Original Article

Analysis of the origin and invasion of prostate cancer from autopsy and radical prostatectomy specimens

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Background: Without a pseudocapsule, prostate cancer is invasive in volume growth and has some regularity in spatial distribution. Our study aims to explore the specific origin location, invasive characteristics, and morphology of prostate cancer.

Methods: Ninety-eight clinical specimens with tumor volume equal to or less than one-third of the organ volume and 111 autopsy specimens were retrospectively analyzed. The origin location and invasion of prostate cancer in four horizontal quadrants and 11 vertical slides were demonstrated. In addition, the median maximum anteroposterior, left-right, horizontal, and vertical diameters of lesions were compared, and the spatial morphology of lesions was described.

Results: There were 335 lesions in the autopsy and clinical specimens. There was no significant difference in the distribution of lesions confined to the horizontal quarter quadrant (P=0.064). The number of lesions with a single positive slide above the apex 0.5–1.4 cm was 75 (49.7%). No significant difference was found when compared with the maximum vertical and horizontal diameters (P=0.421). However, the maximum left-right and horizontal diameters were longer than the maximum anteroposterior diameter (P=0.046 and P<0.001). The number of lesions with a tumor area that decreased from the center to both sides was 85 (46.2%) and decreased from the center to one side was 81 (44.0%).

Conclusions: Approximately 50% of the lesions originated from the apex above 0.5–1.4 cm. The invasive tendency of prostate cancer was consistent in the horizontal and vertical dimensions but less so in the anteroposterior direction. About ninety percent of lesions with tumor area decreased from the center to both sides or one side.

Keywords: Prostate cancer; origin; invasive; morphology

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Introduction

Multifocality is a prominent feature of prostate adenocarcinoma. On average, there are 2–3 prostate cancer lesions in each organ after radical prostatectomy (1). By comparison, autopsy specimens have 1–2 lesions (2). The index and clinically significant lesions play a vital role in diagnosing and treating prostate cancer (3,4). Without a pseudocapsule, prostate cancer is invasive in volume growth. In general, the spatial distribution of prostate cancer shows some regularity (5). It is the result when prostate cancer develops to a certain extent.

However, prostate cancer's specific origin, location, and invasive characteristics are unclear. A systematic description of the morphological characteristics of prostate cancer has not been reported in previous studies. Considering that prostate cancer has specific spatial distribution patterns, it is not known whether it is caused by prostate cancer having some regular original distribution or lesions having certain invasive tendencies. Determining the origin and invasion of prostate cancer can improve the understanding of the pathological characteristics of prostate cancer and is also crucial for understanding the relationship between prostate cancer and its surrounding tissues.

Lesions in autopsy specimens are often small in number and size, which have significant advantages for studying the origin of prostate cancer (2,6). Radical prostatectomy specimens can be used to study prostate cancer's development and invasive tendencies. Considering the difficulty and high cost of obtaining and producing autopsy specimens, clinical specimens with relatively small tumor volumes can serve as good examples. Therefore, the combined study of autopsy and clinical prostate cancer specimens with a small tumor volume can show significant advantages in analyzing prostate cancer's origin and development.

Whole organ sampling and digital pathological slides provide an essential foundation for analyzing the occurrence and development of prostate cancer (7). We have preliminary research foundations studying on clinical and autopsy prostate cancer specimens and have accumulated a considerable database on whole-organ digital pathological slides (1,2,5). Combined with the above research backgrounds, we are committed to further exploring prostate cancer's original and invasive characteristics. We present this article in accordance with the MDAR reporting checklist (available at https://tcr.amegroups.com/article/view/10.21037/tcr-23-1752/rc).

Highlight box

Key findings

- Approximately 50% of the lesions originate from the apex above 0.5–1.4 cm.

What is known and what is new?

- Without the presence of a pseudocapsule, prostate cancer is invasive in volume growth.
- The study demonstrated the origin location, invasion tendency and morphology of prostate cancer lesions.

What is the implication, and what should change now?

- The results indicated that the center of the lesion can be used as a convincing and recommended concept for describing the morphology of prostate cancer.

Methods

Study population

This study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the ethics committee of Peking Union Medical College Hospital, Chinese Academy of Medical Sciences (ZS-1546). Informed consent was not needed as patient data were retrospectively reviewed. From June 2013 to September 2016, 192 clinical specimens were selected from Peking Union Medical College Hospital, and 98 were finally included. From September 2017 to February 2019, 124 consecutive autopsy specimens were collected from the Department of Anatomy, Histology and Embryology, Peking Union Medical College, Chinese Academy of Medical Sciences, and 111 met the inclusion criteria. The inclusion criteria for the clinical specimens were as follows: (I) pathological diagnosis of prostate adenocarcinoma; (II) no neoadjuvant therapy before radical prostatectomy; (III) complete capsule and bilateral seminal vesicles; and (IV) tumor volume equal to or less than one-third of the organ volume. The inclusion criteria of autopsy specimens had been described in our previous study (2).

Sample processing and data acquisition

All clinical and autopsy specimens were sectioned and scanned into whole-mount digital slides. The contours of the lesions were delineated, and Gleason scores were calculated. Lesions with a distance of more than 3 mm on the same slice or vertical discontinuous lesions were

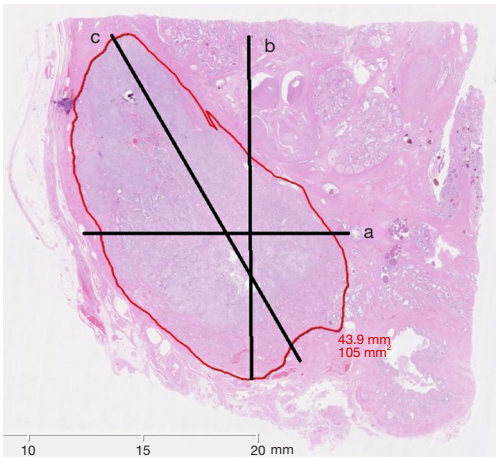

Figure 1 The lesion's maximum anteroposterior, left-right, and horizontal diameters. Lines a, b and c were classified as the maximum left-right diameter, the maximum anteroposterior diameter, and the maximum horizontal diameter, respectively. Hematoxylin-eosin staining.

defined as different lesions (8). Taking the urethra as a boundary, the prostate was divided into the anterior and posterior zones and the left and right halves. Further, it was subdivided into the anterior left, anterior right, posterior left, and posterior right quadrants. The apex was defined as the inferior-most 0.5 cm portion of the prostate. Slides with a thickness of approximately 3 mm were sectioned one by one from the apex to the base, and the remaining 0.5–1 cm of the superior-most part of the prostate was defined as the base (9). In the Gleason grading system, Gleason scores of 6, 3+4, 4+3, 8, and 9–10 were defined as Gleason grade groups 1–5 (10). The lesion with the highest Gleason score was defined as the index lesion. If the Gleason scores were the same, the lesion with the largest volume was regarded as the index lesion (11). Lesions with tumor volume >0.5 cm^3, Gleason grade group ≥2, or capsule invasion were defined as clinically significant lesions (12).

As the volume of the prostate organ varies, the number of vertical slices would be different. In the process of sampling, every specimen had at least five slides, including the apex, the apex above 0.5–0.8 cm, the middle slide, the base below 1.0–1.3 cm, and the base, while more than 50% of the specimens had three more slides above the apex and three more slides below the base. Therefore, we selected these 11 slides for research in our study. The slide with the largest tumor area was defined as the center of the lesion. The lesion's maximum anteroposterior, left-right, and horizontal diameters were depicted and calculated (*Figure 1*). The maximum vertical diameter = the slice thickness × the number of positive slices. The thickness of the slice = (the vertical diameter of the prostate – actual thickness of the apex – actual thickness of the base)/the total number of vertical slides. The spatial morphology of the lesions was divided into three types: (I) the tumor area gradually decreased from the center of the lesion to both sides; (II) the tumor area gradually decreased from the center of the lesion to one side; and (III) the tumor area developed irregularly from the center of the lesion to both sides (*Figure 2*).

Statistical analysis

If a normal distribution was met, the data were described by the means ± standard deviations and compared by independent sample *t*-test. If the data did not conform to a normal distribution, the data were described with the median value and interquartile range (IQR) and compared with the rank-sum test. The Chi-squared test was used to compare the rates. All tests were two-sided, and P<0.05 was considered statistically significant.

Results

General characteristics of prostate cancer lesions

Of the 111 included autopsy specimens, 39 were found to have prostate cancer. The total number of lesions was 67, with an average of 1.7 lesions per specimen. The total number of lesions in 98 included clinical specimens was 268, with an average of 2.7 lesions per specimen. The median volume of 335 lesions in autopsy and clinical specimens was 0.045 mL (IQR, 0.007–0.656 mL), and the median Gleason grade group was 2 (IQR, 1–2). The general characteristics of the lesions are shown in *Table 1*.

The origin of prostate cancer lesions

A total of 276 lesions are confined to the horizontal quarter quadrant of the prostate, with 178 having clinical significance. The distribution of these lesions across different prostate volumes (PVs) is presented in *Table 2*. There were no significant differences in the quadrant distribution for both overall lesions and clinically significant lesions in the groups with all PV sizes, 15≤ PV <30 mL, and PV ≥45 mL. However, in the group with 30≤ PV <45 mL from the anterior zone, the tumor positive rate was notably higher in the left half compared to the right half for both overall lesions (P=0.011) and clinically significant lesions

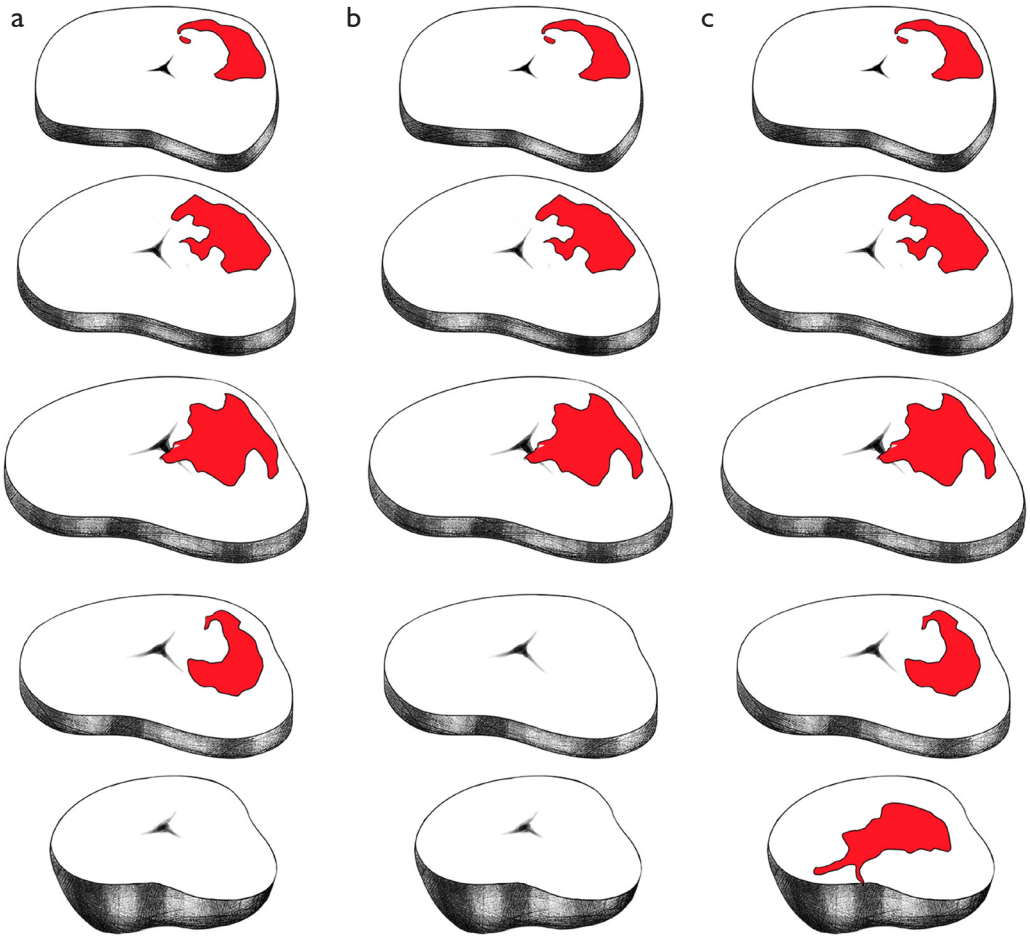

Figure 2 Three types of the spatial morphology of the lesions. The red part was the lesion depicted in each slice. Slides group "a" indicated that the tumor area gradually decreased from the center of the lesion to both sides. Slides group "b" indicated that the tumor area gradually decreased from the center of the lesion to one side. Slides group "c" indicated that the tumor area developed irregularly from the center of the lesion to both sides.

Table 1 The general characteristics of the lesions

Clinical characteristics	Index lesions (n=137), n (%)	All lesions (n=335), n (%)
Tumor volume (mL)		
≤0.5	58 (42.3)	244 (72.8)
>0.5 and ≤1	20 (14.6)	25 (7.5)
>1	59 (43.1)	66 (19.7)
T staging		
T2a	83 (60.6)	263 (78.5)
T2b	12 (8.8)	20 (6.0)
T2c	21 (15.3)	27 (8.1)
T3a	15 (10.9)	19 (5.7)
T3b	6 (4.4)	6 (1.8)
Gleason grade group		
1	28 (20.4)	110 (32.8)
2	65 (47.4)	151 (45.1)
3	21 (15.3)	35 (10.4)
4	7 (5.1)	13 (3.9)
5	16 (11.7)	26 (7.8)
Clinically significant lesions		
Tumor volume >0.5 mL	79 (57.7)	91 (27.2)
Gleason grade group ≥2	111 (81.0)	225 (67.2)
T staging ≥ T3a	21 (15.3)	25 (7.5)

Table 1 *(continued)*

Table 1 *(continued)*

Table 2 Distribution of the lesions confined to the horizontal quarter quadrant

Variables	All PV sizes		15≤ PV <30 mL		30≤ PV <45 mL		PV ≥45 mL	
	Anterior zone	Posterior zone	Anterior zone	Posterior zone	Anterior zone	Posterior zone	Anterior zone	Posterior zone
All lesions, n (%)								
Left half	80 (29.0)	69 (25.0)	27 (25.0)	32 (29.6)	37 (35.6)	23 (22.1)	16 (25.0)	14 (21.9)
Right half	54 (19.6)	73 (26.4)	22 (20.4)	27 (25.0)	16 (15.4)	28 (26.9)	16 (25.0)	18 (28.1)
Clinically significant lesions, n (%)								
Left half	50 (28.1)	45 (25.3)	15 (21.1)	21 (29.6)	25 (37.9)	15 (22.7)	10 (24.4)	9 (22.0)
Right half	34 (19.1)	49 (27.5)	13 (18.3)	22 (31.0)	7 (10.6)	19 (28.8)	14 (34.1)	8 (19.5)

PV, prostate volume.

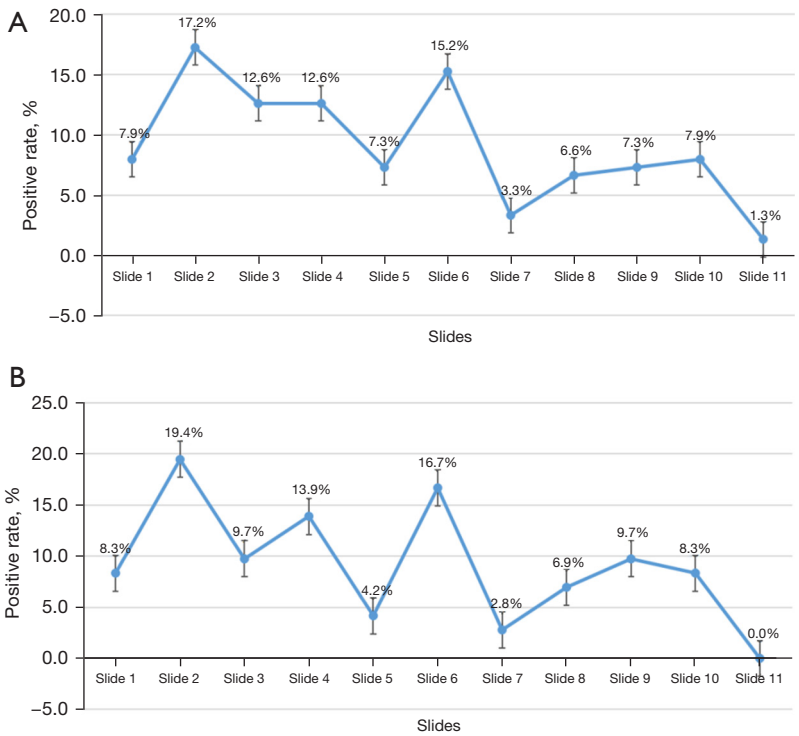

Figure 3 Distribution of all lesions (A) and clinically significant lesions (B) with a single positive slide.

(P=0.005).

In the vertical direction, there were 151 lesions with single positive slides, including 72 clinically significant lesions. The distribution is shown in *Figure 3*. The number of lesions with single positive slides in the superior and inferior halves of the prostate was 63 (41.7%) and 111 (73.5%), respectively (P<0.001). The numbers of clinically significant cancer lesions in the superior and inferior halves of the prostate were 32 (45.7%) and 52 (72.2%), respectively (P=0.001). The number of lesions with a single positive slide above the apex 0.5–1.4 cm was 75 (49.7%). The number of clinically significant lesions with a single positive slide above the apex 0.5–1.4 cm was 40 (55.6%).

Concerning the categorization based on different PVs, the apex above 0.5–0.8 cm exhibited the highest positive rate of vertical single positive slides in the groups with 15≤ PV <30 mL and 30≤ PV <45 mL for both all lesions (21.4% and 21.0%, respectively) and clinically significant lesions. In the group with PV ≥45 mL, the apex above 1.1–1.4 cm demonstrated the highest positive rate of vertical single

Table 3 Distribution of the lesions in vertical direction

Variables	Lesions with a single positive slide, % (n/N)	P1	Centres of lesions, % (n/N)	P2	Positive rates of lesions of all lesions, % (n/N)	P3	P4
Slide 1	7.9 (12/151)	–	10.4 (35/335)	–	38.8 (130/335)	–	0.388
Slide 2	17.2 (26/151)	0.015	20.9 (70/335)	<0.001	46.3 (155/335)	0.051	0.346
Slide 3	12.6 (19/151)	0.258	15.5 (52/335)	0.072	45.3 (151/333)	0.811	0.396
Slide 4	12.6 (19/151)	>0.99	12.2 (41/335)	0.219	43.5 (117/269)	0.650	0.915
Slide 5	7.3 (11/151)	0.124	4.5 (15/335)	<0.001	40.0 (46/115)	0.526	0.203
Slide 6	15.2 (23/151)	0.029	13.7 (46/335)	<0.001	40.9 (137/335)	0.866	0.661
Slide 7	3.3 (5/151)	<0.001	3.0 (10/335)	<0.001	21.7 (25/115)	<0.001	0.847
Slide 8	6.6 (10/151)	0.185	6.3 (21/335)	0.043	23.4 (63/269)	0.720	0.883
Slide 9	7.3 (11/151)	0.821	6.9 (23/335)	0.755	22.8 (76/333)	0.863	0.867
Slide 10	7.9 (12/151)	0.828	4.8 (16/335)	0.248	17.3 (58/335)	0.075	0.165
Slide 11	1.3 (2/151)	0.006	1.8 (6/335)	0.03	10.7 (36/335)	0.014	0.708

Slide 1 = the apex; Slide 2 = the apex above 0.5–0.8 (excluding 0.5) cm; Slide 3 = the apex above 0.8–1.1 (excluding 0.8) cm; Slide 4 = the apex above 1.1–1.4 (excluding 1.1) cm; Slide 5 = the apex above 1.4–1.7 (excluding 1.4) cm; Slide 6 = the middle slide; Slide 7 = the base below 2.0–2.3 (excluding 2.0) cm; Slide 8 = the base below 1.7–2.0 (excluding 1.7) cm; Slide 9 = the base below 1.3–1.7 (excluding 1.3) cm; Slide 10 = the base below 1.0–1.3 (excluding 1.0) cm; Slide 11 = the base. P1 was the comparison between the positive rates of two adjacent slides in lesions with a single positive slide; P2 was the comparison between the positive rates of adjacent slides in centres of lesions; P3 was the comparison between the positive rates of adjacent slides in all lesions; P4 was the comparison between the positive rates of lesions with a single positive slide and centres of lesions; "n" represents the number of positive lesions in the corresponding slide; "N" represents the number of specimens having the corresponding slide. As the volume of the prostate organ varies, the number of vertical slices would be different.

positive slides for both all lesions (21.2%) and clinically significant lesions (25.0%).

The invasion of prostate cancer lesions

The median maximum anteroposterior, left-right, and horizontal diameters of the 335 lesions were 4.0 mm (IQR, 2–10.9 mm), 4.4 mm (IQR, 2–12.1 mm), and 5.4 mm (IQR, 2.4–14.4 mm), respectively. The maximum left-right diameter was longer than the maximum anteroposterior diameter (P=0.046), and the maximum horizontal diameter was longer than the maximum anteroposterior diameter (P<0.001) and left-right diameter (P=0.040). The median of the maximum vertical diameter of all lesions was 6.0 mm (IQR, 2.8–15.5 mm), which was longer than the maximum anteroposterior diameter (P<0.001) and the left-right diameter (P=0.005). No significant difference was found when compared with the maximum vertical and horizontal diameters (P=0.421). The results showed that the invasive tendency of prostate cancer was consistent in the horizontal and vertical dimensions but less consistent in the anteroposterior direction.

In the vertical direction, the distribution of the lesions with a single positive slide, the centers of the lesions, and the positive rates of the lesions in vertical slides are shown in *Table 3*. There was no significant difference in the vertical distribution between the 151 lesions with a single positive slide and the centers of the 335 lesions. For the centers of the 335 lesions, the positive rate of 0.5–1.1 cm above the apex was the highest (36.4%), which was significantly higher than that of the adjacent slides (P<0.001). For the positive rates of lesions in vertical slides, there was no significant difference between the part 0.5–1.1 cm above the apex and the adjacent layers. The results showed that more than 1/3 of the lesions originated from 0.5–1.1 cm above the apex. With the increased volume of these lesions, they invaded the inferior and superior sides.

Regarding the spatial morphology, the number of lesions with a tumor area that decreased from the center to both sides was 85 (46.2%), and the median volume of these lesions was 1.103 mL (IQR, 0.355–3.138 mL). The number of lesions with a tumor area that decreased from the center

to one side was 81 (44.0%), and the median volume of these lesions was 0.098 mL (IQR, 0.031–0.614 mL). Overall, 90.2% of the lesions with tumor areas decreased from the center to both sides or one side. The median volume of the remaining 18 (9.8%) lesions that developed irregularly from the center to both sides was 0.676 mL (IQR, 0.283–1.676 mL).

Discussion

Analyzing the characteristics of prostate cancer on pathomorphology can build a bridge to further study the occurrence and development of prostate cancer from the perspective of molecular biology. At present, research on the origin of prostate cancer is mainly based on the zonal structures, analyzing the prostate's anatomical structure and gland distribution to determine the origin, distribution, and characteristics of lesions (6,13,14). These results show that most prostate cancer originates from the peripheral zone, and a few originate from the transitional and central zones. The research methods on the origin of prostate cancer in the vertical dimension are based on the results of the specimen being sectioned into slides. The specimen is usually divided into the apex, the base, and the middle part with different slides. Overall, few studies have focused on this subject, and the original information about prostate cancer is insufficient due to the small number of slides taken from the middle part (15). In our study, we took the urethra as the boundary to study the origin of lesions in four horizontal quadrants. This anatomical division can provide more intuitive guidance for transperineal prostate biopsy guided by B-ultrasound. Zonal selection and improving the positive rate on anterior and apical sampling have been the main concerns of prostate biopsy in recent years (16-18). Our study showed that prostate cancer had the same chance of origin in the four horizontal quadrants. Therefore, equal sampling in the four horizontal quadrants through transperineal biopsy can be suggested. In the vertical direction, we divided the prostate into the apex, the base, and various middle slides with a thickness of approximately 3 mm by adopting the standard whole organ sampling procedure. The number of slides taken from the middle part was inconsistent among the different specimens. We selected 11 slides that was present in more than 50% of the specimens. In this way, not only can the sample size of each slice be guaranteed, but also the number of layers can be included as much as possible so that the positive rate between the slices can be comparable and the original information of the prostate would be more sufficient.

Currently, research on autopsy specimens mainly focuses on prostate cancer's epidemiological and pathological characteristics (19-22). Few studies have used autopsy specimens to analyze the origin of prostate cancer. In Breslow *et al.*'s study, 350 prostate cancer lesions were divided into large, medium, and small lesions. For small lesions, there was no difference in the distribution in the anterior and posterior zones divided by the urethra. Most small lesions originated from the peripheral zone, and with the increase in tumor volume, the lesions tended to spread inward. Vertically, this study divided the prostate into 4–6 slides according to the size of the prostate. The results showed that the second and third slides above the apex had the highest positive rate (15). However, the number of slices included in this study was relatively small, which would inevitably lead to the missing of some information for the whole prostate organ. Inaba *et al.* studied the distribution of unsuspected lesions in the peripheral and transitional zones and revealed the characteristics of these lesions in cystoprostatectomy specimens (6). Currently, research on radical prostatectomy specimens for analyzing the origin of prostate cancer is mainly based on the peripheral, transitional, and central zones (23,24). Most studies used autopsy or clinical specimens as independent research objects, while we selected autopsy specimens and low- and medium-risk clinical specimens for the combined study. For autopsy specimens, the tumor volume is often small, which can be better used to analyze the spatial origin of prostate cancer. As there is difficulty in obtaining autopsy specimens and the cost of specimen processing is relatively high, the research sample size will not be too large. Clinical specimens with relatively small tumor volumes can well supplement these shortcomings of autopsy specimens. The tumor volume of prostate cancer in clinical specimens is often larger than that of autopsy specimens, so they can be combined to analyze the tendency of lesions from origin to invasion. These are the reasons and advantages for us to mix the autopsy and clinical specimens for analysis.

In our study, we further selected specimens with tumor volumes equal to or less than one-third of the PV to better analyze the invasion tendency of prostate cancer. Aiming to study the origin and invasion of prostate cancer, the included specimens should have a small tumor volume rather than specimens with a low Gleason score or low T stage. Horizontally, we selected lesions limited to the quarter quadrant and determined their original site in these four quadrants. Vertically, we creatively adopted the concept

of a single positive slide and center of the lesion. The origin of lesions in the vertical direction was determined by analyzing the distribution of lesions with a single positive slide. The comparison between the distribution of centers of lesions and lesions with a single positive slide was used to demonstrate the credibility of the concept of the center of the lesion. In our study, there was no significant difference between the distribution of centers of lesions and lesions with a single positive slide. We further compared the distribution of lesions with single positive slides, centers of lesions, and positive rates of lesions in vertical slides to analyze the invasive direction of lesions with increasing tumor volume. The results of our study indicated that lesions originating from 0.5–1.1 cm above the apex invaded both the inferior and superior sides with increasing tumor volume. Clinically significant lesions play a vital role in the diagnosis and treatment of prostate cancer (25,26). For lesions with a single positive slide, the distribution of clinically significant lesions and all lesions were basically consistent. Our investigation into the correlation between the origin of lesions and PV revealed that, within the group with 30≤ PV <45 mL from the anterior zone, there was statistically significant increase in tumor positive rate in the left half compared to the right half. We propose that this observation can be ascribed to the irregular volume of the transitional zone on each side of the prostate in the initial stages of hyperplasia, or the relatively small overall sample size in our study. Additionally, our research suggests that, as the PV surpasses a specific threshold, the primary location of prostate cancer initiation—mainly concentrated in the vertical direction—tends to shift upward.

Without a false envelope, prostate cancer's spatial morphology is generally considered irregular. However, our study explored the invasive tendency of prostate cancer, including the maximum left-right, anteroposterior diameter and horizontal and vertical diameters. The results showed no significant difference between the maximum vertical and horizontal diameters. In the horizontal direction, prostate cancer developed less in the anteroposterior direction. However, since the P value was close to 0.05, the conclusion needs to be further verified with a larger sample size. In addition, our research showed that 90.2% of lesions with tumor areas decreased from the center to both sides or one side. The results further indicate that the center of the lesion can be used as a convincing and recommended concept for describing the morphology of prostate cancer.

This study has some shortcomings. On the one hand, this is a single-center study and may be accompanied by some biases in the selection of the clinical and autopsy specimens. On the other hand, the analysis of the origin and invasion of lesions is limited to the field of pathomorphology. However, it is necessary to carry out a genomic analysis to truly determine the origin of these lesions. Moreover, considering the clonal evolution and heterogeneity of prostate cancer, the occurrence and development of prostate cancer seem more complex at the molecular biological level (27,28). This also points out the direction for our future work. Ultimately, the basic information of our included patients lacks details regarding the treatment of benign prostatic hyperplasia with 5-alpha reductase inhibitors, such as finasteride. These medications selectively constrict the prostate transition zone, potentially creating more room in the peripheral zone and influencing the outcomes related to lesion origin and progression.

Conclusions

In our study, the origin of prostate cancer was consistent in four horizontal quadrants. Approximately 50% of the lesions originate from the apex above 0.5–1.4 cm. The invasive tendency of prostate cancer was consistent in the horizontal and vertical dimensions but less so in the anteroposterior direction. About ninety percent of lesions with tumor area decreased from the center to both sides or one side.

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Footnote

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://tcr.amegroups.com/article/view/10.21037/tcr-23-1752/coif). The authors have no conflicts of interest to declare.

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. This study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). This study was approved by the ethics committee of Peking Union Medical College Hospital, Chinese Academy of Medical Sciences (ZS-1546). Patient data, including physical and laboratory information, were retrospectively reviewed without the need for informed consent.

References

1. Mai Z, Xiao Y, Yan W, et al. Comparison of lesions detected and undetected by template-guided transperineal saturation prostate biopsy. BJU Int 2018;121:415-20.
2. Zhou Y, Mai Z, Yan W, et al. The characteristics and spatial distributions of prostate cancer in autopsy specimens. Prostate 2021;81:135-41.
3. Chesnut GT, Tin AL, Sivaraman A, et al. Defining the index lesion for potential salvage partial or hemi-gland ablation after radiation therapy for localized prostate cancer. Urol Oncol 2021;39:495.e17-24.
4. Exterkate L, Wegelin O, Barentsz JO, et al. Incidence of significant prostate cancer after negative MRI and systematic biopsy in the FUTURE trial. BJU Int 2023;131:313-20.
5. Mai Z, Zhou Z, Yan W, et al. The transverse and vertical distribution of prostate cancer in biopsy and radical prostatectomy specimens. BMC Cancer 2018;18:1205.
6. Inaba H, Kimura T, Onuma H, et al. Tumor Location and Pathological Features of Latent and Incidental Prostate Cancer in Contemporary Japanese Men. J Urol 2020;204:267-72.
7. Cimadamore A, Scarpelli M, Cheng L, et al. Digital whole mount sections of the prostate: heading towards new ways of communicating with clinicians and patients without microscope. Minerva Urol Nephrol 2022;74:127-9.
8. Lemaitre L, Puech P, Poncelet E, et al. Dynamic contrast-enhanced MRI of anterior prostate cancer: morphometric assessment and correlation with radical prostatectomy findings. Eur Radiol 2009;19:470-80.
9. D'Amico AV, Davis A, Vargas SO, et al. Defining the implant treatment volume for patients with low risk prostate cancer: does the anterior base need to be treated? Int J Radiat Oncol Biol Phys 1999;43:587-90.
10. Epstein JI, Egevad L, Amin MB, et al. The 2014 International Society of Urological Pathology (ISUP) Consensus Conference on Gleason Grading of Prostatic Carcinoma: Definition of Grading Patterns and Proposal for a New Grading System. Am J Surg Pathol 2016;40:244-52.
11. Tourinho-Barbosa RR, de la Rosette J, Sanchez-Salas R. Prostate cancer multifocality, the index lesion, and the microenvironment. Curr Opin Urol 2018;28:499-505.
12. Matoso A, Epstein JI. Defining clinically significant prostate cancer on the basis of pathological findings. Histopathology 2019;74:135-45.
13. Kabalin JN, McNeal JE, Price HM, et al. Unsuspected adenocarcinoma of the prostate in patients undergoing cystoprostatectomy for other causes: incidence, histology and morphometric observations. J Urol 1989;141:1091-1094; discussion 1093-4.
14. Chen Y, Yan W. Implications from autopsy studies of latent prostate cancer. Nat Rev Urol 2020;17:428-9.
15. Breslow N, Chan CW, Dhom G, et al. Latent carcinoma of prostate at autopsy in seven areas. The International Agency for Research on Cancer, Lyons, France. Int J Cancer 1977;20:680-8.
16. Satish P, Simpson B, Freeman A, et al. Mapping Contemporary Biopsy Zones to Traditional Prostatic Anatomy: The Key to Understanding Relationships Between Prostate Cancer Topography, Magnetic Resonance Imaging Conspicuity, and Clinical Risk. Eur Urol 2021;80:263-5.
17. Savin Z, Dekalo S, Marom R, et al. Anterior and apical samplings during transperineal image-guided prostate biopsy. Urol Oncol 2022;40:5.e15-21.

18. Liu Y, Wang S, Xu G, et al. Effectiveness and Accuracy of MRI-Ultrasound Fusion Targeted Biopsy Based on PI-RADS v2.1 Category in Transition/Peripheral Zone of the Prostate. J Magn Reson Imaging 2023;58:709-17.
19. Bosland MC, Nettey OS, Phillips AA, et al. Prevalence of prostate cancer at autopsy in Nigeria-A preliminary report. Prostate 2021;81:553-9.
20. Takeshima Y, Suzuki M, Miyakawa J, et al. Latent prostate cancer among Japanese males: a bibliometric study of autopsy reports from 1980-2016. Jpn J Clin Oncol 2021;51:156-9.
21. Kimura T, Takahashi H, Okayasu M, et al. Time Trends in Histological Features of Latent Prostate Cancer in Japan. J Urol 2016;195:1415-20.
22. Zlotta AR, Egawa S, Pushkar D, et al. Prevalence of prostate cancer on autopsy: cross-sectional study on unscreened Caucasian and Asian men. J Natl Cancer Inst 2013;105:1050-8.
23. Teloken PE, Li J, Woods CG, et al. The Impact of Prostate Cancer Zonal Origin on Pathological Parameters at Radical Prostatectomy and Subsequent Biochemical Failure. J Urol 2017;198:1316-23.
24. Luttrell L, Li J, Cohen RJ. Zonal origin of prostate cancer: comparison of long-term outcomes after radical prostatectomy. Int Urol Nephrol 2023;55:1951-6.
25. Kawada T, Yanagisawa T, Rajwa P, et al. Diagnostic Performance of Prostate-specific Membrane Antigen Positron Emission Tomography-targeted biopsy for Detection of Clinically Significant Prostate Cancer: A Systematic Review and Meta-analysis. Eur Urol Oncol 2022;5:390-400.
26. Arif M, Schoots IG, Castillo Tovar J, et al. Clinically significant prostate cancer detection and segmentation in low-risk patients using a convolutional neural network on multi-parametric MRI. Eur Radiol 2020;30:6582-92.
27. da Silva FC, Oliveira P. Tumor clone dynamics in lethal prostate cancer. Eur Urol 2017;71:142-3.
28. Haffner MC, Zwart W, Roudier MP, et al. Genomic and phenotypic heterogeneity in prostate cancer. Nat Rev Urol 2021;18:79-92.

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