Treatment of endoscopy associated cerebral gas embolism.

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Description

Arterial gas embolisms, albeit rare [1], can have devastating outcomes. Iatrogenic cases have mortality of 16% at hospital discharge and 21% at one year [2]. Embolization of gas during endoscopy is a rare complication with only a few cases having been reported [3] including three of our own [4]. The inciting pathophysiology remains unclear. It is likely that gas is entrained first in the venous system and then shunts to the arterial system via an arteriovenous malformation or cardiac septal defect such as a Patent Foramen Ovale (PFO). PFO with shunting can occur in up to 25% of the general population [5] making screening for PFOs impractical [6].

Endoscopy requires insufflation for better visualization. Such insufflation creates pressure gradients that have been cited as a factor in creating gas embolisms [7-9]. Apart from occlusion, vascular irritation from large boluses of air cause higher neutrophil and cytokine release leading to further inflammation [10,11].

Carbon dioxide (CO_2) is recommended over air for insufflation. CO_2 can be more readily absorbed and should not cause an occlusion in the vasculature. Several studies have been performed showed superiority of CO_2 over air in endoscopic procedures [12,13].

Diagnosis can be difficult because other causes must be ruled out, and the gas bubbles might be absorbed before the necessary test is completed. An echocardiogram can be useful [3,14,15]. However, no test, including computed tomography (CT), has adequate sensitivity to rule out gas emboli as bubbles may be reabsorbed quickly [3]. The best strategy may be prompt referral for hyperbaric oxygen therapy (HBO) based on clinical suspicion alone, given the low risk of HBO and the rapid increase of morbidity and mortality with delaying treatment [16].

As for treatment, initially, the patient should be given 100% O_2 to help dissolve the gas bubble [3]. Nitrous oxide (N_2O), if used, must be stopped immediately due its likelihood of entering the gas embolism. The use of the Trendelenburg position to reduce the likelihood of bubbles going to the brain, has been disproved and harm secondary to increased intracranial pressure and cerebral edema may result [17-20]. Positioning in the left lateral decubitus position may help remove gas from the right ventricle outflow tract [14,21]. Central venous line placement has been shown to be helpful in removing gas bubbles from the right heart [14,21].

The most beneficial therapy in eliminating the gas bubbles is hyperbaric oxygen [7,11]. HBO acts by a variety of mechanisms leading to its use in many adjunctive indications. One of its primary indications is in the treatment of gas embolism [22]. Its beneficial effects in the setting of gas emboli include: Reduced bubble volume, increased diffusion gradient out of the bubbles, oxygenation of hypoxemic tissues, amelioration of cerebral edema, reduced platelet aggregation and activation of the coagulation cascade due to bubble induced endothelial trauma, decreased endothelial binding of leukocytes and prevention of oxygen free radical release [23]. In a retrospective study of 16 patients with gas emboli, 50% of the patients made complete recoveries after HBO [11].

Time to chamber is a crucial factor. Patients who reach the chamber within five hours are twice as likely to show a full recovery as those receiving HBO after five hours [11]. There are few adjunctive therapies for cerebral gas embolism. These include IV fluids to maintain preload, inotropic support to maintain cerebral perfusion pressure and lidocaine [20]. However, rapid initiation of hyperbaric oxygen therapy cannot be overstressed.

Gas embolisms are a rare complication in endoscopic procedures that can have dire outcomes. Due to the inescapability of the factors that may cause them, one must be vigilant when performing an endoscopic procedure for the possibility of gas emboli, especially in someone with advanced pathology, in long procedures requiring interventions and much insufflation, and when using air insufflation instead of carbon dioxide. While there are few adjunctive treatments, the definitive therapy for gas embolisms is prompt hyperbaric oxygen [24-34].

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