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Clinical-Bladder Cancer

Clinical utility of vesical imaging-reporting and data system (VI-RADS) in non-muscle invasive bladder cancer (NMIBC) patients candidate for en-bloc transurethral resection: A prospective study

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Abstract

Objectives: To assess accuracy of vesical imaging-reporting and data system (VI-RADS) 5-point score in detection of muscle invasive bladder cancer and avoiding second look transurethral resection of the tumors (TURBT). Additionally, to assess safety and efficacy of bipolar en-block transurethral urethral resection of bladder tumor.

Methods: Patients with bladder mass up to 5 cm were included in the study. VI-RADS 5-point score was done preoperative for all cases and postoperatively before second look TURBT. Patients were followed up for 12 months.

Results: In all, 80 cases were eligible for the study. Preoperative VI-RADS score at cutoff of 3 had sensitivity of 89.3 %, specificity 83.3 %, postive predective value (PPV) 92.6 %, negative predictive value (NPV) 76.9 %, accuracy of 87.5 %, while at cutoff 2 sensitivity was 82.1%, specificity 91.7%, PPV 95.8%, NPV 68.8%, accuracy of 85.0%. Operative time 28.8 ± 9.4 minutes, hemoglobin drop 0.3 ± 0.05 g/dl, catheterization time 2.8 ± 0.8 days, hospital stay 1.4 ± 0.4 days. No complications occurred. Recurrence in field of resection 3.75%. Detrusor muscle was available in 76 cases (95%). Postoperative VI-RADS score at cutoff of 3 had sensitivity of 78.6%, specificity 77.8%, PPV 84.6%, NPV 70.0%, accuracy of 78.3%. At cutoff 2 VI-RADS score sensitivity was 71.4%, specificity 77.8%, PPV 83.3%, NPV 63.6%, accuracy of 73.9%.

Conclusion: VI-RADS 5-point score showed high sensitivity and specificity in preoperative discrimination of non-muscle invasive bladder cancer (NMIBC) from muscle invasive bladder cancer cases and in avoiding unnecessary second look TURBT. Bipolar en-block TURBT technique is both safe and efficacious in resecting NMIBC cases with low recurrence rate. © 2022 Elsevier Inc. All rights reserved.

Keywords: Bladder cancer; En bloc; (VI-RADS)

1. Introduction

Bladder cancer is non-muscle invasive in approximately 75% to 85% of cases treated by adequate initial endoscopic transurethral resection of the tumors (TURBT) coupled with accurate histological diagnosis [1]. The conventional technique of TURBT involves piecemeal resection of the tumor, leading to inadequate resection that may be

https://doi.org/10.1016/j.urolonc.2022.03.008 1078-1439/© 2022 Elsevier Inc. All rights reserved. responsible for the high recurrence rates [2]. Local recurrence occurred in almost 81% of the tumors treated by conventional TURBT technique, which indirectly suggests that the technique of resecting tumor is not adequate [3]. Therefore, En-bloc transurethral resection of bladder tumor is preferred as it can obtain adequate complete tumor specimens, containing the mucosa, lamina propria, and muscle layer in about 96% to 100% of the existing cases for determining pathological diagnosis and treatment procedure [4]. En-bloc TURBT also had shorter hospital stay, catheterization time, fewer complications and lower 24-month recurrence rate [5,6].

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Recently, multiparametric magnetic resonance imaging (MP-MRI) use has been introduced in the diagnostic pathway of bladder cancer with the development of the (vesical imaging-reporting and data system [VI-RADS]) score [7]. The use of VI-RADS score increases the preoperative diagnostic ability in differentiating non-muscle invasive and muscle invasive bladder cancer by detecting the depth of tumor invasion to improve the effectiveness of TURBT [8]. A new application of the VI-RADS 5-point score has been recently used to avoid a second TURBT, where a high-risk non-muscle invasive bladder cancer (NMIBC) was diagnosed or in cases of T1 bladder cancer without muscle in the specimen [9]. Other alternative future directions using molecular profiling has emerged and applied in staging, prognosis, and therapeutic implications [10,11]. With these perspectives, we tried in this study to assess accuracy of VI-RADS 5-point score in detection of muscle invasive bladder cancer (MIBC), and whether it could replace the more invasive second look TURBT. Additionally, to compare the n-bloc TURBT findings with VI-RADS 5-point score criteria in terms of recurrence and progression.

2. Patients and methods

Between March 2020 and March 2021 80 patients, admitted to the Urology Department, presenting with bladder mass up to 5 cm were treated using the en-bloc transurethral resection of bladder tumor technique. Diagnosis was set by Abdominopelvic ultrasound to assess tumor characteristics including Tumor site, size, number. Multi parametric MRI with (VI-RADS) 5-point score was done preoperative in all cases and postoperative only in high-risk NMIBC as T1 tumor or carcinoma in situ or high-grade (G3) or TaG1/G2 tumor with multiple, recurrent, and large (>3 cm) cancer [12] or in cases of T1 bladder cancer without muscle in the specimen that needed second look TURBT. Exclusion criteria were Patients with bladder tumor >5cm, domal bladder mass and tumors associated with hydroureteronephrosis. An informed consent was obtained from all patients and this study was conducted according to ethical principles stated in the Declaration of Helsinki (2013) [13] and the requirement of faculty of medicine, Benha university. Preoperative laboratory investigations included complete blood count, coagulation profile, liver and renal function tests, urine analysis, urine culture in case of urinary tract infection and fasting blood sugar.

Patients' demographic data, tumor characters, perioperative data (Operation time (min), Bleeding(intraoperative and postoperative), Hemoglobin drop, Obturator nerve reflex, Bladder perforation, Postoperative irrigation (%), Catheter time (day), Postoperative hospital stay (day), Second look TURBT (%) were prospectively documented, Postoperative assessment(Histopathological examination (tumor stage, grade and presence of detrusor muscle in specimen) were correlated with preoperative Multi parametric MRI to assess accuracy of VI-RADS 5-point score in detection of MIBC.

Clavien score was used to assess complications. Follow up surveillance was conducted according to EAU guidelines [14].

3. Multiparametric MRI technique

The exams were conducted in radiology department of Benha university hospital using 1.5 Tesla machine "Siemens Magneton Aera." The exam included. Axial turbo-spin echo T2WIs (3 mm slice thickness). EPI DWIs using B values of 0, 400,800, 1,000 sec/mm² (Fig. 1B). Dynamic contrast enhanced (DCE) image: T1 gradient echo sequence with fat suppression. A gadolinium-based contrast agent is administered using a powerinjector system at a dose of 0.1 mmol/kg of body weight and a rate of 1.5 to 2.0 ml/s, followed by saline flush. Initial post contrast image is acquiesced 30 seconds post injection and followed by the same sequences at 70-, 110-, 150- and 190-second post contrast administration (Fig. 1A).

3.1. Operative technique

The operative technique was previously described (1&15). En-bloc transurethral resection of bladder tumor was performed using Bipolar single wire loop, tumor resections were performed routinely with semi filled bladder (with 250-300 ml irrigation fluid). Collin's knife was used to mark macroscopic normal mucosa about 0.5 to 1.0 cm around the tumor base as a safety margin (Fig. 1C). The bladder mucosa was cut with a "small bite." technique in retrograde manner till the deep muscle layer is reached (Fig. 1D). For masses not more than 3 cm, were removed totally by en-bloc resection. For masses >3 cm we used combination of conventional TURBT for exophytic portion followed by en-bloc resection of base. The tumor was resected in one piece retrogradely and if it was too large to be taken out through urethra it was retrieved by using nephroscopy sheath. Biopsy of tumor bases and surrounding mucosa was performed with cold cup forceps after resection of the tumors that were submitted for pathologic evaluation.

Data was analyzed using Statistical Package of Social Science for Windows (SPSS, Chicago, IL) version 20. Descriptive data was presented in terms of number, percentages, medians, and average. Categorical variables were compared using Fisher's exact test while continuous variables were compared by Mann-Whitney U-test and Kruskal-Wallis test or student (t) test and analysis of variance test, whenever appropriate, with significance detected at 2-tailed *P*-value <0.05. Multivariate logistic regression was used for correction of possible confounders.



Fig. 1. (A) Dynamic contrast enhanced curve VI-RADS 5 case showing the region of interest (ROI) positioned to the junction between the tumor base and the urinary bladder wall. The superimposed curve show type 2 pattern (plateau pattern). (B) DWIs of VI-RADS 5 case (b value 800): The tumor showed high DWIs and low ADC value (restricted diffusion) with inner stalk displaying low DWIs signal, yet the intermediate signal of the muscularis propria on DWIS is seen interrupted by the tumor. (C) using coagulation current as a safety margin. (D) cutting the bladder mucosa via a "small bite." Technique in retrograde manner till the deep muscle layer. DWI = diffusion-weighted imaging; VI-RADS = vesical imaging-reporting and data system.

4. Results

A total of 100 patients were recruited into the study, 7 patients died for another reason, 5 patients were lost to follow-up and 8 patients had incomplete data file.

In all, 80 cases were eligible for the study (64 males and 16 females) aging 40 to 85 years with mean \pm SD of 61.9 \pm 12.1 years were included in this study. Demographics and perioperative data were as shown in Tables 1 and 2 respectively.

All cases did preoperative MP-MRI to determine their VI-RADS 5-point score. At cutoff of 3 had sensitivity 89.3 %, specificity 83.3 PPV 92.6 %, NPV 76.9 % with an Accuracy of 87.5 %, while at cutoff 2 preoperative VI-RADS score had sensitivity of 82.1%, specificity 91.7%, PPV 95.8%, NPV 68.8% with an Accuracy of 85.0% (Fig. 2).

Table 1	
Baseline characteristics	s

Age (y)	61.9 ± 12.1
Gender (%)	
Male	64 (80%)
Female	16 (20%)
Site (%)	
Posterior	9 (11.3%)
Lateral	53 (66.3%)
Trigone	18(22.5%)
Size (cm)	
Median (IQR)	3.9 (2-5)
Number	
Single	76 (95%)
Multiple	4 (5%)

IQR = interquartile range.

Table 2 Perioperative data

Operative time (min) (range)	28.8 <u>+</u> 9.4 (15–43)		
Haemoglobin drop (range)	0.3 + 0.05 (0.2-0.35)		
Obturator reflex (%)	4 (5%)		
Postoperative irrigation (%)	14 (17.5%)		
Catheterization time (d)	2.8 + 0.8(1 - 4)		
Hospital stay (d)	1.4 + 0.4(1-2)		
Residual tumour in base of resection			
In NMIBC cases (%)	7 (12.5)		
Detrusor muscle available(%)	76 (95%)		
Second look TURBT (%)	23 (28.75%)		
Recurrence (in NMIBC cases)(%)	. ,		
In field of previous resection	2 (3.57%)		
Out of field	5 (8.92%)		
Tumour stage (%)			
Ta low grade	31 (38.75%)		
Ta high grade	5 (6.25%)		
T1 low grade	9 (11.25%)		
T1 high grade	11 (13.75%)		
T2	24 (30%)		

NMIBC = non-muscle invasive bladder cancer; TURBT = transurethral resection of the tumors.

All 23 cases that needed second look TURBT did MP-MRI preoperatively to determine their VI-RADS score. In these cases, preoperative VI-RADS score at cutoff of 3 had sensitivity 78.6%, specificity 77.8%, PPV 84.6%, NPV 70.0% with an accuracy 78.3%, while at cutoff 2 preoperative VI-RADS score had sensitivity 71.4%, specificity 77.8%, PPV 83.3%, NPV 63.6% with an accuracy 73.9% (Fig. 3).



Diagonal segments are produced by ties.

Fig. 2. Validity of VI-RADS in prediction of tumor invasion preoperative. VI-RADS = vesical imaging-reporting and data system.



Diagonal segments are produced by ties.

Fig. 3. Validity of VI-RADS in prediction of tumor invasion before second look TURBT. VI-RADS = vesical imaging-reporting and data system; TURBT = transurethral resection of the tumors.

5. Discussion

The use of MP-MRI has been proposed to increase the preoperative diagnostic ability in differentiating NMIBC and MIBC improving the effectiveness of TURBT [8]. Since was first described by Panebianco et al. in 2018 [7], VI-RADS 5-point score for assessing the risk of muscle invasion using T2-weighted (T2W) MRI, diffusionweighted imaging, and DCE has become the topic of interest in many recent studies including the current study. Later on, Del Giudice et al., in 2020 proposed another application of this score in avoiding a second TURBT after a first TURBT in patients diagnosed with high-risk NMIBC or in cases of T1 bladder cancer without muscle in the specimen [9]. In the current study, we assessed VI-RADS 5-point score as a non-invasive imaging modality in prediction of bladder cancer staging and its applicability in selecting cases candidate for endoscopic En-bloc resection of the tumor. Additionally, investigating its role in avoiding second endoscopic intervention (Tables 3 and 4).

According to EAU guidelines TURBT is considered the gold standard for the initial diagnosis, staging, and treatment of NMIBC [15]. Not far after it was described for the first time by Ukai et al. in 2000 [16], en block TURBT technique using different sources of energy like laser energy, electrical monopolar and bipolar plasma kinetic energy for tumor ablation has been investigated by many urologists who found that it overcome the drawbacks of the conventional resection technique in terms of safety of the procedure and associated complications, providing adequate specimen for histopathological assessment and recurrence of the tumor and proving to be more superior [6,17,18].

			VI-RADS				Total
			2	3	4	5	
Tumor stage and grade	T 2	Count %	2 8.3%	2 8.3%	10 41.7%	10 41.7%	24 100.0%
	T1 high grade	Count %	9 81.8%	1 9.1%	1 9.1%	$0 \\ 0.0\%$	11 100.0%
	T1 low grade	Count %	8 88.9%	$\frac{1}{11.1\%}$	$0 \\ 0.0\%$	$0 \\ 0.0\%$	9 100.0%
	Ta high grade	Count %	3 60.0%	0 0.0%	2 40.0%	0 0.0%	5 100.0%
	Ta low grade	Count %	26 83.9%	2 6.5%	1 3.2%	2 6.5%	31 100.0%
Total	Count %	48 60.0%	6 7.5%	14 17.5%	12 15.0%	80 100.0%	2001070

Table 3	
Tumour stage and grade vs	VI-RADS score

VI-RADS = vesical imaging-reporting and data system.

In this prospective study, all cases underwent preoperative Multipara-metric MRI to determine their preoperative VI-RADS 5 point score, we used two cutoff values of 2 and 3 and we found that preoperative VI-RADS score at cutoff of 3 had sensitivity of 89.3 %, specificity 83.3 %, PPV 92.6 %, NPV 76.9 % with an accuracy of 87.5 %, while at cutoff 2 preoperative VI-RADS score had sensitivity of 82.1%, specificity 91.7%, PPV 95.8%, NPV 68.8% with an accuracy of 85.0% in detecting muscle invasive bladder cancer. The results of the current study agree with other authors who reported that by using cutoff value of 2, VI-RADS score in 50 patients demonstrated sensitivity 78%, specificity 88%, PPV 78% and NPV 88% [19]. While some authors in their prospective study on 231 patients, used cutoff value of 2 and found that sensitivity, specificity, PPV and NPV were 91.9%, 91.1%, 77.5% and 97.1% respectively [9]. Other authors reported sensitivity of 92.9% and specificity of 95.1% at VI-RADS cutoff value of 3 [20]. On the other hand, another study stated that using cutoff value of 4 improved the specificity of the score from 43.9% at cutoff value of 3 to 76%, it also improved PPV and NPV from 51.6% and 63.7% at cutoff value of 3 to 83.3% and 78.9% respectively, while sensitivity decreased from 94.6% at cutoff value of 3 to 91.3% at cutoff value of 4 [21].

From the previous findings we believe that MP-MRI VI-RADS 5-point score provide a valuable diagnostic tool for preoperative discrimination of NMIBC from MIBC cases and we also believe that its use can be applied in the selection of NMIBC cases candidate for the en-block TURBT technique that we used in this study.

In the current study, our mean operative time was $28.8 \pm$ 9.4 minutes which is comparable to operative time of 35 ± 14 minutes reported by another study [18]. On the contrary, other authors in their study reported mean operation time of 13.4 minutes in the en-block resection group [22], but we believe that this shorter time can be attributed to less tumor burden in the studied cases as their mean tumor burden was 1.82 cm compared to 3.9 cm in our study. The mean hemoglobin drop was 0.3 ± 0.05 g/dl with no intraoperative or postoperative active bleeding encountered in any of the studied cases, this agrees with other authors who found that mean hemoglobin drop was 0.55 g/dl in the bipolar en block resection group vs. 1.24 g/dl in the standard monopolar resection group [23] and others reported mean Hb drop of 0.28 in bipolar en block resection group vs. 0.76 g/dl in the monopolar conventional resection group [22]. This can be explained by the fact that in addition to reduced bleeding associated with bipolar electrosurgery, this technique can approach the tumor base directly and avoid repeated opening of blood vessels during the layerby-layer removal by classical resection [22].

Our technique proved to be both safe and effective as there were no reported cases in our study of bladder perforation, active intraoperative or postoperative bleeding.

Table 4

The efficacy and adverse effects in our study bipolar en-block resection vs. standard monopolar resection literature data

Author	Mean operation time(range) (min)	Mean hemoglobin level drop (g/dl)	Obturator nerve reflex Events (%)	Catheterization period (d)	Hospital stay (d)	Same site' recurrences	Out of field recurrence
Bălan et al. 2018 Hashad et al. 2017 Xishuang et al. 2010	19.7 $36.42 \pm (6.21) (25-50)$ 18.36 ± 4.45	0.76 1.24 (0.61) Not reported	11.1% 15% 8%	2.8 Not reported 2.30 \pm 0.77	3.1 1.76 (0.652) 1–4 4.27 ± 1.01	7.5% Not reported	20% Not reported
This Study	18.30 ± 4.43 $28.8 \pm 9.4 (15-43)$	$0.3 \pm 0.05 (0.2 - 0.35)$	8% 5%	2.39 ± 0.77 2.8 + 0.8 (1-4)	4.27 ± 1.01 1.4 + 0.4 (1-2)	recurrence i 2 (3.57%)	rate 45.1% 5 (8.92%)

Also, obturator nerve reflex occurred only in 4 cases out of 53 cases in which tumor was sited in the lateral wall of urinary bladder. This agrees with the results of other researchers who reported significantly reduced rate of obturator nerve reflex for en bloc resection, when compared to monopolar TURBT (4.4% vs. 11.1%) [22]. Other studies in literature agree that en bloc bladder cancer removal significantly decrease the frequency of obturator reflexes (0% -9%), in comparison to the classical resection (6%-25%) [24,25].

This can be explained by shorter contact time between the active electrode and the tumor tissue during the en-bloc resection technique compared to the conventional staged resection [24-27].

We observed that postoperative bladder irrigation was only needed in 14 (7.5%) cases, mean catheterization time was 2.8 \pm 0.8 days and mean hospital stay was 1.4 \pm 0.4 days .This agrees with other studies in literature in whom en-block resection of the bladder tumour vs. classic technique was used, reported shorter catheterization time 1.9 vs. 2.8 day [22] and 1.4 days vs. 4.2 days [28] and hospital stay 2.3 days vs. 3.1 days [22] and 1.5 days vs. 4.27 days [27].

We found that in all the studied cases there was residual tumour in base of resection in 7 (12. 5%) of the NMIBC cases with complete resection of the tumour in 49 (87.5%) of the NMIBC cases, detrusor muscle in the resected mass was available in 76(95%) out of 80 cases. Recurrence after 1 year follow up in NMIBC cases was detected in the same field of resection in 2 (3.57%) cases only with in field recurrence free survival of 96.42% (54/56) and in 5 (8.92%) cases recurrence was outside field of previous resection with recurrence free survival of 91.07% (51/56). This is consistent with the results of other investigators who reported that the recurrence-free survival after 18 months was 88.5% (23/26) and 74.5% (38/51) for Ta and T1 patients, respectively [18]. This also agrees with other studies in literature who found that none of the tumor base biopsies were positive for malignancy, and the recurrence rate at 3 months for the 51 NMIBC patients was of 15.7% [29] and other authors reported an excellent safety profile without compromising the appropriate oncological outcomes in resecting bladder mass using bipolar energy [30].

Second TURBT is recommended by current guidelines in patients diagnosed with high-risk NMIBC or in cases of T1 bladder cancer without muscle in the specimen [31]. Second look TURBT provide information about misdiagnosed muscle invasive bladder cancer and allow resection of residual NMIBC [32], but it is associated with high costs, risk of complications and it is better if possible to avoid second look TURBT in these cases where no further benefit is going to be provided to the patient [9].

All 23 cases that needed second look TURBT did MP-MRI preoperatively to determine their VI-RADS score. At cutoff of 3 VI-RADS score had sensitivity 78.6%, specificity 77.8%, PPV 84.6, NPV 70.0% with an accuracy of 78.3%, while at cutoff 2 had sensitivity of 71.4%, specificity 77.8%, PPV 83.3%, NPV 63.6% with an accuracy of 73.9% in detecting muscle invasive bladder cancer. This agrees with the results of other authors who found a sensitivity, specificity, PPV and NPV of 85%, 93.6%, 74.5% and 96.6%, respectively [9]. These results support the validity of VI-RADS in the selection of candidates for a second TURBT therefore avoiding non necessary second look TURBT.

The results of the current study in this context enabled us to answer the following research questions: Is VI-RADS 5point score going to be added to the routine radiological investigations of bladder cancer? Will VI-RADS 5-point score help in avoiding the invasive second look TURBT? and Is en-block resection of NMIBC in the near future might be the technique of choice when applicable?

Regarding study limitations, we did not evaluate the diagnostic ability of VI-RADS 5-point score to predict high grade vs. low grade NMIBC as we aimed to investigate its ability to differentiate NMIBC from MIBC cases.

Wide scale of patients and multicenter studies are needed to validate the use of VI-RADS in avoiding second look TURBT that was not feasible in the beginning of the study as it was a single center study is another limitation. Also, 9 patients with stage T2 had no previous suspicious of MIBC on MRI (using the cut-off of VI-RADS 3), we believe that this could be caused by a bias because 70% of patients had clinical stage T1.

The used technique of tumor resection employed in the current study, from the point of tumor recurrence and progression, will indeed necessitate a prolonged follow-up periods in order to determine the long-term benefits of this modality of bladder cancer treatment that was only 12 months in the current study as a second end point.

6. Conclusion

VI-RADS 5-point score showed high sensitivity and specifity in both preoperative discrimination of NMIBC from MIBC cases, helping in selecting cases candidate for en-block resection and in avoiding unnecessary second look TURBT.

Bipolar en-block TURBT technique is both safe with minimal complications and efficacious in resecting NMIBC cases providing high quality specimen for pathological evaluation and associated with high recurrence free survival with favorable postoperative outcomes reflected in short hospital stay, short catheterization time and less need for postoperative bladder irrigation.

References

 Sureka SK, Agarwal V, Agnihotri S, Kapoor R, Srivastava A, Mandhani A. Is en-bloc transurethral resection of bladder tumor for non -muscle invasive bladder carcinoma better than conventional technique in terms of recurrence and progression? A prospective study. Indian J Urol 2014;30(2):144.

- [2] Brausi M, Collette L, Kurth K, Van Der Meijden AP, Oosterlinck W, Witjes JA, et al. Variability in the recurrence rate at first follow-up cystoscopy after TUR in stage Ta T1 transitional cell carcinoma of the bladder: a combined analysis of seven EORTC studies. Eur Urol 2002;41(5):523–31.
- [3] Mariappan P, Smith G, Lamb AD, Grigor KM, Tolley DA. Pattern of recurrence changes in noninvasive bladder tumors observed during 2 decades. J Urol 2007;177(3):867–75.
- [4] Chen X, Liao J, Chen L, Qiu S, Mo C, Mao X, et al. En bloc transurethral resection with 2-micron continuous-wave laser for primary nonmuscle-invasive bladder cancer: a randomized controlled trial. World J Urol 2015;33(7):989–95.
- [5] Kramer MW, Altieri V, Hurle R, Lusuardi L, Merseburger AS, Rassweiler J, et al. Current evidence of transurethral en-bloc resection of nonmuscle invasive bladder cancer. Eur Urol Focus 2017;3(6):567–76.
- [6] Wu YP, Lin TT, Chen SH, Xu N, Wei Y, Huang JB, et al. Comparison of the efficacy and feasibility of en bloc transurethral resection of bladder tumor versus conventional transurethral resection of bladder tumor: a meta-analysis. Medicine 2016;95(45).
- [7] 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 2018;74(3):294–306.
- [8] Carando R, Afferi L, Marra G, Krajewski W, Pagliarulo V, Abufaraj M, et al. The effectiveness of multiparametric magnetic resonance imaging in bladder cancer (Vesical Imaging-Reporting and Data System): a systematic review. Arab J Urol 2020;18(2):67–71.
- [9] Del Giudice F, Barchetti G, De Berardinis E, Pecoraro M, Salvo V, Simone G, et al. Prospective assessment of vesical imaging reporting and data system (VI-RADS) and its clinical impact on the management of high-risk non-muscle-invasive bladder cancer patients candidate for repeated transurethral resection. Eur Urol 2020;77(1):101–9.
- [10] Rizzo A, Mollica V, Cimadamore A, Santoni M, Scarpelli M, Schiavina R, et al. TNM staging towards a personalized approach in metastatic urothelial carcinoma: what will the future be like?—a narrative review. Transl Androl Urol 2021;10(3):1541–52. https://doi.org/ 10.21037/tau-20-1109.
- [11] Mollica V, Rizzo A, Montironi R, Cheng L, Giunchi F, Schiavina R, et al. Current strategies and novel therapeutic approaches for metastatic urothelial carcinoma. Cancers (Basel) 2020;12(6):1449.. https://doi.org/10.3390/cancers12061449:PMID: 32498352; PMCID: PMC7352972.
- [12] Babjuk M, Bohle A, Burger M, Capoun O, Cohen D, Comperat EM, et al. EAU guidelines on non-muscle-invasive urothelial carcinoma of the bladder: update 2016. Eur. Urol. 2017;71:447–61.
- [13] World Medical Association Declaration of Helsinki. ethical principles for medical research involving human subjects. J Am Coll Dent 2014;81(3):14–8.
- [14] Mariappan P, Smith G. A surveillance schedule for G1Ta bladder cancer allowing efficient use of check cystoscopy and safe discharge at 5 years based on a 25-year prospective database. J Urol 2005;173(4):1108–11.
- [15] Witjes JA, Compérat E, Cowan NC, De Santis M, Gakis G, Lebret T, et al. EAU guidelines on muscle-invasive and metastatic bladder cancer: summary of the 2013 guidelines. Eur Urol 2014;65(4):778–92.
- [16] Ukai R, Kawashita E, Ikeda H. A new technique for transurethral resection of superficial bladder tumor in 1 piece. J Urol 2000;163(3):878–9.

- [17] Zhang KY, Xing JC, Li W, Wu Z, Chen B, Bai DY. A novel transurethral resection technique for superficial bladder tumor: retrograde en bloc resection. World J Surg Oncol 2017;15(1):1–7.
- [18] Zhang J, Wang L, Mao S, Liu M, Zhang W, Zhang Z, et al. Transurethral en bloc resection with bipolar button electrode for non-muscle invasive bladder cancer. Int Urol Nephrol 2018;50 (4):619–23.
- [19] Makboul M, Farghaly S, Abdelkawi IF. Multiparametric MRI in differentiation between muscle invasive and non-muscle invasive urinary bladder cancer with vesical imaging reporting and data system (VI-RADS) application. Br J Radiol 2019;92:20190401.
- [20] Gmeiner J, Garstka N, Helbich TH, Shariat SF, Baltzer PA. Vesical Imaging Reporting and Data System (VI-RADS): are the individual MRI sequences equivalent in diagnostic performance of high grade NMIBC and MIBC? Eur J Radiol 2021;142:109829.
- [21] Kim SH. Validation of vesical imaging reporting and data system for assessing muscle invasion in bladder tumor. Abdom. Radiol 2020;45 (2):491–8.
- [22] Bălan GX, Geavlete PA, Georgescu DA, Ene CV, Bulai CA, Păunescu MA, et al. Bipolar en bloc tumor resection versus standard monopolar TURBT-which is the best way to go in non-invasive bladder cancer? Romanian J Morphol Embryol 2018;59(3):773–80.
- [23] Hashad MM, Abdeldaeim HM, Moussa A, Assem A, Abou Youssif TM. Bipolar vs monopolar resection of bladder tumours of>3 cm in patients maintained on low-dose aspirin: a randomised clinical trial. Arab J Urol 2017;15(3):223–7.
- [24] Zhu Y, Jiang X, Zhang J, Chen W, Shi B, Xu Z. Safety and efficacy of holmium laser resection for primary nonmuscle-invasive bladder cancer versus transurethral electro resection: single-center experience. Urology 2008;72(3):608–12.
- [25] Xishuang S, Deyong Y, Xiangyu C, Tao J, Quanlin L, Hongwei G, et al. Comparing the safety and efficiency of conventional monopolar, plasmakinetic, and holmium laser transurethral resection of primary non-muscle invasive bladder cancer. J Endourol 2010;24(1):69–73.
- [26] Chen X, Liao J, Chen L, Qiu S, Mo C, Mao X, et al. En bloc transurethral resection with 2-micron continuous-wave laser for primary non -muscle-invasive bladder cancer: a randomized controlled trial. World J Urol 2015;33(7):989–95.
- [27] Liu H, Wu J, Xue S, Zhang Q, Ruan Y, Sun X, et al. Comparison of the safety and efficacy of conventional monopolar and 2-micron laser transurethral resection in the management of multiple non-muscleinvasive bladder cancer. J Int Med Res 2013;41(4):984–92.
- [28] de Haas RJ, Steyvers MJ, Fütterer JJ. Multiparametric MRI of the bladder: ready for clinical routine? Am J Roentgenol 2014 Jun;202 (6):1187–95.
- [29] Geavlete B, Jecu M, Multescu R, Georgescu D, Drăguţescu M, Geavlete P. TURis plasma vaporization in non-muscle invasive bladder cancer-the first Romanian experience with a new technique. J Med Life 2010;3(1):100.
- [30] Canter DJ, Ogan K, Master VA. HOW I DO IT-Initial North American experience with the use of the Olympus Button Electrode for vaporization of bladder tumors. Canadian J Urol 2012;19(2):6211.
- [31] Babjuk M, Böhle A, Burger M, et al. EAU guidelines on non-muscleinvasive urothelial carcinoma of the bladder: update 2016. Eur Urol 2017;71:4.
- [32] Cumberbatch MG, Foerster B, Catto JW, Kamat AM, Kassouf W, Jubber I, et al. Repeat transurethral resection in non-muscle-invasive bladder cancer: a systematic review. Eur Urol 2018;73(6):925–33.