

## Percutaneous nephrolithotomy: a cause of specific and iatrogenic thoracic complications

*Perkütan nefrolitotomi: Spesifik ve iyatrojenik toraks komplikasyonlarının bir nedeni*

Rasih Yazkan,<sup>1</sup> Taylan Oksay,<sup>2</sup> Alper Özorak,<sup>2</sup> İsa Döngel,<sup>1</sup> Sefa Alperen Öztürk,<sup>2</sup> Alim Koşar<sup>2</sup>

<sup>1</sup>Department of Thoracic Surgery, Medical Faculty of Süleyman Demirel University, Isparta, Turkey

<sup>2</sup>Department of Urology, Medical Faculty of Süleyman Demirel University, Isparta, Turkey

**Background:** This study aims to evaluate thoracic complications which are usually encountered in percutaneous nephrolithotomy.

**Methods:** Between February 2005 and September 2012, 932 patients (586 males, 346 females; mean age 44.98±16.35 years; range 2 to 85 years) underwent percutaneous nephrolithotomy due to the nephrolithiasis. All patients were evaluated with preoperative posteroanterior chest X-ray while all patients who had supracostal access and who had suspected thoracic complications were evaluated with postoperative posteroanterior chest X-rays. Tube thoracostomy was performed in all patients with thoracic complications.

**Results:** A subcostal access was performed in 849 patients (91%), whereas a supracostal access was performed in 83 patients (9%). Thoracic complications were developed in 18 patients (1.93%). Of them, 13 (1.39%) were in patients with supracostal and five (0.54%) were in patients with subcostal approach. Eleven supracostal accesses were performed above the 12<sup>th</sup> rib and two supracostal accesses were above the 11<sup>th</sup> rib. When all complications were evaluated, 12 hemothoraces, four pneumothoraces, and two urinothoraces were detected.

**Conclusion:** Percutaneous nephrolithotomy is a cause of iatrogenic thoracic complications and supracostal approach has a more thoracic complication rate, compared to the subcostal approach. An early postoperative posteroanterior chest X-ray in sitting or standing position following supracostal access in particular is an essential diagnostic tool for early detection of thoracic complications. The tube thoracostomy is usually sufficient for the treatment of such complications.

**Key words:** Complication; iatrogenic; percutaneous nephrolithotomy; thoracic.

**Amaç:** Bu çalışmada, genellikle perkütan nefrolitotomide karşılaşılan torasik komplikasyonlar değerlendirildi.

**Çalışma planı:** Şubat 2005 - Eylül 2012 tarihleri arasında 932 hastaya (586 erkek, 346 kadın; ort. yaş 44.98±16.35 yıl; dağılım 2-85 yıl) böbrek taşı nedeni ile perkütan nefrolitotomi uygulandı. Bütün hastalar ameliyat öncesi arka-ön akciğer grafisi ile değerlendirilir iken, suprakostal girişim yapılan ve toraks komplikasyonundan şüphelenilen hastaların tümü ameliyat sonrası arka-ön akciğer grafisi ile değerlendirildi. Toraks komplikasyonlu hastaların tümüne tüp torakostomi uygulandı.

**Bulgular:** Sekiz yüz kırk dokuz hastada (%91) subcostal girişim, 83 hastada (%9) suprakostal girişim yapıldı. On sekiz hastada (%1.93) toraks komplikasyonu gelişti. Bunlar 13 hastada (%1.39) suprakostal ve beş hastada (%0.54) subkostal yaklaşım idi. On bir suprakostal girişim 12. kaburga üzerinden ve iki suprakostal girişim 11. kaburga üzerinden yapıldı. Tüm komplikasyonlar değerlendirildiğinde 12 hemothoraks, dört pnömotoraks ve iki urinothoraks tespit edildi.

**Sonuç:** Perkütan nefrolitotomi iyatrojenik toraks komplikasyonlarının bir nedenidir ve suprakostal yaklaşım, subkostal yaklaşıma kıyasla, daha fazla torasik komplikasyon oranına sahiptir. Özellikle her suprakostal girişimden sonra erken ameliyat sonrası oturur ya da ayakta durur pozisyonda arka-ön akciğer grafisi, torasik komplikasyonların erken tanısı için temel tanı aracıdır. Bu tip komplikasyonların tedavisi için tüp torakostomi sıklıkla yeterlidir.

**Anahtar sözcükler:** Komplikasyon; iyatrojenik; perkütan nefrolitotomi; torasik.



Available online at  
www.tgkdc.dergisi.org  
doi: 10.5606/tgkdc.dergisi.2013.7928  
QR (Quick Response) Code

Received: November 14, 2012 Accepted: December 29, 2012

Correspondence: Rasih Yazkan, M.D. Süleyman Demirel Üniversitesi Tıp Fakültesi Göğüs Cerrahisi Anabilim Dalı, 32260 Çünür, Isparta, Turkey.

Tel: +90 505 - 483 59 61 e-mail: drrasahyazkan@yahoo.com

Percutaneous nephrolithotomies (PNLs) have been the preferred surgical method for treating staghorn stones, large renal stones, and some upper ureteric stones for 35 years.<sup>[1,2]</sup> Their successful removal requires the proper placement of a percutaneous tract that provides direct access for stone manipulation.<sup>[3]</sup> Subcostal or supracostal access is preferred depending on the stone localization. Traditionally, subcostal access is preferred for PNLs to avoid injury to the lungs and pleura.<sup>[4]</sup> However, in patients, with upper caliceal stones, impacted upper ureteral stones, and staghorn calculi, the supracostal approach is the preferred point of access to the renal collecting system.<sup>[4]</sup>

The PNL procedure is generally safe and effective, but it is associated with a few specific complications which are mostly related to the thorax.<sup>[1,2]</sup> In addition, when supracostal access is used, puncture is possible because of the potential risk of pneumothorax, hydrothorax, and lung injury.<sup>[3]</sup> The objective of this study was to evaluate the thoracic complications usually encountered when performing PNLs.

## PATIENTS AND METHODS

A retrospective analysis was performed on the surgical, radiological, and postoperative findings in a total of 932 patients (586 males, 346 females; mean age 44.98±16.35 years; range 2 to 85 years) who underwent PNLs due to nephrolithiasis between 2005 and 2012. The surgical intervention site was determined according to the localization of the stone. All of the patients were evaluated with a preoperative posteroanterior chest X-ray, and those who required supracostal access along with those suspected of having thoracic complications were also evaluated with an immediate postoperative posteroanterior chest X-ray to determine if a pneumothorax and/or a hydrothorax had occurred. When a hydrothorax was detected, a diagnostic thoracentesis was performed in order to make the distinction between a hemothorax or a urinothorax. In addition, a tube thoracostomy was performed on all of patients with thoracic complications. The chest tube was removed when lung reexpansion had occurred and the air and fluid leaks had stopped.

## RESULTS

Subcostal access was performed on 849 (91%) patients in this study while supracostal access was performed on 83 (9%). After these procedures, thoracic complications developed in 18 of the patients (1.93%). Supracostal access was used for 13 (1.39%) of these patients, and subcostal access was utilized in the other five (0.54%).

Eleven of the supracostal access procedures were above the 12<sup>th</sup> rib, while the supracostal access was performed above the 11<sup>th</sup> rib in two patients. When all the complications were evaluated, 12 hemothoraces, four pneumothoraces, and two urinothoraces were detected. All of these were treated via a tube thoracostomy, and reexpansion was achieved. The length of hospital stay for the 18 patients with thoracic complications ranged from 6-20 days.

## DISCUSSION

Transthoracic fine-needle aspiration biopsies, pleural biopsies, and transbronchial lung biopsies are the most common causes of iatrogenic thoracic complications along with subclavian vein catheterizations, thoracentesis, and positive-pressure ventilation.<sup>[5]</sup> However, in this article we focused solely on the different causes of iatrogenic thoracic complications due to PNLs.

Percutaneous renal surgery via the supracostal approach has the advantage of being able to manage a number of renal and ureteral conditions by providing direct access to the upper pole calculi, ureteropelvic junction, and proximal ureter.<sup>[4]</sup> During this type of surgery, subcostal access is preferred because it carries a very low risk of injury to the lungs and pleura. On the other hand, in some situations, a supracostal approach may provide more direct access and achieve more satisfactory results than the subcostal approach.<sup>[4]</sup>

Complications after PNLs are not rare and have been reported to occur in up to 83% of the cases.<sup>[6]</sup> These are mostly clinically negligible, with minor bleeding or fever often occurring.<sup>[7]</sup> The frequency of major complications has been reported as 0.9-4.7% for septicemia, 0.6-1.4% for renal hemorrhage requiring intervention, 2.3-3.1% for pleural injury, and 0.2-0.8% for colonic injury.<sup>[7]</sup> Michel et al.<sup>[8]</sup> noted that the most common complication encountered after undergoing a PNL was fever (21-32%) followed by transfusion (0-17.5%), extravasation (7.2%), and sepsis (0.3-4.7%).<sup>[6]</sup> The overall complication rate of 33.2% reported in their review is consistent with the rates that have been reported by others. For example, Tefekli et al.<sup>[9]</sup> found complications in 29.2% of 811 subjects who underwent PNLs.<sup>[6]</sup> However, in this study, we only evaluated the thoracic complications which required a consultation with a thoracic surgeon, which probably was the reason for our lower complication rate.

Intrathoracic complications were reported at a rate of 16% for supracostal versus 4.5% for subcostal

tracts in two other studies,<sup>[2,10]</sup> whereas in our study, a total of only 18 patients (1.93%) developed thoracic complications. Additionally, our results showed that the supracostal approach has a significantly higher complication rate than the subcostal approach. It has been suggested that supra-11<sup>th</sup> rib punctures be avoided to minimize thoracic complications in the diaphragm where they most frequently occur.<sup>[2,10]</sup> There was a 35% complication rate with supra-11<sup>th</sup> rib punctures versus only a 10% rate with supra-12<sup>th</sup> rib punctures. Thoracic complications included pneumothorax, hydrothorax, hemothorax, and urinothorax in 8%.<sup>[2]</sup> The main purpose is prevention and management of thoracic complications. If access above the 11<sup>th</sup> rib is mandatory in some difficult cases, puncture should be performed in full expiration and also a computed tomography or ultrasonographic guided renal access will be useful to ensure a correct and uneventful percutaneous puncture.<sup>[2,11]</sup> Additionally, thoracic complications can also be limited by avoiding supracostal access, the use of a flexible nephroscope, and ultrasound-guided puncture whenever possible.<sup>[2]</sup>

### Conclusion

Undergoing a PNL can result in iatrogenic thoracic complications, with the supracostal approach demonstrating a higher complication rate than the subcostal approach. Hemothoraces, pneumothoraces, and urinothoraces may develop during the procedure which can increase the length of hospital stay and morbidity. Percutaneous nephrolithotomies are mainly used for the early diagnosis of thoracic complications plus they allow for theme to be managed more efficiently. If a supracostal approach is needed, an immediate postoperative sitting or standing posteroanterior chest X-ray is an essential diagnostic tool for the early detection of thoracic complications. A tube thoracostomy is usually sufficient for treatment of such kind of complications.

### Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

### Funding

The authors received no financial support for the research and/or authorship of this article.

### REFERENCES

1. Sukumar S, Nair B, Ginil KP, Sanjeevan KV, Sanjay BH. Supracostal access for percutaneous nephrolithotomy: less morbid, more effective. *Int Urol Nephrol* 2008;40:263-7.
2. Seitz C, Desai M, Häcker A, Hakenberg OW, Liatsikos E, Nagele U, et al. Incidence, prevention, and management of complications following percutaneous nephrolitholapaxy. *Eur Urol* 2012;61:146-58.
3. Gupta R, Kumar A, Kapoor R, Srivastava A, Mandhani A. Prospective evaluation of safety and efficacy of the supracostal approach for percutaneous nephrolithotomy. *BJU Int* 2002;90:809-13.
4. Shaban A, Koder A, El Ghoneimy MN, Orban TZ, Mursi K, Hegazy A. Safety and efficacy of supracostal access in percutaneous renal surgery. *J Endourol* 2008;22:29-34.
5. Çobanoğlu U, Hemidli S, Özusan HK. Iatrogenic pneumothorax: analysis of 62 cases. *Erciyes Medical Journal* 2009;31:144-52.
6. Semins MJ, Bartik L, Chew BH, Hyams ES, Humphreys M, Miller NL, et al. Multicenter analysis of postoperative CT findings after percutaneous nephrolithotomy: defining complication rates. *Urology* 2011;78:291-4.
7. Skolarikos A, de la Rosette J. Prevention and treatment of complications following percutaneous nephrolithotomy. *Curr Opin Urol* 2008;18:229-34.
8. Michel MS, Trojan L, Rassweiler JJ. Complications in percutaneous nephrolithotomy. *Eur Urol* 2007;51:899-906.
9. Tefekli A, Ali Karadag M, Tepeler K, Sari E, Berberoglu Y, Baykal M, et al. Classification of percutaneous nephrolithotomy complications using the modified clavien grading system: looking for a standard. *Eur Urol* 2008;53:184-90.
10. Munver R, Delvecchio FC, Newman GE, Preminger GM. Critical analysis of supracostal access for percutaneous renal surgery. *J Urol* 2001;166:1242-6.
11. Matlaga BR, Shah OD, Zagoria RJ, Dyer RB, Strem SB, Assimos DG. Computerized tomography guided access for percutaneous nephrostolithotomy. *J Urol* 2003;170:45-7.