Acute asthma in children

Simon Craig
Overview

• “The basics”

• When to give steroids?

• When to give Atrovent (ipratropium)?

• What to do if they’re not getting better?
Asthma acute

This guideline has been adapted for statewide use with the support of the Victorian Paediatric Clinical Network.
**IMMEDIATELY**

**ASSESS SEVERITY AND START BRONCHODILATOR**

**Mild/Moderate**
Can walk and speak whole sentences in one breath (Young children: can move about and speak in phrases)

- Give salbutamol (100 mcg per actuation) via pMDI plus spacer (plus mask for younger children)
  - 6 years and over: 4–12 puffs
  - 0–5 years: 2–6 puffs

⚠️ Asthma is less likely to be the cause of wheezing in infants less than 12 months old. Monitor closely. If symptoms do not respond, reconsider the diagnosis and contact a paediatrician.

**Severe**
Any of: unable to speak in sentences, visibly breathless, increased work of breathing, oxygen saturation 90–94%

- Give salbutamol (100 mcg per actuation) via pMDI plus spacer (plus mask for younger children)
  - 6 years and over: 12 puffs
  - 0–5 years: 6 puffs

OR
- If patient cannot breathe through spacer and mask, give salbutamol via intermittent nebulisation driven by oxygen:
  - 6 years and over: 5 mg nebu
  - 0–5 years: 2.5 mg nebu

**Start oxygen**
Titrated to target oxygen saturation of at least 95%

**Life-threatening**
Any of: drowsy, collapsed, exhausted, cyanotic, poor respiratory effort, oxygen saturation less than 90%

- Give salbutamol via continuous nebulisation driven by oxygen
  - 6 years and over: use 2 x 5 mg nebules
  - 0–5 years: use 2 x 2.5 mg nebules

**Start oxygen**
Titrated to target oxygen saturation of at least 95%

**WITHIN MINUTES**

**REASSESS SEVERITY**

**ARRANGE IMMEDIATE TRANSFER TO HIGHER-LEVEL CARE**

Notify senior staff
- Ventilate if required (NPPV or intubate and ventilate)

**Figure. Initial management of life-threatening acute asthma in adults and children**
Australian Asthma Handbook

**Ipratropium**

**Magnesium**

**IV salbutamol**

**Non-invasive ventilation**
**Australian Asthma Handbook**

**Within First Hour**

**Start Systemic Corticosteroids**

- Oral prednisolone 2 mg/kg oral (maximum 50 mg) then 1 mg/kg on days 2 and 3
- OR, if oral route not possible
- Hydrocortisone IV initial dose 8–10 mg/kg (max 300 mg), then 4–5 mg/kg every 6 hours on day 1, then every 12 hours on day 2, then once on day 3
- OR
- Methylprednisolone IV initial dose 2 mg/kg (max 60 mg), then 1 mg/kg every 6 hours on day 1, then every 12 hours on day 2, then once on day 3

⚠️ For children 0–5 years, avoid systemic corticosteroids if mild/moderate wheezing responds to initial bronchodilator treatment

**1 Hour**

**Reassess Response to Treatment (1 Hour after Starting Bronchodilator)**

- Perform spirometry (if child capable)
- Repeat pulse oximetry

**After 1-Hour Check**

- No breathing difficulty
- Breathing difficulty persists
**Australian Asthma Handbook**

**After 1-Hour Check**

1. **No breathing difficulty**
   - **Observe** for more than 1 hour after breathing difficulty resolves
   - **Post-Acute Care**
     - Ensure parents are able to monitor and manage asthma at home
     - Provide oral prednisolone for 3-5 days
     - Ensure child has regular inhaled preventer if indicated
     - Check and coach in correct inhaler technique
     - Provide spacer if needed
     - Provide interim asthma action plan
     - Advise/arrange follow-up review

2. **Breathing difficulty persists**
   - **Arrange Hospital Admission**
   - **Continue Bronchodilator and Add-On Treatment**
     - Table. Add-on treatment options for acute asthma
   - **Reassess**
     - Breathing difficulty persists
     - Persisting severe or life-threatening acute asthma
     - **Transfer to Higher-Level Care**
     - **Discuss transfer or retrieval with senior medical staff**

   - **No breathing difficulty for more than one hour**
### Victorian (RCH) CPGs

<table>
<thead>
<tr>
<th>Mild</th>
<th>Moderate</th>
</tr>
</thead>
</table>
| Normal mental state  
Subtle or no increased work of breathing accessory muscle use/recession.  
Able to talk normally | Normal mental state  
Some increased work of breathing accessory muscle use/recession  
Tachycardia |
| Salbutamol by MDI/ **sp”ecer** (dose below table) - give once and review after 20 mins. Ensure device / technique appropriate.  
Good response - discharge on B2-agonist as needed.  
Poor response - treat as moderate.  
Oral prednisolone for acute episodes which do not respond to bronchodilator alone - 2 mg/kg (max 60 mg) initially, only continuing with 1 mg/kg daily for further 1-2 days if there is ongoing need for regular salbutamol.  
Provide written advice on what to do if symptoms worsen. Consider overall control and family’s knowledge. Arrange follow-up as appropriate.  
( **discharge pack** ) | Oxygen if **O**₂ saturation is < 92%. Need for Oxygen should be reassessed.  
Salbutamol by MDI/ **sp”ecer** - 1 dose ( **dose below** ) every 20 minutes for 1 hour; review 10-20 min after 3rd dose to decide on timing of next dose.  
Oral prednisolone - 2 mg/kg (max 60 mg) initially, only continuing with 1 mg/kg daily for further 1-2 days if there is ongoing need for regular salbutamol |
Victorian (RCH) CPGs

<table>
<thead>
<tr>
<th>Severe</th>
<th>Oxygen as above</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agitated/distressed</td>
<td>Salbutamol by MDI/ <strong>spacer</strong> - 1 dose (dose below) every 20 minutes for 1 hour; review ongoing requirements 10-20 min after 3rd dose. If improving, reduce frequency. If no change, continue 20 minutely. If deteriorating at any stage, treat as critical.</td>
</tr>
<tr>
<td>Moderate-marked increased work of breathing accessory muscle use/recession.</td>
<td>Ipratropium by MDI/ <strong>spacer</strong> - 1 dose (dose below) every 20 minutes for 1 hour only.</td>
</tr>
<tr>
<td>Tachycardia</td>
<td>Aminophylline If deteriorating or child is very sick. Loading dose: 10 mg/kg i.v. (maximum dose 500 mg) over 60 min. Unless markedly improved following loading dose, give continuous infusion (usually in ICU), or 6 hourly dosing (usually in ward). <strong>Drug doses</strong></td>
</tr>
<tr>
<td>Marked limitation of ability to talk</td>
<td>Magnesium sulphate 50% (500 mg/mL) Dilute to 200 mg/mL (by adding 1.5mls of sodium chloride 0.9% to each 1ml of Mg Sulphate) for intravenous administration</td>
</tr>
<tr>
<td>Note: wheeze is a poor predictor of severity.</td>
<td>• 50 mg/kg over 20 mins</td>
</tr>
<tr>
<td></td>
<td>• If going to ICU, this may be continued with 30 mg/kg/hour by infusion</td>
</tr>
<tr>
<td></td>
<td>Oral prednisolone (2 mg/kg); if vomiting give i.v. methylprednisolone (1 mg/kg)</td>
</tr>
</tbody>
</table>

Involve senior staff. Arrange admission after initial assessment.
**Victorian (RCH) CPGs**

<table>
<thead>
<tr>
<th>Critical</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Confused/drowsy</td>
<td>Involve senior staff.</td>
</tr>
<tr>
<td>Maximal work of breathing accessory muscle use/recession</td>
<td></td>
</tr>
<tr>
<td>Exhaustion</td>
<td></td>
</tr>
<tr>
<td>Marked tachycardia</td>
<td></td>
</tr>
<tr>
<td>Unable to talk</td>
<td></td>
</tr>
<tr>
<td>SILENT CHEST, wheeze may be absent if there is poor air entry.</td>
<td></td>
</tr>
</tbody>
</table>

**Oxygen**

- **Continuous nebulised salbutamol** (use 2 x 5mg/2.5L nebulers undiluted) - see below re toxicity.
- **Nebulised ipratropium** 250 mcg 3 times in 1st hr only, (20 minutely, added to salbutamol).
- **Methylprednisolone** 1 mg/kg i.v. 6-hourly.
- **Aminophylline** as above
- **Magnesium sulphate** as above. In ICU patients on Mg infusion, aim to keep serum Mg between 1.5 and 2.5mmol/L.
  
  May also consider **i.v. salbutamol**. Limited evidence for benefit. 5 mcg/kg/min for one hour as a load, followed by 1-2 mcg/kg/min.

 **Beware salbutamol toxicity:** tachycardia, tachypnoea, metabolic acidosis. Can occur with both IV and inhaled therapy. Lactate commonly high. Consider stopping/reducing salbutamol as a trial if you think this may be the problem.

- **Aminophylline, magnesium and salbutamol** must be given via separate IV lines.

- **Intensive care admission for respiratory support** (facemask CPAP, BiPAP, or intubation/IPPV) may be needed.
### The basics – salbutamol

<table>
<thead>
<tr>
<th>Asthma Handbook</th>
<th>RCH CPGs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mild</strong></td>
<td>Give once then reassess; repeat dose every 20-30 minutes for the first hour if needed (or sooner if needed)</td>
</tr>
<tr>
<td><strong>Moderate</strong></td>
<td>3 doses over 1 hour. Review 10-20 minutes after 3rd dose</td>
</tr>
<tr>
<td><strong>Severe</strong></td>
<td>Give once then reassess; repeat dose every 20 minutes for the first hour (3 doses) or sooner as needed</td>
</tr>
<tr>
<td></td>
<td>If no improvement, continue 20-minute.</td>
</tr>
<tr>
<td><strong>Critical</strong></td>
<td>Continuous nebulised salbutamol</td>
</tr>
</tbody>
</table>
## Steroids - doses

<table>
<thead>
<tr>
<th></th>
<th>Asthma Handbook</th>
<th>RCH CPGs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Oral</strong></td>
<td>Prednisolone 2 mg/kg (up to 50mg) on day 1, then 1 mg/kg day 2 and 3</td>
<td>Prednisolone 2 mg/kg (max 60 mg) initially Only continuing with 1 mg/kg daily for further 1-2 days if there is ongoing need for regular salbutamol.</td>
</tr>
<tr>
<td><strong>Parenteral</strong></td>
<td>Methylprednisolone 2 mg/kg (max 60mg) initial dose Then 1 mg/kg</td>
<td>Methylprednisolone 1 mg/kg q6h</td>
</tr>
<tr>
<td></td>
<td>Hydrocortisone 8-10 mg/kg (max 300mg) initial dose Then 4-5 mg/kg</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6-hourly day 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12-hourly day 2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Daily day 3</td>
<td></td>
</tr>
</tbody>
</table>
Steroids – when not to give?

- RCH CPGs
  - “Oral steroids for acute episodes which do not respond to bronchodilators alone”

- Asthma Handbook
  - For children 0-5 years, avoid systemic corticosteroids if mild/moderate wheezing responds to initial bronchodilator treatment
# Ipratropium (Atrovent) - doses

<table>
<thead>
<tr>
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<th>Asthma Handbook</th>
<th>RCH CPGs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inhaler</strong></td>
<td>0-5 years: 4 puffs</td>
<td>&lt;6 years: 4 puffs</td>
</tr>
<tr>
<td></td>
<td>6+ years: 8 puffs</td>
<td>&gt;6 years: 8 puffs</td>
</tr>
<tr>
<td><strong>Nebulised</strong></td>
<td>0-5 years: 250 mcg</td>
<td>250 mcg</td>
</tr>
<tr>
<td></td>
<td>6+ years: 500 mcg</td>
<td></td>
</tr>
</tbody>
</table>
Ipratropium (Atrovent)

• RCH CPGs
  • Severe: 3 doses over 1 hour (every 20 minutes)
  • Critical: nebulised, 3 doses over 1 hour

• Asthma Handbook
  • “If poor response, add ipratropium bromide”
If not improving… (RCH CPGs)

- **Aminophylline**
  - If deteriorating or child is very sick.
  - Loading dose: 10 mg/kg i.v. (maximum dose 500 mg) over 60 min.
  - Can run infusion in ICU, or intermittent boluses on ward

- **Magnesium sulphate 50% (500 mg/mL)**
  - 50 mg/kg over 20 mins
  - Can follow with infusion
May also consider i.v. salbutamol. Limited evidence for benefit. 5 mcg/kg/min for one hour as a load, followed by 1-2 mcg/kg/min.

Beware salbutamol toxicity: tachycardia, tachypnoea, metabolic acidosis. Can occur with both IV and inhaled therapy. Lactate commonly high. Consider stopping/reducing salbutamol as a trial if you think this may be the problem.

Aminophylline, magnesium and salbutamol must be given via separate IV lines.

Intensive care admission for respiratory support (facemask CPAP, BiPAP, or intubation/IPPV) may be needed.
<table>
<thead>
<tr>
<th><strong>IV magnesium sulfate</strong></th>
<th>Second-line bronchodilator in severe or life-threatening acute asthma, or when poor response to repeated maximal doses of other bronchodilators</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IV salbutamol</strong></td>
<td>Third-line bronchodilator in life-threatening acute asthma that has not responded to continuous nebulised salbutamol after considering other add-on treatment options</td>
</tr>
<tr>
<td>(only in ICU)</td>
<td></td>
</tr>
</tbody>
</table>
Aminophylline plus beta$_2$ agonist (children)

Overall, evidence from randomised clinical trials in children with acute asthma requiring hospital admission suggests that the addition of intravenous aminophylline to beta$_2$-agonists and corticosteroids, with or without muscarinic antagonists (anticholinergic bronchodilators), improves lung function within 6 hours of treatment, but does not appear to improve symptoms or shorten hospital stay. Aminophylline is associated with a significant increased risk of vomiting in children.
Other options

• Non-invasive ventilation (NIV)
  • BiPap

• Ketamine
  • Little evidence for bronchodilator efficacy
  • Might help facilitate NIV
Overview

• “The basics”

• When to give steroids?

• When to give Atrovent (ipratropium)?

• What to do if they’re not getting better?
“The Basics”

• How sick?

• Salbutamol

• Oxygen to maintain “acceptable” saturations

• Assess response to treatment
Steroids

• Controversial
  • “Mild” asthma that improves very quickly
  • Younger children / “Preschool wheeze”

• 2mg/kg (max 50-60mg) prednisolone initially
  • Then 1 mg/kg for 2 days

• IV methylprednisolone 1-2 mg/kg initial dose
Ipratropium

- Severely ill
- OR
- Not improving on salbutamol alone

- 3 doses, 20 minutes apart, then q6h
Not improving

• Magnesium first-line
  • Least toxic
  • Least controversial

• Aminophylline (if in Victoria)

• Salbutamol (if elsewhere?!)
Critically ill

• “Evidence-free zone”

• Get help!

• Continuous nebulisation
  • Salbutamol
  • Ipratropium
  • Oxygen
Critically ill

- Non-invasive ventilation
  - Ketamine 0.5-1 mg/kg might help keep the mask on

- IV bronchodilators
  - Salbutamol / magnesium / aminophylline
  - ?Adrenaline

- Intubation
  - Experienced intubator
  - Volume load, permissive hypercapnoea
  - High risk of complications
Questions?