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Use of cyanoacrylate glue for the sutureless securement of epicutaneo-caval catheters in neonates

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Abstract

Introduction: Epicutaneo-caval catheters (ECC) are pivotal for drug and fluid infusion in neonates. Given the intrinsic importance of the catheter for the patients' health and the need to avoid stressful and painful procedures on premature or critically ill newborns with fragile and poor vein asset, it is clearly necessary an accurate bundle for ECC insertion and management to avoid complications that may lead to non-elective ECC removal. Among others, dislodgment is an acknowledged complication, and conventionally adopted fixing devices seem alone unsatisfying in relation to ECC securement.

Object: To evaluate the usefulness of medical Cyanoacrylate Glue (CG) as a solution to strengthen conventional ECC securement.

Methods: Since the use of CG has become part of our ECC insertion bundle in 2018, the present study compares all term and preterm neonates admitted in our NICU in 2018 who required an ECC for any cause (92 cases) with an historical cohort formed by all neonates who required an ECC in 2017 (80 patients).

Results: CG added to usual securement devices is effective in reducing ECC accidental dislodgment. Moreover, it is easy and safe to apply and remove, limits bleeding and oozing at the puncture site, and may also be an effective antimicrobial mechanical barrier.

Keywords

Neonates, neonatal intensive care unit, epicutaneo-caval catheters, catheter securement, cyanoacrylate glue

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Introduction

Central Venous Catheters (CVCs) are crucial for fluids, drugs, and parenteral nutrition administration in Neonatal Intensive Care Unit (NICU).

Peripherally Inserted Central Catheter (PICC) placement in newborns, first described in 1973 by Shah and Shah[1] is became a routine.[2] To date, neonatal Peripherally Inserted Central Catheters cannot be correctly named "PICCs" anymore, since the World Congress on Vascular Access (WoCoVA) Foundation recommended the use of the term "PICC" to indicate CVCs inserted by cannulating deep veins of the arm (where "deep veins" are defined as laying 7 mm deeper from the skin layer), commonly used in children and adults.[3] Anyway, there is a huge confusion in literature on the name of these neonatal catheters, that are also indicated as Long Lines, Perc Lines, Percutaneous CVCs, Epicutaneo-Caval Catheters (ECCs). All these things considered, the most appropriate term is ECC.

ECCs are silicone or polyurethane small caliber (1–2.7 Fr) catheters positioned through a peripheral vein, whose tip should be located as close to the Superior Vena Cava (SVC) / Right atrium junction. There, the blood flow guarantees an

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immediate dilution of infusates with a pH lower than 5 or greater than 9, or whose osmolarity is greater than 600 mOsm/L (a typical example is represented by total parenteral nutrition); other indications for an ECC placement are an expected IV infusion exceeding 6 days[4] but inferior than 14 days[3] and/or a poor and fragile vein asset.

An accurate bundle for the insertion and management is necessary in order to avoid complications. In fact, despite all precautions, non-elective ECC removal, that can potentially result in interruptions of intravenous therapy, added costs, and negative impacts on the infants' health, ranges in literature from 2.8 and 20.9%.[5] Costa et al. on a cohort of 524 ECC reported an overall incidence of non-elective removal of 31.5 per 1000 catheter/days: Central-line associated blood stream infections (CLABSI) resulted the most common cause (11.5 per 1000 catheter/days), followed by occlusion (5 per 1000 catheter/days), and dislodgement (4.4 per 1000 catheter/days); phlebitis (1.5 per 1000 catheter/days) and thrombosis (0.2 per 1000 catheter/days) where found to be less frequent.[6]

Given the importance of avoiding non-elective ECC removals and sparing painful and stressful procedures on premature and critically ill neonates, the aim of our study was therefore to evaluate the efficacy of adding medical Cyanoacrylate Glue to the usual securement devices to reduce the risk of ECC dislodgement in a neonatal population.

Methods

Since 2018 the use of medical Cyanoacrylate Glue for securing ECCs in addition to standard fixing device has become routine part of the insertion procedure bundle of our NICU; given that, in the present study we compare all term and preterm neonates admitted in our NICU in 2018 who required an ECC for any cause (92 cases) with an historical cohort formed by all neonates who required an ECC in 2017 (80 patients). In all cases (134 ECC in the intervention group, 124 ECC in the control group) we adopted Polyurethane catheters, measure ranging from 1 Fr to 2 Fr.

ECC insertion bundle

Examination and catheter length/size evaluation

In good light/using vein illumination devices, limbs are inspected for suitable insertion sites with and without tourniquet. Antecubital fossa (ACF) sites are usually considered as first choice, followed by saphenous or popliteal veins,[3] while scalp veins are usually considered less preferable due to the need for shaving before cannulation, the intrinsic tortuosity of the veins, the potential risk of aesthetic damage in case of complications. Once site identified, insertion distance is measured with tape measure. The ultrasound measurement of superficial veins may be difficult due to the vein compression caused by the same probe.[7] Thus, an effective alternative is represented by the systematic choice of the smallest catheter (1 Fr).

Following steps of the catheter positioning procedure

1- the chosen limb surface is cleaned and disinfected using 2% chlorexidine in 70% alchool with predosed applicators (1.5 ml or 3 ml according area to be disinfected)
2- a sterile towel is positioned under and around the limb
3- disinfected skin is allowed to dry
4- the tourniquet is applied approximately 3 cm above the chosen insertion site
5- the vein puncture is performed with a 24G or 20G breakaway needle introducer
6- a 0.9% saline preempted polyurethan catheter is advanced through the introducer until the predetermined measure is reached
7- the central tip position is verified with ultrasound with sterile procedure
8- the introducer is taken out and split, leaving the catheter in situ
9- the catheter is looped and secured with Steri Strips®
10- a sterile dry skin protector pad is placed under the catheter hub
11- the insertion site and the looped catheter are covered with a transparent semi-permeable dressing (TSD Tegaderm 3M diamod pattern® with high MVTR)

Intervention

In the intervention group, before step 9 a few drops of cyanoacrylate glue (CG—Histoacryl,BBrown®) were applied at the exit site of the catheter.

Data collection and analysis

All ECC inserted were registered in a database in which we reported birth date, gestational age and birth weight of the corresponding neonate, the time of positioning, any observation related to the catheter, time of line removal and eventual causes of non-elective removal. At the end of the established period (1 year) cases were compared to controls. Data set is described using measures of central tendency (mean and median) and measures of the dispersion (standard deviation or variance). A Chi-square test was carried out when indicated. The ethic committee approval was not required to include medical cyanoacrylate glue to our ECC insertion bundle, since medical glue is licensed by our hospital's Standards of Care for the

Table 1. Demographics population and Epicutaneo-Caval Catheters caratteristics.

	Intervention	Control	
Infants (*n*)	92	80	
Gestational age weeks	29	29	
Birth weigth grams	1280	1200	
Catheters (*n*)	134	124	
Day of life at the insertion	6	6	
Weight at insertion gramms	1230 (520–3000)	1180 (480–3270)	
Days ECC in place	10.4	11	
Elective ECC removal *n* (%)	95 (70.8)	89 (71.7)	
Dislodgement *n* (%)	1 (0.7)	14 (11.3)	0.0003

sealing of the exit site of all central venous catheters, regardless of patient's age.

Results

In 2018, 134 ECC (1–2 Fr polyurethane catheters) were inserted in 92 preterm and term neonates and all of them were secured with Cyanoacrylate Glue, sterile strips and TSD; 124 ECC inserted in 80 preterm neonates in 2017 and only secured with sterile strips and TSD were used as controls.

Mean postmenstrual age at the time of insertion was 29 weeks in both groups. The use of CG was not associated with any side effect. The incidence of accidental dislodgement was significantly reduced (Table 1).

Discussion

The basic principles of our bundle respond to the need to spare the already poor neonatal vein asset and avoid the leading complications reported in literature. First of all, the importance of a global vein assessment before venipuncture is widely acknowledged,[3] as well as the correct choose of size of the catheter, that should not occupy more than one-third of the vessel internal diameter to reduce thrombosis and phlebitis rate.[8]

Guidelines[9] recommend maximal sterile barrier precautions to reduce infections; as microorganisms that colonize catheter hubs and insertion site- surrounding skin are responsible of Catheter-Related Blood Stream Infections (CRBSI), antisepsis of the insertion site is one of the most important preventing-measures. Moreover, the insertion site is usually protected by dressings, that should be transparent, impermeable to microorganisms, and permeable to water vapor, as occlusive dressings gather moisture, providing an ideal environment for bacterial proliferation.

Regarding dislodgement, it remains a recognized reason of non-elective ECC removal. Wrightson[10] found this complication to be the 5th cause (following supposed sepsis, thrombosis, leakage, and edema/infiltration) of catheter removal in 374 ECC inserted by upper extremities and the 6th cause in 252 ECC inserted by lower limbs where phlebitis resulted more frequent; moreover, as above mentioned, Costa recently reported dislodgment as 3rd cause of non-elective removal, after CLABSI and occlusion.[6] These data are all consistent with the idea that conventionally adopted fixing devices are alone unsatisfying in relation to ECC securement.

Thus, an interesting solution to strengthen conventional ECC securement is represented by monomeric n-butil-2-cyanoacrylate, component of medical Cyanoacrylate Glue (CG).

Medical CG is a tissue adhesive that polymerizes in connection with tissue fluid leading to wound closure in less than a minute, with high mechanical strength, that can remain in place for 5 to 10 days, then naturally starts to dissolve.

In Wilkinson et al.[11] first described the successful use of CG for securing over 30 CVC in adults, focusing on patient comfort and on the combining advantage of a quick and easy both application and removal. This innovation drew some criticism: Lawrence and Hacking[12] reported his experience with a failed pilot evaluation of CG for securing 20 CVCs (three accidental CVC removal, one line dislodged, and six CVCs found to be unsecured at the time of planned removal). On the other hand, Lawrence didn't describe where, how, and in addiction to what CG was applied, nor the specifical kind of secured CVCs, but this criticism may be restricted to the use of CG, alone, as an alternative to suturing, for CVCs in adults.

More recently Scoppettuolo et al.described the advantages of CG for sealing the exit-site of PICCs, focusing on the reduction of risks of pericatheter bleeding and bacterial extraluminal contamination.[13] They also suggested a useful role of CG in CVCs securement, if applied at the exit-site, in addition to suturless devices, that are nowadays recommended as gold standard.[4] Moreover, they hypnotized a role of CG exit site sealing in reducing thrombosis rate by avoiding the endothelial damage due to the "in and out" movement of the catheter.[13]

In our knowledge, anybody ever considered the use of CG for securing catheters in the neonatal population.

However, given that ECC are intrinsically non-sutured catheters, the use of CG for the securement of these catheters, in addition to the commonly adopted Steri-Strips® may combine all the above mentioned advantages of the exit-site sealing, with the added strength of CG.

The results of our study are consistent with this consideration: the incidence of accidental dislodgement was significantly reduced ($p < 0.001$); moreover, we observed that CG was safe and easy both to apply and remove, and it yielded the additional advantage of preventing bleeding/oozing at the puncture site.

We also agree with Scoppettuolo et al. that the glue coat at the exit site of the catheter may also play a role as antimicrobial natural barrier.

Safety and effectiveness of adding CG to our standards for ECC securement were definitively so significative to encourage us to systematically integrate CG in our bundle.

Conclusion

Cyanoacrylate glue added to usual securement devices is effective in reducing ECC accidental dislodgement.

Moreover, it is easy and safe to apply and remove and gives the additional advantage of limiting bleeding and oozing at the puncture site. Nevertheless, further evaluations on the effective role of the exit-site sealing with CG as antimicrobial mechanical barrier may lead to other interesting conclusions.

Declaration of conflicting interests

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