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MR imaging effectiveness in preoperative staging of prostate cancer in correlation with transrectal ultrasonographic examination

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Introduction. Prostate cancer is the most frequent neoplasm throughout the world. Its prognosis depends on early recognition, the degree of tumour malignancy and the administered treatment. Besides methods of establishing of local progression degree, such as clinical examination, histological examination of biopsy material and PSA determination, such imaging techniques as magnetic resonance imaging (MRI) and transrectal ultrasonographic examination (TRUS) have also been introduced.

The purpose of the present study was the assessment of MRI, as compared with transrectal ultrasonographic examination for the determination of prostate cancer progression degree.

Material and methods. MRI of the prostate was carried out in 22 men aged 68 to 79 years. After diagnostic investigations eight patients were qualified for radical radiotherapy.

Eleven patients underwent radical prostatectomy. Preoperative results of MRI and TRUS of the prostate were compared with the results of histological examination after prostatectomy, and preoperative MRI and TRUS in conservatively treated patients were compared with biopsy results. Preoperative MRI and TRUS results were compared with histological findings after the operation considering the following parameters: (a) tumour localization in the prostate, (b) tumour dimensions, (c) infiltration of prostate capsule, tumour reaching beyond the capsule, infiltration of seminal vesicles.

For MRI the intensity of the signal from pathological lesions in both SE T1 and FSE T2 sequences was also assessed. In patients treated conservatively (radiotherapy) the localization was compared according to pathological lesions in MRI, TRUS and in the biopsy material.

Conclusions

1. The results allow to conclude that routine use of MRI with surface coil is not necessary in preoperative assessment of progression degree of prostate cancer in patients with small foci of cancer in clinical examination, with highly differentiated cancer in histological examination, in low grade progression in Gleason scale, and moderately elevated PSA values.

2. An indication to preoperative MRI in prostate cancer is clinical examination suggesting infiltration of the capsule of seminal vesicles in patients qualified for conservative therapy.

Ocena skuteczności badania MR w przedoperacyjnym określeniu stopnia zaawansowania raka gruczołu krokowego, w korelacji z transrektalnym badaniem ultrasonograficznym

Wstęp. Rak gruczołu krokowego jest najczęściej występującym rakiem na świecie. Rokowanie jest zależne od wczesnego rozpoznania, stopnia złośliwości nowotworu i zastosowanego leczenia. Wśród metod służących do ustalania stopnia zaawansowania miejscowego, obok badania klinicznego, histopatologicznego i PSA, stosowane są badania obrazowe: rezonans magnetyczny i ultrasonografia transrektalna.

Celem pracy była ocena wartości badania MR w porównaniu z transrektalną ultrasonografią (TRUS) w określeniu stopnia zaawansowania raka gruczołu krokowego.

Materiał i metoda. Badania MR prostaty wykonano u 22 mężczyzn w wieku od 68 do 79 lat. Po wykonaniu badań diagnostycznych 8 chorych zakwalifikowano do radykalnego leczenia napromienianiem.

U 11 chorych przeprowadzono leczenie operacyjne — radykalną prostatektomię.

Porównano przedoperacyjne badania MR i TRUS gruczołu krokowego z oceną histopatologiczną po operacji, u chorych po prostatektomii oraz przedoperacyjne badania MR i TRUS z wynikami biopsji u chorych leczonych zachowawczo.

Przedoperacyjne badania MR i TRUS porównywano z wynikami histopatologicznymi po operacji, uwzględniając następujące parametry: a) lokalizację guza w obrębie gruczołu krokowego; b) wymiary guza; c) naciekanie torebki narządu, przekraczanie torebki, naciekanie pęcherzyków nasiennych.

W badaniach MR oceniano również wysokość sygnału ognisk patologicznych w obu sekwencjach SE T1 i FSE T2.

U chorych leczonych zachowawczo (napromienianiem) porównywano lokalizację patologicznych ognisk w badaniach MR, TRUS i w biopsji.

Wnioski

1. niecelowe jest rutynowe stosowanie badania MR, z użyciem cewki powierzchniowej, w przedoperacyjnej ocenie stopnia zaawansowania raka gruczołu krokowego u chorych: z małymi ogniskami raka w badaniu klinicznym, z wysokorozdzielcową postacią raka w badaniu histopatologicznym, w niskich stopniach (1-7), w skali Gleasona oraz przy umiarkowanych wartościach PSA.

2. wskazaniem do przedoperacyjnego badania MR w raku gruczołu krokowego jest kliniczne podejrzenie naciekania torebki pęcherzyków nasiennych u chorych kwalifikowanych do leczenia zachowawczego.

Key words: MR imaging, TRUS, staging, prostate cancer

Słowa kluczowe: badanie MR, TRUS, stopień zaawansowania, rak gruczołu krokowego

As stated by Maio et al. /1/ prostate cancer is the most frequent cancer type in the whole world. The prognosis depends on early diagnosis, degree of cancer malignancy and treatment administered. The choice of treatment depends on the progression degree of the tumour established according to various criteria. Methods establishing the degree of local progression of the tumour include, besides clinical and histological examination and PSA determination, also imaging techniques: magnetic resonance imaging (MRI) and transrectal ultrasonography (TRUS).

The purpose of the present study was the assessment of MRI value as compared to TRUS in determining the progression degree of prostate cancer.

Material and methods

MRI of the prostate was done in 22 cases aged 68 to 79 years. In all cases histological examination of biopsy or surgical specimens confirmed the diagnosis of prostate cancer. In 21 cases adenocarcinoma in various degrees of progression was found, in one case adenocarcinoma in the left prostatic lobe coexisted with colloid cancer in the right lobe. Two patients had had radiotherapy before MRI, one patient had had radical prostatectomy and in these patients MRI was carried out because of suspected recurrence.

After the completion of diagnostic investigations eight patients qualified for radical radiotherapy. Eleven patients had radical prostatectomy. MRI before the operation was carried out with an Elscint 2T unit with surface coil according to the following protocol:

- during the FSE T2 sequence, axial, coronal, sagittal planes:
 - matrix 252x316
 - field of view (FOV) 21x21 cm
 - slice thickness 5 mm
- during the SE T1 sequence, axial planes:
 - matrix 240x300
 - field of view (FOV) 38x31 cm
 - slice thickness 7 mm

Preoperative MRI and TRUS prostate examinations were compared with the histological findings after the operation in patients subjected to prostatectomy, while the preoperative MRI and TRUS results were compared with histological findings in biopsy material in conservatively treated patients (Table I and

II). Preoperative results of MRI and TRUS were compared with histological findings according to the following parameters:

- 1) tumour localization within the prostate
- 2) tumour dimensions
- 3) prostatic capsule infiltration, tumour spread outside the capsule, infiltration of seminal vesicles.

In MRI the signal intensity from the pathological foci in both SE T1 and FSE T2 sequences was also evaluated.

In conservatively treated patients (radiotherapy) the localization of pathological foci was compared in MRI, TRUS and biopsy.

Results

The results of comparative assessment of the above parameters are presented in Table I and II.

Only in 9/19 cases (47%) the localization of pathological lesions was correct in MRI, in TRUS the lesions were localized correctly in 8/19 cases (42%).

In MRI the dimensions of the lesion were in unison with the result of postoperative histological examinations in only 2/11 surgically treated patients, in TRUS — in only 1 out of 11 patients operated on, in 6 cases histological examination revealed disseminated lesions. The analysis of signal intensity in SE T1 and FSE T2 sequences in 16 cases showed heterogeneous indirect signal in T1-we-

Tab. II. Comparison of prostatic MRI and TRUS in correlation with results of prostate biopsy in the assessment of tumour localization, tumour size, infiltration of prostatic capsule and seminal vesicles

No.	MR	localization of changes TRUS	Biopsy
1.	right peripheral zone	no changes	right lobe
2.	right lobe	right lobe	right lobe
3.	central zone	right lobe	right lobe
4.	right lobe	right lobe	right lobe
5.	right lobe	left lobe	right lobe
6.	right lobe	both lobes	both lobes
7.	central zone	both lobes	both lobes
8.	right lobe	right lobe	right lobe

Tab. 1. Comparison of preoperative MRI of prostate and TRUS results with histological findings after prostatectomy with reference to localization and dimensions of malignant foci, infiltration of prostatic capsule and seminal vesicles

No.	Dimensions of foci (mm)		localization of foci		prostatic capsule infiltration		seminal vesicles infiltration		
	MR	TRUS	H-P	MR	TRUS	H-P	MR	TRUS	H-P
1.	disseminated	disseminated	none	peripheral zones	peripheral zones	none	(-)	(-)	none
2.	disseminated	disseminated	none	disseminated	disseminated	none	(+)	(-)	none
3.	10x9	no changes	20	l.peripheral zone	no changes	both lobes	(+/-)*	(-)	(-)
4.	13x7	14	none	l.peripheral zone	l.peripheral zone	none	(-)	(-)	none
5.	no changes	no changes	disseminated	no changes	no changes	disseminated	no changes	no changes	(-)
6.	bez zmian	no changes	microfoci	no changes	no changes	both lobes	no changes	no changes	(-)
7.	11x4	7x7	disseminated	r.peripheral zone	r.peripheral zone	both lobes	(+)	(-)	(-)
8.	20x11	19x12	disseminated	peripheral zones	right lobe	both lobes	(+/-)*	(+)	(+)
9.	disseminated	disseminated	disseminated	both lobes	both lobe	both lobes	(-)	(-)	(-)
10.	17x18 6x6	no changes	disseminated	both lobes	no changes	both lobes	(-)	no changes	(-)
11.	20x14	20x9	10x9	right lobe	right lobe	right lobe	(-)	(-)	(-)

(+/-)*-capsule involved but malignant infiltration is not spreading beyond the capsule

ighted images, and reduced signal intensity in T2-weighted images. In 2 cases an indirect signal was in T1-weighted images and higher intensity signal in T2-weighted images. In one case of colloid cancer in the right prostatic lobe the signal was increased in T1 and T2-weighted images, in the left lobe (with adenocarcinoma) the T1-weighted images signal was indirect and in T2 it was decreased. In patients, after previous radiotherapy in T1 and T2-weighted images the signal was not homogeneous.

In 3 patients histological examination after the operation failed to demonstrate malignant cells: in one case only cystic areas were found at the site of cancer found on biopsy (necrosis after hormonal therapy), in one case with cancer focus found before operation cancer was detected in only 1 out of seven biopsy slices, most likely it had been removed during biopsy. In the third case the patient had been treated for lymphoma of a relatively low malignancy, while prostate cancer was an additional finding, and was confirmed by biopsy. In 9/11 patients postoperative histological examination demonstrated, beside malignant infiltrations, foci of benign hyperplasia, inflammatory changes and desmoplastic reactions. In 3/8 patients qualified for conservative treatment full correlation was found between preoperative examinations (MRI and TRUS) in the assessment of the following parameters:

- (1) localization of focal lesion in prostate (confirmed by biopsy),
- (2) infiltration of capsule and seminal vesicles,
- (3) infiltration spread outside the capsule.

The sensitivity of prostate MRI in the detection of prostatic capsule infiltration was 33%, and in the assessment of spread of malignant infiltration outside the capsule this sensitivity was 100%, the overall sensitivity of MRI in the detection of capsule involvement was 50%, and MRI specificity was 71%. In TRUS the sensitivity with regard to malignant infiltration spread beyond the capsule was 100%, but with regard to capsule infiltration it was 0%. Overall TRUS sensitivity in the assessment of capsule involvement was 25%, its specificity was 85%. In postoperative histological examination infiltration of seminal vesicles was observed in 1/11 cases. MRI sensitivity in the detection of the infiltration of seminal vesicles was 100%, its specificity was 100%. In TRUS this infiltration was never found, the sensitivity was thus 0%, and specificity 100%.

Discussion

Literature data shows that none of the methods applied as yet for the assessment of prostate cancer progression has fulfilled the expectations [1–5].

The paper of Yu and Hricak [5] suggested that in the assessment of the spread outside the prostatic capsule TRUS was not more sensitive than per rectum palpation.

The results of studies reported from various centres differ significantly between them, e.g. the sensitivity of MRI carried out with endorectal coil in the assessment of

malignant involvement of the capsule and seminal vesicles is 22–85.7% and 23–100% respectively, and its specificity is 73.5%–100% and 85.7%–100%, according to various authors [2, 3, 4, 6, 7].

When surface coil is used, MRI sensitivity in the assessment of the capsule is 20–62% according to various authors [3, 9, 10] in own material it was 50%, the specificity of the method is 80–90.9%, (71% in own material).

In the assessment of the infiltration of seminal vesicles MRI sensitivity in surface coil examination [8–10] was 30–83.3% (in own material 100%), and its specificity was 86–95.7% (in own material 100%).

According to Bates et al. [6] TRUS examination revealed capsule infiltration with 23% sensitivity and 86% specificity (in own material 23% and 85% respectively). In the recognition of the infiltration of seminal vesicles TRUS sensitivity [6] was 33% and its specificity was 100%, in own material 0% and 100% respectively.

The analysis of the above results indicates that MRI is useful in the macroscopic assessment of tumour spread outside the prostatic capsule, especially infiltration of seminal vesicles, but is less applicable for the detection of microscopic infiltrations. In view of MRI cost and the present observations this method is not useful in the assessment of prostatic cancer progression degree in patients with small likelihood of capsule infiltration. Such patients have well differentiated cancer cells, grades 1–7 in Gleason classification, with relatively low PSA level and without clinical evidence of cancer spread outside the capsule [11, 12]. In such cases TRUS should be used as a supplement to clinical examination for prostatic cancer rating, till further progress would be achieved in MRI, such as spectroscopy or dynamic studies. In the remaining patients (with high likelihood of tumour spread to the structures in vicinity) MRI would be indicated for confirmation of that spread [3].

Summary of the research results

1. Comparing preoperative MRI (surface coil) and TRUS results with postoperative histological findings a low sensitivity was noted for both methods, especially TRUS, in the assessment of prostatic capsule involvement.
2. In the studied group a high sensitivity of MRI was observed in the detection of tumour spread outside the capsule (it was 100 as compared with TRUS (sensitivity 0%).
3. No satisfactory correlation was found in the assessment of the localization and dimensions of cancer foci between MRI and TRUS and histological findings after prostatectomy.

Conclusions

1. The results suggest the conclusion that routine use of MRI with surface coil is not worthwhile in preoperative assessment of prostate cancer progression in pa-

tients: with small cancer foci in clinical examination, with highly differentiated tumour in histological examination, with low Gleason rating 1–7, and with moderately raised PSA level.

2. An indication to preoperative MRI in prostate cancer is a clinical suspicion of infiltration of the capsule of seminal vesicles in patients qualified for conservative treatment.

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References

1. Maio A, Rifkin MD. Magnetic resonance imaging of prostate cancer: update. *Top Magn Reson Imaging* 1995; 7: 54–68.
2. Perotti M, Kaufman RP, Jennings TA, et al. Endo-rectal coil magnetic resonance imaging in clinically localized prostate cancer: is it accurate? *J Urol* 1996; 156: 106–9.
3. Torricelli P, Iadanza M, De Santis M et al. Magnetic resonance with endo-rectal coil in the local staging of prostatic carcinoma. Comparison with histologic macrosections in 40 cases. *Radiol Med* 1999; 97: 491–8.
4. Tuzel E, Sevinc M, Obuz F, et al. Is magnetic resonance imaging necessary in the staging of prostate cancer?. *Urol Int* 1998; 61: 227–31.
5. Yu KK, Hricak H. Imaging prostate cancer. *Radiol Clin North Am* 2000; 38: 59–85
6. Bates TS, Gillatt DA, Cavanagh PM, et al. A comparison of endorectal magnetic resonance imaging and transrectal ultrasonography in the local staging of prostate cancer with histopathological correlation. *Br J Urol* 1997; 927–32.
7. Rorvik J, Halvorsen OJ, Albrektsen G, et al. MRI with endorectal coil for staging of clinically localized prostate cancer prior to radical prostatectomy. *Eur Radiol* 1999; 9: 29–34.
8. Rorvik J, Halvorsen OJ, Albrektsen G, et al. Use of pelvic surface coil MRI imaging for assessment of clinically localized prostate cancer with histopathological correlation. *Clin Radiol* 1999; 54: 164–9.
9. Nicolas V, Beese M, Keulers A, et al. MR tomography in prostatic carcinoma: comparison of conventional and endorectal MRT. *Rofo Fortschr Geb Roentgenstr Neuen Bildgeb Verfah* 1994; 161: 319–26.
10. Deasy NP, Conry BG, Lewis JL, et al. Local staging of prostate cancer with 0.2 T body coil MRI. *Clin Radiol* 1997; 52: 933–7.
11. Lawton CA, Grignon D, Newhouse JH. Oncodiagnosis Panel 1997. Prostatic carcinoma. *Radiographics* 1999; 19: 185–203.
12. Ikonen S, Karkkainen P, Kivasari L, et al. Magnetic resonance imaging of prostatic cancer: does detection vary between high and low Gleason score tumors? *Prostate* 2000; 43: 43–8

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