Gas Embolism in Operative Hysteroscopy; Case Report and Review of Aetiology, Risk Reduction and Management.

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Background and Pathophysiology

Gas emboli are a rare but potentially catastrophic complication of minimally invasive surgery. Operative hysteroscopy is particularly at risk as gas bubbles enter the circulatory system when venous sinuses are exposed. [1]
If emboli enter the pulmonary circulation they create lung regions with high ventilation/perfusion (V/Q) ratios, this reduces end tidal CO_2 ($ETCO_2$). Blood is diverted to areas with lower V/Q ratios which become over perfused. This drops oxygen saturations and causes hypoxaemia.
The gas is produced primarily from vaporisation during electrosurgery[2], but can also enter via inadequately primed giving sets or when the hysteroscope is removed and re-inserted via a dilated cervix.[3]

Understanding Risk

- Incidence of air entry to circulatory system in 44-100% of operative hysteroscopy's.[4,5]
- Largest review of Hysteroscopy complications identified 3 cases of gas embolism with 'catastrophic outcomes' in 17,000 reviewed cases.[6]
- This leads to the conclusion that the vast majority of gas emboli occurring at operative hysteroscopy do not cause any significant cardiopulmonary compromise.
- The volume and rate of gas entrained into a vessel determines the incidence and severity of symptoms for the patient.[7]
- The other factor that increases the risk of morbidity from gas emboli is the patients' cardio-respiratory fitness and their ability to compensate for the additional stress placed on them by gas emboli. Leibowitz et al [4] showed that operative hysteroscopy was associated with a significant increase in pulmonary artery pressures due to gas emboli accumulation in the right atrium, therefore any patients pulmonary hypertension should be treated with extreme caution

Risk Reduction

Preoperative
→ **Patient Selection** - Increased risk in patients with conditions leading to raised pulmonary artery pressures eg left side heart disease, pulmonary arterial hypertension, chronic obstructive pulmonary disease, obstructive sleep apnoea, pulmonary fibrosis.

Equipment
→ **Y Connectors** - Should be used to reduce gas entrapment in lines when changing bags of infusion fluid.
→ **Hysteromat** – Controls intracavity pressure to reduce intravasation of fluid, higher levels of fluid intravasation is associated with increased gas intravasation.[8]
→ **Resectoscope with suction function** – This reduces removal and re-introduction of resectoscope via cervix which reduces gas entrapment.

Intraoperative
→ **Operative time** – minimising operative time reduces volume of gas entering circulation and thus reduces risk.
→ **Recognition of compromise** – Early recognition can reduce mortality and morbidity with timely intervention. Signs of compromise; reduced oxygen sats, reduced $ETCO_2$.

Management

Management primarily consists of resuscitation coupled with respiratory and circulatory support aimed to reduce hypoxaemia. Surgery should be stopped as soon as problem is identified. Another simple technique to avoid reduce risk of further gas entering the pulmonary circulation is 'Durants Manouvre' which involves placing patient in left lateral whilst maintaining Trendelenberg.[9]

Conclusion

Gas bubble entry to circulatory system is a very common occurrence in operative hysteroscopy. Following safety procedures when operating should reduce the risk. A multidisciplinary approach is essential in the following areas;
1.Identification and risk assessment of high risk patients.
2.Planning of intraoperative monitoring and safety thresholds.
3.Modification of surgical procedure.
4.Management of patient in event of cardiorespiratory compromise

Hysteroscopy is a safe and effective procedure until something goes wrong. Both surgical and anaesthetic doctors need to be vigilant and think ahead in order to avoid catastrophic outcomes

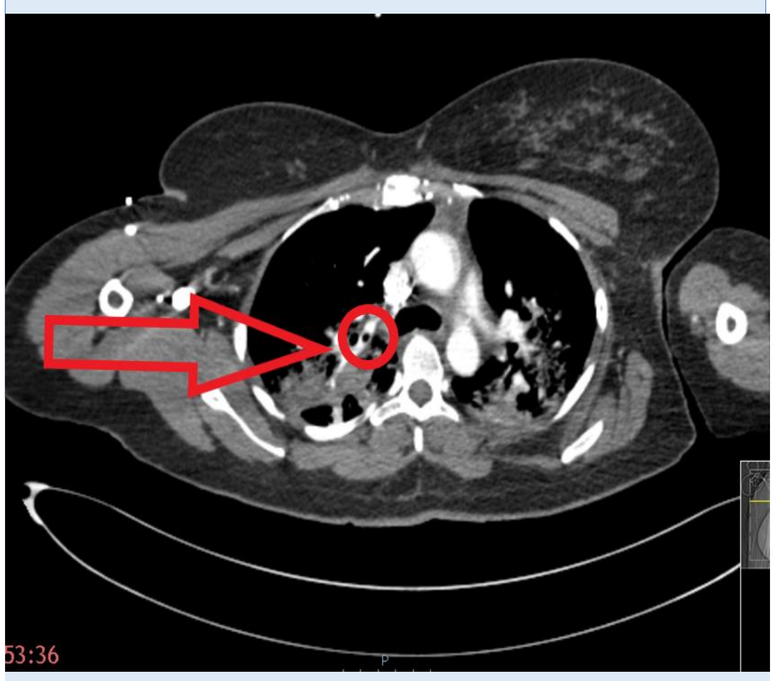
Arterial Gas Embolism during operative Hysteroscopy; A Case Report

Demographics
- 44-year old woman
- Elective TCRF for menorrhagia and ultrasound scan had suggested a submucosal fibroid.
- She had a parity of 3, with 3 previous vaginal deliveries.
- BMI 28
- ASA 1

Presentation
- Hypotension, hypoxia, bradycardia, rise in end tidal carbon dioxide.
- Sudden onset – fibroid resected and cauterisation being performed. Tranexamic Acid given 5 minutes prior to cardiorespiratory arrest.

Management
- Surgery Stopped
- High flow Oxygen
- Atropine and Metaraminol for circulatory support
- 2nd IV access and arterial line
- Anaesthesia maintained
- CTAP
- Ventilated in Intensive Care overnight.

Imaging –CT showing gas emboli in pulmonary vein



Outcome
- Full recovery

Conflict of Interest/ Financial Sponsorship

No conflicts of interest to declare

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