One Pill Can Kill: Highlighting Pediatric Ingestions
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Pharmacist Objectives:
• List medications formulated in doses with risk for mortality among pediatric patients
• Describe the pathophysiological characteristics responsible for pediatric toxicity among these medications
• Differentiate between presenting signs and symptoms of toxicity among these medications
• Create treatment plans for pediatric patients presenting with a toxic ingestion

Technician Objectives:
• List medications formulated in doses with risk for mortality among pediatric patients
• Describe storage recommendations for medications at high risk for causing pediatric toxicity
• Calculate weight based doses of medications at high risk of causing pediatric toxicity

Disclosure
I do not have (nor does any immediate family member have):
– a vested interest in or affiliation with any corporate organization offering financial support or grant monies for this continuing education activity
– any affiliation with an organization whose philosophy could potentially bias my presentation

What is Toxic in a Taste?
• Medicinal preparations
• Fatal to 10 kg child
• Ingestion of 1-2 tablets, capsules, or teaspoons

As an Example
• Iron – not toxic in a taste
• 10 kg toddler
• Needs ten 325 mg ferrous sulfate for serious toxicity
  • > 60 mg/kg needed for serious toxicity
  • 10 tabs * 65 mg/tab = 650 mg
  • 650 mg/10 kg = 65 mg/kg
Epidemiology

• 2017 AAPCC data
  • Exposures
    • ~2.1 million human exposures reported
    • Children < 13 years involved in 1.1 million (52%)
    • Children < 6 years involved in 1 million (45%)
  • Fatalities
    • 12 pediatric deaths < 6 years (0.9% of all deaths reported)
    • Down from 24 in 2016

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Why are Pediatric Poisonings so Common?

• "Inquisitive nature" may oversimplify
• Several factors
  • Rapid growth and development
  • Children become mobile
  • Children able to grab (and climb onto) things
  • Oral sensation is a primary sensory input
  • Imitating parents
  • "Medicine is good for you!"

Most Pediatric Exposures

• Generally don’t require evaluation at a healthcare facility
• Examples of generally benign ingestions
  • Household cleaning substances
  • 3% bleach (Clorox®)
  • Hydrogen peroxide
  • Cosmetics/personal hygiene products
  • Deodorant
  • Makeup
  • Pharmaceuticals
  • Hormones
  • Non-opioid analgesics

Assessment of Pediatric Patient

- History is key!
  - Substance ingested (be specific)
    - Brand names apply to many different substances
    - Concentration, etc.
  - Amount ingested [often not known]
  - Child vs. adolescent
  - Time of ingestion
  - Comorbidities
  - Other medications
  - Patient is taking
  - Patient has available to them

What labs to order?

- For all intentional ingestions (generally > 6 years old)
  - Electrocardiogram
  - Acetaminophen level
  - Pregnancy (if applicable)

What labs to order?

- Situational labs
  - Basic metabolic panel
  - Liver function tests
  - Ethanol
  - Glucose
  - Aspirin
  - Arterial blood gas w/ co-oximetry
  - Creatine kinase
  - Individual drug levels (antiepileptics, etc.)
  - Abdominal radiograph

GI Decontamination

- Syrup of ipecac – not used anymore
- Gastric lavage – rarely used
- Reserved for life-threatening ingestions
- Substances must fit
- Contraindications
  - Corrosives
  - Foreign bodies
  - Aspiration risk
  - Hydrocarbons

GI Decontamination

- Activated charcoal
  - Gold standard for GI decontamination
  - Use within 1 hour of ingestion
  - 2 hours for anticholinergics or opioids
  - Dose: 1 g/kg (up to 25-50 g)
### GI Decontamination

- Activated charcoal
- Contraindications
  - Aspiration risk
  - Foreign body
  - Hydrocarbons
  - Caustic agents
  - Alcohols
  - Heavy metals

[Link](https://www.medicalnewstoday.com/articles/322609.php)


### Pharmaceuticals

- Benzocaine

  - Amino ester local anesthetic
  - Reversibly binds to sodium channels
  - In conducting tissues
  - Found in:
    - Teething gels
    - Hemorrhoid/vaginal creams
    - First aid ointments
    - Throat lozenges/sprays

  - Mechanism of toxicology

  - Metabolized to aniline
  - Further metabolism to phenylhydroxylamine
  - Strong oxidizer
  - Induces methemoglobinemia


Micromedex® Healthcare Series [Internet database].

### Chemistry

\[
\begin{align*}
O_2 & \quad O_2 & \quad O_2 \\
H_2O & \quad H_2O & \quad H_2O \\
Fe^{2+} & \quad Fe^{3+} & \quad e^{-}
\end{align*}
\]


Micromedex® Healthcare Series [Internet database].

### Benzocaine Content

- Baby Orajel® 7.5%
- Baby Anbesol Gel® 7.5%
- Lanacane Spray® 20%
- Americaine Topical First Aid® 20%
Benzocaine

- Ingestion of as little as 22 mg/kg has produced methemoglobinemia
- One teaspoon of Baby Orajel®
  - 7.5% → 375 mg
  - 375 mg/10 kg = 37.5 mg/kg
- Infants less than 4 months are more susceptible
- Deficiency in methemoglobin reductase

Methemoglobinemia

- Onset can be within 30-60 minutes
- Metabolized by plasma esterases
- Tachycardia, cyanosis, hyperpnea can occur
- Chocolate brown blood
- Only detected with ABG w/ Co-oximetry
- Agitation, severe hypoxia, lethargy (20-45% MeHgb)
- Seizures, arrhythmias, shock (55-70% MeHgb)

Benzocaine Treatment

- Methylene Blue
  - Reduces iron back to ferrous state
  - 1-2 mg/kg (0.1-0.2 mL/kg of a 1% solution) IV
- Indications
  - Methemoglobinemia > 30%
  - Cardiac dysrhythmias
  - Respiratory distress
- Contraindications
  - G6PD deficiency

Camphor

- Essential oil distilled from camphor tree
  - Cinnamomum camphora
- Many uses in history
  - Aphrodisiac, contraceptive, cardiac stimulant, antiseptic
  - Moth repellant
- Confusion with castor/cod liver oil
- Ban of OTC sale of camphorated oil in 1983
- No greater than 11% allowed OTC
Camphor

• Mechanism not well understood
• Characteristic odor
• Onset within 5-30 minutes
• Seizures can be delayed
• Clinical presentation
  • Feeling of warmth, nausea, vomiting
  • Confusion, hallucinations, jerky movements
  • Seizures, respiratory depression, coma

Camphor Content

• Vicks VapoRub® 4.81%
• Campho-Phenique® 10.8%
• Bengay® 4%
• Camphorated oil 20%
• Camphor spirits 10%
• Many products also contain methyl salicylate

Camphor

• 1 g has caused death in a small child
• Syncope, cyanosis, hypotension, arrhythmias, and mental status changes occur with 35 mg/kg
• 2 teaspoon (10 mL) Bengay® 4% camphor (40 mg/mL)
  • 400 mg camphor
  • 10 kg child = 40 mg/kg
  • Bengay® also contains 30% methyl salicylate
  • 10 mL is equivalent to ingesting 13 325 mg aspirin tablets

Camphor

• Triage
  • 30 mg/kg in a child is referred to a healthcare facility
• Treatment
  • ABC’s
  • A/C within 1 hour post ingestion
  • Seizure control
    • Benzodiazepines are treatment of choice
    • Asymptomatic for 6-8 hours prior to discharge

Clonidine and Imidazoline Derivatives

• Centrally acting, presynaptic α2 agonists
• Originally studied as nasal decongestant
• Decreased sympathetic outflow
• Reduced heart rate, vascular tone
• Included agents
  • Guanabenz and guanfacine
  • Oxymetazoline, tetrahydrozoline, naphazoline

Case #3

• Further history:
  • Mother and father suffer from seasonal allergies
  • Symptoms: rhinorrhea and conjunctivitis
  • Use OTC medications

Clonidine

- As little as 0.1 mg has produced toxicity in children (0.009 mg/kg)
- If child is on clonidine, can tolerate extra dose
- Used patches contain 20-75% residual drug
- All others go to healthcare facility for any ingestion

Clonidine and Imidazoline Derivatives

- Clinical Presentation
  - Hyporeflexia, hypotonia, miosis, bradycardia, hypotension, respiratory depression, apnea, and hypothermia
  - Hypertension can occur initially (short-lived)
  - Toxic effects generally occur within 0.5-4 hrs
  - Usually resolve within 24 to 48 hours

- Treatment
  - ABC's
  - Activated charcoal if within 1 hour
  - Whole bowel irrigation for a swallowed patch
  - Activated charcoal and polyethylene glycol
  - Only treat initial hypertension if compromising organ function
  - Utilize short acting vasodilators (e.g. nitroprusside)
  - Naloxone may reverse somnolence and bradycardia
  - May need to be aggressive with dosing (up to 10 mg)

What else could this have been?


Methadone/Buprenorphine

- Opiate agonists
- Hallmark is prolonged/recurrent CNS and respiratory depression
- Methadone
  - 10 mg has been lethal in young children
  - Liquid preparations available
- Buprenorphine
- Recurrent respiratory depression 18 hours after 8 mg
Opiates
- Treatment
  - ABC’s
  - Activated charcoal if appropriate
  - Supportive care
  - EKG with methadone
    - Can cause prolonged QTc
  - Naloxone
    - Starting dose: 0.1-0.2 mg/kg IV/IO/IM
    - No risk of withdrawal in opioid naïve children

Non-Pharmaceutical Concerns

Disc Batteries
- 1,995 disc battery exposures in children < 6 years of age in 2015
- Responsible for 1 death

Mechanism of injury
- Generation of electrical current
- Alkaline burn (similar to drain cleaner)
- More tissue injury at negative terminal
- Leakage of alkaline materials
- Not likely to be clinically significant
- Mechanical force exerted on tissue

Who is likely to have a bad outcome?
- Ingestions of > 20 mm batteries
- Children < 4 years old
- Increased risk of major morbidity or mortality
- Esophageal injury seen as early as 2-2.5 hours
Disc Batteries

- Patient disposition
  - Urgent radiograph needed for most ingestions
  - May not be needed if battery known to be < 12 mm in children > 12 years old
  - 36% of lodged batteries present asymptomatic
  - Co-ingestion with magnets may require prompt surgical consult

Urgent radiograph needed for most ingestions
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https://www.poison.org/battery/guideline

Treatment options?
- Cadaveric porcine model used to test neutralizing solutions
- Irrigated esophageal tissue with 10 mL every 10 minutes
- Sucralfate and honey showed best neutralizing capability
- Some centers now recommending honey for ingestions

Laryngoscope. 2019;129(1):49-57
https://www.poison.org/battery/guideline

Neodymium Magnets

- Originally developed in 1982 for MRI machines, electric car motors, etc.
- Rare-earth mineral neodymium – 15 times stronger than traditional magnets
- Popularized as desk toys/stress relievers
- Major target of Consumer Product Safety Commission (CPSC)
- Back on market as of December 2016

Neodymium Magnets

  - 20 ingestions between 2003-2006 from 10 months – 11 years old
  - Bowel perforations – 75%
  - Contracted peritonitis – 20%
  - Mean hospital stay – 8.7 days
  - Majority of magnets were larger disc magnets in toys
- By 2008 CPSC documented > 200 reports requiring emergency surgery


Neodymium Magnets - Management

- Any history of ingestion requires evaluation at a healthcare facility
- Everyone should get an abdominal radiograph (no MRI!)

Poison Prevention Tips

- No such thing as “child-proof”
- Keep products in their original containers
- Utilize child-resistant containers
  - Lock boxes for medications
  - Lock cabinets containing medications/chemicals

Conclusion

- Child exposures are extremely common
- Major toxicity is relatively rare
- Many non/prescription medications can be “toxic in a taste”
- Never underestimate
- If unsure, help is a phone call away!
  - 1-800-222-1222

References

References


Questions?

http://en.wikipedia.org/wiki/Mr._Yuk