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Step-by-Step

Grid-based cognitive diagnostic prostatic biopsy without transrectal ultrasonography

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Introduction

Prostate and colorectal cancers are the second and third most common malignancies affecting men globally [1]. Abdominoperineal resection is the standard of care surgical treatment for patients with malignancy of the distal rectum or anal canal, while pan-proctocolectomy may be indicated for patients with inflammatory bowel disease and familial adenomatous polyposis [2]. Both these procedures require the removal of the rectum and anal sphincteric complex, with the formation of a permanent end colostomy, which negates the possibility for (transrectal ultrasound) TRUS imaging to guide diagnostic prostate biopsy. The current literature (mostly based on small patient cohorts) describes prostatic biopsies performed via the transperineal or transgluteal approach under radiological guidance with the use of transperineal (or less commonly transurethral or transabdominal) ultrasonography, MRI, or CT imaging (Table 1).

Regardless of the imaging technique, all reported approaches require significant investment in resources (theatre and imaging equipment) as well as technical knowhow (urological and imaging). Among the reported series, only two have presented more than 10 patients for whom transperineal ultrasonography was employed to guide prostatic biopsies (Table 1). There remains no consensus on the optimal approach for securing histological diagnosis of prostate cancer when TRUS is not possible, especially when transperineal ultrasonography is not readily available [3]. Here, we describe our technique for grid-based cognitive diagnostic prostatic biopsy without TRUS.

Step-by-Step Description of the Biopsy Technique

The position of the prostate gland can be estimated based on the surface anatomy of the prostate. Cognitive transperineal prostatic biopsies are performed in a grid-based manner as described in the following steps (Fig. 1):

1. The patient is positioned in a Lloyd Davies position under either local or general anaesthesia. Prophylactic antibiotics are administered in accordance with local clinical guidelines. The perineum is shaved and prepared with antiseptic solution.
2. The two ischial tuberosities are located by deep palpation. A surgical marker pen is used to draw a horizontal line on the perineal skin joining the two ischial tuberosities. This line is expected to provide the proximal location of the posterior prostate gland in the perineum (red line in Fig. 1, panel A illustrates the relationship between the prostate and the line joining the ischial tuberosities in four patients).
3. Information on the dimension (particularly the width and height) of the prostate gland is obtained from the magnetic resonance (MR) prostate scan report or measured directly from the MR prostate images. The width of the prostate defines the lateral margins of the prostate in relationship to surface anatomy based on the inter-tuberosity reference line. It is then possible to estimate the approximate location of the suspicious lesion within the prostate gland [4] (see white line in Fig. 1B).
4. A spinal needle, with its stylet *in situ*, is positioned near the target lesion within the prostate (Fig. 1C). The needle is used as a probe to assess the distance between the prostate and the perineal skin. Once the perineal skin is punctured, the needle is advanced slowly in a horizontal plane, ensuring the needle shaft remains parallel/aligned to the patient longitudinally.
5. Advancing the needle slowly into the perineum, increased resistance is anticipated when the needle tip is in direct contact with the prostate gland. This is further assessed by

Table 1 Summary of reported series of diagnostic prostatic biopsies on patients with no anal canal.

Report	Sample size (*n*)	Technique/approach	Results (% with cancer detected)	Number of biopsy cores	Grade Group (GG)
Schapira 1982 (1)	1	IVU-US guided	Single case	NA	NA
Krauss 1993 (2)	1	CT guided	Single case	3 each side	GG 1
Twidwell 1993 (3)	10	TP-US guided	20% (2/10)	1–4	NA; evidence nodal disease
Filderman 1994 (4)	5	TP-US guided	40% (2/5)	NA	NA
Fornage 1995 (5)	1	TP-US guided	Single case	7	GG 4
Seamen 1996 (6)	5	TP-Transurethral U guided	60% (3/5)	Sextant + targeted biopsies	NA
Papanicolaou 1996 (7)	10	Transgluteal CT-guided	60% (6/10)	NA	NA
D'Amico 2000 (8)	1	TP-MRI guided	Single case	6 random + 1 targeted	GG 1
Shinohara 2003 (9)	**28**	**TP-US guided**	**82% (23/38)**	**6–12**	GG 1–5
Morlacco 2013 (10)	2	Combined TP- SP US approach	Two cases (1/2)	6	NA
Kongnyuy 2016 (11)	1	TP-MRI guided	Single case	4	GG 4
Hansen 2016 (12)	**11**	**TP US-guided**	**64% (7/11)**	11–27	GG 1–5
Caglic 2016 (13)	1	Transgluteal CT-guided	Single case	4	GG 3–4
Amin 2019 (14)	1	MRI-US fusion-guided TP	Single case	4 (Left) + 3 (Right)	GG 3
Vulder 2021 (15)	1	MRI-US fusion-guided TP	Single case	6	GG 4
Kailavasan 2021 (16)	3	MRI-US fusion-guided TP	Three cases (3/3)	12–15	GG 2–4

Two reported series with more than 10 patients are presented in bold. (IVU – intravenous urogram, US – ultrasound, CT – computerised tomography, MRI – magnetic resonance imaging, TP – transperineal, SP – suprapubic). References cited in Table 1 are presented in supplementary information (and not included in the references of the main text). For majority of the reports included in this table, information on tumour stage was not provided. When available, information on tumour grade (presented as Grade Group) is included. (NA, not available).

introducing a tapping movement to the needle, which will give a sensation of the prostate bouncing off the tip of the needle, indicating the prostate being in and out of direct contact with the needle tip. The spinal needle is left *in situ* at this exact position and alignment, as a reference for performing prostate biopsies. A second spinal needle may be used and inserted in the perineum ~5 mm from the first needle to provide added confidence in locating the prostate gland.

6. Using the *in situ* spinal needle(s) as a reference, prostate biopsies are carried out using a standard of care prostate biopsy gun. The biopsy gun is advanced to comparable depth to the reference spinal needle(s). The exact depth is further assessed by a tapping movement and associated impression of the prostate bouncing off the tip of the biopsy gun. Once the gun is fired, the quality of the tissue is inspected carefully to check if the tissue obtained appears consistent with prostatic cores. A brachytherapy grid may be used to help position biopsies in rows and columns, cognitively covering the lesion of interest (see blue grid in Fig. 1). Sequential biopsies are performed at 3–5-mm intervals, while careful inspection of the tissue obtained guides the location of additional biopsies (Fig. 1C).
7. At the end of the procedure, the perineum is cleaned, and haemostasis confirmed.

Outcome and Discussion

In the period June 2017 to September 2022, 15 patients with a history of either abdominoperineal resection or pan-proctocolectomy (n = 11 and n = 4, respectively) underwent

Fig. 1 Illustration of the cognitive transperineal prostatic biopsy approach. (**A**) The line joining the two ischial tuberosities (shown in red) is closely related to the posterior aspect of the prostate gland, as shown in four patients. (**B**) Image from MRI of the prostate of a 67-year-old patient with a (right-sided) bulky prostatic lesion, selected to demonstrate the step-by-step biopsy approach. The prostate volume obtained from the MRI was 56 cc (or mL). As illustrated in panel **A**, the red line joining the two ischial tuberosities is marked on the perineal skin and serves as a reference for the posterior aspect of the prostate gland. The prostate contour is outlined in green and the prostatic lesion in white. The blue dot grid signifies the location and pattern of biopsies performed in rows and columns. (**C**) Sequential steps of the biopsy approach, with an image from the MRI of the prostate positioned for illustration purposes: (i) marking of the two ischial tuberosities; (ii) line joining the two tuberosities; (iii) once the location of the prostate lesion is estimated, spinal needles (shown as blue triangles, n = 2) are inserted into the perineum, and (iv) transperineal biopsies (blue hollow dots) were performed based on a grid pattern, with reference to the depth of the spinal needles which are left *in situ*. The accompanying photographs were taken with patient consent and show the corresponding stages of the procedure illustrated in parts (i)–(iv).

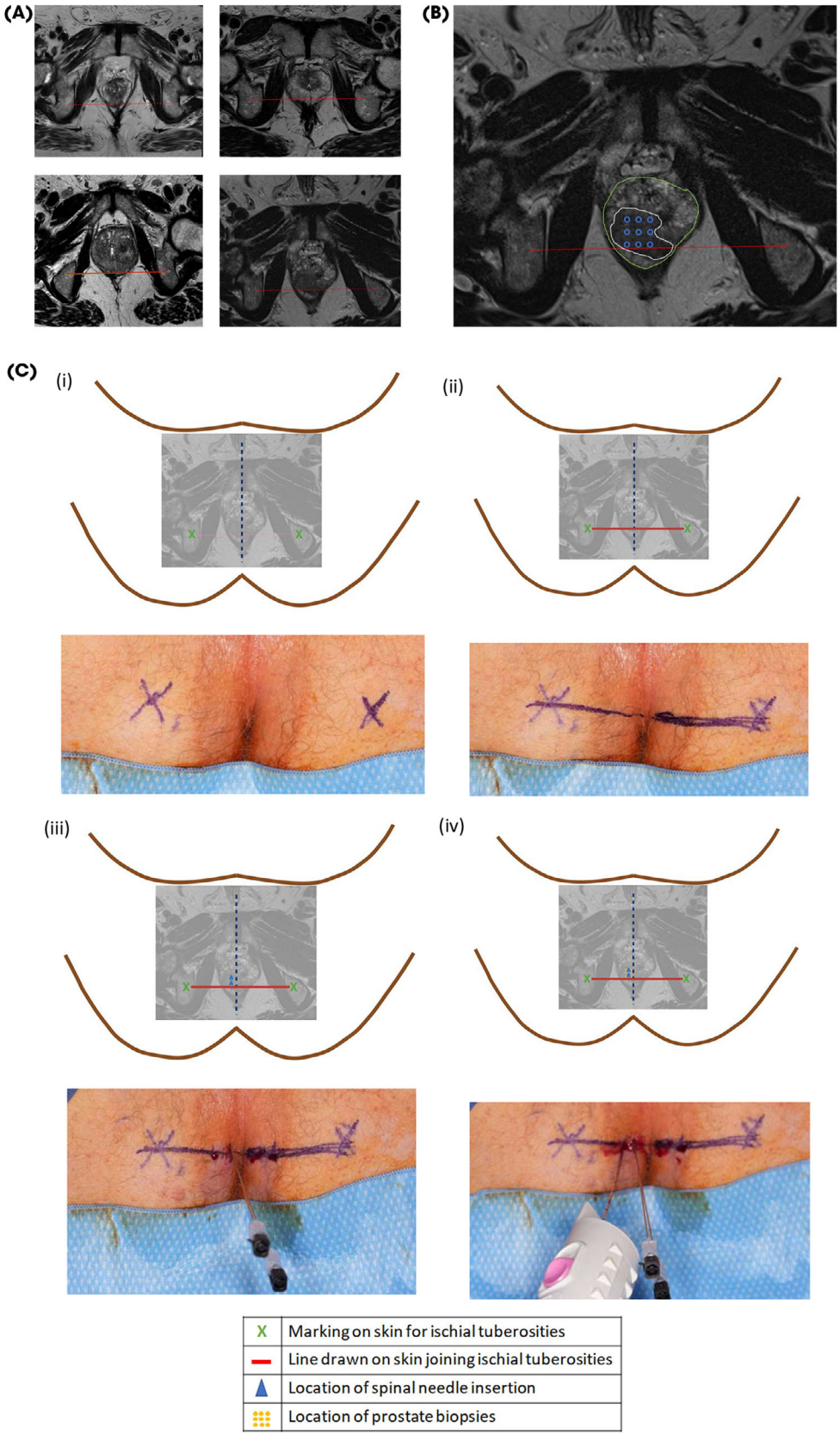

Table 2 Patient demographics and relevant clinical details (n = 15 unless stated otherwise).

Clinical characteristics	All
Age, years, mean/median/range	70/70/56–81
PSA, ng/mL, mean/median/range	16.5/12.8/4.3–40
Prostate volume, mL, mean/median/range	37.6/31.5/19–85
MRI of the prostate	
T staging, T2/T3/T4	6/8/1
Lesion location, right lobe/left lobe/bilateral	8/4/3
Histopathology of prostate cancer detected (n = 14)	
Grade Group 1/2/3/4/5	1/7/2/1/3

investigation for prostatic lesions revealed by MR prostate imaging (with ≥score 3 out of 5 in accordance with the Prostate Imaging–Reporting and Data System v2) at the Department of Urology, NHS Greater Glasgow and Clyde, Glasgow, UK. Each of the scans was reviewed by a multidisciplinary team to confirm the location of the suspicious lesions [4]. All biopsies were performed by a single experienced urological surgeon (H.Y.L.). Five of the patients underwent the procedure under local anaesthesia, while 10 patients received general anaesthesia. The small number of cases performed under local anaesthesia were attributable to strong patient preference and the need to avoid a general anaesthetic during the period of the COVID pandemic. Two patients (out of 15) underwent a repeat procedure as the samples obtained in the first attempt were inconclusive. For these two patients, a relatively small number of biopsy cores was obtained (4 and 5 cores, respectively) in the first attempt. The number of cores was increased in the second attempt, with 16 and 22 tissue cores obtained, respectively. Overall, the median number of cores obtained was 11 (range 4–25). In future, with more experience in determining the location of the prostate gland based on surface anatomy and estimates from MRI, we propose that a more limited biopsy schedule could be considered.

Fourteen of 15 patients were confirmed to have prostate cancer (Table 2), giving an overall cancer detection rate of 93%. All patients were discharged on the same day, and no patient experienced post-procedure sepsis or urinary retention. Our cancer detection rate exceeds those previously reported, which ranges from 50% to 83% (Table 2). Six patients had their cancers detected at early stage (T2) and could be considered for radical treatment. While the mean prostate volume was just under 38 cc (or mL) (Table 2), three patients had prostate volume ≥50 cc (or mL), further suggesting the clinical usefulness of this approach in enlarged prostates. The range of serum PSA levels (4.3–40 ng/mL) was relatively wide, with nine patients presenting with PSA levels <15 ng/mL. Apart from one case, all detected prostate tumours were clinically significant, with a Gleason score ≥7, including four patients diagnosed with highly aggressive disease (≥Gleason score 8/Gleason Grade Group 4; Table 1).

More than 3500 patients undergo rectal surgical procedures in the UK each year, with >1000 of these patients requiring abdominoperineal resection [5,6]. The male patients among them are also reported to be at increased lifetime risk of prostate cancer [7,8]. As a result of the inability to perform conventional TRUS, many of these patients are not investigated in a timely manner to achieve early detection of clinically significant prostate cancer. There are currently no specific guidelines for detecting prostate cancer in patients without a rectum, resulting in substantial delay in investigation and diagnosis [3]. We believe our simple yet effective approach to performing prostatic biopsies without the use of TRUS will help avoid unnecessary delay in the prostate cancer diagnostic pathway for this patient group. It is also worth noting that in the post-proctectomy setting, increased periprostatic scarring and fibrosis may impair confidence in assessing the depth of the prostate from perineal skin. The impact of this report, however, is limited by the fact that all procedures were performed by one urologist. At present, highly experienced surgeons are probably required to determine when the biopsy needle is in contact with the prostate gland. In the future, we hope to explore methodology to measure the distance from perineal skin to the prostate gland based on the MR prostate images to guide the biopsy procedure. It is therefore necessary to test whether the reported technique can be easily adopted in other centres/by other urologists worldwide.

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Disclosure of Interests

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Abbreviation: MR, magnetic resonance; TRUS, transrectal ultrasound.

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix S1. References.