Pediatric Emergency Medicine

Szima Sándor M.D
Difference between the pediatric and the adult

- Anatomy
- Physiologic
- Different pathways
- Age specific disease
- Special management
- Communication
- Aspect of the law
## Scale of the childhood period

<table>
<thead>
<tr>
<th>Age Category</th>
<th>kor</th>
<th>megjegyzés</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn</td>
<td>0 – 28 day</td>
<td>Newl(ly) born: first few hours</td>
</tr>
<tr>
<td>Infant</td>
<td>1 month – 1 year</td>
<td></td>
</tr>
<tr>
<td>Child</td>
<td>1 – 18 yrs</td>
<td></td>
</tr>
<tr>
<td>•Toddler and preschooler</td>
<td>1 – 8 yrs</td>
<td></td>
</tr>
<tr>
<td>•Schooler</td>
<td>8 – 12 yrs</td>
<td></td>
</tr>
<tr>
<td>•Adolescent</td>
<td>12 – 18 yrs</td>
<td></td>
</tr>
</tbody>
</table>
Body weight

- 0-8 years
  \[ \text{Body weight [kg]} = 2 \times (\text{age in years} + 4) \]
- After 8 years
  \[ \text{Body weight [kg]} = 3 \times \text{age in years} \]
- After the puberty

Adult parameters
- Body surface area / body weight is bigger in childhood
Anatomy differences – head-neck

- Big head, short neck, protuberant occiput – flexion of the neck
- The face and the mouth are small
- The tongue is big.

Result: Tendency for the obstruction of the airway
Anatomy differences – nose/throat

- Young infants able to breathing only via nose until 3 months old.
- Narrow nose
- Short mandibula

Result: Tendency for the obstruction of the airway
Anatomy differences – Larynx

- Difficult intubation
  - Big tongue
  - Position of the larynx different from the adults. The glottis and the oropharynx position is NOT straight.
- Tube without cuff until 8 years old.

- The bifurcation and the larynx are closed – Easy endobronchial intubation.
Physiologic differences

- Immature pulmo
- Obligatory nasal respiration until 4 month old.
- Power of the heart depend on the frequency. Bradycardia can cause serious systemic perfusion problem
- The low blood pressure is very late sign of the shock.
Physiologic differences

- Higher body water content (infancy ~75%)
- Extracellular fluid (blood, lymph) is bigger than the adults (~40%)
- Faster water turnover.
- Immature kidney.
- Result: Exsiccosis, dehydration is very frequent.
Physiologic differences

- Respiratory muscles easy exhausted
- Immature immune system – infections
- Increased oxgen consumption
- Apnoe of the infancy
- Need for early support of the ventilation
Physiologic differences

- Lower contractility of the heart
- Higher heart frequency
- Bradycardia tendency (hypoxia)
- Cardiac output depend on the frequency
  - Blood pressure compensation with the frequency, but it can easy exhausted
- The bradycardia is more dangerous than the tachycardia.
Physiologic differences

- Immature central nervous system
  - Increased seizure affection
- Respiratory control problems (apnoe, SIDS)
- Increased affection for the brain oedema
- Later sign of the brainoedema – because the opening suturas
- Different type of the seizures
Physiologic differences

- Hypoglicaemia, seizures, apnoe can cause serious CNS damage
- Immature temperature control
- Relative big body surface area – temperature, evaporation
Physiologic differences

- Bigger fluid demand
- Bigger energy demand
- Bigger oxygen demand
Speciality in the communication

- Limited verbal contact
- The non-verbal communication has bigger part
- Function of the parents (history, non-pharmacology, anxiolysis)
Patophysiologic differences

- Affect for the airway oedema
- Lower functional residual capacity
- Higher oxigen using

Answer for the hypoxia – bradycardia.
Patophysiologic differences

- In case of hypovolaemia, the heart has insufficient contractile capacity. The first compensatory mechanism is the increased frequency.
- In case of hypovolaemia, the organism can compensate for a long time, but the decompensation is rapid.
- Primary arrhythmia is rare.
Patophysiologic differences

- The vomiting is not only sign of the gastrointestinal problem.
<table>
<thead>
<tr>
<th>Age Group</th>
<th>Respiratory rate</th>
<th>Pulsus</th>
<th>Blood Pressure (MAP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 1 month</td>
<td>30-40 / 43/ min&lt;</td>
<td>80 – 180 / min</td>
<td>75 Hgmm (50)</td>
</tr>
<tr>
<td>Under 1 year</td>
<td>30-40 / 34/ min&lt;</td>
<td>80 - 180 / min</td>
<td>100 Hgmm (60)</td>
</tr>
<tr>
<td>2-5 yrs</td>
<td>24-30</td>
<td>60 – 130 / min</td>
<td>100 Hgmm (70)</td>
</tr>
<tr>
<td>6-12 yrs</td>
<td>20-24</td>
<td>60 – 110 / min</td>
<td>100 Hgmm (70)</td>
</tr>
<tr>
<td>13-18 yrs</td>
<td>12-20</td>
<td>60 – 100 / min</td>
<td>110 Hgmm (70)</td>
</tr>
<tr>
<td>Adult</td>
<td>12/ min&lt;</td>
<td>60-100 /min</td>
<td>90/70 years x 2</td>
</tr>
</tbody>
</table>
The sick patient first examination

- AVPU
- A(3) Open – possibility of obstruction - obstructed
- B(4) RR – TV – WOB – SpO2
- C(5) Frequency – RR – CRT – Quality of pulsus – Preload
- Disability
- Events
- Aimed examination
Criticaly ill?

- Loss of consiciouness
- Confusion
- Seizures
- Respiratoric failure
- Increased WOB
- Cyanosis
- Trauma
- Burn
- Fever and purpura
Respiratory tract

- SpO2 immediate!!!
- RR
- WOB
- Paradox breathing
- Sounds
  - Inspiratory: upper airway (extrathorax)
  - Exspiratory: lower tract (intrathorax)
  - “no breath sound” – the worst sign
Respiratory tract

- Grunting especially in newborn
- Cyanosis and pallor – later sign!
- Tachycardia then bradycardia
- Confusion – nervous, anxious than LOC
Circulation - pulsus

- Heart rate
- Most important sign of any stress
  - Fever, anxious, pain, hypoxia, hypovolaemia
  - In the newborn answer for the hypoxia is bradycardia
- Quality of the pulsus
  - Full vs. easy overpress
Compensating mechanism
- Vasoconstriction
- Tachycardia – first sign
- Myocardioum increased contractility

In case of shock the low blood pressure is very late sign! (loss about 40% blood volume)
Circulation – systemic perfusion

- Periferal vascular resistency
- Capillary refill time. Normal time is < 2 sec. First sign of the shock.
- Temperature of the skin
- Difference between the central and the periferal pulsus
Circulation – systemic perfusion

Brain – “D”

- Worsening brain perfusion – confusion, LOC, seizures, dilatation of pupils
- Agitation, lethargy, irritability

- Alert
- Voice response
- Pain response
- Unconscious
Circulation – systemic perfusion

- Renal
- Urine output < 1 ml/kg/hour
- More output is very good sign of the effectiveness of the therapy
Circulation – preload

- Fullness of jugular vein
- Crackles above the pulmo
- Size of the hepar
- Periferal oedema is not general
Neurology

• AVPU
• Size and the reactions of the pupils
• Spontaneous movement
• Sensory examination
Circumstance

- Symptoms
- Allergia
- Medicine
- Past history
- Last meal
- Events
Management of the critically ill children

- A – Airway patency (manually, equipement)
- B – oxigen, ventillation (bag and mask)
- C – monitor
  - IV/IO
    - 20 ml/kg crystalloid
- D – Endotracheal intubation –
  - Respiratory failure
  - GCS< 9 / AVPU
Airway protection

- Manual
  - Neutral position of the head
  - Jaw thrust

- Equipment
  - Nasopharyngeal tube
  - Oropharyngeal tube
  - Supraglottic tube
  - Endotracheal tube
Secure of the airway

• Optimal size
• Premedication
• Preoxygenization

The endotracheal intubation is not condition for the airway patency nor the oxigenization.!!
Drugs for the premedication

- **Analgetics**
  1. Fentanyl 2-4 ug/kg iv.
  2. Morphin 0,1 mg/kg iv.

- **Sedatives**
  1. Midazolam 0,1-0,3 mg/kg iv.
  2. Propofol 1,5-2,5 mg/kg iv.
  3. Ketamin 1-2 mg/kg iv.
  4. Etomidate 0,2-0,3 mg/kg iv.

*In the case of shock give half-dose!*
Tube size in pediatric patient

Tube size (ID): years $4 + 4 \pm 0.5$

End of the tube:

- orotracheal intubation: years/2 + 12 cm
- nasotracheal intubation: years/2 + 15 cm

Think about one size smaller and bigger plus alternative management.

Size of the spatula:
- preterm: 0
- term: 1
- 1 month-1(-2) years: 1-2
- 1(-2) year-8 years: 2
- Over the 8 years: 3
Parenteral fluid intake

- Venal route
- Intraosseal route – Unsuccessful venipuncture or CPR/shock
  Tuberositas tibiae – caudal 1cm, 2cm medial
Parenteral ways for the drugs

- IV/IO.
- Inhalative
- Per rectum
- Intranasal
- Buccal
- Muscular
Cause of the respiratory failure

Pulmonary: tachypnoe + dyspnoe
- Upper airway obstruction
- Bronchiolitis
- Bronchitis
- Asthma
- Pneumonia
- Foreign body
- Trauma
- PTX/HTX/Hyrdothorax

Extrapulmonary: „Only” tachypnoe
- Heart failure
- Kidney failure
- DKA
- Other metabolic problem
- CNS problem
- Anaemia
- Toxin
- Environment hypoxia
Upper airway obstruction

- Nasopharyngitis – little infancy
- Laryngitis
- Foreign body
- Tonsillitis
- Epiglottitis
- Trauma
- Allergy
Laryngitis

- Viral infections
- Influenza, parainfluenza virus, RSV, adeno-, rhinovirus etc.
- Subglottic oedema
- Recidiva is often
Laryngitis

- General night time shortness of breath
- Fall, early winter
- Between 6 months and 3 years
- Bark, hoarsness, dry cough
- Inspiratoric or if serious in- and exspiratoric stridor
## Laryngitis

- **Croup score**
- **3-5 moderate**
- **Overs 6 PICU**

<table>
<thead>
<tr>
<th></th>
<th>Score</th>
<th>0</th>
<th>1</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stridor</td>
<td></td>
<td></td>
<td>Inspir.</td>
<td>In+exspir.</td>
</tr>
<tr>
<td>Cough</td>
<td></td>
<td></td>
<td>muddy</td>
<td>Bark</td>
</tr>
<tr>
<td>Levegő beáramlás</td>
<td>normal</td>
<td>reduced</td>
<td></td>
<td>Minimal</td>
</tr>
<tr>
<td>Nasal flare+dyspnoe</td>
<td>-</td>
<td></td>
<td>Jugular</td>
<td>Jug.+substernális +intercost.</td>
</tr>
<tr>
<td>Cyanosis</td>
<td></td>
<td></td>
<td>21%</td>
<td>FiO2 35%</td>
</tr>
</tbody>
</table>
Laryngitis

- COLD humidification
- Rest
- Micronephrin – inhalation with 3 ml NaCl 0,9%
  - under 20 kg: 0,25 ml
  - 20-40 kg: 0,5 ml
  - over 40 kg: 0,75 ml
- Epinephrine 10x dose.
- Steroid – 2-4 mg/kg
- Anticipate need to intubate, assist ventilations
Epiglottitis

- Bacterial infection
- High fever
- Rare frequency than the laryngitis
  (Vaccination against the H. influenzae B type)

BUT life threatening disease!!

The child is sitting, leak of the saliva, septicotoxic status.

- High concentration oxygen
- Rapid transport
- MUST NOT attempt to visualize airway. Immediate PICU!
Asthma bronchiale

- Genetic predisposition
- Trigger factor - viral infection
- Pathway
  - Bronchospasm
  - Increased mucus
  - Airway oedema
- Signs
  - Tachypnoe, dyspnoe,
  - Obstruction of the airway
  - Expiratory wheezing
  - Silent pulmo
Asthma bronchiale

- **ABC**
- **Oxigen**
- **Bronchodilatation**
  - Salbutamol – Ventolin puff 1-2
  - Ipratrominum bromatum
  - Berodual (20 drops/ ml)0,1 ml / kg
  - Epinephrine/Bricanyl 0,01 mg/k im. or iv., slowly, monitor of the heart rate
- **Steroid i.v. or p.r.**
  - Methylprednisolon – 2mg/kg
- **Magnesium-sulfate** 25-50 mg/kg over 2-4 min.
- **Diaphyllin i.v.**
  - 4-5 mg/kg
  - Infusion 0,5-1mg/kg/óra

- **Ventillation**
  Low TV and frequency, Low PEEP
Anaphylaxys

- Allergen mediated immunology pathways when minimum two organs involved
- Breathings – circulation – GI - Skin
- Respiratory failure
- Primer and secunder circulation failure
- Anaphylactic shock – one type of distributive shock
Anaphylaxis

- Epinephrine
  - under 6 months – 50 ug im.
  - 6 months – 6 yrs. – 150 ug im.
  - 6 yrs. – 12 yrs. – 250 ug im.
  - Over 12 yrs. – 500 ug im.
- Steroid 4 mg/kg
- Chlorpheniramine
  - under 6 months – 0,25 ug/kg
  - 6 months – 6 yrs. – 2,5 mg
  - 6 yrs. – 12 yrs. – 5 mg
  - over 12 yrs. – 10-20 mg
- Fluid – cristalloid minimum 20 ml/kg
Circulation failure

- Arrhythmias
- Congenital or acquired vitium
- Congenital or acquired myopathy
- Extracardiac causes
  - Respiratory failure
  - Sepsis
  - Anaphylaxis
- Metabolic causes
Arrhythmia in pediatric patients

• Primary problems is rare
• In the most cases results of compensation of any serious problem (tachycardia) or sign of the exhausting (bradycardia).
Arrhythmia – Bradycardia

- Bradycardia is always a serious status
- In most cases the serious hypoxia is the reason not the heart problem
- Treat the hypoxia, not the bradycardia
Arrhythmia – Bradycardia

- **ABC**
- **Oxigen**

Treat the cause of the problem
- (Hypoxia, hypovolaemia, hypoglycaemia, hypothermia)

- **Medication**
  - Atropin 0,01-0,02 mg/kg i.v.
  - Epinephrine 0,01 mg/kg – 0,01-0,5 ug/kg/min i.v.
  - Dopamin 5-10 μg/kg/min

- **Pacemaker**
  ONLY when the oxigenization, ventiluation chest compression and the pharmacology therapy not improving the patient.

- **Bad tissue perfusion plus heart frequency under 60/min** – start the chest compression.
Arrhythmia – Tachycardia

• Most important is the sinustachycardia
  Causes: fever, infection, pain, anxious, hypoxia, hypovolaemia.

• Primary in childhood
  PSVT - often
  Atrial fluttern - rare
  Ventricular tachycardia – very rare
  Other – extreme rare
Arrhythmia – Tachycardia

Sinustachycardia – treat the cause.

Supraventricular tachycardia
- Oxigen, Valsalva, cool the face
- i.v/i.o.
- Adenosin (0.1, 0.15, 0.2 mg/kg i.v/i.o.)
  - If not stable: Sedatoanalgesia
  - Cardioversion (1–4J/kg)

- Stable or ineffective cardioversion
  - fast amiodarone (5 mg/kg) or
  - Any medicine which earlier was effective

VT
Stable – amiodarone,
Non-stable – cardioversio, then amiodarone.
Vitium cordis

- Big left – right shunt: the $O_2$ is bad
- In the case of cyanotic vitium the $O_2$ ineffective

Give oxigen only:
If the earlier non cyanotic patient become cyanotic
Earlier cyanotic patient SpO2 worsening
Manage of the cyanotic patient

- Slightly sedation
- Parenteral fluid 20 ml/kg x3
- Drugs
  - $\beta$ blocker iv. (pl.: Betaloc 0,1 mg/kg)
  - Systemic vasopressors
    - noradrenalin, efedrin, fenilefrin
    - vazopressin?
  - Avoid from the $\beta$ mimetics (pl. Dobutrex, epinephrine).
Loss of consciousness

- Respiratory and heart failure
- Meningoencephalitis
- Postconvulsiv tenebrotas
- Hypo/hyperglycaemia
- Trauma
- Intoxication
- Stroke – SAV – ICP
- Metabolic (kidney-hepar-electrolites)
Seizures in childhood

- Febriles seizures
- Meningoencephalitis
- Change in the treatment of the epileptic patient
- Metabolic-electrolyte problem
- Hypoxia, brain ischaemia
- ICP elevated (VP shunt, tumor)
- Trauma
- Hypoglycaemia
- Intoxication (TCA, organophosphate, theophyllin, cyclosporin, Pb etc.)
Seizures in childhood

Simple seizure:
• Between 6 months – 5 years
• Shorter than 15 minutes, generalized, occurs once in a 24h period

Complicated seizure:
• Longer than 15 minutes
• Focal
• New neurolgic symptoms
• Earlier neurologic problem
Seizures in childhood

- ABC
- Diazepam per rectum
  - Under 15 kg: 5 mg
  - Over 15 kg: 10 mg
- Midazolam 0.1 mg/kg iv. 2x repeated every 5 minutes.
- Epanutin 15 mg/kg iv. over 15-20 minutes – monitor!!
- Propofol / Barbiturát - sedatoanalgesia.

Bloodsugar!!!!
Trauma – intox ....
Trauma

- Over 1 year the trauma is the common cause.
- Different injuries – because of different anatomy.
- Less muscle and subcutan fat tissue.
- “Top-heavy”.
Trauma

- ITLS
- Golden hour - Platina ten minutes
- Fast examination
- ABC - MILS + high flow oxigen
- Only treat the life threatening injuries
- Load-go-and-treat:
  - Stop the bleeding,
  - Airway patency, BMV, treat the tension PTX
- Fast atraumatic transport – IV/IO – painkiller – ETI?
Burn

- BSA Lund-Browder formula
- Fluid management: Parkland formula
  - 4ml/kg x % burned area (½-t az in the 1. 8h, second ½-t during 16h)
- If there is shock – give bolus fluid
- Painkiller – Nubain – Fentanyl – Morphin
- Airway burning – early intubation
- Send to special care unit
  - 15 -20% feletti égés
  - head-neck-airway-hand-genitale-encircling
Thank you!