

Portal venous gas resulting from umbilical vein catheterization in a very-low-birth-weight infant with no interruption in early feeding

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ABSTRACT

Introduction: Portal venous gas (PVG) is common in necrotizing enterocolitis and occasionally occurs in neonates after umbilical vein catheterization (UVC). Therefore, determining the cause of PVG requires further clinical evaluation in these cases.

Case presentation: We report the case of a very-low-birth-weight infant who underwent UVC after birth. PVG was an unexpected finding on ultrasound following catheterization. The UVC was immediately removed and replaced with a peripherally inserted central catheter. The infant's physical examination was unremarkable. Bedside X-ray revealed neither PVG nor pneumatosis intestinalis, which would indicate the onset of necrotizing enterocolitis. After full evaluation, breastfeeding was started on the same day. The infant did not develop feeding intolerance, necrotizing enterocolitis, or other disorders.

Conclusion: PVG occasionally occurs in neonates who undergo UVC and is considered to be caused by exogenous gases. PVG is more easily detected with ultrasound than with X-ray and does not affect early feeding in premature infants.

KEYWORDS

Portal venous gas, Very low birth weight, Umbilical vein catheterization, Early feeding

INTRODUCTION

Very-low-birth-weight (VLBW) infants are special among neonates, with high treatment needs and high mortality.^{1,2} VLBW infants also have high nutritional requirements to match postnatal growth during hospitalization.³ With advances in enteral nutrition, umbilical vein catheterization (UVC) has become a common channel for nutrition and fluid delivery in the early postnatal period. Typically, UVC can be used for 7 to 10 days after birth. For VLBW infants without severe complications, it is reasonable to increase feeding to total enteral nutrition during this period. In this

paper, we report a case of portal venous gas (PVG) that was detected on ultrasound after early postpartum UVC in a VLBW infant, raising concern about necrotizing enterocolitis (NEC). After careful examination, the infant's feeding continued without interruption or gastrointestinal complications, such as feeding intolerance or NEC.

CASE REPORT

Twin boys weighing 1.21 kg and 1.20 kg were born at 28 weeks, 1 day of gestation by vaginal delivery after premature rupture of membranes 17 hours earlier. Delivery

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was unremarkable and both twins had Apgar scores of 8, 9, and 9 at 1, 5, and 10 minutes, respectively. Because of the need for noninvasive ventilation on the radiant warmer after birth, neither twin received placental transfusion, either by delayed cord clamping or umbilical cord milking. Their 40-year-old mother had become pregnant by *in vitro* fertilization after diagnosis of tubal obstruction 10 years earlier, for which she had undergone laparoscopic surgery. Before delivery, she received a full course of antenatal steroids.

The 1.21-kg infant was admitted to the neonatal ward of our hospital on noninvasive ventilatory support. Preliminary physical examination revealed polydactyly in the right hand. Blood gas analysis and peripheral blood glucose were normal. Catheter insertion into the umbilical vein (6-cm, 3.5-F OMBILICATH; PRODIMED, Le Plessis-Bouchard, France) was performed in the second hour after birth and the procedure took 30 minutes. Before catheter use, ultrasound examination (S12-4, 4–12 MHz, CX50 system; PHILIPS Healthcare, Bothell, WA) was performed to locate the tip of the catheter. In confirming that the catheter tip was in the inferior vena cava close to the right atrium, PVG was noticed and quickly confirmed by a second sonographer. Multiple non-shaded hyperechoic foci were seen in the liver, as shown in Figure 1. The infant's brother was also catheterized through the umbilical vein, with the catheter tip located in the inferior vena cava approximately 0.5 to 1.0 cm below the septum. The brother's ultrasound did not reveal evidence of PVG.



FIGURE 1 Ultrasound image of portal venous gas after umbilical vein catheterization insertion in the very-low-birth-weight infant. Multiple hyperechoic spots are seen in the liver.

Because it is an invasive procedure, UVC does have complications; however, this is the first time in our department that PVG was detected with ultrasound after UVC insertion. PVG in neonates is usually associated with NEC. Because of concern about the possibility of NEC, we immediately removed the UVC and replaced it with a peripherally inserted central catheter, followed immediately by routine blood testing and X-ray examination. As shown in Figure 2, no evidence of PVG was found on X-ray, the intestine was well inflated,

and there were no other signs indicating NEC, such as intestinal obstruction or intestinal pneumatosis. Similarly, routine blood and liver function tests were normal, and no red or white blood cells were found in the first stool. Blood culture obtained from UVC was negative after 2 days.

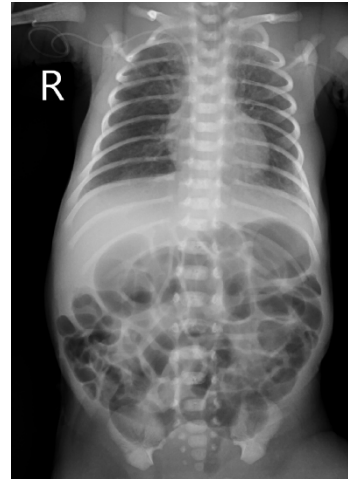


FIGURE 2 Abdominal X-ray taken after replacement of umbilical vein catheterization with peripherally inserted central catheter in the very-low-birth-weight infant. No portal venous gas is seen on X-ray, and the intestine is well inflated.

After careful evaluation and discussion, we excluded the possibility of NEC. Although PVG was present, the intestinal wall remained structurally and functionally intact, and the cause of the PVG was likely UVC. Breastfeeding of the infant began 10 hours after birth; breast milk fortifier was added 8 days later to achieve total enteral nutrition on day 11, followed by removal of the peripherally inserted central catheter on day 12. The infant was in good condition before discharge.

DISCUSSION

UVC is a common pathway for nutrition in early neonates, especially in VLBW infants with high demands for nutrients and homeostasis. In the early postpartum period, the umbilical vein remains open, and UVC can easily reach the right atrium via the inferior vena cava. According to our protocol, UVC can generally be used for 7 to 10 days, and up to 14 days if necessary. UVC greatly reduces the care workload and the risk of infection. Although UVC has many advantages, it also has some complications. Levit et al⁴ reported that 269 of 2017 patients (13.3%) receiving UVC in a level IV NICU over 11-year period experienced complications. Most UVC-associated complications (86.2%) were location problems. In the study of UVC-related complications in a neonatal ward in Singapore, one-third of UVC ($n = 33$) were inappropriately positioned, and 16 infants (14.8%) developed catheter-related infection.⁵ UVC can sometimes cause serious complications, such as pericardial

tamponade and arrhythmias.^{6,7}

UVC catheterization can also cause liver-related complications. Grizelj et al⁸ reported that nine of 1081 neonates were diagnosed with severe liver injury resulting from inappropriate placement of the UVC in the hepatic circulation. The incidence of liver complications associated with UVC may actually be much higher than the report. Derinkuyu et al⁹ reported 244 neonates with UVC were evaluated with ultrasound; 49 (20.1%) of these infants had PVG without evidence to support the diagnosis of NEC. Previous studies have reported that X-ray is less sensitive than ultrasound for detecting PVG; this lower sensitivity may explain the relatively low incidence of PVG in some studies.

Traditionally, X-ray has been used to detect PVG, but in recent years, the advantages of ultrasound in detecting PVG have been widely recognized.^{10,11} In the past, it was thought that PVG was most commonly caused by NEC, which is a multifactorial disease. The pathogenesis of NEC includes abnormal intestinal epithelial permeability and infection. The increase in intestinal wall permeability in patients with NEC allows gas to diffuse into the portal vein system¹²; the gas produced by microorganisms can also directly penetrate the wall and enter the portal vein.¹³ Diagnosis of NEC was mainly based on X-ray findings in the past. Given the advantages of ultrasound, we need to re-evaluate PVG as a finding. In the study of Grizelj et al,⁸ the incidence of PVG was relatively high when ultrasound was applied during UVC implantation.

Intestinal structure and function in VLBW infants are far from mature. Delaying or slowing down the feeding process without clear reasons to do so may lead to atrophy of the intestinal wall structure and impaired function, thereby increasing the incidence of late-onset sepsis, NEC, and other diseases.¹⁴ NEC is a very serious complication, mainly occurring in preterm infants, with important effects on survival and neurological prognosis, especially in VLBW infants.¹⁵⁻¹⁸ Early feeding is not only needed for growth and development, but also to improve the prognosis of VLBW infants.

To our knowledge, this is the first report of uninterrupted feeding after detection of PVG in a neonate. PVG was an incidental finding on ultrasound in our patient; NEC was quickly excluded after comprehensive evaluation. Our discussion focused on feeding plans. We decided to start breastfeeding as soon as possible because PVG most likely originated from the UVC process rather than from changes in intestinal wall permeability, and other tests did not support the diagnosis of NEC. After this minor setback, the baby quickly increased his feeding volume and NEC did not occur. Our case raises another question, which is whether to feed if the UVC is not removed. According to relevant studies, feeding may be a problem in such cases.

CONSENT FOR PUBLICATION

Consent was obtained from the patient's guardians.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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