

## Evaluation of Staging Accuracy of Dynamic MRI in Urinary Bladder Cancer

Hany Mustafa Abdallah, Mohamed Samir Sayed, Ahmed Mohsen Ibrahim Saif

Department of Urology, Faculty of Medicine, Ain Shams University

\*Corresponding author: Ahmed Mohsen Ibrahim, E-mail address: Ahmmohsen2000@gmail.com , Mobile no: 01019789296

### ABSTRACT

**Background:** Urinary Bladder cancer is the second most common neoplasm of the urinary tract worldwide. It accounts for 6-8 % of malignancy in men and 2-3% in women with the highest incidence rates in North American and Europe as well as areas with endemic schistosomiasis in Africa and the middle east.

**Purpose:** To show the staging accuracy of Dynamic MRI in urinary bladder carcinoma.

**Patients and Methods:** This is a Prospective randomized clinical study, study setting: Radiology and Urology Departments, Faculty of Medicine, Ain Shams University, study period: 6 months from August 2017 till February 2018.

**Results:** This study conducted on 20 patients (17 male and 3 females) with age ranged from 42 – 78 years and with mean±SD of 55.95±9.01 years. 4/20 patients (20.0%) were presented to TURP procedure while 16/20 patients (80.0%) were presented to radical cystectomy.

**Conclusion:** In this study, despite small differences between the results of the MRI and pathology, Dynamic MRI was found to be an accurate modality for assessment of tumor staging, and its routine use in bladder cancer staging can lead to significant improvement of diagnostic accuracy of the staging and treatment planning and hence improvement of the prognosis of the patients and their survival rates. Furthermore, the use of Dynamic MRI systems with higher magnetic field and imaging techniques standardized with higher resolution could further enhance the accuracy of the method. Further studies with larger sample size may also help to validate the results of this study.

**Keywords:** Dynamic MRI - Urinary Bladder Cancer - Conventional Computed Tomography.

### INTRODUCTION

Conventional computed tomography (CT) and magnetic resonance (MR) imaging are only moderately accurate in the diagnosis and local staging of bladder cancer, with cystoscopy and pathologic staging remaining the standards of reference. However, the role of newer MR imaging sequences (e.g, dynamic MRI) in the diagnosis and local staging of bladder cancer is still evolving and has a great participation to optimize treatment<sup>(1)</sup>.

Dynamic MRI has the ability to differentiate between invasive from non invasive urinary bladder cancer, organ confined from non organ confined bladder cancer and to identify lymph node metastasis<sup>(2)</sup>.

Staging of urinary bladder cancer using MRI has a great outcome in plans of management. It has high efficacy in determination the extent of tumor, organ metastasis and lymph node metastasis<sup>(3)</sup>.

### PATIENTS AND METHODS

#### Type of Study:

Prospective randomized clinical study

#### Study Setting:

Radiology and Urology Department, Faculty of Medicine, Ain Shams University

**Study Period:** 6 months from August 2017 till February 2018.

#### Study Population:

- Inclusion Criteria: patients with urinary bladder mass in pelviabdominal ultrasound.

- Exclusion Criteria:

1. Patients with urinary bladder mass and unfit for operation.
2. Patients with metastatic deposits to urinary Bladder.
3. Patients have contraindications for MRI: Patients With:
  - a) Implanted electric and electronic devices.
  - b) Heart pacemakers.
  - c) Insulin pumps.
  - d) Implanted hearing aids.
  - e) Intracranial metal clips.
4. Patients with renal impairment.
5. Patients with pathological examination revealed to have no bladder cancer were retrospectively excluded.

**Sampling Method:** Randomized clinical study.

**Sample Size:** 20 patients.

**Ethical Considerations:** approval was obtained from the ethical committee at Ain Shams University before starting the research and all patients were consented to be included in this study after explanation of the study procedures and the follow up course.

**Study Procedures:** Patients with urinary bladder mass in pelviabdominal ultrasound were undergone MRI and results were compared with pathology of specimens of the patients that had transurethral resection of the urinary bladder mass and the patients of cystectomy according to staging of the tumor.

The MRI device used in this study was **Siemens** 1.5 tesla and the dose of gadolinium used was 1ml\10 kgm.

Three dimensional fat-suppressed spoiled T1 weighted images were obtained before and after contrast material administration, this allowed multiplanar reformation. After imaging was finished the reports were recorded by senior radiologist who was blind to the results of pathology of TURT and radical cystectomy.

Then the reports of MRI were compared to these pathology results.

**Statistical Analysis**

The data were collected and revised and the sweet tests were chosen according to the type of the data. The qualitative data was discussed using Chi-square test while the quantitative data was discussed using independent t-test if with normal distribution and Mann-Whitney tests if with non

parametric distribution. The confidence interval of the results was set to 95% and the margin of error accepted will set to 5%. So the p-value was considered significant at the level of <0.05.

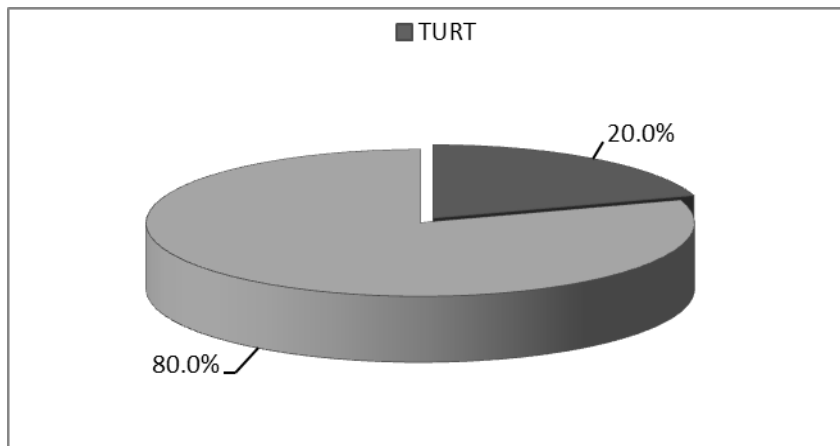
**Statistical Package**

The Statistical Package for Social Science (IBM SPSS) version 23 was used in this study after revision of the collected data.

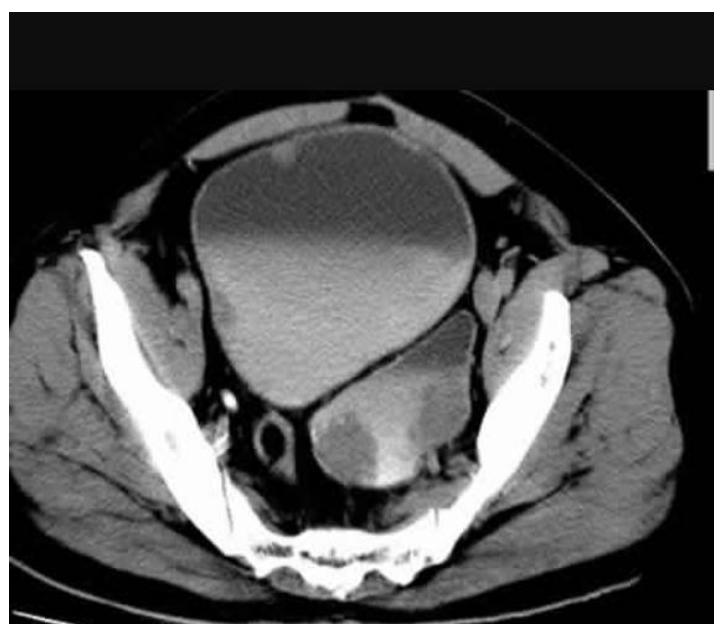
**RESULTS**

**Table (1):** Age and procedure done to the studied patients

		<b>Pts. No. = 20</b>
Age	Mean±SD	55.95 ± 9.01
	Range	42 –78
Procedure	TURT	4 (20.0%)
	Radical cystectomy	16 (80.0%)



**Figure (1):** Age and procedure done to the studied patients.



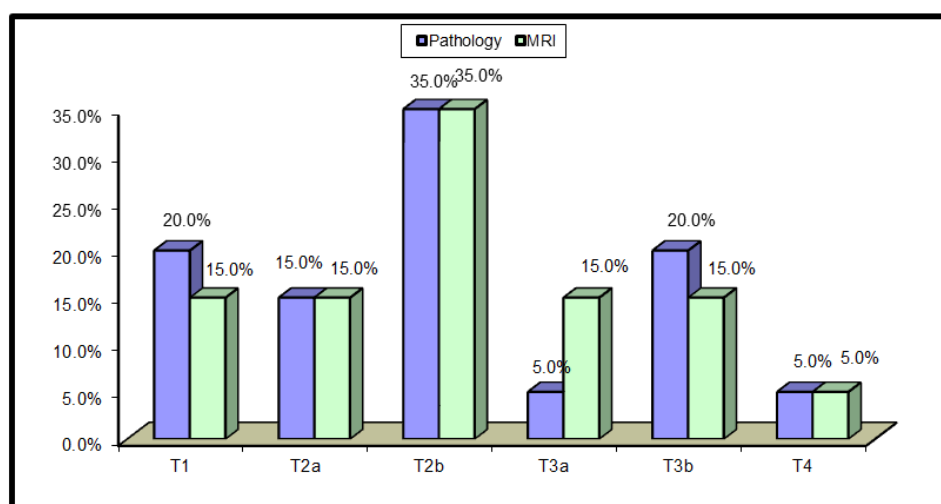
**Figure (13):** MRI showing bladder cancer stage T2a.

**Table (1):** Comparison between pathology and Dynamic MRI findings in the studied patients

Stage	Pathology		MRI		Test value	P-value	Sig.
	No.	%	No.	%			
T1	4	20.0%	3	15.0%	3.653	0.900	NS
T2a	3	15.0%	3	15.0%			
T2b	7	35.0%	7	35.0%			
T3a	1	5.0%	3	15.0%			
T3b	4	20.0%	3	15.0%			
T4	1	5.0%	1	5.0%			

P > 0.05: Non significant; P < 0.05: Significant; P < 0.01: Highly significant

The table shows that there was no statistically significant difference found between the pathology findings and MRI findings with p-value = 0.900.



**Figure (14):** Pathology and MRI findings in the studied patients.

In this study, we found that the accuracy of Dynamic MRI in detection of bladder cancer stage T1 is 15% (3 patients only) compared to the results of the pathology report (20%) which means that 1 patient staged T1 (by pathology) was not detected by MRI, 15% in stage T3a, T3b compared to the pathology reports (5% and 20% respectively). While MRI shows high accuracy in detection of bladder cancer stage T2a, T2b (15% and 35% respectively) compared to the pathology reports.

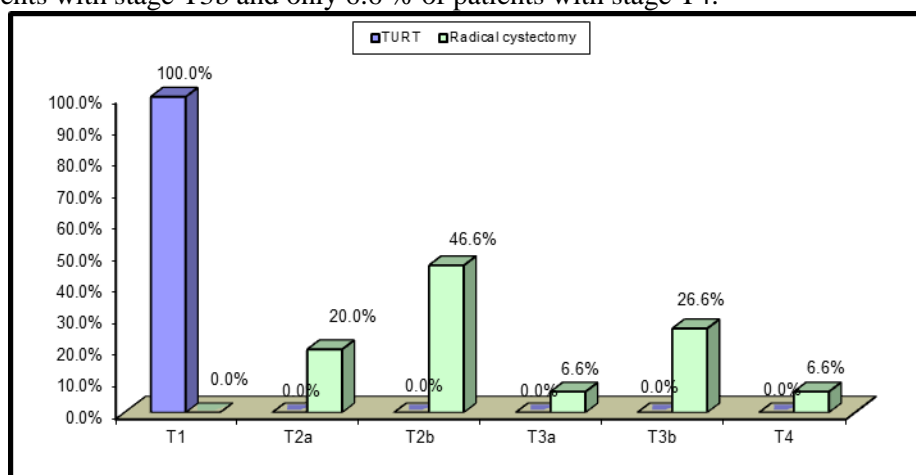


**Figure (15):** MRI showing bladder cancer stage T3b.

**Table (2):** Pathology results in patients presented to TURT and radical cystectomy

Pathology report	TURT		Radical cystectomy	
	No.	%	No.	%
T1	4	100%	0	0.0%
T2a	0	0.0%	3	20%
T2b	0	0.0%	7	46.6%
T3a	0	0.0%	1	6.66%
T3b	0	0.0%	4	26.6%
T4	0	0.0%	1	6.66%

In our study, the pathology report of the 4 patients of TURT is stage T1 while pathology report of 20% of patients had radical cystectomy is stage T2a, 46.6% of patients with stage T2b, 6.6% of patients with stage T3a, 26.6 of patients with stage T3b and only 6.6 % of patients with stage T4.



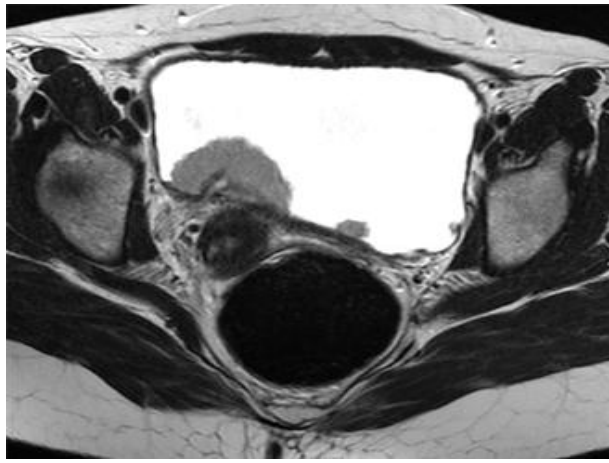
**Figure (17):** Pathology results in patients presented to TURT and radical cystectomy.



**Figure (18):** Bladder cancer stage T2b.

**Table (3):** Agreement between pathology findings and MRI findings in the studied patients

MRI finding	Pathology report											
	T1		T2a		T2b		T3a		T3b		T4	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
T1	3	20.0%	3	15.0%	7	35.0%	1	5.0%	0	0.0%	0	0.0%
T2a	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
T2b	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%
T3a	0	0.0%	0	0.0%	0	0.0%	3	15.0%	4	4.0%	0	0.0%
T3b	0	0.0%	0	0.0%	0	0.0%	0	0.0%	3	15.0%	1	5.0%
T4	0	0.0%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	1	5.0%
Percentage of agreement	16/20 (80.0%)											
Percentage of difference	4 / 20 (20.00%)											



**Figure (20):** MRI showing bladder cancer stage T3b.

## DISCUSSION

In our study, the most commonly diagnostic MRI and pathologic stage was T2b. In the study of Tanya *et al.* <sup>(4)</sup>, the most commonly diagnostic stage was T3b. This difference may be due to the fact that the patients of Tanya *et al.* <sup>(4)</sup>, referring was not early and the treatment started later. According to the MRI findings and comparison of stages with pathologic findings, there was totally 4 mismatches between MRI findings and pathology, two cases (50%) were underestimated and two cases (50%) were overestimated.

The cause of overestimation is due to abnormal signals in perivesical fat in tumor location which is incorrectly identified as tumor invasion as in T3b. While the cause of underestimation as in T3a is due to tumor invasion into hyposignal muscle layer of the bladder, patient movement and perivesical invasion remained hidden from sight of radiologist and also MRI can not clearly detect superficial tumors stage T1.

Accuracy of 92% in our study indicates a good correlation between Dynamic MRI and pathology. In the study of Tanya *et al.* <sup>(4)</sup>, the accuracy of Dynamic MRI was reported 95% that was slightly higher than the accuracy obtained in our study which could be due to greater number of samples and due to use of a three tesla scanner which has the ability to detect microscopic invasion of the tumor so accounts for high accuracy compared to our study.

In our study, Kappa agreement coefficient was 0.7, and the sensitivity and specificity of Dynamic MRI in differentiating superficial tumors from invasive tumors were 99% and 100%, respectively and in differentiating organ confined tumors from non organ confined tumors were 90% and 82% respectively which is acceptable and

consistent with the results of Isbell *et al.*, 2012, (92% sensitivity and 70% specificity respectively).

Gadolinium enhancement has a considerable effect on increasing the accuracy, sensitivity and specificity

A point that was considered in the present study rather than previous studies was the correlation of tumor stage with slope of time-intensity curves of tumor in dynamic changes. Tumor vessels are not normal and tumor epithelial cells within the inner surface of tumor develop gaps. The blood leaking out from the distance between endothelial cells, permeability, and neovascularity of tumor increase abnormally and tumors with higher angiogenesis have higher risk of local recurrence. By Dynamic MRI, the peak of the curve occurs in areas with uptake of contrast, which represents increased permeability, abnormal vascularity, and higher malignancy of tumor. The positive correlation and significant relationship between tumor stage and signal enhancement slope of tumor time-intensity curves suggests that the peak time-intensity curves occur with great slope as tumor stage increases. The relationship can be helpful in diagnosis of severity and progression of tumors, as the slope of the curves is steeper in the non-organ-confined tumors.

## CONCLUSION

In this study, despite small differences between the results of the MRI and pathology, Dynamic MRI was found to be an accurate modality for assessment of tumor staging, and its routine use in bladder cancer staging can lead to significant improvement of diagnostic accuracy of the staging and treatment planning and hence improvement of the prognosis of the patients and their survival rates. Furthermore, the use of Dynamic MRI systems with higher magnetic field and imaging techniques standardized with higher

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