International Journal of Research in Medical Sciences
Dahiphale D et al. Int J Res Med Sci. 2016 Oct;4(10):4286-4289
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012

DOI: http://dx.doi.org/10.18203/2320-6012.ijrms20163100

Research Article

Non-contrast spiral computed tomography diagnosis of urolithiasis and associated features: hospital based study

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Received: 20 August 2016
Accepted: 24 August 2016

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ABSTRACT

Background: Urolithiasis is prevalent across the world and affects a diverse group of people, irrespective of culture, race or geographic location. Non-contrast computed tomography (CT), has been considered as gold standard for the initial as well as follow-up assessment of patients with suspected urolithiasis. Present study describes the findings on non-contrast spiral computed tomography in clinically suspected patients of urolithiasis visiting radiodiagnosis department of a tertiary care hospital.
Methods: It is a descriptive observational study done at Department of Radiodiagnosis and Imaging at Shri Chhatrapati Shivaji Maharaj General Hospital in Solapur district of Maharashtra state in India. Study duration was Jan 2005 to Oct 2006. 120 patients who presented with symptoms and signs of urolithiasis for diagnosis and treatment in Department of Surgery and Medicine, including the referrals from other hospitals and institutes and referred to Department of Radiodiagnosis and Imaging of the institute for computerised tomography (CT) were enrolled. Detailed history and physical examination was done. The description of findings on non-contrast spiral CT study was done with respect to size and CT attenuation value of the calculus, secondary signs of obstruction, CT diagnosis of urolithiasis, genitourinary or other diseases.
Results: In hundred patients diagnosed as urolithiasis on NCSCT, 140 calculi were found. The mean calculus size (breadth) was 4.65 mm ± 7.03 with a range of 1 to 70 mm. The mean calculus size (length) was 11.1±12.87 mm with a range of 2 to 110 mm. The range of CT attenuation value of calculus was from 60 to 1100 with median value of 311 HU. Among the 100 patients of urolithiasis, hydronephrosis (84%) and hydroureter (82%) were the most common secondary signs of obstruction. Out of 120 patients suspected clinically with diagnosis of urolithiasis, 99 (82.5%) had obstruction with or without urolithiasis. In 86 (71.7%) patients, obstruction with urolithiasis was present. In 13(10.8%) patients, obstruction because of cause other than urolithiasis was present. We have observed additional diagnosis related to genito-urinary tract in 16 (13.5%) cases. We have observed additional diagnosis not related to genito-urinary tract in 6 (0.5%) cases.
Conclusions: Non contrast spiral CT scan evaluation helped in diagnosis of urolithiasis and secondary obstruction. It also provided very useful information regarding genitourinary as well as other than genitourinary pathology.

Keywords: CT attenuation value, Hydronephrosis, Size of urinary calculus

INTRODUCTION

Urolithiasis is prevalent across the world and affects a diverse group of people, irrespective of culture, race or geographic location. There has been a reported increase in incidence of urolithiasis in developed as well as developing nations which has been attributed to lifestyle changes and particularly to the increasing prevalence of obesity.[1-4] Imaging modalities play an important role in diagnostic work up, treatment decisions and assessment

after treatment of patients with urinary calculi. Non-contrast computed tomography (CT), has been considered as gold standard for the initial as well as follow-up assessment of patients with suspected urolithiasis. It has several advantages like a high sensitivity and specificity for stone detection, characterization of composition of stone, ease of availability and avoidance of intravenous administration of contrast.[4-8] Clinical profile of urolithiasis patients like age and sex distribution, calculus location are being published separately. Present article describes the findings on non-contrast spiral computed tomography in clinically suspected patients of urolithiasis visiting radiodiagnosis department of a tertiary care hospital in Solapur district of Maharashtra state in India.

METHODS

It is a descriptive observational study done at Department of Radiodiagnosis and Imaging at Shri Chhatrapati Shivaji Maharaj General Hospital in Solapur district of Maharashtra state in India. Study duration was Jan 2005 to Oct 2006. 120 patients who presented with symptoms and signs of urolithiasis for diagnosis and treatment in Department of Surgery and Medicine, including the referrals from other hospitals and institutes and referred to Department of Radiodiagnosis and Imaging of the institute for non contrast spiral computerised tomography (NCSCT) with provisional diagnosis of urolithiasis were enrolled. Detailed history and physical examination was done. Informed consent was obtained from the subjects prior to enrolment in the study. The description of findings on non-contrast spiral CT study was done with respect to size and CT attenuation value of the calculus, secondary signs of obstruction, CT diagnosis of urolithiasis, genitourinary or other diseases.

CT Machine: Third Generation Spiral CT- Philips medical system. (CT model - CT vision, CT-Secura)

Axial sections were taken from dome of diaphragm to pubic symphysis with slice thickness of 7 mm and recon index of three with pitch of 1.5. The images were viewed in abdominal window and bone window. The coronal and sagittal post scans reconstruction done for proper visualisation of renal calculus.

RESULTS

In hundred patients diagnosed as urolithiasis on NCSCT, 140 calculi were found. The mean calculus size (breadth) was 4.65 mm±7.03 with a range of 1 to 70 mm. The mean calculus size (length) was 11.1±12.87 mm with a range of 2 to 110 mm (Table 1).

Out of 140 calculi found in hundred patients diagnosed as urolithiasis on Non contrast spiral CT, the range of CT attenuation value of calculus was from 60 to 1100 with median value of 311 HU. The largest group (47.8%) was found having less than 300 HU value (Table 2).

Among the 100 patients of urolithiasis, hydronephrosis (84%) and hydroureter (82%) were the most common secondary signs of obstruction followed by fat stranding (51%), and rim sign (26%) (Table 3).

Table 1: Size of calculus.

Breadth (mm)	Number	Length (mm)	Number
1-2	40	1-2	2
3-4	58	3-4	10
5-6	18	5-6	15
7-8	8	7-8	31
9-10	5	9-10	25
11-12	2	11-12	19
13-14	1	13-14	10
15-16	3	15-16	10
17-18	0	17-18	8
19-20	2	19-20	2
21-23	1	21-22	0
24-26	1	23-24	1
70	1	25-26	2
-	-	27-28	0
-	-	29-30	1
-		35-40	2
-	-	70-80	1
-	-	110	1
Total	140	Total	140

Table 2: CT attenuation value of calculus.

HU Value	Number	%
<300	67	47.86%
301-600	60	42.86%
601-700	12	8.57%
> 1000	01	0.71%
Total	140	100

Table 3: Secondary signs of obstruction in urolithiasis (n=100).

Signs	Number of patients
Hydronephrosis	84
Hydroureter	82
Fat stranding	51
Renomegaly	24
Periuretric edema	18
Rim sign	26
Parenchymal thinning	4
Urinoma	1

Out of 120 patients suspected clinically with diagnosis of urolithiasis, 99 (82.5%) had obstruction with or without urolithiasis. In 86 (71.7%) patients, obstruction with urolithiasis was present. In 13 (10.8%) patients, obstruction because of cause other than urolithiasis was present. 5(4.2%) patients had normal CT abdomen and

pelvis study. 2 (1.6%) patients had mimics of urolithiasis i.e. parenchyma calcification (Table 4).

Table 4: CT diagnosis.

CT diagnosis	Number	Percentage
Normal (no diagnosis)	5	04.17
Nephrolithiasis without obstruction	14	11.67
Obstruction with urolithiasis	86	71.67
Obstruction without urolithiasis	13	10.83
Other	2	1.67
Total	120	100

Table 5: Additional diagnosis related to genito - urinary tract.

Additional diagnosis	Number
Pyelonephritis	3
PUJ obstruction	3
Retroperitoneal fibrosis	2
Parenchymal calcification	2
Polycystic kidney	1
Malrotated kidney	1
Hypoplastic kidney	1
Ureterocoele	1
Crossed fused ectopia	1
Transitional cell carcinoma with horse-shoe kidney	1
Total	16

Table 6: Additional diagnosis not related to genito - urinary tract.

Diagnosis	Number
Porcelain gall bladder	1
Pelvic lipomatosis	1
Subserosal fibroid	1
Chronic focal pancreatitis	1
Umbilical hernia	1
Pneumonitis	1
Total	6

Table 7: Obstruction without nephrolithiasis.

Diagnosis	Number
Passed out calculus	6
Pyelonephritis	3
Retroperitoneal fibrosis	2
PUJ obstruction	1
Full bladder	1
Total	13

We have observed additional diagnosis related to genito - urinary tract in 16 (13.5%) cases (Table 5). We have observed additional diagnosis not related to genito-urinary tract in 6 (0.5%) cases (Table 6). Obstruction without nephrolithiasis was found in 13 cases (Table 7).

DISCUSSION

In hundred patients diagnosed as urolithiasis on NCSCT, 140 calculi were found. The mean calculus size (breadth) was 4.65 mm±7.03 with a range of 1 to 70 mm. The mean calculus size (length) was 11.1±2.87 mm with a range of 2 to 110 mm. Out of 140 calculi found in hundred patients diagnosed as urolithiasis on non-contrast spiral CT, the range of CT attenuation value of calculus was from 60 to 1100 with median value of 311 HU. The largest group (47.8%) was found having less than 300 HU value.

Calculus size measurement is a method for burden assessment which can be reliably done on Non contrast spiral CT. It determines the decisions regarding selection of urological treatment plan like need of endoscopic or percutaneous interventions or management by medical expulsive therapy.[9,10] Several studies have reported the significance of stone size assessment and CT attenuation value of stones in making treatment decisions in patients. Sasane et al studied 61 patients with urolithiasis diagnosed by unenhanced spiral Computed Tomography and 145 calculi were noticed. The mean calculus size was 5.71 mm and range was 2 to 78 mm.[11] Fowler K et al 6 reported mean size of calculus as 4.2 mm with range from 0.5-26 mm.[12] In a study of 520 patients by Ueno et al, they concluded that calculi larger than 8 mm in width should be removed surgically, while in those smaller than 8 mm in width, higher chances of spontaneous passage by expectant treatment would be anticipated. Study by Mostafavi et al attempted to determine the chemical composition of urinary calculi by CT scanning in an in vitro setting.[13,14] It was done using the absolute CT value measured at 120 kV and the dual kilovolt CT values measured at 80 and 120 kV. They found that absolute CT value measured at 120 kV was able to identify precisely the chemical composition of uric acid, struvite and calcium oxalate stones whereas it was imprecise in differentiating calcium oxalate from brushite stone and struvite from cystine stone. However, dual kilovolt CT value was able to differentiate these latter stones with statistical significance. Uric acid stones were easily differentiated from all other stones using the absolute CT value. Gupta NP et al study concluded that use of non-contrast CT for evaluating the attenuation values of urinary calculi before extracorporeal shock wave lithotripsy maybe of help in predicting the treatment outcome and also in planning alternative management in patients with a likely poor outcome from extracorporeal shock wave lithotripsy.[15]

In our study, out of 120 patients suspected clinically with diagnosis of urolithiasis, 99 (82.5%) had obstruction with or without urolithiasis. In 86 (71.7%) patients, obstruction with urolithiasis was present. In 13 (10.8%) patients, obstruction because of cause other than

urolithiasis was present. Among the 100 patients of urolithiasis, hydronephrosis (84%) and hydroureter (82%) were the most common secondary signs of obstruction followed by fat stranding (51%), and rim sign (26%). We have observed additional diagnosis related to genito - urinary tract in 16 (13.5%) cases.

Smith et al study determined the value of secondary signs of ureteral obstruction on helical unenhanced CT.[16] Over a 19-month interval, 312 patients with acute flank pain were imaged with helical unenhanced CT. Ureteral stone disease was confirmed to be present in 109 patients and confirmed to be absent in 111 patients. The sensitivity of each secondary sign was ureteral dilatation, 90%; perinephric stranding, 82%; collecting system dilatation, 83%; and renal enlargement, 71%. The specificity of each secondary sign was ureteral dilatation, 93%; perinephric stranding, 93%; collecting system dilatation, 94%; and renal enlargement, 89%. The odds ratio for the frequency of the tissue-rim sign with stones versus tissue-rim with phleboliths was 31:1.

CONCLUSION

Non contrast spiral CT scan evaluation helped in diagnosis of urolithiasis and secondary obstruction. It also provided very useful information regarding genitourinary as well as other than genitourinary pathology.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Dahiphale D, Apte A, Dahiphale AP. Non-contrast spiral computed tomography diagnosis of urolithiasis and associated features: hospital based study. Int J Res Med Sci 2016;4:4286-9.