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Multiparametric Magnetic Resonance Imaging for the Detection of Clinically Significant Prostate Cancer: What Urologists Need to Know. Part 4: Transperineal Magnetic Resonance–Ultrasound Fusion Guided Biopsy Using Local Anesthesia

Jos Immerzeel [a,†], *Bas Israël* [b,c,†], *Joyce Bomers* [b], *Ivo G. Schoots* [d,e], *Jean-Paul van Basten* [f,g], *Karl-Heinz Kurth* [a], *Theo de Reijke* [a,h], *Michiel Sedelaar* [c,g], *Frans Debruyne* [a], *Jelle Barentsz* [a,b,*]

[a] *Department of Urology, Andros Clinics, Arnhem, The Netherlands;* [b] *Department of Medical Imaging, Radboud University Medical Center, Radboud Institute for Health Sciences, Nijmegen, The Netherlands;* [c] *Department of Urology, Radboud University Medical Center, Radboud Institute for Health Sciences, Nijmegen, The Netherlands;* [d] *Department of Radiology and Nuclear Medicine, Erasmus University Medical Center, Rotterdam, The Netherlands;* [e] *Department of Radiology, Netherlands Cancer Institute, Amsterdam, The Netherlands;* [f] *Department of Urology, Canisius Wilhelmina Hospital, Nijmegen, The Netherlands;* [g] *Prosper Collaborative Prostate Cancer Clinics, Nijmegen-Eindhoven, The Netherlands;* [h] *Department of Urology, Amsterdam UMC, University of Amsterdam, Amsterdam, The Netherlands*

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Abstract

Background: Transperineal magnetic resonance imaging–transrectal ultrasound fusion guided biopsy (MFGB) is an increasingly popular technique due to increasing rates of biopsy-related infections. However, its widespread implementation has been hampered by the supposed necessity of epidural or general anesthesia.
Objective: To demonstrate the technique, feasibility, and results of transperineal MFGB under local anesthesia, in an ambulatory setting without the administration of prophylactic antibiotics.
Design, setting, and participants: This single-center study enrolled consecutive biopsy-naïve men with a clinical suspicion of prostate cancer into a prospective database between November 2015 and November 2020. Men with Prostate Imaging Reporting and Data System (PI-RADS) version 2 scores 3–5 underwent transperineal MFGB.
Surgical procedure: Transperineal MFGB was performed in an ambulatory setting under local anesthesia by a single operator.
Measurements: Procedure-associated adverse events were recorded. Patient discomfort during both the local anesthesia and the biopsy procedure was determined using a visual analogic scale (0–10). Detection rates of grade group (GG) ≥2 prostate cancer and the proportion of men with GG 1 cancer were assessed.
Results and limitations: A total of 1097 eligible men underwent transperineal MFGB. The complication rate was 0.73% (8/1097); complications comprised five (0.46%) urinary tract infections including one hospitalization and three (0.27%) urinary retentions. In 735 men, the median pain scores were 2 (interquartile range [IQR] 2–3) for the local

† These authors are co-first authors, and they contributed equally.
* Corresponding author. Department of Medical Imaging, Radboud University Medical Center, P.O. Box 9101, Nijmegen 6500 HB, The Netherlands. Tel. +31 24 3619196; Fax: +31 24 3540866.
E-mail address: jelle.barentsz@radboudumc.nl (J. Barentsz) .

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anesthesia procedure and 1 (IQR 0-2) for the biopsy. Prostate cancer was detected in 84% (926/1097) of men; 66% (723/1097) had GG ≥2 and 19% (203/1097) GG 1.
Conclusions: Transperineal MFGB can safely be performed as an outpatient procedure under local anesthesia in an ambulatory setting. The detection rate of clinically significant prostate cancer is high, and biopsy is well tolerated. Although no antibiotic prophylaxis was used, the rate of infectious complications is practicably negligible.
Patient summary: This article shows how tissue samples (biopsies) can accurately be obtained from suspicious regions seen on prostate magnetic resonance imaging via needles inserted in the perineum (skin between the scrotum and the anus) in men with suspected prostate cancer. This technique appears to be very well tolerated under local anesthesia and has a lower risk of infection without antibiotic prophylaxis than the more common biopsy route through the rectum, with antibiotics.

1. Introduction

Prostate cancer is the most common solid tumor in European men and the second leading cause of cancer death [1]. Recently, international guidelines recommend the use of prostate magnetic resonance imaging (MRI) before biopsy in biopsy-naïve men with a suspicion of prostate cancer [2,3]. Subsequently, men with suspicious MRI are recommended to undergo targeted biopsy of the suspected regions and systematic biopsies, whereas in men with non-suspicious prostate MRI, it should be considered to avoid a biopsy [2]. This prebiopsy risk stratification strategy limits the number of men who have to undergo biopsy and reduces overdetection of low-grade grade group (GG) 1 prostate cancer with equivalent detection rates of clinically significant (GG ≥2) cancer [4–7].

As shown in our previous paper (part 3), several methods are available to perform MR guided biopsy (MRGB): visual/cognitive registration MRGB, MRI in-bore guided biopsy, and software-based MRI-transrectal ultrasound (TRUS) fusion guided biopsy (MFGB) [8,9]. Biopsies can be performed either transperineally or transrectally. The transperineal route has the advantage of reducing the risk of infectious complications compared with the transrectal route [10,11]. This has become even more stringent due to rising resistance rates for fluoroquinolones, but particularly because side effects have recently led to the European Commission and the Food and Drug Administration advising to limit the use of fluoroquinolones for prostate biopsy [12–15]. Transperineal biopsy is often performed under spinal or general anesthesia to avoid a potentially painful experience. Only a few studies reported transperineal biopsies under local anesthesia, but with the administration of prophylactic antibiotics [16–18]. The primary aim of our study was to demonstrate the technique of ambulatory transperineal MFGB under local anesthesia, without prophylactic antibiotics. Furthermore, patient tolerability, procedure-related complications, and prostate cancer detection rates were assessed.

2. Patients and methods

2.1. Study design and patient population

Since November 2015, in the Andros Clinics (Arnhem, The Netherlands) a prebiopsy MRI pathway was introduced as a standard diagnostic pathway. Until November 2020, 3244 consecutive patients were registered into a prospectively maintained database. The protocol included multiparametric MRI (mpMRI). In case of suspicious prostate MRI, patients underwent transperineal MFGB with additional random biopsy (RB) cores to sample the nonsuspicious regions. Eligible men were biopsy naïve with a clinical suspicion of significant prostate cancer (ie, serum prostate-specific antigen [PSA] level >3 ng/ml and/or abnormal digital rectal examination [DRE] and/or a positive first-degree family history of prostate and/or breast cancer). Exclusion criteria were inability to undergo MRI (eg, due to claustrophobia), MRI performed elsewhere, previous prostate biopsy, and men with suspicious MRI who did not undergo MFGB (Fig. 1). Institutional review board approval was obtained for this observational single-center registry with a waiver of informed consent (CMO-2020-6599).

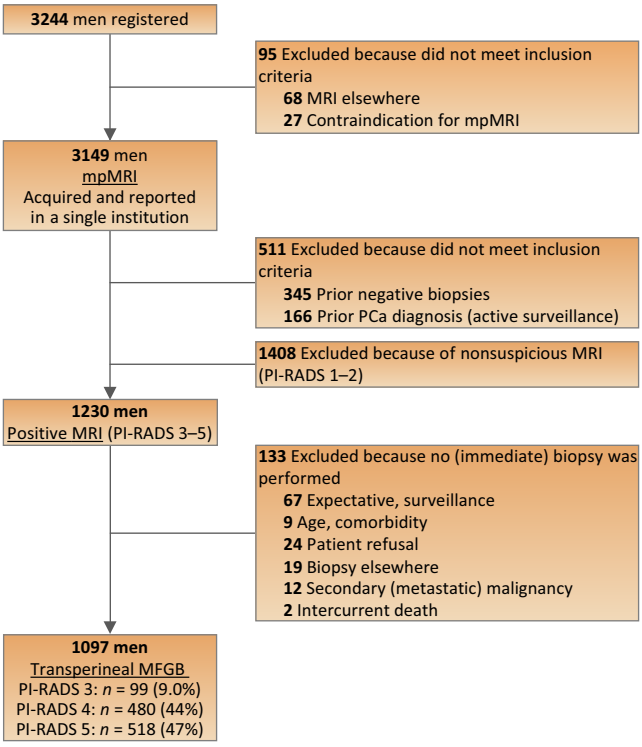

Fig. 1 – Flow diagram of study design and participants. mpMRI = multiparametric magnetic resonance imaging; MRI = magnetic resonance imaging; MFGB = MRI-TRUS fusion guided biopsy; PCa= prostate cancer; PI-RADS = Prostate Imaging Reporting and Data System; TRUS = transrectal ultrasound.

2.2. Prostate MRI acquisition and reporting

Multiparametric prostate MRI (mpMRI) was performed at a single center (Radboudumc, Nijmegen, The Netherlands) using a 3-Tesla MR scanner (Siemens, Erlangen, Germany) with a 32-channel pelvic phased-array coil. Acquisition and reporting were performed according to the Prostate Imaging Reporting and Data System (PI-RADS) version 2 recommendations (since September 2019, version 2.1 was used), as previously described [19–21]. MRI findings were reported in a standard clinical setting by four expert prostate radiologists with 5–25 yr of prostate MRI experience.

2.3. Image processing and lesion contouring

Prior to the actual biopsy procedure, MRI sequences were sent to contouring software (MIM Symphony Dx; MIM, Cleveland, OH, USA). Subsequently, contours of the prostate and one or more MRI-suspected lesions were delineated by a single biopsy operator (J.I.) in the axial planes of T2-weighted (T2W) and diffusion-weighted images, guided by the radiology report and key images. The urethra was delineated on the T2W axial planes at the apex and base of the prostate, and subsequently in the three-dimensional (3D) mode on the sagittal plane. The software allows the use of a "virtual probe" during the contouring process to reslice the MR images in the same direction as the TRUS images, both with a different orientation, creating a more robust fusion (Fig. 2). Contoured MR images were stored as a "biopsy plan." The contouring process took approximately 10–15 min per patient.

2.4. Biopsy procedure

2.4.1. Step 1: patient preparation

Biopsy procedures (video) were performed in an ambulatory setting. No periprocedural prophylactic antibiotics were administered. As part of the clinical checkup, the dipstick test of urine was performed before the procedure, and if indicated, urine culture was plated. To prevent disturbance of TRUS imaging by fecal contamination, a low-fiber diet was prescribed the day before biopsy and a laxative suppository (bisacodyl, 10 mg) in the evening before biopsy. Additional medication (oxazepam, 10 mg) was administered orally 2 h prior to the biopsy to aid the relaxation of the pelvic floor muscles. Patients were placed in the dorsal lithotomy position. To offer a free working area, the scrotum was, if necessary, secured superiorly using a plaster. DRE was repeated, and then the perineum was cleaned with chlorhexidine.

2.4.2. Step 2: biopsy equipment

Initially, TRUS was done with the BK-Flex Focus 800 with an 8848 biplane US probe (BK Medical, Herlev, Denmark), with the MIM contouring and fusion system on a computer digitally connected to the ultrasound (US) unit. Since January 2018, the BK-3000 ultrasound machine was used with the software integrated.

The biplanar US transducer (BK-E14CL4b) was mounted onto a tracked stepper (CIVCO, Peabody, MA, USA) with a sterile disposable grid with 5 mm separated holes—as is used for brachytherapy—and was digitally connected to the US unit. The stepper allowed for tracking of the US probe position throughout the procedure while visualizing the "live" 3D MRI-TRUS fused planes.

2.4.3. Step 3: local anesthesia

A total of 10 ml of 2% lidocaine was injected subcutaneously, 5 ml at both sides of the midline of the perineum, using a "fan technique," over an area of 3 × 4 cm (Fig. 3A).

After introducing the TRUS probe (fixed on the stepper; Fig. 3B), 2–4 ml of 1% lidocaine was injected under TRUS guidance in the trajectory along both neurovascular bundles starting at the junction of the seminal vesicles and the prostate. Additionally, 3–6 ml of 1% lidocaine was injected on both sides at the apex and the pelvic floor, depending on the size of the prostate. A total of 400 mg lidocaine was never exceeded.

2.4.4. Step 4: biopsy planning

The *biopsy plan* with the previously contoured MRI of the prostate and its lesion(s) (see Image processing and lesion contouring) was sent to the US machine. The real-time axial plane was used for 3D TRUS prostatic acquisition. The MRI contours and TRUS images were then fused and 3D aligned on the US screen; aligning of the urethra makes this procedure faster and more precise (Fig. 4A). For the biopsy procedure itself, real-time sagittal TRUS images and overlaying MR contours were projected on the screen. Biopsy positions were chosen, and biopsy needles were directed using the grid holes corresponding to the coordinates on the screen (Figs. 3B and 4B).

2.4.5. Step 5: targeted biopsy and RB

A disposable biopsy gun with an 18G biopsy needle (ABG-2020; Möller Medical GmbH, Fulda, Germany) was used to obtain the samples with a length of 15–17 mm. Targeted biopsy was performed from each MR-suspected lesion (ie, PI-RADS 3–5). A minimum of two targeted cores from each suspicious lesion were taken with an additional two to four "perilesional" biopsies from the 5 mm surrounding rim. Subsequently, RB cores were taken, usually four to six, from the contralateral lobe,

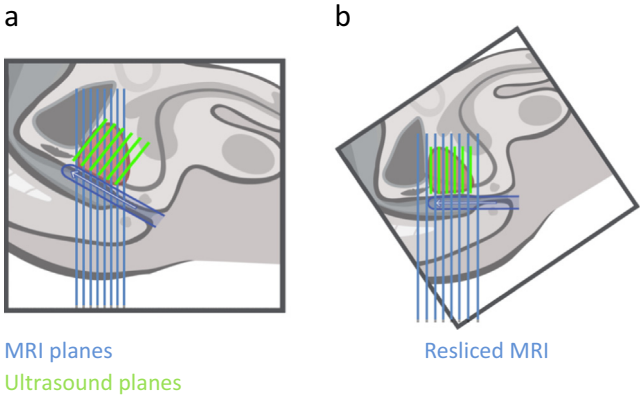

Fig. 2 – Schematic explanation of the "virtual probe". (A) Direction of axial MRI planes (orthogonal to the rectum) in blue and direction of virtual ultrasound probe planes in green. (B) Patient in lithotomy position; reconstruction of MRI planes in the same direction as US planes. MRI = magnetic resonance imaging; US = ultrasound.

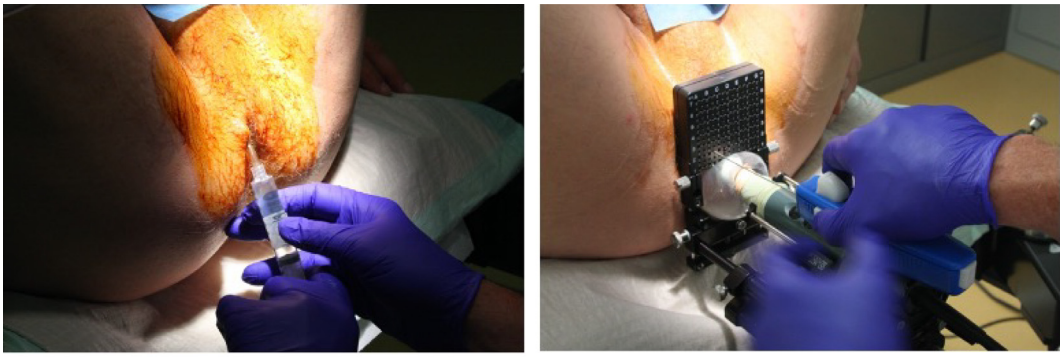

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Fig. 3 – Setup for the transperineal MRI-TRUS fusion guided biopsy under local anesthesia. (A) In lithotomy position, the scrotum was secured superiorly using surgical tape, offering a free working area. After digital rectal examination, the perineum was prepped with chlorhexidine (for visibility on picture, we used iodine here). In a semisterile environment, a total of 5 ml of 2% lidocaine, using a 10 cc syringe and 22G subcutaneous needle, was injected subcutaneously at both sides of the midline of the perineum, using a "fan technique," over an area of 3 × 4 cm^2. (B) After introducing the US probe (fixed on the stepper), 2–4 ml of 1% lidocaine was injected in the trajectory along both neurovascular bundles starting at the junction of the seminal vesicles and the prostate, under TRUS guidance. Additionally, 3–6 ml of 1% lidocaine was injected on both sides at the apex and the pelvic floor, depending on the size of the prostate. Biopsy procedure: water-filled cover over US transducer for optimal contact with the anterior rectal wall, fixed onto the stepper unit with disposable grid and biopsy gun. MRI = magnetic resonance imaging; TRUS = transrectal ultrasound.

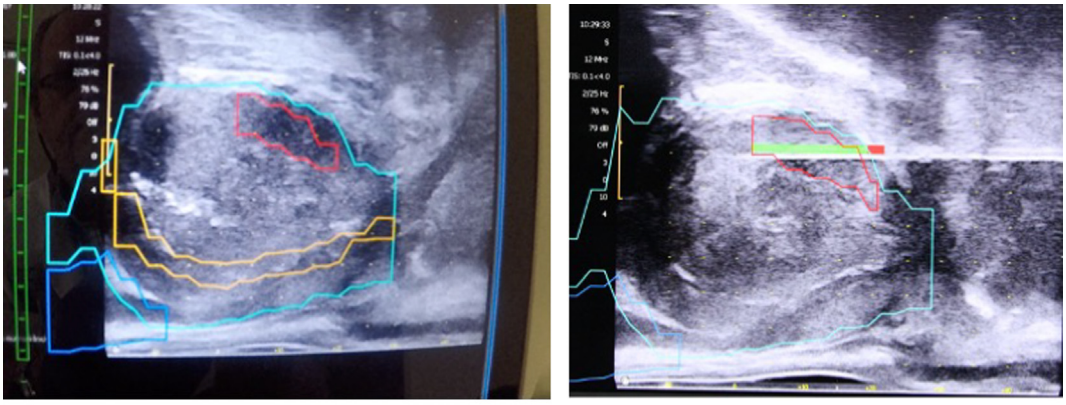

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Fig. 4 – MRI-TRUS fusion ultrasound images of the prostate during the biopsy procedure. (A) Ultrasound image of the prostate acquired by the transrectal probe; sagittal view: base of prostate = left, apex of prostate = right, ventral = up, and dorsal = down. The MR-contouring overlay on top of the ultrasound image demonstrates the delineated prostate (blue), urethra (orange), and suspected delineated lesion on MRI (red). (B) "Live" sagittal view of performing prostate biopsy: needle inserted transperineally in the grid hole corresponding with the plane position: visibility of needle approaching the planned biopsy mark (green) in the delineated target (red contour). MRI = magnetic resonance imaging; TRUS = transrectal ultrasound.

depending on the prostate volume and the number and positions of the targeted lesions. In few patients, no RB was performed in case of obvious locally advanced or metastatic disease (eg, radiological stage T4 or bone metastasis) or bilateral target lesions. Biopsy samples were stored separately in numbered vials, corresponding with the numbers in the biopsy scheme. Following the procedure, the perineum was cleaned and covered with gauze. The biopsy procedure itself (room in and room out) took 25–30 min per patient.

2.4.6. *Step 6: biopsy reporting*

The software delivered a report of the biopsy procedure, with the location, numbers, and coordinates of the targeted and random cores, as an overlay on top of the contours of the prostate, urethra, and delineated MRI lesions (Fig. 5).

2.5. *Postbiopsy evaluation*

Between November 2015 and June 2019, immediately following the biopsy procedure, patients were asked to give a score for pain and discomfort on a visual analog scale (VAS) of 0–10 regarding local anesthesia injections and the biopsy procedure separately. In June 2019, >1000 MFGB procedures had been performed (including men with prior biopsies who were excluded in the present study), and structural pain assessment by VAS was discontinued due to consistently low pain scores.

From 1 to 2 days following biopsy, a nurse contacted the patient by telephone for postbiopsy evaluation. Within 2 wk after the biopsy procedure, the histopathological result of the biopsies was discussed with the urologist in the outpatient clinic. Complications were reported according to the Clavien-Dindo criteria for complication registration [22].

2.6. *Histopathological examination*

All biopsy specimens were evaluated by three expert genitourinary pathologists at the pathology department of a single university center (Radboudumc) with >5 yr of experience. Reporting was done according to the 2014 International Society of Urological Pathology (ISUP) standard for prostate cancer grading [23]. Clinically significant cancer was defined as any cancer core with GG $\geq$2 (Gleason score $\geq$3 + 4), and low-grade prostate cancer was defined as GG 1.

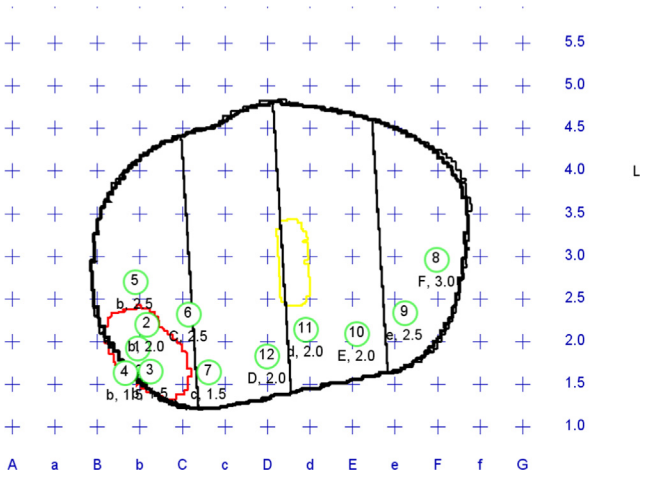

Fig. 5 – Schematic diagram of the prostate with annotated MRI-suspected lesion. Prostate (black), urethra (yellow), and annotated MRI-suspected lesion (red) are presented as an overlay on a 5 mm grid (A–G on the *x* axis; *y* axis: 1.0–5.5 cm). The location, number, and coordinates of the targeted cores (1–4), the surrounding cores (5–7), and the random biopsy cores (8–12) are depicted in the biopsy report. This information can be used for histopathological correlation, rebiopsy, and treatment planning. MRI = magnetic resonance imaging.

2.7. Statistical analysis

Patient demographics, clinical parameters, mpMRI, and MFGB results are reported using medians and interquartile ranges (IQRs) for continuous variables, and numbers with percentages for categorical variables, according to the guidelines on reporting statistics in clinical urological research with adherence to the recommendations of reporting MRI-targeted biopsy studies [24,25]. In case of multiple suspicious lesions, the highest PI-RADS category (or the largest lesion in the case of similar PI-RADS scores) was used as the index lesion. Statistical analyses were performed using SPSS statistical software version 25 (IBM, Armonk, NY, USA).

3. Results

3.1. Patient characteristics and mpMRI results

A total of 1097 eligible biopsy-naïve men underwent MFGB (reasons for exclusion are provided in Fig. 1). The median age was 69 yr (IQR 64–73) with a median PSA level of 7.0 ng/ml (IQR 5.2–9.8). Baseline characteristics of eligible participants are presented in Table 1. Of 1097 men, 99 (9.0%), 480 (44%), and 518 (47%) had maximum PI-RADS categories of 3, 4, and 5, respectively.

3.2. Complications and discomfort

In the first 736 consecutive biopsy-naïve men, the median VAS score for the local anesthesia procedure was 2 (IQR 2–3) and that for the biopsies was 1 (IQR 0–2). A total of eight (0.73% of 1097) Clavien-Dindo grade ≥2 complications were reported. Three patients (0.27%) developed urinary retention 1–6 d after biopsy, which was resolved with a transurethral indwelling catheter for 1–7 d; two had a prostate volume of >90 ml and one of 27 ml. Five men (0.46%) developed fever presumably based on urinary tract infection, and four men recovered quickly after starting oral antibiotics. One patient was hospitalized for antibiotic treatment due to fever up to 40°C, considered to be a urosepsis (urinary culture positive for *Escherichia coli*). After 2 d, this patient was discharged. All five patients with suspected infection had a negative dipstick test prior to transperineal MFGB.

Table 1 – Patient demographics, clinical parameters, mpMRI, and MFGB results

	Total	
Biopsy-naïve men, *n* (%)	1097	(100)
Age (yr), median (IQR)	69	(64––73)
DRE, *n* (%)		
Normal	552	(66) [a]
Suspicious	284	(34) [a]
Missing	261	(24)
PSA (ng/ml), median (IQR)	7.0	(5.2–9.8)
Prostate volume TRUS (ml), median (IQR)	44	(33–58)
PSA density (ng/ml/ml), median (IQR)	0.17	(0.11–0.24)
mpMRI, *n* (%)		
PI-RADS 3	99	(9.0)
PI-RADS 4	480	(44)
PI-RADS 5	518	(47)
Time between mpMRI and MFGB (d), median (IQR)	28	(20–38)
Biopsy cores, MFGB and RB (*n*), median (IQR)	12	(10–12)
Biopsy cores, MFGB (*n*), median (IQR)	4	(3–5)
Biopsy cores, RB (*n*), median (IQR)	7	(4–8)
Biopsy cores positive for prostate cancer (*n*), median (IQR)		
MFGB	4	(3–5)
RB	3	(2–4)
Histology transperineal MFGB and RB, *n* (%)		
No prostate cancer	171	(16)
Prostate cancer	926	(84)
Prostate cancer GG ≥2	723	(66)
Complications, *n* (%)	8	(0.73)
UTI/urosepsis	5	(0.46)
Acute urinary retention	3	(0.27)

DRE = digital rectal examination; GG = grade group; IQR = interquartile range; MFGB = MRI-TRUS fusion guided biopsy; mpMRI = multiparametric magnetic resonance imaging; MRI = magnetic resonance imaging; PI-RADS = Prostate Imaging Reporting and Data System; PSA= prostate-specific antigen; RB = random biopsy; TRUS = transrectal ultrasound; UTI = urinary tract infections.
Percentages may not total 100 because of rounding.
[a] Percentage of available characteristic.

3.3. Prostate cancer detection rates

Prostate cancer was detected in 84% (926/1097) of men undergoing biopsy; 66% (723/1097) had GG ≥2, 19% (203/1097) had GG 1, and 16% (171/1097) had no prostate cancer on MFGB and RB (Table 1). For PI-RADS categories 3, 4, and 5, all prostate cancer detection rates were 51% (50/99), 81% (388/480), and 94% (488/518), respectively. For GG ≥2 cancer, these rates were 26% (26/99), 58% (276/480), and 81% (421/518), respectively (Table 2).

In 87% (958/1097) of men, additional perilesional biopsy and RB were performed. Contralateral prostate cancer was detected in 11% (101/958) of men, of whom 6.4% (61/958) had GG 1 and 4.2% (40/958) GG ≥2 cancer. In eight men (0.83%), contralateral biopsy was the sole location of GG ≥2. Perilesional biopsy cores resulted in histopathological upgrading of transperineal MFGB in 5.7% of men (55/958; Table 3).

Table 2 – Biopsy results per PI-RADS category[a]

PI-RADS			Biopsy histology (MFGB and random biopsy)											
Category, *n* (%)			Benign, *n* (%)		PCa, *n* (%)		GG 1, *n* (%)		GG 2, *n* (%)		GG 3, *n* (%)		GG 4, *n* (%)		GG 5, *n* (%)	
3	99	(9.0)	49	(49)	50	(51)	24	(24)	17	(17)	7	(7.0)	0	(0)	2	(2.0)
4	480	(44)	92	(19)	388	(81)	112	(23)	177	(37)	49	(10)	34	(7.1)	16	(3.3)
5	518	(47)	30	(5.8)	488	(94)	67	(13)	132	(25)	92	(18)	63	(12)	134	(26)
Total	1097	(100)	171	(16)	926	(84)	203	(19)	326	(30)	148	(13)	97	(8.8)	152	(14)

GG = grade group; MFGB = MRI-TRUS fusion guided biopsy; MRI = magnetic resonance imaging; PCa = prostate cancer; PI-RADS = Prostate Imaging Reporting and Data System; TRUS = transrectal ultrasound.
[a] Percentages may not total 100 because of rounding.

Table 3 – Additional value of perilesional and random biopsies, per PI-RADS category

PI-RADS				Perilesional biopsy		Contralateral random biopsy			
Category, *n*		Random biopsy, *n* (%)		Any histopathological upgrading by perilesional cores, *n* (%)		GG 1, *n* (%)		GG ≥2, *n* (%)	
3	99	94	(95)	6	(6.4)	7	(7.4)	0	(0)
4	480	471	(98)	29	(6.2)	29	(6.2)	20	(4.2)
5	518	393	(76)	20	(5.1)	25	(6.4)	20	(5.1)
Total	1097	958	(87)	55	(5.7)	61	(6.4)	40 [a]	(4.2)

GG = grade group; PI-RADS = Prostate Imaging Reporting and Data System.
[a] In eight men (0.83%; 8/958), contralateral biopsy was the only location of clinically significant (GG ≥2) prostate cancer.

4. Discussion

We describe the technique and results of transperineal MFGB in a consecutive series of biopsy-naïve men. In an outpatient setting using local anesthesia, this biopsy technique was shown to be feasible and to have high detection rates of clinically significant cancer. This is one of the largest series of transperineal targeted prostate biopsies to date, comprising more than 1000 biopsy-naïve men undergoing transperineal MFGB by a single biopsy operator.

Compared with other studies reporting transperineal prostate biopsy under local anesthesia, this study shows lower pain scores. The highest median VAS score in the present study was 2 versus a pooled average of 3.2, in a total of 3868 men [26]. A possible explanation for this small difference might be that we start the procedure with anesthesia in the trajectory along both neurovascular bundles, instead of a periprostatic block only; we hypothesize that this could contribute to better anesthesia of the pelvic floor muscles. Furthermore, most studies used a free-hand technique; we used a tracked stepper [26–28]. This enables the TRUS probe position to remain fixed in the distal rectum during the biopsy procedure, avoiding unnecessary and sometimes painful probe movement. Currently, there are no studies that compare the free-hand and the tracked-stepper techniques with regard to pain and prostate cancer detection rates.

Even without prophylactic antibiotics, the infectious complication rate was very low: 0.46%. These findings are consistent with those of recent studies and further support the trend from transrectal toward transperineal prostate biopsy [10,29–33]. A recent meta-analysis including 1330 men in seven randomized controlled trials showed that transperineal biopsy had a lower risk of infection than transrectal biopsy [10]. This resulted in a statement of the European Association of Urology Urological Infections Guidelines Panel to recommend transperineal over transrectal prostate biopsy [34]. It is reported that transperineal biopsy is associated with a higher risk of urinary retention [15]. However, this is correlated with the number of biopsy cores, and most reports were in an era where template mapping under general or spinal anesthesia was the standard when performing transperineal prostate biopsy [31,35,36]. Restricting the number of biopsy cores to appropriate sampling of cancer-suspicious regions with additional cores of contralateral prostate tissue could be the "best of both worlds," that is, high diagnostic accuracy and good patient tolerability while possibly reducing biopsy-related morbidity (eg, pain, acute urinary retention, or bleeding).

The detection rates of clinically significant (GG ≥2) prostate cancer are slightly higher than the rates of other contemporary transrectal cohorts that assess a prebiopsy MRI-based strategy for biopsy-naïve men at risk of prostate cancer [4–6,37]. It has been suggested that the accuracy of transperineal targeted biopsies could be higher than that of transrectal biopsies, particularly of anteriorly located lesions [10]. Furthermore, we hypothesize that deformation of the prostate by the rectal probe while tangentially directing the biopsy needles in the prostate could affect the accuracy negatively when targeting apical lesions. To limit probe movement and subsequent prostate deformation, we used only sagittal imaging during the biopsy procedure. One of the main differences between our transperineal biopsy approach and the biopsy technique using the Ginsburg protocol (under general anesthesia) as described by Hansen et al [36] is that we use the contoured urethra to allow a faster and more accurate procedural alignment of fused MR

and TRUS images. Furthermore, in case of a displacement between the fused MR-TRUS image and the live time sagittal US images, the used technique allows for a fast real-time correction of the prostate and suspicious regions during the biopsy procedure. Marra et al [27] reported the results of free-hand transperineal MFGB under local anesthesia in a cohort of 1014 men that included both biopsy-naïve men and those with prior negative biopsies. Even though baseline characteristics are comparable, the GG $\geq$2 prostate cancer detection rate was significantly higher in our study, 35% versus 66% [27]. We also report a higher prostate cancer detection rate than that reported in a recent Cochrane systematic review and meta-analysis of contemporary biopsy-naïve cohorts. Prostate cancer was detected in 71% of men with positive MRI in the study of Drost et al [37], compared with 84% in the present study. For GG $\geq$2 cancer, the difference is even larger, 44% versus 66%. This could possibly be explained by the variability in targeted biopsy techniques (ie, cognitive vs MR-TRUS fusion) and route (transrectal vs transperineal). However, no sufficiently powered studies have compared the diagnostic accuracy of different biopsy approaches. Another explanation for the difference in prostate cancer detection rates could be the high quality of MRI acquisition and reporting in our study. Lower rates of false-positive MRI assessments will result in a higher positive predictive value.

Our findings support the addition of perilesional biopsies to targeted biopsy cores. Of the men, 6% had histopathological upgrading with the additional perilesional biopsies compared with the targeted biopsy histology alone. This finding is consistent with that of other studies that showed the additional value of perilesional biopsies [38,39].

Generalizability of these results could be limited due to the single-center and single-operator nature of this study. The contouring, as well as the biopsy procedure, was performed by a single experienced operator. Prostate MRI and histopathological analysis were performed in a high-volume center with extensive experience. Optimization of each facet of the prostate cancer diagnostic pathway is crucial to fully utilize its effectiveness. Transperineal MFGB has higher initial costs than non–MRI-TRUS fusion techniques. Despite a current lack of evidence, this technique could be cost effective if the diagnostic accuracy is improved with software-based MFGB [40]. We showed that transperineal MFGB under local anesthesia is ready to be implemented in an ambulatory setting as the standard of care.

5. Conclusions

Transperineal MFGB can safely be performed as an outpatient procedure under local anesthesia in an ambulatory setting. Patient tolerability was good, and the detection rate of clinically significant cancer is high. Even without prophylactic antibiotics, the complication rate was very low.

Author contributions: Jelle Barentsz had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Study concept and design: Immerzeel, Israël, Bomers, Debruyne, Barentsz.
Acquisition of data: Immerzeel.
Analysis and interpretation of data: Immerzeel, Israël, Barentsz.
Drafting of the manuscript: Immerzeel, Israël, Bomers.
Critical revision of the manuscript for important intellectual content: All authors.
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Appendix A. Supplementary data

The Surgery in Motion video accompanying this article can be found in the online version at doi:https://doi.org/10.1016/j.eururo.2021.10.032 and via www.europeanurology.com.

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