CT Scan Parameters as Predictor of Ureteric Stoneimpaction and Ureteric Injury Post Laser Lithotripsy

Laith Amer Al-Anbary[1], Firas S. Alquraishi[1]

[1]Lecturer, College of Medicine, Al-Nahrain University/Iraq

Abstract

Introduction: Renal stone are little, firm deposit inside kidney, the stone consist from acid salts and minerals so the stone form in the urinary system it considered the most common reasons of sudden renal colic, Ureterorenoscopic lithotripsy (URS) for removal of stone is considered optimum procedure for patients suffer from renal stones.

Aims: To Study the relation of CT parameters in stone patients and determine which parameters are the valuable in prediction of the Surgical outcome).

Patient and Method: A prospective study conducted of 20 patients with ureteric stones, followed up in urology consultation unit, Data collected from theater room determined by surgeon were: Stone impaction,iatrogenic injury,DJ use. Data collected from CT imaging were Stone number and side, Stone site, Stone diameter,Tissue rim sign,Degree of hydronephrosis and Stone hounsfield unit.

Results: The collected data showed male (60%) predominance over females (40%) The commonest age group was 30-39 years (30%) The results showed that (70%)of stones lies in one ureter but without any correlation with surgical outcome. Regarding Stone Diameter our study showed (20%)of patients with stones >10 mm in axial image all had impacted stones. Regarding Tissue Rim sign >2.5 mm at level of stone site correlate with impaction and injury. Moderate/sever degree of hydronphrosis correlate with impaction and injury.

Conclusions: CT parameters that had strong relation to the surgical outcome in regard of stone impaction and intraoperative iatrogenic injury.

Keywords: *CT scan, ureteric stone impaction, ureteric injury, post laser lithotripsy.*

Introduction

Renal stone are little, firm deposit inside kidney, the stone consist from acid salts and minerals so the stone form in the urinary system it considered the most common reasons of sudden renal colic, so this type of stone affect any part of urinary system and it formulated when concentrated urine this lead to crystallization of minerals and fuse together, this concentration occur due to mild to severe dehydration[1,2]. The incidence is raise to about 13% in male and 7% in female at same point[3]. When stone pass from kidney to ureter this lead to shout acute pain but without any tissue damage but the trauma occur due to pain and lead to pass blood, clots, fragments of stone considered so painful[2,4]. Site of stone inside ureter (near, middle and away) have effect on stone movement and passing[5]. Shock-wave lithotripsy (ESWL), laparoscopic ureterolithotomy, ante grade percutaneous method are management options but the usual management is URS for remove stones[5]. URS

Corresponding Author:
Laith Amer Al-Anbary
Lecturer, College of Medicine, Al-Nahrain University/ Iraq
e-mail: laithamer3000@gmail.com

for removal of stone is considered optimum procedure for patients suffer from renal stones[6]. ESWL and URS are together have 80% of success rate. Stone of equal or less than 1 cm ESWL more accurate than URS in stone removal (90% vs 80%), stone of equal or more than 1 cm URS more accurate than ESWL in stone removal (68% vs of 79%)[7]. Imaging, therefore, has become an increasingly important tool in the evaluation of patients with flank pain [8]. Before URS all patients most undergo abdominal and pelvic CT scan for evaluation urinary tract CT scan used without contrast and even so the anatomy of urinary tract well show[5]. ¼ of patients with normal radiological findings when examine by Intravenous urography (IVU) show stones [9].So CT scan more reliable than IVU if there is obstruction when many films need to obtain with little radiation dose, also CT scan useful in diagnose other causes of pain especially AAA (abdominal aortic aneurysm)[9]. CT is as simple as passing X-rays through the patient and obtaining information with a detector on the other side. Owing X-rays absorption difference, different tissues seem different when the X-ray film is developed[10].

Patient and Method

A prospective study involving 20 cases,in the period between 10th of August 2017 to 20th of January 2018, were followed up in urology consultation unit,urology Surgical theater and CT department in Al-Imamein Al-Kadhimein medical city,after which non enhanced CT were done and taken as 1mm thickness films in same hospital by Seimens SOMATOM. The ureteroscopicprocedure was done under general or regional anesthesia in lithotomy position. Astiff cystoscopy was done to find ureteric opening and progression of hydrophilic directorwire below fluoroscopic supervision into the renal pelvis or outside the level of calculus. A 6- 7.5 F semi stiff ureter scope(Karl Storz) used forlithotripsy ureter scope. ureter scope put away to stone, we used for lithotripsy holmium laser (550µm) with frequency 8-10 HZ, electrical supply 9.6-16 WAT. Stone was split and recovered and so small fragments were gone for impulsive pass. Dual J implanted when indicated or precausiouosly. Foley catheter was placed post operatively if needed. After consent have been taken from patient, patient been followed up and surgical parameters were taken as determined by the surgeon (impaction,DJ indication and ureteric injury),CT parameters was optained using Sante DICOM viewer v5.3, Stone site was classified as proximal ureter (above the sacroiliac joints), mid ureter (overlying the sacroiliac joints), distal ureter (below the sacroiliac joints),Stone size was defined as the maximum diameter within the plane of the axial CT section, Hydronephrosis determision using "Society of Fetal Ultrasound, SFU" hydronephrosis grading system,the most common used system[11]. A positive tissue rim sign (periureteric fatstrands) was defined as annular soft tissue attenuation (20 to 40 Hounsfield units) caused by an edematous ureteral wall surrounding the stone.[12] Hounsfield Unit was omitted from CT parameters due to overlap of ranges and different HU in different parts of the same stone. This study involved 20 patients, of them 12 were males and 8 females, their ages ranged from 16 to 69years old,only two stones passed spontaneously and required no intervention, one ureteroscopic procedure was turned to laparotomy. Statistical analysis were used SPSS 23, mean, SD and percentage used for descriptive analysis. For analysis of variables and data we used independent T test for continuous independent data while used Fisher's exact for categorical data. So P-value < 0.05 mean significant statistically.

Results

Prospective study involving 20 patients;12(60%) male 8(40%) female, most common age group are thirties constituting 30% with mean age 42±15 years old. So (70%) of calculi in the study group lies in one ureter. In regard to stone Diameter 16(80%) of the study group were less than 10 mm, and only 4(20%) were equal or larger than 10mm. Tissue rim sign surrounding stones were found to be less than 2.5 mm in the axial section in 14(70%) of the cases and only 6 stones (30%) surrounded by more than 2.5mm edema,Mean was 2.11 mm with standard deviation of 0.979. eleven stones(55%) were having HU less than 1300, while 45% having more than 1300 HU. With mean HU 1269.9±220.7. Most common group associated with stones is mild (grade I, II) comprising 40% of the study group. Stone impaction is noticed in 35% while 10% passed spontaneously with no further management, 55% was not impacted but still required lithotripsy.

60% with no injury after laser lithotripsy and 40% with injury.

Results

There was no impact of age on stone impaction (P-value of 0.553). Stone impaction is not affected by the gender difference with P-value equals 1. When comparing the effect of one stone or more than one on impaction we noticed that there is no significant

correlation with P-value of 0.626, regarding effect of stone side whether in one or both ureters on impaction also was found to be insignificant with P of 0.354. number of stones found to be uncorrelated to risk of ureteral injury with p value of 1. No correlation was significant with P value of 0.62 indicate that no effect of stone site on the iatrogenic injury rate. Within population of 20 patient, 80% of them had stones <10mm in diameter of those 15% where impacted, while the other 20% of patients with stones more than 10mm all had impacted stones, P-value was 0.0072 which aided the significant correlation that state: stone diameter >10mm in axial section provide perfect toll for suggesting impaction of stone, as shown in table 1.

Table 1: Stone diameter as predictor of ureteral stone impaction.

Maximum diameter in mm	Passed spontaneously no/%	Not impacted no/%	Impacted no/%	Total no/%
0.1 to 10.00	2/10	11/55	3/15	16/80
10.01 to 20.00	0/0	0/0	4/20	4/20
Total	**2/10**	**11/55**	**7/35**	**20/100**

Stones that are associated with Tissue Rim sign <2.5mm were 70% of our study group, halve of those stones were not impacted,on the other hand those associated with Tissue Rim sign >2.5mm, 25% of them had stone impaction,P value was 0.0128 which state that the diameter of Tissue Rim is strong indicator for impaction, as shown in table 2.

Table 2: Tissue rim sign as predictor of ureteral stone impaction.

Tissue Rim sign in mm	Passed spontaneously no/%	Not impacted no/%	Impacted no/%	Total no/%
Less or equal 2.5	2/10	10/50	2/10	16/80
More than 2.5	0/0	1/5	5/25	4/20
Total	**2/10**	**11/55**	**7/35**	**20/100**

It was found that tissue rim sign around stone <2.5 mm associated with no injury in 55% of the study group, those with edema>2.5mm, had injury of different degrees, P value was 0.0181 which state that tissue rim sign more than 2.5mm is strongly associated with ureteric injury .as shown in table 3.

Table 3: Tissue rim sign as predictor of ureteral injuries.

Tissue Rim sign in mm	No Injury no/%	Mucosal injury no/%	Muscular injury no/%	Turn to laparotomy no/%	Total no/%
Less or equal 2.5	11/55	2/10	1/5	0/0	16/80
More than 2.5	1/5	2/10	2/10	1/5	4/20
Total	**12/60**	**4/20**	**3/15**	**1/5**	**20/100**

In those with no or mild hydro nephrosis according to SFU system, 0% had stone impaction, while 35% of those with moderate to severe degrees of hydro nephrosis had impaction,P value was 0.0013 which signify and state that degree of hydro nephrosis correlate with the state of stone impaction, as shown in table 4 .

Table 4: Degree of hydro nephrosis as predictor of ureteral stone impaction.

Degree of Hydro nephrosis	Passed spontaneously no/%	Not impacted no/%	Impacted no/%	Total no/%
No Hydro nephrosis	0/0	4/20	0/0	4/20
Mild (grade I,II)	2/10	6/30	0/0	8/40
Moderate (grade III)	0/0	1/5	4/20	5/25
Sever (grade IV)	0/0	0/0	3/15	3/15
Total	**2/10**	**11/55**	**7/35**	**20/100**

Mild and no hydro nephrosis associated with only 5% of iatrogenic injury due to ureter scope and or lithotripsy,while those with moderate to severe hydro nephrosis (according to SFU system) associated with 35% of different levels of injuries, P value was 0.0008 which aid the state that moderate and sever degrees of hydro nephrosis associated with more iatrogenic injuries.

Discussion

On our study of the 20 patients the prevalence of renal stones were more common in males (60%) than females (40%),in study done in southern Punjap,Pakistan were on 1176 patients with stones prevalence in males were (74%) and in females (26%)[12]. The high prevalence of renal calculi in males in this study can be described by the effect of sex hormones on some other lithogenic risk factors[13], with no effective correlation between gender and surgical parameters, especially stone impaction. Most common age group were 30-39,which also constitutes the majority of southern Punjap study,with mean age of 41.45±14.1113 while that of our study were 42±15 with other studies near that range, one of them were in same hospital [14], with no effect of gender on surgical parameters especially stone impaction[15].

In regard of stone side the result showed that (70%) were in one ureter whether one stone or more,in a study done in the same hospital in 2006 were including 184 patients,65.8% of them were having stones in same side[16], in other study for complications of laser lithotripsy showed that there were no effect of side of stone on surgical outcome[15], neither our study showed any correlation. Half (50%) of stones in our study group were in the distal ureter, fifteen percent of them were impacted ureter, 46% of patient in a study done at Thanjavur medical college and hospital having stone in distal ureter, and (37%) in proximal ureter[17], other study in Netherlands showed (52.5%)in distal ureter which showed also that there is No correlation of stone location to the surgical impaction or DJ use and iatrogenic injury as our results confirmed statistically[17].

Stone size smaller than 1cm were noted in (80%) in our study, and (86%) in study of Thanjavur medical college, while those larger than 1cm in diameter were only (20%) in our and (14%) in their study[18], never the less, outcome of our analysis result that stone diameter has direct contribution to stone impaction and ureteric iatrogenic injury. American Urological Association/ Endourological Society guild line suggest that stone >10mm will mostly require surgical intervention due to impaction[19], study of Utrecht medical center concluded that the stone size doesn't affect the surgical outcome which refute our results [15]. Tissue rim sign was used In other studies as a sign for stone presence or absence,never used as predictor for outcome of lithotripsy, although its absence doesn't exclude the presence of stone[20],our results showed statistical correlation between tissue rim sign>2.5mm in diameter at the level of maximum stone diameter with stone impaction and iatrogenic injury. Degree of hydro nephrosis results in our study showed that whenever there is moderate or severe degree (grade III or IV) there will be impacted stone as well as more risk to have iatrogenic injury.

Ethical Clearance: The Research Ethical Committee at scientific research by ethical approval of both MOH and MOHSER in Iraq.

Conflict of Interest: Non

Funding: Self-funding

References

1. Sommer FG, Jeffrey RB, Jr, Rubin GD, et al. Detection of ureteral calculi in patients with suspected renal colic: value of reformatted noncontrast helical CT. AJR Am J Roentgenol 1995; 165:509-513.
2. Wang JH, Shen SH, Huang SS, Chang CY. Prospective comparison of unenhanced spiral computed tomography and intravenous urography in the evaluation of acute renal colic. J Chin Med Assoc 2008;71:30–6.
3. Pearle, M.S., Calhoun, E.A., Curhan, G.S. Urologic diseases in America project: urolithiasis. J Urol2005;173:848–857.
4. Luchs JS, Katz DS, Lane MJ, Mellinger BC, Lumerman JH, Stillman CA, Meiner EM, et al. Utility of hematuria testing in patients with suspected renal colic: correlation with unenhanced helical CT results. Urology 2002;59:839–42.
5. Smith's Textbook of Endourology, Third Edition. Edited by Arthur D. Smith, Gopal H. Badlani, Glenn M. Preminger, Louis R. Kavoussi. © 2012 Blackwell Publishing Ltd. Published 2012 by Blackwell Publishing Ltd.
6. Maghsoudi, R., Amjadi, M., Norizadeh, D. et al. Treatment of ureteral stones: a prospective randomized controlled trial on comparison of

Ho:YAG laser and pneumatic lithotripsy. Indian J Urol 2008;24:352–354.

7. Preminger, G.M., Tiselius, H.G., Assimos, D.G. et al. 2007 Guideline for the Management of Ureteral Calculi. J Urol2007;178:2418–2434.
8. Kirpalani A, Khalili K, Lee S, Haider MA. Renal colic: comparison of use and outcomes of unenhanced helical CT for emergency investigation in 1998 and 2002. Radiology 2005;236:55.
9. scan, C. (2016). CT scan: Medline Plus Medical Encyclopedia. [online] Nlm.nih.gov. Available at: http://www.nlm.nih.gov/medlineplus/ency/article/003330.htm [Accessed 7 Feb. 2018].
10. Laupacis A, Keown P, Pus N, Krueger H, Ferguson B, Wong C, Muirhead N (1996). A study of the quality of life and cost-utility of renal transplantation. Kidney Int 50: 235–242.
11. Keays MA, Guerra LA, Mihill J et-al. Reliability assessment of Society for Fetal Urology ultrasound grading system for hydronephrosis. J. Urol. 2008;180 (4): 1680-2.
12. Dalrymple NC, Casford B, Raiken DP, Elsass KD, Pagan RA. Pearls and pitfalls in the diagnosis of ureterolithiasis with unenhanced helical CT. Radiographics 2000;20:439–447.
13. Ahmad S, Ansari TM, Shad MS. Prevalence of renal calculi; type, age and gender specific in Southern Punjab, Pakistan. Professional Med J 2016;23(4):389-395.
14. Fan J, Chandhoke PS, Grampes SA. Role of Sex Hormones in Experimental Calcium Oxalate Nephrolithiasis. J Am Soc Nephrol. 1999; 10: 376-380.
15. Leijte, J. A. P., Oddens, J. R. & Lock, T. M. T. W. Holmium laser lithotripsy for ureteral calculi: Predictive factors for complications and success. Journal of Endourology22, 257–260 (2008).
16. Qaader, D. S., Yousif, S. Y. & Mahdi, L. K. Prevalence and etiology of urinary stones in hospitalized patients in Baghdad. Eastern Mediterranean Health Journal12, 853–861 (2006).
17. Binbay, M. et al. Evaluation of pneumatic versus holmium:YAG laser lithotripsy for impacted ureteral stones. International Urology and Nephrology43, 989–995 (2011).
18. Jeevaraman, S., Selvaraj, J. & Niyamathullah, N. M. A Study on Ureteric Calculi. International Journal of Contemporary Medical Research ISSN (Online ICV83, 2393–915 (2015).
19. American Urological Association, Endourological Society. Chapter1, The Management of Ureteral Calculi: Diagnosis and Treatment Recommendations: 31-34, (2016).
20. Kawashima, A. et al. Unenhanced helicat CT of ureterolithiasis: Values of the tissue rim sign. American Journal of Roentgenology 168, 997–1000 (1997).