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"Computed Tomography In Spectrum Of Urinary Bladder Lesions."

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AIM:
- To study role of computed tomography in different spectrum of urinary bladder lesions.
- To study different characteristics of lesions on Computed Tomography.
- The aim of the study was to evaluate the informativity and usefulness Computer tomography (CT) imaging in the diagnosis of urinary bladder lesions.

I. INTRODUCTION:

The urinary bladder is composed of the following four layers:
1. Urothelium: Transitional epithelium
2. Lamina propria: Vascular layer of connective tissue deep to the urothelium
3. Muscularis propria: Detrusor muscle
4. Adventitia: Connective tissue

The bladder is an extraperitoneal organ with a serosal (peritoneal) covering present only over the dome. The remainder of the bladder is surrounded by perivesical fat.

The urinary bladder is a distal part of the urinary tract and is an extraperitoneal structure located in the true pelvis.Its primary function is as a reservoir for urine.

The bladder has a triangular shape with a posterior base/fundus, an anterior apex and an inferior neck with two inferolateral surfaces. It is lined with a rough, trabeculated transitional cell epithelium except at the trigone.

The apex of the bladder is directed to the top of the symphysis pubis and it is connected to the anterior abdominal wall and umbilicus through the median umbilical fold (remnant of the urachus which is an embryological structure that contributes to the formation of the bladder)
As men age, the trigone overlying the mid-portion of the central zone of the prostate may start to protrude as the prostate enlarges forming a mild hemispherical elevation proximal to the internal urinary sphincter, which is called the uvula of the bladder[1]

The urethra arises from the neck of the bladder and is surrounded by the internal urethral sphincter.As the bladder fills with urine it becomes ovoid and extends superiorly into the abdominal cavity. Contraction is facilitated by the detrusor muscle .

II. MATERIAL AND METHODS:

The current study is a **prospective** study conducted in the **department of radio diagnosis** at **GCS college and Hospital , Ahmedabad,includes 30 patients (females & males) over a period of 24 months from January 2021 – December 2022.Their clinical, and imaging findings of CT scan (computed tomography) done usingCT (Siemens emotion 16 slice MDCT) are assessed for evaluation of matter in interest.**

INCLUSION & EXCLUSION CRITERIA:
INCLUSION CRITERIA:

- Patients who are diagnosed as having urinary bladder lesions on computed tomography between age 16 years to 70 years whose clinical data,imaging investigation reports and images are available.

EXCLUSION CRITERIA:

- Patients whose data is incomplete.
- Pregnancy
- Post-surgery patients were excluded.
- Patients not willing to participate in the study.

CECT KUB protocol:
Contrast enhanced computed tomography KUB is performed on MDCT scanners using a three-phase protocol and contrast (i.e.Iohexol). All patients after ensuring absence of any adverse reactions to test dose to the contrast, 1ml/kg body weight of the patient- dose of the contrast is injected at the rate of 2-4ml/sec using a mechanical pressure injector. CT scans of the abdomen and pelvis are obtained as follows-
• Plain (before contrast injection)
• Nephrographic phase at 45-60 sec.
• Delayed phase after 180 sec.

III. RESULT:

There are different benign and malignant processes that can affect the urinary bladder.

The differential diagnosis is broad when imaging findings are nonspecific and includes both benign and malignant entities. Other benign lesions to consider that also may manifest as single or multiple focal masses include blood clot, cystitis, malakoplakia, and infections such as tuberculosis, schistosomiasis, and fungal infections. Primary bladder carcinomas, lymphoma, and metastatic disease from adjacent or distant organs should be considered among the differential diagnoses for malignant bladder tumors. Clinical presentation, accompanying secondary imaging findings, and histologic analysis allow for more accurate diagnosis.
Other urinary bladder pathologies includes diverticula, Traumatic bladder rupture , fistula, foreign body ETC.
Few different cases are described below.

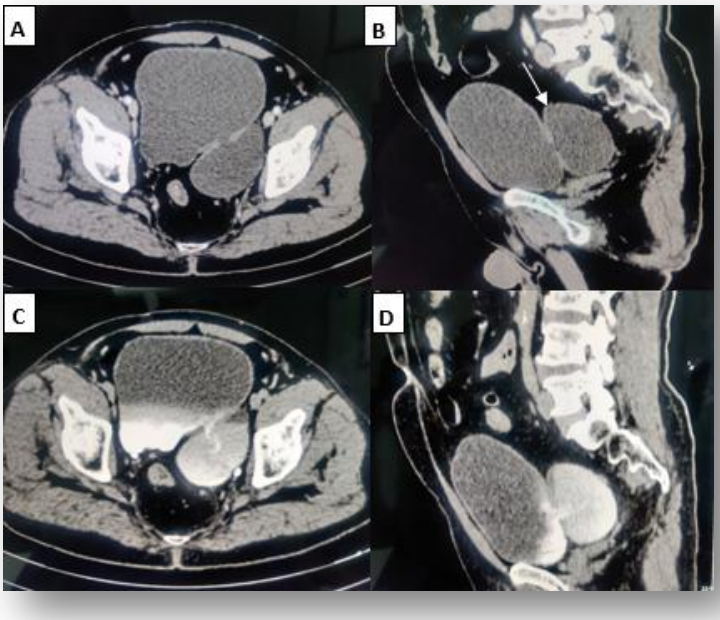
- **Bladder diverticulum:**

Urinary bladder diverticulum (UBD) is an outpouching of the bladder wall creating an additional cavity which is connected by means of a neck with the urinary bladder cavity. There are true / congenital UBD and false / acquired UBD. True diverticula are usually singular and false ones are multiple. The congenital diverticulum is connected with the urinary bladder cavity by a narrow duct; its wall consists of the same layers as the urinary bladder wall. Often the congenital diverticulum is larger and has a bigger capacity than the urinary bladder. False or acquired UBD develop in patients who have had a long-term disturbance of urine discharge from the bladder which appears as urinary difficulty that is most often observed in patients with benign prostate hyperplasia.

Contractions of the detrusor during urination prevent the diverticulum from complete voiding, and residual urine accumulates in it. This caused describing UBD as "urine trap." In spite of differences in views on UBD etiology.

A large bladder diverticulum may displace the bladder to the opposite side and may be larger than the bladder. In such cases, the bladder is identified on CT by its thickened wall, whereas the diverticulum has a smooth thin wall.
Complications:They may be associated with a range of complications due to stasis and low-grade infection including:

- intradiverticular transitional cell carcinoma 1-10% [5-7]
- bladder stones
- bladder rupture



Bladder diverticulum.

A. contrast enhanced pelvic CT axial and B. sagittal image showing outpouching from left postero lateral wall.

C.Delayed contrast-enhanced axial and D. sagittal CT image shows a large bladder diverticulum in the left hemi-pelvis with excreted contrast within the diverticulum.

CT of urotelial neoplasm in bladder diverticulum. An enhancing soft-tissue mass is seen in the middle of diverticulum along the right posterolateral aspect of the bladder(A,B). An area of high attenuation located more posteriorly represents calcification/calculus within the tumor.(Arrow) In late phase (C) it remain as filling defect

- **Infectious Conditions:**

All acute infections of the bladder can, if severe, result in diffuse bullous edema of the urothelium, leading to a nodular irregular contour of the bladder on imaging studies. In many instances, this acute pattern will resolve in a matter of days and the bladder will return to its normal smooth appearance. However, severe infections can progress to a chronic phase, in which the bladder capacity is significantly reduced by fibrosis and contraction of the bladder wall. Multiple causes of cystitis are as below: Bacterial cystits Emphysematous Cystitis, fungal cystitis ,parasitic cystitis, Inflammatory Noninfectious Conditions (like Radiation Cystitis, Hemorrhagic Cystitis, eosinophilic ,etc)

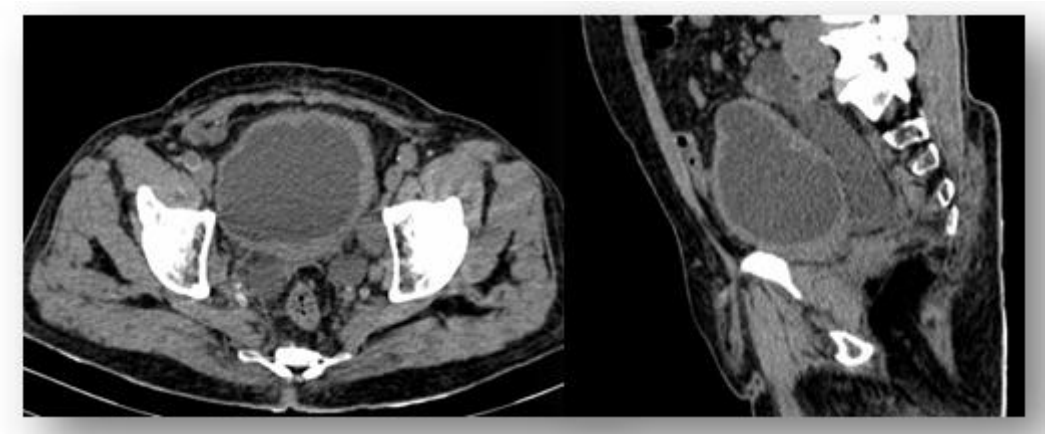
- **Acute Bacterial Cystitis:**

Acute cystitis is present when more than 100,000 bacteria are present in 1 mL of urine. Most bacteria causing cystitis enter the bladder through the urethra. *Escherichia coli* is the most commonlyencounteredorganism, but other common agents include speciesof*Staphylococcus*,*Streptococcus*,*Proteus*, *Pseudomonas*, *Aerobacter*, and *Candida*.

Several factors contribute to a natural resistance of the bladder to infection. These include resistance of the bladder mucosa, the washing of organisms out of the bladder by normal voiding, trapping of organisms entering the bladder through the urethra by mucous secretion of the periurethral glands, and the bactericidal effect of prostatic secretions. For example, infection is more common when the bladder mucosa has been damaged by

trauma, stone, or tumor, when bladder catheterization or instrumentation introduces infection by bypassing the protective mechanisms of the urethra and prostate. Acute cystitis can present with varying degrees of severity. In women, associated hemorrhage is common.

Acute cystitis usually responds well to antibiotic therapy and in uncomplicated cases does not progress to chronic disease. Although cystitis may recur two or three times a year in sexually active women, more frequent recurrence of acute cystitis and cases that are resistant to antibiotic therapy suggest an underlying cause. In such cases, imaging of the entire urinary tract and cystoscopic evaluation of the bladder are indicated to exclude causes such as urinary stone disease, bladder diverticulum, colovesical fistula, and perivesicalabscess.Cystitis due to tuberculosis is an interstitial process initially associated with mucosal edema and later progressing to bladder wall thickening and fibrotic contraction with reduced bladder capacity and a predisposition to vesicoureteral reflux. Rarely, there can be associated calcification of the bladder wall.



Acute Cystitis.
CT axial and sagittal pelvic image showing circumferential irregular wall thickening without any calcification or air foci.

- **Traumatic bladder rupture:**

Bladder trauma is generally associated with high energy injuries, and is associated with pelvic fractures in the majority of cases.[3].Bladder trauma is frequently a radiological rather than clinical diagnosis[7].Hematuria, abdominal pain and difficulty passing urine have been described as a triad of symptoms.Bladder trauma can be categorized into five types depending on the location and extent of the rupture. Appearances vary with the site of injury:

Bladder contusion(Can remain occult, but intramural hematoma may be visible as a focal thickening of the bladder wall or protrusion into the bladder lumen, without contrast in the wall or outside the bladder[4])

Subserosal bladder rupture(Elliptical layering of contrast within the bladder wall deep to the serosal layer. Contrast remains confined to the bladder wall and lumen)

Intraperitoneal bladder rupture: Occurs in approximately ~15% (range 10-20%) of major bladder injuries, and typically is the result of a direct blow to the already distended bladder. It typically occurs at the dome of the bladder. It can also be the result of penetrating trauma, or iatrogenic as a consequence of cystoscopy or surgery. (Contrast will be present within the peritoneal cavity, in the paracolic gutters and between loops of small bowel. Typically a defect will be visible in the bladder dome.)

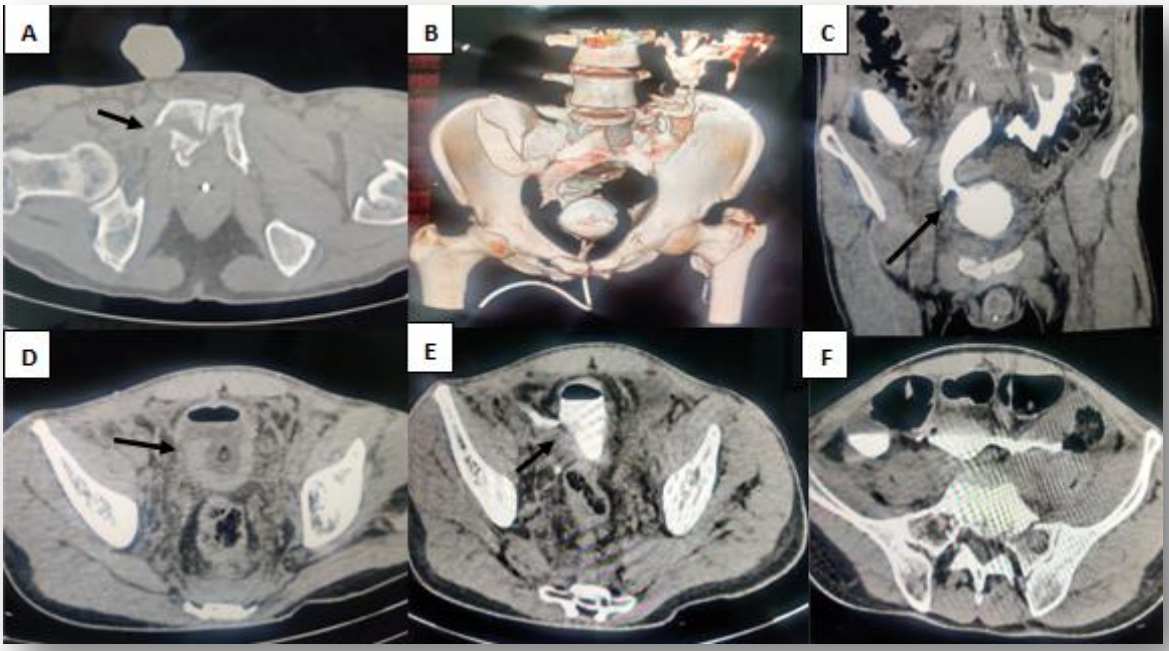
Extraperitoneal bladder rupture: The most common type of bladder injury, accounting for ~85% (range 80-90%) of cases. It is usually the result of pelvic fractures or penetrating trauma. (Contrast will be present in the extraperitoneal spaces surrounding the bladder.The typical location is at bladder base anterolaterally.Extraperitoneal rupture is usually associated with pelvic fractures; the mechanism may be from either direct puncture of the bladder wall, or from shearing forces as the pelvis is fractured[3].The molar tooth sign describes the shape of contrast outlining this space around the bladder[4].)

Combined bladder rupture(Will demonstrate mixed features of intraperitoneal and extraperitoneal rupture.)

CT cystography is performed by instilling water-soluble contrast into the bladder through a urinary catheter. It may be combined with standard CT to evaluate the upper tracts. An extraluminal position of a urinary catheter indicates bladder rupture, although, in an underfilled bladder, the tip of the catheter may falsely appear

extraluminal. Caution should be exercised when catheterizing the patient, in case there is also urethral trauma present.

Treatment and prognosis:
Intraperitoneal rupture requires surgical repair while extraperitoneal injuries may be treated conservatively with a urinary catheter. The presence of other renal tract injuries involving the ureters or urethra may require separate intervention.



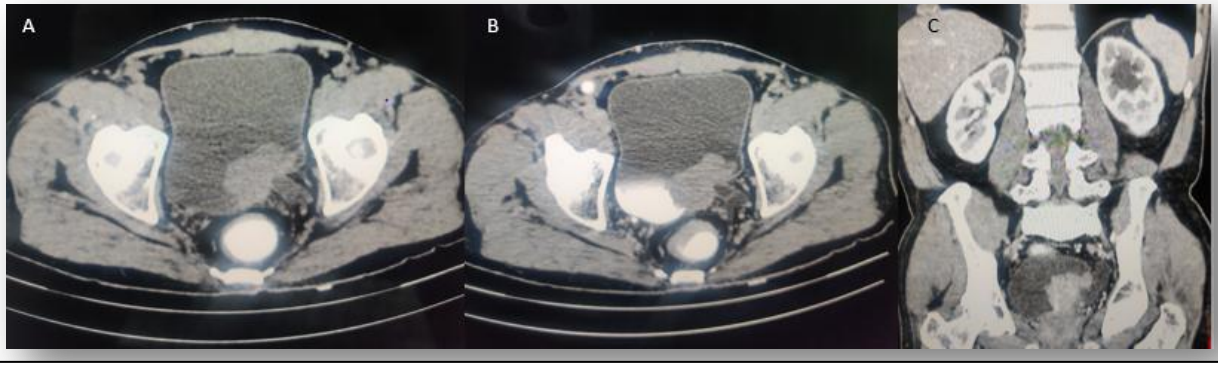
Intraperitoneal bladder rupture:
CT bone window (A) and 3D reconstruction (B) showing pelvic fracture.
CT cystography demonstrates(C,E,F) extravasated intraperitoneal contrast material around bowel loops and mesenteric folds.(Arrow shows rent in bladder dome in image c)
Laceration of the bladder dome (D) with Foley catheter.

- **Urinary bladder neoplasm:**

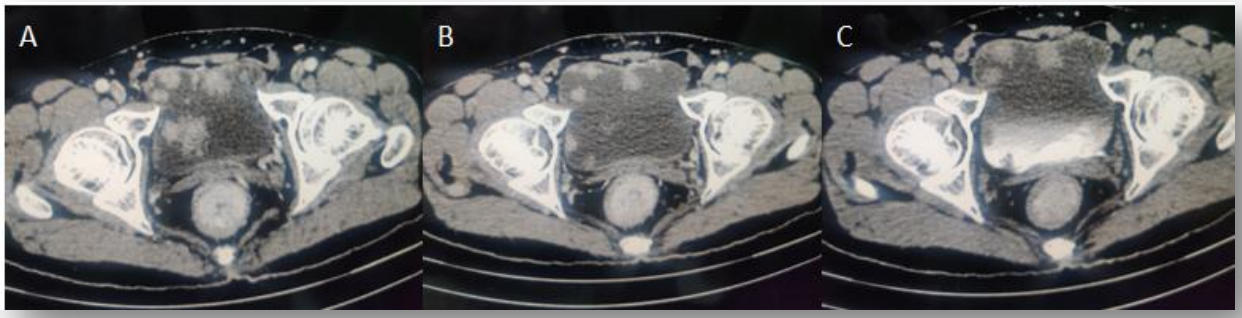
Bladder cancer is a broad term used to describe all types of cancers affecting the urinary bladder[6]

- **Transitional cell carcinoma (urinary bladder)/ urothelial cell carcinoma (UCC)** : most common primary neoplasm of the bladder
- **Squamous cell carcinoma (urinary bladder):** accounts for around 3-8% of all bladder cancers
- **Adenocarcinoma (urinary bladder):** accounts for around 1% of all bladder cancers
- **Small cell carcinoma (urinary bladder):** extremely rare

Computed Tomography: Bladder transitional cell carcinomas appear as either focal regions of thickening of the bladder wall, or as masses protruding into the bladder lumen, or in advanced cases, extending into adjacent tissues. The masses are of soft-tissue attenuation and may be encrusted with small calcifications.
Overall reported accuracy of CT, for the detection of bladder tumors, varies from 60 to 95 %. CT helps in the recognition of local spread, lymphadenopathy, metastatic disease, and synchronous lesions in the bladder, ureter, and kidney.



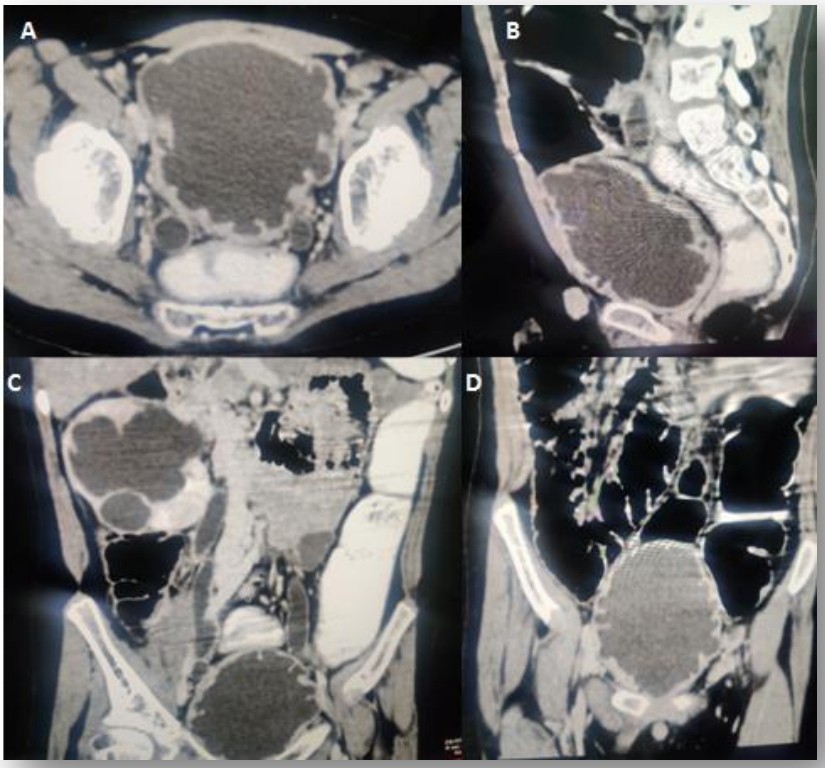
Urinary bladder carcinoma.
(A) Mass in the left posterolateral bladder wall protruding into the bladder with consequent left ureterovesical junction obstruction resultant in backpressure changes. The mass shows intense enhancement following contrast. There is no obvious extravesical extension.
(B)Bladder tumor. Late-phase contrast-enhanced axial CT; tumor on the left posterior wall seen as a filling defect in the contrast material-filled bladder lumen.



Papillary urothelial carcinoma.
(A,B):Multiple intaluminal papillary growth which are enhanced in contrast study.
(C) On delayed phase , multiple filling defect areas in lumen.

- **Neurogenic bladder**

Neurogenic bladder is a term applied to a dysfunctional urinary bladder that results from any lack of coordination between the central nervous system and the somatic nervous system,[6] including injuries to the central or peripheral nerves that control and regulate urination. Injury to the brain, brainstem, spinal cord or peripheral nerves from various causes such as infection, trauma, malignancy or vascular insult can also lead to dysfunctional bladder[8].



Neurogenic bladder :

Distended, thick-walled bladder with pseudo-diverticula in the upper half looking vaguely like a Christmas tree or pine cone with bilateral hydronephrosis and hydroureter due to "back pressure" and incomplete emptying.

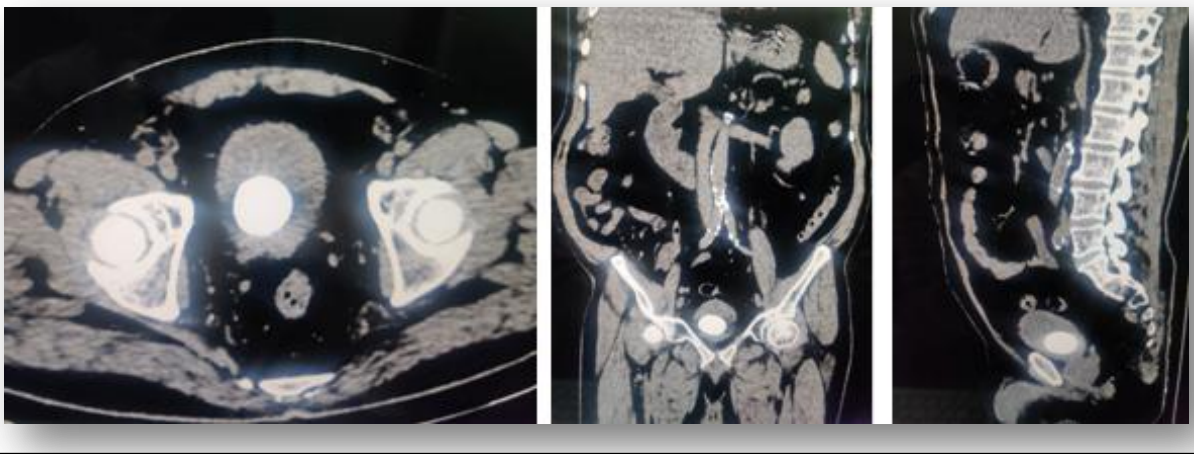
- **Bladder calculi**,

Bladder calculi**,** commonly referred to as **bladder stones**, are urinary stones that are found primarily in the urinary bladder and comprise only 5% of all urinary tract stones. They can be divided into primary, secondary, and migratory stones:[9]

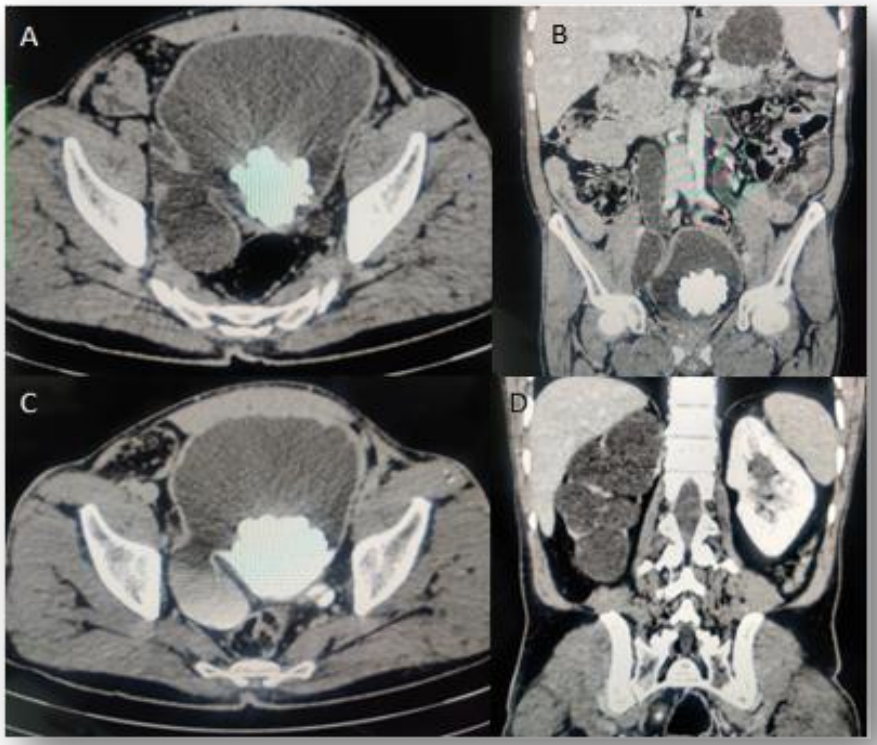
I. **Primary:** bladder stones form in the absence of other urinary tract abnormality, typically seen in children in endemic areas

II. **Secondary:** stones form in an abnormal bladder or from concretions on foreign material (e.g. urinary catheters)

III. **Migratory:** usually renal calculi which have migrated down into the bladder; uncommon[10]



Bladder calculus.



Urinary bladder stone.
Pelvic axial CT image(A) showing Star-shaped Jackstone calculus in the urinary bladder with outpouching (diverticulum) in right posterolateral wall.
coronal image(B, D) showing gross back pressure changes as dilated tortuous ureter and gross hydronephrosis with paper thin cortex.
Delayed phase contrast excretion in bladder also in diverticulum(C)

IV. Conclusions:-.

Different benign and malignant processes that can affect the urinary bladder.
Role of computed tomography in different spectrum of urinary bladder lesions is helpful in finding differential diagnosis.Study also characterize the lesion with its extension and enhancing pattern.
The bladder tumors of different pathological types have certain self-imaging characteristics in CT imaging.
Thus, along with Clinical presentation, accompanying secondary imaging findings by Computer tomography, and histologic analysis allow accurate information in urinary bladder pathologies.

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