Original Article

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Ureteral Avulsion Associated with Transurethral Lithotripsy for Ureteral Stones: A High-Volume Case Series

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Abstract

Background: The present study was conducted to report the incidence rate of ureteral avulsion and its management in two referral medical centers.

Methods: We retrospectively reviewed a total of 36683 transurethral lithotripsy procedures performed during 17 years. All ureteral avulsions were also included in the current study as an intraoperative complication of Transurethral Lithotripsy (TUL). Data including stone location, avulsion site and management details were recorded.

Results: Fourteen cases of complete ureteral avulsion had occurred in the study period (0.038%), consisting of 8 healthy males and 6 healthy females aged 26 to 73 years (mean age: 50 yrs). Out of these 14 cases, 7 cases had distal ureteral avulsion and seven others had proximal ureteral avulsion. Six cases of distal ureteral avulsion had been promptly treated by the reimplant method whereas immediate nephrectomy had been performed in the remaining case due to a history of poor condition of the renal unit. Proximal ureteral avulsions had been treated by combined Boari flap-psoas hitch procedures with renal mobilization in 3 cases, the autotransplant method in another 3 and by ileal interposition in one case.

Conclusion: Although the present study is a case series which is normally classified as low level of evidence, it seems that both autotransplant and combined Boari flap-psoas hitch procedures with renal mobilization are safe and feasible techniques for the management of full-length complete ureteral injury.

Keywords: Intraoperative complications, Lithotripsy, Nephrectomy, Retrospective studies

Introduction

In recent years, the incidence of ureteral stones has been increasing mainly due to environmental and lifestyle changes in the world; it is estimated that about 1 to 15 percent of individuals experience this condition at least once during their lifetime (1,2). Transurethral Lithotripsy (TUL) is the treatment of choice for lower and middle ureteral stones and is considered a therapeutic option in the treatment of upper ureteral stones and even renal stones (3,4).

Despite its non-invasive nature and all therapeutic benefits, TUL has certain side effects. They include bladder distention, stone migration, ureteral injury, mucosal abrasion, perforation and ureteral avulsion. Ureteral avulsion is a very serious and rare complication of ureteroscopy, with an average reported prevalence of 0.06 to 0.45%; it often occurs after excessive stretching of the ureter which can occur in partial or full thickness avulsion (5).

Due to the high prevalence of urinary stones and the simultaneous increase in using ureteroscopic methods to treat this condition, we decided to report the incidence rate of ureteral avulsion and its management in two medical centers in our country, Iran.

Materials and Methods

We retrospectively reviewed all the TUL procedures performed in two medical centers between March 2006 and May 2023. During 17 years, a total of 36683 TUL procedures were performed in Hasheminejad Kidney Center (HKC) and Moheb Mehr Hospital, Tehran, Iran. HKC is an educational hospital affiliated to Iran University of Medical Sciences and all the procedures were performed by urology residents and fellows. Moheb Hospital is a private hospital in which all the procedures were performed by experienced urologists and endourologists.

All the patients were evaluated by Intravenous Urography (IVU) or non-contrast Computed Tomography (CT) before performing TUL. After routine preoperative evaluation, all the patients with ureteral stones had undergone the TUL procedure by semirigid 6 or 8 French ureteroscopes. All the ureteral avulsions were also included in the present study as an intraoperative complication of TUL. Data including stone location, avulsion site and management details were recorded. The study protocol was approved by the Ethics Committee of Iran University of Medical Sciences.

Results

During the study period, 36683 TUL procedures were performed in Hasheminejad Kidney Center (HKC) and Moheb Mehr Hospital; 24802 procedures were performed in HKC as a teaching hospital and 11881 were performed in Moheb Mehr as a private hospital. Fourteen cases of complete ureteral avulsion had occurred in the study period (0.038%), consisting of 8 healthy males and 6 healthy females aged 26 to 73 years (mean age: 50 *yrs*). Various mechanisms for ureteric avulsion in our study included forceful maneuvers during ureteroscopy, forceful attempts to enter the upper ureter with a graduated ureteroscope size with a larger proximal diameter, and the use of a stone basket or grasping forceps to retrieve the impacted stones.

Out of these 14 cases, 7 cases had distal ureteral avulsion and seven others had proximal ureteral avulsion. We used nephrostomy in 5 cases and 9 case were repaired immediately. Six cases of distal ureteral avulsion had been promptly treated by the reimplant method whereas immediate nephrectomy had been performed in the remaining case due to a history of poor condition of the renal unit. Recovery in all cases with distal ureteral avulsion was favorable and serum creatinine remained within the normal range. In patients with proximal ureteral avulsion, the site of injury was the proximal ureteral segment up to the ureterovesical junction. Proximal ureteral avulsions had been treated by combined Boari flap-psoas hitch procedures with renal mobilization in 3 cases, the autotransplant method in another 3 and by ileal interposition in one case. After treatment, proper kidney function was maintained in all the patients without any complications. All the studied patients had resumed normal daily life and work after surgery. Details of all the cases are presented in table 1.

Discussion

Ureteral avulsion following semirigid ureteroscopy and TUL is one of its rarest and most serious complications. Given the advancments made in surgical techniques in recent years and the increaed

Table 1. demographics and management details of all cases

Gender: age	Site of avulsion	Nephrostomy	Treatment	Follow up
M:31	Proximal	Yes	Combined boari flap-psoas hitch with renal mobilization	Functional
F:64	Proximal	Yes	Combined boari flap-psoas hitch with renal mobilization	Functional
M:26	Distal	No	Reimplant	Functional
F:73	Distal	Yes	Reimplant	Functional
F:44	Distal	No	Reimplant	Functional
M:58	Complete	No	Autotranspalnt	Functional
F:30	Distal	No	Reimplant	Functional
F:50	Distal	No	Reimplant	Functional
M:60	Distal	No	Nephrectomy	----------
M:50	Distal	No	Reimplant	Functional
M:50	Complete	Yes	Ileal interposition	Functional
F:63	Proximal	Yes	Combined boari flap-psoas hitch with renal mobilization	Functional
M:54	Complete	No	Autotranspalnt	Functional
M:47	Complete	No	Autotranspalnt	Functional

expertiese of related surgeons, its incidence has decreased. For example, in a 5-year study by Al_ awadi *et al* in 2005, the incidence of this complication was reported to be 3.7% (6), whereas this figure has decreased to 0.06% in recent literature (5). In the present study, among 36683 ureteroscopies, 14 cases of ureteral avulsion with an estimated incidence of 0.038% had occurred; this is much lower than the average incidence of this complication in recent studies.

Furthermore, considering the incidence of this complication in Hasheminejad Teaching Hospital and Moheb Mehr Private Hospital and their differences, it can be concluded that by improving the surgeons' skills and experiences, the incidence of this complication will be reduced significantly.

Due to the importance of ureteral avulsion, despite its rarity, the proper treatment and management of this complication plays an important role in the final outcome. In case of inappropriate management, serious complications such as obstructive uropathy, urinary leakage, retroperitoneal ureinuma and eventually renal failure leading to nephrectomy may occur.

The best approach for complete proximal ureteral evulsion is controversial and depends on some factors including the site of injury, length of injury, patient's condition and the surgoen's experience. Several techniques have been developed to treat this condition such as ileal interposition, autotransplant, and Boari flap alone or in combination with psoas hitch.

In our series, we used extended Boari flap in combination with psoas hitch for full-length ureteral injuries. Boari flap is one of the treatment choices in short-length ureteral injuries and is often suitable for middle and lower ureteral defects with a length less than 15 *cm*. In 2017, Grzegółkowski reported the Extended Boari-flap technique as a reconstruction method for total ureteric avulsion (7).

In the study conducted by Bai *et al* in 2021, evaluating the safety and efficacy of Boari flap in the management of extensive ureteral injuries, this therapeutic technique was stated as a safe and appropriate method for patients with full-length

ureteral or upper ureteral avulsion (8).

Also, renal autotransplant is a suitable treatment method for long-segment ureteral avulsion. In a 10-year study conducted by Bansal *et al* on kidney function and postoperative complications, they concluded that renal autotransplant is a suitable technique for the treatment of extensive ureteral damage without the need for long-term patient follow up (9).

In our study, 3 cases were treated with the autotransplant method and 3 others were managed with Boari flap in combination with psoas hitch. In all the cases, the kidney function was maintained. In our exprience, regarding full-length ureteral injury, ileal interposition is a technique with a high complication rate, therefore autotransplant or combined Boari flap-psoas hitch was used for the treatment of such cases. In addition to the site of injury and technical aspects, one the most important factors in the management of full-length complete ureteral injury is the surgoen's experience. The authors prefer immediate surgery and our protocol consists of 3 phases; first, the surgeon who has injured the uretera is excluded from the surgical team and is only allowed to observe the surgery. Second, a team consisting of two expert urologists evaluates the patient's condition and the site and length of injury. This team and the surgeon make a decision on the preferred technique, choosing between autotransplant and Boari flap- psoas hitch. Third, the operation is performed by the mentioned team.

Conclusion

Although the present study is a case series which is normally classified as low level of evidence, it seems that both autotransplant and combined Boari flap-psoas hitch procedures with renal mobilization are safe and feasible techniques for the management of full-length complete ureteral injury. Nevertheless, when a decision is going to be made on the appropriate technique, the patient's condition, site and length of injury, the suergon's experience and the available surgical equipment are important factors which should be taken into consideration.

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