



Case Report

Hemothorax during miniaturized endoscopic combined intrarenal surgery under ureteroscope-assisted ultrasound-guided access

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Abbreviations & Acronyms

mini-ECIRS = miniaturized endoscopic combined intrarenal surgery
PCNL = percutaneous nephrolithotomy
POD = postoperative day
US = ultrasound
VATD = video-assisted thoracoscopic debridement

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Received 13 March 2019;
accepted 19 May 2019.
Online publication 9 June 2019

Introduction: Hemothorax is a rare but life-threatening complication following mini-endoscopic combined intrarenal surgery. Herein, we describe a patient with left staghorn kidney stone who presented with hemothorax following mini-endoscopic combined intrarenal surgery under ureteroscope-assisted ultrasound-guided access.

Case presentation: A 47-year-old woman with left staghorn kidney stone underwent mini-endoscopic combined intrarenal surgery, after which she developed shortness of breath. Chest radiography and computed tomography confirmed left hemothorax. Conservative management and left intercostal chest drainage were performed without improvement. Subsequently, video-assisted thoracoscopic debridement was performed.

Conclusion: Hemothorax is a severe complication of mini-endoscopic combined intrarenal surgery, which, regardless of accurate access through an ideal renal calyx under ureteroscope-assisted ultrasound-guided access, may lead to pleural injury. Refinement of the surgical technique and management after percutaneous nephrolithotomy is the key to avoiding life-threatening situations.

Key words: hemothorax, mini-endoscopic combined intrarenal surgery, supracostal access, ureteroscope-assisted ultrasound-guided access.

Keynote message

We report a rare case of hemothorax, which could not be prevented by either endoscopic or US-guided access during minimally endoscopic combined intrarenal surgery. The hemothorax was treated by VATD due to failure of conservative treatment. Refinement of the surgical technique and management of hemothorax is critical to avoid life-threatening situations.

Introduction

Mini-ECIRS is a safe and effective treatment option in the management of renal stones. During mini-ECIRS, ureteroscope-assisted US-guided access is considered to be a versatile, safe, and efficient endoscopic procedure. Despite the safe access, this approach rarely causes potential chest complications, including hydrothorax, hemothorax, and reno-pleural fistula, sometimes leading to life-threatening conditions. We report the first case of hemothorax following mini-ECIRS that showed no improvement on conservative management and intercostal chest drainage and required VATD for management.

Case presentation

A 47-year-old woman presented with complex bilateral renal stones and was referred to our hospital for surgical treatment due to failure of conventional PCNL performed at another hospital. Initially, we performed mini-ECIRS for the right renal stone, which was later identified as calcium oxalate, without any complications and residual stones.

Three months after the first mini-ECIRS, she underwent a second mini-ECIRS for the left renal stone. Laboratory studies showed normal values of serum inflammatory markers, liver

and renal function, mineral markers, and urinary parameters. Multi-slice computed tomography and kidney-ureter-bladder radiography revealed a stone (size, $6.5 \times 2.2 \times 2.4 \text{ cm}^3$) with left calyceal fragment (Fig. 1). Mini-ECIRS was performed in the prone position, and *supra*-12th rib access was obtained with a single pass of the 16.5/17.5-Fr metal sheath with a 12-Fr nephroscope under combined US and ureteroscopy guidance. During puncture, we identified the pleural space and pleural line under US to avoid penetration. After puncture, we checked intraoperative fluoroscopy to evaluate potential chest complications. Using the holmium YAG-laser through the rigid nephroscope, all parts of the collecting system and a part of the main stone were cleared. Finally, an ureteral stent without a nephrostomy tube was placed after the procedure. The operative time was 3 h, with no intraoperative complications and an estimated blood loss of $<100 \text{ cc}$.

On POD 1, the patient developed shortness of breath. Tachypnea with normal vital signs was noted with deteriorating breath sounds on the left side. Chest radiography confirmed left pleural collection (Fig. 2a). Her hemoglobin level, which was 12.0 g/dL at discharge, had dropped to 11.0 g/dL. On consultation with the thoracic surgeon, she was conservatively managed without any treatment for several days. On

POD 5, a 16-Fr tube was placed for left intercostal drainage under local anesthesia with ultrasonography guidance by the standard technique because of the aggravation of hemothorax (Fig. 2b). A small volume of old blood was drained without improved expansion of the left lower and middle lobes (Fig. 2c). On POD 9, VATD was performed for the hemothorax. During intraoperative monitoring, some abscesses were observed in the hemothorax, which appeared to be empyema; moreover, a scar hole that had been punctured through the pleural cavity during mini-ECIRS was identified (Fig. 3). Thereafter, blood clot evacuation, decortication, and ablation were performed by VATD. At the end of the procedure, the 20-Fr chest tubes were retained (Fig. 4a). On POD 14, she was discharged after retrieval of the chest tube. Follow-up evaluation showed satisfactory expansion of the left lung with complete resolution of all chest symptoms (Fig. 4b).

Discussion

Mini-ECIRS, which combines flexible ureteroscopy and minimally invasive PCNL, is the preferred surgical treatment for staghorn stones and large renal stones.¹ Although this procedure provides a high stone-free rate, severe complications

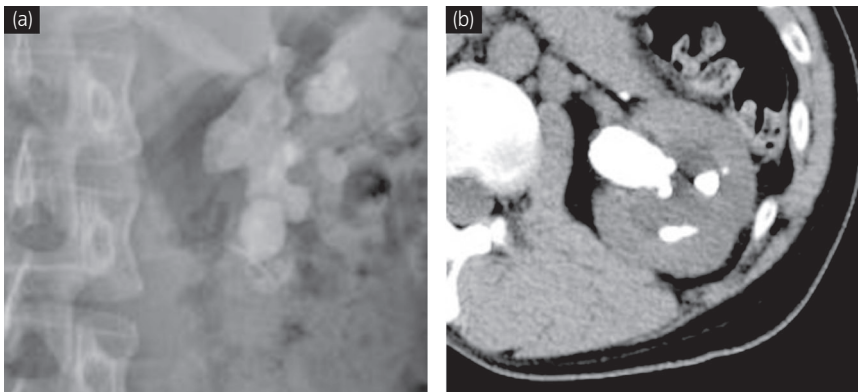


Fig. 1 Preoperative kidney-ureter-bladder radiography (a) and computed tomography (b) demonstrated presence of left staghorn calculus.

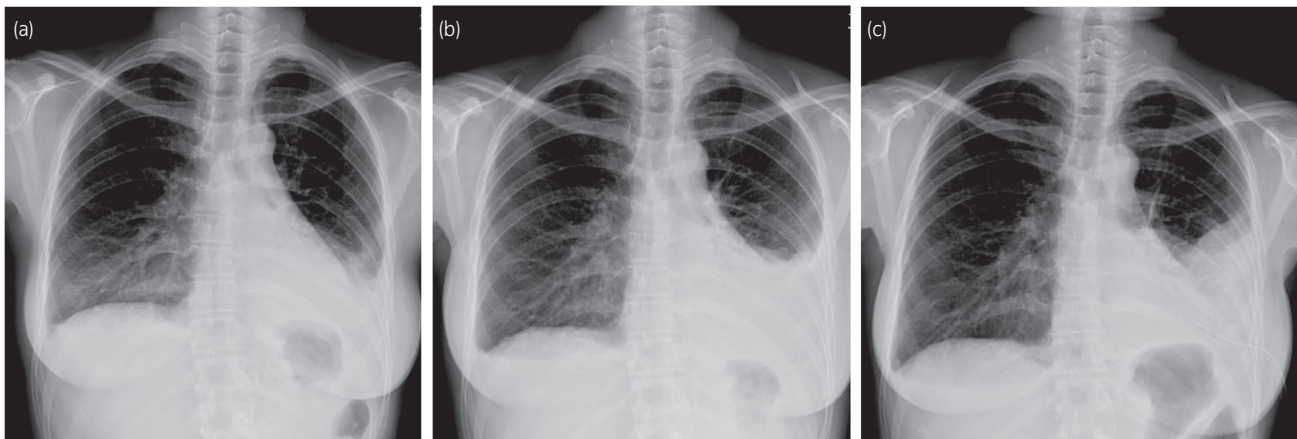


Fig. 2 Chest X-ray performed following PCNL showing pleural collection on the left side. (a) On POD 1, pleural collection on the left side was observed. (b) On POD 5, pleural collection was aggravated during conservative management. (c) On POD 9, the left lung did not show expansion after insertion of the drainage tube.

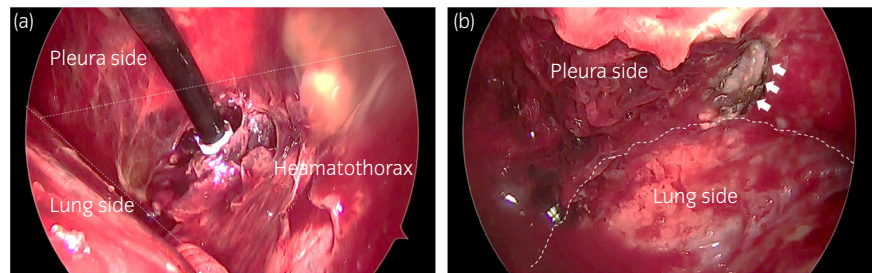


Fig. 3 View of the VATD. (a) Abscesses were observed in the hemothorax. (b) A scar hole, which had punctured through the pleural cavity during PCNL (arrows).

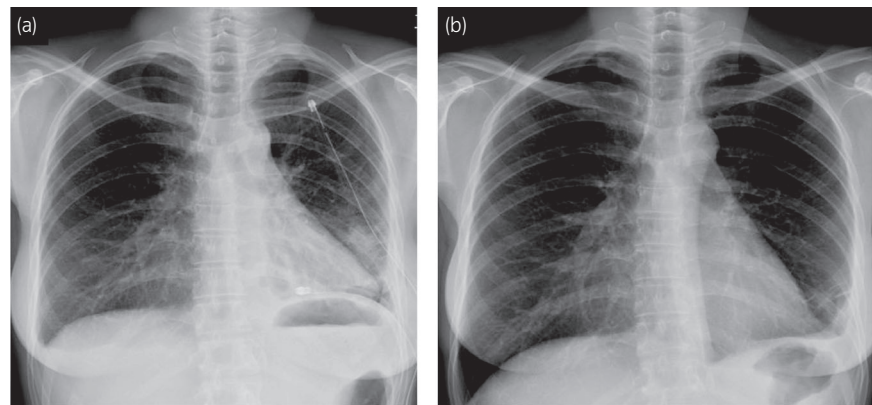


Fig. 4 Chest X-ray performed following VATD showing pleural collection on the left side. (a) One day after VATD, pleural collection had resolved. (b) After discharge, the left lung showed complete expansion.

sometimes occur. One of the life-threatening complications includes hemothorax.

Hemothorax is a rare complication following PCNL. Mousavi-Bahar *et al.* found two cases of hemothorax in 671 patients (0.3%) under fluoroscopy guidance in standard PCNL,² while Hamamoto *et al.* did not find any hemothorax in 60 patients under combined ultrasonographic and fluoroscopic guidance in mini-ECIRS.¹ Obtaining optical access through an ideal renal calyx is important to reduce severe complications. However, we encountered a valuable case in which hemothorax developed despite under ureteroscopy-assisted US-guided access in mini-ECIRS. To the best of our knowledge, this is the first report of hemothorax during mini-ECIRS.

In our case, the supracostal approach may have caused hemothorax. The supracostal approach is indicated for better visualization of the upper pole, ureteropelvic junction, proximal ureter, and lower pole,^{3,4} and has been shown to increase the ability to manipulate the nephroscope along the long axis of the kidney and minimize torque maneuvers, resulting in reduced bleeding.^{4,5} However, pulmonary complications are noted in 10–15% and 25–30% of the cases with *supra*-12th and *supra*-11th rib access, respectively, using conventional PCNL.^{6,7} Therefore, some urologists are hesitant to perform this approach because of the risk of potential chest complications. In our case, the lower calyx stone compacted in lower pole was difficult to approach under ureteroscopy-assisted US-guided puncture, so supracostal approach via the *supra*-12th rib access was carefully obtained and better visualization was achieved. However, we could not avoid pulmonary complications.

In the supracostal approach, achieving non-traumatic access to the appropriate calyx is crucial. Knowledge of the

pleural and diaphragmatic anatomy and refinement of the surgical technique may mitigate complications.⁸ To avoid pulmonary complications, several techniques have been described for supracostal access. Radecka *et al.* recommended puncture on the lateral side of the mid-scapular line, with respect to the anatomical structure of the pleura.⁹ Full expiration during puncture elevated the visceral pleura and lungs. After gaining successful access, deep inspiration was used for downward displacement of the kidney. Additionally, nephrostomy tube replacement was essential for managing hemothorax and reducing its symptoms. Shoma and Elshal evaluated the hemostatic and drainage function of the nephrostomy tube in a prospective randomized trial¹⁰ for patients treated using the supracostal approach; they found that drainage could be important to avoid hemothorax if hematuria develops with obstruction of the pelvicalyceal system. In our case, we could not control respiration sufficiently, such that the time-lapse between ultrasonographic observation and needle puncture caused a slight positional change in the pleural line. Therefore, even when the pleural line can be clearly observed by ultrasonography, close monitoring of respiration is needed to avoid a time-lapse between observation and puncture.

In conclusion, hemothorax is a rare complication of mini-ECIRS that could be lethal. Morbidity can be reduced to a great extent with refinement of the surgical technique and management of hemothorax. Cases of mini-ECIRS through supracostal access should be carefully planned and an optimal method that does not carry a risk of pleural injury should be developed.

Conflict of interest

The authors declare no conflict of interest.

Informed consent

Informed consent was obtained from the patient.

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Editorial Comment

Editorial Comment to Hemothorax during miniaturized endoscopic combined intrarenal surgery under ureteroscope-assisted ultrasound-guided access

Hemothorax rarely occurs following percutaneous nephrolithotomy (PCNL), but it is a significant cause of morbidity and mortality. Some perioperative factors increase the risk of hemothorax, such as renal upper pole approach and supracostal puncture. Typically, the diagnosis is made by routine postoperative chest radiography or imaging obtained for chest symptoms.¹ However, intraoperative chest fluoroscopy can provide the diagnosis of clinically significant hemothorax and offers a chance to manage the patient while being under anesthesia.²

The report by Tanaka *et al.* describes a staghorn stone patient who suffered from hemothorax following mini-endoscopic combined intrarenal surgery with ultrasound-guided renal puncture.³ The pleural line and pleural space are sometimes challenging to identify with ultrasound. Continuous respiration of the patient, displacement of the kidney caused by patient positioning, along with time lapse between ultrasonographic observation and needle advancement, potentially lead to diaphragmatic or pleural injury and subsequent hemothorax.

Although successfully managed with conservative treatment in most cases, hemothorax may require surgical correction. The patient described in this report was eventually treated by thoracoscopic debridement to expand her lung. This situation emphasizes that early detection and prompt

management of hemothorax are necessary to achieve an excellent operative outcome.

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DOI: 10.1002/iju5.12107

Conflict of interest

The author declares no conflict of interest.

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