Selected examples of complications after minimally invasive treatment for urolithiasis

Waldemar Różański[1], Leszek Klimek[2], Marek Lipiński[1], Rafał Kliś[1]

[1]2nd Department of Urology, Medical University of Łódź, Łódź, Poland
[2]Institute of Materials Science and Technology, Division of Materials Investigation of the Technical University of Łódź; Division of Biophysics, Department of Basic and Pre-Clinical Science of the Medical University of Łódź, Łódź, Poland

KEY WORDS

stone ◗ minimally invasive treatment

ABSTRACT

In recent years urologists have concentrated on the intense introduction of minimally invasive methods for the treatment of urinary tract diseases with major progress noted in the treatment of urolithiasis. Nowadays extracorporeal shockwave lithotripsy (ESWL), percutaneous nephrolithotomy (PCNL), and ureteroscopic lithotripsy (URSL) are widely used in the treatment of urinary tract lithiasis. The aim of this study is to present examples of urinary tract lithiasis as the complication after minimally invasive methods used in the treatment of urolithiasis. One should remember that even minimally invasive medical procedures using the instruments retained in long-term contact with urine may be the cause of incrustation and stone formation.

INTRODUCTION

The last several decades have been the period of the intense development of minimally invasive procedures used in the therapy of urinary tract diseases. The greatest progress has been made in the treatment of urolithiasis [1-4]. The use of equipment generating high frequency shock waves that crush the stones in the urinary tract (ESWL – extracorporeal shock wave lithotripsy) has become common and widely accessible [5]. Additional procedures comprise percutaneous nephrolithotripsy (PCNL) and ureteroscopic lithotripsy (URSL) [6, 7]. In order to facilitate the urine outflow, double-J catheters were introduced into day-to-day practice [8, 9]. However, implementation of these new, minimally invasive methods in the treatment of urolithiasis resulted in some new therapeutic problems, including among others residual lithiasis or steinstrasse [10, 11].

The aim of this paper was to present interesting examples of select complications (secondary stone formation) after minimally invasive procedures used in the treatment of urolithiasis and the possibility of holmium laser use in this therapy.

MATERIAL

Cases of five patients hospitalized from 2008 to 2010 in the 2nd Department of Urology were reported. The subjects were diagnosed with urolithiasis as a complication of previous minimally invasive therapy. In three patients previously treated with ESWL, double-J catheters were inserted into the ureters in order to facilitate the evacuation of the broken fragments of the deposits. One patient was treated for bladder stones formed on a guide wire that was left in the urinary tract after URSL. The last patient suffered from bladder stones, which formed on a piece of Foley catheter that was left in the urinary bladder. A description of the cases is presented in Table 1.

METHODS

In order to evaluate the encrustation process of the instruments used in the treatments (catheters, guide wires), their surfaces were analyzed using a scanning electron microscope, the Hitachi 5000 with a magnification factor of 18 to 400x, and pressure of 10^{-4} torr. The electron beam current was 50 to 100 µA, the diameter was 500-1000 Å, and the sample inclination angle was from 10° to 60°. Prior to microscopic analysis the fragments of instruments together with the stone formations were sputtered with gold 4 N (99.9%) or palladium device type JEOL JEE-4X (Japan, Tokyo). The pressure during sputtering was 10^{-5} torr.

For the endoscopic lithotripsy, an 80 Watt Holmium laser (Omni Pulse-MAX™ Holmium Laser, Trimedyne USA) was used.

RESULTS

The manner of treatment of deposits formed on different medical instruments used in prior treatment of urolithiasis depends on the degree of encrustation on the surface of the devices remaining in contact with the patient's urine. In patients in whom double-J catheters were previously used, the formation of rather big stones on both bladder and pelvic ends were observed (Fig. 1 A, B). In case of large stones localized in the renal pelvis, the bladder deposits were crushed with the cutting of the bladder end of the double-J catheter using a holmium laser. This was followed by pyelolithotomy to remove staghorn stones with a ureteral fragment and pelvic end of the catheter.

Table 1. The cause of urinary tract stone formation and the mode of treatment

Number of patients	Prior procedure	Type of implemented instrument	Type of repair procedure
1	ESWL	Double-J catheter	Pelolithotomy and cystolithotomy
2	ESWL	Double-J catheter	YAG-holmium laser lithotripsy or Double-J catheter removal
1	URSL	Gide wire	Edoscopic removal of the guide wire fragment with the stone
1	Foley catheter insertion for complete urinary retention	Catheter fragment	YAG-holmium laser lithotripsy and catheter fragment removal

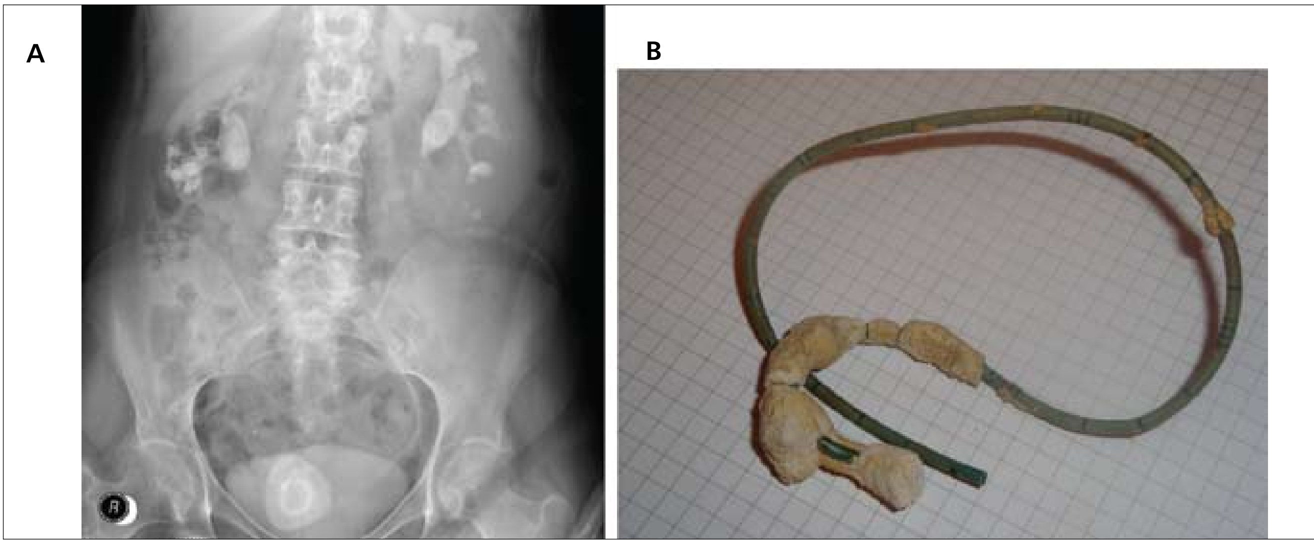

Fig. 1. A. Lithiasis of urinary bladder and left kidney pelvis formed on the Double-J catheter. Intravenous pyelography (IVP). B. Stone on the pelvic end of Double-J catheter after its surgical removal from the urinary tract.

Fig. 2. Double-J catheter with a small stone on its bladder end. Catheter easily removed via endoscopic manner.

Catheters are encrusted to a different degree depending on the time of their presence in the urinary tract. Small stones can be removed endoscopically together with the catheters without any harm to the patient (Fig. 2). Analysis of such catheters under the scanning microscope reveals the stone on its end with a simultaneous encrustation process on other catheter sections and its lumen (Fig. 3 A, B).

Another instrument that was the source of a bladder stone was the guide wire fragment left in the urinary tract after URSL (Fig. 4 A, B).

The extremely rare cause of urinary bladder lithiasis is a deposit that forms on the fragment of the Foley catheter left in the bladder. In our material we noticed one such case. The stone was crumbled endoscopically and easily removed from the bladder (Fig. 5). Analysis of the Foley catheter fragment under the scanning microscope revealed cracked stone layers tightly attached to its outer and inner surfaces (Fig. 6 A, B).

DISCUSSION

The use of minimally invasive procedures in the treatment of urolithiasis is aimed to minimize complications and shorten the hospital stay, thereby reducing costs and increasing the patient's satisfaction. One cannot forget, however, that even these relatively safe and simple therapeutic methods carry the risk of adverse consequences. Therefore, currently used minimally invasive procedures are constantly analyzed and compared, both in terms of their efficacy and safety.

One of the most common complications after minimally invasive methods is the formation of secondary deposits on the medical instruments that were used in the course of the proce-

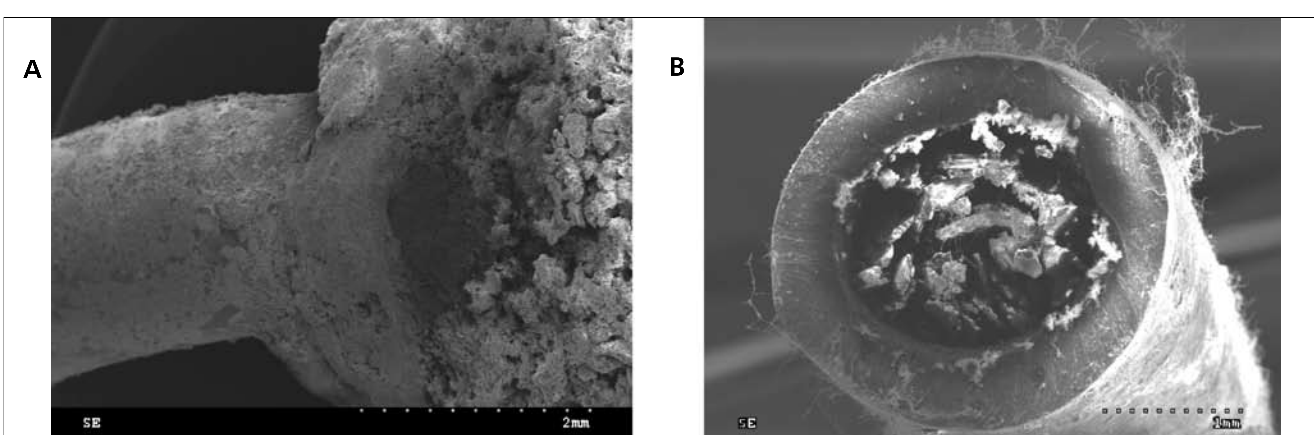

Fig. 3 A. Incrustation of Double-J catheter. Scanning microscope Hitachi 5000, magnification factor – 25. B. Early incrustation of the Double-J catheter lumen. Scanning microscope Hitachi 5000, magnification factor – 25.

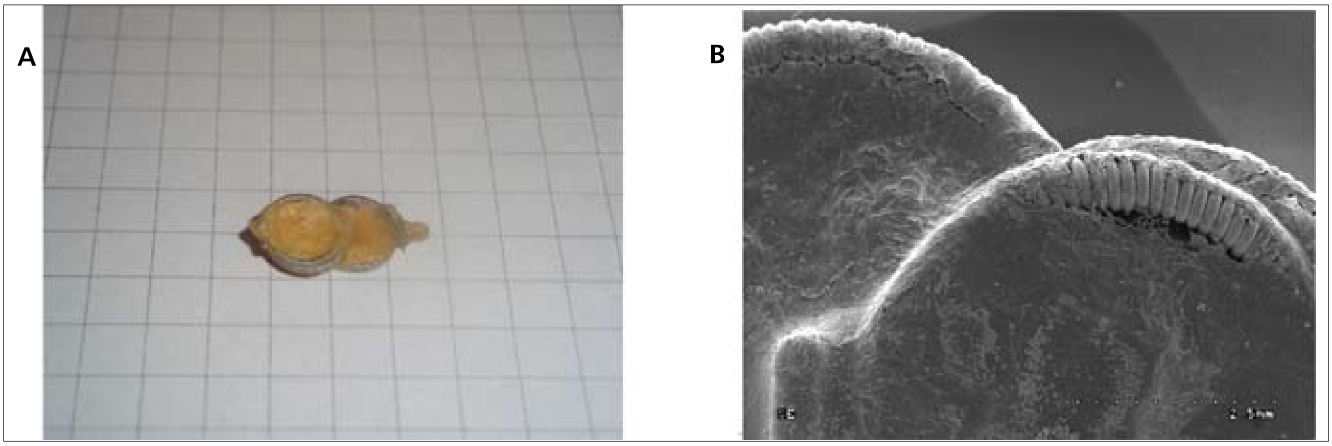

Fig. 4 A. Guide wire fragment left in the urinary tract. Removed endoscopically. B. Visible incrustation. Scanning microscope Hitachi 5000, magnification factor – 18.

Fig. 5. Fragments of crumbled stone and Foley catheter removed endoscopically from the urinary bladder.

dure. The contact of foreign bodies with urine is associated with stone formation on both their surface and in the lumen [12, 13, 14]. In case of the analyzed catheters and guide wire fragment, the deposits were observed on the surface, and the encrustation process was then confirmed by scanning electron microscope (Fig. 3 A, B, 4 B, and 6 B).

In the treatment of the reported complications after minimally invasive treatment of urolithiasis we have performed both open and endoscopic procedures with the use of holmium laser. In case of stones located in the urinary bladder, formed on the fragments of catheters or wires, therapy is much easier and less invasive. Deposits were crushed with the use of a holmium laser and the small fragments of crushed stone and small foreign bodies were easily removed from the bladder endoscopically. In these cases the hospital stay did not exceed two days. It seems that there are several factors increasing the risk of complications after minimally invasive procedures. For example, in a study of Manukian on 162 patients, the risk of steinstrasse increased with the number of ESWL sessions. This justifies the need for intensive supervision of patients after numerous ESWL sessions in order to quickly detect treatment complications and avoid the possible consequences [15]. Rationale for the use of a double-J catheter (considered a foreign body in the lumen of the urinary tract) before ESWL treatment was evaluated in a study of 60 patients with deposits ≤2 cm located in the upper part of the ureter. In half of the patients the double-J catheter was inserted into the urinary tract before surgery. There was no difference in the efficacy of ESWL depending on the presence of a double-J catheter, or the need for re-treatment. In the group in whom the catheter was applied, significantly more complications in the form of dysuria, frequent voiding, urgency, and suprapubic pain were reported. The authors conclude that the insertion of the catheter before ESWL does not yield any additional benefits and is also associated with additional adverse reactions [16].

The presence of urinary tract infections (UTI) after the ESWL procedure appears to be an important issue because it may affect renal function in the long-term. In a study of Vakalopoulos et al., 171 patients were analyzed after treatment with ESWL. Despite prophylactic antibiotics, UTI was diagnosed in up to 21.6% of patients. It was also observed that in patients with positive bacte-

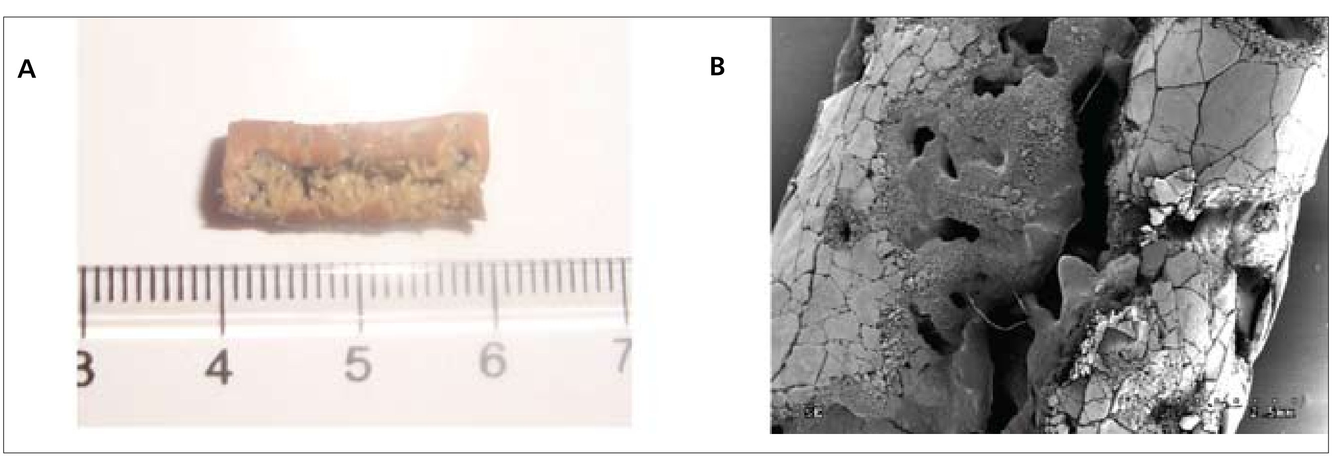

Fig. 6 A. Foley catheter fragment covered with stone. B. Scanning microscope Hitachi 5000, magnification factor – 18.

riological urine test, the levels of lactate dehydrogenase, creatine phosphokinase, and alpha-2 microglobulin in urine were significantly and even several times higher, which is indicative of greater postoperative kidney damage. The authors of the study indicate the need for long-term analysis of this issue to determine the impact on perioperative UTI on renal function [17].

Review of literature revealed reports of serious complications of minimally invasive procedures. Inoue et al. presented a case of shock in a 76-year-old patient on the 5th day after ESWL because of massive retroperitoneal hemorrhage around the treated kidneys. Despite the immediate nephrectomy and multiple blood units that were transfused, the patient died. During autopsy, kidney capsule rupture due to the growing hematoma as well as damage of the renal artery and inferior vena cava were observed, which may have been due to strong shock waves. It should be noted that in the presented case, on the third day after surgery, the patient returned to oral anticoagulant therapy [18]. Kim et al. described a case of hypovolemic shock in a young woman after ESWL applied in order to crush a 9-millimeter stone in the right kidney. The patient had developed a subcapsular liver hematoma of massive size, reaching 13 x 6 cm. Due to the lack of features of active bleeding at the time of diagnosis, conservative treatment was applied and the gradual absorption of the hematoma was observed [19]. Another example is the case of a 33-year-old man with Crohn's disease who developed septic shock in the sixth hour after ESWL for an ureteral stone on the right side. The septic shock was a consequence of a perforation of the ileum at the intestinal anastomosis that was performed previously. The authors describing the above case point to the need for accurate collection of the patient's history and thorough surveillance of patients with gastrointestinal inflammatory disease or a history of surgery within gastrointestinal tract [20].

CONCLUSIONS

One should remember that even minimally invasive medical procedures using instruments that remain in long-term contact with urine may be the cause of encrustation and stone formation in the urinary tract. The manner of treatment of such complications depends on the size and localization of the stone in the urinary tract and on the patient's condition. The basic methods of treatment are procedures performed endoscopically. Occasionally, in extremely difficult cases, a combination of endoscopic and open procedures is performed.

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Correspondence

Waldemar Różański
2nd Clinic of Urology
Medical University of Łódź
62, Pabianicka Street
93-513 Łódź, Poland
phone: +48 42 689 52 11
urologia@poczta.onet.pl