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Case Study

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# PORTAL VEIN THROMBOSIS IN NEONATES AFTER EXCHANGE TRANSFUSION: A CASE SERIES

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**ABSTRACT**

Portal vein thrombosis, characterized by the narrowing or blockage of the portal vein by a blood clot, primarily associated with sepsis, omphalitis, exchange transfusion and presence of umbilical venous catheter.

**KEYWORDS:** Portal vein thrombosis, exchange transfusion, LMWH, Neonate, Sepsis, Hyperbilirubinemia, Umbilical catheterisation.

## INTRODUCTION

Neonatal portal vein thrombosis (PVT) has been described as a rare occurrence, however it is becoming more widely known. Estimates range from one per 100,000 live births[1] to 36 per 1000 neonatal critical care unit hospitalizations.[2] Because portal venous thrombosis rarely presents clinical symptoms in the neonatal period, the majority of cases were previously undiagnosed and discovered later in childhood.[3,4]

The etiology of neonatal PVT is different from that in children and adults. In adults PVT is most frequently secondary to cirrhosis.[5] In older children, PVT is related to liver transplantation, intra-abdominal sepsis, splenectomy, sickle cell anemia, and antiphospholipid antibodies.[5-9] In 50% of children with PVT, an underlying etiology is not identified.[7,10] PVT in neonates commonly occurs secondary to the placement of an umbilical vein catheter (UVC), with or without infection.[11]

The transition from fetal to neonatal life results in significant alterations in hepatic vascular architecture. As blood flow from the umbilical vein to the portal vein terminates, the portal vein assumes its adult role of transporting nutrients and toxins from the stomach and intestine to the liver for processing in hepatic capillary-like vascular sinusoids. In adults, the portal vein provides 70-75% of hepatic blood flow and 50-55% of oxygen requirements. For the first week of life, neonates can gain central venous access through their umbilical vein. The umbilical vein connects to the left portal vein in the liver. The umbilical vein and the ductus venosus form a direct channel that bypasses the liver and connects to the inferior vena cava. The umbilicoportal confluence is the point at which the umbilical vein meets the ductus venosus and crosses the portal vein.[12] There are several mechanisms by which umbilical venous catheters may cause thrombosis; including damage to vessel walls, disrupted blood flow, the infusion of substances such as total parenteral nutrition that damage endothelial cells, and thrombogenic catheter materials.[13]

Autopsy studies have estimated the incidence of umbilical venous catheter-related thrombosis at 20-40% of neonates who die with an umbilical venous catheter in place.[14-15] Some more prospective studies of umbilical venous catheters have also reported that properly inserted catheters are not associated with PVT, with no reported incidences of PVT, when ultrasound imaging was completed weeks to years after the umbilical venous catheter placement.[16,17]

Catheter-related characteristics like as size, duration of installation, and location all influence the incidence of line-associated thrombosis. In Schwartz et al.'s study there was control of a smaller (uniformly 3.0 F) catheter, with respect to catheter position, so that it was not allowed to terminate in the liver,[11] potentially contributing to a lower incidence than studies reporting on all patients with umbilical venous catheters. Prolonged catheterization and transfusion via the catheter were strongly linked with PVT. Neonates with catheter implantation in the portal vein had the highest rate of thrombosis (five out of eight, 63%), with the umbilicoportal confluence (the Rex space) being the primary site of thrombosis.[12]

With the exception of portal vein placement, the specific location of the umbilical venous catheter does not appear to be significantly associated with venous thrombosis. Furthermore, mechanical damage to the endothelium and

impaired blood flow caused by the catheter passing through the umbilical portal fusion, which serves as the initial thrombotic insult, may influence the incidence of thrombosis. In Kim et al.'s study, there was no statistically significant variation in PVT rates associated with catheter position. In contrast to low placement, which had a thrombosis rate of 4/15 (27%), high placement actually had a higher rate of 27/68 (42%).[12] The lone PVT baby in the Schwartz et al. study had an umbilical vein catheter that ended in the right atrium.[11] In the study by Morag et al., the umbilical venous catheter was positioned in a high flow position that was appropriate for 45% of the infants with PVT.[2]

## CASE SERIES

A case series of neonates with portal vein thrombosis in Indira Gandhi medical college Shimla during the year 2022, neonate admitted into neonatal intensive care unit (NICU) of a tertiary care teaching hospital in northern India with sepsis and exchange transfusion. The hospital records of all patients who had portal vein thrombosis were reviewed.

Table 1 shows the clinical profile of patient and risk factor for portal vein thrombosis.

Table 2 shows the laboratory findings, treatment and outcome of all the patient. Out of the 4 cases 3 were female and 1 male with median gestational weeks of 38weeks 1day, with mean birth weight of 2515 grams. The mean age in days at the time of presentation was 6 days, all being referred from other periphery hospital post exchange transfusion. All patient had history of umbilical catheterisation and the mean duration of catheter in situ was 51 hours. The cases underwent umbilical catheterisation for exchange transfusion due to hyperbilirubinemia out of which 1 cases develop sepsis post exchange transfusion. The location of catheter placement insitu is not known as patient where referred from other periphery hospital where modalities and expertise were not available.

### Clinical Characteristics, Laboratory Findings, Treatment, and Outcome

**Table 1: Clinical Characteristics and risk factor.**

| | Case 1 | Case 2 | Case 3 | Case 4 |
|---|---|---|---|---|
| Gestational week of birth | 37weeks 5days | 38weeks 2days | 36weeks 3days | 39weeks |
| Birth weight in grams | 2600 | 3000 | 2400 | 2060 |
| Age of presentation in days | 5 | 7 | 10 | 5 |
| Mode of delivery | Vaginal delivery | Caesarean section | Vaginal delivery | Vaginal delivery |
| Gender | Male | Female | Female | Female |
| PVT risk factor | Umbilical catheterization | Umbilical catheterization | Umbilical catheterization | Umbilical catheterization, sepsis |
| Exchange transfusion due to | Hyperbilirubinemia (Rh negative) | Hyperbilirubinemia (Rh negative) | Hyperbilirubinemia (Rh negative) | Hyperbilirubinemia (Rh negative) |
| Duration of catheter in situ in hours | 48 | 36 | 48 | 72 |

All patients were started on empirical intravenous antibiotics and investigation was done to rule out sepsis and meningitis. Out of the 4 cases 1 patient had sepsis without meningitis and was given 14 days' course of intravenous antibiotics, not patient had evidence of meningitis. Ultrasound Doppler was done to confirm and localise the site of thrombus. There was thrombus in the left portal vein in 2 patients and the other 2 patient developed portal cavernoma without extension to inferior vena cava with multiple periportal collateral formation. All patients were started on Low molecular weight heparin(LMWH) @ 1.5mg/kg/dose for a period of 4 weeks with regular follow up and close monitoring of INR. During the follow up period, 2 patients go completely resolve and the other 2 patients with portal cavernoma have partial resolution.

**Table 2: Investigation and treatment outcome.**

| | Case 1 | Case 2 | Case 3 | Case 4 |
|---|---|---|---|---|
| HEMOGLOBIN(GM/DL) | 14.1 | 14.5 | 11.9 | 12 |
| TOTAL LEUKOCYTE ($MM^3$) | 12320 | 11100 | 9870 | 21200 |
| PLATELET COUNT($MM^3$) | 180000 | 321000 | 175400 | 142700 |
| ESR (MM/HOUR) | 15 | 10 | 22 | 18 |
| CRP (MG/DL) | 21 | 5 | 16 | 72 |
| ALT/AST | 25/40 | 51/32 | 19/26 | 44/94 |

| | | | | |
|---|---|---|---|---|
| TOTAL SERUM BILIRUBIN/ DIRECT BILIRUBIN | 4.2/0.5 | 7.8/0.36 | 10.2/.93 | 9.47/0.84 |
| SERUM CREATININE | 0.55 | 0.50 | 0.61 | 0.72 |
| PLASMA FACTOR LEVEL | Not done | Not done | Not done | Not done |
| BLOOD CULTURE | Sterile | Sterile | Sterile | Sterile |
| SITE OF THROMBUS | Left portal vein | Main portal vein with extension into left and right portal vein without extension to inferior vena cava | Left portal vein | Main portal vein with extension into left and right portal vein without extension to inferior vena cava |
| TREATMENT | | | | |
| ANTITHROMBOLITIC TREATMENT, dose, DURATION | Yes, LMWH @ 1.5 mg/kg/dose 4weeks | Yes, LMWH @ 1.5 mg/kg/dose 4weeks | Yes, LMWH @ 1.5 mg/kg/dose 4weeks | Yes, LMWH @ 1.5 mg/kg/dose 4weeks |
| DURATION OF ANTIBIOTICS, NAME | 7 days, Ampicillin, 5 days Gentamicin | 7 days, Ampicillin, 5 days Gentamicin | 7 days, Ampicillin, 5 days Gentamicin | 14 days cefotaxime |
| FOLLOW UP DURATION | 6 months | 2 months | 3 month | 6months |
| OUTCOME | Complete resolution | Partial resolution | Complete resolution | Partial resolution |

* ALT/AST, alanine aminotransferase/aspartate aminotransferase; CRP, creative protein; ESR, erythrocyte sedimentation rate; LMWH, low molecular weight heparin.

## DISCUSSION

There are no formulated guidelines on treatment of neonatal PVT. The patient may present with no symptoms or laboratory abnormalities on investigation. Some patients may have accompanying thrombocytopenia or hepatic dysfunction. Due to asymptomatic presentation, the diagnosis may not be suspected and missed. Umbilical catheterization and sepsis are the most common risk factors for neonatal PVT. Thrombophilia is possibly a contributing risk factor. However, neonatal PVT may still occur in the absence of risk factors. It has been suggested that PVT may occur less frequently if the umbilical venous catheter tip is present in the right atrium or in the inferior vena cava (high placement). There is greater blood flow in the right atrium and inferior vena cava compared to the portal sinus or umbilical vein (low placement). The greater blood flow was thought to ensure adequate mixing of the infusates with the neonate's blood and to avoid direct exposure of the liver to unphysiologic stimuli.[12] To avoid complications, the catheter must be confirmed with X-ray imaging to be above the diaphragm but below the right atrium, however ultrasound is the modality of choice. Therefore, the procedure of umbilical catheterisation should be done with outmost care and ultrasound guided confirmation of its placement and constant monitoring of development of thrombus should be done to prevent and early diagnosis of thrombus formation.

In conclusion, though the need to treat critical ill neonates may require umbilical catheterisation and infusion of various infusate and blood product, the procedure should be done following standard protocol and its placement and monitoring of thrombus formation should be done. Various studies have suggested its benign nature with self-resolution, however till date there is no standard treatment guidelines and severity grading. So the need for more prospective with standardization of standard treatment guidelines and follow up of these patients.

### Compliance with ethical standards

Ethical standards All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki Declaration of 1964 and later versions. Informed consent was obtained from all patients for inclusion in the study.

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Conflict of interest We declare that we have no conflicts of interest.

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