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Original Article

Laminectomy Infections

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ABSTRACT

Objective: Hematoma, infections, and wound dehiscence are the most common causes of readmission following laminectomy operations. The aim of this study was to identify and prevent infectious agents to reduce additional costs and mortality.

Methods: A retrospective analysis was conducted on 4295 laminectomies performed over a 7-year period. The study included 30 infected adult patients and 40 isolated microorganisms. The analysis determined demographic data, risk factors, isolated microorganisms, and resistance patterns.

Results: Out of 4295 laminectomy operations, only 30 patients (0.7%) developed surgical site infections (SSIs). The median age of the patients was 55.18 years, and the median duration of hospitalization was 35.54 days. Of the patients, 56.7% were female and 43.3% were male. The risk factors for SSI were the use of peripheral venous catheters (93.3%), urinary catheters (26.7%), and central venous catheters (16.7%). The isolated agents were *A.baumannii*, *K.pneumoniae*, and *E.coli*, which accounted for only 50% of the total cases.

Conclusion: The main goal should be to prevent surgical site infections (SSIs) after laminectomy surgery, rather than treating.

INTRODUCTION

The most frequent causes of hospital readmission following spine surgery are hematoma, infections, and wound dehiscence, respectively. Surgical site infection (SSI) after laminectomy is a severe complication. It is classified as primary superficial SSI if it involves the skin and subcutaneous tissues, and primary deep SSI if it involves the muscle and fascia. If it spreads to organs and cavities, it can result in meningitis and ventriculitis. Re-hospitalization can result in new surgical interventions, physical and psychological disorders, additional costs, increased morbidity, and mortality. We aimed to reduce these risks in our hospital.

MATERIALS AND METHODS

A retrospective analysis was conducted on 4295 laminectomy operations performed at our Neurosurgery Clinic between November 2016 and October 2023, using the hospital automation system. The study included 30 patients with surgical site infections (0.7%) and 40 isolated microorganisms. Patients under 18 years of age were excluded. Wound cultures were obtained from patients with superficial and subcutaneous surgical site infections (SSI), while aerobic and anaerobic blood cultures and cerebrospinal fluid (CSF) cultures were obtained from patients with organ cavity infections. The study analyzed demographic data, reasons for surgery, comorbidities, SSI classifications, risk factors, isolated microorganisms, and antibiotic resistance. Categorical variables were presented as frequency and percentage, while continuous variables that did not show normal distribution were presented as median values.

Our study was approved by the Health Sciences University Kartal Dr. Lütfi Kırdar City Hospital Clinical Research Ethics Committee on 29.11.2023 with decision number 2023/514/262/19.

RESULTS

During a 7-year period, 4295 laminectomy operations were performed, resulting in 30 infected patients (0.7%) with positive cultures for a total of 40 microorganisms.

Of these patients, 17 (56.7%) were female and 13 (43.3%) were male, with a median age of 55.18 (range 20-85) years and a median hospitalization duration of 35.54 (range 12-96) days for surgical site infections (SSIs). Two patients (6.6%) were diagnosed with meningitis-ventriculitis, 20 (66.7%) with primary deep SSI, and 8 (26.7%) with primary superficial SSI. The causative agent was isolated from the wound site in blood and cerebrospinal fluid (CSF) cultures obtained simultaneously from two patients with ventriculitis and meningitis. One of these patients (3.3%) died, while the others (96.7%) were successfully treated.

Ten (33.3%) patients underwent surgery for lumbar spondylolisthesis, nine (30%) for lumbar disc herniation, three for fractures due to falls, three for cervical disc herniation, two for malignant tumor metastasis, and one each for lumbar schwannoma, thoracic disc herniation, and thoraco-lumbar disc herniation. A total of 24 laminectomies were performed in the lumbar region, with three laminectomies each in the thoracic and cervical regions.

Out of the total number of patients, 21 (70%) had diabetes mellitus (DM), 14 (46.7%) had hypertension, and the remaining patients had various other conditions, including arrhythmia, cerebrovascular disease, anemia, pulmonary embolism, hyperthyroidism, asthma bronchiale, atrial fibrillation, chronic renal failure, congestive heart failure, rheumatoid arthritis (RA), chronic obstructive pulmonary disease (COPD), and benign prostatic hypertrophy.

Peripheral venous catheter was present in 28 (93.3%) patients, urinary catheter in 8 (26.7%), and central venous catheter in 5 (16.7%). Total parenteral nutrition was used in 3 patients, and endotracheal intubation in 2 patients. These were identified as the most important risk factors facilitating the occurrence of SSI. H2 receptor antagonists were used by 15 (50%) patients.

Table 1. Isolated Microorganisms and Their Rates

Microorganisms	%	n
Acinetobacter baumannii	22.5	9
Klebsiella pneumoniae	15.0	6
Escherichia coli	12.5	5
CNS	10.0	4
Pseudomonas aeruginosa	7.5	3
Staphylococcus aureus	7.5	3
Serratia marcescens	7.5	3
Enterobacter cloacae	7.5	3
Enterococcus faecalis	5.0	2
Enterococcus faecium	2.5	1
Enterobacter hormaechei	2.5	1

CNS; Coagulase-negative Staphylococci.

The mean duration of infection after laminectomy surgery was 12.08 (range 3-39) days. There was growth in 33 (82.5%) wound cultures, 1 abscess culture, 4 blood cultures, and 2 CSF cultures. One patient diagnosed with meningitis and ventriculitis had *A.baumannii* isolated in all cultures, while the other had *K.pneumoniae* isolated.

Standard isolation methods were used to isolate microorganisms. Of the microorganisms, 75% were Gram-negative and 25% were Gram-positive. *A.baumannii*, *K.pneumoniae*, and *E.coli*, the first three, constituted half of all causative microorganisms. Coagulase-negative staphylococci (CNS) was the most frequently isolated Gram-positive microorganism (Table 1).

Carbapenem resistance was observed in all *A.baumannii* strains, while it was present to a lesser extent in other Gram-negative agents. *K.pneumoniae* showed a 20% resis-

Table 2. Resistance Patterns of Isolated Microorganisms

	AMP	CZ	AN	CN	FEP	CAZ	CRO	TZP	CIP	TGC	MER	IMP	COL	SXT	VAN	LZD
A.baumannii			11.1	50				100	100	11.1	100	100	0	100		
K.pneumoniae			16.7	40	33.3	40	50	33.3	33.3	20	16.7	16.7	20	16.7		
E.coli			0	20	60	60	60	0	20	0	0	0	0			
CNS	100	100		75					50	33.3				0	0	0
P.aeruginosa			0	33.3	33.3	33.3	33.3	33.3	33.3		33.3	33.3	0			
S.aureus	33.3	33.3		0					33.3	0				0	0	0
S.marcescens			0	100	100	100		66.7	100	33.3	0	0	100	0		
E.cloacae			0	33.3	33.3	66.7			66.7	0	0	0	0	33.3		
E.faecalis	0	0							0	0				0	0	0
E.faecium	0	0							0	0				0	0	0
E.hormaechei			0	0	0	0	0	0	0	0	0	0	0	0		

AMP; Ampicillin, CZ; Cefazolin, AN; Amikacin, CN; Gentamicin, FEP; Sefepim, CAZ; Seftazidim, CRO; Ceftriaxone, TZP; Piperacillin-tazobactam, CIP; Ciprofloxacin, TGC; Tigecycline, MER; Meropenem, IMP; İmipenem, COL; Polymyxin-E (Colistin), SXT; Trimethoprim-sulfamethoxazole, VAN; Vancomycin, LZD Linezolid, *A.baumannii; Acinetobacter baumannii, K.pneumoniae; Klebsiella pneumoniae, E.coli; Escherichia coli, CNS; Coagulase-negative Staphylococci, P.aeruginosa; Pseudomonas aeruginosa, S.aureus; Staphylococcus aureus, S.marcescens; Serratia marcescens, E.cloacae; Enterobacter cloacae, E.faecalis; Enterococcus faecalis, E.faecium; Enterococcus faecium, E.hormaechei; Enterobacter hormaecei.*

tance to both colistin and tigecycline. Tigecycline resistance was also observed in other Gram-negative agents.

Enterococci did not show any resistance to ampicillin. All Gram-positive agents were susceptible to vancomycin, linezolid, tigecycline, and trimethoprim-sulfamethoxazole (Table 2).

DISCUSSION

The presence of surgical site infections (SSI) can result in hospital readmission, new surgical interventions, physical and psychological impairment, additional costs, and increased morbidity and mortality.[1] The most frequent reasons for reoperations following spine surgery are hematoma, infections, and wound dehiscence.[2] Foraminotomy, rheumatoid arthritis (RA), advanced age, and occipito-cervical surgery are risk factors for surgical site infections (SSI). Other risk factors include dural tear and leakage, a higher number of operated levels, steroid use, male gender, diabetes mellitus (DM), increased subcutaneous adipose tissue thickness, obesity, hypoalbuminemia, and smoking.[3-7] In our patient sample, laminectomy was performed at two levels in 60% (n=24) and at more than two levels in 20% (n=6). The presence of DM was identified as a significant risk factor, with a rate of 70%. A multicenter retrospective study found that smoking did not increase the incidence of SSIs in posterior cervical decompression surgery.[8] The occurrence of surgical site infections (SSIs) is more frequent in posterior approaches compared to anterior approaches, in open surgeries compared to minimally invasive surgeries, and in instrumented surgeries compared to non-instrumented surgeries. Additionally, SSIs are more common in thoracic operations and less common in lumbar operations.[9]

Computerized tomography and magnetic resonance imaging are the most valuable imaging modalities for diagnosing SSI, particularly in cases of abscesses, soft tissue infections, and bone infections.[10]

Preoperative cefazolin prophylaxis significantly reduces the development of surgical site infections (SSI). The appropriate dose should be adjusted according to the patient's weight, with 1 g of cefazolin used for every 60 kilograms. The dose should be repeated every four hours during surgery.[11] Intraoperatively, suprafascial powdered vancomycin has been used to prevent SSI in spine surgery and has been found to be as effective as subfascial use.[12]

The incidence of SSI after laminoplasty ranges from 1.4% to 13%.[1] In our study, this rate was 0.7%. The study included patients with a mean age of 55.18 years (range 20–85 years), with 56.7% being female and 43.3% being male. The mean age of female patients was 59.27 years, while that of male patients was 50.45 years.

The Turkish National Surveillance Guidelines for Healthcare Associated Infections recommend a follow-up period of 30 days for primary superficial and primary deep SSI, and 90 days for meningitis and ventriculitis.[13] The average time for patients to become infected after laminectomy surgery was 12.08 days (range 3–39 days). The infection rate was 10.27 days for men and 13.53 days for women. On average, patients were hospitalized for SSI for 35.54 days (range 12–96 days), with males staying for 30.27 days and females for 39.2 days.

Primary deep surgical site infections (SSIs) were diagnosed in 66.7% of patients, and primary superficial SSIs were diagnosed in 26.7%. Organ and cavity SSIs were considered in two patients. Simultaneous wound, blood, and cerebrospinal fluid (CSF) cultures were obtained. A. baumannii was found in all cultures of one patient, and K. pneumoniae was found in the other. Although the patients were successfully treated, one female patient died in the intensive care unit due to additional complications, including meningitis and ventriculitis.

In our study, indications for laminectomy were disc herniation (46.7%), spondylolisthesis (33.3%), malignancies (10%), and fractures due to falls (10%). Specifically, hepatocellular carcinoma metastasized at L3, malignant breast cancer metastasized at L4-5, and schwannoma involved the L3-4 level. Fractures related to falls occurred between T10 and L2. Laminectomies were performed in the lumbar region in 80% of cases, in the thoracic region in 10% of cases, and in the cervical region in 10% of cases.

The study found that the most common comorbidities were diabetes mellitus (DM) in 70% of cases and hypertension in 46.7% of cases. Another study identified DM and obesity as independent risk factors.[14] No literature was found indicating hypertension as a risk factor. Additionally, one patient each had arrhythmia, cerebrovascular disease, anemia, pulmonary embolism, hyperthyroidism, asthma bronchiale, atrial fibrillation, chronic renal failure, congestive heart failure, rheumatoid arthritis (RA), chronic obstructive pulmonary disease (COPD), and benign prostatic hypertrophy. In a prospective surveillance study conducted across multiple centers, it was found that endoscopic tubular surgery served as an independent protective factor, while operations lasting more than two hours were identified as an independent risk factor.[15]

In our study, the risk factors for SSI were peripheral venous catheter (93.3%), urinary catheter (26.7%), central venous catheter (16.7%), total parenteral nutrition (in 3 patients), and endotracheal intubation (in 2 patients). Additionally, 50% of patients were found to have used H2 receptor antagonists.

Of these, 33 (82.5%) were from wound culture, one was from abscess culture, four were from blood culture, and two were from CSF culture (refer to Table 1). A total of 40 microorganisms were isolated in this study. In contrast to many other studies, Gram-negative microorganisms were the most commonly isolated agents in our study, rather than Gram-positive ones.[14]

A.baumannii (22.5%), the most frequently isolated agent, was not resistant to colistin, while amikacin and tigecycline resistance was the least (11.1%). They were resistant to all

other antibiotics. In K. pneumoniae strains (15%), the least resistance was to carbapenems, amikacin, and trimethoprim-sulfamethoxazole (16.7%), while the highest resistance was to ceftriaxone (50%). *E.coli* strains (12.5%) had no resistance to colistin, tigecycline, piperacillin-tazobactam, and carbapenem, while cefepime, ceftazidime, and ceftriaxone had 60% resistance. Carbapenem resistance was 33.3% in *P.aeruginosa* strains but not in other Gram-negative strains (*S.marcescens*, *E.cloacae*, and *E.hormaechei*) (Table 2).

No resistance to vancomycin or linezolid was observed in coagulase-negative staphylococci (KNS), which accounted for 10% of the microorganisms. Enterococci were sensitive to all antibiotics tested, but methicillin resistance was observed in 33.3% of *S.aureus* strains (Table 2). Studies have shown that treating methicillin-resistant *S.aureus* nasal colonization preoperatively and performing cervical laminectomy did not significantly affect treatment outcomes.[15,16] Our hospital does not perform routine nasal cultures.

Conclusion

Postoperative surgical site infections (SSIs) following laminectomy surgery have been shown to increase readmissions, length of stay, treatment costs, and mortality rates. Therefore, it is crucial to prioritize preventing SSIs rather than treating them. To achieve this, it is recommended that catheter maintenance be performed under appropriate conditions and terminated in a timely manner.

Ethics Committee Approval

The study was approved by the Kartal Dr. Lütfi Kırdar City Hospital Ethics Committee (Date: 29.11.2023, Decision No: 2023/514/262/19).

Informed Consent

Retrospective study.

Peer-review

Externally peer-reviewed.

Authorship Contributions

Concept: B.K., S.Ş., S.D.T., E.A.; Design: B.K., S.Ş., S.D.T., E.A.; Supervision: B.K., S.Ş., S.D.T., E.A.; Fundings: B.K., S.Ş., S.D.T., E.A.; Materials: B.K., S.Ş., S.D.T., E.A.; Data collection &/or processing: B.K., S.Ş., S.D.T., E.A.; Analysis and/or interpretation: B.K., S.Ş., S.D.T., E.A.; Literature search: B.K., S.Ş., S.D.T., E.A.; Writing: B.K., S.Ş., S.D.T., E.A.; Critical review: B.K., S.Ş., S.D.T., E.A.

Conflict of Interest

None declared.

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Laminektomi Enfeksiyonları

Amaç: Laminektomi ameliyatlarına bağlı yeniden yatışların en sık nedenleri hematom, enfeksiyonlar ve yara açılmasıdır. Ek maliyetleri ve mortaliteyi engellemek için enfeksiyon etkenlerinin belirlenip önlenmesi amaçlandı.

Gereç ve Yöntem: Yedi yıllık süreçte yapılan 4295 laminektomi ameliyatı retrospektif olarak irdelendi. Enfekte olan 30 erişkin hasta ve bunlardan izole edilen 40 mikroorganizma çalışmaya dahil edildi. Hastaların demografik verileri, risk faktörleri, izole edilen mikroorganizmalar ve direnç paternleri belirlendi

Bulgular: 4295 laminektomi ameliyatının 30'unda (%0.7) cerrahi alan enfeksiyonu (CAE) gelişti. Hastaların %56.7'si kadın, %43.3'ü erkek olup ortanca yaşları 55.18 yıl, ortanca hastane yatışı 35.54 gündü. CAE için risk faktörleri periferik venöz kateter (%93.3), üriner kateter (%26.7) ve santral venöz kateter (%16.7) kullanımıydı. İzole edilen etkenlerin sadece %50'si *A.baumannii*, *K.pneumoniae* ve *E.coli*'den ibaretti.

Sonuç: Laminektomi ameliyatlarından sonra gelişen CAE'yı tedavi etmek yerine, oluşmasını engellemek primer amaç olmalıdır.

Anahtar Sözcükler: Cerrahi alan enfeksiyonları; laminektomi; spondilolistezis.