COMPARISON OF MDCT VIRTUAL CYSTOSCOPY WITH CONVENTIONAL CYSTOSCOPY IN BLADDER TUMORS

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CERTIFICATE

This is to certify that **DR. R. JEYA** has been a post graduate student during the period May 2007 to March 2010 at Department of Radiodiagnosis, Madras Medical College and Research Institute, Government General Hospital, Chennai.

This Dissertation titled Comparison of MDCT virtual cystoscopy with Conventional cystoscopy in bladder tumors is a bonafide work done by her during the study period and is being submitted to the Tamilnadu Dr. M.G. R. Medical University in Partial fulfillment of the M.D. Branch VIII RadioDiagnosis Examination.

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AIM

The purpose of this study was to evaluate the usefulness of virtual cystoscopy using a volume rendering algorithm performed with multi detector CT in patients with urinary bladder tumors and compare with the standard conventional cystoscopy and to determine the modality's detection rate and positive predictive value. And to rule out multi centric lesions, metachronous urothelial tumors and guiding the urologist with number of lesions in bladder and help in pre cystoscopy and treatment planning.

To follow the patients with (TURBT) transurethral removal of bladder tumor for recurrence and in radical cystectomy patients with urinary diversion for follow up where rigid endoscopy is not possible.

INTRODUCTION

Bladder neoplasms

Primary bladder neoplasms account for 2%–6% of all tumors, with bladder cancer ranked as the fourth most common malignancy[41]. Tumors may arise from the epithelial surface or any of the various layers of the bladder wall. The most common complaints in bladder disease are microscopic and macroscopic hematuria, dysuria and other voiding symptoms. Over 80% of patients with bladder cancer have hematuria, which is typically macroscopic and painless.[42] Patients presenting with macroscopic hematuria should undergo thorough evaluation to determine the cause[43].

Microscopic hematuria, defined as three or more red blood cells per high-power field from two of three urine specimens, is usually an incidental finding. According to the American Urological Association guidelines, patients with asymptomatic microscopic hematuria who have no evidence of primary renal disease and in whom benign causes such as menstruation, exercise, trauma, and infection have been excluded require urologic work-up.[44] The guidelines recommend upper tract imaging evaluation with computed tomography (CT) or excretory urography and bladder evaluation with cystoscopy.[44]

Patients may also experience voiding symptoms such as frequency, dysuria, and pelvic pain and pressure. All these symptoms may also be related to inflammatory, stones, neurologic, obstructive or congenital

abnormalities. Urogram, sonography (US), computed tomography (CT), magnetic resonant imaging (MRI) and some other radiological modality have been used for a long time in all these pathologies.[44] However, conventional cystoscopy is a standard diagnostic approach for urinary bladder evaluation, its primary indication is the diagnosis of lower urinary tract disease, signs, and symptoms that may be related to the urinary tract are evaluated using cystoscopy to directly visualize lower urinary tract anatomy and macroscopic pathology. However, this procedure has drawbacks, including its high costs and an invasiveness that may lead to iatrogenic bladder injury and urinary sepsis.[30]

CT is usually recommended as a useful radiologic approach for assessing bladder disease, but CT has low sensitivity for detection of small bladder lesions. For CT to depict a small bladder lesion, optimal imaging conditions adequate bladder distention and thin-slice scanning must be satisfied.[42] Therefore, negative findings on CT warrant performance of conventional cystoscopy in patients with bladder pathology .Recently, three-dimensional computer-rendering techniques with rapid image acquisition have led to the development of virtual-reality imaging.[22] With commercially available software, virtual reality imaging allows interactive intraluminal navigation through the bladder simulating conventional cystoscopy and ureters all the way up to the pelvi-calyceal system. **This** can be performed as part of a routine contrast-enhanced abdominal CT examination or as part of CT urography.[44]

ANATOMY

The bladder wall consists of four layers. The lumen is lined by uroepithelium, which consists of three to seven layers of stratified flat cells. The more superficial layers contain large cells with large nuclei and acidophilic cytoplasm and small amounts of neutral mucin. These cells are flexible and can change shape from cuboidal to flattened as the bladder distends, hence the term transitional epithelium.

The second layer underneath the epithelium is the lamina propria, which is very vascular. Deep to the lamina propria is the third layer, consisting of bundles of smooth detrusor muscle (muscularis propria). The detrusor muscle is a complex network of interlacing smooth muscle fibers. The inner and outer muscle fibers tend to be oriented in a longitudinal fashion, but distinct layers are usually not discernible. Fibers from the detrusor muscle merge with the prostate capsule or anterior vagina and pelvic floor muscles.

A fourth adventitial layer is formed by connective tissue. A serosal covering, formed by the peritoneum, is present only over the bladder dome. The bladder is within the extra peritoneal space and is surrounded by pelvic fat.

PATHOLOGY OF BLADDER NEOPLASMS

Primary bladder neoplasms account for 2%–6% of all tumors bladder cancer ranked as the fourth most common malignancy. Tumors may arise from the epithelial surface or any of the various layers of the bladder wall. Bladder cancer is more common in men than in women, with a male-to-female ratio of 3–4:1[47] however, in women it is diagnosed at a more advanced stage and has a higher mortality rate than in men. Although urothelial cancer is less than half as common in black men, they have a higher mortality rate than white men. However, the 5-year survival rate currently at 82% over all.[45]

They are broadly classified as either epithelial or nonepithelial (mesenchymal), with over 95% being epithelial .Epithelial tumors with differentiation toward normal urothelium are urothelial.[47]

Epithelial tumors

Urothelial tumors

benign papilloma through carcinoma; in situ to invasive carcinoma

squamous carcinoma and adenocarcinoma.

Much rarer epithelial tumors are small cell/neuroendocrine carcinoma, carcinoid, and melanoma.

Neoplasms derived from mesenchymal tissue differentiate toward muscle, nerve, cartilage, fat, fibrous tissue, and blood vessels.

Benign tumors	Malignant tumors
Leiomyoma, paraganglioma, fibroma, plasmacytoma, aaa hemangioma, neurofibroma, solitary fibrous tumor, and lipoma.	rhabdomyosarcoma, leiomyosarcoma, lymphoma, osteosarcoma

Urothelial Carcinoma

Urothelial (transitional cell) cancer is the most common urinary tract cancer. Both the incidence and mortality increase with advancing age. After the age of 80 years, bladder cancer is twice as likely to develop. Urothelial carcinoma has a propensity to be multi centric with synchronous and metachronous bladder and upper tract tumors[41]. Multi centric bladder tumors occur in up to 30%–40% of cases[41,52]. Upper tract tumors occur in 2.6%–4.5% of bladder tumor cases and are seen most frequently when multiple bladder lesions are present[53,54].

Pathogenesis for urothelial tumor

Direct prolonged contact of the bladder urothelium with urine containing excreted carcinogens, predominantly from cigarette smoking. Smokers have four times the risk of bladder cancer, related to both the

duration and amount of smoking.[47] There is also a well-documented causal link between urothelial cancer and a variety of

occupational and environmental chemicals, including beta-naphthylamines, bladder stones, chronic infection and irritation, as well as drugs such as phenacetin and cyclophosphamide, and arsenic in drinking water. Occupational exposure to hair dyes is also believed to increase the risk of bladder cancer, but not the personal use.[42,48, 49]. Bladder diverticula have an increased risk (2%–10%) of developing cancer because of stasis.[41] urothelial cancer is the most common neoplasm in bladder diverticula. They can be papillary, sessile, or nodular. Sessile lesions include reactive urothelial hyperplasia, atypia, dysplasia, and carcinoma in situ[50]. Carcinoma in situ is a non invasive high-grade lesion[47] with significant anaplastic change within the urothelium and cytologically malignant cells .It accounts for 1%–3% of urothelial neoplasms and may progress to invasive carcinoma. Sessile lesions are more likely to invade muscle. However, the prognosis correlates more with tumor grade than with morphology (ie, papillary vs flat). Most invasive tumors are high-grade carcinoma.[47]

75% of patients have superficial papillary tumors, which have a "frond-like" appearance at cystoscopy .The majority have a prolonged clinical course with multiple recurrences responding to local resection, without progression to malignancy. 20%of tumors are aggressive[43] and invasive de novo, and 10% are metastatic at presentation.

Papillary lesions are papilloma, inverted papilloma, papillary urothelial neoplasm of low malignant potential (PUNLMP), low-grade and high-grade papillary urothelial carcinoma[42]. PUNLMP is a low-grade, small, solitary neoplasm that neither invades nor metastasizes .Distinction from low-grade carcinoma may be difficult and subjective. Since approximately 35% of PUNLMPs recur and 11% progress in grade, surveillance is required[50].

Pathologic stage is the most important predictor of survival[42] The TNM classification from the American Joint Committee on Cancer, a modification of the Jewett-Strong staging system, is in widespread use[55]. Superficial bladder cancer is confined to the mucosa and lamina propria. Once extension occurs into the detrusor muscle layer, the tumor is considered invasive. Invasion may progress to involve local organs including the prostate, vagina, uterus, and pelvic wall. Tumors metastasize most commonly to pelvic lymph nodes, then distant metastases occur in the lung, liver, and bone in decreasing order of frequency.

Jewett-Strong and TNM Staging Systems for Bladder Cancer

Tumors are considered superficial if they do not extend beyond the lamina propria (T1 or less). Once the muscle layer (muscularis propria) has been invaded (T2a or greater), the tumor is considered invasive.[55]

Jewett strong urinary bladder tumor staging

	T N M staging	TNM Histo pathological
0	TO	NO TUMOR
0	Tis	carcinoma in situ
0	TS	papillary tumor confined to mucosa
A	T1	tumor invades lamina propria
BI	T2a	tumor invades superficial muscle
B2	T2b	tumor invades deep muscle
B2	T3a	tumor with microscopic peri vesical fat Invasion
C	T3b	tumor with macroscopic peri vesical fat invasion
D1	T4a	tumor invades surrounding organs
D1	T4b	tumor invades pelvic or abdominal wall
D1	N1-3	pelvic lymph node metastasis
D2	M1	distant metastasis
D2	N4	lymph node metastasis above bifurcation

Treatment of urothelial carcinoma

Depends on the stage and grade. Superficial tumors are treated with cystoscopic resection followed by close monitoring for recurrences.

Recurrent tumors are treated with intravesical agents such as mitomycin C or bacillus Calmette-Guérin.[40]

Transurethral resection (TUR) for bladder cancer

It is a surgical procedure that is used both to diagnose bladder cancer and to remove cancerous tissue from the bladder. This procedure is also called a TURBT (transurethral resection for bladder tumor).[40]

TUR is the most common and effective treatment for early-stage superficial bladder cancer. It may also be effective for more advanced cancer if all the cancer is removed and biopsies show that no cancer cells remain. About 70% of people with early-stage and low-grade superficial bladder cancer can be effectively treated with a TUR[40].

Radical cystectomy and urinary diversion are reserved for invasive cancer.

Systemic chemotherapy is used for local recurrence after surgery or to palliate metastases[40]

Prognosis

Survival is directly related to depth of invasion and presence of metastatic disease.

If the tumor is confined to the lamina propria, 5-year survival after cystectomy is 55%–80%[51]

The 5-year survival drops to 40% with invasion of the muscularis propria.[51]

The 5-year survival drops to 20% when there is invasion of peri vesical fat.

The 5-year survival rate for metastatic cancer is 6%.[41,51]

Imaging plays a limited role in long-term surveillance. Radiation, fibrosis, and intravesical local therapy may cause wall thickening, which

is difficult to distinguish from tumor. Cystoscopy with biopsy remains the standard of reference for detecting recurrence but is both invasive and expensive, especially since surveillance should be lifelong.[54]

Urinary cytology is noninvasive and relatively inexpensive and has been used for both tumor detection and long-term surveillance. It has high specificity (94%–99%), but the lack of sensitivity for low-grade tumors (0%–50%)[65,66]

Squamous Cell Carcinoma

Squamous cell carcinoma accounts for less than 5% of bladder neoplasms[41]. However where schistosomiasis (bilharziasis) is endemic accounting for over 50% of bladder cancers[69]. Patients with non bilharzial squamous bladder carcinoma tend to present after the age of 60 years, with a slight male predominance, whereas those with bilharziasis tend to

be younger and are five times more likely to be male. High grade and locally aggressive with muscle invasion in 80% .There is a predilection for the trigone and lateral bladder, At cystoscopy, squamous carcinoma is a large, often ulcerated, infiltrating mass. In contrast to urothelial carcinoma, squamous carcinoma is sessile rather than papillary, and pure intraluminal growth is not seen .Muscle invasion is present in 80%[71] of cases and extravesical spread may be extensive, involving surrounding organs and the abdominal wall[74]. The overall prognosis for

squamous cell carcinoma is generally poor. Metastases found in only 8%–10% of cases.

Aggressive local treatment with radical cystectomy is the treatment of choice[69]

Adeno carcinoma

Adeno carcinoma is an uncommon bladder neoplasm representing less than 2% of bladder neoplasms.[41]. (It can be sub classified as primary (two-thirds are non urachal and one-third urachal) or secondary (metastases).

	Non urachal	**urachal cancer**
The mean age at presentation	60 years	50yrs
M;f	3:1	1:1

Adeno carcinoma is classically associated with bladder exstrophy, persistent urachus, intestinal metaplasia from chronic mucosal irritation, urinary diversions such as entero cystoplasty, in pelvic lipomatosis because of associated cystitis glandularis. Metastatic adeno carcinoma to the bladder is more common than primary Adeno carcinoma and occurs in a wider age range[77]. Adenocarcinoma is the most common histologic type of secondary bladder neoplasms. The bladder can be directly invaded by adjacent pelvic neoplasms, most commonly in the

colon, prostate, and Rectum[77] . It is extremely important to distinguish primary from secondary Adeno carcinoma because of different treatment options[77]. As bladder metastases are a late manifestation of cancer, there is usually evidence of a locally invasive adjacent primary neoplasm or other signs of a distant primary neoplasm

At cystoscopy, primary Adeno carcinoma is typically a single nodular lesion[77] with 58%–67% favoring the bladder base and the rest located in the region of the urachus. It may be difficult, even with special stains, to distinguish primary adenocarcinoma from metastases to the bladder[77].

Urachal adenocarcinoma is characteristically located at the dome of the bladder in the midline or slightly off midline[76]. Ninety percent of masses occur close to the bladder, with the remainder along the course of

the urachus or at the umbilical end. It has prominent extra vesical component, large, with a mean size of 6 cm[80].

At CT, the tumor is mixed solid and cystic in 84% of cases and solid in the remainder. The cystic contents represent mucin, a common finding in these tumors. Calcification present in 72% of cases and is more commonly peripheral than stippled[80,81]. Urachal carcinoma can be intra luminal, but the bulk of tumor is outside the bladder in 88% of cases[80].

In addition, owing to their extra vesical location, urachal tumors may be clinically silent until quite large, resulting in late presentation and poor prognosis[80,81,41].

Radical cystectomy is considered the treatment of choice for primary adenocarcinoma. Urachal adenocarcinoma, more aggressive surgery including cystectomy and en bloc resection of the urachal mass, posterior rectus fascia, peritoneum, and abdominal wall is the standard of care. In contradistinction to urothelial carcinoma, extravesical spread is very common, with bladder wall invasion in 92% of cases and metastases in 48%[80,82]. Rarely, pseudo myxoma peritonei may result from peritoneal carcinomatosis.

Outcome is poor for invasive tumors, with an overall 20%–40% survival at 5 years[83].

Small Cell or Neuroendocrine Tumor

Small cell bladder tumor is rare, less than 0.5% of bladder neoplasms. They are highly aggressive tumors, with invasive disease in 94% at presentation[41,84,85]. The reported age range is wide, occurring in patients from 20 to 91 years, with a male-to-female ratio of 3–5:1[85].

Small cell bladder tumors from dedifferentiated neuron endocrine cells. Tumors are typically large and polypoid or nodular and may have

an ulcerated surface. The lateral bladder walls are the most common site[85]. Wall invasion is typical, with masses ranging from 3 to 8 cm[84].

Central necrosis and cystic change may be seen with CT[85,86]. Small cell tumors may exhibit very rapid growth .Aggressive behavior is further reflected in extensive local invasion.Diffuse peritoneal metastases, lymph node metastases occur in 66% of cases[86].

Treatment

Radical cystectomy and extended pelvic lymph adenectomy[88].

Surgical resection alone is unlikely to be curative, unless the tumor is confined to the bladder. Combination therapy with adjuvant or neo adjuvant chemotherapy appears beneficial(84,88) .Despite therapy, the long-term prognosis is poor, with a 16% 5-year survival[84,88].

Carcinoid

Primary carcinoid tumors are an extremely rare variant of neuro endocrine tumors and may be pure or mixed. These tumors are round or polypoid and small, with a mean size of 6 mm. Most are located in the bladder neck or trigone and are covered by normal epithelium.[89,90]. Behavior is typically benign, but metastases can occur in up to 30% of cases[89].

Leiomyoma

Leiomyoma is the most common mesenchymal tumor of the bladder but accounts for only 0.43% of bladder tumors.[91] Leiomyoma occur equally in men and women with a wide age range of 22–78 years[92]. Most are small and asymptomatic and are discovered incidentally. Histologically, leiomyomas are noninfiltrative smooth muscle tumors lacking mitotic activity, cellular atypia, and necrosis. Leiomyoma arise in the sub mucosa, but growth may be sub mucosal (7%), intravesical (63%), or extravesical (30%)[93,94].

At cystoscopy, normal bladder mucosa covers the Leiomyoma. Imaging features include either a smooth indentation of the bladder wall or an intra luminal mass. They are smooth, solid, homogeneous masses.

Leiomyoma exhibit intermediate signal intensity on T1-weighted images and low signal intensity on T2-weighted images .Degenerated leiomyomas have more heterogeneous signal characteristics[95].These are benign tumors

Focal excision of the mass is the treatment of choice.

Leiomyosarcoma

Leiomyosarcoma is the most common non epithelial malignant bladder tumor in adults[92]. An increased prevalence is seen after radiation therapy or systemic chemotherapy with cyclophosphamide for another neoplasm[94].

Patients present relatively early secondary to hematuria, and many have urinary obstruction. The age range is wide at 25–88 years with a male-to-female ratio of 3:1[92]. Eighty percent of leiomyosarcoma are high grade at presentation, although both high-grade and low-grade tumors can behave aggressively with local recurrence and distant metastases.

It can be difficult to distinguish Leiomyoma from leiomyosarcoma at imaging. Both can have relatively low signal intensity on T2-weighted MR images .However, necrosis is common in leiomyosarcoma[96] which tend to be poorly circumscribed, invasive masses with a mean size of 7

cm[92,96].Consequently, they are more heterogeneous on T2-weighted images

Rhabdomyosarcoma

Rhabdomyosarcoma is the most common bladder tumor in patients under the age of 10 years, with a mean patient age of 4 years[99]. It affects boys more than girls in a ratio of 3:1[99]. It is exceedingly rare in adults. Rhabdomyosarcoma can manifest as a diffusely infiltrative lesion or as masses, which can be polypoid and “grapelike” (sarcoma botryoides)[98]. There has been a shift in treatment from surgical resection to chemotherapy. With first-line chemotherapy, the need for radical surgery has decreased and the survival rate is greater than 70%.[99,100].

Neurofibroma

Neurofibromas of the bladder are rare, but the bladder is the most common genitourinary site of a neurofibroma. They may be isolated or occur in association with neurofibromatosis type 1 (von Recklinghausen disease,). Neurofibromas arise from the nerve plexuses, which enter near the bladder trigone[101].Neurofibromas may be localized, diffuse, or plexiform. Plexiform neurofibromas consist of nodules. These nodules may dramatically thicken the bladder wall, obstruct the ureteral orifice, and cause hydronephrosis[103]. The mass may also bulge into the bladder lumen. In addition, the tumor may involve the uterus, vagina, and urethra

in females, and the prostate, seminal vesicles, and urethra in male[101,103]. Large tumors may surround the rectum and extend to the perineum. Masses are typically low in attenuation at CT. Target sign on T2-weighted images, which consists of low-signal-intensity fibrosis surrounded by high-signal-intensity myxoid stroma.[104]

Paraganglioma

Paragangliomas may rarely manifest as a bladder mass. They account for 0.1% of all bladder tumors and 1% of all pheochromocytomas[41]. The age range is wide at 10–78 years, and there is a female preponderance. A characteristic clinical syndrome of catecholamine release during micturition, micturition attack," occurs in 50% of patients.Paraganglioma arises in the chromaffin cells of the sympathetic chain in the detrusor muscle layer and may occur anywhere in the bladder[96]. At cystoscopy, the findings are a small, solitary, sub

mucosal mass or nodule. Biopsy may cause release of catecholamine's and hypertensive crisis.

CT

A bladder Para ganglioma is usually a solid, homogeneous, lobulated, well-marginated mass, but cystic areas may result from necrosis or hemorrhage[105]. A sub mucosal location at cross-sectional imaging and marked enhancement with either iodinated contrast material

or gadolinium chelates are key features[108]. Ring calcification around the circumference of the mass is highly suggestive of a bladder paraganglioma[107].

MRI

They are typically of low signal intensity on T1-weighted images and moderately high signal intensity on T2-weighted images[108].

Iodine 131 metaiodobenzylguanidine (MIBG) scanning is highly specific (96%) for paragangliomas. However, MR imaging is more sensitive than either ^{131}I-MIBG scanning or CT[109]. PET with 6-[18F] fluorodopamine (an analogue of dopamine) may be superior to MIBG scanning in identifying metastatic lymph node[110].

Treatment consists of local excision following adrenergic blockade, with lymph adenectomy if the lesion is invasive. Because there

are no reliable histologic criteria to distinguish benign from malignant tumors, long-term follow-up is advisable.

Lymphoma

Primary bladder lymphoma is rare, as there is no lymphoid tissue in the bladder, but secondary involvement of the bladder may be present

in 10%–25% of patients with lymphoma and leukemia .It is most common in middle-aged women[111].

At cystoscopy or imaging, there are well-defined bladder masses at the dome or lateral walls rather than diffuse infiltration[111]. The masses may mimic urothelial carcinoma. The prognosis is good as most tumors are low grade. Treatment can be with chemotherapy or local radiation therapy[88].

Bladder hemangioma

Can occur at any age, but half manifest in childhood, in adults, the mean age is 58 years (range, 19–76 years). And they are more common in males in a ratio of 3.7:1[112]. Hemangioma may either occur in isolation or be associated with syndromes such as Clipped-Trénaunay-Weber or Sturge-Weber[113]. Tumors were small, with a median size of 0.7 cm (range, 0.2–3 cm)[112]. Most were single, broad-based, sessile bladder masses on the postero lateral walls. The finding of a lobulated bluish red lesion at cystoscopy is highly suggestive[112]. Either a focal, lobular,

intramural mass or diffuse bladder wall thickening may be observed. The tumor has low to intermediate signal intensity on T1-weighted images and markedly high signal intensity on T2-weighted images[107]. Increased activity at blood pool scintigraphy is highly suggestive[113]. Cavernous hemangioma is the most common type, accounting for 78% of

cases.Hemangioma run a benign course and are treated by biopsy with fulguration when small or by partial cystectomy.

Solitary Fibrous Tumor

Solitary fibrous tumors are exceedingly rare mesenchymal tumors with fibroblastic differentiation. When small, they may be detected as incidental findings. Larger tumors manifest with urinary frequency or pressure effects. More common in men, they occur in the age group of 42–67 years)[114]. At gross pathologic evaluation, they have a tan, whorled, fibrotic surface resembling a Leiomyoma. Immune histochemical stains are diagnostic. At CT and MR imaging, these are solid enhancing masses[115].They are typically of low signal intensity on T2-weighted images, with larger lesions exhibiting some variability. They are treated surgically and do not recur after partial cystectomy[41].

DIAGNOSIS

The standard imaging work-up for gross hematuria and suspected urothelial tumor has shifted from excretory urography to cross-sectional modalities such as ultrasonography (US), CT, and magnetic resonance (MR) imaging. Cystoscopy and biopsy are the standard of reference for bladder evaluation, but imaging is important for accurate staging and treatment planning[42].

Superficial tumors may not be evident with any imaging study and are not staged radiologically. However, with invasive urothelial tumors, detection of pelvic side wall invasion or lymph adenopathy is critical, as clinical staging is inaccurate. Furthermore, complete evaluation of the urothelial tract (both upper and lower) is indicated because of the propensity for multi centric disease.

US may be used for initial evaluation of hematuria but is rarely the definitive test. Lesions may be missed without adequate bladder distention, especially small, flat tumors.[73]

CT demonstrates tumoral calcification in approximately 5% of cases[47]. The calcification typically encrusts the surface of the tumor and may be nodular or arched. Bladder tumors enhance early approximately 60 seconds from injection, and may be readily detected with multi

detector CT[73] . With progression of disease, wall thickening may become diffuse. The presence of ureteral obstruction strongly suggests

the presence of muscle invasion. Once the tumor has extended into the peri vesical fat, increased attenuation or infiltration is noted in the fat[73].

Virtual CT cystoscopy, performed with carbon dioxide, room air, or contrast material distention of the urinary bladder, has been proposed as a noninvasive alternative to conventional cystoscopy[22]. **Virtual** CT **cystoscopy** of a contrast material–filled bladder can be performed as part of a routine contrast-enhanced abdominal CT examination or as part of CT urography, enabling thorough evaluation of the entire urinary tract the data were downloaded to an independent workstation equipped with software (Navigator; for interactive intra luminal navigation[22].

MR imaging

The high intrinsic contrast of MR imaging permits distinction of bladder wall layers On T1-weighted images, urine is dark; the bladder wall and tumor are intermediate in signal intensity[48]. As fat is high in signal intensity, T1-weighted sequences are optimal for detection of extra vesical infiltration, nodes, and bone metastases.

Tumor is intermediate in signal intensity on T2-weighted images, contrasting with the high signal intensity of urine and low signal intensity

of muscle .T2-weighted sequences are optimal for evaluation of tumor depth and differentiating tumor from fibrosis and for detection of invasion of surrounding organs and marrow metastases[48].

With fast dynamic contrast-enhanced imaging, bladder cancer enhances more avidly and earlier than other tissues such as normal bladder and post biopsy changes[53,54,59].This may enable differentiation of tumor from fibrosis or edema, although this is still difficult soon after transurethral resection. MR imaging has a reported staging accuracy of 72%–96% for the primary tumor and is superior to CT for differentiation of superficial versus deep muscle invasion[58,60].

MR detection of pathologic lymph nodes (sensitivity, 96%; specificity, 95%; and negative predictive value, 98%) has been achieved with an intravenous suspension of ultra small iron particles, ferumoxtran-10[61]. Ferumoxtran is taken up by macrophages in lymph nodes and causes loss of signal in normal nodes on T2*-weighted images. In metastatic nodes, tumor replaces normal macrophages, preventing uptake of the iron particles and maintaining high nodal signal intensity. Distant metastases may be evaluated with either MR imaging or CT

Positron emission tomography (PET)

The usefulness of fluorine 18 fluoro deoxyglucose (FDG) positron emission tomography (PET) in bladder cancer is limited by the excretion of radioisotope into the bladder, which obscures the tumor. Irrigating the bladder with saline improves detection of bladder tumors[62]. Currently, optimal use of PET or PET-CT is for detection of distant metastasis, pelvic lymph node metastasis, or pelvic recurrence and potentially to separate tumor from fibrosis or radiation change[63].

REVIEW OF LITERATURE

KIM et al[22] said that in a Study done in Thirty-three patients with contrast material-filled bladders with single-detector helical CT. Virtual cystoscopy has sensitivity 94%, specificity 90%, positive predictive value 87%, negative predictive value 93%, and accuracy 93%. They concluded as CT virtual cystoscopy is a noninvasive technique that can be used successfully for detection of bladder tumors >5mm

2. Constantine Tsampoulas et al,[24] Evaluated Fifty patients CT pneumo cystoscopy. All patients were examined in the supine and prone positions after bladder distention with room air. Fifty-five (96%) of 57 urinary bladder lesions recognized at conventional cystoscopy were detected with MDCT cystoscopy , including 18 lesions with a diameter of .5 cm or less. Transverse, multiplanar reformatted, and virtual images proved complementary for lesion detection. They concluded as MDCT cystoscopy is an accurate technique for the detection of urinary bladder neoplasm of lesions smaller than .5 cm.

3. D Masulović, et al[25] 17 patients has undergone CT virtual and conventional cystoscopy. Two tumors of bladder vault that were missed on transversal scan were visualized by virtual cystoscopy. One tumor inside the bladder diverticulum was detected, that was not seen by conventional cystoscopy. In two patients, endoluminal origin of mass

that could not be confirmed by conventional radiologic methods was determined. They concluded as CT virtual cystoscopy is useful method a) follow up of bladder tumors; b) supplemental estimation of endoscopically hardly accessible regions; c) differential diagnosis between intravesical and exravesical lesions.

4. Yazgan et al [26] Forty-nine of 54 bladder lesions detected with conventional cystoscopy were also shown on virtual images, three of the seven lesions 5 mm or smaller in diameter could be identified. The sensitivity of the technique was 96.2% for polypoid tumors and 88.9% for sessile lesions. When axial and virtual images were evaluated together, the sensitivity rate increased to 94.4%. They concluded as Bladder tumors can be diagnosed noninvasively using contrast medium-filled virtual cystoscopy.

5. [27]Air filled and virtual cystoscopy (VC) with 64-channel multi detector row CT (MDCT) scanner in Fifty-nine patients. They concluded as VC with 64-channel MDCT scanner was very accurate at identifying masses larger than 0.5 cm and can show mass as small as 1.4 mm. Bladder tumors can be diagnosed less-invasively using air filled VC. However, in the case with severe bladder trabeculation or wall thickening, recommend conventional cystoscopy rather than VC.

6. Regine et al[27] VC demonstrated a good sensitivity for evaluating pedunculated lesions, allowing evaluation of the bladder base and anterior wall, sites that are commonly poorly accessible at conventional cystoscopy. They concluded as Virtual CT-pneumocystoscopy can replace conventional cystoscopy in cases with pedunculated lesions when there is no need for biopsy, Virtual pneumocystoscopy can also be used in the follow-up of treated polypoid lesions in association with pelvic CT-angiography.

7. Merkle EM, et al.,[33] said that All tumors of the urinary bladder identified at fiber optic cystoscopy were also visualized by virtual cystoscopy. The best reconstruction results were obtained from data acquired after the 30-minute latency period.

8. Gualdi GF, et al[28] *90%* of detected on conventional cystoscopy were visualized with virtual cystoscopy. Although only a subjective evaluation of lesion size was possible on conventional cystoscopy, there seemed to be good agreement on mass size and site with both techniques. They concluded as virtual cystoscopy depicted all the masses > 1 cm, and a lesion in a diverticulum with a small opening. The virtual technique could also be complementary to conventional cystoscopy in evaluation of bladder base and anterior bladder neck, as well as for post chemotherapy follow-up

9. Sylvain Jaume et al[29] says that With an expert observer reading the CT, our algorithm achieves89% sensitivity, 88% specificity, 48% positive predictive value, and 98% negative predictive value.

The high negative predictive value makes our software suitable for bladder cancer screening. Our software accurately detects healthy

regions, allowing the clinician to focus on the suspicious bladder scans. It evaluates the bladder neck, a significant advantage over standard cystoscopy.

10. Thiagarajan Nambirajan et al[30] done virtual cystoscopy using an intravenous contrast agent in Eighteen patients with haematuria . (92%) of the abnormal lesions at RC were correctly identified at VC. At VC, all lesions of >4 mm were identified but only one of three <4 mm was seen. There were two false-positive finding at VC; VC correctly identified 17 (94%) of 18 abnormal bladders. They concluded as CT-based VC has a high sensitivity for detecting bladder lesions and is comparable with FC; it may have a potential role as a single imaging tool for haematuria

11. Noriyasu Kawai*, et al[31]Using multi slice CT and a device with 16 rows of detectors, examined five patients using VC that previously involved catheterization, termed 'air VC' and 16 using VC with the new technique, termed 'IVU VC'. The detection rate of bladder

tumors by IVU VC was similar to that from air VC; moreover, IVU VC overcame two significant disadvantages of air VC. The appearance of the water surface and the need for catheterization. They concluded as Conventional cystoscopy is still an essential examination but this new method of IVU VC may be ideal for preliminary examination of the bladder.

12. Allan et al said Computed tomography and magnetic resonance imaging data sets, may now be used to construct a virtual reality endoscopic image. Thus allowing virtual reality to begin to challenge endoscopic evaluation.

13. **Jeong Kon Kim[32] et al says the** agreement between the findings of virtual and conventional cystoscopy was excellent in the reviewers' identification of bladder lesions (= 0.83) and detection of abnormal bladders (= 0.89). The sensitivity and specificity of virtual cystoscopy were 95% and 87% for identifying bladder lesions and 95% and 93% for detecting abnormal bladders. They concluded as Virtual cystoscopy of the contrast material—filled bladder is useful for the evaluation of the bladder in patients with gross heamaturia

14. E M Merkle, et al[33] All tumors of the urinary bladder identified at fibre optic cystoscopy were shown on virtual cystoscopy. The best reconstruction results were obtained from data acquired 30 min

after injection of contrast medium. The ureteric orifices were not visualized at virtual cystoscopy. These data lead us to conclude that, at present, virtual cystoscopy has not reached the quality of fibre optic examination and remains restricted to use in specific cases, for example patients with urethral strictures.

15. Prarotish et al [34] The MDCT-derived volumetric data were used to generate virtual cystoscopy (VC) images, which revealed a

bladder ulcer. The presence of this ulcer was confirmed by conventional cystoscopy-guided biopsy and there was good agreement regarding various features of the ulcer, such as the site, size and shape

16. Halil Arslan, et al[35] studied in Eighteen patients with different bladder pathologies, which consisted of 11 tumors, 3 diverticula, 2 trabecular changes and 2 stones, They found Images in 16 (88%) of the 18 virtual cystoscopic examinations were either of excellent or good quality. While conventional cystoscopy could not evaluate interior part of the diverticulum, virtual CT cystoscopy could demonstrate clearly within it.. They concluded as Virtual CT cystoscopy is a promising technique to be used in the detection of bladder lesions. It should be considered especially at the evaluation of bladder diverticulum.

17. WANG Dong et al[35B]. The sensitivity of the axial, 3D and CTVC images in detecting the bladder tumors were 90.8%, 76.9% and

95.4% respectively. The dynamic contrast-enhanced axial images could provide excellent intramural and extravesical information, and the accuracy in preoperative tumor staging was 87.7%. 3D and CTVC images were useful for displaying the surface morphology of the tumor and the relationship between the tumor and the ureteric orifices, whereas CTVC could depict the tumors smaller than 5 mm not seen in axial images. Concluded as The combination of axial, MPR, 3D and CTVC images with helical CT can provide comprehensive information on bladder tumor.

18. In 1996, Vining et al.[14] showed the feasibility of VC in one healthy volunteer and two patients with bladder tumor. They filled the bladder with carbon dioxide through a urethral catheter and used a volume-rendering algorithm for virtual image processing.

19. Narumi et al.[15] reported their experience of using air as a contrast agent in the bladder and used a surface-rendering algorithm, showing 85% of all tumors, 94% of 31 that were >1 cm, but only 77% of tumors of <1 cm to be correctly identified.

20. Fenlon et al.[16] reported VC in 13 patients with haematuria and abnormal findings on cystoscopy. They used a perspective volume-rendering algorithm and room air as the contrast medium.

21. A similar study by Song et al.[17] confirmed the technique to be useful for lesions of >5 mm, that the optimum evaluation requires adequate bladder distension with the patients both supine and prone, and the interpretation of both transverse and virtual images

22. Kim et al.[18] assessed 73 patients with gross haematuria, using an intravenous contrast agent and a volume-rendering algorithm. The sensitivity and specificity of VC were 95% and 87% for identifying bladder lesions, and 95% and 93% for detecting abnormal bladders.

MATERIALS AND METHODS

It is a prospective study. There is no deviation in the protocol for the evaluation of patients with hematuria. 29 patients, (6 females, 23 males) with hematuria and a recent diagnosis or a history of bladder carcinoma referred by the urology department for CT urography and **cystoscopy**. These patients constituted our study population.

EXCLUSION CRITERIA

Renal failure

Contrast allergy

Pregnancy

Children

Calculus

They were subjected to USG and CT examinations were performed with a 64 slice MDCT scanner, (Philips Medical Systems) slice thickness of 1 mm, after an intravenous injection with 80mL of Iohexol 300mg at 3 ml/s. This was followed by a delayed scan, 60 min after injection with contrast medium. During the delay patients were instructed to move around, with the intention of avoiding sedimentation

of contrast medium in the bladder. The delayed images were obtained as a single breath-hold helical scan, using 120 kV, 250 mA, 1mm thickness

and a pitch of 1. These delayed images were used to reconstruct the VC image.

The data were downloaded to an independent workstation (Extended Brilliance PHILIPS) equipped with software for interactive intra luminal navigation. MPR images 1mm thick at 1-mm intervals were obtained in the transverse, coronal, and sagittal planes .**Virtual** cystoscopic images were obtained with the volume-rendering technique and the same software as for the MPR images. The threshold was optimized for each case to obtain complete visualization of the bladder wall with no artefacts. Using multiplanar reformation from source images, a central observation point was defined in the middle of the lumen of the bladder. The camera for virtual cystoscopy was placed in the center of the bladder lumen and thereafter was advanced to each quadrant in turn. When a possible abnormality was discovered, it was fully evaluated from various angles.

The VC images were reconstructed and analysed by the information for the number, exact location, and other incidental

abnormalities in the bladder. The virtual and conventional cystoscopic findings for each patient were documented on separate worksheets.

The axial, MPR, and **virtual** images were prospectively interpreted, both separately and in combination, by the number, size, location, and morphologic features of the lesions were studied. The lesions were characterized as polypoid, sessile, and areas of wall thickening. A lesion was characterized as an area of wall thickening when there was no associated discrete mass. A lesion was considered polypoid if it protruded into the bladder lumen and was attached to the bladder wall by a narrow stack. A lesion was described as sessile if it was connected to the bladder wall by a broad base.

Detailed forms regarding number, estimated size, and location of bladder tumors found at conventional **cystoscopy** were completed by the urologists. The conventional cystoscopies were performed with rigid 21F cysto scope (Storz, Germany) with a field of view of 30 degrees in all patients under general or local anesthesia The findings at MDCT **cystoscopy** were compared with those of conventional **cystoscopy**

The following data are to be collected for analysis:

1. **Clinical presentation**
2. **Nature of lesion eg. Growth, ulcer**
3. **Site**
4. **Size**
5. **Morphology**
6. **Number of the tumor**
7. **Histopathology and grade of the tumor**

TECHNIQUES OF 3D RECONSTRUCTION IN CT CYSTOSCOPY

The volumetric data obtained with helical CT are computer-rendered to generate three-dimensional images, and with commercially available software, intra luminal navigation through any hollow viscus is possible. There are two main techniques for the reconstruction of virtual image. One of them is volume rendering and the other is surface-rendering algorithm. Of the different three-dimensional rendering techniques available, the perspective volume rendering provides more information because the entire data set is incorporated. I used a volume rendering algorithm in this study

3D Imaging

The process of 3D imaging began with image acquisition protocols, which were optimized for subsequent post-processing. To withhold positive oral and rectal contrast agents to obtain satisfactory 3D CT images. This is particularly important CT urography when 3D reconstruction is planned. Optimum contrast volume, rate of injection, and timing of the scan at the peak concentration are pre-requisites for most 3D angiography applications. Only good source axial image data can provide reasonable quality 3D reconstruction. It is therefore critical to

obtain thin, overlapping sections of the region of interest with minimum motion artifacts.

Surface rendering (shaded surface display, SSD) is a surface-fitting algorithm that creates triangle-based iso surfaces within 3D space. For surface rendering, the user specifies a threshold attenuation value close to the center of the signal difference between the brightest pixel found within the object of interest and the signal in the surrounding structures. Then, the surface-rendering algorithm loops on successive slices and determines whether its corner values straddle the threshold values and chosen to generate surface rendering datasets.

Volume rendering (multiplanar volume rendering, MPVR) is the visualization and manipulation of objects represented as sampled data in three or more dimensions. The technique interpolates the entire data set rather than editing a single scan to generate 3D images directly from scanned volume data.

The maximum intensity projection (MIP) technique displays the pixels of greatest intensity along a predefined axis of the image. It is useful for the depiction of anatomy when there is a large difference between attenuation values (Hounsfield value, HU) pacified by contrast agent, and the surrounding tissues.

Navigation Models

Planned Navigation (“Autopilot“) Predefined navigation for automatic movement along the traversed path with planned protocols .It has Specification of a camera path. Camera is more or less fixed to that path.

Manual/free Navigation

Interactive navigation - For mouse controlled movement

Guided Navigation: Combines flexibility and guidance. Interactive and intuitive. Camera dives through scene like submarine

OBSERVATION AND RESULTS

CT scanning was well tolerated by 29patients. Male 23, Female 6 including one case post cystectomy with ureteric diversion

No complication occurred. Images in 100%of the 29 virtual cystoscopic (vc) examinations were of good quality with adequate bladder distention. 60 lesions were seen in virtual cystoscopy in 29 patients. On conventional cystoscopy 60 lesions were found in 27patients. 55 lesions of vc were found to be tumor on conventional cystoscopy and biopsy. Out of five lesion which are not tumors proved to benign lesions. Out of five 3 were flat lesions found to be trabeculations on conventional cystoscopy . Rest two were sessile lesions one was grade 3mucosal changes, one was enlarged lateral lobe of the prostate on conventional cystoscopy. The masses ranged from1. 7mmto 7.4cm.45 Out of 60 were polypoid lesions. 10 were sessile lesion.5 were flat lesions in vc. All these tumors had been described by the virtual cystoscopy with nearly similar findings in size localization. However the lobulated morphologic characteristics of a small polypoid lesion were better depicted on the virtual image. There is no false positive regarding for lesion identification and polypoidal lesions for correlation of tumor .

	vc	**Conventional cystoscopy**
Pedunculated	45	44
Sessile	10	7
Flat	5	4
Total no lesion	60	60
Adjacent irregularity	15	13
Ureter involvement	2	2
Uvj involvement	2	2
Adjacent cis	0	5
Involvement of pelvis	0	

Single lesion was found in 9 patients in Conventional cystoscopy and Virtual cystoscopy. Patients with More than one lesion was found in 13 patients. Patients with multiple lesions were 2.

HISTOLOGICAL DIAGNOSIS

Lowgrade muscle non invasive TCC in 13 cases (52%).

Highgrade muscle invasive TCC in 8 cases (32%)

Both high and low grade -2 (8%)

TCC 92%

Adeno carcinoma 1 (4%)

Mesenchymal tumor 1 (4%)

TREATMENT FOLLOWUP

TURBT done in 14 patients.

RADICAL CYSTECTOMY was done in 4 patients.

PARTIAL CYSTECTOMY in 2 cases.

Nephro uretrectomy- in 2 cases .

RT&chemo was given for 2cases.

No intervention in 5cases

STATISTICAL ANALYSIS

The clinical trials were described according to their age and sex by the statistical mean and standard derivatives. The difference of age between the sexes was interpreted by the student`s `t` test. The morphology of the study sub sects in terms of number of lesions found by conventional cystoscopy and virtual cystoscopy were analyzed and interpreted by students paired `t` test. The positivity and negativity for morphology and sites of conventional cystoscopy and virtual cystoscopy studies were studied according to the presence and not presence by sensitivity and specificity tests. The above statistical procedures were performed by the statistical package namely S.P.S.S (13.O) at 5% level of significance (p= 0.05).

The clients of the study were described according to their age and sex with comparison

Age group (years)	male		Female		Total	
	no	%	no	%	no	%
40-49	2	9.5	3	50.0	5	18.5
50-59	8	38.1	3	50.0	11	40.7
60-69	8	38.1	-	-	8	29.6
70-79	2	9.5	-	-	2	7.4
80-89	1	4.8	-	-	1	3.8
Total	21	100	6	100	27	100

The above table -1 evaluates the clients according to their age and sex distribution. The mean age of the male was 60.3+/-9.1 and the female was50.3+/- 4.3. The difference of age 10 years between the sexes was statistically significant ($p<0.05$).

Range	50-80YRS	45-57yrs	45-80yrs
Mean	60.3	50.3	58.1
S.D	9.1	4.3	9.2
`t`	2.585		
Significance	P<0.05		

The mean age of the total study subsets was 58.1+/- 9.2 years. The male clients age was ranging in between 50- 80 years. The female ages were ranging in between 45-57.The total age was in between the years 45- 80.

COMPARISON BY MEANS OF TOTAL LESIONS BY MORPHOLOGY

The lesions morphology diagnosed and screened by conventional cystoscopy and_virtual cystoscopy of the study subsets were analyzed and interpreted as follows.

Cystoscopy	morphology		M.D	`t`	d.f	significance
	mean	S,D	0.2	0.811	26	P>0.05
CC	2.0	1.7				
VC	2.2	2.0				

Table-2 Number of lesion morphology by conventional and virtual cystoscopy-comparison.

The above table-2 shows that the mean morphology lesions of conventional cystoscopy was 2.0 +/- 1.7 and the same of the virtual cystoscopy was 2.2 +/-2.0 The morphology lesions which were more in number by virtual cystoscopy was not significant statistically(p>0.05)

Sessile investigated by		conventional Present	conventional Not present	Total	% Sensitivity	% Specificity	% Significance	% ppv	% npv	significance
Virtual cystoscopy	Present	5	4	9	83.3	81.0	P >0.05	55.6	94.4	P <0.05
	N.P	1	17	18						
	total	6	21	27						

In the above the table-3 the presence of sessile lesion was given by the diagnosis and screening by conventional and virtual cystoscopy respectively. The sensitivity and specificity were 83.3% and 81%

respectively. The difference was not statistically significant.(p >0.05).That means with respect to sensitivity and specificity both were same. But there was a significant difference with respect to positive predictive value and negative predictive value. This difference was attributed to the low prevalence of positivity in both investigations.

TABLE - 4 COMPARISON OF PEDUNCULATED LESIONS

		conventional			%		significance	%		significance
Pedunculated		P	NP	total	sensitivity	specificity		ppv	npv	
Virtual cystoscopy	P	19	0	19	86.	100	p>0.05	100	62.5	P<0.05
	NP	3	5	8						
	total	22	5	27						

In the above table -4 also the sensitivity and specificity were not statistically significant (p >0.05). But the positive predictive value(100%) was significantly greater than the negative predicative value(62.5%).This was attributed to the high prevalence of positive(p > 0.05).

TABLE-5 COMPAISION OF FLAT LESIONS

Flat lesion investigated by		conventional			%			%		
		present	Not present	total	sensitivity	specificity	significance	ppv	npv	significance
virtual	Present	3	2	5	75.0	91.3	p>0.05	60.0	95.4	P >0.05
	NP	1	21	22						
	total	4	23	27						

The above table-5 explains the flat lesions presented by both investigation and found that there were no significant differences observed either in between sensitivity and specificity in between positive predictive value and negative predictive value.

With respective to flat lesion detected by both instruments were the same ($p > 0.05$)

TABLE - 6 COMPARISION OF LESIONS PRESENT ON THE DOME.

The presence of the positive lesions on the dome was shown in the below table-6. Clearly shows that 100%o f presentation of positive cases by both investigations since the sensitivity and specificity were equal and the positive predictive value and negative predictive value were also equal. (100%).

Dome lesion investigated by		**conventional**			**percentage**		**sign ifica nce**	**percentage**		**sign ifica nce**
		p r e s e n t	**N ot pr es en t**	**t o t a l**	**se ns iti vit y**	**sp ec ifi cit y**		ppv	npv	
virtual	Present	7	0	7						
	Not present	0	20	20	100.0	100.0	-	100	100	-
	total	7	20	27						

.

TABLE-7 COMPARISON OF PRESENCEOF LESION ON THE BASE

investigated by (lesion on base)		conventional			percentage		significance	percentage		significance
		present	Not present	total	sensitivity	specificity		ppv	npv	
virtual	Present	5	0	5	100.0	100.0	-	100	100	-
	Not present	0	22	22						
	total	5	22	27						

The comparison shown in the table -7 illustrate that there was equal presence of positivity in both instruments (100%).

TABLE-8. COMPARISON OF ANTERIOR SURFACE

anterior surface investigated by		conventional			percentage		significance	percentage		significance
		present	Not present	total	sensitivity	specificity		ppv	npv	
	Present	7	1	8						
virtual	N.P	1	18	19	87.5	94.7	p>0.05	87.5	94.7	p>0.05
	total	8	19	27						

Positive predictive value (PPV)

Negative predictive value (NPV)

In the above table analysis showed in the table-8.States that the sensitivity and specificity were differed not significantly (p >0.05) similarly the PPV and NPV were also not differed significantly (p>0.05).

TABLE-9 COMPARISON OF POSTERIOR SURFACE

		conventional			**percentage**					
posterior lesion investigated by		**present**	**Not present**	**total**	**sensitivity**	**specificity**	**significance**	**percentage**		**significance**
								ppv	npv	
virtual	Present	4	1	5						
	N.P	1	21	22	80.0	95.5	p>0.05	80.0	95.5	p>0.05
	total	5	22	27						

The above comparison shown in the above table -9 shows that there was no significant difference in between the sensitivity and specificity as well as positive predictive value and negative predictive value . It reveals that both were equal in predicting positive cases.

TABLE -10. COMPARISON OF RT LATERAL WALL.

		conventional			percentage					
Rt lateral wall lesion investigated by		present	Not present	total	sensitivity	specificity	significance	percentage		Significance
								ppv	npv	
virtual	Present	18	0	18						
	N.P	0	9	9	100.0	100.0	-	100.0	100.0	-

	total	18	9	27

The above table -10, the conventional and virtual cysto scopies had shows 100% similarity in predicting the positive and negative and also in respect of sensitivity and specificity

TABLE -11. COMPARISON OF LESION ON LEFT LATERAL WALL

Lt lateral wall lesion investigated by		conventional			percentage		significance	percentage		significance
		Present	Not present	total	sensitivity	specificity		ppv	npv	
virtual	Present	7	0	7	100.0	100.0	-	100.0	100.0	-
	N.P	0	20	20						
	total	7	20	27						

The above table -11 explains the sensitivity and specificity of positive presentation in the lateral wall by the two investigations. Both investigation were predicting 100% positive and 100 %negative. It

reveals that the there was no difference between the instruments, since the two tests had screened 100% in all respect.

FINDINGS

The female were 10 years younger than the males with respect to the disease. Since the mean age of female 50.3 +_ 4.3 was significantly earlier than the mean age of males 60.3 + 9.1.($p > 0.05$).

The virtual cystoscopy had identified an average of 2 + 2.0 morphology lesions and the conventional cystoscopy had identified little bit less than an average lesions 1.0+ 1.7. But the difference was not significant.

From the analysis and interpretation of morphology namely sessile, pedunculated, flat, and wall thickening the sensitivity and specificity of the tests were not statistically significant ($p > 0.05$). It proved that both were equal in respect of sensitivity and specificity. But there were significant difference in respective of their positive predictive and negative predictive values in respect of sessile and pedunculated. That difference were attributed to low prevalence and high prevalence of positive cases of respective morphology . The presence of positives on the six sites lay the two investigations namely conventional and virtual cystoscopies were not statistically and significant in respect of sensitivity and specificity and positive predictive

value and negative predictive value. Both were equal in identifying the positive cases.

From the above analysis and interpretation virtual cystoscopy is equal to the conventional cystocopy in identifying lesions.

DISCUSSION

We were able to identify all the lesions which were identified by conventional cystoscopy. No sub centimeter lesion was missed comparing to previous studies due to MDCT thin section imaging

The referral study was conducted in 18 patients sensitivity of VC (virtual cystoscopy) was 92% for detecting all lesions, and 100% for lesions of >4 mm and 94% for abnormal bladders. VC is not sufficiently sensitive to detect tumors of <4 mm because of limited resolution with a slice acquisition of 3 mm with helical CT. In my study using 64 MDCT CONTRAST with 1mm slice no sub cm lesion was missed and the smallest was1.7 mm. sensitivity of VC was 100% for detecting all lesions, and 100% for abnormal bladders

In the referral study Of the total of 36 abnormal lesions seen at RC, 33 (92%) were correctly identified at VC. There were two false-positive identifications of lesions at VC. Of the 18 abnormal bladders on RC, VC correctly detected 17 (94%). Four were <4 mm, and three of these were missed on VC, with one of 3 mm missed on FC and correctly located by VC. Thus all lesions of >4 mm were detected by VC and only one of four <4 mm. In my study from 25 abnormal bladder 60 lesions were identified in VC 60 lesions identified in conventional .no lesion was missed .The smallest is1.7 mm.

Morphological correlation with tumor histology 100% positive predictive value and sensitivity for polypoidal lesions. 2 Sessile lesion which were not tumor one was enlarged lateral lobe of prostate another was grade 3 mucosal change. The sensitivity and specificity were 83.3% and 81% respectively for sessile lesion in diagnosis of tumor by conventional and virtual cystoscopy respectively. For flat lesion sensitivity 75.,specificity91.3 positive predictive value(60 negative predictive value 95.4% .

. Of the 33 lesions seen on VC, the locations of all were correctly described at VC when compared with RC, in the referral study. And also in my study the locations of all were correctly described at VC when compared with RC.

In the referral study the histology results were available for all patients and all had TCC except one who had re-growth of the prostate mimicking a bladder tumor. One patient had carcinoma *in situ* (CIS) in addition to G3pT1 tumor. In my study Lowgrade muscle non invasive TCC in 13 cases (52%). Highgrade muscle invasive TCC in 8 cases (32%) Both high and low grade -2 (8%) TCC 92% adeno carcinoma 1 (4%) ,mesenchymal tumor 1.In my study one case was found to invasive growth from sigmoid proved as Adeno ca.

VC the lesions can be easily related to anatomy outside the bladder.

One case which was sent for CECT abdomen for haematuria .The axial images revealed bladder wall thickening and peri vesical infiltration. With virtual cystoscopy it was clearly

established the extra luminal origin of lesion from adjacent sigmoid growth infiltrating in to the bladder lumen as small polypoidal and a small flat lesion.

Another case which was referred from outside our hospital after inconclusive cystoscopy after biopsy from the lesion due to profuse bleeding.USG findings bladder wall thickening and large mass .The axial images were interpreted as tumor with possible hematoma with help of virtual images we are able to say that leiomyomatous polyp from its cystoscopic appearance with normal looking mucosa which was postoperatively identified as solitary fibrous tumor. We were able to study about the pelvi calyceal system in all the cases which was not possible with conventional cystoscopy .

one case after urinary diversion done with axial images the possible pathology at diversion site and possible metastatic Adeno ca could not be ruled out. With virtual images we were able fly through the renal pelvis to ileal loops for long segment positively rule out lesions. With virtual images we were able to say with confidence about intra luminal pathology without asking for cystoscopic correlation. Virtual CT cystoscopy superior to demonstrate the interior part of the diverticulum.

CONCLUSION

In conclusion, virtual CT cystoscopy is a promising technique for tumor and some other bladder lesions, such as diverticula. This minimally invasive method can be of value for screening, primary diagnosis and surveillance of bladder lesions. Virtual CT cystoscopy may be done as part of routine when ct urography is being done and it also may be done when conventional cystoscopy is contraindicated or restricted in feasibility and interpretation or there is risk of hemorrhage, perforation, or pain especially in young patients. It identifies abnormalities in the bladder as accurately as FC and is feasible in situations where FC could not be used bladder debris obscuring vision and when the patient could not tolerate the procedure.

VC does not identify CIS. This can be seen as a major disadvantage of VC against FC. The one false-negative result was a result of the difficulty is assessing the mucosa in the presence of gross trabeculation.. The advantages of VC include being a totally noninvasive screening test for haematuria, evaluating both upper and lower urinary tracts, replacing several with one test it is possible to view the lesion from many directions and accurately locate and measure it. The data are stored electronically and can be repeated at any time and by different people in different places. VC allows simultaneous staging of the bladder tumor. It

is possible now to create virtual ureteroscopic images from the same datasets and the abdominal organs are simultaneously screened. The processing time has decreased with new workstations, currently taking only a few minutes. The objective of the test is simply to define the patient groups who need further evaluation with RC.

The disadvantages include the cost, radiation exposure .The urethra is visualized poorly and it is not possible to obtain histology.

PROFORMA

NAME:

AGE: SEX:

ADDRESS:

CONTACT NUMBER:

IP NO: OP NO:

PRESENTING COMPLAINTS:

PHYSICAL EXAMINATION:

INVESTIGATION:

1.URINE:

ALBUMIN

SUGAR

DEPOSITS

BLOOD UREA

SERUM CREATININE

:

5. USG KUB:

(R) KIDNEY:

L) KIDNEY:

BLADDER:

Number of Lesion site size morphology

VIRTUAL CYSTOSCOPY FINDINGS:

Number of Lesion site size morphology

7. CONVENTIONAL CYSTOSCOPY FINDINGS:

Number of Lesion site size morphology

8...HISTOPATHOLOGY REPORT :

9.COMMENTS:

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