

1

.

가

24

T1(TR/TE : 500/9), T2(TR/TE : 4000/98)

12 3D-EFGRE(TR/

30 , 90

TE : 4.7/1.1) T1, T2

, 3

,

T1, T2 38%(9/24)

58%(7/12)

(p<0.05).

가

(p<0.05).

가

T1, T2 가

가

가

가 (14-16).

가

(1, 2)

가 50%

(3).

가

33%-96%(4-7), 50%-96%(6-

13) 가

가 (13)

1996 5 1999 3

24

38 73 59

가 21 , 가 3

5

:
 5
 30 (12.6) T1 (signal intensity ratio)
 (contrast to noise ratio)
 UICC(International Union Against Cancer) 가 3
 TNM
 24 pT1 15 (63%), pTII 4
 (17%), pTIIla 2 (8%), pTIIlb 3 (13%)
 1.5Tesla (Signa T1 T2
 Advantage, GE medical system, Milwaukee, U.S.A.) pT1 (sessile) pTII (pedunculated) 가
 가
 T1 (TR/TE : 500/9, 6mm, 7mm),
 T2 (TR/TE :
 4000/98, 6mm, 7mm)
 12 3D-EFGRE(TR/TE;
 4.7/1.1, 5mm, 4mm) Gd-DTPA
 (Omniscan, Nycomed Imaging AS, Oslo, Norway, 0.2mmol/Kg)
 30 , 90
 , 3
 2 가
 Glucagon 1mg
 가 , T1, T2
 pTIIla
 pTIIlb, 가 pTIV . T1
 T2 가
 가
 pTII, 가
 pTIIla, 가
 pTIIlb
 T1
 가

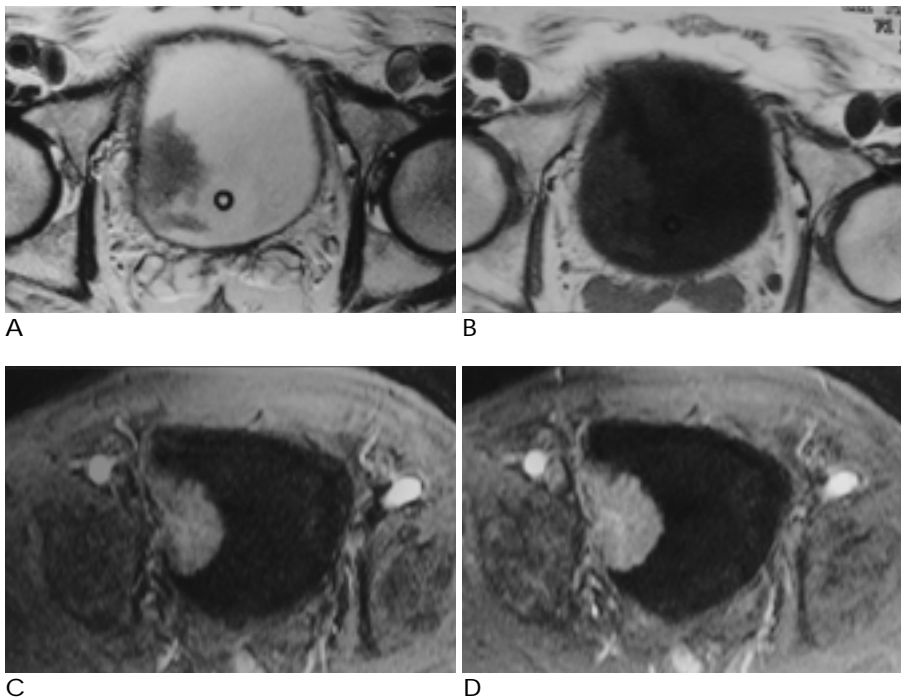


Fig. 1. Transitional cell carcinoma of the bladder, stage pTIIla. Axial T2-weighted image (A), axial T1-weighted image (B), arterial phase of Gd-enhanced dynamic image (C), and capillary phase of Gd-enhanced dynamic image (D) show a protruding mass in the right wall. Tumor invades muscle layer in full thickness. Perivesical extension is not demonstrated on T2WI, T1WI and dynamic MR image.

(cursor)

$$\text{signal intensity ratio} = \text{SI}_x / \text{SI}_0$$

$$\text{contrast-to-noise ratio of tumor-to-bladder muscle} = [\text{SI of tumor} - \text{SI of bladder muscle}] / \text{SD of noise}$$

$$\text{contrast-to-noise ratio of tumor-to-perivesical fat} = [\text{SI of tumor} - \text{SI of perivesical fat}] / \text{SD of noise}$$

T1 T2
 Chi-Square Test
 oneway Anova test
 Duncan

T1 T2
 38%(9/24)
 (overstaging) 50%(12/24),
 (understaging) 13%(3/24)
 50% (12/24),
 75%(18/24)
 (Table 1).
 58%(7/12) T1 T2
 (p<0.05).
 42%(5/12)
 67%(8/12) (Fig. 1)

Table 1. Correlation of T-staging on T1-,T2-weighted MR Imaging with Pathologic Staging

Pathologic staging	T1WI + T2WI				Total
	pTI	pTII	pTIIla	pTIIlb	
pTI	4*	5	2	4	15
pTII	1	2*	1	0	4
pTIIla	0	0	2*	0	2
pTIIlb	0	0	2	1*	3
Total	5	7	7	5	24

* pT1WI + T2WI was concordant with pathologic staging.

Table 2. Correlation of T-staging on Gd-enhanced Dynamic MR Imaging with Pathologic Staging

Pathologic staging	Gd-enhanced Dynamic MR Imaging				Total
	pTI	pTII	pTIIla	pTIIlb	
pTI	3*	2	0	2	7
pTII	0	1*	0	1	2
pTIIla	0	0	2*	0	2
pTIIlb	0	0	0	1*	1
Total	3	3	2	4	12

* Gd-enhanced Dynamic MR Imaging was concordant with pathologic staging.

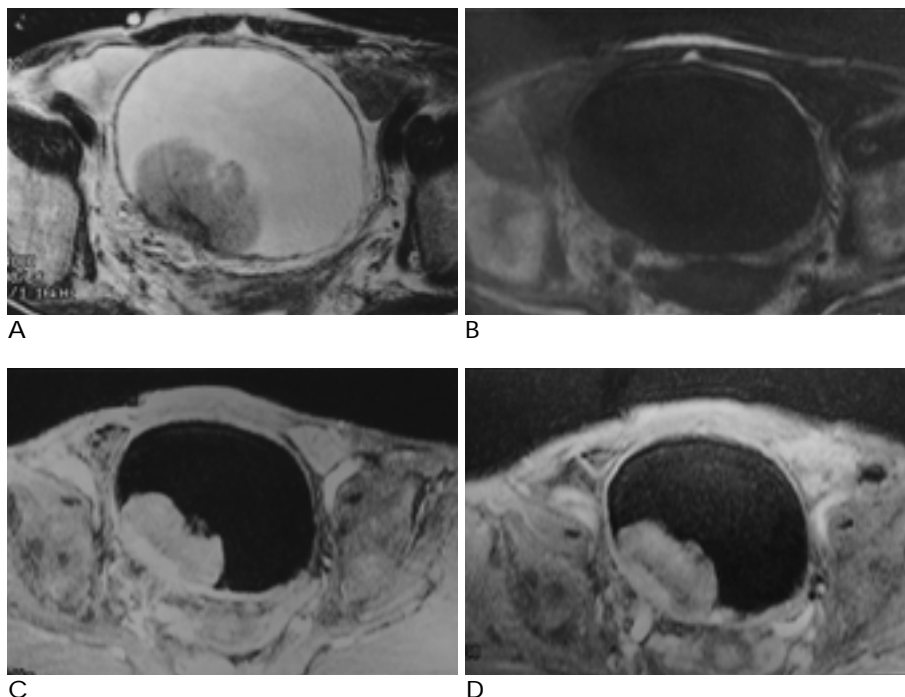


Fig. 2. Transitional cell carcinoma of the bladder, stage pTIIlb. Axial T2-weighted image (A), preenhanced dynamic image (B), capillary phase of Gd-enhanced dynamic image (C), venous phase of Gd-enhanced dynamic image (D) show a protruding mass in the right posterior wall. Invasion to the perivesical fat is not clear on T2-weighted image (A), but can be demonstrated on dynamic Gd-enhanced image where the perivesical fat is well enhanced.

		75%(9/12)	(Fig. 2).						
			67%(8/12)						
		(Fig. 3)(Table 2).	Ta	(p<0.05) (Fig. 4).					
T1, TII	TIIlb							(CNR)	
		67%	50%						
T1	T2	(Table 3).		3.54 ± 2.13,	19.00 ± 7.17,			21.47 ±	
				8.66,	16.04 ± 4.70				
				가					
								4.11 ±	
			3.07	2.15,	20.11 ± 8.55,			25.97 ± 9.30,	
± 1.14,		3.50 ± 0.97,	3.16 ± 1.35	18.92 ± 5.95		가 가		(Fig. 5).	
	가							C-	
		1.31 ± 0.48,	1.49 ± 0.48,	NR					
	1.51 ± 0.51		1.24 ±	(p<0.05)					
0.24,	1.36 ± 0.47,	1.38 ± 0.43	.	.					

Table 3. Overall Staging Accuracy Compared with Staging Accuracy of pTa-pT1 versus pTII-pTIIla for T1-, T2-weighted, and Gd-enhanced Dynamic MR Imaging

	T1WI+ T2WI	Dynamic Gd enhanced image
Correct	9/24(38%)	7/12(58%)
Understaging	3/24(13%)	0/12(0%)
Overstaging	12/24(50%)	5/12(42%)
pTa-pT1 vs pTII-pTIIlb	12/24(50%)	8/12(67%)

Jewett-Strong-Marshall system
UICC(International Union Against Cancer) TNM 가

가 pT1

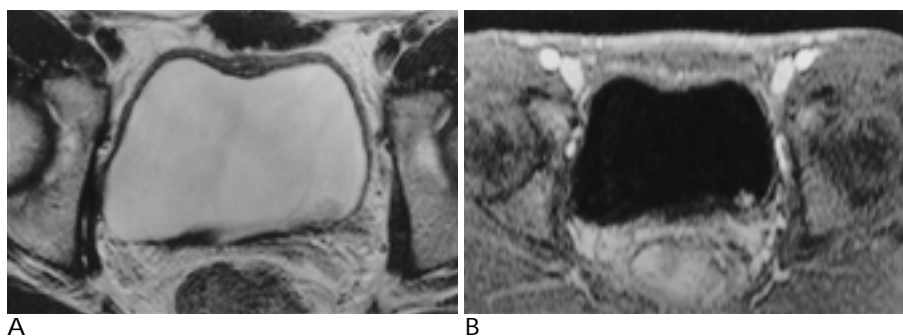


Fig. 3. Transitional cell carcinoma of the bladder, stage pT1. Axial T2-weighted image (A) and arterial phase of Gd-enhanced dynamic image (B) show a sessile mass in the posterior bladder wall. Invasion to the muscle is obscure on T2-weighted image (A), but can be excluded on Gd-enhanced dynamic image (B) where bladder tumor is well enhanced, but the muscle is not enhanced. At histologic examination after TUR-BT, only mucosal tumor at the posterior bladder wall was found.

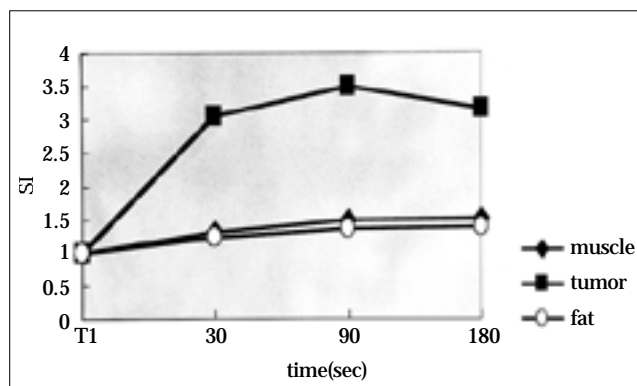


Fig. 4. Quantitative assessment of signal intensity ratio of tumor, muscle and fat on Gd-enhanced dynamic MR imaging.

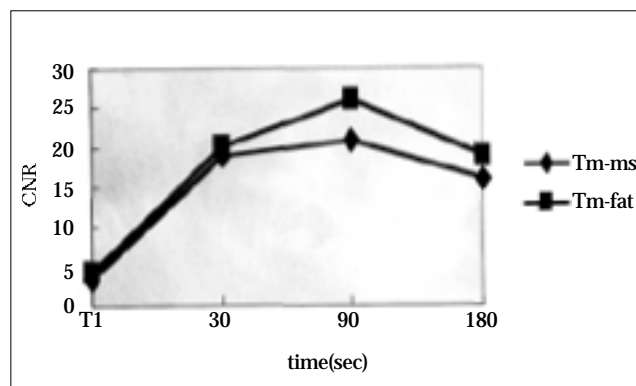


Fig. 5. Quantitative assessment of contrast-to-noise ratio of tumor-to-muscle (Tm-ms) and tumor-to-fat (Tm-fat) on Gd-enhanced dynamic MR imaging.

(grade)가 (pTII) , 가 33%(1/3) T1 T2
(pTIIla) T1
(12, 17, 18).
CT 가
CT 가
(attenuation) CT 가 42%(5/12), T1 T2
50%(12/24)
(16, 19).
T2
(8, 9, 16, 20). 16). 가 (1, 12,
(distruption) 가
(16, 21). T1
(9, 20).
(12).
가
(12, 16).
가
가
가
30 가 90
180
(13, 16). 45 120
Neuerburg(14)
58% T1
T2 38% 95 가
pTa pTI, pTII 가 가
67%, 50%
Narumi(12)
CT 60
(22)
100 가 가
Scattoni(16) Narumi(12) 95
가
T1 T2 가 90 가
가 50%(2/4), 100%(2/2)
가 50%(1/2), 100%(2/2)
)
가
T1
(9, 20)
75%
100%
가
T1, T2

- 가
- 가 가
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Usefulness of Dynamic Gadolinium-enhanced MR Imaging in Staging of Bladder Cancer¹

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Purpose : To evaluate the usefulness of dynamic gadolinium-enhanced MR imaging in the staging of bladder cancer.

Material and Methods : Twenty-four patients with histologically proven bladder cancer underwent MR imaging before tumor resection. Pre contrast axial or sagittal T1- and T2-weighted images were obtained in all patients. In 12, dynamic MR imaging was performed using the 3D-EFGRE technique in the axial plane. Images were obtained 30, 90, and 180 sec after a rapid hand injection of Gd-DTPA. T1WI, T2WI, and Gd-enhanced dynamic images were compared on the basis of lesion conspicuity and correlated with histologic specimens. The signal intensity ratio (SIR) of bladder tumors, muscle, and perivesical fat during each phase, and the contrast-to-noise ratio (CNR) of lesion-to-muscle and lesion-to-fat were determined.

Results : The accuracy of tumor staging using both T1WI and T2WI was 38% (9/24), and the accuracy of dynamic gadolinium enhanced MR imaging was 58% (7/12). The difference was statistically significant ($p < 0.05$). The SIR of tumors was highest during the capillary phase, and decreased during the venous phase. During all phases it was significantly higher than that of bladder muscle and perivesical fat ($P < 0.05$). The CNR of tumor-to-muscle and tumor-to-perivesical fat increased abruptly during the arterial phase, was highest during the capillary phase and decreased slightly during the venous phase.

Conclusion : Dynamic gadolinium enhanced MR imaging improves the diagnostic accuracy of both T1WI and T2WI in the preoperative staging of bladder cancer and can be useful in the management and estimation of prognosis. For evaluation of the staging of bladder cancer, the capillary phase is optimal.

Index words : Bladder, neoplasms
Bladder, MR
Magnetic resonance(MR), pulse sequences

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