

# Peripheral Inotropes in Critically Ill Children: Is It Safe?

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## Abstract

Many children needing pediatric intensive care units care require inotropes, which are started peripherally prior to securing a central venous access. However, many hospitals in low- and middle-income countries (LMIC) may not have access to central lines and the vasoactive medications are frequently given through a peripheral venous access. *Aim:* The aim of our study was to describe the role of peripheral vasoactive inotropes in children. *Methods:* Children requiring peripheral vasoactive medications were included in this study. We retrospectively collected data at 2 time points on use and complications of peripheral vasoactive medications. *Results:* Eighty-four children (51 pre-COVID era and 33 COVID pandemic) received peripheral vasoactive medications. Only 3% of children (3/84) developed extravasation injury, all of whom recovered completely. *Conclusions:* Results from our study suggest that extravasation injury due to peripheral inotrope infusion is very low (3%) and it may be safely administered in children at a diluted concentration.

## Keywords

vasoactive medications, inotropes, PICU, extravasation, peripheral catheters, central catheters

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### What do we already know about this topic?

Central venous access is commonly preferred over peripheral intravenous access for giving vasoactive medications in children.

### How does your research contribute to the field?

Our study adds to the available evidence that vasoactive medications at a diluted concentration may be safely administered through peripheral intravenous access in children who require short duration of vasoactive medications.

### What are your research's implications toward theory, practice, or policy?

This study is beneficial for clinicians in low- and middle-income countries (LMIC) in reducing the need/cost of a central venous access and adds to existing evidence that peripheral inotrope usage is safe with adequate monitoring.

## Introduction

Many children needing pediatric intensive care units (PICU) care require inotropes, which are started peripherally prior to securing a central venous access. Although

many PICU's, health care centers and transport services have started using inotropes via peripheral intravenous catheters,<sup>1,2</sup> the complications from peripherally administered vasoactive infusions in pediatrics are not very well described.<sup>3</sup> In addition, many health care centers in low- and middle-income countries (LMIC) do not have facilities or access for using central venous catheters. Here we describe a study assessing the role of peripheral vasoactive inotropes in children at a large PICU in south India.

## Methods

We retrospectively collected data of children who received vasoactive medications through peripheral intravenous

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**Table 1.** Characteristics of Children Requiring Vasoactive Medications via PIC.

	Pre-COVID 19 era n=51	COVID 19 era n=33
Age in years (range)	2.6 (1 month-18years)	7 (IQR, 5-17)
Male (n)	25	16
Female (n)	26	17
Admitted from (n)		
Emergency room	37	23
Wards	9	6
Other hospital	5	4
Indication for vasoactive medications (n)		
Septic shock	20	3
Dengue shock	17	0
Cardiogenic shock	10	2
Hypovolemic shock	1	0
Traumatic brain injury	3	1
Cardiogenic shock (MIS-C related)	0	27
Length of PICU stay in days (IQR)	3 (0.25-27)	3 (IQR, 2-5)
Type of vasoactive medication, n (%)		
Epinephrine (0.15 mg/kg in 50 ml Saline)	35 (67)	6 (18)
Nor-epinephrine (0.15 mg/kg in 50 ml Dextrose)	33 (65)	27 (81)
Dobutamine (6 mg/kg in 50 ml Saline)	6 (12)	0 (0)
Milrinone (1.5 mg/kg in 50 ml Dextrose)	4 (8)	2 (6)
Dopamine (6 mg/kg in 50 ml Saline)	4 (8)	0 (0)
Mean duration of vasoactive mediations via PIC (hour, range)	12 (1-72)	8 (1-48)
Complications, n (%)		
Extravasation injury	3 (6)	0
Children needing central venous access, n (%)	12 (23)	2 (6)

Abbreviations: PIC, peripheral intravenous catheters; MIS-C: multisystem inflammatory in children.

catheter (PIC) from 1st January 2019 to 1st October 2019 and again from 1st April 2020 to 1st October 2020 (during the COVID 19 pandemic). All children admitted to Pediatric intensive care unit (PICU) of Kanchi Kamakoti Childs Trust Hospital, Chennai, India, a tertiary care children's hospital, were included in this study. Data on the following variables were collected onto a proforma: baseline demographics, age at presenting to PICU, type of peripheral venous catheter used, type of vasoactive medication, duration of the infusion, type of complication, management approach, and outcome. The frequency of local tissue injury and extravasation injury due to peripheral vasoactive medications was determined. We described complication as tissue injury, which included any erythema, blistering, skin breakdown, or necrosis. Peripheral inotrope infusion concentration used was lower than the concentration of central inotrope infusion (Table 1). The concentration was decided and agreed by the PICU pharmacist and PICU consultants. Ethical approval for the study was obtained from the hospital ethical committee.

## Results

Fifty-one children from pre-COVID 19 period with a median age of 2.6 years (IQR: 1 month-18 years) and 33 children during the COVID 19 pandemic with a median age of 7 years (IQR: 5-17 years), received peripheral vasoactive medications. Multisystemic inflammatory syndrome in children (MIS-C) related cardiogenic shock (27/84) and septic shock (23/84) were the most common indication for PICU admission in this cohort and the average length of PICU stay was 3 days (IQR: 6 hours-27 days). Most commonly used vasoactive infusion was Nor-epinephrine (71%, 60/84) followed by Epinephrine (49%, 41/84). The mean duration of vasoactive medications was for 12 hours (range: 1-72 hours) and the mean peak vasoactive infusion score was 26 (range: 5-105). Other demographic and clinical characteristics of all children are shown in Table 1. In all 84 children, 22-gauge peripheral venous catheter was used and only 3 children developed extravasation injury, all of which were local tissue necrosis. They did not require any intervention and recovered completely.

## Discussion

Central venous access (CVA) is commonly preferred over PIC for giving vasoactive medications.<sup>1,2,4</sup> However, in an emergency, CVA in children can be challenging and difficult, delaying the administration of vasoactive medications.<sup>5</sup> Using a PIC may be beneficial in such situations and lifesaving.<sup>2,5</sup>

Adult published studies have documented extravasation injury tends to occur due to long duration of infusion via PIC.<sup>2,5</sup> Our findings appear to be in consistent with this. In all 3 children who developed extravasation injury, vasoactive medications were given for more than 24 hours. Their median infusion time was 28 hours, indicating that duration of infusion may be a risk factor for PIC injuries.

While administering vasoactive medications through PIC, close, and frequent site monitoring is necessary for timely detection of extravasation injury.<sup>1,2,4</sup> In our PICU, children receiving vasoactive medications via PIC are monitored hourly for any signs of tissue injury using standard phlebitis and infiltration scale. There are no available studies to suggest if any particular vasoactive medication or the concentration of infusion increases the risk of injury. The extravasation injury in our study is very low (3%), most likely due to the diluted concentration of vasoactive medications along with frequent assessment of the limb to identify any risks, therefore minimizing the complications.

In children requiring shorter duration of vasoactive medications, using a PIC may be cost effective, especially in LMIC, in addition to minimizing the complications of CVA. During the current COVID 19 pandemic we have successfully administered vasoactive medications through PIC in children presenting with MIS-C, thus avoiding the need for general anesthesia and CVA. We have therefore, continued to administer vasoactive medications through PIC initially for all children needing inotropes in our PICU.

Our study adds to the available evidence that vasoactive medications at a diluted concentration can be safely administered through PIC in children who require short duration of vasoactive medications. This

study is beneficial for clinicians in LMIC and adds to existing evidence that peripheral inotrope usage is safe with adequate monitoring.

## Author Contributions

KS: Contributed to conception and design; Final approval of the version to be published.

RM: Contributed to acquisition, analysis, and interpretation of data; drafting of the manuscript and statistical analysis; Critical revision of the manuscript for important intellectual content; Final approval of the version to be published.

## Declaration of Conflicting Interests

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