International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 9; Issue 05(A); May 2020; Page No.22028-22031
DOI: http://dx.doi.org/10.24327/ijcar.2020.22031.4340

Research Article

# SUPRA UMBILICAL LINE PLACEMENT: ALIFE SAVIOR APPROACH IN SICK NEONATES AND EARLY INFANTS WITH CICATRIZED UMBILICAL STUMP

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**A R T I C L E I N F O**

***Article History:***
Received 14th February, 2020
Received in revised form 29th March, 2020
Accepted 05th April, 2020
Published online 28th May, 2020

***Key words:***
Cicatrized umbilicus, neonatal venous access, supra umbilical line, umbilicus,umbilical venous catheterization

**A B S T R A C T**

**Objective:** The umbilical venous catheterization is one of the fastest approaches for venous access in neonates. We describe here a novel supra umbilical line placement (SULP) technique in neonates and early infants, in whom umbilical stump had cicatrized; as a fast and life saving approach.

**Methods:** A single-center retrospective study over 18 months reviewing complications related to UVC insertion by SULP technique in neonates. Ideal UVC position was defined as catheter tip within 0.5 cm above or below the diaphragm. Catheter-associated bloodstream infection (CABSI) was defined as the positive microbiological growth in one or more blood cultures obtained from a symptomatic infant up to two days after UVC placement or within 48 hours of catheter removal.

**Results:** Total 11 patients had UVC insertion by SULP technique. The mean age at SULP was 25.9 post-natal days. The mean birth weight was 2.5 kg. The primary indications for SULP were prolonged antibiotics in 4, total parenteral nutrition in 4, difficult intravenous access in 2 and recurrent hypoglycemia in 1 patient. Out of 11 SULP, 5 were ideal, 4 were deep and 2 were short in catheter tip position. Mean duration of indwelling catheter was 5.3 days. Complications of SULP included CABSI, peritoneum breach during procedure, catheter blockage, surgical site infection in 1 patient each. None of the neonates had UVCs complicated by malposition, extravasation, venous thrombosis.

**Conclusion:** SULP is an easy, effective and life saving bed side procedure in sick neonates and early infants with difficult intravenous and intra-umbilical line access.

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## INTRODUCTION

Central venous catheters are essential for the care of critically ill neonates and when long-term vascular access is needed and peripheral vascular access is not an option.[1] The most common central venous access points in neonates are the umbilical vein, umbilical artery, and central veins.[2]The umbilical venous catheterization (UVC) is fast and a very safe procedure, but not without complications. It may cause infection, vasospasm, vascular perforation, thrombosis, embolism and catheter migration.[3,4]

We present here a new site for UVC in emergency situations for the care of critically ill neonates in whom peripheral vascular access is difficult and umbilical stump had cicatrized. To the best of our knowledge, this is the first such report of UVC by supra umbilical line placement (SULP) technique in English literature. We presume that our findings would help to inform clinicians of the benefits of SULP as a method of UVC, especially in sick neonates and early infants with difficult peripheral intravenous and trans-umbilical venous access.

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## METHODOLOGY

This retrospective study was conducted in a tertiary care center in New Delhi renowned for the management of difficult neonatal and neonatal surgical cases with dedicated neonatal intensive care unit (NICU). Study duration was between January 2017 to June 2018.In the present study, records of all patients admitted in NICU and wards, in whom supra umbilical line placement (SULP) was done, was retrieved and data was studied for birth weight, sex, indications, age at intervention, duration of indwelling catheter, blood stream associated infection and any associated complication with intervention. The range and median was calculated for continuous variables whereas proportions and frequency tables were used to summarize categorical variables.

Umbilical venous catheterization by SULP was performed by a trained pediatric surgery senior resident. Main indications of putting SULP in neonates and infants are difficult peripheral intravenous line, difficult trans-umbilical line due to cicatrization of umbilical cord and sick patients where general anesthesia (GA) is very risky to put internal jugular vein (IJV) central venous line. There is non-availability of bedside

ultrasound facility at our center to facilitate PICC insertion. Our department protocol for central venous access is to try for umbilical line first, then if it is difficult in late neonates and early infants due to cicatrization of umbilicus, our second option is IJV line under GA (if patient is fit for GA). All our cases were not fit for GA and hadcicatrization of umbilical stump so we tried a novel technique i.e. SULP to rescue our sick neonates.

SULP was inserted under maximum sterile barriers and NICU service conditions. A <1 cm incision was given 0.5 to 1 cm above umbilical stump using a 15 no. scalpel blade **[Fig.1]**. Using fine mosquito artery forceps for blunt dissection parallel to umbilical vein position, confining to pre-peritoneal space; vein was hooked in two silk thread loops. A 26 G insulin needle was used to traverse < 1/3rd of vein circumference, perpendicular to vein in horizontal direction and vein was cut over it. A 4 Fr umbilical catheter in term neonates and 3 Fr umbilical catheter in pre-term neonates was inserted gently after heparin flushing of catheter. Length of catheter insertion was pre-decided on anatomical landmarks so as to reach inferior vena cava. On gentle aspiration, blood flows freely. The venous catheter was secured using vicryl 6-0 round body needle and same was used to close the skin incision.

**Fig 1** Clinical photograph of a neonate showing incision site for supra umbilical line placement (SULP) [white arrow] and cicatrized umbilicus [black arrow]

UVC tip positions were seen on an antero-posterior (AP) view of abdominal X-ray **[Fig 2]** and categorized as deep, ideal, short or malpositioned.[5] An ideal position of UVC tip was at the level of the diaphragm, with allowance for up to 0.5 cm above or below the level of the diaphragm. A ray diagram showing site of umbilical vein cut down during SULP technique for putting UVC and course of catheter is depicted in [**Fig 3**]. A UVC tip was deep if it was placed more than 0.5 cm above the level of the diaphragm while a short UVC was when the UVC tip was placed more than 0.5 cm below the level of the diaphragm. Catheters that turned laterally into the hepatic circulation were labeled malpositioned catheters. SULP related Complications were reviewed which included intra-procedural complications, catheter blockage, catheter-related sepsis including catheter associated blood stream infection (CABSI), surgical site infection, extravasation, venous thrombosis and death.

CABSI was defined as the presence of bacteria or fungus in one or more blood cultures obtained from a symptomatic infant after two days of placement of a SULP catheter or within a 48-hour period after catheter removal.[6] The need for two blood cultures or a blood culture to be drawn from the catheter for diagnosis of CABSI was not pragmatic for neonatal practice.[7]

**Fig 2** Abdominal X-ray showing ideal position of umbilical venous catheter (UVC) tip [black arrow]

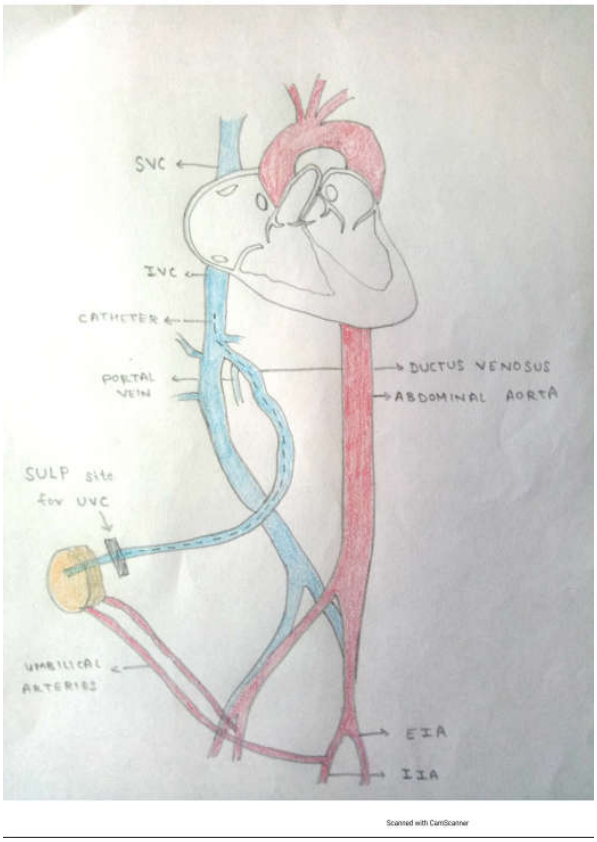


**Fig 3** A ray diagram showing site of umbilical vein cut down during supra umbilical line placement (SULP) technique for putting umbilical venous catheter (UVC) and course of catheter

# RESULTS

From January 2017 to June 2018, UVC was inserted in 11 neonates with SULP technique. The data of 11 subjects was retrieved and analyzed. The age at SULP varied from day 17th to 46th with mean age of 25.9 post-natal days. Eight were male babies and females were 3. Out of 11 subjects, 3 were pre-termers. The birth weight ranged from 2.1 kg to 3 kg with mean of 2.5 kg. Two of the subjects underwent SULP in NICU (one was preterm and needed it for TPN; other was term baby needing if for hyperosmolar glucose infusion). Two term babies were surgical neonates for SULP. Though all subjects had difficult intravenous access at presentation, the primary indications for SULP are enumerated in **table 1**.

**Table 1** Indications for supra umbilical line placement (SULP)

| Indications | Numbers |
|---|---|
| Prolonged antibiotics | 4 |
| Total parenteral nutrition | 4 |
| Difficult intravenous access | 2 |
| Recurrent hypoglycemia | 1 |

**Table 2** Complications of UVCs by novel SULP technique

| Complications | Number (n = 11) |
|---|---|
| CABSI | 1 |
| Peritoneum breach | 1 |
| Catheter blockage | 1 |
| Surgical site infection | 1 |
| Malposition | 0 |
| Extravasation | 0 |
| Venous thrombosis | 0 |

CABSI: catheter associated blood stream infection

Out of 11 SULP, 5 were ideal, 4 were deep and 2 were short in catheter tip position. None of them were malpositioned. The duration of indwelling catheter ranged from 3 to 8 days with mean of 5.3 days. Only 1 subject had catheter associated blood stream infection [CABSI] (9%) required change in intravenous antibiotics. There was inadvertent breach of peritoneum in one subject. One had blockade of catheter due to non-compliance with heparin flushing and had to be removed on day 4 of insertion. One had to be removed on day 6 of insertion in view of pus point at surgical site of incision, though the tip culture was sterile. None of the neonates had UVCs complicated by extravasation or venous thrombosis. Complications of UVCs by SULP technique are enumerated in **table 2**.

# DISCUSSION

With the advent of science and technology, medical field has been able to decrease morbidity and mortality in neonates. In NICU, low birth weight (LBW) and very low birth weight(VLBW) neonates are being able to survive and evolve. The central line placements have become part and parcel of the process in NICUs. It is being used for antibiotic administration, blood and blood products transfusion, total parental nutrition, blood sampling etc. Peripherally inserted central catheters (PICCs) are the most common used device by the neonatologists for LBW and VLBW neonates.[8,9] Usually ultrasound guided placement is sought[8-10]but non-availability or inexperience with small babies still makes surgical placement a common procedure.

Purkayastha *et al*. (2017) did a study on peripherally inserted central venous catheter (PICC) in infants in tertiary care center, in which PICC line was inserted after 20 days of postnatal age in 10 neonates.[11] Out of them, 5 needed PICC for antibiotic therapy, 4 for difficult intravenous access and 1 for TPN. In their study, the median catheter duration was 11 days with a range of 1-35 days. Our study had 5 days of median catheter indwelling duration. This difference may be due to the fact that our 8 out of 11 subjects were neonates. They reported 13.7 % rate of CABSI. They also reported Klebsiella as most common organism in neonatal blood cultures, which was similar to our one case of CABSI.

In a similar study by Uygun I (2016), 32 PICCs were placed in 31 patients from November 2010 to November 2014, out of which 19 (61%) were males and 12 (39%) females. The median age was 7 (range:1–36) days and median weight 2200 (range: 800–4100) gm.[8]The mean duration of catheterization was 10.3 days (range 2-23 days). 28/32 (88%) PICC were placed successfully in first venipuncture. 2 of them had bleeding complication, 1 got occluded, 1 had suspected infection and 2 had accidental removal. Our cases had some similar results, with 100 % success at first placement and no accidental removals.

There are various methods to define an ideal UVC position.[12] For ideal UVC tip position the cardiac silhouette method is superior to the vertebral level method.[13,14] The diaphragm method (position of catheter in relation to diaphragm domes) gives a better correlation to the cardiac silhouette on imaging, and hence was used as the method to determine ideal UVC positioning in our study. We measured the catheter length pre-insertion using anatomical landmarks and confirmed position in inferior vena cava post intervention by X-ray in all patients. None of our patients had malpositioned UVC, extravasation and venous thrombosis. Malpositioned UVCs should be avoided and once diagnosed by X-ray should be corrected or fresh catheter should be inserted to avoid fatal complications like severe hepatic injuries.[15] Extravasation injuries are usually associated with low lying catheters and malpositioned catheters used for hypertonic solutions.[16] Risk factors for neonatal venous thrombosis include extreme prematurity (gestational age $\leq$ 27.7 weeks), extremely low birth weight (birth weight < 900 g), raised haematocrit levels above 55%, and increased duration of indwelling central venous catheters and malpositioned UVCs.[17,18] None of our patients have above mentioned risk factors for venous thrombosis.

The British Association for Perinatal Medicine (BAPM) issued guidelines in 2015 and revised in 2018 after literature review and consultation with practitioners, incorporating the following three main practice points: (a) any clinical deterioration of an infant in whom a central venous catheter is present should raise the question of catheter-related complications, particularly infection, extravasation and tamponade; (b) all central catheter tips should be positioned outside the cardiac silhouette; and (c) a UVC tip should ideally be sited at T8–T9 (assuming this lies outside the cardiac silhouette). A UVC tip sited at or below T10 carries asignificantly higher risk of extravasation. It may be necessary to use these catheters in the short term, but they should be replaced at the earliest opportunity.[19]

There is currently great heterogeneity of practice within and between NICUs regarding risk assessment and refine indications for use of UVCs in neonates. Among the many areas of controversies are the indications for placement in terms of gestational age, birth weight, patient condition, postnatal age, condition of umbilical stump. Our novel SULP

technique of UVC insertion has definite advantage considering above mentioned factors in any level of NICU.

## CONCLUSION

From our study, we found that SULP is an easy and effective procedure during times of difficult peripheral intravenous access, difficult intra-umbilical line insertion due to previous failed attempts or umbilical cicatrization and can be lifesaving in times on non-availability of ultrasound guidance especially in neonates and early infancy. It is an easy bedside NICU procedure in sick neonates not fit for IJV cut down for central venous access under general anesthesia.

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**How to cite this article:**

Parveen Kumar *et al* (2020) 'Supra Umbilical Line Placement: Alife Savior Approach in Sick Neonates and Early Infants with Cicatrized Umbilical Stump', *International Journal of Current Advanced Research,* 09(05), pp. 22028-22031. DOI: http://dx.doi.org/10.24327/ijcar.2020.22031.4340

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