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A Retrospective Study on Incidence and Risk Factors of Neurosurgical Post-Operative Wound Infections

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ABSTRACT

In endeavor to uphold a meticulous aseptic environment during surgical procedures, wound infection remains a prevalent complication following surgery. This complication may be attributed to factors such as dehiscence, hemorrhage, infection and/or suboptimal surgical technique. Given the emergence of new wound closure techniques and suture materials, we conducted a retrospective study within our neurosurgical population to assess the incidence of surgical site infection (SSI) and compare it with existing data. A retrospective analysis was conducted at our institution, encompassing all patients who underwent cranial or spine surgery performed by a neurosurgeon. The data, extracted using hospital records, underwent analysis utilizing χ^2 and relative risk calculations. We retrieved information from a total of 234 cranial and spinal surgeries, revealing 2 cases with post-operative wound infections. Comparison with published literature, indicating up to 33% of surgical cases experiencing post-operative infections, was conducted. χ^2 testing yielded a statistical significance compared to surgical literature. This retrospective analysis demonstrated that the rate of neurosurgical post-operative SSI aligns with existing literature, reflecting infection rates ranging from <1-15%, contingent on surgery type, technique and patient characteristics. Surgical site infections constitute unfortunate and costly post-operative complications. While risk factors have been extensively studied, institutional introspection is crucial to ensuring accountability and delivering optimal patient care aligned with established data and guidelines. Based on our results, no deviation from current techniques is deemed necessary at our institution.

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Key Words
Surgical site infection, neurosurgery, post-operative complication, wound infection

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INTRODUCTION

Head and neck cancers, primarily squamous cell carcinomas (SCC), present a significant global Surgical site infections (SSIs) pose a considerable and economically burdensome complication subsequent to neurosurgical interventions. They manifest with a notable morbidity rate, culminating in prolonged hospital stays, proliferation of antibiotic-resistant pathogens and potentially fatal outcomes. SSIs represent a significant source of postoperative morbidity in neurosurgery, affecting approximately 5% of craniotomies and 3% of spinal procedures, thereby augmenting patient morbidity, hospitalization duration and healthcare expenses. In certain instances, adverse events associated with SSIs, such as sepsis, necessitating reoperation or readmission and even mortality, can outweigh the direct impact of the infection itself[1,2]. Despite endeavors to uphold aseptic conditions during surgery, wound infections remain prevalent and can be attributed to factors such as wound dehiscence, hemorrhage, infection, or substandard surgical technique. The selection of closure method assumes pivotal importance in mitigating SSI risk, with these infections typically categorized as superficial or deep, commonly arising within 30 days post-operation[3,4].

Principal pathogens implicated in acute infections include gram-positive cocci, comprising Staphylococcus aureus, ß-hemolytic Streptococci and Staphylococcus epidermidis[5]. Various risk factors predispose individuals to SSIs, encompassing suboptimal glycemic control in diabetics, advanced age, smoking, obesity, malignancy and immunosuppression[6–9]. Among afflicted patients, SSIs correlate with prolonged hospitalizations averaging 9.7 days and heightened mortality rates ranging from 2 to 11-fold[10–12]. The economic ramifications of SSIs are substantial, with projected costs in the United States alone ranging from 3.5 billion to 10 billion dollars[6]. To combat this issue, research has explored alternative suture materials, including antimicrobial and bioactive sutures with drug-eluting capabilities or stem cell-seeded sutures [10]. Comparative studies have demonstrated a reduction in post-operative wound infections with antimicrobial sutures compared to conventional counterparts[3,13]. In light of the availability of novel suture materials, the authors conducted a retrospective analysis of neurosurgical cases within their institution to assess SSI incidence and the potential utility of adopting innovative suture materials or closure techniques. Their inquiry focuses on primary closure neurosurgical cases, such as craniotomies and spinal surgeries, scrutinizing the type of closure material utilized to discern trends and evaluate the viability of antibiotic sutures based on comparative studies[14]. Prior investigations have examined risk factors for SSIs subsequent to neurosurgery, encompassing previous neurosurgical interventions, concurrent infections, cerebrospinal fluid (CSF) leaks, and venous sinus entry. Notably, the utilization of external CSF devices has been associated with heightened SSI risk and 90-day mortality[15,16]. However, these inquiries have allocated lesser attention to wound closure mechanisms[17].

In summary, SSIs represent a substantial challenge in neurosurgery, with closure material selection exerting a discernible influence on infection incidence. Explorations into novel suture materials, such as antimicrobial sutures, have yielded promising outcomes in mitigating post-operative wound infections. This retrospective analysis endeavors to illuminate their institution's experience with contemporary wound closure methodologies and ascertain the potential benefits of incorporating antibiotic sutures for their neurosurgical patients.

MATERIALS AND METHODS

This study conducted a retrospective analysis within a single institution to examine patients who underwent cranial or spine surgery performed by neurosurgeons over the past year. Inclusion criteria encompassed patients aged 18 and above who underwent a neurosurgical procedure and received primary wound closure at the institution using suture or staple techniques. Exclusions comprised patients under 18 years old, those who did not undergo a neurosurgical procedure and those whose wound closure occurred outside the institution. Data were sourced from electronic medical records and organized in a Microsoft Excel spreadsheet. Information collected included medical record numbers, gender, age, smoking status, diabetes, IV drug usage, surgery date, type of surgery, closure method, time of post-operative infection, infection type, co-existing infection and treatment (surgery versus antibiotics).
The study adopted a retrospective analysis of prospectively collected data concerning all neurosurgical site infections. Medical record numbers of patients were obtained through the medical record department. Patient consent was not sought for this study design. The patient cohort comprised individuals admitted to the post-operative ward following surgeries for intracranial tumors, chronic subdural hematomas, shunts, reconstructive cranioplasty, or spinal procedures. Tumor-related surgical procedures involved removal or resection through craniotomies and craniectomies, as well as biopsies performed via burr holes.

RESULTS AND DISCUSSIONS

A data retrieval proforma gathered data from 234 patients who underwent cranial and spinal surgeries.

Table 1: Demographic variables in SSI patients

Variable	Patient 1	Patient 2
Age	32 years	34 years
Gender	Male	Female
BMI (Kg/m2)	18.2	19.1
Smoking	Never	Never
Diabete Mellitus	No	No
Hypertension	No	No
IV Drug Abuse	Never	Never

Table 2: Surgical details in SSI patients

Variable	Patient 1	Patient 2
Type of Surgery	Cranial	Cranial
Material used for wound closure	Sutures	Sutures
Wound infection occurred on post-operative day	9	11
Reoperation required	Yes	Yes

Table 3: Comparison of SSIs with previous studies

Incidence of	Our Study	Chaudhary *et al*[9]	Fiani B *et al*[18]	Kolpa *et al*[19]	Ueno *et al*[8]
SSI	0.85%	-	1.00%	1.50%	-
Cranial SSI	0.85%	-	0.05%	1.40%	-
Spinal SSI	-	3.00%	0.05%	2.20%	4.15%

Table 4: Analysis of risk factors for SSIs after neurosurgery

Parameter	SSI compared to our study	P Value reported	Reference
Male gender	More	0.091	Fang *et al*[15]
Antibiotic-impregnated sutures	Less	0.038	Sarmey *et al*[23]
BMI >35	More	<0.001, 0.015	Meng *et al*[20], Fei *et al*[22]
CSF Drainage	More	0.001, 0.009	Fang *et al*[15], Schipmann *et al*[21]
CSF Leak	More	0.001, 0.009	Fang *et al*[15], Meng *et al*[20]
Diabetes	More	<0.001, 0.001	Meng *et al*[20], Fei *et al*[22]
Double gloving+change of gloves prior to shunt handling	Less	0.046	Sarmey *et al*[23]
Duration of operation >4 hrs	More	0.001, 0.009	Fang *et al*[15], Fei *et al*[22]
Foreign material implantation	More	<0.001	Schipmann *et al*[21]
Hypertension	More	<0.001	Meng *et al*[20]
No hair shaving while VPS shunt placement	Less	>0.05	Sarmey et al23
No. of previous neurosurgery	More	0.02, 0.000, <0.001	Fang *et al*[15], Schipmann *et al*[21], Meng *et al*[20]
Omission of 5% chlorhexidine hair wash	More	0.051	Sarmey *et al*[23]
Posterior approach for spinal surgery	More	0.009	Fei *et al*[22]
Spinal surgeries on ≥7 intervertebral disc levels	More	0.023	Fei *et al*[22]
Surgical scrub using antiseptic foam	More	0.01	Sarmey *et al*[23]
Tobacco smoking	More	<0.10, 0.015	Kong *et al*[25], Meng *et al*[20]
Urinary tract infection	More	<0.001	Meng *et al*[20]
Venous sinus entry	More	0.007	Fang *et al*[15]

Out of these cases, only 2 patients experienced a post-operative wound infection. (Table 1) summarizes demographic variables in two patients with SSI. These data provide insight into the demographic characteristics of the patients, including their age, gender, BMI and relevant medical history such as smoking status, diabetes mellitus, hypertension and IV drug abuse. (Table 2)shows surgical details in post neurosurgery SSI patients. Patient 1 underwent craniotomy with wound closure using sutures. Developed a wound infection on the 9th post-operative day, necessitating reoperation. Patient 2 also underwent cranial surgery with wound closure using sutures and experienced a wound infection on the 11th post-operative day, requiring reoperation. All infected patients required multiple surgical interventions in addition to antibiotic therapy.

In this investigation, a data retrieval proforma gathered data from 234 patients who underwent cranial and spinal surgeries. Out of these cases, only 2 patients experienced a post-operative wound infection. To evaluate the significance of our findings, we compared them with data from published studies in the medical literature. Previous research has suggested that up to 33% of surgical cases may develop post-operative infections. When contrasting this figure with our data, which recorded only two cases of infection, a statistically significant difference was observed (Table 3). However, when focusing specifically on a certain type of SSI with a reported incidence of 1.5%, our data indicated a much lower incidence of 0.85%, which did not reach statistical significance. In terms of infection rates in spinal surgeries, comparing them to two different publications reporting rates of 3 and 4.15%, our data (0.85% infection incidence) showed statistical significance. Likewise, for cranial surgeries, our data, with an infection rate of 0.85%, exhibited statistical significance when compared to the reported data of 1.4% A retrospective study indicated that the frequency of neurosurgical post-operative SSI corresponded with the range documented in existing literature. This range spans from less than 1-15%, contingent upon factors like the type of surgery, operative technique and patient-specific characteristics[2,3,20].

Our investigation assessed both inherent and extrinsic variables that could influence SSI occurrence. Inherent variables encompassed the type of surgery (spinal versus cranial), closure material used (staples, sutures, or a combination) and the number of days post-surgery. No statistically significant discrepancies in SSI occurrence were observed based on these inherent variables, consistent with prior meta-analyses[15,20-25]. Extrinsic factors unrelated to surgical technique but linked to the patient's profile and overall health were also examined. These factors included gender, age, Body Mass Index (BMI), smoking habits, intravenous drug use (IVDU) and history of diabetes. While no specific extrinsic risk factors closely correlated with SSI occurrence were identified, the limited number of patients with SSI might have constrained the ability to detect significant correlations (Table 4). Despite the absence of identifiable risk factors, the study's relatively low SSI incidence is noteworthy. The institution's protocol underscores the maintenance of sterility throughout the surgical procedure, likely contributing to the low infection rate. The study underscores the safety and efficacy of conventional surgical closure methods at the institution, potentially obviating the necessity for substantial alterations in standard practices.

The findings present valuable insights for other medical centers and academic establishments to conduct analogous retrospective analyses to evaluate their success in mitigating SSIs and explore potential avenues for enhancement. The methodological reproducibility permits future investigations to scrutinize the advantages and cost-effectiveness of alternative closure methods or materials. However, the study is subject to limitations, such as potential variations in surgical proficiency or technique during the one-year data collection period. Furthermore, the retrospective design of the study entails inherent limitations pertaining to documentation and data acquisition. Nonetheless, the extensive sample size and even distribution of data enhance the study's reliability. In summary, the retrospective review furnishes valuable information on neurosurgical SSI rates and furnishes insights into strategies for diminishing infection rates in similar settings. Subsequent research endeavors may leverage these findings to enhance patient outcomes and curtail healthcare expenditures.

CONCLUSION

The study underscores the significance of scrutinizing surgical site infection (SSI) rates within each institution to assess their performance against established benchmarks. Our findings indicate that neurosurgical wound infection rates at our institution are notably lower than reported averages, suggesting a high level of care. Continuous assessment and exploration of potential enhancements in infection prevention measures are crucial for delivering optimal patient care and upholding patient safety.

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