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Research Article

Anatomial Variations in Ureteric Course and Their Clinical Significance in Urolithiasis and Endourological Procedures

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ABSTRACT
Objective: To evaluate the frequency and types of anatomical variations in the ureteric course and to assess their clinical significance in patients with urolithiasis undergoing endourological procedures.
Materials and Methods: This cross-sectional observational study was conducted over a period of one year. A total of 120 patients diagnosed with urolithiasis and planned for endourological procedures, including ureteroscopy (URS), retrograde intrarenal surgery (RIRS) and percutaneous nephrolithotomy (PCNL) were included. Preoperative assessment involved clinical evaluation and radiological imaging, primarily non-contrast CT and CT urography where indicated. Ureteric anatomical variations were identified through imaging and confirmed intraoperatively. Data regarding demographic characteristics, stone location, type of ureteric variation, procedural difficulty, complications and stone clearance were recorded and analyzed using SPSS version 22.
Results: Out of 120 patients, ureteric anatomical variations were observed in 34 patients (28.3%). The most common variation was ureteric tortuosity (35.3%) followed by duplication (23.5%), kinking (20.6%) and medial/lateral deviation (20.6%). Procedural difficulty was significantly higher in patients with ureteric variations (64.7%) compared to those with normal anatomy (20.9%) ($p < 0.05$). Complication rates, including mucosal injury and ureteric perforation were also increased in patients with variations. Furthermore, the stone clearance rate was lower in patients with ureteric variations (79.4%) compared to those with normal ureters (94.1%).
Conclusion: Anatomical variations of the ureteric course are common and have a significant impact on the management and outcomes of urolithiasis. Awareness and identification of these variations through appropriate imaging and careful intraoperative assessment are essential to minimize complications and improve the success of endourological procedures.

Keywords: Ureteric Variations, Urolithiasis, Ureteroscopy, Endourology, CT Urography, Stone Clearance.

INTRODUCTION

The ureter is an important component of the urinary system. Itacts as a tube that carries urine from the kidneys to the urinary bladder. It is a narrow, muscular tube measuring approximately 25–30 cm in length in adults.(Tasian and Copelovitch, 2014) Its course extends from the renal pelvis to the trigone of the bladder. Differences in ureteric anatomy arecommon and these differences can have important implications in both disease processes and surgical interventions.(Lescay et al., 2026)

Under normal conditions, the ureter descends vertically along the anterior surface of the psoas major muscle and then crosses the pelvic brim near the bifurcation of the common iliac vessels which further continues into the pelvis before entering the bladder. (Mikuz, 2018)Along this pathway it maintains close relationships with several vital structures including major blood vessels and reproductive organs. Developmental factors during embryogenesis

can result in a wide spectrum of anatomical variations. (Marshall, 1978)These may include duplication of the ureter, abnormal curvature or tortuosity, ectopic insertion, retrocaval ureter or deviations in its relation to surrounding structures. While some of these changes remain clinically silent but others may predispose individuals to complications or influence disease presentation.(Vaughan and Middleton, 1975)

One of the most clinically important conditions associated with the ureter is urolithiasis. Urolithiasisis defined as the formation of stones within the urinary tract. Urolithiasis is a global health concern andIt's rising incidence is due to lifestyle changes, dietary habits and metabolic abnormalities.(Chewcharat and Curhan, 2021) The ureter is particularly susceptible to the stone impaction due to its relatively narrow lumen and the presence of physiological constrictions.(Dirie et al., 2023) Classically, stones tend to lodge at three main sites: the ureteropelvic junction, the point where the ureter crosses the iliac vessels and the ureterovesical junction. (Baramki, 1974)When anatomical changes are present, these typical patterns may not apply. Stones may become impacted at unusual locations which leads to atypical symptoms that can futher complicate diagnosis and delay treatment.(Assimos, 2021) The clinical presentation of ureteric stones is often characterized by acute flank pain radiating to the groin, hematuria and sometimes urinary obstruction. If the ureter follows an abnormal course the pattern of pain and associated symptoms may differ significantly. (Palit and Joyce, 2008)For example, a medially deviated ureter may produce pain that take off gastrointestinal conditions while a duplicated ureter may lead to recurrent symptoms due to incomplete stone clearance. (Smith and Dunn, 1979)Such differences not only affect symptoms but also affect the interpretation of imaging findings which makes the accurate diagnosis more challenging for clinicians.(Prezioso et al., 2015) The management of urolithiasis has undergone a huge transformation with the advancement of minimally invasive techniques in the recent years. Endourological procedures include ureteroscopy, retrograde intrarenal surgery (RIRS) and percutaneous nephrolithotomy (PCNL). (Chew and Lange, 2016)These procedures have largely replaced open surgical methods due to their reduced morbidity and faster recovery times.(Jobs et al., 2018) These procedures depend on precise anatomical knowledge and the ability to operate the instruments through the urinary tract with minimal trauma. However, anatomical variations in the ureter can represent considerable technical difficulties during such interventions.(Walther et al., 2010)

A tortuous or kinked ureter may hinder the smooth passage of a ureteroscope, which in turn increasesthe risk of mucosal injury or perforation. Similarly, the presence of a duplicated ureter can create confusion in identifying the correct channel that potentially leads to incomplete treatment or procedural failure.(Oshiba et al., 2025)Retrocaval ureter is the ureter that passes posterior to the inferior vena cava. Access of retrocaval ureter can be particularly challenging which require advanced planning and expertise. Even subtle deviations in ureteric anatomy can prolong operative time and increase the likelihood of complications. (Yakupoglu et al., 2013)

Imaging plays an important role in identifying ureteric anatomy and detecting particular changes. Modalities such as ultrasound, intravenous urographyand computed tomography (CT) urography are commonly used in clinical practice.(Pozniak et al., 1998)Non-contrast CT scans have become the gold standard for diagnosing urolithiasis due to their high sensitivity and specificity. (Andrabi et al., 2015)CT urography provides detailed visualization of the urinary tract.Anatomical anomalies that may not be apparent on routine imaging can be find through CT urography.(Smith et al., 1998)

Beyond their impact on urolithiasis, ureteric variations also carry broader clinical significance. The ureter is particularly vulnerable to iatrogenic injury during abdominal and pelvic surgeries which include gynecological, colorectal and vascular procedures.(Sakellariou et al., 2002)An unknown variation in ureteric course can increase the risk of accidental ligation, transection or devascularization. Such injuries may lead to serious complications, including urinary leakage, fistula formation or loss of renal function. Therefore, a comprehensive understanding of ureteric anatomy is essential not only for urologists but also for surgeons across multiple specialties.(Tang and Attwell-Heap, 2011)

The role of ureteric variations in recurrent or complicated cases of urolithiasis is another important consideration. Patients with anatomical anomalies may have altered urinary flow dynamics that lead to urinary stasis and an

increased risk of stone formation. (Namasivayam et al., 2006)For example, a duplicated ureter or an abnormal curvature may create areas where urine flow is sluggish, promoting crystallization and stone development. Recognizing these underlying factors is important for preventing recurrence and guiding long-term management strategies.(Yong and Knudsen, 2016)

Differences in ureteric anatomy may have implications for training and surgical education. As endourological techniques continue to evolve, there is an increasing emphasis on simulation-based learning and preoperative planning.(Miller and Lingeman, 2007) Understanding the potential challenges due to anatomical variations can help trainees develop better procedural strategies and improve their ability to handle unexpected situations in the operating room. This is particularly relevant in resource-limited settings where access to advanced imaging and specialized equipment may be restricted.(McLeod et al., 2014)

Recognizing ureteric changes before and during intervention can significantly improve patient outcomes. Preoperative identification allows for better planning, selection of appropriate instruments and anticipation of potential difficulties. Awareness of these differences can help surgeons adapt their techniques, minimize complications and achieve more effective stone clearance intraoperatively. Ultimately, this will result into reduced operative time, lower complication rates and improved patient satisfaction.

MATERIALS AND METHODS

This multicenter cross-sectional observational study was carried out in the Departments of Urology and Radiology. The study duration was of one year from January 2025 to January 2026. The aim of the study was to evaluate anatomical variations in the ureteric course and to assess their clinical significance in patients presenting with urolithiasis undergoing endourological procedures.Ethical approval for the study was obtained from the institutional review board. Patient confidentiality was strictly maintained throughout the study.

A total of 120 patients diagnosed with urolithiasis were included in the study using a non-probability consecutive sampling technique. Patients of both genders, aged between 18 and 65 years were included. Patients who were planned for endourological intervention such as ureteroscopy (URS), retrograde intrarenal surgery (RIRS), or percutaneous nephrolithotomy (PCNL) were enrolled after obtaining informed consent. Patients with a history of previous ureteric surgery, known congenital urogenital anomalies, malignancy of the urinary tract or severe renal impairment were excluded to avoid confounding factors that could alter ureteric anatomy.

All patients underwent a detailed clinical evaluation, including history taking and physical examination. Relevant demographic data such as age, gender and presenting symptoms (flank pain, hematuria, dysuria) were recorded. Laboratory investigations, including renal function tests and urinalysis, were performed as part of routine preoperative assessment.

Radiological evaluation was carried out in all patients prior to intervention. Non-contrast computed tomography (NCCT) of the kidneys, ureters and bladder (KUB) was used as the primary imaging modality to confirm the presence, size and location of stones. In selected cases, CT urography was performed to obtain a more detailed assessment of the ureteric anatomy. The ureteric course was carefully evaluated on imaging for the presence of anatomical variations such as duplication, abnormal curvature, medial or lateral deviation, kinking or unusual relations with surrounding structures.

During endourological procedures, intraoperative findings were documented by the operating urologist. These included ease of ureteral access, presence of any resistance during instrument passage, identification of anatomical variations and any complications such as mucosal injury, perforation or creation of a false passage. The type of procedure performed (URS, RIRS, or PCNL), operative time and success of stone clearance were also recorded.

Ureteric variations were categorized based on their morphological characteristics observed on imaging and confirmed intraoperatively where possible. The primary outcome measures included the frequency and types of ureteric variations, their association with stone locationand their impact on procedural difficulty and complications.

Data was entered and analyzed using Statistical Package for Social Sciences (SPSS) version 22. Quantitative variables such as age, stone size and operative time were expressed as mean ± standard deviation while qualitative variables such as gender, type of ureteric variation and presence of complications were presented as frequencies and percentages. The association

between ureteric variations and clinical outcomes was assessed using the chi-square test or Fisher's exact test where appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 120 patients diagnosed with urolithiasis and undergoing endourological procedures were included in this study. The analysis focused on demographic characteristics, radiological findings, types of ureteric anatomical variations and their impact on procedural outcomes.

Out of 120 patients, 72 (60%) were males and 48 (40%) were females, with a male-to-female ratio of 1.5:1. The mean age of the patients was 41.6 ± 12.3 years, ranging from 18 to 65 years. The majority of patients (45%) belonged to the age group of 31–50 years.

Table 1: Demographic Distribution of Patients

Variable	Frequency (n=120)	Percentage (%)
Gender		
Male	72	60%
Female	48	40%
Age Group		
18–30 years	28	23.3%
31–50 years	54	45%
51–65 years	38	31.7%

The data shows that urolithiasis was more common in males, with the highest frequency observed in middle-aged individuals.

Flank pain was the most common presenting complaint, reported in 102 patients (85%), followed by hematuria in 68 patients (56.7%) and dysuria in 40 patients (33.3%).

Table 2: Clinical Presentation

Symptom	Frequency	Percentage (%)
Flank pain	102	85%
Hematuria	68	56.7%
Dysuria	40	33.3%

Flank pain remained the dominant symptom across all patients, consistent with typical ureteric stone presentation.

Stone Characteristics: Most stones were located in the lower ureter (45%), followed by the upper ureter (30%) and mid ureter (25%). The mean stone size was 9.2 ± 3.6 mm.

Table 3: Stone Location

Location	Frequency	Percentage (%)
Upper ureter	36	30%
Mid ureter	30	25%
Lower ureter	54	45%

Frequency of Ureteric Anatomical Variations: Anatomical variations in the ureteric course were identified in 34 patients (28.3%) while 86 patients (71.7%) had a normal ureteric course.

Table 4: Presence of Ureteric Variations

Ureteric Anatomy	Frequency	Percentage (%)
Normal	86	71.7%
Variations	34	28.3%

Among the 34 patients with variations, the most common type was ureteric tortuosity (35.3%), followed by duplication (23.5%), kinking (20.6%) and abnormal medial/lateral deviation (20.6%).

Table 5: Types of Ureteric Variations (n=34)

Type of Variation	Frequency	Percentage (%)
Ureteric tortuosity	12	35.3%
Duplication	8	23.5%
Kinking	7	20.6%
Medial/Lateral deviation	7	20.6%

Ureteric tortuosity emerged as the most frequent anatomical variation observed in this study.

Type of Endourological Procedures: Ureteroscopy (URS) was the most commonly performed procedure (55%), followed by RIRS (25%) and PCNL (20%).

Table 6: Type of Procedure

Procedure	Frequency	Percentage (%)
URS	66	55%
RIRS	30	25%
PCNL	24	20%

Association of Ureteric Variations with Procedural Difficulty: Procedural difficulty (defined as difficulty in scope advancement or need for additional maneuvers) was observed in 22 out of 34 patients (64.7%) with ureteric variations, compared to only 18 out of 86 patients (20.9%) with normal anatomy.

Table 7: Procedural Difficulty

Ureteric Anatomy	Difficulty Present	Difficulty Absent
Variations (n=34)	22 (64.7%)	12 (35.3%)
Normal (n=86)	18 (20.9%)	68 (79.1%)

A statistically significant association was found between ureteric variations and procedural difficulty ($p < 0.05$).

Complications: Complications were more frequent in patients with ureteric variations. Mucosal injury occurred in 10 patients (29.4%) with variations compared to 8 patients (9.3%) with normal ureters. Ureteric perforation was noted in 4 patients (11.8%) with variations and only 2 patients (2.3%) without variations.

Table 8: Complications

Complication	Variations (%)	Normal (%)
Mucosal injury	29.4%	9.3%
Perforation	11.8%	2.3%

Complication rates were clearly higher in patients with abnormal ureteric anatomy.

Stone Clearance Rate: Successful stone clearance was achieved in 94.1% of patients with normal ureters compared to 79.4% in patients with ureteric variations.

Table 9: Stone Clearance

Ureteric Anatomy	Clearance Achieved	Clearance Failed
Normal (n=86)	81 (94.1%)	5 (5.9%)
Variations (n=34)	27 (79.4%)	7 (20.6%)

Patients with ureteric variations had a relatively lower success rate of stone clearance.

DISCUSSION

This study was conducted to evaluate anatomical variations in the ureteric course and to determine their clinical significance in patients with urolithiasis undergoing endourological procedures. The findings of this study highlight that ureteric variations are common and have a meaningful impact on both procedural difficulty and clinical outcomes.

In this study, the majority of patients were males (60%), with a peak incidence in the 31–

50-year age group. This is consistent with previously reported data where urolithiasis has been shown to be more prevalent in males due to dietary habits, metabolic differences and occupational exposure to dehydration. Studies by Scales et al., similarly reported a higher prevalence of stone disease in males, particularly in middle-aged individuals.(Scales et al., 2012) The predominance of flank pain as the chief complaint in our study also aligns with the classical presentation of ureteric stones described in standard urological literature.

A key finding of this study was that ureteric anatomical variations were present in 28.3% of patients. This frequency is comparable to earlier anatomical and radiological studies. Dretler and Olssondescribed that variations in ureteric anatomy, including duplication and abnormal course may be encountered in up to 20–30% of individuals. (Dretler et al., 1971)Similarly, Romero et al. reported congenital ureteral anomalies in a significant proportion of the population. The relatively high frequency observed in our study reinforces the importance of considering anatomical variations during both diagnosis and intervention.(Romero et al., 2010)

Among the different types of variations, ureteric tortuosity was the most commonly observed (35.3%), followed by duplication and kinking. These findings are in agreement with studies by Türkvatan et al., who emphasized that ureteral tortuosity and duplication are among the most frequently encountered anomalies on CT urography. Ureteric duplicationhas been reported as a developmental anomaly resulting from early splitting of the ureteric bud during embryogenesis. Such variations may remain asymptomatic but can predispose patients to urinary stasis, infection and stone formation.(Türkvatan et al., 2009)

An important aspect of this study was the association between ureteric variations and procedural difficulty. It was observed that 64.7% of patients with ureteric variations experienced difficulty during endourological procedures compared to only 20.9% of patients with normal anatomy. This difference was statistically significant, indicating a strong correlation between abnormal ureteric course and technical challenges during intervention. These findings are supported by Grasso et al., who reported that anatomical abnormalities of the ureter can complicate ureteroscopic access and increase operative time. (Grasso and Bagley, 1998)Similarly, Preminger highlighted that ureteral anomalies often necessitate advanced endoscopic skills and may require additional procedural modifications.(Preminger et al., 2007)

The complication rate was also notably higher in patients with ureteric variations. Mucosal injury and ureteric perforation were more frequently observed in this group. This can be explained by the altered anatomy, which may create resistance during instrument advancement leading to increased risk of trauma. These findings are consistent with those of Traxer and Thomas, who demonstrated that difficult ureteral anatomy is a major risk factor for ureteroscopic complications. The presence of tortuosity or kinking can result in uneven distribution of force during instrumentation, thereby increasing the likelihood of injury.(Traxer and Thomas, 2013)

Another significant observation was the lower stone clearance rate in patients with ureteric variations (79.4%) compared to those with normal ureters (94.1%). This difference highlights the clinical impact of anatomical variations on treatment success. Incomplete stone clearance in such cases may be due to limited access, difficulty in navigating instrumentsor inability to reach all segments of the ureter effectively. Preminger et al., also reported that anatomical abnormalities can reduce the efficacy of endourological procedures and may necessitate staged interventions.(Preminger et al., 2007)

Radiological evaluation played a crucial role in this study. Non-contrast CT (NCCT) was effective in identifying stone characteristics while CT urography provided detailed information regarding ureteric anatomy. However, it was noted that some variations were only fully appreciated intraoperatively. This observation underscores the findings of Fielding et al., who emphasized that imaging, although highly sensitive may not always detect subtle anatomical deviations. Therefore, a combination of preoperative imaging and intraoperative vigilance is essential for optimal management.(Fielding et al., 1997)

The findings of this study also have implications beyond endourology. Ureteric variations can increase the risk of iatrogenic injury during pelvic and abdominal surgeries. Liapis et al., reported that unrecognized ureteral anomalies are a significant cause of surgical complications, particularly in gynecological procedures. Hence, awareness of these variations is important not only for urologists but also for surgeons in related fields.(Liapis et al., 2001)

CONCLUSION

This study demonstrates that anatomical variations in the ureteric course are relatively common and play a significant role in the clinical management of urolithiasis. These variations not only influence the presentation and localization of ureteric stones but also pose considerable challenges during endourological procedures. This leads to increased procedural difficulty, higher complication rates and comparatively lower stone clearance. The findings highlight the importance of thorough preoperative imaging and a strong awareness of possible anatomical deviations to ensure safe and effective intervention. Earlier recognition of these variations allows for better surgical planning and technique adaptation which ultimately improves patient outcomes and reduce the risk of intraoperative complications.

REFERENCES

1. ANDRABI, Y., PATINO, M., DAS, C. J., EISNER, B., SAHANI, D. V. & KAMBADAKONE, A. 2015. Advances in CT imaging for urolithiasis. *Indian J Urol,* 31, 185-93.
2. ASSIMOS, D. G. 2021. Urolithiasis/Endourology. *J Urol,* 206, 765-767.
3. BARAMKI, T. A. 1974. Embryology of the urogenital system in man and genetic factors in intersex problems and transsexualism. *Clin Plast Surg,* 1, 201-13.
4. CHEW, B. H. & LANGE, D. 2016. The future of ureteroscopy. *Minerva Urol Nefrol,* 68, 592-597.
5. CHEWCHARAT, A. & CURHAN, G. 2021. Trends in the prevalence of kidney stones in the United States from 2007 to 2016. *Urolithiasis,* 49, 27-39.
6. DIRIE, N. I., ADAM, M. H., GARBA, B., DAHIE, H. A., SH NUR, M. A., MOHAMED, F. Y., MOHAMUD, A. K. & HASSAN, J. 2023. The prevalence of urolithiasis in subjects undergoing computer tomography in selected referral diagnostic centers in Mogadishu, Somalia. *Front Public Health,* 11, 1203640.
7. DRETLER, S. P., OLSSON, C. & PFISTER, R. C. 1971. The anatomic, radiologic and clinical characteristics of the pelvic kidney: an analysis of 86 cases. *J Urol,* 105, 623-7.
8. FIELDING, J. R., FOX, L. A., HELLER, H., SELTZER, S. E., TEMPANY, C. M., SILVERMAN, S. G. & STEELE, G. 1997. Spiral CT in the evaluation of flank pain: overall accuracy and feature analysis. *J Comput Assist Tomogr,* 21, 635-8.
9. GRASSO, M. & BAGLEY, D. 1998. Small diameter, actively deflectable, flexible ureteropyeloscopy. *J Urol,* 160, 1648-53; discussion 1653-4.
10. JOBS, K., RAKOWSKA, M. & PATUREJ, A. 2018. Urolithiasis in the pediatric population - current opinion on epidemiology, patophysiology, diagnostic evaluation and treatment. *Dev Period Med,* 22, 201-208.
11. LESCAY, H. A., JIANG, J., LESLIE, S. W. & TUMA, F. 2026. Anatomy, Abdomen and Pelvis Ureter. *StatPearls*. Treasure Island (FL) ineligible companies. Disclosure: Jay Jiang declares no relevant financial relationships with ineligible companies. Disclosure: Stephen Leslie declares no relevant financial relationships with ineligible companies. Disclosure: Faiz Tuma declares no relevant financial relationships with ineligible companies.: StatPearls Publishing Copyright © 2026, StatPearls Publishing LLC.
12. LIAPIS, A., BAKAS, P., GIANNOPOULOS, V. & CREATSAS, G. 2001. Ureteral injuries during gynecological surgery. *Int Urogynecol J Pelvic Floor Dysfunct,* 12, 391-3; discussion 394.
13. MARSHALL, F. F. 1978. Embryology of the lower genitourinary tract. *Urol Clin North Am,* 5, 3-15.
14. MCLEOD, D. J., ALPERT, S. A., URAL, Z. & JAYANTHI, V. R. 2014. Ureteroureterostomy irrespective of ureteral size or upper pole function: a single center experience. *J Pediatr Urol,* 10, 616-9.
15. MIKUZ, G. 2018. [Ectopias of the kidney, urinary tract organs, and male genitalia. German version.]. *Pathologe,* 39, 415-423.
16. MILLER, N. L. & LINGEMAN, J. E. 2007. Management of kidney stones. *Bmj,* 334, 468-72.
17. NAMASIVAYAM, S., KALRA, M. K., SMALL, W. C., TORRES, W. E. & MITTAL, P. K. 2006. Multidetector row computed tomography evaluation of potential living laparoscopic renal donors: the story so far. *Curr Probl Diagn Radiol,* 35, 102-14.
18. OSHIBA, A., OSHIBA, S., KOTB, M. & ABOUHEBA, M. 2025. Ureteral duplication anomalies: two years'

experience in a single center. *BMC Urol*, 25, 125.

19. PALIT, V. & JOYCE, A. D. 2008. Updates in endourology. *Curr Urol Rep,* 9, 122-7.
20. POZNIAK, M. A., BALISON, D. J., LEE, F. T., JR., TAMBEAUX, R. H., UEHLING, D. T. & MOON, T. D. 1998. CT angiography of potential renal transplant donors. *Radiographics,* 18, 565-87.
21. PREMINGER, G. M., TISELIUS, H. G., ASSIMOS, D. G., ALKEN, P., BUCK, C., GALLUCCI, M., KNOLL, T., LINGEMAN, J. E., NAKADA, S. Y., PEARLE, M. S., SARICA, K., TÜRK, C. & WOLF, J. S., JR. 2007. 2007 guideline for the management of ureteral calculi. *J Urol,* 178, 2418-34.
22. PREZIOSO, D., STRAZZULLO, P., LOTTI, T., BIANCHI, G., BORGHI, L., CAIONE, P., CARINI, M., CAUDARELLA, R., FERRARO, M., GAMBARO, G., GELOSA, M., GUTTILLA, A., ILLIANO, E., MARTINO, M., MESCHI, T., MESSA, P., MIANO, R., NAPODANO, G., NOUVENNE, A., RENDINA, D., ROCCO, F., ROSA, M., SANSEVERINO, R., SALERNO, A., SPATAFORA, S., TASCA, A., TICINESI, A., TRAVAGLINI, F., TRINCHIERI, A., VESPASIANI, G. & ZATTONI, F. 2015. Dietary treatment of urinary risk factors for renal stone formation. A review of CLU Working Group. *Arch Ital Urol Androl,* 87, 105-20.
23. ROMERO, V., AKPINAR, H. & ASSIMOS, D. G. 2010. Kidney stones: a global picture of prevalence, incidence, and associated risk factors. *Rev Urol,* 12, e86-96.
24. SAKELLARIOU, P., PROTOPAPAS, A. G., VOULGARIS, Z., KYRITSIS, N., RODOLAKIS, A., VLACHOS, G., DIAKOMANOLIS, E. & MICHALAS, S. 2002. Management of ureteric injuries during gynecological operations: 10 years experience. *Eur J Obstet Gynecol Reprod Biol,* 101, 179-84.
25. SCALES, C. D., JR., SMITH, A. C., HANLEY, J. M. & SAIGAL, C. S. 2012. Prevalence of kidney stones in the United States. *Eur Urol,* 62, 160-5.
26. SMITH, P. & DUNN, M. 1979. Duplication of the upper urinary tract. *Ann R Coll Surg Engl,* 61, 281-6.
27. SMITH, P. A., RATNER, L. E., LYNCH, F. C., CORL, F. M. & FISHMAN, E. K. 1998. Role of CT angiography in the preoperative evaluation for laparoscopic nephrectomy. *Radiographics,* 18, 589-601.
28. TANG, V. C. & ATTWELL-HEAP, A. 2011. Computed tomography versus ureteroscopy in identification of renal tract stone with ureteral stent in situ. *Ann R Coll Surg Engl,* 93, 639-41.
29. TASIAN, G. E. & COPELOVITCH, L. 2014. Evaluation and medical management of kidney stones in children. *J Urol,* 192, 1329-36.
30. TRAXER, O. & THOMAS, A. 2013. Prospective evaluation and classification of ureteral wall injuries resulting from insertion of a ureteral access sheath during retrograde intrarenal surgery. *J Urol,* 189, 580-4.
31. TÜRKVATAN, A., OLÇER, T. & CUMHUR, T. 2009. Multidetector CT urography of renal fusion anomalies. *Diagn Interv Radiol,* 15, 127-34.
32. VAUGHAN, E. D., JR. & MIDDLETON, G. W. 1975. Pertinent genitourinary embryology: review for practicing urologist. *Urology,* 6, 139-49.
33. WALTHER, S., HILBURGER, M., BADER, M. J., STIEF, C. G. & STRITTMATTER, F. 2010. [Urolithiasis]. *MMW Fortschr Med,* 152, 42-5; quiz 46.
34. YAKUPOGLU, H. Y., BUDAK, K. & AMBÜHL, P. M. 2013. [Urolithiasis]. *Praxis (Bern 1994),* 102, 767-74.
35. YONG, C. & KNUDSEN, B. E. 2016. Ureteroscopy: accessory devices. *Minerva Urol Nefrol,* 68, 527-546.