

Diagnostic Accuracy of the nacVI-RADS Scoring System Using Biparametric 3-Tesla MRI After Neoadjuvant Chemotherapy for Muscle-Invasive Bladder Cancer : A Cohort Study with Intermediate-Term Follow-Up

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Abstract

Background:

Accurate assessment of tumor response after neoadjuvant chemotherapy (NAC) in muscle-invasive bladder cancer (MIBC) is essential for guiding treatment decisions. The neoadjuvant vesical imaging-reporting and data system (nacVI-RADS) was recently introduced to standardize MRI-based post-NAC response evaluation.

Objective:

To evaluate the diagnostic performance of the nacVI-RADS using biparametric MRI (T2W and DWI without contrast) in predicting pathological response to NAC in patients with MIBC.

Patients and Methods:

We conducted a non-concurrent cohort study including 59 patients with MIBC who received cisplatin-based NAC followed by radical cystectomy between 2019 and 2021. Restaging pelvic MRI was performed using a standardized non-contrast 3-Tesla biparametric protocol (T2W and DWI). nacVI-RADS scores were retrospectively assigned and compared with final pathology. Diagnostic performance metrics included sensitivity, specificity, predictive values, and area under the curve (AUC).

Results:

Pathologic complete response (ypT0) occurred in 27% of patients. For detecting ypT0, nacVI-RADS demonstrated 81.3% sensitivity, 81.2% specificity, 92% PPV, and 62% NPV (AUC 0.81). For identifying residual muscle-invasive disease (ypT2–4), sensitivity and specificity were 77.7% and 82.6%, respectively (AUC 0.80). Concordance between MRI and pathology was moderate ($\kappa = 0.58$, $p < 0.0001$). NAC responders showed significantly higher 3-year recurrence-free survival compared with non-responders (75% vs 42%, $p = 0.017$).

Conclusion:

nacVI-RADS shows good diagnostic performance on non-contrast 3-Tesla MRI and may serve as a valuable non-invasive tool for post-NAC response assessment particularly with higher scores ($\geq 4-5$) that strongly indicate a residual muscle-invasive disease.

Introduction

Bladder cancer (BC) is a major global health problem, ranking as the tenth most common malignancy worldwide, the sixth most common cancer in men and the ninth leading cause of cancer-related death [1]. Cisplatin-based NAC followed by radical cystectomy (RC) is endorsed by the international guidelines as the standard of care for patients with cT2-4aN0 urothelial BC. It has been associated with improved overall survival owing to downstaging of primary tumor and control of micro-metastasis [2, 3]. Reliable assessment of tumor response following NAC remains a critical unmet need. Although RC is the standard of care after NAC, a substantial proportion of patients achieve complete or marked downstaging, raising the possibility of bladder-sparing alternatives. However, current clinical tools, including axial imaging, cystoscopy and biopsy, lack sufficient accuracy for guiding such decisions [4].

Multiparametric magnetic resonance imaging (mpMRI) has emerged as a promising tool for local staging of BC, particularly when interpreted using the Vesical Imaging Reporting and Data System (VI-RADS) [5]. To extend this approach to the post-neoadjuvant treatment setting, Pecoraro et al proposed the **nacVI-RADS**, a modified scoring system designed to quantify tumor response after NAC by integrating imaging signs of regression with residual disease activity [6]. In their preliminary study, nacVI-RADS showed promising diagnostic performance in predicting pathologic response at RC, offering a potential tool for individualized treatment planning [6]. Subsequent studies validated this system using contrast-enhanced protocols, reporting encouraging diagnostic performance [7, 8].

The recommended imaging protocol for nacVI-RADS typically includes T2-weighted (T2W) imaging, diffusion-weighted imaging (DWI), and dynamic contrast-enhanced (DCE) sequences. Among these sequences, DWI has been considered the most informative for assessing muscle invasion [9]. While contrast-enhanced MRI remains the standard, recent studies evaluating the original VI-RADS system for primary staging have explored the feasibility of contrast-free, biparametric MRI protocols—using T2W and DWI only—with promising diagnostic performance. These studies demonstrated comparable accuracy to standard mpMRI in detecting MIBC while offering advantages such as reduced scan time, lower cost, and improved patient safety by avoiding gadolinium-based contrast agents [10, 11].

However, to our knowledge, no prior studies have evaluated the diagnostic accuracy of the nacVI-RADS system in the post-chemotherapy setting using a non-contrast protocol. Moreover, there remains a lack of high-level evidence assessing whether such simplified protocols can be reliably applied for restaging after NAC. Therefore, our study aimed to externally validate the nacVI-RADS scoring system using a biparametric MRI protocol (T2W and DWI without contrast) on a 3-Tesla scanner, and to assess its diagnostic accuracy in predicting pathological response to NAC before RC.

Patients and Methods

Study Population

After institutional review board approval (R.24.10.2860), we conducted a retrospective analysis of a prospectively collected cohort of BC patients treated at a tertiary academic center between January 2019 and December 2021. A total of 117 consecutive patients with urothelial muscle-invasive bladder

cancer (MIBC) who had received at least four cycles of neoadjuvant chemotherapy (NAC) were identified. Patients were excluded if they declined or were unfit for radical cystectomy (RC) (n = 50), or if re-staging MRI was not performed or available (n = 8), leaving 59 patients available for final analysis.

Preoperative Evaluation

As per our institutional protocol for assessment of BC, preoperative evaluation included a detailed medical history, physical examination, and laboratory investigations (including renal and liver function tests, complete blood count, coagulation profile, and serology). Imaging included multiparametric non-contrast pelvic MRI and distant metastatic workup, if indicated. All imaging was performed within one month prior to surgery.

MRI Technique

Pelvic MRI was performed using a 3-Tesla scanner (Ingenia 3T, Philips, Netherlands) with an 18-channel phased-array external coil. Biparametric MRI protocol included high-resolution T2-weighted (T2W) imaging in axial, sagittal, and coronal planes (TR: 4690 ms, TE: 119 ms, flip angle: 90°, FOV: 23 cm, matrix: 400 × 256–302, slice thickness: 3–4 mm, gap: 0–0.4 mm, NEX: 2–3 (Number of Excitations), and diffusion-weighted imaging (DWI) with apparent diffusion coefficient (ADC) mapping (b-values: 800–1000 s/mm², TR: 2500–5300 ms, TE: 61 ms, flip angle: 90°, FOV: 32 cm, matrix: 128 × 128, slice thickness: 3–4 mm, gap: 0.3–0.4 mm, NEX: 4–10). Additional sequences included T1-weighted imaging with and without fat suppression and axial T2-weighted imaging with fat suppression. To optimize bladder distention and reduce motion artifacts, patients were instructed to drink 500–1000 mL of water 30 minutes prior to imaging and received intramuscular antispasmodic medication (n-butyl-scopolamine, 20 mg) before the scan. No intravenous contrast was administered.

Interpretation of nac VI-RADS

The nacVI-RADS is a five-point scoring system developed to assess radiologic response to neoadjuvant therapy based on comparative analysis of pre- and post-treatment MRI findings including changes in both morphological and functional imaging sequences. Scores of 1–2 indicate a radiologic complete response; a score of 3 suggests radiologic downstaging to likely NMIBC; a score of 4 reflects partial downstaging with persistent MIBC; while a score of 5 denotes residual disease with no evidence of downstaging or evidence of upstaging regardless the initial VI-RAD score[6]. All MRI scans were reviewed jointly by the three radiologists (each with at least 15 years of experience), who reached a consensus score; therefore, inter-reader agreement could not be assessed. All radiologists were blinded to the final pathology.

Intervention

All patients initially underwent examination under anesthesia (EUA) and transurethral resection of bladder tumor (TURBT) to identify the histologic subtype and depth of tumor invasion. Patients with confirmed urothelial MIBC were counseled and treated with a standard cisplatin and gemcitabine NAC

regimen for at least four cycles. Following NAC, re-staging of the primary tumor was carried out using repeat MRI and repeat EUA, cystoscopy with biopsy (re-staging TURBT). Patients who were fit for surgery, underwent RC and urinary diversion. RC with bilateral pelvic lymphadenectomy (PLND) was performed as previously described [12]. The type of urinary diversion—either orthotopic ileal neobladder or ileal conduit—was selected based on each patient’s general condition, as well as renal and hepatic function. All patients provided written informed consent in accordance with the principles of the Declaration of Helsinki.

Pathological Assessment

Pathologic evaluation included: tumor staging (pT and pN stage) as defined in the AJCC 8th edition [13], histologic variants, presence of synchronous carcinoma in situ (CIS), micropapillary component, lymph node (LN) count, number of pathologically positive LN, lymphovascular invasion (LVI), and soft tissue surgical margin (STSM) status.

Follow-up

Patients were followed **every 3 months** in year 1, **every 6 months** in year 2, and **annually** thereafter. Cross-sectional imaging (MRI or contrast-enhanced CT) was obtained biannually in year 1 and annually thereafter or as indicated. **Local recurrence** was pelvic soft-tissue/templated nodal relapse; **distant metastasis** was recurrence at remote sites or extra-template nodes. **RFS** was time from RC to first recurrence.

Outcome Measures

The primary outcome was concordance between post-NAC MRI staging (nac-VIRADS) and final pathology. Specifically, we assessed the diagnostic performance of nac-VIRADS in detecting complete pathologic response (ypT0) and muscularis propria invasion in case of residual tumors.

Radiologic staging (cT stage) was compared against pathological staging (reference standard) using sensitivity, specificity, overall accuracy, positive and negative predictive values.

Statistical Analysis

Continuous variables were summarized as mean $\pm$ SD or median (IQR) and compared using the t-test or Mann–Whitney U test, as appropriate. Categorical variables were presented as n (%) and compared using the χ^2 test or Fisher’s exact test. Diagnostic performance of nacVI-RADS relative to final pathology (primary cut-off ≥ 4 for detection of $\geq$ ypT2; secondary analysis for identifying ypT0) was reported as sensitivity, specificity, PPV, and NPV, each with corresponding 95% confidence intervals. Discriminative ability of the ordinal score was evaluated using ROC curves and AUC values. Recurrence-free survival (RFS) was estimated by the Kaplan–Meier method and compared with the log-rank test. Cox proportional hazards models were used to assess associations between clinicopathologic variables and RFS, including prespecified covariates such as cT stage and hydronephrosis. All tests were two-sided, with $\alpha = 0.05$. Statistical analyses were performed using IBM SPSS Statistics, version 20 (IBM Corp.).

Results

Patient Demographics, Tumor Staging, and Treatment

A total of 59 consecutive patients were included in the study (55 men and 4 women), with a mean age of 61 ± 6.9 years. Baseline demographic and clinical characteristics are summarized in **Table 1**. At initial presentation, 36 patients (61%) had clinically extravesical tumors (VI-RADS 5), while 23 (39%) had clinically positive lymph nodes. Multifocal tumors were identified in 9 patients (15.3%), and histologic variants were present in 15 patients (25.4%) on initial TURBT specimens. All patients received at least four cycles of cisplatin/gemcitabine-based NAC. The median duration of NAC was 15 weeks (IQR: 13–21). **Table 2** summarizes the neoadjuvant treatment regimens, time intervals, and perioperative surgical details.

Clinical Response to NAC Assessed by Restaging MRI (nacVI-RADS)

Overall, 37 patients (62.7%) showed a clinical response to NAC. Complete radiologic response (nacVI-RADS 1–2) was observed in 21 patients (35.6%), while 16 (27%) showed downstaging. Sixteen patients (27%) had stable disease, and 6 (10.2%) were upstaged to nacVI-RADS 5 (**Table 3**). Representative cases corresponding to nacVI-RADS scores 1 through 5 are shown in **Figure 1**, illustrating the spectrum of post-NAC radiologic responses on T2W, DWI, ADC sequences.

Surgical Treatment and Final Pathology

All patients underwent open RC with standard bilateral pelvic lymphadenectomy up to the bifurcation of the common iliac arteries. An orthotopic neobladder was constructed in 43 patients (73%). The mean number of lymph nodes retrieved was 17.7 ± 5.9 . Nine patients (15%) experienced high-grade (Clavien–Dindo grade III–V) complications, and one patient died postoperatively. At final pathology, 16 patients (27%) had a complete response (ypT0), 7 (12%) had ypT1 disease, 13 (22%) had organ-confined ypT2 disease, and 23 (39%) had non-organ-confined disease (ypT3–T4a). Lymph node metastases were present in 10 patients (17%). Positive urethral margins were noted in 3 patients (5%). Histological variants were detected in 19 patients (32.2%), with squamous differentiation being the most common. Findings of definitive pathology are summarized in **Table 4**.

Diagnostic Accuracy of Restaging MRI (nacVI-RADS)

Among the 16 patients with ypT0 disease, 3 (18.7%) were incorrectly assigned higher nacVI-RADS (≥ 3). Conversely, among the 36 patients with ypT2–4 tumors, 8 (22.2%) were understaged (nacVI-RADS ≤ 3). The sensitivity and specificity of nacVI-RADS in identifying complete pathologic response (ypT0) were 81.3% (95% CI 66.6–91.6%) and 81.2% (95% CI 54.4–96.0%), respectively; PPV and NPV were 92% and 62%, with an overall accuracy of 81.3%. Concordance between imaging and pathology was moderate ($\kappa = 0.57$, $p < 0.0001$). The AUC for predicting ypT0 was 0.81 (95% CI: 0.68–0.94, $p < 0.0001$) (**Figure 2**).

For detecting residual muscle-invasive disease (ypT2–4), nacVI-RADS showed a sensitivity of 77.7% (95% CI 60.8–89.9%), specificity of 82.6% (95% CI 61.2–95.0%), PPV of 87.5%, and NPV of 70.3%, with an overall accuracy of 79.6%. The agreement with pathology was moderate ($\kappa = 0.58$, $p < 0.0001$), and the AUC was 0.80 (95% CI: 0.68–0.91, $p < 0.0001$).

Oncologic Outcomes and Recurrence-Free Survival

Over a median follow-up of 24.5 months (IQR: 9–36), 18 patients (30.5%) developed local or distant recurrence. The mean time to recurrence was 13.8 ± 7.75 months. The estimated 1- and 3-year RFS for the entire cohort were 80.6% and 61.8%, respectively. NAC responders (complete or partial) had significantly better RFS compared to non-responders: 1- and 3-year RFS were 93% and 75% vs. 61.2% and 42%, respectively (log-rank $p = 0.017$).

Discussion

Cisplatin-based NAC was introduced more than two decades ago for the management of MIBC[2]. Its use in routine practice has increased in recent years following robust evidence demonstrating a clear survival advantage without increasing perioperative morbidity or length of hospital stay[14–16]. A systematic review and meta-analysis of 57 studies concluded that NAC followed by RC offers the best survival outcomes compared with RC alone or trimodality therapy [17]. Notably, this survival benefit is strongly linked to pathological downstaging.

In the present cohort, complete pathological response (ypT0) was observed in 27% of patients, and an additional 12% showed downstaging to NMIBC. Complete responders demonstrated significantly superior 3-year RFS compared with partial or non-responders (90% vs 40%, $p = 0.001$), confirming the well-established prognostic importance of pathological response. These findings are consistent with the VESPER trial, which reported ypT0 rates of 36–42% with ddGC and MVAC regimens, respectively [18], as well as with neoadjuvant immunotherapy studies such as PURE-01 and ABACUS [19, 20]. The strong outcomes observed in complete responders have renewed interest in bladder-sparing strategies aimed at avoiding the significant morbidity associated with RC [21, 22]. Retrospective data from Mazza et al. showed bladder preservation in 76% and 5-year overall survival of 86% among complete responders managed with active surveillance [23]. Similarly, prospective studies including RETAIN I and HCRN GU 16–257 demonstrated encouraging metastasis-free and bladder-preservation outcomes in carefully selected responders managed non-operatively [24, 25].

A major challenge, however, is the lack of reliable tools to confirm complete clinical response. In one prospective trial, 52% of patients deemed clinically negative on cystoscopy and biopsy were found to have residual disease at RC, including muscle-invasive tumors in half of these cases [26]. These limitations have stimulated interest in MRI-based biomarkers capable of assessing treatment response. Functional MRI provides insights into tumor cellularity and tissue disorganization [27, 28] and Necchi et al. proposed mpMRI criteria for defining complete response after neoadjuvant pembrolizumab in the PURE-01 study [29]. More recently, Pecoraro et al. introduced the nacVI-RADS scoring system to

standardize post-treatment MRI assessment. In their initial report of ten patients, nacVI-RADS showed complete concordance with final pathology in distinguishing complete and partial responders, with excellent inter-reader agreement ($\kappa = 0.816$) [6].

In the current study, we evaluated nacVI-RADS performance in 59 patients treated with NAC and RC. Restaging MRI demonstrated moderate agreement with final pathology ($\kappa = 0.58$). For predicting complete pathological response (ypT0), nacVI-RADS achieved sensitivity, specificity, and accuracy values exceeding 80%, with an AUC of 0.81. The high PPV of 92% indicates that patients with scores ≥ 3 are very likely to harbor residual disease, whereas the modest NPV of 62% highlights the continued risk of understaging among low-score cases.

Our findings align with a recent study evaluating nacVI-RADS after neoadjuvant immunotherapy in 110 patients, which reported comparable diagnostic performance despite differences in treatment modality and imaging protocols (contrast-enhanced 1.5-T MRI vs non-contrast 3-T MRI in our study) [7]. A more recent multicenter validation study reported superior diagnostic accuracy using full mpMRI protocols including DCE, with AUC values of 0.93 for any residual disease (ypT ≥ 1) and 0.95 for persistent muscle-invasive disease (ypT ≥ 2), along with excellent inter-reader agreement ($\kappa = 0.85$) [8]. Although our simplified non-contrast protocol yielded slightly lower performance, AUC values of 0.81 for ypT0 and 0.80 for ypT2–4 still represent good diagnostic accuracy and may better reflect practical workflow constraints in high-volume centers.

Despite these promising results, the modest NPV observed across studies—including ours (62%) and prior validation cohorts (66–77% depending on reader experience) [8] —underscores a critical limitation. A low nacVI-RADS score cannot reliably exclude residual disease, which is an important consideration when contemplating bladder-sparing approaches or delaying cystectomy..

This study has several strengths. It reflects the experience of a single high-volume academic center with a relatively homogeneous cohort receiving standardized NAC and RC. Both radiologic and pathologic assessments were centrally reviewed, enhancing internal validity. Moreover, our findings support the utility of nacVI-RADS even when DCE imaging is not feasible, reinforcing its potential applicability in resource- or workflow-constrained settings.

Nevertheless, several limitations merit consideration. First, the retrospective design introduces potential selection bias, as only patients who proceeded to RC were included. Second, the sample size—particularly in subgroups such as female patients and histologic variants—may limit the generalizability of our findings. Third, although nacVI-RADS provides a structured approach to post-treatment MRI evaluation, distinguishing residual tumor from post-therapeutic changes remains challenging, and inter-reader variability was not assessed owing to consensus reading. Future multicenter prospective studies incorporating multi-reader evaluation are warranted to validate the diagnostic accuracy of nacVI-RADS and refine its integration into individualized decision-making and bladder-sparing algorithms.

Conclusion

The nacVI-RADS scoring system demonstrated good diagnostic accuracy and moderate concordance with final pathology in assessing tumor response to NAC. Its most appropriate clinical role is as a rule-in tool: higher scores ($\geq 4-5$) indicate a high likelihood of residual muscle-invasive disease and should prompt timely cystectomy rather than delay or bladder-sparing consideration. Larger prospective multicenter studies are needed to further validate nacVI-RADS and clarify its role in guiding individualized treatment strategies, including potential bladder-sparing approaches

Abbreviations

ADC – Apparent diffusion coefficient

AUC – Area under the curve

BC – Bladder cancer

DCE – Dynamic contrast-enhanced (MRI)

DWI – Diffusion-weighted imaging

MIBC – Muscle-invasive bladder cancer

NAC – Neoadjuvant chemotherapy

nacVI-RADS – Neoadjuvant Vesical Imaging-Reporting and Data System

RC – Radical cystectomy

RFS – Recurrence-free survival

T2W – T2-weighted imaging

Declarations

Author contribution

Mahmoud Laymon: Study concept and design, data analysis and interpretation, manuscript drafting. **Amr Elsayy:** statistical analysis, Manuscript writing and revision **Mohammed Badawy:** Radiologic image analysis. **Ali Elsorogy:** Radiologic image analysis. **Ahmed Elkarta:** Conceptual input, data analysis and interpretation. **OsamaMahmoud:** Manuscript writing and revision. **Ahmed Mosbah:** Critical revision of the manuscript. **Hassan Abol-Enein:** Critical revision of the manuscript. **Mohamed Abou El-Ghar:** Supervision and critical revision for important intellectual content. **Ahmed Shokeir:** Supervision and critical revision for important intellectual content.

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Human Ethics and Consent to Participate declarations: This study involved human participants and was conducted in accordance with the ethical principles of the Declaration of Helsinki. The study protocol was approved by the **Medical Research Ethics Committee, Institutional Review Board, Mansoura Faculty of Medicine, Mansoura University**, approval code number: **R.24.10.2860**.

Consent to Participate: Written informed consent to participate was obtained from all included patients.

Clinical trial number: Not applicable.

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Tables

Table (1) Baseline characteristics of 59 bladder cancer patients before administration of neoadjuvant chemotherapy (NAC).

Parameter	No (%)
Demographic data	
Age (years)	61 ± 6.9
Gender	
Male	55 (93.2%)
Female	4 (6.8%)
BMI, mean (SD)	28 (±4.9)
ASA score	
I	51 (86.4%)
II	8 (13.6%)
Diabetes mellitus (yes)	13 (22%)
Hypertension (yes)	15 (25.4%)
Radiologic data	
Clinical T stage at first MRI (VIRADS)	
VI-RAD 2	2 (3.4%)
VI-RAD 3	3 (5.1%)
VI-RAD 4	17 (28.8%)
VI-RAD 5	37 (62.7%)
Clinical N stage at first MRI (before NAC)	
cN0	36 (61%)
cN+	23 (39 %)
Preoperative hydronephrosis (yes)	12 (20.3%)
Pathologic type at first TURBT (before neoadjuvant chemotherapy)	
Number of lesions	
Solitary	50 (84.7%)
Multiple	9 (15.3%)
Pathologic type	
Pure urothelial carcinoma	44 (74.6%)
Urothelial carcinoma + squamous differentiation	8 (13.6%)

Urothelial carcinoma + glandular differentiation	6 (10.2%)
Urothelial carcinoma + Micropapillary component	1 (1.7%)
Lympho-vascular invasion (yes)	3 (5%)

Table (2) Neoadjuvant chemotherapy and surgical treatment characteristics of 59 bladder cancer patients

Parameter	No (%)
NAC cycles	
4 cycles	45 (76.3%)
5 cycles	2 (3.4%)
6 cycles	12 (20.3%)
Median NAC duration (IQR)	15 (13-19) weeks
Perioperative blood transfusion	12 (20.3%)
Operative time (min) (mean $\pm$ SD)	406 $\pm$ 61
Urinary diversion type	
Orthotopic neobladder	43 (73%)
Ileal Conduit	16 (27%)

Table (3) Clinical Response Assessment Following Neoadjuvant Chemotherapy (MRI and Restaging TURBT)

Parameter	No (%)
Re-staging MRI	
Clinical T stage at second MRI after NAC (Nac-VIRADS)	
nacVI-RADS1/2 (No residual lesions)	21 (35.6 %)
nacVI-RADS 3 (residual non-muscle invasive tumor)	6 (10.2%)
nacVI-RADS 4 (tumor invading muscularis propria)	10 (17%)
nacVI-RADS 5	22 (37.2%)
<i>No response to NAC</i>	16 (27.1%)
<i>Upstaging of the primary tumor</i>	6 (10.1%)
Clinical N stage at second MRI	
cN0	49 (83%)
cN+	10 (17%)
Re-staging TURBT	
Examination under anesthesia (EUA)	
Free	43 (73%)
Palpable mass	16 (27%)
Pathologic stage at restaging TURBT (after NAC)	
pT0 (No residual lesions)	16 (27%)
pT1	7 (12%)
pT2	36 (61%)

Table (4) Final histopathologic findings of 59 BC patients after radical cystectomy

Parameter	No (%)
Definitive pathology T stage	
ypT0	16 (27%)
ypT1	7 (12%)
yp T2	13 (22%)
ypT3	18 (30.5%)
ypT4a	5 (8.5%)
Definitive pathology N stage	
ypNo	49 (83%)
ypN1	8 (13.6%)
ypN2	2 (3.4%)
Definitive histologic type	
Pure urothelial carcinoma	24 (40.7%)
Urothelial carcinoma + squamous differentiation	10 (16.9%)
Urothelial carcinoma + glandular differentiation	7 (12%)
Urothelial carcinoma + sarcomatoid differentiation	2 (3.4%)
No residual lesions	16 (27%)
Number of removed lymph nodes (mean ± SD)	17.7 ± 5.9
Lympho-vascular invasion	12 (20.3%)
Positive urethral safety margins	3 (5%)
Prostatic stromal invasion	4 (6.8%)

Figures

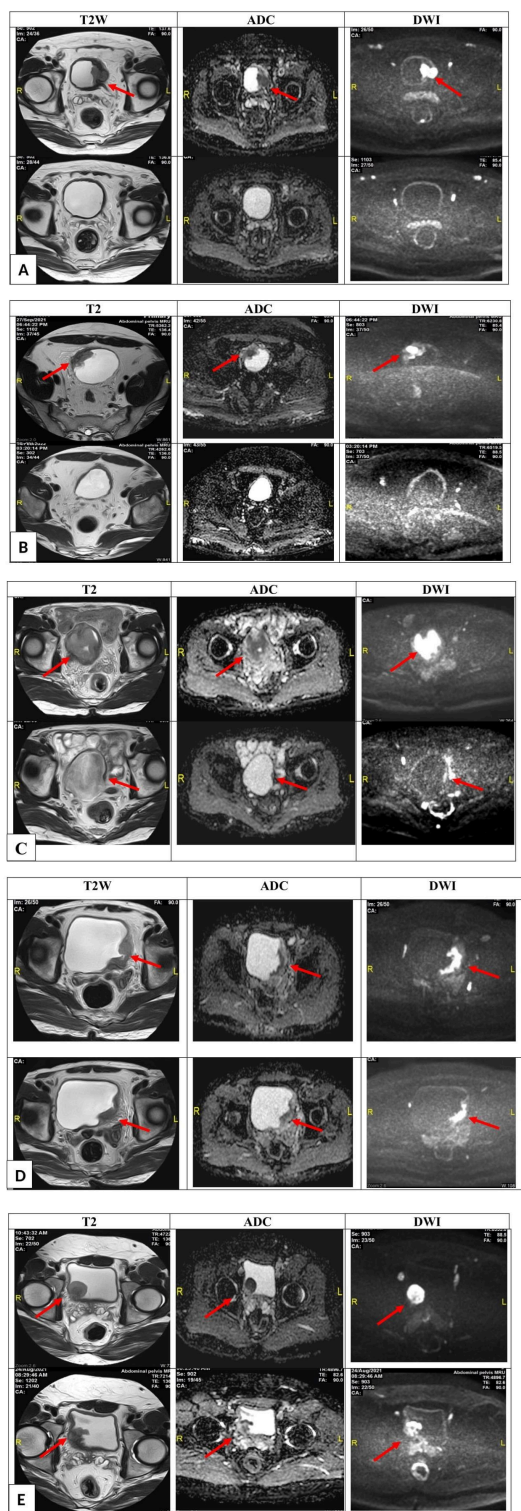


Figure 1

Representative examples of nacVI-RADS scoring after neoadjuvant chemotherapy in patients with muscle-invasive bladder cancer.

(A) A case initially scored VI-RADS 4 (top row), showing a fungating lesion at the left lateral wall invading the muscularis propria on T2W and DWI. Post-NAC imaging (bottom row) reveals complete resolution of

the lesion, consistent with nacVI-RADS 1.

(B) A case initially scored VI-RADS 5 (top row), with a mass extending into the perivesical fat. Post-NAC imaging (bottom row) shows no residual tumor, consistent with nacVI-RADS 2.

(C) A case with initial VI-RADS 4 (top row), showing bulky, multicentric masses involving the right, left, and anterior bladder walls with muscularis invasion. Post-NAC imaging (bottom row) demonstrates a small residual lesion at the right lateral wall without clear muscle invasion (red arrow), consistent with nacVI-RADS 3.

(D) A case with initial VI-RADS 5 (top row). Post-NAC imaging (bottom row) shows reduction in tumor size, but persistent muscle-invasive features, indicating nacVI-RADS 4.

(E) A case with initial VI-RADS 2 (top row), showing a hypointense mass not reaching the muscle layer. Post-NAC imaging reveals progression to muscle-invasive disease, indicating upstaging and nacVI-RADS 5.

Abbreviations: T2W = T2-weighted imaging; DWI = diffusion-weighted imaging; ADC = apparent diffusion coefficient; NAC = neoadjuvant chemotherapy.

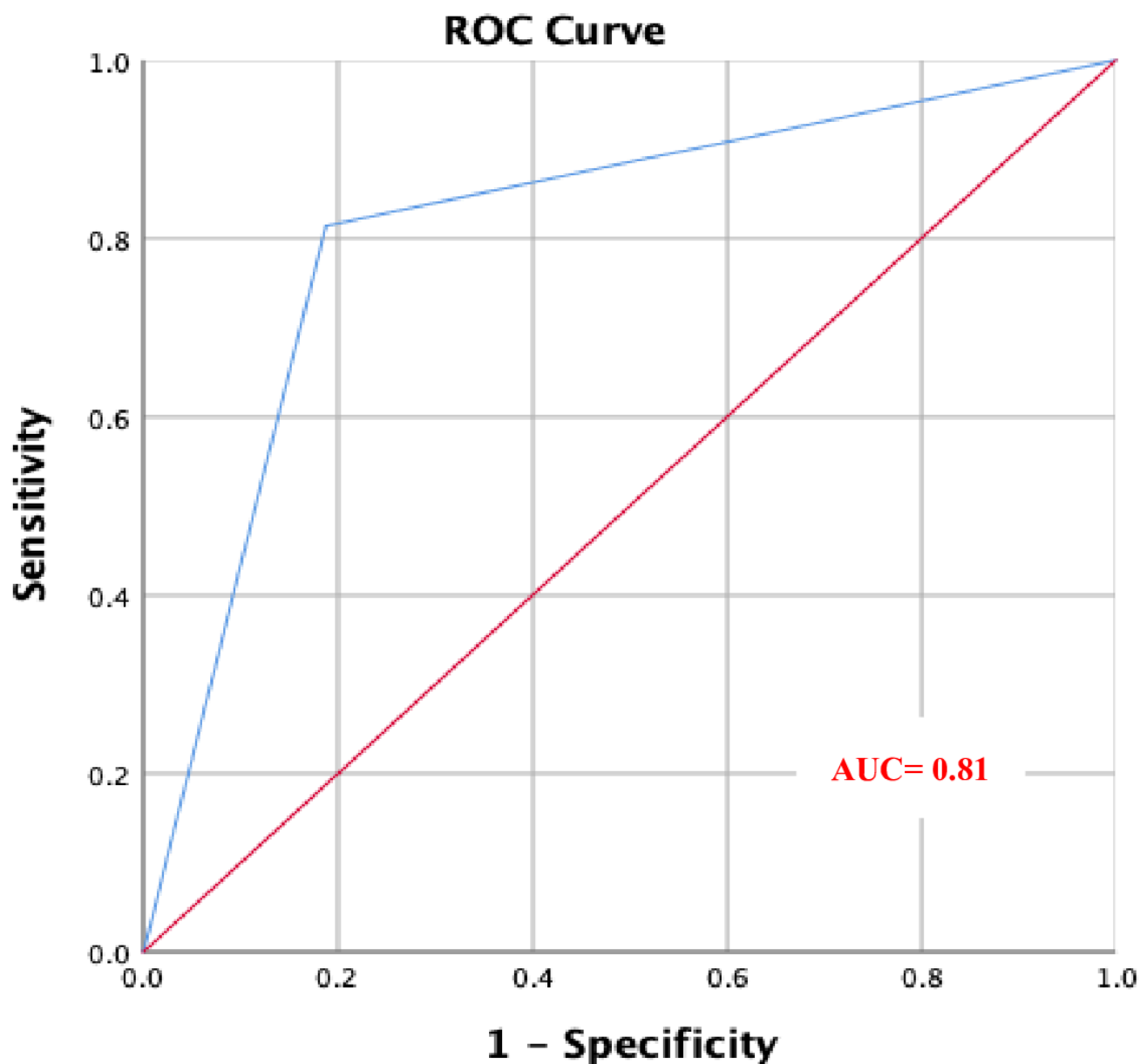


Figure 2

Receiver operating characteristic (ROC) curve illustrating the diagnostic performance of the nacVI-RADS scoring system in differentiating pathologic complete response (pT0) from residual muscle-invasive disease (pT2–T4). The area under the curve (AUC) was 0.81 (95% CI: 0.68–0.94).