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Paraplegia: Complication of Percutaneous Central Venous Line Malposition

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Percutaneously inserted central venous lines are usually a safe and effective means of securing prolonged central venous access but can have serious complications. One patient who experienced clinically important morbidity related to inadvertent malpositioning of a central venous catheter is described. It was inserted via the left saphenous vein into the lumbar venous plexus and resulted in milky cerebrospinal fluid, urine retention, and paraplegia. Reviewing the literature, only 11 patients with the same malposition were reported, three of them with percutaneously inserted central venous lines. In these three patients and our patient the left saphenous vein was used. Neurologic sequelae of paraplegia and urine retention were recorded in 25% (3/12) of patients. The mortality rate approached 42% (5/12) but only two patients were related to catheter misplacement. Although the complication rate is extremely low and difficult to recognize, catheter malposition into the ascending lumbar vein can lead to lethal complications.

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Introduction

Sick preterm infants often require total parenteral nutrition for prolonged periods of time because of extreme prematurity and feeding intolerance. In recent decades the silastic percutaneous central venous line (PCVL) has become commercially available. Shaw [1] was the first to describe PCVL use for parenteral nutrition in a neonate in 1973. Several types of complication have been reported. In this article, the misplacement of a PCVL inserted via the left saphenous vein in a premature newborn is described. It is believed that the catheter passed through the ascending lumbar vein and long-term hyperosmolar fluid infusion resulted in neurologic sequelae. This report highlights the need for personnel involved with the placement of PCVLs to be aware of such possibilities.

Case Report

The patient was a twin B male infant, 1178 gm, and 30-week gestation at birth, who was born to a 37-year-old female gravida 2, para 1, and artificial abortion 1. He was the result of in vitro fertilizaton and embryo transfer. Cesarean section was performed after tocolysis failed. Apgar scores were six and nine at 1 and 5 minutes, respectively. The infant was intubated later in the neonatal intensive care unit because of progressive respiratory distress. High-frequency ventilation and magnesium sulfate were used for persistent pulmonary hypertension. In addition, an imperforate anus was noted and colostomy was performed at 3 days. A large patent ductus arteriosus (PDA) was visualized with cardiac ultrasound at 6 days and IV indomethacin was administered for a total of nine doses. Follow-up cardiac ultrasound revealed closure of the PDA, but a large ventricular septal defect (VSD) was found, and therefore digoxin, lasix, and capoten were prescribed. Total parenteral nutrition was given via a PCVL inserted through the left saphenous vein at 4 days of age. The catheter was removed electively at 24 days because sepsis was suspected clinically. Another PCVL was inserted via the left saphenous vein at the lateral malleolus at 29 days. An abdominal radiograph, using 0.5 mL Urograffin injected through the catheter, was performed to confirm the position of the PCVL. The line was initially judged to be centrally placed in the inferior vena cava and the catheter tip was at the level of L4-L5 (Fig 1). Parenteral nutrition, including intrafat, was given through the PCVL. Unfortunately, mild fever, oxygen desaturation, and seizurelike movement were noted 4 days later. Consequently, a sepsis evaluation including lumbar puncture was performed. Cerebrospinal fluid examination revealed a milky appearance, 1 leukocyte per mm^3, and a high triglyceride level (2950 mg/dL). A cross-table lateral view abdominal radiograph indicated that the central line had deviated posteriorly at the intervertebral level of L5-S1 (Fig 2). The catheter was removed immediately but urine retention and progressively decreasing movement of the lower extremities resulting in paraplegia was noted 2 days after catheter removal. A VSD repair operation took place at 37 days because of

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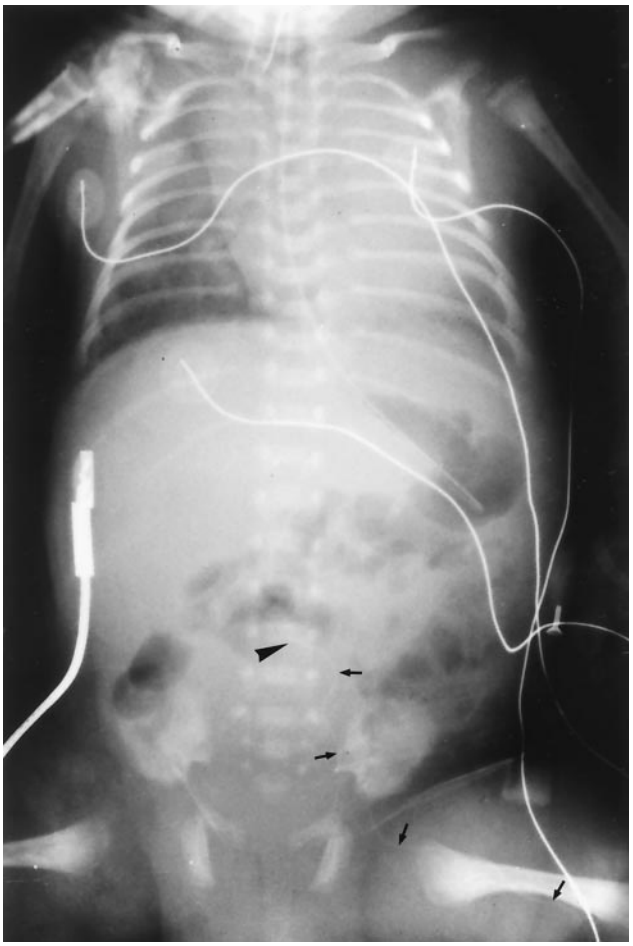

Figure 1. Anteroposterior view of abdominal radiography at 29 days of age. The path of PCVL (arrow) was judged to be placed in the inferior vena cava initially and the catheter tip (arrow head) was at the level of L4-L5.

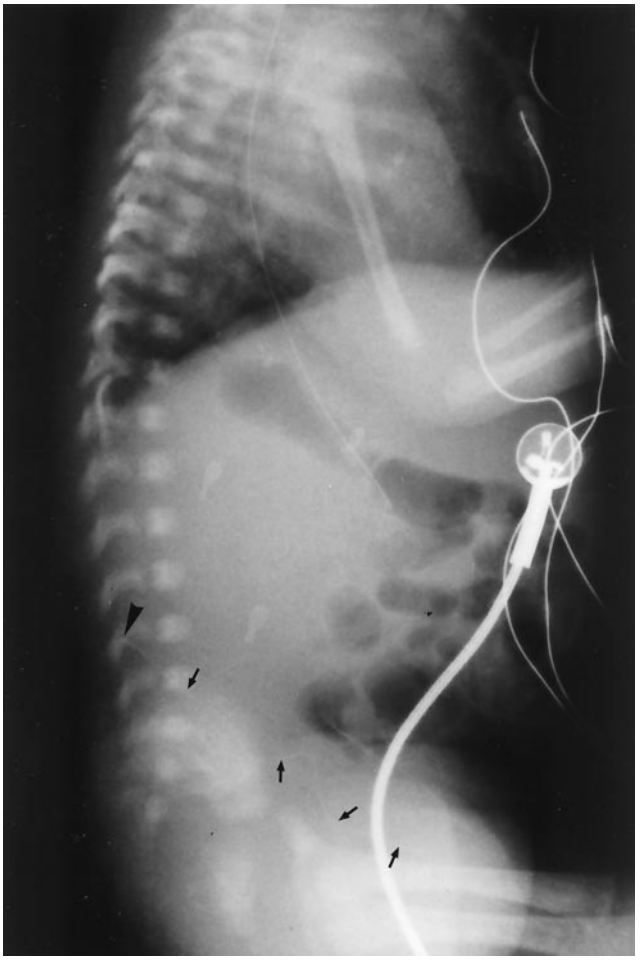

Figure 2. Cross-table lateral view of abdominal radiography at 33 days of age. It demonstrated the catheter deviated posteriorly at the level of L5-S1 with the catheter superimposed on the spinal column (arrow). The catheter tip (arrow head) seemed at the level of L4-L5 vertebral interspace and was presumed to enter the prevertebral venous plexus via ascending lumbar vein.

respiratory difficulties; however, the patient died during the operation. The neurologic sequelae, which included flaccid paraplegia and a neurogenic bladder, did not resolve before death.

Discussion

The PCVL is usually a safe and effective means for securing prolonged central venous access. Recent reviews of the literature document complication rates with PCVL with infectious etiologies at 4-9% and with mechanical difficulties (i.e., accidental dislodgment, occlusion, tethering, perforation or cardiac arrhythmia, extravasation, and misplacement) at 16-27% [2,3]. The complications correlated directly with duration of catheter stay and the size of the infant. Because the smaller diameter of the PCVL relative to central venous catheters, misplacement of the PCVL was rarely seen and was only presented in some case reports. The possible misplacement sites of PCVL insertion included ascending lumbar vein [4-9], subdural space [10], pulmonary artery or formation of a vasculopulmonary fistula [11], pericardial space [11], pleural space [12], and intraabdominal extravasation [13]. Other sites, such as inferior tributaries of the brachiocephalic veins or azygos veins and SVC coil [14], were a problem in central venous catheters with a large diameter.

The choice of insertion sites include upper extremities, scalp, and lower extremities, with veins in the arm preferred [2].

With the use of the lower extremity sites for PCVL placement, there is the possibility of entering the ascending lumbar vein, with potentially lethal complications. Because the ascending lumbar vein drains the vertebral venous plexus into the common iliac vein, the catheter can enter the epidural venous plexus via the ascending lumbar vein. This route was discovered in 1954 when accidental wedging of a catheter took place during infant cardiac catheterization [15]. Based on anatomic information, Miller et al. [15] used lumbar epidural venography to diagnose lumbar disk herniation by opacifying the epidural veins with contrast via femoral catheters. If the misplacement of the PCVL is not accurately and quickly recognized, infusion of fluid through the PCVL may result in venous stasis and pressure being transmitted to the spinal cord, with resultant neurologic sequelae. The pathogenesis of

Table 1. Summary of 12 cases of malposition of central venous lines

Case	Age	Weight (kg)	Venous Site	Catheter Type	CSF Contain	Neurologic Complications	Outcome	Reference
1	10 d/o	2.8	Lt saphenous	CVP	High sugar	Quadriplegia generalize seizure	Death, 10 days later	9
2	21 d/o	3.6	Lt saphenous	CVP	—	None	Full recovery	9
3	7 y/o	37	Lt femoral	CVP	—	—	Death, unrelated to catheter	9
4	5 y/o	16	Rt femoral	CVP	—	—	Death, unrelated to catheter	9
5	16 y/o	32	Rt femoral	CVP	—	None	Full recovery	9
6	30 d/o	2.6	Lt femoral	CVP	—	None	Full recovery	9
7	8 d/o	3.3	Lt saphenous	PCVL	Milky	None	Full recovery	10
8	12 d/o	3.2	Lt femoral	CVP	Milky	None	Full recovery	11
9	9 m/o	—	Lt saphenous	CVP	Milky	Cardiac arrest	Death, 9 days later	13
10	16 d/o	1.1	Lt saphenous	PCVL	Milky	None	Full recovery	8
11	3 d/o	1.1	Lt saphenous	PCVL	Nil	None	Full recovery	8
12	29 d/o	1.8	Lt saphenous	PCVL	Milky	Urine retension, paraplegia	Death, unrelated to catheter	*

* Present patient in our case.

Abbreviations:
— = Not mentioned
CVP = Central venous pressure lines
Lt = Left
PCVP = Percutaneously inserted central venous lines
Rt = Right

the neurologic sequelae may be due to hypertonic solution in the peripheral vasculature predisposing to vasculitis, perforation, and further damage or entry into the subarachnoid space, resulting in spinal cord injury, local mass effects, or inflammation and adhesion effects.

In the literature, only 11 other patients [4-9] with the same malposition have been reported (Table 1). Their ages range from 3 days to 7 years. Four of the 12 patients received PCVLs and others received traditional, larger diameter CVP. Of the 12 patients, the right femoral vein was used in two older children; in the others, the left femoral or saphenous vein was used. Five patients (42%) were found to have milky CSF. Two patients developed neurologic sequelae, including generalized seizure, paraplegia, urine retention, and quadriplegia. One patient (No. 9) suffered from a cardiac arrest before the misplaced catheter could be removed. Full recovery was observed in seven patients where the catheter was removed as soon as possible. The mortality rate was 42% (5/12), but only two were directly related to malpositioning of the catheter.

The following three warning signs were described by Lavandosky et al. [5] after the catheters were in place: (1) absence of blood with aspiration; (2) subtle lateral deviation of the catheter at the level of L4 and L5 on frontal abdominal radiographs; and (3) catheter path directly over the vertebral column rather than to the right of midline for an IVC catheter. In our experience an additional two key points should also be emphasized. If there are signs of acute respiratory distress, lethargy, seizure, neurologic deficits, or a markedly elevated level of protein, glucose, and lipid from a lumbar puncture specimen in an infant receiving central venous hyperalimentation, the position of the catheter should be confirmed immediately.

Finally, abdominal cross-table lateral radiographs are crucial. The interpretation of an anteroposterior radiograph of the abdomen assessing catheter position can be difficult. The findings associated with malposition of these catheters were subtle, especially for inexperienced clinicians. Stark et al. [14], in their evaluation of subclavian and jugular central venous catheters, recommended a lateral chest radiograph when catheter malposition was suggested by a traditional anteroposterior view or when catheter aspiration failed to produce blood. The lateral abdominal view radiograph also plays a role in identifying malposition of the ascending lumbar vein, demonstrating whether the catheter is anterior to the spinal column (in the IVC) or deviates posteriorly into an ascending vertebral vein and entered the prevertebral venous plexus.

Conclusion

Although the incidence of PCVL malposition is low, it can be lethal. To avoid complications associated with accidental cannulation of the ascending lumbar veins, the following five warning signs should be remembered: (1) loss of blood return on aspiration; (2) subtle lateral deviation, or "hump," of the catheter at the level of L4 and L5 on frontal abdominal radiographs; (3) a catheter path directly overlying the vertebral column rather to the right of midline as for a catheter in the inferior vena cava; (4) signs of unexplained acute respiratory distress, lethargy, seizure, or neurologic deficits; and (5) a markedly elevated level of protein, glucose, or lipid from a lumbar puncture specimen in infants receiving central venous hyperalimentation. A cross-table lateral radiograph is recommended whenever an abnormal catheter position is suspected clinically or from findings on the rountine frontal radiog-

raphy. Attention to these simple guidelines may prevent severe morbidity and possible mortality.

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