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Singapore General Hospital

The clinical utility of emerging ultrasound techniques in the assessment of musculoskeletal soft tissue masses Cai S.¹, Kho Y. Y.¹, Ooi C. C.¹, Tan L. W.¹ & Tan E. J.² ¹Radiography Department, Allied Health Division, ² Division of Radiological Sciences

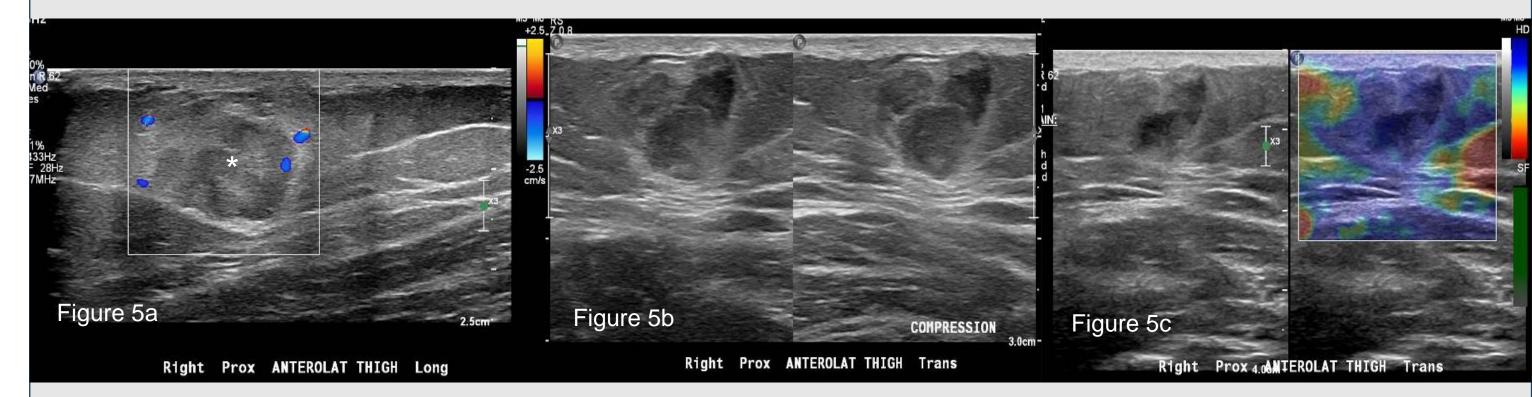
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Background

Musculoskeletal (MSK) soft-tissue tumours comprise a wide-ranging group of heterogeneous and complex masses¹. Ultrasound is an excellent modality to assess these - it confirms the presence of a mass, establishes its location, size, nature and extent. However, conventional greyscale and colour Doppler techniques may on occasion lack specificity necessitating further evaluation or workup.

Emerging techniques such as Superb Microvascular Imaging (SMI), Strain Elastography (SE) and Shear-wave Elastography (SWE) may prove useful. SE and SWE provide additional information on lesion stiffness and in general, malignant lesions tend to be stiffer than their benign counterparts. SE compares the relative stiffness of soft tissue masses to the surrounding soft tissues. Different from SE, SWE employs the use of a higher intensity pulse instead of transducer pressure. SMI enhances visualisation of intra- and peri-lesional minute vessels with slow velocity flow and is sensitive in the detection of tumour angiogenesis. Assessment of the intra-lesional vascularity architecture then allows for better characterisation of the lesion.

Chondroid syringoma

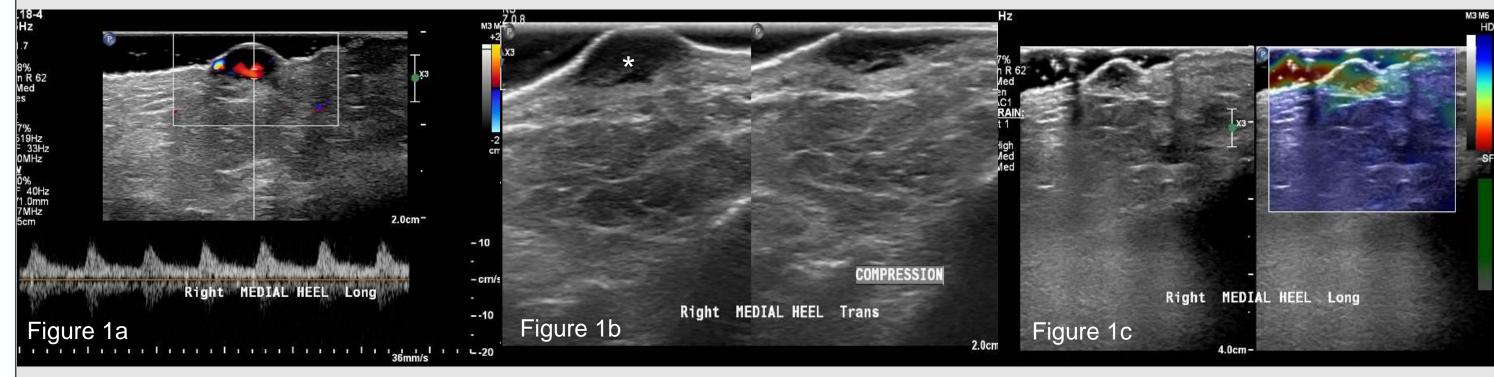


Chondroid syringoma is a sporadic skin appendage tumour that manifests as slow-growing,

In this educational exhibit, we explore the use of these emerging techniques in the assessment of MSK soft tissue masses.

Benign

Neurofibroma



Neurogenic tumours, such as schwannomas and neurofibromas, form approximately 5% of upper extremity tumours in adults. Identification of a nerve entering and exiting the mass is a specific sign for diagnosis though this may be difficult to demonstrate on ultrasound. Neurofibromas can happen at random or associated with underlying neurofibromatosis².

This superficial hypoechoic mass (*) at the right medial heel shows internal arterial flow on colour Doppler (Figure 1a). It is compressible (Figure 1b), though the manual compression method is unable to give an objective assessment of its firmness. On SE, the mass is predominantly green representing medium firmness (Figure 1c).

Do note that just gentle pressure is sufficient when using SE. Excessive pressure is a potential pitfall that may result in increased SE stiffness values.

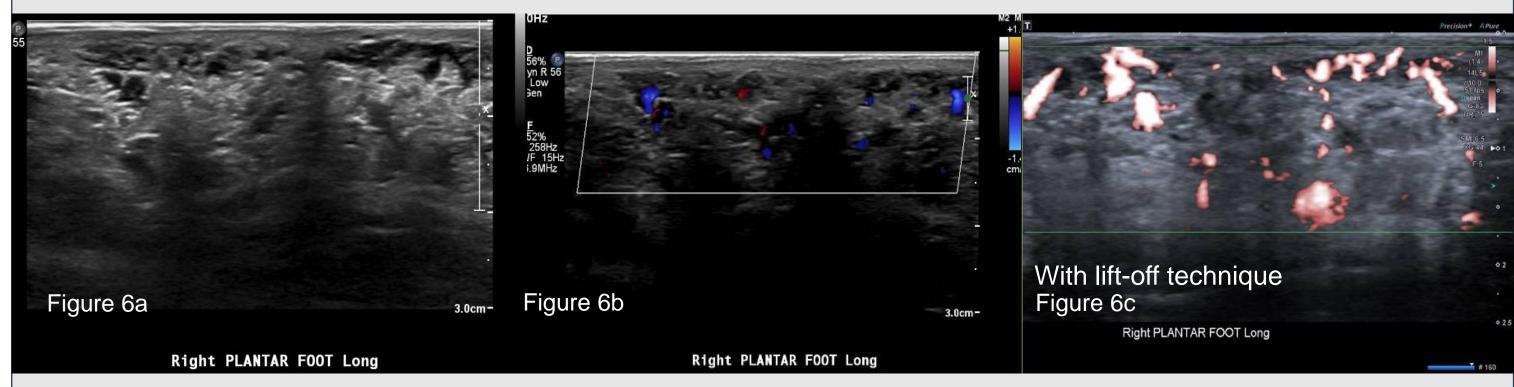
Schwannoma

+2.55Hz

subcutaneous, non-tender, non-ulcerating dermal nodules and most often found in the head and neck. It is rare and easily mistaken for other cutaneous lesions including sebaceous cyst, dermoid cyst and even basal cell carcinoma (BCC)⁶.

In this case, though the mass (*) shows no internal vascularity on colour Doppler (Figure 5a), it is likely solid given that it is incompressible on manual compression (Figure 5b) and hard on SE (Figure 5c). Unfortunately, imaging features alone were non-specific, and diagnosis was only achieved upon final histology.

Venous malformation

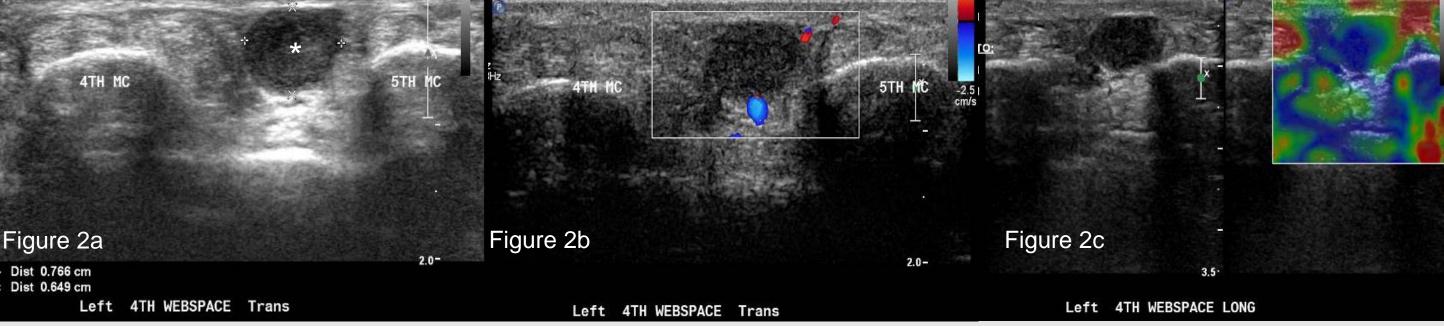


Venous malformations are congenital endothelial malformations that result from errors in vascular morphogenesis. They are also prone to stasis and intraluminal clotting secondary to their slow-flow nature⁷. Greyscale ultrasound shows a hypoechoic region (Figure 6a) with minimal internal signal on colour Doppler (Figure 6b). Coupled with the lift-off technique, SMI shows far better sensitivity (Figure 6c) in detecting presence of slow flow in the hypoechoic area and ascertaining vascular nature of the region in question. Excessive transducer pressure or incorrect Doppler settings on SMI are potential pitfalls which may lead to inaccurate assessment and interpretation.

Malignant

Squamous cell carcinoma (SCC)

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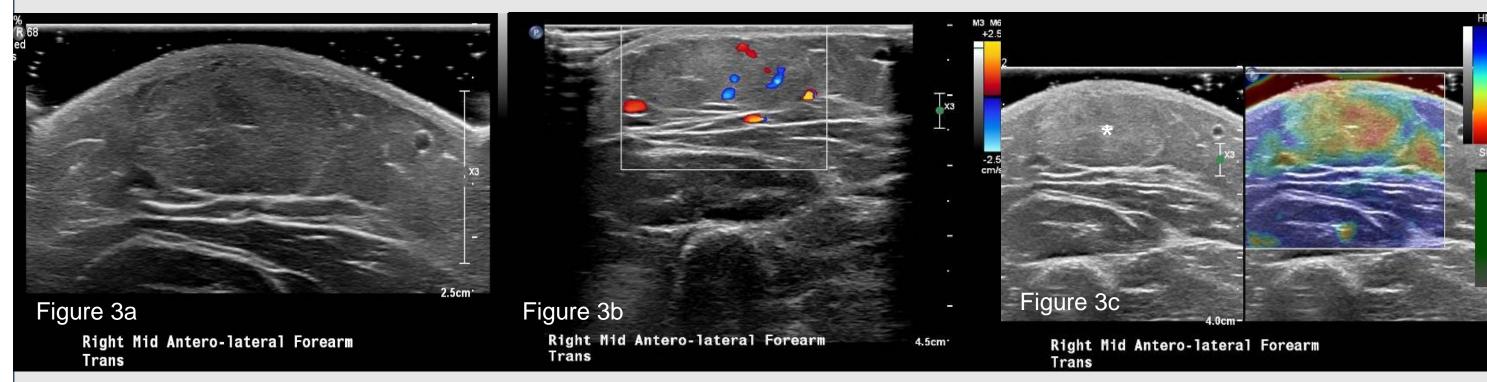


Schwannoma is the most common benign peripheral sheath nerve tumour, accounting for only 5%– 8% of all soft tissue tumours. The incidence of schwannoma of the hand is however reported to be as low as 1%³ and can be difficult to differentiate from other lesions.

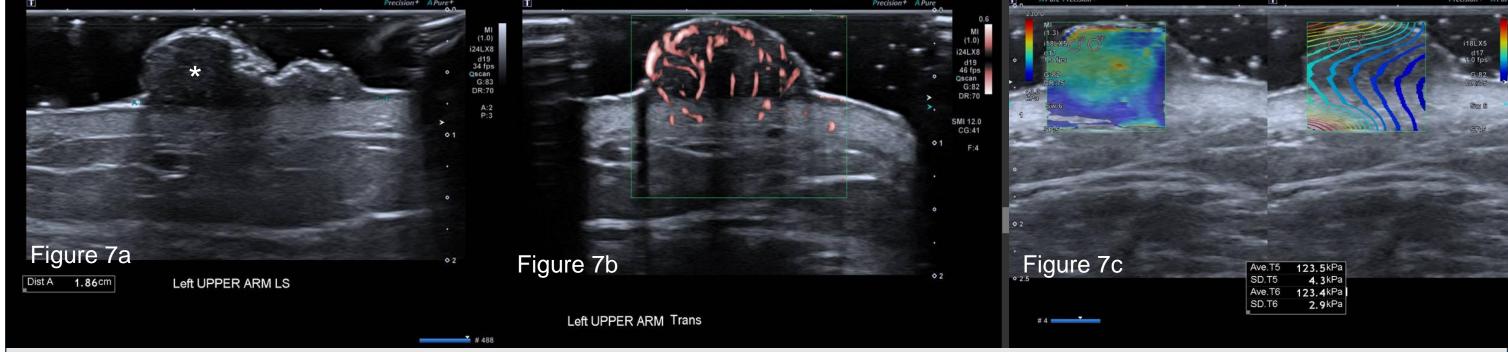
In this case, the mass (*) is located between the metacarpals (Figures 2a & b) and is challenging to determine its stiffness with SE. On SE, the mass is predominantly blue and indicating hard firmness (Figure 2c). Imaging features alone were unable to ascertain benignity of the mass and histology was used to obtain the final diagnosis.

One of the potential limitation in the use of SE is in hard to access or deeper lesions which may limit accurate assessment.

Angiolipoma



Angiolipoma is a benign soft tissue tumour commonly found on the trunk and extremities. Like lipomas, these contain mature adipocytes⁴ though distinguished by the presence of internal neovascularity on colour Doppler (Figure 3b). On SE, the mass (*) is part red and part orange indicating a soft lesion (Figure 3c). In cases such as this where the lesion is poorly circumscribed, SE can be used to better demarcate its margin, as its stiffness is different from the adjacent subcutaneous tissues despite the similar appearance on the greyscale ultrasound (Figure 3a).

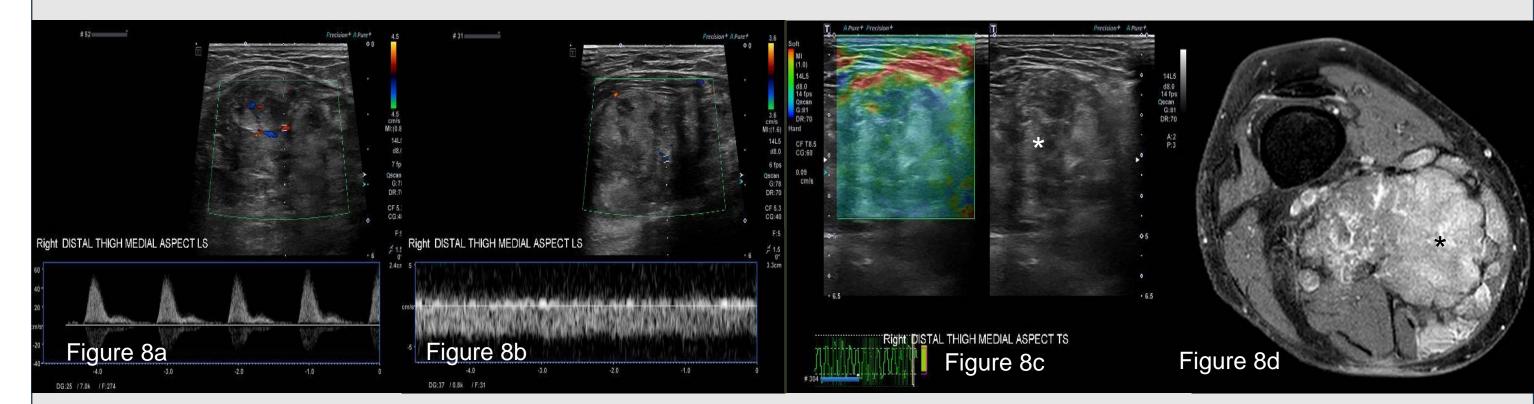


SCC is a type of non-melanoma cancer that arises from sun-exposed sites of fair-skinned individuals. The head, neck, and dorsal hands are commonly affected. A typical SCC appears as a heterogeneously hypoechoic lesion with irregular borders and may involve the deeper tissue layers. Presence of internal hyperechoic spots in BCC is usually used to differentiate it from SCC⁸.

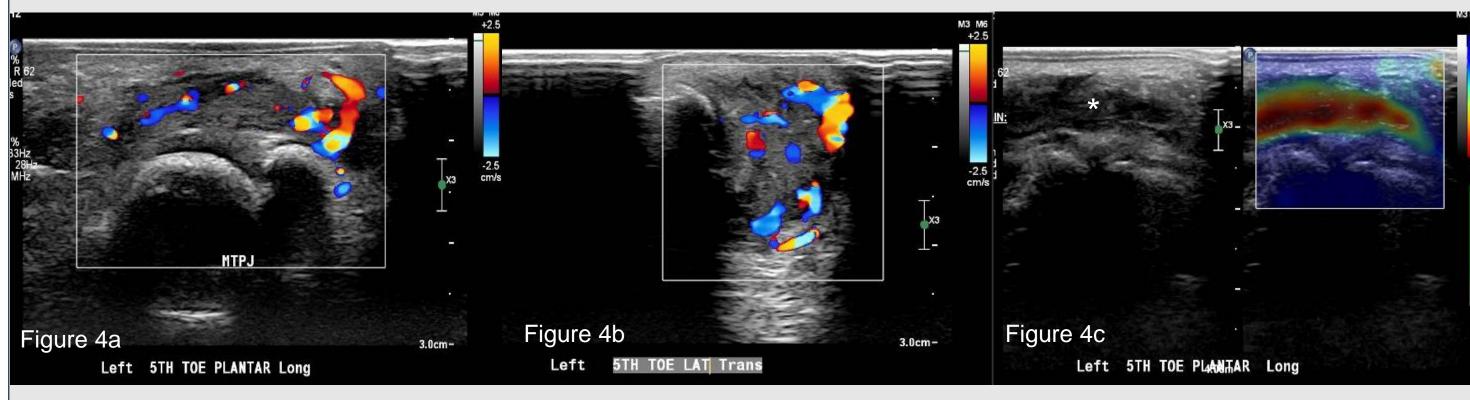
This case features a superficial irregular hypoechoic mass (*) (Figure 7a). SMI demonstrates diffuse increased vascularity throughout the mass (Figure 7b) and shows medium to hard stiffness on SWE (Figure 7c).

SWE reduces subjective interpretation of lesion hardness/stiffness based on palpation. Although histological diagnosis remains the gold standard, SWE may supplement conventional ultrasound to predict malignancy in MSK soft tissue tumours⁹.

Extraskeletal myxoid chondrosarcoma (EMC)



Adventitial bursitis



Adventitious bursae are acquired at sites subject to frequent pressure and friction. In the foot and ankle, adventitious bursae usually develop adjacent to bony prominences⁵. While raised as a possible differential given the location and clinical history in this case, it may be difficult to make the diagnosis given the echogenic appearance on greyscale and increased vascularity on colour Doppler (Figures 4a & b) alone. SE demonstrates that the region (*) is soft (Figure 4c) and aids in making the diagnosis.

EMC is a rare malignant soft tissue sarcoma that accounts for less than 3% of all soft tissue tumours¹⁰. We see here a heterogeneous mass (*) with both arterial and venous flow (Figures 8a & b). SE confirms its solid nature showing that the mass is moderate to hard (Figure 8c). This was deemed indeterminate on ultrasound prompting further evaluation with MRI. MRI confirms presence of a heterogeneous enhancing mass suspicious for malignancy (Figure 8d).

Conclusion

SE, SWE and SMI are excellent adjunctive tools in the evaluation of MSK soft tissue masses. A systematic approach applying proper technique in image acquisition can minimise potential pitfalls and aid accurate diagnosis and management.

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