# Incidence of Nosocomial Infection Associated With Peripheral Venous and Umbilical Catheterization in Neonatal Intensive Care Unit

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**Abstract:** Background: intravascular catheters have been essential devices for the management of critically ill neonates. However their use is often associated with serious infection complication, mostly catheter-related blood stream infection, resulting in increasing duration of hospitalization and additional medical costs. **Objective**: to study the incidence of nosocomial infection in neonatal intensive care unit in El- Galaa Teaching Hospital associated with peripheral venous and umbilical catheterization and making a protocol for insertion of the catheter to decrease these complications. **Patients and Methods**: 102 neonates delivered in El-Galaa Teaching hospital and admitted to NICU (over a period of 3 months) were included in the study. Full history taking, thorough clinical examination and bacteriological studies were done for 34 cases in which infection was suspected clinically including; CRP, full blood picture, blood culture and culture the tip of the catheter either peripheral or umbilical by direct film as well as culture on specific media for identification of the infecting organism. **Results**: out of 102 neonates 34 developed neonatal infection (33.33%); 10 cases with respiratory distress (29.41%), 2 cases with hypoxic ischemic encephalopathy (5.88%), 1 case with neonatal Jaundice (2.94%), 1 case with meconium aspiration syndrome (2.94%), 1 case with multiple congenital anomalies (2.94%) and 19 cases preterm with respiratory distress (55.88%). All the 102 neonates had PVC (83 cases, 81.37%) and 19 cases (18.63%) with UC. 25 cases with PVC developed neonatal infection (30.1%) while 9 cases with UC developed neonatal infection (47.37%) with no statistical significant difference between neonatal infection and the type of catheter. It was found that out of 83 cases with PVC about 20 cases (24.10% ) developed bacteremia. Identification of organism showed staphylococcus aureus in 8 cases (20%), G-ve bacilli 5 cases (12%), one case of pseudomonas (4%) and one case of Klebsiella (4%). **Conclusion**: no association between the type of organism in the blood and the organism found in cannula or catheter culture except only in 2 cases, so continuous quality improvement program, education and training of health care workers and adherence to standardized protocol for insertion and maintenance of intravascular catheters significantly reduce the incidence of catheter related infections.

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## 1. Introduction

Nosocomial infections in NICU defined as those that occur beyond 48 hours after birth and are caused by pathogens that are not maternally derived (Richard and Polin, 2005).

Intravascular device or catheter either central, peripheral or umbilical represent an essential part of the management of critically ill neonate admitted to NICU. However, their use is often complicated by serious infections and associated with increased morbidity, mortality, duration of hospitalization and additional medical costs (Crnich and Maki, 2002).

The greater incidence of infection was found with low birth weight, preterm and who had lower 1 and 5 minutes Apgar score (Guerti et al., 2007).

Intravenous access is a necessity in NICU either peripheral venous cannula (PVC) or umbilical catheter (UC) in providing access for administration of fluids, blood, blood products, parenteral nutrition and medications but have some disadvantage. The major disadvantage is frequency of infiltration because infant's veins are small and fragile; this may require multiple IV sticks, which can increase incidence of neonatal infection (NI) (Judith et al., 2004).

Infection due to intravascular device may occur at the site of cannulation. This local infection is represented by erythema, purulence around the insertion point, tenderness or indurations along the cannulated vein. The hospital guidelines for PVC insertion can improve catheter care and significantly reduce local catheter-related complication (Couzigou et al., 2005).

Bacteremia and septicemia are the most serious infections associated with I.V therapy and is frequently life threatening (Inglis et al., 2007).

**Aim of the study**:

To find the incidence of nosocomial infection in NICU in El Galaa Teaching Hospital associated with peripheral venous and umbilical catheterization and making protocol for insertion of the catheters to decrease these complications.

**2. Patients and Methods:**

102 neonates delivered in El-Galaa Teaching Hospital and admitted to NICU (over a period of three months) were included in this study. A questionnaire form was used for every neonate admitted to our NICU. Data is to be collected to reach information about each patient in the form of personal data, clinical data, type of infection and microbiological investigations which were done to the patient. Bacteriological studies were done for 34 cases in which infection was suspected clinically including: full blood picture, C-reactive protein, blood culture and culture from the tip of the catheter either peripheral or umbilical by direct film as well as culture on specific media for identification of the organism and also the source of infection.

Training of health care workers (doctors-nurses) about the steps of cannula insertion and to follow the available protocol for PVC insertion specially hand washing, wearing a sterile gloves and catheter site dressing. Also follow up the site of catheter insertion for any inflammation is very important step in our study to detect early sign for local site infection.

The tip of the catheter was removed carefully from its place either due to : inflammation at the site of insertion, discharge of the neonate, neonatal death or fulfillment of the route up to 72 hours. After removal of the catheter from its insertion site under complete aseptic procedure, the tip of the catheter was placed in sterile broth as transport media until reach the lab (Augun et al., 2006).

**Statistical methods:**

All the above data were collected and statistically tested by analysis of variance or students' t-test. Correlations were studied by simple persons coefficient. Significance was defined as $P<0.05$.

**3. Results:**

Our study included 102 neonates of whom 34 cases (33.33%) developed nosocomial infection. Out of these 34 cases 17 were male and 17 were females, with no sex statistical significant difference in relation to NI. As regard the mode of delivery 58 cases (56.86%) delivered by C.S while 44 cases (43.14%) delivered by NVD, 14 cases (41.18%) delivered by C.S developed NI, while 20 cases (58.82%) delivered by NVD developed NI with statistically significant difference ($P=0.02$).

Our results also showed a significant statistical difference between NI and prolonged hospital stay, low gestational age and low birth weight (Table 1).

Table (2) revealed the different causes of admission of the neonate to NICU and its percentage with NI. There was no statistical significant difference between the type of illness of the neonate and NI in our study.

All the neonate had either peripheral venous cannula or umbilical catheter as a route of giving IV fluids, parental nutrition and medications. 83 cases (81.37%) with PVC, out of them 25 cases (30.1%) developed NI and 19 cases (18.63%) with UC, out of them 9 cases (47.37%) developed NI, with no statistical significant difference between NI and the type of catheter (Table 3).

As regard the relation between type of catheter insertion and the type of infection. It was found that out of 83 cases with PVC insertion only 11 cases (13.25%) developed local site infection and 20 cases (24.10%) developed bacteremia. While out of 19 cases with UC insertion 5 cases (26.32%) developed local site infection and 8 cases (42.11%) developed bacteremia (Table 4).

Identification of the organism revealed 8 cases (20%) with staphylococcus aureus, 1 case (4%) pseudomonas, 1 case (4%) Klebsiella and 5 cases (12%) with G-ve bacilli. There is only 2 cases where the organism found in the blood is the same found in cannula and catheter cultures (Table 5).

Table (6) shows the relation between NI and the outcome of the neonates, out of 102 cases, 51 cases (50%) discharged, 32 cases (31.37%) died and 19 cases (18.635%) still present. Out of 51 discharged cases, 9 cases (26.47%) developed NI. 19 cases (55.88%) of died cases developed NI and lastly 6 cases (17.65%) of still present cases developed NI. There is a statistical significant difference between NI and the outcome of the neonate in NICU ($P< 0.001$).

**4. Discussion:**

Nosocomial infections are one of the most important causes of mortality and morbidity in hospitals. These are major public health problems worldwide, but particularly in developing countries. These infections have the most common frequency in pediatric hospital-especially in neonatal word (Payman et al., 2006).

Several reports have shown that intravascular devices as PVC and UC are widely used in NICU and associated with increased risk for catheter related blood stream infection especially in preterm and low birth weight babies (Borghesi and Stronati, 2008).

**Table (1) : NI and the demographic factors of the neonates**

| Demographic data | | NI | | | | Fisher's exact test | |
|---|---|---|---|---|---|---|---|
| | | No (n=68) | | Yes (n=34) | | | |
| | | N | % | N | % | P- value | |
| Sex | Female ( n=50) | 33 | 48.53 | 17 | 50 | 0.528 | |
| | Male n=52 | 35 | 51.47 | 17 | 50 | | |
| Mode of delivery | C.S n=58 | 44 | 64.71 | 14 | 41.18 | 0. 020* | |
| | NVD n=44 | 24 | 35.29 | 20 | 58.82 | | |
| Age (D) | Range | (2-6) | | (2-8) | | t | P-value |
| | Mean ± SD | 2.824 ± 0.772 | | 3.412 ± 1.158 | | -3.054 | 0.003* |
| G.A (w) | Range | (25-42) | | (26-41) | | 2.918 | 0.004* |
| | Mean ± SD | 35.353 ± 3.485 | | 33.206 ± 3.540 | | | |
| Weight (kg) | Range | (1-4.5) | | (0.9-4.3) | | 2.021 | 0.046* |
| | Mean ± SD | 2.245 ± 0.882 | | 1.881 ± 0.79 | | | |

**Table (2): NI in relation to the type of illness of newborns**

| Diagnosis | | NI | | |
|---|---|---|---|---|
| | | No | Yes | Total |
| Meconium Aspiration Syndrome | N | 7 | 0 | 7 |
| | % | 10.29 | 0.00 | 6.86 |
| Respiratory Distress | N | 22 | 10 | 32 |
| | % | 32.35 | 29.41 | 31.37 |
| Infant of diabetic mother | N | 3 | 0 | 3 |
| | % | 4.41 | 0.00 | 2.94 |
| Hypoxic Ischemic Encephalopathy | N | 1 | 2 | 3 |
| | % | 1.47 | 5.88 | 2.94 |
| Neonatal Jaundice | N | 0 | 1 | 1 |
| | % | 0.00 | 2.94 | 0.98 |
| Multiple Congenital Anomalies | N | 3 | 1 | 4 |
| | % | 4.41 | 2.94 | 3.92 |
| Meconium Aspiration Syndrome &Hypoxic Ischemic Encephalopathy | N | 0 | 1 | 1 |
| | % | 0.00 | 2.94 | 0.98 |
| Preterm &Respiratory Distress | N | 31 | 19 | 50 |
| | % | 45.59 | 55.88 | 49.02 |
| Respiratory Distress &Infant of diabetic mother | N | 1 | 0 | 1 |
| | % | 1.47 | 0.00 | 0.98 |
| Total | N | 68 | 34 | 102 |
| | % | 100.00 | 100.00 | 100.00 |
| Chi-square | $X^2$ | 15.375 | | |
| | P-value | 0.052 | | |

**Table (3): Relation of NI to the type of catheter insertion.**

| Type of Catheter | | NI | | |
|---|---|---|---|---|
| | | No | Yes | Total |
| PVC | N | 58 | 25 | 83 |
| | % | 69.88 | 30.12 | 100.00 |
| Umbilical | N | 10 | 9 | 19 |
| | % | 52.63 | 47.37 | 100.00 |
| Total | N | 68 | 34 | 102 |
| | % | 66.67 | 33.33 | 100.00 |
| Fisher's exact test (P-value) | 0.122 | | | |

**Table (4) Relation of the type of catheter to the site of infection**

| Site of infection | | | Type of Catheter | | | Fisher's exact test |
|---|---|---|---|---|---|---|
| | | | PVC (n=83) | Umbilical (n=19) | Total (n=102) | |
| PVC I | No | N | 72 | 19 | 91 | 0.091 |
| | | % | 86.75 | 100.00 | 89.22 | |
| | Yes | N | 11 | - | 11 | |
| | | % | 13.25 | - | 10.78 | |
| UC I | No | N | 83 | 14 | 97 | <0.001* |
| | | % | 100.00 | 73.68 | 95.10 | |
| | Yes | N | - | 5 | 5 | |
| | | % | - | 26.32 | 4.90 | |
| Bacteremia | No | N | 63 | 11 | 74 | 0.099 |
| | | % | 75.90 | 57.89 | 72.55 | |
| | Yes | N | 20 | 8 | 28 | |
| | | % | 24.10 | 42.11 | 27.45 | |

**Table (5): Type of organism in the blood culture in relation to the type of organism in cannula or umbilical culture**

| Type of organism | | | Blood | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | No growth (n=19) | Staph. | Pseudom. | Klebs. | Gram -ve | Total | Chi-square (P-value) |
| Cannula culture (n=25) | No growth | N | 9 | 5 | 1 | 1 | 3 | 19 | 0.173 |
| | | % | 36.00 | 20.00 | 4.00 | 4.00 | 12.00 | 76.00 | |
| | Staph | N | 3 | 1 | - | - | - | 4 | |
| | | % | 12.00 | 4.00 | - | - | - | 16.00 | |
| | Gram -ve | N | - | - | - | - | 1 | 1 | |
| | | % | - | - | - | - | 4.00 | 4.00 | |
| | E.coli | N | 1 | - | - | - | - | 1 | |
| | | % | 4.00 | - | - | - | - | 4.00 | |
| | Total | N | 13 | 6 | 1 | 1 | 4 | 25 | |
| | | % | 52.00 | 24.00 | 4.00 | 4.00 | 16.00 | 100.00 | |
| Umbilical culture (n=9) | No growth | N | 6 | 1 | - | - | 1 | 8 | 0.822 |
| | | % | 66.67 | 11.11 | - | - | 11.11 | 88.89 | |
| | Staph | N | - | 1 | - | - | - | 1 | |
| | | % | - | 11.11 | - | - | - | 11.11 | |
| | Total | N | 6 | 2 | - | - | 1 | 9 | |
| | | % | 66.67 | 22.22 | - | - | 11.11 | 100.00 | |

**Table (6): NI and the outcome in NICU**

| Outcome | | NI | | |
|---|---|---|---|---|
| | | No | Yes | Total |
| Discharge | N | 42 | 9 | 51 |
| | % | 61.76 | 26.47 | 50.00 |
| Died | N | 13 | 19 | 32 |
| | % | 19.12 | 55.88 | 31.37 |
| Still present | N | 13 | 6 | 19 |
| | % | 19.12 | 17.65 | 18.63 |
| Total | N | 68 | 34 | 102 |
| | % | 100.00 | 100.00 | 100.00 |
| Chi-square | $X^2$ | 15.380 | | |
| | P-value | < 0.001* | | |

In our study we found that 33.3% of the neonates admitted to NICU were subjected to nosocomial infections which in agreement with a study done by Payman et al. (2006), who found that the reported nosocomial infection in NICU is often high and about 39.8%.

The high incidence in our study was attributed to the fact that the majority of the cases admitted to our unit are preterm neonates with LBW, they have low immunity and a defect in the skin barrier. These factors lead to an increase in the duration of stay in the incubator and also increase the frequency of manipulation of neonates either due to ventilation, catheter insertion, or other invasive procedures and all these are associated with increase rate of NI in our center.

In our study we found a statistical significant difference between NI and the mode of delivery, as there is an increase risk of NI with NVD. This finding was in agreement with that reported by Jimmy (2008), who found that NI increased in preterm babies delivered by NVD.

The weight of the neonate is an important risk factor in development of NI and in our study there is high association between NI and LBW neonates less than 1.8 kg and this finding is also reported by Payman et al. (2006); Richard and Polin (2005) and Barbara et al. (2002).

Our results revealed that NI increased when gestational age of the neonates is less than 33 weeks which fit the same founded by Barbara et al. (2002) and Hwang et al. (2004).

As regard one of the risk factors (mechanical ventilation) in our study, we found that out of 102 cases, 49 cases were ventilated and 27 cases (79%) associated with NI and this agree with the study done by Hwang et al. (2004), whom found that endotracheal intubation and assisted ventilation are recognized risk factors in NICU due to colonization or humidified air with hydrophilic micro-organisms, physical trauma of passing an endotracheal tube and transient bacteremia during routine suction.

In our study, there is no statistical difference between the type of catheter and the incidence of NI, in contrast Chien et al. (2002), found that NI increase with the use of CVC while the frequency of NI remain the same in other types of catheters. Also Dew et al. (2007), found increase risk of NI with insertion of central line than peripheral one.

Thirty four cases in our study were subjected to bacteriological culture, where 8 cases were staphylococcus, 5 cases were G-ve bacilli, 1 case was klebsiella and 1 case pseudomonas A. and this is similar to that found by Kim et al. (2002), who found that staphaureus was the most common isolated organism in catheter related blood stream infection.

In our study there is no association between the type of organism in the blood and the organism found in cannula or catheter culture except in only 2 cases where the bacteremia caused by staph and the same organism found in the cannula culture and the other in catheter culture. Our expectation is that these 2 cases only, the peripheral and umbilical catheter were the cause of sepsis while in other cases in which blood revealed organism with no growth in the PVC or UC, the cause may be endotracheal tube, chest tube, urinary catheter or any other risk factor that help entrance of the organism to the blood.

**Conclusion:**

Our research found high incidence of nosocomial infection within the NICU and most of its causes is preventable. Institution of continuous quality improvement programs, education and training of health care workers and adherence to standardized protocol for insertion and maintenance of intravascular catheters significantly reduce the incidence of catheter related infections.

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