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Surgical site infections in neurosurgery. Case series in a single centre

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ABSTRACT

Background: Surgical site infections in neurosurgery are serious due to their proximity to the central nervous system and their management is a challenge. The aim of our work is to report surgical site infections (SSI) in patients who underwent brain or spinal surgery and to describe their characteristics.

Materials and method: We conducted a retrospective study involving patients who underwent surgery in our facility's neurosurgical emergency department over 5 years from January 2015 to December 2019. The data were collected from medical hospital and follow-up records.

Results: Fifty-eight cases of SSI were identified out of 2889 operations in total, for a frequency of 2%. The series consisted of 36 men (62.07%) and 22 women (37.93%). The average age was 43.9 years (19-72 years). 46 patients (79.31%) had undergone urgent surgery and 12 patients (20.69%) for delayed surgery. 40 patients (68.97%) had undergone cranial intervention and 18 patients (31.03%) underwent spinal surgery. The identified germ was Staphylococcus aureus in 13 cases (76.48%). Mortality was 13.8% (8 out of 58 cases).

Conclusion: The majority of microorganisms that cause the infections contaminate the surgical site intraoperatively. Preventive measures can reduce the rate of surgical site infections.

Keywords
infections,
neurosurgery,
surgical site

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INTRODUCTION

The incision of the skin barrier to perform the surgical procedure connects the inner environment with the external environment. Post-operative infections are the result of exogenous or endogenous contamination not controlled by the body's local and general defenses. This iatrogenic risk rises due to increased accessibility of surgical procedures and the development of surgical services activity. Surgical site infections (SSI) are a challenge for all surgical services. Neurosurgical site infections are severe because of their proximity to the central nervous system and their potential complications. SSI support also has a significant financial impact [1]. Understand the risk factors and identify the pathogens germs are essential to the management.

The purpose of our work is to report surgical site infections in patients who have had cranial and spinal surgery in a neurosurgical emergency unit and to describe their characteristics.

Materials and method

This is a retrospective study that focused on patients operated in a neurosurgical emergency department of our institution over a period of 5 years from January 2015 to December 2019. Patients who underwent neurosurgical procedures and follow-up postoperatively were included. The data were collected from medical hospital and follow-up records.

The variables studied were: age, sex, patient origin, type of intervention, antibiotic prophylaxis, surgical indication and site of intervention, duration of surgery, type of germs identified, evolution. Quantitative variables were presented as an average. The qualitative variables in the form of a percentage. Urgent surgery was defined as a surgical procedure that was performed within the first 48 hours of admission, and delayed surgery was a procedure that took after 48 hours. The classification of Narotam [2] was used to classify the type of intervention into categories to determine the potential to develop sepsis: clean, clean with foreign body, clean-contaminated, contaminated, dirty.

Results

Fifty-eight cases of surgical site infections were identified out of 2889 operations in total, for a frequency of 2%. The average age was 43.9 years (19-72 years). The series consisted of 36 men (62.07%) and 22 women (37.93%). 34 patients (58.62%) lived in urban areas and 24 patients (41.37%) in rural areas. 46 patients (79.31%) had undergone urgent surgery and 12 patients (20.69%) for delayed surgery. 40 patients (68.97%) had undergone cranial intervention and 18 patients (31.03%) underwent spinal surgery.

According to Narotam's classification, surgical procedures were clean in 4 cases (6.3%), clean-contaminated in 6 cases (9.4%), contaminated in 16 cases (25%), and dirty in 32 cases (59.4%). The average duration of the intervention was 260 minutes with extremes ranging from 45 minutes to 540 minutes. The average length of hospitalization was 13 days with extremes of 6 days to 45 days. All patients had benefited from prophylactic antibiotics.

Table 1 summarizes the characteristics of patients who developed a surgical site infection.

Table 1. General characteristics of patients with SSI

Variables	Number of patients	Percentage (%)
Sex		
Female	22	37.93
Male	36	62.07
Origin		
Rural	24	41.37
Urban	34	58.62
Type of surgery		
Urgent	46	76.31
Delayed	12	20.69
Wound classification		
Clean	04	06.30
Clean-contamined	06	09.40
Contamined	16	25.00
Dirty	32	59.40

Table 2. Initial procedure performed to patients and diagnosis of the SSI

Variables	Number of patients	Percentage (%)
Craniotomy procedures		
Traumatic	36	90.00
Tumoral	02	05.00
Infectious	02	05.00
Spine surgery procedures		
Traumatic	08	44.44
Degenerative	07	38.89
Tumoral	03	16.67
Diagnosis of SSI in cranial location		
Superficial wound infection	07	17.50
Osteitis	02	5.00
Meningitis	24	60.00
Abcess or empyema	07	17.50
Diagnosis of SSI in spinal location		
Superficial wound infection	06	33.33
Meningitis	02	11.11
Deep infection	10	55.56

Initial surgical indications in cases of surgical site infection at the cranial level were traumatic in 36 cases (90.00%), tumor, and infectious each in 2 cases (5.00%). The supratentorial location was reached in

34 cases (85%), and infratentorial in 6 cases (15%). The distribution of the type of cranial infection was: superficial wound infections in 7 cases (17.50%), osteitis in 2 cases (5.00%), meningitis in 24 cases (60.00%), abscess or empyema in 7 cases (17.50%).

In the cases of surgical site infection at the spinal level, the surgical indications were traumatic pathologies in 8 cases (44.44%), degenerative in 7 cases (38.89%) and tumors in 3 cases (16.67%). The location of the infection was cervical in 1 case (5.55%), dorsal in 10 cases (55.56%), dorsolumbar in 4 cases (22.22%), and lumbar in 3 cases (16.67%). The type of infection at the operative site after spinal surgery was: superficial wall infection in 6 cases (33.33%), meningitis in 2 cases (11.11%), and deep infection on osteosynthesis material in 10 cases (55.56 %). Table 2 summarizes the indications for the initial procedure and the type of infections presented by patients.

Hyperleukocytosis was found in 24 patients (41.37%) and an increase in the c-reactive protein in 26 patients (44.82%). The culture was positive in 29.31%of cases (17 patients). The most frequently identified germs were: Staphylococcus aureus in 13 cases (76.48%), Pseudomonas aeruginosa 1 case (5.88%), Escherichia coli 1 case (5.88%), Proteus mirabilis 1 case (5.88%), Enterobacter cloacae 1 case (5.88%). Full recovery without significant neurological sequelae was in 75.9% of cases. Six patients had epilepsy (10.3%). In all mortality was 13.8% (8 cases) in the series.

Discussion

Prevalence and risk factors

In our series, the prevalence of postoperative neurosurgery infections was 2%. The rate varies between 0.5% and 8% in studies [1,3–5]. The effect of prophylactic antibiotics helps to control the infection rate of less than 5% [6]. In our study, the low rate could be explained by routinely prophylactic antibiotics in all patients. Antibiotic prophylaxis alters the morbidity of surgical operations. The rate of postoperative meningitis is decreased by antibiotic prophylaxis [7].

Several risk factors for surgical site infections have been reported [5,8–11]. A long operation duration has been reported by several studies [8,9,11,12]. An intervention time of more than 4 hours increases the risk of developing a SSI [8,13]. In our series, the average duration was 4 hours and 20 minutes which was relatively high. Males were considered as a risk factor [13]. However, another study [14] showed that male sex, age, alcohol consumption, and steroid use were not associated with increased incidence of spinal SSI.

An urgent surgery remains an important risk factor for SSI [8]. In our work, 79.3% of postoperative infections were admitted through emergencies. Patients admitted as an emergency, especially in the traumatic setting, carry scalp injuries contaminated by foreign debris. In our study, the initial procedure of the SSI was considered clean in only 6.3% of cases. The presence of foreign bodies was significantly associated with a risk of developing postoperative infection [5,8]. Other risk factors for SSI were: a high American Society of Anesthesiologists score (ASA) [12,13], sinus opening [8], an intervention considered contaminated [10,12], a CSF leak [13,14].

Closure of surgical wounds by staples and use of dural substitute was also reported as risk factors in a study [11]. In the same study, craniotomy was identified as a risk factor and a complicated surgical procedure as a predictor in the development of SSI [11]. Tumor surgery was the most difficult type of intervention for deep infections [4]. In our study, traumatic surgery was the most performed intervention because our unit was dedicated to the management of neurosurgical emergencies.

The surgeon's experience plays a role in the risk of infection [12]. An experienced surgeon contributes to the reduction in the duration of the operative procedure and therefore to the reduction of postoperative infectious complications. Postoperative drainage would increase the risk of infection [12].

Several general factors have been reported as purveyors of post-operative infections. These factors associated with postoperative infection were: diabetes [5], intraoperative blood transfusion [12], use of immunosuppressors [15], urinary tract infection, and smoking in spinal surgery [14]. In our series, diabetes was found in 10 patients and no patients had immunosuppressors medication.

Pathological entities of SSI

The superficial wound infection and flap osteitis are not grouped into the same category of infections. Although the pathophysiology is similar, their consequences and their management are very different. In the case of superficial wound infection, antibiotics alone or debridement can be achieved. In the case of osteitis, aggressive surgery associated with re-reconstruction can be required. In our series, superficial wound infections were 26% of all SSI.

Deep infections that affect the central nervous system are serious and can be accompanied by significant morbidity with a high risk of neurological damage. Meningitis was commonly found and can have lethal complications. In our series, meningitis is the most common infection after cranial procedures but its frequency was lower in the spinal procedures. Ventriculitis is an evolutionary complication of meningitis that affects the cranial ventricular cavities and often causes severe damages. In our series, no cases of ventriculitis were observed.

Intracranial suppurations most often develop by contiguousness with a local outbreak, but also by the hematogenic path of parenchyma. In our series, intracranial suppurations were diagnosed in 7 out of 40 patients or 17.50%.

The most common complication in our series at the spinal level is an infection on osteosynthesis material. The use of foreign materials is a predictor in the development of SSI.

Pathogen germs

Before starting antibiotic treatment, bacteriological documentation is imperative to guide antibiotic therapy for these postoperative bacterial infections depending on the germ in question and its sensitivity. The bacteriological examination of the CSF and the samples from the surgical site is essential and culture was performed to identify pathogens germs. The germs implicated in postoperative infections are different from those identified in community-acquired infections. In our series, the most frequently identified pathogenic germ was staphylococcus aureus in 76.48% of cases. The most common pathogens in the literature are Staphylococcus aureus [3–5] and gram-negative bacilli [4,5,16] namely Acinetobacter baumanii [5,17] and Pseudomonas aeruginosa [16,17], and Escherichia coli [16,17]. Other germs such as Propionibacterium acnes can also be found [3,10]. The majority of microorganisms that cause the infections contaminate the surgical site intraoperatively.

The ecosystem of the unit must be known to allow the prescription of a good probabilistic antibiotic therapy taking into account the bacterial resistance specific to each institution. The management of SSI requires a multidisciplinary approach. The urgency of starting antibiotic therapy varies from situation to situation, but delays in some cases, such as meningitis and intracranial suppurations, can be lethal. The choice of antibiotic is based on bacteriological data and the antibiotic. The front door must be treated urgently if it exists. Corticosteroids could decrease the penetration of antibiotics and the use of mannitol may be preferable during the first 48 hours.

Prevention

Efforts in operating theatres to improve the quality of care, the determination of clean and dirty circuits can significantly reduce the rate of post-operative infections. Recommendations for SSI prevention are surgical handwashing and the use of antibiotic prophylaxis [10]. Decolonization oriented towards Staphylococcus aureus reduces the frequency of SSI [18]. Postoperatively, other recommendations are the observance of rigorous asepsis when handling drains and dressings, as well as strictly enclosed maintenance of the drainage system. Surgical drainage of the surgical site should not exceed 48 hours.

Conclusion

This study presents the profile of surgical site infections, and the germs involved in our neurosurgical emergency unit. The most common germs are staphylococcus aureus and less commonly gram-negative bacilli. The majority of microorganisms that cause the infections contaminate the surgical site intraoperatively. Preventive measures can reduce the rate of surgical site infections.

Abbreviations

SSI: Surgical site infections
CSF: Cerebrospinal fluid

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