Is a drain tip culture required after spinal surgery?

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Abstract

Study Design: The efficacy of use of a drain tip culture for early detection of surgical site infection (SSI) was investigated in 329 patients after spinal surgery.

Objective: To examine the efficacy of a wound drain tip culture for detection of SSI in spinal surgery.

Summary of Background Data: A complication of SSI after spinal surgery has high associated morbidity and mortality, and is often difficult to treat.

Methods: The subjects were patients who underwent spinal surgery at our institution between January 2010 and March 2013. All subjects were treated with antimicrobial prophylaxis based on evidence-based guidelines and were followed for at least 6 months after surgery. Data from culture studies using the distal tip of the wound drain were used for analysis.

Results: Drain tip cultures were positive in 34 cases and there were 19 SSIs. Ten of the 34 tip culture-positive wounds developed SSI. Drain tip cultures had a sensitivity of 52%, specificity of 92%, positive predictive value (PPV) of 29%, and negative predictive value of 97% for predicting a wound infection. The association between a positive suction tip culture and wound infection was significant ($P<0.05$). The PPV for SSI was 60% in cases in which methicillin-resistant bacteria were detected in a drain tip, and the SSI rate in these cases differed significantly compared to those with non-methicillin-resistant bacteria ($P=0.01$).

Conclusions: A drain tip culture is useful for early detection of SSI caused by methicillin-resistant bacteria.

Keywords: drain, infection, surgical site infection, spinal surgery

Introduction

Surgical site infection (SSI) after spinal surgery is a complication that is often difficult to treat and has high associated morbidity and mortality. Early identification of pathogenic bacteria and initiation of antibiotics are desirable for SSI. Most of these infections are thought to originate from bacterial wound contamination during surgery, with an incidence as high as 58% [1]. Most bacteria are removed by local wound defense mechanisms and prophylactic antibiotics may also have a role in bacterial clearance [2,3]. The presence of bacteria in the wound in the early hours following surgery may be due to incomplete elimination and may be a high risk factor for subsequent wound infection [4].

Closed suction drainage of wounds is established as a principle of management following orthopaedic surgery [1]. In spinal surgery, postoperative wound drains are commonly used to decrease the incidence of epidural hematoma, and the wound drain tip culture has been used as a method for early detection of SSIs [5-7]. Drain tubes kept in close proximity to bone or implants may be ideal “swabs” for early detection of bacterial organisms.

To our knowledge, the relationship of SSI and wound drain tip cultures after spinal surgery has not been reported previously in the English-language literature. We performed this study to clarify this relationship and to examine the efficacy of use of a wound drain tip culture for early detection of SSI in spinal surgery.

Materials and Methods

The subjects were patients who underwent spinal surgery at our institution between January 2010 and March 2013. These patients were identified retrospectively using inclusion criteria of no history of spinal infection; spinal surgery performed for diseases other than infection; administration of antimicrobial prophylaxis in accordance with evidence-based standards and guidelines, such as injection of a first-generation cephalosporin within 1 h before the incision or discontinuation of prophylaxis within 48 h after surgery; cases with a culture study using the distal tip of the wound drain; and follow-up for >6 months after surgery. Of the 340 patients who underwent spinal surgery during the study period, 5 had a history of surgical procedures for spinal infection and 6 underwent surgery for spinal infection. Exclusion of these patients left a total of 329 subjects who were enrolled in the study (Table 1).

A closed suction drainage system was applied in all operations. A 10 Fr drain (J-Vac 10Fr; Ethicon®) tube was placed subfascially and brought out through a separate skin incision. The drain was removed under sterile conditions when the drainage was <100 ml in the previous 24 h or the drain had become serous and not bloody. After removal, 3 cm of the inner part of the tube was cut off and put into a sterile transport tube, and drain tips were inoculated in 0.3% sodium thiogluconate. In a case with SSI, wound discharges were spread on 10% aerobic and anaerobic blood agar plates. These plates were incubated at 37°C aerobically and anaerobically, and examined after 24 and 48 h in our microbiology laboratory. A minimum of 20 growth colonies was considered significant. SSIs were classified as superficial SSIs limited to subcutaneous wounds with disunion of scars; or deep SSIs, such as abscesses below muscle layers or around the implanted material.

Statistical analysis was performed using a Fisher exact test and a chi-square test. Continuous variables are shown as means with standard deviations and categorical variables as counts and percentages.

Results

Drains were removed on postoperative day 1 in 9 cases, day 2 in 288 cases, day 3 in 20 cases, day 4 in 9 cases, and day 5 in 3 cases (Table 2). Suction tip cultures were positive in 34 cases and there were 19 SSIs (Table 3). The positive rate of 33% on day 5 was higher than that on each of the previous 4 days (Table 2). Prediction of SSIs was possible based on a positive drain culture (Table 4) and 10 of the 34 tip culture-positive wounds developed SSIs. Suction tip cultures had a sensitivity of 52%, specificity of 92%, positive predictive value (PPV) of 29%, and negative predictive value (NPV) of 97% for detecting a wound infection. The suction tip culture-positive rate and the incidence of wound infection showed a significant association ($P<0.05$).

Methicillin-resistant bacteria (Methicillin Resistant Staphylococcus Aureus (MRSA), Methicillin Resistant Coagulase Negative Staphylococcus (MRCNS), Methicillin Resistant Staphylococcus Epidermidis (MRSE)) were detected in the drain tip culture in 10 cases, and 6 of these cases had SSIs (Table 5). Of the 19 cases with SSIs, methicillin-resistant bacteria were detected in 13 cases. The PPV for prediction of SSIs was 60% in cases in which methicillin-resistant bacteria were detected in the drain tip. In contrast, in 24 cases in which non-methicillin-resistant bacteria were detected in the drain tip culture, only 4 had SSIs, and the PPV for prediction of SSIs was only 17% (Table 6). There was a significant difference in SSIs between cases in which methicillin-resistant and non-methicillin-resistant bacteria were detected in the drain tip culture ($P=0.01$).

In cases with instrumentation use, the positive rate for the drain tip culture was 11.8% and the SSI rate was 5.6% (Table 7). Instrumentation use showed no significant relationship with a positive drain tip culture or SSI.

In the 19 cases with SSIs, 9 had superficial SSIs and 10 had deep SSIs. For superficial SSIs, the surgical wound was healed by systemic antibiotics. For deep SSIs, surgical debridement was performed, along with use of antibiotics. All SSIs finally resolved in all patients.

Discussion

Closed suction drainage is an established method that has the aim of preventing wound hematoma. A drain tip culture is a convenient and non-invasive method [3,4], but may not be appropriate as a routine test because the evaluation of infection may be unreliable [6]. It has also been suggested that bacteria identified in the SSI and in drain tip culture results may not necessarily match [7]. In addition, routine culture of all suction drain tips is expensive and hence may not be cost effective [8]. Thus, the appropriate strategy for use of drain tip cultures is unclear.

Bacterial detection rates of 0-10.8% have been reported in drain tip cultures in orthopaedic surgery [4,7,9,10]. Previously, Sørensen reported that early removal of the drain decreases the risk of retrograde migration of bacteria from the skin, and the frequency of positive drain tip cultures and the risk of infection are substantially increased if the drainage time is more than 6 days; thus, early removal of drains seems to be appropriate [4]. Weinrauch suggested that the low rate of culture-positive drain tips may partly be due to early removal, as well as to postoperative antibiotic prophylaxis while drains remain in place [7]. In our study, the positive rate for drains removed on day 5 was 33%, which was higher than that on earlier days. The patients in the study had various diseases, as expected for an intradural operation for a spinal cord tumor, and there were some cases in which early drain removal was difficult because of CSF leakage prevention. We are unable to draw a definite conclusion regarding the timing of drain removal and we found no significant correlation between infection and duration of drainage due to the small sample size. However, we suggest that long-term placement of the drain is undesirable in terms of wound infection.

In orthopaedic surgery, Sankar et al. found that suction tip cultures had a sensitivity of 75%, specificity of 97%, PPV of 50%, and NPV of 99% for prediction of SSIs [11]. In spinal surgery with instrumentation, Nakayama found a sensitivity of 60%, specificity of 98%, PPV of 60%, and NPV of 98% for prediction of deep SSIs using suction tip cultures [12]. These data differ from our results because all operations were performed with instrumentation and the results are for deep SSIs only. In contrast, our results gave a lower sensitivity of 52%, specificity of 92%, PPV of 29%, and NPV of 97% for prediction of SSIs using a positive drain culture. Since instrumentation was used in about half of our procedures and we included deep and superficial SSIs, the strength of the association between the drain tip culture and SSIs was relatively low.

For cases in which methicillin-resistant bacteria were detected on the drain tip, we found a PPV of 60% for prediction of SSI, which was significantly higher than that in cases with non-methicillin resistant bacteria. This may be because antimicrobial prophylaxis within 48 h after surgery is effective against non-methicillin resistant bacteria; thus, even if these bacteria are present in the wound at the time of drain removal, SSI was avoided by antimicrobial prophylaxis. Also, detection of indigenous skin flora such as Staph epidermidis and Propionibacterium acnes on the drain tip may have been due to contamination during drain removal, although this procedure was performed as carefully as possible.

Infections after spinal surgery are most commonly caused by Gram-positive organisms found on skin flora, most notably Staphylococcus aureus (MSSA) and Staphylococcus epidermis (MSSE) [13]. However, the incidence of infection with methicillin-resistant bacteria (including MRSA) is increasing [14], and MRSA has also increased in postsurgical infection [15]. In postoperative spinal deformity, Ho et al. found that almost 50% of postsurgical infections were caused by MSSE, but the tendency of this organism to form a biofilm makes it resistant to many conventional prophylactic antibiotics [16]. In contrast, lipopeptide antibiotics such as daptomycin have become available for use against MRSA, in addition to vancomycin, and teicoplanin is a bactericidal agent with the potential to treat infections caused by multidrug-resistant Gram-positive organisms [17]. Early diagnosis and treatment of methicillin-resistant bacteria using these drugs are desirable.

There are several limitations in this study, including the retrospective design, modest sample size, and different types of surgery included. We also only used a cultured drain tip, and the drain fluid was not cultured. In addition, it was difficult to determine if contamination had occurred in a case with a positive drain culture but no SSI. Regardless, if bacteria are detected on the drain tip, infection should be suspected and wound puncture and a bacterial culture test should be performed. Cases with detection of the same bacteria in the drain tip and bacterial culture test have a higher possibility of SSI and contamination of the drain tip is unlikely.

We were unable to conclude that the result of a drain tip culture always indicates the presence or absence of an SSI. However, a possible SSI should be considered in a case with methicillin-resistant bacteria in the drain tip culture, and close monitoring of the wound behavior and early intervention is necessary in such cases.

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Table 1. Characteristics of the patients

Item	Number or mean ± SD (n=329)
Background	
Age (years)	52.4 ± 21.6
Female	179
Region of spine *	
Cervical	97
Thoracic	133
Lumbar	161
Sacrum	9
Diagnosis	
Adult deformity	14
Pediatric deformity	17
Degenerative disease	176
Cervical myelopathy	40
Tumor	67
Other	15
Type of procedure	
Fusion	172
Decompression	40
Tumor excision	67
Laminoplasty	37
Other	13
Approach	
Anterior	4
Posterior	319
Anterior/posterior	6
Surgery	
Primary	307
Revision	22
Instrumentation	160

* There is some overlapping.

Table 2

Table 2. Culture results and period until drain removal

Period (days)	Total	Positive drain tip culture (%)	
1	9	1	(11%)
2	288	29	(10%)
3	20	2	(10%)
4	9	1	(11%)
5	3	1	(33%)
Total	329	34	

Mean ± SD = 2.0 ± 0.3 days

Table 3

Table 3. Results for drain tip cultures and SSIs

Drain tip culture	Total	SSI	
		+	—
	n=329	n=19	n=310
Positive	34	10	24
Negative	295	9	286

Data are significantly different ($P<0.05$)

Table 4. Prediction of SSIs using a positive drain culture

Prediction of SSIs	Percentile
Sensitivity	52%
Specificity	92%
PPV*	29%
NPV**	97%

*positive predictive value **negative predictive value

Table 5. Bacteria in positive drain tip cultures and postoperative SSIs

Bacteria	Positive drain tip cultures	SSI -	SSI +		
			Concordant	Discordant	Total
Staph epidermidis	7	6	1	0	1
MRSE*	7	4	3	0	3
Propionibacterium acnes	6	5	1	0	1
Anaerobic gram-positive bacilli	4	3	1	0	1
Klebsiella pneumoniae	3	3	0	0	0
MRCNS*	2	0	2	0	2
Enterococcus faecalis	2	1	1	0	1
MRSA*	1	0	1	9	10
Candida albicans	1	1	0	0	0
Enterobacter cloacae	1	1	0	0	0
Total	**34**	**24**	**10**	**9**	**19**

* Methicillin-resistant bacteria

Table 6. Methicillin-resistant bacteria detected in drain tip cultures and SSIs

Bacteria in drain tip cultures	Methicillin-resistant bacteria		
	+	—	
	n=10	n=24	P value
SSI	6 (60%)	4 (17%)	0.01

Table 7

Table 7. Positive drain tip cultures and SSIs by instrumentation use

	Instrumentation use		
	+ n=160	— n=169	P value
Positive drain tip cultures	19 (11.8%)	15 (8.9%)	0.37
SSI	9 (5.6%)	4 (2.4%)	0.13