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PAPER 2:PRINCIPLES OF ANAESTHESIA-2

<u>TOPIC:MONITORING</u>

- *Monitoring is the most imporatant part of anaesthesia to prevent complications*
- *Although a number of sophisticated monitors are available but nothing can replace the vigilance of an anaesthetist*
- *The principle to use of monitors is they should assist you and you should not be fully dependent on them*

<u>CLINICAL MONITORING:</u>

- *Pulse rate by palpitation*
- *Colour and turgar of skin to assess hydration,oxygenation and perfusion*
- *Blood Pressure:It is measured either by palpatory method or by auscultatory method,two common sources of error are:*
- *Inappropriate cuff size*
- *Rapid deflation*

- *Inflation of chest*
- *Precordial and esophageal stethoscopy*
- *Any signs of sympathetic over activity such as lacrimation, perspiration to detect the depth of anaesthesia*
- *Urine Output :Urine output is the best clinical indicator for assessing adequacy of perfusion it should be >0.5ml/min*

<u>ADVANCE MONITORING:</u>

<u>CARDIOVASCULAR MONITORING:</u>

<u>ELECTROCARDIOGRAPHY:</u>

- *Electrocardiography is the mandatory monitor as it measures heart rate and can detect arrythmias,ischemia and cardiac arrest*
- *It is not possibleto monitor12 leads in perioperative period therefore, the leads most preferred are lead II nd v5 because arrythmias are best detected in lead II and ischemia in lead V5.*

- *It is highly recommended to use monitors which have an option of automatic st analysis.*

BLOOD PRESSURE:

- *Blood pressure can be monitored by non-invasive and invasive methods.*

NON-INVASIVE:

- *Automated nonivasive blood pressure monitors are most frequently used in perioperative periodto measure blood pressure,these instruments automatically measure blood pressure at set intervals by ocsillometry*
- *The maximum interval between two blood pressure recordings sholuld not exceed more than 5 minutes*
- *Other non-invasive methods which can be used are arterial tonometry or using doppler probes in a place of fingers by palpatory methods.*

- *A continous non-invasive method by using finger cuff was tried but could not become popular due to many reasons.*

<u>INVASIVE:</u>

- *Invasive blood pressure monitoring is done by cannulating one of an artery and connecting the cannula to a transducer which in turnis connected to monitor*
- *Invasive blood pressure monitoring is required when surgery or patient condition mandates beat to beat (ie)continous monitoring blood pressure*
- *Invasive blood pressure is considered as gold standard method to monitor blood pressure*
- *Invasive blood pressure can be significantly affected by the dynamics of equipment used for invasive blood pressure monitoring(Transducer,tubing)etc..*
- *Its accuracy should be checked by matching with non-invasive blood pressure.*

- *The difference in invasive blood pressure and non invasive blood pressureshould not bemore than 5-8 mm/hg*
- *Most often transducers are zeroed at the level of heart*
- *As radial artery has collaterals for the blood supply of hand,it is most commonly choosen artery for cannulation*
- *Before doig radial artery cannulation Allens test should be performed to assess the patency of ulnar artery*
- *In allens test after exsanguination of patients hand ulnar and radial arteries are occuluded*
- *Release pressure from the ulnar artery while maintaining the pressure on radial artery*
- *Colour of hand returning to normal within 5-7 seconds indicates patency of ulnar circulation and it is safe to go ahead with radial artery cannulation*
- *Colour returning to normal in >10 seconds indicates severely compromised ulnar circulation contraindicating radial artery cannulation.*

- *Due to the peripheral location,dorsalis pedis is second most preferred artery after radial*
- *Other arteries which can be cannulated are brachial and femoral.*

<u>Complications:</u>

- *Arterial injury,spasmand distal ischemia*
- *Thrombosis and embolization*
- *Sepsis*
- *Tissue necrosis*
- *Fistula or Aneurysm formation*
- *To prevent thrombosis,a continous flush with/without heparin is needed.*

<u>Other uses of arterial cannulation:</u>

- *Taking blood sample for repeated arterial blood gas analysis*
- *Avoid the frequent puncture to take blood sample foer investigations.*

CENTRAL VENOUS PRESSURE MONITORING:

- *Ideal vein for monitoring of central venous pressure id right internal jugular vein*
- *Central venous pressure can also measured by subclavian,basilic and femoral vein*

Indications:

- *Major surgeries where large fluctations in heamodynamic expected*
- *Open heart surgeries*
- *Fluid management in shock*
- *As a venous access*
- *Parenteral Nutrition*
- *Aspiration of air ambolous*
- *Cardiac pacing*
- *Normal CVP is 3-10cm of h2o*
- *In children CVP is 3-6cm of h2o.CVP more than 20cm of h2o indicates right heart failure.*

CVP is increased in:

- *Fluid overloading*
- *Congestive cardiac failure*
- *Pulmonary embolism*
- *Cardiac tamponade*
- *Intermittent positive pressure ventilation with PEEP*
- *Constrictive pericarditis*
- *Pleural effusion*
- *Hemothorax*
- *Coughing and straining*

CVP is decreased in:

- *Hypovolemia and shock*
- *Vasodilators*
- *Spinal/epidural*
- *General anaesthetics*
- *A low CVP with low BP indicates hypovolemia while a high CVP with low BP indicates pump failure*

Technique:

- *It is introduced through seldinger technique.The patient lies in trendelenburg position (to decrease the chances of air embolism).The cannula with stylet is inserted at the tip of triangle formed by two heads of stenomastoid and clavicle.The direction of needle should be slightly lateral and towards the ipsilateral nipple.Majority of the clinicians are ultrasound to locate the internal jugular vein.In fact in many countries it has become mandatory to used ultrasound for cvp insertion.*
- *Once the internal jugular vein is punctured stylet is removed and a j wire is passed through cannula.cvp catheter is railroad over the j wire.The tip of catheter should be at the junction of superior vena cava with right atrium*
- *An x ray chest should be performed to check the position of catheter and to exclude pneumothorax.*

Complications:

Mechanical complication:

- *Arterial puncture*
- *Cardiac arrythmias*
- *Pneumothorax,Hemothorax,Chylothorax*

- *Cardiac perforation/cardiac tamponade*
- *Trauma to brachial plexus,phrenic nerve and airway*

<u>Thromboembolic complications:</u>

- *Arterial or venous thrombosis*
- *Air embolism*
- *Catheter or guide wire embolism*

<u>Infectious complications:</u>

- *Insertion site infection*
- *sepsis*
- *Infection is the most common late complication.*

<u>PULMONARY ARTERY CATHETERIZATION:</u>

- *Because of cost,technically feasibility,complication ranging from minor arrythmias to life threatening such as pulmonary artery rupture,severe arrythmias and death*

- *Pulmonary artery catheterization is hardly done now a days*
- *Swan ganz catheter is used for pulmonary artery catheterization.it is ballon tipped and flow directed .The presence of catheter in different parts of heart is confirmed by pressure recordings,pressure tracings and distance from catheter tip.Entry into right ventricle is confirmed by sudden increase in systolic blood pressure.While entry in pulmonary artery is best indicated by sudden increase in diastolic pressure*

<u>Uses:</u>

- *Measuring cardiac chambers except left ventricle*
- *Calculating cardiac output and stroke volume:cardiac output is calculated by using ice cold saline.The most commonly used method to calculate cardiac output is thermodilution method where ice cold saline is injected and change is temperature is noticed by a thermistorin pulmonary artery.The processors then calculate the cardiac output by computerized algorithms.The alternative to thermodilution method are dye dilution and fick principle.*

- *To decrease the invasiveness of pulmonary arterry catheterization,a modified approach transpulmonary therrmodilution method is used where ice cold saline is injected in superior vena cava through cvp catheter and thermister is placed in femoral artery*
- *Measuring pulmonary artery occlusion pressure also called pulmonary capillary occulsion pressure.Previously pulmonary artery occulsion pressure used to be called as pulmonary capillary wedge pressure.Pulmonary artery occulsion pressure represents left atrial pressure.Normal pulmonary artery occulsion pressure is 4-12mm/hg.Pulmonary artery occulsion pressure is best utilized to differentiate between cardiogenic and non-cardiogenic pulmonary edema.Pulmonary artery occulsion pressure <18mm/hg indicates non-cardiogenicpulmonary edema while cardiogenic pulmonary edema usually develops at pulmonary artery occulsion pressure>25mm/hg.*
- *Taking sample for mixed venous blood pulmonary artery is considered as best site for mixed venous blood sample.Oxygen saturation of mixed venous blood is the best site guide to assess tissue*

perfusion(cardiac output).Normal mixed venous oxygen saturation is 75% less than 60% indicates significant deficiency in tissue perfusion.

- *Special pulmonary artery probes are available which can continously measure the oxygen saturation of mixed venous blood*
- *Titration of fluid therapy:As pulmonary artery occulsion pressure measure preload to left heart,it is definitely better guide for fluid therapy than central venous pressure.Low pulmonary artery occulsion pressure and low stroke volume indicates hypovolemia.High pulmonary artery occulsion pressure and low stroke volume represents pump failure(ie)cardiogenic shock.*

<u>ECHOCARDIOGRAPHY:</u>

- *In present day medicine transesophageal echo cardiography and transthrocic echocardiography are the best tools to assess cardiac graphy are the best tools to assess cardiac function and detect wall motion abnormality (ie) ischemia in perioperative period*

- *Trans thoracic echocardiography/Transesophageal echocardiography can measure all heamodynami parameters (cardiac output,stroke volume,stroke volume variation,left ventricular ejection fraction etc..)can detect structural changes,and diagnose cardiac failure*
- *Transesophageal echocardiography is also most sensitive to detect air embolism*
- *The advantage of Transthoracic echocardiography is that it is non-invasive however limited access to thorax limits its use in perioperative period*
- *Transesophageal echocardiography offers excellent window to visualize heart in perioperative period but is invasive,can be used only for intubated patients in general anaesthesia and has potential to cause life threatening complication such as esophageal rupture*

GASTRIC TONOMETRY:

- *It measures gastric mucosa PH and CO2.It is very good indicator of tissue perfusion but is not popular due to complex,time consuming and cumbersomeness of the process.*

To Summarize:

- *VArious methods which can be used in perioperative period to calculate cardiac output and other cardiac functions such as stroke volume,stoke volume varation etc...*

NON-INVASIVE:

Transthoracic Echocardiography:

- *Very simple,cost effective and devoid of any major complication.The major disadvantage is poor window in obese patients and limited access in surgical patients.*

Thoracic Bioimpedence:

- *Six electrodes are placed over chest which measures changes in lung volume to calculate cardiac functions.Accuracy of this technique is questionable in many patients.*

INVASIVE:

Transesophageal Echocardiography:

- *Provides best window for measuring and assesing cardiac functions in intraoperatie period but can be used only for intubated patients.*

PULMONARY ARTERY CATHETERIZATION:

- *Provides most accurate cardiac output,however is highly invasive,associated with life threatening complications such as pulmonary artery rupture and cardiac tamponade*

PULSE CONTOUR DEVICES:

- *Any artery is cannulated and pulse contour device is attached which analyses the pulse wave to calculate cardiac functions*

- *Partial CO2 rebreathing cardiac output ca be done only in intubated patients.*

RESPIRATORYMONITORING:

PULSE OXIMETRY:

- *Pulse oximeter is the most basic and mandatory monitor to measure the oxygen saturation of hemoglobin in arterial blood*
- *The probe is appiled on fingers,nailbed,toe nailbed,ear lobe and tip of nose.*
- *Normal spo2=95-98%*

Principle:

- *Pulse oximeter works on the principleof beer lambert lawwhich sates that different solvents absorb infrared at different wavelenths.*
- *A pulse oximeter probe emits 2 lights of different wave length(red at 660nm and infrared at 940nm)*
- *Oxyhemoglobin absorbs more infrared light while deoxyhemoglobin absorbs more red light.*
- *The ratio to redto infrared light is measured and converted in numerical value by processor in pulse oximeter.*

Errors:

Abnormal Haemoglobin:

- *Carboxyhemogllobinemia:Carbon monoxide has same absorption pattern of red light such as oxygenated haemoglobin therefore will overestimate the real value*
- *Methemoglobinemia:Shows fix saturation of 85%*
- *However pulse oximeters perform accurately in the presence of sickle andfetal hemoglobin.*

Anemia:

- *Severe anaemia causes underestimation of actual values*

Hypovolemia and vasoconstriction:

- *Especially in cold-difficult in obtaining actual values and false low spo2reading*

- *Vasodilatation:Slightly decrease*

- *Nail polish:Especially blue colour-Impairs the transmission of light therefore shows false reading*
- *Shivering:Constant movement of finger impairs continous transmission of light and hence false reading.*

<u>Cooximeters:</u>

- *As discussed that routine pulse oximeters cannot differentiate between normal and abnormal hemoglobin,therefore are unreliable in carboxyhemoglobinemia and methemoglobinemia*
- *Co-oximeters are the special types of oximeters which can differentiate between normal and abnormal hemoglobin*

<u>Photoplethysmography:</u>

- *Pulse oximeter is not only used to measure oxygen saturation,variations in the ampltitude of the pulse oximetry waveform can be used to assess fluid status and resonsiveness to fluids therapy in mechanically ventilated patients.*

Capnograpphy:

- *It is the continous measurement of end tidal carbondioxide along with its waveform*
- *Normal is 32 to 42mm/hg*
- *Capnography uses the same principal of infrared absorption*
- *Capnography is one of the most important and sensitive tool for monitoring anaesthesia.*

Methods:

- *Side stream-Humidity block chamber*
- *Main stream-Increased dead space*

Uses:

- *To confirm intubation*
- *To diagnose the following conditions.*

Etco2=0

- *Esophageal Intubation*
- *Accidental Intubation*
- *Complete Obstruction*
- *Disconnection*
- *Ventilation failure*

Decrease Etco2

- *Hyperventilation*
- *Decrease delivery of co2 in lungs*
- *Pulmonary embolism*

Increased Etco2

- *Exhausted sodalime*
- *Decreased ventilation*
- *Bicarbonate administration*

Increased Etco2 indicates:

- *Hypoventilation*
- *Malignant hypothermia*
- *Exhausted sodalime*

Etco2=0 indicates:

- *Extubation*
- *Disconnection*
- *Complete obstruction*
- *Cardiac Arrest*

Decrease Etco2 indicates:

- *Hyperventilation*
- *Embolism*
- *Leakage of gas*
- *Partial obstruction or kinking.*

THANK YOU