Case Report/*Olgu Sunumu*

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Venous Air Embolism During Hysteroscopic Myomectomy: A Case Report and Evidence Based-Management

Histereskopik Miyomektomi Sırasında Hava Embolisi: Olgu Sunumu ve Kanıta Dayalı Yönetim

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ABSTRACT

Operative hysteroscopic procedures can be performed safely in the outside the operating room. During hysteroscopic surgery, there is a potential risk for air or gas to enter the circulation from exposed uterine veins. Therefore, pulmonary gas embolism is a complication during operative hysteroscopy that can have significant consequences. In this case report, we wanted to talk about air/gas embolism that developed during hysteroscopy.

A 21-year-old, 160 cm, 61 kg patient underwent hysteroscopic myomectomy. At the 70th minute of surgery, $ETCO_2$ suddenly dropped from 35 mmHg to 15 mmHg, and SpO_2 regressed to 93%. Transesophageal echocardiography revealed enlargement of the right atrium and severe stretching of the right atrial septum. The patient, whose hemodynamics improved after fluid resuscitation and cardiac supportive treatment, was extubated at the end of the operation. Avoiding excessive Trendelenburg position, selection of irrigation fluid and pressure control, surgical technique and surgical time, selection of cauterization, awareness of the anesthesia team, and rapid response time play critical roles in the management of venous air or gas embolism.

Keywords: Gynecologic anesthesia, air embolism, transesophageal echocardiography

ÖZ

Operatif histeroskopiler ameliyathane dışında güvenle yapılabilmektedir. Histeroskopik cerrahi sırasında, açıkta kalan uterus damarlarından dolaşıma hava veya gaz girmesi; bu nedenle, pulmoner gaz embolisi, operatif histeroskopi sırasında önemli sonuçlara yol açabilen bir komplikasyondur. Bu olgu sunumunda histeroskopi sırasında gelişen hava veya gaz embolisinden bahsetmek istedik.

21 yaşında, 160 cm, 61 kg ağırlığındaki hasta, histeroskopik miyomektomi için ameliyat edildi. Ameliyatın 70. dakikasında, $ETCO_2$ aniden 35 mmHg'dan, 15 mmHg'ye, SpO_2 %93'e geriledi. Transözofagiyal ekokardiyografide sağ atriyumun genişlediği ve sağ atriyum septumunun ciddi şekilde gerildiği gözlendi. Sıvı resusitasyonu ve destek tedavisi sonrasında hemodinamisi düzelen hasta operasyon bitiminde ekstübe edildi. Aşırı Trendelenburg pozisyonundan kaçınma, irigasyon sıvısı seçimi ve basınç kontrolü, cerrahi teknik ve cerrahi süre, koterizasyon seçimi, anestezi ekibinin farkındalığı ve hızlı yanıt verme süresi venöz hava embolisinin tanı ve tedavisinde kritik rol oynamaktadır.

Anahtar sözcükler: Jinekolojik anestezi, hava embolisi, transözafageal ekokardiyografi

INTRODUCTION

Hysteroscopy is considered the gold standard diagnostic tool for the evaluation and treatment of uterine intracavitary pathology (1). The increased popularity in minimally invasive gynecology and hysteroscopy turned into a new philosophy called 'see and treat'. Operative hysteroscopic procedures can be performed safely in the office with low complication rates, high-cost effectiveness, and improved patient satisfaction (2).

All complications associated with hysteroscopic surgery are related to access (traumatic or cervical tears), distention media (excessive absorption of liquid or gas), thermal and/or mechanical injuries, or a combination of all of them. During hysteroscopic surgery, there is a potential risk for air or gas to entery the circulation through exposed uterine veins. Large open venous sinuses allow entry of air or gas into the right side of the heart and pulmonary system, especially when there is a favorable pressure gradient created by the Trendelenburg position of the patient and/or the intrauterine distension due to the fluid. Therefore, pulmonary gas embolism is a known complication during operative hysteroscopy that may have significant consequences (3,4). The gas entering

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the circulation may be room air (nitrogen or oxygen) through an open cervix, gas bubbles from the products of electrosurgical vaporization, consisting mainly of hydrogen, carbon monoxide, and carbon dioxide, or during insertion and removal instruments, including the hysteroscope (4).

A sudden drop in end-tidal carbon dioxide ($ETCO_2$) pressure followed closely by a fall in peripheric oxygen saturation (SpO_2) are the characteristic signs of gas embolism. Other accompanying symptoms may vary depending on the volume and/or rate of absorption of the gas emboli. These may include decreased blood pressure, tachyarrhythmias, electrocardiographic changes suggestive of right heart failure or ischemia, and increased airway pressure (5). George A Vilos et al. reported air embolism in 5 in 5707 hysteroscopies, and Van Dijck et al. reported air embolism in 7 patients in 34 hysteroscopies. The authors mentioned the treatment algorithm with 100% O_2 support and fluid resuscitation in all cases (4,6).

In this case report, we would like to discuss an air or gas embolism during hysteroscopy and describe our evidence based management an air or gas embolism during hysteroscopy.

CASE PRESENTATION

A 21-year-old, (height:160 cm, weight:61 kg) American Society of Anesthesiologist (ASA) I patient underwent hysteroscopic myomectomy under general anesthesia. After routine anesthesia monitoring was performed, anesthesia was induced with intravenous (IV) propofol 3 mg kg^{-1}, and fentanyl 1 µg kg^{-1} and endotracheal intubation was fascilitated with IV rocuronium 0.6 mg kg^{-1} using video-laryngoscope. Anesthesia maintenance was provided with desflurane 1 Minumum Alveolar Concentration (MAC) in 50% oxygen/air. Intraoperative analgesia was maintained remifentanil infusion of 0.05 – 0.1 µg kg^{-1} min^{-1}. The patient was placed in the lithotomy with a 20° trendelenburg position. After dilating the cervix, the surgeon continued the submucous myoma excision using a morcellator with normal saline hysteroscopy. Myoma excision was difficult due to a large myoma, so the operation time was longer than expected. At the 70th min of the operation, the $ETCO_2$ was between 30 and 35 mmHg and suddenly dropped to 15 mmHg. Since air embolism was suspected, patient's position was corrected to supine and the surgical team was informed. Inspired oxygen concentration was increased to 100%. Invasive arterial monitoring was performed by inserting a catheter into the left radial artery. Blood pressure was measured as 70/50 mmHg. Arterial blood gas analysis showed metabolic acidosis. When blood pressure dropped to 60/40 mmHg, IV 10 mg of ephedrine HCL was administered. Rapid fluid resuscitation was started and transesophageal echocardiography (TEE) was performed. In TEE images, the right atrium was enlarged, the right atrium septum was severely stretched, the right ventricle was enlarged, and images consistent with air in the right system were very intense (Figures 1 and 2). The diagnosis of major air embolism was reported to the surgical team. No structural abnormality that could cause paradoxical embolism was observed in TEE images. There was no image compatible with air in the left system. Intraoperative electrocardiography (ECG) revealed right bundle branch block (RBBB) and ST-T changes. High-sensitive Troponin-T and Troponin I were analysed. Ephedrine (IV 10 mg) administration was repeated. After achieving 90/60 mmHg, $ETCO_2$ varied between 30–32 mmHg and SpO_2 was 99%. In the control TEE, the image compatible with the air in the right system completely disappeared. It was observed that the right atrium and ventricular wall tension decreased significantly. The patient, was extubated at the end of the operation uneventfully. After the operation,

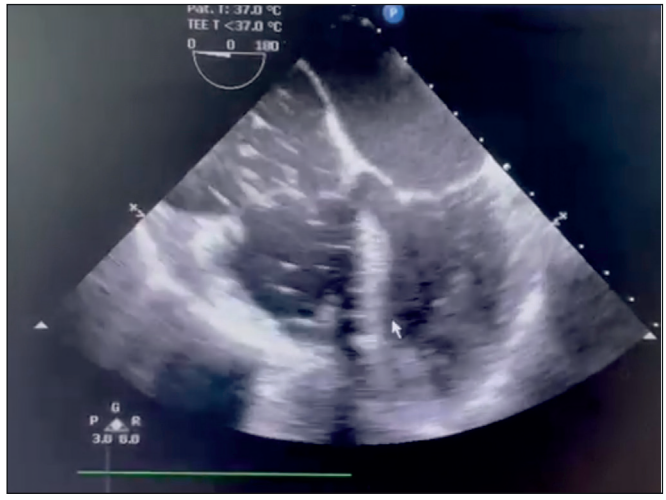

Figure 1. Transesophageal echocardiography image of massive air embolism (image compatible with air in the right system).

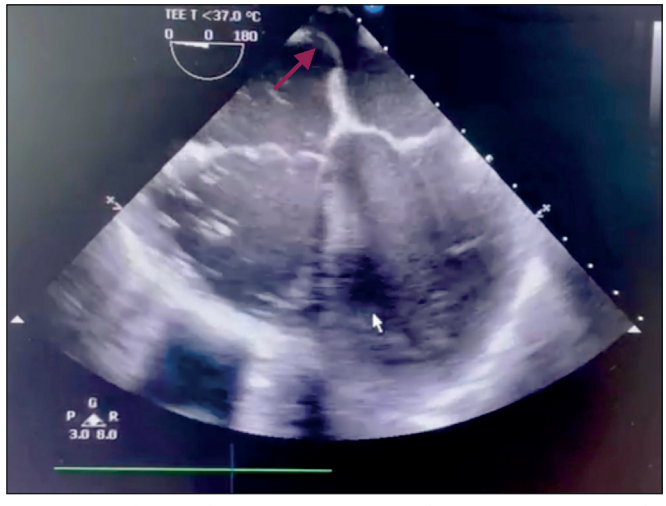

Figure 2. Right atrial septum movement due to massive air, right atrial strain image (red arrow).

T analysis and ECG were repeated, and the patient had no complaints. Electrocardiogram showed slightly decreased ST-T changes. The patient, was transferred to the gynecology ward for follow-up. Control high sensitive troponin and ECG were re-evaluated on postoperative day 1. There was no abnormality. The patient was discharged without any further adverse events.

DISCUSSION

The complication of air embolism during hysteroscopy operations was first reported in 1985 (7). The gas embolus in the pulmonary circulation causes ventilation/perfusion mismatch by increasing dead space, decreasing both $ETCO_2$ and SpO_2. Large amounts of gas can mechanically obstruct the pulmonary vasculature and increase resistance to outflow from the heart's right ventricle. This puts strain on the right side of the heart and decreases left ventricular preload, cardiac output, and blood pressure. Increased pressure in the right heart may force embolus to the left heart via a patent foramen ovale and cause paradoxical arterial embolization and cerebral and cardiac complications (8,9).

Dyrbye et al in their randomized controlled trial of 50 patients undergoing hysteroscopic surgery, observed air or gas embolism by TEE in all but one patient (10). No gas embolism was observed at less than 240 mL liquid intravasation. Gas embolism was equally observed irrespective of the type of electrosurgery; however, more extensive embolism was observed when intravasation of distension fluid exceeded 1 L. High-grade air embolisms were observed in the bipolar diathermia group, likely resulting from higher intravasation in this group. A sudden decrease in $ETCO_2$ was observed in seven of the 13 patients, and a systolic blood pressure decrease exceeding 25% of baseline was noticed in 33% of the study patients. In patients with high-grade gas emboli, more than 90% showed ST-T segment changes indicating right ventricular strain (10). Similarly to the results of previous study, we can attribute air embolsim seen in our patient to the use of more than 1 L of distention fluid and bipolar diathermia.

Storm et al. presented three fatal cases with neurological sequelae with air embolism that indicates air embolism can cause severe consequences (11). In our case, early diagnosis and intervention of severe air embolism may have resulted in the patient's uneventful discharge.

This high incidence of the presence of air necessitates awareness and prompt treatment in patients scheduled for hysteroscopy. Air embolism is possible in this type of surgery, and the entire operating room team should know about this complication and how to manage it.

CONCLUSION

Degree of Trendelenburg position, volume of irrigation fluid, duration of operation, type of diathermia, awareness of anesthesia team and fast response time play critical roles in preventing air or gas embolism.

AUTHOR CONTRIBUTIONS

Conception or design of the work: SKC

Data collection: SKC

Data analysis and interpretation: SKC, ATD

Drafting the article: SKC, ATD

Critical revision of the article: OE

Other (study supervision, fundings, materials, etc): OE

All authors (SKC, ATD, OE) reviewed the results and approved the final version of the manuscript.

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