain duration, or 72 h) (Fig. 1). The data of these six studies were then used in our analysis (Table 1) (see Table 2).

For each of the six papers included, the data was collected, and separated into a short duration (24 h) antibiotic prophylaxis group, and a long duration (length of drain) antibiotic prophylaxis group. For each group the total number of patients was gathered, and the number of SSIs in each group was recorded. The SSI rate for each of the two groups was then calculated. Each paper included was given a level of evidence score based on the American Association of Neurology classification scheme.¹³

Mean difference will be reported for mean SSI rate in each group. A two-tailed, unpaired *t* test will be used to determine significance between SSIs for each group. A 2x2 table will be created for each study and relative risk (RR) will be calculated for each study. Confidence intervals will be calculated as (+/-) 1.96 the square root of the variance. Random effects and fixed effects models will be used to analyze the included studies. Cochran’s Q test and the I² index will be used to determine heterogeneity among the studies. All calculations were performed using Microsoft® Excel® (Version 2208 Build 16.0.15601.20148). Significance was defined as *p* < 0.05.

3. Results

Six studies were included in the analysis (Table 1). A total of 1003

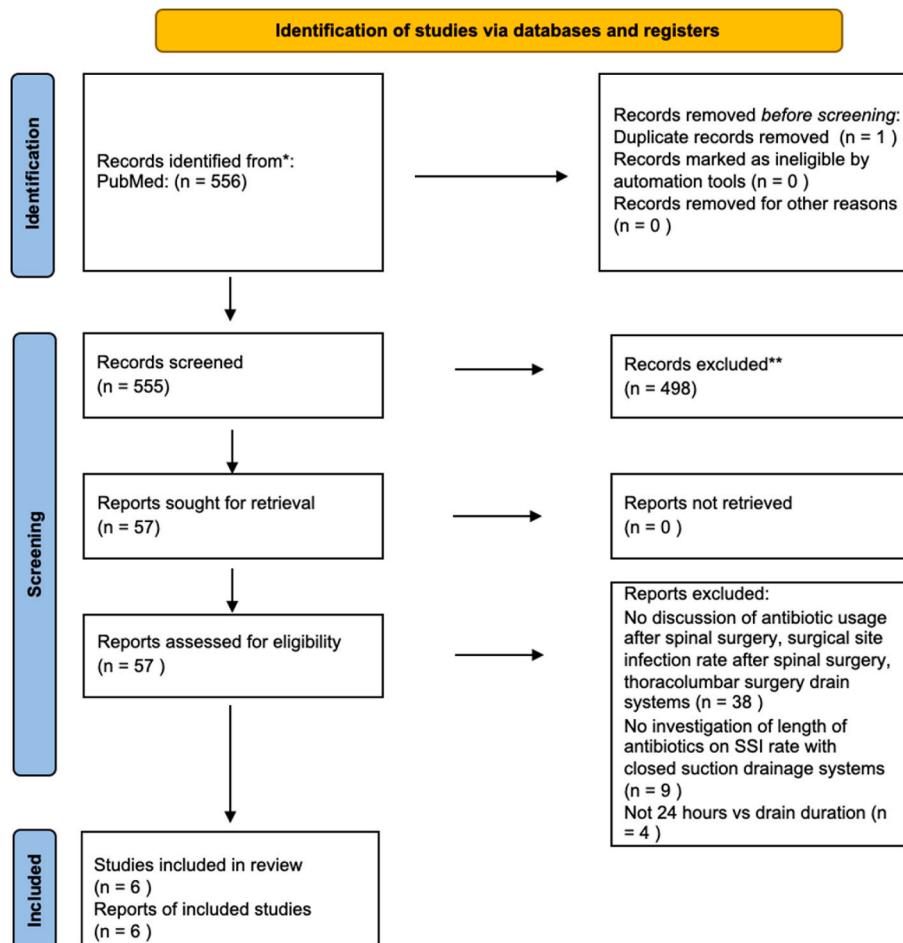


Fig. 1.

Table 1

Summary of included papers.

[Author Name], year	Patients (n)	Short Duration (n)	SSI Short Duration	Long Duration (n)	SSI Long Duration	Level of Evidence	Comments
Pivazyan, 2021 ⁸	336	168	12	168	6	II	24 h vs duration of drain
Urquhart, 2019 ⁹	552	282	17	270	14	I	24 h vs 72 h
Lewis, 2018 ¹⁰	113	55	2	58	0	II	24 h vs duration of drain
Lewis, 2017 ¹¹	346	158	1	188	4	II	<24 h vs > 24hrs
Takemoto, 2015 ¹²	314	170	21	144	19	I	24 h vs duration of drain
Marimuthu, 2016 ⁶	326	170	2	156	4	IV	24 h vs 72 h

SSI = surgical site infection.

Table 2

Analysis of combined papers.

	Short Duration	Extended Duration	p-value
Total Patients	1003	984	n/a
SSI	55	47	n/a
% SSI	5.16 %	4.44 %	0.7865

patients received <24 h of post-operative antibiotics and 984 patients received extended (≥ 24 h) duration post-operative antibiotics. The median duration of extended post-operative antibiotics ranged from 3 to 4 days. There was no significant difference ($p = 0.7865$) in rate of SSI between patients receiving 24 h (5.15 %) or extended duration (4.44 %) post-operative antibiotic prophylaxis while surgical drains were in place.

Relative risk for each paper is summarized in Table 3. There was no paper that demonstrated statistical significance of SSI in patients in the short antibiotic group compared to the extended antibiotic group. Random effects meta-analysis was performed which did not demonstrate statistical significance. The relative risk was found to be 1.001 with a 95 % confidence interval of 0.983–1.020 with a p value of 0.920. Cochran's Q test and I^2 0.2513, and 24.4 %, respectively, demonstrating low heterogeneity within the studies (see Table 4).

4. Discussion

This review examines the necessity of prolonged antibiotic use in the setting of thoracolumbar drains. Antibiotics are commonly used in the setting of thoracolumbar drains after spine surgery to assist with wound healing, reduce wound discharge, prevent hematoma and seroma formation, and reduce SSI occurrence.³ There is no consensus in the form of guidelines or large-scale evidence-based studies within the spine community as to whether using drains for longer durations is helpful in preventing complications in our patients.¹ There are a few studies that suggest that antibiotic use longer than 24 h post-operatively does not have increased benefit in preventing SSIs.¹² The lack of a statistical difference between 24 h of antibiotics and a longer duration that we have found within our analysis suggests that the benefits do not outweigh the potential risks of antibiotic side effects such as nausea, vomiting, rashes, diarrhea, or allergic reactions,¹⁴ prolonged length of stay,¹⁵ and increased hospitalization costs.¹⁵ The results display that additional antibiotic use after the 24-h period while drains are in place

Table 3

Relative risk of SSI in each study.

[Author Name], year	Number of Subjects	Relative Risk	95 % confidence limits	
			Lower	Upper
Pivazyan, 2021 ⁸	336	1.038	0.987	1.093
Urquhart, 2019 ⁹	552	1.009	0.969	1.051
Lewis, 2018 ¹⁰	113	1.038	0.986	1.092
Lewis, 2017 ¹¹	346	0.985	0.961	1.009
Takemoto, 2015 ¹²	314	0.99	0.91	1.078
Marimuthu, 2016 ⁶	326	0.986	0.957	1.016

Table 4

Meta analysis results.

Model	Effect Size	Lower 95 % CL	Upper 95 % CL	P value
Fixed Effects	0.998	0.983	1.013	0.811
Random Effects	1.001	0.983	1.020	0.920

Prob of $Q = 0.2513$ (Cannot reject an assumption of homogeneity across studies.)

I^2 -squared = 24.4 % (very low heterogeneity).

CL = confidence limits.

does not make a significant difference in prevention of SSIs. Furthermore, it is well documented that an increased duration of antibiotics imposes an increased risk of adverse effects.¹⁶ Discontinuation of extended antibiotic prophylaxis in the setting of surgical drains associated with neurosurgical procedures, including spine surgery, has been shown to decrease the incidence of *C. difficile* infection without significant change in postprocedural infection rate.¹⁷

The relationship between subfascial thoracolumbar drain use and development of SSIs has been studied though there is no consensus in their use and is often based on surgeon preference.^{7,18,19} Most studies show that use of drains does not greatly impact the rate of SSI in patients having undergone surgery.¹⁴ However, literature on the necessity of antibiotic use and the necessary duration in the setting of these drains is scarce. Six papers included in the study compared patients with thoracolumbar drains after spinal surgery on antibiotics for 24 h post-operatively and patients on antibiotics for longer than 24 h or for the duration their drain was left in.^{8–10,12} A total of 1987 patients in these studies combined were studied, comparing 1003 patients who received antibiotics for only 24 h against 984 patients who received a longer duration. There was no statistical advantage to receiving antibiotics longer than 24 h when assessing the incidence of SSIs ($p = 0.7865$).

This analysis has limitations. Overall, the class evidence available in the literature is poor and there was a small sample size of papers (six total), which limits the interpretation of these results. There is also a limited number of centers involved in these studies, and results may not be generalizable due to microbiome specifics at each institution. The study is further limited by covariates which were not controlled, including patient comorbidities, institution-specific safe practices, and differences in wound closure. Additionally, only three of the 6 papers specified which antibiotic was used. Further studies on a larger scale are necessary for definitive conclusions and should include other characteristics such as antibiotic adverse effects and cost comparisons due to increased length of stay from prolonged antibiotics.

5. Conclusions

Within the limitations of our study, the data suggests that the use of post-operative antibiotics in the setting of thoracolumbar drains longer than 24 h does not affect the rate of SSIs.

ORCID iD authorship contribution statement

Terry C. Xia: Writing – review & editing, Writing – original draft, Software, Project administration, Data curation. **Gersham J. Rainone:** Writing – review & editing, Writing – original draft, Data curation. **Cody J. Woodhouse:** Writing – review & editing, Project administration, Formal analysis, Conceptualization. **Dallas E. Kramer:** Methodology, Conceptualization. **Alexander C. Whiting:** Writing – review & editing, Validation, Supervision, Project administration, Methodology.

Declaration of competing interest

None

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Abbreviations

SSI =: Surgical site infection
CL =: Confidence limit