

Original Article

Umbilical Venous Catheter Position in Hasan Sadikin General Hospital: Overview of the Time Required

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Abstract:

Background: An umbilical venous catheter (UVC) is one of the most frequently used access in neonates. In developed countries, bedside ultrasonography (USG) is used in assessing the position of the UVC catheter's tip. However, this is difficult to be implemented in developing countries. In Indonesia, which categorized as a middle-income developing country, the evaluation of UVC mainly used chest radiographs. However, this procedure would take time. The delay in ascertaining UVC positioning through chest radiography among neonatologists in Indonesia remains unstudied, despite its potential on the clinical efficacy. Therefore, this study aimed to determine the time required for the installation of the UVC and the interval from the completion of UVC insertion until the release of the chest radiography result.

Method: In this prospective observational cohort study, neonates requiring UVC access were examined in Dr. Hasan Sadikin Hospital in Bandung, West Java. Patients underwent anthropometric measurements and UVC installation. Duration required for UVC installation and the interval between the completion of UVC insertion and the release of the chest radiography result were documented. Descriptive data were shown in percentage, mean and standard deviation.

Result: 127 neonates were studied. The average time taken for UVC insertion was 31 minutes and the average time taken from the completion of UVC insertion until the release of chest radiography results was 6 hours.

Conclusion: The long wait for chest radiography results significantly delayed the administration of fluids, medications, and parenteral nutrition in this study. Therefore, we need alternative tools to evaluate the UVC location that can be used bedside right after the installation.

Keywords: chest radiography, neonates, umbilical venous catheter

Introduction

The use of UVC is essential for newborns, particularly those at high risk. Some of the main indications for using UVC are hemodynamic monitoring, volume resuscitations, parenteral nutrition, and administration of medications.¹ UVC is one of the most frequently used central venous access in neonates due to its ease of use and affordability.²

After installation, it is important to ensure the correct positioning of the UVC. Misplacement of the catheter may lead to problems such as venous thrombosis, as well as liver and heart issues. The correct tip location is at the junction between the inferior vena cava (IVC) and the right atrium (RA), which can be reached after entering the umbilical vein and passing through the ductus venosus (DV).³ This position is considered to be associated with the lowest incidence of complications.^{3,4}

The rapid evaluation of UVC is essential for the prompt administration of nutrition and fluids. In developed countries, bedside USG is frequently used to evaluate UVC, particularly for determining the position of the catheter's tip. However, in developing countries such as Indonesia, this procedure is not applicable as the availability of bedside USG is still limited. Majority of the hospitals in Indonesia rely on radiograph examinations to assess the position of the catheter's tip. However, this procedure is time-consuming as immediate radiograph examination may not be possible due to the inavailability of portable X-ray machine, requiring transfer of the baby to the radiography room for examination.

In Indonesia, the delay in evaluating UVC positioning through chest radiography among neonatologists has not been studied. Therefore, this study aimed to determine the time required for the installation of the UVC and the interval from the completion of UVC insertion until the release of the chest radiography result.

Method

This prospective observational cohort study was conducted from January to June 2023 in Dr. Hasan Sadikin Hospital, Bandung, West Java. This study employed a consecutive sampling method. The inclusion criteria were all neonates indicated for UVC access insertion. All neonates underwent UVC installation immediately within 0-1 hour age after birth. Neonates with major gastrointestinal or abdominal congenital anomalies were excluded. All study participants were inserted a polyurethane 4Fr catheters UVC. The Shukla and Ferrara method was used to estimate the optimal length of UVC insertion ($\text{Length (cm)} = [(3 * \text{BW in Kg} + 9) / 2 + 1]$). Upon insertion, the UVC first entered the umbilical vein, then passed through the medial part of the left portal vein and ductus venosus, eventually reaching the junction of IVC and RA.

After the UVC were inserted, all participants then underwent a chest radiography examination. The UVC tip should be visualized at or just above the diaphragm (within 0.5–1.0 cm) on the anteroposterior chest and abdominal radiograph. The time taken for UVC installation, as well as the duration between the completion of UVC until the release of chest radiography results, were recorded.

This study was approved by the Research Ethical Committee Hasan Sadikin General Hospital, Bandung, West Java. Data were analyzed using SPSS statistical software version 25.0. Descriptive data were shown in percentage, mean and standard deviation.

Result

A total of 127 were included in this study. male neonates (47.8%) highlighting a balanced gender distribution within the study. Subjects mean birth weight was 1699.8 gram and mean body length was 40.9 cm. The demographic characteristics of subjects are shown in **Table 1**.

In this study, it was found that the average time taken for UVC installation was 31 minutes. The time required for installation ranged from a minimum of 5 minutes to a maximum of 60 minutes. We discovered the average time taken from the completion of UVC insertion until the release of chest radiography results was 6 hours. The time required from a minimum of 39 minutes to a maximum of 24 hours. The details are shown in **Table 2**.

Discussion

In this study, prematurity was the main indication of UVC insertion, with a mean gestational age of 33 weeks. Consequently, preterm birth leads to low birth weight.⁵ The average birth weight was also markedly low at 1699.8 gram, with the majority of neonates weighing less than 2500g. Only six neonates were observed to have a birth weight exceeding 2500g. A previous study in Singapore mentioned that 108 neonates who underwent UVC insertion had an average birth weight of 1536.2 g.⁶ Low birth weight, very low birth weight and extremely low birth weight infants are special among neonates, with high treatment needs and high mortality.⁷ They also have high nutritional requirements to match postnatal growth during hospitalization.⁸ With advances in enteral nutrition, UVC has become a common channel for nutrition and fluid delivery in the early postnatal period.⁹

The second most frequent underlying cause in this study is respiratory distress syndrome (RDS), which was found in 82 neonates (64.6%). A previous study on 100

neonates revealed that RDS (56%) was the most frequently observed condition requiring UVC insertion.¹⁰ Another study on 82 neonates highlighted RDS (82%) as **Table 1.** Characteristics of Subjects

Characteristics	n (%)
Gender	
Male	60 (47.2)
Female	67 (52.8)
Birth weight (g) – Mean ± SD	1699.8 ± 482
Body length (cm) – Mean ± SD	40.9 ± 4.2
Gestational age (weeks) – Mean ± SD	33 ± 2.8
Head Circumference (cm) – Mean ± SD	30.3 ± 2.2
Chest Circumference (cm) – Mean ± SD	25.2 ± 4.2
Indication for UVC insertion	
Prematurity	115 (90.5)
Low Birth Weight	74 (58,3)
Very Low Birth Weight	43 (33.9)
Extremely Low Birth Weight	4 (3.2)
Respiratory Distress Syndrome	82 (64.5)
Transient Tachypnea of Newborn	13 (10.3)
Sepsis	6 (4.8)
Pneumonia	1 (0.9)

Table 2. Time required for neonatologists to insert and determine UVC position using chest radiography

Time Required	n =127
Insertion of the UVC (minutes) - Mean ± SD	31.4 ± 10
From the completion of UVC insertion until chest radiography result were released (hour) – Mean ± SD	6,3 ± 5,8

the most frequent condition found in neonates with UVC insertion.¹¹ RDS primarily affects preterm and low birth weight neonates due to a deficiency of surfactant. Optimal fluid and electrolyte management is critical in the initial course of RDS. Some neonates may require volume resuscitation using crystalloids and vasopressors to manage hypotension. Furthermore, these patients often exhibit high nutritional requirements due to low birth weight. The umbilical vein is the easiest and most-used

access during neonatal resuscitation.¹² Therefore, UVC has become a channel for the treatment of the RDS.

Our study found that the average time for UVC installation was 31 minutes, which are in line with previous studies. Prior study on 100 neonates showed the median duration of the UVC procedure was 30 minutes.¹⁰ Another study on 144 neonates also highlighted the mean time needed for UVC insertion was 28.31 minutes.¹³ Furthermore, the average time taken from the completion of UVC insertion to the release of chest radiography results was 6 hours, with times ranging from a minimum of 39 minutes to a maximum of 24 hours in our study. A study conducted by Gerdina on 100 neonates mentioned that the duration from the start of the procedure until the catheter was used (including waiting time for the chest radiography to be performed and time needed to reposition catheters if necessary) was 74 (57–110) min.¹⁰

In this study, UVC was installed as soon as possible, within the 0–1-hour age after birth, with the average time for UVC installation was 31 minutes. According to NICE guidelines, when a baby qualifies for UVC insertion or parenteral nutrition, initiation should occur as soon as possible, and at the latest within 8 hours.¹⁴ For subjects who had not yet received parenteral nutrition due to awaiting chest X-ray results, temporary peripheral access was provided while waiting for the results.

The long wait for chest radiography results significantly delayed the administration of fluids, medications, and parenteral nutrition in this study. This delay was due to the process that depended on the coordination of many people, including nurses, operators, and radiologists. Another imaging method useful to confirm the positioning of UVC is USG. USG bedside is increasingly used in developed countries and has been suggested in several papers as an alternative to chest radiography as it seems more reliable, faster, and without side effects.¹⁵ Limiting the duration of the procedure may be very useful to enhance the treatment of neonates; therefore, we need an alternative tool to evaluate the UVC location that can be used bedside right after the installation.

Conclusion

In conclusion, our study revealed that the time taken from the completion of UVC insertion until the release of chest radiography results was 6 hours. The long wait of chest radiograph result significantly impacts patient management. Thus, alternative tool that can be used in directly after installation is needed to enhance treatment for neonates.

Conflict of Interest

None declared

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