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(CASE REPORT)

Iatrogenic hydrohemothorax during percutaneous nephrolithotomy: A case report

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Abstract

Background: Percutaneous nephrolithotomy (PNL) is a widely used surgical method for renal stone management. However, it can be associated with several complications.

Case: We report an acute hemothorax during PNL in 57-year-old male patient with a stone. After observing air bubbles at the diaphragm on the laparoscopic screen, we considered pulmonary complications. A chest radiograph demonstrated a shade that measured 130 mm wide and 70 mm long and fluid retention on the right side of the chest. During drainage of 200 ml of blood through a chest tube, the patient's vital signs became unstable. After the patient received hydration and intravenous injection of vasopressor, his vital signs stabilized.

Conclusions: Pulmonary complications due to pleural injury during PNL can result in death, but the complications can be managed by early diagnosis and treatment. Close cooperation between surgeon and anesthesiologist and routine chest radiographs after PNL can reduce the pulmonary complications.

Keywords: Complications; Iatrogenic diaphragmatic injury; Hemothorax; Percutaneous nephrolithotomy; Supracostal approach

1. Introduction

Since percutaneous nephrolithotomy (PNL) was first introduced by Fernstrom and Johansson in 1976 [1], this minimally invasive surgery has been widely used, especially for large and complex renal stones. Like other minimally invasive surgeries, PNL has advantages of reduced morbidity, short operative time and hospital stay, cost-effectiveness, and fewer complications [2].

During PNL and according to the location of the renal stone, either a subcostal or a supracostal approach can be used to approach the renal calyx. Percutaneous access to the mid and lower poles of the kidney can be achieved via the subcostal approach, and access to staghorn, upper ureteral and upper caliceal calculi can be achieved via the supracostal approach.

The lungs and pleura are susceptible to injury during PNL, with an occurrence ratio of 8% in a prospective study of 100 [3]. Pulmonary complications are a significant cause of mortality and include pneumothorax, hydrothorax, and hemothorax. We report a case of iatrogenic hemothorax during PNL in the operating room that was successfully managed by chest tube insertion and drainage.

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2. Case Report

A 57-year-old male (174 cm, 77 kg) with a staghorn stone in the right kidney was hospitalized for treatment with PNL. His past medical history included well controlled hypertension. Preoperative examinations of the patient were within the normal limit. Preoperative evaluations, including chest radiography (Fig. 1A), electrocardiography, and blood laboratory tests, were normal.

After intramuscular midazolam 3.0 mg and atropine 0.5 mg were preoperatively administered, propofol and rocuronium were injected intravenously to induce anesthesia. Endotracheal intubation was performed, and mechanical ventilation with a tidal volume of 7 mL/kg and a respiratory rate adjusted to normocapnia were provided. Anesthesia maintenance was secured with desflurane in a 50% O_2-air mixture. Standard monitoring, including continuous electrocardiography, pulse oximetry (SpO_2), and end-tidal CO_2 ($ETCO_2$), was applied. A left radial artery cannula was inserted to assess invasive blood pressure and perform blood sampling during the intraoperative period. The arterial blood gas analysis showed all parameters to be within normal limits.

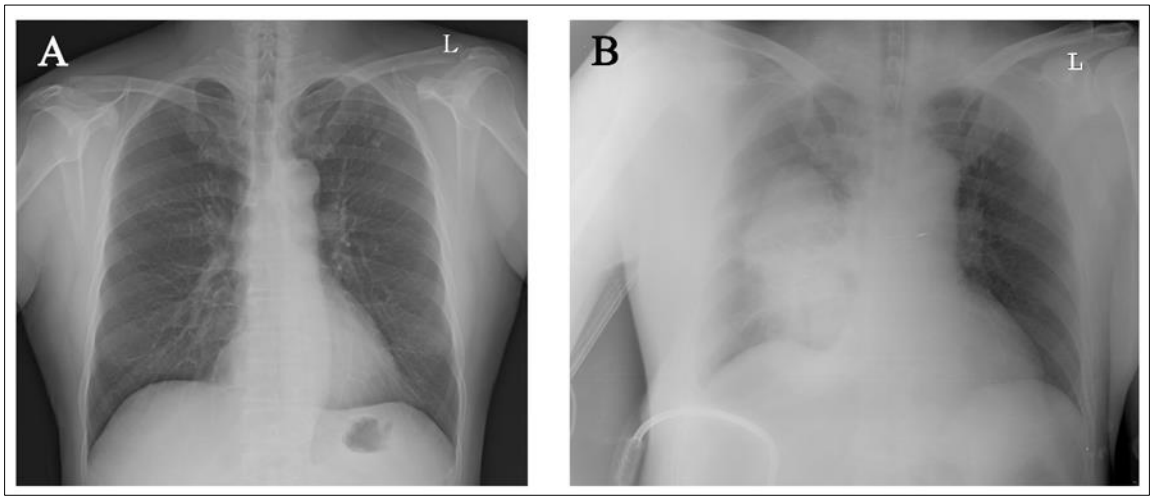

Figure 1 Chest radiographic findings. (A) Preoperative chest radiograph shows normal findings. (B) Chest radiograph in the operating room reveals fluid retention of 130 mm x 70 mm, suspicious for hydro- or hemothorax, on the right middle and lower thorax

Figure 2 Postoperative radiographic findings. Hydrohemothorax was resolved by insertion of a thoracostomy tube

With the patient in the lithotomy position, cystoscopy, retrograde ureteropyelography on the right side, and ureteric catheter insertion were performed as the initial steps before PNL. Afterward, the patient was turned over to the prone position for PNL. At that time, both lung sounds were normal, and the maximum airway pressure (MAP) was 17 cmH_2O. Insertion of the working sheath was performed in the "lung down" position to prevent pleural injury. About two hours after commencing surgery, the surgeon noticed air bubbles under the right diaphragm on the laparoscopic screen. Iatrogenic diaphragm rupture caused by a laparoscopic instrument was strongly suspected. At that time, pulmonary auscultation, end tidal carbon dioxide observation, and arterial blood gas test were normal, and the MAP was 17 cmH_2O.

An emergent chest radiograph revealed fluid retention (130 mm x 70 mm) suspicious for hemothorax on the right (Fig. 1B). A chest tube was inserted and drained approximately 200 mL of blood. During thoracic drainage, the patient's blood pressure suddenly decreased to 60/40 mmHg, and heart rate increased to 130 beats per minute. We administered ephedrine 10 mg intravenously with sufficient hydration, and the blood pressure increased to 100/60 mm Hg while the pulse rate decreased to 105 beats per minute. An arterial blood gas analysis showed all parameters to be within normal limits. Following hemodynamic improvement, the patient was extubated uneventfully with reversal by sugammadex 150 mg and was taken to the post-anesthesia care unit (PACU). Follow-up chest radiograph showed that the hemothorax was resolved by the thoracostomy tube (Fig. 2).

3. Discussion

According to studies using the National Health and Nutrition Examination Survey (NHANES), renal stone is common, found in 19% of men and 9% of women before age 70 [4]. Approximately 10% to 20% of all renal stones require surgical removal. The three minimally invasive surgical techniques most widely used are PNL, rigid and flexible ureteroscopy (URS), and shock wave lithotripsy (SWL). These techniques offer significant benefits in terms of patient morbidity and cost compared with conventional open renal surgery. Large (>2 cm in diameter) or complex stones (like staghorn stones and cystine stones) that are resistant to SWL are indications for PNL.

Due to the anatomical proximity of the kidney to the pleural cavity, PNL carries a risk of pleural injury, especially during upper pole renal access [5]. Pleural injury is associated with high risk of intrathoracic complications. In one study of upper pole percutaneous access for PNL, the total intrathoracic complication rate was 2.6% (eight in 300), and seven of eight intrathoracic complications (87.5%) developed in supracostal cases [6].

Symptoms of intrathoracic complications from pleural injury depend on the size and body side of the defect and coexistent pulmonary disease. Although pleural injury impairs ventilation and oxygen delivery, diagnosis is difficult because the time to onset of symptoms varies from minutes to days. Therefore, clinicians must maintain a high index of suspicion, especially in patients who cannot express their symptoms due to intubation. To minimize the risk of pleural injury, clinicians must perform deflation of the lung and standstill of ventilation during percutaneous access puncture. In addition, anesthesiologists must pay attention to changes in airway pressure, SpO_2, and/or a decrease in $ETCO_2$, and they should auscultate the lungs before and after pleurotomy with a percutaneous puncture. A close working relationship between the surgeon and the anesthesia team is essential in the process of discovering and treating these complications, which can be life-threatening.

In our case, there were no significant change in airway pressure, SpO_2, or $ETCO_2$ intraoperatively. Only a temporary drop in blood pressure occurred during drainage of blood through the chest tube after hemothorax was confirmed. The air bubble, noted on the laparoscopic screen by the surgeon, led to suspicion of pleural injury. Consequently, chest radiograph quickly performed in the operating room allowed immediate diagnosis of hemothorax before aggravation of symptoms.

Case reports about pulmonary complications after PNL have been shared to highlight the importance of suspicion and immediate chest tube insertion for treatment. Lee et al [7] reported that the signs of a massive hydrothorax were elevation of peak airway pressures to 27 cmH_2O, $ETCO_2$ to 36 cmH_2O, and absence of breath sounds on the right during auscultation. In another case [8], the signs of acute hemothorax were decreased left-sided breath sounds on auscultation, abrupt decrease of systolic blood pressure to 60-70 mm Hg, and pale face and conjunctiva. Therefore, complications due to pleural injury show various patterns, from asymptomatic to severe hypotension. Furthermore, depending on the size and location of the pleural injury and the volume of the hemothorax, the injury might not be discovered until the patient leaves the PACU. Therefore, a chest radiograph in the PACU is recommend after every PNL and whenever pulmonary complication is suspected. Chest radiograph or fluoroscopic monitoring of the chest is a sensitive tool for timely diagnosis of pneumothorax and hydro/hemothorax [9].

4. Conclusion

Vigilance by the anesthesiologist and an understanding of the anatomy of the surgical site are needed during PNL. Moreover, the anesthesiologist should be aware that hemodynamic or physical changes can appear unclear or late, so pulmonary imaging and appropriate treatment should be determined early.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

The authors have no ethical conflicts to disclosure.

Statement of informed consent

Patients had signed the informed consent for submission of case report and any accompanying images.

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