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## Complications of umbilical vein catheterisation. Case Report

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### Summary

**Background:**

Umbilical vein catheterization is a relatively easy procedure performed routinely on the neonate intensive care units. It provides a fast central vein access, but some complications have been described in the literature.

**Case Reports:**

We presented a case report of a premature infant (34 hbd) with extravasation of the parenteral nutrition and drugs to the liver after umbilical vein catheterization. Fever and increasing biochemical markers of infection were observed. USG revealed a heterogenic, well-limited space of 4 cm in diameter, located in the right lobe of the liver. CT excluded liver abscess. Considering neoplastic process or incorrect location of the catheter of the central vein, we performed liver biopsy.

**Results:**

Cytological and biochemical analysis of the aspirated fluid revealed extravasation of parenteral nutrition to the liver.

Our case confirms the necessity of controlling a proper location of the central catheter right after its insertion and during hospitalization.

**Key words:**

umbilical catheterization • newborn • extravasation to the liver

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### Background

Catheters introduced to central veins are a standard component of neonate intensive care. Catheterization of the umbilical vein is one of the fastest and easiest methods of gaining access to a deep vein. The advantages of central vein catheters in comparison to peripheral vein cannulas in neonates are commonly known and include: a possibility of a total parenteral nutrition, safe administration of many drugs, and elimination of stress and pain connected with repeated puncture of peripheral veins. Unfortunately, central vein catheterizations are also connected with a risk of multiple complications, the number of which increases with an incorrect placement of the tip of the cannula. Some of the complications are not connected with the type of cannula or vascular access. However, some of them, due to a specific anatomy (as in case of umbilical veins) are typical

only for a given vessel or type of cannula. The complications of umbilical vein catheterization may include: blood-borne catheter-related general infection, air embolism, a substantial blood loss during catheterization or due to detachment of the cannula, thromboembolic complications, heart tamponade, disorders of the heart rhythm, pericardial or pleural effusion [1-3]. In case of improper insertion of the catheter to the portal vein, there may appear thrombosis of hepatic vessels, necrotizing enterocolitis, perforation of the intestines, portal hypertension, or liver cyst. Infusion of hypertonic fluids into the liver tissue may lead to a substantial damage of the liver parenchyma or its necrosis [1,4].

We would like to present a case in which wide diagnostics and cooperation of many specialists were required. The newborn was finally diagnosed with a complication of

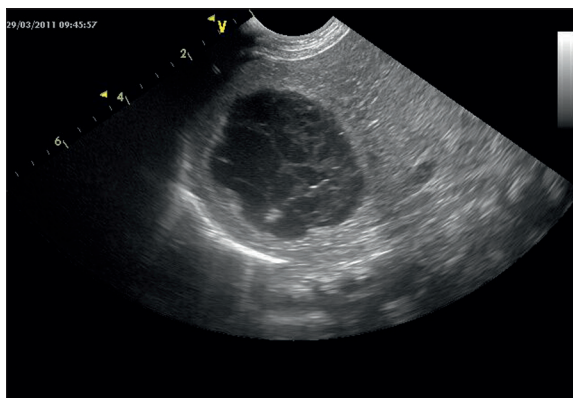
umbilical vein catheterization, i.e. extravasation of large volumes of the nutritional fluid into liver parenchyma, due to an incorrect location of the catheter.

## Case Report

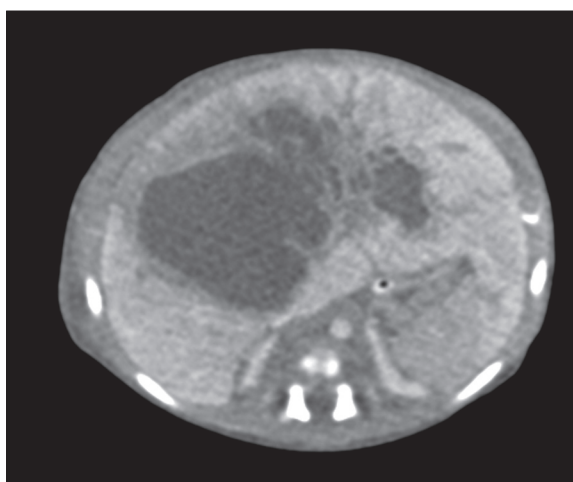
A newborn, AK, (patient file No. 004884/11), female sex, from the third gravida at risk (bleeding from the genital tract; the mother received a complete course of steroid therapy), the second birth at 34 weeks with cesarean section due to a premature detachment of the placenta and bleeding from the genital tract, imminent intrauterine asphyxia, premature outflow of the amniotic fluid, and status post cesarean section, with a birth mass of 2800 g, who received 8-4-8-8 points in Apgar scale. After birth, the newborn initiated spontaneous respirations. Transient respiratory disorders were observed. X-ray of the chest showed inflammatory lesions. Due to increased biochemical markers of infection in laboratory tests, empirical antibiotic therapy was introduced (ampicillin, netilmicin). On the third day of life, patient's general condition deteriorated. There appeared tenderness, anxiety, disorders of peripheral perfusion,  $\text{SaO}_2$  decreases, increased oxygen supply, and mixed acidosis in laboratory tests. A follow-up chest X-ray revealed a progression of inflammatory lesions. Due to increasing respiratory insufficiency, mechanical ventilation was introduced. A thick pus was aspirated from the tracheal tube. A central cannula was introduced through the umbilical vein. Patient's files did not contain information whether the placement of the catheter was controlled. Drugs and parenteral nutrition were given through the catheter. At the end of day four, the newborn developed fever. Blood culture collected on the first day remained sterile. On the following days, the fever was still present and blood biochemical markers of infection were increasing. Antibiotics were changed for vancomycin and meropenem. Immunoglobulins were administered as adjunctive treatment. Trophic feeding with mother's milk was introduced, with a good tolerance. Total parenteral nutrition through a cannula in the umbilical vein was used. A subsequent blood culture showed an increase in the level of methicillin-resistant *Staphylococcus haemolyticus*. The patient required a single supplementary transfusion.

On day 9, the abdominal circumference increased, with abdominal distention and liver enlargement. No gas escaped after the rectal tube was introduced. Enteral nutrition was withheld and the catheter was removed from the umbilical vein due to dripping of the fluid. After the cannula was withdrawn, there started relatively profuse oozing of a milky fluid from the umbilical vein. Due to a persistent distension and abdominal rigidity, an abdominal US was performed. It revealed areas with polycyclic outlines, hyperechoic peripheral parts and fluid content, in both lobes. The largest fluid collection was  $4.7 \times 2.6$  cm in size. There was a trace amount of fluid in the abdominal cavity. Other structures were normal. Abscesses of the liver were suggested and the newborn was transferred to the Clinic of Neonatology, Neonatal Pathology and Intensive Care, at Children's Memorial Health Institute.

On admission, the general condition of the patient was severe. The newborn was ventilated mechanically. Vital



**Figure 1.** Ultrasound image of the liver on the day of admission to the Clinic (9<sup>th</sup> day of life).



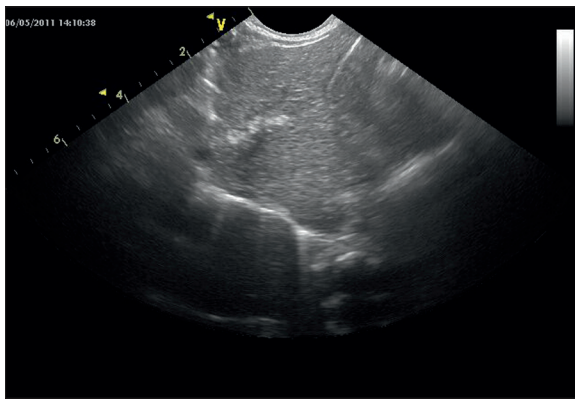
**Figure 2.** CT image of the lesion in the liver on day 9 of life.

signs were normal. The physical examination showed the following abnormalities: pallor, liver palpable 3 centimeters below the costal margin, distended, rigid abdomen, weak bowel movements.

Laboratory tests performed on admission showed extremely increased markers of infection (leukocytosis of  $38.7 \times 10^3$ , granulocyte smear including metamyelocytes, platelet count of  $159 \times 10^3$ , CRP of 14.78 ( $N < 0.5$ )), a slightly increased level of aminotransferases: AST of 58 U/L, and ALT of 82 U/L. Other parameters within the normal range. Cerebrospinal meningitis was excluded – a normal result of a general examination of the cerebrospinal fluid. CSF culture was sterile. In order to differentiate the lesions from hepatoblastoma, AFP ( $\alpha$ -fetoprotein) was determined, which turned out to be increased but within normal ranges for age.

Detailed diagnostics of hepatic lesions was carried out. Abdominal US showed a well-limited, irregular hypoechoic area with inhomogeneous echogenicity, measuring  $4 \times 4.1 \times 4$  cm, located in the central part, in the right lobe mainly. Moreover, hyperechoic irregular structures with hypoechoic centers were detected in the vicinity (Figure 1).

Due to an equivocal US image, CT of the liver with vascular mode was carried out. The examination showed irregular



**Figure 3.** Ultrasound image of the liver at the age of 1.5 months.

fluid collections in the central part of the liver. The largest one was 4.6×3.7×4 cm in size. No enhancement was found after contrast administration. There was also fluid in the peritoneal cavity (Figure 2).

A case management conference was held. It included a radiologist, surgeon, oncologist, and neonatologist. Clinical and radiological picture was suggestive of a iatrogenic complication of parenteral nutrition through cannula in the umbilical vein, in the form of fluid extravasation to the liver. To confirm the diagnosis and exclude a potential neoplasm or abscess, it was decided to carry out a biopsy of the lesion in the liver. On the third day of hospitalization, the surgeon performed an US-guided core needle biopsy in the central part of the liver. A volume of 15 ml of a yellow milky fluid was collected. Cytological and biochemical analysis of the fluid confirmed parenteral nutrition extravasation to the liver.

In the course of hospitalization, antibiotic therapy with vancomycin and meropenem was continued, leading to a gradual improvement in patient's health state and decrease in blood infection parameters. Antibacterial treatment was used for 3 weeks in total. All microbiological samples collected during hospital stay were sterile. For 4 days of hospitalization, the patient required mechanical ventilation and parenteral nutrition through a central cannula inserted into the femoral vein (due to symptoms of paralytic obstruction of the GI tract). From the 5<sup>th</sup> day on, the patient was breathing on her own and enteral nutrition was started using mother's milk. The general health state of the newborn was gradually improving.

Follow-up US examinations of the abdomen showed a slow reduction in the size of abnormal fluid collections in the liver. The AFP level in subsequent examinations was decreasing. The patient was discharged in the third week of life, in a good general health state, breastfed on demand, and with indications for further outpatient treatment at Surgery Clinic and Clinic of Liver Diseases at Children's Memorial Health Institute. At present, the patient is 4 months old and remains under outpatient care. She develops normally, is breastfed on demand and is gaining on weight very well. Follow-up US examinations of the liver showed a significant regression of the described lesions (Figure 3).

## Discussion

Cannulation of central veins is a common procedure at Neonate Intensive Care Units. One of the most frequently used vascular accesses, especially on the first day of life, is the umbilical vein. Cannulation of the umbilical vein is considered to be relatively simple. The procedure is short and does not require general anesthesia [1,2]. The tip of the cannula should be placed in the inferior vena cava, over the diaphragm (Th 12). After catheterization, the position of the cannula should be assessed with radiological examinations of the abdomen and chest. Depending on the type of the catheter used, it may be necessary to administer a contrast agent to the catheter [1].

A disadvantage of this method is the possibility of an incorrect placement of the catheter, which may lead to a much higher number of complications, including pericardial tamponade, hydrothorax, and thromboembolic complications. When being introduced, the catheter frequently moves towards the liver, through the portal vein. This is when it should be removed immediately [1,2,3,5,6]. Leaving it in a hepatic vessel (usually due to ignorance of its incorrect location) results in many serious complications that may put the newborn's life at risk. The most common are the thromboembolic complications which may lead to portal hypertension. A direct administration of concentrated infusion fluids, drugs or parenteral nutrition to liver parenchyma may in turn result in a damage of liver parenchyma due to a direct chemical irritation of the parenchyma and, to a lower extent, in a compression of normal tissues by extravasated fluid [4,7]. Patient's history (dripping of the alimentation fluid from the umbilical vein after removal of the cannula), as well as radiological and clinical picture suggested that this complication was responsible for a substantial worsening of patient's condition and appearance of lesions in the liver.

Differential diagnosis included liver abscesses in the course of a generalized infection, hamartoma of the liver, and, the least possible, hepatoblastoma. The last diagnosis was rejected after CT examination and AFP test performed twice. In newborns and infants, the level of AFP is always increased, but tends to decrease over follow-up time [8]. It should be remembered that nonspecific diseases of the liver, accompanied by the damage of the hepatic tissue, may lead to an increase in AFP levels, however not as pronounced as in hepatoblastomas. Hamartomas of the liver are more common than hepatoblastomas. These are non-neoplastic tumours, being most probably a developmental abnormality of unknown etiology, connected with proliferation of the mesenchymal tissue. Their diagnosis is usually based on imaging examinations (CT and US). The tumors are of mixed solid and cystic type [9]. In case of the presented patient, the radiologist, after performing CT, took this diagnosis into consideration. However, it was excluded after biopsy of the lesion.

Liver abscesses are a very rare complication of a generalized infection in the neonatal period. They were diagnosed in children with generalized infection and an incorrectly placed cannula in the umbilical vein [10–12]. In a patient with fever, rapidly increasing markers of infection, and

abdominal manifestations, such a diagnosis was possible. Abdominal CT allowed an exclusion of liver abscesses. After the biopsy of the lesion, a final diagnosis was established, i.e. extravasation of the parenteral nutrition and drugs to liver parenchyma. The presented case shows how dangerous may be the incorrect placement of the central catheter tip. There was no information on whether the catheter was misintroduced during cannulation or displaced in the course of nursing care, due to its poor fixation [13].

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## Conclusions

- For a safe administration of drugs and parenteral nutrition, it is necessary to check on the location of the catheter tip after its insertion.
- The catheter should be carefully secured on the skin, in order to avoid its coming out or displacement.
- In case of any concerning symptoms, especially after a thromboembolic incident or abdominal manifestations, the catheter should be removed as fast as possible.