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# Clinical Guidance

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## Paediatric Critical Care: Severe Asthma

### Summary

This guidance offers advice for staff treating children with severe Asthma. It offers advice on treatment, ventilation techniques and patient assessment. It also refers to treatment within a PICU setting. Advice on salbutamol dosing differs between British Thoracic Society guidelines and the BNF. STRS has chosen the lower dosing due to concerns of salbutamol toxicity.

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<p>This clinical guideline has been produced by the South Thames Retrieval Service (STRS) at Evelina London for nurses, doctors and ambulance staff to refer to in the emergency care of critically ill children.</p> <p>This guideline represents the views of STRS and was produced after careful consideration of available evidence in conjunction with clinical expertise and experience. The guidance does not override the individual responsibility of healthcare professionals to make decisions appropriate to the circumstances of the individual patient.</p>	

Glossary: MgSO<sub>4</sub> is magnesium sulphate, DNase= Dornase Alfa

Change History		
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# Severe Asthma

**Asthma** = reversible airflow obstruction ( $\beta_2$  bronchodilator responsive).

**Lack of reversibility:** a) mucus plugs or plastic bronchitis b) rarely other diagnoses (vascular rings etc., foreign body and airway mass)

**Risk factors fatal asthma:** (usually pre-hospital event) brittle asthma, heavy use  $\beta_2$  bronchodilators, previous ICU admission

Standard treatment for acute asthma (as per BTS guideline) <sup>1</sup>	
<b>FIRST LINE</b>	<ul style="list-style-type: none"> <li>Oxygen to maintain saturation &gt;94%</li> <li>Salbutamol MDI 2-10 puffs (can be repeated)</li> <li>Nebulized Salbutamol 2.5 -5mg MAX every 20-30 minutes</li> <li>Ipratropium bromide 250 micrograms nebulised 6 hourly may help</li> <li>Oral prednisone 20mg if &lt;5yr, 40mg if &gt;5yr 2mg/kg if on maintenance steroids, MAX 60mg (3 days usually enough)</li> <li>4mg/kg IVI hydrocortisone (Max 100mg) if oral not tolerated</li> </ul>
<b>SECOND LINE</b>	<p><b>Worsening clinical status</b></p> <ul style="list-style-type: none"> <li>40 mg/kg IVI MgSO<sub>4</sub> over 30min (Max 2 grams) (may help mucus plug lysis) (Consider 2<sup>nd</sup> dose if positive response. Side effect hypotension - monitor BP)</li> <li>IVI Salbutamol infusion (0.5 to 1mcg/kg/min – <b>MAX 20micrograms/min</b>) Monitor for hypokalemia. Side effect = tachycardia.</li> <li>No benefit increasing &gt; 1mcg/kg/min as side effects ↑ (agitation, tachycardia, hypokalaemia, lactic acidosis &amp; worsening respiratory function)</li> <li>If Aminophylline DGH policy: 5 mg/kg over 20 min then 0.5-1mg/kg/h (Max dose: 0.8mg/kg/h if 9-15 yrs, ≥16 yrs 0.5mg/kg/h). Monitor levels as narrow therapeutic range and side effects common</li> </ul>

<p><b>Baseline CXR to look for:</b></p> <ul style="list-style-type: none"> <li>Atelectasis / consolidation</li> <li>Pneumothorax</li> <li>Alternative diagnosis (airway compression, foreign body)</li> </ul> <p>Arterial blood gas sampling on clinical grounds</p> <ul style="list-style-type: none"> <li>Venous or capillary gases of limited use (CO<sub>2</sub> error high, especially if cold or shock)</li> <li>Salbutamol increases lactate production</li> </ul>
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<p><b>Asthma severity can be difficult to assess</b></p> <ul style="list-style-type: none"> <li>Tachycardia universal with <math>\beta_2</math> stimulants</li> <li>Respiratory rate varies with respiratory drive vs fatigue (slow breathing suggests fatigue)</li> <li>Agitation or drowsiness may occur</li> </ul> <p>If concerns get consultant paediatric &amp; anaesthetic review</p>
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<p><b>Consider intubation on clinical grounds if</b></p> <ul style="list-style-type: none"> <li>Saturation &lt; 92% despite high flow/face mask O<sub>2</sub> after 1<sup>st</sup> / 2<sup>nd</sup> line therapy</li> <li>Hypercarbia CO<sub>2</sub> &gt; 6kpa (rare in acute asthma = sign of fatigue)</li> <li>Inability to speak short sentences (severe airflow obstruction)</li> <li>Poor air entry/absent wheeze</li> </ul> <p><b>Intubation = high risk</b> (difficult to ventilate after securing airway)</p> <ul style="list-style-type: none"> <li>Pre oxygenate adequately (3 min). Rarely CO<sub>2</sub> may rise with O<sub>2</sub>.</li> <li>Ketamine (2 – 4mg/kg IV) / rocuronium 1mg/kg as muscle relaxation</li> <li>BP may fall if dynamic hyperinflation / air trapping: may need volume</li> <li>Use end tidal (if dead space high, end tidal 50-60% of true pCO<sub>2</sub>) if end tidal does not reach plateau = incomplete expiration</li> <li>Post intubation CXR mandatory</li> <li><b>Don't manually decompress chest</b> (risk cardiac arrest if air trapping is dynamic)</li> </ul>
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<p><b>In PICU</b></p> <ul style="list-style-type: none"> <li>Reduce IV salbutamol &lt; 0.5 mcg/kg/min as can cause lactic acidosis (↑ glycolysis)</li> <li>NO nebs if ventilated or on IV salbutamol</li> <li>Early physiotherapy opinion</li> <li>Bronchoscopy if diagnosis uncertain or poor response to treatment</li> <li>As patient improves use pressure support 10-30cm H<sub>2</sub>O (not SIMV). Titrate to WOB.</li> <li>Refer to tertiary respiratory team who must review prior to discharge (Send IgE + tryptase)</li> </ul> <p><b>Criteria for intra-tracheal DNase</b></p> <ul style="list-style-type: none"> <li>PIP &gt; 28 cm H<sub>2</sub>O</li> <li>Insp peak to plateau pressure &gt; 10 cm H<sub>2</sub>O</li> <li>Not ventilated but &gt; 48hrs of IV salbutamol &amp; no clinical improvement</li> <li>In severe cases bronchoscopy with PICU consultant</li> <li>Response to DNase may be dramatic: reduce PIP as tidal volumes increase</li> </ul>
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<p><b>Initial ventilation principles (saturation &gt; 90% adequate)</b></p> <ul style="list-style-type: none"> <li>Use pressure control mode ONLY with muscle relaxation (NOT SIMV).</li> <li>High peak pressure (PIP) to move chest. MAX plateau press = 35 cm H<sub>2</sub>O</li> <li>If severe, PIP 40-50 cm H<sub>2</sub>O may be needed if inspiratory peak to plateau &gt;10</li> <li>Fixed PEEP at 5 cm H<sub>2</sub>O (do not measure auto-PEEP)</li> <li>SLOW RATE 10 - 15 bpm (flow should reach zero before next breath)</li> <li>High CO<sub>2</sub> is acceptable (7-14kPa).</li> <li>End tidal CO<sub>2</sub> may not correlate with arterial CO<sub>2</sub> (deadspace)</li> <li>In ICU setting use tidal volume and flow loops (see figures)</li> <li>Measure inspiratory peak to plateau difference (approx. large airway resistance)</li> <li>Ensure adequate minute ventilation (tidal volumes need to be 8-10ml/kg min)</li> <li>If ventilation difficult, use manual bagging with enough pressure to move the chest. Allow enough time for expiration (plateau on ETCO<sub>2</sub>)</li> <li>PERSISTING HYPERCARBIA – Troubleshoot cause (Tube obstruction or leak, pneumothorax, mucous plugs)</li> </ul>
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