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ORIGINAL ARTICLE

Heparin for clearance of peripherally inserted central venous catheter in newborns: an *in vitro* study

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KEYWORDS
Central venous catheterization;
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Abstract
Objective: To compare the efficacy of two concentrations of heparin to clear the lumen of *in vitro* clotted neonatal peripherally inserted central catheters (PICCs).
Methods: This is an *in vitro*, experimental quantitative study of 76 neonatal 2.0-Fr PICCs coagulated *in vitro*. The catheters were divided into two groups of 38 PICCs each. In both groups an infusion of low molecular weight heparin was administered with a dose of 25IU/mL for Group 1 and 50IU/mL for Group 2. The negative pressure technique was applied to the catheters of both groups at 5, 15 and 30min and at 4h to test their permeability. Kaplan–Meier survival analysis was used to verify the outcome of the groups according to time intervals.
Results: The comparison between both groups in the first 5min showed that more catheters from Group 2 were cleared compared to Group 1 (57.9 *vs.* 21.1%, respectively). Kaplan–Meier survival analysis showed that less time was needed to clear catheters treated with 50IU/mL of heparin ($p<0.001$).
Conclusions: The use of low molecular weight heparin at a concentration of 50IU/mL was more effective in restoring the permeability of neonatal PICCs occluded *in vitro* by a clot, and the use of this concentration is within the safety margin indicated by scientific literature.

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PALAVRAS-CHAVE
Cateterismo venoso central;
Obstrução do cateter;
Heparina;
Recém-nascido

Heparina para desobstrução de cateter venoso central de inserção periférica no recém-nascido: estudo *in vitro*

Resumo
Objetivo: Comparar a eficácia de duas concentrações de heparina para a desobstrução por coágulo do cateter venoso central de inserção periférica (CCIP) neonatal *in vitro*.
Métodos: Estudo experimental *in vitro* quantitativo que usou 76 CCIPs neonatais de tamanho 2 French coagulados *in vitro*. Os cateteres foram divididos em dois grupos com 38 CCIPs cada. Ambos os grupos receberam infusão de heparina de baixo peso molecular, com dose de 25UI/mL no Grupo I e de 50UI/mL no Grupo II. Os cateteres de ambos os grupos foram submetidos à técnica de pressão negativa com cinco, 15 e 30 minutos e com quatro horas e testou-se sua permeabilidade. Usou-se a análise de sobrevivência para verificar o desfecho dos grupos conforme os intervalos de tempo.
Resultados: A comparação dos dois grupos no intervalo de tempo de cinco minutos mostrou um número maior de desobstrução de cateteres no Grupo II (57,9%) em relação ao grupo 1 (21,1%). A análise de Kaplan Meier indicou menor tempo para desobstrução dos cateteres quando a heparina em maior concentração (50UI/mL) foi usada (p<0,001).
Conclusões: O uso de heparina de baixo peso molecular na concentração de 50UI/mL foi mais eficaz na restauração da permeabilidade de CCIPs neonatais ocluídos *in vitro* por coágulo e situou-se tal concentração dentro da margem de segurança indicada na literatura científica.

Introduction

The peripherally inserted central catheter (PICC) has been shown to be safe for intravenous infusion of solutions in neonates.[1,2] It has a lower incidence of complications when compared to other central venous catheters, supporting the thesis that it is a safe and useful device to be used in situations to be used when venous access is limited and difficult.[3]

Eventually, complications can occur, anticipating the unscheduled removal of the catheter.[2] Among the main complications are obstructions, with rates that can vary from 11% to 50%, and catheter rupture.[2–8] Obstruction may be caused by thrombus formation, a poorly positioned catheter tip or drug precipitation.[9,10]

These complications can be prevented and minimized through specific interventions. There are many practices related to maintaining the PICC permeability, although there is little scientific evidence on the best thrombolytic agent, as well as its safe and effective concentration that can support a single practice.[11–13]

Although heparin is almost universally used in clinical practice, its benefits have not been firmly established, as well as the effective and safe dose of this substance for arterial and venous catheters in neonatology.[12,13] The lack of scientific evidence and standardization through protocols leads to the use of several heparin concentrations, which can often be abusive as well as be as underdoses, which can result in unknown side effects or failure in catheter clearance.[14]

In this context, the aim of this study was to compare two different concentrations of sodium low molecular weight heparin (SLMWH) regarding its efficacy to restore the permeability of neonatal PICC obstructed by a clot in the laboratory.

Method

This is an experimental, *in vitro* study of quantitative approach, developed in the Analysis Laboratory of a university hospital in Londrina, state of Paraná, from July to December 2013. The study sample consisted of 76 PICC used in newborns admitted at the Neonatal Intensive Care Unit. In this unit, the indication for PICC use is the administration of antibiotics for longer than 7 days, start of vasoactive drugs, need for glucose infusion rate (GIR) >7, and parenteral nutrition; thus, all the catheters used in this study received all or some of these therapies. The catheters were obtained from the Neonatal Intensive Care Unit (NICU) of the above-mentioned hospital, after being removed from the newborns because of the end of the treatment. After they were removed, the catheters were immediately washed with a 10mL syringe, filled with distilled water, at least twice, until they were clean, and tested for integrity and permeability, after which they were stored in the original catheter plastic packaging. These catheters were stored in a cabinet away from light or moisture for approximately 6 months, the necessary time to obtain a sufficient number of catheters to start the study.

The criteria for catheter inclusion were minimum length of 11cm, 2.0-Fr caliber, made of polyurethane, single brand, and having remained in the newborn for a minimum of 1 week and a maximum of 30 days. The exclusion criterion was the impossibility of maintaining catheter permeability after its removal. For that purpose, the catheters were tested through the infusion of distilled water at their distal end using a 10mL syringe, and the visualization of the water output through the proximal end. Additionally, catheters that were not adequately stored after their removal were excluded.