Double-Catheter Technique for the Proper Insertion of Umbilical Venous Catheters in Newborns

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Key Words

Umbilical vein · Double catheter · Newborn

Abstract

Objectives: To document the usefulness and safety of inserting a second umbilical venous catheter in ill neonates, while a previously misplaced first catheter was still in its place. **Subjects and Methods:** The case series involved 25 newborn babies who were admitted to the Neonatal Intensive Care Unit, Maternity Hospital, Kuwait, over a 3-year period from 1999 to 2002. The umbilical venous catheter of the babies was misplaced and diverted to the liver, necessitating insertion of a second catheter while the previous one was still in place. The characteristics of the babies and possible catheter-related complications were recorded. **Results:** Of the 25 babies, 19 had the second catheter properly placed in the right atrium, while in the remaining 6 neonates, the catheter was still misplaced. Misplacement occurred mostly in full-term babies or the catheter was inserted at a later stage. No life-threatening complication was observed during the procedure. **Conclusion:** Insertion of a second umbilical venous catheter with the misplaced first catheter in situ is a useful and safe procedure.

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Introduction

Central venous access is one of the necessary procedures in the care of newborn infants in the intensive care unit. Umbilical venous catheterization is used for central venous access in many neonatal intensive care units for various reasons. It is a simple procedure, has fewer complications than a central line inserted peripherally and does not require skin incision or a venous cut-down [1–3]. The ideal position of the umbilical venous catheter is in the right atrium, that can be confirmed on a plain X-ray of the abdomen with the tip of the catheter lying just above the diaphragm. However, it is not always done correctly, in some cases because the catheter gets diverted towards the portal veins away from the inferior vena cava. When this happens, complications may arise due to thrombosis and infection of the vein or the metabolic effects of the drugs given through this route on the liver [4, 5]. Pericardial effusion has also been reported as one of the complications [6, 7].

There have been 2 case reports and a case series with a limited number of patients have been reported in which a second umbilical venous catheter was successfully inserted while the misplaced first catheter was still in situ [8, 9], hence we decided to conduct a study involving a larger series of patients to confirm the usefulness of the procedure.

Fig. 1. Umbilical venous catheters. A = First catheter; B = second catheter; C = umbilical artery.

Subjects and Methods

Of approximately 300 newborn admissions per year to the Neonatal Intensive Care Unit, Maternity Hospital, Kuwait, 225 required umbilical venous catheterization mostly for blood sampling and then as a central venous access. We followed consecutively those infants who required catheterization immediately after the procedure with X-rays of the chest and abdomen. 17 infants had respiratory distress syndrome, three had persistent pulmonary hypertension of the newborn, one had pneumonia, one had pulmonary hypoplasia, one hypoxic-ischemic encephalopathy, one congenital heart disease and one epidermolysis bullosa. The proper insertion of the catheter was achieved by using the formula developed by Shukla and Ferrara [10], aiming the tip of the catheter in the right atrium, i.e. just above the diaphragm as seen on the X-rays. The size of the catheters used were either F 3.5 or F 5 depend-

Table 1. Characteristics and data on the procedure in the study patients

No.	Sex	Birth weight g	Gestational age weeks	Age (h) of catheterization	Result
1	male	500	25	< 12	success
2	female	730	25	< 12	success
3	male	750	29	< 12	success
4	male	800	27	< 12	success
5	female	810	26	< 12	success
6	male	930	27	< 12	success
7	female	1,011	28	< 12	success
8	female	1,050	29	< 24	success
9	male	1,150	31	< 12	failure
10	female	1,300	32	< 12	success
11	female	1,320	34	< 12	success
12	female	1,484	36	< 12	success
13	female	1,495	32	< 24	success
14	male	1,850	35	< 12	success
15	male	1,900	36	< 12	success
16	male	1,910	36	< 24	success
17	male	2,000	35	< 24	success
18	male	2,240	35	< 12	success
19	male	2,400	44	< 24	failure
20	female	2,450	38	< 12	failure
21	male	3,105	40	> 72	failure
22	male	3,500	40	> 96	failure
23	male	3,800	40	< 24	failure
24	male	3,950	38	< 24	success
25	female	3,950	40	< 24	success

ing on the size of the baby. In those babies where the catheter was diverted towards the portal vein, a second catheter of the same size was introduced within 1 h while the misplaced one was still in its original position. A second set of X-rays was taken to confirm the position of the second catheter. If the second catheter was in the right atrium, the first catheter was pulled out and the procedure was declared as a success, otherwise a failure.

During a 3-year period (1999–2002), 25 newborn babies were involved in this study. The following data were collected: sex, gestational age, birth weight, diagnosis, indications for catheterization, the insertion length of both catheters and the ease of insertion as recorded by the neonatal staff. Blockage of the catheter lumen was documented by Doppler ultrasonography. All catheter tips were sent for culture at the time of removal to document any sepsis.

Results

The characteristics of the infants are shown in table 1. Nineteen babies (76%) had a second catheter successfully inserted in the right atrium within the first day of life. There were 6 failures, 5 full-term babies and 1 preterm, 2 of whom had catheterization on the fourth and fifth days (patients 21 and 22) of life and the remaining 4 were

Fig. 2. Umbilical venous catheters. D = First catheter; E = second catheter.

still in the first and second days of life (table 1). Of the 6 failures, 5 of 15 (33.3%) were male and 1 of 10 (10%) female. *Candida* species was isolated from the tip of the second catheter in only 1 baby (patient 4) and no other catheter-related complication was recorded. There were no complications of necrotizing enterocolitis or pericardial effusion encountered.

Discussion

Umbilical venous catheterization is a common procedure in a neonatal unit. It is easy to perform but failures are also frequently seen. A major problem with the technique is the misdirection of the catheter into the portal system, where it could be hazardous. Success is achieved when the catheter is placed in the right atrium, and has been able to bring down the failure rate following the rec-

ommendations of Shukla and Ferrara [10] for this procedure, from 12.6 to 4.6%.

In this study we have shown the usefulness and safety of employing the 'double-catheter' technique when a misplaced catheter is encountered. Other investigators have reported similar successes. Davies et al. [8] attributed their success to the assumption that the first catheter had blocked the route towards the portal vein thereby allowing the second catheter an easier access to the right atrium. Schreiber et al. [11] described success with a similar technique in catheterizing the umbilical arteries when they were misdirected towards the internal iliac arteries. In the 2 cases of late catheterization, we assumed that the failure was likely due to the fact that the ductus venosus was closed by the time catheterisation was attempted. However, Loberant et al. [12] and Fugelseth [13] in two separate studies have shown that the ductus remains patent in almost all healthy full-term infants at 48 h of age and in around 75% of them at the age of 7 days. The chances for success seem better in preterm infants than in term as seen in some of our failure cases mostly in full-term babies. This could be partly explained by the fact that term babies have more muscular ductus venosus than preterm, thereby encouraging an early closure. Additionally, our term infants were sicker than the preterm. We have no explanation for the preponderance of the male infants who failed the procedure except that they were mostly full-term babies.

In our study, the actual length of the second catheter inserted was sometimes different from the calculated length based on the Shukla and Ferrara [10] recommendation because of the resistance caused by the first catheter or the need to get adequate free back flow from the second catheter.

In the Neonatal Intensive Care Unit of our hospital, blood sampling was one of the major indications for umbilical venous catheterization because the umbilical artery catheter could not be fixed or had to be removed because of complication. In addition, unfortunately, we do not have phlebotomists and nurses are understaffed. Blood sampling was especially frequent in those patients, and sampling via a properly placed umbilical venous catheter was believed to decrease exposure to prolonged manipulation and pain.

Conclusion

Insertion of a second umbilical venous catheter while the misplaced first catheter was in situ was performed safely in most neonates.

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