Cardiac Arrest in Anesthesia

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Abstract

Aim of this study is fast Recognition, Management of situation of Cardiac Arrest during Anesthesia and treatment of complications. Objectives are: Analysis of Causes that trigger Cardiac Arrest, analysis of risk factors and prevention of Cardiac Arrest in Anesthesia. Is known that Cardiac Arrest occur at 0.5/ 10.000 cases of Anesthetized Patients. Between other Causes, Human Mistake is one of cause of Cardiac Arrests. Cardiac Arrest can be defined as an physio-pathologic situation of acute Cardiac failure ,when the Heart stop and can not supply with blood -vital organs, mainly the Brain. Causes of Cardiac arrest are multiple and more important are: Cardiac arrest with Reflector origins, direct cardiac trauma, overdose of anesthetic drugs, Ventricular Fibrillation, acute coronary failure, acute diminished venous reflux, cardiac arrest from metabolic disorders, massive blood transfusions, anaphylactic reactions and cardiac arrest from special surgical procedures as prosthesis with implanting cement. Symptoms during Anesthetized patients are poor, but Anesthesiologist must be very careful. Symptoms are, hypotension, cyanosis, disrythmia, hypoxia, hipercarbia, surgeon see `black blood`, and asystolia. Mydriasis occur r 45 sek after Cardiac Arrest and is in fact a late symptom of Cardiac Arrest during Anesthesia. Cardiac Arrest con cause within 2-4 min irreversible changes, that can cause death or permanent grave neurologic and psychiatric inabilities. Treatment must be emergent within 20-40 sec after Anesthetist has diagnosed Cardiac Arrest and must include Interruption of surgical Operation, change of position of patient in surgical bed, interruption of Narcotic agents, giving of Oxygen 100%,careful cardiac monitoring, and starting of CPR. The predetermined objectives are: Analyzing the causes of cardiac arrest under anesthesia, Analyzing the risk factors of cardiac arrest in anesthesia, Prevention of cardiac arrest under anesthesia, Treatment of Cardiac Arrest During Anesthesia,

Discuss the role of the Protocols in cardiac arrest management. Terapeutic Principles are: Phase of CPR, Phase of Patient Ventilation and careful Monitoring, Fase of Diagnosticcation and Intensive Care Therapy.

***Key words**. CPR, Anesthesia, Cardiac Arrest, Monitoring, BLS- Basic Life Support, ACLS-Advanced Cardiac Life Support. CPR-Cardio Pulmonary Resuscitation, AED-Automated External Defirbrilator.*

Incidence of Cardiac Arrest under Anesthesia

- Cardiac Arrest in General Anesthesia 0.5 / 10,000 Anesthesia occurs, in the US in 20 anesthesia performed -1,000 patients per year under cardiac arrest during Anesthesia, or 3 patients daily.
- In Neuro-axial Anesthesia, Cardiac Arrest during Anesthesia occurs in 1.8 per 10,000 patients, but most occur in Spinal Anesthesia 2.9 / 10,000 than in Epidural 0.9-10,000 patients.
- Hypoxemia is not charged more than high spinal anesthesia. as well as the selection of vasopressors in these cases (Anesth Analg 2005; 100: 855-865).

One statement to keep in mind is the Muray phrase that says: `` Human error is one of the major causes of Cardiac Arrest during Anesthesia, but the structural complex of the recurring human error, formerly called the 'chain of accidental evolution', challenges it even the most successful strategies` (Murray DJ, 2004).

Epidemiology of Cardiac Arrest under Anesthesia

- The Epidemiology of Cardiac Arrest under Unique and Special Anesthesia. Managed 518,294 patients with Cardiac Arrest during Anesthesia (Mayo Clinic in Rochester, Sprung J, et al. 2002).

Cardiac arrest due to dysrhythmia and hypoxemia is rarely observed when good monitoring, sedation, and general or regional anesthesia are provided.

- During the Anesthesia, it is important to have proper recognition and current diagnosis, which lead to successful management.

Cardiac arrest can be defined as a cardiac arrest causing an acute inability to maintain sufficient Cerebral circulation.

Causes of Cardiac Arrest in General and During Anesthesia

1.Arrest Reflector due to vago-vagal stimulation

Vago-vagal stimuli are induced by

- surgical trauma in the Aorta region,
- Hilus Pulmonar,
- flexion during traction,
- the carotid sinus
- when the vagus nerve is cut.
- anesthetic procedures such as Intubation, Tracheobronchial Irritation,
- immediate movements to position the patient

2. Direct Trauma to the Heart such as

- Cardiac operations in the pericardium,
- Cardiac operations,
- Pressure of the diverticula (retractor) on the heart or aorta

3. Overdose of anesthetic substances which depress circulation

- through the direct effect on the heart by depressing the myocardium (such as Chloroform, Chlorethylene,

Cyclopropane, which is not used or used today, as well as anesthetic substances inhalers that give hypoxia

- by vasodilatation as, anesthetic I / v.

4. Ventricular fibrillation due to adrenaline release

- By endogenous pathway in case of excitation of adrenal glands a large amount of adrenaline is released,
- During an inappropriate, light anesthesia, adrenaline is released which causes ventricular fibrillation

5. Arrest originating from coronary insufficiency: (high risk at waking time because heart rate increases)

The drop of Pa02 with only 20 mm Hg, creates major disturbances.

- Excessive analgesic effect after surgery, aches and pains begin to increase, post-cardiac output increases, T / A increases and consequently, rhythm disorders that precipitate cardio-circulatory arrest from hypoxia begin, and greater oxygen demand in the immediate postoperative period

6. Arrest of decreased venous reflux

- usually occurs in hypovolemic patient,
- In patients who have suffered asphyxia,
- In patients with respiration directed to PEEP,
- We hypovolemic patients even while changing their position in bed brusquely

7. Arrest from metabolic disorders

- An accidental excess of potassium,
- After giving i / v to miorelaxin (which increases potassium to 12 mEq / l, gives Asistol, but there are no signs of hyperkalaemia in ECG because it occurs very quickly),
- In metabolic acidosis (shock, politrauma, oligo-anuria, mass transfusions, because toxic metabolites and inorganic acids (from anaerobic metabolism) accumulate, which are not eliminated in a timely manner.
- It may also occur from Hypokalemia during expressed alkalosis

8. Arrest from the introduction of ischemic territories into the systemic circulatio

- High relief, who stayed for a long time (over 75-90 minutes) from the lower extremities in orthopedics, when there were snake bites on the leg and the patient was transported to the hospital for a long time),
- Crush-syndrome. Due to the introduction in a very short time of a large amount of toxic metabolites, as well as of inorganic acids produced by anaerobic metabolism, such as lactic acid, pyruvic acid)

9. Arrest by mass blood transfusions

- occurs due to the introduction into the blood of the recipient of citrate, which binds plasma calcium giving Hypocalcemia,
- but cold blood may also occur, which immediately lowers body temperature by several degrees causing cardiac arrests and arrests, if no measures are taken.

10. Cardiac arrest by anaphylactic reactions

- from peripheral vasodilatation that reduces venous reflux by giving circulatory collapse.
- from hypoxia caused by bronchospasm (due to an increase in histamine, bradykinin by an anaphylactic reaction),
- by the direct action of the antigen-antibody complex on the heart

11. Cardiac arrest in special operations such as

- Cement Properties during the placement of Femoral Head Prosthesis in Orthopedics,
- manipulation of the Spermatic Cord,
- manipulation of fractured femur,
- broken amniotic membranes.
- Electroconvulsive therapy

Physiopathology of Cardiac Arrest

Cardio-circulatory arrest is a physiopathological condition where the heart cannot supply blood to the vital organs (Brain, Heart, Pulmonary). The factors are many like:

- Hypoxia PaO2 <20-50 mmHg, PaCO2> 60 -100mmHg,
- Collection of toxic metabolites and acidic substances through anaerobic metabolism such as Lactic acid, Pyruvic acid, NH4 + ions.
- The Cardiac Arrest under Anesthesia is divided into three groups of Factors:
- Intra-operative hemorrhage

Pre-existing cardiac pathology

- Acute hypoxia. Disorders that occur in General Anesthesia and Neuro-Axial Anesthesia (regional) are:
  - Bradicardia that continues up to asystole (45%),
  - Ventricular tachycardia and ventricular fibrillation (14%),
  - Electric activity without pulse (7%),
  - Lack of 33% heart rate (heart rate is not fully documented).

Patogenesis

Cardio-circulatory arrest that occurs during anesthesia:

- It is benign and returns in 70% of cases.
- The myocardial reserves are for 12 systoles only: then heart dilation occurs;
- Pa02 <60 mm Hg has rhythm disorders;
- Pa02 <50 mm Hg bradycardia occurs.
- Pa02 <30 mm Hg, heart enters lethal threshold.
- PaC02> 90 mm Hg + Halotan, has rhythm disorders.
- PaC02> 100 mm Hg Cardiac arrest occurs.

Hypoxia also occurs when the HB02 dissociation curve crosses the right and oxygen is not absorbed by the tissues.

When Cardiac Arrest Anesthesia Occurs

- During the Perioperative Period The patient in a `sudden ‘manner receives Pulse Arrest without pulse for a period of several minutes - up to several hours.
- This requires taking aggressive and aggressive measures using ACLS (Advanced Cardiac Life Support) in the Operating Room.
- Cardiac arrest can cause irreversible changes within 2-4 minutes

Some features of Cardio-Circulatory Arrest

Cardio-circulatory arrest occurs immediately after the above-mentioned symptoms:

- The respiratory arrest may come shortly after 20-60 seconds after cardio-circulatory arrest;

Cardio-circulatory arrest arrives immediately after 3-5 minutes after respiratory arrest.

- Deep coma occurs after 4-8 seconds after cardio-circulatory arrest.
- Midriasis is a late sign of cardio-circulatory inhibition because it occurs after 45 seconds to 1 minute and 45 seconds.

Immediately after Cardiac Arrest: Acute brain cell suffering begins immediately in the brain: When PaO2 <50 mmHg, PaCO2> 60 mmHg of brain occurs:

- Massive cerebral glycolysis,
- After 3-5 minutes.trom diffuse cerebral artery boils with cerebral necrosis arise.
- Over 3 minutes and 10 seconds, brain function can return without any subsequent disturbance.
- The inhibition lasts 3 minutes and 30 seconds, then the patient will notice psychic changes.
- When Arrest lasts up to 6 minutes, it leaves disorder and appearance changes
- When the Arrest lasts over 7 minutes, the brain dies.
- This time may decrease in hypoxemia and may increase if the patient is anesthetized or the patient is at low temperature.

The Cardio-Circulatory Arrest Warning Signs are

- Circulatory arrest does not come unexpectedly,
- The anesthetist must be very attentive,
- Every detail is evaluated by asking: Why is this symptom occurring?
- Warning signs are few,
- bradycardia,
- T / A movements,

- cyanosis
- rhythm disorders,
- lack of peripheral pulse,
- very rare carotid pulse that is extra-ventricular systole,
- Dark (black) blood in the surgeon's operative field
- ACLS Cardiac Monitoring Data:
- pulse-free ECG (ventricular tachycardia or ventricular fibrillation),
- Pulse loss x 10 seconds
- End-Tidal Loss of CO2
- Loss of the plethysmograph

Following on from the Cardio-Circulatory Arrest Clinic we can conclude that

Cardio-circulatory arrest is not diagnosed quickly when the patient is under the anesthetic effect, when the patient is not monitored.

There may be confusion at first, but CPR should not be delayed. CPR in the operating room should begin within 20-30 seconds of diagnosis. CPR is also initiated if the doctor is not fully convinced, whether or not he is under arrest. The patient with Arrest Cardio Circulatory (clinical death) should always be treated with CPR even in the operating room.

Cardio - Vascular Arrest Diagnosis

In Anesthesia it is problematic and depends on a careful and efficient evaluation by the Anesthetist

(minor) symptoms that occur during Anesthesia depend on the changes in the ECG rhythm,

Oxygen De-saturation, Capnography Level, Sufficient Monitoring, Respiratory Depression, Condition of Consciousness in the Awakening Room or During Local and Regional Anesthesia.

Differential diagnosis can be made by

- Hypoxia from Trauma / hypovolemia,
- Hypovolemia from Pneumo-Thorax Valvular,
- Hyper-vagal coronary thrombosis,

- Tamponade of Hydrogen Ions,
- Hypokalemia from Thrombus in Pulmonary Artery,
- Prolonged `QT 'syndrome in Malignant Hyperthermia,
- Hypothermia due to toxins (anaphylaxis),
- Hypoglycemia during Pulmonary Hypertension

Immediately treatment

Once diagnosed by the Anesthesiologist & Resuscitator, the primary surgeon is immediately notified of the surgery; Stop Blood Loss, Put Patient in Horizontal Stretch Position, Expose Thoracic, Non-Gestational Head, Give Precordial Blow, and Start External Cardiac Massage 30/2, (or 100 / min), Ventilate Patient with 100% O2, in Anesthesia Case Emergency Regional - Intubate the patient, Careful ECG monitoring to ascertain: bradycardia, asystole, tachycardia and fibrillation.

Provide a correct dose of Adrenaline i / v, heart injection, or electric syringe,

- Liquid supply i / v,
- Use of Atropine in bradycardia,
- Use of Lidocaine in Ventricular Tachycardia,
- Defibrillation with AED,
- BLS (basic life support) extension
- Preparation of other medicines:
- Symptomatic Agonist Medications: Metaraminol, Dopamine, Noradrenaline, Isoprenaline,
- Bicarbonate as Sol NaHCO3 8.4%,
- Beta blocker Atenolol,
- Beta2-stimulants such as Salbutamol,
- Cortisone like Hydrocortisone, Dexametazon
- Aminofilini,
- Arteriolo-venulo dilator as Lenitral.
- Naloxon, Magnesium Sulphate, Prochlorperazine

BLS / ACLS in the Operating Room

CPR for Patients Under Anesthesia Doesn't Begin With '.. Hey, Are You Good…?

- Install relevant personnel to start an effective CPR,
- Continue Anesthesia and Surgery,

- Keep AED (defibrillator),
- Ventilate with Ambu if the patient is not intubated but intubate immediately with FiO2 = 1,
- Don't stop CPR! Capnography is a more reliable indicator of the resumption of spontaneous circulation than the palpation of a. carotid, or a.femoral,

Manually ventilate at 8-10 ventilation / min with 1 sec Inspiration, and with O2-100%,

- Evaluate if there is obstruction: if -no, start mechanical ventilation, if-yes, obstruction-aspiration, fibrobronchoscopy,
- Continue CPR,
- Keep all roads open.

Cardio-Circulatory Arrest Management for Specific Causes

In case of suspicion of occlusion of the inferior vena cava in the operation of the uretero-litho-tomoma the operating table should be directed which in this case is placed in a separate position.

Emergent thoracotomy should be performed in the case of Pulmonary Embolism and in the case of a Thoracic rupture (in order to provide upper respiratory tract).

Lower head, used in the case of gas embolism,

- Autonomous stimulation may be interrupted in the case of:
- traction of the extra-ocular muscle,
- traction of muscle and release of CO2 from peritoneal cavity.

Specific treatments through ACLS

ACLS- Advanced Cardiac Life Support; -It is known that: in a state of reduced flow, prolongation of increased thoracic pressure is proportional to Ventilation rate and inverse, is proportional to T / A, and Coronary and Cerebral perfusion.

- Lower levels of ventilator support are recommended because, Ventilation at 20 respirations / min is associated with lower survivance than ventilation at 12 respirations / min, thus using negative pressures during ventilation.

Cardioversion. Special considerations

Immediate cardioversion for the patient with serious signs associated with tachycardia, or when ventricular rhythm> 150 min,

- Always be prepared for patients with transcutaneous pacing who have undergone cardioversion to convert them to deep bradycardia.
- Biphasic Defibrillators (AEDs) are more effective than Monophasic ones,
- The combination of Vasopressin with Adrenaline (together), is more effective than their individual use.

1. In penetrating traumatic injuries, Open Heart CPR is recommended as an optional treatment to improve% of survival. It is important that this procedure is started as soon as possible and at least within 20 minutes of starting the standard CPR.
2. In closed trauma cases the outcome was the same.

(J Trauma. 2004 Oct; 57 (4): 809-14. «Open-chest cardiopulmonary resuscitation after cardiac arrest in cases of blunt chest or abdominal trauma: a consecutive series of 38 cases»).

Therapeutic Principles

1. The first phase or the phase of artificial respiration + cardiac massage (30/2) at the scene and during transport,
   - the cause is not yet known exactly,
   - continues until the restoration of the central and peripheral pulse and spontaneous respiration, normal coloration of the skin, normalization of the pupils and gaining consciousness.
2. Second stage or ventilator phase:
   - continues in the hospital, where artificial respiration and cardiac massage continue while monitoring the patient (with cardiac monitor + defibrillator alert),
   - adding oxygen and bringing the patient into mechanical ventilation,
   - alkalinizing the patient,
   - adding vasopressors.
3. Third phase - the phase after the patient is diagnosed,
   - continues in Reanimation,
   - What kind of Cardio-Circulatory Arrest it is. The diagnosis is based on the therapy,

All three phases are performed continuously and dynamically, which are not substantially different from CPR measures.

Extreme Care

- Confirm and correct the Cause,
- Treat Anaphylaxis and Septicemine,
- Prevent and correct Hypothermia,
- Regulate the patient's admission to Resuscitation,
- Document the event carefully as soon as possible.

Cardiac Arrest Post Care

- Care has the significant potential to reduce Early Mortality caused by Cardio-vascular instability, and later by Morbidity and Mortality due to Multi-Organic Insufficiency and Brain Damage.
- Post-Cardiac Arrest Care after returning to cardio-vascular-spontaneous circulation rates can improve patient survival with a good quality of life.
- Check temperature to optimize survivance and neurological healing,
- Identify and treat Acute Coronary Syndrome,
- Optimize mechanical ventilation to minimize pulmonary damage,
- Reduce the risk of multi-organ damage and improve organ function,
- Objectively evaluate the healing prognosis,
- Assist survivors through Rehabilitation services when required.

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