Anaphylaxis and the Role of Diphenhydramine, Epinephrine and Ventolin

Dwayne Cottel
Regional Paramedic Educator

Matthew Davis
Medical Director of Education
Learning Objectives

• Describe the pathophysiology of an allergic reaction/anaphylaxis

• Describe the basic pharmacology of Diphenhydramine, Epinephrine, and Salbutamol

• Appropriately apply the *Moderate to Severe Allergic Reaction Medical Directive* to a variety of patient care scenarios

• Describe how anaphylaxis may cause cardiac arrest and it’s possible treatments
Pathophysiology of an Allergic Reaction

• An exaggerated response to a foreign protein (antigen)

• Foreign proteins enter the body

• Inhalation, ingestion, injection and absorption

• Histamine secreted from mast cells

• Results in bronchoconstriction, increased GI motility, GI edema, vasodilation, and increased gastric acids
Differences in Allergic Reaction and Anaphylaxis

**Allergic Reaction**
- Pruritus (itching)
- Erythema (redness)
- Urticaria (hives)
- Epiphora (watery eyes)
- Rhinitis (runny nose)

**Anaphylaxis**
- Wheezing
- Stridor
- Generalized urticaria
- Generalized edema
- Hypotension
- Chest tightness
- Swollen lips
- Edematous airway
- Cardiac arrest
Mild Allergic Reaction

• An antigen antibody reaction

• Not life threatening

• Presentation of patients varies

• Usually relieved with antihistamines

• Self limiting once allergen removed
Severe Reaction/Anaphylaxis

- Much more severe antigen/antibody response
- Can be life threatening
- Risk of airway edema and circulatory collapse
- Multiple system response: respiratory, cardiovascular, GI, CNS
- Must be treated aggressively for patient survival
- IM Epinephrine should be administered immediately upon recognition
Severe Reaction/Anaphylaxis

- Minutes to hours in onset and can lead to death
- Usually under recognized and untreated
- Goal is early recognition and treatment with epinephrine
- Prevention of respiratory and cardiovascular collapse
Case 1

- 35 year old male with hives
- Pt. possible exposure to environmental allergen
- Pt. was bailing hay and started to get itchy eyes, runny nose, body hives
- Pt. states he does have seasonal allergies but never this bad
Case 1 (cont’d)

- Vitals: P: 84, R: 20, BP: 140/80, SpO2 98%, Temp 36.7
- Chest sounds are clear
- Generalized hives to chest, arms, and neck
- On transport, tells you he is feeling nauseated from the motion in the ambulance. Vitals are unchanged, no other changes in condition
Case 1 Management

- BLS care i.e. O2, monitor, vitals
- Benadryl administration 50mg IV or IM
- IV access
- Monitor for progression or improvement of symptoms
Pharmacology of Diphenhydramine

• Diphenhydramine: H1 (histamine) blocker
• Prevents histamine from binding to specific receptor sites
• Minimizes signs and symptoms of the allergic reaction
• Has anticholinergic properties
Pharmacology of Diphenhydramine

- H1 antihistamines relieve itching and hives
- May help antagonize some cardio and respiratory effects
- H1 antihistamines do not relieve upper/lower airway edema
- They also do not prevent or treat hypotension
- Do not inhibit release from mast cells and basophils
Pharmacology of Diphenhydramine

- Onset of Diphenhydramine is 15-30 minutes
- Duration is between 4-6 hours
- Side effects: anticholinergic effects (i.e. sedation)
- Allergy is rare
- Helps to relieve symptoms of pruitus and hives
Administration of Diphenhydramine

- Administration: IM or IV injection
- Does not have to be diluted
Calculation of Diphenhydramine Dosing

- Less than 25kg = none
- 25-49kg: 25mg IV/IM
- 50kg and greater: 50mg IV/IM
- Only contraindication is allergy
Consider *diphenhydramine* (if certified and authorized):

<table>
<thead>
<tr>
<th>Weight</th>
<th>Route</th>
<th>Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥25 kg to &lt;50 kg</td>
<td>IV</td>
<td>IM</td>
</tr>
<tr>
<td>Dose</td>
<td>25 mg</td>
<td>25 mg</td>
</tr>
<tr>
<td>Max. single dose</td>
<td>25 mg</td>
<td>25 mg</td>
</tr>
<tr>
<td>Dosing interval</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Max. # of doses</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Weight ≥50 kg</th>
<th>Route</th>
<th>Route</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dose</td>
<td>50 mg</td>
<td>50 mg</td>
</tr>
<tr>
<td>Max. single dose</td>
<td>50 mg</td>
<td>50 mg</td>
</tr>
<tr>
<td>Dosing interval</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Max. # of doses</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
Case 2

- 21 year old female pt. with menstrual cramps
- Took 2 Aleve for pain
- Became flush, facial swelling
- Pt. took 50mg Benadryl 10 min. prior to EMS arrival
- Under investigation for Allergy to NSAIDs
- Epi-pen present but not used
Case 2 (cont’d)

• Vitals: P: 63, R: 20, BP: 149/88, SpO2 98%, Temp 37, LOA: Unaltered

• Chest sounds clear upon auscultation

• No airway compromise noted

• Pt. has now developed hives and itching
Case 2 Management

- BLS care i.e. O2, monitor, vitals
- Benadryl administration 50mg IV or IM
- IV access
- Epinephrine and fluid administration if patient condition deteriorates
Case 2 cont’d

• Later en route your patients condition changes

• They complain of an itchy throat, feels tight

• You auscultate wheezes

• The patient is complaining of a “swollen tongue”

• Vitals: P: 56, R: 40, BP: 80/60, SpO2 93%
Pharmacology of Epinephrine

- Directly stimulates Alpha, Beta 1+2 effects
- First drug of choice for Anaphylaxis
- Causes vasoconstriction of peripheral vessels
- Vasodilation of coronary vessels
- Bronchodilates airways
Pharmacology of Epinephrine

• Increases force of contractions (inotropic)

• Increases heart rate (chronotropic)

• Antagonizes the effects of histamine

• Increases blood pressure

• Onset is 5 mins.

• Duration is 4 hours
Pharmacology of Epinephrine

- Side effects: headache, nausea, restlessness, tachycardia, dysrhythmias
- Allergy is rare (usually caused from the suspension)
- IM injection
- This is a life saving medication
Calculation of Epinephrine dosing

- 0.01mg/kg rounded to the closest 0.05
- Administered IM only
- 1 dose only unless patch for second
- Maximum single dose 0.5mg (based on Pt’s weight in kg)
- Weight determination (2x Pt’s age + 10kg) for pediatric patients
- In adults ask or estimate
- If additional epi is needed a BHP is required
Consider **epinephrine**:

<table>
<thead>
<tr>
<th>Weight</th>
<th>Route</th>
<th>Concentration</th>
<th>Dose</th>
<th>Max. single dose</th>
<th>Dosing interval</th>
<th>Max. # of doses</th>
</tr>
</thead>
<tbody>
<tr>
<td>N/A</td>
<td>IM</td>
<td>1:1,000</td>
<td>0.01 mg/kg*</td>
<td>0.5 mg</td>
<td>N/A</td>
<td>1</td>
</tr>
<tr>
<td>≥10 kg to &lt;25 kg</td>
<td>Pediatric Autoinjector</td>
<td>1:1,000</td>
<td>1 injection (0.15 mg)</td>
<td>1 injection</td>
<td>N/A</td>
<td>1</td>
</tr>
<tr>
<td>≥25 kg</td>
<td>Adult Autoinjector</td>
<td>1:1,000</td>
<td>1 injection (0.3 mg)</td>
<td>1 injection</td>
<td>N/A</td>
<td>1</td>
</tr>
</tbody>
</table>

*The epinephrine dose may be rounded to the nearest 0.05 mg.*
Special considerations

• Anaphylaxis presentation is variable

• Wheezing (bronchoconstriction) can also be present

• < 25kg: 600mcg MDI or 2.5mg nebulized

• ≥ 25kg: 800mcg MDI or 5.0mg nebulized

• Maximum of 3 doses, interval 5-15 minutes as needed
Pharmacology of Salbutamol

• Classified as a bronchodilator

• Beta 2 agonist

• First drug of choice for Bronchoconstriction/Wheezing

• Causes smooth muscle relaxation/dilation of the Bronchioles

• Can be used in the setting of Anaphylaxis when wheezing is present
Pharmacology of Salbutamol

- Onset is 8-10 minutes
- Duration is 3-4 hours
- Side effects: tachycardia, dizziness, hypertension, muscle cramps
- Allergy to salbutamol is rare
- Administered by MDI, Nebulization, IV
Consider **salbutamol**:  

<table>
<thead>
<tr>
<th>Weight</th>
<th>Route</th>
<th>Dose</th>
<th>Max. Single Dose</th>
<th>Dosing interval</th>
<th>Max. # of doses</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;25 kg</td>
<td><strong>MDI</strong> (if available)*</td>
<td>Up to 600 mcg (6 puffs)</td>
<td>2.5 mg</td>
<td>5-15 min. PRN</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>NEB</strong></td>
<td>2.5 mg</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>≥25 kg</td>
<td><strong>MDI</strong> (if available)*</td>
<td>Up to 800 mcg (8 puffs)</td>
<td>5 mg</td>
<td>5-15 min. PRN</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>NEB</strong></td>
<td>5-15 min. PRN</td>
<td>800 mcg</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

* 1 puff=100 mcg
Case 2 En Route Management Summary

- Epi
- IV Fluids
- Ventolin
Case 3

- 25 year old male Pt. VSA after possible ingestion of peanuts
- Ingestion of cookies, possible exposure to nuts
- Head, neck, lips, tongue edematous, urticaria to chest, neck and arms
- Hx. of peanut allergy
Case 3 Management

• ANSWER:
  
  • ROSC is unstable
  
  • Benadryl will provide little to no benefit
  
  • Don’t delay transport
  
  • Focus on ABC’s, IV therapy
Case 3 Management

- Start Compressions (CPR)
- Attach Defib Pads
- Analyze Pt.
- Treat accordingly (shock or no-shock)
- Epi IM (Do not delay defib)
- Airway Management
Rare events

- VSA due to anaphylaxis
  - IM epinephrine can be administered

- Administer Epi ASAP but do not delay defibrillation

- Dosing is 0.01mg/kg rounded to the closest 0.05mg.

- Maximum single dose is 0.5mg IM only

- 1 dose
TOR and Anaphylaxis - Question

• If epi is given and the patient has no ROSC, arrest is unwitnessed, and by the 3rd analysis no shock is given, is it acceptable to patch for TOR, or is the TOR contraindicated due to the arrest being of non-cardiac origin?
TOR and Anaphylaxis - Answer

• Given this more evident clinical appearance of anaphylaxis, coupled with the clearly different underlying pathophysiology of the cardiac arrest, TOR should not be considered or applied

• no TOR, follow Medical Cardiac Arrest Medical Directive and transport when directive complete.
What happens in ER post transport?

- Ongoing management based on condition
- Fluid administration
- Steroids administration
- Epinephrine (usually by infusion)
- Possible H2 blocker administration
- Observation for several hours
Conclusion

- In the setting of an anaphylactic reaction, epinephrine is the first drug to be administered.

- Diphenhydramine can be utilized for allergic reactions, and secondary for anaphylaxis.

- Salbutamol can be utilized in an anaphylactic or allergic event when wheezing is present.
Questions?

• If you have any questions regarding these or any of your Medical Directives, please contact your Regional Paramedic Educator.

  • Christine Hardie – Christine.Hardie@LHSC.on.ca
  • Dwayne Cottel – Dwayne.Cottel@LHSC.on.ca
  • Peter Morassutti – Peter.Morassutti@LHSC.on.ca
References


• Canadian Pharmacists Association (2102). CPS 2012 Compendium of Pharmaceuticals and Specialties.

• www.uptodate.com