URINARY BLADDER CANCER :

VALUE OF CT AND MRI IN DIFFERNTIATING NON MUSCLE INVASIVE BLADER CANCER FROM MUSCLE INVASIVE BLADDER CANCER WITH HISTOPATHOLOGICALLY STAGED TUMORS

Principal Investigator: Dr Mahlet Kifle (MD, Radiologist, Fellow in body imaging)
Advisors:
Dr Tesfaye Kebede, MD, Associate Professor of Radiology and body imaging subspecialist
Dr Assefa Getachew, MD, Associate Professor of Radiology and body imaging subspecialist.

2024 G.C Addis Ababa, Ethiopia

URINARY BLADDER CANCER :

VALUE OF CT AND MRI IN DIFFERNTIATING NON MUSCLE INVASIVE BLADER CANCER FROM MUSCLE INVASIVE BLADDER CANCER WITH HISTOPATHOLOGICALLY STAGED TUMORS

Principal Investigator: Dr Mahlet Kifle (MD- Radiologist, fellow in Body Imaging)

Advisors:

Dr Tesfaye Kebede, MD, Associate Professor of Radiology and body imaging subspecialist

Dr Assefa Getachew, MD, Associate Professor of Radiology and body imaging subspecialist.

ACKNOWLEDGEMENTS

Praise and Gratitude to Almighty GOD and his mother the virgin Mary for blessings and help to complete.

I would also like to express my deepest gratitude to my Insightful advisors Dr Tesfaye Kebede, Dr Assefa Getachew, and my colleagues Dr Amanuel Yegnanew,Dr Aga Legesse, for their valuable knowledge, sharing datas , constructive support , patience and their critical comments during the development of this paper.

I am also thankful to the urology and oncology departments which provided with patient data whenever needed and their kind cooperation. Last but no least to my family who supported me and strengthened me constantly.

TABLE OF CONTENTS

LIST OF ACRONYMS

CHS – Collage of health sciences
TASH -- Tikur Anbessa hospital collage of health sciences
CT-- Computed Tomography
MRI – Magnetic resonance imaging
CA/ca - Cancer
TCC—Transitional cell cancer
SCC- squamus cell cancer
Mp-MRI—Multiplanner Magnetic resonance imaging
VCTC – Virtual Computed Tomographic colonography
BC—Bladder cancer
NMIBC – Non muscel invasive bladder cancer
MIBC – Muscle invasive bladder cancer
TURBT—Trans uretral resction of bladder tumor
T1W—T1 weighted MRI image
T2W—T2 weighted MRI image
DWI—Diffusion weighted image
VI-RADS--Vescial Imaging Reporting and Data System
LAPs- Lymphadenopathies

LIST OF FIGURES

LIST OF TABLES

URINARY BLADDER CANCER: VALUE OF CT AND MRI IN DIFFERNTIATING NON MUSCLE INVASIVE BLADER CANCER FROM MUSCLE INVASIVE BLADDER CANCER WITH HISTOPATHOLOGICALLY STAGED TUMORS

1. Summary

1.1 INTRODUCTION

Bladder cancer ranks as the tenth most prevalent cancer globally, representing 2% of all malignant urinary tract tumors. Diagnosis entails utilizing Cystoscopy first, followed by TURBT and histology. Imaging is primarily valuable for determining the stage. CT imaging is useful for assessing larger, higher-staged tumors and for metastatic evaluation. Meanwhile, MRI has the potential to provide value in evaluating local and regional staging, as well as assessing muscular invasion in bladder cancer, which is crucial for prognosis and treatment decisions.

1.2 OBJECTIVE

Evaluating the Value of CT and MRI in characterizing, differentiation of NMIBC from MIBC and T staging of urinary bladder tumors with correlation of the histopathology staging at TASH.

1.3 METHODS

This is a retrospective record review that has included 109 patients with 86 contrast enhanced CT scans and 23 MRIs performed over 2 and 1/2 years (May 2021 and Dec 2023 G.C period) in patients with histology results of bladder CA who visited TASH, department of radiology, urology and oncology, Addis Ababa, Ethiopia.

1.4 RESULTS

A total of 109 pathologically proven Bladder cancer patients were included .86 patients with post CT and 23 patients with mp MRI showed bladder CA is more common in males with M:F ratio of 2.6:1.The mean age was 57.7 yrs.' with SD of 14.54 .Post contrast CT showed bladder cancers are hyper vascular tumors.

Up on Post contrast CT evaluation Bladder tumors 2 patients (2.32%) have tumor localized to the epithelium(T1), 3 patients have tumor extending to the muscle but no extension to perivesical fat, (T2a/b) , 42 patients (48.8%) have adjacent perivesical fat invasion(T3) , 39 (45.3%) having adjacent organ having adjacent organ and/or pelvic side wall infiltration (T4a/b). Based on MRI, T2W and DWI sequences we were able to assess MIBC vs. NMIBC as well as T staging .We found that 4 patients (17.3%) have NMIBC , 1 patient (4.3%) has MIBC(T2), 6 patients (26%) have perivesical fat infiltration-(T3) and 13 patients(52.4%) having adjacent organ or pelvic side wall invasion(T4). From the total 109 patients metastasis to Lymph nodes were found in 55 (50.4%)of patients .Distant organ metastasis were assessed only with CT and found in 6 patients (7%) .Liver was the most common site (4.6%). Biopsy result showed Among the total 106 patients , 89 patients (85.5 %) have urothilial CA/TCC- among these the most common finding was MIBC, found in 64patients (71.9%) .

1.5 CONCLUSION

Over all regarding differentiation of NMIBC from MIBC and higher t stages CT has sensitivity of 96.2% , specificity 13.4%, accuracy of 80% . PPV and NPV are 79.6% and 50% respectively. MRI has sensitivity 100 %, specificity 50% and accuracy of 83.4%., PPV of 80% and NPV of 100% . These findings indicates MRI is superior in loco regional staging and eivaluation of muscular invasion and CT is preferred for higher stages > T3B , presence of hydronephrosis , Lymphadenopathies and distant metastasis.

2. INTRODUCTION

2.1 BACKGROUND

Bladder cancer ranks as the tenth most prevalent cancer globally [1]. It is the second most common malignant tumor of the urinary tract in both males and females, following prostate cancer, and comprises 2% of all malignancies [1,2,6]. Transitional cell carcinoma accounts for approximately 90% of urinary malignancies, while squamous cell and adenocarcinoma make up 5-10%. The remaining cases are largely composed of sarcomas and metastases from other primary tumors. Accurate pretreatment staging of bladder urothelial carcinoma is crucial for determining the most appropriate treatment. This staging process primarily relies on cross-sectional studies and histopathology obtained during TURBT.

Bladder cancer is subdivided into two main groups; Non-muscle-invasive bladder carcinoma (NMIBC), which is confined to the urothelium and/or lamina propria of the bladder, and muscle-invasive bladder cancer (MIBC), which by definition invades the detrusor muscle [1, 3, 15]. TURBT is both diagnostic and therapeutic procedure done after cystoscopic diagnosis. which includes T1- and T2 weighted sequences and functional sequences, such as diffusion weighted and dynamic contrast-enhanced MRI, has been proposed to stage tumors more accurately as the specific components of the bladder wall are visualized in more detail (1, 31-34)

The wall of the bladder is composed of four layers: the epithelium or mucosa, the sub epithelial connective tissue or lamina propria, the muscle layer, and the serosa. Proton-density weighted images can sometimes differentiate the mucosa and the lamina propria from the muscle layer, as the mucosa and lamina propria exhibit higher signal intensity (6,30).

CT is commonly used for screening, characterizing, and staging after receiving a histological diagnosis following TURBT. CT urography is employed to evaluate both the upper urinary tract and the bladder. Evaluation of the upper tract is important in staging because 2% of patients with bladder UC have a synchronous upper tract tumor [11, 35]. Both CT and MRI can be used for evaluating the upper tract, although CT is more commonly used.(11), CT is most useful in identifying tumors that have macroscopically invaded through the serosa into the perivesical fat (T3b) and invaded adjacent organs (T4) [11].

, the presence of hydronephrosis and potential lymphadenopathy are additional advantage of CT

The use of CT is limited as fat stranding alone might indicate inflammation or a desmoplastic reaction [29]. Furthermore, the absence of fat planes between a bladder tumor and neighboring organs may cause a false-positive perception of organ invasion. Distinguishing tumor confined to the mucosa from muscle-invasive disease is challenging using CT. Some studies have proposed that the retraction of the bladder wall serves as an indirect indicator of T2b muscle-invasive disease [38]. Detecting subtle wall thickening, tumors at the bladder neck near the prostate, and flat sessile lesions is difficult using CT.

MRI is preferred modality for the loco regional staging and evaluation of muscular invasion of BC, which is critically important for prognostication and treatment decision-making, this qualities of high soft tissue resolution make mpMRI is currently the superior imaging modality for soft-tissue resolution, which allows for more accurate loco regional BC staging than CT[4].

Post therapeutic cases are also well assessed with MRI (8). In T1-weighted SE, the tumor has an intermediate to low signal, In T2-weighted SE, the signal from the tumor is much lower than the signal from urine, is higher than the hypo signal from the wall and lower or the same as that of fat.. The presence of a hypo signal border (muscle layer) at the base of the tumor indicates a stage T1 tumor. An irregular internal contour indicates a stage T2a tumor and the hypo signal border being interrupted by a hyper signal, with no infiltration of perivesical fat, indicates a stage T2b tumor. Finally, a lesion with an irregular internal contour and striations in the perivesical fat is evidence of a stage T3b tumor the injection of a contrast agent increases the sensitivity of MRI for detecting small tumors and improves analysis of parietal invasion. Diffusion imaging has excellent sensitivity for detecting lesions, with, as in any tumor process, slowing of diffusion seen in diffusion imaging as a hyper signal and a low apparent diffusion coefficient (ADC) (< 1000 × 10−3mm3/sec)(8).

The presence of a signal in the muscle identical to the tumor signal is the most reliable indicator. If the cortical bone disappears and there is medullary infiltration, it suggests that the tumor has extended into the bone. Evaluation of seminal vesicle invasion relies on morphological criteria in T1-weighted SE, as the signal remains unaltered: vesicle enlargement with replacement of the interseminal vesicle fatty hyper signal by a hypo signal. In T2-weighted SE, there is a localized or diffuse decrease in the hyper signal from the seminal vesicle, replaced by a signal that changes upon injection, similar to the tumor signal development.Invasion of the prostate is assessed in the frontal or sagittal plane and in T2-weighted SE, based on two criteria: disappearance of the clear limit between the bladder and the prostate, and a mass in the parenchyma of the prostate with a signal identical to that from the bladder tumor. Urethral invasion is impossible to confirm. Extension to the vaginal fornix, cervix and uterine body are studied with similar criteria with male. (8)

The primary use of CT or MRI is not to detect bladder tumors, but rather to stage them prior to treatment, primarily to search for any intraperitoneal spread in stages beyond T2a. Because MRI can produce slices, its overall reliability is higher than that of CT, which is partially due to its superior contrast resolution. more suitable

To discern lymph nodes from adenopathies, MRI and CT share the same primary morphological analysis criterion, which is based on size.. Adenopathies is diagnosed when additional tissue has formed around the vascular axes. The ‘mean’ consensus threshold value beyond which a lymph node is considered to be pathological is 10 mm for retroperitoneal lymph nodes and 8 mm for pelvic cavity lymph nodes (38). In the post-therapeutic period, MRI is the examination of choice for detecting recurrence. This is frequent in male patients treated by radical cyst prostatectomy or in women treated by anterior pelvectomy, and estimated at 45% in some series . A T1-weighted sequence is used to look for adenopathies. Uniform adenopathies have the same characteristics: neither the density value nor the signal intensity or uptake of the contrast agent is sufficiently discriminating to distinguish malignant adenopathies from inflammatory adenopathies or even from a common lymph node.(8).

Comparison of CT and MRI for T stage.

MRI has a higher overall reliability than CT, which can be attributed to its superior contrast resolution and its capacity to generate slices that are more tailored to the bladder's morphology, enabling the exploration of tumors located in the base and dome. In actuality, it is only necessary if it is suspected that the disease has spread to nearby organs, starting at the pT3b stage. If renal function is adequate, uro-CT is currently the most dependable method for investigating the upper

urinary tract. (8)

2.2 The rationale of the Study:

The degree of lymph node and distant metastases, the histological tumor type, and the depth of tumor infiltration all have a significant role in determining the course of treatment and prognosis for BC. As such, precise staging is essential. This section will review and provide examples of the function of CT and MRI in tumor detection, as well as their sensitivity, specificity, accuracy, positive predictive value, negative predictive value, and correlation with the histopathologic staging of the same disease. Imaging is used to stage patients who are not candidates for curative cystectomy due to involvement of the pelvic side wall. As far as we are aware, there have been no studies conducted in Ethiopia at the hospital or national level that evaluate the role of CT and MRI for staging and detection.

3. LITERATURE REVIEW

The tenth most frequent cancer in the world is bladder cancer. Furthermore, 2 percent of all malignancies are prostate cancers, the most prevalent malignant tumour of the urinary system in both genders (1, 2, 6).

The majority of individuals diagnosed with bladder cancer are reported to have non-muscle-invasive bladder cancer (NMIBC). Additional management recommendations include close monitoring and local retention followed by intravesical therapy.danger of the disease eventually progressing to a more advanced level. Nonetheless, at the time of diagnosis, about 25% of individuals initially exhibit MIBC. Magnetic resonance imaging (MRI) or contrast-enhanced computed tomography (CT) can be used to detect distant metastatic spread as well as local or regional extravesical tumour invasion.

TURBT is still the most effective non-invasive imaging method for achieving tumour staging between MIBC and NMIBC.

The most widely used imaging modality, computed tomography (CT), performs exceptionally well in assessing nodal and distant visceral metastatic disease (4, 15). First Diagnosis The most widely utilised imaging technique in the world for the diagnosis and staging of urothelial cancers, as well as for the localization, loco-regional staging, and identification of distant metastases, is computed tomography (CT), and more especially, CT urography (CTU).(4). It has been suggested that CT urography, which comprises thin-section pictures both before and after intravenous contrast material injection, provides a thorough assessment of the BC.Determining the involvement of lymph nodes in the belly and pelvis can also be done with CT. The most common method for suspecting nodal metastases on CT is lymph node size; however, aberrant morphologies, such rounded or irregular nodes, may indicate metastatic involvement. N-stage

Study conducted by Dr. Cheryl A. Sadow Stuart G. Silverman, MD, In Academic Medical Centre Bladder Cancer Detection Using CT Urography Overall, for CT urography, the results showed that the results were 79% (117 of 149), 94% (649 of 689), 91% (766 of 838), 75% (117 of 157), and 95% (649 of 681) for bladder cancer detection; for cystoscopy, the results were 95% (142 of 149), 92% (634 of 689), 93% (776 of 838), 72% (142 of 197), and 99% (634 of 641). Among patients tested solely for hematuria, the NPV of CT urography was higher (98%, 589 of 603). However, patients with a history of urothelial cancer had much worse CT urography accuracy (78%, 123).

For loco-regional staging, magnetic resonance imaging (MRI) has been assessed, along with the assessment of muscularis propria invasion.(4,15). To ascertain whether the tumour is muscle-invasive and whether the complete lesion has been removed, this tumour excision should involve the detrusor muscle [1].

According to reports that have surfaced recently, magnetic resonance imaging (MRI) may be a better imaging modality for bladder tumour local staging. It has been suggested that multiparametric magnetic resonance imaging (mpMRI), in particular, can more accurately stage tumours because it allows for a more detailed visualisation of the specific bladder wall components. This includes T1- and T2 weighted sequences as well as functional sequences like

diffusion weighted and dynamic contrast-enhanced MRI [1]. MRI: The tumour has an intermediate to low signal in T1-weighted SE, comparable to

Studies conducted in the Netherlands According to Eline H. Huelea, MRI is useful for local staging of invasive bladder tumours. After undergoing mpMRI, thirty-seven individuals with known bladder tumours were diagnosed with muscle-invasive bladder cancer (MIBC) and ten with non-muscle-invasive bladder cancer (NMIBC). Twelve subjects had NMIBC and twenty-five persons had MIBC in the "whole-mount" pathology results. For the assessment of MIBC, we discovered a sensitivity and specificity of 0.88 and 0.58, respectively. The predictive values for favourable and negative outcomes were 81% and 70%, respectively. 78% of patients could be diagnosed with NMIBC and MIBC using mpMRI.(1).

MRI was also demonstrated in a subsequent study by Janet E. S. Husband, FRCP, FRCR, on bladder cancer staging using CT and MRI imaging.

As with all cancers, imaging(CT and MRI) plays a significant role in the management of patients with BC, including the loco-regional staging and evaluation for distant metastatic disease, which cannot be assessed at the time of cystoscopy and biopsy/resection. Researches showed that MRI has better sensitivity and low specificity when compared to CT with less sensitivity but better specificity.

4. OBJECTIVES

4.1 GENERAL OBJECTIVE

- Evaluating the Value of CT and MRI in characterizing , differentiation of NMIBC from MIBC and T staging of urinary bladder tumors with correlation of the histopathology staging at TASH.

4.2 SPECIFIC OBJECTIVES ,

To assess the socio-demographic characteristics of patients with diagnosed Bladder CA

To characterize the CT and MRI features of bladder tumors including size, site ,location , local extent and distant lymphnode and organ metastasis

To Assess the sensitivity, specificity, and overall accuracy , predictive values of the CT and MRI in differentiating NMIBC from MIBC in histopathology confirmed cases .

5. METHODS AND MATERIALS

5.1 STUDY AREA &PERIOD

Ethiopia, TASH which is a tertiary hospital ,. The hospital provides a tertiary level care . Study period is from May 2021 – Dec 2023.

5.2 STUDY DESIGN

A retrospective cross- sectional descriptive study.

5.3 SOURCE AND STUDY POPULATION

5.3.1 SOURCE POPULATION:

These are patients who visited TASH who visited Urology and oncology departments During the study period 2021 -2023 G.C.

5.3.2 STUDY POPULATION

All registered and Histologically proven BC patients with cross sectional imaging (CT and MRI imaging).

5.4 INCLUSION CRITERIA

All patients with clinical and /or cystoscopy and Histopathology diagnosis of Bladder CA and classified as MIBC vs. NMIBC during the study period.

5.5 EXCLUSION CRITERIA

Patients who have discrepancy between histology and imaging, Patients with histologic samples were muscle was not represented (not staged by pathology as MIBC Vs. NMIBC).

5.6 SAMPLING TECHNIQUE AND SAMPLE SIZE

Total population sampling technique applying the inclusion and exclusion criteria , A total of 86 patients with post contrast CT and 23 patients with mp PRI were included.

5.7 DATA COLLECTION TOOLS AND PROCEDURES

Data collection was undertaken by the principal investigator using a structured EXCEL .sheet which later copied to SPSS for analysis .the CT and MR images and patient data were collected from Radiology-Urology –Oncology MDT telegram group, from oncology and urology registration books.

MDT- (multi-disciplinary team) - team of specialists meet to talk about the best treatment based on national treatment guidelines . CT scan were 64 and above slices which mean the CT scan can take 64 high resolution anatomical images per rotation in less than 15 seconds , MRI of 1.5 T is used in 20 patients, 3 patients have 0.3T MRI.

We address 18 variables on the CT evaluation and 13 variables in the MRI evaluation to assess the value of this cross sectional imaging in detecting , characterizing, ,t staging and most importantly in differentiation MIBC from NMIBC and the variables questing mainly socio-demographic status, characteristics of tumors, post contrast values on CT and MRI basic sequence features , histologic diagnosis with t staging correlation , metastasis and Concomitant upper tract tumors were major divisions . Post contrast CT enhancement was taken as hyper vascular if it I enhancing more than the background muscle in the arterial or venous phases. Lymohnodes were taken enlarged if > 10 in the retro peritoneum and common iliac regions, and 8mm in the pelvic region . CT and MRI diagnosis was made by fellows and consultant radiologists (Abdominal imaging subspecialists) .name and MRN were included in the data collection format to avoid repeat data

Finally sensitivity, specificity, accuracy, PPV, NPV will be calculated. Images were reviewed by the principal investigator (abdominal imaging fellow and by 1 abdominal imaging consultant radiologists.) . The histopathological the results of the patient were also collected from patient record in the pathology department where all the results were signed by one resident and one consultant pathologist. Based on TNM guidelines above the level of the aortic bifurcation, are now considered to be distant metastases Regional lymph nodes include: inguinal, hypogastric (internal iliac chain), obturator, external iliac chain, perivesical, and presacral lymph nodes, all of which are located below the level of the common iliac arteries recommended size thresholds that have been utilized are ≥8 mm in short axis for suspected abnormal pelvic lymph nodes and ≥10 mm in short axis for abdominal lymph nodes The loss of this normal appearance and a more rounded or irregular configuration and necrosis are considered metastatic tumor.

5.8 DATA PROCESSING AND ANALYSIS

The data was double-checked for clarity and completeness. IBM SPSS Statistics, version 26.0 (IBM Corporation, Armonk, NY, USA) was utilized to conduct the statistical analysis, the data was then compared and summarized. For the clarity standard T **Transitional cell carcinoma of the bladder staging** uses the TNM system was used(these system is currently used staging system which is available in the radiologic articles and books .. pathologic results only came as MIBC or NMIBC we were pushed to divide the t stages in to two major categories in order to assess sensitivity, specificity, accuracy, and predictive values so our two major categories are one is as NMIBC which are localized to epithelium and the other MIBC and above as including T2 and above where muscle is invaded, t3 (perivesical invasion and T4(Adjacent organ and pelvic side wall invasion.

5.8.1 DEPENDENT AND INDEPENDENT VARIABLES

Independent Variables,

- Age, Gender, MRN(Hospital registration number0

Dependent Variables

- Clinical presentation, Tumor size , tumor location ,distribution , , , extent of tumor as ,Muscle invasion or no invasion , ,T - staging ,Pick enhancement time on CT , Peak enhancement value on CT , metastasis Lymph nodes, with location, Hydronephrosis, distant metastasis, Biopsy results, concomitant upper tract involvement.

5.10 ETHICAL CONSIDERATIONS

Ethical clearance was obtained from TASH department of radiology patient identifiers were removed from the data collection tool a Any piece of information was kept confidential by keeping anonymity of the study subjects. The information gathered during the study will be used strictly for the research purpose only.

5.11 DISSEMINATION OF THE STUDY FINDINGS

The findings of this study will be submitted to the department of radiology, College of Health Sciences, Addis Ababa University as partial fulfillment of a sub specialty certificate in radiology. After evaluation The outcome of this study will be presented to other interested stakeholders through annual conferences/academic symposia and meetings. Finally, the manuscript will be submitted to a reputable scientific journal for possible publication

6. RESULTS

6.1 SOCIO DEMOGRAPHIC CHARACTERISTICS

A total of 109 patients were included in this study. Among these 86 patients had post contrast CT scan and 23 patients MRI .78 patients were male and 31female (M:F ratio of 2.5:1).The mean age was 57.57 with standard deviation of 14.535. The age ranges between 23 years and 80 years,

6.2 CLINICAL PRESENTATION

The most common clinical presentation was hematuria with associated low urinary tract symptoms in 57 patients (52.3 %).

6.3TUMOR SIZE

we were able to measure in 107 patients who have post contrast CT scans and MRI were included among these 81 patients (75.7 %) have tumor size > 5cm ,23 patients (21.4%) have size of 2-5 cm, 2 patients have size <2cm.

6.4 TUMOR LOCATION

Tumor location	Frequency	Percent
Dome only	5	4.5%
Anterior or posterior wall only	20	18.3%
>trigon only	5	4.5%
Neck only	5	4.6 %
Wall extending to trigon and neck	38	34.8 %
3 and more areas of involvement	35	32.1%
Total	109	100%

Table 1: Tumor location in the bladder wall

6.5 TUMOR DISTRIBUTION

From total of 109 patients The most common tumor distribution is multifocal areas of involvement in 52 (47.7%) patients followed by single focal area in 38 patients (34.8%) and diffuse circumferential involvement in 19 patients (17. 5%) .

6.6 LYMPNODE AND DISTANT ORGAN METASTASIS

From total of 109 patients were able to assess in 108 patients and Lymph node metastasis were found in 55 (50.4%)) patients. Among these 27 patients (49.1 %) have Lymphadenopathies in the true pelvis(regional LNs) and the remaining 28 patients(50.9%) have Lymph nodes beyond true pelvis (common iliac, inguinal or retroperitoneal) suggesting stage IV disease .

Distant organ metastasis were assessed only with CT and found in 6 (7 %) of patients ,.Liver being most common site liver - 3 patients, both liver and lung - 1 patient, Only Bone -1 patient and lung only – 1 patient.

6.7 HYDRONEPHROSIS AND CONCOMITANT UPPER TRACT TCC

From the 109 patients Hydronephrosis was found in 79 (72.4%) patients which is an indicator of higher stage tumor and needs more radical treatment even if imaging examination shows no peri-vesical invasion.

Concomitant TCC in the upper urinary tract involving ureter and/or renal collecting system in 7 patients(6.4 %) , 2 patients with renal collecting system involvement, 5 patients ureteric involvement.

6.8 CT IMAGING FINDINGS

6.8.1 TUMOR PEAK ENHANCEMNT TIME AND ENHANCEMNT VALUE

. The most common timing for most tumors to enhance maximally were at the Porto venous phase (41-60 seconds) in 55 patients (79.6%) followed by arterial phase in 17 patients(21.5%). All Bladder tumors in the study were found to have enhancement more than the pre-contrast value Enhancement as detailed in the table below

Enhancement value	**Frequency**	**Percent**
50-90HU	56	70.9%
90-110 HU	13	16.4%
>110 HU	10	12.7%
Total	79 patients	100%

Table 2: Table illustrating Enhancement in HU

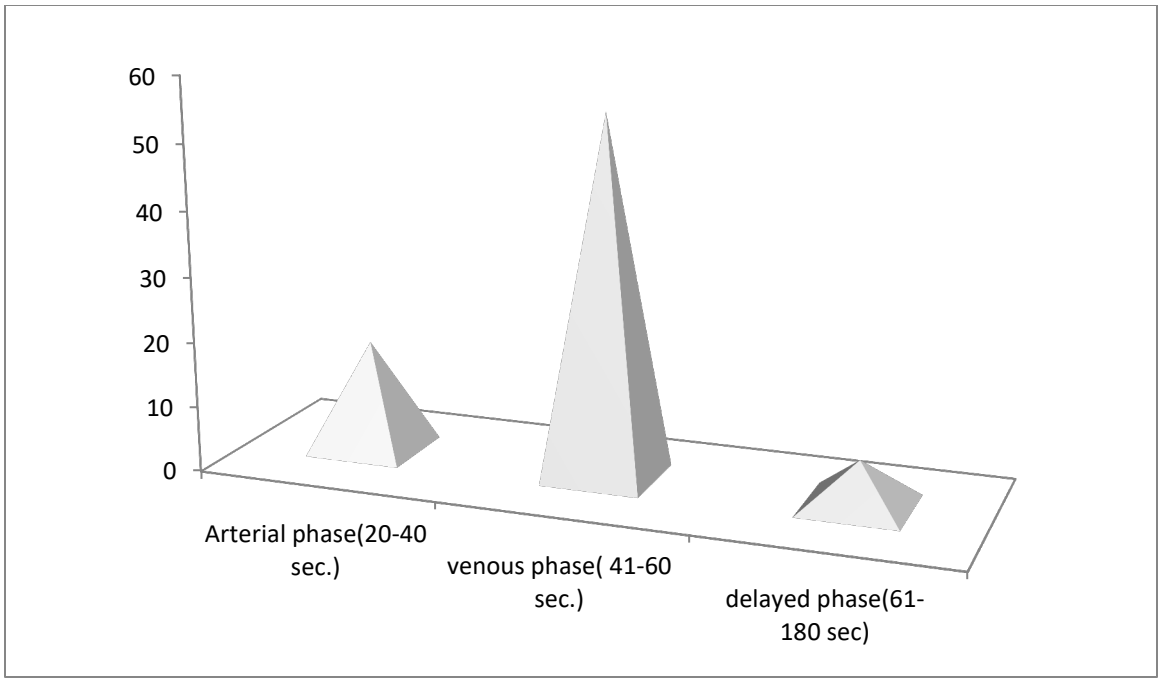

Figure 1: Histogram illustrating peak enhancement time of tumors

6.8.2 T - STAGING WITH CT

Up on Post contrast CT evaluation Bladder tumors 2 patients (2.32%) have tumor localized to the epithelium(T1), 3 patients have tumor extending to the muscle but no extension to perivesical fat, (T2a/b) , 42 patients (48.8%) have adjacent perivesical fat invasion(T3) , 39 (45.3%) having adjacent organ having adjacent organ and/or pelvic side wall infiltration (T4a/b).

6.9 MRI IMAGING FINDINGS

6.9.1 TUMOR MRI FEATURES

All the tumors in the 23 patients appear T1 iso intense to the muscle with 21patients (91.2%) having T2 intermediate signal, and 2 patients have T2 high signal intensity when compared to the muscle . We were able to find properly done DWI sequence in 13 patients and 11 patients (84.6%) showed restriction and there was no restrictions in 2 patient's (15.4%) patients .

MRI,T2W sequence features	Frequency	Percent
Intermediate signal compared to muscle	21	91.3%
Higher signal than the muscle	2	8.7%
Total	23	

Table 3: MRI T2W features

6.9.2 TUMOR T - STAGING WITH MRI

Based on MRI, T2W and DWI sequences we were able to assess MIBC vs. NMIBC as well as T staging .We found that 4 patients (17.3%) have NMIBC , 1 patient (4.3%) has MIBC(T2), 6 patients (26%) have perivesical fat infiltration-(T3) and 13 patients(52.4%) having adjacent organ or pelvic side wall invasion(T4),

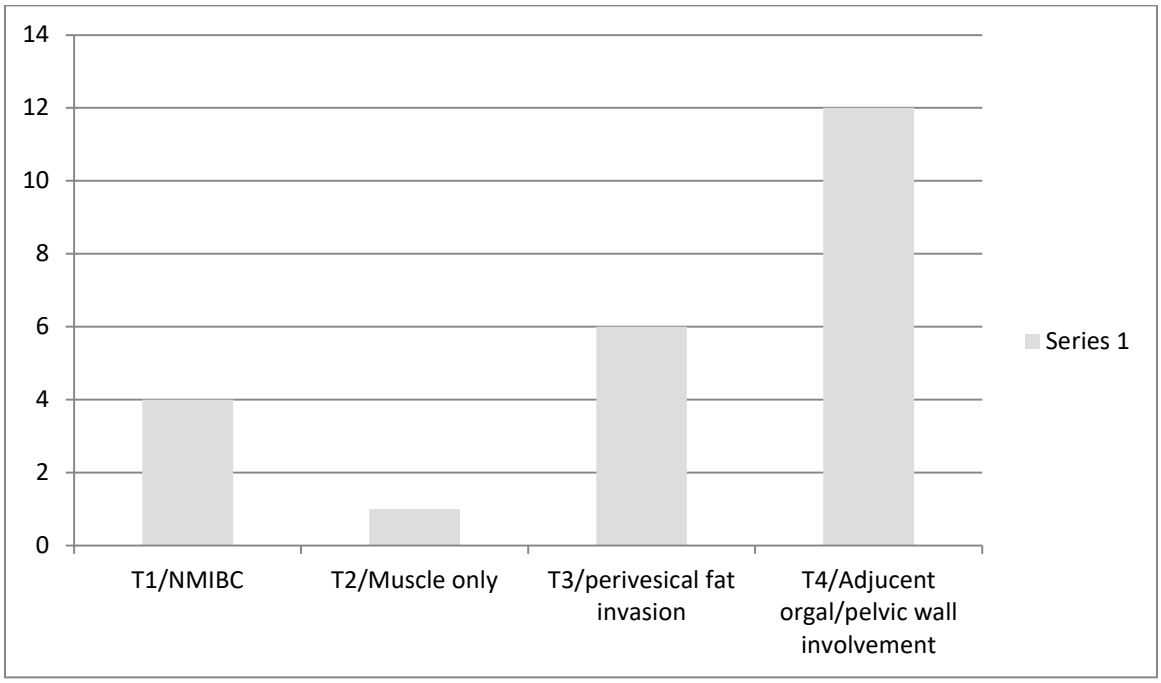

Fig 2. T staging based on MRI (T2W and DWI sequences)

6.10 DETERMINING SENSITIVITY, SPECIFICITY AND PREDICTIVE VALUES

Over all regarding differentiation of NMIBC from MIBC and higher t stages the table below summarizes our findings

NMIBC from MIBC	CT	MRI
Sensitivity	96.2 %	100 %
Specificity	13.4 %	50 %
Accuracy	80 %	3.4 %
PPV	79.6 %	80 %
NPV	50 %	100 %

Table 4: *Summary of Sensitivity, Specificity and predictive values*

6.11 BIOPSY RESULT OF TOTAL PATIENTS

From total of 106 patients biopsy result were found in 104 patients and among these patients with biopsy - 89 patients (85.5 %) have pathologically confirmed urothelial CA-TCC and the rest 15 patients(14.6%) have non –Urothilial tumors,

from the 89 patients with TCC ,most common findings were MIBC found in 64 patients (71.9%) and non MIBC were found 25 patients(28.1 %),. from the 64 patients with MIBC High grade-MIBC found in 44patients (68.7%)which was the most common pathologic finding .

7. DISCUSSION

Upon the evaluation of bladder cancer the infiltration in the muscle layer must be determined before treatment (41). These is retrospective study focused on the distinction between NMIBC and MIBC on mpMRI and CT , as this determines the possible treatment options and prognosis for patient with a bladder tumor. A systematic review done by Cornelissen et al to determine the value of mpMRI in the initial staging of bladder tumors, found a pooled sensitivity and specificity of0.92 and 0.88 respectively, to differentiate between NMIBC and MIBC. They conclude that mpMRI is effective for making the distinction between NMIBC and MIBC, but not for determining T-stage, so it can be used for confirmation when muscle-invasive disease is suspected at initial diagnosis. (21).

Husband et al (5) argued against the superiority of MR imaging and demonstrated that MR imaging was slightly inferior to CT. Kim et al (29) showed that dynamic gadolinium-enhanced MR imaging was slightly more accurate than CT and other MR techniques, although the difference was not statistically significant. According to their results with dynamic gadolinium-enhanced MR imaging, the cancer detection rate was 100%, and the sensitivity 100% , specificity73%, and overall accuracy 93%. Another study by Jeong KonKim,(13) showed sensitivity (89%) and higher specificity (95%) and accuracy of 93% accuracy for . Our study showed that MRI has sensitivity 100 %, specificity 50% and over all detecting and local staging accuracy of 83.4%. , a study done by Eline H in Netherlands (1) show,14 ed sensitivity and specificity of 88% and 58% ,positive Predictive value of 81 and negative predictive value of 70%. Our findings are more or less similar to Kim et al studies. In addition, Woo et al. and Huang et al. performed a meta-analysis of ≥1.5T MRI for identifying MIBC and found similar sensitivity and specificity similar to Cornelissen et .study and concluded that 3T MRI devices showed higher specificity than 1.5T scanners. Our findings showed mainly that there are no false negative values and there are 3 cases with false positive values which is indicator of over staging of the T-stage of the tumor,. The advantages of dynamic contrast-enhanced images compared with later contrast-enhanced images are that tumors are relatively higher in signal intensity than the background bladder immediately after contrast administration and fluid in the bladder is void of signal. These factors allow for better detection of small tumors and generally more accurate tumor staging(29). They found out with use of dynamic post contrast study increased sensitivity from 83 %to 86 % but lower specificity from 78% to 73%, suggesting T2W and Post contrast has comparable detection and staging values. Our result which is based on DWI and T2W showed 100 % sensitivity and lower specificity of 50 %.

CT is suboptimal compared with MRI for local staging up to t3a and for differentiating non-muscle-invasive bladder cancer (NMIBC) (T1) from muscle-invasive bladder cancer (MIBC) (T2)(22,23). We observed that sensitivity of CT is 96.2% and specificity of 13.6% and accuracy of 80%, PPV 79.65 and NPV 50%.In differentiating of NMIBC from MIBC . In a research done by

hongmei gu(41) found out CT has the sensitivity, specificity, accuracy, were 73% ,81% and 79%, respectively, which showed lower sensitivity and higher specificity when compared to our study . Tumors into stage <T2 and stage ≥T2, there are some early models using machine learning that may help stratify which may increase CT utility in this area of local staging in the future, but currently, this differentiation requires further investigation and validation prior to clinical implementation and acceptance .CT imaging is best used locally in the assessment of higher-staged larger tumors(4) .

Hydronephrosis was found in 63 (73.3%) patients which is an indicator of higher stage tumor and needs more radical treatment even if imaging examination shows no peri-vesical invasion(39).

Although TCC has typically been regarded as a hypo vascular tumor, these lesions have considerable urothelial hyper vascularity and are typically most conspicuous on early phase images. As a result any focal increased enhancement of the bladder urothelium must be considered suspicious for malignancy. This tells us that the delayed phase has typically been considered the most important for identifying bladder tumors, but early phase images (whether arterial or venous) are likely more important for lesion conspicuity, this is due to subtle lesion enhancement may be more difficult to detect in delayed phase since the contrast material has been excreted into the bladder, lesion can be missed easily either from beam hardening artifact and/or washout of enhancement)-(13). In our study, we found results with maximum tumor enhancement were seen in the Porto venous phase (40- 60 second) in 64% of patients and, the enhancement value was b/n 50 -90 HU in 71% and 90-110HU in the remaining 29% of our patients which indicates hyper vascularity of these tumors. A similar study by Kim et al.also mentioned that the attenuation of 20 bladder tumors was measured on arterial, venous, and delayed images. The investigators found that the enhancement of bladder TCC peaked at approximately 105 HU, and range of 78-129 HU, usually at approximately 60 seconds, before washing out slowly over time. As a result for any patient presenting with hematuria One arterial /Porto venous phase CT is critical (14).

Identifying lymph node involvement on CT is usually based on lymph node size and shape. Lymph nodes greater than 8 mm in the pelvic and 10 mm in the abdomen when measured din short axis are considered as abnormal though there is a risk of missing lymph nodes smaller than 8 mm in short axis diameter, Pichler et al. demonstrated that the best cutoff value for metastatic pelvic lymph node identification was 8 mm (sensitivity and specificity of 45.5% and 91.5%) (24.) we found that with post contrast CT, there was a LN metastasis in 49.8% of patients based on Pichler et al cut off value >8mm . Nodal disease on MRI is identified by size (>8 mm in short axis) and morphological criteria, such as round shape, irregular borders, central necrosis, and loss of fatty hilum (4). We found out among patients who had CT Lymph node metastasis were found in 42 (49.8) patients. Among these 19 45.3%) have Lymphadenopathies in the true pelvis(regional LNs) and the remaining 23 patients(54.7%) have Lymph nodes beyond true pelvis (common iliac, inguinal or retroperitoneal) which is suggesting stage IV disease .Among patients who has MRI , 13 (59%)

patients have Lymph node metastasis .Among these 8 patients (61.5%) . have pelvic nodal metastasis and remaining 5 patients (38.4 %)have distant Lymohnodpathies in the retroperitoneal and inguinal regions. Over all Lymph node metastasis were found in 55 patients (50.4%)

Yousem DM mentioned that It is also important that bladder UC because metachronous tumor in the upper tract has been reported in 3.9% of such patients(including post treatment follow up patients(27) , we found out 7 patients (6.6%) have concomitant upper tract TCC .There is still controversy about whether CT or MR imaging is better for evaluation of bladder cancer. Some authors demonstrate that CT is superior and some MRI as superior in the detection and differentiation of NMIBC from MIBC, our study indicates MRI is superior in t staging with better sensitivity, specificity and all predictive values.

\

8. CONCLUSION

Clinical staging with TURBT followed by CT and MRI staging is essential for bladder CA staging. We conclude that CT has sensitivity of 96.2 % ,Specificity of 13.4%, accuracy of 80% and MRI has sensitivity 100 %, specificity 50% and accuracy of 83.4% in overall staging of BC. LNs is better assessed with CTU than by MRI .Distant metastasis was only assessed by CT in our study with 7% rate. Overall with MRI which is superior in determining local tumor growth especially with T2W it is possible to differentiate non-muscle-invasive bladder cancer (NMIBC) (T1) from muscle-invasive bladder cancer (MIBC) (T2), and CT was quite useful for differentiating between tumors staged up to T3a from higher-staged T3b and T4 BCs. Metachronus tumors, lymphadenopathies and distant metastasis are better assessed with CT.

9. RECOMMENDATION

The limited number of participants especially with MRI disables us to conclude the value of MRI in staging of bladder cancer, Ideally It is recommended that staging requires MRI prior to Clinical staging which is costly, The other limitation was the quality of the MRI images .
Future study with cystectomy outcomes correlation is also recommended rather than TURBT histology correlation.
Lymph node pathologic assessment especially post cystectomy outcome with CT correlation should be studied separately.

REFERENCES;

1. Eline H. Huelea , Paul W. Veenboera , Frank J. Wesselsb , Trudy N. Jongesc , Richard P. Meijera,accepted 23 September 2022, Value of multipara metric magnetic resonance imaging for local staging of invasive urinary bladder tumours
2. International agency for research on cancer. Cancer today, Estimated number of new cases in 2020, worldwide, both sexes, all ages, 2021 [Internet]. 2021. Available from: https://gco.iarc.fr/today/online_analysis-
3. Sobin DH, Gospodarowicz M, Wittekind CE. TNM classification of malignant tumours. 7th Edition. Wiley-Blackwell; 2010. Goggle scholar
4. Samuel J. Galgano 1,2, Kristin K. Porter 1 , Constantine Burgan 1 and Soroush Rais-Bahrami; Published: 16 September 2022,Value of multiparametric magnetic resonance imaging for local staging of invasive urinary bladder tumours
5. Janet E. S. Husband, FRCP, FRCR #{149}Julie F. C. Olliff, MRCP, FRCR #{149}Michael P. Williams, MA, FRCR Christine W. Heron, MRCP, FRCR2 #{149}Graham R. Chennyman, FRCR, Bladder Cancer: Staging with CT and MR Imaging'
6. J. O. Barentsz ~ , G. J. Jager 1 , J. A. Witj es 2, J. H. J. Ruijs ~Accepted 7 December 1995,Primary staging of urinary bladder carcinoma: the role of MRI and a comparison with CT
7. Jewett HJ (1973) Cancer of the bladder. Cancer 32:1072-1075
8. Service de radiologie B, nouvel hôpital civil, hôpitaux universitaires de Strasbourg, 1, place de l'Hôpital, BP 426, 67091 Strasbourg cedex, France, 2012,Tumour pathology of the bladder: The role of MRI
9. Siegel, L.R.; Miller, K.D.; Jemal, A. Cancer statistics, 2019. CA Cancer J. Clin. 2019, 69, 7–34. [CrossRef]
10. Anna Lois Lai,Publised: Jan 02,2023 ,VI-RADS in bladder cancer,Overview,Pearls and Pitfalls,DOI: https://doi.org/10.1016/j.ejrad.2022.110666.
11. Chau Hung Lee1 Cher Heng Tan1 Silvana de Castro Faria2 Vikas Kundra2, December 29, 2016, Role of Imaging in the Local Staging of Urothelial Carcinoma of the Bladder, DOI:10.2214/AJR.16.17114
12. Cheryl A. Sadow, MD Stuart G. Silverman, MD Michael P. O'Leary, MD James E. Signorovitch, PhD ,april 24,200,Bladder Cancer Detection with CT Urography in an Academic Medical Center
13. Kim JK, Park SY, Ahn HJ, Kim CS, Cho KS. Bladder cancer: analysis of multi-detector row he lical CT enhancement pattern and accuracy in tu mor detection and perivesical staging. Radiology 2004; 231:725–731
14. Siva P. Raman1 Elliot K. Fishma, October 31, 2013, Bladder Malignancies on CT: The Underrated Role of CT in Diagnosis. DOI:10.2214/AJR.13.12021
15. Soroush Rais-Bahrami, M.D.a,b, *, Jason A. Pietryga, M.D.b , Jeffrey W. Nix, M.D. accepted 26 August 2015, Contemporary role of advanced imaging for bladder cancer staging [8]
16. Shariat SF, Palapattu GS, Karakiewicz PI, Rogers CG, Vazina A, Bastian PJ, et al. Discrepancy between Clinical and Pathologic Stage: Impact on Prognosis after Radical Cystectomy. Eur Urol 2007;51 (1):137–51. [9]

17. Svatek RS, Shariat SF, Novara G, Skinner EC, Fradet Y, Bastian PJ, et al. Discrepancy between clinical and pathological stage: External validation of the impact on prognosis in an international radical cystectomy cohort. BJU Int 2011;107(6):898–904. E.H. Huele et al. / Urologic Oncology: Seminars and Original Investigations 41 (2023) 49.e7−49.e12 49.e11 Downloaded for Anonymous User (n/a) at ClinicalKey Global Guest Users from ClinicalKey.com by Elsevier on October 19, 2023. For personal use only. No other uses without permission. Copyright ©2023. Elsevier Inc. All rights reserved. [10]

18. Dutta SC, Smith JA, Shappell SB, Coffey CS, Chang SS, Cookson MS. Clinical under staging of high risk nonmuscle invasive urothelial carci_noma treated with radical cystectomy. J Urol 2001;166(2):490–3. [11]

19. Miladi M, Peyromaure E, Zerbib M, Sa _ ~o D, Debre B. European Urol_ogy The Value of a Second T ransurethral Resection in Evaluating Patients with BladderTumours. Eur Urol 2003;43:241–5.

20. S Mojdeh Mirmomen[1], Atul B Shinagare[2 3], Kristin E Williams[2 3], Stuart G Silverman[3], Ashkan A Malayeri[4 5] preopimaging for locoregional staging of bladder cancer , 2019 Dec;44(12):3843-3857. doi: 10.1007/s00261-019-02168-z.

21.] Cornelissen SWE, Veenboer PW, Wessels FJ, Meijer RP. Diagnostic Accuracy of Multiparametric MRI for Local Staging of Bladder Cancer: A Systematic Review and Meta-Analysis. Urology [Internet] 2020;145:22–9. https://doi.org/10.1016/j.urology.2020.07.021

22. Lee, C.H.; Tan, C.H.; Faria, S.D.C.; Kundra, V. Role of Imaging in the Local Staging of Urothelial Carcinoma of the Bladder. Am. J. Roentgenol. 2017, 208, 1193–1205. [CrossRef] [PubMed] 13.

23. Mossanen, M.; Chang, S.L.; Kimm, S.; Sonpavde, G.P.; Kibel, A.S. Current Staging Strategies for Muscle-Invasive Bladder Cancer and Upper Tract Urothelial Cell Carcinoma. Urol. Clin. N. Am. 2018, 45, 143–154. [CrossRef] [PubMed]

24. Pichler R, De Zordo T, Fritz J, Kroiss A, Aigner F, Heidegger I, Virgolini I, Horninger W, Uprimny C (2017) Pelvic lymph node staging by combined 18F-FDG-PET-CT imaging in bladder can cer prior to radical cystectomy. Clinical genitourinary cancer 15(3):e387-95.

25. Amin, M.B.; Greene, F.L.; Edge, S.B.; Compton, C.C.; Gershenwald, J.E.; Brookland, R.K.; Meyer, L.; Gress, D.M.; Byrd, D.R.; Winchester, D.P. The Eighth Edition AJCC Cancer Staging Manual: Continuing to build a bridge from a population-based to a more "personalized" approach to cancer staging. CA Cancer J. Clin. 2017, 67, 93–99.

26. Sadow, C.A.; Silverman, S.G.; O'Leary, M.P.; Signorovitch, J.E. Bladder Cancer Detection with CT Urography in an Academic Medical Center. Radiology 2008, 249, 195–202.

27. Yousem DM, Gatewood OM, Goldman SM, Mar shall FF. Synchronous and metachronous transi tional cell carcinoma of the urinary tract: preva lence, incidence, and radiographic detection. Radiology 1988; 167:613–618

28. . McPartlin DS, Klausner AP, Nottingham CU, et al. Is cystoscopy indicated for incidentally identi f ied bladder wall thickening? Can J Urol 2013; 20:6615–6619

29. Kim B, Semelka RC, Ascher SM, Chalpin DB, Carroll PR, Hricak H. Bladder tumor staging: comparison of contrast-en hanced CT, T1- and T2-weighted MR im aging, dynamic gadolinium-enhanced imaging, and late gadolinium-enhanced imaging. Radiology 1994; 193:239–245

30. Barentsz JO, Debruyne FMJ, Ruijs SHJ (1990) Magnetic reso- nance imaging of carcinoma of the urinary bladder Kluwer, Dordrech

31. Panebianco V, Narumi Y, Altun E, Bochner BH, Efstathiou JA, Hafeez S, et al. Multiparametric Magnetic Resonance Imaging for Bladder Cancer: Development of

VI-RADS (Vesical Imaging Reporting And Data System). Eur Urol [Internet] 2018;74(3):294 306. https://doi.org/10.1016/j.eururo.2018.04.029. [13]
32. Saksena MA, Dahl DM, Harisinghani MG. New imaging modalities in bladder cancer. World J Urol 2006;24(5):473–80. [14]
33. panebianco V, Barchetti F, de Haas RJ, Pearson RA, Kennish SJ, Gian narini G, et al. Improving Staging in Bladder Cancer: The Increasing Role of Multiparametric Magnetic Resonance Imaging. Eur Urol Focus 2016;2(2):113–21. https://doi.org/10.1016/j.euf.2016.04.010. [15]
34. De Haas RJ, Steyvers MJ, F€ utterer JJ. Multiparametric MRI of the bladder: Ready for clinical routine?, 202. American Journal of Roent genology; 2014:1187–95.
35. Brown RF, Meehan CP, Colville J, Power R, Tor reggiani WC. Transitional cell carcinoma of the upper urinary tract: spectrum of imaging findings. RadioGraphics 2005; 25:1609–1627
36. Yousem DM, Gatewood OM, Goldman SM, Mar shall FF. Synchronous and metachronous transi tional cell carcinoma of the urinary tract: preva lence, incidence, and radiographic detection. Radiology 1988; 167:613–618

Kundra V, Silverman PM. Imaging in oncology from the University of Texas M. D. Anderson Cancer Center: imaging in the diagnosis, staging, and follow-up of cancer of the urinary bladder. AJR 2003; 180:1045–105
37. Ng CS. Radiologic diagnosis and staging of renal and bladder cancer. Semin Roentgenol 2006; 41:121–138
38. Jager GJ, Barentsz JO, Oosterhof GO, Witjes JA, Ruijs S. Pelvic lymphadenopathy in prostatic and urinary bladder car cinoma: MR imaging with a three-dimensional T1-weighted magnetization-prepared-rapid gradient-echo sequence. AJR 1996;167:1503—7.

39. Przemysław Adamczyk,[1,*] Paweł Pobłocki,[1] Mateusz Kadlubowski,[1] Adam Ostrowski,[2] Andrzej Wróbel,[3] Witold Mikołajczak,[1] Jan Adamowicz,[2] Tomasz Drewa,[1,2] and Kajetan Juszcz**comprehensive Approach to Clinical Staging of Bladder Cancer,** Published online 2022 Jan 30. doi: 10.3390/jcm11030761
40. Prasad R. Shankar, Daniel Barkmeier, Lubomir Hadjiiski, and Richard H. Cohan, **A pictorial review of bladder cancer nodal metastases,**Transl Androl Urol. 2018 Oct; 7(5): 804–813.doi: 10.21037/tau.2018.08.25