

Original Research Article

Incidence of complications following umbilical vein catheterisation in neonates

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ABSTRACT

Background: Umbilical vein catheter (UVC) insertion in newborns has life threatening complications like Catheter related bloodstream infections (CRBSI), Portal vein thrombosis (PVT) and other mild complications. This study has been done to assess the incidence and risk factors of complications in neonates with umbilical vein catheterisation.

Methods: A prospective observational study was carried out in neonates admitted to a South Indian tertiary care hospital between January 2017- June 2018.

Results: Umbilical vein catheterisation was done for 65 neonates, of them 46 completed the study. One neonate (2%) developed CRBSI and none of them developed PVT in both baseline and follow up scans. Minor complications noted were repositioning in 26%, umbilical site leak in 23%, reattempts in 19%, catheter block in 13%, periumbilical erythema in 6% and umbilical site bleed in 2%. There was no statistical significance between minor complications and baseline study characteristics.

Conclusions: Although UVC is a common and easy vascular access, it is not without complications. Incidence of serious complications following umbilical vein catheterisation is low when proper technique and sterile precautions are followed. However, the occurrence of mild complications following UVC insertion is high.

Keywords: Catheter related bloodstream infections, Portal vein thrombosis, Repositioning, Umbilical vein catheterisation, Umbilical vein catheter

INTRODUCTION

Insertion of UVC is a commonly used procedure for intravenous access in NICU's. Critically ill neonates usually need UVC insertion for administration of parental fluids, blood products, medications and elimination of stress and pain related with repeated puncture of peripheral veins. However, the advantages of umbilical catheters must be carefully balanced against the complications. Umbilical vein catheterization has few life threatening complications like catheter related infections, intestinal necrosis, portal vein thrombosis, cardiac arrhythmias, myocardial perforation, as well as pleural

and pericardial effusion.¹ According to literature, complications due to mechanical cause occur in 5 to 19%, infectious cause in 5 to 26% and thrombosis in 2 to 26 % of neonates who undergo umbilical vessel catheterization.¹

Hence, a knowledge about the common complications and its predictors will help in formulating guidelines for umbilical vein catheterization. There is paucity of regional prospective studies on short term outcomes viz., portal vein thrombosis (PVT) and catheter related blood stream infections (CRBSI) of neonates who undergo umbilical vein catheterisation.² Hence, author have

conducted this prospective study in this neonatal unit to estimate the rate of complications and its associated risk factors.

METHODS

This prospective observational study was conducted in a South Indian tertiary care hospital between January 2017 and June 2018. The Institutional Human Ethics Committee approved the study and written informed consent was obtained from parents. All the neonates who underwent umbilical vein catheterisation in NICU were included in the study. 65 neonates were eligible, out of them 5 neonates died due to extreme prematurity and 10 neonates were referred to other hospitals.

Umbilical Vein Catheter was inserted by trained residents based on the treating physician's decision. Umbilical vein catheter insertion length was estimated using Dunn's method.³ Standard aseptic precautions were followed during umbilical vein catheterisation. The position of umbilical vein catheter was kept at an optimal level (between 8th and 10th thoracic vertebra) which was confirmed by a post-procedure X-ray. If the position was high (above the 8th thoracic vertebra), or low (below 10th vertebra), readjustment was done immediately.⁴

Strict aseptic precaution was followed during and after procedure. The need for reattempts, repositioning, umbilical site leak, periumbilical erythema, umbilical bleed and catheter block were noted till the removal of catheter. Catheter tip and a simultaneous peripheral blood sample were sent for culture to look for CRBSI. Based upon the clinical condition and culture sensitivity reports, neonates were treated. USG abdomen and portal vein doppler was done before discharge and at 14 weeks.² If there was presence of portal vein thrombus in initial scans, repeat scan was planned every 2 weeks until regression of thrombus or to intervene on further progression of thrombus.

Statistical testing was conducted with the statistical package for the social science system version SPSS 22.0. Continuous variables were presented as mean \pm SD and categorical variables were presented as absolute numbers and percentage. Nominal categorical data between the baseline characteristics and complications were compared using Chi-squared test. $P < 0.05$ was considered statistically significant.

RESULTS

Fifty neonates were included in the study, of them 4 neonates lost to follow up. Data analysis was done for 46 neonates. Preterm and term neonates were evenly distributed in the study. Umbilical vein catheter was inserted by trained residents using shoulder umbilical length graph by Dunn's method.³ Demographic details are listed in Table :1. Indication for catheterisation were exchange transfusion in 3 (6.5%), need of central line in

25 (54.3%), due to the difficult peripheral line in 14 (30.4%) and for glucose infusion in 4 (8.7%). The desired position of catheter tip (between 8th and 10th thoracic vertebra) was observed in 34 (74%) and high position of catheter tip (above the 8th thoracic vertebra) in 12 (26%).

Table :1 Demographic details of the study population.

Demographic data	Mean
Gestational age	33 \pm 1.2 weeks
Birth weight	1676 \pm 370 grams
Time of UVC insertion	10 \pm 7 hours
Duration of UVC	73 \pm 2 hours

CRBSI was noted in 1 (2%) extreme preterm neonate with birth weight of 900 grams and catheter duration of more than 8 days. Appropriate antibiotics was started based on culture sensitivity and recovery was uneventful. None of the study subjects developed portal vein thrombosis or stenosis in baseline and follow up USG abdomen and in portal vein doppler. Repositioning of catheter was done in 26% (n=12) of neonates due to high position of catheter. Umbilical catheter leakage was noted in 23% (n=11). Other minor complications noted were reattempts, catheter block, periumbilical erythema and umbilical site bleed (Table 2).

Table: 2 Incidence of complications.

Complications	N (%)
Catheter related blood stream infections (CRBSI)	1 (2%)
Portal vein thrombosis (PVT)	0
Repositioning	12 (26%)
Leakage	11 (23%)
Reattempts	7 (15%)
Catheter block	6 (13%)
Periumbilical erythema	3 (6%)
Bleed	1 (2%)

Minor complications were analysed with baseline characteristics like gestational age, birth weight, position, duration of catheter and there was no statistically significant correlation.

DISCUSSION

Umbilical vein catheterisation is an essential part in management of critically ill neonates. Incidence of serious complications following UVC insertion depends on associated risk factors such as gestational age, birth weight, duration of catheter and aseptic precautions followed while handling UVC. Mechanical complications like malpositioning and reattempts occur at increased frequency following UVC insertion and these babies had to be followed to look for short term and long term complications.

In the present study, 46 neonates who underwent umbilical vein catheterisation were prospectively evaluated for mechanical and infectious complications. Catheter malposition was one of the common complication following umbilical vein catheterisation and its reported rate ranges from 20% to 37%.^{2,4,5} In this study also catheter malposition was the most common complication noted. High position of the catheter (above the 8th thoracic vertebra) was seen in 26% (n=12) and repositioned to desired level (between 8th and 10th thoracic vertebra). This finding was similar to the study done by Verheij et al, which showed high position in 32% by Dunn's method and in 55% by Shukla's methods.⁴ Another study by Sushma et al, showed acceptable catheter position was in 56% by JSS formula (6.5 + weight in kg) and 39.6% using modified Shukla's formula. High placement of catheter is associated with cardiac complications like arrhythmias, myocardial perforation, pericardial effusion etc., and low placement associated with hepatic complications like hepatic parenchymal injury, hepatic abscess and necrosis, abdominal distention, liver dysfunction etc.^{2,5-9}

Apart from catheter repositioning, minor complications encountered during this study were reattempts in 19% (n=9), umbilical site bleed in 2% (n=1), Periumbilical erythema in 6% (n=3), leakage from umbilical site in 23% (n=11) and catheter block in 13% (n=6). Umbilical site bleed was arrested uneventfully after the removal of catheter. Special attention was paid for the neonate with umbilical site bleed and neonates who required catheter removal due catheter block to look for long term major complications. No complications were noted in the baseline and follow up USG and portal vein doppler in both categories. However, these complications are under reported in many studies.

One of the serious complications following umbilical vein catheterisation is Portal vein thrombosis (PVT). PVT is the major cause for extra hepatic portal hypertension and gastrointestinal bleeding in children. In the past, majority of cases were unrecognized in the neonatal period and were found later in childhood.² None of the study subjects developed PVT in both baseline and follow up USG abdomen and portal vein doppler which is contrasting with the results of study done by Kim et al, Kim et al, found that 43% of neonates had PVT following umbilical vein catheterisation.¹⁰ In their study catheter duration of more than 6 days was found to be a statistically significant risk factor for PVT followed by high position, transfusion, prematurity and sepsis.¹⁰ In this study, mean catheter duration of 73 + 12 hours and optimal position of catheter (between 8th and 10th thoracic vertebra) was strictly ensured in all the neonates. The above two factors could be the key elements behind the minimal complications of this study.

Catheter related bloodstream infection (CRBSI) is the most common serious adverse event, with reported incidence ranging from 3% to more than 20%, depending

on the precise diagnostic criteria applied and the demographics of the population studied.¹¹⁻¹³ Out of 46 neonates, only one neonate had CRBSI, organism being coagulase negative staphylococcus aureus (>15 CFUs in both cultures). This neonate was an extreme preterm with birth weight of 900 grams and catheter duration of more than 8 days who made uneventful recovery with appropriate antibiotics. In this neonate catheter was removed due to umbilical site leak. Prematurity and catheter duration played a key role in the occurrence of CRBSI in this neonate which is consistent with a retrospective study done in Sweden.¹⁴ The same neonate did show PVT on follow up. Limitation of this study is small sample size.

CONCLUSION

From this study, we conclude that occurrence of serious complications with umbilical vein catheterisation in a tertiary care hospital setting is low due to optimal catheter position and minimal duration. Follow up USG is the hallmark in this study, which has ruled out long term complications of umbilical vein catheterisation. However, this study showed significant percentage of minor complications especially catheter repositioning, reattempts, umbilical site leak and catheter block. Though there are various methods available to estimate the umbilical vein catheter insertion length, the incidence of catheter repositioning is high. Hence further research is needed to compare all the methods available and to develop appropriate methods for ascertaining length of the catheter.

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Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Sengupta A, Lehmann C, Diener-West M, Perl TM, Milstone AM. Catheter duration and risk of CLABSI in neonates with PICCs. *Pediatrics*. 2010;125(4):648-53.
2. Williams S, Chan AK. Neonatal portal vein thrombosis: Diagnosis and management. *Semin Fetal Neonatal Med*. 2011;16:329-39.
3. Dunn PM. Localization of the umbilical catheter by post-mortem measurement. *Arch Dis Child* 1966;41:69-75.
4. Verheij GH, Te Pas AB, Witlox RS, Smits-Wintjens VE, Walther FJ, Lopriore E. Poor accuracy of methods currently used to determine umbilical catheter insertion length. *Int J Pediatr* 2010;2010:873167.
5. Mutlu M, Aslan Y, Kul S, Yılmaz G. Umbilical venous catheter complications in newborns: a 6-year single-center experience. *J Matern Fetal Neonatal Med*. 2016;29(17):2817-22.

6. Narang S, Roy J, Stevens TP, Butler-O'Hara M, Mullen CA, D'Angio CT. Risk Factors for Umbilical Venous Catheter-Associated Thrombosis in Very Low Birth Weight Infants. *Pediatr Blood Cancer.* 2009;52(1):75-9.
7. Grizelj R, Vukovic J, Bojanic K, Loncarevic D, Stern-Padovan R, Filipovic-Grcic B, et al. Severe liver injury while using umbilical venous catheter: case series and literature review. *Am J Perinatol.* 2014;31(11):965-74.
8. Hollingsworth C, Clarke P, Sharma A, Upton M. National survey of umbilical venous catheterisation practices in the wake of two deaths. *Arch. Dis. Child. Fetal Neonatal Ed.* 2015;100(4):371-2.
9. Shareena I, Khu YS, Cheah FC. Intraperitoneal extravasation of total parental nutrition infusate from an umbilical venous catheter. *Singapore Med J.* 2008;49(2):35-6.
10. Kim JH, Lee YS, Kim SH, Lee SK, Lim MK, Kim HS. Does umbilical vein catheterization lead to portal venous thrombosis? Prospective US evaluation in 100 neonates. *Radiology.* 2001;219(3):645-50.
11. O'Grady NP, Alexander M, Dellinger EP, Gerberding JL, Heard SO, Maki DG, et al. Guidelines for the prevention of intravascular catheter-related infections. *MMWR Recomm Rep.* 2002;51:1-29.
12. Butler-O'Hara M, D'Angio CT, Hoey H, Stevens TP. An evidence-based catheter bundle alters central venous catheter strategy in newborn infants. *J Pediatr.* 2012;160(6):972-7.
13. Schulman J, Stricof R, Stevens TP, Horgan M, Gase K, Holzman IR, et al. Statewide NICU central-line-associated bloodstream infection rates decline after bundles and checklists. *Pediatrics.* 2011;127(3):436-44.
14. Mermel LA, Allon M, Bouza E, Craven DE, Flynn P, O'Grady NP, et al. Clinical practice guidelines for the diagnosis and management of intravascular catheter-related infection: Update by the Infectious Diseases Society of America. *Clin Infect Dis.* 2009;49(1):1-45.

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