Original Article

A Retrospective Study Comparing Transrectal Ultrasound-Guided Biopsy and Magnetic Resonance Imaging-Transrectal Ultrasound Fusion Biopsy for the Detection of Prostate Cancer

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Objective: To compare the prostate biopsy results in patients that underwent a second transrectal ultrasound (TRUS) biopsy with those obtained from the magnetic resonance imaging (MRI) fusion TRUS biopsy.

Materials and Methods: A retrospective review was conducted of the patients with a negative TRUS biopsy who had undergone either a second TRUS biopsy or an MRI fusion TRUS biopsy. Data were collected between January 2015 and July 2017 and included age, biopsy results, pre- operative PSA, prostate imaging reporting and data system (PI-RADS), and prostate volume.

Results: Out of the patients that underwent a second prostate biopsy, 39 were performed as MRI fusion TRUS biopsies, and 72 were performed as TRUS biopsies. The MRI fusion TRUS biopsy group had a higher percentage of positive biopsy results (41.0% versus 8.3%, p<0.005). When patients were divided into positive and negative biopsy groups, there was no statistical difference in the serum PSA [10.73 (7.62, 13.58) versus 9.09 (6.42, 11.91), p=0.191], or the prostate volume [33.0 (19.63, 45.58) versus 46.5 (28.49, 49.62), p=0.063]. In the MRI fusion TRUS biopsy group, the biopsies of those patients with PI-RADS score of 3 were all negative (0%), while 45% (10/22) of those with a PI-RADS score of 4 were positive, and 75% (6/8) of those with a PI-RADS score of 5 were positive.

Conclusion: Patients with previous negative TRUS biopsies, the MRI fusion TRUS biopsy better detected prostate cancer compared to a second TRUS biopsy alone.

Keywords: MRI fusion TRUS biopsy, Prostate cancer, TRUS prostate biopsy

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Prostate cancer is responsible for five percent of all carcinomas found in Thai males[1]. The widely used prostate-specific antigen (PSA) test identifies a number of patients with abnormal serum PSA levels. According to Bjurlin et al[2], the transrectal ultrasound-guided (TRUS) biopsy has been the standard follow up procedure used to detect prostate cancer in patients with abnormal PSA levels.

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Although the double sextant TRUS biopsy had been considered the gold standard for prostate cancer diagnosis, the efficacy of this procedure has been called into question. Djavan et al[3] reported troubling results on a cohort study of patients who had undergone a first TRUS biopsy and only 20% to 30% of these prostate biopsies were positive for carcinoma.

Patients with a serum PSA level of more than 4 ng/dl and a negative TRUS biopsy result are typically given the option of a follow up PSA test. If a patient's PSA continues to rise, most then undergo a second TRUS biopsy. Unfortunately, Djavan et al[3] had shown that a second TRUS biopsy in the same patient was positive only in about 10% of the patients. It is suspected that this procedure is missing some prostate

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Table 1. Demographic data and prostate biopsy pathology results

	Double sextant TRUS+bx (n=72)	MRI fusion TRUS+bx (n=39)	p-value
Biopsy positive for cancer, n (%)	6 (8.31)	16 (41.02)	<0.001*
Min Gleason	6	6	-
Max Gleason	9	8	-
PSA, Mean±SD	9.51±1.58	9.50±1.43	0.953
Volume, Mean±SD	46.2±1.68	46.5±1.72	0.819
Age, Mean±SD	68.4±0.98	68.2±1.14	0.832

Double sextant TRUS+bx=the second double sextant transrectal ultrasound-guided biopsy group; MRI fusion TRUS+bx=the magnetic resonance imaging fusion TRUS biopsy group; PSA=prostate-specific antigen; SD=standard deviation

* Statistical significance (p<0.05)

cancers.

Given the widespread use of magnetic resonance imaging (MRI) in current clinical practice, it has become increasingly common to use an MRI scan to guide a TRUS biopsy toward potential areas of carcinoma. This method is called MRI fusion TRUS biopsy. Tyson et al have reported positive results in 60% to 80% of biopsies performed using this method[4].

The present retrospective study compared the efficiency of a traditional double sextant TRUS biopsy with an MRI fusion TRUS biopsy in patients suspected of prostate carcinoma and a previous negative TRUS biopsy.

Materials and Methods

Population and parameter

Medical records dated between January 2015 and July 2017 were retrospectively reviewed and analyzed. Patients with a negative double sextant TRUS biopsy who had undergone either a second double sextant TRUS biopsy or an MRI fusion TRUS biopsy were included in the present study. The patient's age, preoperative PSA, prostate volume, prostate imaging reporting and data system (PI-RADS), and biopsy pathology results were collected and analyzed.

The principles of the Helsinki Declaration were followed during the present study, and the confidentiality of the patients' data was guaranteed. The Committee for Research of the Faculty of Medicine, Ramathibodi Hospital, Mahidol University approved the present study (date of approval: May 5, 2017, ID 05-60-07).

Statistical analysis

A descriptive study was performed. The data were analyzed using the Kruskal-Wallis test, the chi-squared test, and the unpaired t-test to identify the statistical significance of the differences in means ± standard deviation, median (IQR), and proportions, respectively. Analysis was accomplished using Stata version 14, with a p-value less than 0.05 was considered statistically significant.

Results

The present study retrospectively analyzed the data from 111 patients who had undergone a second prostate biopsy after receiving negative results from an initial double sextant systematic TRUS biopsy. The patients were divided into two groups, the MRI fusion TRUS biopsy group of 39 patients and the second double sextant TRUS biopsy group of 72 patients.

The demographic data and prostate biopsy pathology results are shown in Table 1. Between the second double sextant TRUS biopsy group and the MRI fusion TRUS biopsy group, there were no statistically significant difference in the mean serum PSA (9.51±1.58 versus 9.50±1.43, p=0.953), the mean prostate volume (46.2±1.68 versus 46.5±1.72, p=0.819), or the mean age (68.4±0.98 versus 68.2±1.14, p=0.832). Within the second double sextant TRUS biopsy group, there were positive biopsy results in 6 of the 72 cases (8.31%). Within the MRI fusion TRUS biopsy group, there were positive biopsy results in 16 of the 39 cases (41%). This corresponded to a statistically significant difference between the two groups in the number of positive biopsy results for prostate carcinoma (8.31% versus 41.0%, p<0.001). The minimum and maximum Gleason scores in the second double sextant TRUS biopsy group were 6 and 9, while in the MRI fusion TRUS biopsy group, the minimum and maximum Gleason scores were 6 and 8. No patient with a Gleason score of 10 was identified in the present study.

Table 2. A comparison of PSA and prostate volume

	Positive biopsy	Negative biopsy	p-value
PSA, Median (min, max)	10.73 (7.62, 13.58)	9.09 (6.42, 11.91)	0.191
Prostate volume, Median (min, max)	33.0 (19.63, 45.58)	33.0 (19.63, 45.58)	0.063

PSA=prostate-specific antigen

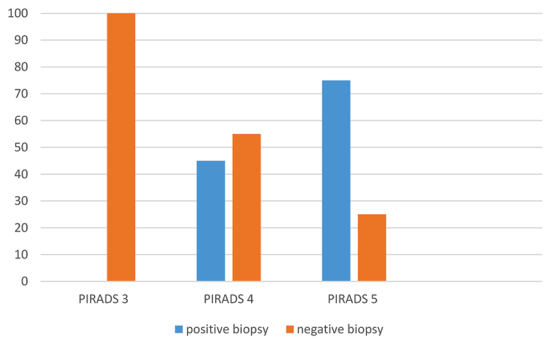

Figure 1. Percentage of positive biopsy results for patients in the MRI fusion TRUS biopsy group, separated by PI-RADS score.

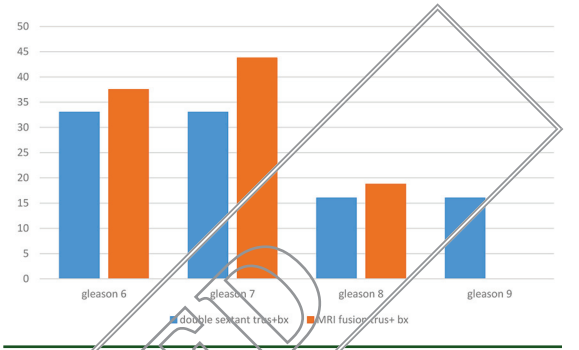

Figure 2. Percentage of positive biopsy results in the double sextant TRUS biopsy group (double sextant TRUS+bx) and the MRI fusion TRUS biopsy group (MRI fusion TRUS+bx) separated by Gleason score.

The data from both groups were then pooled together and divided into positive and negative biopsy results. Between these two groups of patients, there was no statistically significant difference in the median PSA [10.73 (7.62, 13.58) versus 9.09 (6.42, 11.91), p=0.191] or the median prostate volume [33.0 (19.63, 45.58) versus 46.5 (28.49, 49.62), p=0.063] (Table 2).

In the MRI fusion TRUS biopsy group, the prostate MRI scan was interpreted using the PI-RADS. Patients included in the present study had PI-RADS scores of 3, 4, and 5. The patients with a PI-RADS score of 3 all had negative prostate biopsy results. In patients with a PI-RADS score of 4, there were positive biopsy results in 10 of the 22 cases (45%). In patients with a PI-RADS score of 5, there were positive biopsy results in 6 of the 8 cases (75%) (Figure 1). The authors' results indicated that the higher a patient's PI-RADS score, the greater the chance of a positive biopsy result.

In both groups, patients with a Gleason score of 7 were the most prevalent, followed by those with a Gleason score of 6 (Figure 2). There was no patient with a Gleason score 9 in the MRI fusion TRUS biopsy group.

Discussion

Prostate cancer is currently diagnosed by prostate tissue biopsy and pathological analysis. For years, the TRUS biopsy has been the gold-standard method for obtaining this tissue sample, providing positive biopsy results in about 20% to 30% of patients with a PSA score greater than 4[3]. However, for patients with a PSA score greater than 4 who receive a negative TRUS biopsy result, prostate cancer cannot be definitively ruled out. In these cases, a prostate MRI scan is often used to evaluate the prostate. The image is analyzed and scored using PI-RADS. Patients with PI-RADS scores of 3 to 5 are suspected of having prostate cancer. As reported by Tyson et al[4], these techniques have been combined in a new technology called the MRI fusion TRUS biopsy. It is important to evaluate whether this new method should replace the previous standard.

In the present study, the demographic data of both patient groups included minimum and maximum Gleason scores, mean PSA, and mean prostate volume. There was no statistically significant difference between the groups on any of these parameters. However, there were positive biopsy results in 41% of the patients in the MRI fusion TRUS biopsy group compared with 8.31% in the double sextant TRUS biopsy group. The small percentage of positive biopsies from the second TRUS biopsy in the present study was similar to the 10% previously reported in the Djavan et al study[3].

The present data indicate that the MRI fusion

TRUS biopsy procedure is more efficient at detecting prostate cancer than the TRUS biopsy alone.

Both the MRI fusion TRUS biopsy and the second TRUS biopsy were performed with real-time guidance. The significant number of positive biopsy results in the MRI fusion TRUS biopsy group are due to the method of targeting. MRI imaging can identify specific areas of the prostate with a high probability of carcinoma. When those suspected areas are targeted for biopsy, a higher percentage of positive biopsy results are achieved.

All aspects of the data should be analyzed. While 41% of the biopsy results in the MRI fusion TRUS biopsy group were positive, about 60% were negative.

Wu et al[5] reported a negative biopsy rate in the MRI fusion TRUS biopsy group at about 73%. There are many potential explanations for this high percentage of negative biopsy results. Cash et al[6] identified several factors that can negatively impact a targeted biopsy, including prostate motion, patient motion, a mismatched image, or even the wrong biopsy. Nevertheless, in the comparable second TRUS biopsy group for the Wu et al study, the percentage of negative biopsies was about 90%[5].

Arsov et al[7] reported that the MRI fusion TRUS biopsy in addition to a 12-core systematic biopsy resulted in a significant number of positive biopsy results compared to the MRI-guided in-bore prostate biopsy (5.6±0.8). Borkowetz et al[8] concluded that the MRI fusion TRUS biopsy plus a systematic TRUS biopsy was the best way to make a final tumor assessment. The present study analyzed the combination of a targeted biopsy with a random biopsy. The authors suspect that if 12-core biopsies had been performed in addition to the MRI fusion TRUS biopsies, more positive biopsies may have been identified.

When the patients in the MRI fusion TRUS biopsy group were separated by their PI-RADS scores, a trend was identified of positive biopsies being associated with higher PI-RADS scores, similar to the results of the Maxeiner et al study[9]. In the present study, there were no positive biopsy results on patients with a PI-RADS score of 3 (this is an intermediate PI-RADS score, indicating that the presence of clinically significant cancer is equivocal). Borkowetz et al[8] also demonstrated a positive relationship between PI-RADS scores and Gleason scores. In patients with a PI-RADS score of 3, about 30% had negative biopsy results. In those with a PI-RADS score of 4, about 10% had negative biopsy results. All of the patients with a PI-RADS score of 5 had positive biopsy results. It is possible to obtain negative biopsy results even after PI-RADS scores of 3 to 5.

The present study was limited by the small sample size, making it difficult to analyze the subgroups, particularly with respect to the Gleason score data. In addition, because the present study was a retrospective study, the data in some cases were incomplete, particularly in the number of target biopsy cores and the number of random biopsy cores obtained for each patient.

Conclusion

The MRI fusion TRUS biopsies are associated with more positive biopsy results than the double sextant systematic prostate biopsies. The higher a patient's PI-RADS score, the greater chance of a positive biopsy result. For patients with a high PSA and a negative TRUS biopsy, the MRI fusion TRUS biopsy should be considered to improve the chances of identifying potential prostate cancer.

What is already known on this topic?

Patients with a serum PSA level of more than 4 ng/dl with previous negative TRUS biopsy result are typically given the option of a follow up PSA test. If a patient's PSA continued to rise, mostly they underwent a second TRUS biopsy, which had quite low positive predictive value.

What this study adds?

For patients who previously had negative biopsy with high PSA, the MRI fusion TRUS biopsies are associated with more positive biopsy results than the double sextant systematic prostate biopsies. The higher a patient's PI-RADS score, the greater the chance of a positive biopsy result.

Conflicts of interest

The authors declare no conflict of interest.

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