Original Article

# Tumor characteristics, treatments, and oncological outcomes of prostate cancer in men aged ≤60 years: real-world data from a single urological center over a 10-year period

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**Background:** Prostate cancer (PCa) has emerged as one of the most common malignancies among men globally. However, its pathogenesis, clinical features, and treatment responses in younger patients (aged 60 years or below) remain underexplored. This study aims to evaluate the distinctive clinical features, treatment strategies, and oncological outcomes of PCa in men aged 60 years or younger over a 10-year period at a single urological center.

**Methods:** We retrospectively analyzed data from The Second Hospital of Tianjin Medical University, spanning January 2010 to June 2020. The study included patients aged ≤60 years who underwent prostate biopsies. We examined clinical characteristics, pathological findings, treatment approaches, and survival outcomes using *t*-tests and chi-square tests. Adjusted linear regression models evaluated the relationships between treatment modalities and outcomes, while Kaplan-Meier survival analysis and Cox regression assessed progression-free survival (PFS), cancer-specific survival (CSS), and overall survival (OS).

**Results:** Of the 5,686 patients who underwent prostate biopsy, 643 (11.3%) were ≤60 years old. Among these, 42.8% (275/643) were diagnosed with PCa, with 59.6% presenting at advanced stages. Compared to those with negative pathology, patients with PCa were older and more likely to have hypertension, alcohol consumption, and metabolic syndrome. Most patients (69.8%) received definitive local therapy, while 22.2% opted for palliative care and 8.0% were loss to follow-up. The median follow-up period for the entire cohort was 28.0 months and the median PFS was 77.0 months. For patients receiving definitive local therapy, the median CSS and OS were not reached, while those undergoing palliative therapy had median CSS and OS of 52.0 and 59.0 months, respectively. Multivariable analysis identified prostate-specific antigen >20 ng/mL, International Society of Urological Pathology >3, bone metastasis, and localized treatment as independent factors affecting PFS. Propensity score matching showed that definitive therapy led to superior PFS compared to palliative therapy for patients with localized PCa and a life expectancy of over 5 years.

**Conclusions:** Our findings highlight the influence of incidence, diagnostic characteristics, and treatment methods in younger men with PCa, emphasizing the need to identify specific risk factors and treatment

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response patterns. Further large-scale, multi-center research is necessary to improve diagnosis and outcomes for PCa patients in this age group.

**Keywords:** Prostatic neoplasms; young; clinical characteristics; prognosis; survival

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## Introduction

Prostate cancer (PCa) is the most prevalent malignant tumor in the male genitourinary system, with an estimated 1.3 million new cases diagnosed in 2024. The incidence of PCa increases significantly with age, making it a typical age-related tumor (1-3). Data from the Surveillance, Epidemiology, and End Results (SEER) database reveal an increase in the proportion of men aged 55 and younger at diagnosis over the study period, from 2.3% between the years 1988–1991 to 9.0% between the years 2000–2003 (4).

### Highlight box

**Key findings**

- Among men aged 60 years or younger who underwent prostate biopsies, 42.8% were diagnosed with prostate cancer (PCa), with 59.6% presenting at advanced stages.
- Patients with PCa showed higher rates of hypertension, alcohol consumption, and metabolic syndrome compared to those with negative pathology.
- Definitive local therapy resulted in better progression-free survival (PFS) than palliative care.
- Prostate-specific antigen >20 ng/mL, International Society of Urological Pathology >3, bone metastasis, and localized treatment were identified as independent factors influencing PFS.

**What is known and what is new?**

- PCa's clinical features and outcomes vary by age group, but the association between younger age and aggressive disease is debated.
- This study highlights a high incidence of advanced-stage PCa in younger men and demonstrates that definitive local therapy significantly improves survival outcomes in this group.

**What is the implication, and what should change now?**

- Early diagnosis and tailored treatment for younger men with PCa are crucial. Identifying specific risk factors and treatment responses can enhance younger patient outcomes.
- Increased awareness and possibly more aggressive screening in younger men are needed. Healthcare providers should consider earlier and definitive treatments to improve survival rates. Further large-scale, multi-center studies are essential to validate and extend these findings.

Younger men with PCa often present with more aggressive disease and distinct clinical and pathological features compared to their older counterparts, underscoring the importance of understanding the most effective diagnostic and treatment approaches for this demographic (5,6). Consequently, the optimal age for first prostate-specific antigen (PSA) screening and the role of multiparametric magnetic resonance imaging (mpMRI) characteristics continue to be subjects of debate (7,8).

While the standard treatment for PCa includes radical prostatectomy, radiation therapy, and active surveillance, the optimal treatment approach for younger patients remains controversial due to their unique characteristics (9-12). In addition, the role of androgen deprivation therapy (ADT) in the management of younger PCa patients, especially those with advanced disease, is not well-defined (13,14). Understanding the impact of different treatment modalities on the outcomes of younger PCa patients, including overall survival (OS), disease-specific survival, and quality of life, is crucial for personalized treatment planning. For example, previous reports suggest that "younger" men have better outcomes after prostatectomy, but conflicting results exist (15-17).

This study aims to assess real-world data on the incidence, diagnostic methods, and treatment modalities for PCa in patients 60 years or younger, using data from a single urological center over a 10-year period. Specifically, we explore how clinical characteristics influence prognosis and evaluate the efficacy of various treatment approaches in this subgroup. We present this article in accordance with the STROBE reporting checklist (available at https://tau.amegroups.com/article/view/10.21037/tau-24-410/rc).

## Methods

### *Study design and population*

This retrospective study utilized data from The Second Hospital of Tianjin Medical University between January

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2010 to June 2020. Patients aged 60 years or younger who underwent prostate biopsy for suspected PCa were included in the study. All patients were diagnosed via primary prostate biopsy. In cases where metastasis was initially suspected, a confirmatory prostate biopsy was still performed. Patients determined not to have PCa were confirmed after at least one negative biopsy, with additional measures like follow-up exams and PSA level monitoring to ensure diagnostic accuracy. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the Ethics Committee of The Second Hospital of Tianjin Medical University (No. KY2024K160) and was exempted from patient informed consent due to the retrospective nature of this study.

### *Data collection*

Baseline clinical data, including age, body mass index (BMI), comorbidities (hypertension, diabetes, dyslipidemia), and smoking and alcohol consumption, were collected for all patients. Biochemical markers, including PSA levels, prostate-specific antigen density (PSAD), International Society of Urological Pathology (ISUP) grade, clinical staging, and presence of bone or lymph node metastasis, were also recorded. BMI was calculated as weight (kg) divided by height squared ($m^2$). Waist-to-hip ratio (WHR) was calculated as waist circumference (cm) divided by hip circumference (cm). High WHR was defined as a WHR greater than 0.9 in men or greater than 0.85 in women. Hypertension was defined as elevated baseline blood pressure, self-reported history of hypertension, or use of antihypertensive medications. Diabetes was defined as elevated baseline fasting glucose, self-reported history of diabetes, or use of antidiabetic drugs or insulin. Energy intake from fat and carbohydrate was divided into three groups (energy intake from fat: low, moderate, high. Energy intake from carbohydrate: low, moderate, high). Low physical activity was defined as less than 600 metabolic equivalent task (MET) minutes per week or less than 150 minutes per week of moderate intensity physical activity. Metabolic score for insulin resistance (MET-IR) was calculated as ln [2 × fasting plasma glucose (mg/dL) + fasting triglycerides (mg/dL)] × BMI ($kg/m^2$) / ln [high density lipoprotein (HDL) cholesterol (mg/dL)].

### *Definitions of survival outcomes*

Palliative therapy refers to treatments aimed at managing symptoms and improving quality of life, without curative intent. This includes approaches for patients who are either unable or unwilling to undergo local treatment. Palliative therapies encompassed options such as active surveillance, watchful waiting, and androgen deprivation monotherapy, and transurethral resection of the prostate (TURP). In contrast, definitive local therapy, such as radical surgery or radiation therapy, was employed for those opting for aggressive intervention. The primary outcomes of interest were biochemical progression-free survival (PFS), cancer-specific survival (CSS), and OS. PFS was defined as the time from the start of treatment to the occurrence of biochemical progression, CSS was defined as the time from the start of treatment to PCa-specific death, and OS was defined as the time from the start of treatment to all-cause death.

### *Statistical analysis*

Statistical analysis was performed using Excel 15 (Microsoft, Redmond, CA, USA) and SPSS version 25.0 (SPSS, Chicago, IL, USA). Continuous variables were presented as mean ± standard deviation (SD) and compared using the analysis of variance (ANOVA) test. Categorical variables were expressed with counts and percentages and compared using the Chi-squared test. Baseline clinical characteristics were compared between the two treatment groups using *t*-tests and chi-square tests. Kaplan-Meier survival analysis and log-rank tests were used to compare PFS, CSS, and OS between the two treatment groups. Cox regression analysis was used to evaluate the correlation between different treatment regimens, metabolic syndrome, and survival outcomes.

## Results

### *Population and clinical characteristics*

Between January 2010 and June 2020, among the 5,686 patients who underwent prostate biopsy for suspected PCa, 643 (11.3%) were aged 60 or below. Of these younger patients, 42.8% (275/643) were diagnosed with PCa, while 56.5% (363 cases) had benign prostate tissue or other prostatitis (*Figure 1*). *Table 1* presents the clinical characteristics and pathological data of included younger patients. The median age of diagnosed PCa patients was 58 years (range, 55–59 years), with an average BMI of 25.49±3.03 $kg/m^2$. Furthermore, 42.5% of these patients had hypertension, 17.1% had diabetes, 2.9% had a family

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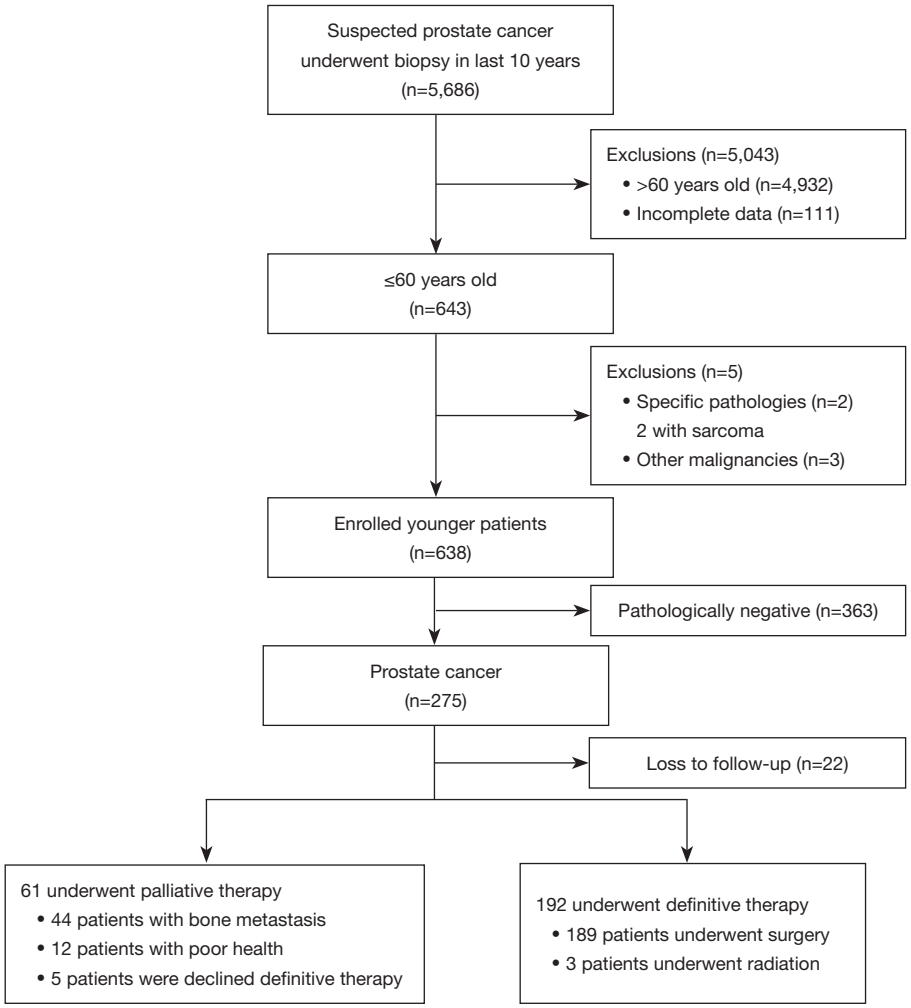


**Figure 1** Flow chart.

history of PCa, 45.1% had a history of smoking, and 32.0% had a history of alcohol consumption. Younger patients diagnosed with PCa exhibited significant differences in older age, higher BMI, hypertension, diabetes, alcohol consumption, and metabolic syndrome compared to the benign group (P<0.05).

The younger PCa patients had a median PSA level of 21.7 ng/mL (9.68–77.8 ng/mL), a median prostate volume of 38.3 $cm^3$ (range, 26.8–56.9 $cm^3$), and a median PSAD was 0.58 ng/mL/$cm^3$ (range, 0.26–1.78 ng/mL/$cm^3$) (*Table 1*). In terms of tumor ISUP group, 154 cases (60.9%) had worse pathological results (ISUP 4–5). Additionally, 137 cases (54.2%) had a higher tumor stage (clinical T stage > T2), along with 63 cases (24.9%) lymph node metastasis, and 55 cases (21.7%) bone metastasis (*Table 2*). Concerning treatment modalities, 192 cases (69.8%) received definitive local treatment, with 189 undergoing radical prostatectomy (RP) and 3 receiving brachytherapy. Meanwhile, 61 cases (22.2%) received palliative therapy—44 due to metastasis, 12 due to poor health, and 5 who declined definitive therapy. The treatment status of 22 cases (8.0%) remains unknown due to loss to follow-up. Patients who received definitive local treatment exhibited a lower prevalence of smoking and alcohol history, lower PSA levels, lower ISUP grades, earlier clinical staging, and lower incidence of bone or lymph node metastasis (P<0.05, *Table 2*).

### *Oncological outcomes*

After a median follow-up of 28.0 months, the cohort had

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**Table 1** Baseline characteristics of included participants

| Parameter | Enrolled younger patients (n=638) | Prostate cancer (n=275) | Negative (n=363) | P value |
|---|---|---|---|---|
| Age, years | 58 [55–59] | 58 [55–59] | 57 [55–59] | 0.03 |
| Body mass index, kg/m$^2$ | 25.13±3.02 | 25.49±3.03 | 24.86±2.99 | 0.01 |
| Waist circumference, m | 0.79 [0.77–0.82] | 0.80 [0.77–0.82] | 0.79 [0.77–0.82] | 0.40 |
| Hypertension | 236 (37.0) | 117 (42.5) | 119 (32.8) | 0.01 |
| Diabetes | 82 (12.9) | 47 (17.1) | 35 (9.6) | 0.01 |
| Dyslipidemia | 32 (5.0) | 21 (7.6) | 11 (3.0) | 0.01 |
| CHD | 39 (6.1) | 19 (6.9) | 20 (5.5) | 0.47 |
| CVD | 33 (5.2) | 18 (6.5) | 15 (4.1) | 0.17 |
| MetS | | | | 0.01 |
| 0 | 614 (96.2) | 258 (93.8) | 356 (98.1) | |
| 1 | 24 (3.8) | 17 (6.2) | 7 (1.9) | |
| Cigarette smoking | 267 (41.8) | 124 (45.1) | 143 (39.4) | 0.15 |
| Alcohol consumption | 174 (27.3) | 88 (32.0) | 86 (23.7) | 0.02 |
| Family history of prostate cancer | 15 (2.4) | 8 (2.9) | 7 (1.9) | 0.42 |
| PSA, ng/mL | 10.38 [6.70–22.36] | 21.7 [9.68–77.8] | 8.01 [5.50–12.21] | <0.001 |
| ≤20 | 468 (73.4) | 134 (48.7) | 334 (92.0) | <0.001 |
| >20 | 170 (26.6) | 141 (51.3) | 29 (8.0) | |
| FPSA, ng/mL | 1.18 [0.66–2.49] | 1.83 [0.86–6.65] | 0.98 [0.56–1.64] | <0.001 |
| F/T | 0.11 [0.07–0.16] | 0.08 [0.06–0.12] | 0.13 [0.08–0.17] | <0.001 |
| <0.15 | 462 (72.4) | 229 (83.3) | 233 (64.2) | <0.001 |
| ≥0.15 | 176 (27.6) | 46 (16.7) | 130 (35.8) | |
| PV, mL | 51.03 [33.02–74.73] | 38.3 [26.8–56.9] | 62.42 [41.14–84.91] | <0.001 |
| PSAD, ng/mL/cm$^3$ | 0.20 [0.11–0.50] | 0.58 [0.26–1.78] | 0.14 [0.09–0.21] | <0.001 |
| ≤0.20 | 320 (50.2) | 51 (18.5) | 269 (74.1) | <0.001 |
| >0.20 | 318 (49.8) | 224 (81.5) | 94 (25.9) | |

Data are presented as median [interquartile range], number (percentage) or mean ± standard deviation. CHD, coronary atherosclerotic heart disease; CVD, cerebrovascular disease; MetS, metabolic syndrome; PSA, prostate-specific antigen; FPSA, free prostate-specific antigen; F/T, free prostate-specific antigen/prostate-specific antigen; PV, prostate volume; PSAD, prostate-specific antigen density.

a median biochemical PFS of 77.0 months. Specifically, patients receiving definitive local therapy had a median PFS of 99.0 months, while those undergoing palliative therapy had a median PFS of 22.0 months. For CSS and OS, patients who received definitive local therapy did not reach median CSS or OS times, whereas those who underwent palliative therapy had median CSS and OS times of 52.0 and 59.0 months, respectively (*Figure 2A-2C*). Multivariate analysis identified PSA >20 ng/mL, ISUP >3, bone metastasis, and definitive local treatment as independent factors influencing PFS (*Table 3*).

To reduce bias and improve treatment effect comparability, propensity score matching was used to compare oncological outcomes between palliative and definitive therapy for patients with localized PCa and a life expectancy of over 5 years. Kaplan-Meier survival curve analysis demonstrated superior PFS with definitive therapy compared to palliative therapy. However, because

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**Table 2** Treatment characteristics of different modalities

| Parameter | Total (n=253) | Definitive therapy (n=192) | Palliative therapy (n=61) | P value |
|---|---|---|---|---|
| Age, years | 58 [55–59] | 58 [56–59] | 58 [54–59] | 0.90 |
| Body mass index, kg/m$^2$ | 25.57±2.95 | 25.70±2.83 | 25.17±3.30 | 0.22 |
| Waist circumference, m | 0.80 [0.77–0.82] | 0.80 [0.77–0.82] | 0.80 [0.77–0.82] | 0.82 |
| Hypertension | 106 (41.9) | 80 (41.7) | 26 (42.6) | 0.90 |
| Diabetes | 44 (17.4) | 30 (15.6) | 14 (23.0) | 0.19 |
| Dyslipidemia | 19 (7.5) | 12 (6.3) | 7 (11.5) | 0.29 |
| CHD | 16 (6.3) | 13 (6.8) | 3 (4.9) | 0.83 |
| CVD | 17 (6.7) | 12 (6.3) | 5 (8.2) | 0.81 |
| MetS | | | | 0.41 |
| 0 | 236 (93.3) | 181 (94.3) | 55 (90.2) | |
| 1 | 17 (6.7) | 11 (5.7) | 6 (9.8) | |
| Cigarette smoking | 113 (44.7) | 74 (38.5) | 39 (63.9) | <0.001 |
| Alcohol consumption | 84 (33.2) | 57 (29.7) | 27 (44.3) | 0.04 |
| Family history of prostate cancer | 8 (3.2) | 5 (2.6) | 3 (4.9) | 0.63 |
| PSA at biopsy, ng/mL | 21.92 [9.71–77.46] | 14.42 [8.97–36.32] | 106.70 [42.77–438.01] | <0.001 |
| PSA, ng/mL | | | | <0.001 |
| ≤20 | 123 (48.6) | 115 (59.9) | 8 (13.1) | |
| >20 | 130 (51.4) | 77 (40.1) | 53 (86.9) | |
| FPSA, ng/mL | 1.84 [0.85–6.11] | 1.42 [0.71–3.38] | 8.50 [3.46–34.75] | <0.001 |
| F/T | 0.08 [0.06–0.12] | 0.08 [0.06–0.12] | 0.08 [0.06–0.11] | 0.48 |
| <0.15 | 211 (83.4) | 160 (83.3) | 51 (83.6) | 0.96 |
| ≥0.15 | 42 (16.6) | 32 (16.7) | 10 (16.4) | |
| PV, mL | 37.99 [26.25–55.76] | 37.32 [25.53–52.93] | 40.19 [30.41–71.17] | 0.08 |
| PSAD, ng/mL/cm$^3$ | 0.59 [0.27–1.74] | 0.47 [0.23–1.03] | 2.94 [0.68–10.81] | <0.001 |
| ≤0.20 | 44 (17.4) | 40 (20.8) | 4 (6.6) | 0.01 |
| >0.20 | 209 (82.6) | 152 (79.2) | 57 (93.4) | |
| ISUP grade | | | | <0.001 |
| ≤3 | 99 (39.1) | 95 (49.5) | 4 (6.6) | |
| >3 | 154 (60.9) | 97 (50.5) | 57 (93.4) | |
| Clinical stage | | | | <0.001 |
| ≤ T2 | 116 (45.8) | 107 (55.7) | 9 (14.8) | |
| > T2 | 137 (54.2) | 85 (44.3) | 52 (85.2) | |
| Lymphatic metastasis | | | | <0.001 |
| 0 | 190 (75.1) | 174 (90.6) | 16 (26.2) | |
| 1 | 63 (24.9) | 18 (9.4) | 45 (73.8) | |
| Bone metastasis | | | | <0.001 |
| 0 | 198 (78.3) | 181 (94.3) | 17 (27.9) | |
| 1 | 55 (21.7) | 11 (5.7) | 44 (72.1) | |

Data are presented as median [interquartile range], number (percentage) or mean ± standard deviation. PSA, prostate-specific antigen; FPSA, free prostate-specific antigen; F/T, free/total prostate-specific antigen; PV, prostate volume; PSAD, prostate-specific antigen density; CHD, coronary atherosclerotic heart disease; CVD, cerebrovascular disease; MetS, metabolic syndrome; ISUP, International Society of Urological Pathology.

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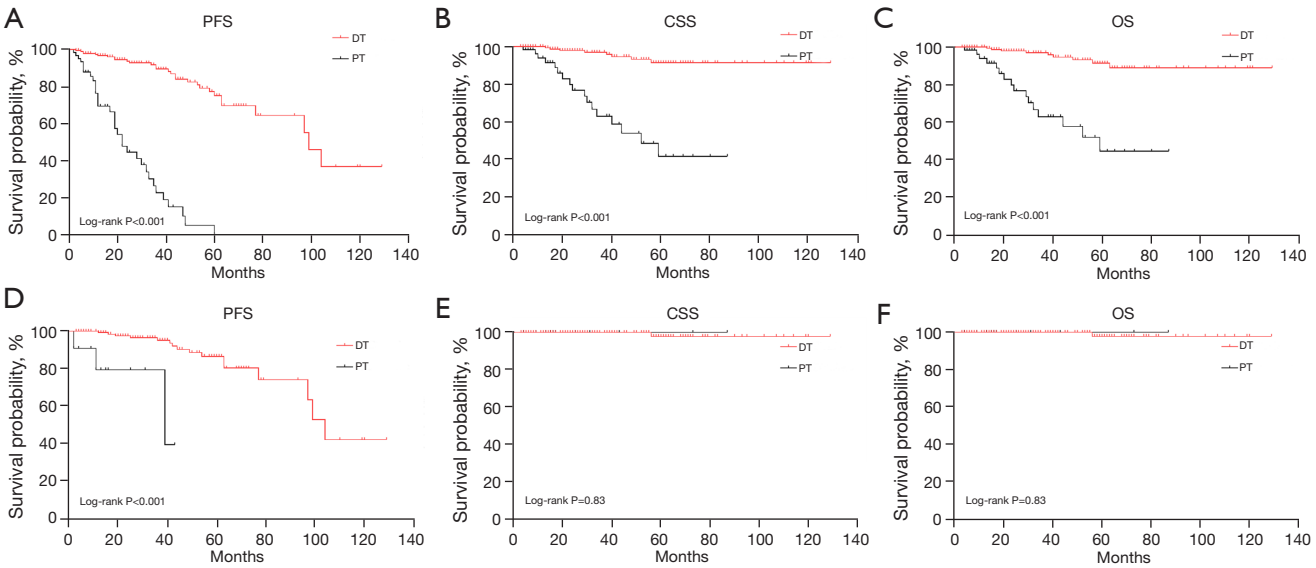


**Figure 2** Kaplan-Meier analysis. (A) Kaplan-Meier curves illustrating PFS outcomes between definitive therapy and palliative therapy. (B) Kaplan-Meier curves depicting CSS outcomes between definitive therapy and palliative therapy. (C) Kaplan-Meier curves presenting OS outcomes between definitive therapy and palliative therapy. (D-F) Subgroup analysis between definitive therapy versus palliative therapy for localized PCa patients with a life expectancy of over 5 years in PFS, CSS, and OS. The P values were determined using stratified log-rank tests. DT, definitive therapy; PT, palliative therapy; PFS, progression-free survival; CSS, cancer-specific survival; OS, overall survival.

the median CSS and OS times were not reached for either treatment group, direct comparisons for these outcomes could not be made (*Figure 2D-2F*).

## Discussion

It is essential to consider age as a significant risk factor for PCa, given the distinct differences in incidence, clinical features, and prognosis observed in younger patients compared to other age groups (18,19). The proportion of patients aged 64 years or younger has steadily increased, particularly in the 55- to 64-year age group (20). This trend highlights the importance of recognizing and addressing the specific challenges of PCa in younger men, emphasizing the need for tailored screening, diagnostics, and treatment strategies to improve outcomes in this demographic. There is ongoing debate about whether younger PCa patients present with more aggressive disease. Some studies report a higher prevalence of low-grade PCa in younger patients, while others suggest a greater occurrence of metastatic disease (21,22). In contrast to international studies, research in China has found that young-onset PCa patients are more likely to have high-risk and metastatic features, pointing to differences between PCa populations in China and the West (23). Our study found that younger PCa patients with high-grade or advanced disease have a higher risk of PCa-related death compared to those with negative pathology. This suggests that some young-onset PCa cases may have unique biological traits, making age alone an inadequate criterion for defining young-onset PCa. The median PSA level in younger suspected PCa patients was elevated, with a median of 10.38 ng/mL—21.7 ng/mL in the PCa-positive group and 8.01 ng/mL in the negative group—possibly due to conditions like prostatitis, which can elevate PSA levels. Factors such as PSA >20 ng/mL, ISUP group >3, and the presence of bone metastasis are associated with higher disease progression risks in young-onset PCa patients, highlighting the need for individualized treatment approaches.

The causes of the trend towards young-onset PCa remain unknown. Research shows that familial PCa occurs 6–7 years earlier than sporadic cases, and mutations in susceptibility genes such as BRCA and HOXB13 increase the risk of early-onset PCa. As a result, genetic testing is recommended for younger PCa patients to help prevent disease progression (24,25). However, in our study, only a small subset of patients underwent genetic testing, which may have introduced bias into the findings. Future studies

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**Table 3** Univariate and Cox proportional hazards models for progression-free survival as the observed endpoint

| Parameter | Univariate analysis | | Cox regression model | |
|---|---|---|---|---|
| | HR (95% CI) | P value | HR (95% CI) | P value |
| Age, years | | | | |
| ≤55 | Ref | | | |
| 55.01–60 | 0.934 (0.520–1.676) | 0.81 | | |
| MetS | | | | |
| 0 | Ref | | Ref | |
| 1 | 2.806 (1.378–5.713) | 0.004 | 2.868 (1.344–6.120) | 0.01 |
| PSA | | | | |
| ≤20 | Ref | | Ref | |
| >20 | 10.699 (4.599–24.890) | <0.001 | 2.733 (1.033–7.231) | 0.04 |
| F/T | | | | |
| ≥0.15 | Ref | | Ref | |
| <0.15 | 3.746 (1.359–10.326) | 0.01 | 1.799 (0.640–5.061) | 0.27 |
| PSAD | | | | |
| ≤0.2 | Ref | | | |
| >0.2 | 6.695 (0.927–48.383) | 0.06 | | |
| ISUP | | | | |
| ≤3 | Ref | | Ref | |
| >3 | 15.128 (4.725–48.435) | <0.001 | 3.667 (1.026–13.109) | 0.05 |
| Clinical stage | | | | |
| ≤2 | Ref | | Ref | |
| >2 | 8.107 (4.020–16.348) | <0.001 | 1.839 (0.758–4.467) | 0.18 |
| Lymphatic metastasis | | | | |
| 0 | Ref | | Ref | |
| 1 | 9.711 (5.558–16.968) | <0.001 | 1.193 (0.535–2.659) | 0.67 |
| Bone metastasis | | | | |
| 0 | Ref | | Ref | |
| 1 | 14.227 (7.895–25.638) | <0.001 | 3.071 (1.378–6.842) | 0.01 |
| Treatment | | | | |
| DT | Ref | | Ref | |
| PT | 12.344 (7.004–21.753) | <0.001 | 2.494 (1.125–5.529) | 0.02 |

PSA, prostate-specific antigen; F/T, free/total prostate-specific antigen; PSAD, prostate-specific antigen density; MetS, metabolic syndrome; ISUP, International Society of Urological Pathology; DT, definitive therapy; PT, palliative therapy; HR, hazard ratio; CI, confidence interval.

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should explore genetic testing beyond BRCA to include genes such as RB1 and PTEN, which could provide deeper insights into the poorer outcomes observed in younger PCa patients. Additionally, the westernization of diet and lifestyle has contributed to earlier onset of metabolic syndrome, which is linked to a higher risk of various cancers, including PCa (26,27). Patients with PCa are more likely to have metabolic syndrome, which can affect their response to treatment and overall prognosis (28,29). In our study, younger PCa patients were found to have a higher association with metabolic syndrome. Further research is needed to explore the mechanisms behind the increasing prevalence of young-onset PCa. Understanding the interactions between genetic predisposition, lifestyle factors, and metabolic conditions could lead to more effective, personalized treatment strategies. By expanding genetic testing and considering metabolic syndrome as a contributing factor, healthcare providers can optimize treatment and improve outcomes for younger PCa patients.

Previous studies indicate that nonmetastatic cancer in men under 50 is primarily detected through PSA testing (5,6). The proportion of nonmetastatic versus metastatic disease at diagnosis is similar across all age groups. However, younger men diagnosed with metastatic disease before age of 50–55 years are strongly associated with poor prognosis (30). In our study, we identified several independent factors influencing PFS in younger PCa patients: PSA levels above 20 ng/mL, ISUP scores exceeding 3, bone metastasis, and initiation of palliative therapy. Due to limited data on disease volume, we could not draw definitive conclusions about its impact on treatment outcomes. We recommend further large-scale clinical trials on younger patients receiving palliative therapy, with a focus on disease volume and factors affecting treatment decisions. To reduce bias and improve treatment outcomes comparability, we employed propensity score matching for patients with localized PCa and a life expectancy of over five years. Our results showed that, for these patients, definitive local therapy provided superior oncological survival outcomes compared to palliative therapy.

There are several limitations in this study that should be considered. Firstly, as a retrospective study, it is prone to biases that may affect the reliability of our findings. Missing data significantly challenges the robustness of our results. Prospective trials are essential to enhance the validity of our conclusions, particularly for assessing treatment outcomes in younger patients. Secondly, the absence of a comparison group, such as patients over 65, hampers our ability to comment on higher-grade PCa fully and introduces potential selection bias. To mitigate this, we implemented strict inclusion and exclusion criteria in this 10-year, single-center analysis. In the future, we plan to conduct multi-center, larger-sample studies comparing clinical and pathological characteristics, as well as outcomes, between younger and older age groups. Thirdly, the study is limited by the relatively small number of young-onset PCa patients who underwent genetic testing, potentially introducing selection bias and affecting the generalizability of our findings regarding genetic predispositions. Although we used propensity score matching to address treatment comparability, the small sample size remains a limitation. Additionally, our study identified an association between metabolic syndrome and young-onset PCa but did not fully explore the underlying mechanisms or assess the impact of lifestyle factors on disease progression. Further research with larger sample sizes, more extensive genetic testing, and a thorough examination of lifestyle and metabolic factors is needed to gain a comprehensive understanding and refine treatment strategies for young PCa patients.

## Conclusions

These findings emphasize the influence of incidence, diagnostic characteristics, and treatment methods in younger men with PCa, highlighting the need to identify specific risk factors and treatment response patterns. Patients receiving definitive therapy showed better PFS than those undergoing palliative treatment. Further research is essential to explore the factors behind the more aggressive nature of PCa in younger patients and to develop targeted strategies to improve outcomes in this group.

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## Footnote

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*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the Ethics Committee of The Second Hospital of Tianjin Medical University (No. KY2024K160) and was exempted from patient informed consent due to the retrospective nature of this study.

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## References

1. Siegel RL, Giaquinto AN, Jemal A. Cancer statistics, 2024. CA Cancer J Clin 2024;74:12-49.
2. Clark R, Vesprini D, Narod SA. The Effect of Age on Prostate Cancer Survival. Cancers (Basel) 2022;14:4149.
3. Du XL, Gao D, Li Z. Incidence trends in prostate cancer among men in the United States from 2000 to 2020 by race and ethnicity, age and tumor stage. Front Oncol 2023;13:1292577.
4. Lin DW, Porter M, Montgomery B. Treatment and survival outcomes in young men diagnosed with prostate cancer: a Population-based Cohort Study. Cancer 2009;115:2863-71.
5. Song P, Peng Z, Shu M, et al. Reduced survival of young patients under 55 years with metastatic prostate cancer: a population-based study. J Cancer 2021;12:4985-92.
6. De Vrieze M, Al-Monajjed R, Boschheidgen M, et al. Prostate Cancer Screening in Young Men. J Pers Med 2024;14:818.
7. Carlsson SV, Arnsrud Godtman R, Pihl CG, et al. Young Age on Starting Prostate-specific Antigen Testing Is Associated with a Greater Reduction in Prostate Cancer Mortality: 24-Year Follow-up of the Göteborg Randomized Population-based Prostate Cancer Screening Trial. Eur Urol 2023;83:103-9.
8. Boschheidgen M, Albers P, Schlemmer HP, et al. Multiparametric Magnetic Resonance Imaging in Prostate Cancer Screening at the Age of 45 Years: Results from the First Screening Round of the PROBASE Trial. Eur Urol 2024;85:105-11.
9. Alam MU, Kumar J, Norez D, et al. Natural history, and impact of surgery and radiation on survival outcomes of men diagnosed with low-grade prostate cancer at ≤ 55 years of age: a 25-year follow-up of > 60,000 men. Int Urol Nephrol 2023;55:295-300.
10. Salari K, Kuppermann D, Preston MA, et al. Active Surveillance of Prostate Cancer is a Viable Option for Men Younger than 60 Years. J Urol 2019;201:721-7.
11. Jacques J, Sahki N, Meknaci É, et al. Brachytherapy for favorable prognostic prostate cancer in men up to 60 years of age: Long term follow-up. Brachytherapy 2024;23:301-8.
12. Peng B, Yang C, He J. Radiotherapy cannot prolong overall survival of young prostate cancer patients with bone metastases. J Transl Med 2016;14:102.
13. García Fuentes C, Guijarro A, Hernández V, et al. Survival Differences in High-Risk Prostate Cancer by Age. Urol J 2023;20:215-21.
14. Sletten R, Berger Christiansen O, Oldervoll LM, et al. The association between age and long-term quality of life after curative treatment for prostate cancer: a cross-sectional study. Scand J Urol 2024;59:31-8.
15. Holze S, Bräunlich M, Mende M, et al. Age-stratified outcomes after radical prostatectomy in a randomized setting (LAP-01): do younger patients have more to lose? World J Urol 2022;40:1151-8.
16. Hong SK, Nam JS, Na W, et al. Younger patients have poorer biochemical outcome after radical prostatectomy in high-risk prostate cancer. Asian J Androl 2011;13:719-23.
17. Lu Y, Huang HH, Lau WKO. Survival outcomes of Asian younger men (< 55 years) undergoing radical prostatectomy: a review of prostate cancer database in a tertiary hospital in Singapore. Int Urol Nephrol 2020;52:1885-91.

18. Bergengren O, Pekala KR, Matsoukas K, et al. 2022 Update on Prostate Cancer Epidemiology and Risk Factors-A Systematic Review. Eur Urol 2023;84:191-206.
19. Xiao X, Wang JX, Wang Y, et al. Management considerations and treatment outcomes for newly diagnosed prostate cancer in advanced age patients (≥80 years): real-world data from a single urological center over a 10-year period. Transl Androl Urol 2024;13:1506-16.
20. Zhai Z, Zheng Y, Li N, et al. Incidence and disease burden of prostate cancer from 1990 to 2017: Results from the Global Burden of Disease Study 2017. Cancer 2020;126:1969-78.
21. Macneil J, Maclean F, Delprado W. Pathological Characteristics of Prostate Cancer Occurring in Younger Men: A Retrospective Study of Prostatectomy Patients. Urology 2019;134:163-7.
22. Mehring G, Tilki D, Heinzer H, et al. Histopathological results of radical prostatectomy specimen of men younger than 50 years of age at the time of surgery: possible implications for prostate cancer screening programs? World J Urol 2023;41:421-5.
23. Ji G, Huang C, Song G, et al. Are the Pathological Characteristics of Prostate Cancer More Aggressive or More Indolent Depending upon the Patient Age? Biomed Res Int 2017;2017:1438027.
24. Marino F, Totaro A, Gandi C, et al. Germline mutations in prostate cancer: a systematic review of the evidence for personalized medicine. Prostate Cancer Prostatic Dis 2023;26:655-64.
25. Aguiar JA, Li EV, Siddiqui MR, et al. Utilization of genetic testing in men with advanced prostate cancer. Prostate 2023;83:516-23.
26. Esposito K, Chiodini P, Colao A, et al. Metabolic syndrome and risk of cancer: a systematic review and meta-analysis. Diabetes Care 2012;35:2402-11.
27. Liu T, Liu CA, Zhang QS, et al. Association of the age of onset of metabolic syndrome with the risk of all cancer types. Diabetes Metab Syndr 2023;17:102896.
28. Lifshitz K, Ber Y, Margel D. Role of Metabolic Syndrome in Prostate Cancer Development. Eur Urol Focus 2021;7:508-12.
29. Hernández-Pérez JG, Torres-Sánchez L, Hernández-Alcaráz C, et al. Metabolic Syndrome and Prostate Cancer Risk: A Population Case-control Study. Arch Med Res 2022;53:594-602.
30. Thorstenson A, Garmo H, Adolfsson J, et al. Cancer Specific Mortality in Men Diagnosed with Prostate Cancer before Age 50 Years: A Nationwide Population Based Study. J Urol 2017;197:61-6.

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