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Original Article

Biofilm formation is a cause of ureteral resonance metallic stent blockage: a case report

Ludong Qiao[1], Wei Yan[1], Zhen Du[1], Qing Cai[2], Shan Chen[1]

[1]Department of Urology, Beijing Tongren Hospital, Capital Medical University, Beijing, China; [2]Medical Experiment and Test Center, Capital Medical University, Beijing, China

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Abstract: Introduction: The ureteral resonance metallic stent guarantees the patient of ureteral obstruction a safe and sufficient long-term urinary drainage. The encrustation has been reported to be a main reason of the ureteral resonance metallic stents failure. We herein report a case of the resonance metallic stent blockage because of the formation of biofilm on the surface and internal lumen. Case presentation: A 63-year-old male patient was operated to insert the bilateral ureteral resonance metallic stent for the treatment of hydronephrosis on both sides caused by lymph nodes metastasis of bladder cancer. Four months after insertion, the patient hospitalized again with symptoms of fever, bilateral flank pain, anuria and acute renal failure. Emergency bilateral percutaneous nephrostomies were performed. After removing the bilateral resonance metallic stents, we visualized the stents by SEM. The results showed that biofilm filled in the crevice of spiral coil and lumen of the stents. The microbial cultures of the stents revealed the existence of *Staphylococcus epidermidis*. Conclusion: This case demonstrated that biofilm formation caused by bacterial colonization is a cause of ureteral resonance metallic stent blockage.

Keywords: Resonance metallic stent, biofilm, ureteric obstruction

Introduction

The resonance metallic stent prevents the patients from suffering ureteral obstruction. To date, the resonance metallic stents of 22% of patients appears to be failure by the encrustation of stone material at 8-12 months [1]. We herein report the blockage of ureteral resonance metallic stent at 4 months after insertion by the formation of biofilm on the surface and internal lumen. The study was conducted in accordance with the Declaration of Helsinki and approved by the ethics committee of Beijing Tongren Hospital Capital Medical University and written informed consent was obtained from the patient for publication of this case report and case series and accompanying images.

Case report

A 63-year-old male patient was rehospitalized because of fever, bilateral flank pain and anuria for 6 hours. 4 months ago, the patient diagnosed with hydronephrosis on both sides caused by lymph nodes metastasis of bladder cancer. The blood analysis showed that the creatinine level was 365 μmol/L and the urea nitrogen level was 20.3 mmol/L. The ureteral resonance metallic stents (Cook Medical, Bloomington, Indiana, USA) were retrograde inserted on both sides under cystoscopy, general anesthesia. 1 month after resonance metallic stents insertion, renal function improved with the creatinine level of 267 μmol/L and the urea nitrogen level of 15.9 mmol/L. But 2 months after insertion, the creatinine level and urea nitrogen level rose to 754 μmol/L and 33.5 mmol/L, respectively. The hydronephrosis was aggravated slightly under the images of ultrasound. However, the patient's urine volume was maintained at 2000-2500 mL/day. We took catheterization to prevent too high pressure of bladder and also utilize diuretic, but it made no improvement.

The patient presented fever, flank pain on both sides, anuria 6 hours before rehospitalization. The tempreture was 39.5°C, the creatinine

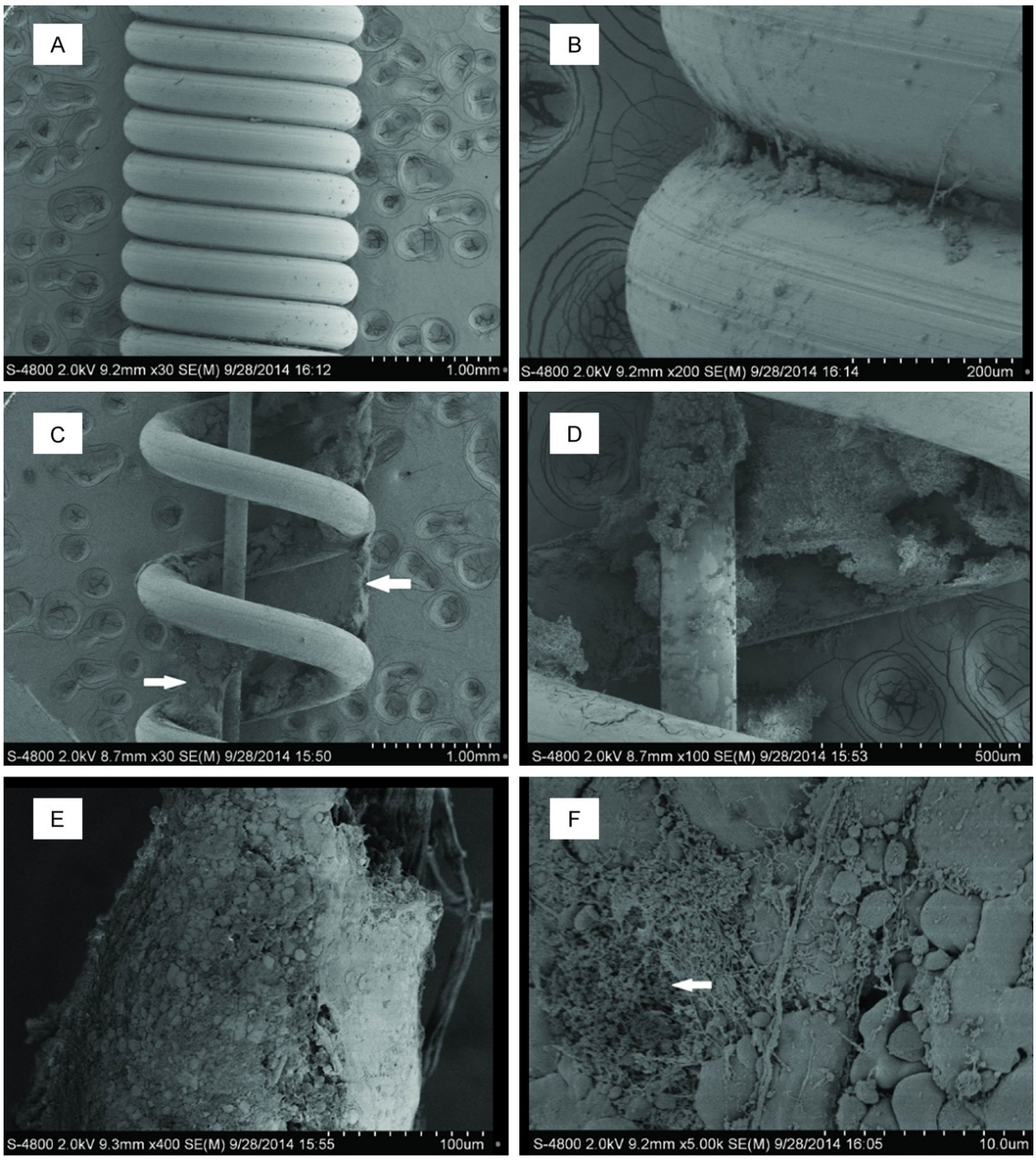

Figure 1. A. SEM (×30) revealed the stents was clear on the surface; B. SEM (×200) revealed the crevice of spiral coil of the stent was filled by biofilm; C. SEM (×30) revealed fibrin and biofilm were filled in the crevice of spiral coil (arrow) and lumen of the stent; D. SEM (×100) revealed the lumen of the stent was filled by biofilm; E. SEM (×400) showed the biofilm in the lumen of the stent; F. SEM (×5000) showed the fibrin, coccus (arrow) and biofilm.

level was 1033 μmol/L and urea nitrogen was 46.5 mmol/L. Then he got diagnosed with acute renal failure and upper urinary tract infection. After admission, emergency bilateral percutaneous nephrostomies were performed under local anesthesia. Bilateral renal pelvic urines were clear and urine cultures were negative. The intravenous antibiotics were used after procedures. The patient's temperature went to be normal the next day after operation and the creatinine level and urea nitrogen level were improved to be 851 μmol/L and 38.1 mmol/L respectively. 3 days after procedure, plain abdominal x-ray (KUB) showed that the ureteral resonance metallic stents were in right position and right form, there is no sign of

deformities, tortuousity, fracture or stone formation. 2 weeks later, we performed bilateral percutaneous nephroscopy under general anesthesia and found no stone in both kidneys. Then the two resonance metallic stents were removed by nephroscopy for detection. The stents surface was clear. We cut the stents into 1 cm pieces and pull some pieces stretch for culture and scan electron microscopy (SEM) examination. The stents cultures revealed small quantitys of *Staphylococcus epidermidis*. The SEM results showed that lots of fibrin, coccus and biofilm were filled in the crevice of spiral coil and lumen of the stent (**Figure 1A-F**). Now the patient kept the nephrostomy tubes and the creatinine level and urea nitrogen level were 507 μmol/L and 23.3 mmol/L respectively 1 month after operation.

Discussion

The lymph node metastasis of urothelial malignant neoplasms may cause obstructions of bilateral ureters, thus leads to the hydronephrosis and renal failure. The ureteral resonance metallic stent provides safe and sufficient management of malignant extrinsic ureteral obstruction to preserve renal function. The management of malignant extrinsic and benign intrinsic ureteral obstruction has been reported in the literature with promising results [2-4].

Cases of ureteral resonance metallic stents failure have been reported [1]. The inducements include encrustation, kinking damage, deposits between the coils and material flattening and the deformities on the stent surface. As to this case, the two ureteral resonance metallic stents showed no encrustation, damage or deformities. The SEM results revealed amounts of fibrin and bacterial biofilm filled in the crevice of spiral coil and lumen of the stents. Some coccus could be seen in the biofilm. The resonance metallic stent has a unique design without end holes: Urine drainage takes place through the tight spiral coil that makes the stent flexible and moveable. The latter characteristic allows the space to open between coils, which permit fluid access to the lumen [5]. Combined with the result of stents culture, we thought it is the bacterial biofilm formed by *Staphylococcus epidermidis* which stuck the drainage ways of ureteral resonance metallic stents.

The medicine biofilm infection has a major impact on temporary and permanent implants or devices in human body. Immediately after insertion of the stents into the urinary tract, Tamm-Horsfall glycoprotein, various polysaccharides and other components diffuse within minutes toward the stent surface from the bulk urine [6]. Proteinaceous macromolecular components just like serum albumin, fibrinogen, collagen and fibronectin from urine adsorb extremely fast onto the material surfaces to form a conditional film which alters the characteristics of stents surface [7]. The next step of the formation of a biofilm is the attachment of microorganisms. Microbial colonization on the conditional film is the final stage of the biofilm formation. Depending on the species involved, the microcolony may be composed of 10-25% cells and 75-90% exopolysaccharide matrix. Reid *at al* found that 90% of indwelling silicone double J stents are colonized by adherent bacteria, while the incidence of urinary infection detected clinically is only 27%. The isolated organisms are Gram-positive cocci (77%), Gram-negative rods (15%) and Candida sp. (8%) [8]. Conventional laboratory procedures are difficult to detect biofilm formation. It has been shown that 68% of stents were actually colonized but only 30% of patients were found to have bacteriuria. A negative urine culture does not rule out the possibility of stent colonization just like our case. Only the stent culture uncovered the *Staphylococcus epidermidis* colonization but not the renal pelvic urine culture.

This case demonstrates that biofilm formation caused by bacterial colonization is a cause of ureteral resonance metallic stent blockage.

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Disclosure of conflict of interest

None.

Address correspondence to: Ludong Qiao, Department of Urology, Beijing Tongren Hospital, Capital Medical University, No. 1, Dong Jiao Min Xiang, Beijing 100730, China. Tel: +8613910102618; E-mail: qiaoludong@163.com

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