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Abstract

Continuous caudal anesthesia has been commonly used for intra- and post-operative analgesia in infants and children. However, it has a potential risk of bacterial infection, especially in infants in whom the catheter site is easily contaminated with loose stool. To avoid infection, the authors applied a new procedure using subcutaneous tunneling for continuous caudal anesthesia. In the 18 cases studied with subcutaneous tunneling, clinical signs of infection were absent and bacterial colonization was not found on the catheter tip after 3.9 +/- 1.4 days of catheterization. The incidence of catheter colonization after continuous caudal anesthesia without tunneling had been reported. In their reports, the incidence of catheter colonization ranged from 20% to 37%. Therefore, caudal catheterization with subcutaneous tunneling is a simple and safe method, and has proved very effective to reduce the risk of epidural infection.

KEYWORDS: continuous caudal anesthesia, subcutaneous tunneling, cathter infecton

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Original Article

Decreased Risk of Catheter Infection in Infants and Children Using Subcutaneous Tunneling for Continuous Caudal Anesthesia

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Continuous caudal anesthesia has been commonly used for intra- and post-operative analgesia in infants and children. However, it has a potential risk of bacterial infection, especially in infants in whom the catheter site is easily contaminated with loose stool. To avoid infection, the authors applied a new procedure using subcutaneous tunneling for continuous caudal anesthesia. In the 18 cases studied with subcutaneous tunneling, clinical signs of infection were absent and bacterial colonization was not found on the catheter tip after 3.9 ± 1.4 days of catheterization. The incidence of catheter colonization after continuous caudal anesthesia without tunneling had been reported. In their reports, the incidence of catheter colonization ranged from 20% to 37%. Therefore, caudal catheterization with subcutaneous tunneling is a simple and safe method, and has proved very effective to reduce the risk of epidural infection.

Key words: continuous caudal anesthesia, subcutaneous tunneling, catheter infection

Caudal anesthesia has been commonly used for intra- and post-operative analgesia in infants and children [1]. Recently, this technique has been applied to abdominal and chest surgery in young children in order to decrease the risk of nerve injury and benefit from the ease by which the catheter can be advanced to the lumbar and thoracic region [2]. However, it has a potential risk of bacterial infection, especially in infants in whom the catheter site is easily contaminated with loose stool [3, 4]. To avoid infection, the authors applied a new procedure using subcutaneous tunneling for catheter placed during continuous caudal anesthesia. The purpose of this study was to introduce this technique and analyze the risk of infection.

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Materials and Methods

The design of this study was approved by the Human Research Committee of Iwakuni National Hospital and signed informed consent from the parents was obtained. Eighteen children of ASA physical status I or II, who were scheduled for abdominal or thoracic surgery, were enrolled in this study. The age distribution was from 3 to 61-months, the average being 19.6 ± 17.2 (mean ± SD). The body weight ranged from 6.5 to 16.7 kg, averaging 9.5 ± 2.8 kg (mean ± SD). All children older than 6 months received oral midazolam (0.4 mg · kg^{-1}) with clear water (5 ml · kg^{-1}) 1 h before surgery. Electrocardiogram,

noninvasive arterial pressure, pulse oximetry, and end-tidal carbon dioxide pressure were monitored. General anesthesia was induced with 50%N_2O/50%O_2, 5% Sevoflurane and atropine (0.01 mg・kg^{-1}). Tracheal intubation was facilitated by vecuronium (0.1 mg・kg^{-1}) for neuromuscular block. Anesthesia was maintained with 60%N_2O/40%O_2 and 1% Sevoflurane. Each patient was then placed in the lateral decubitus position and prepared with povidone-iodine. Prior to insertion the epidural catheter length was estimated by measuring the distance from the sacral hiatus to thoracic or lumbar vertebra. The epidural catheter was placed using the following technique.

Using an 18-G needle, the skin was cut and the subcutaneous tissue was carefully dissected with mosquito forceps without spreading the skin nick. This step was important to allow adequate room to lay the epidural catheter subcutaneously. An 18-G 1.25 inch i.v. catheter was introduced in the epidural space through the sacrococcygeal ligament and the obturator needle was withdrawn. The 19-G epidural catheter was inserted through the i.v. catheter which was then removed. A separate 18-G 2.5 inch i.v. catheter was carefully inserted in the same skin nick and advanced subcutaneously in the cephalo-lateral direction until the tip of the needle emerged from the skin at a desired distance (Fig. 1A). The obturator needle was withdrawn and the hub of the i.v. catheter was cut and discarded. Next, the free end of the epidural catheter was passed through the i.v. catheter which made a tunnel in the subcutaneous tissue (Fig. 1B). The i.v. catheter was removed once the epidural catheter was passed beyond the distal end of the tunnel. The epidural catheter was pulled out until the exposed loop lied completely within the subcutaneous space without a kink (Fig. 1C). The first skin nick was closed with surgical tape (Leukostrip®; Beiersdorf, Germany). The visible part of the epidural catheter was covered with a transparent adhesive dressing (Tegaderm®; 3 M health care, Ontario, Canada) after reinforcement with a bacteriostatic pad (Biopatch Cathter Care Pad®; Johnson & Johnson Medical Inc., Arlington, TX, USA) and surgical tapes. A bacterial filter was connected to the free end of the catheter. A test dose of 0.5 ml of 1% lidocaine with epinephrine (1:200,000) was injected prior to dosing with 0.25% bupivacaine for intraoperative analgesia. At the end of surgery, inhalation anesthesia was discontinued, neuromuscular blockade was reversed, and the trachea tube was extubated. Caudal anesthesia was continued for postoperative analgesia. After assessing epidural catheter site for erythema,

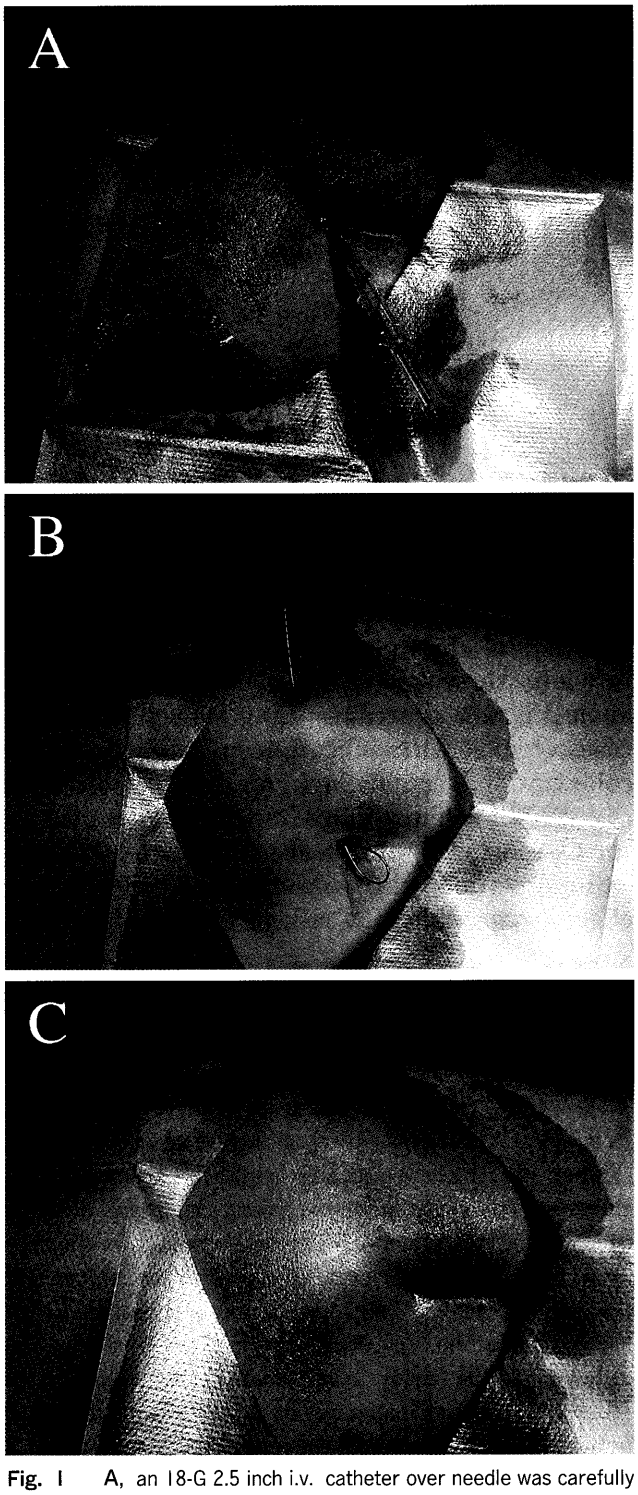

Fig. 1 A, an 18-G 2.5 inch i.v. catheter over needle was carefully inserted from the skin nick and advanced subcutaneously in the cephalo-lateral direction. B, the caudal epidural catheter was pulled through the tunnel allowing the exposed loop to lie within the subcutaneous space. C, the epidural catheter was pulled out and the exposed loop lied completely within the subcutaneous space without a kink.

edema, and purulent discharge, the skin was cleaned with a chlorhexidine swab, and the catheter was carefully withdrawn. Two centimeters of the catheter tip was cut and sent to the laboratory for bacterial examination. All children received antibiotics postoperatively until the epidural catheters were removed.

Results

Patient demographics, diagnosis, and surgical procedure are given in Table 1. Length of subcutaneous tunnel, duration of catheter in use, bacterial colonization and skin inflammation at the catheter sites are given in Table 2. Average length of subcutaneous tunnel was 4.4 ± 1.2 cm (6–2 cm). Average duration of catheter in use after operation was 3.9 ± 1.4 days (6–1 days). Average duration of placement from first stool to removal was 1.6 ± 1.2 days (4–0 days). No patient developed subcutaneous or epidural abscess, meningitis or systemic infection during the study. Bacterial culture of the catheter tips showed no colonization out of 18 samples. The first skin nick was closed without any sign of infection when the catheter was removed. All catheters were removed without complications.

Discussion

Regional anesthesia has been increasingly important for intra- and post-operative pain relief in infants and children [1]. This procedure could decrease morbidity, mortality, and overall cost in the treatment of selected surgical patients [5]. Caudal epidural anesthesia is notable for its simplicity, safety, and effectiveness and is one of the most frequently used regional technique in infants and children [1]. Recently, this method has proved feasible for pain relief in abdominal and chest surgery in infants and children considering the ease with which the catheter can be advanced up to the lumbar and thoracic region [2]. Although the risk of neurological damage is lower, there is a potential risk of bacterial infection especially in infants in whom the catheter site is easily contaminated with loose stool. For this reason, this procedure has been discouraged by some authors [3, 4]. To avoid bacterial contamination at the puncture site near the anus, the authors applied a subcutaneous tunneling technique. Subcutaneous tunneling has been used for patients with chronic pain to improve fixation of the epidural catheter and to prevent central venous catheter infection in children [6, 7, 8]. We expect that this technique might reduce the incidence of infection at the catheter site and ensure catheter stabilization. In the 18 cases studied, clinical signs of infection were absent and

Table 1 Patient demographics, diagnosis, and operation

No	Age (months)	Body weight (kg)	Diagnosis	Operation
1	11	7.1	Gastroesophageal reflux	Fundoplication
2	10	7.0	Rectourethral fistula	Fistulectomy
3	7	9.0	Neuroblastoma	Resection
4	37	11.7	Funnel chest	Sternal elevation
5	61	16.7	Hypospadias	Urethroplasty
6	31	10.4	Ventral hernia	Herniorrhaphy
7	13	8.3	Esophageal Stenosis	Partial Esophagectomy
8	11	7.5	Imperforate anus	Colostomy
9	5	6.5	Congenital biliary dila	Choledochojejunostomy
10	10	10.0	Hypospadias	Urethroplasty
11	36	13.7	Congenital biliary dila	Choledochojejunostomy
12	27	11.5	Ventral hernia	Herniorrhaphy
13	52	13	Vesicoureteral reflux	Reimplantation of the ureter
14	4	8.0	Vesicoureteral reflux	Reimplantation of the ureter
15	3	6.6	Vesicoureteral reflux	Reimplantation of the ureter
16	9	8	Vesicoureteral reflux	Reimplantation of the ureter
17	18	9.5	Vesicoureteral reflux	Reimplantation of the ureter
18	8	6.9	Congenital biliary dila	Choledochojejunostomy

Table 2 Length of subcutaneous tunnel, duration of catheter use, and catheter tip colonization

No	Length of Tunnel (cm)	Catheter in Use (days)	Catheter in Use after first stool (days)	Catheter Tips colonzation	Site Inflammation
1	4	5	0	(−)	(−)
2	3	5	1	(−)	(−)
3	5	4	3	(−)	(−)
4	5	6	3	(−)	(−)
5	5	2	1	(−)	(−)
6	4.5	5	4	(−)	(−)
7	6	4	1	(−)	(−)
8	5	4	2	(−)	(−)
9	6	1	0	(−)	(−)
10	5	2	1	(−)	(−)
11	2	5	0	(−)	(−)
12	2	5	2	(−)	(−)
13	5	5	0	(−)	(−)
14	4	3	3	(−)	(−)
15	5	3	3	(−)	(−)
16	3	2	2	(−)	(−)
17	5	5	1	(−)	(−)
18	5	5	2	(−)	(−)
Average ± SD	4.4 ± 1.2	3.9 ± 1.4	1.6 ± 1.2		
Max-Min	6-2	6-1	4-0		

bacterial colonization was not found on the catheter tip after 3.9 ± 1.4 days of catheterization. The incidence of catheter colonization after continuous caudal anesthesia without tunneling ranged from 20% to 37% [9, 10] In their reports, patients received antibiotics perioperatively and catheters were removed when epidural analgesia was no longer required or if medically indicated. The incidence of bacterial colonization in the caudal epidural catheter tip was higher than in the lumbar epidural catheter tip. Gram-negative organisms were found more frequently in the caudal epidural catheter tip than in the lumbar epidural catheter tip which suggests that catheters were contaminated from the skin at the insertion site close to the anus. Although the incidence of bacterial colonization was high in the caudal epidural catheter tip, they concluded that the risk of significant infection could be low if the duration of placement were short. Recently, the feasibility of the tunneling of caudal epidural catheter was reported [11]. In this report, none of the catheter tips from tunneling group showed any bacterial growth and these results were the same as ours. Therefore, very low incidence of catheter colonization in our cases suggested that subcutaneous tunneling reduce the potential risk of catheter colonization and the risk of clinical epidural infection.

Predicted complications related to the subcutaneous tunneling were kink of the catheter, infection at the initial puncture site and catheter sequestration during removal [12, 13]. To prevent these problems, the first skin nick was made as small as possible with a pocket underneath to avoid a sharp angle.

Caudal catheterization with subcutaneous tunneling is a simple and safe method, and has proved very effective to reduce the risk of epidural infection.

References

1. Yaster M and Maxwell LG: Pediatric regional anesthesia. Anesthesiology (1989) **70**, 324-338.
2. Bosenberg AT, Bland BA, Schulte-Steinberg O and Downing JW: Thoracic epidural anesthesia via caudal route in infants. Anesthesiology (1988) **69**, 265-269.
3. Emmanuel ER: Post-sacral extradural catheter abscess in a child. Br J Anaesth (1994) **73**, 548-549.
4. Blanco D, Llamazares J, Rincon R, Ortiz M and Vidal F: Thoracic epidural anesthesia via the lumbar approach in infants and children. Anesthesiology (1996) **84**, 1312-1316.
5. Meignier M, Souron R and Le Neel JC: Postoperative dorsal epidural

analgesia in the child with respiratory disabilities. Anesthesiology (1983) **59**, 473–475.
6. Carl P, Crawford ME and Ravlo O: Fixation of extradural catheters by means of subcutaneous tissue tunnelling. Br J Anaesth (1984) **56**, 1369–1371.
7. Du Pen SL, Peterson DG, Williams A and Bogosian AJ: Infection during chronic epidural catheterization: Diagnosis and treatment. Anesthesiology (1990) **73**, 905–909.
8. Chung DH, Ziegler MM: Central venous catheter access. Nutrition (1998) **14**, 119–123.
9. Kost-Byerly S, Tobin JR, Greenberg RS, Billett C, Zahurak M and Yaster M: Bacterial Colonization and Infection Rate of Continuous Epidural Catheter in Children. Anesth Analg (1998) **86**, 712–716.
10. McNeely JK, Trentadue NC, Rusy LM and Farber NF: Culture of bacteria from lumbar and caudal epidural catheters used for postoperative analgesia in children. Reg Anesth (1997) **22**, 428–431.
11. Vas L, Naik V, Patil B and Sanzgiri S: Tunnelling of caudal epidural catheters in infants. Paediatr Anaesth (2000) **10**, 149–154.
12. Lenox WC, Kost-Byerly S, Shipley R and Yaster M: Pediatric caudal epidural catheter sequestration: An unusual complication. Anesthesiology (1995) **83**, 1112–1114.
13. De Armandi AJ, Ryan JF and Chang HM: Retained caudal catheter in a pediatric patient. Paediatr Anaesth (1992) **2**, 325–327.