STUDY ON PROFILE OF CRITICALLY ILL CHILDREN TREATED WITH VASOACTIVE AGENTS IN PEDIATRIC INTENSIVE CARE UNIT

Dissertation submitted for

MD DEGREE EXAMINATION

BRANCH VII – PEDIATRIC MEDICINE

INSTITUTE OF CHILD HEALTH

AND

HOSPITAL FOR CHILDREN

MADRAS MEDICAL COLLEGE

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY

CHENNAI.

MARCH 2010

CERTIFICATE

This is to certify that the dissertation titled **"STUDY ON PROFILE OF CRITICALLY ILL CHILDREN TREATED WITH VASOACTIVE AGENTS IN PEDIATRIC INTENSIVE CARE UNIT"** submitted by Dr.C.S..SENTHIL KUMAR to the Faculty of pediatrics, The Tamilnadu Dr. M.G.R. Medical university, Chennai in partial fulfillment of the requirement for the award of M.D. Degree(Pediatrics) is a bonafide research work carried out by him under our direct supervision and guidance.

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SPECIAL ACKNOWLEDGEMENT

My sincere thanks to Prof.Dr.Mohana sundaram M.D.,the Dean, Madras medical college, for allowing me to do this dissertation and utilize the institutional facilities.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to **Prof. Dr. S. Saratha suresh, M.D., Ph.D, FRCP** (Glasgow) Director and superintendent of Institute of child health and hospital for children for permitting me to Undertake this study and for her guidance, invaluable help, encouragement and support throughout the study.

I am extremely thankful to **Prof.Dr. V.Seetha, M.D., DCH.** Additional Professor of pediatrics and my unit chief for her guidance, invaluable and timely help,encouragement and support throughout the study.

I would like to thank **Prof.Dr.P.Jayachandran,M.D.,DCH.,** Chief, Pediatric intensive care unit, **Dr.S.Thangavelu, M.D., DCH., MRCP.,** Former Reader, Pediatric intensive care unit, **Dr.S.Shanthi, M.D., DCH., Dr. V.Poovazhagi, M.D.,Dr.Ezhilarasu, M.D.,** Asst. Professors , PICU for their meticulous guidance and support throughout the study.

I am extremely thankful to **Dr.S.Luke Ravi, M.D.,DCH.,** Registrar, for his valuable suggestions, invaluable help and guidance in doing this work.

I would like to thank our unit Assistant professors, **Dr.J.Hemachitra, M.D., Dr.P.Ramkumar,M.D., Dr.A.Sridevi ,M.D.,** for their valuable guidance and support throughout the study.

I am greatly indebted to **Dr.K.Nedunchezhian, M.D., DCH.,** for his support and guidance in doing this study.

I sincerely thank all the children and their parents who have submitted themselves for this study and who made this study possible.

CONTENTS

INTRODUCTION

Early recognition of critical illness followed by time sensitive goal directed management is crucial to improve the survival. Among the critically ill children, shock occurs in most of the children. The mortality rate among the patients with shock varies from 20% to 50%. Shock is one of the most dramatic, dynamic and life threatening problems faced by the physician in critical care settings.(1)

CLASSIFICATION OF SHOCK :

There are five major types of shock namely :-

Hypovolemic shock

Septic shock

Cardiogenic shock

Distributive shock

Obstructive shock

Hypovolemic shock:-

Hypovolemic shock is charecterized by decreased preload secondary to internal or external losses.

Eg.

Loss of components of intravascular volume:-

Blood: hemorrhage,

Plasma:burns, nephrotic syndrome

Water and electrolytes: diarrhea, vomiting, diabetes

Cardiogenic shock:-

Cardiogenic shock is charecterised by cardiac pump failure secondary to poor myocardial function.

Eg.

Congenital heart disease

Cardiomyopathies:infectious or acquired, dilated or restrictive

Ischemia

Dysrhythmias

Septic shock:-

Septic shock includes multiple forms of shock. That includes hypovolemic by third spacing; distributive by early shock with decreased afterload; cardiogenic by depression of myocardial function by endotoxins.

Caused by bacterial, viral or fungal infection.

Distributive shock:-

Distributive shock is due to the abnormalities of vasomotor tone, loss of venous capacitance decreases preload, loss of arterial capacitance decreases afterload or systemic blood pressure.

Eg.

Anaphylaxis,

Neurologic: loss of sympathetic vascular tone secondary to spinal cord or brainstem injury.

Drugs.

Obstructive shock:-

Obstructive shock is due to significant obstruction to right or left heart function, or restriction of all cardiac chambers.

Eg.

Pericardial tamponade,

Tension pneumothorax.

STAGES OF SHOCK(2,3)

Early or Compensated Shock

In early compensated shock several compensatory mechanism are activated. It is defined by the presence of systolic blood pressure within the normal range with signs of symptoms of inadequate tissue and organ perfusion. Vital organ function is maintained.

In children, vascular tone is maintained in low flow states (4) of septic and cardiogenic shock. Therefore, children can often maintain their blood pressure until they are in profound shock.

If shock is left untreated, the compensatory mechanisms will fail and uncompensated shock develops. Failure of normalization of peripheral pulses, skin temp, and capillary refill with treatment predicts death from shock. (5)

Children are mostly dependent on their heart rate to increase cardiac output.

Ability to increase contractility in response to catecholamine stimulation is limited due to insufficient muscle mass and "stiffness" of the young myocardium compared to the adult heart. (6) When the compensatory mechanisms are activated, children become dependent on intravascular volume (preload) to maintain CO. (7) Since afterload is already increased in an effort to maintain SVR and BP, maintaining adequate intravascular volume is the key aspect of successful resuscitation

Uncompensated shock

When signs of shock are associated with systolic hypotension then it is called as decompensated shock. Hypotension is a late sign of shock.

When the compensatory mechanisms fail to meet the increased metabolic demands at the tissue level uncompensated shock with hypotension will develop. Tissue hypoxemia and ischemia will trigger anaerobic metabolism resulting in lactate build-up and the development of metabolic acidosis. A number of other vasoactive metabolites such as adenosine, nitric oxide are also released and accumulate locally.

Once the blood pressure falls, the patient will progress into irreversible shock if the perfusion pressure to tissues is not restored. Irreversible shock, as the name implies, is the point of no return and the mortality rate is high irrespective of interventions.

CARDIOPULMONARY ASSESSMENT

Respiratory rate:-

Tachypnea is one of the signs of shock. Bradypnea or normal respiratory rate in the presence of shock (relative bradypnea) occurs in profound shock.

Skin colour:-

Normal or abnormal (cyanosis / dusky / pallor / mottling / hyperpink)

Heart rate :-

Tachycardia is the earliest sign of shock. Bradycardia or normal heart rate in the presence of shock (relative bradycardia) may occur in late decompensated shock.

Pulse volume:-

Pulse volume is assessed by simultaneously palpating the central (femoral) and distal (dorsalis pedis) pulses. In shock there may be thready distal pulse or absent distal pulse.in warm shock of sepsis,there will be bounding distal pulses.

Capillary refill time :-

When capillary refill is evaluated, lift the extremity slightly above the heart level to ensure assessment of arteriolar capillary and not venous stasis. It is prolonged in shock and cold ambient temperature.

Liver span :-

It provides noninvasive information of myocardial contractility. Increase in liver span suggests cardiogenic component.

Blood pressure :-

Shock may be present with normal, low or high blood pressure.

Normal blood pressure: compensated shock

Hypotension : decompensated shock

Hypotension is not synonymous with shock

Table – 1: Age specific vital signs(8)

AGE	RESPIRATORY RATE per min	HEARTRATE per min	SYSTOLIC BP mm of hg
newborn	30-60	90-180	50-70
6 months	24-40	85-170	65-106
1 year	20-40	80-140	72-110
3 years	20-30	75-120	78-114
6 years	18-25	70-110	80-116
8 years	18-25	65-110	84-122
10 years	16-20	65-110	90-130
12 years	14-20	60-110	94-136

The above table shows the normal age specific vital signs.

RATE AND VOLUME OF FLUID ADMINISTRATION:-

Start fluid resuscitation for shock with 20 ml /kg of isotonic crystalloid administered as a bolus over 5 to 20 minutes. Then repeat boluses of 20 ml/kg as needed to restore blood pressure and perfusion(9).

Give fluid boluses more rapidly to correct hypotensive shock and septic shock. Resuscitation of most children in hypotensive or septic shock may require atleast 40 to 80 ml/kg of isotonic crystalloid solution during the first hour(s) of therapy. As much as 240 ml /kg has been used in the first 8 hours of septic shock therapy.(10,11)

Table - 2

TYPE OF SHOCK	VOLUME OF FLUID	RATE OF DELIVERY
hypovolemic, distributive and obstructive shock	20 ml/kg bolus (repeat PRN)	deliver rapidly over 5 to 10 minutes
cardiogenic shock	5 to 10 ml/kg bolus (repeat PRN)	deliver more slowly over 10 to20 minutes

The above table provides a general guide to fluid boluses and rates of delivery based on the underlying cause of shock.

INOTROPES(12,13)

1. DOPAMINE

Classificati

on:catecholamine,vasopressor,inorope

Dopamine is a chemical precursor of epinephrine, possessing alpha and beta receptor – simulating actions. The specific effects of dopamine are related to the dose delivered.

LOW DOSE **----** ≤ 2mcq/kg/minute (Dopaminergic effect)

Vasodilation of renal and splanchnic (pertaining to the viscera) arteries. Doses at

this level promote blood flow and increased GFR (glomerular filtration rates in patients who become resistant to diuretics). Urine output may increase without significant effect on blood pressure or heart rate.

INTERMEDIATE DOSE **----** 2 to 10 mcq/kg/minute

At this delivery rate, beta-adrenergic receptor activity is increased in the heart. Partial antagonism of alpha – adrenergic receptors will mediate vasoconstriction. Cardiac output and CVP (central venous pressure) will increase with only modest increase in (SVR) systemic vascular resistance.

HIGH DOSE **---** 10 to 20 mcq/kg/minute

Alpha effects dominate at this delivery rate. This results in renal, mesenteric, peripheral arterial and venous vasoconstriction. This will increase SVR, PVR, pre-load, heart rate and potentiate arrhythmias. Monitor the patient carefully for decreased circulation in the extremities.

If extravasation occur, the infusion should be immediately stopped.

ADVERSE EFFECTS:

Dopamine extravasation can cause severe tissue necrosis

- Tachycardia
- Supraventricular tachycardia
- Ventricular arrhythmias
- Pulmonary congestion
- Nausea
- Vomiting
- Hypotension when used concomitantly with phenytoin

DOBUTAMINE

Dobutamine is chemically related to dopamine. It has Beta 1 and Alpha adrenergic stimulating qualities but does not affect renal blood flow like dopamine. Dobutamine will increase renal and mesenteric blood flow, but it achieves this by increasing cardiac output

The maximum effective dose of dobutamine depends on the individual patient. It's inotropic effect is considered superior to dopamine.

INITIAL DOSE 2 TO 3 mcg/kg/minute
Titrate for desired effect including:
Increased cardiac output

Decreased PAWP (PCW, wedge)

Decreased PVR

Increased coronary blood flow

USUAL DOSE 2.5 to 10 mcq/kg/minute

Desired effects include:

Increased cardiac output

Increased stroke volume

This dose will not increase heart rate or cause vasoconstriction.

ADVERSE EFFECTS:

- Tachycardia
- Arrhythmias
- Blood pressure fluctuation
- Myocardial ischemia
- Headache
- Nausea
- Tremors
- Hypokalemia

EPINEPHRINE

Epinephrine has both “Alpha” and “Beta” adrenergic agonist activity depending on the dose administered. As a continual infusion,epinephrine will increase heart rate, cardiac conduction, contractility and vasodilation, thus increasing cardiac output.

As the dose gets higher, alpha receptors are stimulated resulting in increased vascular resistance and blood pressure.

Epinephrine accelerates the sinus rate of the heart and may precipitate ventricular dysrhythmias in the presence an ischemic heart.

Epinephrine delivered as a continuous infusion is always diluted per institutional policy and always used with an infusion pump. Intensive monitoring of the patient is required.

CARDIAC RHYTHMS REQUIRING EPINEPHRINE USE DURING CARDIAC ARREST.

1. Ventricular Fibrillation
2. Pulseless Ventricular Tachycardia – Unresponsive to initial countershock.
3. Asystole
4. Pulseless Electrical Activity
5. Dosage --- 1mg IV bolus
6. Intervals --- Should not exceed 3 – 5 minutes

ADVERSE EFFECTS:

Cardiac Arrhythmias	Dizziness
Palpitations	Weakness
Tachycardia	Temors
Sweating	Headache
Nausea and vomiting	Apprehension
Respiratory difficulty	Nervousness
Pallor	Anxiety

NOREPINEPHRINE

Norepinephrine is a potent alpha – receptor antagonist with minimal effect on beta 2 receptors. Norephinephrine increases myocardial contractility due to its beta 1 adrenergic effects. Its potent alpha effect leads to arterial and venous constriction. Use of norephinephrine is effective in septic shock and neurogenic shock.

Hypotensive shock

IV/IO 0.1 to 0.2microgram/kg. per minute extravasation produces ischemic necrosis and sloughing of superficial tissues

Use of a central line is recommended due to the risk of extravasation into surrounding tissue.

PRECAUTIONS

1. Possible inaccurate peripheral blood pressure measurements due to vasoconstriction.
2. Increased myocardial oxygen requirements.
3. Arrhythmias

REVIEW OF LITERATURE

Daljit singh et al(14),conducted a prospective study at Punjab,to determine the frequency,etiology,type and outcome of shock in hospitalized children in the age group of 1 month to 15 years. There were 98 cases of shock, constituting 4.3% out of total admissions. Mean age was 2.8 ± 3.4 years. Maximum number of patients (39) was seen in infancy. Hypovolemic shock due to acute diarrheal disease was the commonest type (45.9%) followed by septic, cardiogenic and distributive shock. Compensated stage was common in hypovolemic shock (88.9%) whereas majority of patients with septic shock (73.5%) presented in decompensated stage. Overall survival was 73.6%. The survival rate was best in hypovolemic shock (97.7%) followed by septic(53.3%) and cardiogenic shock(43.7%). Inotropes and ventilatory support were required in 46% and 23% patients, respectively. Diagnosis and management of shock in compensated stage carried better prognosis than in uncompensated shock irrespective of the age of the patient

Kutko et al(15), in a retrospective study observed that overall mortality rate in 80 patients with septic shock was 13.5%. There were difference in mortality rates between patients requiring one inotropic agent (0%) and patient requiring multiple inotropic agents (42.9%) and between patients with multiple system failure (18.6%) and those without multiorgan system failure (0%).Finally the concluded the mortality rate in pediatric septic shock is lower than has been previously reported and also concluded that mortality from septic shock occurs most frequently in the context of multiple organ

system failure.

Jacobs RF et al(16), in a retrospective analysis of 2110 admissions to the pediatric intensive care unit,identified 564 cases of septicshock(26.7% of the total admissions).study was conducted in university of Arkansas for medical sciences,Little Rock.In this study population,inotropic support required in 268(47.5%) patients.Septic shock with confirmed bacterial infection occure in 143 patients(25.2%).They finally concluded that septic shock occurs more frequently in children than previously appreciated.

Patel et al(17),in a prospective study observed that the 28 day mortality rate was 50%(67/134) with dopamine has the initial vasopressor compared to 43%(51/118) for nor-epinephrine treatment(p=0.282).There was significantly greater incidence of sinus tachycardia with dopamine(27.5%) than nor-epinephrine(5.3%) and arrhythmias noted with dopamine treatment 23.3% compared to nor-epinephrine treatment(5.3%).p (<0.0001) respectively.In this protocol directed vasopressor support strategy for septic shock ,dopamine and nor-epinephrine were equally effective as initial agents as judged by 28 day mortality rates.However there were significantly more cardiac arrhythmias with dopamine treatment.

Santhanam I et al(18), in a study conducted in Pediatric Emergency Medicine, Institute of Child Health and Hospital for Children Madras Medical College, Chennai, India. Concluded that Early recognition of shock is the key to successful resuscitation in

critically ill children. Often, shock results in or co-exists with myo-cardial dysfunction or acute lung injury. Recognition and appropriate management of these insults is crucial for successful outcomes. Resuscitation should be directed to restoration of tissue perfusion and normalization of cardiac and respiratory function. The underlying cause of shock should also be addressed urgently. The physiological response of individual children to shock resuscitation varies and is often variable and unpredictable. Therefore, repeated assessments with continuous, non-invasive monitoring are needed for taking appropriate decisions in the ED. Although global indices of tissue oxygen delivery such as the mixed venous oxygen saturation (SvO(2)) help in targeting therapies more accurately, it is often unavailable in emergency settings. Isotonic fluids form the cornerstone of treatment and the amount required for resuscitation is based on etiologies and therapeutic response. After resuscitation has been initiated, targeted history and clinical evaluation must be performed to ascertain the cause of shock. Management of co-morbidities such as asthma and seizures should be implemented simultaneously. Inotropes, respiratory support, antibiotics and steroids may also be needed during the management of shock. While the management of shock can be protocol based, the treatment needs to be individualized depending on the suspected etiology and therapeutic response.

JUSTIFICATION OF THE STUDY

Around 800 children are treated in pediatric intensive care unit every year. Of this more than 500 cases are treated for shock with vasoactive agents.

There are not many publications in India in this subject, even though large number of children are on vasoactive agents. Hence , we want to stud the various aspects of vasoactive agents.

Traditionally all over the world vaoactive agents are infused via central vein under strict invasive monitoring. For a resource poor country like India,v asoactive agents are infused in peripheral venous lines. Based on unproved data available at our institution , adverse effects of vasoactive agents in peripheral vein infusion is very few.

Being life saving medications, the vasoactive agents can be used in peripheral hospitals when much expenditure on monitoring is not feasible. If the safety profile of use of these agents in peripheral line can be documented, it may be helpful in using the drugs in prehospital stabilization during transfer of the patient in resource poor settings.

OBJECTIVE OF THE STUDY

Critically ill children admitted with different kinds of shock are treated in Pediatric intensive care unit of the tertiary care center with various types of vasoactive agents like dopamine,dobutamine,epinephrine and norepinephrine.

Objective of this study is to find out:- Indications and adverse outcome among children treated with above mentioned vasoactive agents.

MATERIALS AND METHODS

Study design:-

Descriptive study

Study place:-

Pediatric intensive care unit , Institute of child health and hospital for children, Egmore, Chennai.

Study period:-

One year,from October 21st , 2008 to October 20th ,2009.

Inclusion criteria:-

All children beyond 30 days and upto 12 years, presenting with shock requiring vasoactive agents either started in emergency room or PICU will be included in the study.

Exclusion criteria:-

- Children less than 30 days of age.
- Children for whom vasoactive agents started prior to hospitalization or in the ward and then referred to PICU.

MANOEUVER

Patient in the age group of one month to 12 years admitted for shock in PICU ,during the period from October 21st , 2008 to October 20th, 2009; who fulfill the inclusion criteria were included in the study.

Cardiopulmonary assessment were done and entry made in the data sheet. All sick children were initially evaluated in the emergency room of the hospital and initial stabilization of the patient including airway, breathing followed by fluid resuscitation were carried out. Those patient who require inotropic support was started either in the emergency room or in the PICU according to the condition of the patient, according to the availability of the bed in the PICU, the children were admitted there. When there is no availability of bed in PICU, the child would be shifted to the concerned ward and those cases were excluded from the study.

Eligible children are registered for the study and the following particulars are collected through proforma:-

- Type of shock / degree of shock.
- Cardiopulmonary status while starting vasoactive agents (heart rate, respiratory rate, blood pressure, capillary refilling time,liver span).
- Amount of fluid received before starting vasoactive agents.

- Vasoactive agents used.
- IV line used- central / peripheral / intraosseous route.
- Starting dose, maximum dose, time taken to reach the maximum dose of vasoactive agent.
- When tapered? / Whether dose increased after tapering?
- Duration of vasoactive agents used.
- Whether restarted?
- Complications like extravasations, arrhythmias, hypertension, and hyperglycemia.
- Number of IV lines used.
- Number of infusion pumps used.
- Monitoring heart rate, respiratory rate, blood pressure, pulse volume, capillary refilling time, urine output, saturation-
    - -2nd hourly in first 6 hours
    - -4th hourly in the next 24 hours
    - -6th hourly after that; till 12 hours after stopping the vasoactive agents.
- Intubation needed or not / duration of ventilation / manual or mechanical.

- Lab abnormalities if any.

- Outcome / duration of stay in the PICU.

The patients were managed according to the protocol adopted from text book of pediatric intensive care and as per PALS guidelines.

CASE DEFINITION

Hypovolemic shock:-

Children were classified as having hypovolemic shock based on the definitive history of fluid loss and signs of dehydration.

Cardiogenic shock:-

Clinically diagnosed by features of shock and cardiac involvement as evidenced by the presence of gallop, muffling of heart sounds and signs of underlying heart disease if any and increasing liver span.

Septic shock:-

History compatible with infection and children having features of systemic inflammatory response syndrome (hyper/hypothermic, tachycardia, tachypnoea).

Distributive shock:-

Patients with acute exacerbation of asthma, status epilepticus and other cause of distributive shock, without evidence of sepsis and causes of shock.

Decompensated shock:-

Features of shock with hypotension.

Compensated shock:-

It is defined by the presence of systolic blood pressure within normal range with signs of symptoms of inadequate tissue and organ perfusion.

Adverse outcome:-

Extravasation, hyperglycemia, arrythmias, hypertension are taken as adverse outcome.

Inotrope(s) used:-

Either single inotrope or more than one inotropes used was recorded. Cardiopulmonary assessment before starting vasoactive agents and monitoring till 12 hours after stopping the inotrope were recorded.

Ventilatory support:-

If ventilatory support was given then the type of ventilation given were recorded either manual or mechanical or both.

Outcome :-

It is classified as discharged, expired and discharged against medical advise.

STATISTICAL ANALYSIS

As the data collected were discrete, the statistical method applied were properties of usage of inotropes and the outcome. The outcome as against the total number of cases was evaluated.

Data was entered in the Microsoft office excel and analysed using SPSS ver 11.0 for windows. As the variables are in qualitative form we have used chi square test in the univariate analysis to observe the association between the study variables and the outcome.

OBSERVATIONS

Total number of cases studied:-204

Total number of PICU admission during the one year study period is:-812

So, 21.1% of the PICU admission is taken into the study group as they fit for the inclusion criteria mentioned earlier.

Table -3: AGE DISTRIBUTION OF CHILDREN TREATED WITH INOTROPES

Age in months	No. of cases	percentage
1-12	120	58.8%
13-60	56	27.5%
61-120	21	10.3%
>120	7	3.4%
total	204	100%

From the above table it is evident that most of the children affected with shock and treated with inotropes are children less than one year(58.8%).

Table – 4: SEX DISTRIBUTION OF CHILDREN TREATED WITH INOTROPES

Sex	No. of cases	percentage

Female	95	46.6%
Male	109	53.4%
total	204	100%

The above table shows that male children were more affected than the female children.

Table – 5: TYPES OF SHOCK

S.no.	Type of shock	No. of cases	Percentage
1	Hypovolemic	17	8.3%
2	Cardiogenic	43	21.1%
3	Septic	135	66.2%
4	Distributive	8	3.9%
5	Septic cardiogenic	1	0.5%
	Total	204	100%

From the above table, it is evident that septic shock (66.2%) is the commonest type of shock among the study group, with cardiogenic (21.1%) and hypovolemic (8.3%) being the next two categories.

Table - 6 :DEGREE OF SHOCK

S.No	Degree of shock	No of cases	Percentage
1.	Compensated	181	88.7 %
2.	Decompensated	23	11.3 %
	Total	204	100.0 %

From the above table, it is clear that the compensated shock (88.7%) is much more higher than the decompensated shock (11.3%) in our study group.

Table – 7 : AMOUNT OF FLUID GIVEN BEFORE STARTING INOTROPES

S.No	Amount of fluid ml/kg	No. of cases	Percentage	Cumulative percentage
1.	<20	104	51.0 %	51.0 %
2.	20 – 40	49	24.0 %	75.0 %
3.	40 – 60	46	22.5 %	97.5 %
4.	60 – 80	5	2.5 %	100.0 %
		204	100.0 %	

It is evident from the above table that 97.5% of the children in the study received less than 60 ml/kg of fluid,of which 104 children (51%) received less than 20 ml/kg of fluid before starting inotropes.

Table – 8 : TOTAL FLUIDS GIVEN IN 24 HOURS

S.No	Amount of fluid given in 24 hrs ml/kg	No of cases	Percentage
1.	<60	66	32.4 %
2.	60 – 100	66	32.4 %
3.	100 – 150	41	20.1 %
4.	150 – 200	12	5.9 %
5.	200 – 250	12	5.9 %
6.	250 – 300	6	2.9 %
7.	>300	1	0.5 %
		204	100.0 %

About 64.7%(132 cases) of the children received less than 100 ml/kg of fluid in the first 24 hours. Remaining 35.3% (72 cases) needed more than 100 ml/kg in the first 24 hours

Table – 9: VASOACTIVE AGENTS USED

S.No	Vasoactive agents	No of cases	Percentage
1.	Dopamine (1)	82	40.2 %
2.	Dobutamine (2)	14	6.9 %
3.	Noradrenaline (3)	-	-
4.	Adrenaline (4)	10	4.9 %
5.	1 + 3	45	22.1 %
6.	1 + 4	23	11.3 %
7.	2 + 4	5	2.5 %
8.	1 + 3 + 4	9	4.4 %
9.	1 + 2	7	3.4 %
10.	2 + 3	2	1.0 %
11.	1 + 2 + 3	5	2.5 %
12.	1 + 2 + 4	1	0.5 %
13.	3 + 4	1	0.5 %
	Total	204	100.0 %

Dopamine is the commonly used inotrope as a single vasoactive agent (82/204; 40.2%). When more than one inotrope is used, combination of dopamine with noradrenaline is predominantly used(45/204; 22.1%).

Table – 9: ROUTE OF ADMINISTRATION

S. no.	Route	No. of cases	Percentage

1.	Peripheral vein	200	98%
2.	Central vein	1	0.5%
3.	Intraosseous	3	1.5%
	Total	204	100%

Of the 204 cases studied 200 cases were treated with inotropes through the peripheral vein. Of the remaining 4 cases one child was treated with cental vein. Of the three cases treated through intraosseous route, 2 cases were started with peripheral vein later on.

Table – 10 :ADVERSE OUTCOME

S.no.	Adverse effect	No. of cases	Percentage
1.	Extravasations	3	1.5%
2.	Arrythmias	1	0.5%
3.	Hypertension	2	1%
4.	Hyperglycemia	6	2.9%
5.	No adverse effect	192	94.1%
	Total	204	100%

Of the 204 cases studied, only in 3 cases extravasations had been encountered with the incidence of only 1.5%. The extavasations occurred in two individuals treated with adrenaline infusion and one treated with dopamine infusion. Hyperglycemia is the commenest adverse effect following the usage of inotropes and its mainly due to the adrenaline infusion. Three out six children with hyperglycemia received adrenaline infusion.

Table -11 : IMPROVEMENT OF RESPIRATORY RATE, HEART RATE, PULSE VOLUME,CAPILLARY REFILLING TIME , LIVER SPAN , BP & URINE OUTPUT AFTER TREATING WITH VASOACTIVE AGENTS

S.no.	Duration after starting vasoactive agents	RR	HR	Pulse volume	CRT	Liver span	Blood pressure	Urine output
1.	Not improved	79	28	24	36	33	5	26
2.	<6 hours	6	29	65	79	46	52	89
3.	6-12 hours	19	53	20	28	7	38	42
4.	12-24 hours	18	38	10	15	2	22	10
5.	24-48 hours	31	28	7	8	0	3	34
6.	>48 hours	45	10	1	5	0	3	3
	Total	198	186	127	171	88	123	204

In the above table numerical denotes the number of children. The total total number denotes that particular parameter was abnormal, which improved over that given time interval. Other missing number of cases were having normal findings before starting the vasoactive agent.

Respiratory rate improved in most cases (45/198; 22.7%) only after 48 hours. Heart rate in the time interval of 6-12 hours in most cases(53/186; 28.5%). All other

parameters improved within 6 hours. The percentage of children improved within 6 hours are: pulse volume-51.2%, capillary refilling time-46.2%, liver span-52%, Blood pressure-42.3%, urine output-43.6%.

Table – 12: INTUBATION

S.no.	Intubation	No. of cases	Percentage
1.	Needed	192	94.1%
2.	Not needed	12	5.9%
	Total	204	100%

Of the 204 cases studied, 12 cases (5.9%) were not intubated and all other cases were intubated (94.1%).

Table – 13 : TYPES OF VENTILATION

S.no.	Types of ventilation	No. of cases	Percentage
1.	Mechanical alone	0	0
2.	Manual alone	113	58.9%
3.	both	79	41.1%
	Total	192	100%

From the above table, it shows that of the 192 intubated child, 113 children were ventilated with manual method alone. Only 41%, that is 79 children had mechanical ventilation after few hours to days of manual ventilation.

Table – 14: LAB ABNORMALITIES

S.no.	Lab abnormalities	No. of cases	Percentage
1.	No abnormalities	148	72.5%
2.	Dyselectolytemia	10	4.9%
3.	Hypoglycemia	2	1%
4.	Hyperglycemia	8	3.9%
5.	Coagulopathy	1	0.5%
6.	Anemia	5	2.5%
7.	Thrombocytopenia	21	10.3%
8.	Renal failure	9	4.4%
	Total	204	100%

From the above data, it is clear that thrombocytopenia (21 cases) is the major abnormality noted in the study group. Next order of abnormalities is the Dyselectolytemia(10 cases) and the renal failure(9 cases).

Table – 15 : DURATION OF VENTILATION

Hrs	No. of cases	Percentage	Valid percentage
0-6	20	9.8	10.4
7-24	65	31.9	33.9
25-72	64	31.4	33.3
>72	43	21.1	22.4
Total	192	94.1	100

Of the 192 ventilated children, most were ventilated for 7-24 hours. (65/192;31.9%)

Table – 16 : DURATION OF STAY

S.no	Duration(hrs)	No of cases	Percentage	Valid %
1	0-6	42	20.6	21.5
2	6-24	69	33.8	35.4
3	25-72	84	41.2	43.1
4	>72	195	95.6	100

From the above table, it is clear that more than 95% of the children had stayed for more than 3 days in the PICU

Table – 17: OUTCOME

S.no	Outcome	No of cases	Percentage
1	Discharged	98	48
2	Expired	100	49
3	AMA	6	2.9
4	Total	204	100

From the above table, it is evident that mortality rate of the shock patients treated with inotropes is 49%.

Table – 18 : VASOACTIVE AGENT USED AND OUTCOME

S.NO	Inotropes	Discharged(no of cases/%)	Expired(no of cases/ %)	AMA	Total
1	Dopamine	51(25%)	28(13.7%)	3(1.5%)	82
2	Dobutamine	6(2.9%)	8(3.9%)	0	14
3	Nor epinephrine	0	0	0	0
4	Adrenaline	1(0. 5%)	9(4.4%)	0	10
5	1+3	33(16.2%)	11(5.4%)	1(0.5%)	45
6	1+4	1(0.5%)	20(9.8%)	2(1%)	23
7	2+4	0	5(2.5%)	0	5
8	1+3+4	1(0.5%)	8(3.9%)	0	9
9	1+2	3(.5%)	4(2%)	0	7
10	2+3	1(0.5%)	1(0.5%)	0	2
11	1+2+3	0	5(2.5%)	0	5
12	1+2+4	0	1(0.5%)	0	1
13	3+4	1(0.5%)	0	0	1

From the above table, it is clear that when dopamine is used as a single agent (in 82 cases),the mortality rate is 13.7%(28 cases). In more than one inotrope usage, dopamine and nor-epinephrine has favourable outcome of 33 children discharged among the 45 children used.

With the above table we are able to derive a chi square value of 63.433 and p value of 0.0001, which is significant.

Table – 19: EXTRAVASATION AND THE OUTCOME

S.NO	Extravasation	Discharged	Expired	AMA	Total
1	Occurred	1(0.5%)	1(0.5%)	1(0.5%)	3
2	Not occurred	97(47.5%)	99(48.5%)	5(2.5%)	201

With the above table we are able to derive a chi square value of 9.852 and p value of 0.007, which is significant.

Table – 20 : ARRHYTHMIAS AND THE OUTCOME

S.NO	Arrhythmia	Discharge	Death	AMA	Total
1	Developed	1(0.5%)	0	0	1
2	Not developed	97(47.55%)	100(49%)	6(2.9%)	203

With the above table we are able to derive a chi square value of 1.087 and p value of 0.581, which is not significant.

Table – 21 : HYPERTENSION AND THE OUTCOME

SNO	Hypertension	Discharged	Death	AMA	Total
1	Developed	0	2(1%)	0	2
2	Not developed	98(48%)	98(48%)	6(2.9%)	202

From the above collected data,chi square value derived is 2.101 and the p value is 0.350, which is not significant.

Table – 22 : HYPERGLYCAEMIA ND THE OUTCOME

SNO	Hyperglycaemia	Discharged	Death	AMA	Total
1	Developed	1(0.5%)	4(2%)	1(0.5%)	6
2	Not developed	97(47.5%)	96(47.1%)	5(2.5%)	198

From the above collected data, chi square value derived is 5.619 and the p value is 0.06.

Table – 23 :INTUBATION AND OUTCOME

Sno	Intubation	Discharged	Death	AMA	Total
1	Needed	86(42.2%)	100(49%)	6(2.9%)	192
2	Not needed	12(5.9%)	0	0	12

From the above table we derive a chi square value of 13.79 and a p value of 0.001,which is significant.

DISCUSSION

In the present study the maximum patients with shock were observed in the infancy. This is also reported by Daljit singh et al in their study.

In our study, we found that septic shock is the most common type of shock(66.2%) followed by cardiogenic shock(21.1%), hypovolemic shock(8.3%) and distributive shock(3.9%).This is in contrary to the previous studies which showed that hypovolemic shock is common type of shock among children.

The total amount of fluid given before the start of inotropes as boluses is less than 20 ml/kg in more than half of the shock patient in our study population. And 64.7% of the patient required less than 100 ml/kg as the total fluid received in 24 hours along with the inotropic study. Joseph A Carcillo et al(19) in their study concluded that in shock large fluid deficits typically exist, and initial volume resuscitation usually requires 40 to 60 ml/kg but can be as much as 200ml/kg.In our study, less than 20ml/kg was given even though more number of cases had septic shock.

The adverse outcome due to the usage of inotropes through the peripheral venous infusion is less with extravasation being 1.5%, arrhythmias 0.5%, hypertension 1% and hyperglycaemia 2.9%. The incidence of arrhythmias after administration of inotropes was high (23.3%) in the study conducted by Patel et al.

There is no clear cut study for the usage of inotropes in peripheral vein and it

outcome like extravasation, as most of the centres are using central vein as the route of administration. In a hospital like our institution, it is practically difficult to secure central vein for all the shock patients treated in PICU as the input of cases is very high. 98% of the individuals are treated with vasoactive agents through peripheral vein, 0.5% with cntral vein and 1.5% through intraosseous route.

Of the shock patients analysed in our study, most patients presented with compensated shock (88.7%) and decompensated shock were 11.3%. In the study done by Daljit singh et al, where they observed out of 98 patients 39 patients were presented with decompensated shock (39.8%).

Of the 204 patients included in our study,for whom inotropes were used,106 patients were treated with single vasoactive agent and mortality rate among those children is 42%.In remaining 98 patients more than one inotrope were used and mortality rate among those patients were 56%. This can be compared with the study done by Daljit singh et al, in which mortality rate is 47.9% for those patients with single inotrope usage when compared with usage of more than one inotrope with mortality rate of 84.1%. In the present study the mortality rate is better when compared to Daljit singh et al study.

In the study conducted by Kutko et al,the mortality rate was more in patients requiring multiple inotropes(42.9%) than patients requiring single inotrope(0%).It is much higher in our study when compared this study.

SUMMARY AND CONCLUSION

- The etiology of shock varies with age groups with incidence decreasing as age advances

- Most of the shock is presented as compensated shock with septic shock being the most common type of shock in children admitted in PICU.

- Dopamine is the single most common inotropic agent used in the management of shock.

- In our study almost all patient tearted for shock, peripheral venous infusion is the route of administration for inotropic agent.

- Even though the children were treated with inotropes through peripheral venous infusion, the adverse reaction particularly extravasation is very minimal and so it can be safely used in resource poor settings in which central vein cannot be used for infusion of inotropic agents.

- Shock patient treated with more than one than inotropic support have a higher mortality rate than those patient treated single inotrope support, mortality rate is doubled in those patient presented with decompensated shock while starting vasoactive agent.

RECOMMENDATION

Inotropes can be safely used through the peripheral venous infusion in resource poor settings like our country.

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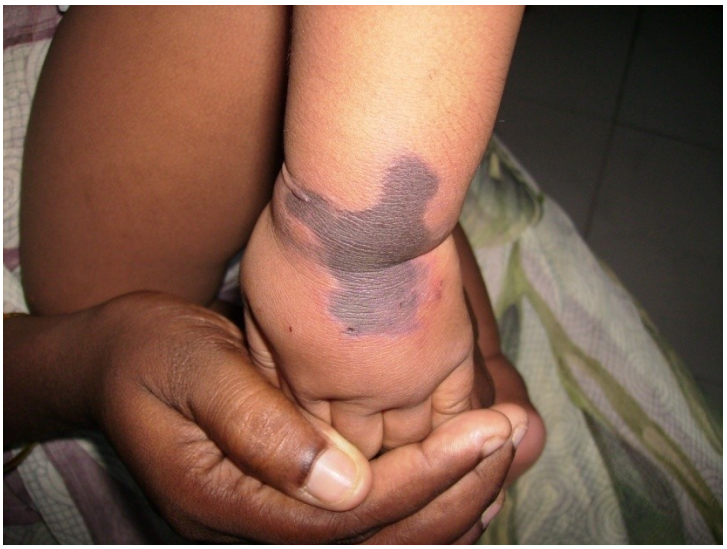
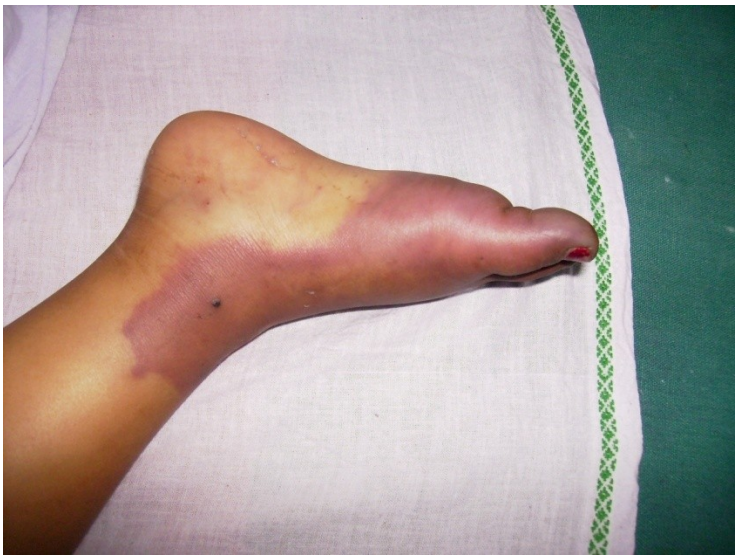
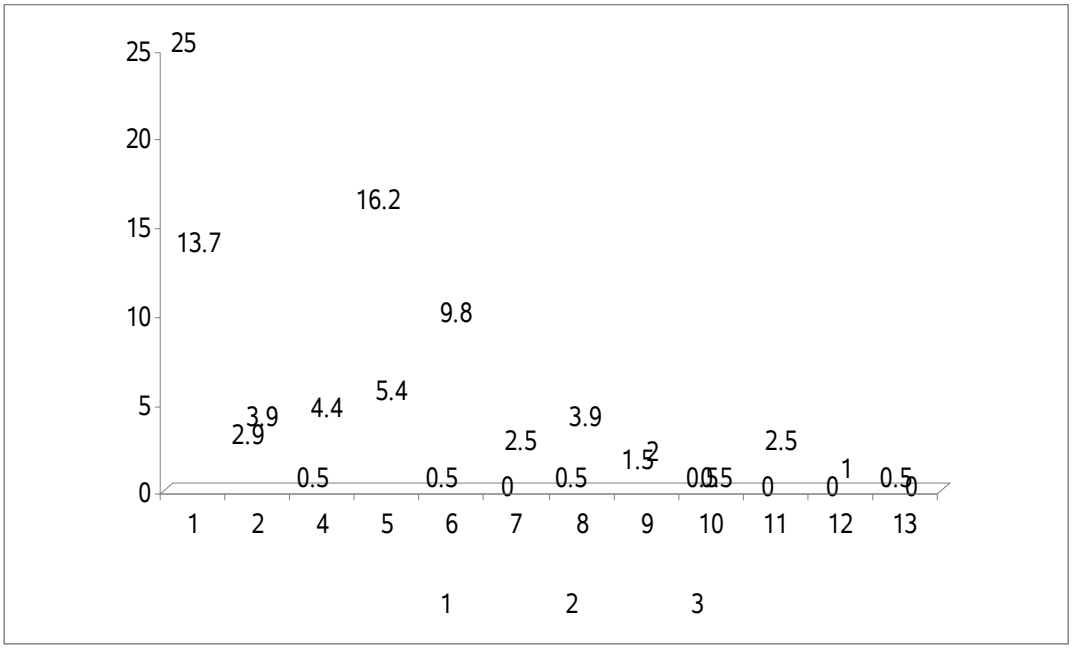
PHOTOGRAPHS OF EXTRAVASATIONS







Vasoactive agents used and its outcome
1-discharged; 2-death; 3-AMA

Extravasations and the outcome
1-extravasation occurred; 2-extravasations not occurred

Intubation and the outcome
1-intubation needed; 2-intubation not needed

PROFORMA

FOR CRITICALLY ILL CHILDREN TREATED WITH

VASOACTIVE AGENTS IN PICU

NAME: AGE: SEX: IP No.:
WEIGHT:

TYPE OF SHOCK: Hypovolemic / Cardiogenic / Distributive / Obstructive/septic

DEGREE OF SHOCK: Compensated / Decompensated

HEMODYNAMIC STATUS WHILE STARTING VASOACTIVE AGENT(S):
Respiratory rate:- /min
Heart rate:- /min
Pulse volume:-
CRT:- Normal / prolonged / flash refill
Liver span:- cm
Blood pressure:- mm of HG

AMOUNT OF FLUID GIVEN BEFORE STARTING VASOACTIVE AGENT(S):-
ml/kg

	1 hour	**6 hours**	**12 hours**	**24 hours**
Total fluid received				
Urine output				

VASOACTIVE AGENTS USED:- Dopamine/ Dobutamine/Noradrenaline/ Adrenaline / Others

TIME OF STARTING VASOACTIVE AGENT FROM ARRIVAL:-
ROUTE OF ADMINISTRATION: Central vein/peripheral vein/intraosseous
NUMBER OF IV LINES USED:-

NUMBER OF INFUSION PUMPS USED:-

Inotropes	Initial dose	Maximum dose	Time taken to reach the maximum dose	Maximum dose maintained for	Weaning period	Restarted
Dopamine						
Dobutamine						
Noradrenaline						
Adrenaline						
Others						

COMPLICATIONS:-

Extravasations/Arrhythmias/Hypertension/Hyperglycemia/Others

MONITORING:-

Time	RR	HR	Pulse volume	CRT	Blood pressure	Urine output	Saturation

INTUBATION:-Needed/Not needed{Manual/Mechanical}

Duration of ventilation ____hours

LAB ABNORMALITIES IF ANY {Related to-
Dyselectrolytemia/Hypoglycemia/Hyperglycemia/Coagulopathy/Anemia/
Thrombocytopenia/Renal failure}:-

DURATION OF STAY IN THE PICU:-

OUTCOME:-