ORIGINAL ARTICLE

STUDY OF VASOACTIVE INFUSIONS THROUGH PERIPHERAL LINE

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Abstract

Vasoactive agents are ideally infused through central line in sick children. However its use in peripheral lines has been approved for emergency situations only. In resource poor countries there is a need for peripheral infusion of vasoactive agents in the absence of central lines in the emergency room and in the pediatric intensive care unit (PICU). This study was conducted to identify the feasibility of use of vasoactive agents through peripheral line in a PICU set up. Among the 204 children who received vasoactive agents (adrenaline, noradrenaline, dopamine and dobutamine) through peripheral line, adverse events were encountered in 12 (5.9%). Under strict monitoring, peripheral infusion of vasoactive agents are safe in resource poor settings.

Keywords: inotropes, peripheral infusion, complications

Introduction

Vasoactive agents are traditionally administered via central veins under strict hemodynamic monitoring. Central venous catheters (CVC) are expensive and needs expertise to insert. Meticulous monitoring of these lines is needed to prevent blood stream infections. In resource poor settings, cost and lack of adequate nursing personnel are important constraints for the routine use of central venous access in the pediatric intensive care units (PICU). The number of children needing inotrope infusions far exceed the availability of CVCs. Hence inotropes are administered through peripheral veins in most pediatric intensive care units (PICU) and emergency departments in developing countries. Invasive hemodynamic monitoring is used for only a few critically ill children. The existing western literature recommends only central venous access for administering vasoactive agents (1) except in the emergency department. (2,3) Extravasation of the vasoactive agents can cause severe local reaction and tissue necrosis. This is the main concern for the use of peripheral veins for administering vasoactive agents. As per the American college of Critical Care Medicine guidelines if central access is likely to delay infusion of inotrope then it can be infused in a peripheral line with monitoring. (4) The present study was undertaken to identify the feasibility of inotrope infusion through peripheral lines in resource poor settings.

Methods & Materials

This descriptive study was undertaken at PICU, Institute of child health and hospital for children, Egmore, Chennai over a period of 1 year from Oct 2009 to Sep 2010. All children beyond 30 days and upto 12 years of age, presenting with shock and for whom vasoactive agents were either started in emergency room or PICU through a peripheral line were studied. Children less than 30 days of age and children for whom vasoactive agents started prior to hospitalization or in the ward and then referred to PICU were excluded from the study. The dose of inotropes varied from 10–20 mcg/kg/min for dopamine and dobutamine and 0.1-1 mcg/kg/min for adrenaline and noradrenaline. The standard concentration for these agents were according to the rule of six (weight x 6 mg in 100 ml of normal saline for dopamine and dobutamine and weight x 0.6 mg in 100 ml of normal saline for adrenaline and noradrenaline. (2) Venous access was obtained at the dorsum of hands, forearm, ante cubital fossa or dorsum of foot. The type of shock, amount of fluid used for resuscitation, type of vasoactive agents, the duration of vasoactive infusion, complications like extravasations, arrhythmias, hypertension and hyperglycemia (blood glucose more than 200 mg/dl that was not present prior to vasoactive infusion, that lasted for 6 hours or more) were noted. Isolated tachycardia was not considered as arrhythmia as the etiology could be multifactorial. Similarly hypertension explained by other causes was not considered as a complication of inotropes. The peripheral lines infusing the vasoactive agents were meticulously monitored every 2 hours until the infusion was stopped. Edema, pain and discoloration of the skin of the extremity were regularly checked to look for any signs of extravasation. Pain at the site of infusion as assessed by verbal or facial scale was considered as an indication to remove the venous access device. Monitoring of the heart rate, respiratory rate, blood pressure, pulse pressure, capillary refill time, urine output and oxygen saturation were done 4 hourly. The need for ventilation, stay in PICU and final outcome were documented. The management of shock was as per the unit guidelines. Standard definitions were used to define shock as per PALS guideline. (2) Outcome was defined as discharge (recovery), death or discharge against medical advice. The study was approved by the Institutional ethical committee and informed written consent was obtained from the caregivers of the children enrolled for the study. Data was analyzed using SPSS version 11. Percentages were calculated. Univariate analysis was done for the study parameters the significance of association was calculated using chi square test.

Results

Over a period of one year, 204 (21.1%) children were included in the study out of 812 admissions to the PICU. One hundred and twenty (58.8%) were infants, 56 (27.5%) were between 1 and 5 years, 21 children (10.3%) were between 6 and 10 years and 7 children (3.4%) were more than 10 years. Male: female ratio was 1.14:1. Septic shock was encountered in 135 (66.2%) children, cardiogenic shock in 43 (21.1%), hypovolemic shock in17 (8.3%), distributive shock in 8 (3.9%) and septic cardiogenic shock in 1 (0.5%) child. Mechanical ventilation was required in 192 (94.1%) children. The total amount of fluid received in the first 24 hours varied from 32 ml/ kg to 352 ml/ kg with a mean ±SD of 133 ±63 ml/kg. Various inotropes given are depicted in table 1. Mean duration of dopamine was 31.4±41 hours, dobutamine 26.2±26.6 hours, norepinephrine 11.9±8.9 hours and epinephrine 16.6

±16.9 hours. In 3 children vasoactive agents were initially administered through interosseous route (for a duration of 24 hrs, 8 hours and 3 hours respectively) and later changed to a peripheral vein. Adverse effects encountered in the children with vasoactive infusions were minimal and were hyperglycemia in 6 (29%), extravasation in 3 (1.5%), hypertension in 2 (1%), supraventricular tachycardia in1 (0.5%) patient. Cutaneous extravasations occurred in two children with adrenaline infusion and one with dopamine infusion. None had vascular compromise. Cutaneous discoloration persisted till discharge in two children. Three out six children with hyperglycemia received adrenaline infusion. Others were on combination of multiple inotropes. Ninety-eight (48%) patients recovered, 100 (49%) died and 6 children were discharged against medical advice.

Table – 1: Vasoactive agents used in the study group

Vasoactive agents	No of children (%)
Dopamine	82 (40.2)
Dobutamine	14 (6.9)
Noradrenaline	-
Adrenaline	10 (4.9)
Dopamine +Noradrenaline	45 (22.1)
Dopamine+ Adrenaline	23 (11.3)
Dobutamine + Adrenaline	5 (2.5)
Dopamine+ Noradrenaline +Adrenaline	9 (4.4)
Dopamine+ Dobutamine	7 (3.4)
Dobutamine+ Noradrenaline	2 (1)
Dopamine+ Dobutamine +Noradrenaline	5 (2.5)
Dopamine+ Dobutamine +Adrenaline	1 (0.5)
Noradrenaline+ Adrenaline	1 (0.5)
Total	204 (100)

Discussion

Extravasation is the inadvertent leakage of a vesicant solution from its intended vascular pathway (vein) into the surrounding tissue. Infiltration is defined as inadvertent leakage of a non vesicant solution from the vein into the surrounding tissue. (5) Extravasation injury in the intensive care unit is a dreaded complication and this has been reported to be around 0.1 % – 6.5% among inpatients. (6) Children are more prone to extravasation injury due to the small size of veins, shock and capillary leak. (7) Inotropes are one of the common drugs implicated in extravasation injury. (6) Extravasation injuries can be classified into four stages. Stage I injury has pain at the site, no swelling, blistering or hard areas. Skin may be normal or discoloration may be mild, skin is warm with intact integrity, pulses in the limb will be normal with normal refill time. Stage 2 has pain with mild swelling and leakage around the site, no blisters, possible hard areas with blanching redness or discolouration. Skin is warm with good pulses and normal capillary return below the site. Stage 3 has pain at the site, moderate swelling with leakage around the site, may have blistering with hard areas, blanching of skin and purple or black discoloration, skin cool to touch with altered integrity, good or weak pulses with a capillary refill of 2-3 sec. Stage 4 is a medical emergency. Pain may or may not be felt in the limb with severe extravasation. Severe swelling, with leakage, blistering with hard areas blanching of skin with purple or black discoloration, skin cold to touch, altered skin integrity, weak or absent pulses, prolonged capillary refill time below the site are noted. In stage 1 and 2 it is difficult to flush the cannula while in stage 3 and 4 it will not be possible to flush the cannula. (8,9) Extravasation can occur in the central as well as the peripheral veins. Recent Cochrane review has shown that that centrally placed catheters undergo extravasation as frequently as peripheral access in neonates. (9,10) Covering the cannula insertion site with non transparent dressing, poor technique of securing the venous access, high inflow pressure on infusion pumps increase the risk for extravasation. (8,11) Antecubital veins are not to be used for vesicant drugs. (11) The degree of tissue damage due to extravasation is dependent upon: the volume of the infusate, its pH & osmolarity and pharmacological action of drug being infused. (9) Extravasation related injury could be due to patient factors, cannulation procedures, equipment used, drug related and trouble in identifying much earlier. (11) Extravasation of these vasoactive agents lead to severe tissue necrosis. Emergency management includes stoppage of the infusion, pain relief, specific antidotes like phentolamine as early as possible, removal of the cannula, limb elevation, documentation and information to the parents. (5,12,13) Notification of the plastic surgeons may be required in severe extravasation injuries especially stage 3 and 4. (13,14) The adverse effects due to inotropes were minimal in this study. Extravasation was encountered in only 3 children. They were only cutaneous extravasation and did not lead to major adverse events in any of the children. Meticulous nursing care is the major reason for such low incidence of extravasation. Extravasation injuries due to dopamine have been reported irrespective of the dose as even in low dose infusion extravasation can lead to significant concentration locally to cause tissue necrosis. (15) Deep segmental full thickness tissue necrosis and brachial plexus injury have been reported following dopamine infusion. (6)

Sinus tachycardia was common in the study group and this is attributable to many other reasons and unlikely to be due to vasoactive agents alone. Other adverse effects like hypertension and hyperglycemia were not life threatening. Factors like stress, pain and dehydration could also be contributing factors for these complications. The incidence of arrhythmias was much higher in study by Patel et al. (16) Our study did not include sinus tachycardia as an arrhythmia since it is

multifactorial among children admitted in the intensive care unit. None of the children in this study group had limb threatening complications, which are the most feared when vasoactive agents are used.

Even in developing countries very few literature exists with regard to the use of vasoactive agents in peripheral lines. Hence the present study may be considered as supportive evidence for the infusion of vasoactive agents in peripheral line in resource poor settings. Literature revealed a study on peripheral infusion of vasoactive agents during transport of critically sick children. This was a study conducted on peripheral infusion of vasoactive drugs among 73 subjects. This study revealed 1.5% extravasation and all resolved without lasting tissue injury. (17)

Conclusion

Though it is ideal to infuse vasoactive drugs through a central line, in resource poor setting, use of vasoactive agents through peripheral line in children with shock is justifiable as it is found to be safe without serious adverse effects if meticulous nursing care can be provided. It is also cost effective.

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