

## Investigation into Infections Related to Umbilical Vein Catheter in Neonates

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### Abstract:

**Background:** Umbilical vein catheterisation is a common procedure performed in neonatal intensive care unit for the management of pre-term and ill neonates. Although umbilical vein catheterisation is imperative for intensive neonatal care and their survival, its use has been associated with several complications. Infection related to the use of intravascular catheters including UVC may cause significant morbidity and mortality.

**Objectives:** To find out the incidence of umbilical vein catheter related infections in neonates in our hospital and to identify commonest microorganisms causing catheter related infections and its sensitivity pattern to antibiotics.

**Methods:** The study included 100 neonates admitted in BMIMS Pawapuri, Informed consent was obtained from the parents. Umbilical vein catheter was inserted on day 1 and catheter care done as per standard protocol. The neonate was assessed daily for clinical signs of sepsis and during catheter removal; catheter tip as well as blood from peripheral vein was sent for culture. Collected data was analysed using frequency, percentage and chi-square test.

**Results:** The incidence of umbilical vein catheter related infection in our study was 1%. Umbilical vein catheter colonization was 37%; out of which 32.4% were terms and 67.6% pre terms. Escherichia Coli was responsible for catheter related sepsis which was sensitive to amikacin, piperacillin/ tazobactam, cefoperazone/ sulbactam, imipenem, meropenem, vancomycin, colistin and tigecycline. The mean duration of catheter placement in neonate UVC related sepsis was 20 days.

**Conclusion:** The study concluded that the incidence of Umbilical Vein Catheter related infection was not significant in our NICU.

**Keywords:** Umbilical Vein Catheter, Sepsis.

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### Introduction

Sepsis is common in low birth weight newborns in neonatal intensive care unit and is mainly attributed to catheter use. [1] It continues to be one of the major causes of mortality and morbidity worldwide. Umbilical venous catheterization is a common procedure performed in the neonatal intensive care unit. It is commonly used in the management of newborn infants who are preterm or have other potentially life-threatening illness. Umbilical catheters provide convenient and relatively painless intravascular access. Umbilical vein catheters are used for intravenous administration of fluids, parenteral nutrition, hypertonic solutions, blood products and medication. Umbilical artery catheters are used for blood gas sampling and continuous monitoring of arterial blood pressure in critically ill neonates. However, use of umbilical catheter can lead to serious complications. Complications associated with umbilical catheter use include infections, thrombosis,

embolism, vasospasm, vessel perforation and hemorrhage. Gastrointestinal, renal, and limb tissue damage are among the sequelae. Complications due to mal-position include cardiac arrhythmias, hepatic necrosis, hydrothorax, pericardial effusion with cardiac tamponade, and erosion of the atrium or ventricle from the catheter tip. [2] According to the literature, mechanical adverse events occur in 5 to 19% of patients with a umbilical venous catheter, infectious adverse events in 5 to 26% and thrombosis in 2 to 26%. [3] The rate of catheter-related bloodstream infection (CRBSI) ranges from 6.4 to 8.3 episodes per 1,000 patient days in the NICU. [5] The recent medical advances achieved in the NICU in the last few decades have enabled a significant increase in pre-term newborns survival rates, particularly in those with low birth weight [4]. Numerous resources have been routinely used in these units, such as mechanical ventilation, parenteral nutrition and the insertion

of umbilical catheters as well as the extensive use of antibiotics. These factors, although imperative to the survival of a preterm newborn, act as predisposing factors to the development of nosocomial neonatal infections. As the risk of complications may increase with duration of use [5]; UVCs are often removed after relatively short periods and replaced with percutaneous central venous catheters for maintenance of long-term fluid and nutritional status. On the basis of these limited data, the Centre for Disease Control and Prevention (CDC) currently recommends use of UVCs limited to 14 days. [3]

### Objectives

To find out the incidence of catheter related infections in neonates.

To identify the most common organism associated with catheter related infections and their sensitivity to antibiotics.

### Material and Methods

Infants admitted to neonatal intensive care unit of BMIMS Pawapuri Nalanda, Bihar in whom umbilical vein catheter needs to be inserted as a part of treatment protocol; formed the study population. A sample size of hundred was selected using purposive sampling technique.

The purpose of the study and details of protocol were discussed with the parents and an informed written consent was obtained.

The umbilical vein catheter was inserted under strict aseptic conditions by standard technique and care of the catheter was done as per our neonatal intensive care unit protocol. All infants were clinically assessed daily for signs of sepsis like temperature instability (hypothermia/hyperthermia), poor feeding, feeding intolerance, apnea, bradycardia, lethargy and documented accordingly. Complete blood counts, C-reactive protein and blood culture was done in all the babies. The catheter tip was clipped directly into a sterile container and simultaneously a blood sample (whole blood: 0.3-1ml) collected from the peripheral vein. The collected samples were immediately transported to the microbiology laboratory for processing.

Microbiological culture was done by qualitative

method by standard techniques. The catheter tip was cultured by immersing it in Brain Heart Infusion (BHI) with subsequent incubation at 37°C for 72 hours. The broths were examined daily and when cloudy, a subculture was performed in Blood Agar. The tip was then smeared on the surface of Blood Agar plate and McConkey's media and incubated at 37°C for 72 hours. The plates were examined daily and checked for growth. And the growth of the microorganisms was assessed by qualitative method and categorized as scanty, moderate and heavy growth.

Blood sample obtained from the peripheral vein was cultured in BACTEC and incubated for 5 days under aerobic conditions. The antibiotic culture and sensitivity of the organism was determined by disc diffusion method.

The catheter was considered the source of sepsis when the same organism isolated from the catheter tip and from blood and associated with clinical signs of sepsis.

### Inclusion Criteria

1. Neonates in whom umbilical vein catheter is inserted.

### Exclusion Criteria

1. Infants with culture proven sepsis or clinically suspected sepsis before the insertion of the catheter.
2. Infants born to mothers with puerperal sepsis.
3. Infants born to mothers with premature rupture of membranes for > 18 hours.
4. Infants born outside our hospital.

### Results

This study was conducted in the Department of Pediatrics, Bhagwan Mahavir Institute of medical sciences Pawapuri, Nalanda. Study duration of Two years. The study comprised of total 100 neonates and included 78 pre terms and 22 term neonates. Maximum were appropriate for gestational age 82 % and 18 % were small for gestational age neonates.

Male: Female ratio was 0.92 : 1 Term: Pre Term ratio was 0.28 : 1 AGA: SGA ratio was 4.55 : 1

**Table 1: Study group characteristics**

	Frequency
Males	48
Females	52
Term	22
Pre-Term	78
AGA	82
SGA	18
Total Number of Neonates	100

Out of 100 neonates with Umbilical Vein Catheter 82 were appropriate for gestational age and 18 were small for gestational age. The distribution of cases according to appropriate for gestational age and small for gestational

**Table 2: Duration of umbilical vein catheter placement in the study group**

	Duration of UVC Placement	
	Mean	Standard Deviation
Female	11.87	4.93
Male	11.54	4.45
Term	13.14	3.86
Pre Term	11.31	4.84
AGA	11.48	4.76
SGA	12.78	4.25

Mean duration of UVC placement in female babies was 11.87 days & male babies 11.54 days. Mean duration of UVC placement in term babies 13.14 days & pre term babies 11.31 days. Mean duration of UVC placement in AGA babies 11.48 days & SGA babies 12.78 days.

The various micro-organisms responsible for UVC

colonization is. Staphylococcus aureus (n=8), Pseudomonas species (n=8), Candida species (n=6), Klebsiella species (n=4), Enterococcus species (n=3), Escherichia coli (n=2), Acinetobacter species (n=2), Enterobacter species (n=2), Citrobacter species (n=1) and Coagulase negative staphylococcus (n=1).

**Table 3: Chi-square test to correlate neonates with uvccolonisation and GENDER**

	Value	Df	P VALUE
Pearson Chi-Square	3.894	1	0.048
N of Valid Cases	100		

UVC colonization was significantly higher in females compared to males with p value 0.048

**Table 4: Comparison of birth weight in uvc related infection, uvc colonisation and in non infected neonates**

	Birth Weight		
	Mean	Standard Deviation	P Value
UVC Related Infection	3.07		0.097
UVC Colonisation	1.98	0.97	
Non Infected	1.73	0.64	

Birth weight in neonate with UVC related infection was 3.07 kgs, mean birthweight in neonates with UVC colonisation was 1.98 kgs & in non-infected neonates was 1.73 kgs. However it was not statistically significant. APGAR at 1 minute in neonate with UVC infection was 2 and is significantly lower compared to mean APGAR in neonates with

UVC colonisation (6.38) and non-infected neonates (7.16) with p value 0.002 APGAR at 5 minutes in neonate with UVC infection was 6 which is significantly lower compared to mean APGAR in neonates with UVC colonisation (7.95) and non-infected neonates (8.52) with p value 0.010.

**Table 5: Chi square test to correlate neonates with uvccolonisation and non-infected neonates with aga/sga**

	Value	Df	Asymp. Sig.(2-sided)
Pearson Chi-Square	0.470	1	0.493
N of Valid Cases	99		

UVC colonization was not significant compared to non-infected neonates with respect to appropriate or small for gestational age babies.

### Discussion

The Umbilical Vein Catheter was inserted and maintained as per our neonatal intensive care unit protocol. Complete blood counts, C-reactive protein,

blood culture was done and all neonates were assessed daily for clinical signs of sepsis. On the day of catheter removal, blood from peripheral vein and catheter tip was sent for culture simultaneously. The catheter was considered as the source of sepsis when same organism isolated from the catheter tip and from blood and was associated with clinical signs of sepsis. [6]

### Incidence of Umbilical Vein Catheter Related Infection

According to literature, the incidence of umbilical vein catheter related infection has a wide spectrum ranging from 2.24 % to 13 %. However our study revealed that the incidence of UVC related infection was 1 %. Green C and her co-workers conducted a study on placement, use and complications related to umbilical arterial and venous catheter. 35 infants were enrolled in the study. The infection rate was low as 2.24 % which is similar to our study results. [7]

Castrillo in Spain to evaluate the current use of umbilical catheters in neonates by analysing its complications in their study cultured a total of 461 umbilical catheter tips, out of which 21.2% were positive. [8] Catheter related sepsis was confirmed in 11 neonates. The incidence of infection was 2.4% which is similar to our study results. Landers S and associates in their study to determine the factors associated with umbilical catheter-related sepsis included 225 infants. Catheter-related sepsis occurred in 14 infants out of which 3 % of infants had umbilical venous catheter. The results are similar to our study. [9] Balagtas R C and his associates conducted a study to determine the risk of local and systemic infections associated with umbilical vein catheterization among 86 infants. 8% of the neonates were found to have sepsis while the catheter was in place. The study concluded that the risk of local and systemic infections associated with UVC was

significant. Hei MY and his colleagues conducted a study to determine the incidence and pathogens of umbilical venous catheter related sepsis. [10] A total of 516 patients were enrolled and the incidence of UVC related septicemia was 9.5%. Krauss A N<sup>6</sup> et al conducted a study to find out the incidence of contamination of umbilical catheters in neonates. Positive cultures were obtained from 57 % of all catheters (6/11 arterial; 13/22 venous. Pseudomonas (9) and staphylococci (9) were the most common bacteria responsible for UVC colonization. Our study revealed similar culture results. Castrillo in his study conducted in Spain concluded that Staphylococcus epidermidis was the most common organism responsible for umbilical vein catheter colonization. It was isolated in 72.2 % neonates with UVC colonization. Cronin WA and his colleagues conducted a study on intravascular catheter colonization in critically ill neonates. Castrillo in his study to evaluate the current use of umbilical catheters in neonates revealed that the main risk factor for UVC contamination was duration of catheterization > 3 days. Similar findings were noted in our study. Balagtas R C and his associates conducted a study and concluded that the rate of catheter colonization was not dependent on duration of catheterization. Kumagai T and Watanabe in their study concluded that the rate of catheter colonization was not dependent on sex, gestational age, birth weight or duration of catheterization.

UVC colonization	Duration of UVC catheterization	P value
Cronin WA [9]	Significant	< 0.001
Castrillo [7]	Significant	-
Balagtas R C [8]	Not significant	-
Kumagai T [10]	Not significant	-
Our study	Significant	0.044

### Conclusion

This study revealed that umbilical vein catheterisation is not significantly associated with catheter related sepsis. The incidence of UVC related infection was as low as 1%. Our study concluded that increased duration of catheterization was associated with increased risk of UVC related infection. The incidence of UVC colonization was 37 % in our study. However, it is not clear whether UVC catheter colonization would lead to UVC related sepsis.

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