**WORKSHEET for Evidence-Based Review of Science for Emergency Cardiac Care**

**Worksheet author(s)**

<table>
<thead>
<tr>
<th>Amelia Reis</th>
<th>Date Submitted for review:</th>
</tr>
</thead>
</table>

**Clinical question.**

"In infants and children in shock, does early intubation and assisted ventilation compared to the use of these interventions only for associated respiratory failure lead to improved patient outcome (hemodynamics, survival?)"

**Is this question addressing an intervention/therapy, prognosis or diagnosis?** Intervention/therapy

**State if this is a proposed new topic or revision of existing worksheet:** new topic

**Conflict of interest specific to this question**

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet?

- no financial conflict of interest
- no scientific conflict of interest

**Search strategy (including electronic databases searched).**

- **PUBMED:** ("Intubation, Intratracheal"[Mesh]) AND ("Shock"[Mesh])
- **EMBASE:** #1 ('intubation'/exp OR 'ventilation'/exp) AND 'shock'/exp AND [humans]/lim AND [embase]/lim AND [1970-2008]/py
- AHA Endnote Master Library “(intubation as title and (shock as keyword)"
- Cochrane database for systematic reviews “(intubation or mechanical ventilation) and (“shock”)”
- Web of Science. "Title=(intubation or ventilation) and Title=(shock)"
- LILACS “Title=(intubation or ventilation)"
- Google scholar: intubation or ventilation

**State inclusion and exclusion criteria**

Studies that address intubation or ventilation in patients or animals in shock were included.

Were excluded: abstract only studies, articles published in different languages from English, Portuguese or Spanish

**Number of articles/sources meeting criteria for further review:**

7 studies met criteria for further review. All of them were LOE 5 (not directly related; animal studies).
## Summary of evidence

### Evidence Supporting Clinical Question

<table>
<thead>
<tr>
<th>Level of evidence</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
</table>

| 1 | 2 | 3 | 4 | 5 |

<table>
<thead>
<tr>
<th>Evidence</th>
<th>Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Viire, Sillye et al. 1983 Hussain and Roussos 1985</td>
</tr>
<tr>
<td>Fair</td>
<td>Boony, Habibi et al 2001</td>
</tr>
<tr>
<td>Poor</td>
<td>Ledingham, McArdle 1978 Hussain, Simkus et al. 1985 Tang, Pakula et al. 1996</td>
</tr>
</tbody>
</table>

### Level of evidence

A = Return of spontaneous circulation  
B = Survival of event  
C = Survival to hospital discharge  
D = Intact neurological survival  
E = Other endpoint  

Indicates animal studies  

### Evidence Neutral to Clinical question

<table>
<thead>
<tr>
<th>Level of evidence</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
</table>

| 1 | 2 | 3 | 4 | 5 |

<table>
<thead>
<tr>
<th>Evidence</th>
<th>Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>Griffel, Astiz et al. 1990</td>
</tr>
</tbody>
</table>

### Evidence Opposing Clinical Question

<table>
<thead>
<tr>
<th>Level of evidence</th>
<th>Good</th>
<th>Fair</th>
</tr>
</thead>
</table>

| 1 | 2 | 3 |

<table>
<thead>
<tr>
<th>Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
</tr>
<tr>
<td>Fair</td>
</tr>
</tbody>
</table>
REVIEWER’S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

The need for intubation for children in shock and respiratory failure is unquestioned, but early intubation of children in shock without respiratory failure is a difficult decision even for those who care for critically ill children.

Research with this focus is rare and there are no human studies that objectively address the question proposed: "In infants and children in shock, does early intubation and assisted ventilation compared to the use of these interventions only for associated respiratory failure lead to improved patient outcome (hemodynamics, survival?)"

Current recommendations for intubation in pediatric patients with shock are based on consensus opinion and not evidenced-based data. Recently, some experts (Pollard, Nadel et al. 2007), in an article discussing their personal management of meningococcal disease, proposed to change the time at which elective tracheal intubation is recommended, suggesting that intubation be performed if shock persists after 40–60 ml/kg of volume resuscitation instead of the 40 ml/kg previously recommended. Gray (Gray, Gour et al. 2007) argued that although early intubation in fluid refractory septic shock is desirable, the trigger for tracheal intubation should not be based solely on the volume of resuscitation fluid administered; the trigger should be based on clinical need. Russell (Ross Russell, Morley et al. 2008) pointed out that is important that the cardiovascular benefits of intubation are considered as well as the respiratory benefits, and anecdotally commented that waiting until the patient is moribund is too late.

A guideline for hemodynamic support of neonates and children with septic shock from the Society of Critical Care Medicine (Carcillo and Fields 2002) recommended that the decision to intubate and ventilate be made on clinical recognition of increased work of breathing, hypoventilation, impaired mental status, or presence of a moribund state (adequate scientific evidence is lacking but widely supported by available data and expert opinion). The indication for early intubation in infants and children in shock that have no other symptoms indicating intubation was not mentioned. Other international guidelines for management of severe sepsis and septic shock (Dellinger, Carlet et al. 2004; Parker, Hazelzet et al. 2004; Dellinger, Levy et al. 2008) pointed out that due to low functional residual capacity, young infants and neonates with severe sepsis may require early intubation (no graded recommendations)

One LOE-2 study in pediatric meningococcal disease (Boony 2001 p386) suggested significant reduction in mortality associated with the use of a bundle of early interventions such as elective tracheal intubation with ventilation and aggressive fluid resuscitation.

There are five level 5 studies (Ledingham and McArdle 1978, Viires, Sillye et al. 1983; Hussain and Roussos 1985; Hussain, Simkus et al. 1985; Tang, Pakula et al. 1996) that support the early intubation in shock.

Two animal studies (Viires, Sillye et al. 1983; Hussain, Simkus et al. 1985) reported an increase in blood flow to respiratory muscles in dogs in shock with spontaneous breathing when compared to mechanical ventilation. On the other hand, blood flow to the other organs was significantly greater in the mechanical ventilation group. Therefore, according to those results, better tissue perfusion reduces anaerobic metabolism and improves prognosis.

An adult study of septic shock (Ledingham and McArdle 1978) reported a significant reduction in mortality with early intermittent positive-pressure ventilation and aggressive surgery in addition to conventional management with fluids, oxygen, and antibiotics. One study with dogs in endotoxic shock showed that the death occurred due to respiratory muscle fatigue (Hussain and Roussos 1985). This study did not have a control group. Another experimental study with a rat model designed to test if vasopressor increases the duration of survival in spontaneous breathing or in mechanical ventilation, reported that mechanical ventilation by itself prolonged survival (P<0.01) (Tang, Pakula et al. 1996).

Two studies did not show improvement in outcome with early intubation and assisted ventilation of patients with shock. An experimental study (Griffel, Astiz et al. 1990) tested the effect of mechanical ventilation on systemic oxygen extraction and lactic acidosis during early septic shock in rats. Cardiac output, central venous oxygen saturation, systemic oxygen extraction, and arterial lactate were similar in the spontaneous breathing group compared to the
mechanical ventilation group. Therefore mechanical ventilation did not decrease systemic oxygen extraction or ameliorate the development of lactic acidosis during early septic shock in rats.

A prospective, randomized study in adult patients (Rivers, Nguyen et al. 2001) evaluated the efficacy of early goal-directed therapy before admission to the intensive care unit. Early, generous fluid resuscitation, 500 ml bolus of crystalloid every 30 minutes to achieve a central venous pressure of 8 to 12 mm Hg, reduced the number of shocked patients who required tracheal intubation and ventilation. Early intubation in shock, without other specific indications, may not be necessary if the hemodynamic therapy is appropriate

The available data are quite poor to make a recommendation about early intubation in pediatric patients in shock without respiratory failure. Prior recommendations have been based on expert or consensus opinions, not on scientific evidence. It is logical that mechanical ventilation decreases the work of breathing and thereby systemic oxygen requirements, and, as a consequence, probably decreases the perfusion deficit that occurs in shock

Acknowledgements:
Citation List


LOE 2 fair supportive

Comments: - study in pediatric meningococcal disease that suggested significant reduction in mortality associated with the use of a bundle of early interventions such as elective tracheal intubation with ventilation and aggressive fluid resuscitation


Comments: It is not original article; it is a task force.


Comments: It is not original article; it is a group expert opinion. The authors commented other three articles (Carcillo and Fields 2002, Pollard, Nadel et al. 2007, Gray, Gour et al. 2007) and recommend that tracheal intubation, in pediatric patients with septic shock, should be based on clinical sign, not only on the volume of resuscitation fluid administered.


Comments: It is not original article; it is a task force.


Comments: It is not original article; it is a task force.


LOE 5 good neutral

Comments: - experimental study with rats in septic shock; -there was no significant difference between spontaneous breathing and mechanical ventilation group when the following parameters were analyzed: cardiac output, central venous oxygen saturation, systemic oxygen extraction, and arterial lactate.

LOE 5  fair  supportive

Comments: -experimental study with animal model of septic shock in spontaneous breathing; -endotoxic shock was induced by Escherichia coli endotoxin; -blood pressure, heart rate, ventilatory variables, and integrated respiratory muscle EMG signs were recorded continuously; -main findings: 1. the diaphragm and inspiratory muscles failed as pressure generators, despite increased central inspiratory neural drive and muscle excitation (these muscles became fatigued), 2. respiratory muscle fatigue alone can explain the reduction in mean inspiratory flow, which resulted in decreased minute ventilation and possibly CO₂ retention, 3. as the muscle approached exhaustion, frequency of breathing decreased followed by central apnea; - there is no control group.


LOE 5  good  supportive

Comments: - experimental study with two groups of dogs in septic shock; - group 1 in spontaneous breathing and group 2 in mechanical ventilation; - Mean arterial blood pressure and cardiac output decreased in both groups, however blood flow to respiratory muscles increased in group 1 (8.8% of cardiac output 60 min after the administration of endotoxin) and decrease in group 2 (1.9% of cardiac output); - blood flow to the vital organs increased to a level higher than that seen during endotoxic shock in animals breathing spontaneously; - the study concluded that mechanical ventilation in animals in shock leads to better perfusion of organs.


LOE 5  fair  supportive


Comments: It is not original article; it is a task force.


Comments: It is not original article; it is a group expert opinion. The authors recommend elective tracheal intubation, in pediatric patients in septic shock, if shock persists after 40-60ml/kg of volume resuscitation. They also pointed that if signs of respiratory decompensation are present, emergency intubation should be performed immediately.

LOE 5   good   neutral

Comments: - prospective, randomized study in adult patients who presented to the emergency department in an academic tertiary care hospital with severe sepsis, septic shock, or the sepsis syndrome; - patients were randomly assigned either to early goal-directed therapy or to standard (control) therapy; - to decrease oxygen consumption, patients in whom hemodynamic optimization could not be achieved, received mechanical ventilation and sedatives; during the period from 7 to 72 hours, however, the patients assigned to standard therapy received significantly more fluid than those assigned to early goal-directed therapy (P=0.01), more red-cell transfusion (P<0.001) and vasopressors (P=0.03), and underwent mechanical ventilation more frequently (P<0.001); - early and generous fluid resuscitation reduced the number of shocked patients who required tracheal intubation and ventilation; -maybe early intubation in shock, without other specific indications, is not necessary if the hemodynamic therapy is appropriated.


Comments: It is not original article; it is a group expert opinion. They emphasized that, based in animal model, early intubation in pediatric shock would reduce the blood demand to respiratory muscle and improve cardiovascular condition. Also commented that children in shock that required over 40-60ml/kg fluid replacement may be treated without tracheal intubation only if the signs of shock reduce with volume infusion.


LOE 5   fair   supportive

Comments: - experimental study with rat model -the effect of vasopressor was analyzed in septic shock animals in spontaneous breathing or mechanical ventilation; -the objective was to test if such treatment singly or in combination increases the duration of survival; -Mechanical ventilation by itself prolonged survival (P<0.01)


LOE 5   good   supportive

Comments: - two groups of dogs with decreased blood pressure and cardiac output provoked by pericardial tamponade; -blood flow to respiratory muscles (diaphragm, external and internal intercostals, internal oblique, and transverse abdominis) increased (p<0.001) in animals in spontaneous breathing, and decreased in animals in mechanical ventilation; -flows to the liver, brain and quadriceps were significantly higher in the mechanical ventilation group (p<0.005)