Section: Urology

Original Research Article

MEASURE OF URINE HOUNSFIELD IN IMPACTED PCS SYSTEM TO DIFFERENTIATE BETWEEN HYDRONEPHROSIS, INFECTED HUN, AND PYONEPHROSIS – A RETROSPECTIVE STUDY

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ABSTRACT

Background: In addressing renal and ureteric calculi, measuring Hounsfield units of stones in non-contrast CT plays a vital role in management. Impacted stones, with chronic duration and periureteral edema, can still pose a challenge to operating surgeons, ranging from the field of vision to complete stone clearance. In this study, we tried to incorporate the Hounsfield unit of backed-up urine to plan and foresee complications in managing impacted calculi.
Objectives: To study and measure urine Hounsfield units in non-contrast CT images over a zone of impacted HUN/HN (grade 3 /4). Apply them to make preoperative decisions. To assess the outcome of patients postoperatively(URSL) with elevated urine Hounsfield.
Materials and Methods: A Retrospective Observational Study. sample size 100, including all patients with impacted (>2months duration, ureteral kinking, periureteral edema) unilateral/bilateral ureteric and renal calculi. we measured the Hounsfield unit of dilated PCS and compared it with the post-interventional outcome. In our tertiary care hospital for a duration of 1 year from Jan 2024 – dec 2024.
Results: Mean age 40±2years.16 pyonephrosis, 44 infected HUN, 40 HUN in the impacted PCS system who underwent management. Average urine HU - 5.12± 9.6. The mean operative time is 40 minutes for unilateral and 70 minutes for bilateral calculi.16 patients underwent PCN insertion. Average hospital stay 1 week 2 days. Auxiliary procedures were needed for 24 patients.
Conclusion: In using the Hounsfield unit of clogged urine in the PCS system, we are able to differentiate between hydronephrosis, infected HUN, and pyonephrosis. It gives an idea regarding the dilated system so that we can plan preoperative PCN in pyonephrosis, step up antibiotics, and anticipate intraoperative difficulty in the infected system. The higher the Hounsfield unit, the more likely one can expect turbidity in urine to be Frank pus that can guide our management.
Keywords: Hydronephrosis, Infected HUN, Pyonephrosis, renal calculi.

INTRODUCTION

Acute or chronic obstruction of the urinary tract may be due to a variety of different causes. Patients with pyonephrosis usually complain of a triad of fever, loin pain, and elevated white blood cell count (WBC) in cases of acute obstruction. Sometimes they are also septic and hypotensive. These patients have to be treated with appropriate decompression, or they may develop septic shock. So it is imperative to know the proper differentiation of the collecting system before approaching the patient for any kind of invasive procedure. Patients presenting with pyonephrosis may often show the clinical picture of acute infection, weight loss, and pain, or low-grade fever; however 11% may present with no fever.

Clinically, it is not practical to differentiate both. Hounsfield unit (HU) measurement is considered an excellent predictor of pyonephrosis and may aid in the diagnosis and management of this disease, which may be fatal. The reason behind the slow increase in viscosity and turbidity of the urine as the disease progresses is due to the accumulation of infected urine, debris, and microparticles. These increase the density of the system and HU values. This study was primarily done to incorporate CT in classifying an infected system from an uninfected one to help us guide the treatment.

Aims and Objectives

- To study the feasibility of incorporating the urine Hounsfield unit in an obstructed PCS system for managing ureteric calculi.
- To assess the outcome of the procedure with respect to stone clearance and complications.

MATERIALS AND METHODS

Study Design: A retrospective observational study(n=100) conducted in Dept. of Urology, Madurai GRH in a tertiary care hospital.

Duration of Study: Jan 2024-Dec 2024

Selection of Patients

Inclusion Criteria

Patients who presented with chronic ureteric calculi, which can be either unilateral or bilateral, with significant periureteral edema, along with kinking of the ureter, are included in the study group. The duration of illness and pain for more than 2 months is taken. A proper consent form was attached to the case sheet, to be signed by the patient before we proceeded.

Exclusion Criteria

Patients presenting with features of pyuria, stones in anomalous kidneys, ectopic kidney locations, with frank pyuria, morbidly septic patients who need immediate intervention, and non-dilated PCS systems are excluded from the study. Patients with other comorbid illnesses whose management cannot be delayed are also not taken into account.

Methods of study

Nearly 100 patients presented to our outpatient department with a history of acute or chronic, unilateral or bilateral flank pain. Data were collected over the period of 1 year. Their mean age was 40±2 yrs. All patients with chronic impacted calculi underwent abdominal ultrasound, and those who had obstructive uropathy underwent non-enhanced CT of the urinary tract.

NC CT was performed 24 hours prior to the procedure using a 16-row multidetector CT scanner

A radiologist with at least 3 years of experience is asked to measure the minimum and maximum HU values in the dilated pelvicalyceal system of all patients using the elliptical region of interest(ROI). we included patients with hydronephrosis grade higher than 1 in our study. This categorical classification system was proposed by the Society of Fetal Urology.

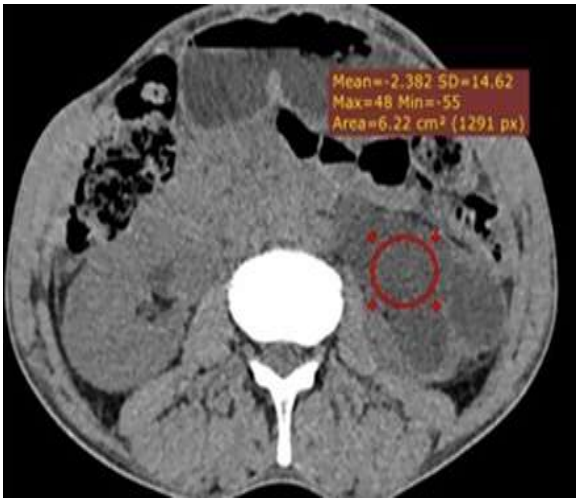
Measurement of HU values in the PCS system is made by an elliptical window of the region of interest in the maximally dilated portion of the pelvicalyceal system. Care is taken not to incorporate any adjacent structures while maintaining an adequate ellipse to avoid unwanted conundrums. Care was taken not to include the adjacent part of the parenchyma or stones in the area measured. We then classified the patients based on the grade of hydronephrosis and HU values of the impacted system into groups and followed them with culture results, intra-operative time, and postoperative complications to assess the outcome.

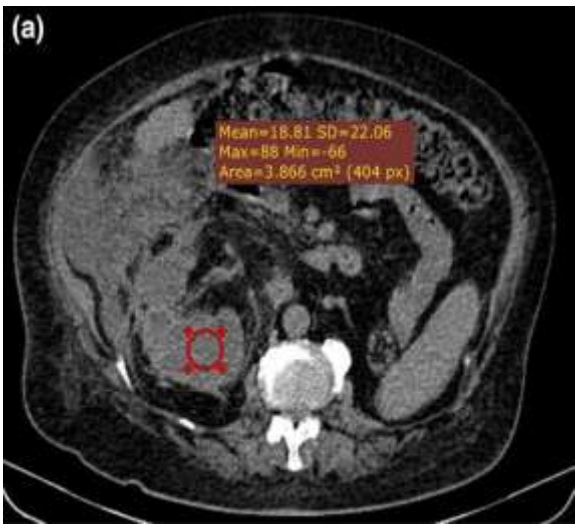
Statistical Analysis: The data was collected using the proforma (enclosed) and entered and analyzed with the SPSS software version 22. Descriptive analysis of study variables was expressed as proportion, mean, median, and standard deviation. The chi-square test was used for non-parametric variables. The confidence interval was set at 95%. A p-value less than 0.05 ($p<0.05$) was considered to be statistically significant. Data has also been represented using appropriate pictorial representations using MS Excel.

Imaging Modality: Using non-contrast computed tomography, after grading the PCS system, we have included 40% of grade 2, 51.7% grade 3, and 31.3% of grade 4 in the HN group. We had included 60% grade 2,48.3% grade 3, and 68.8% grade 4 patients in the Infected HN/Pyonephrosis group.

After organising the study group, the ROI ellipse is placed over the maximum dilated centre of the collecting system, and the maximum with minimum HU values is recorded. Generally, HU values of air are -1000, fat being -100, and water stands at 0. With a gradual increase in density and intensity of the measured structure simple fluid can range from -10 to 20. This is our desirable window through which we subject our patients. The measured HU values between -10 to 4 are considered as hydronephrosis. Anything more than 17 HU is considered to be pyonephrosis, and between 4 to 16 stands for infected hydronephrosis. Following this classification, we have followed up the patients after subjecting them to appropriate management. The mean Hounsfield unit of the pyonephrosis group was 18±2 HU, and that of the hydronephrosis group was 1.3HU. The anteroposterior diameter is also relatively identical in both groups.

ROI IN HYDRONEPHROSIS





ROI IN IHN/PYONEPHROSIS

RESULTS

Table 1: Baseline characteristics

		GROUP				P value
		HN		IHN/PYO		
		Count	Row N %	Count	Row N %	
Age group	<40	8	44.40%	10	55.60%	0.787
	41-50	12	46.20%	14	53.80%	
	51-60	18	47.40%	20	52.60%	
	>61	6	33.30%	12	66.70%	
Sex	Female	16	36.40%	28	63.60%	0.08
	Male	28	50%	28	50%	
Side	Bilateral	18	40.90%	26	59.10%	0.742
	Left	12	42.90%	16	57.10%	
	Right	14	50.00%	14	50.00%	
Obstruction	Mild	4	40.00%	6	60.00%	0.166
	Moderate	30	51.70%	28	48.30%	
	Severe	10	31.30%	22	68.80%	
HN grade	2	4	40.00%	6	60.00%	0.166
	3	30	51.70%	28	48.30%	
	4	10	31.30%	22	68.80%	
DM	No	32	72.70%	12	27.30%	<0.0001*
	Yes	12	21.40%	44	78.60%	

Majority of the study participants were in 51-60 years of age 38% followed by 41-50 years of age 26%.Male preponderance was observed 56%.Bilateral presentation was most common 44%Most of the study participants have moderate obstruction 58%.Most of the study participants have Grade 2 HN 58%.DM was present in 56% of the study participants. The baseline characteristics was found to be not statistically significant. History of Diabetes Mellitus was found among 56% of the study participants.DM was found to be statistically significant.

Table 2: Clinical presentation, Time taken, post complications, Duration of stay of the study participants

		GROUP				P value
		HN		IHN/PYO		
		Count	Column N %	Count	Column N %	
Procedure	PCN INSERTION	0	0.00%	16	28.60%	0.0001*
	URSL	44	100.00%	40	71.40%	
Scope in time (bl)	< 1 hour	42	95.50%	0	0.00%	<0.0001
	> 1 hour	2	4.50%	56	100.00%	
Scope in time (ul)	15-30 min	40	90.90%	0	0.00%	<0.01
	> 30 min	4	9.10%	56	100.00%	
Fever	No	40	90.90%	8	14.30%	<0.0001
	Yes	4	9.10%	48	85.70%	
Hematuria	No	42	95.50%	6	10.70%	<0.0001
	Yes	2	4.50%	50	89.30%	
Urine culture	Negative	38	86.40%	10	17.90%	<0.0001
	Positive	6	13.60%	46	82.10%	

Post op abs course	<5	40	90.90%	0	0.00%	<0.0001
	>5	4	9.10%	56	100.00%	
Average duration of stay	<7	40	90.90%	0	0.00%	<0.0001
	>7	4	9.10%	56	100.00%	
Presence of complications	No	44	100.00%	0	0.00%	<0.0001
	Yes	0	0.00%	56	100.00%	

URSL was done in all the study participants in HN group 44% whereas in IHN/PYO 16(28.6%) of study participants underwent PCN insertion and 40(71.4%) underwent URSL.Scope of time for bilateral was <1 hr majority of the in HN group whereas >1 hour in all the patients in IHN group.Similarly the scope of time for unilateral was 15-30 minutes in 40(90.9%) in HN group whereas it took >30 minutes in IHN group 56(100%).Fever and Hematuria was reported in majority of the study participants in IHN group 48(85.7%).Urine culture was positive in majority of the study participants in IHN group 46(82.1%).Average duration of stay and complications was found more in IHN group 56(100%).All the variables like scope in time for unilateral and bilateral, fever, hematuria, complications postoperatively and duration of stay were found to be statistically significant.

DISCUSSION

Non-contrast CT is the gold standard investigation of choice for any patient with a ureteric calculus. Rather than subjecting the patient to multiple accessory investigations to get the complete clinical picture, a simple click in the zone of interest adds tremendous value to the patient's workup. Any urine that stays in the obstructed system is initially a clear fluid. As time goes by, depending on several factors, they slowly start changing their nature from being cloudy to frank pus. Incorporation of chronically impacted calculus in patients is due to the nonreliability of the urine routine to pick up the pus cells in simple microscopy. This non-reliability is mainly due to the fact that we take the urine that drains perurethrally is not an accurate determinant of the stagnant stale collected urine.

The evolution of infected HN to pyonephrosis also depends upon the underlying co-morbid conditions and virulence of infecting pathogens. There is no strict cut off to tell the difference between the HU of Infected HN and pyonephrosis due to significant overlap between the radiological and observed findings. The imaging modality NCCT is 97% accurate in the detection of stones in the ureter; contrast-enhanced CT is more suitable for parenchymal and functional changes.

A CT scan can pick up indirect signs of pyonephrosis, which are renal pelvic and ureteral wall thickening and significant perinephric stranding. The presence of bridging septa and thickening of renal fascia are not specific for pyonephrosis because they also occur in significant cases of infections, trauma, retroperitoneal neoplasms, and infarctions.

By looking at the HU of impacted urine, one can preplan the intervention and, in some cases, directly opt for PCN rather than facing intraoperative difficulty. This helps in accurate counselling of patients and relatives regarding what to anticipate during the outcomes of the procedure.

General idea regarding Opting for higher-generation antibiotics, anticipating post-operative recovery, and axillary procedures can be made by looking at the urine HU of the impacted system.

HU values to differentiate between transudate and exudate markedly differ, with significant sensitivity and specificity.

So that not only the HU of calculi plays a role in management, use of HU in impacted PCS can be used for making decisions. by applying this clinical parameter to the cases, one can make an informed decision and choose an appropriate modality of treatment from the urological armamentarium.

CONCLUSION

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Conflict of Interest: Nil

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