Clinical Audit on the Use of Vasopressors and Inotropes in Pediatric Intensive Care Unit in Assiut University Children Hospital

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Abstract

Background: Shock is a state of circulatory dysfunction where the metabolic demands of the tissue cannot be met by the circulation. The early recognition of signs of shock and aggressive therapy to restore the intravascular volume and reverse the biochemical cascade is believed to improve outcome.

Patients and Methods: The study was done on children with shock admitted to intermediate care unit and PICU in assiut university children hospital in one year duration. An observational checklist based on guidelines of management of shock according to Early Goal Directed Therapy (EGDT) developed by the investigators in order to assess the management plane and the use of vassopressors and inotropes in pediatric shock.

Results: In management at 0min.; Items of recognition of mental status, skin colour and determination of high flow O2 each were recorded in 99.05%. Establishing IV/IO access was done in 100%. In management at 5min.; fluid therapy was given to 97.14% of patients, in 77.5% of them it was recorded. RBG was done for 96.19% of patients, recorded in 100% of them. Calcium level was assessed in 98.1% of patients, in 96.1% of them it was recorded. The percentage frequency of using inotropes in management of the studied patients at 15min as follow: Dopamine alone was used in 55.3% of cases, dobutamine alone was used in 44.7% of cases, adrenaline was used in 31.4% of cases in combination with other inotrope and noradrenaline was used in 14.2% of cases in combination with other inotrope. In management of shock at 60min. 35.24% of patients were given hydrocortisone.

Key Words: Paediatric – Shock – Early goal directed therapy – Inotropes – Monitoring – Intensive care unit.

Introduction

SHOCK is a physiologic state characterised by a significant, systemic reduction in tissue perfusion, resulting in decreased tissue oxygen delivery. Although the effects of inadequate tissue perfusion are initially reversible, prolonged oxygen deprivation leads to generalised cellular hypoxia and derangement of critical biochemical processes. These abnormalities rapidly become irreversible and result sequentially in cell death, end-organ damage, failure of multiple organ systems, and death. The challenge for the clinician is to recognise children in shock early (before they develop hypotension), when they are more likely to respond favourably to treatment. A strong index of suspicion, early recognition, timely intervention and transfer to an intensive care unit are critical for successful outcomes in the management of paediatric shock [1].

Although the cause of shock may not be initially apparent, treatment must begin immediately. To assist with this early recognition, a systematic approach to the evaluation of children with evidence of poor perfusion typically identifies features of the history, physical examination, and ancillary studies that suggest the underlying condition. The paediatric assessment triangle (PAT) provides this systematic approach and rapidly provides a quick evaluation of appearance, breathing, and circulation for acutely ill or injured children that should identify conditions that require immediate intervention. To direct rapid and appropriate treatment, early goal directed therapy was developed to provide an efficient and effective means of immediate intervention. Early Goal Directed Therapy (EGDT) for shock refers to an aggressive systematic approach to resuscitation involving a series of controlled manipulations of physiologic parameters. The goal is to carry out appropriate treatment according to the algorithm within the first hour of presentation to hospital [2,3].

The aim of this study is:

To evaluate the physicians compliance to the guidelines for the use of vasopressors and inotropes
Clinical Audit on the Use of Vasopressors & Inotropes in Pediatric Shock at PICU of Assiut University Children Hospital compared to the recent guidelines [4] and what should be done for improvement of the system. The outcome of this study will be the subject for another audit to re-evaluate the application of the recommendation to improve physician performance and patient outcome.

Patients and Methods

The study was done on children with shock admitted to intermediate care unit and PICU in Assiut University Children Hospital in one year duration in the period between April 2016 and April 2017. The study included 105 cases aged from 1 year to 18 years, 66 males and 39 females.

Inclusion criteria:

All patients admitted to PICU and vasopressors and inotropes were used in their management.

Exclusion criteria:

Any patients in PICU for whom vasopressors and inotropes were not indicated to be used.

Tools of study:

An observational checklist based on guidelines of management of shock according to Early Goal Directed Therapy (EGDT) was developed by the investigators in order to assess the management plane and the use of vasopressors and inotropes in pediatric shock [4].

The parameters to be assessed were included:

History: Traumatic injury-Bleeding-Vomiting and diarrhea-Infection and fever-Heart disease-Inadequate immune system-Allergic exposure.


Management: At 0min: Recognize mental status-Restrain perfusion (capillary refill time-skin colour)-Begin high flow O2-Establish IV/IO access.

At 5min: Initial resuscitation (20cc/kg saline Or colloid up to and over 60 cc)- Correct hypoglycemia and hypocalcemia. At 15 min: What inotrope used-Is it the right choice- Is it in the right dose Is there is monitoring of: Urine output (presence of Catheter-record of output and input) Capillary refill time-Blood pressure-Pulse-Respiration-Conscious level. At 60min: Use hydrocortisone.

Result: Is there is improvement.

Results

The study was done on children with shock admitted to intermediate care unit and PICU in Assiut University Children Hospital in one year duration in the period between April 2016 and April 2017. The study included 105 cases.

Table (1): Demographic data of studied patients.

<table>
<thead>
<tr>
<th>Age</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤1 year</td>
<td>72</td>
<td>68.6</td>
</tr>
<tr>
<td>1-5 years</td>
<td>22</td>
<td>21.0</td>
</tr>
<tr>
<td>6-12 years</td>
<td>9</td>
<td>8.6</td>
</tr>
<tr>
<td>13-18 years</td>
<td>2</td>
<td>1.9</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Sex</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>66</td>
<td>62.9</td>
</tr>
<tr>
<td>Female</td>
<td>39</td>
<td>37.1</td>
</tr>
</tbody>
</table>

Table (2): History performance for the studied patients with shock.

<table>
<thead>
<tr>
<th>Infection and fever</th>
<th>Done</th>
<th>Recorded</th>
<th>Not done</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Infection and fever</td>
<td>95</td>
<td>90.48</td>
<td>89</td>
</tr>
<tr>
<td>Vomiting and diarrhea</td>
<td>91</td>
<td>86.67</td>
<td>85</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bleeding and diarrhea</th>
<th>Done</th>
<th>Recorded</th>
<th>Not done</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Inadequate immune system</td>
<td>90</td>
<td>85.71</td>
<td>85</td>
</tr>
<tr>
<td>Heart disease</td>
<td>24</td>
<td>22.86</td>
<td>19</td>
</tr>
<tr>
<td>Traumatic injury</td>
<td>18</td>
<td>17.14</td>
<td>17</td>
</tr>
<tr>
<td>Allergic exposure</td>
<td>5</td>
<td>4.76</td>
<td>4</td>
</tr>
</tbody>
</table>

Table (3): General clinical manifestations for the studied patients with shock.

<table>
<thead>
<tr>
<th>Heart rate</th>
<th>Done</th>
<th>Recorded</th>
<th>Not done</th>
</tr>
</thead>
<tbody>
<tr>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>Heart rate</td>
<td>104</td>
<td>99.05</td>
<td>101</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>104</td>
<td>99.05</td>
<td>102</td>
</tr>
<tr>
<td>Capillary refill time</td>
<td>103</td>
<td>98.1</td>
<td>35</td>
</tr>
<tr>
<td>Conscious level</td>
<td>102</td>
<td>97.14</td>
<td>99</td>
</tr>
<tr>
<td>Respiratory distress</td>
<td>95</td>
<td>90.48</td>
<td>95</td>
</tr>
</tbody>
</table>
Table (4): Numbers and percentages of what is done in cases of shock at 0min and what recorded from them.

<table>
<thead>
<tr>
<th></th>
<th>Done</th>
<th>Recorded</th>
<th>Not done</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognize mental status</td>
<td>104</td>
<td>103</td>
<td>99  1</td>
</tr>
<tr>
<td>Skin color</td>
<td>104</td>
<td>102</td>
<td>98.1 1</td>
</tr>
<tr>
<td>High flow O2</td>
<td>104</td>
<td>104</td>
<td>100 1</td>
</tr>
<tr>
<td>Establish IV/IO access</td>
<td>105</td>
<td>100</td>
<td>9 9 0</td>
</tr>
</tbody>
</table>

Table (5): Percentage frequency of using inotropes in management of the studied patients at 15min.

<table>
<thead>
<tr>
<th>Inotrope:</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dopamine</td>
<td>58</td>
<td>55.3</td>
</tr>
<tr>
<td>Dobutamine</td>
<td>47</td>
<td>44.7</td>
</tr>
<tr>
<td>Combined with adrenaline</td>
<td>33</td>
<td>31.4</td>
</tr>
<tr>
<td>Combined with noradrenaline</td>
<td>15</td>
<td>14.2</td>
</tr>
</tbody>
</table>

Fig. (1): Percentage frequency of types of shock among the studied cases.

Fig. (2): Numbers and percentages of what is done in cases of shock at 5min and what recorded from them.

Fig. (3): Percentage frequency of monitoring of clinical follow-up items in management of shock among the studied cases.

**Discussion**

Shock is a state of circulatory dysfunction where the metabolic demands of the tissue cannot be met by the circulation. Millions of children die of shock due to various etiologies each year. Several different etiologies from hypovolemia to severe infection can result in shock.

Early recognition and timely intervention are critical in treating shock and preventing progression of the shock cascade. Furthermore, early goal directed therapy has been shown to decrease mortality in adults and children [5]. In infants and children a 9 fold improvement in survival rate was achieved when aggressive resuscitation was initiated early by the emergency room physician [6].

So we did comparison between guidelines of management of shock according to Early Goal Directed Therapy (EGDT) and what we do in pediatric intermediate and ICU units of Assiut University Pediatric Hospital [4].

Fisher [7] reported that the incidence of type of shock in pediatric patients who present to the emergency department, sepsis is the highest leading cause (57%), followed by hypovolemic shock (24%), distributive shock (14%), and cardiogenic shock (5%). While in the present study the majority of patients had mixed shock (40%) then septic shock (31.07%), cardiogenic shock (18.1%) and hypovolemic shock (11.4%).

Concerning recording, no recorded informations in the patient's files about type of shock was detected in all studied cases.
As regards general clinical manifestations of the studied patients with shock, according to EGDT assessing heart rate, blood pressure, capillary refill time, conscious level and detection of respiratory distress were essential for all patients suspecting to have shock [8].

While in the present study, assessing heart rate and blood pressure both were done in 104 cases (in 99.05% of cases), capillary refill time in 103 cases (in 98.1% of cases), conscious level in 102 cases (in 97.14% of cases) and respiratory distress in 95 cases (in 90.48% of cases).

Concerning recording, heart rate was recorded in 101 cases (in 97.1% of assessed cases), blood pressure in 102 cases (in 98.1% of assessed cases), capillary refill time in 35 cases (in 36.75% of assessed cases), conscious level in 99 cases (in 97.1% of assessed cases) and respiratory distress in 95 cases (in 90.48% of assessed cases).

As regards management of shock at 0 min.:

According to EGDT, Providing oxygen, stabilization of the airway, and establishment of vascular access are immediate goals, followed rapidly by fluid resuscitation. Supplemental oxygen should be administered to all patients with oxygenation measured by pulse oximetry. Intubation may be required for airway stabilization when mental status changes occur to prevent imminent respiratory failure or to decrease the work of breathing and oxygen consumption [3].

Comparing with the guidelines, in the present study items of recognition of mental status, skin color, determination of high flow O2 and establishing IV/IO access each were done in 104 cases (in 99.05% of cases). While recording data was good (98.1%-100%) but it was highly defective in recording establishing IV/IO access (9 cases only 8.7%).

Concerning management of shock at 5min.:

According to EGDT, Initial fluid resuscitation should be started with isotonic crystalloid infusions. A 20mL/kg infusion over 5 minutes should be given to hypotensive children without signs of cardiogenic or obstructive shock. Patients with compensated shock should still receive the same rapid infusion over 5-20 minutes as long as there are no signs of cardiogenic or obstructive shock, diabetic ketoacidosis (DKA) or other conditions that may worsen with fluid administration [3]. In the case of cardiogenic shock, fluid must be administered cautiously and at a lower volume (510ml/kg over 10-20 minutes) [3].

In the present study fluid therapy was given to 102 cases (in 97.14% of patients) and recorded in 79 cases (in 77.5%) of them. The amount of fluid was given according to the items of guidelines in 63 cases (in 60% of patients) but applied not completely in 42 cases (in 40% of patients).

Also at 5min according to guidelines, RBG and Ca levels should be checked to all patients [9]. While in the present study RBG was done for 101 cases (in 96.1% of patients) and recorded in 100% of them, but Ca level was assessed in 103 cases (in 98.1% of patients) and recorded in 96.1% of them.

Concerning management of shock at 15min:

According to EGDT, testing for signs of fluid overload (decreased oxygenations, rales, gallop rhythm, tachypnea, wet cough and hepatomegaly) must be done before and after each bolus [8]. Presence of these signs is usually an indication to stop fluid resuscitation and initiate inotrope therapy.

Vasoactive drug therapy is suggested for children with cardiogenic or septic shock who have not responded to isotonic fluid resuscitation (up to 60ml/kg or more).

If cold shock has been identified, this can be treated with central dopamine or if resistant, central epinephrine. Warm shock should be reversed with norepinephrine [3].

In the present study, dopamine alone was used in 58 cases (in 55.3% of cases), dobutamine alone was used in 47 cases (in 44.7% of cases), adrenaline was used in 33 cases (in 31.4% of cases) in combination with other inotrope and noradrenaline was used in 15 cases (in 14.2% of cases) in combination with other inotrope.

The choice of type and dose of inotropes used were applied completely according to items of guidelines in 67.6%, but applied not completely in 32.4% of patients.

False choice was in 32.4% of patients. This was due to either start giving an inotrope other than dopamine (in the indicated type of shock), or due to addition of drugs not respecting items of guidelines.

As regards monitoring and evaluation:

According to EGDT, frequent monitoring of physiologic parameters and the appropriate adjustments of therapeutic adjustments are the core of the management. This therefore requires continuous
hemodynamic monitoring and end organ perfusion assessment (brain, kidneys, skin) [10].

During the initial stage of shock, many parameters can be monitored non invasively and if the child responds well, invasive monitoring can often be avoided [11]. Continuous measurement of heart rate and pulse oximetry is necessary with frequent blood pressure measurements. In addition to these parameters, the following should be assessed before and after each fluid bolus:

- Quality of central and peripheral pulses.
- Skin perfusion (indicated by temperature and capillary refill).
- Mental status.
- Auscultation of lung and heart sounds.
- Palpation of liver edge (to identify hepatomegaly as a sign of heart failure).
- A urinary catheter should be placed to monitor urine output.

The quality of central and peripheral pulses, skin perfusion, mental status and urine output have all been shown to be appropriate signs of the response to therapy [10].

While in the present study:
- Assessment of urine output was done in 101 cases (in 96.1% of patients) and recorded in 81 cases (in 77.2% of patients). While not assessed only in 4 cases (in 3.81% of patients). Catheters were inserted in 62.86% of patients. Fluid input and urine output were monitored in 81 cases (in 77.2% of patients).
- Assessment of capillary refill time was done in 103 cases (in 98.1% of patients) but recorded only in 9 cases (in 8.7% of them).
- Blood pressure measurement was done in 104 cases (in 99.05% of patients) and recorded in 97 cases (in 93.3% of them).
- Heart rate assessment was done in 104 cases (in 99.05% of patients) and recorded in 98 cases (in 94.2% of them).
- Respiration assessment was done in 103 cases (in 98.1% of patients) and recorded in 99 cases (in 96.1% of them).
- Conscious level assessment was done 104 cases (in 99.05% of patients) and recorded in 96 cases (in 92.3% of them).

About monitoring:
- Items of blood pressure, heart rate, respiration and conscious level each were monitored in 104 cases (with a percentage of 99.05% of cases). Capillary refill time monitored only in 10 cases (with a percentage of 9.53% of patients).

About improving:
- Capillary refill was improving in 77 cases (in 73.33% of cases).
- Items of blood pressure, heart rate, respiration and conscious level each were improving in 80 cases (in 76.19% of cases).

Concerning management of shock at 60 min. and use of hydrocortisone:

According to EGDT, any shock resistant to epinephrine or norepinephrine should raise suspicions of adrenal insufficiency and a cortisol level under 18mg/dL can aid in the diagnosis [2]. In this situation, hydrocortisone succinate therapy should be initiated at a dose of 50mg/kg followed by the same dose over 24 hours [12]. Hydrocortisone is preferred to methylprednisolone or dexamethasone as it has both glucocorticoid and mineralocorticoid effects [8].

In the present study 37 cases (with a percentage of 35.34% of patients) were given hydrocortisone and 24 cases (with a percentage of 22.86%) of them were recorded.

Improvement of the condition and reversal of the shock occurred in 59 cases (with a percentage 56.2% of patients) but death occurred in 46 cases (with a percentage 43.8% of patients).

Conclusion:

We need to stick with the international guidelines as a reference standard to avoid missing important investigations or use of unnecessary investigations or lines of management unless recommended to improve the health services provided in emergency unit.

References
Clinical Audit on the Use of Vasopressors & Inotropes in Pediatric

1822


هدف الرسالة: تقييم أداء الأطفال بعد العلاج بالريبومبيوم في استخدام قابضات الأوعية ومقياسات التقاس العظمي في وحدة العناية المركزة والمركز للأطفال في مستشفى الأطفال بجا معًا أسبوتو مقاومة للمبيدات الحشرية الحديثة وما ينبغي القيام به لتحسين هذه الدراسة تكون موضوع لدراسة دقيقية أخرى لإعادة تقييم إلزام الأطفال بالتصنيفات من أجل تحسين أداء الأطباء والقائمة الصحية للمرضى.

معايير الأداء: كل المرضى الذي تم إعطائهم قابضات الأوعية ومقياسات التقاس العظمي المحجوزين بالعناية المركزة للأطفال في مستشفى جامعة أسبوتو.

معايير الاستدامة: كل المرضى بالعناية المركزة والمركز للأطفال في مستشفى جامعة أسبوتو الذين لم يلزم لهم استخدام قابضات الأوعية ومقياسات التقاس العظمي.

وقد اسفرت نتائج هذه الدراسة على التوصيات الآتية:

- ينبغي أخذ التاريخ المرضي بالأكمل وخصوصًا تاريخ الصدمة والتعرض للحساسية بالدواء المتكررة وأمراض القلب.
- يجب تحديد نوع الصدمة أمر هام جدا.
- يجب القيام بتسجيل بيانات المريض بطريقة صحيحة لتحذير متابعة الحالة الصحية للمريض ومن أجل توفير سجلات وأبحاثات دقيقة.
- يجب إعطاء السوائل اللازمة في الوقت المناسب والكمية المطلوبة.
- يجب تحديد نسبة الجلووكوز والكالسيوم ومن الأمور الهموم.
- ينصح بالإختيار الصحيح للفئات الأوعية ومقياسات التقاس العظمي حسب نوع الصدمة والحالة الصحية للمريض.
- متانة ممتازة لحالة المرض المصاب بالصدمة وخصوصًا في المريض الذين يعانون من أمراض القلب والأوعية الدموية الشديدة. إذا كانت نسبة الهيموجلوبين أقل من 10 جرام ينبغي أن يعطى نقل الدم للمريض لتحسين وصول الأكسجين للأنسجة.