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Magnetic resonance image parameters as prognostic factors in the differential diagnosis of soft tissue tumours

Małgorzata Tacikowska

Aim. To analyse the usefulness of MR imaging in the differential diagnosis of sarcomas and non-malignant lesions, on the basis of the following features: septa in the tumour, signal intensity, homogeneity and homogeneity change of the signal, enhancement after administration of paramagnetic contrast medium, presence of necrosis.
Material and method. One hundred and ten patients with soft tissue tumours entered the study, 60 men and 50 women aged 16 to 84 years. Magnetic resonance was carried out with Elscint 2T or 0,5T unit using surface coils (passive) or circular polarized (active) coils, field of view from 20x24 cm or 40x40 cm to 44x35 cm, matrices 200-256, 256x256 or 252x315, layer thickness from 3 to 10 mm, gap 20-30%. Sequences SE T1 (TR=500-800 ms, TE=15-20 ms) and FSE T2 (TR 2000-4500 ms, TE 96-104 ms) were obtained at least in two planes: transverse and frontal or sagittal. SE T1 sequences after Gd-DTPA administration in doses 0.1-0.2 mmol/kg body weight were also obtained.
Conclusions. 1. Static MR imaging does not allow to assess the possible tumour aggressiveness on the basis of the evaluated parameters (septa present in tumour, signal intensity, homogeneity and change of signal in T1 and T2, tumour enhancement). 2. Only the presence of necrosis (found in 75.9% of sarcomas, and 3.2% of non-malignant lesions) and the rarely present signs of infiltration of vessel-nerve bundles and bones can be regarded as significant evidence in the assessment of tumour aggressiveness.

Parametry obrazu MR jako czynniki prognostyczne w różnicowaniu guzów tkanek miękkich

W pracy analizowano parametry obrazu MR guzów tkanek miękkich pod względem przydatności statycznego badania MR w różnicowaniu zmian łagodnych i złośliwych, a także wartości MR w ustaleniu stopnia zaawansowania klinicznego guza.
Cel pracy. Analiza przydatności badania MR w różnicowaniu mięsaków i zmian łagodnych na podstawie następujących parametrów: przegród w guzie, intensywności, jednorodności i zmiany jednorodności sygnału, wzmocnienia po podaniu paramagnetyku, obecności martwicy.
Materiał i metoda. Materiał stanowi 110 chorych z guzami tkanek miękkich, 60 mężczyzn i 50 kobiet, w wieku od 16 do 84 lat. Badanie metodą rezonansu magnetycznego wykonano aparatem 2T lub 0.5T firmy Elscint. Stosowano cewki powierzchniowe (bierne) lub polaryzowane kołowo (czynne), pola widzenia od 20x24 cm lub 40x40 cm do 44,0x35,0 cm, matryce: 200x256, 256x256 lub 252x315, grubość warstw od 3 do 10 mm, gap 20-30% Wykonywano sekwencje SE T1 (TR = 500-800 ms, TE = 15-20ms) i FSE T2 (TR 2000-4500 ms, TE 96-104 ms), co najmniej w dwóch płaszczyznach: poprzecznej, czołowej lub/i strzałkowej, oraz sekwencje SE T1 po podaniu Gd-DTPA w dawce 0,1-0.2 mmol/kg cc.
Wnioski. 1. Statyczne badanie MR nie jest metodą umożliwiającą ocenę agresywności guzów tkanek miękkich na podstawie ocenianych parametrów (obecność przegród w guzie, intensywność, jednorodność, zmiana sygnału w czasie T1 i T2, wzmocnienie sygnału). 2. Tylko obecność martwicy (stwierdzona w 75,9% mięsaków i 3,2% zmian niezłośliwych) oraz rzadko występujące objawy naciekania pęczków naczyniowo-nerwowych i kości, można uznać za parametry istotne w ocenie agresywności guzów.

Key words: static MR, soft tissue tumours
Słowa kluczowe: statyczny MR, guzy tkanek miękkich

Department of Radiology
The Maria Skłodowska-Curie Memorial Cancer Center
and Institute of Oncology, Warsaw, Poland

This article presents a second part of our research on the diagnostic value of static MR examination in soft tissue tumours. In the first part of the study the tumour size, borders and local extent were examined. Now we tested the usefulness of MR examination in the differentiation among the sarcomas and non-malignant lesions. The aim of this study was to analyze the usefulness of MR imaging in the differential diagnosis of sarcomas and non-malignant lesions on the basis of the following features: septa in the tumour, signal intensity, homogeneity and homogeneity change of the signal, enhancement after administration of paramagnetic contrast medium, presence of necrosis.

Material and method

The material comprised 110 patients with soft tissue tumours, 60 men and 50 women aged 16 to 84 years. Histological diagnosis in all cases of soft tissue tumours was established basing on biopsy. 69 patients were treated surgically the rest conservatively. The whole material consisted of 79 cases of sarcomas, 49 of which were primary tumours and 30 recurrences, and 31 non-malignant lesions – 20 benign neoplasms and 11 non-neoplastic lesions.

The study by MR imaging method was carried out using Elscint 2T or 0.5T unit, using surface coils (passive) or circular polarized (active) coils, field of view from 20-24 cm or 40x40 cm to 44x35 cm, matrices 200x256, 256x256 or 252x315, layer thickness from 3 to 10 mm, gap 20-30%. Sequences were obtained SE T1 (TR=500-800 ms, TE = 15-20 ms) and FSE T2 (TR 2000-4500 ms, TE 96-104 ms) at least in two planes: transverse, frontal or/and sagittal, and SE T1 sequences after Gd-DTPA administration in doses of 0.1-0.2 mmol/kg body weight.

The following parameters were analysed: presence of septa of low signal in T1 and T2 images in the tumour, signal intensity in T1 and T2 times (low, intermediate, high), signal homogeneity (homogenous, non-homogenous), signal homogeneity change in T1 and T2 weighted images (homogenous in T1, non-homogenous in T2 weighted images), enhancement after administration of paramagnetic contrast medium (homogenous, non-homogenous), necrosis presence.

Necrosis was sought and analysed in the whole material of 110 patients, and in the group of 69 patients treated surgically comparing the results with histological findings and calculating MR imaging sensitivity and specificity.

In 69 surgical patients infiltration of vessel-nerve bundles and bone was assessed.

Results

Presence of septa of low signal in tumour (in T1 and T2 weighted images)

In the sarcoma group, in 58 out of 79 cases (73.4%) septa in tumours were found. In the group of non-malignant lesions, septa were found in 12 out of 31 cases (36.7%).

Signal intensity

The results of signal intensity assessment in T1 and T2 weighted images of soft tissue tumours divided into groups of sarcoma and non-malignant lesions are presented in Table I and II.

Signal homogeneity

In MR imaging homogenous signal from soft tissue tumours was found in 2 sarcomas (2.5%) and in 10 cases of non-malignant lesions. Non-homogenous signal was found in 77 sarcoma cases (97.5%) and in 21 non-malignant tumours (67.7%).

Signal uniformity change in times T1 and T2

These changes were observed in 35 out of 79 cases of sarcoma, that is 44.3%,and in 5 out of 31 cases of non-malignant lesions, that is in 16.1%.

Enhancement after administration of Gd--DTPA

In the sarcoma group homogenous enhancement after contrast administration was observed in 1 case (1.3%). In the remaining 78 cases (98.7%) enhancement was not homogenous. Among non-malignant lesions enhancement was homogenous in 9 cases (29%) and not uniform in 22 cases (71%).

Presence of necrosis

In the whole material of 110 patients tumour necrosis was noted in 61 cases (55.5%). In sarcoma cases necrosis was observed in 60 out of 79 patients (75.9%). In non-malignant lesions it was noted in 1 case (3.2%). The results of the search for necrosis in the group of 69 surgical patients compared with histological examinations are presented in Table III.

Necrosis was found in 38 out of 55 sarcoma cases (69%) in the group of patients operated on. In the group of non-malignant lesions necrosis was found in one patient operated on who had haematoma (7.1%). MR imaging sensitivity in necrosis detection was 97.4% for the whole group, and its specificity was 83.3%.

Infiltration of the vessel-nerve bundle.

Table 4 presents the comparison of MR imaging and histological findings in the detection of vessel-nerve bundle infiltration. The sensitivity of MR in the assessment of the infiltration was 77.8% and its specificity was 73.3%.

Table I. Signal intensity assessment in T1 and T2 weighted images in 79 patients with soft tissue sarcomas

	Signal intensity		
	low n / %	intermediate n / %	high n /%
images T1 weighted	16 / 20.2	58 / 73.4	5 / 6.3
images T2 weighted	0	0	79 / 100.0

Table II. Signal intensity assessment in T1 and T2 weighted images in 31 patients with non-malignant soft tissue tumours

	Signal intensity		
	low n / %	intermediate n / %	high n /%
images T1 weighted	5 / 16.1	15 / 48.3	11 / 35.5
images T2 weighted	3 / 9.7	0	28 / 90.3

Table III. Tumour necrosis in 69 surgically treated patients, compared with histological findings

		necrosis present		necrosis absent	
		sarcomas	non-malignant tumours	sarcomas	non-malignant tumours
MR+HP examination (MR and HP agreement)	n	37/55	1/14	12/55	13/14
HP examination (no agreement with MR)	n	1/55	0	5/55	0

Table IV. Assessment of vassel-nerve bundle infiltration in MR, compared with histological findings in 69 surgically treated patients

		bundle infiltration		no infiltration	
		sarcomas	non-malignant lesions	sarcomas	non-malignant lesions
MRvsHP (agreement)	n	7/55	0	31/55	13/14
HP examination (no agreement with MR)	n	2/55	0	15/55	1/14

In the sarcoma group MR imaging sensitivity in the assessment of this infiltration was 77.8% and its specificity was 67.4%.

Bone infiltration

In the group of 69 surgically treated patients bone infiltration was found in MR imaging in 15 cases. Histological examination confirmed this infiltration in seven cases. The sensitivity of MR in bone infiltration assessment was 100%, and its specificity was 87%.

In the whole group of non-malignant lesions (31 cases) bone infiltration was found in one case (3%) of villonodular synovitis of foot.

Discussion

The analysis of signal intensity and uniformity in T1 and T2 weighted images. In the sarcoma group low or medium intensity signal was found in T1 weighted images in 93% of cases, in the group of non-malignant lesions in 64%. Low intensity signal was not found in any sarcoma case in T2 weighted images; this sign was present in only 10% of non-malignant lesions.

Similar results have been reported by de Schepper [1] who found 100% specificity for absence of low intensity signal in T2 weighted images in malignant lesions. Other authors [2] reported low intensity signal in T2 weighted sequences, in certain MFH and malignant schwannoma cases.

The results of signal homogeneity assessment in the presently reported study were similar to those reported by others [5,6]. De Sehepper [1] and Crim [3] obtained similar results – homogenous signal in T1 and T2 weighted times was found in 4% [1], 3-9% [3] sarcomas, and 25% [1], 91-97% [3] of non-malignant lesions.

In the material of Berquist [4] 95% of sarcomas had non-homogenous signal. Other authors [5, 6] reported similar results.

In the present study the results obtained by Hermann [7] were not confirmed. This author found septa with low-intensity signal in T1 and T2 weighted images in 80% of sarcomas and 8% of non-malignant lesions [7]. Hermann observed also signal change in T1 and T2 times in 72% of malignant and 13% of non-malignant lesions [7].

In the present study septa were found in 73% of sarcomas and 39% of non-malignant lesions, and signal change was observed in 44% of sarcomas and 39% of non-malignant lesions. No other authors, apart from Hermann, have observed these signs.

Enhancement of contrast medium was observed in the present material in the group of sarcomas as well as non-malignant lesions. Slight differences in both groups concerned the occurrence of not homogenous enhancement observed in 99% of sarcomas but also in 71% of non-malignant lesions.

Most authors, among those quoted above, were not studying MR imaging after administration of gadolinium Gd-DTPA i.v. Only de Schepper [1] reported the results after administration of paramagnetic contrast – in his study no differences were found in contrast enhancement between sarcoma group and the group of non-malignant lesions, non-homogenous enhancement was observed in 77% of sarcomas and 65% of non-malignant lesions.

In the present material necrosis was found mainly in sarcomas, in 76% of cases. In the group of non-malignant lesions necrosis was revealed in only one case (3%). De Schepper [1] observed necrosis in 63% of sarcomas and 3% of benign lesions, the remaining tumours failed to show enhancement.

In the present study MR imaging was regarded as highly sensitive and specific in necrosis assessment.

The infiltration of the vessel-nerve bundle is a characteristic finding in soft tissue sarcomas. In the group of 69 surgically treated patients it was observed exclusively in sarcomas. However, in view of infrequent occurren-

ce of infiltration (4% of sarcomas in the present material) its diagnostic value is negligible. MR imaging sensitivity and specificity in detection of vessel-nerve bundle infiltration were low, 78% and 67% respectively.

Similary, infiltration of bone is rare in soft tissue tumours, and although it occurs much more frequently in sarcomas (13% of sarcomas and only 3% of non-malignant lesions in the present material) it is without value in the differential diagnosis.

In the study of Crim [3] in place of vessel-nerve bundle infiltration assessment the analysis concerned bundle surrounding by tumour mass without finding of significant difference between sarcomas (9%) and non-malignant lesions (4-10%). Similar criteria were accepted by Berquist [4], in his material in 7% of sarcomas the tumour surrounded the bundle.

In the material of Crim [3] bone infiltration was found in 6% of sarcomas and about 2% of benign lesions.

Conclusions

1. Static MR imaging does not allow to assess the possible tumour aggressiveness on the basis of the evaluated parameters (septa present in tumour, signal intensity, homogeneity and change of signal in T1 and T2, tumour enhancement).
2. Only the presence of necrosis (found in 75.9% of sarcomas, and 3.2% of non-malignant lesions) and the rarely present signs of infiltration of vessel-nerve bundles and bones can be regarded as significant evidence in the assessment of tumour aggressiveness.

Małgorzata Tacikowska M.D., Ph.D.
Department of Radiology
The Maria Skłodowska-Curie Memorial Cancer Center
and Institute of Oncology
Roentgena 5
02-781 Warsaw, Poland

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