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Role of Computed Tomography in Evaluation of Causes of Hematuria

[1]Dr. VadlamudiNagendra ,[2]Dr. RajasbalaPradeepDhande

[1]Junior Resident, Department of Radio-diagnosis, Jawaharlal Nehru Medical College, DattaMeghe Institute of Medical Sciences, Wardha; Email: nagvad@gmail.com,

[2]HOD & Professor, Department of Radio-diagnosis, Jawaharlal Nehru Medical College, DattaMeghe Institute of Medical Sciences, Wardha; Email: dhanderajas@gmail.com,

Abstract: Understanding the causes of hematuria due to genito-urinary pathologiesin Indian population in different age groups, gender predisposition and co morbid conditions, would help us better understand the pathology of the various conditions associated with hematuria and thereby diagnose accurately and plan therapy accordingly. **Objectives:**In this study we aim to evaluate the patients with ct urography who present with the complaints ofeither micro-hematuria or macro-hematuria, its pathological causes and the diagnostic accuracy of ct urography in detecting the cause of hematuria. **Methodology:**A cross-sectional study will be done at AcharyaVinobaBhave Rural Hospital, Sawangi, involving50 patients who present with hematuria for CT Urography. All the patients will beevaluated for the cause based on parameters like presenting symptoms, duration and type of hematuria,site, size, number and enhancement pattern of the lesion in different phases, lesions involvement of adjacent structures with or without vascular invasion and lesions internal content will all be evaluated using non contrast, corticomedullary, nephrographic and excretorysequences. These dimensions would be compared gender and age wise and correlated with their resultant pathologies. **Results:** After appropriate statistical analysis, we expect to find age, gender, duration and presenting symptoms, disease association with other comorbid conditions, differences in early and accurate detection of eachcause of hematuria, its prognostic and its positive association with these parameters. **Conclusion:** In this observational study, we expect to precisely diagnose the causes of hematuria due to genitor-urinary causes with the help of ct urography and its positive association with age, gender, presenting symptoms, type of hematuria, patients co-morbidities, smoking and occupational history respectively.

Keyword: CT UROGRAPHY, HEMATURIA, RENAL MASSES.

INTRODUCTION:

One of the commonly encountered clinical symptom in day to day practice is hematuria. When a patient with the symptoms of hematuria visits the hospital, ultrasonography and computed tomography are the first modalities used to detect the cause. A wide range of etiologies like calculi, renal mass, reno-vascular malformations, parasitic infections, trauma, infectious lesions such as UTI and pyelonephritis, polycystic kidney disease, prostratomegaly, coagulation disorders, drugs, vigorous exercise, menstruation, sexual activity and miscellaneous causes.Grosshematuria basically explains a far increased chance of malignancy than microscopic disease and should be investigated thoroughly, but a full work-up is required literally for all patients complaining of hematuria as described by AUA

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guidelines.(1)Special situations in which a full radiological work-up is not required are teenage girls with a clinical image of clear cystitis and whose hematuria improves resolves after effective therapy and a in patients who have direct evidence of glomerulopathy.(1)
The strategies of medical and surgical management used for causes of renal mass lesions like abscess, neoplasms, cysts are different thus creating a significant treatment dilemma. This makes it necessary for us to ensure that we have made a correct diagnosis.Hematuria is of two types - microscopic (non visible) and macroscopic (visible) hematuria. Macroscopic hematuria is characterised by red urine. Microscopic hematuria is established as more than three RBC's per high-power field from two out of three urine samples without urinary tract infection, or menstruation(2)Around 30 percent of the patients with CKD will have baseline dipstick hematuria, and the prevalence is higher for higher albuminuria values and lower eGFR. Hematuria is substantially correlated with both CKD development and death within the first one year, following its examination. (3)

CT urography is characterized as CT assessment of kidneys, ureters and bladder after receiving of intravenous contrast agent, with at least one series of images taken at the excretory phase.Renal mass is one of the most significant cause of hematuria, where one should rule out the nature of mass whether it is malignant or benign. Characterizing renal mass as a either cystic or solid lesion.In patients below 40 years of age, the most common cause of macroscopic hematuria and in persons more than 40 years with microscopic hematuria excluding urinary tract infection is calculus; whereas renal parenchymal disorders are the most common cause of hematuria in patients aged less than 40 years with microscopic hematuria.(4)Simple cystic lesions are benign and no workup is necessary, but solid lesions must be evaluated completely to rule out malignant changes.MRI is also a good alternative for delineating renal masses but it is poor in detecting calcification, even Intra-venous urography is less sensitive in differentiating cystic and solid lesions.In children and pregnant women with hematuria, ultrasonography plays an especially important role in preventing the use of ionising radiation.But as a routine IVU is used to demonstrate ureteral lesions, but it only demonstrate luminal pathologies but not the extrinsic abnormalities that affect ureter.
The main principal advantages of using CT in evaluating hematuria is increased rate of imaging and increased spatial resolution which makes perfect isotropic imaging study. This multiplanar imaging isotropic resolution is the basis for high diagnostic precision of ct urography in the detection of position and size of renal pathologies, contributing to early detection and management of malignant lesions.Helical CT helps in detecting secondary changes like perirenal and periureteral fat stranding and locating small calculi by using image reformation to a 1mm slice thickness. It also localizes wedge shaped infracts as enhancing thin cortical rim, absence of parenchymal striations and enhancement of rim during venous phase is used an important criteria in differentiation from segmental pyelonephritis.CT urography also noticeable disadvantages like contrast reactions, patients affordability, increased radiation exposure than other imaging modalities which can be overcome by use low-dose MDCT, duration of scan, contraindication in pregnant women, infrastructure, maintaining strict procedural protocol and quality assurance, flat tumorsof bladder may go undiagnosed (4)

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Many different radiological imaging modalities can be done to find out the cause of hematuria but CT Urography is a single best comprehensive evaluation to find out the cause of hematuria (5).Because of its high diagnostic precision, CTU is useful for detecting bladder cancer, given that the test consistently involves the acquisition of the arterial and urographic phases.Cystoscopy should still be followed by radiological examination to prevent false positives due to changes in biopsy sites. CTU findings will help in cystoscopy procedure when the lesion difficult to reach (e.g., ureteral meatus) or in a thickened or trabecular bladder wall where the identification of cancerous lesions is impeded, particularly if the urothelium shows no gross changes.(6)In the coming days efforts in continued refinement of these protocols must focus on radiation dose optimization and radiation dose reduction, which will likely be achieved by reducing the number of imaging phases and by using emerging technologies for radiation dose reduction at MDCT. MDCTU will tend to be the most possible imaging trial to provide extensive imaging modality of choice for the urinary tract if attempts to optimise radiation exposure result in appropriate radiation dosages equivalent to IVU. (7)

Rationale:

Causes of hematuria are broad and are difficult to delineate and often go undiagnosed on Ultrasonography or Intra venous urogram. Use of Multidetector helical Computerized tomography is recommended as a superior alternative than other conventional modalities as it is more sensitive and specific.

OBJECTIVES:

- To study characteristic imaging finding of various causes of hematuria.
- To differentiate neoplastic from non-neoplastic renal masses using CT Urography.
- To study the role of CT Urography in assessment of various upper and lower urinary tract lesions.
- To analyze efficacy of CT Urography in adjunct with histopathological correlation or follow up whenever possible in correctly diagnosing the causes of hematuria.

METHODS:

Study design: Prospective Cross Sectional Analytical Study

Study Area: AcharyaBhave Rural Hospital (AVBRH), Sawangi and Jawaharlal Nehru Medical College (JNMC)

Source of Data: Patients from AVBRH attached to DMIMS. The patients are taken from both IPD and OPD basis.

Subjects: Patients presenting with hematuria referred to our department for CT.

Sampling Procedure: All patients referred to the department of Radiology, AVBRH, Sawangi with hematuria will be subjected for the study.

Sample Size: 52 patients with hematuria referred to AcharyaVinobaBhave Rural Hospital, Sawangi (Meghe) will be included. Calculated by formula:

Total patients in the last 2 years N= 60

= chi square value for 1 degrees of freedom at some desired probability level= 3.84

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P = 50% proportion
C = confidence interval of the one choice
= 0.05
N = 3.84x60x0.5x0.5/0.05x0.05x92+3.84x0.5x0.5 = 52

Duration of study: 2020 – 2022

16 Slice Multidetector CT (Siemens) with pressure injector.

PROTOCOL :

- All patients will undergo CT study of the abdomen. All the cases will be evaluated by conventional CT technique with contrast using a 16 slice multidetector CT(Siemens).

- Serum creatinin will be done prior to scan.

- Non contrast imaging
- Contrast
- 1.Arterial phase imaging (corticomedullary) 25 - 45 sec.
- 2.Venous phase imaging (nephrographic) 60 - 90 sec.
- 3.Delayed phase imaging (excretory) 240 - 300 sec
- Injection Rate 3-4 ml / Sec.
- Contrast volume 100 - 120 ml.

Inclusion Criteria:

1. Patients with complaints of Gross and microscopic hematuria.
2. Patients having hematuria due to Renal pathologies on CT.
3. All age groups irrespective of sex will be included.

Exclusion Criteria:

1. Patients with causes of red urine other than hematuria.
2. Pregnant women presenting with hematuria.
3. Patients with prior history of Renal calculi or calculi as cause of hematuria.
4. Extra Genito urinary causes of hematuria.
5. Patient with prior history of contrast reaction.

METHODOLOGY:

In order to prevent complications while administering contrast medium, patients are kept nil orally four hours before the CT scan.The patient is told about the side effects of

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contrast prior to its administration, consent is obtained.Routine anterio-posterior abdominal topography is initially performed in all patients with breath held in the supine position. The axial plain sections are imaged from the level of lung bases to the level of ischial tuberosity with a thickness of 5 mm at 130 KV.Simple scans are accompanied in all cases by intravenous contrast scans with suspended inspiration.
Contrast Enhancement Phases in the kidney and pelvi-calyceal system, depending on acquisition time, four different phases of renal enhancement is visualised. We routinely inject (commonly used Intravenous contrast in AVBRH is positive IV contrast - Omnipaque or Ultravist given at 2ml per kg of body weight)at 3ml/sec in antecubitalvein. Around half a liter of water is given to patients, which should be taken over a duration of 20 minutes preceding the scan.The arterial enhancement phase is a short phase that occurs approximately 15 to 25 seconds after the intravenous contrast medium is given, it is characterised by highest renal artery enhancement.In late arterial process, the renal veins will be typically opacified.

The angionephrographic or the corticomedullary process begins after the start of contrast medium injection at around 30 to 40 seconds. Cause the arterial flow is towards cortex which is followed by glomerular filtration of the contrast, there is extreme renal cortex enhancement, but the medulla stay comparatively less enhanced. This step is strongest for full renal venous enhancement.

After the start of contrast medium injection, the nephrographic process starts at 80–120 seconds. Homogeneous improvement of the renal parenchyma is provided by tubular filtration of contrast content. This is the safest step for subtle parenchymal lesion detection.After the start of the contrast medium injection, the excretory phase or the urographic phase begins at three minutes (180sec). Excretion of the contrast material causes the calyx, renal pelvis and ureter to become opacified, while the pressure of the nephrogram gradually decreases. To ensure opacification of the ureters and bladder, we routinely acquire 10-minute excretory process images.

At 0.5 mm, post study reconstructions were performed. Coronal and Sagittal reconstructions are made in all the cases.In newer CT which can image multiple slices, newer techniques such as volume rendering, curved planar reformatting, maximum and minimum intensity projections have been carried out as and when necessary. The magnification mode is widely used and the scans were examined at different window settings on a direct display console (i.e. 320/40 abdomen window; 1400/-600 lung window; 2400/200 bone window)

In terms of pre and post contrast attenuation values, scale, position of mass, presence of calcification, presence of fat, and extension into the adjoining structures, the pathological lesions were evaluated.

Bias: Intra-observer variability will be minimized by taking the average of 3 readings of each dimension.

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Expected Outcomes:

In this observational study, we expect early detection and characterisation of causes of hematuria by CT Urography like size, location, enhancement of lesion, lymphadenopathy, calcification, necrosis, spread, secondary extension into adjacent areas, vascular involvement. We expect to find a positive association between hematuria with UTI, renal ureter and bladder masses, pyelonephritis respectively.

DISCUSSION:

Hematuria is a common clinical condition, has a prevalence rate of 9-18 percent and can originate along the urinary tract from any area.In determining the cause of haematuria, MDCTU is firmly known as the most sensitive modality.It is the gold standard in the diagnosis of renal parenchymal masses, urothelialtumours, and extrinsic lesions.18 It is also regarded by several authors as a possible one-stop investigation for the haematuria phenomenon of urinary tract disorder.The advantages of MDCT include : (a) the use of contiguous single breath- hold data acquisition, thereby decreasing or eliminating respiratory motion artifacts (b) the ability to perform thin-section scanning with small-interval reconstruction, which decreased partial volume artifacts and increased sensitivity of lesion detection and (c) the ability to acquire images in corticomedullary, nephrographic and excretory phases and perform three-dimensional SSD,MIP, VRT and curved planar reformatting. A number of related studies were reported. Pattabiramanet. al reported on bilateral sporadic renal angiomyolipoma, ultrasonography and computed tomography imaging (8). Agrawalet. al. assessed accessory renal arteries and their clinical implications(9). Alaghet. al. reported on assessment of renal function in obese individuals(10). A series of studies and cases were reported by Balwaniet. al. on various aspects of kidney diseases (11-15). Related studies by Prasad et. al. (16), Goswamiet. al (17) and Jain et. al. (18) were reviewed.

CONCLUSION:

The data obtained through this study can be used to understand the most common and undetectedcauses of hematuria due to any renal pathology in Indian population and understand correlation with the existing causes. This data can be used to plan early and better interventional options for renal pathologies and improving the overall outcome of the disease.

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