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Histopathological Profile of Prostatic Lesions and the Role of Gleason Score in Surgical Treatment Decision-Making

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Rezumat

Profilul histopatologic al leziunilor prostatice si rolul scorului Gleason în luarea deciziilor privind tratamentul chirurgical

Introducere: Scorul Gleason joacă un rol cheie în stratificarea riscului şi selecția tratamentului chirurgical pentru cancerul de prostată. Acest studiu evaluează corelația dintre scorul Gleason, vârsta pacientului şi agresivitatea tumorii, cu implicații pentru practica medicală.
Metode: Acest studiu retrospectiv a inclus 215 pacienți de la Spitalul Clinic de Urgență al Județului Constanța (2023-2024) cu leziuni prostatice confirmate histopatologic. Au fost analizate variabilele demografice (vârsta), scorul Gleason (clasificat conform ISUP 2019) şi gradul histologic. Datele au fost analizate statistic utilizând teste t, ANOVA şi regresie logistică.
Rezultate: Hiperplazia benignă de prostată (HBP) a reprezentat 42,8% din cazuri, cancerul de prostată 44,7%, iar carcinomul urotelial 8,4%. Dintre cancerele de prostată, 87,5% au prezentat boală semnificativă clinic (Gleason ≥7), 29,2% cu risc ridicat (Gleason 8-10). Scorul Gleason 7 a fost cel mai frecvent (58,3%), predominant 3+4. O corelație semnificativă a fost observată între vârsta înaintată (>70 de ani) şi agresivitatea tumorii (OR = 2,3; IC 95%: 1,4-3,8). Prostatectomia radicală a fost aleasă în principal pentru scorurile Gleason ≥7, cu rate mai mari ale complicațiilor la pacienții mai în vârstă.
Concluzii: Vârsta înaintată şi un scor Gleason ridicat sunt factori independenți ai agresivității tumorii. Intervenția chirurgicală precoce la pacienții cu Gleason ≥7 îmbunătățeşte rezultatele oncologice. Integrarea histopatologiei cu RMN multiparametric şi biomarkeri moleculari ar putea optimiza gestionarea acestor pacienți.

Cuvinte cheie: cancer de prostată, scor Gleason, prostatectomie radicală, risc oncologic

Abstract

Introduction: The Gleason score plays a key role in risk stratification and surgical treatment selection for prostate cancer. This study evaluates the correlation between Gleason score, patient age, and tumor aggressiveness, with implications for medical practice.

Methods: This retrospective study included 215 patients from Sf. Apostol Andrei Clinical Emergency Hospital of Constanta County (2023-2024) with histopathologically confirmed prostate lesions. Demographic variables (age), Gleason score (classified according to ISUP 2019), and histological grade were analyzed. Data were statistically analyzed using t tests, ANOVA, and logistic regression. While international guidelines provide a standardized framework for management, local and regional variations in healthcare access, diagnostic pathways, and patient preferences significantly influence real-world clinical practice. This study aims to describe the histopathological spectrum of prostatic lesions and evaluate the prognostic relevance of the Gleason score in surgical decision-making within the specific context of a Romanian tertiary care center. By highlighting regional particularities, such as the high burden of aggressive disease and the challenges in implementing active surveillance, our findings contribute to a more nuanced understanding of global prostate cancer care.

Results: Benign prostatic hyperplasia (BPH) accounted for 42.8% of cases, PCa for 44.7%, and urothelial carcinoma for 8.4%. Among prostate cancers, 87.5% had clinically significant disease (Gleason ≥7), with 29.2% high-risk (Gleason 8–10). Gleason 7 was most frequent (58.3%), predominantly 3+4. A significant correlation was observed between advanced age (>70 years) and tumor aggressiveness (OR = 2.3; 95% CI: 1.4-3.8). Radical prostatectomy was primarily chosen for Gleason scores ≥7, with higher complication rates in older patients.

Conclusions: Advanced age and a high Gleason score are independent factors of tumor aggressiveness. Early surgical intervention in patients with Gleason ≥7 improves oncological outcomes. Integrating histopathology with multiparametric MRI and molecular biomarkers could optimize management of these patients.

Keywords: prostate cancer, Gleason score, radical prostatectomy, oncological risk

Introduction

Prostate cancer is a leading male malignancy globally, with rising incidence in Romania. Here, access to screening and advanced histopathology is increasingly relevant for clinical practice. The Gleason score, based on prostate gland architecture, is the key prognostic indicator for adenocarcinoma, guiding the choice between radical prostatectomy and conservative or multimodal options (1,3).

Although essential, biopsy-based Gleason scoring can underestimate true tumor grade, with known discrepancies between biopsy and prostatectomy specimens (4-7). This has direct implications for surgical selection, as underdiagnosis or overstaging affects prognosis and biochemical recurrence rates (3,8).

In Romania, where advanced imaging and standardized pathology are still developing, consistent use of the Gleason score and ISUP 2019 system is crucial for risk stratification and treatment optimization (2). Incorporating modern techniques like multiparametric MRI and radiomic biomarkers may improve lesion assessment and reduce Gleason underestimation.

Based on these considerations, this study aims to describe the histopathological spectrum of prostatic lesions and evaluate the prognostic role of the Gleason score in surgical decision-making (9-11).

Materials and Methods

Study Objectives

For a thorough evaluation of the histopathological spectrum of prostatic lesions, while highlighting the relevance of the Gleason score in guiding surgical treatment decisions, we established the following main objectives:

Primary objectives: (a) to evaluate the distribution of Gleason scores in adenocarcinoma and their correlation with age; (b) to analyze the distribution of histological grades (ISUP 2019).

Secondary objectives: (a) to determine the frequency of prostatic lesions (BPH, adenocarcinoma,

urothelial carcinoma); (b) to identify the proportion of high-risk cases (Gleason ≥7); (c) to describe demographic characteristics according to histological diagnosis.

Study Design and Population

We retrospectively analyzed 215 patients with histologically confirmed prostatic lesions and surgically treated at The Clinical Emergency Hospital of Constanta County, Romania, during 2023-2024 (*Table 1*).

Inclusion criteria were all patients with a histopathologically confirmed prostatic lesion (benign or malignant). Exclusion criteria were incomplete medical records or missing histopathological data and prostates that microscopically showed extensive ischemic necrosis lesions and metastases. Demographic and clinical data (age, diagnosis type, Gleason score, histological grade, associated lesions such as PIN or AAH) were retrieved from hospital records and pathology reports. Preoperative PSA levels were recorded when available. However, PSA density could not be reliably calculated or analyzed for this cohort. This was because MRI examinations, required for accurate prostate volume measurement, were performed at various external medical centers using different protocols and devices, making the data inconsistent and unsuitable for a unified analysis. All histological samples were processed according to standard protocols with hematoxylin-eosin staining; immunohistochemistry was used when indicated. Gleason scoring was performed according to ISUP 2019 guidelines by experienced pathologists.

The histopathological samples were processed according to the standard protocol: paraffin embedding and hematoxylin-eosin staining. In cases with suspected atypical lesions or rare neoplasms, additional immunohistochemistry was performed according to laboratory protocols. Gleason scoring was performed by experienced pathologists according to ISUP 2019 guidelines.

Statistical Analysis

Data processing and analysis

The data were processed and analyzed using Microsoft Excel and SPSS version 26 software (IBM Corp).

The variables included in the study were coded and classified as follows: primary diagnosis (benign prostatic hyperplasia - BPH, prostate cancer - PCa, urothelial carcinoma - UC and other associated lesions), Gleason score (classified according to the ISUP 2019 system into three risk categories), and histological grade (classified on the WHO scales in Grade Groups 1-5).

Applied statistical methods

The statistical analysis included both descriptive and inferential methods:

1. Descriptive statistics: for continuous variables (e.g., age), we calculated arithmetic means accompanied by standard deviations to describe the central distribution and dispersion of the data; for categorical variables (diagnosis, Gleason score), we used absolute frequencies and

Table 1. General clinical characteristics of patients (n=215)

Characteristic	Overall	BPH	PCa	UC	Other	p-value
Age (years)						
- Mean ± SD	68.1 ± 7.4	67.3 ± 6.7	70.2 ± 7.3	71.6 ± 5.8	65.3 ± 6.1	0.002
- Range	45-93	45-85	53-93	58-82	54-85	
Age Groups						<0.001
- ≤ 60 years	37 (17.2%)	21 (22.8%)	12 (12.5%)	1 (5.6%)	3 (33.3%)	
- 61-70 years	100 (46.5%)	46 (50.0%)	42 (43.8%)	7 (38.9%)	5 (55.6%)	
- >70 years	78 (36.3%)	25 (27.2%)	42 (43.8%)	10 (55.6%)	1 (11.1%)	
Gleason Score *						<0.001
- ≤ 6 (Low-risk)	28 (13.0%)	-	12 (12.5%)	4 (22.2%)	-	
- 7 (Intermediate-risk)	114 (53.0%)	-	56 (58.3%)	10 (55.6%)	-	
- ≥ 8 (High-risk)	73 (34.0%)	-	28 (29.2%)	4 (22.2%)	-	
Grade Group						<0.001
- Grade 1	92 (42.8%)	92 (100%)	-	-	-	
- Grade 2	40 (18.6%)	-	34 (35.4%)	6 (33.3%)	-	
- Grade 3	25 (11.6%)	-	22 (22.9%)	3 (16.7%)	-	
- Grade 4-5	58 (27.0%)	-	40 (41.7%)	9 (50.0%)	-	

BPH - benign prostatic hyperplasia, PCa - prostate cancer, UC - urothelial carcinoma

percentages to describe the distribution of cases.

2. Inferential statistics: for the comparison of mean ages between groups (e.g., PCa versus BPH), we applied independent samples t-tests or analysis of variance (ANOVA), as appropriate. We assessed the association between categorical variables (lesion type and Gleason score) using the chi-square (χ^2) test. The correlation between age and Gleason score was analyzed by Spearman correlation coefficient. To identify independent predictors of Gleason scores ≥7, we used logistic regression analysis.

Interpretation of results

We established a statistical significance threshold of $p < 0.05$ for all applied tests. For key estimates, we calculated 95% confidence intervals. Before applying parametric tests, we checked the assumptions of normality (Shapiro-Wilk test) and homogeneity of variances (Levene test), opting for nonparametric tests when these assumptions were not met.

Theoretical basis of the analysis

We chose these statistical methods based on recommendations in the specialized literature. The Gleason scoring followed the 2019 International Society of Urological Pathology (ISUP) standards, and the statistical analysis approach was based on the principles outlined by Altman et al. in the guidelines for statistical analysis in medical research.

This rigorous methodological approach ensures the validity of the results presented in the following section and the relevance of our conclusions to clinical practice. In the following, we will present in detail the results obtained by applying these methods to our dataset.

Ethical approval

All patients included in the study signed informed consent regarding the use of biological material for research purposes. The study protocol was approved by the Ethics Committee of The Clinical Emergency Hospital of Constanta County (No. 42767/02.07.2024), in accordance with the provisions of the Declaration of Helsinki regarding research on human subjects.

Results

Demographic and Clinical Profile of the Study Group

The study included 215 men surgically treated for prostatic lesions in 2023–2024. Mean age was 68.1 ± 7.4 years (range 45–93), consistent with prostatic disease being most common in middle and advanced age, though early-onset cases (<50 years) also occurred, primarily with BPH (*Table 2*).

Age distribution showed peak incidence in patients aged 61–70 (46.5%, n=100), followed by >70 years (36.3%, n=78) and ≤60 years (17.2%, n=37), indicating increasing malignancy risk with age.

BPH was the most frequent lesion (42.8%, n=92), particularly in patients aged 61–70 (50.0%), but also present in younger patients (22.8% ≤ 60 years) (*Fig. 1*). Prostate cancer (PCa) accounted for 44.7% (n=96), with >43% of cases occurring in patients >70 years, underscoring the age-malignancy correlation (*Fig. 2, Table 2*). Urothelial carcinoma (UC) was less common (8.4%, n=18) but clinically significant, with 55.6% of cases in patients >70 years (*Fig. 3*). Other rare lesions comprised 4.2% (n=9).

Mean age differed significantly between lesion types (p=0.002): BPH (67.3 years), PCa (70.2 years), and UC (71.6 years), supporting the link between advanced age and malignant potential.

Nearly half of all patients had malignant tumors (PCa or UC), strongly associated with older age. While BPH prevailed at intermediate ages, malignancies dominated in patients over 70.

Gleason Score Distribution in Prostate Cancer

Among 96 PCa cases, Gleason score distribution

Table 2. Diagnostic distribution and demographic characteristics

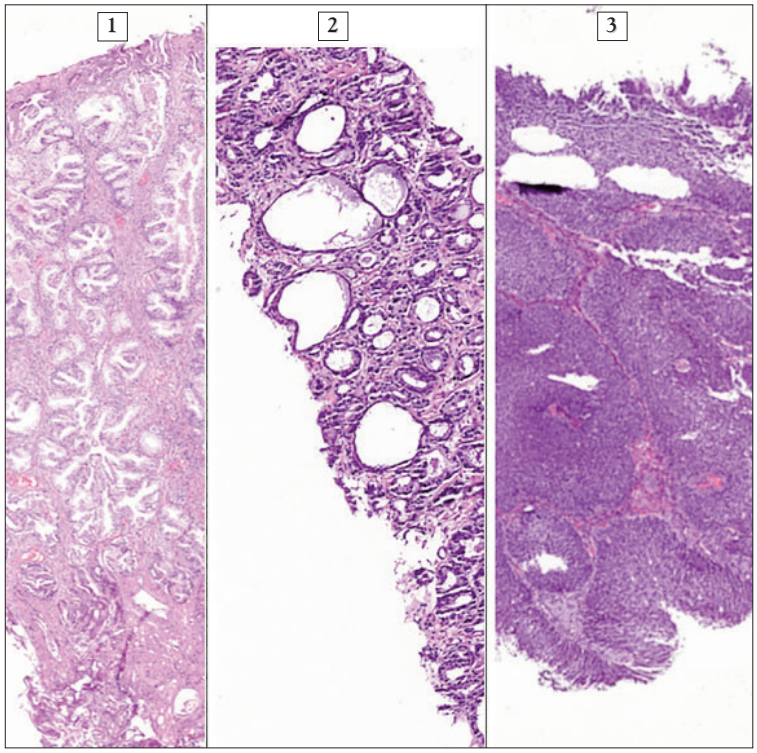
Parameter	Total (n=215)	BPH (n=92)	PCa (n=96)	UC (n=18)	Other Lesions (n=9)
Mean age (years ± SD)	68.1 ± 7.4	67.3 ± 6.7	70.2 ± 7.3	71.6 ± 5.8	65.3 ± 6.1
Age distribution					
- ≤60 years	37 (17.2%)	21 (22.8%)	12 (12.5%)	1 (5.6%)	3 (33.3%)
- 61-70 years	100 (46.5%)	46 (50.0%)	42 (43.8%)	7 (38.9%)	5 (55.6%)
- >70 years	78 (36.3%)	25 (27.2%)	42 (43.8%)	10 (55.6%)	1 (11.1%)

BPH - benign prostatic hyperplasia, PCa - prostate cancer, UC - urothelial carcinoma

Figure 1. Benign prostatic hyperplasia with characteristic adenomatous and stromal proliferation (H&E, x100).

Figure 2. Prostate adenocarcinoma with crowded glands, loss of interglandular distance, and absent basal cell layer (H&E, x40).

Figure 3. Urothelial carcinoma showing disordered architecture, nuclear atypia, and loss of polarity (H&E, x100).



showed clear predominance of clinically significant disease: 87.5% (n=84) had Gleason ≥7, indicating intermediate or advanced stages at diagnosis (*Table 3*). Only 12.5% (n=12) had low-risk tumors (Gleason ≤6) (*Fig. 4*), a low proportion reflecting both our emergency hospital setting (with frequent late presentations) and limited access to screening programs in Romania, where indolent tumors are less commonly detected.

Gleason score 7 was most frequent (58.3%, n=56), predominantly subtype 3+4 (n=48, 82.1% of Gleason 7 cases). The less common 4+3 subtype (n=8, 8.3% of all PCa) carries worse prognosis (*Fig. 5*). High-grade tumors (Gleason 8-10) accounted for 29.2% (n=28) (*Figs. 6-7*), a proportion higher than in Western screening studies but consistent with regional data, suggesting later diagnosis.

A strong correlation existed between age and Gleason score (p=0.003): mean age increased with aggressiveness – 65.2 years (Gleason ≤6), 68.7 years (Gleason 3+4), and 72.3 years (Gleason ≥8) – confirming that older patients develop more advanced disease.

Therapeutically, radical prostatectomy was indicated for nearly all Gleason ≥7 tumors. Notably, some Gleason ≤6 patients also underwent surgery, primarily due to patient preference, elevated PSA, or suspicious imaging findings, reflecting limited confidence in active surveillance in our setting. For Gleason ≥8 tumors, multimodal strategies (surgery with radiotherapy/hormonal therapy) were often required.

Table 3. Gleason Score Distribution in Prostate Cancer (n=96)

Gleason Score	n (%)	Mean Age (years ± SD)	Mean Total PSA (ng/mL ± SD)	Grade Group
≤6	12 (12.5%)	65.2 ± 5.1	6.5 ± 2.1	1 (100%)
7 (3+4)	48 (50.0%)	68.7 ± 6.3	9.8 ± 4.3	2 (82.1%)
7 (4+3)	8 (8.3%)	70.1 ± 5.9	14.2 ± 6.7	3 (94.4%)
≥ 8 (8-10)	28 (29.2%)	72.3 ± 7.5	18.9 ± 10.4	4-5 (100%)
p-value		0.003	<0.001	

PSA = prostate-specific antigen; SD = standard deviation
P-values for age and PSA comparisons calculated using ANOVA

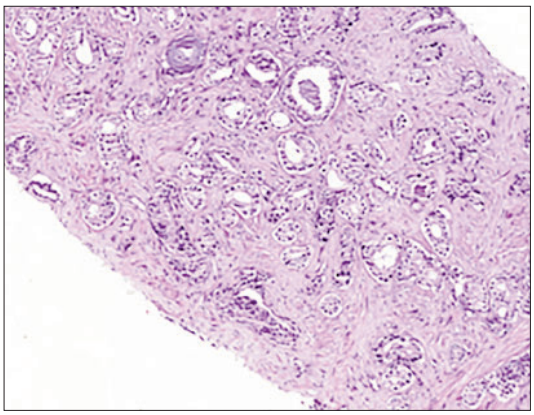


Figure 4. Prostate adenocarcinoma, Gleason score 6 (3+3), with crowded glands and stromal interposition (H&E, x100).

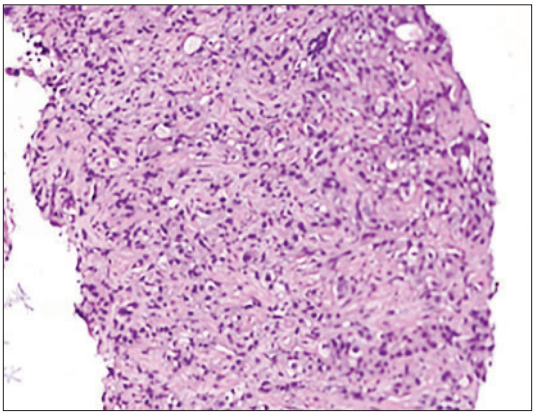


Figure 5. Prostate adenocarcinoma, Gleason score 7 (4+3), with fused glands and poorly formed lumens (H&E, x100).

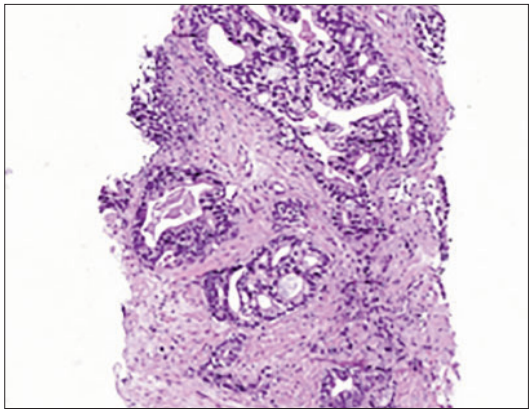


Figure 6. Prostate adenocarcinoma, Gleason score 8 (4+4), with cribriform patterns and fused glands (H&E, x40).

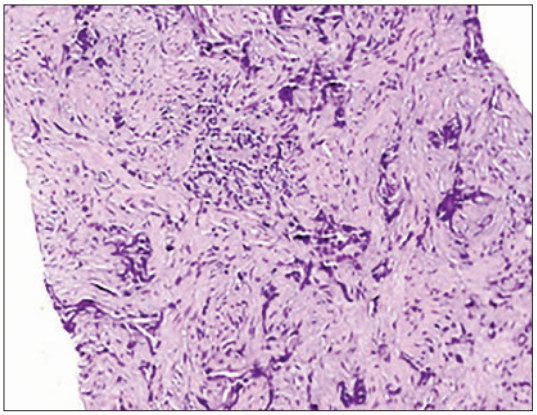


Figure 7. Prostate adenocarcinoma, Gleason score 9 (5+4), with trabecular patterns and isolated malignant cells (H&E, x100).

This Gleason distribution underscores that most patients presented with intermediate- or high-risk disease, justifying the predominant surgical approach and highlighting the need for earlier detection in Romania.

Distribution of ISUP Histological Groups (2019)

PCa cases were reclassified using the ISUP 2019 system for improved risk stratification. The distribution was: Group 1 (Gleason ≤6): 12.5% (n=12); Groups 2-3 (Gleason 7): 58.3% (n=56), predominantly Group 2 (Gleason 3+4); and Groups 4-5 (Gleason ≥8): 29.2% (n=28). Overall, 41.7% (n=40) of PCa cases were high-grade (Groups 4-5), indicating a substantial burden of aggressive disease (*Table 3*).

Urothelial carcinomas (UC) showed an even higher proportion of high-grade lesions (55.6%, n=10/18; p=0.02 vs. PCa) (*Table 4*), underscoring their aggressive behavior and need for multimodal management.

The ISUP system allowed finer risk stratification than the classic Gleason score, particularly in distinguishing Group 2 (Gleason 3+4; favorable intermediate-risk) from Group 3 (Gleason 4+3; more aggressive, often requiring adjuvant therapy). The high rate of Group 4-5 tumors

Table 4. PCa vs. urothelial carcinoma comparison

Parameter	PCa (n=96)	UC (n=18)	p-value
Mean age (years)	70.2 ± 7.3	71.6 ± 5.8	0.04
Gleason ≥7	84 (87.5%)	14 (77.8%)	0.12
Grade Group 4-5	40 (41.7%)	10 (55.6%)	0.02
Associated lesions	32 (33.3%)	9 (50.0%)	0.03

PCa - prostate cancer, UC - urothelial carcinoma

likely reflects late diagnosis and limited screening in our region, emphasizing the need for earlier detection strategies.

Correlation between Age and Tumor Aggressiveness

Older age was significantly associated with more aggressive tumors. Patients with PCa were older than those with BPH (70.2 ± 7.3 vs. 67.3 ± 6.7 years, p=0.008) (*Table 2*). A strong positive correlation existed between age and Gleason score: mean age was 65.2 years for Gleason ≤6, 68.7 for Gleason 3+4, and 72.3 for Gleason ≥8 (p=0.003) (*Table 3*).

This trend was reinforced by age-group analysis (*Table 5*): only 16.7% of patients ≤60 years had Gleason ≥8 tumors, versus 31% of those aged 61–70. Furthermore, 62.5% of patients >70 years had Gleason ≥7 disease.

These findings confirm that advanced age is linked to both higher prostate cancer risk and more aggressive histology, underscoring the need for age-adapted diagnostic and treatment strategies.

Predictive Factors for High-Risk Tumors (Gleason ≥7)

Multivariate logistic regression identified several independent predictors for Gleason score ≥7 tumors (*Table 6*):

1. Age >70 years: Patients in this group had a 2.3-fold higher risk of aggressive tumors (OR = 2.3; 95% CI: 1.4–3.8; p=0.001).
2. Associated lesions (PIN/AAH): The presence of these precursor lesions increased risk 1.8-fold (OR = 1.8; 95% CI: 1.1–2.9; p=0.03).
3. PCa diagnosis: This was the strongest predictor (OR = 3.1; 95% CI: 1.9–5.0; p<0.001), with PCa patients having over threefold higher risk of aggressive tumors compared to those with BPH or UC.

These findings highlight both biological mechanisms (age and precursor lesions driving carcinogenesis) and clinical implications: once PCa is diagnosed, the high probability of significant disease (Gleason ≥7) warrants immediate comprehensive evaluation and aggressive treatment planning. From a surgical perspective, patients >70 years or with PIN/AAH should be considered prime candidates for radical treatments, absent major contraindications. This confirms the role of histopathology not only in diagnosis but also in risk stratification and therapeutic decision-making.

Surgical Implications of the Gleason Score

The Gleason score (ISUP 2019) was the primary histopathological guide for surgical decisions. Radical prostatectomy was the main treatment for patients with Gleason ≥7 tumors (87.5%, n=84/96) (*Table 3*), confirming the clinical importance of this threshold.

Although patients with Gleason ≤ 6 (12.5%, n=12) were theoretically eligible for active surveillance, most underwent surgery in our cohort. This reflects real-world factors such as patient preference, elevated PSA levels, or suspicious MRI findings, highlighting the limited applicability of active surveillance in the Romanian context due to late presentations and underdeveloped screening.

Preoperative total PSA levels showed a significant positive correlation with tumor aggressiveness, increasing from a mean of 6.5 ng/mL in Gleason ≤6 tumors to 18.9 ng/mL in Gleason ≥8 tumors (p<0.001), as detailed in *Table 3*.

For high-grade tumors (Gleason ≥8, ISUP 4-5), treatment frequently required multimodal strategies (surgery with radiotherapy/hormonal therapy), consistent with EAU/NCCN guidelines. Age significantly influenced surgical decisions: patients >70 years had higher Gleason scores and higher perioperative complication risks, necessitating careful risk-benefit assessment. In frail elderly patients, radiotherapy or hormonal therapy were often preferred over surgery.

In our institution, Gleason score functioned as both a prognostic tool and a surgical triage system: Gleason ≥7 prompted radical prostatectomy, while Gleason ≥8 triggered multidisciplinary planning for combined therapies. These findings underscore the need for individualized treatment integrating histopathological data with clinical patient profiles.

Table 5. Age-Gleason score correlation

Age Group	Gleason ≤6	Gleason 7	Gleason ≥8	p-value*
≤60 years (n=12)	4 (33.3%)	6 (50.0%)	2 (16.7%)	<0.001
61-70 years (n=42)	5 (11.9%)	24 (57.1%)	13 (31.0%)	
>70 years (n=42)	3 (7.1%)	26 (61.9%)	13 (31.0%)	

Table 6. Predictive factors for Gleason ≥7 (logistic regression)

Factor	OR	95% CI	p-value
Age >70 years	2.3	1.4-3.8	0.001
Associated lesions (AAH/PIN)	1.8	1.1-2.9	0.03
PCa diagnosis	3.1	1.9-5.0	<0.001

Discussion

The findings of this study must be interpreted within the specific context of a Romanian tertiary care center. Our data from Sf. Apostol Andrei Clinical Emergency Hospital of Constanta County highlight a distinct clinical reality characterized by a high burden of aggressive disease on diagnosis. This profile, marked by a high proportion of ISUP Grade Group 4-5 tumors (41.7% among PCa cases), likely reflects limited access to organized nationwide screening programs and a tendency for later patient presentation. Consequently, our clinical practice often deviates from guideline-based 'ideal' management, adapting instead to local challenges. For instance, the unanimous decision to perform surgery even in patients with low-risk disease (Gleason ≤6) was driven by pragmatic concerns regarding patient follow-up compliance and limited confidence in active surveillance within our healthcare framework. This regional perspective is a key contribution of our work, offering a valuable counterpoint to outcomes reported from centers in regions with established screening protocols.

An important aspect influencing treatment decisions in our center is the variable availability of a standardized multidisciplinary tumor board (MDT). While complex cases, particularly those with high-risk features (e.g., Gleason ≥8, locally advanced disease, or diagnostic dilemmas), are frequently discussed in an ad-hoc manner among urologists, oncologists, and pathologists, a formal, regularly scheduled MDT meeting was not consistently implemented during the study period. This reflects a common challenge in resource-limited settings.

Regarding surgical outcomes, our data align with the established literature indicating higher complication rates in elderly patients. Although a formal comparative analysis of complication rates was beyond the primary scope of this histopathological study, our clinical observation and institutional reports indicate that patients over 70 years of age, who often present with greater comorbidity burdens (e.g., cardiovascular disease, diabetes), experienced higher rates of perioperative complications. These included surgical site infections, bleeding requiring transfusion, and longer catheterization times compared to younger patients. This elevated risk necessitates a thorough preoperative assessment and careful individualization of treatment for elderly patients, where alternative modalities like radiotherapy may be considered to mitigate surgical risk despite aggressive histology.

Correlation between Age, Gleason Score, and Surgical Decision-Making

Our study confirms a strong association between advanced age and high-risk prostate cancer, with patients over 70 years exhibiting a significantly higher likelihood of harboring Gleason ≥ 7 tumors (OR = 2.3, 95% CI: 1.4–3.8; p = 0.001), consistent with literature (12,13). Biologically, this may reflect cumulative genetic alterations, diminished immune surveillance, and prostatic microenvironment changes (e.g., chronic inflammation, fibrosis) that favor progression (14).

Clinically, while younger patients more often have low-grade tumors (Gleason ≤6) suitable for active surveillance or curative surgery, elderly patients (>70 years) more frequently present with aggressive disease (Gleason ≥7) and face higher perioperative risks due to comorbidities (15,16). Thus, age serves as both a biological predictor and a practical surgical factor: although Gleason ≥7 typically indicates radical prostatectomy, older patients require individualized decision-making that weighs surgical risks against multimodal alternatives (radiotherapy, hormonal therapy).

Surgically, 87.5% of Gleason ≥7 patients underwent radical prostatectomy, confirming pivotal role of this score in therapeutic guidance. However, elderly patients (>70 years) comprised 43.8% of this cohort and experienced higher complication rates, underscoring the need for careful risk-benefit assessment and tailored strategies in older populations with high-risk histology.

Gleason Score Distribution and Implications for Surgical Management

The high prevalence of intermediate-risk (Gleason 7: 58.3%) and high-risk (Gleason ≥8: 29.2%) tumors in our cohort reflects a population with clinically significant disease, likely due to our tertiary care setting and limited screening in Romania. These proportions exceed those in systematic screening programs (e.g., ERSPC) (17), suggesting regional disparities in disease aggressiveness and diagnostic timing (18).

Surgical implications were score-dependent:

- Gleason 7 (3+4): Representing 50% of PCa cases, most underwent radical prostatectomy. Select cases with low-volume disease and favorable parameters might qualify for active surveillance (19,20).
- Gleason ≥8: Accounting for 29.2% of cases, these patients typically required multimodal

therapy (surgery + radiotherapy ± androgen deprivation), per EAU guidelines (21).
- Urothelial carcinoma: Showed the highest-grade profiles (55.6% Grade Group 4-5), necessitating multidisciplinary management involving urologic and medical oncology (22,23).

Clinical Utility of Gleason Scoring in Surgical Practice

Our findings demonstrate that the Gleason score was the primary determinant for radical prostatectomy, with the vast majority of surgeries (≈96%) performed for Gleason ≥7 tumors. Specifically:
- Gleason 7–10 justified curative-intent surgery in 84/96 cases (87.5%).
- Gleason ≤6 tumors (12.5%) were still operated due to patient preference, elevated PSA, or MRI findings, reflecting real-world deviations from strict active surveillance protocols.

These observations underscore the role of Gleason scores not only as a prognostic tool but also as a practical surgical triage instrument. In our institution, a Gleason score ≥7 triggered urologic oncology referral and preoperative multidisciplinary discussion, while scores ≤6 encouraged shared decision-making regarding surveillance versus intervention.

Limitations and Future Directions

This study has limitations: its retrospective design may introduce selection bias; missing PSA data limited risk stratification; and inconsistent urothelial carcinoma classification affected subgroup analyses (23). Future prospective studies should integrate molecular biomarkers (e.g., PCA3, SelectMDx) multiparametric MRI, and standardized pathological protocols to refine surgical indications and optimize outcomes (23,24). Long-term survival analyses are also needed to validate the impact of Gleason-driven treatment strategies in the Romanian context.

Therefore, the Gleason score remains the cornerstone of prostate cancer management, directly shaping surgical indications. Gleason ≥7 was the definitive threshold for radical prostatectomy in our cohort, while elderly patients required tailored approaches due to heightened surgical risks. Integrating histopathology with clinical parameters and modern diagnostics will enhance precision in surgical decision-making, particularly in resource-limited settings like Romania.

Methodological limitations

We acknowledge several important limitations of our study:
1. The retrospective design may introduce selection bias and limitations in controlling confounding variables.
2. The presence of incomplete data (e.g., unrecorded Gleason scores for some PCa cases) may affect the validity of specific analyses.
3. Variability in the formulation of diagnoses in medical records required a substantial standardization effort during the data processing stage.

Conclusions

The study demonstrates that advanced age is strongly associated with higher Gleason scores and more aggressive prostate cancer. Gleason 7 remains the most frequent category, with a predominance of 3+4, highlighting the importance of distinguishing between favorable and unfavorable subgroups. A significant proportion of patients presented with high-grade disease (Gleason ≥8), underlining the need for multimodal therapeutic strategies.

Radical prostatectomy is effective for intermediate - and high-risk cases, but individualized approaches are required in elderly patients due to higher complication risks. Integration of Gleason scoring with modern imaging and molecular biomarkers is essential for optimizing diagnosis and treatment pathways in Romania.

Therefore, this study provides a critical perspective from a Romanian tertiary care center, Sf. Apostol Andrei Clinical Emergency Hospital of Constanta County, highlighting a clinical reality dominated by high-grade prostate cancer on diagnosis. The high prevalence of aggressive tumors underscores the need for earlier detection strategies in our region. While the Gleason score remains the cornerstone of surgical decision-making, its application in our setting is adapted to local challenges, often favoring more interventionist approaches due to limitations in follow-up and screening. These findings emphasize that management of prostate cancer must balance international guidelines with local resource availability and patient demographics. Future efforts should focus on developing tailored protocols for Romanian and similar healthcare settings, integrating advanced diagnostics while addressing specific regional barriers to care.

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