Single Voxel 1H MR Spectroscopy in the diagnosis of Soft Tissue Tumors

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Authors: S. Agarwal, Z. S. Kundu, S. Kumar, S. S. Sangwan
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Purpose

- Magnetic Resonance Spectroscopy (MRS) has been shown to improve diagnostic accuracy in brain, breast and prostate cancers.
- Very few authors have studied the role of 1H MRS in the evaluation of soft tissue tumors which are increasingly being evaluated with conventional MR imaging the world over.
- MRS detection of elevated choline peak was reported to be 95% sensitive in differentiating benign from malignant musculoskeletal tumors by Wang et al [1].
- We undertook this prospective study to evaluate the role of 1H MR spectroscopy in the diagnosis of musculoskeletal tumors.
Methods and Materials

• MRI, dynamic contrast-enhanced MRI and single-voxel 1H MRS was performed in 30 consecutive patients with histologically proven benign and malignant musculoskeletal tumors each.

• **Equipment**: 1.5-T whole body MRI scanner.

• **MRI** was performed in three planes: axial, sagittal and coronal plane using following sequences:

  1. T1-weighted turbo spin-echo (TSE) (TR/TE; 500/15, Matrix 400x 400, 03 signals acquired);
  2. T2-weighted TSE (TR/TE; 3780/100, Matrix 400x 400, 03 signals acquired)
  3. Fat suppressed images (spectral presaturation with inversion recovery)/ STIR (TR/TE; 6240/100; matrix 352x352)

• Field of view, section thickness and intersection gap varied depending on the size of the lesion.

• **Dynamic contrast-enhanced MRI**: 3D T1-weighted GE (TR/TE; 3.2/1.13, flip angle 35, 01 signal acquired, total sequence time 3 minutes) after the injection of 0.1 mmol/ kg of body weight of gadepentetate di-meglumine injected at 2 mL/sec (using MR-compatible power injector) . Each dynamic scan lasted no longer than 8 sec. The delayed contrast-enhanced T1-weighted TSE spectral presaturation with inversion recovery sequence (TR/TE; 500/14, two signals acquired, 512 x 512 matrix) were also acquired.

• **Signal intensity curves**:

  1. Type I curve- Maximum signal intensity was achieved rapidly after contrast agent administration followed by a gradual decrease (washout).
  2. Type 2 curve- Rapid initial enhancement was followed by a plateau phase or sustained late enhancement.
  3. Type 3 curve- Gradual increase or no increase in signal intensity was seen until the end of dynamic imaging.

• **MR Spectroscopy**: It was performed 10-15 minutes after administration of contrast material by using the PRESS with TE of 40, 135, and 270 msec and TR as 2000. Volume of interest (VOI) was carefully placed to include early enhancing areas of the tumors. Choline was said to be present when there was a clearly identifiable peak at 3.2 ppm in atleast two spectra acquired at different TEs.

MRS imaging and enhancement patterns were compared in these two groups and were analyzed by a radiologist blinded to the histopathological findings.
Results

- Ages of patients in the malignant age group ranged from 2 to 65 years (M: F- 19:11).
- Ages of patients in the benign group ranged from 7 months to 56 years (M: F- 17:13).
- There were 2 patients with Type I curve, 18 with Type II curve and 10 with Type III curve on dynamic contrast enhanced images in the malignant group, while there were no patients with Type I curve, 5 with Type II curve and 25 with Type III curve in the benign group.
- **MALIGNANT GROUP**: Spindle cell ca; 03, lymphoma;02, fibrosarcoma; 04 (one was a case of recurrent tumor and one patient had inflammatory fibrosarcoma), myxoid liposarcoma; 01, osteosarcoma; 04, ewings sarcoma; 03 (One was a case of soft tissue ewings sarcoma), malignant nerve sheath tumors; 02, squamous cell ca ;01, synovial cell ca;01, rhabdomyosarcoma; 01, Papillary cell cystadenosarcoma of the ovary infiltrating into soft tissue; 01, high grade anaplastic undifferentiated sarcoma; 02, Well differen mesenchymal malig tumor revealing myxoid chondroid differentiation;01, reticulum cell ca; 02, metastasis;01.
- No choline peak was seen in : well differen mesenchymal malig tumor revealing myxoid chondroid differentiation; 01, Reticulum cell ca;02, ewings sarcoma(out of these one case was of recurrent tumor);03, Osteosarcoma;04, squamous cell carcinoma;01, myxoid liposarcoma;01.
- **BENIGN GROUP**: Abscess; 04 (01 patient had a fungal abscess), osteomyelitis; 01, bursitis; 01, cystic hygroma; 01, Aneurysmal bone cyst;01, Giant cell tumor (GCT); 04( one patient had recurrent soft tissue GCT), neurogenic tumor; 06 (including two patients with plexiform neurofibroma), juvenile aponeurotic fibroma; 01, fibroma; 01, desmoids tumor; 02, hamartoma; 01, humeral lipoma;01, fibrolipoma;02, hypertrophid scar; 01, Leiomyoma;01, Fibromatosis;01, Lipoma;01.
- Findings suggestive of malignancy was seen in 02 patients of Giant cell tumor. These revealed a Type I curve and Type III curve each.
- The sensitivity of MRS for predicting malignancy was 18/30 (60%), specificity was 28/30 (93.33%), positive predictive value (PPV) was 18/20 (90%), negative predictive value (NPV) was 28/40 (70%) and accuracy was 46/60 (76.66%).
Fig. 1: Metastasis thigh

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Fig. 2: Metastasis Thigh

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Fig. 3: Fibrosarcoma

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Fig. 4: Fibrosarcoma

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Fig. 5: Myxoid Liposarcoma

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**Fig. 6:** Myxoid Liposarcoma

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Fig. 7: Fibromatosis

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Fig. 8: GCT

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Conclusion

MR spectroscopy is a promising technique for evaluation of soft tissue tumors. The accuracy at present remains low. We recommend that it be used as an adjunct to routine MR imaging.
Personal Information

Dr. Shalini Agarwal M.D, DNB
Associate Professor,
Pandit Bhagwat Dayal Sharma
Post Graduate Institute of Medical Sciences
Rohtak-124001 (Haryana) India

Email: agarwalsdr@gmail.com