

## Guidelines for Application of Central Venous Catheters in Pediatric ICU of Assiut University Children Hospital (Clinical Audit)

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### Abstract

**Background:** Central venous catheterization can be life-saving but is associated with complication rates of approximately 26.2%. Operator experience, familiarity with the advantages and disadvantages of the various catheterization sites, and strict attention to detail during insertion help in reducing mechanical complications associated with catheterization.

**Aim of Study:** Evaluation of health care providers compliance to guidelines of application of CVL (central line-associated blood stream infection (CLABSI) guidelines 2013) in PICU (Assuit University Children Hospital).

**Patients and Methods:** The study was conducted on patients 1m to 17 years of age for whom CVCs was applied on attending Assuit University Children Hospital in PICU. The study included 80 cases during aperiod of one year from 1/9/2016 till 1/9/2017. The study data were collected by using checklist and observing health care provider compliance to guidelines of application of CVL.

**Results:** Central venous catheterization can be lifesaving but is associated with complication rates of approximately 26.2% and the main indication for CVC application was shock 56.6%and stick of application of guidelines ranged between 65%-100%.

**Conclusion:** We need to stick with the international guidelines as a reference standard and proper catheter maintenance care to decrease the frequency of complication mainly displacement and catheter-related infections.

**Key Words:** CVCs – Indications – Complications– Application.

### Introduction

**CENTRAL** venous access is defined as insertion of catheter into the venous great vessels. The venous great vessels include the superior vena cava, inferior vena cava, brachiocephalic veins, internal jugular veins, subclavian veins, iliac veins, and common femoral veins. Catheters that terminate in a systemic artery are excluded [1].

The earliest pioneers of central venous catheterization in humans were Werner Forssmann, André Cournand and Dickinson Richards who jointly shared the 1956 Nobel Prize for Medicine. The first to report the use of a catheter in humans for obtaining mixed venous blood for the measurement of right atrial pressure or cardiac output were Cournand and Ranges (1941). They mentioned Forssmann (1929) as the originator of central venous catheterisation technique [2].

The line can be left in for weeks, months or years. In order for it to last as long as possible, it is important to understand what a catheter is, what it is used for and how to take care of it. With advancing paediatric healthcare, the use of central venous lines has become a fundamental part of management of neonates and children. Uses include haemodynamic monitoring and the delivery of lifesaving treatments such as intravenous fluids, blood products, antibiotics, chemotherapy, haemodialysis and total parenteral nutrition.

There are common types of central venous catheter as nontunneled CVCs implantable ports, tunneled CVCs, peripherally inserted central catheter. Central line infections in children are associated with increased mortality, increased length of hospital and intensive care unit stay, treatment interruptions, and increased complications. Prevention is paramount, using a variety of measures including tunnelling of long-term devices, chlorhexidine antiseptics, maximum sterile barriers, aseptic non-touch technique, minimal line accessing, and evidence-based care bundles [3].

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### Abbreviations

CVCs : Central Venous Catheters.

PICU : Pediatric Intensive Care Unit.

CLABSI : Central Line-Associated Blood Stream Infection.

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## Patients and Methods

*Type of the study:* Prospective randomized study over 1 year from Sept. 2016 – Sept. 2017.

*Study setting:* On PICU at Assiut University Children Hospital.

*Study subjects:*

*A- Inclusion criteria:* All patients from 1 month to 17 years of age in whom CVCs were applied.

*B- Exclusion criteria:*

- Local infection.
- Distorted local anatomy.
- Coagulopathy.
- Previous radiation therapy.
- Suspected proximal vascular injury.

## Results

The study was conducted on patient from 1m to 17 years of age for whom CVCs were applied on attending Assiut University Children Hospital in PICU during period of one year from 1/9/2016 till 1/9/2017. The study included 80 cases 66.3% were males, 33.7% were females.

Table (1): Shows the demographic data of studied cases and revealed that 66.3% were males, 33.7% were females. According to the distribution of age the majority of cases were in the age range 1 day-1 years by 43.7% followed by the age range 1 year-6 years 35%, lastly 6-17 years 21.3% each respectively.

Table (2): Shows indications of application of CVCs in studied cases and revealed that: The main indications were shock (56.2%), lack of peripheral venous access (30%), hypoglycemia (5%), support of frequent blood sampling (3.8%), then plasmapheresis and burn equally (2.5%).

Fig. (1): Shows percentage of complications of application of CVCs in studied cases and revealed that: Complication presented only in 26.2%.

Table (3): Shows types of complications of CVCs in studied cases and revealed that: Complications presented only in 21 case.

Complication related to maneuver pneumothorax and hemothorax were equally 9.5%.

*Complication after application of CVCS:*

Main complication were misplacement 28.6%, infection 23.8%, then occlusion and hematoma was equally 14.3%.

Table (4): Shows evaluation of guidelines of application of CVCs in studied cases and revealed that: Hand hygiene was ideally done in 93.7% and not ideally done in 6.3%. Personal protective equipment was done in 75% and not done in 25%.

Sterile towels use done in 65% and not done in 35%. Skin antiseptis was done ideally 95% and not ideally done (by alcohol only) in 5%. Optimal catheter type selection was done 100%. Optimal catheter site selection was done in 87.5% and not done in 12.5%. Sterile dressing was done perfectly in 88.7% and was not perfectly handling in 11.3%. Daily review of line necessity ,with prompt removal of unnecessary CVCs was done in 86.3% and not done in 13.7%.

Table (5): Shows evaluation of maintenance care of CVCs in the studied cases and revealed that: Daily dressing, site assessment was performed in 85% while not performed 15%. Catheter entries care was done 60% while not done in 40%. Cap/ tubing/dressing/needle changes was done by using cap of double valve way in 62.5% while not in 37.5%. Catheter site care was done ideally in 85% while not ideally done in 15%. Catheter hub/cap/ tubing care was done in 67.55% while not done in 32.5%.

Table (1): Demographic data of studied cases.

Variable	No.	%
Total number of cases	80	100
<i>Age:</i>		
Range	33 day-17 year	
(a) 1-<12 (month)	35	43.7
(b) 1-<6 (year)	28	35
(c) 6-17 (year)	17	21.3
<i>Sex:</i>		
Male	53	66.3
Female	27	33.7

Table (2): Indications of application of central venous catheters in studied cases.

Variable	No.	%
Total number of cases	80	100
Lack of peripheral venous access	24	30
Shock	45	56.2
Plasmapheresis	2	2.5
Burn	2	2.5
Hypoglycemia	4	5
Support frequent blood sampling	3	3.8

Table (3): Types of complications of central venous catheter in studied cases.

Variable	No.	%
Number of complicated cases	21	100
<i>Complication related to maneuver:</i>		
Pneumothorax	2	9.5
Hemothorax	2	9.5
<i>Complication after application of CVCS:</i>		
Infection	5	23.8
Misplacement	6	28.6
Hematoma	3	14.3
Occlusion	3	14.3

Table (4): Evaluation of application of guidelines of application of central venous catheters in studied cases.

Variable	No.	%
Total number of cases	80	100
<i>Hand hygiene:</i>		
Done	75	93.7
Not done	5	6.3
<i>Personal protective equipment:</i>		
Done	60	75
Not done	20	25
<i>Sterile towels use:</i>		
Done	52	65
Not done	28	35
<i>Skin antiseptis:</i>		
Done (ideally)	76	95
Not done (ideally) Alcohol only	4	5
<i>Optimal catheter type selection:</i>		
Done	80	100
Not done	0	0
<i>Optimal catheter site selection:</i>		
Done	70	87.5
Not done	10	12.5
<i>Sterile dressing:</i>		
Done	71	88.7
Not done (no perfect handling)	9	11.3
<i>Daily review of line necessity, with prompt removal of unnecessary CVCs:</i>		
Done	69	86.3
Not done	11	13.7

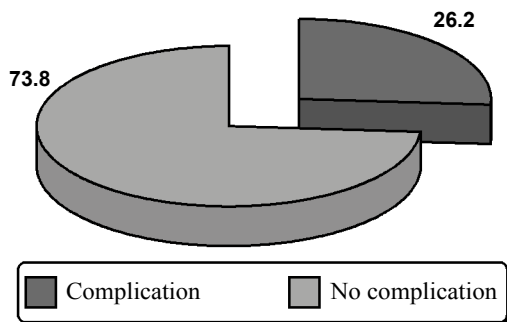


Fig. (1): Percentage of complications of application of central venous catheter in studied cases.

Table (5): Evaluation of maintenance care of central venous catheter in studied cases.

Variable	No.	%
<i>Daily dressing, site assessment performed:</i>		
Done	68	85
Not done	12	15
<i>Catheter entries care:</i>		
Done	48	60
Not done	32	40
<i>Cap/tubing/dressing/needle changes:</i>		
Done (using cap of double valve way)	50	62.5
Not done	30	37.5
<i>Catheter site care:</i>		
Done (ideally)	68	85
Not done (not ideally )	12	15
<i>Catheter hub/cap/tubing care:</i>		
Done	54	67.5
Not done	26	32.5

### Discussion

Our study included 80 cases who used non tunneled central venous catheter type which is the only available type of CVCs in our PICU.

Our study included, 53 males (66.3%) and 27 females (33.7%). Which is similar to a results obtained by Cruzeiro et al., who started a similar study and found that 58.7% were males and 41.3% were females [4].

According to the distribution of age the majority of cases 43.7% were in the age range 1 day to 1 years followed by the age range 1 year to 6 years (35%), lastly 6-17 years 21.3%. Which nearly comes in accordance to the study done by Cruzeiro et al., [4].

According to indications of application of CVCs in the studied cases the results are in agreement with Smith et al., [5].

According to complication of application of CVCs in our studied cases.

This was nearly similar to results obtained by Eisen et al., [6].

In our study guidelines of application of central venous catheters in studied cases and maintenance care applied accordingly to central line-associated blood stream infection (CLABSI) guidelines 2013 ranged between 65-100%.

### Conclusion:

Appropriate catheter and site selection, sufficient operator experience, careful technique, and

proper catheter maintenance with removal as soon as possible are associated with optimal outcome.

#### Recommendations:

- Hand hygiene should be done ideally according to the guidelines.
- Personal protective equipment must be used whatever the cause to prevent infection.
- Sterile towel use should be main part of sterilization system.
- Routine use of skin anti septic and not replaced by alcohol chlorohexidin is better according to our result so now it's used in our PICU.
- Daily follow-up of inserted CVCs for early detection of unnecessary or infected one.
- Early detection of CVCs infection and early treatment.
- Proper selection of the site to avoid complication during application of CVCs.
- Accurate calculation of length to avoid misplacement of CVCs.

#### Recommendation for paramedical:

- Sterile dressing should be handled perfectly to avoid infection.

- Daily dressing, site assessment should performed routinely.
- Catheter entries care should done daily.
- Catheter site care should be ideally done.
- Catheter hub, cap, tubing care should be done daily, flushing solution and anticoagulant daily to avoid occlusion.

#### References

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## دراسة إكلينيكية عن تركيب القسطرة الوريدية المركزية بالعناية المركزة للأطفال بمستشفى الأطفال الجامعي بأسسيوط

يمكن للقسطرة الوريدية المركزية أن تكون منقذة للحياة ولكنها ترتبط بمعدلات مضاعفات تبلغ ٢٦.٢٪ تقريباً. إن خبرة مقدم الخدمة الطبية ومعرفته بمزايا وعيوب مواقع القسطرة المختلفة والإهتمام الدقيق بالتفاصيل أثناء الإدخال يساعد في تقليل المضاعفات الميكانيكية المرتبطة بالقسطرة.

الهدف من العمل: تم تقييم المبادئ التوجيهية لتطبيق تركيب القسطرة الوريدية المركزية في وحدة العناية المركزة لمراجعة الحسابات السريرية في مستشفى الأطفال بجامعة أسسيوط.

أجريت الدراسة على المرضى الذين تتراوح أعمارهم بين ١ و١٨ سنة من العمر الذين يحضرون مستشفى جامعة أسسيوط للأطفال في العناية المركزة. وشملت الدراسة ٨٠ حالة ٦٦.٢٪ من الذكور، ٣٣.٧٪ من الإناث.

ويوصى الباحثون بإتباع المبادئ التوجيهية لتطبيق تركيب القسطرة الوريدية المركزية لتجنب مضاعفاتها. وحساب دقيق لطول القسطرة لتجنب سوء وضع مكان القسطرة الوريدية المركزية. وتغيير على القسطرة يوميا، ومراقبه موقعها يجب أن يتم بشكل روتيني.

يجب تسليك مركز القسطرة، غطاء، وأتابيب يوميا بمحلول ومضاد للتخثر يوميا لتجنب إنسداد.