Management of Acute Severe Asthma

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- Chronic inflammatory disorder of the airway
- Characterized by recurrent episodes of wheezing, breathlessness and coughing
- Global prevalance: 1-18% of the population in different countries
- Annual world wise death from asthma:250,000
- No data regarding incidence of acute asthma exacerbation in children in India

- Exacerbation of asthma are episodes characterised by a progressive increase in symptoms of shortness of breath, cough, wheezing and chest tightness.

- Acute severe asthma ,formerly known as status asthmaticus, is defined as severe asthma unresponsive to repeated course of nebulised bronchodilator agents(beta- agonist therapy).

Pathophysiology

- Primary pathophysiology:
  - -Airway inflammation & hyper-reactivity
  - - Smooth muscle spasm
  - - Mucosal edema & plugging

- Pathologic changes in airway → airflow obstruction → premature airway closure on expiration → dynamic hyperinflation → hypercarbia
- Dynamic hyperinflation or "air-trapping" also leads to ventilation/perfusion (V/Q) mismatching causing hypoxemia

Clinical presentations

- Cough
- Wheezing
- Increased work of breathing
- Agitation
- Altered level of consciousness
- Inability to speak
- Central cyanosis
- Diaphoresis
- Inability to lie down

Clinical presentation

- varies by severity, asthmatic trigger, and patient age.
- Degree of wheezing does not correlate with severity of the disease.
- Presence of pulsus paradoxus correlates with the severity of asthma attack
- HIGH RISK FACTORS FOR ASTHMA SEVERITY & FATALITY:

-Previous severe sudden deterioration

-Past PICU admission

-Previous respiratory failure with the need for mechanical ventilation

Assessment of severity

- Based on clinical observation of the child
- Severity of exacerbation is assessed by evaluating-
  - PR
  - RR , BP ,SPO2
  - use of accessory muscles ,
  - ability to complete a sentence
  - cyanosis
  - altered sensorium

Assessment of severity

Becker Asthma Score:

Score	Respiratory rate	Wheezing	I/E ratio	Accessory muscle use
0	<30	None	1:1.5	None
1	30-40	Terminal expiration	1:2	1 site
2	41-50	Entire expiration	1:3	2 sites
3	>50	Inspiration & entire expiration	>1:3	3 sites or neck strap muscle use

Score > 4 – Moderate asthma exacerbation

Score 7 or above – Severe & needs ICU admission

Assessment of severity

- Oxygen saturation should be closely monitored by pulse oximetry
- Oxygen saturation <90% signals the need for aggressive therapy
- Complicating factors such as
  pneumonia,
  atelectasis,
  pneumothorax,or pneumomediastinum
  should be identified early

Chest Radiography

Limited role but indicated in-

- First time wheezers
- Clinical evidence of parenchymal disease
- Those requiring admission to PICU
- Suspected air leak or pneumonia
- When the underlying cause of wheezing is in doubt

Arterial blood gas

- ABG should be done in all children at baseline and subsequently as indicated
- Usually hypocarbia in early stage
- Normalisation of CO2 with persistent respiratory distress indicates impending respiratory failure
- A PaO2 <60 mmHg and a normal or increased PaCO2(>45 mmHg) indicates the presence of respiratory failure

Management

- PICU admission
- IV access
- Continuous pulse oximetry
- Cardiorespiratory monitoring
- Avoid sedation in non-intubated children
- If ventilated- arterial and central venous access

Fluids

- Restoration of euvolemia
- Isotonic fluid like normal saline or ringer's lactate should be used for correction of dehydration
- Once euvolemia is restored, maintenance IV fluids should be started
- Avoid overhydration; Risk of pulm edema
- Serum potassium monitoring

Antibiotics

- Not routinely indicated
- Used in children with evidence of bacterial infection
  - High fever
  - Purulent secretion
  - Consolidation on X-ray film
  - Very high leukocyte counts

Oxygen

- Administered by nasal cannulae, by mask, or rarely by head box in some infants
- Oxygen saturation monitoring with pulse oximetry
- Maintain oxygen saturation 93-95%(94-98% for children 6-11yrs)

Pharmacological therapies

- B2 agonist
- Steroids
- Anticholinergics
- Magnesium sulfate
- Aminophylline
- Ketamine
- Heliox

Child with acute asthma exacerbation

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clinical assessment (pulmonary index score),pulse oximetry

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CXR and ABG if indicated

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Assessment of severity of status asthmaticus

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Admit to PICU if Becker asthma score ≥ 7

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Supportive care

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Management

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Medications

Ventilation

Pulmonary index score

1. Respiratory rate
2. Wheezing
3. Inspiration/expiration ratio
4. Accessory muscle use

- Comfortable enviornment
- IV access
- Maintain euvolemia
- Continuous cardio-respiratory monitoring
- Avoid sedation
- Monitor potassium
- Antibiotics , if indicated
- If ventilated, arterial and central venous access

medications

β_2 agonist

- salbutamol continuous nebulization 0.15-0.5 mg/kg/hr,or 10-20 mg/hr
- Sabutamol intermittent nebulisation-0.15 mg/kg at 20 min 3 times
- salbutamol MDI with spacer (100 mcg) 4-8 puffs
- subcutaneous Terbutaline - 0.01 mg/kg/dose (max 0.3 mg),may be repeated q 20-30 min for total 3 times
- IV Terbutaline - loading dose 10 mcg/kg IV over 10 min followed by 0.1-10 mcg/kg/min

Antcholinergic

- Ipratropium bromide 125 - 500 mcg (if nebulized)
- administered every 20 min for up to three doses
- Then every 4 - 6 hrs

Corticosteroids

Hydrocortisone ?

- 10 mg/kg IV stat
- then 5 mg/kg IV q 6 hr
- switch to PO

Prednisolone 1- 2 mg/kg/d when stable ,total 3 to 5 days

Methyl prednisolone-iv/im 1-2mg/kg/day qd or bid for 3-7 days

Dexamethasone -0.6 mg/kg/day orally OD for 1-2 days

Other medications

1.Magnesium sulphate – 25-75 (50) mg/kg/dose over 30 min or infusion at a rate of 10 – 20 mg/kg/hr , can repeat once or twice after 4-6 hrs

Nebulized isotonic magnesium suphate -150 mg 3 doses in 1st hr of t/t in >2 yrs –benefit in some pts

2.Theophyline – loading dose of 5-7 mg/kg infused over 20 min followed by 0.5 – 0.9 mg/kg/hr

3.Ketamine – 1 mg/kg/hr , titrated to effect,usually combined with benzodiazepine infusion

4. Vecuronium – 0.1 mg/kg/hr , titrated to effect.

5.fentanyl ,no morphine for sedation as it releases histamine

B2 agonist

- The mainstay of therapy
- Administered via inhalation, intravenous, subcutaneous, or oral routes
- Salbutamol & Terbutaline- preferred

No difference in clinical response to treatment with racemic salbutamol Vs levo- salbutamol in acute severe asthma in children

Qureshi F. et al. Ann Emerg Med. 2005;46:29-36.

Inhaled B2 agonist

- Continuous nebulisation
  0.15-0.5 mg/kg/hr or 10-20 mg/hr
- Intermittent back-to-back nebulization
  0.15 mg/kg
- MDI 4-10 puffs every 20 min

MDI with a holding chamber is at least as effective as nebulized salbutamol in young children with moderate to severe asthma exacerbations.

Castro-Rodriguez JA et al J Pediatr.2004;145:172-7

Intravenous B2 agonist

- Indications-

  -Unresponsive to inhaled B2 agonist

  -Nebulization is not feasible(Intubated patients, Patients with poor air entry)

- Terbutaline is the intravenous agent of choice

  Loading dose of 10 mcg/kg IV over 10 min, followed by continuous infusion at 0.1-10 mcg/kg/min

No evidence to support the routine use of IV B2 agonist in acute severe asthma

Travers A. et al. Cochrane Database Syst Rev.2001;(2): CD002988

Subcutaneous B2 agonist

- Primarily used for children with no IV access
- As a rapidly available adjunct to inhaled B2 agonist
- Subcutaneous Terbutaline

  0.01 mg/kg/dose(max of 0.3 mg)
- May be repeated every 15-20 min for up to three doses

Anticholinergic agents

- Standard of care in the treatment of acute asthma in children in combination with B2 agonist
- Administered via inhaled route
- Most commonly used –Ipratropium bromide
- Ipratropium bromide-Nebulisation/MDI

  125-500 mcg or 4-8 puffs every 20 min for up to three doses
- Subsequently every 4-6 hr

Corticosteroids

- First line of therapy
- Oral or parenteral corticosteroids have equal efficacy
- Parenteral steroids – preferred for critically ill children
- Whenever possible, administered within 1 hr of presentation
- Aerosolized corticosteroids-limited role
- Commonly used parenteral steroids

  -Hydrocortisone

  -Methyl prednisolone

  -Dexamethasone

Magnesium sulphate

- Studies showed some benefit of adding IV magnesium sulfate to nebulized B agonists and corticosteroids
- Dose-50 mg/kg/dose over 30 min or by continuous infusion at a rate of 10-20 mg/kg/hr
- May be repeated once or twice after 4-6hrs

Aminophylline

- Loading dose: 5-7 mg/kg over 20 min
- Continuous infusion: 0.5-0.9 mg/kg/hr

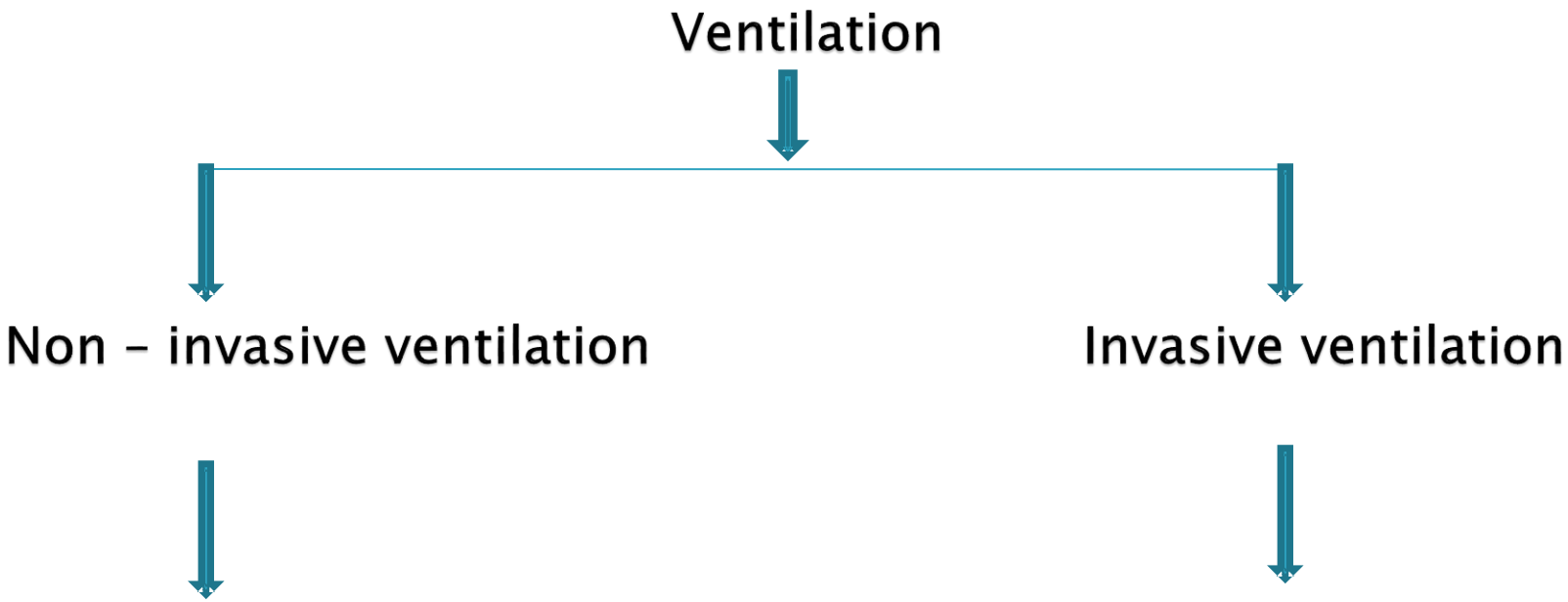
- Limited role in children unresponsive to steroids, inhaled and IV B2 agonist,and O2.

Ream RS et al. Chest 2001;119:1480-8.

Mechanical Ventilation

Indications-

- Poor response to initial therapy
- Severe hypoxia
- Rapid deterioration in mental state
- Rising PCO2
- Cardiopulmonary arrest



Non – invasive positive pressure ventilation should be tried prior to conventional ventilation

- Volume control mode
- V_T < 6 ml/kg
- RR approximately half of the normal for age
- I:E ratio 1:3
- PEEP of 0–2 cm of H_2O
- In Infants – pressure control ventilation with PIP adjusted

Intubation Tips

- Preoxygenate with 100% oxygen
- Cuffed ET tube with the largest appropriate diameter should be used
- Avoid histamine producing agents like morphine or atracurium
- Ketamine-preferred induction agent due to its bronchodilatory action
- Use atropine ,Benzodiazepam and a rapid acting muscle relaxant(Vecuronium)

Ventilation Strategy

- Maintain adequate oxygenation
- Permissive hypercarbia and adjust minute ventilation to maintain arterial pH of >7.2
- Slow ventilator rates
- Prolonged expiratory phase
- Short inspiratory time
- Minimal PEEP(controversial)

Ventilator setting

- Vt of 5-6 ml/kg
- RR approximately half of the normal for age
- I:E ratio of 1:3
- PEEP of 0-2 cm of H2O
- In infants, pressure controlled ventilation may be used with PIP adjusted to achieve adequate ventilation

Sedation, Analgesia and Muscle Relaxants

- Sedation is generally not indicated except
  - Excessively anxious children(not hypoxemic or hypercarbic)
  - Intubated children
- Mechanically ventilated children require heavy sedation
- Ketamine(1-2 mg/kg/hr) is a good choice
- Among opiates, fentanyl is preferred
- Vecuronium is commonly used to achieve paralysis

Heliox

- Reasonable adjunct therapy
- Indications-
  - Children unresponsive to conventional therapy
  - Children on high pressure mechanical ventilatory support

Colebourn CL et al. Anaesthesia 2007;62:34-42

Noninvasive Mechanical Ventilation

- An alternative to conventional mechanical ventilation in early phase
- While weaning off from conventional ventilator

Carroll CL, Schramn CM, Ann Allergy Asthma Immunol.2006;96:454-9

Leukotriene Modifiers

- Little data to suggest a role for leukotriene modifiers in acute asthma
- It is not part of standard management of status asthmaticus

Todi VK, Lodha R, Kabra SK. Arch Dis Child. 2010;95:540-3

Chest Physiotherapy

- Useful in children with segmental or lobar atelectasis

- In others no therapeutic benefit in the critically ill patient with status asthmaticus


THANK YOU
WELLS FARGO
THE WALK TO CURE DIABETES
JDRF 2005
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