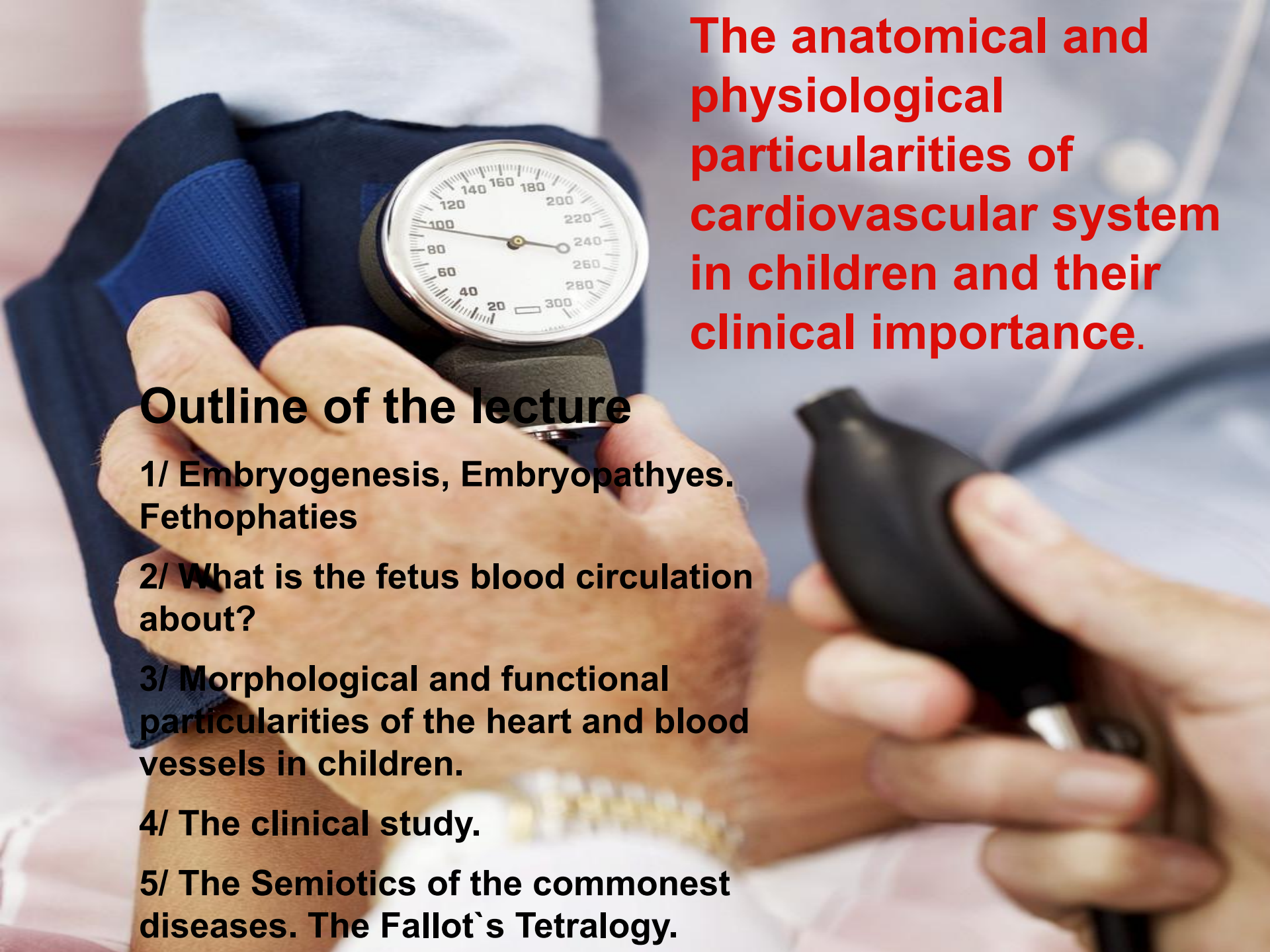


The anatomical and physiological particularities of cardiovascular system in children and their clinical importance.

Outline of the lecture

1/ Embryogenesis, Embryopathyes. Fethophaties

2/ What is the fetus blood circulation about?

3/ Morphological and functional particularities of the heart and blood vessels in children.

4/ The clinical study.

5/ The Semiotics of the commonest diseases. The Fallot`s Tetralogy.

The heart and large blood vessels appears at the 3-rd week of the embrionic phase. The first contractions of two chambers embryonic heart occur at the 4-th week of the embryogenesis. The heart sounds can be heared through the mother`s abdominal wall since the fourth month of gestation.

Briefly the process of heart and large blood vessels embryogenesis can be described as a complex process of yolk sack and umbilical vessels interactions forming two tube-shaped hearts. After that thay merge forming the primitive

embryonic heart.

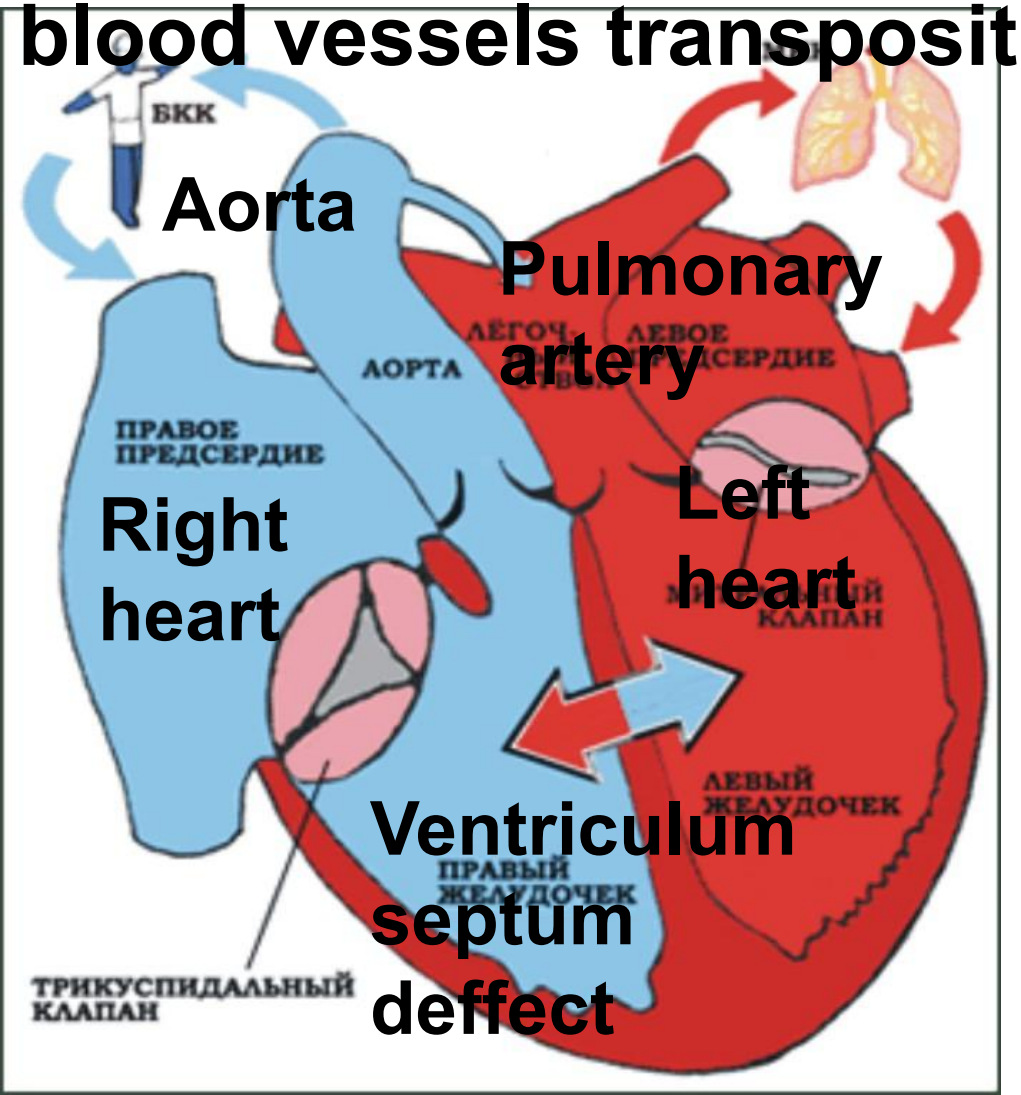
In this time the simultaneous embrionic heart migration proseedes from the neck`s area of embryo into its thorax.

Heart congenital abnormalities

- It is important to confess that embryo heart during at list the 1-st month of life is staying in raised risk to get a damage due to teratogenic (causing congenital abnormalities) factors.
- The viruses are the most common pathogens damaging heart`s growing and differentiation and leading to congenital heart disease.

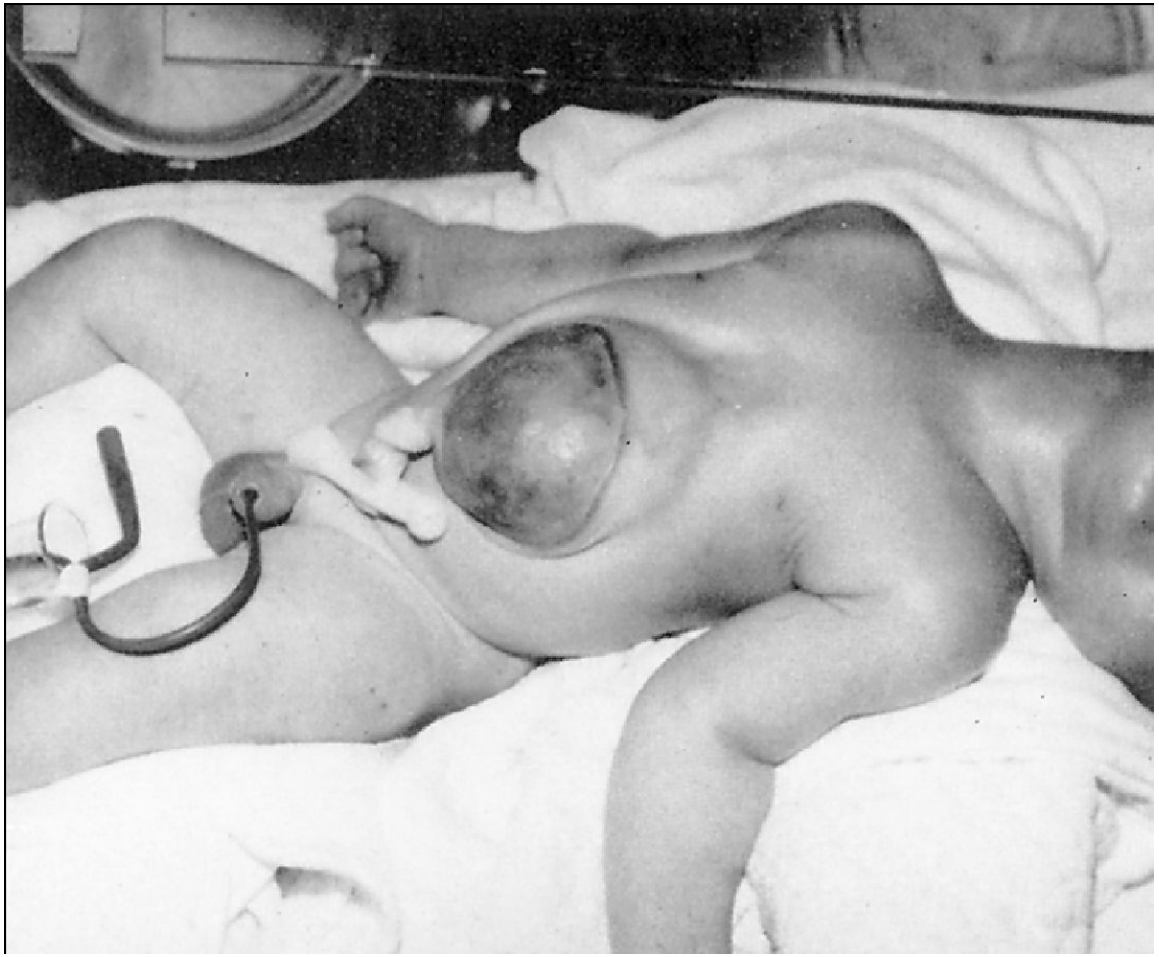
Embryopathyes.

blood vessels transposition

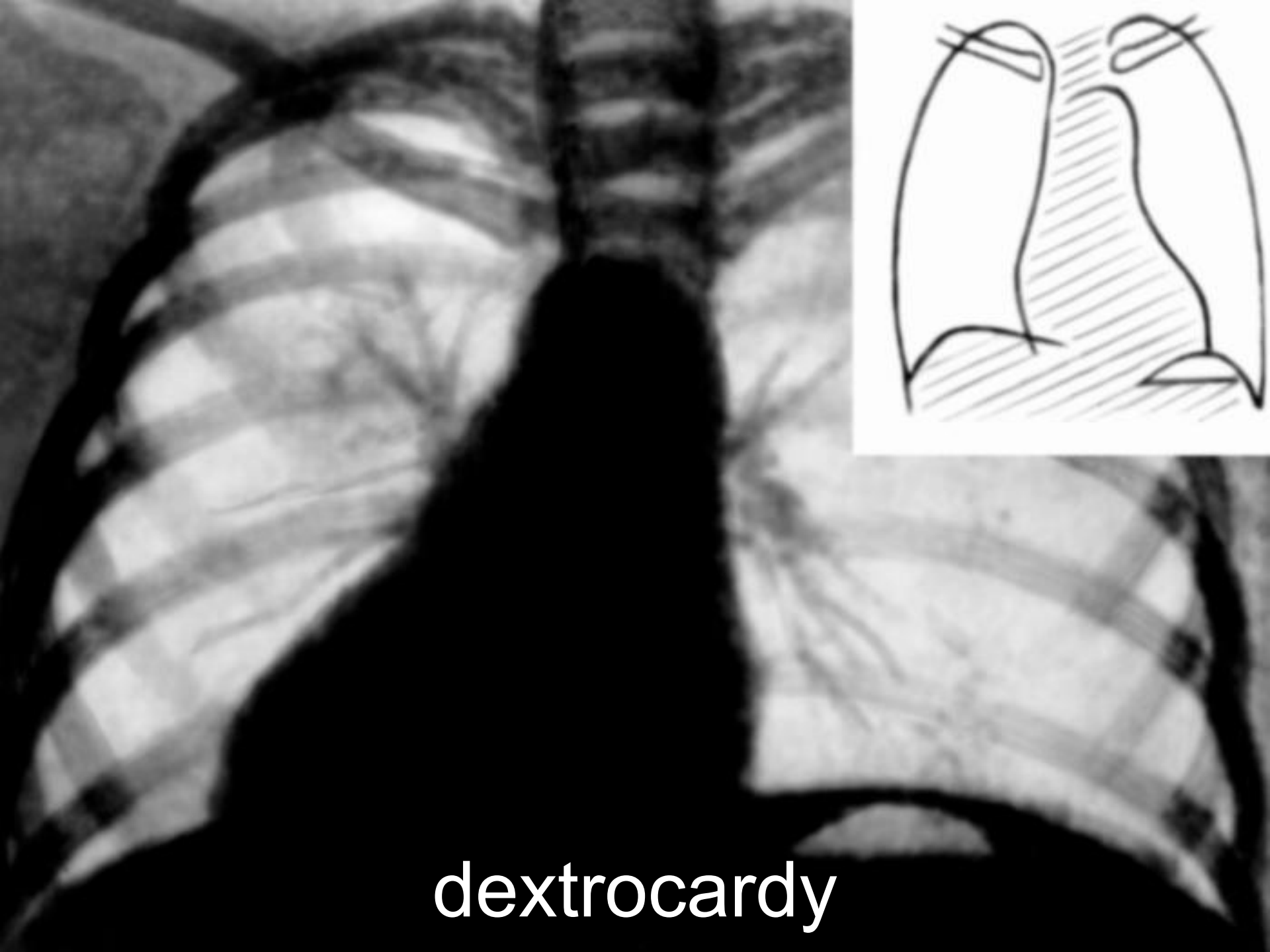


- Develop within first 9 weeks of gastation
- Are usually severe diseases
- Show huge anatomical abnormalities

Heart ecthopia



Newborn male with thoracoabdominal ectopia cordis (Cantrell pentalogy). Flaring of the lower thoracic cavity is present with a large epigastric omphalocele. The transverse septum of the diaphragm and the inferior portion of the pericardium were absent. The patient also had tetralogy of Fallot. (From Shamberger R, Welch K: Chest wall deformities. Ashcraft K, Holder T (eds): Pediatric Surgery, 2nd ed. Philadelphia, WB Saunders, 1993, p 158.)



dextrocardy

Ultrasound investigation in utero

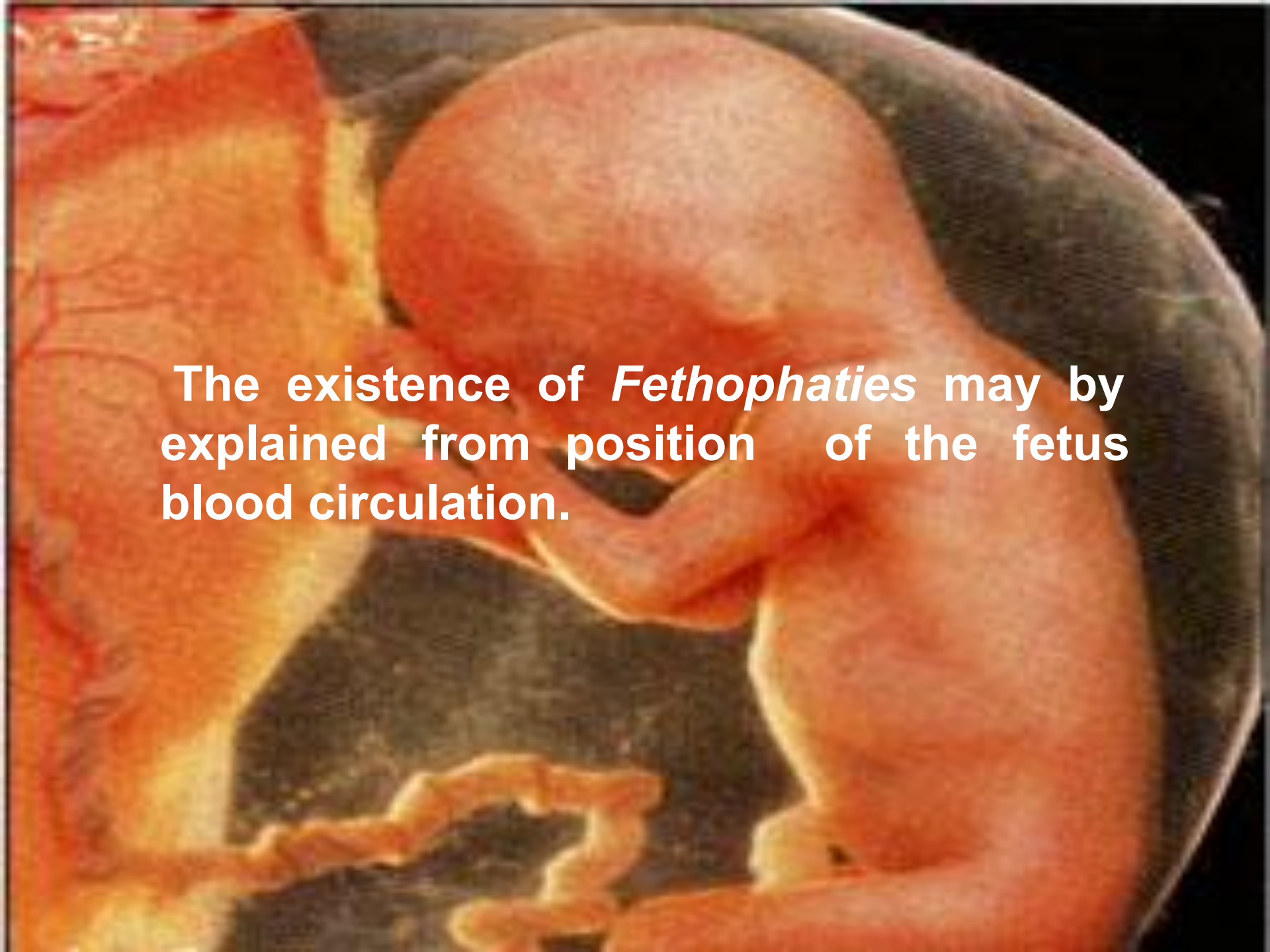
- By means of ultrasound investigation method it is possible to define embryo and fetus heart`s contractions, to consider a heart rate, to assess the heart and its chambers sizes, shape and even some abnormities that allows to required surgical handling for children immediately after delivery.

Fethophaties

- **The 3-rd month old normal fetus has an already wholly formed heart.**
- **If congenital heart disease starts at this time it`ll be less severe and easier in subject for surgical correction.**
- **This sort of heart desease pertaines to fethophaties.**
- **A clinical examples of fethophaties are:**

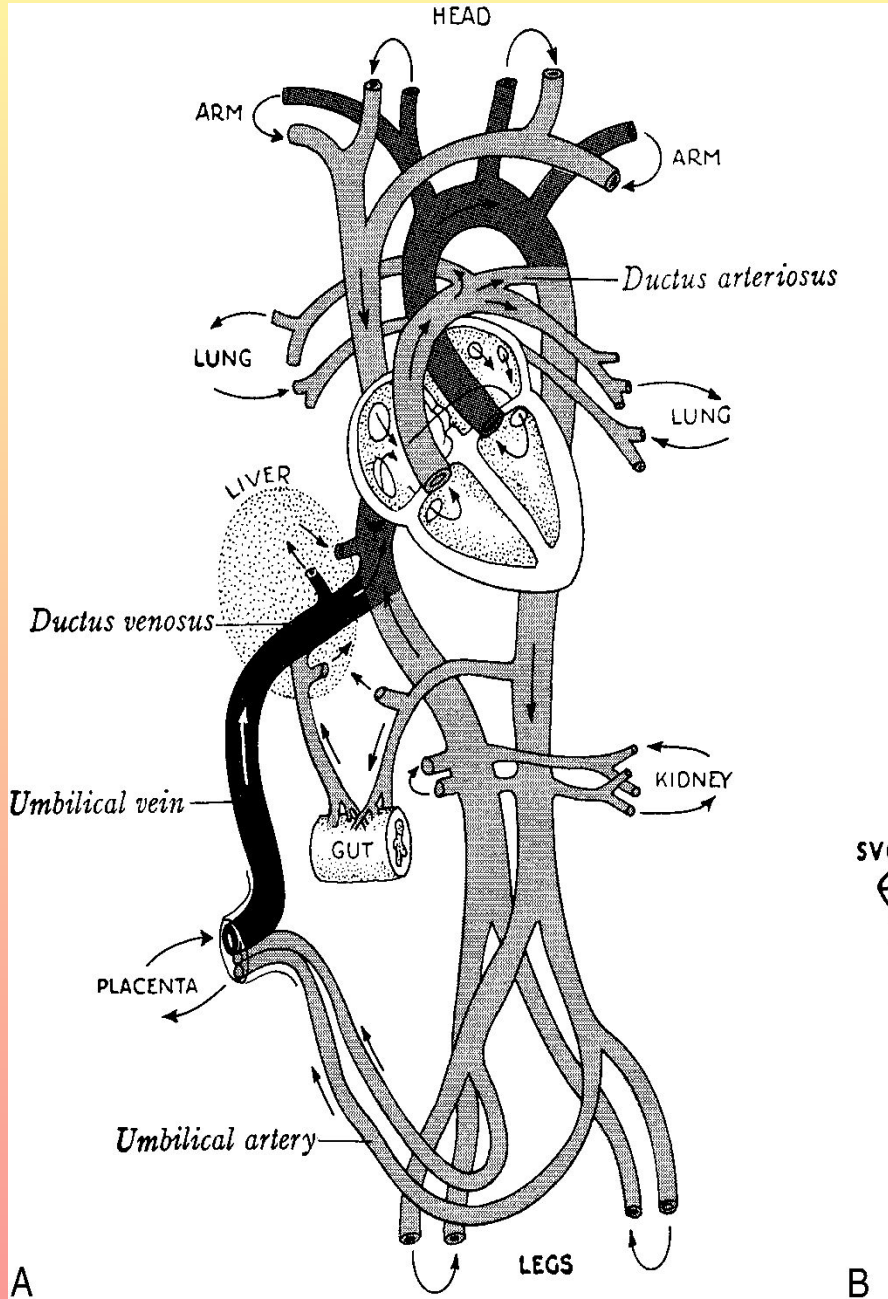
  - the patient ductus arteriosus (which matches the aorta and pulmonary arteria);

  - open foramen ovale linked right and left atriums.

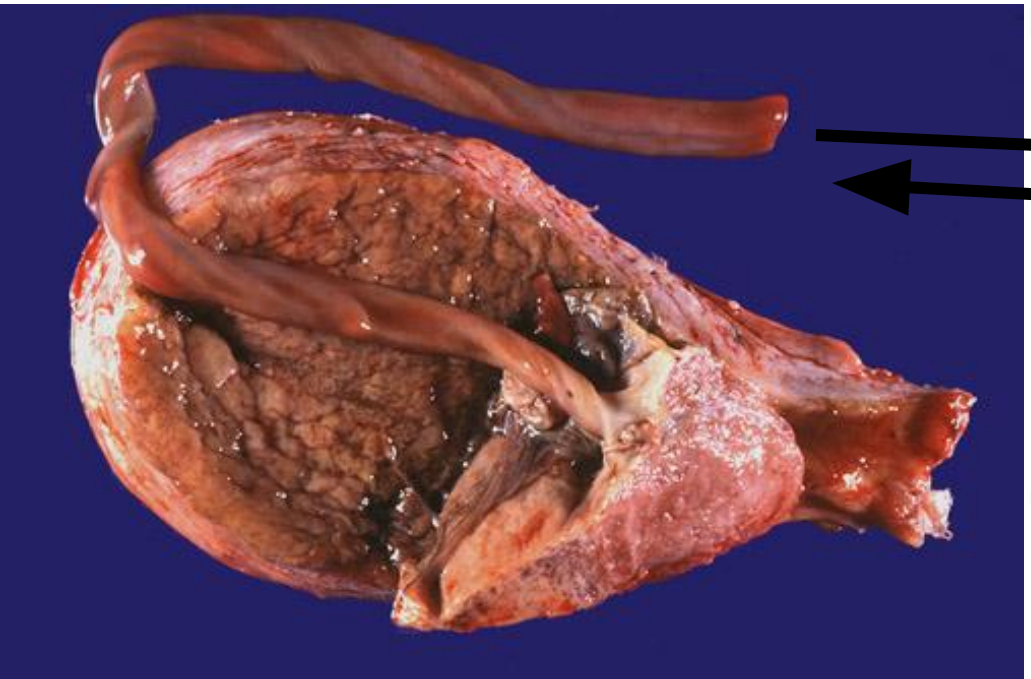

The existence of *Fethophaties* may by explained from position of the fetus blood circulation.

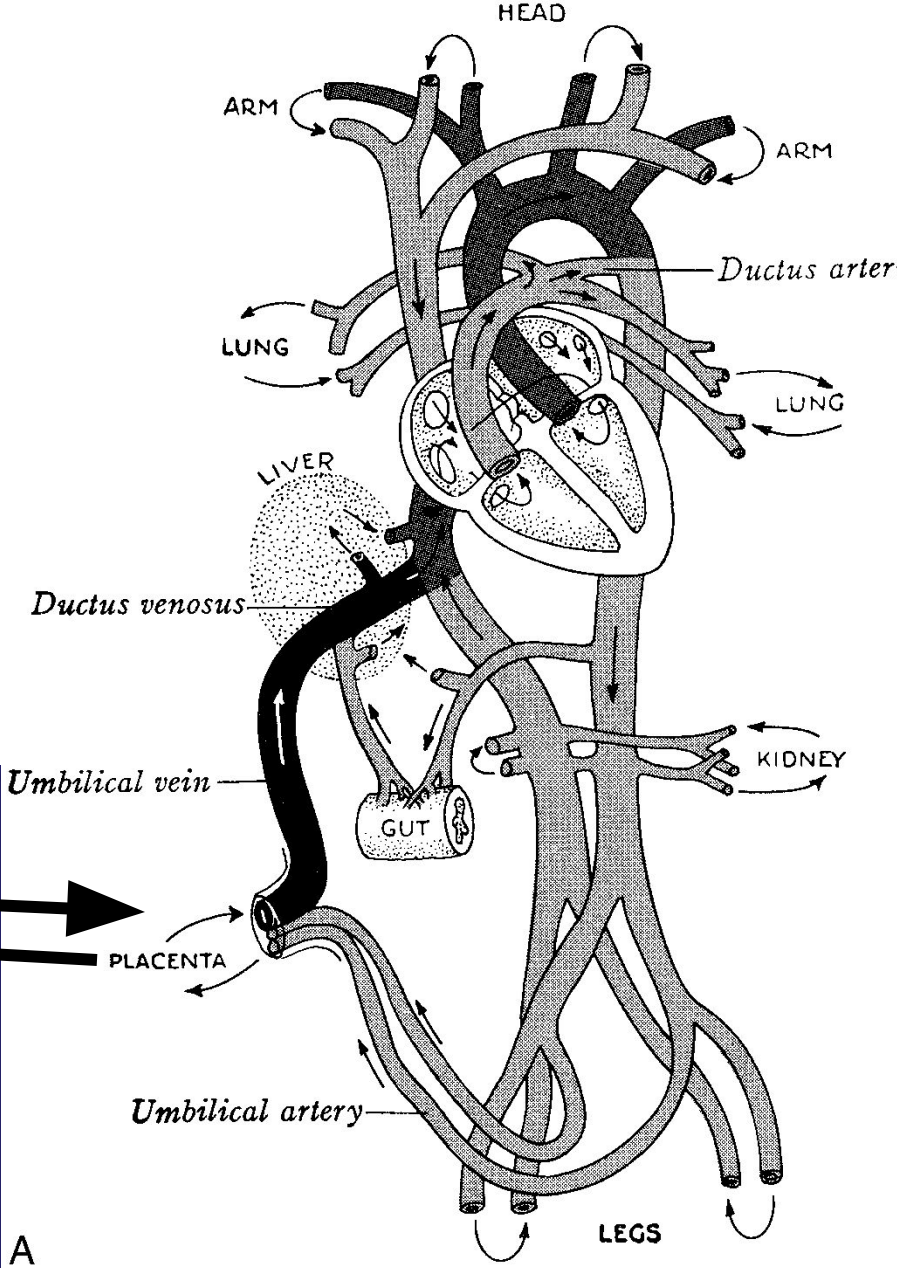
What is the fetus blood circulation about?

Plan of the human circulation before birth. Black shading indicates more oxygenated blood, and arrows indicate the direction of flow. (From Rudolph AM: Congenital Diseases of the Heart. Chicago, Year Book Medical Publishers, 1974.)



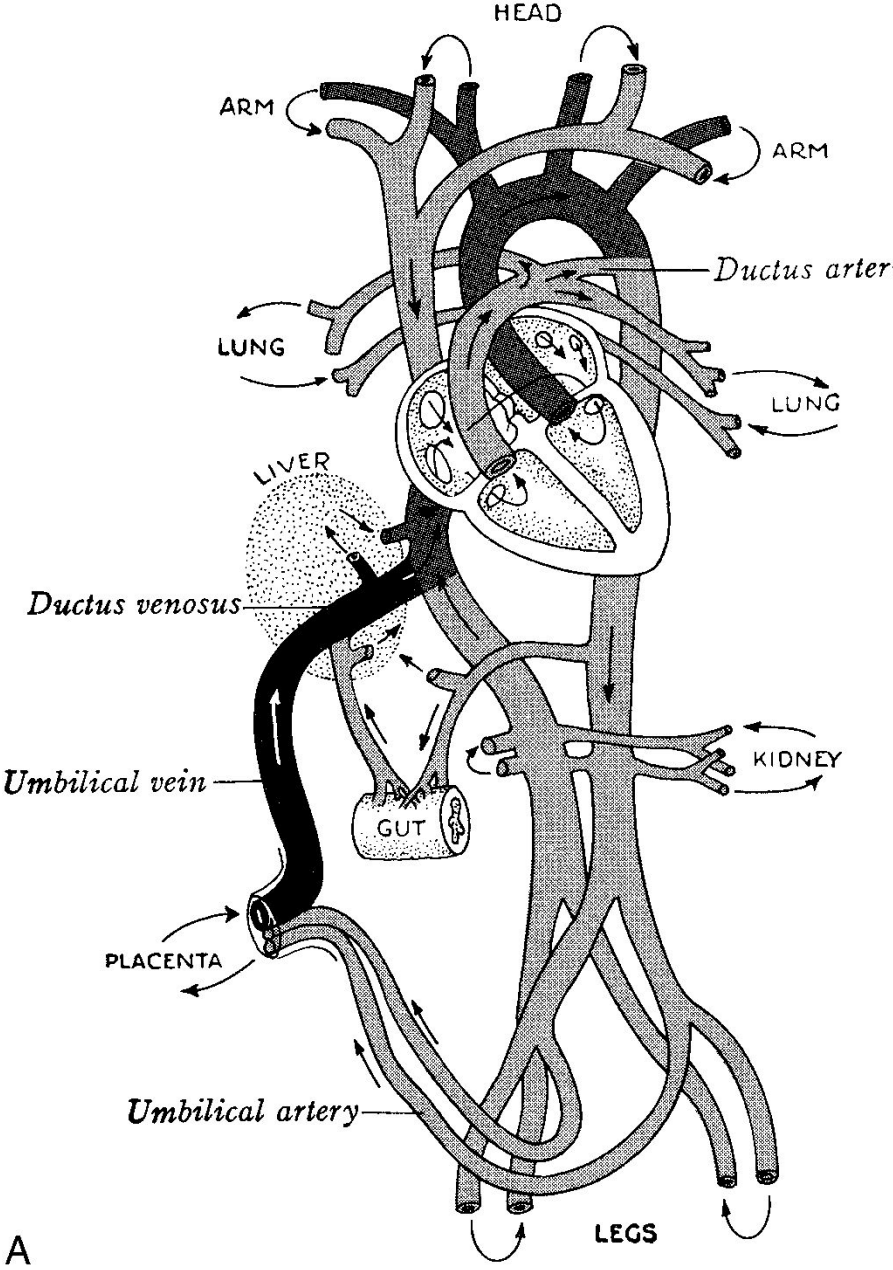
The fetus type of blood circulation is defined by placenta existence before the birth. **Placenta** is a specific vascular organ ontogenetically equally pertaining both to mother and fetus. It provides the fetus blood gas diffusion, nutrients delivery and products of metabolism removing. Herewith in placenta there are two parallel arterial-venous systems separated by biological membrane.



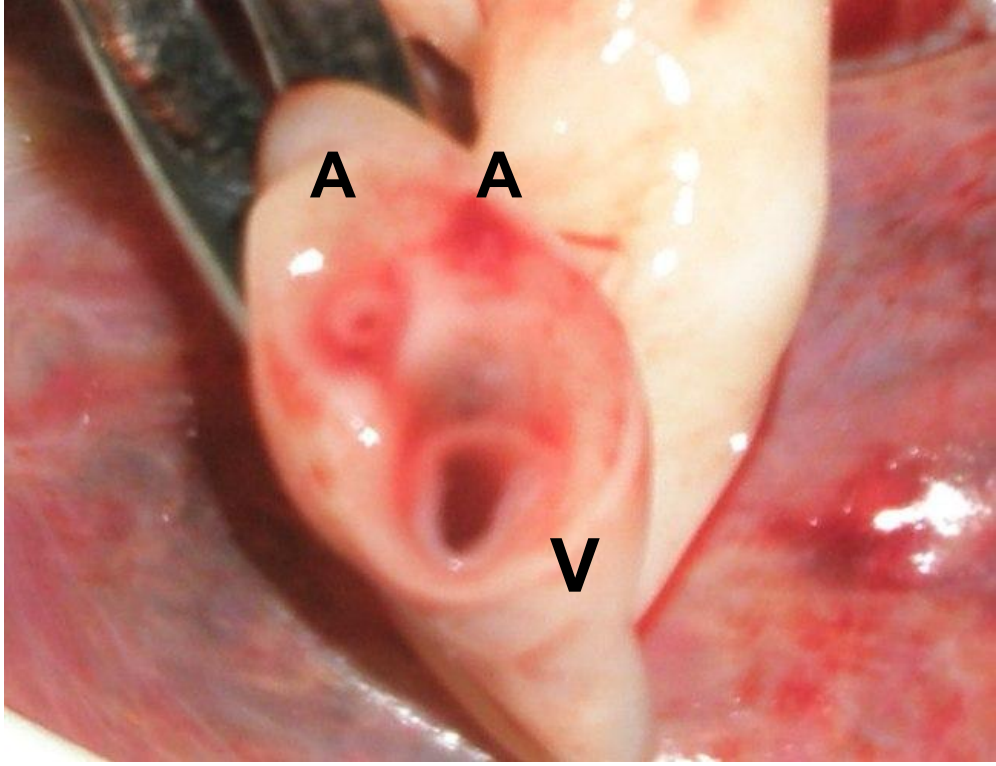


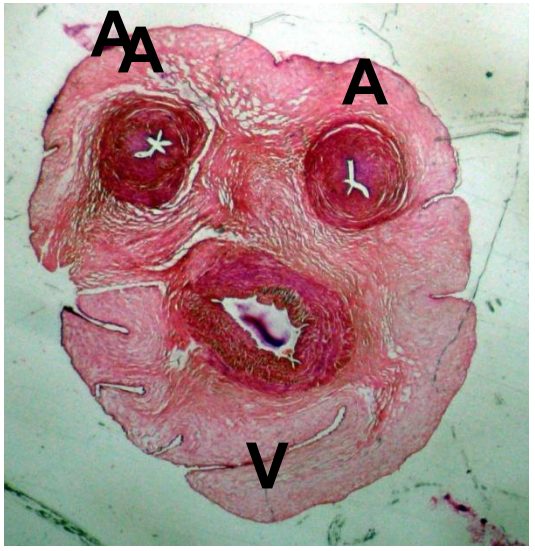
A

The pump function of fetus heart and two arteries connected with fetus aorta in place of its fission in low abdomen provide the fetal placental blood circulation. This two arteries come out through umbilical ring, reach placenta and inside it divide onto capillary network. From here the blood enriched by nutritive materials and oxygen required for fetus development comes back to fetus body by means of umbilical vein. Two arteries and one vein, thereby, form the umbilical cord of the fetus.



After delivery the umbilical cord crossing (cut) usually has to be done. Immediately after the umbilical cord must be examined for congenital vessels abnormalities. In normal umbilical cord the umbilical vein looks like a single big usually mildly bloody vessel. Also there are two contracted vessels which must be defined as an umbilical arteries.

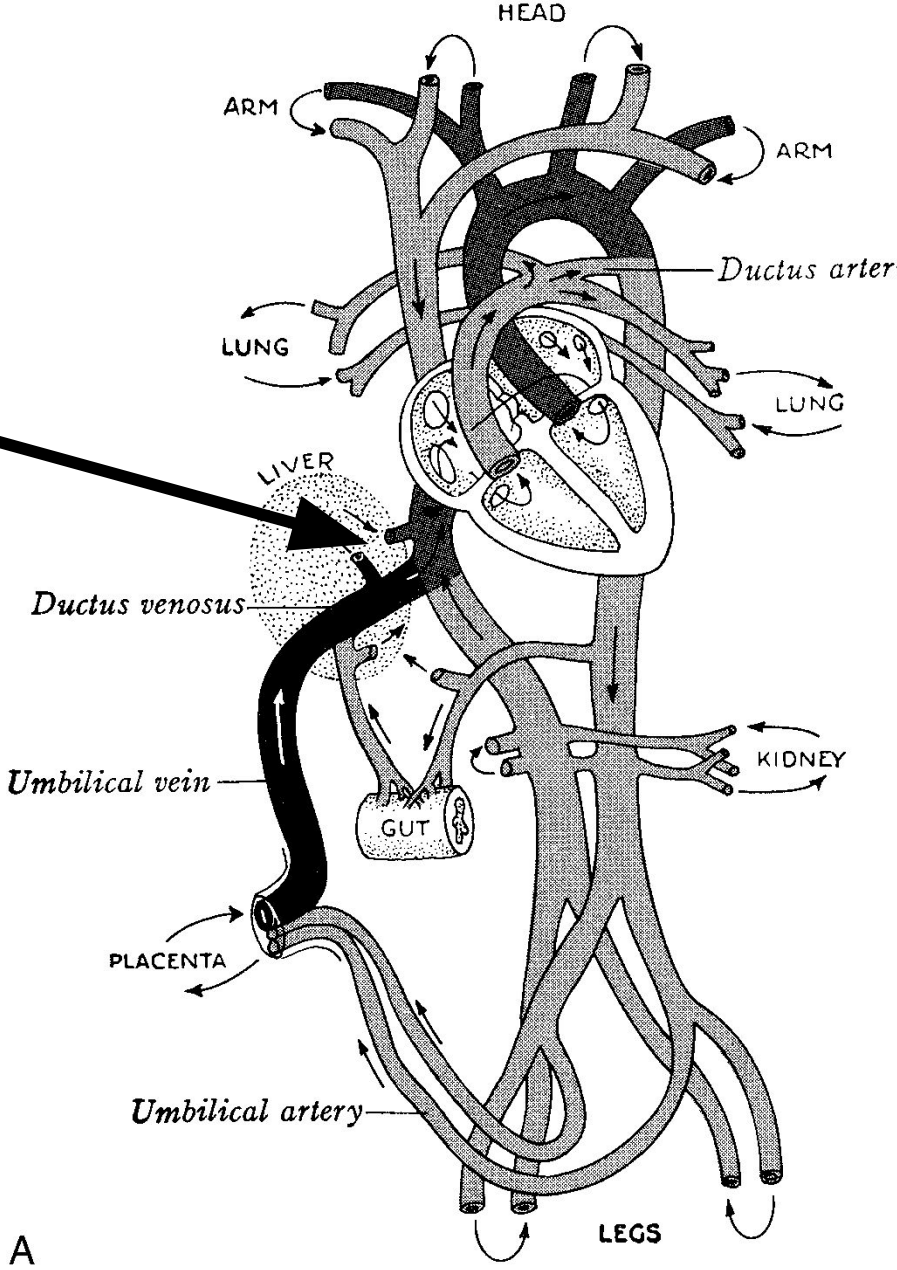




The abnormalities of the umbilical cord are indicative for different congenital internal organs abnormalities especially kidneys.

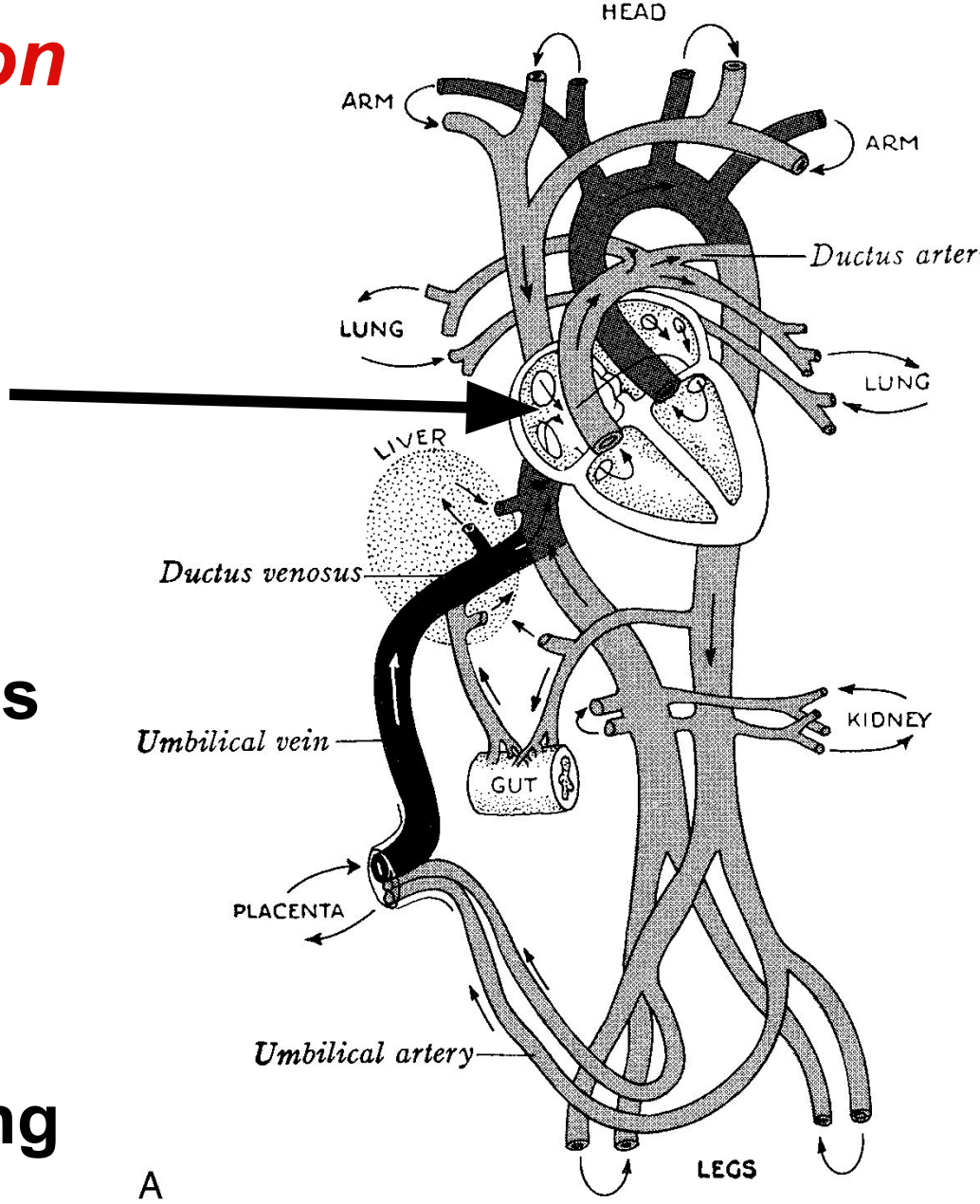
Fetus blood circulation phenomenons

The first phenomenon is a splitting umbilical vein on two venous vessels. One falls into portal vein carrying blood to liver. The second (ductus venosus) falls into inferior cava-vein, which carries the blood to the right atrium.



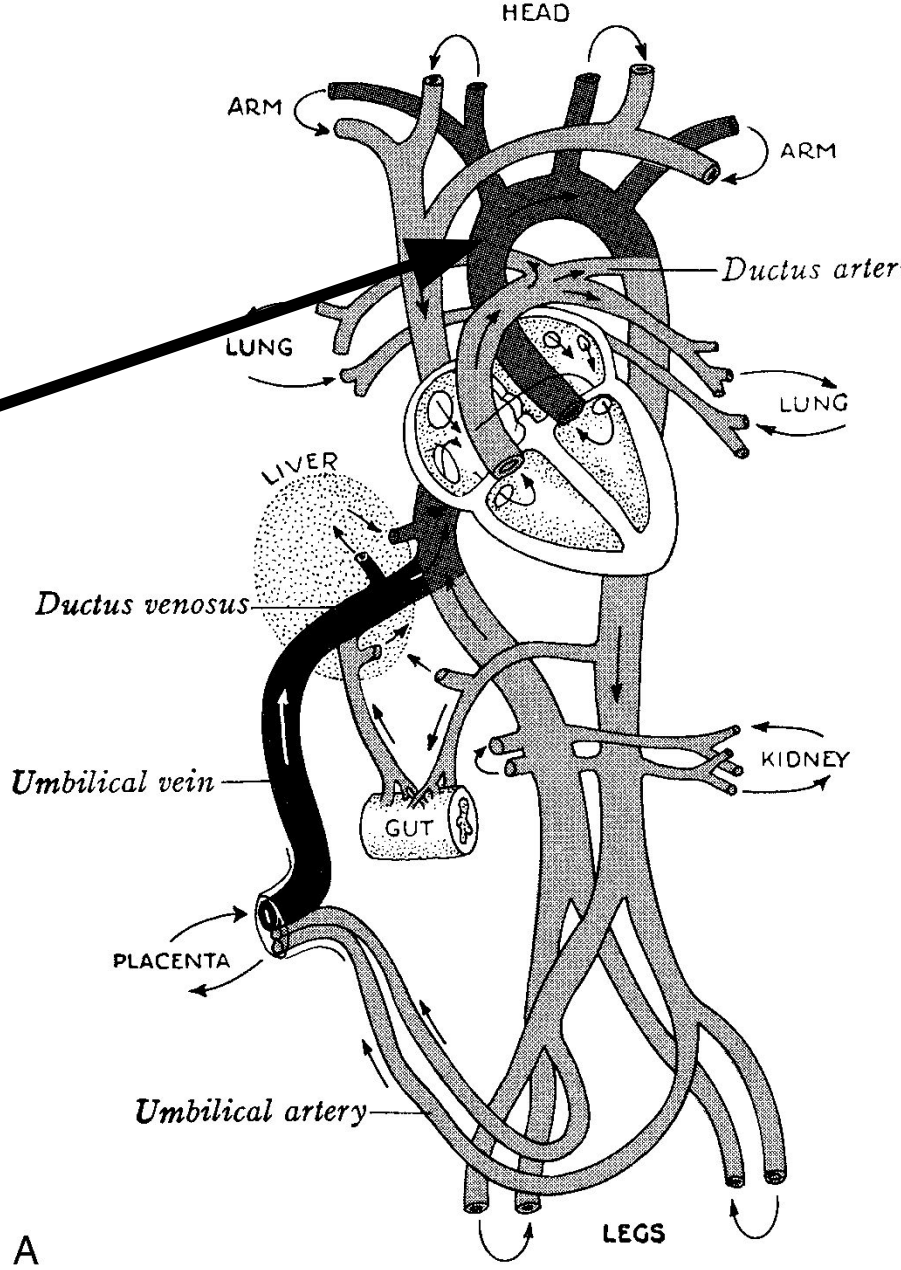
Fetus blood circulation phenomenons

The second phenomenon: in right atrium the umbilical blood flow by miraculous reason does not mingle with other venous blood. It can be explained by special damper in right atrium and foramen oval leading from right atrium to the left existence.



Fetus blood circulation phenomenons

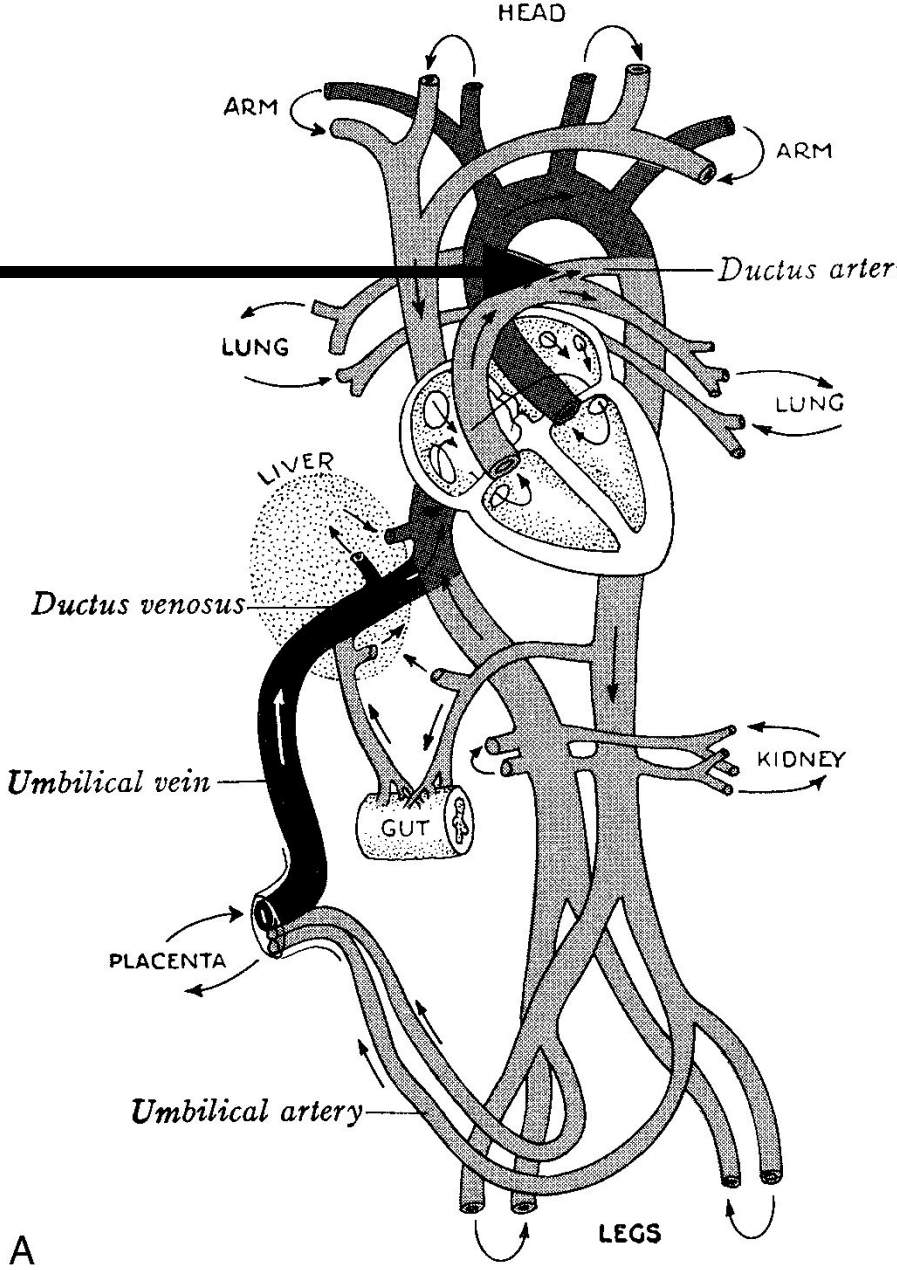
***The third phenomenon*: in the rising aorta and big arteries leaving from it there is an arteriolized (oxigeneted) blood which is strongly required for developing fetus brain.**

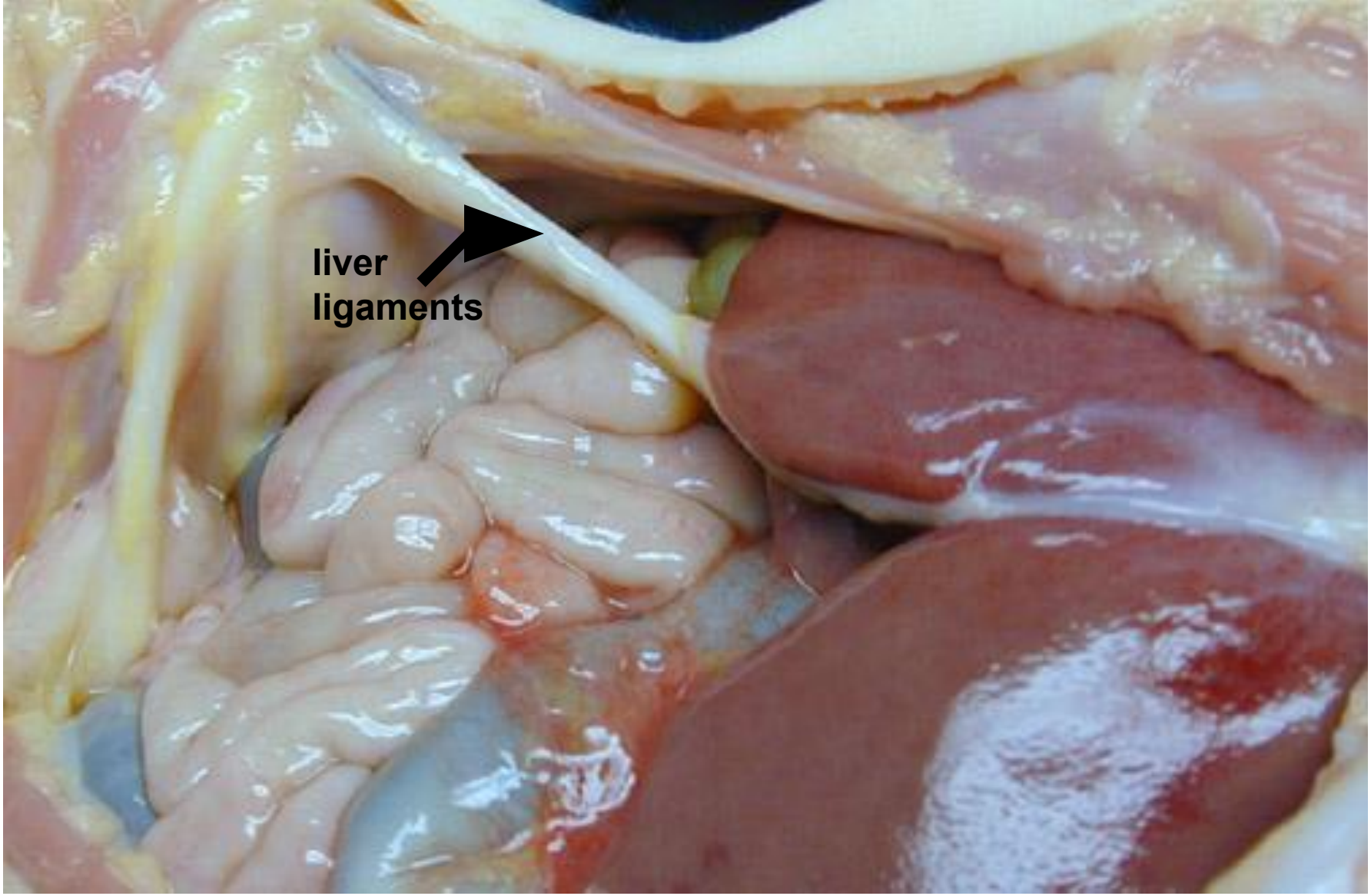


Fetus blood circulation phenomenons

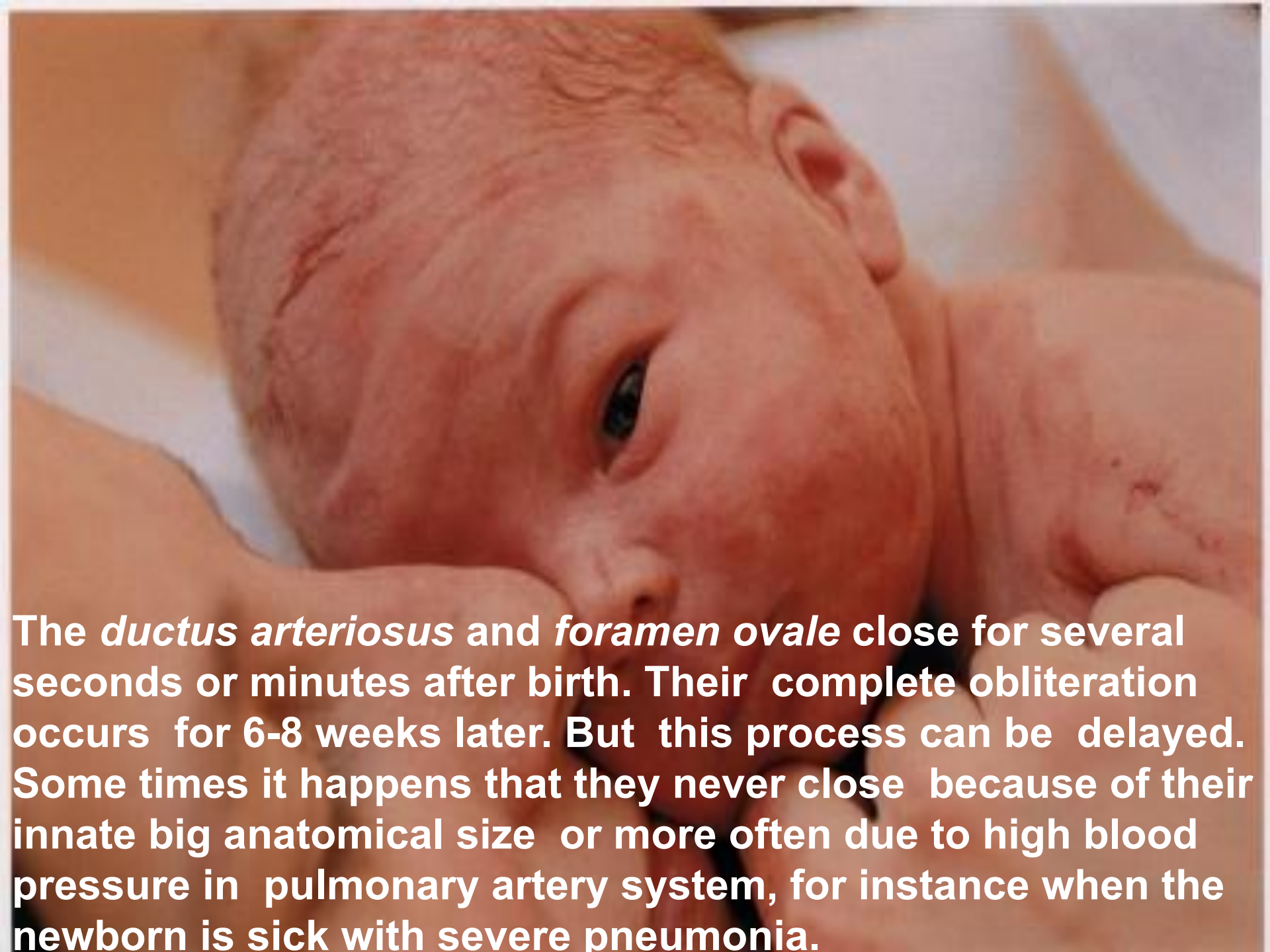
The fourth phenomenon is possible to nominate as a "decision of the venous problem of the fetus". The dial is that the venous blood in fetus does not enter in lung capillaries because in utero they are collapsed and do not participate in blood oxiganation. The main part of venous blood which right heart ventricle puts out is entering in a wide vessel (ductus arteriosus, also called Botallov). The ductus arteriosus connects the pulmonary artery and aorta and fetus blood goes from the right ventricle into descendent aorta avoiding the lungs.

Thereby, the full rotation of fetus blood is realizing.





After birth the ductus venosus and umbilical vessels obliterate and from the second week of life start to convert into liver ligaments.



The *ductus arteriosus* and *foramen ovale* close for several seconds or minutes after birth. Their complete obliteration occurs for 6-8 weeks later. But this process can be delayed. Some times it happens that they never close because of their innate big anatomical size or more often due to high blood pressure in pulmonary artery system, for instance when the newborn is sick with severe pneumonia.

Morphological and functional particularities of the heart and blood vessels in children.

The heart size

The heart of the fetus or newborn is comparatively greater that one in older children and forms nearly 1% from mass of the body. In children aged 1 yr and older it is approximately 0,5%. All the time the left ventricle mass is bigger than the right one. But in very small children the electric and mechanical activities prevalence of the right ventricle must be emphasized. This fact can be explaned by fetal blood circulation.

The myocardial infarction in children is a casuistry

- *Heart coronary arteries* before age two are distributed in children on splinting type. In children aged 2 yr the coronary arteries are distributed on mixed and after 10 years on adult type. It means the main arterial branches existence. According to this anatomical feature the child heart is not predisposed to ischemic heart attack like adult heart. In this conditions the myocardial infarction in children is a casuistry.

The myocardium.

In small children the heart myocytes are fine, have not transverse lines and contain big amount of nucklear substance. During the first two years of the child life the intensive growing and differentiation of myocardium occur. The muscular filaments become to be more thick and strong. In 10 year old child the heart in its histology corresponds to such one as in adult persone. A little bit later in 14-15 year old children the histological development of heart conductive system forme definitively from specialized cardiomyocytes losted contractive activity.

The nerviouse system supplementation of the heart

is realized through surface and deep plexuses combination formed by nervus vagus and sympathic nerve filaments contacting with sinus and atrio-ventricular ganglions of the heart rate pasmacer center. The vagus nervial branches pertaining to the parasympathetic nervous system finish their development and myelinization in children aged of 3-4 years. Before this age the heart rate is defined by unilateral activity of sympathic division of nervious system. This fact explains comparatively high rate of heart rhythm in smoll children. In age 4-5 after increasing parasympathic activities the pulse rate is getting low. In this period in well-children the physiological phenomenon well known as respiratory arrhythmia characterized by some lengthened intervals between heart bites also appears.

The premature heart bites

- **The premature heart bites (extrasystoles) if they are not occurring often also are characteristic for children.**

The heart rate

- **In children the heart rate is very changeable due to different physiological and pathological influences. The heart rate changes according to physical and emotional activity, due to stimuli from internal organs, CNS receptors and corresponding reflexes.**

Characterizing anatomical and physiological particularities of children heart

it is necessary to underline its high level of endurance, ability to execute big volume of work, possibility without harm vastly to enlarge the heart rate. The inherent for children low arterial pressure which is conditioned by small volume of heart out-put and low arterial vessels resistance is also considered as one of the age depending factor protecting a child from heart and vascular attackes vastly characteristic for adult persons.

The vessels

conduct and distribute the blood on organ and tissues. The acute difficiency of blood circulation leads to the shock. The shock is an universal pathophysiological reaction of the organism in toto connected with significant low blood circulation in the capillaries.

By origin the shock can be

- **cardiogenic** connected with low heart out-put looks like a deficiency of pump work forcing blood in vessels. This type of shock is rare in children.
- **distributive (anafilactic) shock** occures when the big amount of blood agglomerates in extended venous riverbed especially in abdominal cavity. At the same moment the capillary blood flow in others organs becomes vastly ripoffed.
- **hipovolemic shock** develops due to blood circulating volume loss. In children the typical condition leading to this shock type is dehydration state (for instance, in diarrhea).
- **infectious toxic type of shock** develops due to precapillary sphincters spasm of areterioles, when the blood can not enter in capillaries.

The clinical study of cardiovascular system.

The cardiovascular dependent complaints

- in children are very unspecific. Especially they are doubtful when the child claims on the heart pain. Unlike as in adult patientes in children the complains on heart pain are often formed as conscious or unconscious aggravation when a child repeats the wide-spread complaints of adults, his or her relatives. The good appiarence of a well child can help to differentiate the exaggeration from real disease.
- If complaint on a heart pain really exist it as a rule acompanias with palpitations, palor, fear and other serious signs. In this situation it is necessary immediately to exert all efforts to install the reason of the chest or heart pain and render the aid. Delay in this condition can be dangerous for a child!

The physical load intolerance complaint

- **In children the big clinical importance in diagnostics of cardiovascular diseases has a complaint of insufficient tolerance of the physical load (for instance, then the child rising on stairway has to have some minutes to rest) The physical load intolerance serves one of the most objective signs of heart failure.**

The heart rate, arterial blood pressure

The clinical characteristics of cardiovascular system pertain to vitality-important signs of the human body. So all physicians have to possess the concrete knowledge about the age dependent normal heart rate (frequency of pulse) and value of arterial blood pressure.

The normal frequency of pulse is changing depending on age:

- **- in newborns 120 - 140 per minute (immediately after the birth it is 100-160 per minute),**
- **- in infants and late infants (1-2 yrs.) - 110-100 at minute,**
- **- in toddlers and preschoolers (3-7 years) - 100-90 at minute,**
- **- in school` children and teens - 80 per minute and less.**

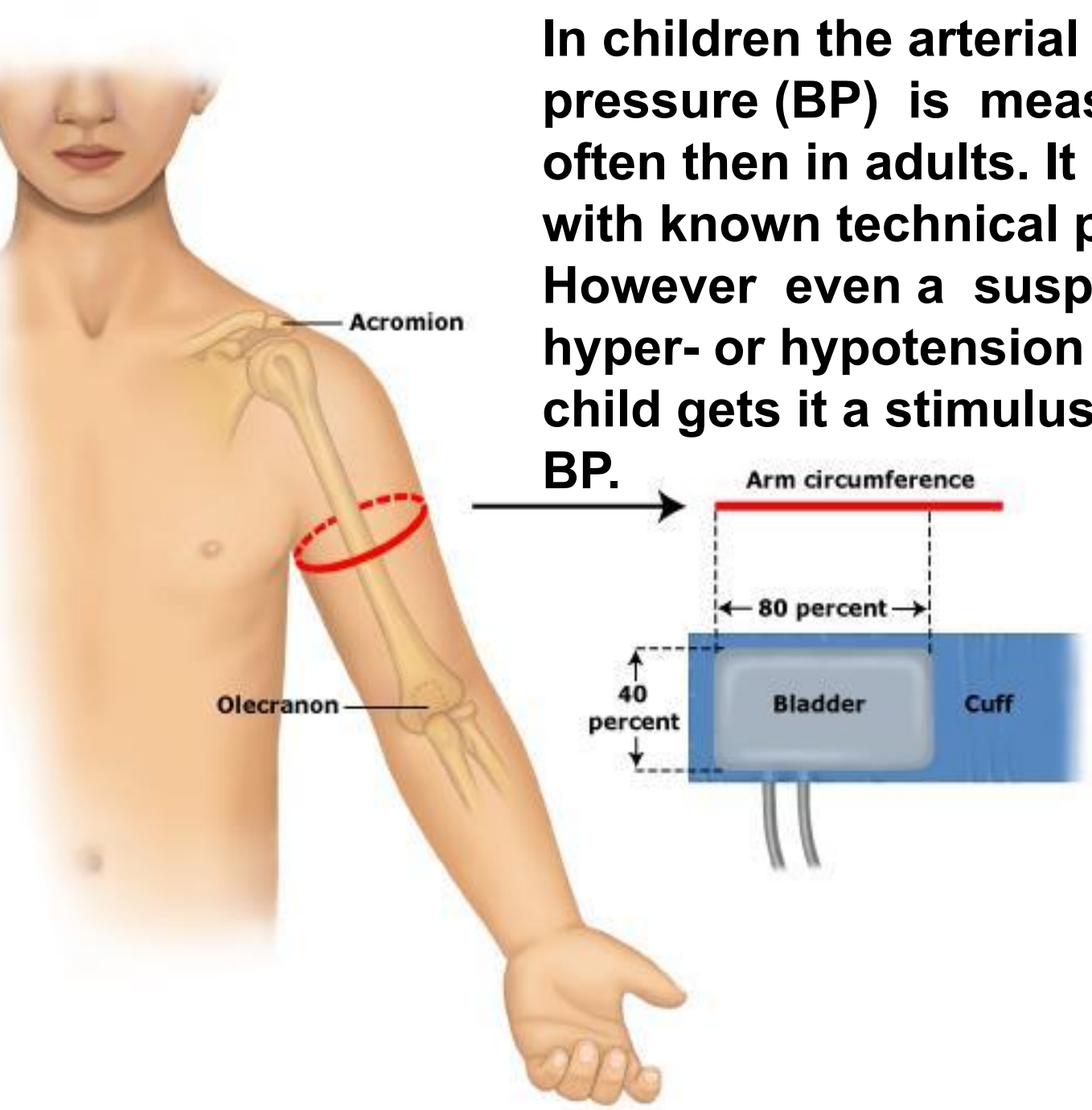
Pulse count

- **An important practical remark consists in necessary to create for the patient a standard reference conditions before to count the pulse frequency. The child must not be motor and emotional excited. This conditions can be established before usual morning round when in the hospital all patients have to stay in beds.**

Pulse count

- The pulse rate also depends on the body temperature. In fever the pulse usually is getting more frequent. After normalizing of the body temperature the pulse rate returns to the normal level. In other events the tachycardia (the heart rate measured for minute is over normal level) in children has to be evalueted as a sign of shock or heart failure.

In children the arterial blood pressure (BP) is measured less often then in adults. It is connected with known technical problem. However even a suspection on hyper- or hypotension presence in a child gets it a stimulus to evaluate BP.

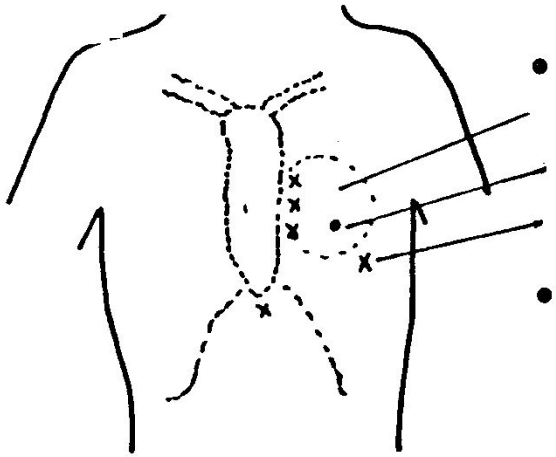


The Normal values of arterial blood pressure

- **depend on the child age and should be approximately considered:**
- **in newborns 80/50 mm Hg,**
- **in infants (up to 1 year) - 85/55 mm,**
- **in children adult then 2 years - 90/60мм.**

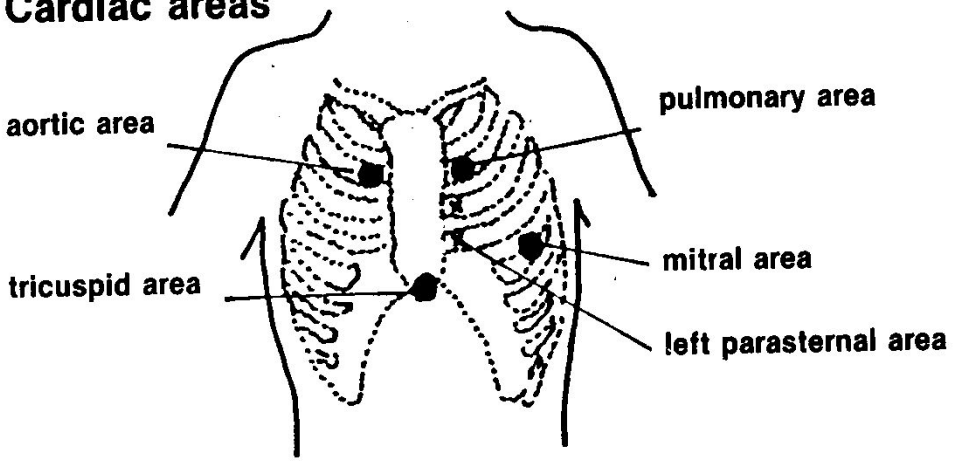
Current cardiac examination is made in 4 steps.

Cardiac Examination



- **Inspection :**
  - precordial bulge
  - apex beat
  - visible pulsations
- **Palpation :**
  - maximal impulse
  - palpable thrills
- **Auscultation :**
  - heart sounds
  - murmurs
  - pericardial rub

Cardiac areas



I. The inspection of heart area allows to reveal following symptoms:

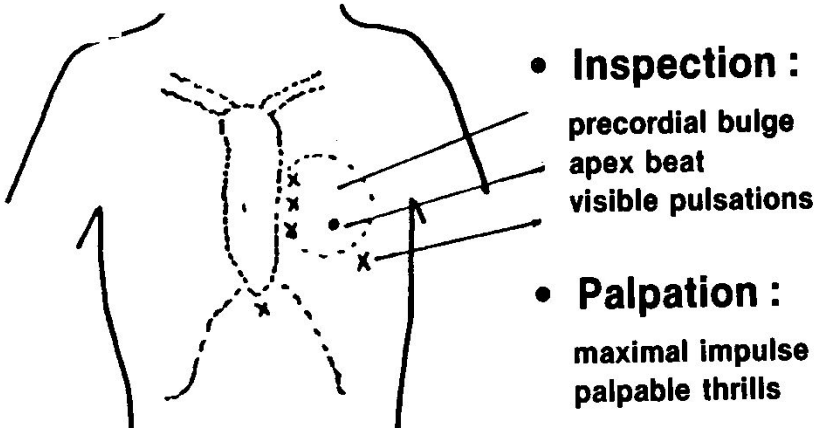
- **Precordial bulge**, which is indicative for significant increasing of heart in size.
- **Visible pulsations**. Their localization has a diagnostic relevance:

a) Exaggerated apical pulsations is indicative for left ventricular hypertrophy (LVH).

b) Left parasternal and epigastric pulsations can denote right ventricular hypertrophy (RVH).

c) Pulmonary arteria pulsations (over left second intercostal space) are present in pulmonary hypertension (raised blood pressure in pulmonary artery).

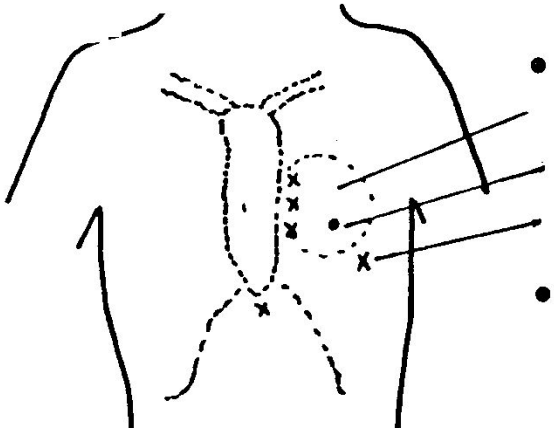
Cardiac Examination



- **Inspection :**
  - precordial bulge
  - apex beat
  - visible pulsations
- **Palpation :**
  - maximal impulse
  - palpable thrills

II. Palpation is important for determination:

Cardiac Examination



- Inspection :
  precordial bulge
  apex beat
  visible pulsations
- Palpation :
  maximal impulse
  palpable thrills

- **Apex beat**. It is shifted downwards and outwards in LVH and outwards in RVH.
- **The maximal impulse** is apical in LVH and left parasternal in RVH.

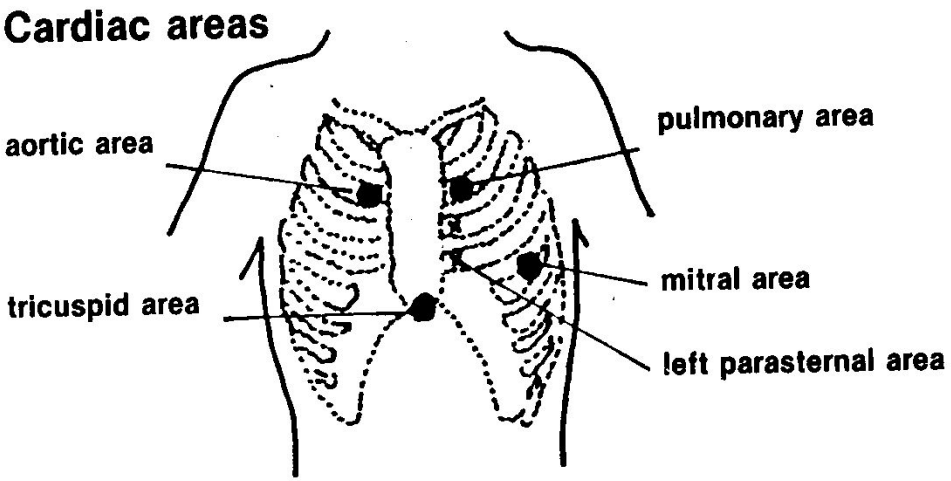
  Palpable thrills (flutter) are sensations of vibration felt by hand of the physician. They accompany usually the significant organic murmurs.

III. Percussion.

- **The percussion of cardiac borders is obsolete now in modern cardiology. It can not easily detect cardiac enlargement or to differentiate between left and right hypertrophy. The inspection and palpation are clinically more informative. The percussion of heart borders can be useful in hydropericardium evoluation. In this case the conclusion that “the heart is dramatically enlarged and its borders are extended so it is difficult to define them" could be done.**

- **Auscultation :**

  heart sounds
  murmurs
  pericardial rub



It should be made on the four cardiac areas and on the left parasternal area (see the picture).

IV. Auscultation.

The clinical comment of auscultation shold include next characteristics:

The heart sounds.

- Normal heart sounds can be marked like the abbreviation S1+S2 (sound 1 and sound 2).
- The heart sounds can be splinted or reduplicated. It means a broad gap existents between dubbed sound. For example the heart sounds formula can be written as S1+S2+S2 and it is serious application for congenital heart disease as atrial septal defect existence.
- When one tone is heard as louder then other it can be noted as the fixed sound: s1+S2, for instance. This tune over aortal area is typical for arterial hypertension.
- If the additional sounds are listened they have to be marked as s3 and even s4. As a rule they are not too much loud.
- Muffled (weak) sounds (s1+s2) with tachycardia suggests myocarditis (inflammation disease of heart muscle).
- Distant sounds with quiet precordium suggests pericardial effusion.
- The second sound (S2) on pulmonary area is a essentially useful for diagnostics noncyanotic congenital heart disease (see latter).

The clinical comment of auscultation shold include next characteristics:

- **Murmurs. Their comment should include the next points.**
- **Duration and relationship with cardiac phases: systolic, diastolic or continuous.**
- **Intensity: faint or loud, graded from 1 to 6 degree by Styll.**
- **Character: soft, harsh or rumbling.**
- **Location: area of maximal intensity.**
- **Propagation: on body back, according blood flow etc.**

The clinical comment of auscultation shold include next characteristics:

- **Pericardial rub. It is a friction sound heard in pericarditis.**

The heart sounds can be visualized in paper or electronic screen by phonocardiography method. Phonocardiogram allows to study the frequency of acoustic waves forming heart sounds and cordial murmurs, abnormal fluctuations corresponding to splitting or additional sounds and other parameters.

For successful diagnostics of cardiovascular diseases in children it is necessary to master several acceptances of clinical study and to know important cardiological signs and syndromes.

Cyanosis

is defined as skin or mucosa bluishness.

- Acute cyanosis with respiratory distress is observed in respiratory or heart failure.
- Chronic cyanosis is moistly due to congenital cyanotic heart disease.
- In both events the capillary blood is deficient to oxygen and this way has a dark color.

A femoral pulsation

or palpation of the pulse on hip artery is important sign.

Weak or absent pulsation suggests coarctation (narrowing) of the aorta.

The syndrome of congestive heart failure

is formed from specific signs.

It can be acute or chronic.

For understanding the developmental mechanisms of this important syndrome it is necessary to consider the heart as pump executing blood pumping from venous riverbed into arterial.

In acute failure, the cardinal triad is tachycardia, tachypnea and enlarged and tender liver.

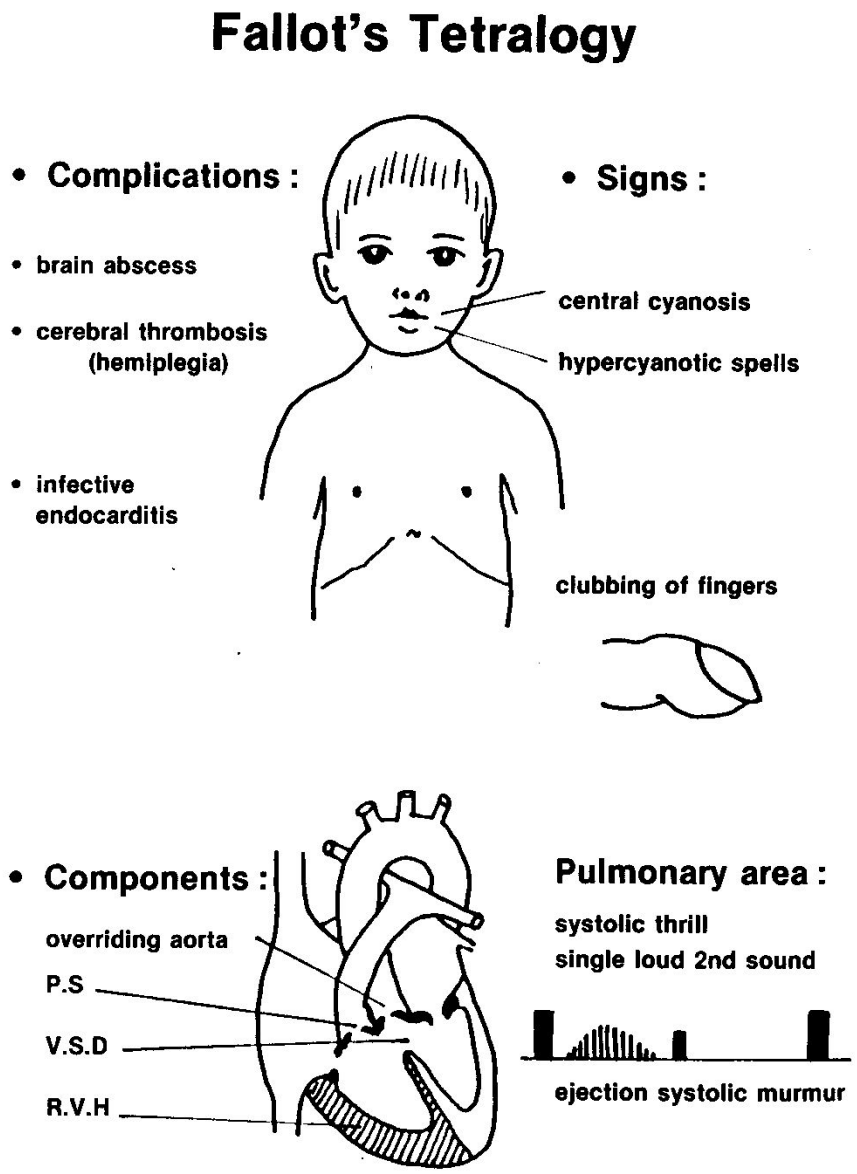
1. Tachycardia (high heart rate): The sick heart tries to compensate its pumping insufficiency by frequency of own efforts. Pulse is rised.

- 2. Tachypnea (breathing frequency increasing): The organism tries to rise blood oxygen because in conditions of slowly blood circulation there is tissues hypoxia.
- 3. Enlarged and tender liver due to venous blood sequestration in it in conditions when the diastolic heart function is insufficient.

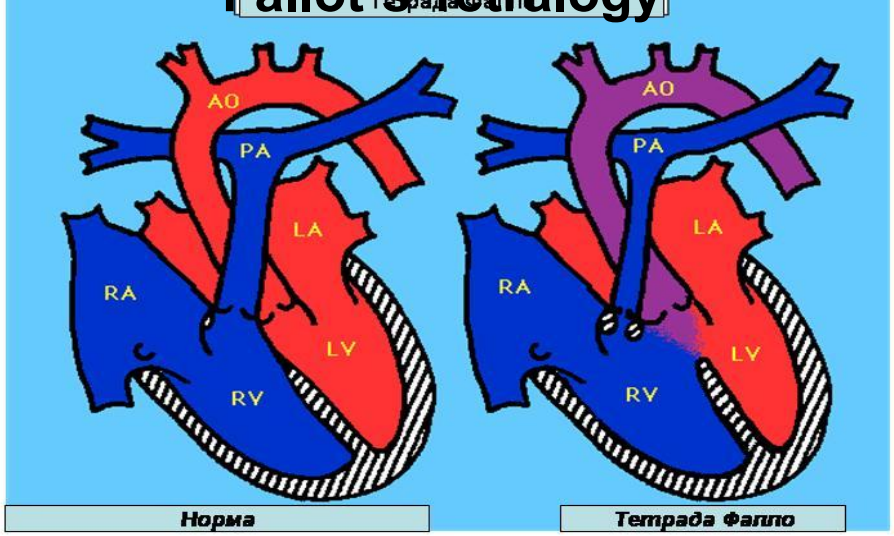
In chronic failure:

- 1. Exertional dyspnea is present. The breathlessness appears in response to physical load, for instance, the rising on floors is getting difficult for the child.
- 2. Other features as engorged neck veins, hepatomegaly and edema of lower limbs are presented.

The Semiotics of the commonest diseases of cardiovascular system in children.



The Fallot`s Tetralogy is a one of the commonest congenital heart diseases being accompanied by cyanosis. It accounts the 10% of all congenital heart disease and about 50% of cyanotic cases.



It is most probably that the main heart defect forming the Fallot`s Tetralogy is pulmonary stenosis. In this conditions the blood can not enter in lungs enough. The lungs are olygemic. The blood oxyganation in lungs is insufficient and arterial blood reminds venous. Other biological defects have more adaptive role in sick children and allow tham to survive. The aorta overriding, venricular septal defect and right venricular hypertrophy help to remove the excess of venous blood from the right ventriculum in pass-by to stenotic pulmonary artery into the left ventricle.

The Biological heart defects of this congenital abnormality are the following:

1. Intermediate position of the aorta in which aorta is capable to collect the blood both from left and from right heart ventricles. By other words it calls the overriding of aorta.
2. Pulmonary artery stenosis .
3. Venricular septal defect.
4. Right Venricular hypertrophy.

The *semiotics* reflect pathophysiological changes occurring in this congenital heart disease.

- **In advanced stage of disease in children with Fallot`s Tetralogy always there is the central cyanosis. It is a bluish discoloration mostly seen in lips, tongue, mucosa membranes of oral cavity and fingernails.**
- **The onset of cyanosis is usually delayed to 1 – 2 months after birth. In early cases it reveals only during physical exertion (for example, crying or mother`s breast sucking) and appears near the mouth (this is so-called circumoral cyanosis) and eyes (circumocular cyanosis).**

High hemoglobin

- **The compensaroty hemoglobin and erythrocytes elevation reachs the level nearly double exceeding the normal. The polycytemic blood is characterized by high viscosity. In this conditions in young patient with Fallot`s tetralogy the hypercyanotic spells appear.**

Hypercyanotic spells

They are attacks of deep cyanosis and respiratory distress which may by precipitated by crying or infection. In this conditions the high polycytemic blood viscosity provoke severe disturbance of blood circulation in lungs. It leads to sudden hypoxemic attacks look as hypercyanotic spells. Mild attacks (for minutes) are followed by weakness and sleep, while severe attacks (for hours) may progress to convulsions and unconsciousness. It is characteristic that children aged above 2 years are trained to fight with beginning of the spell, sitting squat. In this position with heavy flexed hips and knees the squeezing of lower limbs large arteries reduces aortal out-put and directs more blood in pulmonary artery. It provides pulmonary oxygenation improve. Seems, the nature itself prompts to physician how to help to the patient with hypercyanotic spell.

Fallot's Tetralogy

bells

clubbing of fingers

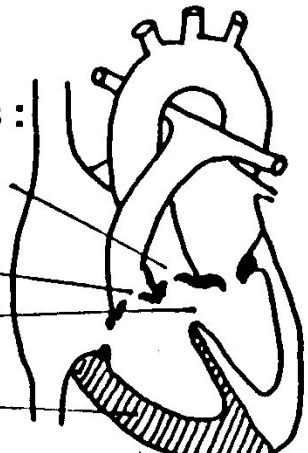
- Components :

overriding aorta

P.S

V.S.D

R.V.H



Pulmonary area :

systolic thrill

single loud 2nd sound

ejection systolic murmur

The other suggestive clinical features: Clubbing of fingers. It is usually observed after the age of 1-2 years and the clubbing looks blue.

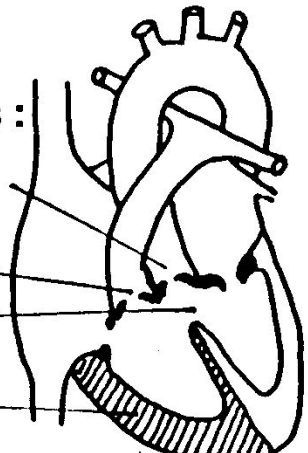
Fallot's Tetralogy

Cardiac examination:

- **Complications :**
  - brain abscess
  - cerebral thrombosis (hemiplegia)
  - infective endocarditis
- **Signs :**
  - central cyanosis
  - hypercyanotic spells
  - clubbing of fingers

The heard is not enlarged, the heart failure is not typical for the cases.

- **Components :**
  - overriding aorta
  - P.S
  - V.S.D
  - R.V.H



Pulmonary area :

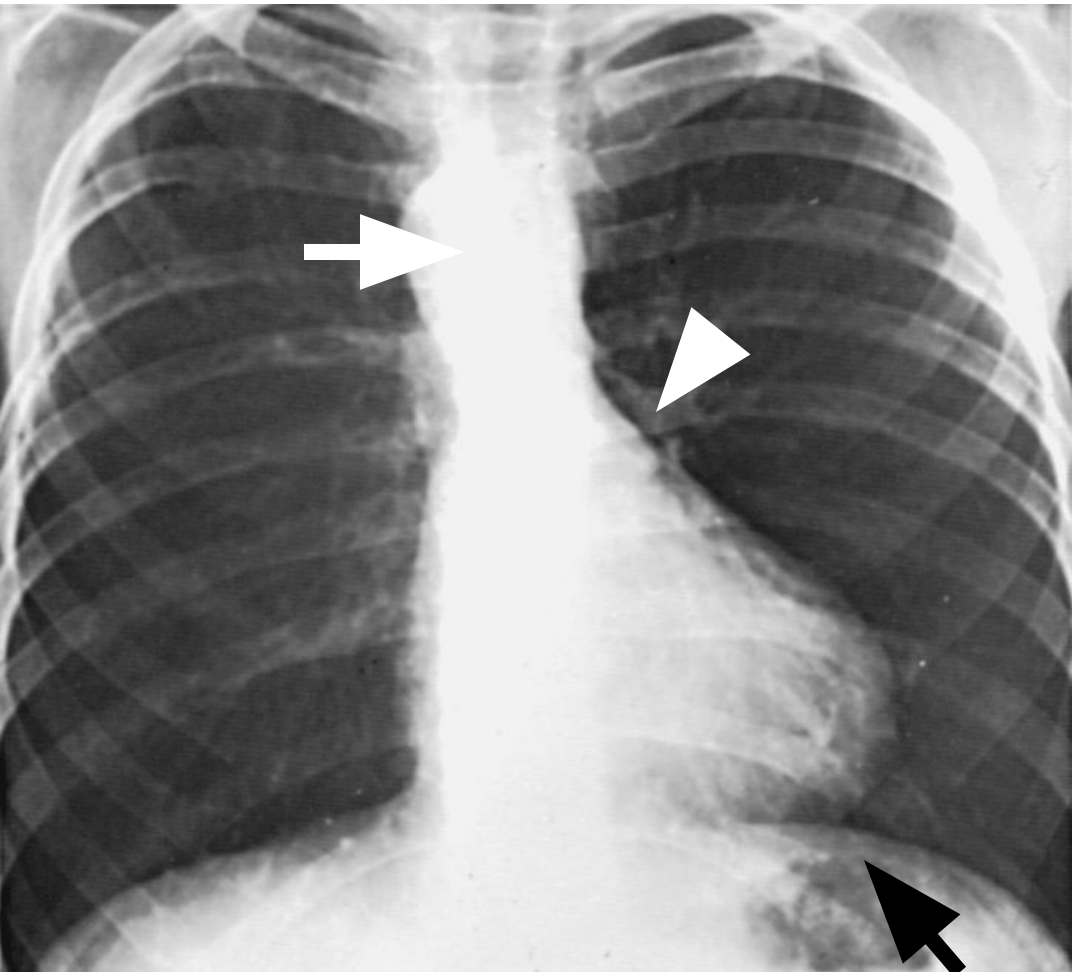
systolic thrill

single loud 2nd sound

ejection systolic murmur

- Left parasternal pulsations denotes right ventricular hypertrophy.
- Systolyc thrill over second and third left parasternal spaces is palpated.
- Ejection systolic murmur or pansystolyc murmur is usually heard over the pulmonary area.

The additional clinical investigations.
Chest X-ray shows pulmonary oligemia, normal sized heart, prominent right ventricle with uplifted apex ("boot shaped" heart or "duck sitting on the water").



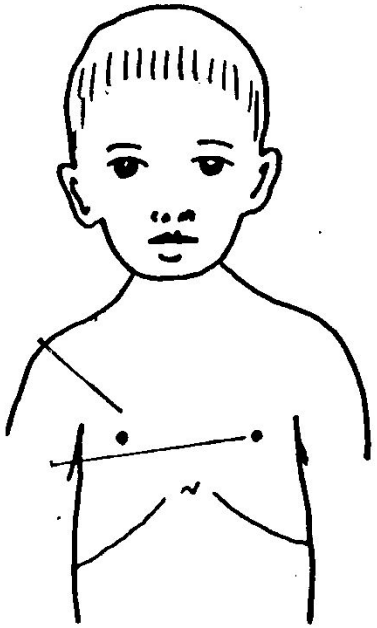
Roentgenogram of an 8-yr-old boy with tetralogy of Fallot. Note the normal heart size, some elevation of the cardiac apex, concavity in the region of the main pulmonary artery, right aortic arch, and diminished pulmonary vascularity.

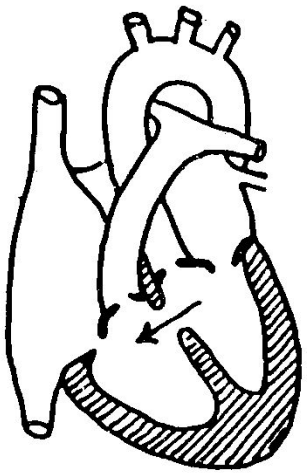
The guidelines of care for the sick children.

- When the hypercyanotic spell happens it is necessary to becalm a child and put him or her on "frog" on belly position with flexed hips and knees brought to the bosom until the condition will improve. The moistened oxygen from mask also can be helpful.
- Other important element of the permanent care is reasonable overdrinking in a sick child. The patients with Fallot`s Tetralogy must use more fluids because it counteracts with the high blood viscosity.

Ventricular Septal Defect
(V.S.D)

- **Presentations :**
  - asymptomatic
  - recurrent chest infections
  - congestive heart failure





- **Cardiac signs :**
  - ± precordial bulge
  - ± left parasternal pulsations
  - ± palpable systolic thrill

- harsh and loud left parastern pansystolic murmur

The Ventricular septal defect (VSD) is the most spread congenital heart disease as it accounts 30% of all hereditary heart abnormalities. VSD causes left-to-right blood shunting and increase in pulmonary blood flow (making the lungs plethoric). The severity of shunting is dependant on the size of the defect. With large defects, right ventricular or biventricular dilatation occurs.

Patients with VSD are frequently asymptomatic and the condition is accidentally discovers on routine cardiac examination. In severe cases the disease revels on recurrent chest infections due to plethoric lungs. In this cases the pneumonia is complicated with congestive heart failure. So this condition in a young child can be the main presentation of VSD
In other hand the children with a small VSD (so called the Rogee`s disease) do not show signs of severe heart disease and develop well. The small defects of ventricular septum (about 60% of cases) are capable to close spontaneously within 2 – 4 years making joy for parents, patient and physician in charge.


Murmur,
VSD!


Healthy!

Semiotics of V.S.D.

- **Characteristic murmur** is pansystolic, loud, harsh, and left parasternal mainly over 3rd and 4 rd left parasternal spaces localized. This murmur should be clinically differentiated from other causes of pansystolic murmurs especially mitral incompetence (maximum intensity is heard over mitral area) and tricuspid incompetence (maximum intensity is heard over tricuspid area). Both conditions are much less commoner than V.S.D and are characteristic for chronic rheumatic heart disease in school aged children.
- **Cardiomegaly** occurs with moderate and large sized V.S.D. It can be detected clinically by the precordial bulge and the left parasternal pulsations.
- **Congestive heart failure (CHF)** also occurs with moderate and large sized

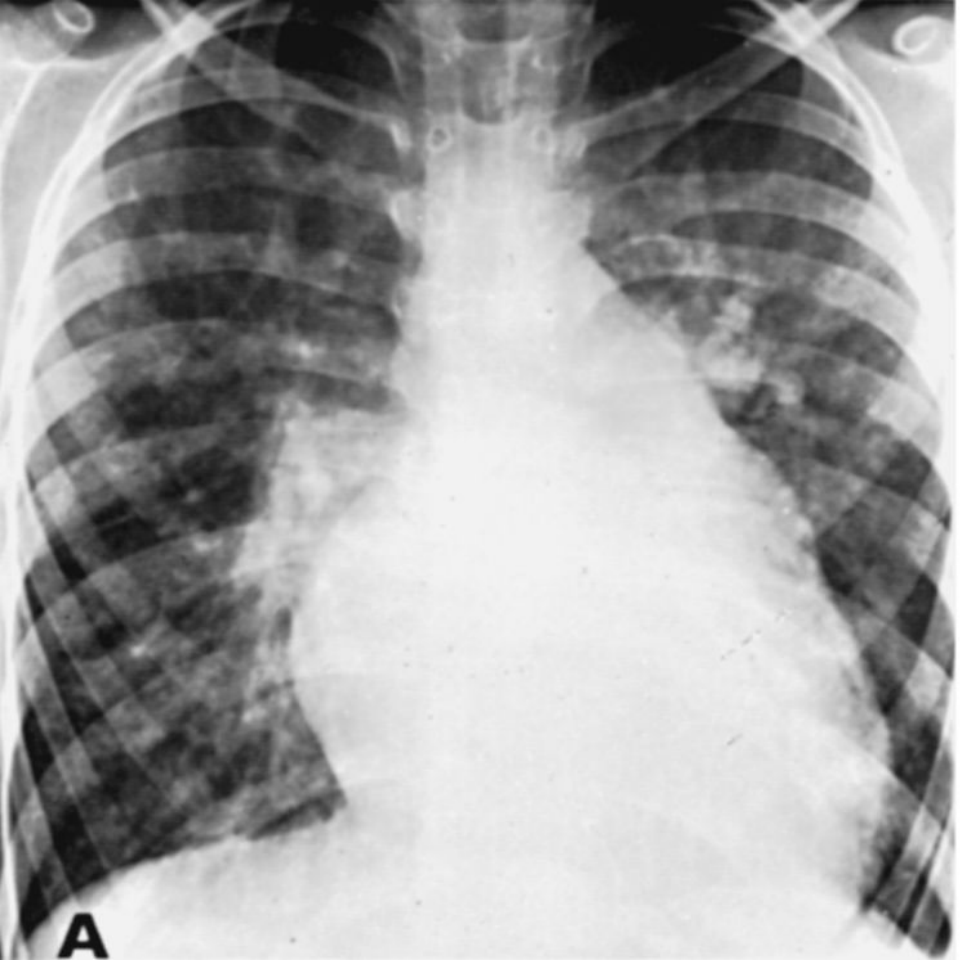
The manifestations of CHF may by chronic or acute.

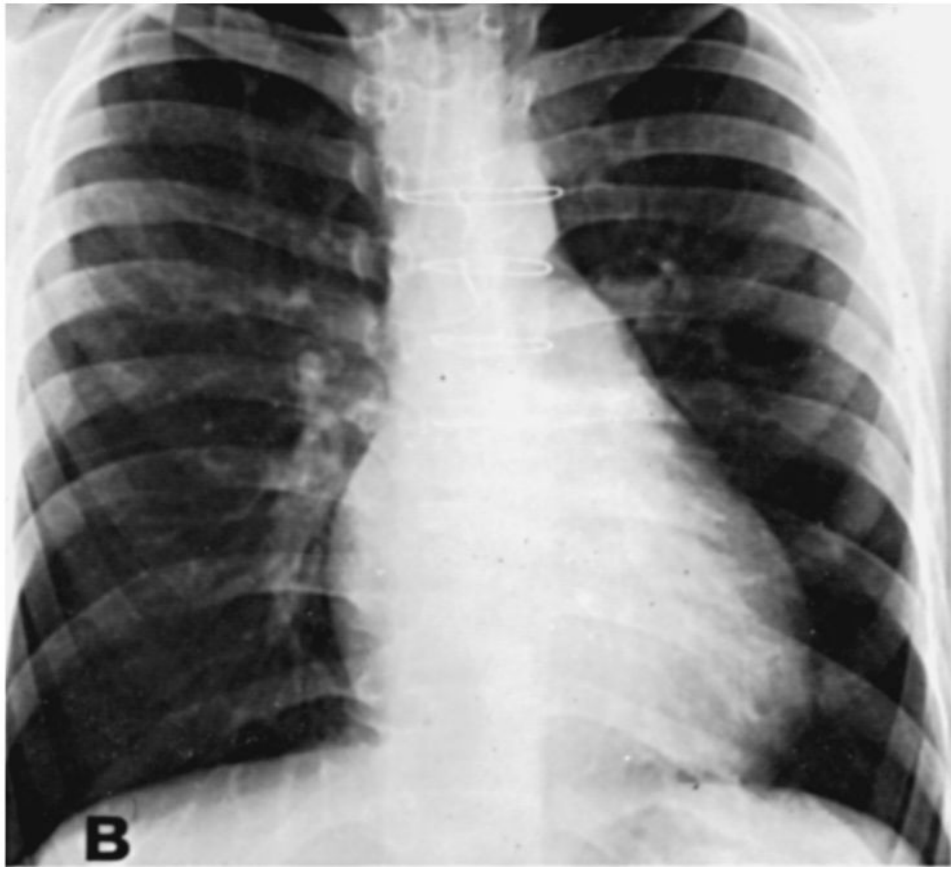
- Chronic CHF appears gradually in the form of dispnea during breast feeding and can lead the children to growth delay. The Explanation is that the nursing provokes in baby a physical effort (especially sucking) but any physical efforts in congestive heart failure are bad tolerated. The other explanation is concluded that each breast feeding is a water load. In this conditions the infants with CHF can instinctively avoid to enlarge the blood circulating volume and worse the diastolic function of insufficient heart.
- In advanced cases the dispnea becomes evident at rest and other manifestations of chronic failure as engorged pulsating neck veins, hepatomegaly and edema of lover limbs appear.
- b) Acute CNF is usually precipitated by chest infection. Diagnosis depends on the presence of the clinical triad of tachycardia, tachypnea and tender liver. In severe cases chest retractions and bilateral crepitations as manifestations of pulmonary edema may appear.

Other diagnostic approaches

- **Diagnostic echocardiography demonstrates the septal defect, its size as well as the degree of cardiac enlargement**
- **Chest X-ray shows variable degree of cardiomegaly and typical pattern of pulmonary plethora.**

Presence of cardiomegaly or congestive heart failure in infancy is an indication for early surgical intervention in VSD.





A) Preoperative roentgenogram in a ventricular septal defect with a large left-to-right shunt and pulmonary hypertension. Significant cardiomegaly, prominence of the pulmonary arterial trunk, and pulmonary overcirculation are evident.

B) Three years after surgical closure of the defect. There is a marked decrease in the heart size, and the pulmonary vasculature is normal.

The guidelines of care for sick children.

- The children sufferring from VSD with chronic congestive heart failure need a patient care providing sufficient feeding supply especially nursing. All anthropometrics like weight and length in sick children mast be controlled attentively.
- The children are predisposed to respiratory infections. That is way the contacts between chronic and acute sick patients have to be restricted.
- Even for children with small size of VSD the prevention of bacterial endocarditis mast be provided very early. The kids aged 2 years should be accustomed to use toothbrush that reduces the risk of toothcaries, odontogenic bacteriemia and septic endocaditis localized in VSD area.

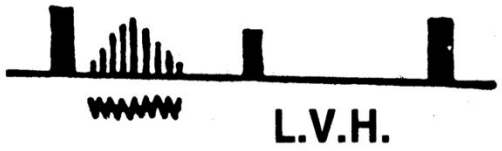
The atrial septal defect (ASD)

- The atrial septal defect (ASD) is other one of the wide-spread innate heart diseases as it accounts 30% of all hereditary heart abnormalities.
- Atrial septal defect (or ostium secundun defect) causes left-to-right at the atrial level. The blood abnormally enters from the left atrium to the right throught the abnormal foramen overloading right intraventricular volume and blood volum in pulmonary vessels riverbed.
- Patients with ASD are frequently asymptomatic and the condition can be accidentally discovered on routine cardiac examination. In severe cases the disease reveals on recurrent chest infections due to plethoric lungs. In this cases the sudden pneumonia is complicated with congestive heart failure. So this condition in a young child can be the main presentation of ASD.

Symptoms of ASD

1. **The systolic murmur** over the pulmonary area is usually heard. It is not very loud (grade 1-2 by Styll) and seldom accompanied by thrill felt in palpation of heart area.
2. **Abnormal second sound**. A broadly (widely) split (forked) and fixed (exaggerated) second sound (S1+S2+S2) on pulmonary area is the most characteristic finding of ASD This important clinical phenomenon appears due to insimultaneouse closing aorta`s (first component of sound 2) and pulmonary artery valves (second component of sound 2) in conditions of high blood pressure in right ventricle.
3. **The leftside parasternal pulsations** is defined over the chest and denotes a right ventricular hypertrophy.
4. **Diagnostic echocardiography** demonstrates the defect and degree of righr atrial and right ventricular enlargement.
5. **Chest X-ray** shows variable degree of right atrium, right ventricle or common cardiomegaly and tipical pattern of pulmonary plethora.

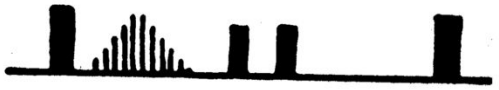
Ejection Systolic Murmurs



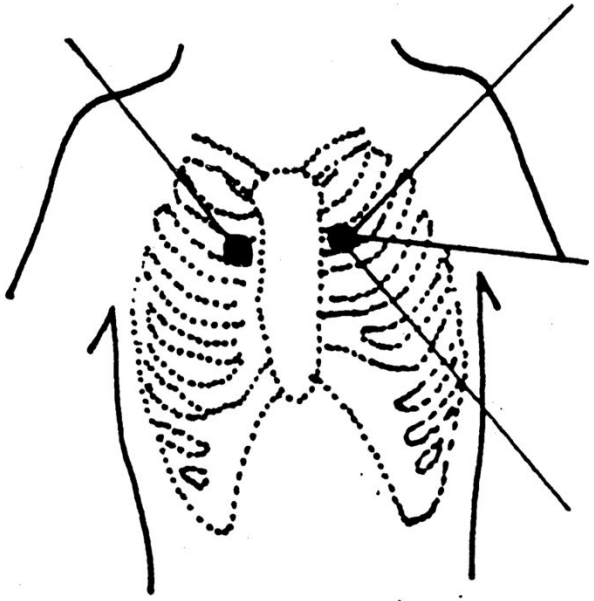
A.S

L.V.H.

A.S.D



+ R.V.H



P.S

+ + R.V.H

Hemic

anemia

Echocardiography is diagnostic

: palpable thrill

The other causes of ejection systolic murmur

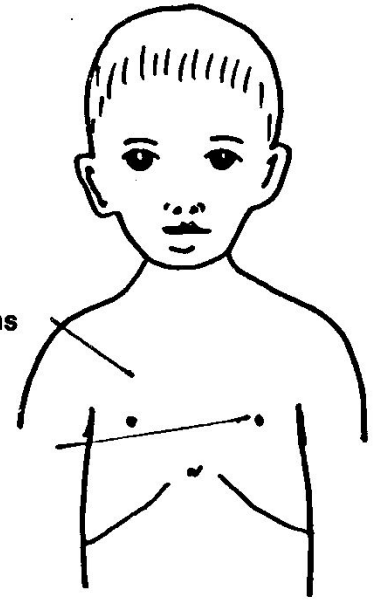
1. Innocent (functional, non-malignant) systolic murmur is faint, soft and short. It is commonly heard in up to 50% of well children. This murmur should not be confused with the significant pathological murmurs of congenital heart disease.
2. Hemic murmur. It is soft murmur maximally heard over pulmonary area. It changes in character with changes in body position and not associated with a thrill. A symptoms of severe anemia are usually presented, especially a skin pallor and Hb < 100 g/l.
3. Pulmonary stenosis (PS) murmur is systolic and maximally heard over the pulmonary area. It is commonly associated with a palpable thrill. The second sound is split with weak even inaudible pulmonary component (S1+S2+s2). Sygnificant right ventricular hypertrophy is usually present.
4. Aortic stenosis (A.S.) provokes the maximum intensity of the ejection systolic murmur over aortic area. The murmur is rough and loud and commonly associated with palpable thrill. It usually propagates to the neck. Left ventricle hypertrophy is usually present.

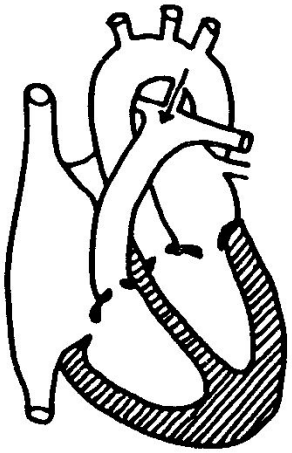
The guidelines of care for sick children with ASD.

They are the same as discussing before in patients with VSD. The children sufferring from A.S.D. with chronic congestive heart failure need a patient care providing sufficient feeding supply especially nursing. The children with A.S.D. are predisponded to respiratory infections. That is way a contacts between chronic and acute sick patients have to be restricted. Also the prevention of bacterial endocarditis mast be provided very early. The kids aged after 2 years should be accustomed to use toothbrush that reduces the risk of toothcaries, odontogenic bacteriemia and septic endocaditis localized in ASD area.

Patent Ductus Arteriosus (P.D.A.)

- **Presentations :**
  - asymptomatic
  - recurrent chest infections
  - congestive heart failure





- **Relevant signs :**

bounding arterial pulsations

continuous machinery murmur over pulmonary area.

Symptoms PDA.

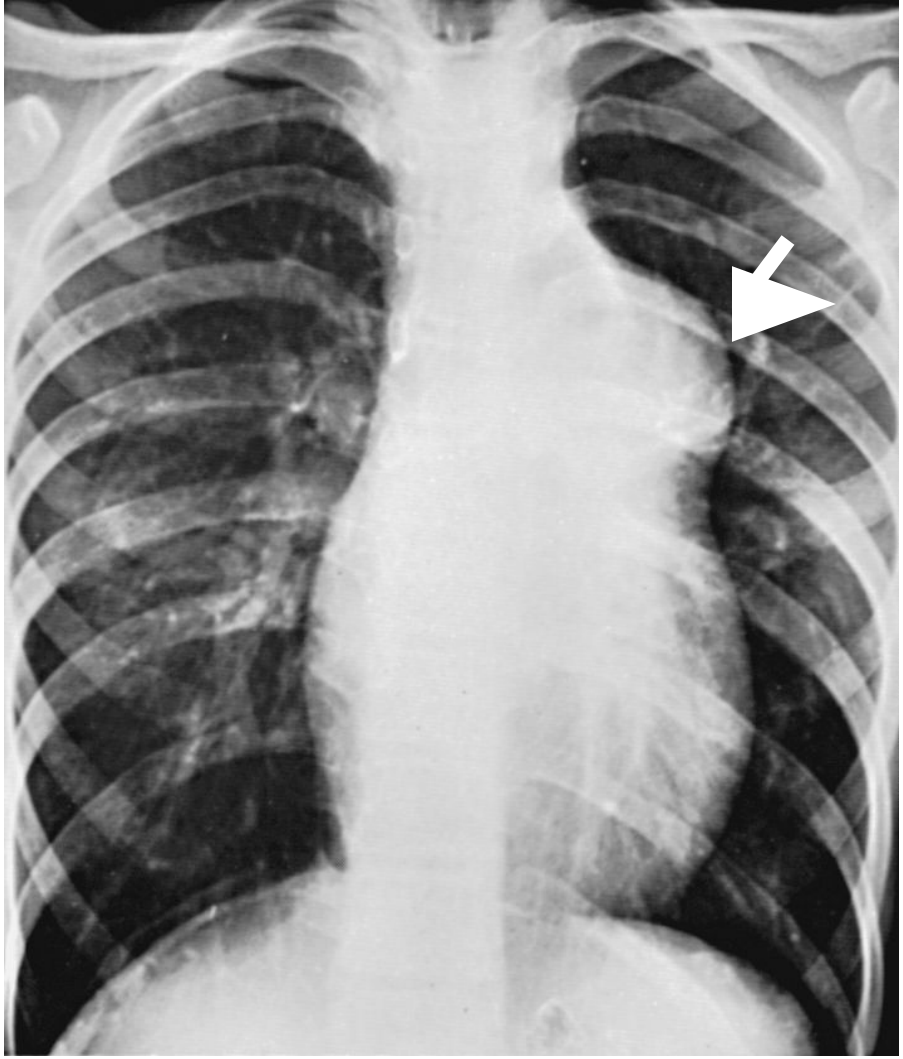
- **Continuous machinery murmur.** It is maximally heard over the pulmonary area and may radiate to left clavicular or left sternal borders. It is usually associated with a palpable thrill.
- **Bounding (jumping) arterial pulsations.** The pulses is prominent and can be easy felt due to the wide arterial pressure. The artery dorsalis pedis pulsations can be easily felt. in children with PDA.

The cardiomegaly and congestive heart failure

Other diagnostic approaches

- **Echcardiography reveals increased left atrial and left ventricular sizes.**

  UltraSound-Scanning from the suprasternal notch can visualize the ductus.
- **For confirming diagnosis PDA some times the contrast aortography is recommended.**



Chest X-Ray in a patient with PDA. The heart size is normal, the pulmonary artery segment is dilated, and the pulmonary vascularity is slightly increased.

The Rheumatism (rheumatic fever) is an autoimmune disease, which develops as complication of streptococcal infections (pharyngitis or scarlet fever), caused by beta-haemolytic streptococcus of group A

Jones`s criteria

- 5 Jones`s criterias (or clinical manifestations) are generally used for diagnosis of rheumatic fever.
- The criteria`s using is based on two rules.
- For diagnosis it is necessary the presence of 2 major criterias (or major clinical manifestations) or one major and 2 minor manifestations.
- There is an evidence of recent streptococcal infection (case history, positive ASL-O test showing antistreptococcal antybodies in serum etc.).

Major criteria (Jones`s criteria or manifestations) of rheumatic fever.

- **1/ Polyarthritis occurs in 75% of cases. The rheumatic arthritis is typically multiple and affects mainly the large joints as knees, ankles, elbows and wrists. The inflamed joints are usually swollen, red, hot and tender with limitation of movements. The rheumatic arthritis is also transient (lasts less then one week in the affected joint never produsing destruction or other complicatons) and migratory (leaves one joint to affect other).**

Major criteria (Jones`s criteria or manifestations) of rheumatic fever.

- 2/ Carditis occurs in 50% of cases. The next symptoms are characteristic for carditis.
  - Disproportionate tachycardia. It means the heart rate is bigger as it has to be according the child age and his or her fever.
  - Significant murmur. In common cases it is systolic murmur localized in apical area of heart and characteristic for mitral valvulitis (inflamarory disturbans of mitral valve).
  - Pericardial friction rib is tipical for pericarditis (inflammation of pericardial serosa).
  - Congestive heart failure may be also present.

Major criteria (Jones`s criteria or manifestations) of rheumatic fever.

- 3/ **Reumatic chorea**. The chorea is the neurological manifestation of rheumatic fever. This syndrome is characteristic for 10% patients suffering from rheumatism. The condition occurs mainly in school age children and females are often more affected.

The main features of rheumatic chorea are the following.

- **Chorea movements**. They are rapid, jerky, purposeless and nonrhythmic involving mainly the muscles of the face, trunk and distal extremities. Movements are aggravated by emotional stress and disappear during sleep. The condition can be misinterpreted as a conscious intention to irritate parents or teachers.
- **Emotional lability**. The patients often appears nervios and may show crying without apparent reason.
- **Muscle hypotonia** of variable degree. The child becomes unable to eat by himself and frequently drops objects. In severe cases the pseudoparalysis due to muscle hypotonia can be revealed.

Major criteria (Jones`s criteria or manifestations) of rheumatic fever.

- **4/ Erythema marginatum (annular erythema) revels in 5% children with acute rheumatic fever. It forms wavy lines or rings of sharp margins mainly over the trunk.**

Major criteria (Jones`s criteria or manifestations) of rheumatic fever.

- **5/ Subcutaneous nodules. It can be found in 1% children with acute rheumatic fever. They are a small round hard and painless nodules felt in the field over bony prominences.**

The Chronic rheumatic heart disease is a continuation of the acute rheumatic fever and is characterized by inconvertible valvular damage.

Recognition of the valvular lesions depends on auscultation of the characteristic murmur.

Mitral incompetence (M.I.).

- An apical harsh pansystolic murmur is present. It always propagates to the axillaries area and commonly accompanied with a systolic thrill.
- Simultaneously the left ventricular hypertrophy (LVH) develops.

Mitral stenosis (M.S.).

- **An apical mid-diastolic rumbling murmur is present.**
- **Simultaneously the right ventricular hypertrophy (RVH) develops.**

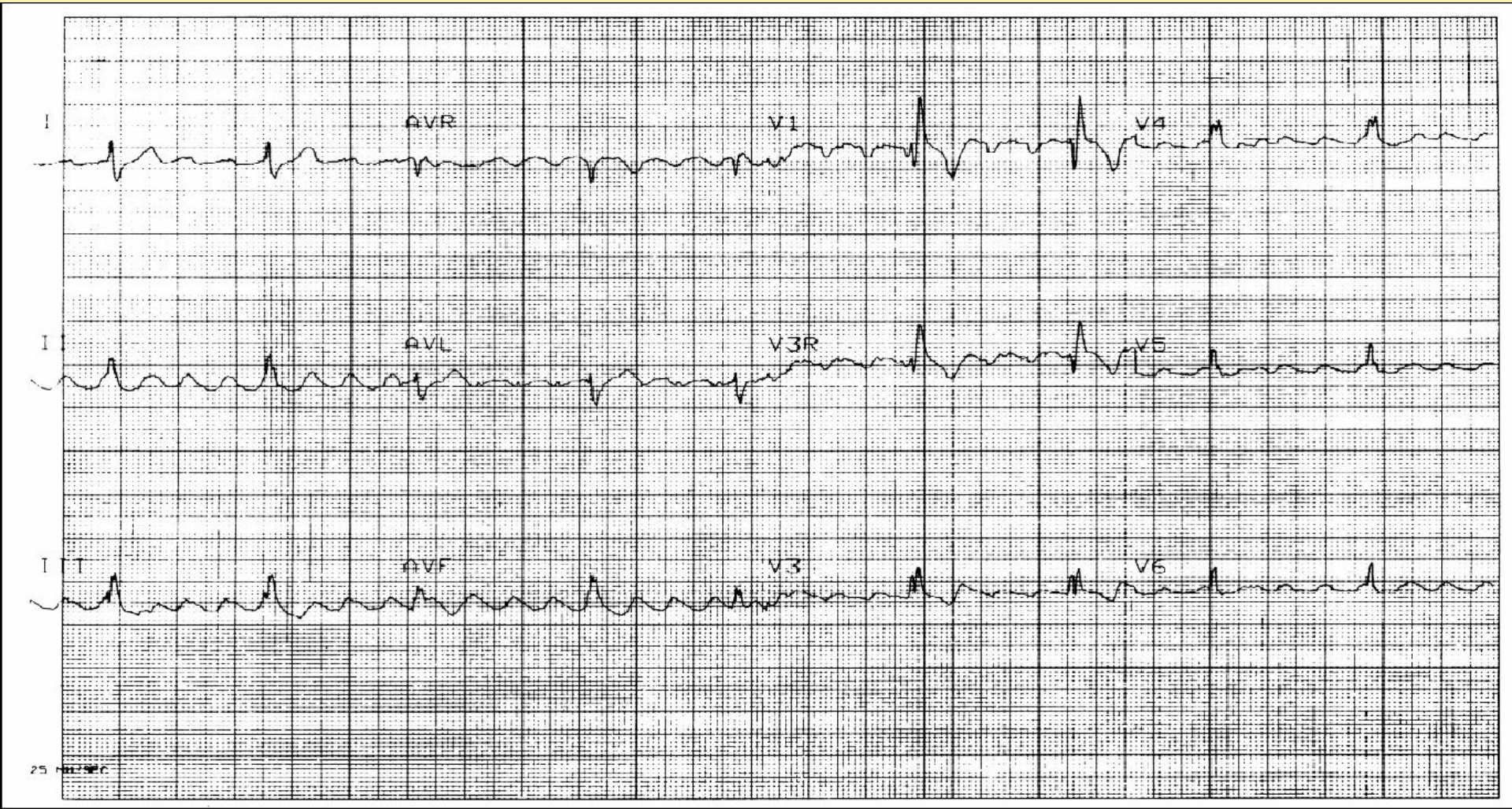
Aortic incompetence.

- A soft and bloving diastolic murmur is heard over aortic area.
- The left ventricular hypertrophy (LVH) develops in severe cases.
- Periferal signs of wide pulse pressure are present. It is so-called water hummer pulse and elevated systolic with lowered diastolic blood pressure (for instance, 140/40 mm Hg).

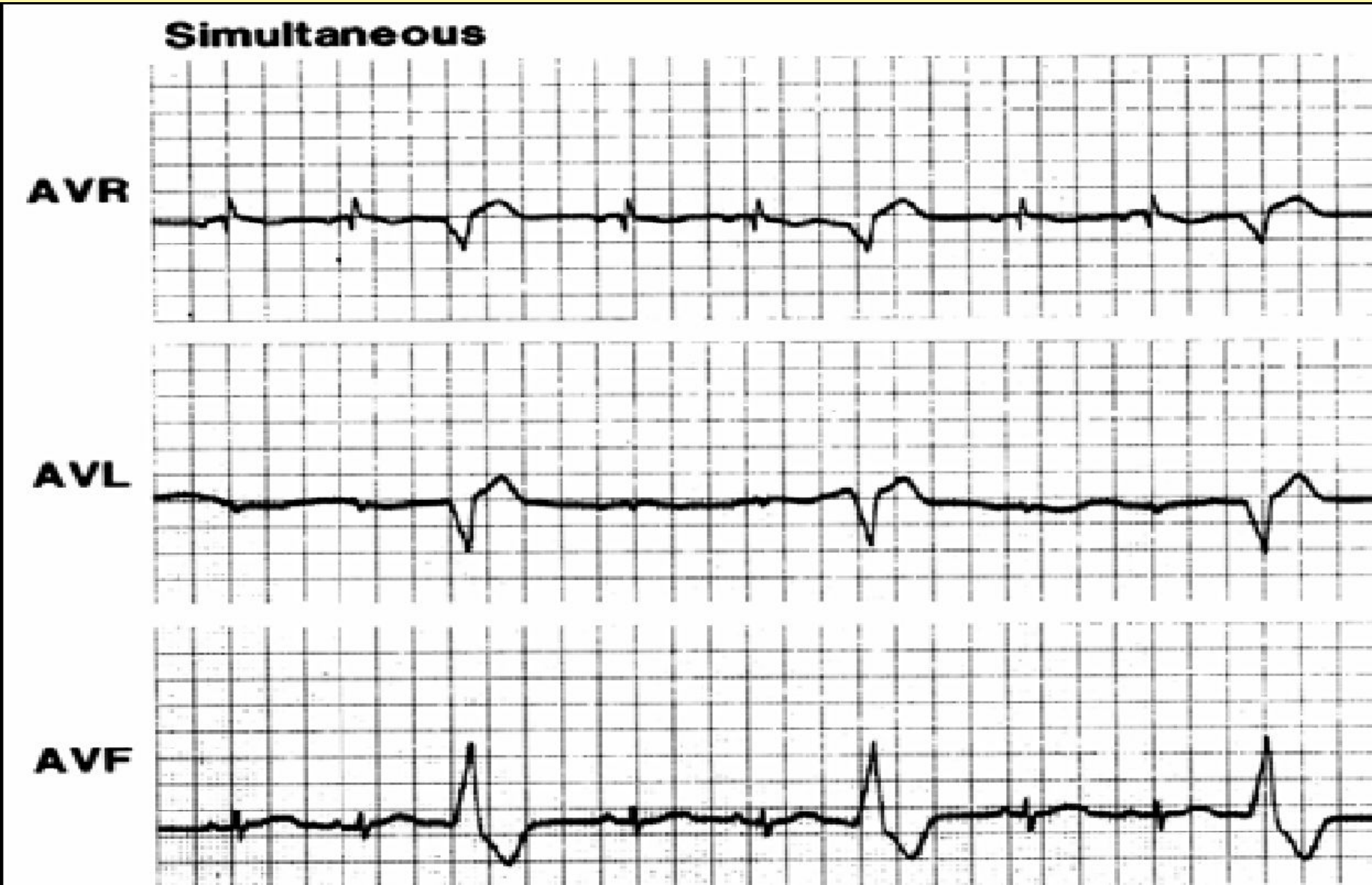
Aortic stenosis.

- **A harsh and loud ejection systolic murmur is heard over aortic area. It usually propagates to the neck and is commonly associated with systolic thrill.**
- **The left ventricular hypertrophy (LVH) of varios degrees develops in some cases.**

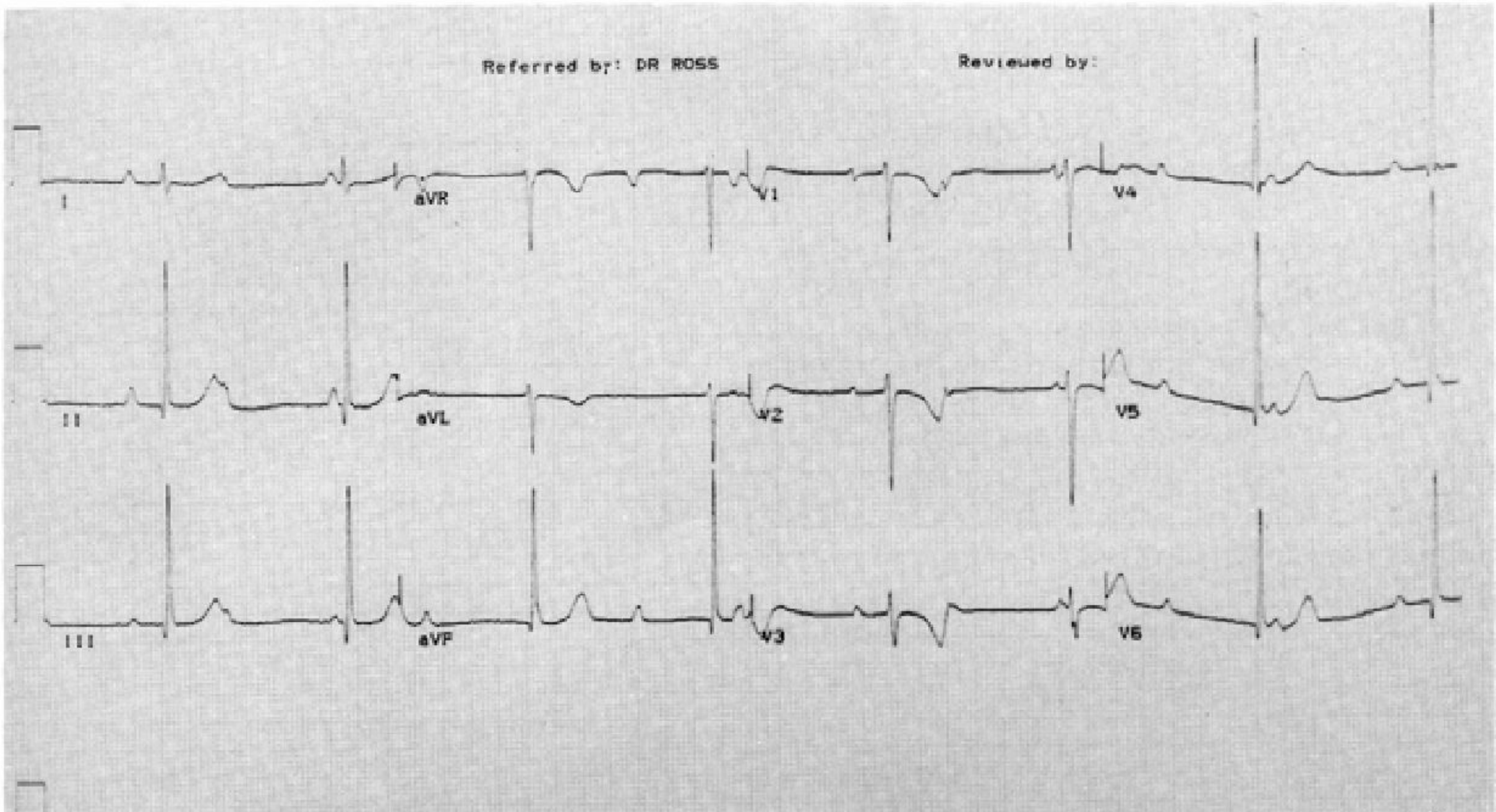
Atrial flatter



Ventricular premature bites (exstrasystols)



AV - block

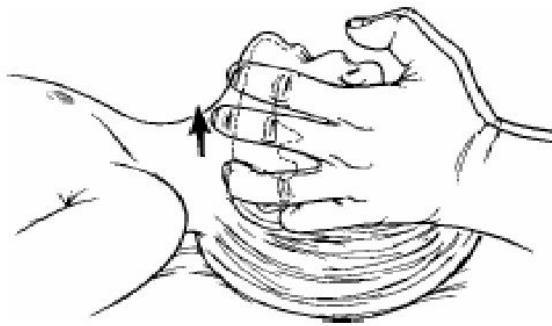

Referred by: DR ROSS
Reviewed by:
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6

ABC program of cardio-pulmonary and cerebral resuscitation

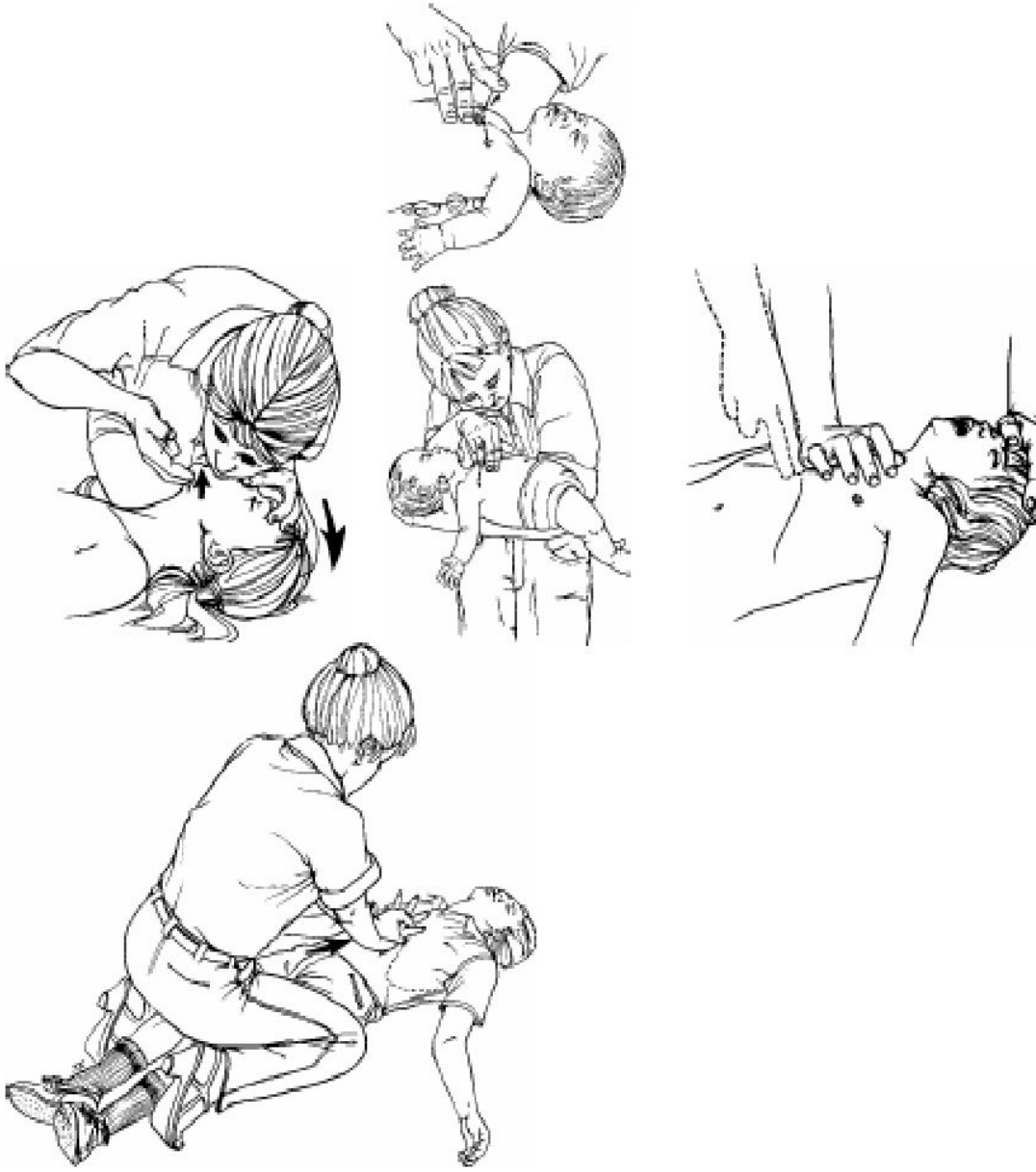
The sudden cardial arrest for several minutes leads a child to the clinical death, which without skilled help ends by biological death. That is why everybody but medical staff in the first hand must know the practical approaches and always has to get ready to render the cardio-pulmonary and cerebral resuscitation.

The principles of resuscitation are:

to restore air-ways abili for air pass (A), organize artificial lung ventilation (breathing) (E



to make rhythmic squeexing of the thorax capable to provide blood circulation in a heart chambers and main arteries (circulation, cerebration) (C). The criterion of efficiency is cerebral safety state. The efficacy of resuscitation is characrerized by appering of pupil reflex a response to the light. During effective resuscitation the patient eye pupils get narrow.




ANNE GEDDES®
www.annegeddes.com
© 1995 Anne Geddes