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mpMRI features of mucinous prostate cancer: two case reports

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Abstract

Background Mucinous adenocarcinoma of the prostate (MACP) is one of the rarest variants of prostatic neoplasm, with more aggressive behavior than non-mucinous prostatic cancer. Previous studies suggested that these tumors exhibit different imaging magnetic resonance imaging (MRI) features compared with those of non-mucinous adenocarcinoma of the prostate upon which the conventional PIRADS v2.1 is based. To the best of our knowledge, this case series is the first to describe the multiparametric magnetic resonance imaging features of the MACP.

Results We presented two cases of biopsy proven mucinous adenocarcinoma of the prostate studied with multiparametric MRI. In both cases, diagnosis was late because of the different MRI features of MACP than those of the more common adenocarcinoma of the prostate. In both mpMRI, MACP appears to be hyperintense on T2WI, there was not a significant decrease in diffusivity in ADC maps and it exhibits early enhancement in DCE-MRI; the septa resulted in hypointense on T2WI compared to the PZ

Conclusions According to our experience, the conventional PIRADS v2.1 score is not suitable for mucinous prostate adenocarcinoma. MACP appears to be hyperintense on T2WI, has a lower ADC value, and exhibits early enhancement in DCE-MRI; the septa are usually hypointense on T2WI compared to the PZ. It is imperative for radiologists and urologists to be cognizant of this rare variant of prostate cancer to promptly identify and diagnose it, thereby preventing any diagnostic delays.

Keywords Mucinous adenocarcinoma, Prostate cancer, MRI, PIRADS

Background

Mucinous adenocarcinoma of the prostate (MACP) is an uncommon histological variant of prostate cancer, representing up to 0.4% of all malignant prostate tumors [1]. MACP is characterized by pools of extraluminal mucin. Since the first description by Samaratunga et al. in 1882, less than 200 cases have been reported so far in the scientific literature. Elbdawi et al. stated that for the diagnosis of MACP, a minimum of 25% of the tumor must exhibit pools of extracellular mucus. It should be noted that while other forms of prostate cancer may also produce mucus, their secretion rates are generally lower [2, 3]. MACP clinically behaves similarly to pure prostate adenocarcinoma, with increased prostate-specific antigen (PSA) levels, as described in up to 77,8% of reported cases with commonly diagnosed metastatic spread to bones in advanced tumors [4].

We report our clinical experience in the treatment of two patients diagnosed with MACP, focusing on the importance of multi parametric magnetic resonance imaging (mpMRI) characteristics in the diagnostic

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pathway of MACP, pointing out radiological differences from the common prostatic adenocarcinoma.

Case presentation

Case 1

A 72-year-old patient with a history of rising total PSA levels during the previous six years was referred to our outpatient clinic. His past medical history was uneventful. He reported a negative mpMRI of the prostate, performed with a rising PSA of 7.2 ng/ml one year earlier [Prostate Imaging Reporting & Data System v2.1 (PIRADS) 2 score lesion]. The last total PSA was 40 ng/ml. A soft nodule was identified on the right lobe on digital rectal examination. The patient consequently underwent a prostatic mpMRI showing a 37-mm multi-lobular nodular lesion with high signal intensity on T2 images, hyperintense on dynamic contrast-enhanced (DCE) MRI with no sign of diffusion restriction (hyperintense on both diffusion-weighted imaging (DWI) and apparent diffusion coefficient (ADC) map), on the right side of the prostate, and with extension into the posterior periprostatic tissue (Fig. 1). According to specific radiological features, this lesion was classified as PIRADS 2, despite the suspicious extra-prostatic extension of the nodule. Despite the radiological classification, due to the positivity of digital rectal examination, the patient underwent an MRI/ultrasound fusion targeted biopsy (3 cores) associated with 12 cores of systematic biopsies. Targeted and right systematic biopsies diagnosed a prostatic adenocarcinoma Gleason score 4+3 with numerous mucous pools (mucin lakes) and extra-prostatic extension. Bone scintigraphy and computed tomography (CT) scan were negative for metastasis. Following a multidisciplinary consultation, the patient underwent a robotic-assisted radical prostatectomy accompanied by a standard bilateral pelvic lymphadenectomy. The final histopathological report confirmed the presence of MACP Gleason Score 7 (4+3) with evidence of extra-prostatic extension and infiltration of both seminal vesicles (pT3bN0). At the 5-month interval during the postoperative follow-up period, we noted a gradual increase in prostate-specific antigen (PSA) levels (1.4 ng/ml). Subsequently, an 18F-choline positron emission tomography (PET) scan was conducted, revealing abnormal tracer uptake indicative of potential metastatic involvement in a presacral lymph node, right ischiopubic branch, D10 vertebra, and the third right rib (standardized uptake value [SUV] of 15.2). Following multidisciplinary reassessment, the

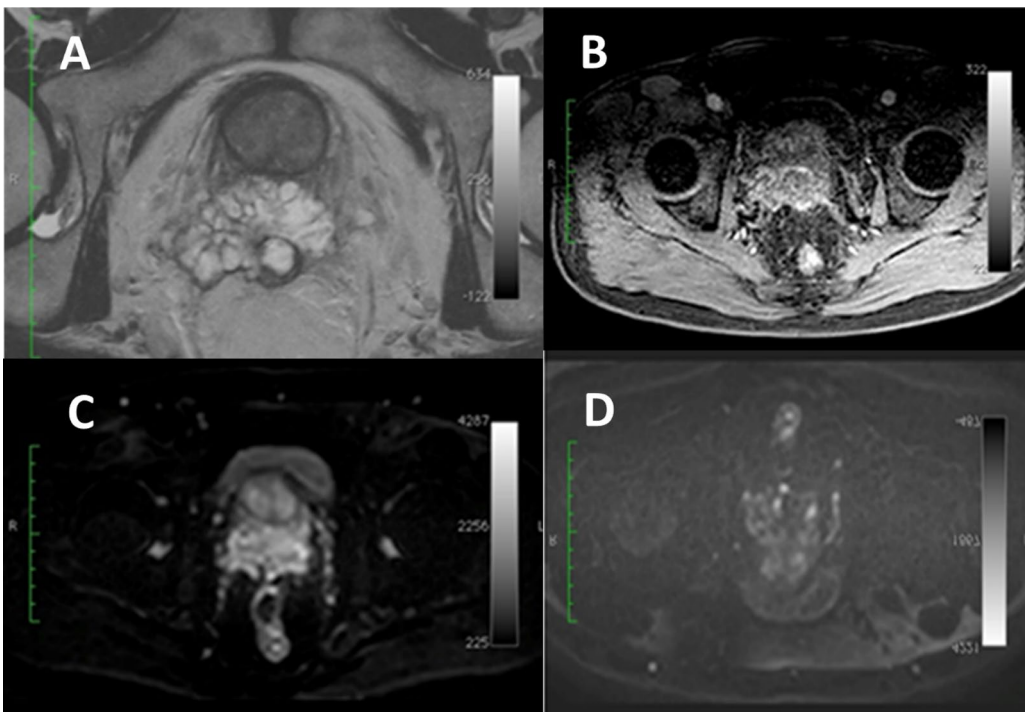

Fig. 1 **A** Axial T2 sequence demonstrating a homogeneous moderate T2 hyperintense mass in the peripheral zone (PZ) extending into the posterior periprostatic tissue. **B** Axial post-contrast T1 THRIVE sequence of the prostate demonstrating inhomogeneous enhancement of the lesion, with intense early enhancement in the septa and no enhancement in the mucoid matrix. **C**–**D** Axial high-b value DWI sequence and the respective ADC map demonstrating a moderately hyperintense prostatic mass on DWI with corresponding markedly hyperintense signal on ADC, findings consistent with T2 shine-through effect [10]

case was commenced on androgen deprivation therapy, in conjunction with a regimen of 6 cycles of systemic chemotherapy (Taxotere). Following a 6-year period of hormonal deprivation, the disease progressed to a castration-resistant state, and an 18F-PET scan revealed tracer uptake in the liver and right ischiopubic branch. The patient subsequently initiated radium-223 therapy along with palliative care to manage bone pain. The patient is still engaged in oncological and urological follow-up.

Case 2

A 67-year-old man was referred to our urological unit due to lower urinary tract symptoms and a rising PSA of 20 ng/ml. The prostate was enlarged and asymmetrical on digital rectal examination, with no palpable nodules. The patient's medical history was characterized by a negative systematic biopsy for PSA 10 ng/ml one year earlier. A prostatic mpMR was performed, showing a T2 weighted imaging (WI) high signal multiloculated mass with low signal intensity septum (Fig. 2), The mass exhibited septations with low signal intensity (Fig. 2) and extended from the posterior right lobe into the posterior periprostatic tissue. It reached the anterolateral wall of the rectum posteriorly as well as the posterior wall of the bladder anteriorly. The observed lesion exhibited no diffusion restriction on DWI, with moderate hyperintensity on DWI and pronounced hyperintensity on the ADC map. Furthermore, post-contrast imaging demonstrated an uneven and predominantly peripheral pattern of contrast enhancement. Consequently, scoring the lesion according to the PIRADS score was deemed not feasible. Enlarged lymph nodes with similar MRI characteristics were detected in both the right external and left internal iliac locations.

Subsequently, the patient underwent target plus systemic prostate biopsy, with the histopathological finding reporting the presence of prostate adenocarcinoma Gleason Score 8 (4+4) with numerous mucous pools (mucin lakes). Bone scintigraphy yielded negative results, whereas a CT scan revealed enlarged right paracaval lymph nodes measuring 32.5 mm. Subsequently, an 18F-choline PET scan confirmed tracer uptake (with a SUV of 12.3) in the aforementioned locations. After a multidisciplinary evaluation, androgen deprivation therapy in association with systemic chemotherapy (Taxotere, 6 cycles) was started. After 6 months of follow-up, both CT and bone scintigraphy showed partial remission. The patient is currently on follow-up.

Discussion

MACP is a rare prostatic adenocarcinoma variant characterized by a single round and cribriform glands with relatively bland cytology floating within the mucinous lakes. The prognostic significance of mucinous adenocarcinoma has been controversial. In the past years, MACP was considered an aggressive variant. Still, recent studies demonstrated that MACP does not appear to behave differently than pure adenocarcinoma,

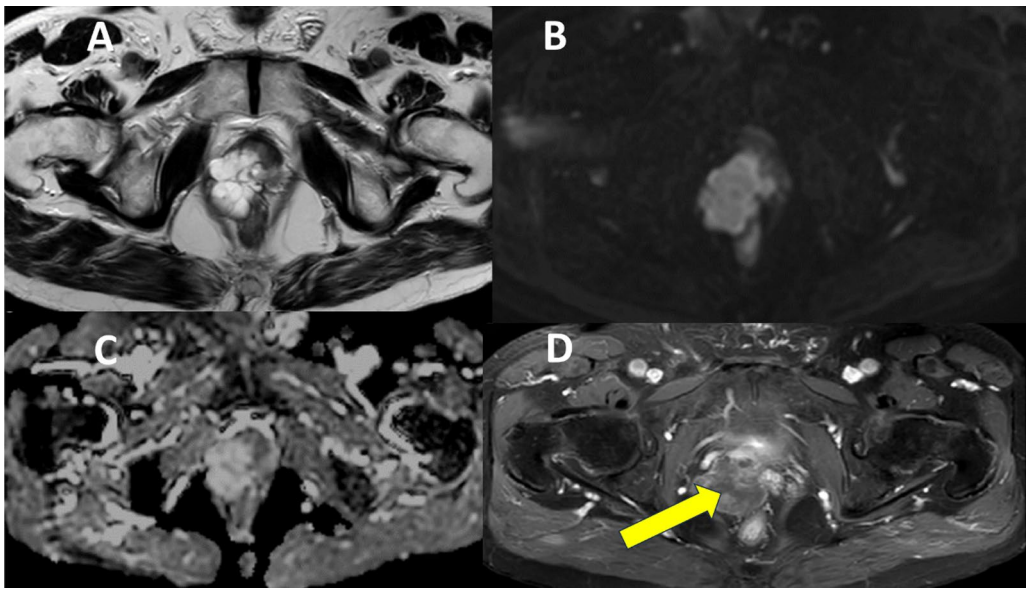

Fig. 2 **A** Axial T2 sequence demonstrating a multiloculated mass, hyperintense to the surrounding PZ, and with irregular and non-continuous hypointense septa, extending into the posterior periprostatic fat reaching the rectum and the bladder walls. **B**–**C** On axial high-b value DWI, sequence of the prostatic mass appears hyperintense. **C** The ADC map shows high signal intensity in the mucoid matrix and medium-to-low signal intensity in the septa. **D** DCE-MRI sequence of the prostate demonstrating inhomogeneous enhancement of the lesion's septa

and the Gleason score was demonstrated to be the only predictor of aggressiveness [5].

The aggressiveness that had been attributed to MACP in the past years is hypothesized to be related to the radiological diagnostic delay that often occurs with this specific histopathological tumor: MACP cannot be scored according to PIRADS 2.1 classification because its MRI features, as we reported in our cases, are different from the ones used to categorize pure prostatic adenocarcinoma. This is also important in order to exclude other entities to consider in the differential diagnosis of MACP such as mucinous adenocarcinoma arising from the prostatic urethra or bladder and colorectal adenocarcinoma involving the prostate [6]. There are very few studies regarding mpMRI characteristics of MACP, and most of these works were published before the introduction of the PIRADS score classification (only T1- and T2-weighted imaging). According to these reports [6, 7], MACP appears to be hyperintense on T2WI, reflecting the great presence of mucin. The septa are usually hypointense on T2WI compared to the PZ, reflecting their high cellularity. Therefore, it can be difficult to recognize MAPCs on MRI when confined in the PZ, which also appears hyperintense on T2WI. The DWI and DCE-MRI characteristics were only recently described in four patients by Yamada et al. [8], where they demonstrated that mucinous adenocarcinoma is hypointense on T2WI, has a lower ADC value, and exhibits early enhancement in DCE-MRI.

In our cases, MACP was highly hyperintense on DWI ($b=1000$). In contrast to previous reports [8], the lesions did not show a significant signal reduction in DWI with a higher b value ($b=1500$). The mucoid matrix was hyperintense in the ADC map, while lower values were found in the septa. In DCE-MRI, intense early inhomogeneous enhancement was observed in the septa, while the mucoid matrix did not enhance.

We speculate that these imaging features may reflect pathological findings, such as the relative proportion of extracellular mucin and tumor cells within the prostate and the cell density.

Pure prostatic adenocarcinoma is commonly hypointense on T2WI, with a lower ADC value, and exhibits early enhancement on DCE. Conversely, in MACP, hyperintensity on DWI is attributed to the T2 shine-through effect [10], whereas hyperintensity on DWI is known to be due to diffusion restriction in pure adenocarcinoma [9]. Consequently, a diagnosis of MACP could be difficult using the PIRADS scoring system, which is based on imaging features of common prostate adenocarcinoma. When interpreting an MRI of the prostate according to PIRADSv2.1 classification, it is mandatory to be aware that such a rare variant exists and PIRADS score cannot be a reliable tool for MACP.

The low number of patients reported in the literature does not allow a clear MRI feature of MACP. Still, suspicious MRI lesions warrant a prompt biopsy even with no PIRADS characteristics. Indeed, our first case demonstrated extra-prostatic extension, whereas the second one was characterized by suspicious seminal vesicle invasion and lymph nodes metastasis too. Therefore, in the case of high MRI suspicious lesions, a prostate biopsy is mandatory, even in the case of low-grade (1–2) PIRADS score lesions.

Conclusion

We presented two cases of aggressive MACP that exhibited distinct and unusual MRI characteristics compared to pure prostatic adenocarcinoma. The conventional PIRADS score is not applicable for MACP due to its atypical MRI presentation. It is imperative for radiologists and urologists to be cognizant of this rare variant of prostate cancer to promptly identify and diagnose it, thereby preventing any diagnostic delays.

Abbreviations

MACP	Mucinous adenocarcinoma of the prostate
PSA	Prostate-specific antigen
MRI	Magnetic resonance imaging
mpMRI	Multiparametric magnetic resonance imaging
PIRADS	Prostate Imaging Reporting & Data System
DCE	Dynamic contrast-enhanced
DWI	Diffusion-weighted imaging
ADC	Apparent diffusion coefficient
CT	Computed tomography
PET	Positron emission tomography
SUV	Standardized uptake value
PZ	Peripheral zone

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Author contributions

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Availability of data and materials

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Declarations

Ethics approval and consent to participate

No ethical approval needed for the conduction of this report was needed, and patient consent was acquired prior to submitting the manuscript.

Consent for publication

Patient consent for publication was acquired prior to submitting the manuscript.

Competing interests

The authors declare that they have no competing interests.

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