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Case Series

Ultrasound as a convenient tool in assessment of masses in obscure locations: A case series

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ABSTRACT

Diagnostic imaging is an important tool in the work up of patients with suspected superficial masses. The likelihood of difficulties when such masses are located in obscure positions is a practical reality. It is well documented that Ultrasound plays a pivotal role in such circumstances. Improvements in digital Ultrasound technology, specialized high resolution multi frequency probes and use of Doppler techniques combine to make Ultrasound a modality of choice in the screening and assessment of superficial masses in obscure locations.

Keywords: Ultrasound, Radiography, Obscure locations, Diagnostic imaging, Diagnostic dilemmas, Superficial masses.

INTRODUCTION

Diagnostic imaging is an important tool in the work up of patients with suspected superficial masses. The likelihood of difficulties when such masses are located in obscure positions is a practical reality. It is well documented that Ultrasound plays a pivotal role in such circumstances. Improvements in digital Ultrasound technology, specialized high resolution multi frequency probes and use of Doppler techniques combine to make Ultrasound a modality of choice in the screening and assessment of superficial masses in obscure locations (Hwang S, 2005).

Diagnostic Ultrasound has many advantages which include absence of ionization radiation, portability, repeatability, accessibility and low cost. Ultrasound allows the determination of the nature, size, number, consistency and vascularity of any identified mass/lesion. Its key drawback lies in the fact that it is operator dependent and thus requires good knowledge and experience for interpretation.

The outcome of the ultrasound determines the line of management and is therefore invaluable for emergency physicians in resolving diagnostic dilemmas or planning interventions.

We present case series highlighting the use of ultrasound in resolving diagnostic dilemmas occasioned by superficial masses in rare or obscure locations.

PREPARATION AND TECHNIQUE

All examinations were performed using a Logic P9 Ultrasound machine with a Linear Matrix probe with frequencies of 5-16 MHz.

Power and Doppler modes were used when necessary, to ascertain the degree of vascularity of each lesion. In addition, assessment of any lesions with Strain Elastography technique was done whenever possible. In certain cases, when infection control is a concern, elastic probe covers are used.

CASE SERIES

(A) A 56 year old man presented with a swelling over the right shoulder. Swelling was soft, fixed and non-tender to touch, and hardly painful. Swelling was first noticed 24 months earlier and appears to be gradually increasing in size. Patient now feels discomfort when wearing shirts (Figure 1).

(B) A 26year old female with a balloon-looking vulval mass. Mass has been increasing in size over the previous 8 months and not particularly painful, except during coitus. The case is represented by (Figure 2).

(C) A 52 year old female presented with a large pedunculated vulval mass. Patient confirmed the mass to be of long-standing origin and has been progressive in size. Mass completely overlies the labial and clitorial structures (Figure 3).

(D) A 31 year old female presented with a swollen soft tissue on left thenar-eminence of the thumb (Figure 4).

(E) A 53 year old woman, presented with a painful right inguino-labial swelling. She complained of fluctuating size. At the time of presentation, she was afebrile, but feels severe pain on palpation. Mass was soft, fluctuant and warm to touch (Figure 5).

(F) A 19 year old male is presented with a right temporal

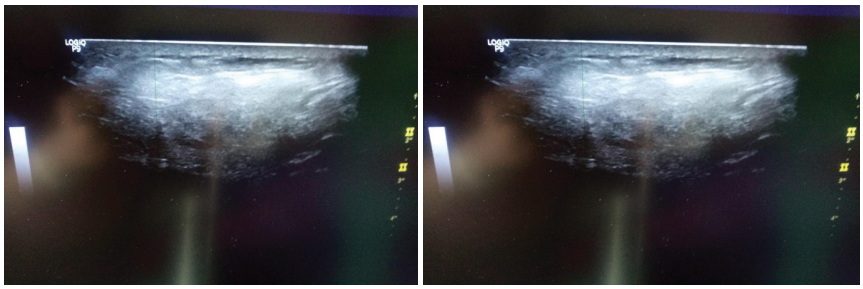

Figure 1. There is a subcutaneous swelling overlying the right deltoid muscle/region. It measures approximately 2.4 × 4.34 cm. Mass has a fairly homogeneous consistency and shows no vascularity on Doppler interrogation. There was no calcification or areas of cystic necrosis. The mass has appearances similar to those of adipose tissues. Normal strain elastographic indices were noted with soft to middle stiffness ranges. No abnormal ratios. Features are suggestive of a Lipoma.

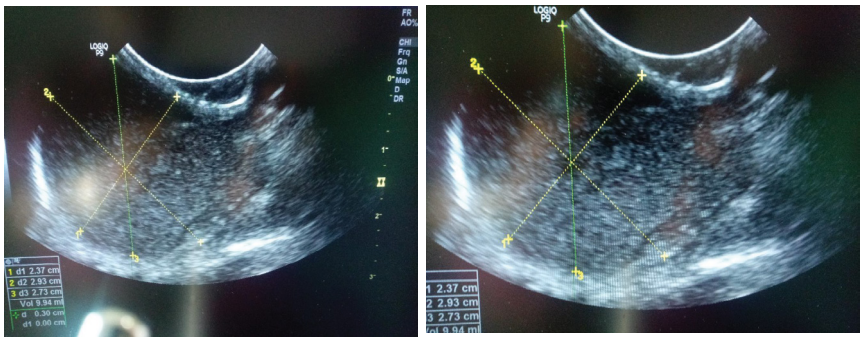

Figure 2. There is a complex soft tissue clitoral/vulval swelling. It measures about 3.68 × 1.86 × 2.03 cm and harbor very thick debritic fluid with volume estimate of 10 ml. No vascularity on Doppler interrogation. Mass was fairly compressible. Sonographic appearances are suspicious for a long standing Bartholin cyst.

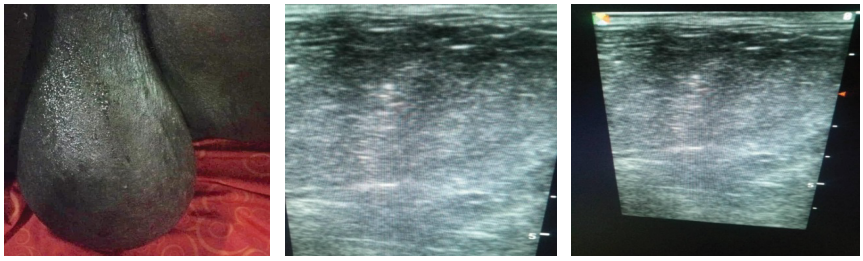

Figure 3. There is a large uniformly echogenic pedunculated mass arising from the right labial Majorca with a subtle stalk. Mass is essentially of solid/soft tissue consistency with fibrillation echogenic pattern typical of muscle tissues. Mass is avascularized on Power and Doppler interrogation and slightly compressible with probe pressure. No calcification or cystic changes. Possible differentials include a Giant angiomyofibroblastoma, labial leiomyomas.

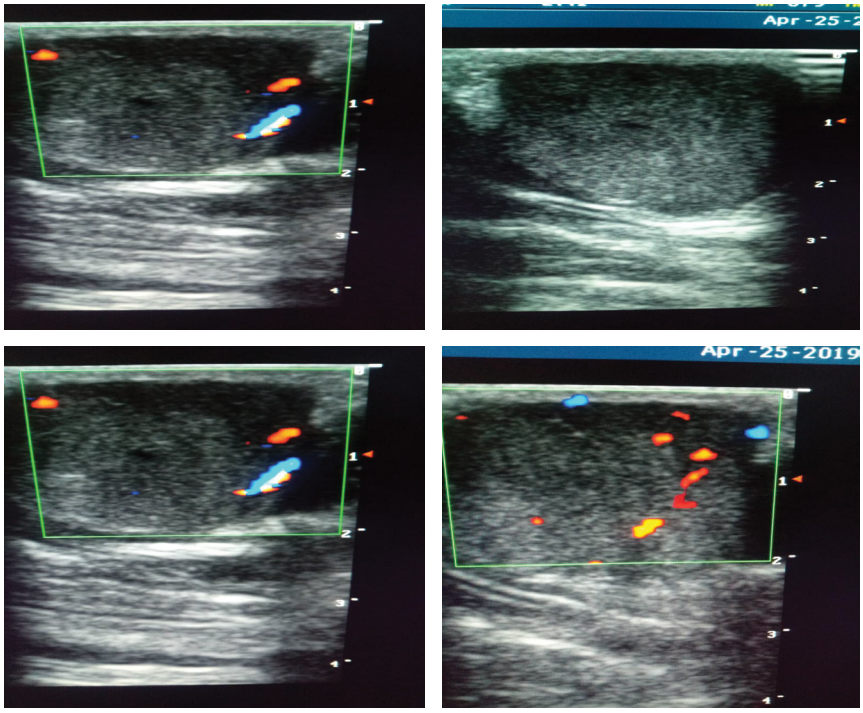

Figure 4. There is a well circumscribed rather subcutaneous-soft tissue mass (superficial) in the region of thenar-eminence (base of the thumb). Mass is inherent solid, non-compressible and has a homogeneous consistency measuring approximately 2.3 × 3.0 cm.There is no calcification or cystic changes and Doppler shows some degree of vascularity with arterial signals. Possible differentials included Epidermoid inclusion cyst and Liposarcoma.

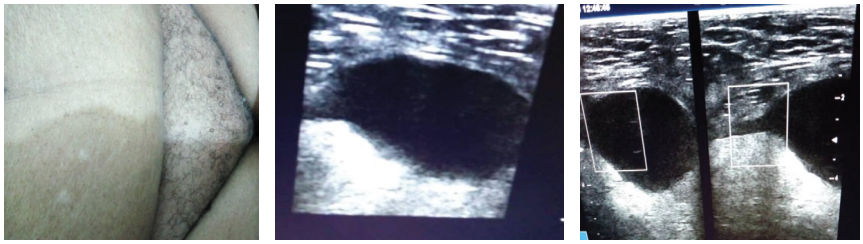

Figure 5. There is a cystic mass of size 3.6 × 3.0 cm in inguino-labial region (right). Mass was avascular on Doppler interrogation and has no communication with the ipsilateral iliac blood vessels. There is a comet-tail sign which shows a slight continuity with the inguinal canal. Mass has some thin septations and internal debris. Hydrocele of the canal of Nuck's primary sonographic diagnosis was made.

Figure 6. Right temporal region shows a soft tissue mass. It measures about 2.1 × 1.8 cm, non-compressible and has well defined margins. It has no vascularity on Power or Color Doppler and shows no calcifications. The primary consideration was a Lipoma.

swelling which has been noticeable over a period of six months. He has no history of trauma. Mass was warm to touch, and recently painful (Figure 6).

DISCUSSION

Digital ultrasound (US) improved advancements, innovation and the utilization of high-recurrence broadband transducers make ultrasound (US) imaging the principal screening instrument in exploring tissue lesions which are superficial.1 US is a safe (no ionizing radiation), convenient, effectively repeatable, and modest type of imaging in contrast with other imaging modalities. Ultrasound is a fantastic imaging methodology to decide the idea of a mass lesion (strong/cystic) and its anatomic connection to bordering structures. With ultrasound and Doppler ultrasound predominantly with power Doppler Ultrasound (Lin J, 2000) masses can be characterized in terms of their vascularity, component, number and size.

Sonography is an alluring modality for assessing masses which are superficial due to its low cost, high resolution, accessibility and absence of radiation in relation to MRI. The sonographic appearance of masses which are superficial has been portrayed by numerous authors (Jacobson JA, 2007; Cardinal E, 1994; Middleton WD, 2004; Doyle AJ, 2000). In the evaluation of masses which are superficial the diagnostic accuracy of sonography remains controversial as the reports from certain authors indicate urging caution and low diagnostic accuracy (Doyle AJ, 2000).

Soft-tissue masses which are superficial can generally be categorized as skin appendage lesions, mesenchymal tumors, metastatic tumors, inflammatory lesions or tumor like lesions and other tumors. These masses may be further categorized into lesions that arise in intimate association with the fascia overlying the muscle, lesions that arise within the substance of the subcutaneous adipose tissue, or lesions that arise in association with the epidermis or dermis (cutaneous lesions) with regard to their imaging features (Hwang S, 2005; Lin J, 2000; Jacobson JA, 2007; Wortsman X, 2013).

Ultrasound is also important in the evaluation of masses in obscure location as the female genital tract. US is typically the first imaging modality used to evaluate vulval masses due to its intrinsic high resolution, availability, and cost effectiveness (Tappouni RF, 2011; Stewart LK, 2001).

The vulva, which consists of the vaginal opening, vestibule containing the urethral meatus, clitoris, labia minora, labia majora, and the mons pubis can be affected by a wide range of dermatological conditions some of which are unique to this region. The variable- and high-frequency ultrasound application increases the degree to which common vulvar lesions can be characterized and identified with respect to their content, vascularity, size and location (Sarnelli G, 2003).

Variable- and high-frequency transducers working with upper frequencies of 15 MHz or higher are recommended, as in other dermatologic applications, preferably. A lower-frequency transducer can be utilized, but the definition of skin layers may be suboptimal. The scanning techniques for the vulva are identical to those that have been delineated for skin lesions on other parts of the body (Tappouni RF, 2011; Stewart LK, 2001; Sarnelli G, 2003). However, acoustic gel can slide off very quickly despite numerous applications as the vulva is in a peculiar location. Scanning should be quick with occasional replacement of the gel over the involved area. To avoid distortion of the vulvar structures, no or only minimal pressure should be applied on the skin. The greyscale examination of a lesion should be carried out in at least two perpendicular planes, followed by color Doppler imaging if necessary. Identification and measurements of the blood flow (type, distribution, and maximum peak systolic velocity of the arterial vessels), measurement of its size, an evaluation of the echogenicity patterns, and localization, particularly in relation to the skin layers, should all be reported if the target lesion is identified (Tappouni RF, 2011; Stewart LK, 2001; Sarnelli G, 2003; Eppel W, 2000; Wortsman X, 2017).

The skin consists of three layers: the epidermis, dermis, and hypodermis (subcutaneous tissue). The echogenicity of each layer depends on its main component: keratin in the epidermis, collagen in the dermis, and fat lobules in the subcutaneous tissue on a 2-dimensional greyscale sonography. The epidermis appears as an echogenic line usually. However, the echogenicity of the epidermis on the vulva can vary as the vulvar skin has various degrees of keratinization from keratinized epithelium on the labia majora to non-keratinized epithelium on the labia minora. The epidermis may appear as a bilaminar parallel hyperechoic structure in regions with a thicker corneous layer, like the medial aspect of the labia minora (Doyle AJ, 2000; Tappouni RF 2011; Barcaui Ede O, 2015).

To investigate the pelvic floor primarily transperineal ultrasound is used, for example to assess defecation disorder, pelvic organ prolapse, perineal injury or labor progression (Tappouni RF, 2011; Barcaui Ede O, 2015; Kim JW, 2008). As Transvaginal ultrasound has poor intra and inter observer reliability to determine the pathology of perineal masses this sonographic technique is seldom used. However, for the investigation of cervix, bladder, ovaries, ureter, placenta, pelvic tissues and organs, including the endometrium and pelvic floor muscle transvaginal ultrasound is an effective and accurate imaging technique (Doyle AJ, 2000; Leal RF, 2007). In differentiating between ectopic and orthotopic endometria this technique has a diagnostic accuracy that is homogeneous to that of laparoscopy (Leal RF, 2007; Beer-Gabel M, 2002, Beer-Gabel M, 2004).

It has been shown that transvaginal ultrasound effectively differentiated between solid, cystic-solid and cystic perineal masses, and that it indicated the possible underlying pathologies consistent with the histological results (Sarnelli

G, 2003; Eppel W, 2000; Eggebo TM, 2006). 3D reconstruction also helped to demonstrate the anatomical relationship of the perineal masses with the major surrounding structures, especially the bladder, urethra and vagina (Leal RF, 2007; Beer-Gabel M, 2002; Beer-Gabel M, 2004; Eggebo TM, 2006; Kim IO, 2000). Vaginal cysts are normally single but sometimes multifocal, and are typically categorized, according to the lining epithelia, into the following types: Bartholin duct cyst, Mullerian cyst, epidermal inclusion cyst and, occasionally, other pathological-type cyst (e.g. vaginitis emphysematosa, dermoid cysts, hidradenoma and Bartholin's gland cysts). The clinical manifestations include perineal mass, pain, dyspareunia and vaginal mass (Ebert AK, 2009). Vaginal wall cyst has been characterized on transvaginal ultrasound by a clearly defined, localized, cystic mass; larger cysts or cases with complicating infection may demonstrate circular or band-like hypoechoic areas. Endometriotic cysts, enterocele and Rectocele need to be ruled out. Vaginal epidermoid cyst (vaginal epidermal inclusion cyst) is a particular type of vaginal cyst that often results from injury, for example from the entrapment of squamous epithelia due to trauma and surgery, such as episiotomy (Eggebo TM, 2006; Kim IO, 2000; Ebert AK, 2009; Sperling DC, 1998). It occurs more frequently in women (child bearing age), and involves mainly the major labia or minor labia, and occasionally the vagina. This mass manifests as well-demarcated, round cyst, with its internal echogenicity dependent on the volume and content of its keratinous debris and sebaceous-like component. Differential diagnosis involves exclusion of common types of vaginal cyst, hydrocele and urethral diverticulum (Stewart LK, 2001).

Due to the greater awareness of clinicians the prevalence of female urethral diverticula has increased to 1%–6%. This condition is now investigated with numerous diagnostic imaging modalities, including double-balloon urethrography, postvoiding cystourethrography, contrast-enhanced CT and MRI, rigid or fiberoptic urethroscopy and transvaginal ultrasound (Dai Y, 2012; Panayi DC, 2010). By perineal/translabial ultrasound urethral diverticula can be diagnosed easily, and in urogynecological patients who may require this modality in any case for a variety of reasons this may well be the most convenient method (Pandis GK, 2001; Testa AC, 2009). Female urethral diverticulum typically manifests as a hypoechoic cyst, normally irregular in shape, intermixed with low density echoes if it is complicated with infection. The primary advantage of using a transvaginal ultrasound is its ability to differentiate a solid tumor from a cystic mass (Dai Y, 2012; Timor-Tritsch IE, 2005). However, it is hard to differentiate other lower urogenital tract cyst-like lesions, such as a paraurethral abscess from urethral diverticulum, using this technique (Dai Y, 2012; Dietz HP, 2001). In the diagnosis of female urethral diverticulum transvaginal contrast-enhanced sonourethrography has been tested, providing 4D visualization and it showed good correlation with surgical findings in terms of configuration, location, size and position of orifice.

In case of female patients developing neoplastic perineal masses following cancer surgery urinary bladder transitional cell carcinoma, ovarian cancer and endometrial adenocarcinoma are most likely the primary diseases (Testa AC, 2009; Timor-Tritsch IE, 2005; Dietz HP, 2011). Perineal metastases manifest as irregular, heterogeneous solid masses like other metastatic diseases, showing moderate- and low-density echoes on transvaginal ultrasound and with abundant blood-flow signals on color Doppler imaging (Testa AC, 2009; Bezircioglu I, 2012). 3D reconstruction may reveal that these infiltrative lesions involve other pelvic organs and the pelvic floor. In the investigation of perineal metastases contrast-enhanced MRI and Endoanal ultrasound can also be used (Timor-Tritsch IE, 2005; Gentry-Maharaj A, 2013). Transvaginal ultrasound is generally well-tolerated and safe, but is contraindicated in patients who have known vaginal malformation or have excessive vaginal discharge (Lin J, 2000; Jacobson JA, 2007; Gentry-Maharaj A, 2013). It is accepted by the patients as a screening tool for ovarian cancer in both parous and nulliparous women. Disadvantages include embarrassment and inconvenience felt by some women. When using transvaginal ultrasound the issue of hygiene is a safety concern as currently no standardized probe decontamination guidelines are available (Beer-Gabel M, 2004; Gentry-Maharaj A, 2013).

Malignant soft-tissue masses which are superficial are primary or metastatic neoplasms and the incidence of sarcomas increases with age. In first two decades the most common malignant sarcoma is rhabdomyosarcoma and during fifth to seventh decades it is malignant fibrous histiocytoma (Jacobson JA, 2007; Wortsman X, 2017; Beer-Gabel M, 2002). Malignant soft-tissue tumors commonly appear as hyper-vascular and hypoechoic on ultrasound and they can be well-defined. Dystrophic calcifications, areas of necrosis, and Cystic components may also be sighted. The degree of neo-angiogenesis correlates with Tumor vascularity. Numerous authors have recommended that power and color Doppler ultrasound may be useful in differentiation of malignant and benign tumors and also in the staging of malignant tumors (Testa AC, 2009; Venclauskas L, 2009). Only in the benign lesions absence of flow is observed and the negative predictive value is also high. The presence of flow is not very discriminative and can be seen in both malignant lesions and benign lesions. Hyperemia is not a constant feature of all the malignant tumors. Again, for all the benign tumors absence of hyperemia is not a decisive feature. Regular and linear course of the vessels are more suggestive of benignity whereas irregular and scattered course of the vessels or the sudden change in diameter of the vessel might be associated with irregular tumor angiogenesis and suggestive of malignancy (Testa AC, 2009; Gentry-Maharaj A, 2013; Venclauskas L, 2009).

In the evaluation of masses which are superficial several recently published studies have found sonography technique effective (Jacobson JA, 2007; Doyle AJ, 2000; Sarnelli G, 2003;

Fornage BD, 1999). Kuwano et al., found that sonography is useful in the pre-operative examination of the subcutaneous lesions, increasing the sensitivity for the diagnosis of lipoma from 55% to 88% and the specificity for the diagnosis of an epidermal cyst from 94% to 99% compared with palpation alone (Kuwano Y, 2009). In a retrospective study which involves 818 patients (693 patients with benign masses and 125 patients with malignant masses), Chiou et al., found that the most predictive sonographic features of malignancy are an infiltrated margin, a scalloped shape, and a size greater than 5 cm, however the overall diagnostic accuracy of sonography was not mentioned (Chiou HJ, 2009). Lakkaraju et al., used sonography to prospectively evaluate 358 patients referred to a sarcoma service for soft tissue masses (Lakkaraju A, 2009). On the basis of a combination of biopsy, magnetic resonance imaging and clinical follow-up, they found sarcoma in 1.7% of the patients (6 of 358 patients), with all the six sarcomas successfully recognized by sonography technique. In addition, 79% of the patients (284 of 358 patients) were classified as having benign lesions on sonography technique with a recommendation for clinical follow-up, and none of these patients developed evidence of malignancy during a two year period.

PDUS (Power Doppler ultrasound) and Ultrasound are practical and useful imaging modalities and the advantages of being easily available, low cost, and high efficiency in the assessment and monitoring of soft tissue lesions which are superficial and are in obscure locations.

CONCLUSION

In summary, in the assessment of lesions of superficial locations high resolution ultrasound remains invaluable. The availability, low cost, convenience, dynamic nature and the possibility of combining physical and ultrasound manipulations during scanning are excellent reasons to choose ultrasound as a first line investigation technique. The ability of ultrasound to differentiate cystic from solid lesions and to estimate the extent of vascularity reduces the diagnostic dilemmas experienced by primary care physicians and improves specificity.

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