Post-Percutaneous Nephrolithotomy Extensive Hemorrhage: A Study of Risk Factors

Ahmed R. El-Nahas, Ahmed A. Shokeir,* Ahmed M. El-Assmy, Tarek Mohsen, Ahmed M. Shoma, Ibrahim Eraky, Mahmoud R. El-Kenawy and Hamdy A. El-Kappany

From the Urology and Radiology Departments(TM), Urology and Nephrology Center, Mansoura University, Mansoura, Egypt

Purpose: We identified risk factors predicting severe bleeding due to percutaneous nephrolithotomy.

Materials and Methods: Computerized data on 2,909 patients who underwent a total of 3,878 percutaneous nephrolithotomy procedures between January 1995 and December 2005 were retrospectively reviewed. Data on patients who experienced severe bleeding requiring angiographic renal embolization were compared with those on other patients using univariate and multivariate analyses. We tested the characteristics of patients, kidneys and stones together with details of the operative procedure and surgeon experience.

Results: Severe bleeding complicated a total of 39 procedures (1%) in 25 males and 14 females with a mean age of 50.7 ± 12.6 years. Associated morbidity included shock in 6 patients and perirenal hematoma in 4. Renal angiography revealed pseudoaneurysm in 20 patients, arteriovenous fistula in 9, the 2 lesions in 8 and arterial laceration in 2. Bleeding could be controlled with superselective embolization in 36 patients (92.3%). Followup was available on 33 patients (mean 21 ± 15 months). Renal function was stable in all patients except 3 who had a post-embolization increase in serum creatinine, of whom all had a solitary kidney and none required renal replacement therapy. Significant risk factors for severe bleeding were upper caliceal puncture, solitary kidney, staghorn stone, multiple punctures and inexperienced surgeon.

Conclusions: Percutaneous nephrolithotomy should be performed by an experienced endourologist in patients at risk for severe bleeding, such as those with a solitary kidney or staghorn stones.

Key Words: kidney; kidney calculi; nephrolithotomy, percutaneous; hemorrhage; embolization, therapeutic

Percutaneous nephrolithotomy is an established procedure for large and complex renal calculi.[1] Refinement of the technology and increasing experience in the last 2 decades led to increased safety and efficacy. Nevertheless, complications may still occur. Renal hemorrhage is one of the most dangerous complications of PNL. Fortunately conservative measures are adequate to control bleeding in most cases and angiographic embolization is needed in less than 1%.[2–5] Although the diagnosis of and treatment for post-PNL renal bleeding was previously discussed,[6–9] only a few groups have investigated risk factors [7,10] and one of these studies failed to identify any risk factors.[7] Identification of the risk factors of post-PNL severe hemorrhage is of paramount importance for their avoidance. We identified risk factors predicting post-PNL severe bleeding requiring angiographic renal embolization.

PATIENTS AND METHODS

Computerized data on 2,909 patients who underwent a total of 3,878 PNL procedures between January 1995 and December 2005 at our center were retrospectively reviewed. Preoperative patient evaluation included history, clinical examination, serum creatinine estimation, complete blood count, coagulation profile and liver function tests. Radiological investigations included excretory urography or noncontrast computerized tomography in patients with high serum creatinine.

With the patient prone the skin was punctured at the posterior axillary line. Supracostal approach was needed in 531 procedures (13.7%). Percutaneous renal access was established under biplane or multidirectional C-arm fluoroscopic guidance through the posterolateral plane of the kidney. The pelvicaliceal system was entered at the lower posterior calix in patients with renal pelvis or lower caliceal stones. Middle or upper calix punctures were used when stones were present in these calices. One-stage PNL (puncture, dilation and stone retrieval) was performed in 45% of the patients. The tract was dilated using coaxial telescopic dilators, which fit tightly to the 30Fr Amplatz sheath, because a discrepancy between the size of the sheath and the size of the last coaxial dilator can cause renal injury and subsequent bleeding. Small stones were removed with forceps and large ones were disintegrated with pneumatic or ultrasonic lithotrites. A 22Fr nephrostomy tube was placed at the end of the procedure. The tube was removed after 48 hours and the patient was discharged home, provided that there were no complications or residual stones.

Mild bleeding was managed conservatively by clamping the nephrostomy tube, adequate hydration, diuretics and hemostatic drugs. Moderate hemorrhage was successfully treated with blood transfusion, in addition to conservative measures. Severe bleeding leading to hemodynamic insta-

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* Correspondence: Urology Department, Mansoura Urology and Nephrology Center, Mansoura, Egypt (telephone: + 2050 226 2222; FAX: +2050 226 3717; e-mail: ahmedshokeir@hotmail.com).

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bility was treated with blood transfusion plus superselective renal angiography to identify the site and type of vascular injury (fig. 1). Embolization of the injured vessels was then performed using platinum microcoils. At the end of the procedure angiography was repeated to ensure occlusion of the offending vessel (fig. 2). The patient remained in bed with vital sign monitoring every 4 to 6 hours. Ultrasonography and complete blood count were performed daily until stabilization of the condition. If bleeding recurred, another embolization session was performed.

To identify risk factors for severe bleeding data on patients who needed embolization were compared with those on other patients using chi-square univariate and logistic regression multivariate analyses. We tested all characteristics of patients (age and sex), renal units (side, morphology and whether it was a solitary kidney) and stones (site, burden and recurrence). Stone burden was classified as single, multiple or staghorn stones. The details of the operative procedure (number and site of percutaneous tracts) and surgeon experience in doing PNL were also studied.

RESULTS

Of 3,878 PNL procedures blood transfusion was needed in 213 (5.5%) and superselective renal angiography was required in 39 (1%). They were 25 males and 14 females with a mean ± SD age of 50.7 ± 12.6 years (range 25 to 80). A total of 29 patients experienced perioperative severe bleeding, while 10 experienced severe hematuria after hospital discharge. Mean time before late hematuria was 6.3 days (range 3 to 22). Associated morbidity included hemorrhagic shock in 6 patients and perirenal hematoma in 4. The median number of blood transfusion units was 3 (range 1 to 6).

Renal angiography revealed pseudoaneurysm in 20 patients, AVF in 9 and the 2 lesions in 8 (fig. 1), while arterial laceration was seen in 2. Vascular injuries were related to the upper, middle and lower segmental renal vessels in 9, 6 and 22 patients, respectively, while injury to the upper and lower branches was noted in 1 and injury to a large hilar artery was observed in another.

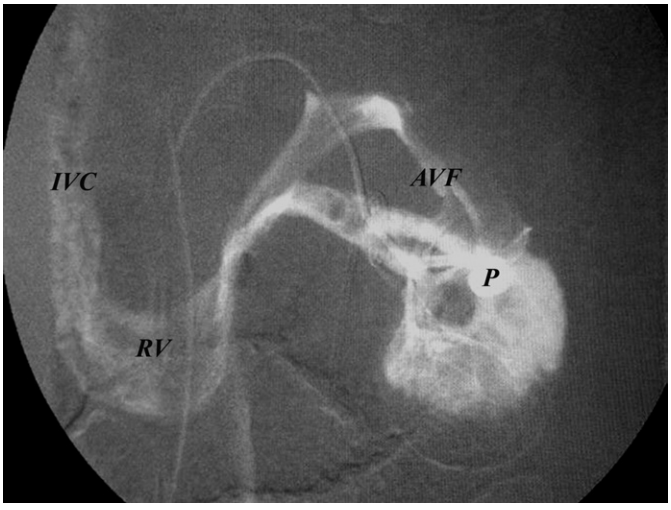

FIG. 1. Superselective renal angiography of lower segmental branch of left kidney shows pseudoaneurysm (*P*) and AVF, leading to opacification of renal vein (*RV*) and inferior vena cava (*IVC*).

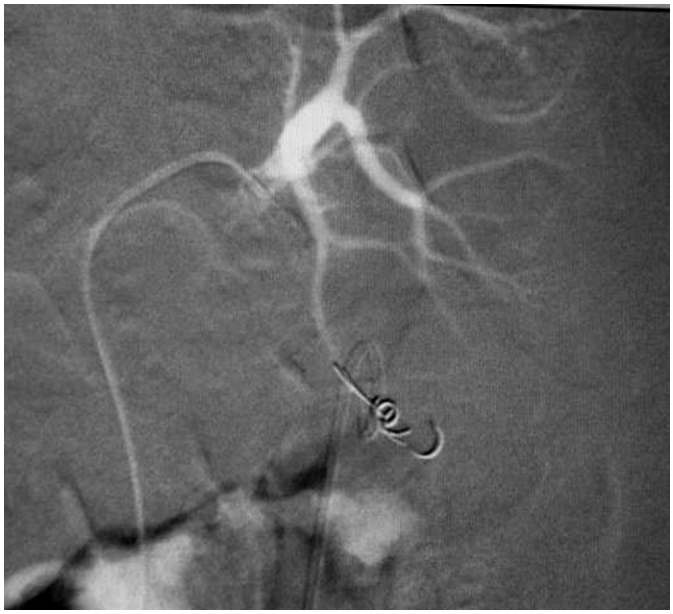

FIG. 2. Superselective renal angiography of lower segmental branch of left kidney after insertion of 3 microcoils demonstrates no perfusion through affected artery.

Bleeding could be controlled with superselective embolization in 36 patients (92.3%) after 1 session in 26 and 2 sessions in 10. The second session was required because of failure to demonstrate vascular injuries during the first session in 2 cases and recurrent hemorrhage in the remaining 8. The early post-embolization course was smooth in 30 patients with cessation of hematuria within 24 hours, while morbidity was observed in 6. Two of these patients had urinary leakage through the nephrostomy tract, which was successfully managed by a double pigtail ureteral stent for 4 weeks. One patient with a perinephric abscess due to perinephric hematoma infection was treated with percutaneous tube drainage. In 3 patients with a solitary kidney serum creatinine increased from preoperative values of 0.8, 1 and 1.3 to 2.5, 3.6 and 6 mg/dl, respectively.

Superselective embolization failed to control bleeding in 3 patients, including 2 with a large AVF and 1 with hilar vascular injury. Urgent exploration was performed in the 3 patients. Deep sutures at the site of the nephrostomy tube controlled bleeding in the first patient and nephrectomy was required in the second patient. The third patient died during exploration from profuse internal hemorrhage due to injury to a large hilar artery.

Of the 39 patients followup was available on 33 (mean 21 ± 15 months). Renal function was stable in all patients except 3 who had a post-embolization increase in serum creatinine. All of them had a solitary kidney and none required renal replacement therapy.

Mean age ± SD in patients with and without severe bleeding was comparable (50.7 ± 12.6 vs 46.9 ± 10.9 years, $p = 0.224$). Significant risk factors on univariate analysis were upper calix puncture, solitary kidney, staghorn stone, multiple punctures and inexperienced operator (table 1). On multivariate analysis all of these factors maintained significance as independent risk factors (table 2).