http://jmscr.igmpublication.org/home/
ISSN (e)-2347-176x ISSN (p) 2455-0450
crossref DOI: https://dx.doi.org/10.18535/jmscr/v9i2.35

IGM Publication
Journal Of Medical Science And Clinical Research
An Official Publication Of IGM Publication

A Prospective Study on Complications of Central Venous Access in Neonates in a Tertiary Care Hospital

Authors
Dr Kranthi Kumar Kambam[1], Dr Rajendran. K[2]*, Dr Balakrishnan R[3]
[1]Post Graduate, Department of Paediatrics & Neonatology, Kovai Medical Centre, and Hospital, Coimbatore, Tamil Nadu India
[2]Professor & Head, Department of Paediatrics & Neonatology, KMCH Institute of Health Sciences & Research, Coimbatore, Tamil Nadu India
[3]Consultant Neonatologist, Kovai Medical Centre and Hospital, Coimbatore, Tamil Nadu India
*Corresponding Author
Dr K Rajendran

Abstract
Introduction: *Insertion of an intravascular catheter is the most common invasive procedure in the neonatal ICU (NICU). Central Lines (CL)s including Umbilical Venous Catheter (UVC)s and Peripherally Inserted Central Catheter (PICC)s are often used in the care of neonates to provide arterial and venous access. However, the use of CLs is associated with several complications including infection[(1),(2)]. For this reason, the decision to insert a CL should always be carefully considered for every patient individually, and the benefits must be weighed against the risks. The insertion and use of a CL expose the neonate to several potential risks and complications. The relative risk of sepsis is several times higher in a neonate with a CL[(3)]. The present study is an attempt to obtain actual data on the incidence of complications associated with central line insertions in our Neonatal ICU.*
Aim: *Aim of the study is to provide data on the use of Umbilical Venous Catheters and Peripherally Inserted Central Catheters in newborn infants admitted to our neonatal ICU and to study complications and their rates of occurrences.*
Methods: *All neonates admitted to the Neonatal Intensive Care Unit (NICU) at the Kovai Medical Centre and Hospital (KMCH) in the period from April 2018 until March 2019, who needed at least one Central Line during their hospitalization, were included. The study design is a Prospective Observational Study. The data were entered into the SPSS spreadsheet and double-checked. The analysis was done in SPSS version 20.0 for windows.*
Results: *Of all the Indications for the lines, prolonged use/TPN constituted the most – 82 (50.9%) out of which umbilical lines constituted 32 (39%) and PICC lines constituted 50 (61%). Several sites have been used for inserting PICC lines. The most common site being the Right Great Saphenous Vein (GSV). 46 out of 56 PICC lines have been secured in Right GSV which constituted 82.1 % of all PICCs. The second commonest being Left GSV – 7 (12.5%). Out of all the complications that occurred, Umbilical lines were found to have 8 complications (7.62% of all Umbilical lines) whereas PICC lines had 9 complications (16 % of all PICC lines). There were 17 complications in total which accounted for 10.55%. PICC lines have been found to have a greater number of complications and are statistically significant when compared to UVCs. Three cases of thrombophlebitis have been reported in our study. It constituted to 5.3% of all the PICC lines. Of the 7 occlusions that were reported, as many as 6 (85.7% of all occlusions and 10.7% of all PICC lines) have been in PICC lines whereas Umbilical lines had only 1 occlusion. Of the 2 extravasations that were reported, one was in UVC and the other was in the PICC group.*
Conclusion: *Most common indication for a central line in a neonate was poor venous access and prolonged use of TPN. Malposition in PICC lines was associated with a greater number of complications. Hence great care must be taken in the following line placed in an inappropriate position. Ongoing efforts are required to assure that the catheter does not migrate. Central Venous Catheters must be removed as soon as their potential risks outweigh their benefits. Umbilical Venous Catheters are usually safe upto 10 – 14 days. PICCs are usually safe for up to 4 weeks following which it is prudent to secure a new line and remove the existing line. Manipulating or handling these Central Lines without following proper hand hygiene practices increases the risk of infections.*
Keywords: *Central Venous Catheters, PICC Lines, Malposition, Infections.*

Introduction

Vascular catheters are considered ‘‘lifelines,’’ indispensable in neonatal intensive care. Insertion of an intravascular catheter is the most common invasive procedure in the neonatal ICU (NICU). With every passing decade, technological innovations in catheter materials and sizes have allowed vascular access in infants who are smaller and sicker, for purposes of blood pressure monitoring, blood sampling, and infusion of intravenous fluids and medications. On the other hand, there is growing recognition of potential risks to life and limb associated with the use of intravascular catheters. Medical literature is now replete with isolated case reports of complications succinctly described by Garden and Laussen[(1)] as ‘‘An unending supply of ‘unusual’ complications from central venous catheters’’ (CVCs).Central Venous Catheter (CVC) -the insertion is far from new. A similar technique was first described in 1912. However, the use of CVCs in the Neonatal Intensive Care Unit (NICU) has become widespread in 1970[(2)]. At that time, a new design for long-term indwelling was introduced by Broviac and Hickman in respectively 1973 and 1974[(3)]. Catheterization of peripheral veins is impractical and technically difficult in neonates. Therefore, when long-term intravenous access is needed a CVC is typically placed. These have several indications and distinct advantages. Firstly, CVCs provide continuous fluid replacement and the ability to deliver more calorie-dense and concentrated total parenteral nutrition (TPN), for instance in neonates with congenital anomalies and disorders of the gastrointestinal tract. Secondly, medications that are irritating or damaging (e.g. vancomycin, phenobarbital) can also be safely administered to a centrally located vein (the superior or inferior caval vein). Thirdly, CVCs provide stable intravenous access in neonates with congenital cardiac diseases for the continuous supply of critical medications; prostaglandins, dopamine, and dobutamine, some of which also need to be administered into a central vein. Finally, the need for painful repeated intravenous attempts is reduced, because of the extended dwell time of CVCs[(4)]. A CVC is defined as any catheter with the tip located in a large central vein. This is one near the center of the circulation (the heart); the superior vena cava (SVC) or the inferior vena cava (IVC)[(5)]. However, these cannot catheterize directly. The SVC can be reached through the cephalic or basilic vein in the antecubital fossa and the IVC through the femoral vein, for instance. Other common insertion sites include the cubital and subclavian vein and the great saphenous vein. Central Lines (CL)s including Umbilical Venous Catheter (UVC)s and Peripherally Inserted Central Catheter (PICC)s are often used in the care of neonates to provide arterial and venous access. However, the use of CLs is associated with several complications including infection,[(6)]. For this reason, the decision to insert a CL should always be carefully considered for every patient individually, and the benefits must be weighed against the risks. A CL should only be inserted when necessary and should be removed when no longer essential.[(7)] UVCs are commonly used to administer drugs, fluid and blood products, TPN, hypertonic fluid (concentrations of glucose solution above 12.5% in hypoglycaemia infants needing fluid restriction for instance), or for exchange transfusion in the early neonatal period. The insertion and use of a CL expose the neonate to several potential risks and complications. The relative risk of sepsis is four times higher in a neonate with a CL compared with a neonate without a CL, for instance[(8)]. The risk of developing complications depends on various factors. First, it is determined by patient factors; for instance, very low birth weight is related to a higher complication rate[(9)]. Second, the risk of a complication is influenced by catheter-related factors. The incidence of CL-related infection is significantly higher if catheter dwell time is prolonged. The present study is an attempt to obtain actual data on the incidence of complications associated with central line insertions in Neonatal ICU.[(10)]

Materials and Methods

In this Prospective study, neonates admitted to the Neonatal Intensive Care Unit (NICU) at the Kovai Medical Centre and Hospital (KMCH) in the period from April 2018 until March 2019, who needed at least one, Central Line, during their hospitalization, were included. CLs are primarily inserted percutaneously by the attending neonatologist. All neonates delivered in Kovai Medical Centre and Hospital. All neonates were admitted in our tertiary care Neonatal Intensive Care Unit for whom a central line was inserted.All the neonates will be closely monitored for complications and their incidence will be noted. Data will be collected and analyzed statistically at the end of the study periodfrom April 2018 to March 2019.Date of birth, gender, gestational age, birth weight, Apgar scores, the reason for admission, underlying condition(s), indication for surgical treatment (if any), and indication and date for CL placement were all noted. Gestational Age was divided into 4 groups. < 28 weeks, 28 – 32 weeks, 32 – 37 weeks, > 37 weeks. Birth weight was divided into 4 weeks. < 1000 grams, 1000 – 1500 grams, 1500 – 2500 grams, >2500 grams. Indications for CL placement were divided into – Line difficulty, prolonged use / TPN, hypoglycemia, Exchange transfusion. Multiple indications for one CL placement were possible. However, only the most important indication has been taken into account when analyzing the data, namely the most beneficial indication for CL placement for the patient, or which indication would provide the best long-term administration.

Central Venous Catheter Characteristics: The following data were collected to describe catheter characteristics: date of CL placement insertion site (which vein, left/right), the position of the catheter tip after placement, CL dwell time, and reason for removal. Furthermore, the duration of CVC use was recorded at the time of removal/complication. For Umbilical lines 4Fr single and double lumen catheters and 5fr single lumen, catheters were used, whereas for PICC lines Premi Cath (Vygon) 28G, 26G, and 24G were used. The decision on which vein to use for catheter placement depended on the preference of the neonatologist and the veins used previously. In the KMCH the first choice is Right Great Saphenous Vein. When the catheter could not be placed at the first site, a second vein was tried in the other lower extremity or eventually in the upper extremities (cephalic or basilic vein). In this study, potential sites of CL insertion in the upper extremities were: 1. Cephalic vein .2. Cubital vein 3.Basilic vein. Common insertion sites in the lower extremities were: 1. Great saphenous vein .2. Femoral vein CL dwell time was calculated as the number of days from the date of CL insertion to the date of CL removal (for any cause), death, or transferral to another institution. The catheter tip for the Umbilical line was preferably at the junction of the right atrium and inferior vena cava. The tip for the PICC line was preferably placed in the superior vena cava or the inferior vena cava, respectively for PICC insertion in the upper extremity and lower extremity. Here, the first radiograph obtained after insertion was utilized to determine the location of the catheter tip. Malposition of the catheter tip was defined as the tip in any location other than the superior vena cava for upper extremity vein catheterization or the inferior vena cava for lower extremity vein catheterization. Malposition was not recorded as a complication, since this can be due to the patient's anatomy, which precludes advancement of the CVC into the central veins. In the case of malposition, attempts to obtain proper CVC position after insertion have been recorded. This was defined as manipulation of the CVC.

Inclusion Criteria: All neonates delivered in KMCH will be included. The central line was placed in our hospital.

Exclusion Criteria: Neonates transferred from outside hospital. Central lines placed in the outside hospital and referred to KMCH

Statistical Tools: The data will be entered into the SPSS spreadsheet and will be double-checked. The analysis will be done in SPSS version 20.0 for windows. Descriptive analysis such as mean,

standard deviation, and the percentage is used to exhibit the clinical parameters considered in the research pro-forma. All the statistical tests will be examined with a 5% (P≤0.05) level of significance.

Observations and Results

Table: 1 Distribution of Samples according to Gestational Age

GA		UVC	PICC	Total
<28 weeks	N	10	13	23
	%	9.52%	23.21%	14.29%
28 - 32 weeks	N	38	23	61
	%	36.19%	41.07%	37.89%
32 - 37 weeks	N	30	15	45
	%	28.57%	26.79%	27.95%
> 37 weeks	N	27	5	32
	%	25.71%	8.93%	19.88%
Total	N	105	56	161
	%	100.00%	100.00%	100.00%
P-Value = 0.017				

Table:1 In Extreme preterm, i.e., GA <28 weeks, the total number of lines was 23 out of which Umbilical lines were inserted in 10 neonates whereas PICC lines were used in 13 neonates. In neonates between 28 – 32 weeks, the total number of lines was 61 out of which Umbilical lines were used in 38 neonates whereas PICC lines were used in 23 neonates. In neonates between 32 – 37 weeks, the total number of lines was 45 out of which umbilical lines were inserted in 30 neonates whereas PICC lines were used in 15 neonates. In Term neonates, the total number of lines was 32 out of which Umbilical lines were inserted in 27 neonates whereas PICC lines were inserted in 5 neonates only. A maximum number of Umbilical lines were used in the GA between 28 – 32 weeks. 38 lines were inserted in this age group which constituted 36.1%. The minimum number of Umbilical lines used were in extreme preterm which constituted 9.52% (10 lines). A maximum number of PICC lines were inserted in the GA between 28 – 32 weeks. 23 lines were used in this age group which constituted 41% of all PICC lines. The minimum number was used in term babies which constituted only 8.9% (5lines).

Table 2 Distribution of Samples according to Birth Weight

Birth Weight		UVC	PICC	Total
< 1000 grams	N	10	13	23
	%	9.52%	23.21%	14.29%
1000 - 1500 grams	N	31	24	55
	%	29.52%	42.86%	34.16%
1500 - 2500 grams	N	37	15	52
	%	35.24%	26.79%	32.30%
> 2500 grams	N	27	4	31
	%	25.71%	7.14%	19.25%
Total	N	105	56	161
	%	100.00%	100.00%	100.00%
P-Value = 0.003				

Table: 2 In ELBW babies, i.e., Birth weight less than 1000 grams, the total number of lines was 23 out of which Umbilical lines were inserted in 10 neonates whereas PICC lines were used in 13

neonates. In VLBW babies, i.e., Birth weight between 1000 – 1500 grams, the total number of lines was 55 out of which Umbilical lines were used in 31 neonates whereas PICC lines were used in 24 neonates. In LBW babies, i.e., Birth weight between 1500 – 2500 grams, the total number of lines was 52 out of which umbilical lines were inserted in 37 neonates whereas PICC lines were used in 15 neonates. In babies weighing > 2500 grams, the total number of lines was 31 out of which Umbilical lines were inserted in 27 neonates whereas PICC lines were inserted in 4 neonates only. A maximum number of Umbilical lines were used in the Birth weight between 1500 – 2500 grams. 37 lines were inserted in this weight group which constituted 35.2%. The minimum number of Umbilical lines used were in ELBW babies which constituted 9.52% (10 lines). A maximum number of PICC lines were inserted in the GA between 28 – 32 weeks. 24 lines were used in this age group which constituted 42.8% of all PICC lines. The minimum number was used in babies weighing more than 2500 grams which constituted only 7.1% (4 lines).

Table 3 Distribution of Samples according to Indication

Indication		**UVC**	**PICC**	**Total**
Line Difficulty	N	65	5	70
	%	61.90%	8.93%	43.48%
Prolonged Use/TPN	N	32	50	82
	%	30.48%	89.29%	50.93%
Hypoglycemia	N	3	1	4
	%	2.86%	1.79%	2.48%
Exchange transfusion	N	5	0	5
	%	4.76%	0.00%	3.11%
Total	N	105	56	161
	%	100.00%	100.00%	100.00%
P-Value < 0.001				

Table :3 shows Of all the Indications for the lines, prolonged use/TPN constituted the most – 82 (50.9%) out of which umbilical lines constituted 32 (39%) and PICC lines constituted 50 (61%). The second most common indication was Line Difficulty constituting as many as 70 lines (43.4%) out of which Umbilical lines constituted a major chunk – 65 (92.9%) and PICC lines being only 5 (7.01%). Hypoglycaemia and Exchange transfusion were other less common indications. For Umbilical lines, the most common indication was Line difficulty. As many as 65 out of 105 umbilical lines were inserted given line difficulty (61.9%). For PICC lines, the most common indication was TPN. As many as 50 out of 56 PICC lines were secured only for TPN purposes which constitutes to 89.2%.

Table 4 Distribution of Samples according to Site

Site		**UVC**	**PICC**	**Total**
Umbilical cord	N	105	0	105
	%	100.00%	0.00%	65.22%
Right GSV	N	0	46	46
	%	0.00%	82.14%	28.57%
Left GSV	N	0	7	7
	%	0.00%	12.50%	4.35%
Right Cephalic Vein	N	0	1	1
	%	0.00%	1.79%	0.62%
Left Cephalic Vein	N	0	2	2
	%	0.00%	3.57%	1.24%
Total	N	105	56	161
	%	100.00%	100.00%	100.00%

Table: 4 Several sites have been used for inserting PICC lines. The most common site being the Right Great Saphenous Vein (GSV). 46 out of 56 PICC lines have been secured in Right GSV which constituted 82.1 % of all PICCs. The second commonest being Left GSV – 7 (12.5%). Right and left Cephalic veins were very rarely used.

Table 5 Distribution of Samples according to Dislodgement

Dislodgement		**UVC**	**PICC**	**Total**
Yes	N	2	0	2
	%	1.90%	0.00%	1.24%
No	N	103	56	159
	%	98.10%	100.00%	98.76%
Total	N	105	56	161
	%	100.00%	100.00%	100.00%
P-Value = 0.424				

Table: 5 Out of all the 161 lines, there were only 2 instances of the catheter being dislodged. Both instances were involving Umbilical lines. No PICC lines were dislodged in this study period.

Table 6 Distribution of samples according to Hemorrhage

Hemorrhage		**UVC**	**PICC**	**Total**
Yes	N	4	0	4
	%	3.81%	0.00%	2.48%
No	N	101	56	157
	%	96.19%	100.00%	97.52%
Total	N	105	56	161
	%	100.00%	100.00%	100.00%
P-Value = 0.177				

Table: 6 Four instances of hemorrhage have been witnessed in this study period, all of which were in Umbilical lines. None of the PICC lines had any hemorrhage.

Table 7 Distribution of Samples according to Thrombophlebitis

Thrombophlebitis		**UVC**	**PICC**	**Total**
Yes	N	0	3	3
	%	0.00%	5.36%	1.86%
No	N	105	53	158
	%	100.00%	94.64%	98.14%
Total	N	105	56	161
	%	100.00%	100.00%	100.00%
P-Value = 0.041				

Table: 7 Three cases of thrombophlebitis have been reported in our study. It constituted to 5.3% of all the PICC lines.

Table 8 Distribution of samples according to Extravasation

Extravasation		**UVC**	**PICC**	**Total**
Yes	N	1	1	2
	%	1.0%	1.8%	1.2%
No	N	104	55	159
	%	99.0%	98.2%	98.8%
Total	N	105	56	161
	%	100.0%	100.0%	100.0%
P-Value = 0.576				

Table: 8 Out of all the 161 lines in our study, the number of Extravasations was2 (1.2%). Of the 2extravasations that were reported, one was in UVC and the other was in the PICC group. There

is no significant statistical difference in the number of extravasations between Umbilical and PICC lines.

Table: 9 Mean Duration of Catheter Days

Catheter Days	N	Mean	SD	P-Value
UMBI	105	6.48	1.33	P<0.001
PICC	56	10.20	4.54	

The mean duration of the Umbilical line is 6.48 days with a standard deviation of 1.33. The mean duration of the PICC line is 10.20 days with a standard deviation of 4.54.There is a significant statistical difference in the mean duration of both the lines with PICC being the longer one. We had a total of 1251 catheter days out of which Umbilical lines constituted 680(54.3%) and PICC lines constituted 571(45.6%).

Table 10 Showing site vs Thrombophlebitis

Site		Thrombophlebitis		
		Yes	No	Total
Right GSV	N	2	44	46
	%	4.30%	95.70%	100.00%
Left GSV	N	1	6	7
	%	14.30%	85.70%	100.00%
Right Cephalic Vein	N	0	1	1
	%	0.00%	100.00%	100.00%
Left Cephalic Vein	N	0	2	2
	%	0.00%	100.00%	100.00%
Total	N	3	53	56
	%	5.40%	94.60%	100.00%
P-Value = 0.714				

Table: 10 Out of a total of 46 PICC lines inserted in Right GSV, 2 (4.3%) were having thrombophlebitis. Left GSV was found to have 1 event of thrombophlebitis out of 7.Cephalic veins did not have any such episodes.

Discussion

The total number of babies included was 126. Out of these, 32 babies required both an Umbilical line and a PICC line. One baby required two PICC lines and one baby required 3 PICC lines. In the present study, the purpose was to analyze the overall outcomes of central lines (CLs) in neonates. CL-related complications were the primary outcomes of this study. First, the incidence and types of complications were identified.[10] Secondly, whether there was any significant difference between the incidence of complications between Umbilical lines and PICC lines was determined. Population demographics were similar to several other studies. However, the number of extreme preterms was low compared to other studies.[11] In our study, PICCs remained in situ longer than UVCs. Also, the duration of CLs was considerably longer in the extreme preterm age group and extremely low birth weight group. This difference was more obvious in the case of PICC lines – extreme preterm babies requiring prolonged duration of TPN was the major reason.[12] A similar pattern has also been noted concerning birth weight. The lesser the birth weight more is the number of catheter days. The maximum duration of a catheter in our study was a PICC line that was kept in situ for 29 days.[13] The site of insertion of the PICC line is different in different centers. We preferred to insert first in Right Great Saphenous Vein followed by Left Great Saphenous Vein. We could not find data about the incidence of local complications for UVCs, suchas redness of the umbilical rim or a

persistent wet umbilical stump in the literature. Therefore we assumed that the incidence of these local complications is very low or negligible. In our study, the incidence of such complications has been very less.[14] Malposition (versus proper initial position) may increase the complication risk, complication rate was more than two times higher in non-central CLs compared with CLs positioned in a central vein[15]. In the case of malposition, the tip was supposedly located in a vein with a smaller diameter compared to the vena cava. Therefore, the possibility of tip contact with the vein wall increases, which may damage the intima and trigger the clotting process. In our study, the frequency of CL malposition was significant. 35 of 105 Umbilical lines and 4 of 56 PICC lines were not in the appropriate position.[16] It accounts for a total of 24.2% of all CLs. In this study, a restricted definition was used for the appropriate positioning of the tip of CL.[17] For the Umbilical line, it was at the junction of the right atrium and Inferior Vena Cava whereas for the PICC line it was considered appropriate only if the tip was either in IVC or SVC.A study done by Nixon SJ et.al study of 1266 PICCs showed that true central placement of the catheter tip results in fewer complications. There were 42 complications in 1096 centrally placed catheters(3.8%) versus 49 complications in 170 non central catheters (28.8%). In our study of complications in PICC lines, there were 6 complications in 52 centrally placed catheters (11.5%) versus 3 complications in 4 non central catheters (75%). Thus our study showed a significant increase in complication rates if there is non central positioning of the tip of the catheter.[18] The rates are quite high when compared with the study quoted above.[19] In a study done by Sandoval Det.al . out of 352 catheters studied, the Occlusion rate was found to be 4.3%.[20] In our study the most common complication was occlusion of the PICC line. 6 cases of occlusion were noted which was around 10.7% which was slightly higher than most of the reports. If an occlusion was found, initially a flush was given to see if the occlusion relieves. If not, then that line was removed. The other frequent complication observed was thrombophlebitis (5.4%).[20] The lower the weight and gestation at birth, the higher the risk of complication. Moreover, premature and LBW infants usually need longer NICU stays, placing them at greater risk for nosocomial infections, including CVC-related infections[21]. Low birth weight (<2500 g) at the time of insertion was predictive for complications as well, probably for the same reasons. Brokencatheter, Embolization, Airembolization, Thrombosis, Liver damage, Myocardial rupture, Cardiactamponade, Arrhythmias, Hydrothorax, and pneumothorax are extremely uncommon complications that can be expected. Our study did not have any of these complications. Pneumothorax can be a serious complication, with the frequency of occurrence that varies between 0.01 and 6% (77). Our study did not have any instances of pneumothorax.[22] In another study the rate of CLABSI reported from a NICU in China, where the incidence of UVC – related septicaemia was 9,5%, with a rate of 13,6 per 1000 catheter – days. The CLABSI rates in our study appear to be very less when compared to these studies, however, our results are difficult to extrapolate to these studies given less sample size. Well-known factors that can increase CLABSI are the indwelling time of a central line, birth weight, gestational age, and total parenteral feeding.[23] Vierboom Ret.al found an adjusted relative risk from 2.5 for the use of a UVC comparing to no UC use, causing nosocomial bloodstream infections. Also, frequent manipulations of the UVC are a contributing factor in CLABSI. An average of3.2 manipulations per day (0-15) is associated with a 5-fold increase in CLABSI in very low birth weight infants.[24] We did not count the manipulations per day, so this adjusted risk cannot be mentioned but is an important issue. In our study of 105 UVCs, we did not find a single case of bloodstream infection. Infection rates in our NICU have been very low when compared to many other studies.[25]

Conclusion

The most common indication for central line in a neonate was poor venous access and prolonged use of TPN. The most common route of insertion selected was Right great saphenous vein was selected due to fewer chances of mechanical complications, easy access. Malposition in PICC lines was associated with more number of complications. Hence great care must be taken in the following line placed in an inappropriate position.Contrary to the belief, we found that the number of complications in UVC was more in the case of tips placed in appropriate positions rather than inappropriate positions. Central venous catheters (UVCs and PICCs) should be placed in the SVC or the IVC, not in the heart. Immediately after placing or repositioning a central catheter (arterial or venous), a radiograph should be obtained to confirm the proper location. Ongoing efforts are required to assure that the catheter does not ‘‘migrate.’Central Venous Catheters must be removed as soon as their potential risks outweigh their benefits. They are usually safe up to 3-4 weeks following which it is prudent to secure a new line and remove the existing line. Manipulating or handling these Central Lines without following proper hand hygiene practices increases the risk of infections.

References

1. Alshafei A, Tareen F, Maphango N, White D, O’Connor B, Sriparan T. Open tunneled central line insertion in children − external or internal jugular vein? J Pediatr Surg. 2018; 53:2318–2321
2. Arul GS, Lewis N, Bromley P, Bennett J. Ultrasound-guided percutaneous insertion of Hickman lines in children. A prospective study of 500 consecutive procedures. J Pediatr Surg 2009; 44:1371–1376.
3. Arul GS, Livingstone H, Bromley P, Bennett J. Ultrasound-guided percutaneous insertion of 2.7 Frtunneled Broviac lines in neonates and small infants. Pediatr SurgInt 2010; 26:815–818.
4. Auyong DB, Hsiung RL. Ultrasound in central venous cannulation. Adv Anesth 2010; 28:59–79.
5. Avanzini S, Guida E, Conte M, Faranda F, Buffa P, Granata C et al. Shifting from open surgical cut down to ultrasound-guided percutaneous central venous catheterization in children: learning curve and related complications. PediatrSurgInt 2010; 26:819–824. Back to cited text no. 17
6. Bannon MP, Heller F, Rivera M. Anatomic considerations for central venous cannulation. Risk ManagHealthc Policy 2011; 4:27–39. Back to cited text no. 5
7. Blum LV, Abdel-Rahman U, Klingebiel T, Fiegel H, Gfroerer S, Rolle U. Tunneled central venous catheters in children with malignant and chronic diseases: a comparison of open vs. percutaneous implantation. J PediatrSurg 2017; 30:30. Back to cited text no. 16
8. Davis MH. Pediatric central venous catheter management: a review of current practice. JAVA 2013; 18:93–98. Back to cited text no. 3
9. Fragen M, Gravvanis A, Dimitriou V, Papalois A, Kouraklis G, Karabinis A et al. Real-time ultrasound-guided subclavian vein cannulation versus the landmark method in critical care patients: a prospective randomized study. Crit Care Med 2011; 39:1607–1612. Back to cited text no. 11
10. Fratino G, Molinari AC, Parodi S, Longo S, Saracco P, Castagnola E, Haupt R. Central venous catheter-related complications in children with oncological/hematological disease: an observational study of 418 devices. Ann Oncol 2005; 16:648–654. Back to cited text no. 12
11. Hosseinpour M, Mashadi MR, Behdad S, Azarbad Z. Central venous catheterization in neonates: comparison of complications with percutaneous and open surgical methods. J Indian Assoc Pediatr Surg 2011; 16:99–101
12. Karakitsos D, Nikolaos L, De Groot E, Patrianakos AP, Kouraklis G, Poularas J et al.

Real-time ultrasound-guided catheterization of the internal jugular vein: a prospective comparison with the landmark technique in critical care patients. Crit Care 2006; 10:162–175. Back to cited text no. 14

13. Lorenz JM, Funaki B, Van Ha T, Leef JA. Radiologic placement of implantable chest ports in pediatric patients. AJR 2001; 176:991–994. Back to cited text no. 24
14. Loveday HP, Wilson J, Pratt RJ, Golsorkhi M, Tingle A, Bak et al. Epic3: national evidence-based guidelines for preventing healthcare-associated infections in NHS hospitals in England. J Hosp Infect 2014; 86:S1–S70.
15. Maizel J, Bastide MA, Richecoeur J, Frenoy E, Lemaire C, Sauneuf B et al. Practice of ultrasound-guided central venous catheter technique by the French intensivists: a survey from the BoReal study group. Ann Intensive Care 2016; 6:76–78.
16. Massicotte MP, Dix D, Monagle P, Adams M, Andrew M. Central venous catheter-related thrombosis in children: analysis of the Canadian registry of venous thromboembolism complications. J Pediatr 1998; 133:770–776.
17. McMullan C, Propper G, Schuhmacher C, Sokoloff L, Harris D, Murphy P, Greene WH. A multidisciplinary approach to reduce central line-associated bloodstream infections. Jt Comm J Qual Patient Saf 2013; 39:61–69.
18. Nixon SJ. Death after inserting the Hickman line was probably avoidable. BMJ 2002; 324:739.
19. Prabhu V, Juneja D, Gopal PB, Sathyanarayanan M, Subhramanyam S, Gandhi S, Shivan and KN. Ultrasound-guided femoral dialysis access placement: a single-center randomized trial. Clin J Am Soc Nephrol 2010; 5:235–239.
20. Sandoval D, Srceva MJ, Todorova ZN. Comparative analysis of ultrasound-guided central venous catheterization compared to blind catheterization. Pril (Makedon Akad Nauk Unmet Odd Med Nauki) 2017; 38:107–114. Back to cited text no. 8
21. Taylor JE, McDonald SJ, Tan K. Prevention of central venous catheter-related infection in the neonatal unit: a literature review. J Matern Fetal Neonatal Med 2015; 28:1224–1230. Back to cited text no. 2
22. Troiano's CA, Hartman GS, Glas KE, Skubas NJ, Eberhardt RT, Walker JD, Reeves ST. Guidelines for performing ultrasound-guided vascular cannulation: recommendations of the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists. JASE. 2011; 24:1291–1318.
23. Verghese ST, McGill WA, Patel RI, Sell JE, Midgley FM, Ruttimann UE. Ultrasound-guided internal jugular venous cannulation in infants: a prospective comparison with the traditional palpation method. Anesthesiology 1999; 91:71–77. Back to cited text no. 25
24. Vierboom R, Darani A, Langusch C, Soundappan SVS, Karpelowsky J. Tunnelled central venous access devices in small children: a comparison of open vs. ultrasound-guided percutaneous insertion in children weighing ten kilograms or less. Journal of Pediatric Surgery 2018; 53:1832–1838.
25. Willetts IE, Ayodeji M, Ramsden WH, Squire R. Venous patency after open central-venous cannulation. Pediatr SurgInt 2000; 16:411–413.