Fascial tail, T2 hypointense band and orientation along muscle fibres: MRI triad of desmoids

Poster No.: C-0970
Congress: ECR 2015
Type: Scientific Exhibit
Authors: M. Khanna¹, S. Ramanathan¹, M. Alberawi¹, D. Kumar¹, S. B. Ladumor¹, J. Khanna¹, Y. Palaniappan², A. Kambal¹, ¹Doha/QA, ²Puducherry/IN
Keywords: Abdomen, Oncology, Soft tissues / Skin, MR, MR-Diffusion/Perfusion, Diagnostic procedure, Neoplasia
DOI: 10.1594/ecr2015/C-0970

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**Aims and objectives**

Desmoid tumors are rare soft tissue tumors arising from connective tissue of muscle, overlying fascia or aponeurosis. They are a histologically benign tumors with high tendency to recur. the most common site of involvement is the anterior abdominal wall with a strong female predominance, the majority of patients fall between puberty and 40 years old.

MR imaging is the most useful modality for desmoid tumors evaluation, this is because the MR appearance of the tumors are highly correlated with the histological features i.e amount of fibroblasts, collagen contents and extent of fibrosis. However, there are no specific imaging feature to differentiate desmoid tumors from other soft tissue tumors.

The objectives of this study were to evaluate the general imaging characteristics of histologically proven desmoid tumours on MRI and to analyze if any characteristic imaging features can be used to differentiate it from other soft tissue neoplasms.

**Methods and materials**

After the ethical approval from the research committee, a retrospective review of 17 soft tissue masses histologically proven to be desmoid tumors from 13 different patients that underwent imaging between 2008-2014, was performed.

All these cases were imaged in Hamad Medical Corporation radiology department, Qatar. Using a 1.5 Tesla SIEMENS MRI machine, Multiplaner and multisequences MR images were obtained using similar protocol including: T2 spin echo sequence in axial, sagittal and coronal planes, diffusion weighted images in three increasing b values (0, 500 and 1000) with its corresponding apparent diffusion coefficient (ADC) maps, T1 spin echo, In- and out- of phase T1W and 3D VIBE 'gradient echo" pre- and dynamic post-Gadolinium images in three orthogonal planes.

A RIS/PACS keyword search for desmoid and soft tissue tumours was performed to identify cases. Images were reviewed by an abdominal imaging staff and a fellow who were blinded of each others findings. Most of these patients had prior imaging studies like ultrasound and / or CT scan which were also reviewed.

A data collection using Excel sheet was formed for different parameters that may help in differentiating desmoid tumors from other soft tissue masses. Parameters include; outlines of the lesion, its T1 and T2 signal intensities, internal characteristics
(homogenous or heterogenous), presence of necrosis, hemorrhage or fat signal within it or diffusion restriction. Pattern of enhancement in dynamic arterial, venous and delayed phases were also reviewed.

Different proposed MR signs that may help in identifying desmoid tumors from other soft tissue masses like fascial tail, T2 hypointense bands and mass orientation along the muscle fibers were looked for in all selected cases.

All cases were correlated with the histopathological results; cases without available histopathology reports were excluded.

**Results**

The mean age at diagnosis was 42 years (Range 16-79 years) with male to female ratio of 1:5.5.

Among the 17 lesions, 16 were primary tumors (no history of prior surgery or intervention) and 1 lesion was recurrent.

9/17 lesions (53 % of cases) were involving the abdominal wall. 4/9 (44%) of the abdominal wall desmoids were along the external oblique, 4/9 (44 %) involved the rectus abdominis and 1/9(11%) lesion was found in rare location involving the diaphragm (Fig 1).

6/17 (35%) desmoids were found in extra-abdominal locations (4/6 involving the forearm, 1/6 involving the arm and 1/6 in the calf).

2/17 (11%) desmoids were intraabdominal (mesentric) in location.

MRI apperance of these tumors were analyzed according to the proposed parameters described in the methods. The mean size of the lesions was 7.1 cm (Range 3.5- 9 cm). 82% (14/17) desmoids lesions had well-defined margins.

The tumour was heterogenously high signal on T2W in comparison to the adjacent muscle (14/17; 85%) and showed iso- signal intensity to adjoining muscle on T1 weighted images in (13/17; 80%). Necrosis was found in 30% (5/17) of these lesions, while no lesion demonstrated presence of hemorrhage or fat (Table 1).

12/17 (70%) desmoid tumours had dynamic post contrast images and all of them showed moderate to intense progressive centripetal enhancement.
Diffusion weighted imaging (DWI) at different b values (i.e. b0, b500 and b1000) were available in 5 cases and showed increased diffusivity within these lesions (mean apparent diffusion coefficient (ADC) of $1.9 \pm 0.4 \times 10^{-3} \text{mm}^2/\text{s}$) (Fig 2,3).

While it's known that desmoid tumors may show local infiltration, 3/17 (17%) cases showed bone involvement and 5/17 (29%) lesions demonstrated extra-compartamental extension.

Since the MR appearance of desmoid tumors is highly dependent on the origin and the histological components mainly the fibroblasts and collagen contents; 16/17 (94%) of the desmoids demonstrated presence of thin T2 hypointense bands mainly in a swirled pattern. This pattern was common to both abdominal wall, intra and extraabdominal desmoids (Fig. 2-5). 1/17 (5%) lesion that did not show this finding, was arising from the diaphragm.

Fascial or desmoid tail sign (akin to the dural tail in cases of meningioma) i.e a thin beak or nipple like extension of the tumor along the orientation of the involved muscle fibers / aponeurosis, was encountered in 8/17 (47%) desmoids. This finding, though, was encountered in almost all the abdominal wall desmoids (8/9, 88%) (Fig. 2-5). Also the abdominal wall and extraabdominal desmoids had there longest dimensions and orientation along the long axis of muscle fibers or aponeurosis involved (14/17 cases; 82%). (Fig.2 and 3).

Fascial/Desmoid tail and orientation along the long axis of the muscle were not relevant in mesenteric and diaphragmatic desmoids.

Two out of these three features (i.e T2 dark internal lines or bands, fascial tail and lesion orientation along the long axis of the muscle or aponeurosis) were present in 82% of tumors and at least one of these features was seen in 100% of desmoids.

As the desmoid tumors arise from the muscle, fascia or the aponeurosis, the long axis of these lesions is expected to be parallel or along the same muscle/ fascial plane. As part of the normal fascia or the aponeurosis, these tumors arise or can grow along the corresponding fascia/ aponeurosis forming a thin beak or nipple - desmoid or fascial tail sign. (Fig 2-5)

Low signal intensity internal band- like pattern within these lesions is due to its collagen content. This has otherwise been described in other collagenous soft tissue tumours such as leiomyoma, neurofibroma and fibrosarcoma. However, along with the fascial tail and long axis orientation along the involved muscle fibres / aponeurosis, this is highly suggestive of a demoid tumour.
Fig. 1: Desmoid tumors location distribution.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Positive by cases number</th>
<th>Negative by cases number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Margins</td>
<td>Well-defined (14/17)</td>
<td>Ill-defined/ irregular (3/17).</td>
</tr>
<tr>
<td>T2 Signal</td>
<td>Mainly high (14/17)</td>
<td>Iso- or low (3/17)</td>
</tr>
<tr>
<td>T1 Signal</td>
<td>Iso- signal (13/17)</td>
<td>Hypointense (4/17)</td>
</tr>
<tr>
<td>Necrosis</td>
<td>Present in (5/17)</td>
<td>Not seen (12/17)</td>
</tr>
<tr>
<td>Enhancement</td>
<td>(12/12)</td>
<td>0</td>
</tr>
<tr>
<td>T2 hypointense bands</td>
<td>Seen (16/17)</td>
<td>Not seen (1/17)</td>
</tr>
<tr>
<td>Fascial tail sign</td>
<td>Seen in (8/17), (8/9 in the abdominal wall desmoids)</td>
<td>(9/17) mainly not seen in the extremities and intra-abdominal cases</td>
</tr>
<tr>
<td>Orientation along muscle</td>
<td>Seen in 14/17</td>
<td>Not seen in (3/17)</td>
</tr>
</tbody>
</table>
Table 1: Summery of the MRI radiological findings in our study by cases number

Fig. 2: Left rectus muscle desmoid. A. T2 HASTE axial image shows heterogeneously hyperintense mass in left rectus muscle with few linear hypointense areas (short arrows). B. Diffusion weighted image (b1000) shows hyperintense mass (T2 shine through) involving the left rectus muscle. C. Apparent diffusion coefficient map shows hyperintense signal (high ADC) within the lesion. D. T2 fat saturated sagittal image shows hyperintense mass with nipple like fascial tail along its superior aspect (long arrow). E. Contrast enhanced T1 sagittal image in the venous phase shows enhancing mass with fascial tail along its superior aspect (long arrow). F. Delayed contrast enhanced T1 axial image shows enhancing mass in the left rectus muscle. Note the progressive enhancement within the lesion when compared to image E.
Fig. 3: Left rectus muscle sheath desmoid tumor. A. T2 axial HASTE image shows heterogeneously mainly hyperintense mass with few hypointense T2 "bands" and fascial tail (arrows). B. Sagittal T2 HASTE image demonstrating the mass. C. Diffusion weighted images showing hyperintense signal (T2 shine through). D. ADC map shows no restriction. E. Post contrast T1 axial image shows moderate heterogeneous
enhancement. F. T1 axial post contrast subtraction image showing the enhancing part of the mass.

**Fig. 4:** Axial T2 HASTE image of the pelvis, showing mainly hyperintense lesion along the right lower abdominal wall with hypointense T2 band seen within the lesion "thick arrows", and the dark fascial extension along the medial aspect of the mass "thin arrow", the fascial tail sign.
**Fig. 5:** Sagittal T2 HASTE sequence, showing the orientation of the desmoid lesion along the fascial plane (arrow).
**Fig. 6:** Axial and Coronal T2 HASTE sequences, showing a rare location for desmoid tumor arising from the right hemidiaphragm, appear heterogeneously hyperintense on T2 WI's with multiple dark areas and mass effect on the liver, appreciating more easily on the coronal view with line of cleavage between the mass and liver (arrows).
Conclusion

Three characteristic MR imaging features (Fascial tail, T2 hypointense bands and long axis orientation) could be a helpful tool to differentiate desmoids from other soft tissue lesions irrespective of location.

Significantly high ADC values in desmoid tumours differentiates it from most malignant soft tissue tumours or metastasis.

Moderate to intense progressive enhancement within desmoids can also be a helpful differentiating feature.

Personal information

Maneesh Khanna
Consultant Radiology (Abdominal Imaging) , Hamad Medical Corporation- Qatar.
Mkhanna@hamad.qa

Sabramaniyan Ramanathan
Consultant Radiology, Hamad Medical Corporation- Qatar.
SRamanathan@hamad.qa

Mohammad Alberawi
Radiology Resident, Hamad Medical Corporation- Qatar.
Malberawi@hamad.qa

Devendra Kumar
Consultant Radiology, Hamad Medical Corporation - Qatar
dkumar@hamad.qa

Sushila B Ladumor
Consultant Radiology (Abdominal Imaging), Hamad Medical Corporation - Qatar
Sladumor@hamad.qa

Aalaa Salaheldin Kambal
Radiology Resident, Hamad Medical Corporation- Qatar.
Akambal@hamad.qa

Jyoti Khanna
GP, Aster Medical Centre - Qatar
jyoti_khanna999@yahoo.co.in

Yegu Palaniappan
MO, Indira Gandhi Govt. General Hospital- Puducherry, India
yegupalan@gmail.com

Acknowledgement:
We would like to acknowledge the medical research committee at Hamad Medical Corporation- Qatar, for their efforts in support and sponsoring this poster

References


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