

Transcatheter embolization for iatrogenic renal hemorrhage: a single center experience

İyatrojenik böbrek kanamalarında transkateter embolizasyon: tek merkez deneyimi

Kosti Can Çalışkan¹, Mesrur Selçuk Sılay², Orhan Tanrıverdi³, Sıtkı Mert Ulusay¹, Emin Çakmakçı¹, Zeki Karpat¹, Cengiz Miroğlu³

ABSTRACT

Objective: To report our experience with transcatheter embolization (TCE) for iatrogenic renal hemorrhage at our institution.

Materials and methods: A total of 18 patients underwent superselective embolization for iatrogenic renal hemorrhage from 2005 to 2010 at our hospital. Patient age, gender, Clavien classification, transfusion units, indications for TCE and embolic material were noted. The numbers of TCE and percutaneous nephrolithotomy (PNL) performed during the years of the study were recorded. The data are represented as the mean±standard deviation.

Results: Of 18 patients (12 male, 6 female), the mean age was 39.3±12.0 years (range 18 to 65). The procedures leading to massive renal hemorrhage were renal biopsy (n=2), nephrostomy placement (n=1), partial nephrectomy (n=3) and PNL (n=12). In total, there was 3 performances of TCE in the first two years, 9 in the second two years and 6 in the remaining two years. Accordingly, the numbers of PNLs performed during these periods were 92, 208 and 143, respectively. The mean number of transfusion units prior to TCE was 2.9±2.2. The Clavien grade was IIIa for 17 patients and IVa for one patient. Technical success was achieved in 94.4% of the patients, whereas clinical success was achieved in 83.3%.

Conclusion: TCE is a safe and effective procedure for the treatment of iatrogenic renal hemorrhage. PNL is the most common procedure leading to the need for TCE because of its frequent performance at our institution.

Key words: Percutaneous nephrolithotomy; renal hemorrhage; transcatheter embolization.

ÖZET

Amaç: İyatrojenik böbrek kanamaları nedeniyle uygulanan transkateter embolizasyon (TKE) sonuçlarını bildirmektir.

Gereç ve yöntem: Hastanemizde 2005-2010 yılları arasında toplam 18 hastaya iyatrojenik böbrek kanaması nedeniyle süperselektif embolizasyon tedavisi uygulandı. Hastaların yaşı, cinsiyeti, Clavien skorları, transfüzyon sayısı, TKE endikasyonları ve uygulanan embolik maddeler retrospektif olarak değerlendirildi. Aynı yıllar içerisinde uygulanan perkütan nefrolitotomi (PNL) ameliyat sayıları ile TKE sayıları not edildi. Veriler ortalama±standart sapma olarak bildirildi.

Bulgular: On sekiz hastanın (12 erkek, 6 kadın) yaş ortalaması 39.3±12.0 olarak tespit edildi (18-65). Masif böbrek kanamalarına yol açan nedenler; renal biyopsi (n=2), nefrostomi kateteri yerleştirilmesi (n=1) parsiyel nefrektomi (3) ve PNL olarak belirlendi. Belirlenen süre dahilinde ilk iki yılda TKE uygulama sayısının 3, ikinci 2 yılda 9, son iki yılda ise 6 olduğu görüldü. Bununla ilintili olarak aynı süre zarfında PNL uygulanma sayıları sırasıyla; 92, 208 ve 143 olarak tespit edildi. TKE uygulanmadan önceki ortalama kan transfüzyon miktarı 2.9±2.2 üniteydi. İşlemin teknik başarısı %94.4 olarak belirlenirken klinik başarının ise %83.3 olduğu görüldü.

Sonuç: İyatrojenik böbrek yaralanmalarının tedavisinde TKE güvenilir ve etkin bir yöntemdir. PNL sonrası gelişen böbrek kanamaları konservatif yöntemlerle durdurulamadığı takdirde TKE tedavisi uygulanabilir.

Anahtar sözcükler: Böbrek kanaması; perkütan nefrolitotomi; transkateter embolizasyon.

¹Department of Radiology, Şişli Etfal Training and Research Hospital, Istanbul, Turkey

²Department of Urology, Faculty of Medicine, Bezmialem Vakıf University, Istanbul, Turkey

³Department of 2nd Urology, Şişli Etfal Training and Research Hospital, Istanbul, Turkey

Submitted:
14.12.2011

Accepted:
28.03.2012

Correspondence:
Mesrur Selçuk Sılay
Adnan Menderes Bulvarı, Vatan
Caddesi, Fatih 34093
Istanbul, Turkey
Phone: +90 505 645 40 05
E-mail: selcuksilay@gmail.com

©Copyright 2012 by Turkish
Association of Urology

Available online at
www.turkishjournalofurology.com

Introduction

Renal vascular injuries are the main complications of percutaneous procedures and require close observation. Although the majority of these patients can be managed with conservative treatments, a number of complications such as prolonged hematuria, persistence of bleeding with unstable condition, arteriovenous fistula formation and pseudoaneurysm require active operative or angiographic intervention. Renal biopsy, nephrostomy placement, partial nephrectomy and percutaneous nephrolithotomy (PNL) are some of the procedures that may cause massive bleeding, which can be treated successfully by transcatheter embolization (TCE).^[1] Additionally, the introduction of smaller catheters and novel embolic agents has decreased the morbidity associated with this technique.^[2]

Over the last decade, PNL became one of the most frequently applied surgeries in urology departments. Concurrently, the complications of PNL have recently been the subject of numerous publications. It has been reported that bleeding is one of the most common complications after PNL.^[3] It is therefore important for urologists to work in close collaboration with interventional radiologists if worrisome renal hemorrhaging is to be prevented with minimally invasive techniques.

In this study, we aimed to report our experience with TCE in 18 consecutive patients with massive renal bleeding after renal procedures. In addition, we investigated whether the increasing number of TCE procedures for iatrogenic renal injuries at a single hospital was associated with the performance of PNL.

Materials and methods

From 2005 to 2010, eighteen patients underwent twenty TCE procedures for iatrogenic renal injury at our institution. Embolization procedures used for the elective cases including; treatment of angiomyolipoma, before nephrectomy for renal mass and end-stage renal disease were excluded from the study. Patient age, gender, Clavien classification, transfusion units, indications for TCE and embolic material were noted. The numbers of TCE and PNL performed during the years were reviewed retrospectively. The TCE-related complications were obtained from the medical records. The data are represented as the mean±standard deviation.

All TCE procedures were performed at the same angiography unit (Siemens Axion Artis FA, Germany) of our institution by the same interventional radiologist (KCC). The decisions to perform TCE were made after consultations between the departments and after informed consent was obtained from the patients. Duplex ultrasound of the kidneys (n=8) and/or computed tomography (CT) angiography (n=14) was performed

prior to TCE treatment in each patient. Prophylactic antibiotics and analgesics were administered and pre-procedural anxiolytics were given, depending on the indication and context. The patients were appropriately hydrated before the embolization to avoid any deterioration of renal function.

The Seldinger method was used for introduction from the right femoral arterial access site under local anesthesia. Aortography was initially performed via insertion of a pig-tail catheter and followed by selective renal arteriography to elucidate any pathology related to the iatrogenic injury. A total of 25 mL of non-ionic contrast material was used at 15 mL/second for visualization. After determination of the renal artery ostia, a 5F catheter was used to facilitate the advancement into the renal artery. Additionally, a 2.7F micro-catheter was used for the superselective catheterization into the distal branches. Subsequently, any vascular structures causing bleeding were identified. Embolizing materials used for the treatment are listed as follows: periferic coil (Hilal microcoil 0.18 COOK, Azur hydrocoil pushable 0.18 TERUMO), glue (liquiband MEDLOGIC), and Onyx-18 (MTI-EV3, Irvine, CA, USA). The embolizing materials were selected according to the lesion diameter and the type of hemorrhage.

The serum creatinine and hemoglobin levels, blood pressure and vital status of the patient were monitored closely prior to and after the procedure. TCE was repeated if any failure of the embolization was detected. Technical success was defined as occlusion of the lesion documented by immediate post-procedural angiography. Clinical success was defined as complete cessation of hematuria and the return of normal hemoglobin and creatinine values with no recurrence within 4 weeks.

Results

Of the 18 patients (12 male, 6 female) whose charts were reviewed, the mean patient age was 39.3±12.0 years (range 18-to-65). The mean time for the TCE performance after the main procedure leading to iatrogenic renal hemorrhage was 4.8±4.0 days (range 1 to 14). The mean hemoglobin value was 7.8±1.4 mg/dL (range 5 to 11) prior to TCE. The Clavien grade was IIIa for 17 patients and IVa for one patient. The mean number of transfusion units prior to TCE was 2.9±2.2 (range 1 to 8). The procedures leading to severe renal hemorrhage were renal biopsy (n=2), nephrostomy placement (n=1), partial nephrectomy (n=3) and PNL (n=12).

In total, there were 3 performances of TCE for iatrogenic injuries in the first two years, 9 in the second two years and 6 in the remaining two years. In accordance, the numbers of PNL procedures performed during these defined periods were 92, 208 and 143, respectively. The proportion of the PNL over the other causative procedures leading to TCE is shown in Figure 1.

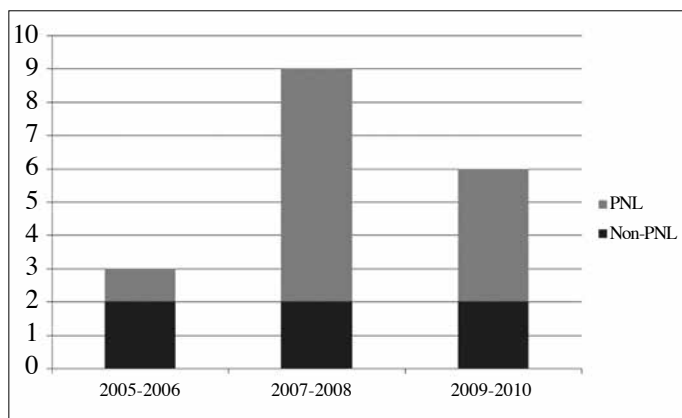


Figure 1. Proportion of the causative procedures leading to TCE.

Of the 18 patients, angiography revealed pseudoaneurysm as the main cause of bleeding in 10 (Figure 2). In the rest of the patients, arteriovenous fistula (AVF) was detected in 2, and persistent bleeding into the collecting system was detected in 6 (Figure 3). A total of 16 patients underwent single endovascular intervention, whereas two patients (11.1%) required a second TCE procedure to stop the bleeding. Technical success was achieved in 17 of the patients, whereas clinical success was achieved in 15. The overview of patient characteristics, including the embolizing agents, is summarized in Table 1. One patient, in whom PNL was the causative procedure of massive hemorrhage requiring TCE, had undergone nephrectomy. Regardless of the technically successful TCE performance, prolonged hematuria developed, and the patient became hemodynamically unstable. After performance of nephrectomy, the hematuria ceased, and the patient became stable within the following week.

Following TCE, two of our patients experienced flank pain in the early period, but the rest of the cases did not experience any TCE-related complications, such as pyrexia, ectopic coil placement, renal intimal dissection, renal abscess or renal deterioration.

Discussion

TCE is a minimally invasive, safe and effective procedure for stopping problematic renal bleeding after iatrogenic injury. We have found that the frequent performance of PNL has resulted in increasing performance of TCE at our institution.

The most frequently performed institutional procedures that may cause iatrogenic renal injury are renal biopsy, percutaneous nephrostomy placement, laparoscopic or open partial nephrectomy and PNL.^[1] When compared to the other procedures, although practiced for almost 30 years, the number of PNL

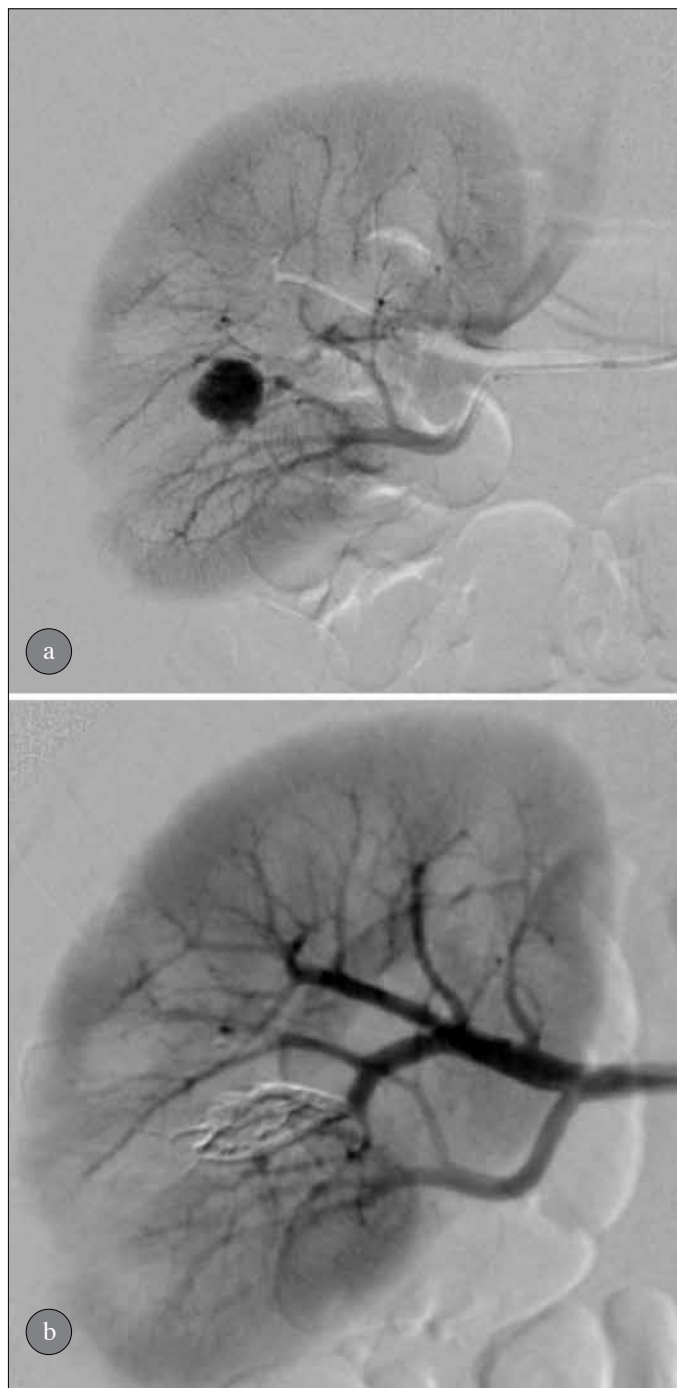


Figure 2. Pre-and post-embolization of pseudoaneurysm.

performances significantly increased after the superiority of this procedure on open stone removal was proven over the last decade. Regardless of large stone sizes or anatomically abnormal kidneys, PNL became a method of choice in the majority of the urology departments in which this technology was available because of its less invasive nature.^[4,5] Technical advances in the design of nephroscopes have encouraged the compact use of

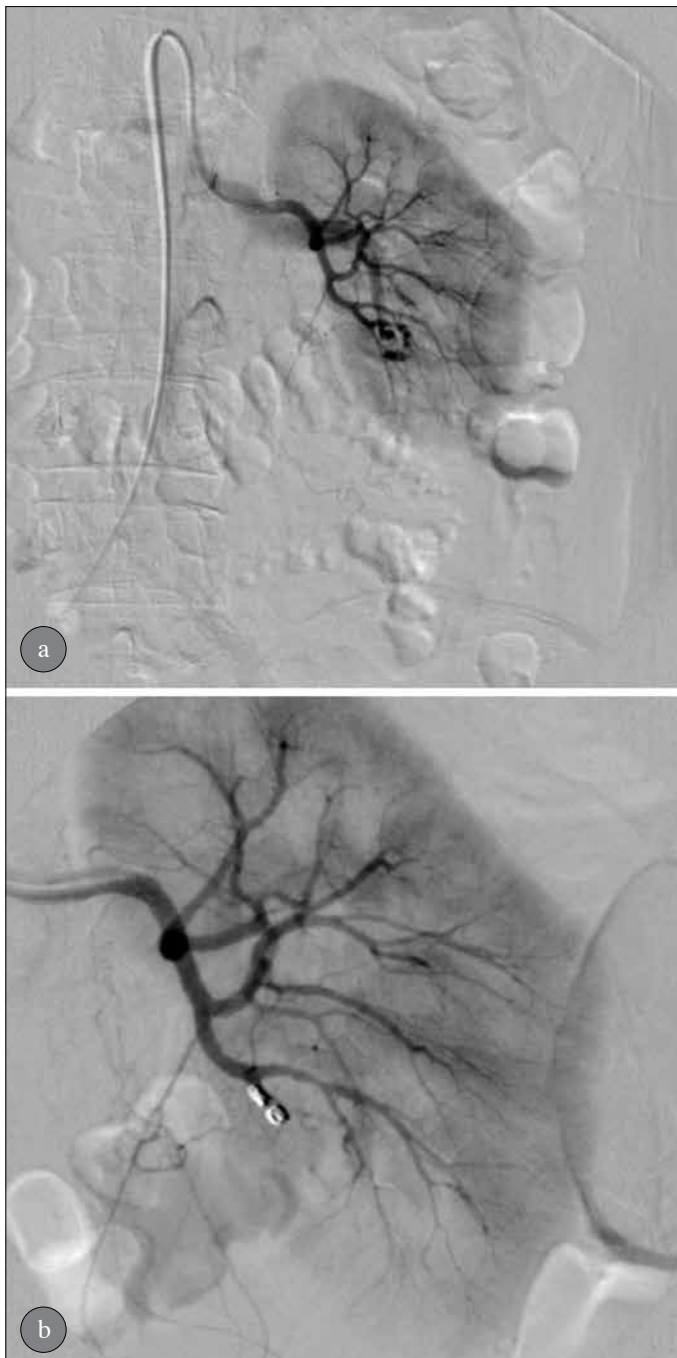


Figure 3. Pre- and post-embolization of AVF in the lower pole of the kidney.

PNL for the treatment of renal calculi. Continuously evolving fiberoptic visualization, downsizing of the devices, safer use of fluoroscopy and improvements in stone fragmentation have all broadened the indications of PNL. In 2005, PNL became available at the urology departments in our hospital and soon replaced open surgical procedures for kidney stone removal.^[6] Even though PNL is a safe and minimally invasive procedure, surgical difficulties may still occur, some of which have lasting

consequences. Renal hemorrhage is the most serious complication of PNL, which has been previously addressed elsewhere.^[7] Massive bleeding may occur during needle passage, tract dilation, stone fragmentation, manipulation of the amplatz sheath or nephrostomy placement. Tube clamping, hydration, and tamponade placement are some of the bleeding prevention methods that are used. Nevertheless, the incidence of severe bleeding requiring angiography and embolization is approximately 1.4%.^[8] In our series, 2.7% (12 of 443) of the patients required TCE following PNL, which is slightly higher than the current data, most likely because of our tendency to choose a safer treatment in patients with severe bleeding. When the numbers of our PNL and TCE procedures were separated by year, we noted that 3 TCE procedures were performed in the first two years, 9 in the second two years and 6 in the remaining two years. The numbers for PNL performance during these defined periods were 92, 208 and 143, respectively. Accordingly, when we evaluated the proportion of the causative procedures leading to renal hemorrhage requiring TCE, we observed that the numbers of PNL performance directly affected the overall performance of TCE in the defined periods at our institution (Figure 1).

Another procedure that may cause severe renal hemorrhage due to iatrogenic renal injury is the partial nephrectomy operation. It has been previously reported that partial nephrectomy can cause bleeding in 0 to 4.5% of cases.^[9] Three of our patients experienced severe renal bleeding following this procedure. Although technical success was achieved in these three patients after TCE, one experienced prolonged hematuria and required another session of TCE to stop the bleeding. Finally, all patients were successfully treated without the need for total nephrectomy.

Kidney biopsy is another important procedure frequently used by nephrologists and radiologists that may lead to severe bleeding. Soares and colleagues reported on 289 renal biopsy cases in an investigation of amyloidosis in the absence of abnormal international normalized ratio (INR).^[10] They observed severe hemorrhage in 5 of the patients (1.7%) who received embolization for the treatment. In our series, 2 of 18 patients received TCE because of renal biopsy. Pseudoaneurysm formation was detected in both cases, and both were successfully treated after appropriate embolization.

Typically, segmental arteries rather than small intrarenal vessels are the cause of severe renal hemorrhage. The most common reasons for bleeding from these vessels are AVF and pseudoaneurysm formations. Srivastava et al.,^[8] reported 13 pseudoaneurysms and 6 AVFs between 27 TCE procedures. In our series, we also detected pseudoaneurysm as the most common angiographic appearance leading to hemorrhage in our population (Figure 2a, b). 10 out of 18 patients were treated because of pseudoaneurysm formation, and 2 of our patients had AVFs

Table 1. Overview of the characteristics of the patients undergoing TCE.

Pt no.	Age	Causative procedure	Clavien score	Hgb mg/dL	Embolizing material	Technical success	Clinical success
1	65	Biopsy	3	7	PVA+glue	Yes	Yes
2	34	PNL	3	9	Glue	Yes	Yes
3	18	Nephrostomy	3	8	PVA	Yes	Yes
4	44	PNL	3	10	Coil	Yes	Yes
5	51	Partial nephr.	3	8	Glue	Yes	No
6	35	PNL	4a	5	Coil	Yes	No
7	25	Biopsy	3	10	Coil	Yes	Yes
8	39	PNL	3	8	Glue	Yes	Yes
9	38	PNL	3	10	Coil+glue	Yes	Yes
10	53	PNL	3	11	Glue	Yes	Yes
11	33	PNL	3	8	Coil	Yes	Yes
12	60	PNL	3	8	Coil	Yes	Yes
13	32	PNL	3	9	Glue	No	No
14	48	Partial nephr.	3	10	Glue	Yes	Yes
15	28	PNL	3	10	Onyx	Yes	Yes
16	35	PNL	3	8	Glue	Yes	Yes
17	33	PNL	3	9	Onyx	Yes	Yes
18	38	Partial nephr.	3	10	Onyx	Yes	Yes

(Figure 3a, b). The rest of the patients had persistent bleeding from different segmental arteries.

Although the majority of percutaneous renal procedures are safe with minimal morbidity, it has been reported that renal vascular injuries requiring blood transfusion may occur in 1 to 11% of cases.^[1] However, only a few of those patients become clinically unstable despite transfusion, appropriate medication and simple maneuvers to stop bleeding and consequently require further intervention. Therefore, in these circumstances, percutaneous angiography with superselective embolization is superior to open surgical exploration because of its lower morbidity, lower hospital costs, high success rate and lower risk of nephrectomy.^[11,12] Breyer et al.,^[13] performed a review of 10 published case series of embolization therapy for renal trauma. They found that the overall technical success rate was 90% (151 of 167), and the clinical success rate was 79% (132 of 167). In our series, the rate of technical success was 94.4%, and the clinical success rate was 83.3%, which makes our results comparable with those of previous studies. Considering the existing data, TCE, a preferred method of treatment at our institution, is safe and effective for stopping problematic renal bleeding after iatrogenic injury.

In conclusion, TCE is a minimally invasive, safe and effective procedure for stopping serious renal bleeding after iatrogenic injury. Wide performance of PNL has resulted in increasing performance of TCE at our institution. At centers where PNL is frequently performed, both the urologists and interventional radiologists should collaborate on the treatment of vascular complications.

Conflict of interest

No conflict of interest was declared by the authors.

References

- Vignali C, Lonzi S, Bargellini I, Cioni R, Petrucci P, Caramella D, et al. Vascular injuries after percutaneous renal procedures: treatment by transcatheter embolization. *Eur Radiol* 2004;14: 723-9. [\[CrossRef\]](#)
- Keller FS. Interventional radiology: New paradigms for the new millennium. *J Vasc Interv Radiol* 2000;11:677-81. [\[CrossRef\]](#)
- Michel MS, Trojan L, Rassweiler JJ. Complications in percutaneous nephrolithotomy. *Eur Urol* 2007;51:899-906. [\[CrossRef\]](#)
- Cracco CM, Scoffone CM, Scarpa RM. New developments in percutaneous techniques for simple and complex branched renal stones. *Curr Opin Urol* 2011;21:154-60. [\[CrossRef\]](#)

5. Miller NL, Matlaga BR, Handa SE, Munch LC, Lingeman JE. The presence of horseshoe kidney does not affect the outcome of percutaneous nephrolithotomy. *J Endourol* 2008;22:1219-25. [\[CrossRef\]](#)
6. Tanriverdi O, Boylu U, Kendirci M, Kadihasanoglu M, Horasanli K, Miroglu C. The learning curve in the training of percutaneous nephrolithotomy. *Eur Urol* 2007;52:206-11. [\[CrossRef\]](#)
7. Kurtulus F, Fazlioglu A, Tandogdu Z, Karaca S, Salman Y, Cek M. Analyses of factors related with bleeding in percutaneous nephrolithotomy using balon dilatation. *Can J Urol* 2010;17:5483-9.
8. Srivastava A, Singh KJ, Suri A, Dubey D, Kumar A, Kapoor R, et al. Vascular complications after percutaneous nephrolithotomy: are there any predictive factors? *Urology* 2005;66:38-40. [\[CrossRef\]](#)
9. Polasjik TJ, Pound CR, Meng MV, Partin AW, Marshall FF. Partial nephrectomy: technique, complications and pathological findings. *J Urol* 1995;154:1312-8. [\[CrossRef\]](#)
10. Soares SM, Fervenza FC, Lager DJ, Gertz MA, Cosio FG, Leung N. Bleeding complications after transcutaneous kidney biopsy in patients with systemic amyloidosis: single-center experience in 101 patients. *Am J Kidney Dis* 2008;52:1079-83. [\[CrossRef\]](#)
11. Fisher RG, Ben-Menachem Y, Whigham C. Stab wounds of the renal artery branches: Angiographic diagnosis and treatment by embolization. *AJR Am J Roentgenol* 1989;152:1231-5.
12. Poulakis V, Ferakis N, Becht E, Deliveliotis C, Duex M. Treatment of renal-vascular injury by transcatheter embolization: Immediate and long-term effects on renal function. *J Endourol* 2006;20:405-9. [\[CrossRef\]](#)
13. Breyer BN, McAninch JW, Elliott SP, Master VA. Minimally invasive endovascular techniques to treat acute renal hemorrhage. *J Urol* 2008;179:2248-52. [\[CrossRef\]](#)