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Research papers

Multi-parametric (mp) MRI for the diagnosis of abdominal wall desmoid tumors

Maneesh Khanna[a,*], Subramaniyan Ramanathan[a], Aalaa Salaheldin Kambal[a], Mohammed Al-Berawi[a], Santosh Yadav[b], Devendra Kumar[c], Nicola Schieda[d]

[a] Department of Clinical Imaging, Hamad Medical Corporation, Doha, Qatar
[b] Department of Translational Medicine, Sidra Medical and Research Center, Doha, Qatar
[c] Department of Clinical Imaging, Al Wakra Hospital, HMC, Doha, Qatar
[d] Department of Clinical Imaging, The Ottawa Hospital, Ottawa, Ontario, Canada

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ABSTRACT

Introduction: Desmoid tumors are benign myofibroblastic neoplasms, originating from the muscle aponeurosis and classified as deep fibromatoses. The aim of this study was to evaluate the utility of multi-parametric (mp)-MRI for the diagnosis of abdominal wall desmoid tumor (awdt).

Material and methods: This Institutional review board approved retrospective study compared 10 patients (mean age ± SD; 38.2 ± 13 years; 9 females and 1 male) with awdt to 14 subjects (mean age ± SD; 45.6 ± 14.7 years; 9 females and 5 males) with non-desmoid abdominal wall tumors (ndawt). All included subjects underwent mp-MRI, which included conventional, diffusion weighted and dynamic contrast-enhanced (DCE) MRI. Two blinded experienced fellowship trained radiologists (MK and SR) evaluated each lesion characteristics qualitatively and quantitatively which included margin, homogeneity, T2W/T1W signal intensity (SI), T2 dark strands, and fascial tail together with measurements of apparent diffusion coefficient (ADC) and semi-quantitative DCE analysis. Inter-observer agreement was assessed using Cohen's kappa and data were compared between groups using independent sample *t*-tests and Chi-square tests.

Results: No significant differences in age or gender appeared between groups. On qualitative analysis, T2 dark strands were identified in 90% by both radiologist (K = 0.82) of awdt, while fascial tail was identified in 70% by radiologist 1 and 80% by second radiologist (k = 0.91) of awdt; however no other lesions showed these findings. Other subjective imaging findings did not significantly differ between groups with moderate-to-strong agreements (k = 0.7–1.0). On quantitative measurements, diffusion imaging awdt lesions showed higher mean ADC value compared to other lesions, although it did not reached at the level of significance. While on DCE MRI, all awdt lesions showed type 1 (progressive) DCE curve, however no significant difference was observed between groups.

Conclusions: T2 dark strands and fascial tail are characteristic features of awdt, whereas other subjective/qualitative findings are not useful. Quantitative findings such as ADC measurements and DCE curve analysis may have additional value to differentiate awdt from ndawt, but will require further analysis.

1. Introduction

Desmoid tumors also known as aggressive fibromatosis are rare soft tissue tumors arising from connective tissue of muscle, overlying fascia or aponeurosis [1]. They are histologically benign tumors characterized by proliferation of the fibroblasts with high tendency to demonstrate infiltrative growth and local recurrence [2]. Histology comprises of a spindle shaped myofibroblastic cells, dense intercellular collagen fibres, variable amounts of myxoid matrix and vessels [2,3]. Biological behavior varies from benign to locally aggressive which may demonstrate infiltrative growth and local recurrence [4,5]. The exact etiology of the diseases is unknown, however physical, genetic and endocrine

Abbreviations: awdt, abdominal wall desmoid tumor; ndawt, non desmoid abdominal wall tumor; mp MRI, multi-parametric magnetic resonance imaging; DWI, diffusion weighted imaging; ADC, apparent diffusion coefficient; DCE, dynamic contrast enhancement; VIBE, volumetric interpolated breath-hold examination; HASTE, half-Fourier acquisition single-shot turbo spin-echo

* Corresponding author.
E-mail addresses: Khanna.maneesh@gmail.com, mkhanna@hamad.qa (M. Khanna), drrmsubbu@gmail.com (S. Ramanathan), AKambal@hamad.qa (A.S. Kambal), mberawi@gmail.com (M. Al-Berawi), syadav@sidra.org (S. Yadav), dkumar@hamad.qa (D. Kumar), nschieda@toh.on.ca (N. Schieda).

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Table 1
Magnetic Resonance Imaging parameters used in this study on a 1.5 T clinical scanner.

MR Sequence	Imaging plane	FOV[a](mm)	Matrix size	Slice thickness/ gap (mm)	TR/ TE[b] (ms)	Turbo factor/ Echo train per slice	Flip angle (deg[c])	Accelaration factor	Receiver bandwidth (Hz/voxel)	Acquisi-tion time (min)	Number of signals averaged
Dual Echo T1W (opposed and in phase)	Axial	380	256 × 173	6/1.2	4.9/1.1–1.3; TE1, 2.2–2.5; TE 2, 4.4–5	NA	10	2	390	21 s	1
T2 TSE[d]	Axial/Sagittal	200/200	256 × 160	5/1	3500–5000/ 85–110	23/15	150	2	260	4 min	1
T2 FS[e] TSE	Axial/Sagittal	200/200	256 × 160	5/1	4000–5000/ 85–110	15/14	140	2	260	3.45 min	1
DWI[f] (b 50, 400, 800) e	Axial	200	192 × 148	5/1	4200/79	NA	NA	2	1736	4 min	4
T1 3D VIBE[g] pre and dynamic post contrast images f	Axial with delayed coronaland sagittal images	200	256 × 150	3/0	4.74/2.39	NA	10	2	410	16 s each dynamic	1

a) FOV – Field of view; b) TR/TE – Repetition time/Echo time; c) Deg – Degrees; d) TSE – Turbo spin echo; e) FS – Fat saturated; f) DWI – Diffusion weighted imaging; g) VIBE – Volumetric interpolated breath-hold examination.

factors are all implicated [6].

There is a definite role for hormones in the development of these lesions as highlighted by a female preponderance (especially between puberty to age 40), increased incidence during or more frequently within the 1st year of pregnancy and associated with the use of oral contraceptives [7]. Added demonstration of estrogen receptors in approx 80% of these tumors further confirms the role played by hormones. After age 40 though, there is equal sex preponderance and approximately equal incidence of both abdominal wall and extra abdominal subtypes [8,9]. They may also occur at the sites of prior surgery or in polyposis syndromes [10–12].

Fibromatosis is broadly classified into superficial (arising from fascia or aponeuroses at palmar, plantar, knuckle pad or penile i.e. Peyronie disease) and deep (arising from within the deep soft tissues) benign tissues. Deep fibromatosis is further subdivided into extra-abdominal, abdominal wall, and intra-abdominal types. World Health Organization now labels these lesions together as deep or desmoid-type fibromatoses [3]. The estimated overall incidence of desmoid tumours ranges between 2 and 4/million/year with the abdominal wall subtype being the most common (49%) followed by extra-abdominal (43%) and abdominal/mesenteric subtypes (8%) [5]. Although relatively less common than extra-abdominal desmoids, awdt also locally recurs frequently (15–30% vs 35–65%) [13,14]. Like extra abdominal fibromatosis, wide local excision remains the treatment of choice. Adjuvant radiation therapy may be added for inoperable or recurrent lesions [15,16].

Classic location (rectus muscle), demography (young female) and low signal bands within the lesion on MRI are valuable clues for the diagnosis. However other benign lesions especially endometriotic deposits, lesions such as hematoma, lipoma, soft tissue primary benign and malignant mesenchymal tumours and metastasis can all occur in similar demography and locations [17]. Imaging can be quite non-specific too with overlapping ultrasound and computed tomographic findings. Presence of low signal (T2 dark) bands within the lesion on MRI are also not specific to desmoids and can also be encountered in densely calcified mass, pigmented villonodular synovitis (PVNS)/giant cell tumor of tendon sheath (GCTTS), elastofibroma, granular cell tumor, desmoplastic fibroblastoma, and malignant fibrous histiocytoma (MFH)/fibrosarcoma [18].

Although there are a few studies available in English literature that have assessed desmoids and malignant soft tissue neoplasms on conventional and diffusion weighted imaging (DWI), none of these studies have taken conventional MRI imaging, DWI and semiquantitative DCE images altogether in differentiating awdt from ndawt [7,19,20]. The purpose of this study was to evaluate role of multiparametric MRI in differentiating awdt from ndawt using both subjective imaging features and quantitative/semiquantitative analysis of functional imaging parameters.

2. Materials and methods

This retrospective case-control study was approved by Institutional ethics committee. An electronic radiology information system (RIS) search was made between Jan 2010 and Feb 2015 for the following keywords: Abdominal wall – mass/lesion/tumor/desmoid/metastasis/endometriosis/fibrosis. The preliminary search yielded a total of 42 patients with abdominal wall lesions. Twenty four out of 42 patients had undergone both MRI and or surgery/biopsy and were included in the final analysis. Eighteen out of 42 cases were excluded from the study due to the absence of MRI. Out of the 24 patients that underwent MRI with or without biopsy/surgery; 10 patients had awdt confirmed at histopathology; while rest of 14 patients had non-desmoids abdominal wall tumors.