ENDOUROLOGY
Original Article

Evaluation of postoperative hydronephrosis following semirigid ureteroscopy: Incidence and predictors

Semirijit üreteroskopi sonrası gelişen hidronefrozun değerlendirilmesi: İnsidans ve öngörü faktörleri

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ABSTRACT

Objective: Hydronephrosis developing following ureteroscopy (URS) is an important issue associated with the long-term postoperative renal functions. Studies investigating the role of postoperative imaging revealed conflicting results. In this study, we aimed to determine the incidence and predictors of hydronephrosis following semirigid URS.

Material and methods: We evaluated the results of 455 patients who underwent URS and postoperative imaging with non-contrast computed tomography (CT). Primary endpoints of the study were to determine the frequency of development of hydronephrosis and factors associated with the development of hydronephrosis. Logistic regression analysis was used to define factors effecting on the development of hydronephrosis.

Results: Postoperative non-contrast CT revealed hydronephrosis in 81 (17.8%) patients. Stone- free status was achieved in 415 (91.2%) patients. Univariate analysis revealed history of ipsilateral URS (p=0.001), duration of operation (p=0.022), presence of multiple stones (p=0.001), and occurrence of a renal colic episode postoperatively (p=0.013) as the parameters associated with increased risk of postoperative hydronephrosis. In the multivariate analysis, history of ipsilateral URS (OR: 2.724, p=0.017) and presence of multiple stones (OR: 2.116, p=0.032) were found to be the independent prognostic markers of developing postoperative hydronephrosis.

Conclusion: Ipsilateral hydronephrosis following URS develops in a significant number of patients. In patients with history of ipsilateral hydronephrosis and multiple stones, risk of development of postoperative hydronephrosis is higher, therefore physicians should be keep these parameters in mind in the decision making process of selective imaging postoperatively.

Keywords: Hydronephrosis; non-contrast CT; Ureteroscopy; ureteral stricture.

ÖZ

Amaç: Üreteroskopi (URS) sonrası gelişen hidronefroz ameliyat sonrası uzun dönem böbrek fonksiyonu açısından önemlidir. Ameliyat sonrası görüntüleme üzerine yapılan çalışmaların sonuçları çelişkilidir. Bu çalışmada URS sonrası hidronefroz gelişim insidansının belirlenmesi ve hidronefroz gelişimine etki eden faktörlerin belirlenmesi amaçlanmıştır.

Gereç ve yöntemler: Bu çalışmada URS yapılan ve ameliyat sonrası kontrastsız bilgisayarlı tomografi (BT) ile görüntüleme yapılan 455 hastanın verileri incelenmiştir. Çalışmada birincil hedefler hidronefroz gelişme sıklığının saptanması ve hidronefroz gelişimine etki eden faktörlerin belirlenmesidir. Hidronefroz gelişimine etki eden faktörlerin belirlenmesi için lojistik regresyon analizi yapılmıştır.

Bulgular: Ameliyat sonrası kontrastsız BT de hidronefroz 81 (%17,8) hastada tespit edildi. Taşsızlık 415 (%91,2) hastada elde edildi. Tek değişkenli analizde aynı taraflı URS öyküsü olması (p=0,001), ameliyat süresi (p=0,022), çoklu taş olması (0,001) ve ameliyat sonrası dönemde renal kolik gelişmesi hidronefroz ile ilişkili faktörler olarak tespit edildi. Çok değişkenli analizde ise aynı taraflı URS öyküsü (OR: 2,724, p=0,017) ve çoklu taş olması (OR: 2,116, p=0,032) hidronefroz gelişmesi açısından bağımsız risk faktörleri olarak tespit edildi.

Sonuç: URS sonrası aynı taraflı hidronefroz hastaların önemli bir kısmında gelişmektedir. Aynı taraflı URS öyküsü olan ve çoklu taşı olan hastalarda ameliyat sonrası dönemde hidronefroz gelişme riski daha yüksektir. Bu nedenle ameliyat sonrası takiplerde hekimler görüntüleme yöntemlerinin kullanımı için karar verirken bu faktörleri göz önünde bulundurmalıdır.

Anahtar Kelimeler: Hidronefroz; kontrastsız BT; üreteroskopi; üreter darlığı.

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Submitted: 18.12.2015

Accepted: 14.10.2016

Available Online Date: 03.05.2017

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Available online at www.turkishjournalofurology.com

Introduction

Stone disease is an important health problem with its long- term consequences on renal functions and a prevalence of (14.8%) in Turkey.[1] Ureteroscopy (URS) is the standard treatment for ureteral stones together with shock wave lithotripsy (SWL) and antegrade percutaneous

Turk J Urol 2017; 43(2): 171-5
DOI:10.5152/tud.2017.80106

nephrolithotomy in patients with indications for active stone removal or following failed conservative management.[2-4] Technical improvements especially in the last decade provided better optical quality and miniaturization of the instruments leading to worldwide increase in application of URS for the management of ureteral stones. Recently published results of The Clinical Research Office of the Endourological Society (CROES) URS Global Study revealed satisfactory success rates (85.6% stone-free rate) with lower complication rates (3.5% in all).[5]

Ipsilateral hydronephrosis following URS is an important issue associated with the long- term postoperative renal functions. Controversy exists on the incidence of symptomatic and /or asymptomatic post procedural obstruction due to the non-standard application of imaging modalities postoperatively. Ureteral stricture is one of the reasons for the development of hydronephrosis and incidence rates of up to 3.5% were reported in the formerly published series.[6-9] Recently, hospital readmission rates of 0.5% and 0.3% were reported due to ureteral obstruction and ureteral stricture respectively in the CROES URS Global Study.[5] This decrease in ureteral stricture rate is possibly associated with advances in the instrumentation and technique of URS. However, a recently published single center series of ureteroscopic management of ureteral and renal stones revealed hydronephrosis rates of 15% as detected by imaging studies performed at least 4 weeks after stent removal.[10] Therefore one should still keep in mind the possibility of postoperative hydronephrosis or ureteral stricture after URS.

Studies investigating the role of postoperative imaging revealed conflicting results. Therefore routine postoperative imaging following URS, is also under debate.[11-14] To date, selective postoperative imaging for patients with higher risk of developing ureteral obstruction seems to be reasonable due to cost and side effects (radiation exposure) of imaging modalities.[13] Ultrasonography or non-contrast computerized tomography (CT) can be used as an imaging modality, but the latter has become the standard for diagnosing acute flank pain, with sensitivity of 97% and specificity of 95% in patients with urolithiasis.[15,16]

In this study, we aimed to determine the incidence of ipsilateral hydronephrosis and factors associated with development of ipsilateral hydronephrosis in a cohort of patients who underwent URS for ureteral stone and postoperative non-contrast CT.

Material and methods

The study was conducted in accordance with the ethical principles for medical research involving human subjects of Declaration of Helsinki. Data of 753 patients treated with semirigid URS for ureteral stone disease in our center between May 2009 and June 2015 were investigated retrospectively. From this cohort, we evaluated the results of 455 patients who underwent imaging with non-contrast CT at least 3 weeks after the URS procedure (without ureteral stent placement) or 3 weeks after removal of ureteral stent. Time interval of at least 3 weeks was allowed to discriminate the effect of postoperative edema on the results of imaging. Informed consent was obtained from all participants included in the study.

All procedures were performed under general anesthesia and antibiotic prophylaxis. A semirigid ureterescope of 8.5 Fr to 9.5Fr (Karl Storz®, Tuttlingen, Germany) was used. Baloon dilation of ureteral orifice was applied depending on the structure of the ureteral orifice. Ureteral stenting was inserted depending on the surgeon's preferences according to the properties of the patient, stone and intraoperative course. JJ stents of 4.7 Fr to 7 Fr were used. As our center is a referral center and involved in resident training the procedures were performed by different surgeons.

Demographic, stone- related and operative characteristics were collected including age, gender, stone size, localization and multiplicity, history of ipsilateral URS, presence, and duration of stone impaction (defined based on previous study, as time interval from preoperative imaging showing hydronephrosis until time of surgical intervention)[13], pre-URS hydronephrosis, duration of operation, ureteral dilation, stone extraction, post-procedural stent implantation, intraoperative complication, presence of residual stone after the operation, ureteral stent placement, duration of ureteral stent, symptomatic episode and presence, and etiology of postoperative hydronephrosis.

Primary endpoints of the study were the incidence of postoperative hydronephrosis and factors associated with the development of postoperative hydronephrosis. All of the CT images were evaluated by a radiologist (BG) to determine the presence of hydronephrosis and to identify the underlying pathology, residual stone, postoperative edema or ureteral stricture.

Statistical analysis

Statistical analysis was performed with IBM Statistical Package for the Social Sciences for Windows, version 20.0. (IBM SPSS Statistics Armonk, NY: IBM Corp, USA). Descriptive statistics for the parameters were provided. Logistic regression analysis was used to define factors associated with the presence of hydronephrosis. P value of 0.05 was accepted as the level of statisstical significance.

Results

Totally data of 455 patients (male, n=260; 57.1%, and female, n=195; 42.9%) were evaluated and the mean age of the population was 42.4±9.9. History of ipsilateral URS was detected in 112 (24.6%), and preoperative hydronephrosis in 132 (28.6%) patients. The characteristics of the whole population are summarized in Table 1. The reason for postoperative imaging was the occurrence of acute renal colic episode in 104 (22.8%) patients. Postoperative non-contrast CT revealed hydronephrosis in 81 (17.8%) patients. Residual stone in the ureter was detected in 40 of these patients with hydronephrosis, 3 patients were found to have ureteral stricture disease diagnosed by retrograde pyelography and diagnostic URS and in 38 patients hydronephrosis

developed due to postoperative edema. Hydronephrosis in patients with postoperative edema was seen to be resolved in the subsequent imaging modalities obtained on ultrasonograms or CT within 6 months. Stone- free status was achieved in 415 (91.2%) patients following the procedure. Ureteral stent was placed in 298 (65.5%) patients. URS was performed in 26 of 40 patients with residual stones to establish stone- free status. Ten of them passed their stones spontaneously and SWL was performed in 4 patients. Concomitant ureteral stricture was not detected in these patients. Six (1.3%) patients were found to have hydronephrosis despite becoming stone- free after secondary treatments and all of these patients were found to have hydronephrosis preoperatively.

Results of logistic regression analysis

Univariate analysis revealed history of ipsilateral URS (p=0.001), duration of operation (p=0.022), presence of multiple stones (p=0.001), and presentation with a postoperative renal colic episode (p=0.013) as the parameters associated with increased risk of postoperative hydronephrosis. Results of univariate analysis are summarized in Table 2. These parameters were further used in a multivariate model, and history of ipsilateral URS (OR: 2.724, 95% CI: 1.128-5.877, p=0.017) and presence of multiple stones (OR: 2.116, 95% CI: 1.114-4.996, p=0.032) were found to be the independent prognostic markers for the development of postoperative hydronephrosis.

Discussion

In this study we retrospectively reviewed the results of 455 patients who underwent semirigid URS for ureteral stones and imaged with non-contrast CT postoperatively to identify the incidence of postoperative hydronephrosis and factors that have a role in the development of this condition. We found incidence of preoperative hydronephrosis (17.8%), history of ipsilateral URS (p=0.017) and presence of multiple stones (p=0.032) as independent predictors of postoperative hydronephrosis.

We excluded patients without a postoperative imaging or imaged with modalities other than non-contrast CT and all images were analyzed by an independent radiologist blinded to demographic and operative details. Non-contrast CT is the standard for diagnosing acute flank pain, and has sensitivity and specificity of 97% and 95% respectively.[15,16] Also the value of non-contrast CT to detect residual fragments following surgery has been shown to be higher than ultrasonography and abdominal X-ray.[17] Therefore this methodology takes away the drawbacks related to non-homogeneity of the imaging modalities.

Most devastating reason for postoperative hydronephrosis is ureteral stricture and in the early series incidence rates of up to 3.5% were

Table 1. Demographic, stone related and operative characteristics of the population

Parameter	Whole population	Non-hydronephrotic group (n=81)	Hydronephrotic group (n=374)
Age, mean±SD (years)	42.4±9.9	42.8±8.1	42.3±9.7
Sex			
Male, n (%)	260 (57.1)	47 (58)	213 (56.9)
Female, n (%)	195 (42.9)	34 (42)	161 (43.1)
History of ipsilateral URS, n (%)	112 (24.6%)	31 (38.2)	81 (21.6)
Preoperative hydronephrosis, n (%)	132 (28.6%)	23 (28.3)	109 (29.1)
Mean stone size, mm	7.1±2.2	7.2±2.3	7.1±1.9
Stone location, n (%)			
Proximal ureter	117 (25.7)	20 (24.7)	97 (25.9)
Mid-ureter	137 (30.1)	27 (33.3)	110 (29.4)
Distal ureter	201 (44.2)	34 (41.9)	167 (44.6)
Presence of multiple stones, n (%)	118 (25.9)	24 (29.6)	94 (25.1)
Presence of impacted stone, n (%)	74 (16.3)	14 (17.3)	60 (16)
Duration of impaction, days, mean±SD	32±8.1	31.5±8.9	32.1±7.8
Ureteral stent placement, n (%)	298 (65.5)	56 (69.1)	242 (64.7)
Duration of operation, mean±SD minutes	45.5±22.3	53.9±22.8	43.6±19.2
Intraoperative perforation / mucosal injury, n (%)	12 (2.6)	4 (4.9)	8 (2.1)
Episode of acute renal colic, n (%)	104 (22.8)	27 (33.3)	77 (20.6)

URS: Ureterorenoscopy

Turk J Urol 2017; 43(2): 171-5
DOI:10.5152/tud.2017.80106

Table 2. Results of univariate analysis for the presence of postoperative hydronephrosis

Parameter	Whole population	Non-hydronephrotic group (n=81)	Hydronephrotic group (n=374)
Age (years)	1.156	0.645-1.316	0.844
Sex (male vs. female)	1.148	0.677-1.842	0.812
History of ipsilateral URS	3.551	1.388-7.542	0.001
Preoperative hydronephrosis	1.117	0.526-1.867	0.855
Mean stone size (cm)	1.266	0.603-2.655	0.781
Stone location (distal vs. mid and proximal ureter)	1.205	0.497-2.667	0.821
Presence of multiple stones	2.884	1.322-5.398	0.001
Presence of impacted stone	1.209	0.804-2.114	0.572
Duration of impaction	1.381	0.804-3.022	0.657
Ureteral stent placement	1.085	0.381-1.884	0.965
Duration of operation	1.534	1.078-2.544	0.022
Intraoperative perforation/mucosal injury	1.879	0.980-3.102	0.128
Episode of acute renal colic	2.234	1.131-5.712	0.003

reported.[6-9] However with the advanced equipment and developing experience, ureteral stricture rates decreased to level of 0.3% as reported in CROES URS Global Study.[5] In a recent series of URS performed for both renal and ureteral stones, Barbour et al.[10] detected hydronephrosis (n=49) and ureteral stricture (n=2) in in a total of 324 patients. Similarly, hydronephrosis (n=81; 17.8%) and ureteral stricture (n=3) were detected in our 455 patients. Therefore, routine postoperative imaging following URS especially with CT is questionable due to the risks associated with radiation exposure and low incidence of ureteral strictures, however silent postoperative hydronephrosis may end up with renal failure therefore identification of patients that need imaging is important.

Weizer et al.[12] investigated the results of 241 patients who had undergone URS and found that silent obstruction developed in 2.9% of the patients. One of the cases was reported to end up with hemodialysis and therefore the authors recommended routine postoperative imaging within 3 months after URS. On the other hand, several studies opposed to routine imaging and recommended imaging under certain circumstances. Bugg et al.[18] found out that preoperative obstruction and postoperative pain were significant determinants for obstruction and in the absence of these two conditions 96% of the cases were found to have no evidence of persistent obstruction or residual stone fragments. Therefore the authors recommended functional imaging studies in cases presenting with preoperative obstruction and postoperative pain. Beiko et al.[19] reported results of 68 patients and suggested routine postoperative imaging in cases of preexisting impairment of renal function, chronic stone impaction, significant ureteral trauma, endoscopic evidence of stricture, and postoperative flank pain or fever. Our findings revealed history of ipsilateral URS and presence of multiple stones as being associated with postoperative hyrdonephrosis. Therefore, we suggest postoperative imaging following URS in these particular cases.

In a more recent study, Karadag et al.[14] reported the results of 268 patients who had undergone URS for ureteral stones. The authors reported 95% overall success rate and ureteral symptomatic strictures were observed in 2 (0.7%) cases. It should be noted that non-contrast CT has not been used in this study and imaging was done by x-ray or ultrasonography. Based on their results the authors concluded that radiologic surveillance for stricture formation and obstruction was not mandatory after complete stone removal with uncomplicated URS. With the idea of selective postoperative imaging, Adiyat et al.[13] reported the results of 214 patients who had undergone URS and postoperative non-contrast CT. In this study patients had undergone CT imaging within the postoperative first month in case of an impacted stone, ureteral trauma, need for intraoperative balloon dilation, or the presence of pain after stent removal. Imaging was done 6-12 months after surgery in the absence of all of these conditions and the authors mentioned that they did not miss any case of silent obstruction in the latter group. Therefore they concluded that patients undergoing uncomplicated URS do not require routine postoperative imaging. Selective imaging should be performed in case of an impacted stone, ureteral trauma, or need for balloon dilation. In our analysis we did not identify neither presence of impacted stone nor intraoperative injury responsible for the development of postoperative hydronephrosis.

In another recent study, Barbour et al.[10] investigated postoperative hydronephrosis following URS. In that study patients had undergone either non-contrast CT or ultrasonography and the authors found greater stone diameter, prior ipsilateral URS, longer operative duration and symptomatic presentation at the time of imaging as independent predictors for the development of postoperative hydronephrosis. Similarly we detected history of ipsilateral URS, duration of operation, presence of multiple stones, and presentation with a postoperative renal colic episode to have association with development of postoperative hydronephrosis in the univariate

analysis. In the multivariate analysis only history of ipsilateral URS and presence of multiple stones were still associated with the development of postoperative hydronephrosis.[10] Presence of multiple stones is probably associated with duration of operation therefore the latter factor was not found to be significant in the multivariate analysis. Also laser lithotripsy was applied in all of our cases therefore we did not include the relevant results in the analysis.

Most important drawback of our study is the retrospective nature and about 23% of the patients had CT imaging due to renal colic. This reminds us the selection bias possibly associated with the high incidence of hydronephrosis. Also an important number of patients were not found to have CT evaluation at the same period of time and therefore they were not included in the study. Additionally due to the retrospective design of the study, no standardized classification could be performed for mucosal injuries.

In conclusion, ipsilateral hydronephrosis following URS develops in a significant number of patients. Identification of the patients that need postoperative imaging is crucial to prevent devastating complications while protecting patients from side effects of imaging. In patients with history of ipsilateral hydronephrosis and multiple stones, risk of postoperative hydronephrosis is higher, therefore physicians should keep these parameters in mind during the decision making process of selective imaging postoperatively.

Ethics Committee Approval: Authors declared that the research was conducted according to the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects", (amended in October 2013).

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – M.İ.G..; Design – M.İ.G., B.E., B.G.; Supervision – M.Ö., E.S.; Resources – M.İ.G. A.H.; Materials – A.H.; Data Collection and/or Processing – B.E., M.İ.G.; Analysis and/or Interpretation – M.İ.G., B.G., E.S.; Literature Search – B.E., A.H.; Writing Manuscript – M.İ.G.; Critical Review – B.G., E.S.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

Etik Komite Onayı: Yazarlar çalışmanın World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects", (amended in October 2013) prensiplerine uygun olarak yapıldığını beyan etmişlerdir.

Hasta Onamı: Yazılı hasta onamı bu çalışmaya katılan hastalardan alınmıştır.

Hakem Değerlendirmesi: Dış bağımsız.

Yazar Katkıları: Fikir – M.İ.G..; Tasarım – M.İ.G., B.E., B.G.; Denetleme – M.Ö., E.S.; Kaynaklar – M.İ.G. A.H.; Malzemeler – A.H.; Veri Toplanması ve/veya İşlemesi – B.E., M.İ.G.; Analiz ve/veya Yorum – M.İ.G., B.G., E.S.; Literatür Taraması – B.E., A.H.; Yazıyı Yazan – M.İ.G.; Eleştirel İnceleme – B.G., E.S.

Çıkar Çatışması: Yazarlar çıkar çatışması bildirmemişlerdir.

Finansal Destek: Yazarlar bu çalışma için finansal destek almadıklarını beyan etmişlerdir.

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