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Stephan Zangos
Katrin Eichler
Kerstin Engelmann
Mukhtiar Ahmed
Sebastian Dettmer
Christopher Herzog
Wasilios Pegios
A. Wetter
Thomas Lehnert
Martin G. Mack
Thomas J. Vogl

MR-guided transgluteal biopsies with an open low-field system in patients with clinically suspected prostate cancer: technique and preliminary results

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S. Zangos · K. Eichler · K. Engelmann
M. Ahmed · S. Dettmer · C. Herzog
W. Pegios · A. Wetter · T. Lehnert
M. G. Mack · T. J. Vogl
Department of Diagnostic
and Interventional Radiology,
University Hospital Frankfurt,
Johann Wolfgang Goethe-University,
Theodor-Stern-Kai 7,
60590 Frankfurt/Main, Germany

S. Zangos (✉)
Institute for Diagnostic
and Interventional Radiology,
Johann Wolfgang Goethe-University,
Theodor-Stern-Kai 7,
63590 Frankfurt/Main, Germany
e-mail: zangos@em.uni-frankfurt.de
Tel.: +49-69-63014738
Fax: +49-69-63017258

Abstract The purpose of this study was to examine the feasibility and safety of MR-guided biopsies with a transgluteal approach in patients with uncertain or suspicious prostate lesions. Twenty-five patients with uncertain or suspicious focal prostate lesions detected by high-field MR imaging of the prostate gland using endorectal coil imaging were biopsied with a transgluteal approach in a low-field MRI system (0.2 T, Concerto, Siemens). The procedures were guided using T1-weighted FLASH sequences. The prostate gland was biopsied repeatedly with a coaxial technique through a 15-gauge pencil tip with a 16-gauge biopsy handy (median 3.8 samples per patient). Complications and biopsy findings were documented retrospectively. Using T1-weighted sequences biopsy procedures were performed successfully with MR guidance in all cases without any side effects or complications. The median intervention time was 11.3 min. Pathological findings revealed ten cases of hyperplasia or atrophy, three cases of prostatitis, ten cases of carcinoma and two cases of normal tissue. The clinical follow-up showed that in two patients prostate cancer was missed at MR-guided biopsy. Transgluteal MR-guided biopsy of the prostate gland is a safe and promising approach for histological clarification of uncertain or suspicious lesions.

Keywords Prostate MR · Prostatic neoplasm · Interventional procedures · MR-guided biopsy

Introduction

Prostate cancer is the most common malignancy in the Western hemisphere in men aged 50 years and older, and the incidence of prostate carcinoma has been declining since 1992 after a period of marked increase [1, 2]. Early detection programs for prostate cancer with prostate-specific antigen (PSA) level testing and an annual digital rectal examination (DRE) should be performed in men aged 50 years or older. The serum concentration of PSA is considered to be an important indicator in the early detection of prostate cancer [2]. In patients with a PSA level higher than 4 ng/ml, a transrectal ultrasonography (US) has often been performed [3] for the detection of possible tumors. Likewise, magnetic resonance imaging (MRI) is an accepted and promising diagnostic option for prostate examinations. Recent studies showed that MR imaging with the use of an endorectal coil improved results in the detection of tumor foci in patients who had elevated PSA levels [4, 5] and described cancer detection rates between 37 and 87% for T2-weighted endorectal MR imaging [5–10]. Particularly, the detection of lesions smaller than 5 mm in diameter is poor [11]. Likewise, less differentiated prostate cancer showed only a

poor T2-contrast [12]. With better detection of prostate tumors, an increasing number of patients need a precise histological tumor clarification before the planning of further treatment. The gold standard of histological confirmation of prostate cancer in patients with elevated PSA levels is at the moment systematic sextant biopsy of the prostate, involving the apex, middle and base of both sides of the prostate gland [13]. However, a large number of patients with elevated PSA levels have negative biopsy results with US guidance, so that repeated biopsies are necessary for a sufficient diagnosis of prostate cancer [14]. For these reasons alternative image-guiding modalities like CT and MRI have been evaluated for specific indications [15–17].

MRI examinations of the prostate gland for the detection of prostate cancer are a promising imaging modality and this technique may also be useful for the guidance of prostate biopsies. The purpose of this study was to examine the feasibility and safety of a transgluteal approach for MR-guided biopsies in patients with uncertain or suspicious prostate lesions in endorectal high-field MRI.

Materials and methods

Patients

In an 18-month period 25 patients ranging in age from 48 to 74 years (median 61.9 years) were examined with endorectal body-phase array coil followed by MRI-guided biopsies of the prostate gland if MRI showed uncertain or suspicious prostate lesions for histological clarification. The median PSA level was 11.8 ng/ml in all patients ranging from 4.8 to 28.0 ng/ml.

Fifteen of these patients had been referred to us by their urologists; ten came without referral by a urologist because they had heard something about our new biopsy technique. In 17 patients prior transrectal US-guided quadrant or sextant biopsy results were negative. The other patients refused prior US-guided biopsies. Informed consent was obtained from all patients. The patients included in the study had a PSA level higher than 4 ng/ml and/or uncertain or suspicious MR imaging results. Patient exclusion criteria were contraindications to MR imaging and to biopsies.

High-field MR imaging technique

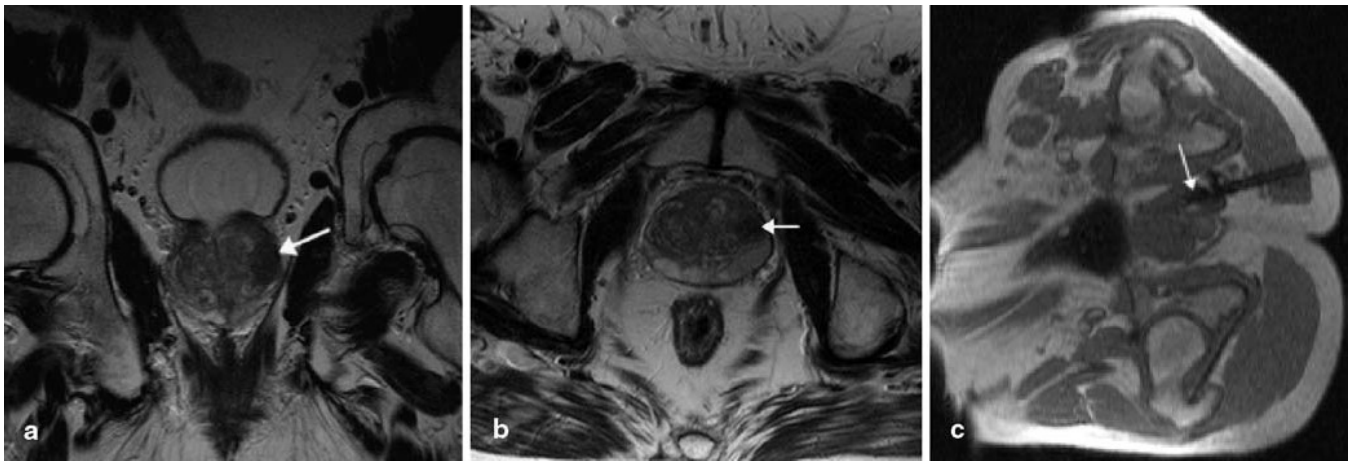
Before the biopsies, we performed endorectal MR imaging using a 1.5-T unit (Magnetom Symphony; Siemens, Erlangen, Germany) and an endorectal surface coil (Medrad; Indianola, USA) coupled to an anterior body-phase array coil. The examination was performed with a routine imaging protocol. After the coil position had been checked using a gradient-echo localizer sequence, fast T2-weighted turbo spin-echo sequences were acquired (TR/TE=3,500/100; 4-mm section thickness, 0.8-mm intersec-tion gap, 512×256 matrix) at angulated transverse-section and coronal-section orientations by using 16×16-cm field of view. Supplementary angulated transverse T1-weighted spin-echo images (TR/TE=500/10; 4-mm section thickness, 0.8-mm intersection gap, 512×256 matrix; 16×16-cm field of view) were acquired. During the examination no medications for suppression of peristaltic artifacts were applied. One patient refused the introduction of the endorectal coil (Fig. 1).

The MR imaging findings of the high-field system were analyzed by two readers (S.Z.; T.V.). Diffuse and inhomogeneous hypointense areas of the peripheral zone in T2-weighted images were classified as uncertain findings. The presence of cancer or suspicious areas, identified as areas of low signal intensity within the peripheral zone in T2-weighted images, was estimated on a four-point rating scale: 1, normal tissue; 2, probably normal tissue; 3, possible cancer; 4, definite cancer. In patients with findings rated three or four we performed MRI-guided biopsies for histological differentiation of these lesions.

MRI-guided biopsies

Two to 16 days (median 6 days) after high-field MR imaging of the prostate gland with suspicious MRI results, MRI-guided biopsies were performed in 25 patients by one radiologist and one technical assistant with the MR imaging findings taken into account. The biopsies were performed after elimination of all contraindications, detailed information of the patient and a written

Fig. 1 Coronal (**a**) and transversal (**b**) view of T2-weighted FSE (TR/TE=3,500/100) images with a 1.5-T system obtained from a 69-year-old patient with a PSA level of 18 ng/dl and negative US-guided biopsy result. The images show a small hypointense tumor in the left peripheral zone (*arrow*). **c** Transversal T1-weighted FLASH sequence (TR/TE=100/9) in a 0.2-T system during the biopsy (**c**): the needle tip (*arrow*) was placed in the left peripheral zone. Pathological result of the sample was prostatic adenocarcinoma



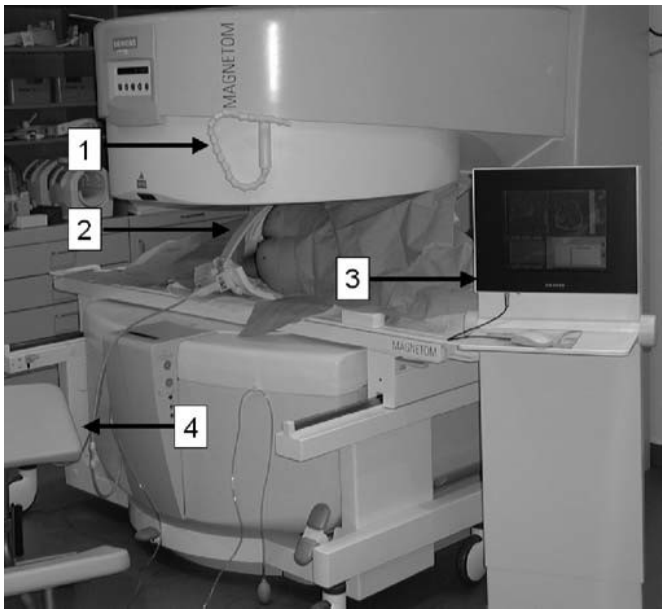


Fig. 2 Typical positioning of the patient in lateral decubitus during the biopsy of the prostate gland for an optimal biopsy approach. MR compatible in-room components of the interventional MRI (Magnetom Concerto: 0.2 T): a lamp (*1*) for optimal lighting of the insertion, a flexible surface coil (*2*), an in-room console with mouse (*3*) and a seat (*4*) for an easy performance of the biopsy

consent. All patients had to stop eating 6 h before the biopsy. Fluids and necessary medications could be consumed until 2 h before the intervention.

For the guidance of the biopsies an open 0.2-T MR imaging device (Magnetom Concerto, Siemens; Erlangen, Germany) with a vertical field-axis was used because it provides the performing physician with a wide lateral access to the patient. The receiver was a flexible, standard, multi-purpose coil (Siemens; Erlangen, Germany) with a diameter of 45 cm, and the coil was positioned at the patients' greater trochanter. Constant monitoring and evaluation of the path of the biopsy instruments as well as the imaging management was done with a standard in-room workstation (Siemens; Erlangen, Germany). The setup for the biopsy is demonstrated in Fig. 2. The previously sampled MR images were recruited for the planning of the biopsy path and the positioning of the patients. The patients' position was chosen to allow a real-time MRI-guided biopsy and to facilitate access by the physician. We used a transgluteal approach for the biopsy of the prostate gland (Fig. 3). After choosing the path for the procedure the point of insertion was marked by taping a marker to the expected point of insertion or by using real-time imaging together with a finger as an external marker.

For the localization and the planning of the biopsy path, a FLASH (fast low angle shot) 2-D-GRE sequence (TR/TE=100/9; flip angle 70°, 8-mm section thickness, 96×256 matrix, acquisition time 18 s) and a modified FLASH 2-D-GRE sequence (TR/TE= 100/7; flip angle 70°, 8-mm section thickness, 96×256 matrix; acquisition time 16 s) were used. We did not take T2-weighted images because the needle cannot be visualized as well as in T1-weight images during the biopsy.

Monitoring during the procedure was performed using the FLASH 2-D-GRE sequence (TR/TE=100/9; flip angle 70°, 8-mm section thickness, 96×256 matrix, acquisition time 18 s). After the biopsy FLASH 2-D-GRE sequences (TR/TE=100/9; flip angle 70°, 8-mm section thickness, 96×256 matrix, acquisition time 18 s) were used to rule out further complications.

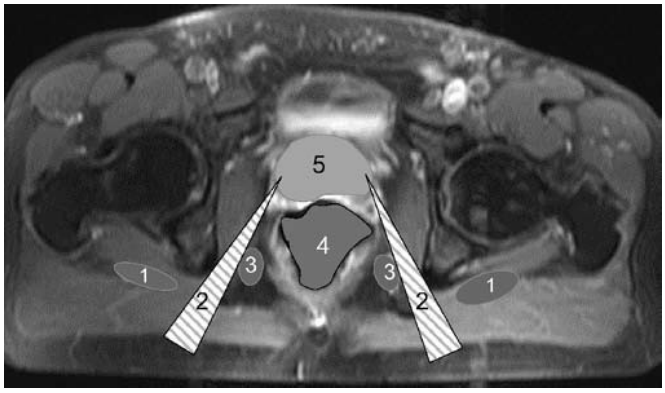


Fig. 3 Exposure of the vital structures of the male pelvis, which might be marked during the biopsy of the prostate gland (*5*) with a transgluteal access (*2*): rectum (*4*), internal pudendal artery and vein/pudic nerve (*3*), gluteal artery and vein/ischiadic nerve (*1*)

After disinfection of the skin and local infiltration anesthesia [10–20 ml local anesthetic (Scandicain; AstraZeneca; Wedel, Germany)], a 15-gauge biopsy needle (Pencil Tip, Somatex, Berlin, Germany) was guided to the target lesion so that a true-cut MRI-compatible biopsy handy (Somatex; Berlin, Germany) of 16 gauge in size could be inserted into the suspicious areas. Multiple tissue samples of one lesion were withdrawn with this coaxial technique to ensure that enough histological material could be acquired for histological clarification. A total of 98 tissue samples were taken (median 3.8 per patient) from uncertain or suspicious lesions, and the trephine biopsy samples were fixed in 10% formaldehyde. The procedure time was recorded. The biopsies were performed in all patients as an outpatient treatment with observation for 2 h after the procedure. Side effects after the biopsies were evaluated by an interview of the patients in the following weeks.

Insufficient samples or diagnosed necroses in trephine biopsies were determined as false negative. The current or final diagnosis of patients with benign results was made by a clinical follow-up between 6 and 13 months (median time 9.7 months). The diagnostic accuracy was achieved by comparing the changes in the PSA level and the histopathological diagnosis. The indication for surgical treatment was made by the urologist and the patient based on our results and the patients' request. The diagnostic accuracy for the histology of the biopsy samples was reported as true positive, true negative, false positive or false negative, confirmed with surgery or clinical follow-up.

Results

The average size of the prostate gland was 38.8 cm^3 (range 27.1–83.2 cm^3). High-field MRI documented signal abnormalities in 14 patients in the left peripheral zone of the prostate gland and in 11 patients in the right peripheral zone. Mean size of the suspicious prostate lesion was 11 mm ranging from 8 to 15 mm.

The biopsies were performed technically successfully in all patients. The biopsies were performed in all patients using the FLASH sequences, and additionally in five patients using the modified FLASH sequences. The

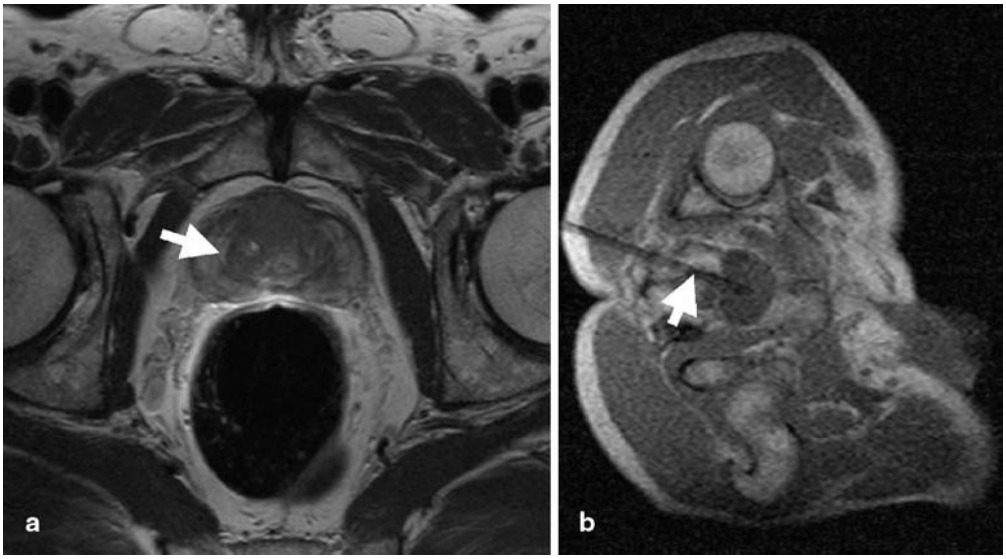


Fig. 4 **a** Transversal T2-weighted TSE image obtained with a 1.5-T system using an endorectal coil (TR/TE= 3,500/100) from a 64-year-old patient who showed a suspicious lesion in the central zone of the prostate gland (*arrow*), which was classified as a possible cancer. **b** T1-weighted FLASH (TR/TE=100/9) during biopsy of the central zone in the 0.2-T open field system. The images showed that a safe insertion of the biopsy needle (*arrow*) into central prostatic structures is possible. Histological tissue demonstrated a prostatic adenocarcinoma

mean number of image acquisitions used during the procedure was 13.7, ranging from 7 to 22.

In all cases the location of the area with the suspicious lesion leads to a safe approach by using MR guidance. The median needle artifact measured was 3.2 mm (range 1.9–5.6 mm). The position of the needle tip could be well visualized in all patients. The visualization of the soft tissue, the vessels and the biopsy needle was good or moderate in all patients, resulting in a safe guidance of the biopsy (Fig. 4).

The median operation time from entering to leaving the operating room was 19.4 min (maximum 35.3 min and minimum 13.5 min). The median puncture time from the insertion of the needle through the skin to needle retraction was 11.3 min (maximum 16.8 min and minimum 5.3 min). The median distance of the access path was 12.1 cm (ranging from 10.5 to 13.2 cm).

At the time of the biopsies all patients tolerated the treatment with minimal or no discomfort after local anesthesia. Only two patients (8% of all patients) showed hematuria after the biopsies. No rectal bleeding or other minor complications were observed during the procedure or the following days. Likewise, no major complications, defined as those requiring hospital admissions, were observed in any patients.

The trephine biopsy yielded a malignant diagnosis in ten patients, an infectious reaction in three patients, regressive tissue in one patient, a hyperplasia of the prostate gland in nine patients and non-pathological findings in two patients. Six-month clinical follow-up in two patients showed that the lesions were wrongly classified as negative. These must be seen as failed biopsies. The biopsy and the follow-up results are shown in Table 1.

None of the patients complained of fever at the time after the biopsy, although they did not receive any antibiotic prophylaxis. No complications were ascertained in a patient with an indwelling catheter, either.

Discussion

Early cancer detection programs seem to be the key to achieving an early detection of prostate cancer and may lead to an increase in the number of patients with curable diseases who can undergo curative radical prostatectomy or curative radiation therapy [18]. Thus, the mortality of this disease can be decreased. Tumor volume, TNM stage, Gleason score and PSA level are relevant prognostic factors of prostate carcinoma.

In patients with elevated PSA levels, transrectal ultrasonography (US) is routinely performed. Likewise, since 1989 endorectal MR imaging was been used increasingly to prove and to predict the extension of prostate cancer [2, 19–21]. In this regard MR imaging provides a high tissue contrast of the detailed structure of prostate gland and periprostatic tissue without the use of a contrast medium. However, non-cancerous tissue, such as prostatitis, dysplasia and prostatic hyperplasia, can show low-intensity areas similar to prostate cancer [5, 19, 22–24]. T2-weighted echo-planar imaging (EPI) has potential usefulness in the detection of impalpable PSA detected prostate cancer [25]. New developments in MR techniques such as the gadolinium-enhanced dynamic subtraction technique [26, 27] and spectroscopic imaging [8, 28, 29] may improve the results for prostate cancer detection in the future. However, because of largely overlapping enhancement pattern, cancer will probably not be depicted within adenoma by dynamic imaging, at least by using low temporal resolution [26].

For the assessment of indistinct prostate lesions, histological clarifications have mostly been performed. At

Table 1 Histological results after MR-guided biopsy and follow-up [prostatic specific antigen (PSA), Gleason score (GS)]

Patient	Age	Histology	GS	PSA	Follow-up
1	61.4	Fibromatous hyperplasia	–	9.4	PSA/clinic
2	58.6	Carcinoma with perineural infiltration, GS 6	6 (3+3)	11.2	PSA/clinic/surgery
3	55.2	Hyperplasia	–	8.6	PSA/clinic
4	63.4	Hyperplasia, lymphocytic infiltration	–	4.8	PSA/clinic
5	61.3	Chronic prostatitis	–	12.8	PSA/clinic/antibiosis
6	55.6	Adenomatous hyperplasia	–	13.5	PSA/clinic
7	62.8	No malignancy	–	6.4	PSA/clinic
8	69.0	Well-differentiated adenocarcinoma	6 (3+3)	9.7	Surgery
9	57.7	Hyperplasia	–	13.4	PSA/clinic
10	65.3	Regressive prostate tissue	–	10.9	PSA/clinic/surgery
11	60.9	Adenomatous hyperplasia	–	16.1	PSA/clinic/surgery
12	59.1	Fibromyomatous hyperplasia	–	10.1	PSA/clinic
13	74.1	Hyperplasia	–	17.2	PSA/clinic
14	65.7	Chronic prostatitis	–	10.9	PSA/clinic/antibiosis
15	59.4	No malignancy	–	7.4	PSA/clinic
16	48.7	Hyperplasia	–	5.2	PSA/clinic
17	68.6	Acinar adenocarcinoma	1–2	11.8	PSA/clinic
18	63.6	Adenocarcinoma	7 (3+4)	28.0	PSA/clinic/surgery
19	65.0	Azonal clear cell carcinoma	6 (3+3)	16.1	PSA/clinic/surgery
20	68.4	Acinar adenocarcinoma	7 (3+4)	15.2	PSA/clinic
21	66.0	Adenocarcinoma	6 (3+3)	14.9	PSA/clinic/surgery
22	69.2	PIN 1	–	8.4	PSA/clinic
23	68.5	Chronic prostatitis	–	16.3	PSA/clinic
24	66.0	Adenocarcinoma	6 (3+3)	21.6	PSA/clinic/surgery
25	64.6	Adenocarcinoma	7 (4+3)	12.7	PSA/clinic

the moment, transrectal ultrasound-guided systematic sextant biopsies as described by Hodge [30] have become a gold standard, and they are commonly performed on an outpatient basis. Nevertheless, it remains unclear how many biopsy cores are mandatory for optimizing tumor detection. So far, biopsies of 12 sites of the prostate have been described to increase the detection rate of prostate cancer and commonly have been applied [19, 31, 32].

Frequently, a negative result after transrectal ultrasonography is achieved in patients with a highly suspicion index of prostate cancer. The detection of prostate cancer through a second US-guided biopsy is a rather common finding and was encountered in previous studies in 12–30% of patients with the results of the first biopsy being negative [14]. In contrast, cancer detection in the third and fourth biopsy is rare. Third and fourth biopsies should only be obtained in an exclusive group of patients with high suspicion of cancer [14].

The cancer detection with targeted biopsy of the prostate performed on the basis of high-frequency Doppler ultrasonography (US) showed no benefit for the biopsy results, and a substantial number of cancers detected with sextant biopsy findings will miss [33]. Possibly patient position caused flow asymmetry in patients who underwent biopsy resulting in these poor results [34].

Transrectal ultrasound-guided prostate needle biopsies are generally safe, although the incidence of complications after transrectal ultrasound-guided needle biopsies has been reported by different authors [14, 18, 31]. Fever or general signs of infections could be observed in 1.2% up to 53.3% and sepsis in up to 5.4% of the biopsied patients [18]. At least two deaths from anaerobic septicemia have been reported [35, 36]. Several studies have shown a decreased rate of infectious complications after application of antibiotic prophylaxis [18]. The literature indicates that hemorrhage with gross hematuria is the most common complication after transrectal ultrasound-guided biopsies. At least 50% of all patients have persistent hematuria 3–7 days after the biopsies [18].

The depiction of suspicious prostate areas with high-field MRI offers the possibility to use this imaging method also for the guidance of the needle to the prostate gland during biopsies in order to achieve better biopsy results. Localizing and targeting tumor foci with MR imaging before the prostate biopsy may increase the cancer detection rate [9, 37]. Vilanova et al. published that endorectal MR imaging may be helpful in patients with discrepancy of clinical status and biopsy or with PSA range of 10–20 ng/ml. Systematic biopsies should not be performed in patients with negative results after endorectal MR imaging [38]. Perotti et al. showed a high rate of tumor detection with transrectal US-guided biopsies of suspected tumor foci after the use of endorectal MR imaging findings [4]. Nevertheless, MR imaging-guided biopsy may improve accuracy because it can be performed directly, without matching MR imaging and transrectal US findings.

However, a problem in the initial years of MR imaging was the great amount of time that was necessary

to take MR images, so that MR-guided interventions seemed unlikely. The speed of MR imaging has been drastically increased so that in 1988 the first interventions with an MRI device could be performed [39–41]. The increased interest in open systems is mostly due to the higher comfort level of the patients and the lower system and service costs. Even though open MRI devices were first described in 1987 [42, 43], it was not until 1995 that open MRI devices were established for routine clinical diagnostics and interventions with a wide spectrum of applications.

Papanicolaou et al. [15] reported about the safe use of a transgluteal approach for prostatic biopsies after proctocolectomy with CT guidance. In these patients, no complications were observed, and all patients tolerated the procedure well [15]. The transgluteal approach makes it possible to minimize the risk of injury to the bladder, bowel loops and external iliac vessels. The lateral access at the MRI improved the patient comfort, because a prone position as with CT-guidance is not necessary [44]. Other groups described their first experiences with a transperineal access for MR-guided biopsy of the prostate gland [16, 17]. This transperineal access was used by different groups for the MR-guided insertion of the therapy needles for cancer treatment [45, 46].

Also, the first robotic systems were used for a transperineal needle placement into the prostate and showed a positive potential in a variety of other percutaneous clinical applications [47]. However, these systems were not regularly applied in human bodies and could therefore not be used in a magnetic field. Hata et al. [17] preferred the direct way through the perineum for the biopsy of the prostate gland and expected an increasing sample volume in the peripheral zone. We believe that the use of the transgluteal approach provides comparable results for the biopsy of the peripheral zone and superior results for the biopsy of the apex. The puncture of lesions in the periphery of the prostate gland is probably easier to perform. However, no comparison of the access routes was implemented.

For a successful biopsy, two parameters are of importance. First, tracing the instrument path and position for secure positioning into the lesion. Second, the monitoring process for control and presentation of the performed biopsy. It is possible to monitor functional information such as blood flow, temperature dispersion, organ perfusion and diffusion, which makes MRI superior to other monitoring devices. While using other imaging devices, compromises between the two points of interest listed above have to be made.

The cancer detection rate with transrectal US-guided biopsies was described to be from 10 to 50% in different studies [18, 48]. Although our sample size is small, it seems that the obtained results of MRI-guided biopsies are comparable or superior to US-guided biopsies in patients with previously negative US-guided biopsies. The falsely negative results might be caused by a multifocal appearance of the prostate cancer and the small volume of sampled biopsy specimens, which represents only a small part of the area assessed with MR imaging. The repeated collection of biopsy trephine with the coaxial access might improve the clinical results. Withdrawal of a specimen from different suspicious lesions of the prostate might improve the diagnostic accuracy.

In our study, we showed that percutaneous MRI-guided biopsies of the peripheral zone of the prostate gland with a transgluteal approach are feasible, safe and accurate. The long transgluteal needle passage is stabilized by the gluteal muscles so that accurate positioning of the needle is possible [44]. All patients were treated on an outpatient basis with no significant complications after the biopsy.

The transgluteal access used by us facilitated the biopsy of the peripheral zone of the prostate gland without the introduction of intestinal germs, as there was no contact with the intestine. Our first data show that a prophylactic antibiotic coverage seems unnecessary for the transgluteal biopsy approach of the peripheral zone of the prostate gland without increasing the number of prostate infections. Nevertheless, it is still possible that the bowel could be nicked or traversed using this access path to take histological samples from the medial parts of the prostate gland [44]. In those cases, and in patients with possible contact of the biopsy needle to the bowel during the intervention, antibiotics should be given to decrease the risk of septic shock [18]. Therefore, transgluteal MR-guided biopsies of the prostate are generally considered to cause no or minimal discomfort, and it has become common practice to perform them without general anesthesia.

A disadvantage of our study was the difference in the imaging technique for diagnostics and intervention. For the diagnostics of the prostate lesions we used a high-field MRI and the images were obtained in a supine position with the use of an endorectal coil. For the diagnosis high resolution T2-weighted images were used.

In contrast, the images used for biopsy-guidance were T1 weighted, obtained in a lateral decubitus position, with less resolution and without an endorectal coil. Neither the zonal anatomy of the prostate nor the suspicious lesions can be well differentiated in T1-weighted sequences. For these reasons the biopsied lesions cannot be directly visualized, so that the target lesions had to be extrapolated based on probable movement and deformation of the prostate relative to other structures in the pelvis.

At the moment the quality of the T2-weighted sequences is not satisfactorily for the guidance of the biopsy. A further problem with T2-weighted images is that the needle cannot be visualized as well as in T1-weighted images. However, better visualization of the zonal anatomy might be achieved with modified fast T2-

Table 2 Total results after MR-guided biopsies of the prostate gland

Patients	Positive biopsy	Negative biopsy	TM in follow-up after negative biopsy
25	10	13	2

weighted sequences for low-field MRI resulting in better biopsy results. In contrast to this the additional use of an endorectal coil at the low-field system provides better results in the detection of the target lesion resulting in a higher biopsy sensitivity for the detection of prostate cancer.

Possibly in the future the transgluteal access can be also used for the guidance of prostate biopsies in a high-field system. The shape of the new MRI systems might be a further step to the performance of biopsies in a high-field system. However, first the instrument producers have to transform their technical applications for a wide range of uses.

Despite these first positive results, further randomized studies have to follow to evaluate the clinical value of MR-guided biopsies of the prostate gland in comparison to US-guided biopsies to detect prostate cancer in patients with suspicious lesions.

It is not the intention of the MRI-guided biopsies to replace the more simple, effective, prevalent and economical transrectal US-guided biopsies. This biopsy technique is rather intended to provide an alternative to the prevalent US-guided biopsy in patients with high suspicion of prostate cancer, with persistent elevation of PSA level and indistinct results from endorectal coil MR imaging after prior negative routine systematic US-guided biopsies, which should be performed in specialized clinics. Since the costs of MR-guided biopsies are higher, the indication for this technique must be critically verified. However, a cost reduction of this expensive technique can be achieved by avoiding repeated unsuccessful TRUS.

In the future, it might be possible to reduce costs in patients with negative US biopsy findings with this expensive technique when repeated US-guided biopsies are expected over a long time (Table 2).

Conclusion

Transgluteal access to uncertain or suspicious prostate lesions by MR-guidance is a safe access with a low complication rate and could be used as an alternative method to transrectal US-guided biopsies.

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