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Study on evaluation of bladder neoplasms using MDCT virtual cystoscopy versus conventional cystoscopy

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Abstract
Background: Bladder cancer is the fourth most common cancer in males and eighth most common cancer in females. It is the most common cancer of the urinary tract. Evaluating the efficacy in diagnosing bladder cancer using conventional cystoscopy versus MDTCT- virtual cystoscopy is the main aim of this study.
Materials and Methodology: All patients with clinical or ultrasound evidence of bladder masses referred to the Department of Radiology, Kamineni Academy of Medical Sciences and Research Centre, LB Nagar, for further evaluation over a period of 18 months were included in the study.
Results: A total of 75 patients were included in the study**.** Most of the patients were males. The average age of study is 53.6 years. The total number of lesions detected was 93 among which 60 were malignant and 33 were benign. Urothelial variant was the most common malignant lesion. CT-VC was able to detect lesions with a sensitivity of 98%. However, the sensitivity was further reduced in detecting lesions <5 mm in size.
Conclusion: CT-VC even with its own set of advantages and disadvantages, cannot completely replace conventional cystoscopy. However, it can be used in patients in whom conventional cystoscopy is contraindicated (Stricture urethra), during follow-up evaluation post treatment for bladder cancer and mapping of bladder lesions prior to conventional cystoscopy.

Keywords: Conventional cystoscopy, virtual cystoscopy, bladder cancer, MDCT

Introduction
Bladder carcinoma is the most common cancer of the urinary system. It is the 7th most common cancer worldwide, with incidence twice as high as in developing countries when compared to developed countries due to higher incidence of schistosomiasis [1]. The incidence increases with age and has a male preponderance.
Bladder carcinoma is associated with numerous risk factors such as smoking, schistosomiasis infection, occupational hazards by exposure to certain chemicals. Smokers are 2-6 times at more risk of developing bladder cancer than non-smokers. Chronic infection of schistosomiasis in developing countries predispose to the development of squamous cell variant of bladder cancer. Industries processing rubber, paints, and petroleum products are known to have high levels of exposure to arsenic, aryl amine dye and aniline. These are carcinogenic to the bladder epithelium predominantly [2-4].
Urothelium of bladder wall is a thick layer of stratified non-squamous epithelium (Also known as transitional epithelium) is the most common site of bladder cancer, making urothelial carcinoma the most common histological variant. The other histological types include squamous cell carcinoma, small-cell carcinoma and adenocarcinoma [5, 6].
There are numerous imaging modalities for diagnosing bladder cancer such as ultrasonography of bladder, intravenous pyelogram, CT scan, MRI scan and cystoscopy. Cystoscopy is considered the gold standard for diagnosing and taking biopsy from a neoplastic bladder lesion. However, conventional cystoscopy has causes discomfort to patient, high chances of bleeding and increased risk of infection; has a high cost and is unable to detect extravesical extensions of bladder cancer.
Multi-detector CT virtual cystoscopy provides a 3- dimensional image of the bladder and extravesical structures.

The main advantage of this imaging modality is that it is non-invasive and is an emerging tool for diagnosis of bladder cancer.
This study evaluates the efficacy of conventional cystoscopy versus MDCT virtual cystoscopy in diagnosis of bladder carcinoma.

Materials and Methods

This prospective observational study was conducted in the Department of Radiology, Kamineni Academy of Medical Sciences and Research Centre, LB Nagar over a period of 18 months, i.e. from June 2018 to December 2019.
Patients with complaints of hematuria, or abdominal pain or detection of bladder mass in ultrasound examination presenting to the Department of urology who got referred to the Department of Radiology for undergoing further investigative work-up were included in the study. Patients who are allergic to contrast media or who have deranged renal function tests were excluded from the study.
Demographic details regarding the age, gender and occupation were taken. A detailed clinical history, along with history of any addictions or usage of chemotherapeutic drugs (Cyclophosphamide) was taken. All patients were subjected to regular investigations such as complete blood picture, renal function test, complete urine examination, etc. Anti-bilaharzial antibodies were done wherever required. Routine radiological investigations included ultrasound examination of the bladder and pelvis.

MDCT preparation

Multi-detector computed tomography cystography (MDCTC) and virtual cystography (VC) was performed using a 160 multi-slice CT scanner (Aquilion Prime, Toshiba Medical Systems).

Air-filled method: This method was employed for patients with borderline renal function tests. A 12-Fr Foley's catheter was placed and bladder was insufflated using 300-500 mL of carbon dioxide through Foley's, depending upon tolerance of the patient. Bladder distension was assessed in antero-posterior view of scout film. 32 patients underwent air-filled technique.

Contrast- filled method: The procedure was done after ascertaining normal renal function parameters and confirming no history of contrast allergies. Patients were asked to fast for 4 hours prior to the procedure and void urine immediately prior to procedure. Patients were then injected intravenously with 40-60 mL of non-ionic low-osmolar contrast medium. Patient was asked to wait till they felt their bladder was distended. 30 patients underwent contrast-filled method and the rest of 13 patients underwent both air-filled and contrast-filled methods.
Images were taken both in supine and prone positions. Multi-planar reconstruction (MPR) images were processed from CT slices and obtained in a 3-dimensional plane (Transverse, coronal and sagittal planes).

Virtual cystoscopy with MDCT: Stereoscopic images of the inner surgace of the bladder were generated by segmentation of bladder into 6 sides, i.e. anterior, posterior, superior, inferior, lateral (Right and left). The bladder was searched for any evidence of masses. The axial, MPR and virtual images were interpreted. The number, size, location, morphology of bladder lesions was assessed. Tumours were categorized based on their size, < 5mm or > 5mm. based on morphology, lesions were divided into 3 types- polypoidal (Lesion connected to base with a narrow stalk); sessile (Lesion connected to the base via a broad stalk) and area of wall thickening.

Conventional cystoscopy

It was performed using a flexible cystoscope on all patients and biopsies were taken from suspicious lesions. Patients with stricture urethra were excluded.
The findings of conventional cystoscopy (CC) and those of virtual cystoscopy (CT-VC) were compared and histological findings were correlated.
Ethical committee approval was taken prior to the initiation of the study. All data was compiled and analyzed using SPSS software. Qualitative data was represented by numbers and percentages; quantitative data was represented through mean, median and range. Chi square test was done to determine the significance of correlation between two variables.

Results

A total of 75 patients with clinical and radiologically diagnosed cases of bladder cancer were included in the study. Conventional cystoscopy and MDCT virtual cystoscopy was done for all patients.
Majority of the study subjects were males (n = 58; 77.3%) and the rest 23% (n = 17) were females. Males: Females ratio is 3.4: 1. The average age of study population was 53.6 years.

Table 1: Age and gender wise distribution

Age in years	Total No. of patients	males	females
<30 years	3	3	0
31- 40 years	4	3	1
41-50 years	6	4	2
51- 60 years	38	32	6
61-70 years	16	12	4
>70 years	8	4	4
Total	75	58	17

Majority of the patients had a solitary mass (83%). The total number of detected lesions in 75 patients using conventional cystoscopy was 93. Most of the lesions were >5mm in size (67%). Amongst the 93 lesions, 64 were polypoidal and 29 were sessile. There were no areas of wall thickening.

Table 2: Number of masses.

No of masses	No of patients
Solitary mass	62 (83%)
2 masses	10 (13.3%)
3 masses	2 (2.3%)
5 masses	1 (1.3%)

Imaging using MDCT: all 75 patients were subjected to CT scans. 32 patients underwent air-filled technique; 28 patients underwent contrast-filled technique and 15 patients underwent CT scan using both methods.
CT- virtual cystoscopy combined with MPR imaging was able to detect 90 lesions (27 sessile and 63 polypoidal).

Table 3: Comparison between CC and CT-VC in detecting the type of lesion and size of lesion.

Morphology	Conventional cystoscopy		CT-virtual cystoscopy	
	No. of lesions	Sensitivity	No. of lesions	Sensitivity
Polypoidal	64	100%	63	98.15%
Sessile	29	100%	27	93.10%
Total no of lesions detected	93		90	
P value = 0.750 (not significant)				
Size of lesions				
<5mm	31	100%	29	93.5%
>5mm	62	100%	61	98.39%
P value = 0.564 (not significant)				

Table 4: Anatomical distribution of 93 bladder wall lesions

Location	No. of lesions
Anterior wall	13 (13.9%)
Posterior wall	5 (5.3%)
Base	15 (16.1%)
Dome	25 (26.8%)
Lateral wall	33 (35.4%)
Trigone	2 (2.1%)

Lateral wall is the most common site of involvement (35.4%). Histopathological examination of the 93 lesions was done. Among these 93 lesions, 60 were malignant (64.5%) and the rest 33 (35.4%) lesions were benign.

Table 5: Histological type

Histological type			
Malignant (n = 60)	No. of lesions	Benign (n = 33)	No. of lesions
Transitional cell carcinoma	51	Polypoidal cystitis	28
Squamous cell carcinoma	5	papilloma	5
Small cell carcinoma	2		
Carcinoma in situ	2		

Discussion

Bladder cancer is the ninth most common cancers worldwide. Numerous imaging modalities are present to diagnose bladder cancer – ultrasound examination, CT and MRI. Cystoscopy remains the gold standard investigation of choice for diagnosing and taking biopsy. However, conventional cystoscopy has its own set of disadvantages. With the advent of virtual cystoscopy using MDCT, diagnosing bladder cancer has become relatively non-invasive. The present study evaluates the efficacy of detecting bladder cancer in 75 patients suspected clinically or radiologically to have bladder cancer.

In present study, all 93 patients had underwent conventional cystoscopy and MDCT- virtual cystoscopy. 32 patients underwent air-filled methods using Foley's catheterization, 30 patients underwent contrast-filled method and 13 patients underwent both methods of preparation.

Narumi *et al*. [7] and Tsampoulas *et al*. [9] have used air-filled bladder technique, while Nambirajan *et al*. [9] and Kim *et al*. [10] used contrast-filled technique. Air- filled method involves Foley's catherization is this is more likely to cause infection. Injecting contrast material always is associated with the risk of allergic reaction to the contrast material.

In present study, 75 patients were detected to have 93 lesions in total by conventional cystoscopy. Amongst the 93 lesions, 60 are malignant lesions and 33 are benign. Among the 60 malignant lesions, urothelial variety is the most common histological subtype.

In a study done in Egypt by Felix *et al*, squamous cell variant was the most common type earlier, owing to high incidence of schistosomiasis and smoking in developing countries. But after taking measures to curb schistosomal infection and reduce chemical exposures in industries, the incidence of squamous cell variant had decreased. However, the urothelial variant is now the most common subtype [11].

In present study conventional cystography was able to detect all sizes of lesions. CT-VC was able to detect upto 93.5% of lesions < 5mm and upto 98.7% of lesions >5mm in size. Narumi *et al*. [7] in their study reported detection of lesions <10 mm to be difficult using CT-VC. However, in contrast to this, Fenlon *et al*. [12] in their study, were able to detect all the bladder lesions, even <10mm.

Conclusion

CT-VC is almost comparable to conventional cystoscopy in terms of detection of lesion. It has the advantage of being relatively non-invasive, no requirement of anesthesia, no complaints of bleeding, trauma to the bladder wall, ability to visualize extravesical structures. However, CT-VC has its own disadvantages such as it is less sensitive in detection of lesions <5mm in size, and inability to take biopsy from lesion. Therefore it cannot completely replace conventional cystoscopy.

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Conflicts of Interest

Nil

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