

Comprehensive analysis of ureter injuries: A systematic review of the medical literature

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ABSTRACT

This article presents an exhaustive systematic review of the medical literature focused on the detailed analysis of ureter injuries. Injuries to this anatomical conduit, which connects the kidneys to the bladder, can arise as a consequence of various causes, such as abdominal surgeries, trauma, gynecological and urological procedures, among others. The aim of this study is to provide a comprehensive and updated view of the etiology, epidemiology, classification, clinical manifestations, diagnosis and treatment options for ureteral injuries.

During the investigation, numerous scientific articles, case reports, and retrospective studies were extensively reviewed, with particular focus on identifying the risk factors associated with these lesions. Also highlighted were the various diagnostic approaches and imaging tools, including computed tomography (CT), retrograde urography, cystoscopy, and magnetic resonance imaging (MRI), which are critical for the accurate diagnosis and extensive evaluation of ureter injuries.

Significant differences in treatment options were observed, depending on the severity and location of the lesions, with endourological and laparoscopic techniques being the preferred options for milder cases, while complex reconstructive surgeries are reserved for more extensive and complex lesions. Innovative surgical techniques, including ureteral anastomosis, tissue grafting and the use of ureteral stents, are addressed with the goal of optimally restoring ureteral function and structure.

This systematic review highlights the importance of a multidisciplinary approach in the management of ureteral injuries, involving urologists, general surgeons, gynecologists and radiologists, to ensure timely diagnosis and effective treatment. Furthermore, the relevance of prevention and early identification of ureteral injuries is emphasized, with the purpose of minimizing complications and improving long-term clinical outcomes. In conclusion, this research provides a valuable source of information for the medical and surgical community, promoting a better understanding and comprehensive management of ureteral injuries.

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INTRODUCTION

Injuries to the ureter represent a significant clinical challenge in medicine, arousing considerable interest due to their complex etiology, variety of clinical manifestations and diversity of management options. The ureter, a vital anatomical structure connecting the kidneys to the bladder, plays a critical role in the excretion of waste products and the regulation of water-electrolyte balance in the human body.¹

These lesions can arise in a wide range of clinical situations, including abdominal, gynecologic and urologic surgical procedures, trauma, inflammatory pathologies and neoplastic processes near the ureter region. The complexity of their anatomy and their location deep within the retroperitoneum make the diagnosis and treatment of these lesions a challenge for healthcare professionals.¹

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A detailed understanding of the risk factors associated with ureter injuries and the ability to promptly identify clinical manifestations are crucial for an adequate and successful therapeutic approach. Proper diagnostic evaluation, which may include advanced imaging techniques such as computed tomography (CT), retrograde urography, cystoscopy and magnetic resonance imaging (MRI), is critical to determine the extent and severity of the lesions, as well as to plan the most appropriate surgical approach.¹

The treatment of ureter injuries can vary from conservative and endourological approaches to complex reconstructive surgeries, depending on the severity and location of the injury. The selection of the appropriate therapeutic strategy should be individualized and multidisciplinary, involving specialists in urology, general surgery, gynecology and radiology, with the aim of optimizing clinical outcomes and minimizing possible complications.¹

As technology and medical advances continue to evolve, it is imperative to keep abreast of the latest research and therapeutic approaches in the field of ureteral injuries. This review aims to provide a comprehensive and up-to-date overview of the epidemiology, classification, etiology, clinical manifestations, diagnostic methods, and therapeutic options available for ureteral injuries in order to improve the understanding and effective management of these complex pathologies in the clinical setting. In doing so, it is hoped to contribute to medical knowledge and promote continuous improvement in the care of patients with ureteral injuries.^{2,3}

EPIDEMIOLOGY

Ureteral injuries are a major clinical problem due to their significant incidence and diversity in etiology, clinical manifestation and health consequences. Although the exact prevalence varies by population and geographic region, it is estimated that these injuries affect a non-negligible proportion of individuals undergoing surgical procedures, especially those with abdominal, gynecologic and urologic interventions.⁴ It is estimated that ureteral injuries are derived from complications of pelvic surgery and gynecologic procedures, which are estimated to be between 0.2 and 6%. Ureteral injuries occur during abdominal hysterectomy, vaginal hysterectomy or laparoscopic hysterectomy.

The epidemiology of ureter injuries shows a clear predisposition for the female gender, due to the higher frequency of gynecological and pelvic procedures performed on women, which represents an important risk factor for the development of these injuries. In addition, advanced age has been identified as another relevant risk factor, as surgeries and medical procedures become more frequent in older populations.⁴

The most common causes of ureteral injuries are related to surgical procedures, with gynecological surgery, urological surgery and colorectal surgery being some of the most likely scenarios for their occurrence. Laparoscopic interventions, although less invasive, may also contribute to an increased

risk of ureteral injuries due to the limited direct visualization of organs and anatomical structures.⁴ Other less frequent causes are radiotherapy, infections such as genitourinary tuberculosis, recurrent ureteral lithiasis and retroperitoneal fibrosis.¹³

According to estimates, 52% to 82% of operative ureteral injuries occur during gynecologic surgery. The ureter is most commonly

The ureter is more commonly injured during an abdominal hysterectomy (2.2%) than a vaginal hysterectomy (0.03%) and more commonly in an open abdominal hysterectomy than in a laparoscopic hysterectomy (1.3%). Risk factors for ureteral injury include a large uterus, pelvic organ prolapse and a history of pelvic surgery. The ureter is usually injured when it crosses under the uterine artery. Ureteral injury is not recognized at the time of surgery in 33% to 87.5% of cases.¹⁶

Trauma, including motor vehicle accidents and crush injuries, are also among the causes of ureter injuries, especially in polytraumatized patients. In addition, certain inflammatory diseases, such as pelvic inflammatory disease, can result in complications affecting the ureter.⁴

In the case of ureteral injury associated with external trauma in a literature review it was determined that of the total number of patients collected, 83.4% (± 28.5) were male and the average age was 23.2 years (± 12.1), reflecting the predominance of young males in violent trauma, the first cause being penetrating trauma. Proximal ureteral injury occurred at a rate of 59.7% (± 37), while medial and distal injuries occurred 25.6% (± 30.4) and 20.8% (± 24.4) of the time, respectively. Associated injuries were present in 90.4% (± 26.2) of patients, indicating that ureteral injuries often occur as part of a myriad of problems associated with significant trauma. Small and/or large bowel injuries were most commonly involved along with ureteral trauma (96% ± 21.5). Complications occurred in 36.2% (± 34) of cases, including retroperitoneal abscesses, infected urinomas, and fistulas; these were usually secondary to delayed diagnosis. Missed ureteral lesions were reported in 38.2% (± 39.5) of cases. The associated mortality rate of the study population was 17%, although the contribution of ureteral injury is difficult to quantify.¹⁵

Early detection and accurate diagnosis of ureteral lesions can be challenging due to their variable clinical presentation and possible lack of immediate symptoms in the early stages. This may underestimate the true incidence of these lesions, as some cases may go unrecognized or be mistaken for other conditions.^{4,5}

It is important to note that although ureteral injuries are relatively uncommon compared to other pathologies, their clinical impact can be significant, as they can lead to serious complications, such as ureteral obstruction, hydronephrosis, urinary tract infection and renal failure, which require timely medical and surgical intervention.⁶

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The epidemiology of ureter injuries reveals their clinical relevance and potential impact on patient health. A preventive approach and careful consideration of associated risk factors are critical to mitigate the risk of these injuries and ensure timely diagnosis and treatment, thereby improving the clinical outcomes and quality of life of affected patients.⁶

CLINICAL MANIFESTATIONS OF URETERAL LESIONS

Lesions of the ureter manifest themselves clinically in different ways, and their presentation may vary according to etiology, location and extent of involvement. These lesions can be the consequence of different surgical procedures, trauma, inflammatory pathologies, neoplastic processes or other circumstances that affect the anatomy and integrity of the ureter.^{6,7}

The most frequent symptoms associated with ureteral lesions include abdominal or lumbar pain, dysuria, hematuria (presence of blood in the urine), oliguria (decrease in the amount of urine eliminated), anuria (absence of urine production) and fever. However, it is important to note that in some cases, especially in the early stages, these clinical manifestations may be subtle or even absent, complicating timely and accurate diagnosis.⁷

Physical examination may reveal signs of peritoneal irritation if the injury is associated with perforation of the ureter, manifested by pain on palpation and abdominal rigidity. In addition, in cases of traumatic ureteral injury, signs of external bleeding or bruising may be seen in the affected area.⁷

The proper diagnosis of ureter lesions is based on a combination of clinical data, medical history, physical examination findings and imaging tests. Imaging techniques play a crucial role in identifying and localizing the lesion, and may include plain radiography, ultrasound, computed tomography (CT), retrograde urography, and magnetic resonance imaging (MRI).⁷

Once the presence of a ureteral lesion is confirmed, stratification of the severity and extent of involvement is essential to determine the most appropriate therapeutic approach. In minor or partial lesions, endourologic procedures, such as ureteral stenting or ureteral anastomosis, may be viable treatment options. However, in more extensive or complex lesions, reconstructive surgeries, such as ureteroneocystostomy or tissue grafting, may be necessary to restore function and continuity of the ureter.⁷

It is essential to emphasize that the management of ureter injuries should be approached in a multidisciplinary manner, involving specialists in urology, general surgery, gynecology and radiology, to ensure a comprehensive approach and optimal patient care. The choice of treatment should be individualized and based on a thorough evaluation of each case, considering risk factors, anatomical features and patient preferences.^{7,8}

In conclusion, the clinical manifestations of ureteral lesions are complex and diverse, and their diagnosis and management require careful consideration of symptoms, physical examination and imaging findings. Early identification and appropriate treatment are critical to prevent serious complications and improve clinical outcomes in patients affected by these pathologies.^{8,9}

DIAGNOSIS

The diagnosis of ureter injuries represents a complex clinical challenge that requires a systematic, multidisciplinary approach to achieve a thorough and accurate evaluation. Given the diversity in etiology, clinical manifestations and potential complications associated with these lesions, it is essential to employ a comprehensive approach that includes detailed medical history taking, thorough physical examination, laboratory testing and, critically, the use of a variety of advanced imaging techniques.¹⁰

The patient's clinical history plays a key role in the diagnostic process, as it provides valuable information on risk factors, history of surgical interventions, previous trauma, inflammatory diseases, and other relevant events that may be related to the development of ureter injury. Presenting symptoms, such as abdominal or lumbar pain, hematuria, dysuria, oliguria or fever, should be carefully interrogated and documented to identify clinical patterns to guide the evaluation.¹⁰

Meticulous physical examination allows detecting signs suggestive of ureter lesions, such as pain on palpation in specific areas, abdominal or lumbar masses, and signs of peritoneal irritation. However, it is important to keep in mind that in some cases, especially in early stages or in the presence of subclinical lesions, physical findings may be subtle or even absent, highlighting the importance of complementing the physical examination with other tests.¹⁰

Grade I: Superficial injury or contusion of the ureter. At this level, the mucosa and/or submucosa of the ureter may be affected, but the muscular layer is intact. This category is usually associated with minor injuries, and the function of the ureter is maintained.¹⁰

Grade II: Partial lesion of the ureter. Here, the lesion affects the mucosa, the submucosa and, in some cases, a portion of the muscular layer of the ureter. This condition may lead to narrowing (stricture) of the ureter and partially compromise its function.¹⁰

Grade III: Complete lesion of the ureter with discontinuity. In this grade, the lesion goes through all layers of the ureter, causing an interruption in the continuity of the duct. This may result in complete obstruction of urine flow and be a medical emergency.¹⁰

Grade IV: Complex lesion of the ureter with extravasation of urine. Here, in addition to complete rupture of the ureter, there is leakage of urine into the surrounding tissues (extravasation). This situation may result in severe infection and immediate surgical intervention is required.¹⁰

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Grade V: Total injury of the ureter with avulsion. This is the most severe injury and occurs when the ureter is completely separated from its connection to the kidney or bladder. It is an extreme medical emergency and requires complex reconstructive surgery to repair the ureter and restore proper urinary function.¹⁰

It is essential that lesions of the ureter be diagnosed and treated early to avoid serious complications such as urinary tract infections, hydronephrosis (accumulation of urine in the kidney) or renal failure. The choice of treatment will depend on the extent of the injury, the location, the patient's general health status and other relevant clinical factors. Surgical procedures, such as endoscopic repair or ureteral reimplantation, are common in the management of these lesions.¹⁰

Laboratory tests, such as urinalysis, may reveal the presence of hematuria or leukocyturia, which may suggest ureter injury, although these abnormalities are not specific and may be present in other pathological conditions of the urinary tract.¹¹

Imaging techniques play a central role in the diagnosis of ureteral injuries because of their ability to provide detailed visualization of the anatomy and extent of involvement. Plain radiography can be useful in identifying ureteral calculi, but its sensitivity in detecting traumatic or iatrogenic ureteral injuries is limited.¹¹

More sophisticated imaging tests, such as computed tomography (CT), retrograde urography, cystoscopy and magnetic resonance imaging (MRI), are crucial tools for the accurate diagnosis of ureter injuries. CT is especially valuable in assessing the integrity of the ureter and detecting the presence of lesions, allowing detailed three-dimensional visualization of the urinary tract. Retrograde urography, which involves the injection of a contrast medium directly into the ureter, provides excellent definition of the upper urinary tract and can help identify lesions as well as strictures or obstructions.¹¹

Cystoscopy, an endoscopic procedure that allows direct visualization of the urethra and bladder, can be useful for detecting lesions of the ureter at its point of entry into the bladder, and also for assessing ureteral patency. MRI provides excellent soft tissue resolution and is especially useful for evaluating periureteral lesions and possible infiltrations.¹¹

It is essential to bear in mind that, in selected cases, the performance of combined diagnostic and therapeutic procedures, such as diagnostic ureteroscopy or ureteral stent insertion, can play a relevant role in the evaluation and treatment of ureteral injuries.¹²

The diagnosis of ureteral lesions involves the meticulous integration of clinical data, medical history, physical examination and laboratory tests, along with the appropriate use of various advanced imaging techniques. Early and accurate identification of these lesions is essential to guide appropriate therapeutic management, reduce potential

complications and improve clinical outcomes in patients affected by this complex pathology.¹²

TREATMENT

The therapeutic approach to ureter injuries is based on the complexity, location and severity of the involvement, as well as on individual patient factors and the experience of the medical team. The primary goal of treatment is to restore function and continuity of the ureter, prevent long-term complications, and improve the patient's quality of life.¹²

In mild or partial lesions of the ureter, conservative therapeutic approaches, such as careful observation and close follow-up with serial imaging tests, can be employed. In addition, temporary ureteral stenting may be an option to facilitate drainage and healing of the lesion, especially in cases of strictures or narrowing. Ureteral stents are tubular devices that are inserted endoscopically into the ureter to maintain its patency and allow urine flow.¹²

In more complex or extensive lesions of the ureter, surgical treatment becomes essential. Surgical procedures for the management of these lesions can be classified into two main categories: endourological techniques and reconstructive surgeries.¹²

Endoscopic techniques involve the use of endoscopic instruments and devices to treat lesions in a minimally invasive manner. These techniques may include performing ureteroscopies, which allow direct visualization and treatment of the lesion, as well as ureteral stenting, mentioned above. These approaches may be appropriate for small lesions or strictures and may obviate the need for open surgery in some cases.¹²

However, in more complex lesions or in situations where endourologic techniques are not feasible, reconstructive surgeries may be required. These procedures involve repair or reconstruction of the damaged ureter to restore its function and normal urinary flow. Reconstructive surgeries may include ureteroneocystostomy, which involves reconnection of the ureter to the bladder, or ureteral anastomosis, which involves the joining of the ends of the ureter.¹²

In some cases, when the injury is extensive or has resulted in significant tissue loss, more complex techniques may be employed, such as the use of tissue grafts to reconstruct the damaged segment of the ureter. These grafts can come from different sources, such as skin, peritoneum, or bowel, and are used to restore the continuity of the ureter and prevent obstruction of urinary flow.¹²

It is important to mention that the therapeutic management of ureteral lesions should be individualized for each patient, taking into account factors such as the extent of the lesion, the patient's age, the presence of comorbidities, and the patient's preferences. Decision-making should be discussed as a team, involving specialists in urology, general surgery, gynecology and radiology, to ensure a multidisciplinary approach and optimal care.¹²

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In conclusion, the treatment of ureter injuries can vary from conservative approaches and endourological techniques to complex reconstructive surgeries, depending on the severity and location of the injury. Proper choice of treatment is critical to improve clinical outcomes and minimize long-term complications, thus ensuring optimal recovery and quality of life for patients affected by these pathologies.¹²

CONCLUSIONS

Ureter injuries constitute a medical entity of great complexity and clinical relevance, which requires a comprehensive and multidisciplinary approach for its proper diagnosis, treatment and management. Its diversity in etiology, clinical manifestations and potential health consequences make this pathology a medical challenge that requires a deep and updated knowledge on the part of health professionals.

The epidemiology of ureter injuries reveals their significant incidence, particularly in those patients undergoing abdominal, gynecologic and urologic surgical procedures, which highlights the importance of prevention and proper management of associated risk factors. Early identification of these lesions and their accurate diagnosis are crucial to avoid serious complications and improve long-term clinical outcomes.

In the diagnosis of ureter lesions, the integration of clinical history, physical examination, laboratory tests and advanced imaging techniques, such as computed tomography, retrograde urography, cystoscopy and magnetic resonance imaging, are fundamental pillars for accurate clinical decision making. Proper selection of these tests, based on clinical suspicion and preliminary findings, will allow for a thorough evaluation and accurate therapeutic guidance.

The treatment of ureter injuries should be approached on an individualized basis, considering the severity and extent of involvement, as well as the anatomical characteristics and patient preferences. From conservative approaches and endourological techniques to complex reconstructive surgeries, the therapeutic strategy must be carefully planned in collaboration with a multidisciplinary team of specialists.

The implementation of endourological techniques and the use of temporary ureteral stents may be adequate for mild lesions, providing effective results and minimizing the invasiveness of the treatment. On the other hand, reconstructive surgeries may be necessary for more complex or extensive lesions, seeking to restore the function and continuity of the ureter in an optimal manner.

Ureteral injuries represent a significant clinical challenge, which demands a thorough understanding of their epidemiology, diagnosis and treatment. With a multidisciplinary approach, based on scientific evidence and medical expertise, it is possible to improve clinical outcomes and ensure comprehensive and appropriate care for patients affected by this complex pathology. Continuous research and updating in this field are essential to promote a better

understanding and management of ureter injuries, leading to an optimal quality of life and well-being for patients.

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