APPLICATION OF NONVASCULAR INTERVENTIONAL RADIOLOGY PROCEDURES IN THE TREATMENT OF IATROGENIC URETERAL INJURIES

Igor Sekulic[1], Jelena Stevanovic[1], Srdjan Prodanovic[2], Jelena Boskovic Sekulic[3], Berislav Vekic[4,5] and Nemanja Rancic[1]
[1]Institute for Radiology, Military Medical Academy, Belgrade, Serbia
[2]Institute for Rheumatology, Belgrade, Serbia
[3]Center for Urgent medicine, Clinical Center Kragujevac, Kragujevac, Serbia
[4] University of Kragujevac, Faculty of Medical Sciences, Kragujevac, Serbia
[5]Department of Surgery, Clinical Centre "Dr Dragiša Mišović- Dedinje", Belgrade, Serbia

PRIMENA NEVASKULARNIH INTERVENTNIH RADIOLOŠKIH PROCEDURA U LEČENJU JATROGENIH POVREDA URETERA

Igor Sekulić[1], Jelana Stevanović[1], Srđan Prodanović[2], Jelena Bošković Sekuluć[3], Berislav Vekić[4,5] i Nemanja Rančić[1]
[1]Institut za radiologiju, Vojnomedicinska akademija, Beograd, Srbija
[2]Institut za reumatologiju, Beograd, Srbija
[3]Urgentni centar, Klinički centar Kragujevac, Kragujevac, Srbija
[4] Univerzitet u Kragujevcu, Fakultet medicinskih nauka, Kragujevac, Srbija
[5]Klinika za hirurgiju, Kliničko bolnički centar "Dr Dragiša Mišović-Dedinje", Beograd, Srbija

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ABSTRACT

Introduction. *He most common ureteral injuries are iatrogenic injuries. Diagnosis of ureteral lesions includes ultrasound, computer tomography, intravenous urography, anterograde and retrograde ureterography. For a definitive diagnosis it is necessary to determine the existence of the extralumination of contrast media from the ureter. Minor ureteral injuries can be treated with nonvascular interventional radiology procedures.* ***Case presentation.*** *We have presented two patients with iatrogenic ureteral injuries. Injury in the first patient occurred at the sigmoid colon resection and partial resection of the bladder, whereas in the second patient the lesion was formed as a result of cesarean section. In both patients, there was a history of previously conducted interventions, clinical picture included fever and pain, a diagnosis was made by intravenous and anterograde urography. Patients were treated with interventional radiology procedures and they have been definitely cured.* ***Conclusion****. Methods of nonvascular interventional radiology can be successfully applied in the treatment of minor iatrogenic ureteral injuries.*

Keywords: *ureter, iatrogenic trauma, anterograde urography, ureteral endoprosthesis*

SAŽETAK

Uvod. *Najčešće povrede uretera su jatrogene prirode. Dijagnoza ovih lezija uključuje primenu ultrazvuka, skenera, intravenske urografije, anterogradne i retrogradne ureterografije. Za definitivnu dijagnozu neophodno je utvrditi postojanje ekstraluminacije kontrastnog sredstva iz uretera. Minimalne lezije uretera mogu se lečiti procedurama nevaskularne interventne radiologije.* ***Prikazi slučajeva.*** *Prikazana su dva slučaja jatrogenih povreda uretera. Kod prvog pacijenta povreda je nastala tokom resekcije sigmoidnog kolona i parcijalne resekcije mokraćne bešike, dok je kod drugog pacijenta povreda nastala tokom carskog reza. Kod oba pacijenta u anamnezi je postojao podatak o prethodnoj intervenciji. Klinička slika je uključivala temperaturu i bol, a dijagnoza je postavljena intravenskom i anterogradnom urografijom. Pacijenti su tretirani procedurama interventne radiologije, kojima su i definitivno izlečeni.* ***Zaključak.*** *Metode nevaskularne interventne radiologije mogu se uspešno primeniti u lečenju minornih jatrogenih povreda uretera.*

Ključne reči: *ureter, jatrogena povreda, anterogradna urografija, ureteralna endoproteza*

ABBREVIATIONS

US - ultrasonography
IVU - intravenous urography
CT - computer tomography
INR - interventional nonvascular radiology

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Corresponding author:
Nemanja Rancic, MD, PhD,
Institute for Radiology Military Medical Academy, Belgrade
Tel: +381638524443
E-mail: nece84@hotmail.com

INTRODUCTION

Injuries to the ureter are one of the most serious complications of any abdominal or pelvic procedure (1). Ureteral injuries can be divided by cause into traumatic (usually the result of traffic accidents) (2) and iatrogenic which are far more common and they are the cause of 75% of ureteral lesions (3, 4).

Pelvic or abdominal surgeries, including laparoscopy and ureteroscopy, are a risk of ureteral injuries (5-11). According to the extensive retrospective studies, the most common interventions that occur as a cause of ureteral trauma are: urological (42%), gynecology and obstetrics (34%), while general surgical interventions are the cause of ureteral lesions in 24% of cases (8). The most common injuries are of the distal ureter (74%) (3). Other authors showed that gynaecological surgery is involved in about 52-82% of all cases with ureteral injuries: it was estimated that the risk of ureteral injuries is approximately from 0.0027 to 0.09% during emergency Caesarean section, 0.5-8% during intra-cesarean hysterectomy, 0.04-3% during abdominal hysterectomy and 0.02-0.47% during vaginal hysterectomy (9, 10).

Clinical symptomatology that occurs includes the pain by type of renal colic, pain in the loins, fever, and weakness (1, 7). This clinical picture including the data on the recently performed surgical, gynecology or any procedure, should arouse suspicion of ureteral lesion.

Ureteral lesion diagnosis is very difficult because clinical manifestations are non-specific. Radiology plays a critical role in diagnosis of these injuries (12). Diagnostic procedures include ultrasonography (US) with a potential findings of ureterohydronephrosis or periureteral pathological fluid collection; intravenous urography (IVU) with the findings of the extralumination of contrast medium; anterograde and retrograde urography in which the extralumination of contrast medium as well as the lesion location are clearly detected; and computer tomography (CT) urography with the findings of contrast medium extravasation, hydronephrosis, ureteric obstruction, urinary ascites, and periureteral collection or localized fluid collections such as urinoma (13-15). If the diagnosis is still equivocal after IVU and/or CT urography, then bilateral retrograde pyelography should be performed. It is the most accurate imaging exam to determine the location, type, and degree of iatrogenic ureteric injury.

Ureteral lesions of I-IV grade (Table 1 (16-18)), that is, those lesions with less than 2 cm can be successfully treated by the method of nonvascular interventional procedure, while for those of V grade, that is, with more than 2 cm, surgical treatment is required.

The aim of case study of these two patients is to show that lesions of the ureter, less than 2 cm, can be quite successfully treated with nonvascular interventional radiology procedures that are comfortable for the patient. One patient previously underwent a general surgery, and the other patient previously underwent gynecological and obstetric surgery. In both patients, as a result of these interventions, ureteral lesions occurred.

Case I

A secretion of urine through the abdominal drains in the postoperative course was detected in the patient of 61 years of age, who underwent sigmoid colon resection and partial resection of the bladder due to cancer of the sigmoid colon. The patient underwent cystoscopic exploration and the insertion of "JJ" endoprosthesis was attempted. The IVU was performed and the extralumination of contrast agent at the level of distal third of the left ureter was detected. The patient was referred to the department of nonvascular interventional radiology of the Institute of Radiology, Military Medical Academy, for further treatment.

Ultrasound shows left kidney without dilatation of pyelocaliceal system (Figure 1). Ultrasound guided anterograde urography shows the puncture site, non-dilated dorsal calyx and pyelocaliceal system without dilatation (Figure 2). As guidance for puncture under ultrasound guidance, dorsal Malpighi's pyramid in the interpolar region was used. After inserting the guide catheter, nephrostomy tube of caliber 8F (French) was placed and nephrotomography showed the left ureter to the prevesical part wherein the extralumination of contrast medium was detected (Figure 3). After 10 days, the control nephrotomography showed the maintenance of the extralumination of contrast medium but to a lesser extent. The guide wire and the manipulation catheter were inserted through the existing nephrostomy tube. After passing by the place of ureteral injury with the guide wire and inserting it into the bladder, the modified ureteral prosthesis was placed as a function of external-internal drainage. Modification of the original 'pig-tail' catheter of caliber 7F was performed by the scalpel and three holes, positioned in the pyelon and the proximal ureter, were made. The distal end of the catheter, with the original holes, was positioned in the bladder. In the next follow-up, anterograde urography showed normal mobility of endoprosthesis without the extralumination of contrast medium (Figure 4). Therefore, a drainage bag was removed, and endoprosthesis was left as a function of the internal derivation of urine.

Case II

This case describes a 30 year old patient who reported the pain in the left lumbar lodge and the increased body temperature after giving a birth by C-section. Three days after the delivery, CT urography was performed and on that occasion the extralumination of contrast agent from the left ureter with the creation of perirenal urine was observed. Female patient was subsequently admitted to the Clinic for Urology Military Medical Academy as an emergency. At the department of nonvascular interventional radiology she underwent antegrade urography and the extralumination of contrast medium was confirmed (Figures 5a and 5b). The guide wire and the manipulation catheter were inserted and after passing by the injury site, the original ureteral endoprosthesis in the function

of internal drainage caliber 8F was placed. (Figures 6a and 6b). In this way, the extralumination of urine was prevented. Percutaneous drainage of urine was performed and it was completed after seven days (Figures 7a and 7b). After a month, the follow-up anterograde urography showed the complete patency of the canal system without the extralumination (Figures 8a and 8b and 9a and 9b).

The extraction of endoprosthesis (Figures 10a and 10b) was performed and the follow-up ultrasound examination did not show any signs of hydronephrosis.

Table 1. Grading ureter lesions

I grade	Hematoma: contusion or hematoma without devascularization
II grade	Laceration: < 50% transaction
III grade	Laceration: > 50% transaction
IV grade	Laceration: complete transection with < 2 cm of devascularization
V grade	Laceration: avulsion with > 2 cm of devascularization

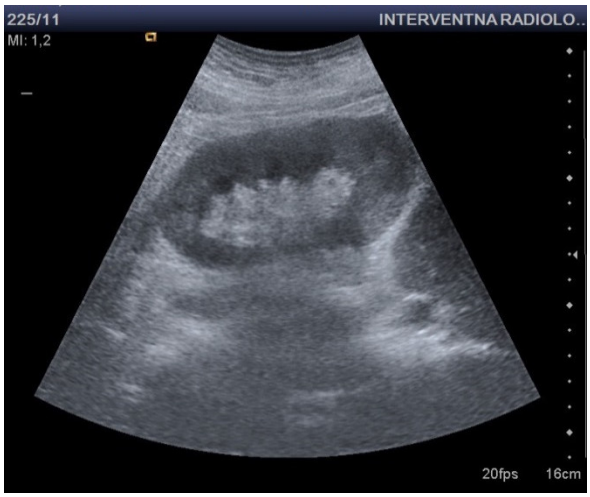


Figure 1. Normal morphology of the left kidney without dilatation of pyelocaliceal system

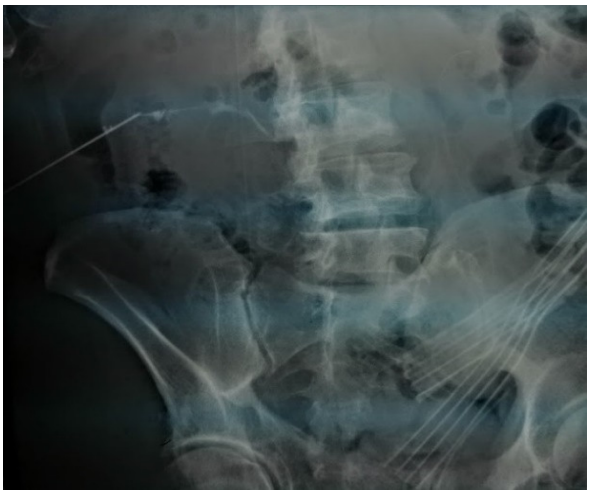


Figure 2. Punctuated non-dilated dorsal calyx



Figure 3. Nephrotomography was showed the location of the extralumination



Figure 4. Normal patency of the endoprosthesis without the extralumination



Figure 5a. Dilation of pyelocaliceal system and the ureter of the left kidney

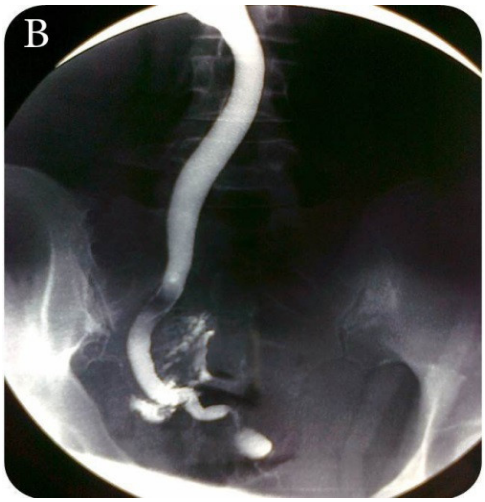
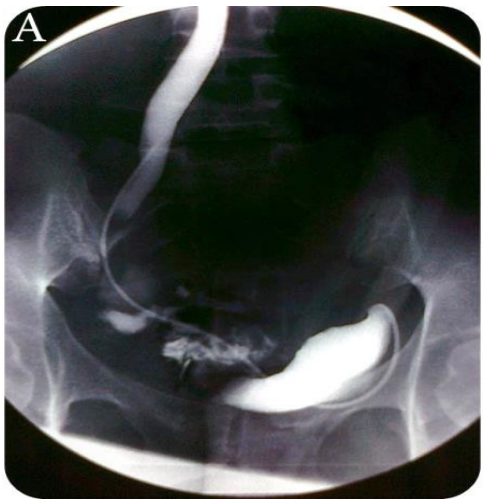
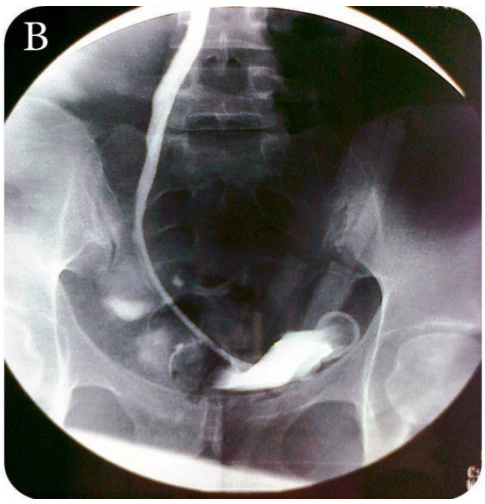
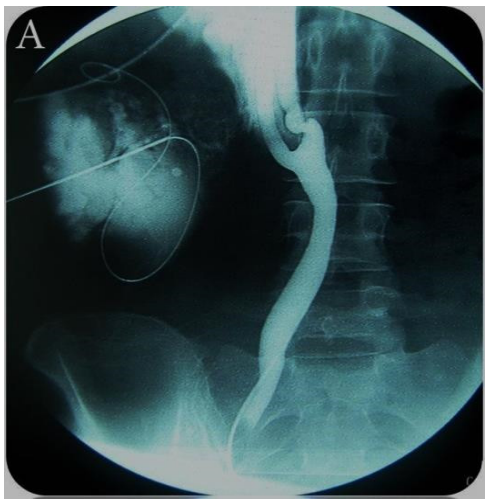


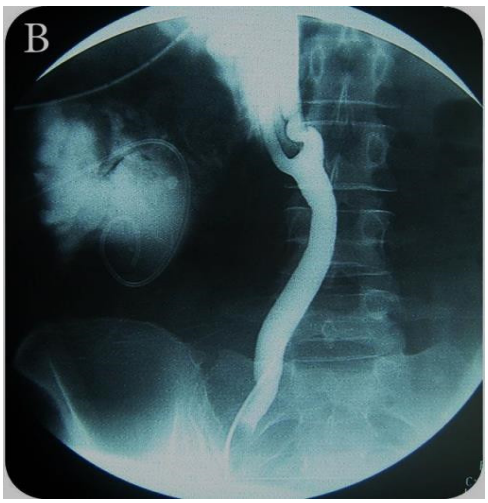
Figure 5b. The extralumination of contrast medium in the prevesical region



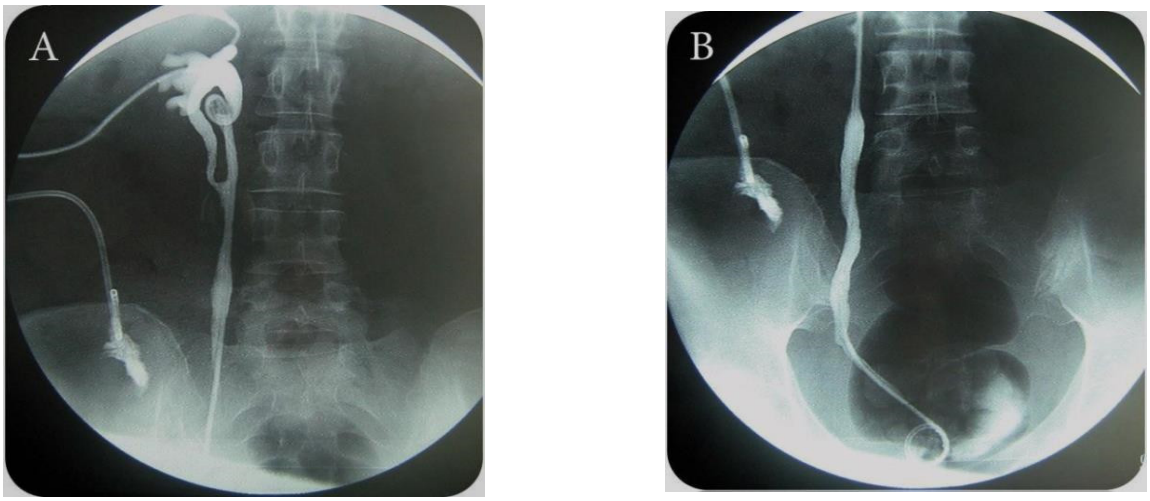


Figures 6a and 6b. Passing by the location of the injury, placing the external-internal ureteral endoprosthesis

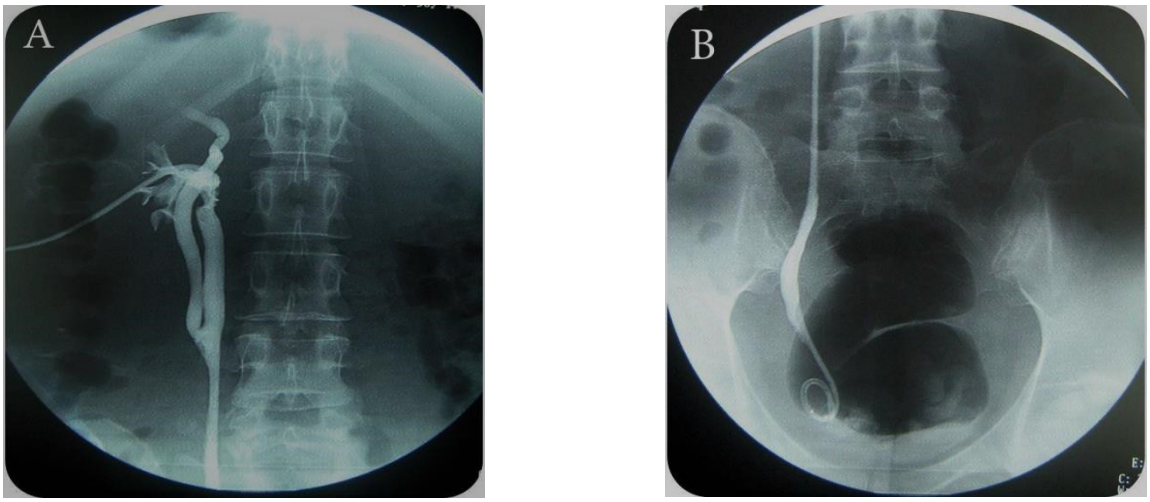




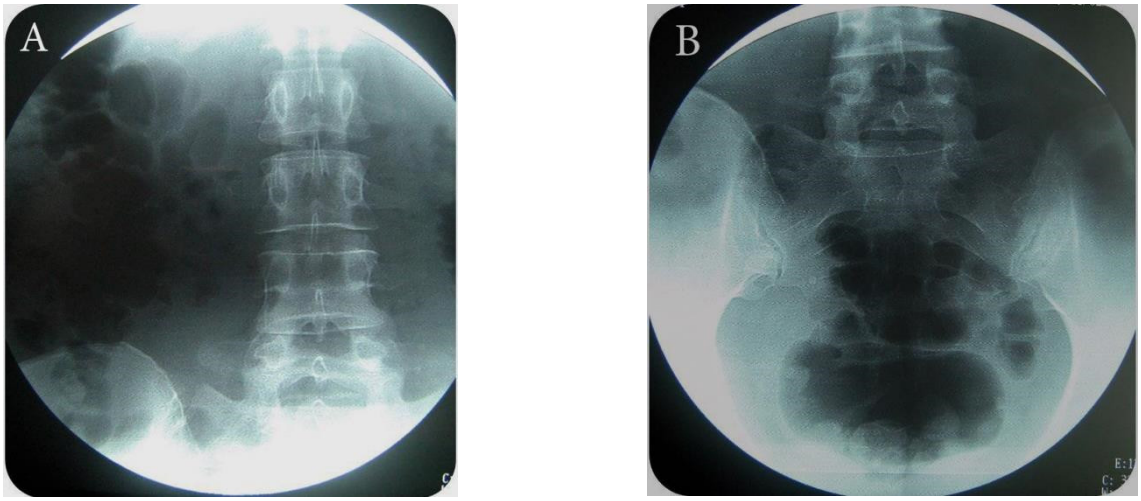
Figures 7a and 7b. Placing catheter of caliber 6F for the purpose of the drainage of urine



Figures 8a and 8b. After a month, the follow-up anterograde urography.
Pyelon duplex et ureter fissus (incidental findings)



Figures 9a and 9b. After a month, follow-up before extraction of endoprosthesis



Figures 10a and 10b. Contrast medium lagging was not detected post-micaceous

DISCUSSION

Ureteral injuries are serious complications of any abdominal or pelvic procedure. These complications can result in high morbidity (increased hospital stay, secondary invasive interventions, reoperation, potential loss of renal function and deterioration patient's quality of life) and mortality for these patients (19-21). In one new study, mortality rate was even 7.3% (1). High mortality rate in this study is attributed to delayed presentation, deranged renal function tests on admission, missed ureteral injuries and presence of postoperative complications mainly surgical site infections.

The risk factors for iatrogenic ureteric injury include nature and indication of the abdominal or pelvic surgery, experience of the operating surgeon and patient related factors (pelvic adhesions from previous surgeries, history of pelvic radiation, enlarged uterus, pelvic malignancy, pelvic endometriosis, and anatomical abnormalities) (22, 23).

Ureteral injuries cause a significant mortality rate, therefore prompt diagnosis and then adequately care for the patient are of crucial importance. The three-quarters of ureteral injuries are of iatrogenic nature, that is, they occur as a result of an intervention in the abdomen or pelvis, whether it is a urological, gynecological and obstetrical, or general-surgical intervention. The risk of iatrogenic lesion is principally due to the close anatomic rapport between ureter, visceral organs and vascular structures. In fact, the distal third of the ureter is the most affected tract (51%), followed by the proximal and the middle third (30%, 19%, respectively) (24).

If the patient, his relatives or attending physician (in the case of hospitalized patient) provide information about recently performed procedure in the abdomen or pelvis, and the patient shows no clinical signs of the ureteral injury, then this is one of the possibilities we should surely think about, and the patient should be accordingly referred to the adequate diagnostics, whether it be the US as a preliminary examination or CT, IVU, anterograde urography and retrograde urography, on the basis of which, if the extralumination of contrast medium is diagnosed, it is possible to make a definitive conclusion.

Adequate and timely diagnostics is certainly one of the most important steps in the successful care of the patient. After the diagnosis, the treatment method is discussed on. This may include conservative methods, if it is a lesion of the ureter in the first degree, that is, the hematoma only. If it is a serious injury, methods of treatment that are in the selection include the surgical procedures or some of the INR techniques. The aim of our study was to show based on these two cases, that minor ureteral lesions can be very successfully treated with the interventional nonvascular radiology (INR) techniques and procedures, which are effective, significantly more comfortable and much cheaper. The latter is probably the most crucial for those patients in whom it is possible and justified to apply the INR as a method of treatment, because the fact that it is a iatrogenic injury means that there is a comorbidity in these patients, that is, it is quite possible that they have been exhausted with the previous interventions, and each quart of these patients means a great contribution to healing and reducing mortality and morbidity.

The first case described a patient that underwent resection of the sigmoid colon and partial resection of the bladder due to carcinoma of sigmoid colon. As a result of this intervention, there was a lesion of the ureter. Ureteral stents were placed by cystoscopy, but without significant effect, and therefore the patient was sent for treatment at the department of nonvascular interventional radiology. Firstly, the drainage catheter 6F was placed for the purpose of derivation of urine. After ten days, the modified ureteral endoprosthesis of 6F was placed, as a function of the internal-external derivation of urine. Since the extralumination of contrast medium or dilation of pyelocaliceal system was not detected in the follow-ups, the drainage bag was removed and endoprosthesis was left for the purpose of the internal derivation, and the satisfactory effects of treatment were achieved in the patient.

The second case involved a patient that gave birth by Caesarean section and on this occasion a ureteral injury occurred. This is quite a rare complication of cesarean section with the incidence 0.1-0.27% (25-27). After canalicular passing the location of injury, we placed the external-internal ureter-endoprosthesis for the purpose of derivation of urine. Also, since we detected the presence of peri-renal-ureteral pathology collection (urine), we performed firstly the puncture, and then we placed catheter 8F for the purpose of drainage. Follow-up radiography firstly showed partial and then complete regression of fluid collection, therefore the drainage catheter was removed. Since follow-up anterograde urography showed patency of endoprosthesis without dilation of pyelocaliceal system, the prosthesis was removed. Upon the removal of prosthesis, follow-up radiography showed patency of ureter without the extralumination of contrast medium and contrast medium lagging was not detected post-micaceously as well.

Finally it should be noted that, in recent years, the growth of the performance of endoscopic surgery (laparoscopy and ureteroscopy) leads to an increase in the incidence of ureteral injuries (28, 29), therefore we must consider the recommendations which may contribute to a reduction in the incidence of iatrogenic ureteral lesions and which include good knowledge of ultrasound anatomy of the abdomen and pelvis as well as possibly performing preoperative IVU, including placement of ureteral catheters for procedures to be carried out near the ureter (30).

CONCLUSION

Iatrogenic ureteral injuries are still an unsolved problem in abdominal surgery. Their management is controversial for the lack of guidelines. Radiologists may play a key-role in the diagnostic ureteral injuries and also in treatment. Presenting these cases, we have shown that minor ureteral lesions

can be successfully treated with nonvascular interventional radiology procedures that are comfortable for the patient.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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