RICKETS
HYPERVITAMINOSIS D
SPASMOPHILIA

Plan of the lecture

- 1. Definition of Rickets
- 2. Biological activity of VitD metabolites
- 3. Exogene and endogene reasons of Vit D deficiencies
- 4. Rickets classification
- 5. Changes of skeleton in rickets
- 6. Treatment fnd prevention of rickets
- 7. Hypervitaminosis D
- 8. Spasmophilia

Rickets is the disease of growing organism characterized by metabolism impairment, especially of phosphorus-calcium content abnormality that leads for bone formation, bone growths mineralization failure.

Necessity of Vit D

Age of child	0-12 mo	1-3 years old	3-7 years old	7-10 years old	11-17 years old
Vit D (mcg)	10	10	2,5	2,5	2,5

- **Vit D activity is measured in IU. One IU contains 0,025 mcg of Vit D. 400 IU contain 10 mcg of Vit D**

Biological activity of VitD metabolites

- Enhancing of intestine Ca absorbtion
- Active Ca and P reabsorbtion in kidney
- Mineralization of cartilages and bone formation
- Bone collagen and bone proteins synthesis activation (osteocalcin, osteopontine)
- Bone resorbtion stimulation
- Immune response modulation, phagocytosis activation

Vit D deficiency consequences

Organs	Deficiency consequences
Bones and bone marrow	Osteoporosis, osteomalacia, myelofibrosis, anemia, myeloid dysplasia
Gut	Ca, P absorbtion retardation, hepatolienal syndrome, dyskinesia of gut
Lymphoid system	Immunity suppression, interleukin 1, 2, phagocytosis, interferon production decreasing. Realise predisposing to atopy and allergy
Muscular system	Muscular hypotonia, seizures (tetany)

Rickets predisposing factors

Mother's	Child's
-Mother's age <17 and> 35 years old -Toxicosis during pregnancy - Extragenecologic pathology (metabolism abnormality, chronic kidney, gut diseases) - Defects of feeding during pregnancy and breast feeding (deficiency of proteins, Ca, P, Vit D,Vit B) - Lack of insolation, hypodynamia -Complicated delivery - Poor social- economic conditions	-Time of birth (children delivered in fall or winter) -Prematurity, morphofunctional immaturity -Birth weight more 4 kg -Quick weight gaining during first 3 mo -Early weaning - Rare outdoor staying -Diseases of skin, liver, kidney, malabsorbtion syndrome -Frequent respiratory infection -Anticonvulsant drugs

Exogene reasons of Vit D deficiencies

- Lack of Vit D consumption with food. Poor containing of products in diet that are rich in VitD (yolk, fish, oil, milk, butter, liver)
- Deficiency of insolation and rare outdoors walks that leads to poor production of Vit D in skin under influence of sun beams (UV spectrum 280-310 nm)
- Inproper intake of phosphates and Ca with food

Endogene reasons of Vit D deficiency

- Malabsorption of Vit D in intestine
- Hydroxylation of Vit D precursors impairment into active metabolites in liver, kidneys due to chronic diseases of theses organs
- Genetic or inherited abnormalities of Vit D synthesizing process
- Outstanding loosing of Ca and P by kidneys into urine or impairment of bone absorption of Ca and P.
- Absence or degradation of Vit D receptors functional activity.

Risk group of Vit D deficiency

- Premature children with low body weight
- Neonates with signs of immaturity
- Malabsorbtion syndrome (celiac disease, food allergy, exudative enteropathy)
- Convulsions that demand specific therapy (anticonvulsants)
- Decreasing of motion activity (paresis, paralysis, prolonged immobilization)
- Chronic pathology of liver, bile ducts
- Frequent respiratory pathology
- Children fed by nonadapted formula
- Abused by inherited abnormalities of Ca-P metabolism
- Twins or neonates from pregnancies with short period between them.

Rickets classification

Degrees	Disease period	Disease course
1-st mild	Initial	Acute
2-nd moderate	Clinically obvious (swing) period	Subacute
3-d severe	Reconvalescence	Recurrent
	Residual	

Criteria of rickets' severity

- !-st degree rickets is characterized predominantly by neuro-muscular abnormalities and minimal disturbances of bone formation (craniotabes, occiput flattening, minimal tissue signs in growing zones of metaphysic
- 2-nd degree rickets (moderate) – beside neuro-muscular dystonia bone deformities of sculp, chest and limbs are present, moderate functional changes of inner organs
- 3-d degree rickets (severe) – prominent bone and muscular abnormalities, articular hypermobility, static and locomotor function retardation, impairment of inner organs function due to acidosis and concomitant microvasculature changes

Criteria of rickets' course

- Acute course – prompt development of all symptoms, clear neurologic and vegetative disorders, significant hypophosphatemia, high level of alkaline phosphatase, osteomalacia symptoms prevelance
- Subacute course –moderate and vague neurologic and vegetative abnormalities, not significant biochemical changes, osteoid hyperplasia predominance
- Recurrent course – typical periods of exacerbation and remission with residual signs. X-ray reveals in methaphysis several calcification lines

Criteria of rickets period

- Initial period – signs of disease can be seen in 2-3 mo old child 9 in premature children at the end of first mo). Behavior of child changes. He becomes irritated, jerky. Neuro-vegetative symptoms become visible. Ca level is slightly elevated or normal (N-2,37-2,62 mmols/l), P level is decreased (N- 1,45-1,77 mmols/l), alkaline phosphatase is slightly elevated, acidosis is present, hyperphosphateuria, hyperaminoaciduria can be find. Initial period elongation in rickets acute course can be 2-6 weeks, in subacute course – 2-3 month

Criteria of rickets period

- *Swing period* (clinically obvious) (6 mo of life) – is characterized by more prominent neuro-muscular and vegetative disorders, retrardation of psychomotor and somatic development, visible skeletal disorders especially in growing zones of bones. Hypophosphatemia become obvious, moderate hypocalcaemia, elevated level of alkaline phosphatase

Criteria of rickets period

- Reconvalescence period – condition improves, neurologic ad vegetative disorders disappear, static function improves, new reflexes appear but muscular hypotonia and skeletal deformities can be present for long time. The levels of Ca, P, alkaline phosphatase normalize
- Residual period – all reversible changes in skeleton disappear (muscular hypotonia, joint and ligament dysfunction) biochemical indexes normalize, but nonreversible changes of skeleton are present (deformities, osteoid hyperplasia symptoms).

Changes of skeleton in rickets

Part of skeleton	Bone deformities
Bone deformities	**Craniotabes (in young infants pressure over the soft membranous bones of the skull is felt like ping-pong ball)** **Skull deformities(bossing of frontal and parietal bones, delayed eruption of primary teeth, defects of teeth enamel, inclination to caries** **Large anterior fontanel with delayed closure**
Chest	**Clavicular deformities, rachitic rosaries** **Wide low aperture, narrowing of the chest from the sides –"pigeon breast", sternum project forward** **Navicular depression on the lateral side of chest**

Changes of skeleton in rickets

Upper limbs	**Deviation of humerus and arms** **Joint deformities: "bracelet" (bossing in radiocarpal joints), "pearl fibers" (bossing in fingers distal part)**
Column	**Scoliosis, kyphosis or lordosis**
Pelvis	**Flat pelvis, narrow low aperture of pelvis**
Lower limbs	**Anterior bowing of legs, knock knee, coax vera**

Main treatment goal

- Restoration of Ca-P metabolism
- Normalizing of peroxydative process in lipids
- Elimination of metabolic acidosis and hypokaliemia
- Elimination of VitD deficiency

Treatment must include

- Proper regimen for child. Infant must spend not less than 2-3 hours outdoors, room of child must be aired.
- Proper feeding. Diet must contain products rich in vit D and mustn't be overloaded by wheat or semolina porridge because it absorb Ca and P and decrease it penetration through intestine
- Medication with vit D
- Hygienic bathing, massage, physical exercises

Antinatal nonspecific prevention of rickets

Pregnant woman must spend outdoors not less than 2-4 hours every day, must be active, get proper diet with high containing of vit D and C and other micro and macro nutrients, proteins

Specific antenatal prophylaxis : Pregnant woman must take vit D 400-500 IU daily from 28-32 week of pregnancy beside summer month. If woman has chronic nephropathy or another extragenital pathology like diabetus mellitus, rheumatic fever, hypertension dosage of vit D increases to 1000-1500 IU daily for 8 weeks. Another way can be performed UV radiation of skin.

Postnatal nonspecific preventive efforts

- Consist of performing everyday massages and exercises, walking outdoors, bathing, proper feeding (breast feeding is preferable. In the case of hypogalactia –proper formula feeding must substitute breast milk) Mother's breast milk contain the most suitable quantity of Ca and P in most rational rate of these electrolytes to be absorbed in gut.

Specific preventive activity

For full term children with natural feeding vit D is proposed from 3-4 week after birth in fall, winter period in daily dosage 400-500 IU. If child was born in spring or summer you needn't prescribe vit D.

Premature neonates with 1 degree of immaturity are prescribed vit D 500-1000 IU from 10-14 day old for 2 mo with 2 mo intervals.

Premature neonates with 2-3 degree of immaturity must get 1000-2000IU of vit D from 10-20 day old daily for 1 year, except summer months. When they get 1 year dosage of vit D must be 500-1000 IU daily. You must also add treatment with medications of Ca and P. UV radiation can be prescribed 1-2 times per year. Course consist of 10-12 radiations starting from 1/8 biodosages of UV with steady elevation to 1,5 – 2 biolog. dosages.

Rickets' treatment

- **Prescribing specific treatment you must take into account period and course of disease. Daily dosage differs from 2000to 5000 IU for 30-45 days. After gaining therapeutic effect child is proposed preventive dosage (500IU) daily for 3 years.**
- **Such medications can be used**
- **Videchol (0,125% oil solution of cholecalciferolum (D3). 1 ml of solution contain 25000 IU, 1 drop – 500IU.**
- **Vit D2 (0,125% oil solution of ergocalciferoli; 1 ml of it contain 50 000IU, 1 drop-1000 IU**
- **AQUADETRIM water solution of vit D3 1 drop contain 500 IU**

Main biological functions of Ca in organism

- Mineralization of bones and formation of skeleton
- Generate electrical potential of cell
- Regulate activity of cells, biologically active substance
- Take part in integrity of organism function
- Maintain normal neuro-muscular excitability and contractility
- Maintain homeostasis
- Activate big quantity of enzymes and biologically active substance

Food and products that contain Ca

Quantity of Ca (mg/100g)	Products
Plenty (>100)	Cheese, milk, kefir, cottage cheese, pod, parsle. spring onion
Big quantity (51-100)	Sour cream, eggs, buckwheat, oatmeal, pea, carrot, horse mackerel, herring, caviar
Moderate (25-50)	Butter, perch, cod, millet. Cabbage, reddish, beet, apricot, cherry, plums grapes, oranges, strawberry
Lack (less than 25)	Meat products, semolina, macaroni, potato, cucumber, tomato, water melon, apple, pears

Contraindications for Vit D treatment

- Intrapartum intracranium trauma or hypoxia
- Jaundice
- Little sizes of anterior fountanella.
- If child is fed by adopted formula that contain vit D.

Hyper-VitD treatment

- Stop intake of Vit D
- Decrease Ca intake
- Eliminate milk, cheese from diet
- Plants, cereals are recommended because they fix Vit D and Ca in intestine and help eliminate it
- In severe conditions is recommended IV injections of albumin, 5% solution of glucose, Ringer solution, Vit C. Prednisone (2 mg/kg) is recommended. It can decrease absorbtion of Ca from intestine and induce resorbtion of Ca from bone and thus accelerate loses of this macroelement from organism.

Vit D antagonists

- Vit A
- - Vit E
- Furosemide (1 mg/kg)
- Myocalcic (synthetic thyrocalcitonin – 5-10 U/kg IV)

Medication that bind Ca in intestine

- Cholestiramine (o,5 g/kg bid)
- Almagel (50-100 mg/kg daily)
- Trilon B (50 mg/kg daily IV)

Diagnostic approach

- Principle approach is monitoring of ionized Ca (normal one is 1,1-1,4 mmols/l; in spasmophilia less than 0,85 mmol/l)
- Decreasing of common Ca level (less than 1,75 mmols/l)
- ECG –elongation of QT and ST intervals
- Metabolic alkalosis

Spasmophilia treatment

Latent form

- Regimen normalization
- Diet restrict of cow milk and milkfish products
- Ca containing medication
- Necessity of Ca in infants is 50-55 mg/kg daily
- Neonates -400mg daily
- Infants – 600 mg
- Children from 1 to 5 years old – 800-1200 mg
- Adolescents – 1200-15000mg
- Adults -1000-1200-1500 mg

To restore Ca level can be used

- 10% solution of Ca gluconates (I ml of solution contain 9 mg of CA)
- 5% sol. Of Ca gluconatis, Ca lactis
- To eliminate alkalosis by 10% sol. Of ammonii chloride (1 teaspoon tid)

Control questions

- Function of vitamin D (active metabolites). Ways of receipt to the organism of child.
- To explain adjusting of metabolism of calcium in an organism is suction of Ca, adjusting of concentration in blood, feature of bones mineralisation.
- To name the clinical displays of violation of the bone system at a rickets (acute and subacute motion).
- To explain metabolism of phosphorus in an organism, correlation of concentrations of Ca and phosphorus in the whey of blood.
- To name clinical displays of violation of exchange of phosphorus at a rachitis.
- To specify factors which assist development of rachitis (outside pregnant, from the side of child).
- To define the clinical displays of initial period of rachitis. To explain the mechanism of their origin.
- To specify the medical doses of vitamin D.
- Clinical displays of hypervitaminosis D.
- To define diseases, at which stability is to treatment of vitamin D by “ordinary” doses (vitamin D stability rachitis, Illness Toni-Debre-fankoni, kidney tubular acidosis, hupophosphatasia).
- Why for children with the clinical displays of rickets can there be a convulsive syndrome?
- Are there what clinical signs at latent and obvious spazmofiliya?
- What treatment is appointed at the convulsive state for children.