

## MANAGEMENT OF CRISES DURING ANESTHESIA AND SURGERY. PART XII: EMBOLISM

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### EMBOLISM

**E**mbolism 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 embolus<sup>1</sup>:

- (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 embolism<sup>2</sup>.

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 changes<sup>1,3</sup>.

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 cord<sup>4</sup>) 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 pressure<sup>5</sup>. 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 surgery<sup>6</sup>, IPPV on low compliance lungs<sup>4</sup>).

**Signs<sup>7-9</sup>:**

A sudden fall in ETCO<sub>2</sub>

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

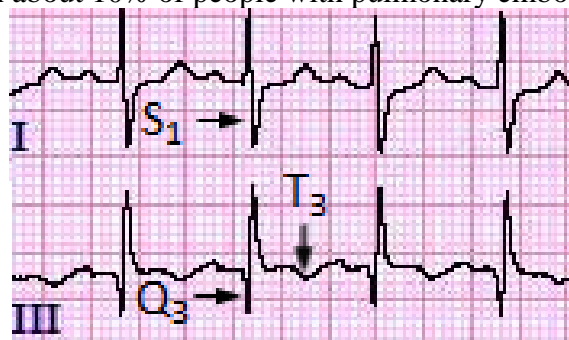
Mottled skin

Change FIO<sub>2</sub> 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<sup>10</sup>.



## The S<sub>1</sub>Q<sub>3</sub>T<sub>3</sub> pattern

LearnTheHeart.com

**Emergency management during anesthesia:**

Inform the surgeon<sup>11</sup>

Prevent further infusion of gas<sup>2</sup>

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)<sup>1</sup>.

**Further care**<sup>12</sup>

Careful postoperative review of the patient to:

Confirm nature/source of embolism with proper investigations<sup>2</sup>

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**<sup>8</sup>

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.

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