Use of Hypertonic Saline in Critically Ill Children in Emergency Department of Aga Khan University

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Background

Hypertonic Saline Use

• Hypertonic Saline (HTS) is a crystalloid solution containing higher molar concentration of sodium and chloride.

• Intravenous HTS (IV HTS) use has been described in the management of traumatic brain injury, non traumatic coma and symptomatic hyponatremia.

• Its mechanism of action include
  – Osmotic shift of fluid $\rightarrow$ reduction in cerebral edema.
  – Hemodynamic effect $\rightarrow$ increased MAP
  – Microcirculatory and vascular effects
  – Immunologic effects.
Background
Hypertonic Saline Use

- The use of IV HTS has been increasing in children in various conditions
- Data regarding its use from our country is scarce
- It is being used in few hospitals in our country
Objectives

Hypertonic Saline Use

• To describe the use of IV HTS in various pediatric conditions presenting to the pediatric emergency department (PED)

• To study the effects of use of IV HTS on heart rate, blood pressure, respiratory rate, GCS and sodium levels
Materials and Methods

Hypertonic Saline Use

• **Study Design and duration:**
  – Retrospective cross sectional descriptive study from January to December 2013

• **Setting:**
  – Pediatric Emergency Department (PED), Aga Khan University Hospital

• **Inclusion Criteria:**
  – All children from 1 month to 16 years who received Intravenous Hypertonic Saline during their stay in PED

• **Exclusion Criteria:**
  – Patients whose records did not show nursing documentation of IV HTS administration were excluded
Materials and Methods
Hypertonic Saline Use

• Study was approved by the ethical review committee

• Study population was identified using the pharmacy records of physician order entry system.

• This was double checked with nursing documentation of IV HTS administration

• Demographic and clinical characteristics were recorded from patients medical record.
• Site of administration, time and doses administered was taken from nursing documentation.
Materials and Methods

Hypertonic Saline Use

• All Sodium (Na) values were obtained by basic metabolic panel

• Indications for IV HTS were taken from ED physician documentation and cross-checked with final hospital discharge summaries to ensure correct categorization.

• Data recorded included vital signs, GCS and Na levels before and after IV HTS, and urine output

• All patients were observed for adverse effects of IV HTS like AKI, Hypernatremia and local extravasations leading to phlebitis.

• Data Was analyzed by SPSS v 19
Results
Hypertonic Saline Use in Children

• Total 216 patients were identified

• All patients received 3% HTS through peripheral intravenous line except four patients

• All patients received a median dose of HTS 5ml (IQR 1)

• No adverse event was observed
Gender and Age Distribution of children who received IV HTS

**Gender Distribution**

- Male: 146 (68%)
- Female: 70 (32%)

**Age Distribution**

- <1 yrs: 24 (11%)
- 1-5 yrs: 88 (41%)
- >5 yrs: 104 (48%)

Mean Age = 6.1±4.36
Diagnosis
of children who received IV HTS

n = 216

- TBI: 110 (51%)
- Non Traumatic Coma: 106 (49%)
Etiology of Non Traumatic Coma

n=106

n= 77
Primary Neurological Illnesses

<table>
<thead>
<tr>
<th>Disease</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNS Infection</td>
<td>46</td>
</tr>
<tr>
<td>Intracranial bleeding</td>
<td>8</td>
</tr>
<tr>
<td>Brain Tumor</td>
<td>8</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>8</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>7</td>
</tr>
</tbody>
</table>

n= 29
Secondary Neurological Illnesses

<table>
<thead>
<tr>
<th>Disease</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Hepatic failure</td>
<td>11</td>
</tr>
<tr>
<td>Sepsis</td>
<td>7</td>
</tr>
<tr>
<td>DKA</td>
<td>5</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>6</td>
</tr>
</tbody>
</table>
Indications for HTS Use in Children

\[ n = 216 \]

- Depressed Consciousness: 156 (72%)
- Signs of Raised ICP: 50 (23%)
- Symptomatic Hyponatremia: 10 (5%)
Patient **Disposition** who received HTS in ED

\[ \text{n} = 216 \]

<table>
<thead>
<tr>
<th>Disposition Areas</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admitted ICU</td>
<td>85</td>
<td>40%</td>
</tr>
<tr>
<td>Admitted SCU</td>
<td>60</td>
<td>27%</td>
</tr>
<tr>
<td>Admitted in ward</td>
<td>21</td>
<td>10%</td>
</tr>
<tr>
<td>ER discharge</td>
<td>19</td>
<td>8.5%</td>
</tr>
<tr>
<td>Transferred Out</td>
<td>16</td>
<td>7.5%</td>
</tr>
<tr>
<td>Left Against Medical Advice</td>
<td>15</td>
<td>7%</td>
</tr>
</tbody>
</table>
In Hospital Outcome of children who received HTS in ED

- 85% Alive
- 15% Expired

n= 166
## Changes in different Parameters after HTS therapy

*n = 216*

<table>
<thead>
<tr>
<th>Vitals (mean/SD)</th>
<th>Baseline</th>
<th>After HTS administration</th>
<th>P-value</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H/R</td>
<td>120.9(± 27.09)</td>
<td>116.5(± 25.42)*</td>
<td>&lt;0.005</td>
<td>2.39 – 6.59</td>
</tr>
<tr>
<td>R/R</td>
<td>29.7(± 12.34)</td>
<td>29.1(± 111.75)*</td>
<td>0.109</td>
<td>0.13 – 1.35</td>
</tr>
<tr>
<td>BP</td>
<td>102(±17)</td>
<td>104(± 14)*</td>
<td>0.051</td>
<td>-2.88 – 0.08</td>
</tr>
<tr>
<td>GCS</td>
<td>11.8(± 3.2)</td>
<td>12.2(± 2.9)*</td>
<td>&lt;0.005</td>
<td>-0.5 – -0.14</td>
</tr>
<tr>
<td>Na</td>
<td>132(± 8)</td>
<td>138.5(± 7.78)**</td>
<td>&lt;0.005</td>
<td>-6.94–11.64</td>
</tr>
</tbody>
</table>

*Measured after 0-60 minutes after HTS

** Measured after 2-4 hours of IV HTS
Conclusion

• IV HTS is safe, effective and benign therapy

• We observed significant improvement in heart rate, GCS and serum sodium after IV HTS therapy

• No significant adverse event was observed
Strengths and Limitations

• First comprehensive report from Pakistan

• Retrospective, single center study

• PRISM score was not calculated
Acknowledgements

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