

A Survey on Factors Promoting Early and Delayed Complications in Neonate and Infants Using Cvc Line

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How to cite this article:

Peyvasteh M, Askarpour SH, Motamedfar A, Keshri R, Shafieyan T, Momengharibvand M, Kazemnia KH. A Survey on Factors Promoting Early and Delayed Complications in Neonate and Infants Using Cvc Line. Iranian Journal of Pediatric Surgery 2023; 9 (1):98-111.

DOI: <https://doi.org/10.22037/irjps.v9i1.37493>

Abstract

Introduction: Central venous catheter placement (CVC) is an accepted venous access method in the treatment of critically ill neonates & infants, evaluation of factors that induce complications are necessary. Therefore, the aim of this study was to investigate the effective factors in causing early and late complications of central venous catheter placement in infants less than one year old hospitalized in Imam Khomeini and Golestan hospitals.

Materials and Methods: This study was performed on 400 infants less than one year old. Patients information, early and delayed complications were recorded. Data were compared based on Chi-square and Fisher tests.

Results: The most common complication of central venous catheter placement in the neonates and infants were as followed, infection (5.5%), venous thrombosis (5%), thrombophlebitis (4.3%), bleeding (3.8 %), hematoma (2.5%), arterial injury (0.3%) and pneumothorax (0.3%). Hemothorax and malposition were not observed. Frequency of bleeding in patients in whom catheterization was attempted 3 times was significantly higher (75%) than patients that had been tried twice (26.3%). Also, the frequency of hematoma and arterial injury were higher in cases who had tried twice. Finally, one case of pneumothorax was observed in cases who had been tried three times (25%). Also, the incidence of infection and thrombophlebitis in patients who had a catheter for more than 14 days was significantly higher than patients who had a catheter less than 14 days. However, it was found that the frequency of complications was not related to age, sex, height and weight, underlying disease of the infant, catheter location and catheter needle.

Keywords

- Central venous catheter
- Early and late complications
- Infant

Conclusion: The incidence of central venous catheter complications in infants is low and has a significant relationship with the attempting times of placement and duration of catheter placement. This is a suitable venous access method for the treatment of infants and had no association with the underlying disease and neonatal demographic indicators.

Introduction

In recent years, despite advances in pregnancy care and control of preterm births, the overall prevalence of preterm births has increased, resulting in

hospitalization of preterm infants and access to venous pathways in these infants for fluid and electrolyte supply and intravenous medications are essential and

are among the common problems in these wards.

Despite the tendency to start oral feeding early, many of these neonates still need a safe intravenous for a long time.

Repeated attempts to access the peripheral venous line with angiocath impair the health of very sensitive neonatal skin, which is considered the first line of defense against systemic infections, and expose infants to more damage.

But so far, no ideal method for long-term delivery of fluids, drugs and intravenous nutrition has been identified.¹

According to the long-term hospitalization of premature infants in intensive care units and since it is not possible to take a vein through the peripheral vessels for a long time and has little stability, it is necessary to find another way to access the venous pathways.²

Since the 1970s, the central venous lines have become the main line for meeting the nutritional and fluid needs of infants who are not ready to receive oral nutrition.

Central vein catheters (CVC) insertion is standard, under anesthesia and in the operating room, which requires special techniques and is associated with serious risks, such as pneumothorax and hemothorax and bleeding.³⁻⁵

Although the preferred line for CVC has not yet been mentioned in pediatrics, the jugular vein is one of the best options for CVC.

Complications of CVC occur in 9 to 94% of cases and include pneumothorax and infections and damage to the arteries. The prevalence of these complications varies based on the patient's age and physician experience.⁵ Various modalities, including the use of ultrasound, fluoroscopy, and CXR, have been used to reduce these complications, but none have been proven to be effective, and none have yet definitively increased the success rate of CVC.⁷ Complications such as pneumothorax and chylothorax have been observed in patients undergoing CVC under ultrasound guide through jugular and subclavian vein.⁷⁻⁸

In this study, we surveyed on factors promoting early and delayed complications CVC in neonate and infants admitted to the intensive care units.

Materials and Methods

In a descriptive-analytical study in Imam Khomeini and Golestan Medical Centers in Ahvaz city, all infants less than one year old who were born from April 2016 to

March 2017 and are candidates for central venous catheter were studied, which was unlikely to be selected consecutively.

Exclusion criteria included neonates with life-threatening congenital anomalies (such as anencephaly, and bilateral renal agenesis), chromosomal abnormalities, major heart disease (such as hypoplastic left heart, and large vascular displacement), bleeding disorders and skin infection at the catheter site.

Infants who needed a central venous catheter for any reason were inserted a subclavian or jugular vein under ultrasound guidance in accordance with scientific principles, and the patient was evaluated if there were no exclusion criteria.

Number of attempts and other related information were recorded. In this study, if the CVC insertion was unsuccessful, the same person tried again to perform the catheter insertion, and if the attempt to insert the CVC failed for the third time, it was considered a case of failure.

After catheterization, the correct location of the catheter tip was confirmed by performing anterior-posterior thoracic x-ray.

If any signs of infection were observed, it

was reported and recorded. If the catheter was removed, the date of removal and the reason for removing the catheter was recorded.

To diagnose catheter colonization, culture was sent from the tip of the catheter, and finally patients were divided to two groups: uncomplicated and complicated. The complications were divided into two type including early complications (pneumothorax, arterial injury, hematoma, bleeding, malposition detected by chest X Ray), and late complications (infection Catheter location, thrombophlebitis, venous thrombosis that lasts until the catheter is present).

influencing factors on complications (including sex, age of the infant, duration of catheter use, location of catheter and number of times catheter insertion attempt) were compared in the two groups.

Finally, the collected data were analyzed using SPSS v.20 statistical software; Chi-square test was used to analyze the data with nominal scale and in cases where more than 20% of the expected frequencies of the tables were less than 5 (Cochran), Fisher's exact test was used and P-value<0.05 was statistically significant.

Result

In this study, 400 neonates and infants less than one year old were included in the study, of which 248 (62%) were boys and 152 (38%) were girls. Also, the mean age of the subjects was 2.89 ± 2.85 months.

The most common diseases in neonates and infants were respiratory diseases (33.5%) and hydrocephalus (29.5%), need for surgery (18%), preterm (9.5%), heart disease (7%), respectively. and septic shock (3.3%). The most common complications of central venous catheter implantation in neonates and infants were infection (5.5%) and venous thrombosis (5%), thrombophlebitis (4.3%), bleeding (3.8%), hematoma. (2%), arterial injury (0.3%) and pneumothorax (0.3%). Hemothorax and malposition were not seen in any of the patients. It was also found that 86% of catheter insertions were in the right jugular and 14% in the left jugular. 64.3% of the catheter size was 5 French. In 89.5% of cases, only one attempt was made for embedding, 9.5% twice and 1% three times. Catheter duration was less than 14

days in 52.8% and more than 14 days in 47.3%. Catheter removal did not occur in 83.5% and in other cases that did occur, 5.5% was due to infection, 5.3% was due to obstruction and 4.8% was due to other causes.

In cases where culture was performed, only 36.4% of them were positive.

It was also found that the frequency of bleeding in patients who had tried catheter insertion 3 times was significantly higher (75%) and then in case who had tried twice (26.3%).

The frequency of hematoma and arterial injury was highest in case who had tried twice. Finally, a case of pneumothorax was found in case who had tried three times (25%). The incidence of infection and thrombophlebitis in patients who had a catheter for more than 14 days was significantly higher than patients who had a catheter less than 14 days (Table No. 1). It was found that the frequency of complications was not related to age, sex, height and weight, underlying disease of the infant, catheter location and catheter needle (Table 1).

Table 1: Frequency of central venous catheter implantation complications in Neonates and infants

Complication Variable		Pneumothorax	Arterial injury	Hematoma	Bleeding	Thrombophlebitis	Thrombosis	Infection
<1 month	Age	1 (0/8)	0	4 (3/4)	4 (3/4)	7 (5/9)	6 (5)	5 (4/2)
>1 month		0	1 (0/4)	6 (2/1)	11 (3/9)	10 (3/6)	14 (5)	17 (6)
P-value		0/298	0/99	0/493	0/99	0/292	0/98	0/459
Male	Sex	0	0	4 (1/6)	8 (3/2)	9 (3/6)	15 (6)	12 (4/8)
Female		1 (0/7)	1 (0/7)	6 (3/6)	7 (4/6)	8 (5/3)	5 (3/3)	10 (6/6)
P-value		0/38	0/38	0/147	0/481	0/432	0/219	0/459
No	Cardiac disease	0	1 (0/3)	8 (2/2)	12 (3/2)	17 (4/6)	18 (4/8)	22 (5/9)
Yes		1 (3/6)	0	2 (7/1)	1 (10/7)	0	2 (7/1)	0
P-value		0/07	0/99	0/15	0/079	0/621	0/642	0/386
No	Respiratory disease	0	0	4 (1/5)	8 (3)	9 (3/4)	13 (4/9)	15 (5/6)
Yes		1 (0/7)	1 (0/7)	6 (4/5)	7 (5/2)	8 (6)	7 (5/2)	7 (5/2)
P-value		0/335	0/335	0/092	0/271	0/226	0/884	0/863

No	Shock	1 (0/3)	1 (0/3)	10 (2/6)	13 (3/4)	17 (4/4)	18 (4/7)	20 (5/2)
Yes		0	0	0	2 (15/4)	0	2 (15/4)	2 (15/4)
P-value		0/99	0/99	0/99	0/081	1	0/133	0/156
No	Hydrocephaly	1 (0/4)	1 (0/4)	7 (2/5)	9 (3/2)	12 (4/3)	13 (4/6)	15 (5/3)
Yes		0	0	3 (2/5)	6 (5/1)	5 (4/2)	7 (5/9)	7 (5/9)
P-value		0/99	0/99	0/99	0/363	0/993	0/58	0/806
No	Need to Surgery	1 (0/3)	1 (0/3)	9 (2/7)	13 (4)	16 (4/9)	14 (4/3)	17 (5/2)
Yes		0	0	1 (1/4)	2 (2/8)	1 (1/4)	6 (8/3)	5 (6/9)
P-value		0/99	0/99	0/99	0/99	0/329	0/152	0/553
No	Preterm	0	1 (0/3)	9 (2/5)	14 (3/9)	14 (3/9)	20 (5/5)	20 (5/5)
Yes		1 (2/6)	0	1 (2/6)	1 (2/6)	3 (7/9)	0	2 (5/3)
P-value		0/095	0/99	0/99	0/99	0/212	0/239	0/99
<55cm	Height	1 (0/7)	0	4 (2/8)	6 (4/2)	9 (6/3)	9 (6/3)	8 (5/6)
55cm<		0	1 (0/4)	6 (2/3)	9 (3/5)	8 (3/1)	11 (4/3)	14 (5/4)
P-value		0/355	0/99	0/784	0/71	0/125	0/362	0/931

<2.5kg g	Weight	0	0	2 (3)	0	4 (6)	1 (1/5)	3 (4/5)
2.5kg <		1 (0/3)	1 (0/3)	8 (2/4)	15 (4/5)	13 (3/9)	19 (5/7)	19 (5/7)
P- value		0/99	0/99	0/677	0/086	0/503	0/22	0/99
R Jugula r	Catheter location	1 (0/3)	1 (0/3)	8 (2/3)	14 (4/1)	15 (4/4)	20 (5/8)	21 (6/1)
L Jugula r		0	0	2 (3/6)	1 (1/8)	2 (3/6)	0	1 (1/8)
P- value		0/99	0/99	0/637	0/705	0/99	0/091	0/338
4F	Catheter size	0	0	1 (0/7)	5 (3/5)	6 (4/2)	6 (4/2)	7 (4/9)
5F		1 (0/4)	1 (0/4)	9 (3/5)	10 (3/9)	11 (4/3)	14 (5/4)	15 (5/8)
P- value		0/99	0/99	0/104	0/842	0/968	0/581	0/692
once	Number of attempts	0	0	3 (0/8)	2 (0/6)	16 (4/5)	19 (5/3)	20 (5/6)
Twice		0	1 (2/6)	7 (18/4)	10 (26/3)	1 (2/6)	1 (2/6)	1 (2/6)
Three times		1 (25)	0	0	3 (75)	0	0	1 (25)
P- value		<0/001	0/008	<0/001	<0/001	0/793	0/694	0/171

<14day	Catheter duration	1 (0/5)	1 (0/5)	5 (2/4)	9 (4/3)	5 (2/4)	12 (5/4)	7 (3/3)
14day < _		0	0	5 (2/6)	6 (3/2)	12 (6/3)	8 (4/2)	15 (7/9)
P-value		0/99	0/99	0/86	0/566	0/049	0/505	0/049

Discussion

The findings of our study showed that the most common complication of central venous catheter implantation in the neonates and infants studied included infection (5.5%) and venous thrombosis (5%), thrombophlebitis (4.3%), and bleeding (3.8), respectively. Hematoma (2.5%), arterial injury (0.3%) and pneumothorax (0.3%). It was also found that the frequency of bleeding in patients who had tried catheter insertion 3 times and the frequency of hematoma and arterial injury in people who had tried twice had been highest and finally it was found that one case of pneumothorax was seen in case who had been tried three times. The incidence of infection and thrombophlebitis in patients who had a catheter for more than 14 days was significantly higher than patients who had a catheter for less than 14 days. However,

it was found that the frequency of complications was not related to age, sex, height and weight, underlying disease of the infant, catheter location and catheter needle.

Aminnejad and etal in a 2013 clinical trial study, evaluated the success, failure, and complications of central cannulation in pediatric patients. In this study, 1941 neonates less than one month old and 1324 infants over one month old were included in the study. Failure were reported in 55 cases, one of whom developed pneumothorax. In 21 cases, the guide was damaged. In 381 cases the cannulation was successful in the first attempt. In 1924 cases, children aged 1 month to 8 years reported only 14 failures, and 1155 cases of convulsions the first attempt was successful. Also, the success rate of cannulation in children older than 1 month

was significantly higher than children less than 1 month.⁹ The findings of this study regarding the frequency of pneumothorax and also the frequency of the first attempt to insert a central catheter are quite similar to the findings of our study. However, in our study, the aim was only to investigate the complications and effective factors, and in future studies, the focus should be on the cause of more efforts to insert the catheter.⁹ Wilson et al. In a study of central catheters in neonates in 2007 in 96 preterm infants found that 39% of infants who had a central venous catheter implanted became infected or died, and infection or death occurred in 28% of neonates who underwent peripheral venous catheter implantation. However, this difference was not statistically significant, but in terms of the number of attempts to implant a catheter in the neonates of the peripheral vein implantation group, this difference was significant.¹ The findings of the study regarding the incidence of infection following central catheterization as the most common complication are like the findings of our study. But in our study, only 5.5% were infected, which is much less than the percentage expressed in Wilson's study. The reason for this difference may be due to differences in sampling,

differences in controlling the effect of confounders, differences in the place and time studied, differences in the sample size. Janes et al in a study called central catheter examination in neonates, which was performed on 63 infants weighing less than 1.251 g, stated that the incidence of sepsis and the duration of catheter use in both central and peripheral catheters was no difference, but the number of attempts to insert the central catheter was less than the number of attempts to insert the peripheral catheter, which was a significant difference ($p = 0.008$). In this study, it was also stated that the main problem of central catheters is infection and obstruction, and finally it was stated that the insertion of a central catheter reduces the painful procedures for implantation of a catheter in these infants.¹² The findings of this study regarding the complication of central catheters are quite similar to our study. In our study, it was found that infection is one of the most common complications of central catheter implantation. However, in our study, complications in the two methods of peripheral and central catheterization were not compared, which requires more detailed study in future.

In 2016, Fathi et al Compared the internal jugular vein cannulation under ultrasound

guide and the internal jugular vein cannulation using anatomical landmarks. In this study, 921 patients who were admitted to the surgical ward for heart surgery and needed central venous cannulation were randomly selected. Central venous cannulation was performed in 151 patients based on anatomical landmarks and in 191 patients under ultrasound guidance. The success rate of the procedure based on anatomical landmarks was 98.7% and the success rate of the procedure under the ultrasound guide was 99.4%.¹⁰

Although in our study the catheterization method (based on landmark and ultrasound) was not examined, but the success rate for the first time in the study is less than both methods expressed in the study. The reason for this discrepancy may be due to differences in sample size, differences in the study method, and differences in the definition of catheterization success rate, because in our study we considered the third unsuccessful attempt as failure. Although to compare success, we compared the success rate for the first time with the findings of the study.¹¹

Hosseini et al. In 2013 Conducted a study comparing the early consequences of

insertion of a central venous catheter through a peripheral vein with a peripheral vein in very low birth weight preterm infants. The aim of this study was to compare the advantages and disadvantages of implanting a central catheter through a peripheral vessel with conventional peripheral catheters. In a clinical trial, 11 premature infants weighing less than 1500 g were included in the study. For 59 neonates, a central venous catheter was inserted through a peripheral vein, and for 11 neonates, peripheral artery cannulation was performed with an angiocath. Early outcomes such as catheter persistence, chance of infection, and mortality were evaluated and compared in the two groups. The mean neonatal weight in the PICC group was 1061 g and in the peripheral vessel group was 1054 g. Sepsis (positive blood culture) occurred in 8 cases of PICC group and 9 cases in peripheral blood group. In 9 cases, positive culture of central catheter tip (colonization) occurred in PICC group. The number of deaths in the PICC group was 1 neonatal and in the peripheral vessel group was 5 neonates.¹² The findings of this study regarding the prevalence of complications in central venous catheter in the studied neonates are quite similar to the findings of our study.

In a study conducted by Nazem et al. In 2006 with the aim of investigating the results of central venous catheter implantation in infants and children of Alzahra Hospital in Isfahan.

During the first 6 months of 2005, 21 central venous catheters were performed in the surgical and internal wards of infants and children. All operations were performed in the operating room and under the MAC. For the operation, in the neck hyperextension position, by cutting the skin on the SCM muscle, the back muscle was pushed and the internal jugular vein was identified. Then the lateral wall of the vessel was opened and CVC catheter No. 14 was placed in it.¹³

If possible, the catheter entry site was repaired with 6-0 nylon sutures; otherwise, the vessel was cut as a cut-off and the catheter was fixed through the subcutaneous canal to the skin.

In all patients, intraoperative complications including bleeding and failure and pre-discharge complications including catheter thrombosis, fluid leakage, bleeding, and catheter maintenance time were recorded. In this study, 21 patients (9 boys, 12 girls)

were studied, 15 of whom were infants. The minimum age was one day and the maximum was 3 months. The mean age of children was 47.9 ± 18.47 days. The lowest patient weight was 700 g. Catheter maintenance time was 18.9 ± 11.9 days (1-198 days); There were no failures during the operation. Postoperative bleeding occurred in two cases (9.5%), in one case it was so rapid that the patient died and in the other case it was controlled with maintenance treatment. Leakage rate was 4.8 (one case), thrombosis rate was 9.5% (2%) and catheter removal rate was 9.5% (2 cases). There was no relationship between patient age and duration of catheter maintenance and complications. The use of a catheter (CVC) in neonatal and pediatric wards can be used for a long time. In doubtful cases, the cut-down method seems to be preferable to the vessel repair method.¹³ Although the prevalence of complications in our study is lower than the study, but the findings regarding the lack of relationship between age and the incidence of complications are quite similar to the findings of our study.

Conclusion

According to the findings of this study, it can be seen that the incidence of complications due to central venous catheter in infants and infants is low and has a significant relationship with more attempts to insert the catheter and longer catheter placement and can be a suitable method for treating neonates and Infants were indicated and had no side effects associated with underlying disease and neonatal demographic indicators.

Ethical Consideration

This study was approved by Ethical Committee of Ahvaz Jundishapur University of Medical Sciences with code number IR.AJUMS.REC.1399.463

Acknowledgment

Not applicable

Funding/Support

Not applicable

Conflict of interests

There is no conflict of interest

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