ORIGINAL ARTICLE

Bacteriological Profile of Epidural Catheters

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Abstract

The bacteriological profile of epidural catheters was studied in 88 patients. Skin swabs before catheterization and before removal of catheter with their controls were cultured in TSB Medium. The catheter hub, the portion at the skin puncture site and at the tip were cultured in TSB Medium. The 1cm of the catheter bit just before the tip was cultured in TGB medium for anaerobes.Both, the skin controls swabs and the anaerobic culture, were negative. From the remaining, 56 positive cultures were obtained. Staphylococcus epidermidis was the predominant organism in 52% followed by staphylococcus aureus 25%. The remaining 23% was shared by Acinetobacter, Pseudomonas, Klebsiella, and E. coli. All the positive cultures from skin prior to epidural catheterization had turned sterile by 48 hours, indicating continued bactericidal action of the disinfectant. The likely source of positive skin cultures at 48 hours is hair follicles.The catheter tip culture was positive in 9 specimen, none of which resulted in the formation of epidural abscess. In 3 cases the cultures of skin puncture site and the tip were identical indicating tracking-in of the organisms.

Key Words

Baceriological Profile, Edidural Catheters, Anaesthesiology

Introduction

Primary epidural abscess (PEA) is a well described entity with the incidence of 0.2 to 1.2 per 10,000 admissions (1).Practise of cannulation of epidural space with a catheter for pain relief opened the possibility of iatrogenic epidural catheter influenced abscess (ECIA) formation (2-4).Which genrated need to control and prevent this complication with disastrous effects. Both invivo and invitro studies were, therefore, directed at finding the best skin disinfectant for preparing the back region (5-8).The epidural catheter tip culture has been recorded positive in 8.6% and 8.8% of cases (9,10),while catheter contamination as a whole in 30% (11). Other sources of contamination identified are : epidural needle or catheter track (12) , syringes particularly when reused (13) or contaminated epidural infusate (14). Even multiuse bottles of povidone iodine 10% could also provide contamination(15).The predominant causative organism cultured from epidural abscesses is the Staphylococcus aureus (SA) in 57 to 93% , followed by streptococci in 18%, a variety of gram negative organisms in 13% of cases and the remaining like E Coli, prevotella, listeria and micrococci have been reported (4).The aim of this study is to determine the bacteriological profile of the whole length of epidural catheters at predetermined sites with matching swab cultures from skin areas, in a predominantly rural population.

Material and Methods

The study comprised 88 patients of ASA Grade I, II, and III, undergoing gynaecological and orthopedic operations, at Kasturba Hospital of MGIMS, Sevagram. The study was approved by the IEC. Informed consent was obtained.The anaesthesiologist washed and disinfected his hands, and had full sleeved gown and gloves, and was wearing cap and mask. A company sterilized and packed epidural catheter was provided to the tray using aseptic precaution. The back of the patient was prepared from the shoulder to buttocks with a solution of 2 % iodine in 80% ethyl alcohol, followed by 2 applications of denatured alcohol, the whole procedure being spread over about 4 minutes.The epidural space between L1 and L2 vertebrae was identified under full aseptic and antiseptic precautions, using loss of resistance technique with Tuohy Needle and the catheter inserted taking usual precautions.All patients had received antibiotics in the postoperative period according to the schedules followed in different operating units. The epidural catheter was removed after 48 hours under full aseptic and antiseptic precautions. It was aseptically cut in approximately 1 cm length (bits) at 4 predetermined sites for microbiological evaluation. From each patient 8 samples were sent which included 4 swabs also as described below. They were numbered A to H. All samples were sent in Tripticase Soya Broth (TSB) for

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aerobic cultures, except for sample F which was sent in Thio-Gluconate Broth (TGB) for anaerobic culture. Swabs and samples were collected: Prior to introduction of catheter (P1), Prior to removal of catheter (P2), and on removal of Catheter (P3) *(Table 1)*

Whenever a fresh lot of catheter was taken out, one catheter of the same lot, still company packed, was sent for aerobic and anaerobic culture to microbiology department. This served as a control to indicate the sterility of the whole lot. The processing of swabs and samples was done as described below :

1. Samples A,B,C,D,E,G, & H received in TSB were incubated for 24 hours at 37°C and subcultured in blood agar and Mac Conkey's agar. The plates were incubated for 24 hours at 37°C and all isolates were identified by standard techniques (16).
2. Sample F received in TGB was incubated at 37°C for 24 hours and then subcultured on Brain Heart Infusion Agar (Plain and with gentamicin), and incubated at 37° degree centigrade for 48 hours in McIntosh Fields Jar after placing a metronidazole disc. No anaerobe was isolated from any specimen (16).
3. Pieces of catheter from each fresh lot of catheters used were placed in TSB and processed as per Sr. No 1 described above.

Statistically,evaluation was not carried.

Results

The percentage wise sex & age distribution is shown in *Fig 1*. The growth/ absence of different types of organisms from culture, from the 8 different swabs or samples, are shown in *Table 2*. Excessive inflammation, or pus discharge from the site of catheter were not observed in any patient.A total of 704 swabs or samples were sent for culture from the 88 patients. The swab controls of A prior to cannulation and swab controls C prior to removal of the catheter were all sterile.The skin swab B (P1) after skin disinfection, had 15% positive culture growth. But none of these survived to remain positive at skin swab culture P2 on removal of the catheter 48 hours later. The skin swab P2 also showed a 15% positive culture, but they all were newly appearing organisms in altogether different cases. The predominant cultured organisms were Staphylococcus epidermidis (S epid) 69 to 46%, followed by Staphylococcus aureus (SA) 15 to 31%. However a group of Acinetobacter, Pseudomonas, Klebsiella, and E. coli (APKE group) were found in approximately 20% of these cultures.The catheter hub sample H had positive culture in 10% of samples with usual predomination of the two staphylococci mentioned above. However, 3 out of these 9 cultures (33%) belonged to the APKE group. The skin puncture site catheter bit sample G had positive culture in 14% samples, with the two staphylococci predominating. But here also 3 (25%) belonged to the APKE group.The catheter bit F, proximal to the tip, sent for culture in TGB medium was negative for aerobic organisms. The catheter Tip E in the epidural space had 9 (10%) positive cultures. Of these 56% were S epid,

Table No. 1: Description of Swabs and Samples

Category	Samples	Site of Swab / Sample
P1	Swab A	Acted as swab control
	Swab B	From skin over lumbar area before puncture
P2	Swab C	Swab control at 48 hours just before removal of catheter
	Swab D	From skin around puncture site before catheter removal
P3	Sample E	1 cm tip of catheter in epidural space
	Sample F	1 cm bit of catheter just after the tip for TGB medium
	Sample G	1 cm bit of catheter from skin puncture site
	Sample H	1 cm bit of catheter at the hub of catheter

22% SA, and 22% were the APKE group. Thus, out of the total 704 swabs and samples sent for culture, the 176 swab controls A and C were sterile. Another 88 samples for anaerobic cultures were also sterile. There were 56 positive cultures for various organisms. Of these 52% were S epid, and 25% were SA. The remaining 23% had the APKE group which has special significance for this study in a rural population. There were 9 positive cultures from the catheter hub bit, 12 positive cultures from the bit at the skin puncture site and 9 positive cultures from the catheter tip in the epidural space.

Master Sheet Evaluation of the 9 Positive Catheter Tip Cultures: As shown in *table 3*, this revealed 2 growths of SA, 5 growths of S epid, and 1 growth each of pseudomonas and klebsiella species. In cases of the 2 SA positive catheter tip cultures all the other skin swabs and samples were sterile. Out of the 5 S epid cultures from the catheter tip, 3 also had simultaneous S epid positive culture from catheter bit at skin puncture site, while the two positive P1 skin swab cultures for S epid are of no significance as they had become sterile at 48 hours. In the fourth positive tip culture for S epid, the other swab and sample cultures were sterile. In the fifth, the P2 skin swab had positive S epid culture but the catheter hub bit was positive for klebsiella.In the remaining two positive cultures from the catheter tip, pseudomonas, and klebsiella were detected. Thus catheter tip itself in the epidural space had positive cultures of 10%. The post operative antibiotic regime for the 88 patients is shown in *table 4*& *5*.

Discussion

Epidural abscess following epidural catheter, is dreadful to the patient and to the anaesthesiologist. Passage of infection from nasal source in absence of face mask, to epidural space is described (14). The personal prophylaxis methods are scrupulously followed in our institute.The possibility of epidural space infection had stimulated interest in micorbiological studies of the skin of the back, and of the catheter, from around 1962 (9, 10, 17-19). All these studies, however, did not look at the whole epidural catheter length through predetermined serial sections with matching skin swab cultures. After Iodine-denatured alcohol disinfection, the skin swab cultures P1 were positive in 15% of cases (13 out of 88). Out of these 13, i.e. 9 (69%) were S epid, 2 (15%) were SA, and Acinetobacter and Pseudomonas were one each (16%). The arguments against the use of iodine in alcohol are centered around the skin irritation it produces in some populations (17). In our institute two applications of iodine

followed by two of denatured alcohol have served the purpose very well for a long time.The other disinfectants are 10% Povidone iodine (PVP) which is a watery solution, and 0.5% Chlorhexidine (CHE) in alcohol. A study comparing the two found that CHE in alcohol was more effective in preventing catheter colonization in children (7). Similar conclusions were noted when PVP, CHE alone, or CHE in alcohol were compared, suggesting that CHE in alcohol enhanced bactericidal activity (5).Cultures of skin specimens in a study taken prior to laminectomy showed positive cultures in 32% of PVP disinfected skin specimens, compared to only 6% with CHE in alcohol (6). Another skin specimen culture study using skin disinfection with 1.5% iodine in 70% alcohol, or 0.5% CHE in 70% alcohol, found reduced colony counts by 95.5% and 87.6% respectively. Microscopically, they could show viable bacteria exuding from hair follicles and concluded that presence of a lipid plug at the hair follicle orifice protects the bacteria from disinfectants (20).This plug is removable by alcoholic disinfectant solutions rather than watery solutions like povidone iodine. The continued use of Iodine and denatured alcohol in our institute, thus, stands corroborated. Normally the S epid (65-69%) and SA (1-2%) are the most frequently detected organisms in skin flora (5). However, in cases of epidural abscess the SA is obtained in 82% of cultures, to the 18% of S epid (2). The skin swab culture P1 in our study has similar findings. The presence of Acinetobacter and pseudomonas will be referred to later.Skin swab cultures P2 done after 48 hours showed sterile result for all the P 1 positive swabs. This indicates a continuing bactericidal effect of the iodine - denatured alcohol combination, which has been reported earlier (8). The positive cultures for P2 swabs were also dominated by two staphylococci groups. Out of the 13 positve cultures, 23% were formed by acinetobacter and E coli. All of these were new cultures the organisms for which must have come from hair follicles (17, 6). No difference was observed between the cultures from P1 and P2 swabs.The catheter bit samples H, G, and E, also showed the predominance of S epid and SA in positive cultures, while the APKE group had positive cultures in 33%, 25%, and 22% for the H, G, and E, samples respectively. This will be referred to later. The difference between culture positivity of 10%, 14%, and 10% in H,G, and E, samples was not statistically significant. Positive catheter tip cultures were found in 9 out of 88 cases (10%). The determination of its relationship with other positive sample bits of swab culture is attempted from *Table 3.* The SA was cultured in 2 cases of positive tip cultures, where all the other skin swabs and catheter bits were negative. The source of this SA can be from contaminated syringes, from contaminated analgesic solutions, or from the hands of the personnel (13, 14).The S epid was cultured from 5 catheter tips out of 9 positive cultures. In 3 of these cases, the S epid was also cultured from catheter bit G indicating the possibility of the organism tracking inside, as has been reported by others (12). Of the other 2 positve S epid cultures, one had the same culture from the P2 skin swab though the G catheter bit was sterile. One each of Pseudomonas and Klebsiella cultures (total 22%) were the remaining positive tip cultures out of 9. These will be referred to later. Though out of 56 positve cultures 9 were from the catheter tip, they did not result in epidural abscess, not even catheter tip infection or superficial pus formation. This is also noted by other workers (9,10,13,17,18). Thus despite positive tip cultures, the incidence of ECIA remains low. This may be due to low prevalence of SA in skin flora, good host immune

Fig.1 Sex & Age Distribution (n=88)

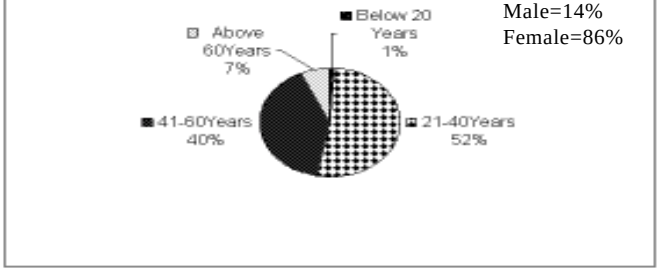

Table 2. Showing Presence or Absence of Growth From Epidural Catheters or Matching Skin Swabs

Organisms	Swab A	Swab B	Swab C	Swab D	Sample E	Sample F	Sample G	Sample H
Staphylococcus Epidermidis	0	9	0	6	5	0	6	3
Staphylococcus Aureus	0	2	0	4	2	0	3	3
Acinetobacter	0	1	0	2	0	0	1	1
Pseudomonas	0	0	0	0	1	0	1	2
Klebsiella	0	1	0	0	1	0	0	0
E. Coli	0	0	0	1	0	0	1	0
Growth in Nos out of 88	0	13	0	13	9	0	12	9
Percent of Growth	0	15%	0	15%	10%	0	14%	10%
Sterile Nos out of 88	88	75	88	75	79	88	76	79
Percent sterile	100%	85%	100%	85%	90%	100%	86%	90%
Total Nos	88	88	88	88	88	88	88	88

Table 3. Showing Master Sheet Evaluation of Positive Catheter Tip Culture in 9 Patients

No	Swab B	Swab D	E sample	G sample	H sample
1	Sterile	Sterile	S Aureus	Sterile	Sterile
2	Sterile	Sterile	S Aureus	Sterile	Sterile
3	S epid	Sterile	S epid	S epid	S epid
4	S epid	Sterile	S epid	S epid	Sterile
5	Sterile	S epid	S epid	Sterile	Klebsiella sp
6	Sterile	Sterile	S epid	Sterile	Sterile
7	Sterile	S Aureus	S epid	S epid	Sterile
8	Sterile	S epid	Klebsiella sp	Sterile	Sterile
9	Sterile	Sterile	Pseudomonas	Sterile	Sterile

Table 4.Showing Use of Post Operative Antibiotic Regimes

Antibiotic Regime	No of Patients (%)
2 Drugs	57 (65%)
3 Drugs	24 (27%)
Initially 2 then 3 Drugs	7 (8%)

Table 5. Showing Use of Post Operative Antibiotic

Groups of Antibiotics	Individual Drugs
Penicillins	Crystalline Penicillin, Ampicillin
Cephalosporins	Ceftriaxone, Cefotaxime Cefixime, Cefuroxime
Quinolones	Ciprofloxacin
Aminoglycosides	Gentamicin, Amikacin
Anti-Bacteroides	Metronidazole

competence, the antimicrobial property of local anaesthetic agents, and concomitant effective antibiotic administration (6).The factors determining successful infection are a minimum infecting dose, and for lethal action a minimum lethal dose, of bacteria entering the host. They are more correctly identified as statistical expressions ID 50 or LD 50, as the dose required to infect or kill 50% of the organism under standard conditions (21).Thus absence of epidural abscess reflects failure of the infecting dose to reach ID 50 values, to which the above mentioned factors also contribute (6). The antibiotic therapy to our patients employed a 2 drug or 3 drug regime, which seemed effective.In preceeding sections and paragraphs, the cultures positive for APKE group have been noted. The pseudomonas and acinetobacter are widely distributed in soil and water. P aeruginosa is the major pathogen, while acinetobacter is a commensal which can cause nosocomial infection sometimes (22). The klebsiella and E. coli comprise enterobacteriaceae whose natural habitat is animal and human intestine (22).In the past, there have been studies where micropore bacterial filters were not used (9, 17, 18). The filters had been subsequently adopted (2, 13). In our institute as well the bacterial filters had not been used traditionally, but they have since been adopted.Scrupulous attention to use of cap, face masks, hand wash with disinfectant application, and full sleeved gown are emphasized. This study wishes to suggest putting on 2 pairs of gloves.

Conclusions

Thus, of the 56 positive cultures, 77% were skin conmensal staphylococci. 23% culture reflected organism of soil - water manure cycle of agrarian occupation. The catheter tip cultures were positive in 10% of the samples showing similar organism presence as mentioned above. None of them produced epidural abscess in any patient. The positive cultures occurred despite the use of full aseptic and antiseptic precautions, except the use of micropore bacterial filters.

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