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Bacterial Colonization and Infection Rate of Epidural Catheters used for Postoperative Analgesia

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Abstract

Background & Aim

Epidural analgesia is one of the commonest modes for providing postoperative analgesia after surgery and epidural space infection is a major concern despite low incidence. We prospectively studied the incidence of bacterial colonization of epidural catheters, infection and also investigated any potential risk for colonization.

Methods

180 patients of both sexes, older than 20 years receiving patient controlled epidural analgesia for postoperative pain management were recruited in this prospective study. Epidural catheter tips of patients receiving analgesia for longer than 48 hrs were cultured semi quantitatively. Regression analysis was used to find correlation between potential risk factor and epidural colonization.

Results

Out of 180 tips cultured, 167(92.8%) were sterile whereas 13 (7.2%) were colonized predominantly with coagulase negative Staphylococcus epidermidis (61.5%). Out of porential risk factors, duration of catheterization showed significant correlation with colonization ($p<0.05$). None of the patients exhibited signs or symptoms of local or epidural space infection.

Conclusion

7.2% of epidural catheter tips had positive culture, leading organism being coagulase negative Staphylococcus epidermidis. Colonization was related with time for which catheter remained in place. Despite colonization no patient developed epidural space infection.

Introduction

Epidural techniques are increasingly employed worldwide both for anaesthesia as well as to provide postoperative analgesia. Retrospective reviews [1,2] suggest that incidence of infection following short term use of epidural catheter is extremely low [3-5] but some infections eg. epidural abscess, have been reported in literature [6-8]. Several mechanisms by which epidural catheterization can cause infection have been described [9]. The micro-organism may reach epidural space during epidural needle or catheter insertion, from contamination of catheter emergence site or its lumen, by contamination of syringes and medication or via haematogenous spread from elsewhere in the body. Bacterial colonization in reported literature ranges

between 0-28% of patients [10-15] but incidence of epidural space infection is low. Although not proved, but bacterial colonization may be source of life threatening epidural space infection [15] and this has always been a matter of anxiety among pain managing physicians. Tremendous increase in use of epidurals for postoperative pain management in yester years and increase in number of patients with significant co-morbidity can increase catheter infection rate [16]. The present prospective study was done to determine the frequency of epidural catheter tip colonization and epidural space infection in patients receiving postoperative epidural analgesia for more than 48 hrs. In addition, we also investigated micro-organism involved and predisposing risk factors that may play key role in bacterial colonization.

Methods and Materials

This prospective study was done on 180 adult patients of both sexes who required postoperative epidural analgesia. Study was done after approval from institutional ethics committee and written informed consent from patients. Eligible patients were those who underwent major lower extremity orthopaedic, urologic, gynaecologic or general surgery and epidural analgesia was required for minimum of 48 hours. Obstetric patients were not considered. Epidural catheter was inserted under local anaesthesia before induction of general anaesthesia under full asepsis. All the material used was from a commercially available set which included epidural needle (16-18 G), catheter and a filter. Standard protocol during catheter insertion included use of sterile gown, gloves and wearing cap and mask. Before performing epidural block, the skin was prepared with cetavlon and 10% povidone-iodine solution and covered with sterile drapes. After placement of epidural catheter, insertion site was covered with transparent adhesive dressing and edges were reinforced with tape. The exposed length of catheter was directed cephalad over the patients back and fixed with adhesive tape over shoulder. The distal end of the catheter was connected with bacterial filter and kept in sterile bag. The surgery was conducted under epidural anaesthesia with sedation or in combination with general anaesthesia as required. We did not prescribe any antibiotic for epidural catheter. However, all patients received antibiotic during perioperative period, first dose being given prior to epidural catheterization. The choice and dose of antibiotics was decided by surgical team based on departmental protocol. Patient controlled epidural analgesia was used and the analgesic regimen consisted of 0.25% bupivacaine or 0.2% ropivacaine with 2 microgram/ml of fentanyl prepared under sterile conditions.

Each patient was visited twice daily by the anaesthetist providing analgesia and he inspected and palpated catheter insertion site for any tenderness, discharge or staining. The patients were instructed to report any symptoms suggestive of epidural space infection such as pain in neck or back, weakness in limbs or fever. The catheter dressing was not changed unless there was any soiling or pealing.

The catheter was left in space for a minimum of 48 hrs but removed earlier if local or systemic infection was suspected (temperature > 39°C), accidently removed or no longer required for analgesia. In all other patients' catheter was removed when anaesthetist team managing post-operative pain considered that epidural analgesia was no longer required. Catheter was withdrawn (without prior antiseptic skin preparation) carefully with sterile forceps and the externalized part was directed upwards keeping away from skin surface to avoid contamination with skin organism [17]. The distal 3-4 cm of catheter was cut with sterile scissors and placed in sterile tube which was transported to microbiology lab and was cultured within two hours semi quantitatively as described previously [17]. It was cultured at 37degree C under aerobic and anaerobic conditions for 48 hrs. Microbiological identification of cultured organization was done by standard procedure including gram staining, colonial appearance, catalase and coagulase testing and by VITEK 2 system. Positive culture was defined as > 15 colony forming units as used by Maki et al 1977 for vascular catheters. Any local site inflammation if present was noted. All the patients were visited daily till discharge from hospital and checked for any sign or symptoms of spinal-epidural space infection and also instructed to inform if any symptom appeared after discharge.

Data Collection and Statistical Analysis

For each patients following data were noted: demographic details, type and duration of surgery, level of catheter insertion, number of attempts to identify epidural space, duration of catheterization, need to change the insertion site dressing, duration of antibiotic therapy, signs and symptoms of local or epidural space infection. The conditions or diseases which can cause immune-modulation and are considered potential risk for infection were also recorded for each patient. These included: diabetes, pulmonary tuberculosis, auto-immune diseases, malignancy, cirrhosis of liver, chronic renal failure (CRF), alcoholism, smoking, long term steroid use and drug abuse.

Data are expressed as median and inter-quartile range (IQR), or number of patients and % as appropriate. Multiple logistic regression with backward stepwise analysis with maximum likelihood method was used to find correlation between potential risk factors and epidural catheter colonization. All possible risk factors were included in the first step and subsequently removed if not significant i.e. $p > 0.05$.

Results and Discussion

During study period, total 205 patients were included, but only 180 patients completed the study. 25 patients were excluded because of removal of catheter earlier than 48 hrs, accidental removal, reoperation or culture after stipulated time (2 hrs). Out of 180, epidural catheters tips of 167(92.8%) patients was sterile while 13 (7.2%) showed bacterial colonization (Table 1). Median age, gender, attempts for successful epidural, type and duration of surgery, site of epidural, days of antibiotic therapy and associated co-morbid conditions causing immune-modulation were similar in patients with sterile and colonized catheter patients (Table 1). Median time duration for which epidural catheter remained in situ was 52 (IQR 48-92) hrs in sterile tip patients while it was 74 (IQR 52-120) hrs in colonized tip patients ($p < 0.05$). Blood transfusion during period of catheterization was more frequently done in patients with colonized tip (32% vs 38% in sterile and colonized tip respectively) but the difference was not significant statistically (Table1). Data of patients with colonized tips are depicted in Table 2. Commonest micro-organism cultured was coagulase negative Staphylococcus epidermidis (61.5%) followed by Staphylococcus aureus and Enterococcus species (15.4%) and Klebsiella (7.7%).

Table 1- DEMOGRAPHIC DATA & OTHER VARIABLES

	Sterile catheter tip (n=167)	Colonized catheter tip (n=13)	P value
Age (years)	45 (36-65)	47 (35-71)	0.43
Male/Female	98/69	7/6	0.28
Level (Thoracic/lumbar)	23/144	1/12	0.67
Attempts 1/2/>2	54/72/41	3/5/5	0.58
Duration (hrs)	52(48-92)	74(52-120)	0.04
Antibiotic (days)	7(5-10)	7(5-10)	0.32
Blood transfusion (no of patients)	37(23%)	4 (31%)	0.07
Associated co-morbidity	94(56%)	8(61%)	0.89
Diabetes	14(8%)	2(15%)	
Pulmonary TB	10(6%)	0	
Alcoholism	21(13%)	1(9%)	
Cirrohosis liver	05(3%)	1(9%)	
Malignancy	13(9%)	1(9%)	
CRF	0	1(9%)	
Steroid use	07(4%)	0	
Smoking	20(12%)	0	
Drug abuse	04(2%)	0	
Type of surgery			0.78
Orthopaedic	60(36%)	5(38%)	
Gen surgery	35(21%)	4(30%)	
Urologic	37(22%)	2(16%)	
Gynaecologic	35(21%)	2(16%)	

TABLE 2 -DATA OF PATIENTS WITH POSITIVE CULTURE OF CATHETER TIP

Serial no.	Age/sex	Surgery	Co-morbidity	Level of catheterization	Attempts (n)	Duration (hrs)	Organism cultured
1	48/M	Ortho	-	Lumbar	1	78	CNS
2	73/M	Ortho	Diabetes	Lumbar	3	72	CNS
3	53/F	Gynaec	-	Lumbar	1	90	CNS
4	65/M	Urologic	CRF	Lumbar	>3	92	S aureus
5	67/M	Urologic	-	Lumbar	2	96	CNS
6	42/F	Ortho	-	Lumbar	1	56	CNS
7	57/M	Gen Surgery	Malignancy	Thoracic	2	120	Klebsiella
8	35/F	Ortho	-	Lumbar	1	96	CNS
9	72/M	Gen Surgery	Cirrhosis liver	Thoracic	>3	100	Enterococcus sp
10	50/M	Ortho	Alcoholism	Lumbar	1	75	S aureus
11	45/F	Gynaec	Diabetes	Lumbar	1	90	CNS
12	61/M	0rtho	-	Lumbar	2	96	Enterococcus sp
13	34/M	Urologic	-	Lumbar	1	100	CNS

CNS-Coagulase negative Streptococcus, S aureus-Staphylococcus aureus, Enterococcus sp-Enterococcus species

Step wise multiple regression analysis was done to find correlation between colonization and potential risk factors (age, duration of catheterization, level of insertion, number of attempts, associated co-morbidities (diabetes, pulmonary tuberculosis, cirrhosis liver, malignancy, CRF, alcoholism, smoking, steroid use and drug abuse) (Table 3). It showed that all the variables other than duration of catheterization were removed at some stage indicating that they did not significantly increase incidence of positive culture. Time duration for which catheter remained *in situ* increased the incidence of catheter tip colonization (Table 3). No patient had local site inflammation, cellulites, erythema or tenderness or epidural space infection.

TABLE 3- STEPWISE LOGISTIC REGRESSION ANALYSIS (ALL POTENTIAL RISK FACTORS INCLUDED IN 1ST STEP & REMOVED SUSEQUENTLY IF NOT SIGNIFICANT, i.e. P>0.05)

Risk factor	Removal at step	Odd ratio	P value
Age /decade	1	0.117	0.57
Attempts (n)	2	0.91	0.85
Level (lumbar/thoracic	11	0.13	0.86
Duration(per 24 hr)	Not removed	3.43	0.01
Diabetes	10	2.98	0.39
Alcoholism	5	0.44	0.67
Cirrhosis	8	3.41	0.40
Pulmonary TB	9	0.97	0.91
CRF	3	0.76	0.87
Steroid use	12	0.31	0.56
Drug abuse	4	1.5	0.66
Malignancy	6	2.21	0.48
Smoking	7	3.7	0.96

Rate of epidural catheter colonization in published literature varies from 0-28% [6,10-15,18], although incidence more than 50% has also been reported [6] . The 7.2% incidence reported in this study is in keeping with previous reports. Some authors found higher rates of colonization ranging between 17-53% [11,14,19-21], whereas others reported lower incidence [10,12,13]. Wide variation in results could be as a result of methodological differences such as duration of catheterization, type of patients etc, and making inter-study comparison difficult.

Coagulase negative Staphylococcus (CNS) was the commonest micro-organism identified in this study. Although this organism has been regarded as a common normal human skin flora with little clinical significance, it can though rarely be a source of hospital infection [22]. If natural cutaneous barrier is damaged such as during epidural placement, the organism may gain entry into host tissue [10]. Most of the studies reported this to be the leading organism of positive epidural culture [10,11,13,15,23,24]. But the finding culture of Staphylococcus aureus and Gram -ive pathogens like Klebsiella in this study and Pseudomonas and Eschericia coli in other studies [12,21,23] emphasize that more virulent organisms could colonize leading to possible epidural space infection [13].

Despite frequent catheter tip colonization, no patient in this study developed systemic or spinal-epidural space infection, a finding in agreement with other studies [10-13,24]. The definite causative relationship of catheter colonization and catheter related infection has not yet been established, probably due to very low incidence of clinically significant infection [15], making routine culture of catheter unnecessary [15,24].

Any correlation between epidural colonization and epidural space infection is not clear but few predisposing risk factors have been suspected to abet this [5,15,25]. These include age, site, number of attempts to place catheter, duration of catheterization and conditions that can cause immune-modulation such as prolonged steroid therapy, malignancy, alcoholism, drug abuse, smoking, pulmonary tuberculosis, chronic renal failure, diabetes etc. In stepwise regression analysis we included all these potential risk factors to determine any correlation with positive culture. The analysis revealed that out of these factors, only duration of catheterization remained in final analysis as statistically significant suggesting that frequency of positive culture increased when catheter remained in place for longer period. In this study, over 90% of patients were catheterized for ≥ 95 hrs. Our results are in agreement with other studies [6,8].

What is the safe duration for which epidural catheter can be left in space before the risk of colonization and infection becomes too great, is unknown. But data on IV catheters suggests that majority of the infections occur after five days, lending some support to wide spread practice of removing epidural catheter by the 5th day of insertion [5,26]. All other risk factors were removed at some or the other step as non significant showing that frequency of colonization was independent of these factors. Many other studies also could not find any relation with majority of the risk factors cited above [6,8,11,15,25,27,28].

Role of antibiotics in reducing the incidence of colonization was not investigated in this study. In our hospital all the patients receive antibiotics in perioperative period for major surgery. It has been shown that antibiotics given up to one hour before surgery minimizes surgical site infection [26,29]. In this study, we cultured catheter tips beyond 48 hrs because epidural space infection is related directly to catheter time [10]. To dress the epidural site, we used transparent occlusive dressing. Chlorhexidine impregnated dressing might have reduced the incidence of epidural catheter colonization [30].

There were few limitations of our study. We did not use measures to disinfect skin before removal of catheter which could have contaminated the catheter tip during withdrawl [14]. Many other authors did not use disinfection before removal [11,12], and as such it is impossible to exclude contamination that could have occurred during withdrawal. Many potential risk factors that were included in stepwise regression analysis correlated with each other. Thus, if one such factor was removed during stepwise exclusion process, a certain part of the information of the removed factor is transferred to the correlated factor still in model. Therefore risk factor remaining as significant in the final model might not have been truly significant [25]. Other limitation was a small sample size. The number of patients recruited in this study was small and thus was not sufficiently powered to detect the incidence of epidural space infection which is too low [3-5,23].

Conclusion

To conclude, despite 7.2% incidence of catheter colonization predominantly with coagulase negative streptococcus epidermidis, none of the patients developed systemic or epidural space infection. No significant correlation between potential predisposing risk factors and colonization could be detected except the time duration for which epidural catheter was in space. It showed that 'longer the duration of catheterization, higher the chances of colonization'.

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