

Complications of Percutaneous Nephrostomy Tube Placement to Treat Nephrolithiasis

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Percutaneous nephrostomy tube placement is commonly performed to relieve urinary obstruction.¹ The percutaneous nephrostomy tract is also used for the treatment of pathologic processes (eg, for stone removal). Although percutaneous nephrostomy tube placement is a widely accepted and a relatively safe procedure, potentially serious complications may occur, including severe bleeding, septicemia, and injury to adjacent organs (eg, bowel perforation, splenic injury).¹ Pleuropulmonary complications such as pneumothorax and pleural effusion are very uncommon, especially when a subcostal approach is used in establishing the nephrostomy tract.¹⁻³ An intercostal approach may be associated with a higher incidence of pleuropulmonary complications.¹ This article discusses a patient with nephrolithiasis who developed pleuritis, a pleural effusion, and septicemia as complications of percutaneous nephrostomy tube placement that was performed via an intercostal approach. The article reviews pleuropulmonary and other complications of percutaneous nephrostomy tube placement as well as the differential diagnosis of pleural effusions in patients with renal disorders.

CASE PRESENTATION

Previous Clinical Course

A previously healthy 56-year-old man underwent extracorporeal shock wave lithotripsy at another hospital for treatment of a proximal left ureteral stone 9 weeks before presenting to our institution. The extracorporeal shock wave lithotripsy was followed by ureteroscopy that was complicated by ureteral damage and extravasation. Subsequently, a ureteral stent was placed in a retrograde manner, and a percutaneous nephrostomy tube was placed through the superior pole of the left kidney. A nephrogram with ionic contrast was later obtained. After this procedure, the patient began to experience left-sided pleuritic chest pain and fever. A computed tomography (CT) scan of the chest showed a small amount of contrast material within the left pleural space. Two days later, the patient

was transferred to our medical center for further management.

Continued Clinical Course

On physical examination, the patient was in severe pain that was made worse by movement. His temperature was 38.2°C (100.8°F). His blood pressure was 160/80 mm Hg. His heart rate was 108 beats/min, and his respiratory rate was 28 breaths/min. The nephrostomy tube was observed entering the posterior thorax on the left at the level of the 11th intercostal space. Breath sounds were diminished over the left lung base.

Laboratory findings were as follows: leukocyte count, $11.2 \times 10^3/\text{mm}^3$; hemoglobin concentration, 13.6 g/dL; creatinine level, 1.1 mg/dL; urea level, 26 mg/dL. His admission chest radiograph showed a modestly sized left-sided pleural effusion (**Figure 1**). CT scan of the chest showed a partially loculated fluid collection in the left lung base posteromedially with adjacent atelectatic lung (**Figure 2**). Ultrasound-guided thoracentesis yielded 85 mL of a cloudy, yellow fluid, which was sent for Gram staining and bacterial cultures. Gram staining showed many leukocytes but no microorganisms.

Diagnosis and Treatment

Because of persistent fevers (highest temperature, 39.5°C [103.1°F]), intravenous antibiotic therapy with vancomycin, ceftazidime, and metronidazole was started for coverage of potential skin flora and genitourinary tract pathogens. Blood and pleural fluid cultures grew coagulase-negative staphylococcus bacteria. A repeated CT scan of the chest showed persistence of the loculated pleural effusion, which was slightly smaller than it had been before the antibiotic therapy. A percutaneous drainage catheter was placed in the posterior left pleural

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Figure 1. Chest radiograph showing a left-sided pleural effusion of modest size and the percutaneous nephrostomy tube.

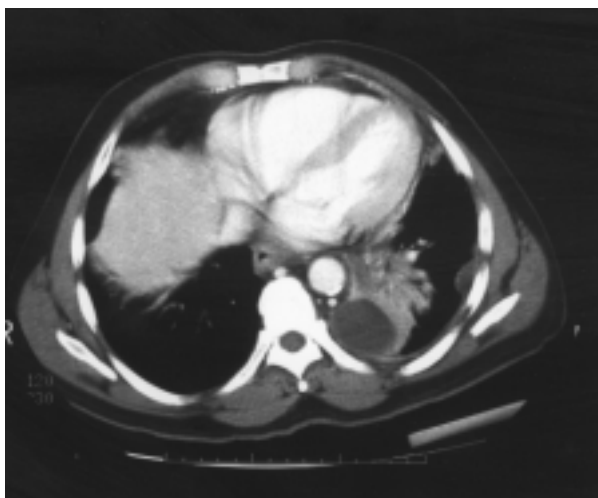


Figure 2. Computed tomography scan of the chest showing a partially loculated effusion in the left posteromedial pleural space and adjacent atelectasis.

space under fluoroscopic guidance. Approximately 15 mL of serosanguinous fluid was aspirated, and the catheter was left in place to allow bulb suction.

Patient Outcome

Six days after admission, cystoscopy was performed for removal of the ureteral stent that had previously been inserted at the other hospital. Retrograde ureteropyelogram showed a healed left ureter and no residual kidney stones. A subsequent nephrostogram through the existing percutaneous tube showed free flow of contrast into the bladder without evidence of leak. The nephrostomy tube was removed, and the patient remained afebrile and free of pain. The pleural drainage catheter was removed after 3 days, and oral antibiotic therapy was continued for an additional week. The patient's subsequent clinical course was uneventful.

DISCUSSION

Percutaneous Nephrostomy Tube Placement

Indications. Percutaneous kidney stone extraction was first reported as a primary procedure in 1976.⁴ Technical advances in uroradiology have dramatically increased the indications for and the usefulness of percutaneous nephrostomy tube placement over the past 10 years. It has become a standard procedure for pa-

tients with large renal calculi or calculi that are resistant to extracorporeal shock wave lithotripsy (such as cystine calculi), as well as for those patients with ureteral stricture or obstruction. Percutaneous nephrostomy tube placement is an important first step in obtaining antegrade access to the kidney for a variety of procedures. It is currently the most commonly performed urologic intervention. Thus, clinicians should be aware of this procedure and its potential complications.

Complications. The complications associated with percutaneous nephrostomy tube placement are minimal and usually minor when small catheters are used only for drainage purposes. The complication rate increases when therapeutic procedures require a large (28F to 30F catheter) nephrostomy tract, extensive intrarenal manipulation, or an intercostal approach.

The most common complication of percutaneous renal entry is bleeding, which occurs in most patients undergoing nephrostomy tube placement. The bleeding is usually manifested as transient hematuria for 1 to 3 days.^{5,6} Serious bleeding requiring transfusion occurs in 1% to 3% of patients undergoing nephrostomy tube placement.⁵ Other major complications include sepsis (1% to 2.5%), adjacent organ injury (0.1% to 0.3%), and death (0.046% to 0.3%).⁵ Additional complications that have been reported include abscess formation, pyonephrosis, urinoma, pneumothorax, pleural effusions, hydrothorax, air embolism, avulsion of the ureter and delayed ureteral stricture, ureteral perforation, extravasation, pain, tube dislodgement, pulmonary infiltrates, basket breakage, and introduction of a foreign body into the collecting system.¹⁻⁹ Nonoperative

management is usually successful for most of these complications.⁵

Pleuropulmonary complications and methods of obtaining renal access. The disease process being treated determines the best approach to obtain renal access. When the only goal is to establish drainage, renal access is gained through the lower pole of the kidney with a subcostal approach (ie, below the 12th rib). In some cases of nephrolithiasis, the percutaneous nephrostomy tract may require an intercostal approach (ie, at the 10th or 11th intercostal space) because of the location of the calculus or the anatomic level of the kidney.

Overall, percutaneous nephrostomy tube placement for stone removal is a safe procedure with low complication rates.¹⁻⁵ Segura et al reported only a single case of pleuropulmonary complication (pneumothorax) in a series of 1000 consecutive patients undergoing percutaneous removal of kidney stones.² However, an intercostal approach may be associated with a higher rate of pleuropulmonary complications than is a subcostal approach.

Pleuropulmonary complications occur mainly because of entry into the pleural space or puncture of the lung. Puncture of the lung or pleura allows air, infused fluid (as in the case patient), or draining fluid to enter the pleural space.

In a series of 140 patients with urinary calculi,¹⁰ 24 patients required an intercostal approach. Pleural effusions complicated 9 of the 24 intercostal procedures. One patient had a large hydrothorax caused by irrigation fluid from the nephroscope and subsequently required thoracentesis. The remaining 8 patients with pleural effusions (including 6 patients with minimal effusions) did not require treatment, and no patient had pneumothorax. The incidence of pleural effusion was higher with techniques involving the upper pole of the kidney than it was with techniques involving the middle or lower pole. Other authors have reported the frequency of pleural effusions complicating percutaneous nephrostomy tube placement to be 0% to 12%.^{3,11-13}

Pneumothorax and pleural effusion occurring as a complication of nephrostomy tube placement can usually be managed conservatively with careful observation or small-bore catheters. In cases of large pneumothorax or pleural effusion, large-bore tubes may be required for adequate drainage. Surgical exploration may rarely be needed, such as in cases of pleural sepsis or bleeding not controlled with drainage catheters.

Other Potential Causes of Pleural Effusions

Pleural effusions occurring in patients after nephrostomy tube placement may not necessarily be a com-

plication of the procedure itself. Pleural effusions may be associated with a variety of renal disorders, including acute glomerulonephritis, nephrotic syndrome, and uremia, as well as with peritoneal dialysis.^{14,15} In addition, patients with renal diseases are also subject to other common causes of pleural effusions, such as congestive heart failure, pneumonia, atelectasis, and pulmonary embolism (especially in patients with nephrotic syndrome).^{14,15} Urinothorax (ie, retroperitoneal leakage of urine into the pleural space) may be associated with nephrolithiasis, genitourinary tumor, and other causes of obstructive uropathy, as well as with trauma, surgical stents, kidney biopsy, and kidney transplantation.¹⁴

CONCLUSION

Because of the proximal location of the ureteral stone in the case patient, the optimal trajectory for nephrostomy tube placement required access via the upper pole of the kidney with an intercostal approach. The case patient experienced pleuritis, pleural effusion, and septicemia as complications of percutaneous nephrostomy tube placement using this approach. Clinicians should be aware that an intercostal approach to percutaneous nephrostomy tube placement may be associated with pleuropulmonary complications. HP

REFERENCES

1. Papanicolaou N. Interventional urology. In: Walsh PC, Retik AB, Vaughan ED Jr, Wein AJ, editors. *Campbell's urology*. 7th ed. Philadelphia: WB Saunders; 1998:244-50.
2. Segura JW, Patterson DE, LeRoy AJ, et al. Percutaneous removal of kidney stones: review of 1,000 cases. *J Urol* 1985;134:1077-81.
3. Farrell TA, Hicks ME. A review of radiologically guided percutaneous nephrostomies in 303 patients. *J Vasc Interv Radiol* 1997;8:769-74.
4. Fernstrom I, Johansson B. Percutaneous pyelolithotomy: a new extraction technique. *Scand J Urol Nephrol* 1976;10:257-9.
5. Dyer RB, Assimos DG, Regan JD. Update on interventional urology. *Urol Clin N Am* 1997;24:623-52.
6. Brown JM, Denbow N, Glickman MG. Interventional radiology. In: Weiss RM, George NJR, O'Reilly PH, editors. *Comprehensive urology*. London: Mosby; 2001: 149-59.
7. Coleman CC, Kimura Y, Reddy P, et al. Complications of nephrolithotomy. *Semin Interv Radiol* 1984;1:70-4.
8. O'Donnell A, Schoenberger C, Weiner J, Tsou E. Pulmonary complications of percutaneous nephrostomy and kidney stone extraction. *South Med J* 1988;81:1002-5.
9. Lang EK. Percutaneous nephrolithotomy and lithotripsy: a multi-institutional survey of complications. *Radiology* 1987;162(1 Pt 1):25-30.

10. Young AT, Hunter DW, Castaneda-Zuniga WR, et al. Percutaneous extraction of urinary calculi: use of the intercostal approach. *Radiology* 1985;154:633-8.
11. Picus D, Weyman PJ, Clayman RV, McClennan BL. Intercostal-space nephrostomy for percutaneous stone removal. *AJR Am J Roentgenol* 1986;147:393-7.
12. Lee WJ, Patel U, Patel S, Pillari GP. Emergency percutaneous nephrostomy: results and complications. *J Vasc Interv Radiol* 1994;5:135-9.
13. Li MK, Wong MY, Toh KL, et al. Percutaneous nephrolithotomy: results and clinical experience. *Ann Acad Med Singapore* 1996;25:683-6.
14. Sahn SA. The pleura. *Am Rev Respir Dis* 1988;138:184-234.
15. Jarratt MJ, Sahn SA. Pleural effusions in hospitalized patients receiving long-term hemodialysis. *Chest* 1995;108:470-4.

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