Case series – Liver injury during percutaneous nephrolithotomy

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INTRODUCTION

KEY MESSAGES

- Liver injury during PCNL is uncommon but does occur.
- Liver injury secondary instrumentation during PCNL can generally be managed with observation and supportive care.

Although percutaneous nephrolithotomy (PCNL) remains gold standard treatment for large renal stones, there exists minimal reports describing management of liver injury during PCNL.[1-3] Here, we present a multi-institutional series of cases of liver injury during PCNL.

Endourologists across four academic medical centers reviewed procedure logs identifying cases of liver injury during PCNL. The authors received IRB approval/exemption from their respective institutions. Herein summarizes case notes and management of three cases of liver injury associated with PCNL.

From January 1, 2017, to December 31, 2020, three cases of liver injury during PCNL were identified from a total of 1213 cases reviewed (0.25%).

CASE SERIES

Case 1

A 49-year-old female presented with computed-topography (CT) imaging demonstrating 2.4 cm of nephrolithiasis in right renal pelvis (liver unremarkable). She underwent PCNL in modified Galdako-Valdivia positioning with (subcostal) renal access obtained using endoscopic guidance

combined with ultrasonography (US) and fluoroscopy. Rigid and flexible nephroscopy (with ultrasonic-lithotripsy and endo-basketing) were utilized to remove stones prior to placing a 5Fr-nephro-ureteral catheter. Operative time was 120 minutes with <100mL estimated blood loss (EBL). At PCNL conclusion, the patient appeared free of stone/complications.

On post-operative-day (POD) 1, patient's physical evaluation was unremarkable. Labs demonstrated hemoglobin (Hgb) of 10 g/dL (from 12.4 g/dL preoperatively) and normal serum creatinine (SCr). She was discharged home POD1. Routine outpatient CT revealed the nephrostomy tube (NT) traversing liver (figure 1) and the patient was readmitted. Except for Hgb of 7.7 g/dL, she remained clinically unremarkable for two days (during which the NT tube was removed). At six-week-follow-up, patient was well-appearing with a CT demonstrating a resolving hematoma (figure 1).

Case 2

A 53-year-old female presented with CT imaging demonstrating bilateral nephrolithiasis including a 2.2 cm right proximal ureterolith (liver unremarkable)—figure 2a. The patient underwent right PCNL (prone positioning). Renal access was obtained via fluoroscopic bull's-eye technique (figure 2b). Partial urinary tract duplication (to mid-right ureter) necessitated additional percutaneous access to the lower moiety. Nephroliths were removed utilizing endo-graspers and ultrasonic-impact-lithotripter. A 14Fr-pigtail nephro-ureteral catheter was placed alongside an 8Fr-variable-length-J-ureteral-stent. Operative time was 150 minutes with 200mL EBL. At PCNL conclusion, the patient appeared free of stone/complications.

On POD1, her physical evaluation was unremarkable. Routine CT imaging from POD1 revealed the nephro-ureteral catheter traversing 4cm of liver (Figure 2c). Labs revealed Hgb of 9.9 g/dL (from 11g/dL) with SCr of 0.6 mg/dL. The patient remained inpatient for PCN removal by Interventional Radiology (IR) on POD4—discharge home occurred POD5. At outpatient follow-up (POD6), she appeared well with resolving liver injury observed on repeat CT.

Case 3

A 68-year-old male with horseshoe kidney presented for definitive treatment of right moiety nephrolithiasis (following 15 shockwave lithotripsy procedures). CT imaging revealed bilateral moiety nephrolithiasis including a 5.9x2.8 cm nephrolith filling the middle- and lower-third of the right renal moiety (figure 3a). CT also displayed two <3cm liver cysts without hepatomegaly. The patient underwent a pre-PCNL NT placement (right moiety) by IR using fluoroscopic guidance (Figure 3b). The patient underwent a (prone) PCNL accessing the kidney through indwelling NT. The nephrolith was fragmented/basketed. A 10-French NT was placed in the collecting system with an open-ended 5F catheter extending from the ureter through flank incision. Operative time was 119 minutes with 100mL EBL. At PCNL conclusion, the patient appeared free of stone/complications.

On POD1, his physical evaluation was unremarkable. Routine CT imaging on POD1 revealed residual nephroliths and the percutaneous NT tract passing through the caudal tip of a posterior hepatic lobe with trace amount of surrounding hemorrhage (Figure 3c). Hgb was 12.9 g/dL and SCr was 1.1 mg/dL. He was discharged on POD1 (with NT and open-ended catheter in place). On POD5, a repeat PCNL was performed utilizing a flexible cystoscope to inspect the existing PCNL tract (without further dilation or sheath placement) and to retrieve the two residual nephroliths. The patient was left with a 10Fr NT and open-ended ureteral catheter. On POD7, CT imaging and an antegrade nephrostogram were obtained noting elimination of nephroliths as well as antegrade drainage of contrast (all drains/catheters were then removed). Follow-up imaging demonstrated subsequent resolution of liver injury without residual stone burden.

DISCUSSION

Adjacent organ damage or violation of the pleura space are potential risks during PCNL. Known risk factors for liver injury include hepatomegaly and supracostal access during surgery.[4]

In addition to our series, we identified only three prior case studies published in peer reviewed literature. In the first report, the patient underwent a right PCNL (supracostal fluoroscopic access) for multiple upper pole nephroliths.[1] Postoperatively, the patient developed abdominal pain and gross hematuria through the NT. The NT was immediately capped, and the patient underwent resuscitation including IV hemostatic agents (ethamyslate 250mg every 6 hours and tranexamic acid 500 mg every 12 hours) and one unit of red blood cells. CT imaging demonstrated a 6x5 cm intrahepatic fluid collection and the NT traversing the inferior edge of the right hepatic lobe. On POD3, the NT was removed under fluoroscopy with concurrent instillation of fibrin sealant across the liver parenchyma. The patient was discharged on POD5.

The second report involved a patient with a 2.2-cm stone in the lower pole of the right kidney.[2] On POD1 from PCNL, the patient developed right shoulder pain with erythema noted around the nephro-ureteral catheter. CT imaging demonstrated a small peri-hepatic free fluid collection. The patient became febrile POD2 with an elevated white blood cell (WBC) count of 17.7 10^3/mL. The patient defervesced by POD4 while receiving antibiotic therapy and supportive care. CT imaging demonstrated a 19x5.8 cm right sub hepatic fluid collection; however, vital signs were unremarkable and Hgb was stable at 10 mg/dL thus patient was discharged home. As an outpatient on POD7, interval CT imaging obtained for shortness of breath noted the persistent hepatic fluid collection. The fluid, drained by IR, had a bilirubin level consistent with bile. Endoscopic retrograde cholangiopancreatography allowed for placement of biliary stents and the patient was discharged on POD12. Repeat CT imaging one month later noted resolution of the fluid collection.

The third reviewed publication documented two patients with liver injury after PCNL.[3] One patient underwent PCNL for 1.4cm nephrolith accessed via upper pole posterior calyx. The second patient presented large nephroliths in the bilateral moieties of horseshoe kidney. In both cases, liver injury was incidentally detected on routine postoperative CT-imaging. Neither

patient exhibited excessive abdominal pain, abnormal laboratories, or hemodynamic concerns postoperatively. Both patients were managed with supportive treatment and delayed removal of NT on POD 13 and POD 7, respectively.

While patient positioning seems to play a role in PCNL associated injuries, access location (supracostal) may present the greatest risk of liver injury considering a review of CT-scans suggesting that access obtained at/above the 11th rib during respiratory expiration have 14% risk of liver injury.[5-6] Although efforts are now made to standardize operative reports, the precise location of access in our case series was not clear for two of the liver injuries—limiting our ability to infer risk. Furthermore, US offers a means for real-time viewing of the access needle and adjacent organs during renal puncture potentially reducing liver injury.[8] Ng *et al.* compared 184 PCNL patients, noting that while stone free rate remained similar between fluoroscopy and US cohorts, the only organ injury occurred in the fluoroscopy cohort. Rassweiler-Seyfried *et al.* reviewed PCNL renal access methods, considering safety/efficacy of novel techniques such as electromagnetic tracking and real-time 3-D renal reconstruction.[9] Overall, due to the uncommon nature of liver injury during PCNL, it is difficult to fully understand the risk factors. The primary lesson learned from our review appears to be that PCNL related liver injuries may be managed non-operatively.

CONCLUSIONS

This series (and existing literature) suggest that liver injury during PCNL is uncommon and, although includes risk for severe bleeding, can generally be managed with observation/supportive care.

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FIGURES AND TABLES

Figure 1. Representative CT scan images depicting NT traversing inferior caudate lobe of liver associated with hematoma.

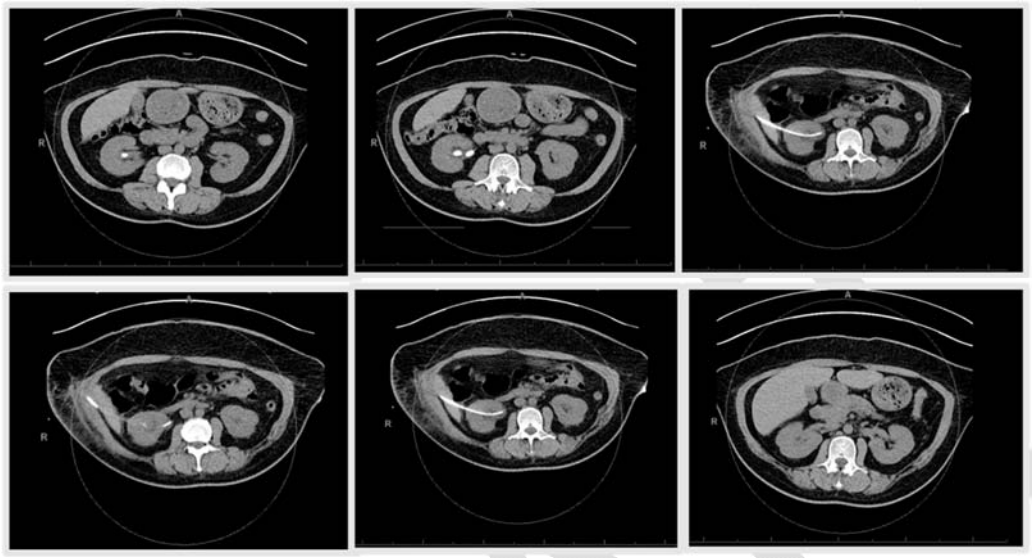

Figure 2A. Representative images from preoperative CT-scan 2.2 cm right obstructing proximal stone and smaller non-obstructing right kidney stones.

Figure 2B. Representative intraoperative images depicting access sheath (left) and nephrostogram showing duplication (right).

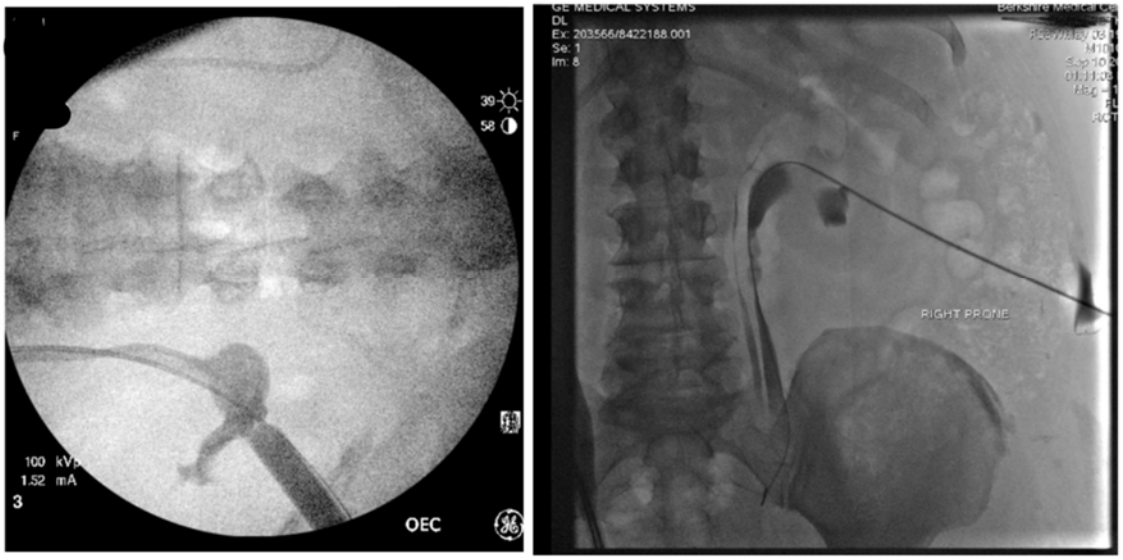

Figure 2C. Representative postoperative images depicting nephrostomy tube going through the liver (first and second) and resolving liver injury after removal of nephrostomy tube on POD 4 (third image).

Figure 3A. Representative images from preoperative CT-scan depicting horseshoe kidney with a 5.9 x 2.8 cm complex shaped staghorn calculus in the right renal moiety and 1.5 x 1.0 cm stone burden in the lower third of the left renal moiety.

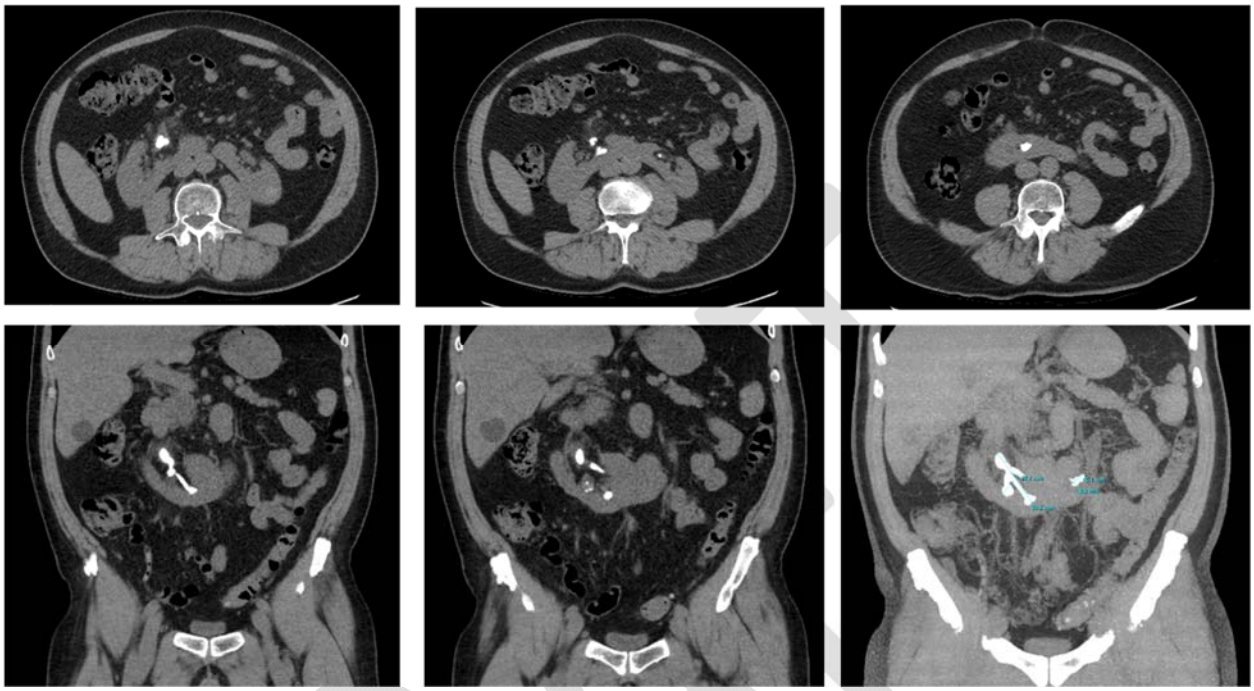

Figure 3B. Representative images from preoperative IR placement of NT into right renal moiety.

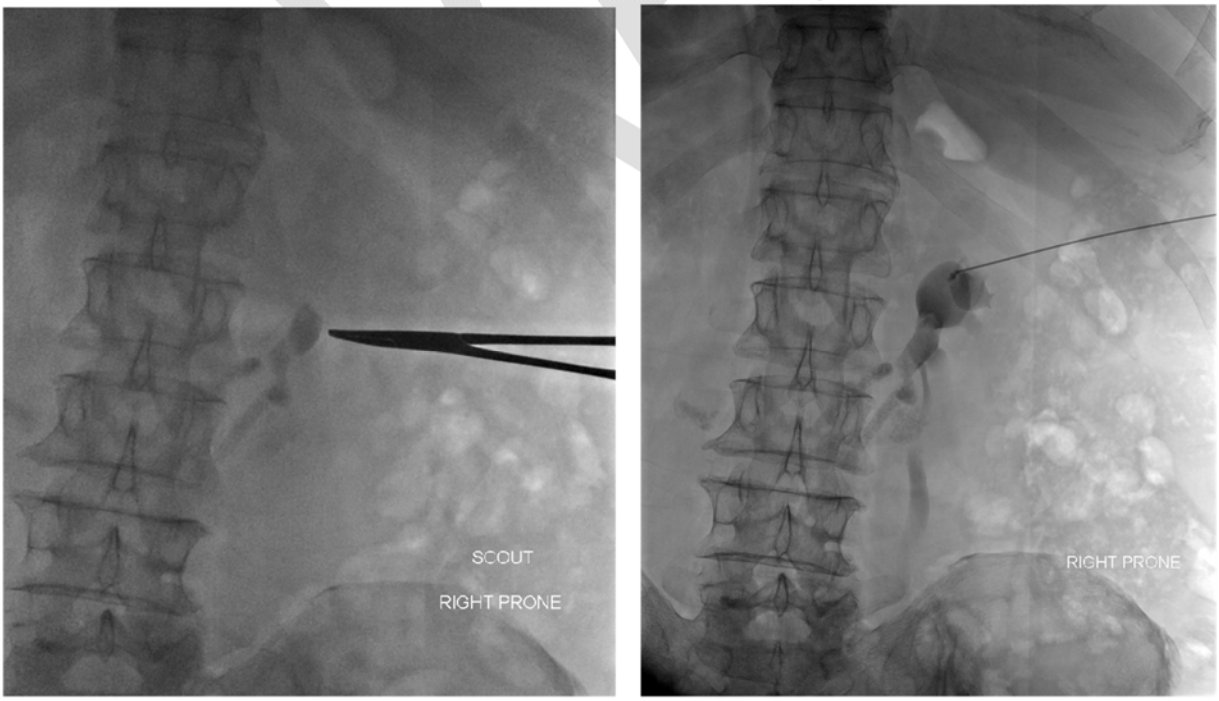

Figure 3C. Representative images from postoperative CT-scan depicting percutaneous NT tract passing through the caudal tip of the posterior segment of right hepatic lobe with trace hemorrhage adjacent to the tubes, liver, and the right kidney.