Clinical audit on umbilical venous catheterization at NICU of Assiut University Children Hospital

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Introduction
It is known that neonates have a friable Peripheral blood vessels and it is difficult to access, particularly in preterm so we use umbilical arterial catheters (UACs) and umbilical venous catheters (UVCs) to provide easy and rapid access during resuscitation, administration of fluids and parenteral nutrition, frequent blood sampling and blood transfusion in unstable neonates who need urgent intervention.

Objectives
To check the adherence of the physician to the accepted guidelines for umbilical venous catheterization at Neonatal Intensive Care unit of Assiut University Children Hospital, educate healthcare personnel about the proper method of insertion and maintenance of this line and educate them how to prevent intravascular catheter-related infections.

Patient and methods
This was prospective Clinical audit study, From the 1st of April 2020 up to the end of December 2020, included All newborn admitted to NICU, at Assiut University Children Hospital during the study period and in need for central lines.
We applied Checklist Steps of Umbilical Catheterization (UVC) and determined the percentage of achievement of each step.

Results
The mean gestational age of the studied cases was 32.61 ± 2.68 weeks, The median birth weight (gram) of the studied cases was 1720, Out of 94 studied cases, 42 (44.7%) were males and 52 (55.3%) were females. and Regarding maturity; the vast majority of the studied cases were preterm (92.6%) and only seven cases (7.4%) were full-term. Concerning the steps of UVC insertion; those steps were done in 100% of cases (washing the cord with an antiseptic tincture, Insertion a sterile umbilical catheter into the vessel, detect a good blood flow through the catheter and adding Tape Bridge for further stability.followed by determining the length of catheter, Cutting the cord in a horizontal way with a scalpel to a length of 1 cm from skin, putting a sterile gloves, a mask and gown, Positioning of the catheter were verified by x-ray and Scrubbing hands to elbow was done in 90 (95.7%) 87 (92.6%), 84 (89.4%),77 (81.9%), 59 (62.8%) of the studied cases respectively. but other steps were done in lower percentages.

Conclusion
Those steps were done in 100% of cases (washing the cord with an antiseptic solution, Insertion a sterile umbilical catheter into the vessel, detecting a good blood flow through the catheter and Adding Tape Bridge for further stability, but there were defects in all other steps with different percentages.

Keywords:
newborns, NICU, umbilical catheterization

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Introduction

Neonates, who are admitted in NICU, are usually in need to a vascular access, either for short-time 'temporary needs' or long-time 'permanent access'.

There are various methods for vascular access to meet the required treatment and investigations in neonates [1].

The physicians should minimize the number of attempts and the trauma to neonates, so the indication and duration of vascular access should be carefully considered before placement is attempted. And also they should have a good knowledge about the anatomy and have awareness of the likely complications associated with each vascular access [2].

Neonates have a friable peripheral blood vessels and usually is difficult to access, particularly in preterm, so we use umbilical arterial catheters (UACs) and umbilical venous catheters (UVCs) to provide suitable

access during resuscitation, administration of fluids, parenteral nutrition, blood transfusion and frequent blood monitoring in unstable neonates [3].

After insertion the catheter in right place, precautions to avoid the risk of infection must be taken; careful handling and using antiseptic solution [1].

The contraindications for the umbilical artery are the same as the umbilical vein, These include omphalocele, omphalitis, gastroschisis or peritonitis. But there are more contraindications for umbilical artery catheterization as evidence of vascular compromise in the lower limbs or buttocks and necrotizing enterocolitis [4].

Aim of work

To check the adherence of the physician to the accepted guidelines for umbilical venous catheterization at Neonatal Intensive Care unit of Assiut University Children Hospital, educate healthcare personnel about the proper method of insertion and maintenance of this line and educate them how to prevent intravascular catheter-related infections.

Patients and methods

This was prospective Clinical audit study, From the 1st of April 2020 up to the end of December 2020, included All newborn admitted to NICU, at Assiut University Children Hospital during the study period and in need for central lines while any infant >28 days old or who did not need UVC were excluded.

Technique of umbilical vein catheterization [5]

(1) Detect the Size of the catheter for infants weighing <3.5 kg and those weighing >3.5 kg is No. 6 Fr and a No. 8 Fr, respectively.
(2) Measure the length from the xiphoid to the umbilicus and add 0.5–1 cm to determine the specific length of catheter is needed.
(3) Suspect entrance of catheter into portal vein when there is a resistance and the catheter cannot be advanced to the desired distance, or if a bobbing motion of the catheter is detected.
(4) Give only isotonic solution in catheter until the position of it is confirmed by x-ray films.
(5) Remove the Umbilical venous catheters as soon as possible when no longer needed, but can be used up to 14 days under aseptic control.

Complete checklist for central catheter insertions in NICU [Table 1]: [6]

Table 1 Complete Checklist Steps of Umbilical Catheterization (UVC)

Checklist Steps of Umbilical Catheterization (UVC)	Yes	No	Comment
1. Determine length of catheter			
2. Scrub hands to elbow			
3. Wear sterile gloves, gown and mask.			
4. wash the cord with an antiseptic solution			
5. Drape the abdomen with sterile towels			
6. Place a tape around the cord and tie a single knot.			
7. Cut the cord in a horizontal way with a scalpel to a length of 1 cm from skin.			
8. Remove clots with forceps and identify cord vessels			
9. Grasp cord stump, using toothed forceps			
10. Gently dilate the opening of vessel by using iris forceps			
11. Insert a sterile umbilical catheter into the vessel			
12. Determine a good blood flow through the catheter.			
13. Do x-ray to detect the position of the catheter			
14. Make a suture using silk thread around base of the cord to prevent bleeding			
15. Add Tape Bridge for further stability.			

Statistical analysis

All statistical calculations were done using SPSS (statistical package for the social science; SPSS Inc., Chicago, IL, USA) version 21. Quantitative data were statistically described in terms of mean ± standard deviation (±SD), median and range; qualitative data were statistically described in terms of frequencies (number of cases) and relative frequencies (percentages) when appropriate.

Ethical considerations

The study proposal approved by Ethical Committee of Scientific Research of Faculty of Medicine Assuit University. An informed written consent was obtained from those who welcome to participate in the study.

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Results

The demographic data of the studied participants were summarized in Table 2

The mean gestational age (weeks) of the studied cases was 32.61 ± 2.68 and ranged from 26 up to 38 weeks.

The median postnatal age (days) of the studied cases was two days and ranged from 1 up to 4 days.

The median birth weight (gram) of the studied cases was 1720 and ranged from 900 up to 2600 gm.

Out of 94 studied cases, 42 (44.7%) were males and 52 (55.3%) were females.

Regarding maturity; the vast majority of the studied cases were preterm (92.6%) and only seven cases (7.4%) were full-term.

The steps of Umbilical Catheterization (UVC) insertion were shown in Table 3

(1) Determine the length of catheter 'was done in 90 (95.7%) of the studied cases,
(2) Scrub hands to elbow 'was done in 59 (62.8%) of the studied cases,
(3) Wear sterile gloves, gown and mask' was done in 84 (89.4%) of the studied cases,
(4) Cleanse the cord with an antiseptic solution' was done in all (100.0%) of the studied cases
(5) Drape the abdomen with sterile towels' was done in fifty percent of the studied cases,
(6) Place a tape around the cord and tie a single knot 'was done in 68 (72.3%) of the studied cases,
(7) Cut the cord in a horizontal way with a scalpel to a length of 1 cm from skin was done in 87 (92.6%) of the studied cases,
(8) Remove clots with forceps and identify cord vessels' was done in 59 (62.8%) of the studied cases,
(9) Grasp cord stump, using toothed forceps 'was done in 63 (67.0%) of the studied cases,
(10) Gently dilate the opening of vessel by using the forceps 'was done in 22 (23.4%) of the studied cases,
(11) Insert a sterile umbilical catheter into the vessel' was done in all (100.0%) of the studied cases,
(12) Detect good blood flow through the catheter' was done in all studied cases,
(13) Do x-ray to detect the Position of the catheter 'were verified in 77 (81.9%) of the studied cases,
(14) Make a suture using silk thread around base of the cord' was done in 36 (38.3%) of the studied cases,
(15) Add Tape Bridge for further stability was done in all (100.0%) of the studied cases.

Table 2 Demographic data of the studied cases (*n*=94)

Variable name	*n*=94	
Gestational age (weeks)		
Mean±SD	32.61±2.68	
Range	26–38	
Postnatal age (days), median (range)	2 (1–4)	
Birth weight (gm), median (range)	1720 (900–2600)	
Sex, *n* (%)		
Male	42	(44.7)%
Female	52	(55.3)%
Maturity, *n* (%)		
Preterm	87	(92.6)%
Full-term	7	(7.4)%

Quantitative data are presented in the form of mean±SD with median (range), qualitative data are presented in the form of *n* (%).

Discussion

The umbilical venous catheter (UVC) is one of the most generally used central lines in newborns. It can be fluently fitted soon after birth to provide intravenous access in babies requiring advanced resuscitation in the delivery room or to give fluids, therapies and parenteral nutrition during the 1st days of life. All Residents should train about insertion of UVC. There are still no standard guidelines for assessment or monitoring of tip location, securement, management, or dwell time despite UVCs being used by neonatologists for over 60 years [7].

We reported 94 cases of neonates with UVC fixed during the first week of life at NICU of Assiut University Children Hospital. The mean gestational age (weeks) of the studied participants was 32.61 ± 2.68, the median

Table 3 Checklist of the steps of Umbilical Catheterization (UVC) insertion (*n*=94)

Checklist steps	Done		Not done	
1. Determine length of catheter	90	(95.7)	4	(4.3)
2. Scrub hands to elbow	59	(62.8)	35	(37.2)
3. Put on sterile gloves, a mask and gown.	84	(89.4)	10	(10.6)
4. Cleanse the cord with an antiseptic solution	94	(100.0)	0	(0.0)
5. Drape the abdomen with sterile towels	47	(50.0)	47	(50.0)
6. Place umbilical tape around the cord and tie a single knot.	68	(72.3)	26	(27.7)
7. Cut the cord horizontally with a scalpel to a length of 1 cm from skin.	87	(92.6)	7	(7.4)
8. Remove clots with forceps and identify cord vessels	59	(62.8)	35	(37.2)
9. Grasp cord stump, using toothed forceps	63	(67.0)	31	(33.0)
10. Gently dilate the vessel by inserting iris forceps	22	(23.4)	72	(76.6)
11. Insert a sterile, saline-filled, umbilical catheter into the vessel	94	(100.0)	0	(0.0)
13. A good blood flow should be established through the catheter.	94	(100.0)	0	(0.0)
14. Position of the catheter should be verified by x-ray.	77	(81.9)	17	(18.1)
15. Place a purse-string suture using silk thread around base of the cord	36	(38.3)	58	(61.7)
16. Add Tape Bridge for further stability.	94	(100.0)	0	(0.0)

Data are presented in the form of *n* (%).

birth weight (gm) was 1720 and ranged from 900 up to 2600 gm and There is no sex predilection among studied cases, out of 94 studied participants, 42 (44.7%) were males and 52 (55.3%) were females, In line with the current study, Dongara *et al*. reported that the mean gestational age of the studied cases was 34.93 ± 4.19 weeks, the mean birth weight (gm) was 2139 ± 772 gm and 73.6% were males [8], Also Goh *et al*. reported that the mean gestational age and birth weight were 30.4 ± 4.0 weeks and 1,536.2 g ± 788.9 g respectively [9].

In the study of Konstantinidi *et al*., the reported gestational age was less than the mean gestational age reported by the current study. The author found that the mean gestational age of studied neonates was 28.5 ± 1.99 weeks [10].

The major goal of UVC insertion is to provide safe vascular access immediately after birth in high-risk neonates which result in rapid increase in survival rate of newborns [11].

However; up to date no current available data regarding the evaluation of insertion and monitoring of umbilical catheters insertion at AUCH. The goal of this study is to offer a practice-oriented overview on UVCs at AUCH that might improve clinical outcomes.

According to the recommendation of the WHO guidelines for hand-washing, it is advised that health workers should care about hand hygiene before touching hospital instruments and equipment, before any manipulation with newborns, and between dealing with neonates [12], Unfortunately; scrubbing hand to elbow was defected in 37.2% cases in this study. It is important to support the health workers for the correct technique in addition to the actual time spent on hand-washing. Proper design and convenient location of hand-washing facilities is another important factor [13].

Place sterile towels so that just the area around the stump is exposed [14], in the current study only in fifty percent of the studied cases, the clinicians drape the abdomen with sterile towels.

In the current study, physicians do not apply secured tie around the base of the umbilicus in 26 cases (27.7%), which may increase liability of bleeding due to inappropriate hemostasis. As tying a single knot around the base of the umbilicus is crucial to provide enough secure to maintain hemostasis [14].

In the present study; physicians do not remove clots with forceps or identify cord vessels in 35 cases (37.2%), and in 31 cases (33.0%) physicians do not grasp cord stump by using a toothed forceps. This is against the Clinical Guideline that advised' Umbilical Venous Catheter Insertion and holding the stump with the toothed forceps and remove any visible clots is an important step for UVC insertion' [15].

Confirm catheter location by x-ray was also a defect point in this study as it was only done in 81.9% of the studied cases. This defect was against what was stated by previous publications which reported that, confirming catheter location radiographically is an essential step to assure the correct position of umbilical venous catheter [16].

In 58 cases (61.7%) the physicians do not applying silk thread around base of the cord. Placing purse-string suture or umbilical tape around the base of the cord is to provide hemostasis and to secure the venous line [14]

Conclusion

Concerning the steps of UVC insertion; those steps were done in 100% of cases (washing the cord with an antiseptic tincture, Insertion a sterile umbilical catheter into the vessel, detecting a good blood flow through the catheter and adding Tape Bridge for further stability. followed by determining the length of catheter, Cutting the cord in horizontal way with a scalpel to a length of 1 cm from skin, wearing sterile gloves, gown and mask, Positioning of the catheter were verified radiographally and Scrubbing hands to elbow was done in 90 (95.7%) 87 (92.6%), 84 (89.4%),77 (81.9%), 59 (62.8%) of the studied cases respectively. but other steps were done in lower percentages.

Limitations of the present study

We didn't follow the studied cases to record outcome of UVC insertion, to determine the success rate, and to document the post-procedure complications.

Recommendation

(1) Great need for programs for training of physicians in Neonatal Intensive Care Unit team.
(2) We recommend gentle dilation of the vessel by inserting iris forceps, confirm catheter location radiographically.
(3) Also, further studies are needed to compare the Neonatology Unit's agreed upon protocol to one of the international guidelines and to identify defects in insertion and monitoring of umbilical intravascular catheters at AUCH and prescribe how to correct these defects.

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Conflicts of interest

None declared.

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