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Research article

Freehand transperineal prostate biopsy with a coaxial needle under local anesthesia: Experience from a single institution in Malaysia

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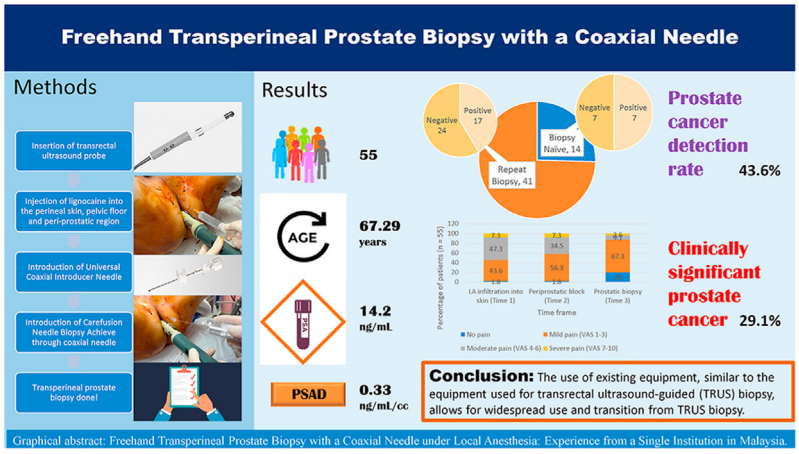
HIGHLIGHTS

- Experience of freehand transperineal prostate biopsy with an off-the-shelf coaxial needle was first reported in Malaysia.
- Freehand transperineal prostate biopsy with a coaxial needle is an alternative to other diagnostic biopsy techniques.
- Our technique of transperineal biopsy has high pain tolerability with low pain scores and zero infection rate.
- Advantages are office setting, cost-efficient with the use of existing equipment for transrectal ultrasound-guided biopsy, and high efficacy and accuracy.
- Our techniques allow for the widespread use and transition from transrectal biopsy in prostate cancer diagnosis.

GRAPHICAL ABSTRACT



Graphical abstract: Freehand Transperineal Prostate Biopsy with a Coaxial Needle under Local Anesthesia: Experience from a Single Institution in Malaysia.

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ABSTRACT

Background: Freehand transperineal prostate biopsy (TPPBx) using a coaxial needle technique offers an alternative to probe-mounted freehand or template-guided techniques in the diagnosis of prostate cancer (PCa). It only requires the same equipment used for transrectal ultrasound-guided (TRUS) biopsy. Our study is the first in Malaysia to report this experience and its outcomes. We aim to determine PCa detection rate and pain tolerability of freehand TPPBx utilizing a coaxial needle under local anesthesia (LA).

Methods: Institutional review board approval was obtained from National Medical Research Register (NMRR ID-21-02052-VIL). We retrospectively reviewed the medical records of patients who underwent TPPBx between August 2020 and April 2022. Records were reviewed for patients' characteristics, prostate volume, prostate-specific antigen (PSA) results, biopsy results and pain tolerability. Data was analyzed to determine PCa and clinically significant prostate cancer (csPCa) detection rate. LA was achieved using perineal skin infiltration and a periprostatic nerve block. The commonly used standard side-firing transrectal ultrasound with its Prostate Biplane Transducer was used as an imaging guide. The principles of the Ginsburg protocol were followed. Pain tolerability was assessed using a visual analog scale.

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Results: A total of 55 patients with elevated PSA levels underwent freehand TPPBx under LA. The mean age was 67.3 years, the median PSA was 14.2 ng/mL, and the median PSA density (PSAD) was 0.33 ng/mL/cc. The optimal PSAD cutoff for predicting csPCa was 0.35 ng/mL/cc (area under the curve [AUC], 0.792; sensitivity, 87.5%; specificity, 69.2%). PCa was detected in 24 patients (43.6%), of whom 16 (29.1%) had csPCa. The median pain scores during LA infiltration and biopsy were four and two, respectively, which were significant different ($P < 0.05$). TPPBx exhibited an infection rate of zero.
Conclusion: The PCa detection rate and patient tolerability of freehand TPPBx using a coaxial needle are similar to those of a contemporary published series. The use of existing equipment that is used for TRUS biopsy allows for widespread use and transition from TRUS biopsy.

Introduction

Prostate cancer (PCa) is the third most common cancer in Malaysia, and it accounted for 2146 new cases (9.3%) in 2020.[1] Globally, PCa is responsible for one-fifth of cancer deaths in males.[2] Systematic transrectal ultrasound-guided biopsy of the prostate (TRUS biopsy) is recommended by several international guidelines as the investigation of choice for PCa detection. Moreover, transperineal prostate biopsy (TPPBx) has gained popularity with the introduction of multiparametric magnetic resonance imaging (mpMRI) in the detection of PCa.[3] TPPBx is superior to TRUS biopsy in terms of ease of access to all sectors of the prostate, especially the anterior and apical regions of the prostate,[4,5] yield, detection of clinically significant PCa (csPCa),[6] and infection rate.[7] TPPBx can be performed using a template-guided mapping biopsy or freehand procedure. The drawbacks of template-guided mapping biopsy include the need for general anesthesia and hospitalization pre- and post-procedure, unavailability of unique equipment, difficult sustainability, and increased procedure length when compared with traditional TRUS biopsy.[8] In local practice settings, patients are required to purchase nonstandard equipment such as a brachytherapy stepping unit and grid for template-guided biopsy or a PrecisionPoint device or CamPROBE for freehand probe-mounted TPPBx before prostatic biopsy. Freehand TPPBx with a coaxial needle technique under local anesthesia (LA) offers an alternative to probe-mounted freehand or template-guided techniques in the diagnosis of PCa. TPPBx technique can be easily performed under LA in an office setting; compared with template-guided counterparts, it is less painful,[9] more cost-effective,[10] and associated with a lower admission rate and lower bed occupancy. These advantages are important considering the burden on the healthcare system, especially during the COVID-19 era. Furthermore, it requires the same equipment used for TRUS biopsy. These factors allow for the widespread use and transition from TRUS biopsy in PCa. To the best of our knowledge, our study is the first in Malaysia to report the experience and outcomes of freehand TPPBx with an off-the-shelf, cost-efficient coaxial needle under LA. Herein, we report a technique for using a coaxial needle for freehand TPPBx, to determine the PCa detection rate and tolerability.

Methods

Patients

Freehand TPPBx was first performed in the Department of Urology, Sarawak Heart Centre, Malaysia, in August 2020 by a single consultant urologist. From August 2020 to April 2022, 55 patients underwent freehand TPPBx under LA. The inclusion criteria for biopsy were clinical suspicion of PCa, which included a raised prostate-specific antigen (PSA) level >4 ng/mL, with or without abnormal digital rectal examination or positive mpMRI (Prostate Imaging Reporting and Data System [PI-RADS] 3–5). There were two groups of patients: repeated biopsy patients (who had a negative previous TRUS biopsy) and biopsy-naïve patients. All data were retrospectively collected from patient records and local databases.

Multiparametric magnetic resonance imaging of the prostate

MpMRI was performed using a Philips Ingenia 1.5 T Evolution scanner (Amsterdam, The Netherlands). The review and reporting of MRI were performed by either of two radiologists from the single center according to the PI-RADS version 2 recommendations as described in the European Society of Urogenital Radiology prostate MR guidelines 2012.[11] The locations of suspicious lesions were drawn on a sector map.[12]

Biopsy procedure

Step 1: patient preparation

The prostate MpMRI was reviewed by a consultant urologist before TPPBx. Oral ampicillin/sulbactam (375 mg) was administered before the procedure. After obtaining consent, the patient was placed in the Lloyd-Davies position, and digital rectal examination was performed to determine the clinical T stage. To obtain an adequate working area, the scrotum was secured superiorly using plaster. Subsequently, the perineum was cleaned with povidone-iodine.

Step 2: biopsy equipment

Standard side-firing transrectal ultrasound (BK Medical model Flex Focus 500 Ultrasound system, Copenhagen, Denmark) with a Prostate Biplane Transducer 8808e (10-5 MHz) was used as the imaging guide. The estimated prostate size was calculated using the following formula: anteroposterior × width × height × 0.52. Additionally, potential pathological regions were identified.

Step 3: anesthesia

After introducing the TRUS probe, a total of 5 mL of 1% lignocaine was injected via a 25 G needle into the skin and via an 18 G cannula into the subcutaneous tissue and pelvic floor under vision. The injection was given 1.5 cm laterally and superior to the anal verge on each side. Subsequently, 5 mL of LA was infiltrated into the trajectory along both neurovascular bundles, starting at the junction of the seminal vesicles and the prostate on each side as the TRUS probe was advanced. The urologist preferred to start with the left prostate gland because he was right-handed. Thereafter, a 15 G Universal Coaxial Introducer needle was placed into the same tract as the lignocaine injection. Once the coaxial introducer needle was placed on the pelvic floor and stabilized, the integrated needle was removed, leaving only the coaxial access sheath [Figure 1A–C].

Step 4: transperineal prostate biopsy technique

Under ultrasound guidance, a Carefusion CA1811 Needle Biopsy Achieve 18 G × 11 cm from the BD was reintroduced through a coaxial introducer needle into the left lobe of the prostate, and its tip location was confirmed by ultrasound. The freehand cognitive fusion technique was used to biopsy the prostate gland according to Ginsburg protocol[13] whereby four cores were taken medially to laterally in each sector (anterior, mid, basal, and posterior). The basal sector biopsy was omitted if the ultrasonography (USG)-estimated prostate gland size was <30 mL. The ultrasound probe was rotated, angled, and manipulated in an in–out direction to visualize the biopsy needle entry direction and biopsy sites during each acquisition. A similar procedure was performed for the right prostate gland. An additional targeted biopsy was performed for any suspicious lesion identifiable on mpMRI. Biopsy specimens were stored separately in labeled containers according to acquisition sector with

additional bottles for the targeted biopsy, yielding at least six bottles of specimens to be evaluated by a pathologist. Following the procedure, pressure was applied to the perineum for 2–3 min, and it was subsequently cleaned.

Post-biopsy evaluation

Following TPPBx, patients were asked to give a pain score on a visual analog scale (VAS) of zero to 10 (with zero being no pain and 10 being the worst pain ever) regarding LA infiltration at the perineal skin (Time 1), during the peri-prostatic block (Time 2), and during the prostate biopsy (Time 3). After the patients had passed urine, they were discharged with scheduled clinic visits to provide and discuss the histopathological results.

Histopathological examination

All biopsy specimens were evaluated by pathologists at the Pathology Department of Sarawak General Hospital. Reporting was performed in accordance with the 2014 International Society of Urological Pathology (ISUP) standard for PCa grading. csPCa is defined as an ISUP of 2–5. Low-grade PCa (total Gleason score of 6) was defined as an ISUP of 1.

Statistical analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences software (SPSS) version 25 (IBM, Armonk, NY, USA). Patient age is reported as mean ± SD, whereas other numerical data are expressed as median and interquartile range (IQR). Categorical variables are reported as numbers with percentages. The highest PI-RADS score was adopted as the index lesion in cases with multiple suspicious lesions reported on mpMRI. The cancer detection rate (CDR) was calculated by dividing the number of PCa patients by the total number of patients who underwent TPPBx. Cross tabulation between PI-RADS and csPCa was plotted and analyzed using the chi-squared test. PI-RADS scores were compared between the positive and negative biopsy groups and between csPCa and the remaining cases, using the Mann–Whitney *U* test. Forward logistic regression analysis was also performed for the overall PI-RADS as a predictive factor for positive biopsy and csPCa detection. Continuous data (age, PSA, prostate volume, and prostate-specific antigen density [PSAD]) were compared between the positive and negative biopsy groups using an independent samples *t*-test. A paired *t*-test was conducted to compare pain scores at Time 1 *vs.* Time 2 and Time 1 *vs.* Time 3. The receiver operating characteristic (ROC) curve was plotted using PSAD as the X-axis and csPCa as the Y-axis to evaluate the most acceptable PSAD threshold for detecting csPCa by TPPBx. *P*-values <0.05 were considered to indicate statistical significance.

Results

Patient characteristics and multiparametric magnetic resonance imaging results

Fifty-five patients with elevated PSA levels underwent freehand TPPBx between August 2020 and April 2022. Three patients did not undergo mpMRI before biopsy. Table 1 shows the patient characteristics, clinical parameters, and mpMRI results. The mean age was 67.3 years

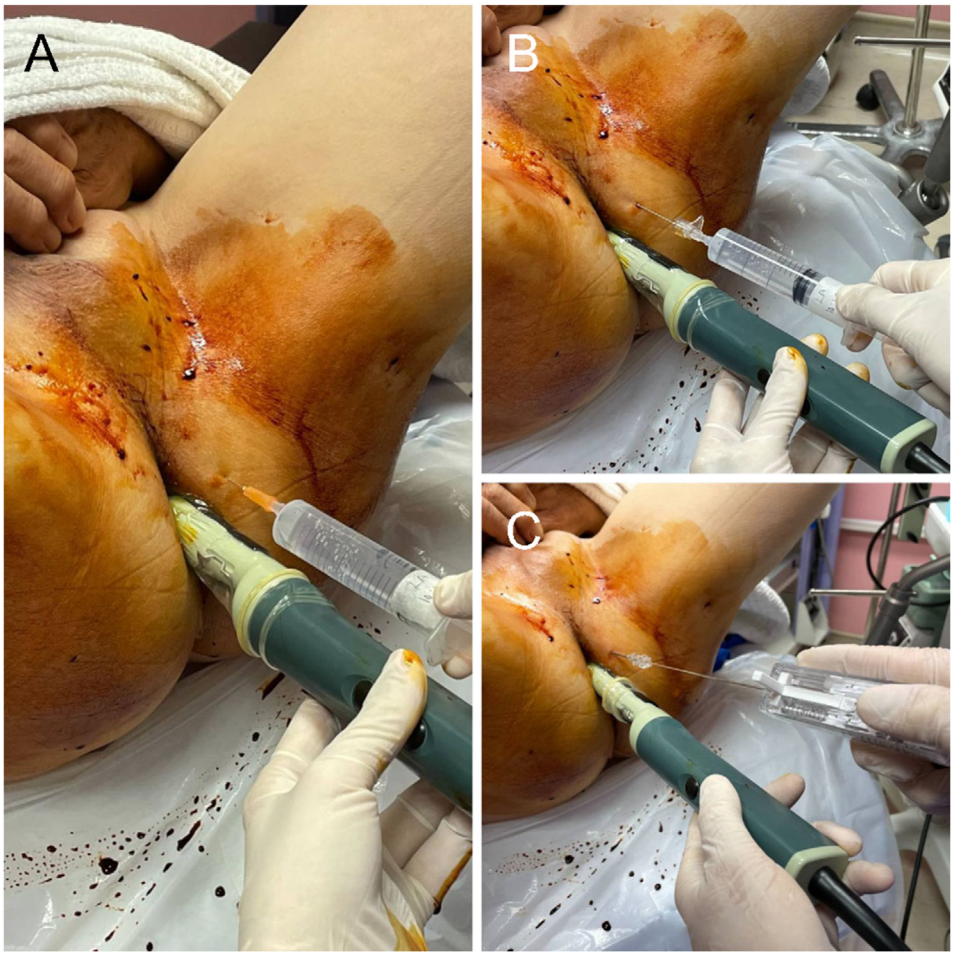

Figure 1. Setup for freehand transperineal prostate biopsy under local anesthesia (A) Infiltration of lignocaine into the skin (B) Infiltration of lignocaine into subcutaneous region, pelvic floor, and trajectory along both neurovascular bundles (C) Transperineal prostate biopsy using Carefusion CA1811 Needle Biopsy.

Table 1
Patient characteristics, clinical parameters, and multiparametric magnetic resonance imaging results.

Variables	Value
Age (years)	67.3 ± 5.7
Race	
Malay	7 (12.7)
Chinese	38 (69.1)
Borneo locals	10 (18.2)
PSA (ng/mL)	14.2 [9.5–26.0]
PSA range (ng/mL)	
>4,<10	16 (29.1)
10–20	21 (38.2)
>20	18 (32.7)
Prostate volume (mL)	43.7 [30.0–55.0]
≥30	43 (78.2)
<30	12 (21.8)
PSA density (ng/mL/cc)	0.33 [0.21–0.62]
MpMRI	
No mpMRI	3 (5.5)
PI-RADS 3	16 (29.1)
PI-RADS 4	17 (30.9)
PI-RADS 5	19 (34.5)
Patient subgroups	
Repeat biopsy (prior negative TRUS biopsy)	41 (74.5)
Biopsy-naïve	14 (25.5)

The values are presented as *n* (%), median [IQR], or mean ± SD.IQR: Interquartile range; MpMRI: Multiparametric magnetic resonance imaging; PI-RADS: Prostate Imaging Reporting and Data System; PSA: Prostate-specific antigen; TRUS: Transrectal ultrasound.

(standard deviation [SD] = 5.69), the median PSA was 14.2 ng/mL, and the median PSAD was 0.3 ng/mL/cc. Most patients had negative TRUS biopsy results (74.5%).

Prostate cancer detection rates

PCa was detected in 24 (43.6%) patients who underwent biopsy [Table 2]. Sixteen patients (66.7%) with csPCa were diagnosed by positive biopsy. The PCa detection rate was higher in the biopsy-naïve group than in the repeat-biopsy group (7 [50%] *vs.* 17 [41.5%], respectively). However, csPCa was detected in 11 and five patients in the repeat-biopsy and biopsy-naïve cohorts, respectively. The PCa detection rates were 12.5%, 35.3%, and 68.4% for PI-RADS categories 3, 4, and 5, respectively.

Table 2
Prostate cancer detection from transperineal prostate biopsy ($n = 55$).

Results	Total, *n*	Percent (%)
Histology		
No prostate cancer	31	56.4
Prostate cancer	24	43.6
csPCa	16	29.1
Detection by patient subgroups Repeat biopsy		
No cancer	24	58.5
ISUP 1	6	14.6
ISUP 2	4	9.8
ISUP 3	0	0
ISUP 4	3	7.3
ISUP 5	4	9.8
Biopsy naïve		
No cancer	7	50
ISUP 1	2	14.3
ISUP 2	2	14.3
ISUP 3	2	14.3
ISUP 4	1	7.1
ISUP 5	0	0
Detection of PCa by PI-RADS subgroup		
PI-RADS 3	2	12.5
PI-RADS 4	6	35.3
PI-RADS 5	13	68.4
Detection of csPCa by PI-RADS subgroup		
PI-RADS 3	1	6.3
PI-RADS 4	3	17.6
PI-RADS 5	10	52.6

csPCa: Clinically significant prostate cancer; ISUP: International Society of Urological Pathology; PI-RADS: Prostate Imaging Reporting and Data System; TPPBx: Transperineal prostate biopsy.

PCa detection by prostate gland volume, which was categorized into <30 mL and ≥30 mL groups, was analyzed [Table 3]. There was a significant difference in PCa detection between the two groups ($P = 0.013$). Moreover, there was a significant difference observed between PCa ($\chi 2 = 11.554$, $P = 0.003$) and PI-RADS three, four, and five. Forward logistic regression analysis demonstrated that the overall PI-RADS score was an independent predictive factor for positive biopsy (odds ratio, 3.908; 95% confidence interval [CI], 1.664–9.182; $P = 0.002$) and for the diagnosis of csPCa (odds ratio, 4.411; 95% CI, 1.578–12.331; $P = 0.005$).

Comparisons of PCa detection and csPCa findings with the PI-RADS score, PSA, prostate volume, and PSAD are presented in Tables 4 and 5, respectively. The overall PI-RADS score was significantly higher in the positive biopsy group than in the csPCa group. Age was not significantly different between the positive and negative biopsy groups or between csPCa and the remaining cases. Nevertheless, PSAD was higher in patients with positive biopsies.

Lesions harboring malignancy were found at the anterior zone of the prostate in 23 patients (41.8%), but it was the only lesion harboring malignancy in three patients (5.5%). ROC analysis and the Youden index were generated to evaluate the effectiveness of PSAD in detecting csPCa. The optimal cutoff PSAD value to predict csPCa was 0.35 ng/mL/cc (area under the curve [AUC], 0.792; sensitivity, 87.5%; specificity, 69.2%). Moreover, prostatic biopsies in 2019 and 2021 were compared. Only TRUS biopsy was performed in 2019, whereas both TRUS biopsy and TPPBx were performed in 2021. The mean PSAs were 116.2 ng/mL and 81.3 ng/mL in 2019 and 2021, respectively. PCa was detected in 35 of 85 patients (41.2%) who underwent biopsies in 2019, in contrast to 47 of 82 patients (57.3%) in 2021. In 2021, PCa was detected in 33 of 51 patients (64.7%) who were biopsy naïve with the mean PSA level of 118.1 ng/mL. In comparison, six of 16 patients (37.5%) from biopsy-naïve cohort of TPPBx were diagnosed with PCa in the same year, with a mean PSA of 15.8 ng/mL.

Pain tolerability

Table 6 summarizes the number and percentage of patients experiencing different degrees of VAS scores at different stages of TPPBx. The median VAS score during skin infiltration of the LA (Time 1) was four (IQR 2–5), whereas the VAS score during the periprostatic block (Time 2) was three (IQR 2–5). Furthermore, the median VAS score during prostatic biopsy after LA skin infiltration plus the periprostatic block was two (IQR 1–3). A paired sample *t*-test was performed to compare the pain scores at Time 1 and Time 2, as well as between Time 1 and Time 3. There was no statistically significant difference between Time 1 (M = 3.8, SD = 1.909) and Time 2 (M = 3.64, SD = 1.879), $t\,(54) = 0.702$, $P = 0.486$. However, there was a significant difference in VAS scores recorded between Times 1 and 3 (M = 1.91, SD = 1.86), $t\,(54) = 5.196$, $P < 0.05$.

To further note, none of the patients developed infectious complications.

Table 3
Distribution of prostate cancer detection by prostate volume ($n = 55$).

Prostate volume (mL)	Positive biopsy, *n* (%)	Negative biopsy, *n* (%)
<30	9 (75)	3 (25)
≥30	15 (34.9)	28 (65.1)

Table 4
Comparison of magnetic resonance imaging and prostate-specific antigen parameters with biopsy results.

Parameters	Positive biopsy	Negative biopsy	*P*
Patients, *n/N* (%)	24/55 (43.6)	31/55 (56.4)	
Age (years), mean	68.3	66.6	0.350
PSA (ng/mL)	27.4	13.5	0.001
PSAD (ng/mL/cc)	0.75	0.27	<0.001
Prostate volume (mL)	39.0	55.0	0.007
PI-RADS score	4.0	3.7	0.028

MRI: Magnetic resonance imaging; PI-RADS: Prostate Imaging Reporting and Data System; PSA: Prostate-specific antigen; PSAD: Prostate-specific antigen density.

Table 5
Comparison of magnetic resonance imaging and prostate-specific antigen parameters with clinically significant prostate cancer results.

Parameters	CsPCa	Negative biopsy or clinically insignificant PCa	*P*
Patients, *n/N* (%)	16/55 (29.1)	39/55 (70.9)	
Age (years), mean	69.6	66.3	0.055
PSA (ng/mL)	24.2	17.7	0.068
PSAD (ng/mL/cc)	0.64	0.41	0.001
Prostate volume (mL)	37.3	52.4	0.061
PI-RADS score	4.0	3.7	0.031

CsPCa: Clinically significant prostate cancer; MRI: Magnetic resonance imaging; PI-RADS: Prostate Imaging Reporting and Data System; PSA: Prostate-specific antigen; PSAD: Prostate-specific antigen density.

Table 6
Distribution of pain scores over the three transperineal prostate biopsy timepoints ($n = 55$).

Time frame	No pain (VAS 0)	Mild pain (VAS 1–3)	Moderate pain (VAS 4–6)	Severe pain (VAS 7–10)
LA infiltration into skin (Time 1)	1 (1.8)	24 (43.6)	26 (47.3)	4 (7.3)
Periprostatic block (Time 2)	1 (1.8)	31 (56.3)	19 (34.5)	4 (7.3)
Prostatic biopsy (Time 3)	11 (20.0)	37 (67.3)	5 (9.1)	2 (3.6)

The values are presented as *n* (%).LA: Local anesthesia; VAS: Visual analog scale.

Discussion

PCa detection

In this study, the overall PCa and csPCa detection rates were 43.6% and 29.1%, respectively, which are consistent with other studies that used either probe-mounted or template-based techniques [Table 7]. Furthermore, our CDR is consistent with that reported by Marra et al., a team that utilized a coaxial needle during TPPBx. However, some studies, such as those by Gorin et al., Lopez et al., and Kum et al., reported higher detection rates, which could be explained by the inclusion of patients on active surveillance. These patients have PCa, resulting in positive biopsies. Furthermore, our results demonstrate that the overall PI-RADS score is an independent predictor of positive biopsy and csPCa detection, consistent with the findings of Murphy et al.[14]

In our study, cancer was detected in the anterior peripheral zone in 28 patients (41.8%), with exclusively anterior lesions in four patients (5.5%). These numbers are higher than the 18.6% reported by Meyer et al.,[15] that utilized the PrecisionPoint device. In the negative biopsy group, anterior involvement was detected in 17 patients (70.8%). This percentage was higher than that published in the study on MRI-directed cognitive fusion TRUS-guided biopsy of anterior prostate tumors by Murphy et al.[14] In that study, the overall yield of targeted anterior biopsy was 46.2%. These data provide further insight into the advantages of TPPBx, as it is difficult to access the anterior prostate using the transrectal approach. Moreover, Faisal et al. found that anterior lesions harbor molecular subtypes linked to a more aggressive cancer phenotype.[16]

The CDR among the patients with previous negative TRUS biopsy In this study was 41.5%, corresponding to the findings of Kum et al. who found that TPPBx detected cancer in one-third of patients with previous negative TRUS biopsies.[10] In contrast, the results of our study were concordant with those of Symons et al.[17] and De Gorski et al.[18] which revealed a lower detection rate of pCa in larger prostates. This inverse relationship between CDR and prostate size was postulated to be due to anatomical compression of the peripheral zone, where the cancer is mostly found, by hyperplasia in the transitional zone.[19]

Transperineal prostate biopsy vs. transrectal ultrasound biopsy

Unlike the study by Jia et al. that employed TRUS biopsy, which had a CDR of 42.8%, our study found a higher CDR of 50% among biopsy-naïve patients.[20] In 2019, when all prostatic biopsies were performed using TRUS guidance, the CDR was 41.2% compared to 57.3% in 2021, when

Table 7
Comparison with other studies on magnetic resonance imaging ultrasound cognitive fusion transperineal prostate biopsy.

Study	Nature of study	Sample size	Median PSA (ng/mL)	Median prostate volume (mL)	PCa DR	CsPCa DR
Meyer et al.[15]	Retrospective Freehand using PrecisionPoint Transperineal Access System under LA	43 (27.9% AS)	6.1	42.9	48.80%	16.30%
Lopez et al.[9]	Observational Freehand using PrecisionPoint Transperineal Access System under LA	1218 (24% AS)	7.6	46	67%	52%
Marra et al.[26]	Prospective Freehand using Coaxial Bard Needle under LA	1014 (AS excluded)	8.1	51.3	43.90%	39.40%
Kum et al.[10S]	Retrospective Freehand using PrecisionPoint Transperineal Access System under LA/sedation	176 (9% AS, 2% Restaging post treatment)	7.9	45	79%	51.10%
Ristau et al.[27]	Retrospective Freehand using PrecisionPoint Transperineal Access System under LA/sedation	1000 (29.5% AS)	7.9	41.8	60.70%	40.30%
Aziz and Manogran[28]	Retrospective Template-guided Under spinal anesthesia	123 (8.2% AS)	15.5	68.2	43.40%	24.60%
Gorin et al.[21]	Retrospective and prospective Freehand using PrecisionPoint Transperineal Access System Under LA	95 (41.1% AS)	6.9	36	83.20%	54.70%
Dekalo et al.[29]	Retrospective Template-guided Under general anesthesia	114 (5.5% AS)	14.3	63	45%	35%

AS: Active surveillance; CsPCa DR: Clinically significant prostate cancer detection rate; LA: Local anesthesia; MRI: Magnetic resonance imaging; PCa DR: Prostate cancer detection rate; PSA: Prostate-specific antigen; TPPBx: Transperineal prostate biopsy; US: Ultrasound.

both TRUS biopsy and TPPBx were performed at our center. Interestingly, the mean PSA level was lower in the 2021 population, despite a similar number of patients being biopsied. In contrast, a greater percentage of biopsy-naïve patients were diagnosed with PCa in 2021 in the TRUS biopsy cohort (64.7%) compared to TPPBx cohort (37.5%). The difference can be explained by the high mean PSA level in the TRUS biopsy cohort. Overall, the CDR increased by incorporating freehand TPPBx into our center's clinical practice. The minor added cost for this freehand technique still makes this procedure more cost-effective than TRUS biopsy because the infectious complications of TPPBX are negligible.[21,22] These early results suggest that freehand TPPBx with coaxial needles can be a substitute for TRUS biopsy as a new standard of care.

Pain tolerability

Smith et al.[23] evaluated the VAS scores for template stepper-based TPPBx. The mean pain scores reported during LA infiltration and biopsies were 3.29 and 2.88, respectively, which were similar to those in our study (4 and 2, respectively). However, a higher pain score during biopsy is expected for template stepper-based biopsy due to multiple needle entries, requiring a higher LA requirement to anesthetize a wider area compared to freehand TPPBx. Furthermore, periprostatic LA blockage was performed visually, and the probe position was more comfortable than the probe-mounted device.[24] Our findings corresponded to the pain scores reported by Hong et al.,[25] who utilized the probe-mounted freehand method. The patients in our study did not request additional analgesia or discontinuation of the procedure because of severe discomfort. Our experience implies that this technique is well-tolerated or even better than other TPPBx techniques.

Cost

The financial impact on both patients and the healthcare system is of paramount importance in this era, especially since, in our community practice, patients must bear the cost of the equipment used. Since template-based TPPBx requires general anesthesia, it is more costly than LA and the office setting of our technique. It also requires specialized equipment, such as brachytherapy stepping units, stabilizer arms, and template grids.[10] Compared to the freehand probe-mounted counterparts, our method remains cheaper because it utilizes existing equipment and consumables in any urology unit, such as a standard TRUS probe, branula, and biopsy needle. In Malaysia, stepping units and template grids are sold at around RM2600 (USD 548), whereas the PrecisionPoint device for probe-mounted freehand TPPBx is sold at RM2085 (USD 439). Both are meant for single use per patient. However, the price of the coaxial needle used in our technique of TPPBx was only RM 75 (USD 16). Carefusion CA1811 Needle Biopsy Achieve and Universal Coaxial Introducer needle are also available as a set at the price of RM 220 (USD 46). In addition, the freehand TPPBx with a coaxial needle technique requires only a single assistant, similar to standard TRUS biopsy staffing. Sustainability, reduced cost, and readily available equipment are the major advantages of this technique, which accelerates its acceptance and widespread in clinical practice, and hence the transition of TRUS biopsy to TPPBx as a new standard of care globally.

Prostate-specific antigen density

Based on the AUC analysis and Youden index calculation, the optimal PSAD diagnosis for csPCa is 0.35 ng/mL/cc. Patients with a PSAD above this value should be counseled and strongly advised to undergo prostatic biopsy. In countries with a high prevalence of PCa, screening is required at a low PSAD value of 0.13. At this value, the sensitivity is high (100%), but the specificity is low (2.6%). The high median PSAD of 0.33 ng/mL/cc in our study was due to opportunistic screening practices.

A limitation of this study is that all biopsies were performed by a single urologist and the sample size was relatively small. If this technique is adopted by more urologists, it could become a new standard of care. Future clinical trials could compare this technique with other TPPBx methods and analyze its cost-effectiveness and benefit.

Conclusion

The PCa detection rate and patient tolerability of freehand TPPBx using a coaxial needle are similar to those of contemporary published series in terms of overall cancer and csPCa detection rates; moreover, the technique shows high patient tolerability. The use of existing equipment (only standard TRUS equipment) and significant cost benefits for health service delivery (and thus high sustainability) should pave the way for widespread implementation and transition from TRUS biopsy.

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Author contributions

Study concept and design: Ing Soon Ngu, Ming Soen Ngooi, Han Kun Ng, Kenny Tang Long Tee, Chee Hoong Loo, Meng Shi Lim; Data acquisition: Ing Soon Ngu, Ming Soen Ngooi, Han Kun Ng, Kenny Tang Long Tee, Chee Hoong Loo, Meng Shi Lim; Formal analysis: Ing Soon Ngu, Ming Soen Ngooi, Han Kun Ng, Kenny Tang Long Tee, Chee Hoong Loo, Meng Shi Lim.

Ethics statement

The study was conducted in accordance with the *Declaration of Helsinki*. Institutional Review Board approval was obtained from the National Medical Research Registry (NMRR 21-02052-VIL). Written informed consent was obtained from all subjects before the study.

Data availability statement

The data that support the findings of this study are available from the corresponding author, Ngu Ing Soon, upon reasonable request.

Conflict of interest

None.

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