

CASE REPORT

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Pulmonary edema in a pediatric patient undergoing ureteroscopy: a case report

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Abstract

Background: This report demonstrates a case of pediatric pulmonary edema, detected due to the overuse of irrigation fluids during ureteroscopy.

Case presentation: A 7-year-old girl was hospitalized due to the large number of opaque stones in the right kidney. After extubation, the patient's oxygen saturation dropped down to 85%, and respiratory distress was observed. It was determined that the surgical team used 5 Lt 0.9% NaCl solution as irrigation fluid. Positive pressure ventilation with mask continued, and intravenous bolus injection of furosemide was administered to the patient with a preliminary diagnosis of pulmonary edema.

Conclusions: In prolonged operations, patients should be checked for the presence of pulmonary edema with lung auscultation, and noninvasive mechanical ventilation and diuretic treatment should be instituted if necessary.

Keywords: Fluid therapy, Noninvasive positive pressure ventilation, Pulmonary edema, Ureteroscopic surgery

Key messages

Pulmonary edema after ureteroscopy (URS) is a rare complication. Approximately 1 mL of irrigation fluid is absorbed per minute during URS in the presence of intact ureter. Therefore, pulmonary edema may occur in prolonged operations.

Background

Ureteroscopic (URS) procedures are the most frequently used diagnostic and therapeutic methods for the management of ureteral stones in ureter and kidney pathologies (Li et al., 2017; Turk et al., 2016). Generally, saline is used as an irrigation fluid, and it is not known how much of this liquid is absorbed during URS (Cybulski et al., 2004). During the other endoscopic urological procedures using hypotonic solutions as irrigation fluids, fluid overload, hyponatremia, hemolysis, and congestive heart failure may develop (TUR syndrome) (Johnson & Pearle, 2004). However, pulmonary edema after URS is a rare condition in the presence of an intact urinary

collecting system (Johnson & Pearle, 2004; Abdelrazzak & Bagley, 1992). In this article, we present a case of pediatric pulmonary edema detected due to the overuse of irrigation fluid in URS, which was successfully treated after extubation.

Case presentation

A 7-year-old girl (22 kg, 110 cm) was hospitalized for the purpose of endoscopic lithotripsy due to the large number of opaque stones (biggest one 1 cm) which took the shape of middle and lower pole calyceal structures in the right kidney. Her medical past was not remarkable except for a history of bilateral hydronephrosis and percutaneous nephrolithotripsy. Written informed consent was obtained from the patient's parents. The patient was given midazolam (0.5 mg/kg) for peroral premedication, and general anesthesia was performed under standard anesthesia monitoring (electrocardiogram, pulse oximetry, noninvasive blood pressure, and esophageal temperature monitoring). Atropine (10 µg/kg IV), ketamine (0.5 mg/kg IV), dexamethasone (0.5 mg/kg IV), and rocuronium (0.6 mg/kg IV) were administered to the patient after induction of anesthesia with 8% sevoflurane

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inhalation. Maintenance of anesthesia was provided with sevoflurane (0.5–1 MAC), remifentanyl infusion (0.25–0.5 $\mu\text{g}/\text{kg}/\text{min}$), and rocuronium (0.15 mg /kg IV) when necessary. Mechanical ventilation settings after intubation with volume control mode were as follows: tidal volume (6 ml/kg 130 mL), respiratory rate (25/min), positive end-expiratory pressure (PEEP 5 cmH_2O), fraction of inspired oxygen (FiO_2 45%), peak pressure 14 cmH_2O , and plateau pressure 12 cmH_2O (The Dräger Perseus A500 (Perseus) anesthetic workstation, Dräger Medical, Lubeck, Germany). Ventilator settings were not changed, and secretions in endotracheal tube were not detected throughout the operation. The fluid treatment was provided with 4/2/1 rule (Holliday and Segar formula) and 0.9% NaCl. The operation time was 200 min, and the anesthesia period was 220 min. Totally, 600 mL of fluid was given to the patient. At the end of the operation, a urinary catheter was inserted to the patient who underwent endoscopic ureteral stone treatment. The neuromuscular blockade was reversed with sugammadex (4 mg/kg IV). After extubation, the patient's oxygen saturation dropped down to 85% (room air), and respiratory distress (respiratory rate 40/ min, noninvasive arterial blood pressure 85/40 mmHg, and heart rate 135 bpm) was observed. Positive pressure ventilation with mask continued, and widespread crepitant rales were detected in lung auscultation. It was determined that the surgical team used 5 Lt 0.9% NaCl solution as irrigation fluid. A bolus dose of furosemide (0.5 mg /kg IV) was administered to the patient with a preliminary diagnosis of pulmonary edema. After 5 min, the same dose of furosemide was repeated. Pulmonary edema was confirmed on posterior-anterior chest X-ray obtained in the operating room (Figs. 1 and 2). After 2 bolus doses of furosemide, the patient had 300 ml of urine output. As 0.9% NaCl was used as irrigation fluid, there was no electrolyte disturbance in biochemical analysis. After positive



Fig. 1 Preoperative posterior-anterior chest radiograph

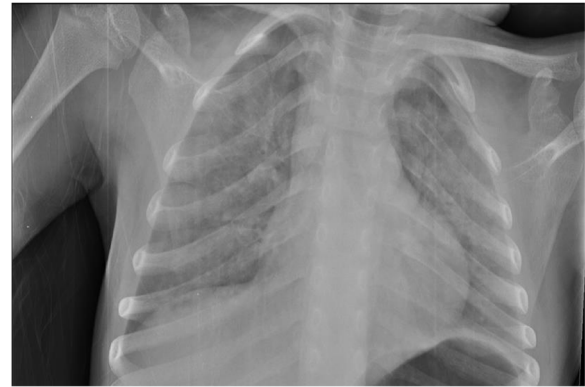


Fig. 2 Postoperative posterior-anterior chest radiograph

pressure mask ventilation was applied for 40 min without reintubation, oxygen (5 L/min) therapy was started with a simple face mask (noninvasive arterial blood pressure 90/45 mmHg, heart rate 115 bpm, oxygen saturation 94%, and respiratory rate 26/min). The patient was taken to the ICU, and 24-h fluid balance was maintained with furosemide (6 \times 0.5 mg/kg IV) around minus 500 mL. Furosemide and oxygen therapy were terminated at the postoperative 24th hour, and the patient was followed up in the service. She was discharged from the hospital on postoperative 3rd day without any further complications.

Discussion

Ureteroscopic procedures are effective diagnostic as well as therapeutic methods for the management of upper urinary tract pathologies such as ureteral strictures, ureteropelvic obstruction, and upper urinary tract carcinomas (Li et al., 2017; Turk et al., 2016; Cybulski et al., 2004; Johnson & Pearle, 2004). The most recent guidelines suggest that the complication rates after URS range between 9 and 25%, and severe complications such as urethral rupture or stenosis development are rare (< 1%). Most of the complications are simple to treat, and observation of the patients is sufficient (Li et al., 2017; Turk et al., 2016; Cybulski et al., 2004; Johnson & Pearle, 2004; Abdelrazzak & Bagley, 1992).

In an intact urinary collecting system, only small amounts (1 mL per minute) of the irrigation fluid are absorbed to the systemic circulation. However, when ureteral perforation occurs during URS, the systemic absorption of the irrigation fluid accelerates and can double (Cybulski et al., 2004). Cybulski et al. (Cybulski et al., 2004) stated that the duration of URS affects the amount of liquid absorbed rather than the amount of fluid used during URS. The use of physiological saline solution as irrigation fluid ensures avoidance of electrolyte disturbance (especially hyponatremia), convulsion,

and hemolysis which are usually seen in TUR syndrome, even if an insignificant amount of fluid is introduced into the systemic circulation.

This is more common in patients requiring sorbitol or glycine irrigation and use of an electrosurgical probe. The use of pressurized irrigation solution may contribute to calyceal perforation or rupture (Johnson & Pearle, 2004). Abdel-Razzak et al. (Abdelrazzak & Bagley, 1992) reported extravasation only in three of their 290 cases (1%). However, a retrograde pyelogram is not routinely performed on these patients. The degree of urinary extravasation is likely to vary depending on the size of the perforation and the length of the operation. Li et al. (Li et al., 2017) reported that they applied 66 flexible ureteroscopic lithotripsy procedures in 55 pediatric patients aged between 3 and 36 months each lasting between 15 and 90 min (mean 30 min), and they used an average amount of 500 mL (200–1200 mL) isotonic solution as irrigation fluid. The authors did not describe excessive volume loading in any patient.

In our patient, 5000 mL isotonic solution was used as an irrigation fluid due to prolonged operation time. Due to longer operation time and use of pressurized irrigation, the amount of fluid absorbed to the circulation led to pulmonary edema. Approximately 1 mL of irrigation fluid is absorbed per minute during a URS in the presence of intact ureter. Using this rough estimate, we think that at least 200 mL of fluid was added to the systemic circulation during the 200 min of URS procedure and caused pulmonary edema due to heart failure. If urinary tract is damaged, this amount should be expected to be higher. Pulmonary edema was regressed with diuretics and noninvasive mechanical ventilation and rapidly treated. The use of isotonic fluid as an irrigation fluid prevented the appearance of signs and symptoms of TUR syndrome such as hyponatremia, hemolysis, confusion, and convulsions. Thus, orotracheal intubation was not required and the patient responded to treatment more quickly.

Conclusion

If urinary collecting system is intact, only small amounts of irrigation fluid may be absorbed systemically. However, in prolonged operations, small amounts of absorbed fluids can lead to pulmonary edema. Therefore, patients should be checked for pulmonary edema by lung auscultation and noninvasive mechanical ventilation, and diuretic therapy can be tried primarily in patients who develop pulmonary edema.

Abbreviations

NaCl: Sodium chloride; URS: Ureteroscopy; TUR syndrome: Transurethral resection syndrome

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Authors' contributions

ITD: designed, literature searched, collected the data, wrote and critically reviewed the manuscript. CS: designed, literature searched, collected the data, wrote and critically reviewed the manuscript. TB: designed and critically reviewed the manuscript. All authors approved the final version of the manuscript.

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Availability of data and materials

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Declarations

Ethics approval and consent to participate

Ethics approval is not required, and consent was taken.

Consent for publication

Written informed consent was taken from the patient's parent for the publication of this case.

Competing interests

The authors declare that they have no competing interests.

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