



Cardiologic critical care in childhood

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Plan of the lecture

- **1. Acute circulatory dysfunction**
- **2. Syncope**
- **3. Collapse**
- **4. Shock**
- **5. Acute cardiac failure**
- **6. Heart rhythm and conductivity disorders**
- **7. Emergency care**

Acute circulatory dysfunction

Is defined as a pathologic state due to decreased vessel's smooth muscle tonicity, developed arterial hypotension, impaired venous return and blood releasing from depot. It can be realized like **syncope, collapse or shock.**

Syncope -

**Is sudden short-term loss of
conscience with muscle tonicity
loss due to transient cerebral
circulation disturbances**

Syncope reasons in children:

- **Vessels neurotic dysregulation : vaso-vagal, orthostatic, sinocarotid, reflectory, hyperventilation syndrome**
- **Cardiogenic syncope in:**
 - **bradyarrhythmia (AV-blockage of 2-3-й grade, sinus node disfunction),**
 - **Tachyarrhythmia (paroxysmal tachycardia, QT-long syndrome, atrial fluttering)**
- **Mechanical circulatory restriction on the level of heart or big vessels (aorta stenosis, hypertrophic subaortic stenosis, aorta valves insufficiency)**
- **Hypoglycemic syncope**
- **Cerebrovascular etc.**

Critical care in syncope

- Put down in horizontal position with slightly raising legs, loose belts, collar etc.
- Reflectory actions: splash patient by water, pat on face, give to inhale liquid ammonia
- In prolonged syncope :
 - 10% sol of coffeini benzoatis 0,1 ml/per year intra cutaneous or
 - Cordiamini sol. 0,1 ml/year IC
- In the case of arterial hypotension 1% sol. Mesatoni 0,1 ml/year IV In hypoglycemic condition 20-40% glucose sol. 2 ml/kg IV
- In bradycardia and Morganie- Adams-Stocks attack-cardiopulmonary resuscitation – chest compression, 0,1% atropine sol 0,01 ml/kg IV.

Collapse -

Life threatening acute vascular insufficiency with acute vessel dystonia, circulatory blood volume decrease, signs of cerebral hypoxia, and life support function depression

Reasons of collapse

- Severe course of acute infectious pathology (intestine infection, flu, pneumonia, angina, pyelonephritis etc.)
- Acute suprarenal gland failure
- Hypotensive medications overdosage\
- Acute bleeding
- Severe trauma

Critical care in collapse

- Put down to back with throw back head, heat patient, provide air access
- Provide respiratory tract patency
- In the case of sympathotonic collapse : IV spasmolytics, in the case of neurotoxicosis – corticosteroids 1-2 mg/kg.
- In the case of vagotonic paralytic collapse: IV infusion of reopolyglucin, Ringer solution, corticosteroids 5-10mg/kg
- In the case of stable hypotension: mesaton 1% IV slowly or norepinephrine 0,2% 0,1 ml/year IV in 50 ml of 5% glucose 10-20 drops/min
- If all efforts aren't effective – dopamine 8-10 mcg/kg IV titrating dosage

SHOCK

Acute threatening life pathologic process characterized by progressive tissue perfusion diminishing, subsequent CNS impaired functioning, respiratory, circulatory failure and metabolic disarrangement.

Reasons of shock

- Decreasing of circulatory volume (hypovolemic shock): due to bleeding, dehydration, burns, etc. Main mechanism: preloading heart insufficiency because of venous return deficiency.
- Blood storage in venous pools (distributive shock) – in anaphylactic reactions, acute suprarenal failure, sepsis, neurogenic or toxic shock. Mechanism – postloading insufficiency.
- Little cardiac output (cardiogenic shock) –cardiac pump function failure or venous inflow obstruction : pericarditis, pneumothorax etc.

Critical care in shock

- Put down in horizontal position with slightly raising legs, moisturized oxygen
- To eliminate reasons for shock
- If lung edema is absent but hypotension is obvious – colloid and Ringer sol. infusion with BP, auscultation and diuresis monitoring.
- Dopamine IV 6-8-10 mcg/kg slowly wit BP and HR monitoring
- Accompanied conditions correction – hypoglycemia, metabolic acidosis, suprarenal insufficiency
- Cardiopulmonary resuscitation complex if necessary

Acute cardiac failure

Pathologic condition characterized by cardiac output decreasing due to myocardial pumping function reduction or impairment of diastolic myocardial relaxation

Acute cardiac failure (ACF) reasons

- Shock due to rhythm disorders –bradycardia (sinus or due to AV- blockage, ventricular group extrasystol) or tachycardia (acute coronary insufficiency in infants, supraventricular paroxysmal tachycardia, atrium fluttering, ventricular fibrillations);
- Cardiogenic shock- acute focus or total myocardium hypoxia (condition with hypoxia and acidosis);
- Acute pericardium tamponade (wounding or rupture of myocardium, pericarditis, pneumomediastinum and pneumopericardium) or extracardial heart tamponade in asthmatic status of 3-4 grade, interstitial emphysema
- Terminal stage of congestive heart disease due to congenital heart disease, myocarditis or cardiomyopathies

ACF reasons:

- **Acute lung and bronchial disorders (pneumonia, atelectasis, hydro- and pneumothorax etc.) Main mechanism of ACF is hypoxia, and lung hypertension due to intrapulmonic circulatory blood shunt.**
- **Any conditions accompanied by tissue hypoxia: toxicosis, syndrome of systemic inflammation, burning disease, severe purulent-inflammatory diseases, i.e. conditions with excessive catabolism where oxygen , glucose necessity are not covered by circulation. In these situations minute blood volume (MBV) necessity rises predominantly due to increased HR. Raised loading to myocardium demand more oxygen but diastole decreases so from one side it decreases ventricular filling and reduce cardiac output and from another side coronary circulation is decreased that cause myocardium ischemia and contractility decreasing.**

ACF clinical presentation:

- *Little cardiac output syndrome (LCOS)*: arterial hypotonia, and signs of centralized circulation;
- *Congestive heart failure (CHF)* with pulmonary or/and systemic circulation overloading
- **Signs of systemic congestion**: peripheral edema, hepatomegaly, prominent neck veins, ascites, hydrothorax.
- **Signs of pulmonary congestion**: dyspnea, moist rales in lower pulmonary lobes, lung edema, ineffective oxygen inhalations.

Acute left ventricular failure

Algorithm of critical care

- Patient position in bed sitting or semisitting
- Oxygen therapy with 30-40% mixture through mask or nasal catheter
- Venous tourniquet to both legs or hips
- Furosemide 2-4mg/kg IV
- Prednisone 3-5 mg/kg IV
- Euphyllin diluted in physiologic solution 1 ml/year (not more than 5 ml) IV slowly
- Hospitalization into intensive care unit
- Dobutamine 2-15 mcg/kg/min, Dopamine 5-8 mcg/kg/min
- Promedol
- Basic-acid condition correction
- Wide spectrum activity antibiotic

Acute right ventricular failure algorithm of critical care

- Causative factors eradication (bronchospasm, pneumothorax, foreign body)
- Oxygen therapy by 40-50% mixture
- If bradycardia or bronchospasm are present
euphyllini 1 ml/year diluted in 10-20 ml of NaCl
IV slowly
- In the case of circulatory blood volume increase –
lasix 1% 1-2 mg/kg
- Basic –acid condition and electrolyte-fluid
correction
- Glycosides and vasodilators are contraindicated
- **HR, BP, ECG – monitoring are necessary**

Heart rhythm and conductivity disorders

- Sinus tachy- bradycardia, arrhythmia
- Sick sinus node
- Extrasystoles
- Paroxysmal tachycardia (supraventricular, ventricular)
- Atrium, ventricular fibrillation
- Ventricular pre-excitation syndrome (WPW, CLC)
- Atrium, atrium-ventricular and ventricular blockages

Arrhythmia treatment

- **Pharmacologic medications**
- **Reflectory methods**
- **Psycho-physical methods**
- **Electrical methods**
- **Surgical methods**

Antiarrhythmic drugs features

- **Class 1** – membrane stabilizers, block rapid Na channels of cell membrane, retard initial cell depolarization. Subclasses:
 - **subclass IA** – medications that moderately retard Na flow and prolong action potential. In high dosages retard conductivity in atrium and ventricular, widen ventricular complex and interval QT:
chinidin, procainamide, dysopyrimid, ethmosin, ethacisin, aimalin, praimalin, cibendzoline, pyrmenol.

Antiarrhythmic drugs features

- **subclass IB** – medications that shorten repolarization and the whole action potential. Refractory and interval QT shorten, improving impulse conduction through AV node:

lidocaine, trimecaine, tocainid, phenotoin, mixelytin, phenotoin, pyromecain.

- **subclass IC** – medication that abruptly suppress phase 0 and action potential, but slightly influence on repolarization period or duration of action potential. They retard conductivity, widen ventricular complex QRS, slightly change refractory capacity and QT duration :

Flecainid, lorcainid, allapinin, propaphenon, bonecor, recainam

Antiarrhythmic drugs features

- **Class II** – β -adrenoblockers, limit sympathetic influence on heart. They suppress sinoatrial node activity, retard impulses spreading throughout conducting system:
propranolol, timolol, metoprolol, acebutalol, esmolol, flestolol.
- **Class III** – medications that prolong repolarization phase and action potential:
amiodoron, bretiliy, clofiliy, pranoliy, sotalol, N-acetylnovocainamid, betanidin
- **Class IV** – slow-Ca- channels blockers. They inhibit cell depolarization with slow electric response. :
verapamil, diltiazem, beprylil, thyapamil, gallopamil

Sinus tachycardia

- ***Clinics.*** Complaints to heartbeats, heart pain, dyscomfort, HR >10-60% from age norma
- ***ECG:***shortening or absence of TP, P-wave is normal, intervals PR and QT are shortened, ST interval can be under isoline, T wave amplitude is decreased, wave U can appear
- ***Treatment.*** Therapy of the main disease. Such medications as Valeriana, mint, Crataegus, Leonurus, bromides; short courses of β -blockers or Ca-antagonists can be proposed, K containing medications.

Sinus bradycardia

- **Clinics.** Weakness, dizziness, head ache, cardiac pains, HR 95-60% from age norma
- **ECG.** Intervals PP, TP elongation. Wave P amplitude and width are lowered. Interval PQ and QT more long, moderate increasing of QRS and T waves, with dislocation of interval ST higher isoline. In the case of severe bradycardia replacing, escape rate from AV node.
- **Treatment.** In moderate grade isn't necessary. In severe grade –adaptogenes (Panax, Schizandra, Rhodiola rose, Glycyrrhiza root, Urtica, Echinacea). If not efficient add – M-cholinolytics (amysil), psychostimulant (sydnocarb) short courses Propose green tea and coffee consumption.

Sick sinus node syndrome

- Can be inherited or acquired one (after myocarditis, cardiomyopathies, amyloidosis, hemochromatosis,, malignancies, trauma).
- **Clinics.** Asystolia or bradycardia. Weakness, syncopes, seizures, memory loss.
- **ECG.** Alternate tachy- brady-arrhythmia: sinus rhythm can subside frequent ectopic rhythm, paroxysmal tachycardia or atrium fibrillation can occur. Asystolia can be due sinus node arrest. If sinus rhythm will not be restored or subsided by slow ectopic rate cardiac arrest can happen
- **Treatment** –surgical (pacemaker implantation).

Premature contractility

Allocation: supraventricular, from AV-node.

Left-right-ventricular; functional and organic.

- **Clinics** – signs of vegetative dystonia.
Sometimes short heartbeats intervals or gapping sensation

- **Treatment.** In supraventricular ES – verapamil, propranolol, amyadaron, in vagotonia – ethmosin, procainamide, chinidin.

In ventricular ES – propaphenon (rhythmonorm), etcysin, ethmosin, aimalin

Supraventricular paroxysmal tachycardia

- **HR 180-220 /min (infants – 250-300/min).**
- Heartbeats, unpleasant sensation or heart , epigastrium pains, nausea, weakness, dizziness.
- Pulsation of carotid vessels; pulse is weak, rhythmic, can't be calculated. BP normal or decreased predominantly systolic one. If attack is long signs of cardiac failure become evident.
- In infants – dyspnea, cough, irritability later flaccidity; sometimes syncope , convulsions.

Treatment

- Semisitting position, respiratory therapy
- Mechanical stimulation of nervous vagus: Ashner reflex- pressing by 2 fingers onto eyebulbs while eyes are closed for 30-40 sec.; 1-2 min later you can repeat massage of right carotid sinus. Valsalve manoeuvre – straining effort during expiration with respiration retention.
- If child is conscious – sedative medications (relanium, sibazon, seduxen, diazepam) 0,2-0,3 mg/kg or 0,1 ml/year IM.

Treatment

- IV 0,25% isoptin (verapamil) sol. without dilution for 20-30 sec in dosages: for neonates 0,3-0,4 ml, for infants – 0,4-0,8 ml, toddlers – 0,8-1,2 ml, schoolchildren- 1,2-1,6 ml, teenagers – 1,6-2,0 ml
- If effect absent for 3-5 min repeat reflectory manoeuvre, if effect negative repeat verapamil in the same dosages, if not effective 10% novocainomide sol 0,15-0,2 ml/kg (not more than 10 ml)
- If effect isn't gained trachea intubation and perform mechanical ventilation
- Cardioversion 0,5 J/kg, repeat cardioversion if it's not effective – 1,0 J/kg

Ventricular paroxysmal tachycardia (VPT)

- Abrupt heartbeating attack, dyspnea, cardialgia
- Condition is severe with progressive worsening, loss of conscience is possible, ventricular fibrillation can complicate prognosis
- *If patient's condition is satisfactory, with high probability you can exclude VPT!*
- Treatment at intensive care unit: semisitting position, respiratory treatment, catheterization of central vein.

VPT treatment

- Lidocain IV injection 1 mg/kg for 5 min. If it's ineffective repeat injection 0,5 mg/kg (max dosage -3 mg/kg)
- Novocainamide 0,15-0,2ml/kg diluted with 10-20ml of 10% glucose if previous treatment ineffective
- Aimalin 1 mg/kg
- Etmosin IV slowly diluted with 10-20 ml of 5% glucose
- Kordaron or/and propranolol
- If result is absent – cardioversion as previously has been mentioned
- Cardio surgeon consultation

Atrium fibrillation treatment

- Isoptin 0,15mg/kg I V slowly diluted with 10-20ml of 5% glucose
- Propranolol very slowly 0,1-0,2 mg/kg
- Glycosides – digoxin 0,025-0,05 mg/kg
- Chinidin 10-15 mg/kg/day (3-4 injections) together with verapamil 2 mg/kg/day. Effect can be gained on 3-10 day.
- Efficiency of another medications (procainamide, flecainid, propranolol) is inversely to attack duration
- As fibrillation predispose to thromboembolism – indirect anticoagulants

Anoxic spells-

Is paroxysmal attack of dyspnea in child with congenital heart disease with cyanosis more frequently in tetralogy of Fallot. Attack is due to right ventricular outflow obstruction.

Provocative factors:

psycho-emotional, physical exertion, intercurrent diseases especially with dehydration, anemia, neuro-reflectory excitability syndrome

Clinical presentation

- **Sudden onset**
- **Irritability, moaning, crying with dyspnea and cyanosis**
- **Sitting posture-squatting or lateral decubitus position**
- **Tachycardia**
- **Systolic murmur of lung artery stenosis become silent**
- **In severe cases – seizures, loss of conscience, coma**

Emergency care

- To calm child, put into knee-chest position, give humidified oxygen
- Morphine or promedol 0,1 to 0,2 mg/kg subcutaneous injection
- Correct acidosis. Obtain pH , Give sodium bicarbonate IV
- Propranolol 0,1 mg/kg/IV (during spell) 0,5 to 1,0 mg/kg/4-6 hourly orally
- Vasopressors: Cordiamine 0,1-0,5 ml subcutaneously
- Nospani, papaverin 0,2-0,5 ml IM
- Na oxybutiratis 20% sol. 50-100 mg/kg IV slowly in seizures.
- Correct anemia
- Consider operation –aortic-pulmonary anastomosis

Questions

- **Prevention of cardiologic disease**
- **Frequency and prognosis**
- **Clinical symptoms of cardiologic disease**
- **Additional (instrumental) methods of investigations**
- **Principles of treatment of cardiologic disease**