MANAGEMENT OF CRISIS DURING ANESTHESIA AND SURGERY. PART XII: EMBOLISM

Salam N Asfar@ & Jasim M Salman#

@MB, ChB, MSc, Professor of Anesthesiology, College of Medicine, University of Basrah. #MB, ChB, DA, FICMS, Lecturer & Consultant Anesthesiologist, College of Medicine, University of Basrah, IRAQ.

EMBOLISM

Embolism can occur unexpectedly and unpredictably during anesthesia, causing a diagnostic and management dilemma for the anesthesiologist.

Types of embolus:

Embolism may result from: intravascular gas such as; air, carbon dioxide, oxygen or nitrogen. It can also occur due to thrombus, amniotic fluid, fat, bone marrow, aggregated blood components, and a multiplicity of foreign bodies such as cannula fragments.

Common sources of embolus¹:

(a) Air, from venous sinuses or large veins, specially from operative site higher than level of the right atrium. Procedures most commonly concerned includes; neurosurgical and maxillofacial, others such as spinal, intrathoracic, and hepatic.

(b) Infusion of air or carbon dioxide; from vascular lines such as warming coils or infusion devices, insufflation of body cavities, pressure operated dissection devices and re-use of partly empty blood bags.

(c) Thrombotic embolism; most commonly from pelvic veins.

(d) Fat embolism; occurring after any trauma, or long bone surgery.

Effect of embolus:

Considerable embolism to the right side of the heart and the pulmonary circulation may cause acute heart failure. Even small arterial emboli that access the cerebral and coronary circulations may result in catastrophic outcome. The presence of right-to-left shunt predispose to venous embolism².

Venous or arterial emboli may produce sudden cardiovascular decompensation with fast developing falls in end tidal carbon dioxide, hemoglobin saturation, and blood pressure accompanied with heart rate and rhythm changes¹,³.

Air may pass from any venous sinus or large vein (more often during or immediately after surgery on the brain, head and neck, and spinal cord⁴) or may be enforced under high pressure into a vein from badly set infusion devices, the re-use of part empty blood infusion bags, and high pressure tissue dissection devices. Carbon dioxide or air may be forced into the circulation via a vascular tear or perforation during minimum access surgery utilizing insufflation of a body cavity under pressure⁵. Also embolic air may get access to the cerebral circulation during cardiopulmonary bypass procedures. In addition to happening in these well recognized situations, embolism may occur suddenly and without warning under a variety of less usual conditions (for example, central line disconnection, joint replacement surgery⁶, IPPV on low compliance lungs⁷).
**Signs**\(^7-9^\):  
A sudden fall in ETCO\(_2\)  
Hypoxia and/or central cyanosis  
Air in surgical field or vascular line  
Hypotension  
A sudden change in spontaneous breathing pattern  
A change in the heart rate  
Raised CVP or distended neck veins  
Cardiac murmur  
Mottled skin  
Change FIO2 to 1.0  
Confusion (fat embolism) during spinal anesthesia  
Transoesophageal echocardiogram is valuable in making diagnosis in operating rooms.  
A change in the ECG configuration: Sinus tachycardia is the most common ECG finding during a pulmonary embolus. However a large S wave in lead I, a Q wave in lead III and an inverted T wave in lead III together indicate acute right heart strain. This pattern only occurs in about 10% of people with pulmonary embolism\(^{10}\).

![The S1Q3T3 pattern](LearnTheHeart.com)

**Emergency management during anesthesia:**  
Inform the surgeon\(^{11}\)  
Prevent further infusion of gas\(^2\)  
Turn the vaporizer off  
Flood the field with fluid  
Increase IV fluids  
Aspirate central venous line if already in situ  
100% oxygen and hand ventilate  
Consider valsalva or PEEP  
Level the patient or head down position  
Do not hesitate to treat as a cardiac arrest  
Change to manual IPPV  
If hypotensive:  
Volume expansion with crystalloid 10 ml/kg  
Consider adrenaline; give 0.001 mg/kg IV bolus (adult dose 1 ml of 1:10,000) followed if necessary by an adrenaline infusion starting at 0.00015 mg/kg/min (1 ml/min of 1 mg in 100 ml=10µg/min)\(^1\).
Further care
Careful postoperative review of the patient to:
- Confirm nature/source of embolism with proper investigations
- Stabilize long bone fractures
- Consider admission to ICU with proper medication
If there is confirmed cerebral gas embolism
- Give IV lignocaine at 0.06 mg/kg/min
- Early hyperbaric oxygen therapy

Risk factors
Trauma victims, prostate or orthopedic surgery, are at increased risk of venous thromboembolism. Malignancy, immobility, obesity, smoking, oral contraceptives, hormone replacement therapy, or antipsychotic medications carry highest risk.

References:
12. J A Williamson, S C Helps, R N Westhorpe, et al: Crisis management during anaesthesia: embolism. Downloaded from qshc.bmj.com on May 20, 2010-Published by group.bmj.com