

Introduction to clinical medicine

2nd Department of the Pediatrics – Semmelweis University

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In this lesson we will discuss the following parts of the clinical medicine in pediatrics:

1. What is the difference between children and adults?
2. The main steps of the clinical practice
 - History taking
 - Physical examination (you will learn about it, during your bedside practice)
3. Case presentation

First of all, let me introduce our Pediatric Clinic, the 2nd Department of Pediatrics.

The institution was established in 1946, as a direct successor of the White Cross Children's Hospital, which had been established in 1885. It was the first in Hungary to initiate modern diagnostic methods and the operation of congenital heart defects. The first cytogenetic examinations for clinical purposes were carried out here and the National Pediatric Leukemia and Oncology Network was also set up in this Department.

Our Hospital profile:

- general pediatric care

- pediatric intensive care
- pediatric cardiology
- pediatric endocrinology
- pediatric gastroenterology
- genetics
- surgery
- hematology
- hypertonia and metabolic disorders
- pediatric nephrology
- pediatric neurology
- pediatric oncology
- pediatric immunology
- pediatric psychology
- pediatric pulmonology
- pediatric radiology
- pediatric rheumatology

Our main profile is the hemato-oncology.

1, What is the difference between children and adults?

Children are not little adults!

The clinical assessment of infants and children differs in many ways from that of adults. Because children are growing and developing both physically and mentally, values for parameters such as dietary requirements and prevalence of disease, expected normal laboratory values and responses to drug therapy will be different from those observed in adults.

Hence, depending on the age of the children, we can find differences in the communication abilities, the anatomy of the child (body ratio), normal ranges, the dose of drugs and the course of disease too.



a, Pediatrics is a specialty governed by the age – the six ages of children

- The illnesses and problems children encounter are highly age-dependent. The age of the child will determine the questions you ask during history taking, the way you conduct the examination, the diagnosis or differential diagnosis and your management plan.
- **When you start examining a child, first ask 'What is the child's age?'**



Figure 1 The six ages of children (from Illustrated Textbook of Pediatrics)

1, Newborn, neonate = first month of life (<4 weeks)
2, Infant = 1 month to 1 year
3, Toddler = 1 year to 2 years

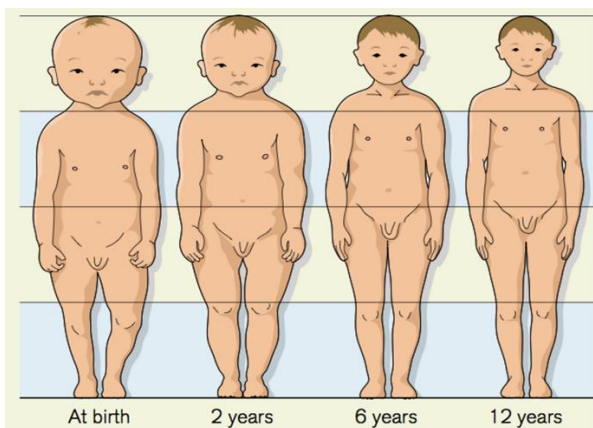
4, Preschool child = 2 years to 5 years
5, Schoolchild = 5 years to 18 years
6, Adolescent = early: 10-14 years, late: 15-18 years

When can we talk about premature babies?



Preterm refers to a baby born before the 37th week of the pregnancy. The preterm baby care is a special part of the pediatrics.

b, Changes in body ratio



The head is proportionally large and the legs proportionally short during childhood. At birth the head is one quarter of the length of the body compared with about one sixth in the adult. The legs are about one third the length of the body at birth and one half in the adult. Because the body proportions change this means that not all of the body segments grow by the same amount.

Figure 2 Changes in body ratio

c, Normal ranges in pediatrics

→ Vital signs

Age	Respiratory rate	Heart rate	Systolic Blood Pressure
Newborn	30 - 50	120 - 160	50 - 70
Infant	20 - 30	80 - 140	70 - 100
Toddler	20 - 30	80 - 130	80 - 110
Preschooler	20 - 30	80 - 120	80 - 110
School Age	20 - 30	70 - 110	80 - 120
Adolescent	12 - 20	55 - 105	110 - 120

Table 1 Vital signs of children

→ Complete blood count in children

CBC in children						
Age	WBC (G/l)	neutr.	lymph.	mono.	eo.	baso.
adult	5-10	2-7	1-3	0.2-1	0.02-0.5	0.02-0.1
40.Gwk	10-26	2,7-14,4	2,0-7,3	0,0-1,9	0-0,85	0-0,1
2 wk	6-21	1,5-5,4	2,8-9,1	0,1-1,7	0-0,85	0-0,1
2 mo	5-15	0,7-4,8	3,3-10,3	0,4-1,2	0,05-0,9	0,02-0,13
6 mo	6-17	1,0-6,0	3,3-11,5	0,2-1,3	0,1-1,1	0,02-0,2
1 yr	6-16	1,0-8,0	3,4-10,5	0,2-0,9	0,05-0,9	0,02-0,13
2-6 yr	6-17	1,5-8,5	1,8-8,4	0,15-1,3	0,05-1,1	0,02-0,12
6-12 yr	4,5-14	1,5-8,0	1,5-5,0	0,15-1,3	0,05-1,0	0,02-0,12
12-18 yr	4,5-13	1,5-6,0	1,5-4,5	0,15-1,3	0,05-0,8	0,02-0,12

Table 2 (CBC in children)

2, What are the main steps of the clinical practice?

a, History taking

b, Physical examination

c, Other examination: laboratory, imaging, biopsy, etc.

d, Diagnosis

e, Therapy

f, Control

a, History taking

Listening to mothers!

The most important attribute of a good doctor is being a good listener. Always listen carefully to the mothers. She may not know what's wrong, but she most certainly knows something is wrong.

- **Presentation symptoms – main complaint:**

Let the parents and child recount the presenting complaints with their own words and at their own pace.

-**Why are you visiting the doctor today?** (vomiting, coughing, etc.) = **it is not a diagnosis!**

-**Ask about:** initial complaints, duration, progress, fever, contact with ill individuals, travels, use of any medications, effect of this medication

- **Past Medical History:**
major medical illnesses, major surgical illnesses (operations), trauma, fractures, previous hospital admission (date, cause), current medications, immunization status!!, known allergies (food, drug, inhalant)
- **Pregnancy and Birth History:**
maternal health during the pregnancy, place of birth, the gestational age at delivery (full term or preterm), the type of the delivery (vaginal, cesarean section), birth weight, length, head circumference, chest circumference, Apgar score, neonatal period (breathing problems require intensive care, birth injuries, feeding problem, length of stay)
- **Developmental History:**
developmental milestones, school-present grade, specific problems, interaction with peers, bladder and bowel control, child's temperament, behavior, sleeping problems
- **Feeding history:**
breast or bottle fed, types of formula, frequency, solids when introduced, any other diet
- **Family history:**
similar disease, related disease, infant death/miscarriages, congenital malformation, genetic disease, any sister/brothers,
- **Social/environmental history:**
living situation and conditions, daycare, safety issues, composition of family, occupation of parents

b, Physical examination

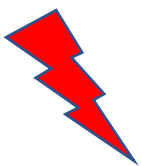
Always adapt the examination to suit the child's age. While it may be difficult to examine some toddlers and young children fully, it is usually possible with resourcefulness and imagination on the doctor's part.

Look before touching the child. Inspection will provide information on:

- severity of illness
- growth and nutrition
- behavior and social responsiveness
- level of hygiene and care



General appearance



If you think that the child is seriously ill, you always have start with a quick, 'ABCD' examination

- **Airway, Breathing:** look, listen and feel for:
 - Airway obstruction or respiratory distress, work of breathing (respiratory effort)
 - Respiratory rate
 - Stridor, wheeze

- Auscultation for air entry
- Cyanosis
- Circulation:
 - Heart rate
 - Pulse volume
 - Peripheral temperature
 - Capillary refill time
- Disability:
 - Level of consciousness

The main part of the physical examination

- 1, General appearance (skin, how ill is the child?)
- 2, Respiratory system: inspection, palpation, auscultation
- 3, Cardiovascular system: inspection, palpation, auscultation
- 4, Abdomen: inspection, auscultation, palpation
- 5, Neurology/neurological development
- 6, Bones and joints
- 7, Head, neck, eyes, ears
- 8, Throat (it can be the latest one)

+Measurements:

- Weight
- Length/height: by convention, in infants 2 years and younger, we measure length, in children over 2 years we measure height
- BMI
- Head circumference: the average newborn head circumference is 35 cm
- Temperature
- Blood pressure

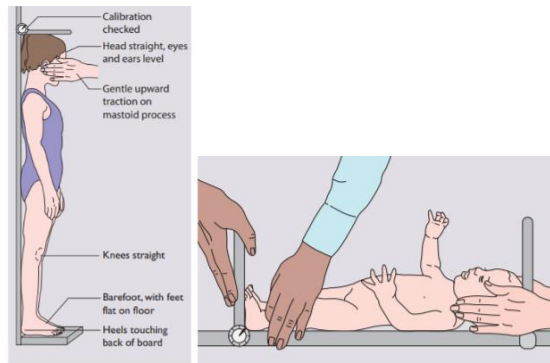


Figure 3 Height and length measurement in children (from Illustrated Textbook of Pediatrics)

Growth percentile charts

After we completed these measurements, the result should be plotted on an appropriate growth centile chart as a dot.

- Growth charts are standardized graphs upon which a child's measurements may be plotted. This information allows a visual mechanism to compare the child's rate of growth over time (for example, months and years). This technique allows an assessment of how a child's rate of growth compares to his peer group as well as his own previous rate of growth. Cumulative measurements over a standardized block of time enhance the precision of such an assessment.
- You have to choose the correct chart, depending on the child's age and sex.

Infants, birth to 36 months:

1. Length-for-age and Weight-for-age
2. Head circumference-for-age and Weight-for-length

Children and adolescents, 2 to 20 years

3. Stature-for-age and Weight-for-age
4. BMI-for-age

Preschoolers, 2 to 5 years

5. Weight-for-stature

Example:

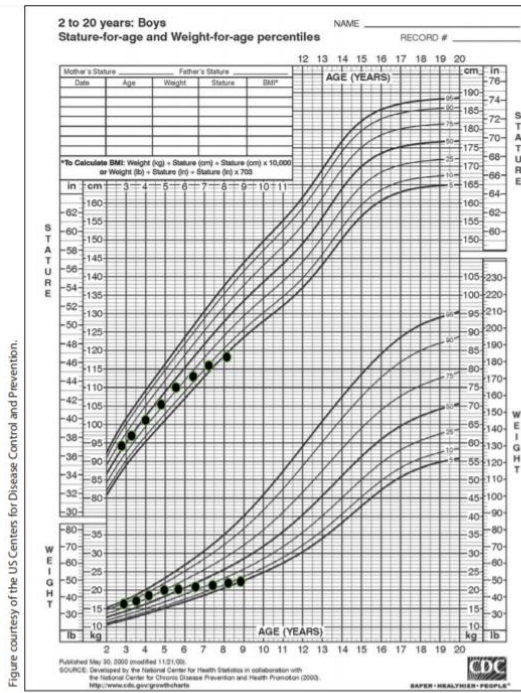


Figure 2. A representative growth chart for a child with celiac disease.

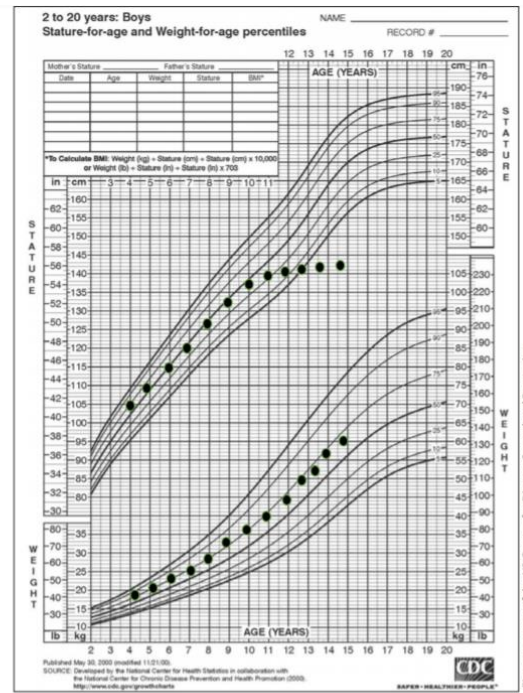


Figure 3. A representative growth chart for a child with acquired hypothyroidism.

Figure 5 (from Clinical Dilemmas in Evaluating the Short Child)

Short stature due to poor nutrition or gastrointestinal illnesses typically demonstrate a decrease in weight gain followed by a decrease in height velocity (left side).

In contrast, the typical growth pattern of a child with an endocrinopathy causing short stature, such as hypothyroidism or growth hormone deficiency, reveals a decrease in linear growth velocity with normal or increased weight (right side).

Case presentation

A 12-month-old male has just come in with his mother with the chief complaint of cough and working hard to breathe. On further history you learn that the symptoms started about 30 minutes after eating lunch and have been present for an hour. The patient has a dry intermittent cough, lethargy and irritability. The patient has had no sick contacts. There is negative history for: fever, rhinorrhea, rash, drooling and lip swelling. There are no concerns with stooling or voiding. The patient has never had a prior episode of such an event. Mom did not notice a choking episode and feels guilty that she was not watching him closely while he crawled/walked around the house.

Summary: the dry coughing started after eating, no fever or any other symptoms!!

- **What else would you like to find out about the history?**
 - Past medical history of illnesses/surgeries?
 - Medications?
 - Social history?
 - Family history of illnesses
 - Allergies?
 - Immunizations?

Past medical history of illnesses/surgeries: One prior visit to the hospital for wheezing and fever when he was 6 months of age. Diagnosed with bronchiolitis at the time. No surgeries and no other significant past history. He was born at term and was discharged from hospital the next day with no history of infections at birth.

Medications: He is taking Vitamin D 800 IU every day.

Social history: The patient lives in a house in Edmonton with his mom and dad. He does not attend daycare. Mom does not work outside the home while dad works in construction. Mom has supports in place and is doing well with the patient but is worried since this is her first child. Dad is a smoker, but he smokes outside the home only and they have no pets.

Family history of illnesses: Dad is allergic to peanuts and mom used to have asthma as a child.

Allergies: None known.

Immunizations: Up to date on the 12-month immunizations.

- **Based on what you presently know, what are the top 3 things on your differential diagnosis before you do the physical examination?**
 - Croup? – fever? barking cough?
 - Bronchiolitis? – respiratory distress?
 - Foreign body aspiration? – rapid starting? no fever? during eating?
 - Asthma? – dry cough? are there any trigger? history?
 - Epiglottitis? – high fever? three D's?
 - Meningitis? – high fever? lethargy? irritability? neurological signs?
 - Anaphylaxis? – skin, mucous membrane changes? GI, neurological signs? low blood pressure? allergen?

✘ **Croup:** The classic signs of croup would be fever, barking cough, hoarseness and stridor. In this case, croup is less likely to be the cause since there is no fever, and the cough is described as a dry intermittent cough, not a barking one.

Bronchiolitis: Bronchiolitis generally presents with fever, cough and respiratory distress. It is also preceded by upper respiratory tract infection symptoms such as runny nose and nasal congestion, which this patient does not have but it is still on the differential as he does present with cough and respiratory distress.

Foreign body aspiration: Foreign body aspirations can present in three different ways: If the object is blocking the upper airway, the presenting symptoms are choking, coughing and respiratory distress including stridor. Most patients present in this way and the symptoms can be quite significant if the foreign body is large and it is blocking a critical area of the upper airways. If the foreign body moves below the larynx to a less critical area of the airway, the initial choking/coughing symptoms settle down and the patients may present with wheezing, cyanosis or decreased breath sounds. If the foreign object is not removed, it can start to cause issues like significant atelectasis, consolidation, infections, erosion and hemoptysis and this occurs much later in comparison to the other two presentations. In this case, the mom did not witness a choking episode, but the patient fits the presentation of a lower airway foreign body aspiration and thus it is on our differential.

Asthma: Asthma can often present with a dry cough that is triggered by cold, exercise, nighttime and infection. This fits the picture in the scenario and thus is on the differential. There is also a family history of asthma in the mother.

✘ **Epiglottitis:** Epiglottitis would present with high fever, and the three D's (Drooling, Distress and Dysphagia). It is uncommon since the emergence of the H.Influenza vaccine, which is given at 2, 4 and 6 months of age in infants. As there is no fever or drooling in this case and the patient is up to date with his immunizations, it is highly unlikely.

✘ **Meningitis:** Meningitis presents with fever, focal neurological signs, photophobia/phonophobia, lethargy, and irritability. It is unlikely that this patient has meningitis, as he is afebrile.

✘ **Anaphylaxis:** An anaphylactic reaction must have involvement of two systems. The classic signs of an anaphylaxis reaction would be exposure to an allergen, skin and mucous membrane changes such

as urticarial rash and lip swelling, and respiratory distress. Other systems that could be involved would be GI (nausea and vomiting), central nervous system (decreased level of consciousness) and cardiovascular (critically low blood pressure). The classic signs are not present in this patient.

- **Physical examination**

- **The patient has vitals** of HR= 160 beats per minute, RR = 70 breaths per minute, BP = 80/60 mmHg, SpO2 = 90%, Temp = 37 °C in tympanic membrane.
- **General Appearance:** Leaning forward in tripod position, working hard to breathe.
- **HEENT Exam:** Pupils equal and reactive to light, normal nasal turbinates and tympanic membrane. Normal oropharynx with no angioedema. Nasal flaring is present. No lymph nodes palpable.
- **Cardiology exam:** Normal heart sounds (S1/S2), no extra sounds or murmurs. Bilateral and equal femoral pulses felt. Capillary refill time of 2 seconds.
- **Pulmonary exam:** On inspection the patient is leaning forward and has accessory muscle use and subcostal indrawing while breathing. On palpation, there is bilateral and symmetric chest wall movement on inspection and palpation. The right side is more hyper resonant on percussion compared to the left side of the chest. On auscultation, breath sounds are heard clearly on the left side while the right side has minimal breath sounds with an audible wheeze on expiration.
- **Abdominal exam:** No significant findings.
- **Neurology Exam:** No photophobia/phonophobia. Patient is able to flex neck to chest. Patient has normal reflexes and no focal neurological signs.
- **Skin Exam:** no rashes present.

- **What is your most likely diagnosis now?**

- Bronchiolitis?
- Foreign body aspiration?
- Asthma?

This is most likely explanation for the findings on physical examination. Asthma and bronchiolitis can be ruled out, as there is a unilateral wheeze on auscultation, which is not characteristic for both illnesses.

- **With the most likely diagnosis in mind, what would your initial investigations include?**

- CBC?
- Chest X-ray? Inspiratory? Expiratory? Lateral?
- Venous blood gas?

- ✘ **CBC:** is not required in this case.
- ✘ **Chest X-ray (Inspiratory view):** this is important since it will show how the lungs look at baseline and if there is a lobar collapse or pneumothorax.

Chest X-ray (Expiration view): In foreign body aspiration, on inhalation as the lung expands, air passes around the object but on expiration air trapping occurs in the affected lung as the object blocks air from getting out. This is known as the ball valve mechanism. Thus, the side that has the foreign body will appear bigger in size and much darker since it has more air trapped inside of it.

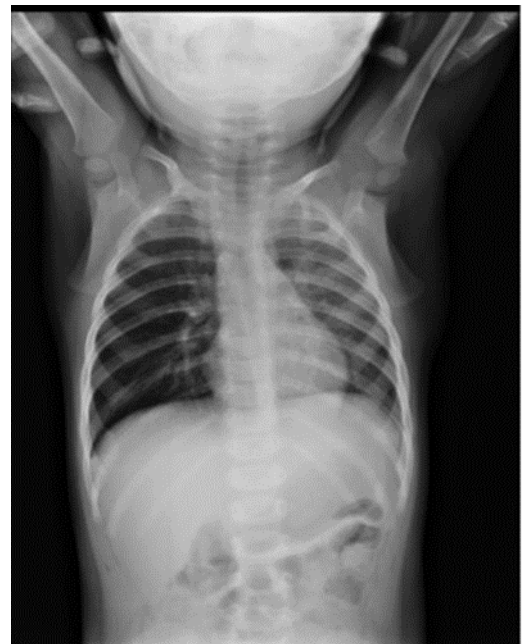
- ✘ **Chest X-ray (Lateral decubitus view):** In younger children who may not cooperate with an expiratory view X-ray, a lateral decubitus view could be used instead. When the lung is placed in the dependent position, it should collapse more normally unless there is a ball valve mechanism causing air trapping. The most inflated lung in the decubitus position is the obstructed lung.

- ✘ **Venous blood gas:** not required for this patient.

Let's see this expiratory X-ray view of the patient chest:

Where is the trapped foreign body?

- Trachea? stridor?
- Right bronchus?
- Left bronchus?
- Right Bronchiole? lobar findings?
- Left Bronchiole?



- ✘ **Trachea:** If a foreign body were stuck in the trachea, it would result in a stridor being heard along with cough and respiratory distress. It would not present with unilateral breath sounds and X-ray lung findings. Also, this is rare.

Right bronchus: The right lung is darker and more inflated compared to the left. This suggests that there is air trapping in the right bronchus. There is slight tracheal deviation towards the left side as well.

- ✘ **Left bronchus:** The left lung is less inflated and has more lung markings compared to the right, which would make it less likely to have air trapping on expiration.
 - ✘ **Right Bronchiole:** Right bronchiolar blockage would not result in the entire right lung being darker. It would present with lobar findings such as lobar collapse. Also there would be dullness in percussion of that area due to atelectasis instead of hyper resonance due to air trapping.
 - ✘ **Left Bronchiole:** Same as right bronchiole.
-

What is the recommended management of foreign body aspiration in this case?

- Oxygen and admit? SpO2?
- Oxygen until rigid bronchoscopy under general anesthesia? the best choice
- Oxygen until flexible bronchoscopy in emergency department? only diagnostic
- Heimlick maneuver to try and remove the foreign body? is there a life threatening tracheal foreign body?
- Immediately intubate patient? breathing?

- ✘ **Oxygen and admit:** This is needed since the patient has a SpO2 of 90%. However, it must be followed by a way to remove the foreign body as soon as possible.

Oxygen until rigid bronchoscopy under general anesthesia: Rigid bronchoscopy is best for foreign body removal since it allows you to see the airways really well, to pull out the foreign body through forceps and management of any bleeding that might occur during this process. This needs to be done under general anesthesia, which is best for a child this age.

- ✘ **Oxygen until flexible bronchoscopy in emergency department:** The benefits of flexible bronchoscopy is that it can be done without general anesthesia, but it would be difficult to do in this patient. Also, it is mainly done for diagnostic purposes, not for foreign body removal.

- ✘ **Heimlick maneuver to try and remove the foreign body:** The Heimlick maneuver would only be done with life threatening tracheal foreign bodies. If the child can cough and speak, then just support and watch rather than attempt a Heimlich maneuver. Also, in this case, attempting a Heimlick maneuver might cause the object to move deeper into the bronchioles so it would not be the best course of action.

✘ **Immediately intubate patient:** The patient is able to breathe on his own and intubating this patient might do more harm than good in this case. But if he goes into respiratory failure or respiratory arrest, then intubation would be ideal.

Congratulations!

The patient is now on his way to get the foreign body removed by ENT through rigid bronchoscopy. Before you leave, the mom asks you how she can prevent this to happen again?

What would you tell her?

- **Children should be supervised while eating solid foods and food should be eaten while sitting upright, chewing well before swallowing and with no talking.**
 - ➔ This prevents choking on foods.

- **Small items should not be placed anywhere where the child may reach it.**
 - ➔ This includes small toys, marbles, coins, batteries, magnets etc. This should be done before the age of 4 months when infants explore the world by putting things into the mouth.

- **Vacuum and check floors for items that that could be choking risks such as small toy parts or balloons especially after parties.**
 - ➔ This is important to do to make sure that kids don't discover something on the floor that they can put into their mouth. This should be done before 9 months of age when the child is able to pull up to stand and crawl around.

- **No pets in the house before the age of 2.**
 - ➔ This is not a rule, but with pets it is important to make sure that pet food is not lying around for the toddler to swallow and choke on.

- **Avoid toys with magnets.**
 - ➔ Toys with magnets are dangerous for children under the age of 4 years since it is a life-threatening event if ingested.

- **Children should be supervised while eating solid foods and food should be eaten while sitting upright, chewing well before swallowing and with no talking.**

References: Illustrated Textbook of Pediatrics, Fourth Edition, by Tom Lissaur and Graham Clayden,

Case reports: Pediatric Education Online: <https://www.pedscases.com/>