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**Case Report**

**Keywords:** Hysteroscopic surgery, Fluid overload, Water intoxication, Multidisciplinary collaboration, Complication management

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We confirm that written informed consent was obtained from the patient for participation and publication of this case report.

**Case Report**

# Anaesthetic Management of Pulmonary Edema and Metabolic Disorders Caused by Massive Absorption of Irrigation Fluid During Hysteroscopy: A Case Report of Multiple Uterine Myomectomy

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**Abstract**

Hysteroscopic surgery is a common minimally invasive approach for treating benign gynecological conditions, but intraoperative absorption of distension media can lead to life-threatening complications. This article reports the case of a 44-year-old female who underwent combined hysteroscopic-laparoscopic myomectomy for multiple uterine fibroids. The prolonged surgical duration due to discrepancies between preoperative ultrasound assessment and actual lesions resulted in massive absorption of normal saline irrigation fluid, manifesting as metabolic acidosis, hypokalaemia, hypocalcaemia, and haemodilution. Anesthesiologists detected early signs of fluid overload through subtle changes in lung auscultation and promptly implemented interventions, including furosemide diuresis and potassium supplementation. The patient regained consciousness postoperatively and was discharged uneventfully. This case highlights that preoperative imaging assessment inaccuracies, insufficient intraoperative team risk communication, and a lack of dynamic fluid monitoring were key contributing factors to excessive fluid absorption. Vigilance and decisive interventions by anesthesiologists are crucial

for successful management. This case provides practical insights for optimizing preoperative evaluation, intraoperative fluid control, and multidisciplinary collaboration mechanisms in hysteroscopic surgeries, emphasizing the importance of establishing standardized fluid safety thresholds and team communication protocols.
Keywords: Hysteroscopic surgery, Fluid overload, Water intoxication, Multidisciplinary collaboration, Complication management

## Introduction

Hysteroscopic surgery has become a widely applied minimally invasive technique for the treatment of benign gynecological diseases, with indications covering common conditions such as abnormal uterine bleeding, endometrial polyps, and submucosal uterine fibroids[1][2]. The cumulative incidence of uterine fibroids among women of reproductive age has reached 70%-80%, further highlighting the importance of minimally invasive treatment strategies. Overall, hysteroscopic surgery demonstrates good safety, with a complication rate of approximately 2.3/1000 cases, although the complication risk for operative hysteroscopy can be three times higher than that for diagnostic procedures[1]; another study involving 5,474 surgeries reported a uterine perforation rate of 0.27%, with surgical hysteroscopy showing significantly higher perforation rates (1%) than diagnostic hysteroscopy (0.06%) did[2]. Additionally, the average incidence of intrauterine adhesions following hysteroscopic myomectomy is approximately 10%, with higher risks associated with specific conditions such as multiple or kissing fibroids[3]. Notably, surgical hysteroscopy also carries risks of fluid perfusion-related complications, including fluid overload, pulmonary edema, and electrolyte disturbances[4]; previous studies have reported an overall incidence of fluid absorption-related complications during hysteroscopic surgery ranging from 0.22% to 3.7%. Although the overall incidence of these complications is relatively low, the potential risks of specific complications still require clinical vigilance, particularly as fluid absorption-related adverse events can rapidly progress to life-threatening conditions[5].

Fluid absorption-related complications remain among the most challenging issues in hysteroscopic surgery. The procedure relies on distension media to maintain uterine cavity visualization, but low-osmolarity, electrolyte-free distension fluids can be massively absorbed into the bloodstream through open venous sinuses or endometrial vascular beds, leading to dilutional hyponatremia and circulatory hypervolemia, with pathophysiological processes similar to those of transurethral resection of prostate syndrome (TURP syndrome)[6][7]. Although relatively rare, these complications can have severe consequences: the incidence of hyponatremia can reach 4/7 during myomectomy, with the severity correlating with fibroid size[8]; case reports have shown that fluid absorption causes serum sodium levels to decrease to 78 mmol/L, accompanied by secondary laryngeal edema, acute respiratory distress syndrome, and multiple organ dysfunction, including disseminated intravascular coagulation. In other cases, the intraoperative sodium concentrations decreased to 87 mmol/L, 106 mmol/L, and 104 mmol/L, all of which necessitated aggressive intervention to prevent permanent neurological damage. Overall, the reported incidence of fluid overload with hyponatremia during hysteroscopic surgery can reach 6%, which can progress to pulmonary edema, cerebral edema, and even death if not promptly recognized and managed[9]. Despite established monitoring protocols, fluid absorption can accumulate rapidly within short time frames (with reported net irrigation fluid reaching 11,900 mL in one case) and manifests clinically even at low absorption volumes (e.g., 2,400 mL), highlighting the time-sensitive nature and challenges of early recognition[10]. Severe hyponatremia may also trigger seizures and cerebral edema, with postoperative sodium levels decreasing to 84.1 mmol/L followed by convulsions[11]; another case involved acute water intoxication leading to cardiac arrest requiring extracorporeal membrane oxygenation (ECMO) and continuous veno-venous hemofiltration (CVVH)[12]. Furthermore, water intoxication-related

clinical symptoms may be masked under general anaesthesia, further complicating early detection[12]. With respect to fluid management strategies, studies suggest that maintaining the intraoperative mean arterial pressure at 100%-120% of baseline values can significantly reduce the incidence of pulmonary edema and decrease distension fluid absorption[13]; however, other studies have indicated that maintaining intrauterine pressure below the mean arterial pressure reduces the risk of intravascular fluid absorption. Lung ultrasound has also been employed for early diagnosis and assessment of intraoperative and postoperative pulmonary edema[14]. This challenge becomes particularly prominent in complex uterine fibroid surgeries. This case report describes a 44-year-old female who underwent combined hysteroscopic-laparoscopic myomectomy for multiple uterine fibroids and experienced severe complications related to hysteroscopic irrigation fluid absorption. The uniqueness of this case manifests in three interrelated aspects: preoperative ultrasound assessment discrepancies with intraoperative findings, significantly prolonged surgical duration and continuous irrigation fluid absorption, increasingincreased fluid overload risk, and precise recognition of early fluid absorption signs through hemodynamic monitoring and dynamic laboratory parameter changes by intraoperative anesthesiologists, demonstrating critical decision-making value in multidisciplinary collaboration; ultimately, successful patient recovery with favourable outcomes. This case highlights the decisive importance of close coordination between anaesthesia management and gynaecological surgical teams for early detection and effective management of such complications in complex fibroid surgeries while also providing practical experience for optimizing preoperative imaging evaluation, intraoperative fluid management strategies, and team communication mechanisms in clinical practice. This report aims to increase clinicians' vigilance regarding this complication and emphasize the central role of multidisciplinary collaboration in ensuring patient safety.

## Case Overview

The patient was a 44-year-old female, 150 cm tall and weighing 55 kg, with a previously healthy medical history. In 2011, she underwent an appendectomy for her appendicitis. Preexisting comorbidities included hypertension, cardiac disease, and hepatic and renal disorders. On the day of elective surgery for a “submucosal uterine leiomyoma and multiple intramural uterine fibroids (anterior wall: 3 cm; posterior wall: 1.5 cm; intramural fibroid below the anterior wall: 2.5 cm)”, the patient was admitted to the operating room at 09:50. In the absence of oxygen supplementation, her blood oxygen saturation was 99%, her blood pressure was 135/70 mmHg, and her vital signs were stable. At 09:55, general anaesthesia was induced with sequential intravenous boluses of 30 μg of sufentanil, 25 mg of cyclobenzaprine, and 50 mg of rocuronium. Endotracheal intubation proceeded smoothly, and postintubation bilateral lung breath sounds were clear and symmetrical. At 11:00 during the operation, the preoperative ultrasound findings regarding the fibroids did not match the actual intraoperative lesions, specifically because the presence of fibroids was not reported on the ultrasound. Nevertheless, the hysteroscopic myomectomy procedure continued. By 11:20, the operation had not yet concluded; the anesthesiologist repeatedly advised the surgeon to complete the procedure as soon as possible and suggested transitioning to laparoscopic surgery or performing a staged second-stage procedure. The surgeon responded accordingly. At 12:25, the anaesthesiologist assessed the patient’s spontaneous respiratory function and removed the endotracheal tube. The patient was in a drowsy state and failed to open her eyes upon verbal stimulation; pure oxygen via a face mask was administered, and blood oxygen saturation was maintained at 99%. At 12:30, the patient was transferred to the anaesthesia recovery room for monitoring. At 13:00, the patient regained consciousness and could cooperate with verbal commands, reporting dizziness and nausea. At 14:00, attempts were made to remove residual hysteroscopic irrigation fluid, totaling 5 bags of normal saline, with a total irrigation volume of 15,000 mL. Intraoperative drainage was 3,500 mL, and postoperative drainage was 3,000 mL, resulting in a total output of 6,500 mL. On the day

following the procedure, the patient reported throat pain and cough with sputum production; symptomatic treatment via nebulized inhalation was administered. Follow-up laboratory tests revealed a hemoglobin concentration of 12 g/L, white blood cell count of 15.29 × $10^9$/L, serum potassium concentration of 3.43 mmol/L, and serum sodium concentration of 141 mEq/L.

## Discussion

This case involved a 44-year-old female patient who underwent combined hysteroscopic–laparoscopic surgery for multiple uterine fibroids. During the procedure, significant prolongation of the operation time occurred because of discrepancies between the ultrasound findings and intraoperative observations, leading to massive absorption of normal saline irrigation fluid. The patient manifested metabolic acidosis, hypokalaemia, hypocalcemia, and hemodilution. Consciousness was restored, and the patient was discharged successfully after diuresis, potassium supplementation, and postextubation oxygen therapy. Although hysteroscopic surgery is minimally invasive and has an overall low complication rate, fluid overload remains a serious complication requiring high vigilance, occurring in a certain proportion of cases and potentially being life-threatening. This case highlights the critical role of anesthesiologists in maintaining high alertness when imaging findings conflict with surgical field observations. Early identification of water intoxication through subtle changes in lung auscultation and prompt intervention is crucial for successful management, laying the foundation for further analysis of fluid absorption mechanisms, pathophysiological evolution, and treatment strategies.

The total hysteroscopic irrigation fluid volume in this case reached 15,000 ml, far exceeding the conventional amounts reported in the literature. Excessive fluid absorption involves multiple contributing factors. Discrepancies between intraoperative ultrasound reports and surgical findings led to additional myomectomy procedures beyond the original surgical plan, substantially prolonging the operative time. Large-scale studies have confirmed that prolonged surgical duration is an independent risk factor for fluid absorption in transurethral endoscopic procedures[15]. Other studies have shown an increased risk of fluid absorption-related complications with extended surgical time. Data from hysteroscopic procedures indicate an average fluid deficit of only 480 ml with a mean operative time of 26 minutes, supporting a clear dose–effect relationship between surgical duration and fluid absorption from both positive and negative perspectives. Furthermore, this submucosal myomectomy case carried potential risks of opening uterine venous sinuses or exposed intramural vessels, with multivariate analyses confirming that open venous sinuses significantly increase the risk of irrigation fluid absorption. Notably, the anesthesiologist repeatedly warned about fluid overload risks and suggested alternative surgical approaches, but these were not adopted until signs of pulmonary edema emerged. Previous endoscopic literature also emphasizes that inadequate monitoring of irrigation fluid input–output can lead to undetected massive absorption, necessitating preset time limits for difficult procedures. Studies indicate that close intraoperative monitoring of perfusion fluid volume and time restrictions can effectively prevent such complications, with some studies suggesting procedure termination when fluid deficit reaches certain thresholds[16]. This case demonstrates that in hysteroscopic myomectomy, discrepancies between imaging assessments and actual lesions, inadequate response to intraoperative warnings, and deficient team fluid management coordination may represent common predisposing factors for excessive fluid absorption.

The superposition of these multiple risk factors ultimately triggered the pathophysiological process of massive normal saline irrigation fluid absorption in this case, which manifested as multisystem chain reactions. Intraoperative blood gas analysis revealed that the preoperative hemoglobin concentration decreased from 13 g/L to 9.1 g/L and that the preoperative hematocrit concentration decreased to 28%, indicating significant hemodilution. A pH of 7.153 and a $HCO_3^-$ concentration of 13.6 mmol/L indicated severe metabolic acidosis, which is consistent with the

clinical features of isotonic irrigation medium absorption reported in the literature[10]. Decreased serum potassium (2.4 mmol/L) and calcium (0.78 mmol/L) levels may result from dilution effects and intracellular shifts under stress, with the literature reporting that hypokalaemia and metabolic acidosis are accompanied by excessive fluid absorption[5]. The evolution of pulmonary edema—from bilateral coarse breath sounds to reduced left lung rales after furosemide administration—is consistent with reports of rapid pulmonary edema resolution following diuretic treatment. These reports also mention safety thresholds for isotonic medium absorption, with this case's 15,000 ml irrigation volume far exceeding such thresholds, explaining the occurrence of pulmonary edema. Hysteroscopic fluid overload can lead to pulmonary edema and potentially progress to acute respiratory distress syndrome[4], with the pathological mechanisms of pulmonary edema following massive fluid absorption documented in the literature[17][18]. Notably, the patient's serum sodium concentration remained normal at 145 mmol/L, differing from that associated with classic hyponatremic water intoxication. Similar cases of isotonic crystalloid absorption-induced pulmonary edema without hyponatremia have been reported in the literature[18], suggesting that isotonic fluid absorption primarily manifests as volume overload and hemodilution rather than hypotonic medium-induced cerebral edema. In contrast, hyponatremia and related neurological complications are more prominent when electrolyte-free hypotonic irrigation media is used[19][11].

In terms of these pathophysiological processes, the anaesthesiologist's immediate implementation of furosemide diuresis, potassium supplementation, and additional staged diuretics clearly demonstrated pathophysiological targeting. The literature indicates that fluid overload from irrigation fluid absorption during hysteroscopy can cause severe complications such as pulmonary edema, with diuretics being common interventions[13]. Early furosemide use also facilitates pulmonary edema resolution[20]. In this case, timely potassium supplementation for intraoperative hypokalaemia (2.4 mmol/L) maintained myocardial and neuromuscular stability, which is consistent with the literature emphasizing electrolyte correction, particularly hypokalaemia management, in the management of hysteroscopic complications[21], which further highlights that severe hypokalaemia significantly increases treatment difficulty. Postoperative hypoxemia ($SpO_2$ 89%-90%) requiring oxygen monitoring after extubation suggests caution in the timing of extubation and the need for postanaesthesia care unit monitoring when fluid overload persists. The literature reports that general anaesthesia may mask water intoxication symptoms and delay diagnosis[12], further emphasizing the need for postoperative monitoring. The sequential interventions of diuresis, potassium supplementation, respiratory support, and postextubation monitoring addressed the core pathological aspects of fluid overload, electrolyte imbalance, and pulmonary dysfunction, establishing reasonable causality with favourable outcomes.

This case's uniqueness lies in the discrepancies in preoperative imaging–surgery findings, which resulted in significant operative time prolongation, coupled with insufficient vigilance from the surgical team toward increasing fluid absorption risk, creating major fluid management challenges. The literature indicates that excessive irrigation fluid absorption can cause water intoxication, with a fibroid diameter ≥4 cm being an independent predictor of irrigation fluid volumes exceeding 5000 ml. Preoperative focused ultrasound ablation to reduce fibroid size before hysteroscopy may decrease surgical difficulty and complication risks[22]. Notably, bipolar hysteroscopy reduces hyponatremia risk but still has water intoxication risks closely related to perfusion fluid volume, necessitating meticulous intraoperative monitoring[23]. Simultaneously, transurethral prostatectomy and hysteroscopic water intoxication correlate with fluid load and surgical duration, necessitating careful fluid measurement and monitoring[24]. Massive irrigation fluid absorption can cause volume overload, pulmonary edema, congestive heart failure, and electrolyte imbalance[25], with hysteroscopic fluid absorption risk factors including open uterine venous sinuses, uterine perforation, prolonged surgery, and excessive perfusion pressure. As general anaesthesia may mask water intoxication symptoms and delay diagnosis[12], severe cases

may even lead to cardiac arrest[12]. Anesthesiologists' detection of subtle lung auscultation changes and timely intervention proved crucial in this case. This highlights the need for closer anesthesiology-gynecology team collaboration, optimized fluid balance monitoring, and heightened vigilance in similar high-risk scenarios to improve risk预警 and rapid response protocols.

As a single case report, this study has inherent limitations, including potential confounding from individual variations, surgical details, and anaesthesia management factors. The lack of long-term complication follow-up or renal function data restricts the generalizability of the conclusions. Therefore, universal conclusions should not be drawn. Future large-scale prospective studies are needed to systematically evaluate optimized real-time fluid absorption monitoring strategies (e.g., dynamic ultrasound assessment and end-tidal ethanol concentration monitoring) in hysteroscopy and quantify the preventive effects of standardized team communication on perioperative fluid safety events. Various intraoperative monitoring and management strategies for reducing pulmonary edema risk have been explored[13], with ultrasound also aiding early detection of fluid overload and pulmonary edema. This case report further suggests that strengthening multidisciplinary collaboration and establishing patient safety-centered surgical culture have important practical implications for preventing such avoidable complications.

Conclusion: This case report describes a scenario in which hysteroscopic myomectomy resulted in a prolonged operation duration because of discrepancies between preoperative imaging findings and intraoperative observations, subsequently leading to severe irrigation fluid absorption-related complications. Through the anaesthesiology team's ability to detect subtle changes in pulmonary auscultation, coupled with timely interventions such as diuresis and potassium supplementation, the patient achieved a favourable outcome.

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