# Sonographic Pictorial Review of Benign Palpable Paediatric Lumps: Head to Foot

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## INTRODUCTION

This pictorial review illustrates the ultrasound (US) features of commonly encountered benign palpable paediatric lumps in our clinical practice. For ease of description, we have classified them as head and neck lumps and trunk and extremity lumps (Table I). Some lumps however like vascular malformations, lipomas, nerve sheath tumours, lymphadenopathy, abscesses and epidermal inclusion cysts commonly overlap in both locations.

## LUMPS IN THE HEAD AND NECK

Palpable paediatric head and neck lumps may be inflammatory or non-inflammatory in nature. Many of these lesions are site specific and their location in conjunction with clinical history and US charaterstics help to reach the correct diagnosis[1].

*Haemangiomas and vascular malformations*

Vascular lesions are the most common paediatric soft tissue masses[2]. They are classified into haemangiomas and vascular malformations. Infantile haemangiomas are true neoplasms that proliferate and then involute. Vascular malformations are congenital developmental anomalies that continue to grow proportionately with the child. The diagnosis of these lesions is often clinical. Imaging is used to characterise the lesion and assess deeper extent prior to therapy[2,3].

Infantile haemangioma is the most common vascular tumour in infants[2]. It is commonly seen in the face and neck (60%) with a particular predilection for the parotid gland[2,4]. It appears as a red lobulated cutaneous lesion akin to a strawberry surface. On grey scale US, it is usually seen as a well defined solid hypoechoic mass. Colour Doppler shows high vessel density typically more than 5/sq.cm and on spectral Doppler, peak arterial shifts of more than 2kHz are usually noted[2]. On follow up imaging, the mass usually diminishes in size and appears less vascular, in keeping with the natural history of fibrofatty involution[2,4,5].

Vascular malformations can present as high flow lesions such as arterio-venous malformations and arterio-venous fistulae or low flow lesions like venous, capillary and veno-lymphatic malformations. High flow vascular malformations tend to show high vessel density and peak arterial shifts similar to haemangiomas (Fig 1). Venous tumours usually show anechoic compressible vascular spaces, low vascular density and low Doppler flow (Fig 2). Phleboliths if present, confirm the diagnosis of venous malformations [2,4].

*Lymphatic malformations / cystic hygromas*

Lymphatic malformations are a subtype of slow flow vascular malformations. The ones with large cystic spaces (usually >1 cm) are called cystic hygromas[1,2]. These lesions involve the head and neck in 48% cases and are usually found at the posterior triangle[1,2]. It is estimated that 90% of patients present by the age of 2 [1,2,5]. Patients commonly present clinically with a painless mass that may be compressible or transilluminant[1]. On grey scale US, uncomplicated cystic hygromas are seen as large, multilocular anechoic lesions with thin intervening septae. They are often transpatial and do not cause mass effect. Mild vascularity may be demonstrated within the septae on colour Doppler (Fig 3). Complications such as infection and haemorrhage may lead to acute increase in the size of the lesion with internal echoes or fluid-debris level within the cysts. MRI is necessary to delineate the deep extent of the lesion when sclerotherapy is considered for treatment. US can then be used to assess for post-therapy response in selected cases[1,2,3,5].

*Thyroglossal duct cyst*

Thyroglossal duct cysts (TDC) result from failure of thyroglossal duct regression. They account for about 70% of congenital neck masses in the paediatric population[5]. TDCs are often located in the midline and often seen in close association to the hyoid bone. The relationship with the hyoid bone varies with the majority of TDCs occuring at the infrahyoid region. About 50% of patients present before age 10 with a painless midline neck mass and often with history of previous incision and drainage[1,5]. An uninfected TDC is typically seen on US as a midline, unilocular, anechoic and avascular lesion with posterior acoustic enhancement (Fig 4). It characteristically moves with tongue protrusion and swallowing. Infected TDC may show debris and septae. They may rarely appear pseudo-solid due to high proteinaceous content. Some TDCs may show a track leading to the hyoid on US (Fig 5). It is essential to look for a solid nodule within a TDC, though rare it may indicate malignant transformation[1,6]. Midline dermoids may mimic TDCs. Off-midline TDCs may be confused with branchial cleft cysts. In these cases, the relation of TDC with the hyoid bone and the mobility of the lump is crucial in its identification[1,5,6,7].

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*Branchial cleft cyst*

Branchial cleft cysts are the most common non-inflammatory lateral neck masses seen in children[5]. About 95% of these arise from the second branchial apparatus [1]. A second branchial cleft cyst is typically seen high in the lateral neck along the anterior border of the sternocleidomastoid. It lies superficial to the common carotid artery and internal jugular vein but deep to the submandibular gland (Fig 6). Occasionally, the cyst may be associated with a tonsillar fossa fistula or sinus tract to the anterior border of sternocleidomastoid[1,5]. A typical branchial cleft cyst will sonographically appear as a unilocular, well defined, anechoic lesion without internal debris or vascularity. Posterior acoustic enhancement may be seen. Complications such as infection or haemorrhage may result in thickened walls, internal debris and septae. Cystic metastases from papillary thyroid carcinoma may mimic a complicated branchial cleft cyst. Fine needle aspiration of the cyst and evaluation of the thyroid gland is recommended in these cases. CT or MRI is usually performed to assess deeper pharyngeal involvement prior to surgical excision[1,5,6].

*Dermoid cyst*

Dermoid cysts are rare congenital cystic lesions with an incidence of 7% in the head and neck[1]. They frequently present as midline lumps in the floor of the mouth, suprasternal notch, forehead, orbits and nasal cavities. They are lined by epithelium and contain skin appendages. Dermoid cysts on US appear pseudosolid with mixed internal echoes due to their cellular and fat content. They are avascular. Posterior acoustic enhancement is uncommon (Fig 7). Osseous-dental structures if present, appear as echogenic foci with dense posterior acoustic shadowing. Fat globules within the lesion give rise to the 'sac of marbles' appearance on CT or MRI that helps to confirm the diagnosis [1,5,6].

*Ranula*

A ranula is a true mucous retention cyst of the sublingual gland. It presents as a painless swelling in the sublingual space. A simple ranula may enlarge and rupture into the submandibular space, it is then known as a plunging ranula[1]. On US, a simple ranula is seen as a unilocular, well defined, anechoic avascular lesion in the submental region. It lies above the mylohyoid and elevates the tongue. The bulk of a plunging ranula is however seen in the submandibular space below the mylohoid with a small beak into the sublingual space (Fig 8). An infected ranula can appear complex with internal echoes, septae and debris. CT or MRI may be used to assess the depth of the ranula prior to surgical excision [1,6,8].

*Fibromatosis colli*

Fibromastosis colli, also known as sternomastoid tumour of infancy is a benign mass that is thought to originate from fibroblastic proliferation of the sternocleidomastoid muscle secondary to birth trauma. It presents as a firm mass along the sternocleidomastoid muscle in a neonate between 2 to 4 weeks of age[2]. It is usually unilateral and may lead to torticollis in 14-30% of cases[2]. It usually resolves spontaneously or with stretching exercises. Fibromatosis colli appears on US as a focal fusiform mass or as a diffuse enlargement of the sternocleidomastoid muscle. The lesion is non-specific in echogenicity but characteristically moves with the muscle. Minimal vascularity may be seen on colour Doppler although calcification is uncommon (Fig 9). Further imaging and biopsy are seldom required. Gradually regression can be assessed by serial follow up US [2,9].

*Lymphadenopathy*

Reactive or suppurative nodes are common inflammatory neck masses in children [10,11]. Enlarged lymph nodes in children are mostly reactive and represent a transient response to local or systemic inflammatory process. Chronic lymphadenopathy however may have infective (viral, bacterial, fungal, protozoal) or malignant aetiology (lymphoma, leukaemia, metastases)[10,12]. Cervical lymph nodes measuring less than 1 cm in diameter are considered normal in children under 12 years of age. Reactive lymph nodes on US appear ovoid with fatty hilum and prominent hilar vascularity on colour Doppler. Their short to long axis ratio is less than 0.5 (Fig 10) [10,11].

Pathological nodes have some typical US features such as round contour, absence of echogenic hilum, intranodal necrosis, calcifications, matting and adjacent soft tissue oedema[10,11]. Intranodal necrosis and calcifications may be seen in tuberculous nodes and nodal metastases from papillary thyroid carcinoma (Fig 11). Matting of nodes and adjacent soft tissue oedema are common in tuberculous lymphadenopathy. Mixed or peripheral vascularity is abnormal and commonly seen in malignant nodes[10]. US is often the only modality needed for assessment and follow up of reactive lymphadenopathy post treatment. It can also be used for guided fine needle aspiration of suspicious nodes and drainage of lymph nodal abscesses.

**Lumps in the trunk and extremities:**

Unlike neck lumps, palpable lumps of the trunk and extermities are not very specific to any particular site. They vary in aetiology with some also seen in the head neck region.

*Lipoma*

Lipomas are the most common benign mesenchymal tumours and account for two thirds of all paediatric adipocytic tumours[2]. They are typically subcutaneous, however intra-and intermuscular locations may be seen. They commonly occur in the upper back, neck and proximal extremities. Lipomas present clinically as soft, painless, mobile masses. They may be solitary or multiple. Lipomas on US usually appear as encapsulated elliptical subcutaneous masses parallel to the skin surface. They are typically homogeneous and hyperechoic relative to adjacent soft tissue. They may contain echogenic lines parallel to the skin surface (Fig 12). Lipomas can appear isoechoic and hypoechoic less frequently. They tend to displace rather than infiltrate surrounding structures and are often compressible. Posterior acoustic enhancement is not seen in most cases. Lipomas are typically avascular on colour Doppler[13,14,15]. Intralesional vascularity may suggest sarcomatous transformation of the lipoma[15].

*Nerve sheath tumours*

The most common type of benign peripheral nerve sheath tumours are neurofibromas and schwannomas. These lesions are often asymptomatic and malignant transformation is

**Table I: Summary of the different benign palpable paediatric lumps according to their location. Note that vascular malformations, lipomas, nerve sheath tumours, lymphadenopathy, abscesses and epidermal inclusion cysts can overlap in locations**

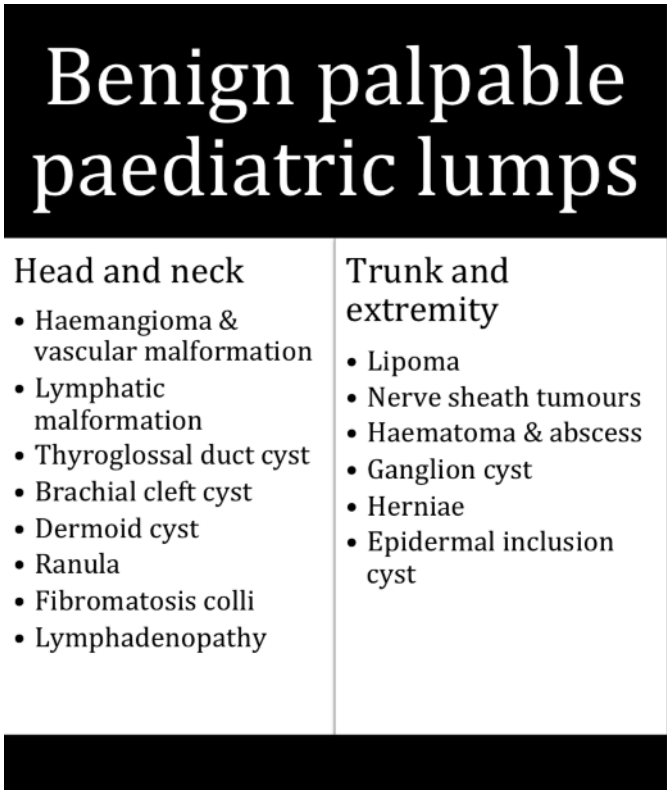


**Table II: Summary of the sonographic findings of the benign palpable lumps presented**

| Pathology | Typical locations | Typical ultrasound findings |
|---|---|---|
| Haemangiomas | Anywhere | Solid hypoechoic lesion with high vessel density that involutes with time |
| Vascular malformations | Anywhere | Ill or well defined lesions with vascular channels that show high or low velocity flow |
| Lymphatic malformation/ cystic hygroma | Posterior triangle of the neck | Multiloculated transpatial anechoic cystic lesion |
| Thyroglossal duct cyst | Midline neck, infrahyoid | Well defined, unilocular, anechoic, avascular cystic neck lesion; moves with tongue protrusion or swallowing. Posterior acoustic enhancement may be seen. |
| Branchial cleft cyst | Along anterior border of sternocleidomastoid muscle | Well defined, unilocular, anechoic, avascular cystic lesion. May have sinus draining along the anterior border of the sternocleidomastoid muscle |
| Dermoid cyst | Junction of dermatomes, periorbital, midline | Well defined, pseudosolid, mixed echogenic avascular lesion at the head and neck |
| Simple ranula | Floor of mouth above the mylohyoid | Well defined, unilocular, anechoic avascular lesion |
| Fibromatosis colli | Sternocleidomastoid muscle | Focal fusiform mass or diffuse enlargement |
| Lymphadenopathy | Lateral neck, axillary, inguinal | Ovoid, hypoechoic enlarged nodes with fatty hilum and prominent hilar vascularity |
| Lipoma | Anywhere – subcutaneous layer | Ill to well defined, subcutaneous or intramuscular avascular echogenic lesions parallel to skin surface |
| Nerve sheath tumour | Adjacent to nerve | Well defined, ovoid hypoechoic lesion. Nerve passes central or peripheral to mass |
| Hematoma | Anywhere | Initially ill defined echogenic lesion that undergoes interval decrease in size and echogenicity with temporal evolution |
| Abscess | Anywhere | Ill to well defined, hypo-/anechoic lesion with shaggy walls and rim vascularity; "dirty" internal echoes |
| Ganglion cyst | Periarticular adjacent to tendons | Well defined, anechoic and avascular cystic lesion, posterior acoustic enhancement and communication to joint may be seen |
| Herniae | Inguinal, scrotal and periumbilical | Distended internal inguinal ring measuring >4 mm in width and presence of fluid, omentum or organs within the inguinal canal |
| Epidermal inclusion cyst | Subcutaneous regions | Well defined, anechoic cystic lesion within the skin and subcutaneous tissue; pseudosolid appearance and sinus track to skin surface may be seen |

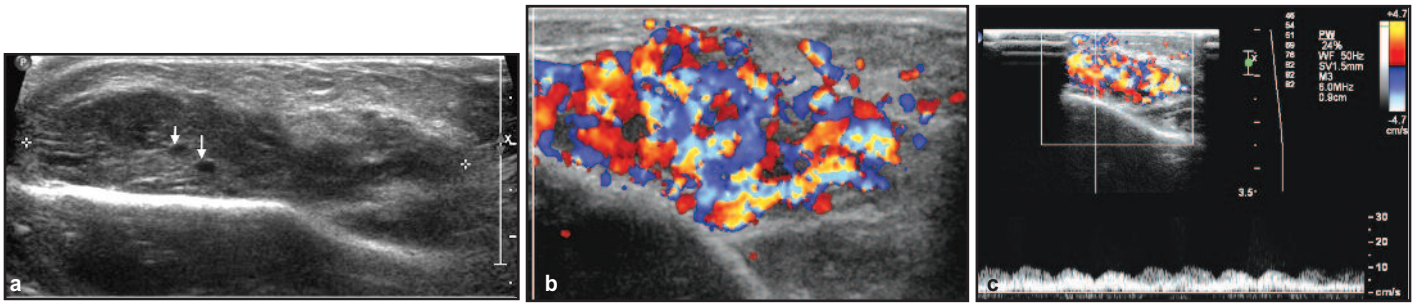


**Fig. 1 :** 1 year old girl with left facial lump. (a) Grey scale US shows an ill-defined, hypoechoic subcutaneous mass in the left cheek . Few anechoic vascular channels are seen within (arrows). (b) Colour Doppler shows high vascular density within the lesion (c) Spectral Doppler shows pulsatile arterial flow within the vessels. US confirmed clinical suspicion of AVM. Child treated conservatively and on regular US follow up.

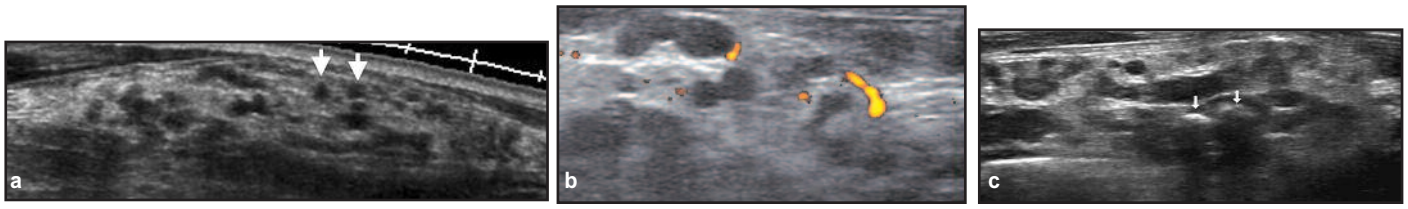


**Fig. 2 :** 13 year old boy with suspected venous malformation on the left side of the neck. (a) Grey scale US shows an ill defined mass with anechoic serpiginous vascular spaces (arrow). (b) Doppler shows very low amplitude flow within the vascular spaces in keeping with a low flow vascular malformation. (c) Echogenic phleboliths (arrows) within the vascular spaces confirm the diagnosis of venous malformation. The lesions is stable in appearance and size on follow up US.

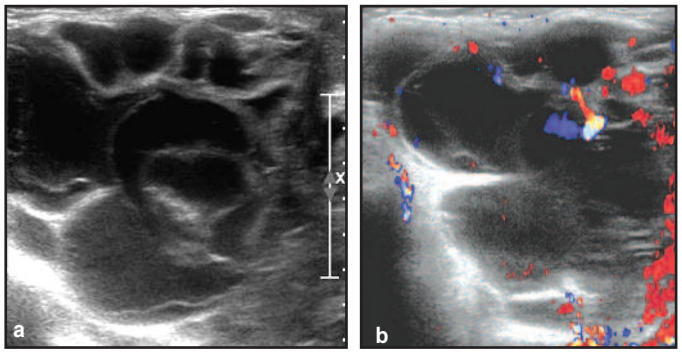


**Fig. 3 :** 8 month old boy with fluid filled lump in the neck. (a) Grey scale US shows a transpatial multilocular cystic lesion. (b) Colour Doppler shows minimal vascularity within the thin intervening septae. These features in the given clinical setting are characteristic for a cystic hygroma. Patient was later treated with sclerotherapy.

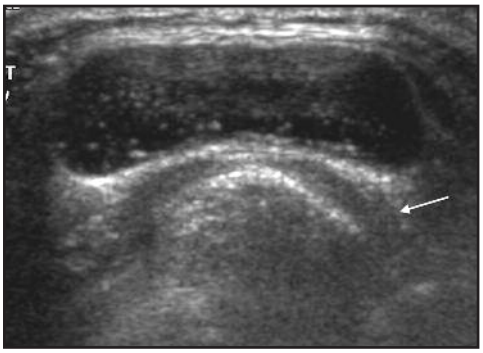

**Fig. 4 :** 8 year girl with midline neck lump. Grey scale US shows well circumscribed anechoic cystic lesion in the midline of the neck, anterior to the thyroid cartilage (arrow), that moves with tongue protrusion. The cyst shows internal echogenic debris and posterior acoustic enhancement. Thyroglossal duct cyst was confirmed on surgical excision.

**Fig. 5 :** 11 year old girl with midline neck lump. Grey scale US shows a well circumscribed hypoechoic lesion at the midline of the neck with small track leading to the hyoid bone (arrow). The lesion was excised surgically and histologically proven to be thyroglossal cyst.

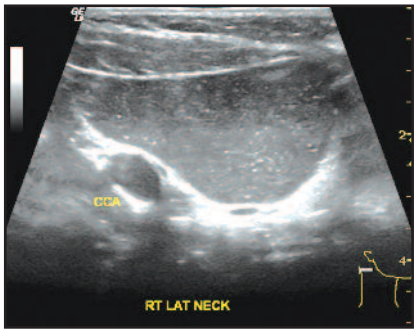


**Fig. 6 :** 13 year old girl with lateral neck lump. Grey scale US shows a large cystic lesion located anterior to the common carotid artery (annotation). Internal echogenic debris suggests a complicated cyst. Fine needle aspiration was performed to exclude metastatic lymphadenopathy that was negative. The lesion was excised surgically and histologically proven as branchial cleft cyst.

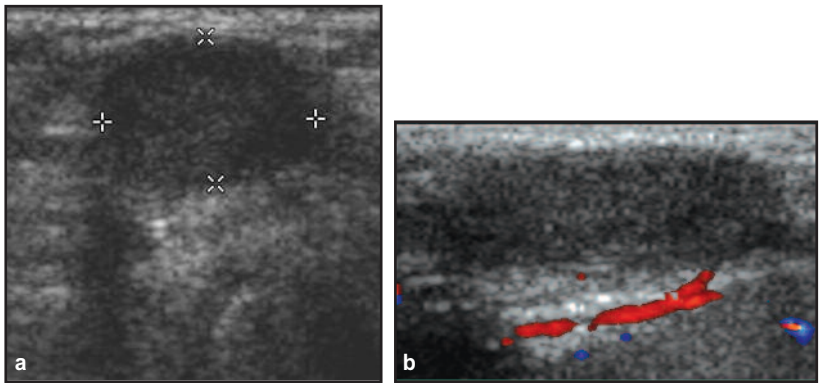


**Fig. 7 :** 8 year old girl with midline neck lesion. (a) Grey scale US shows well circumscribed hypoechoic lesion with no relation to the hyoid bone. The lesion does not move with tongue protrusion. (b) Colour Doppler shows absent vascularity. The lesion was surgically excised and histologically proven to be dermoid.

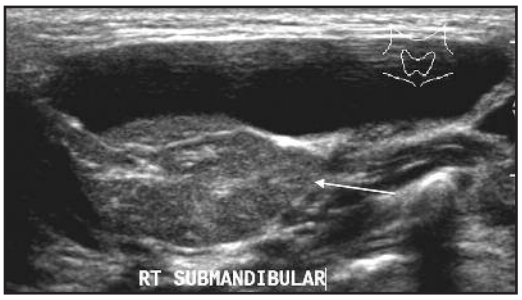


**Fig. 8 :** 10 year old boy with painful right submandibular swelling. Grey scale US shows the bulk of the well defined cystic lesion in the right submandibular space, adjacent to the submandibular gland (arrow). The clinical presentation in combination with sonographic findings are in keeping with plunging ranula. Surgical marsupialization was performed.

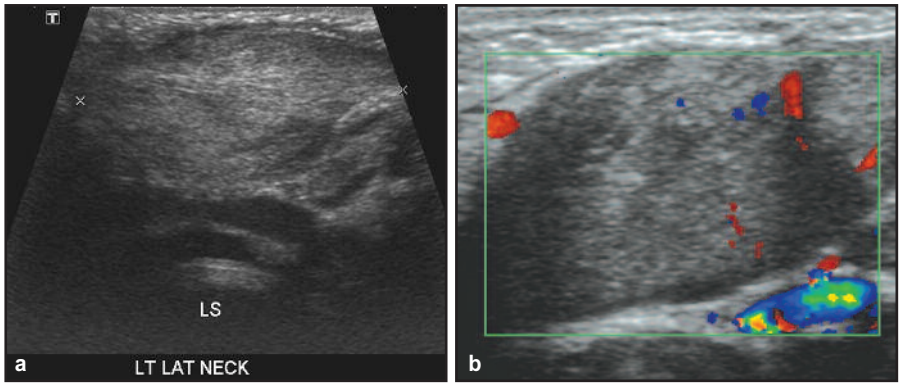


**Fig. 9 :** 2 week old boy with torticollis. (a) Grey scale US shows an oval, slightly hypoechoic mass within the sternocleidomastoid muscle (b) Colour Doppler shows some patchy vascularity within the mass. The US features appear consistent with fibromatosis colli. The lesion gradually involuted on follow up US .

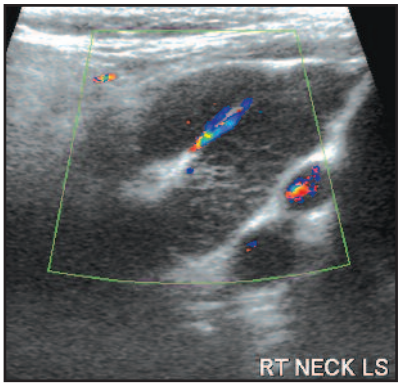


**Fig. 10 :** 6 year old boy with right sided painful neck lump. Colour Doppler shows an enlarged, ovoid hypoechoic node with prominent fatty hilum and prominent hilar vascularity in keeping with reactive lymphadenopathy.

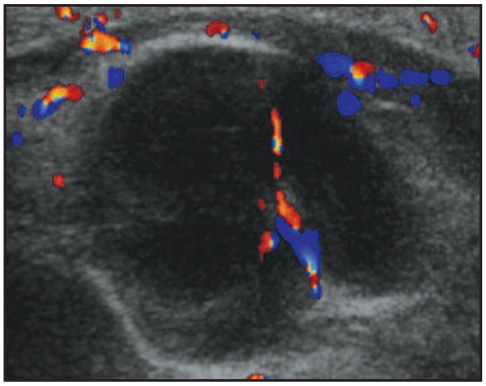

**Fig. 11 :** 14 year old girl with prominent supraclavicular lump. Colour Doppler shows a round hypoechoic enlarged lower cervical node with mixed hilar and peripheral vascularity. The node was biopsied under US guidance and diagnosis of lymphoma was confirmed.


**Fig. 12 :** 13 year old boy with a large lump over the anterior abdominal wall. (a) Grey scale US shows a well encapsulated, elliptical subcutaneous lesion with echogenic lines parallel to the skin surface. (b) Colour Doppler shows absence of vascularity. The features are consistent with lipoma and no further follow up imaging was performed.

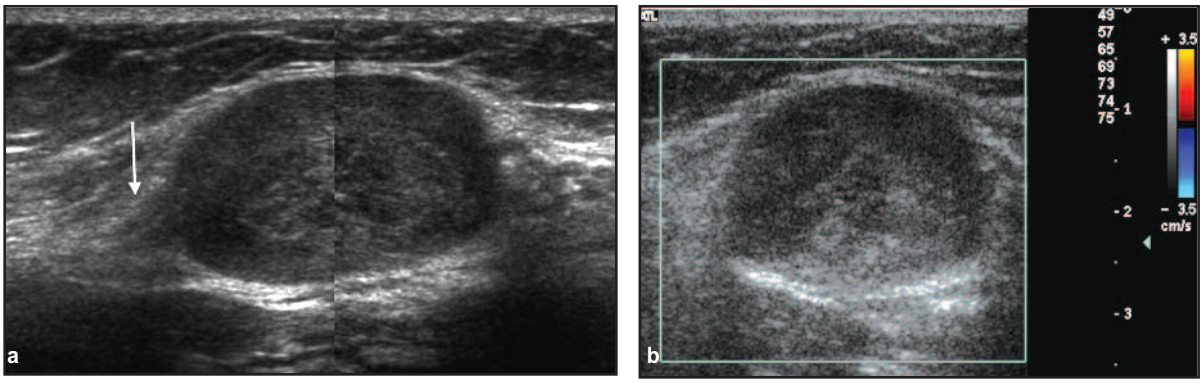


**Fig. 13 :** 9 year old girl with right forearm lump. (a) Grey scale US shows a well defined, solid hypoechoic lesion with tail-like appearance representing the exiting nerve (arrow) in keeping with schwannoma. (b) Colour Doppler shows no internal vascularity. Surgical excision was performed and histological analysis confirmed schwannoma.

**Fig. 14 :** 11 year old boy with recent trauma and swollen right thigh. Grey scale US shows a poorly circumscribed organizing hyperechoic avascular mass in the right thigh. Diagnosis of hematoma was made and the child was followed up with US until complete resolution.

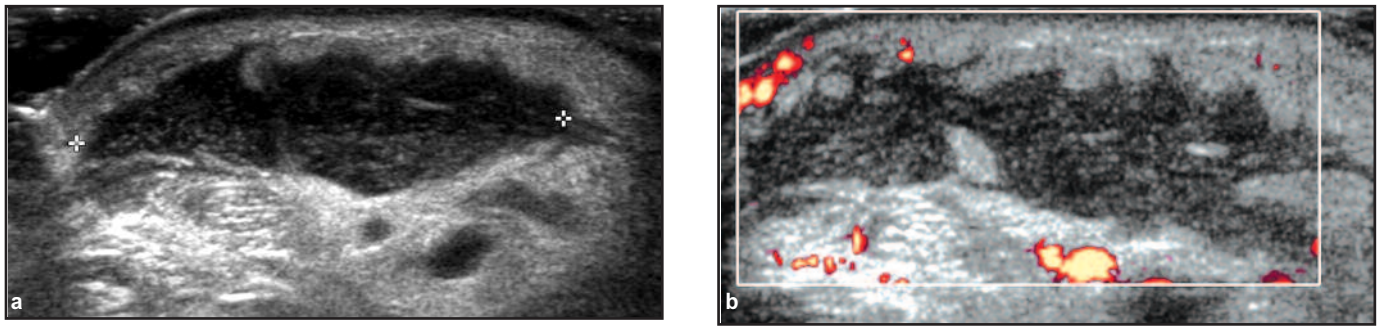


**Fig. 15 :** 14 year old boy with painful red wrist lump. (a) Grey scale US shows an anechoic liquefied abscess with dirty internal echoes and shaggy walls. (b) Colour Doppler shows peripheral vascularity within the walls of the abscess. Surgical incision and drainage was performed.

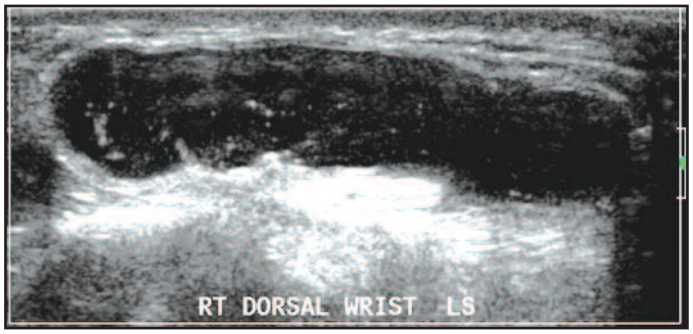


**Fig. 16 :** 12 year old boy with non tender right wrist lump. Grey scale US shows a well circumscribed anechoic cystic lesion dorsal to the extensor tendons of the right wrist. Internal debris and posterior acoustic enhancement noted. The features were consistent with ganglion cyst and the patient is being followed up with US.

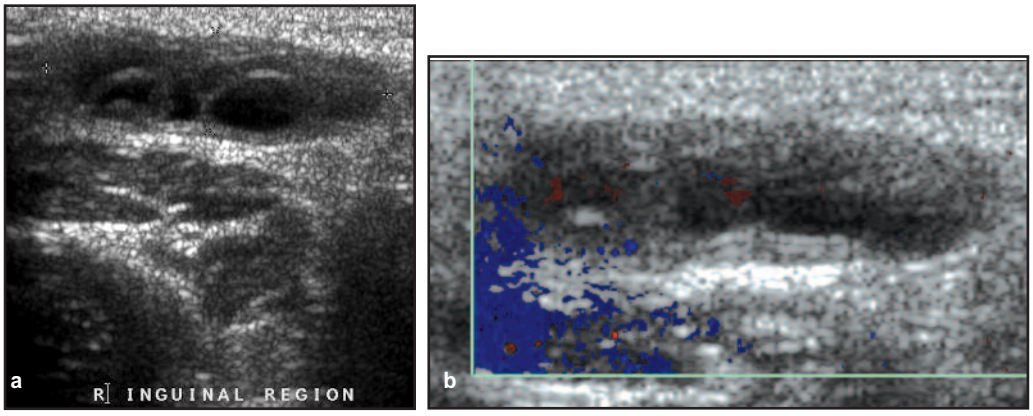


**Fig. 17 :** 2 year old girl with painful right groin lump. (a) Grey scale US of the right inguinal region shows a well defined structure with internal cystic areas within. The features appear characteristic for a herniated ovary with numerous follicles within (b) Colour Doppler shows intact vascularity of the pedicle. No other imaging was performed and child underwent surgical exploration and repair. Herniated right ovary identified intra-operatively.

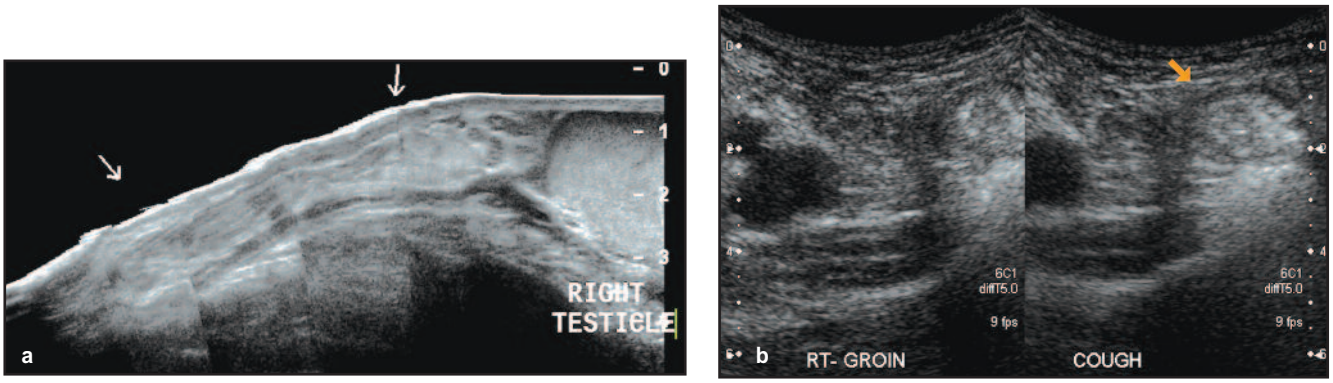


**Fig. 18 :** 6 year old boy with right inguinal lump. (a) Grey scale US shows herniation of omental fat into the inguinal canal. (b) Positive cough impulse demonstrated. The features were consistent with right inguinal hernia and confirmed during surgical repair.

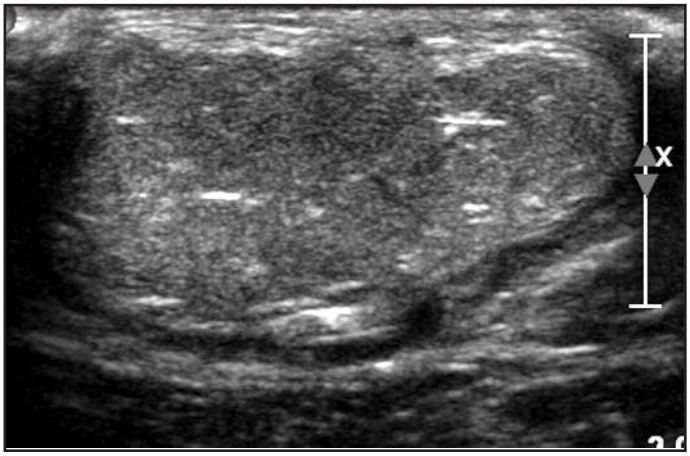


**Fig. 19 :** 14 year old boy with lump at the ankle, over the lateral malleolus. Grey scale US shows a well defined iso to hyperechoic lesion with echogenic foci No posterior acoustic enhancement or vascularity demonstrated. The lesion was surgically excised and histologically proven to be epidermal inclusion cyst.

rare[16]. US is poor at distinguishing between neurofibromas and schwannomas. Both commonly appear as well defined, ovoid or fusiform, homogeneous and hypoechoic masses (Fig 13). Posterior acoustic enhancement and 'target' appearance i.e. hyperechoic centre with hypoechoic periphery may be occasionally visualized. The nerve is seen to pass through the centre of the mass in neurofibroma whereas the nerve is related to the periphery of the mass in a schwannoma. Schwannomas may appear cystic and more vascular than neurofibromas [15,16,17,18].

*Haematoma and Abscess*

Haematomas and abscesses are common in the extremities. Clinical history is crucial to distinguish between the two as they have similar sonographic features. The sonographic appearance of haematoma changes with time. Acute haematoma is usually ill defined and hyperechoic whilst chronic haematoma reduces in echogenicity and size (Fig 14). Vascularity is often absent in a haematoma. An infected haematoma can progress onto an abscess.

An abscess on US usually appears as an ill to well defined hypo or anechoic lesion with shaggy walls. It may show 'dirty' internal echoes, fluid-fluid levels, septae and rim vascularity on colour Doppler (Fig 15). An abscess is frequently associated with adjacent oedematous subcutaneous tissue and enlarged reactive regional nodes. US may be used for guided aspiration and follow up till resolution [18,19].

*Ganglion cyst*

About 50-70% of soft tissue masses in the wrist region are ganglion cysts [18]. They are less common at the shoulder, elbow, hip, knee and ankle. A wrist ganglion on US typically appears as a well defined, anechoic and avascular lesion, lying dorsal to the extensor tendons (Fig 16). Posterior acoustic enhancement is common. Some ganglions may be compressible. Lobulations, septations and internal echoes may be seen. An anechoic duct leading to the joint may be visualized. An infected ganglion can mimic a solid mass and appear heterogeneous with internal echoes [18,20].

*Herniae*

Congenital indirect inguinal herniae are the most common external herniae in children. These usually contain omental fat, bowel loops and peritoneal fluid [21]. Unusual sac contents may include the vermiform appendix, part of the urinary bladder and ovaries and/or fallopian tubes in female infants.

A herniated ovary if detected on US must be differentiated from a round ligament cyst. Torsion of the ovarian vascular pedicle must be ruled out in all cases of herniated ovary (Fig 17) [22]. US criteria that have been decribed for paediatric inguinal herniae include internal inguinal ring greater than 4 mm in diameter and presence of fluid or organs in the inguinal canal at rest or during straining [23]. Herniated omental fat appears hyperechoic whilst bowel loops will demonstrate peristalsis (Fig 18). Bowel viability must be assessed in all cases by evaluating for peristalsis, reducibility and mucosal vascularity. Valsalva manoeuvre and examination in the standing position helps to assess sliding motion and reducibility of herniae in older cooperative children [24].

*Epidermal inclusion cyst*

Epidermal inclusion cyst results from the implantation of epidermal components into the dermis. The aetiology may be congenital (secondary to misplacement of the remnant ectodermal tissues during embryogenesis) traumatic or post-surgical [25]. They usually occur in the back, neck, scalp and extremities. Patients commonly present with a palpable nodule that discharges oily material through a punctum. An intact epidermal cyst on US appears as a well defined, anechoic lesion within the skin or subcutaneous tissue. Some cysts may show a sinus track leading to the skin surface [15,26]. They may sometimes appear pseudo-solid with bright internal echoes (pseudotestis appearance) due to their keratin content (Fig 19) [27]. A ruptured cyst may show irregular margins, rim vascularity and adjacent inflammatory changes [25]. Both intact and ruptured epidermal cysts may show posterior acoustic enhancement [15,26].

## CONCLUSION

US along with Doppler is a safe and reliable first line modality for the evaluation of palpable paediatric lumps. Accurate clinical history and awareness of the specific US characteristics of these lesions helps in correct diagnosis. The commonly encountered benign palpable lumps in children along with their common locations and typical US characteristics have been summarized in Table II. US also plays an important role in follow up of benign paediatric lumps, imaging guided needle aspiration for cytology and drainage of abscesses and collections.

## REFERENCES


1. Ahuja AT. Lumps and bumps in the head and neck. In: Ahuja AT, Evans RM (eds). Practical Head and Neck Ultrasound, 1st ed. New York, USA: Cambridge University Press, 2000: 87-104.
2. Navarro OM. Soft tissue masses in children. Radiol Clin N Am 2011; 49: 1235-59.
3. Donnelly LF, Adams DM, Bisset GS.Vascular malformations and hemangiomas: a practical approach in a multidisciplinary clinic. AJR Am J Roentgenol 2000; 174: 597-608.
4. Abernathy L. Paediatric neck lumps III- Vascular and lymphatic malformations. Ultrasound. 2007; 15: 142-7.
5. Petrovic S, Petrovic D, Pesic Z, Kovacevic P. Sonography of congenital neck masses in children. Medicine and Biology 2005; 12: 164-9.
6. Wong KT, Lee YY, King AD, Ahuja AT. Imaging of cystic or cyst-like neck masses. Clin Radiol 2008; 63: 613-22.
7. Kutuya N, Kurosaki Y. Sonographic assessment of thyroglossal duct cysts in children. J Ultrasound Med 2008; 27:1211-19.
8. Jain P, Jain R, Morton RP, Ahmad Z. Plunging ranulas: high resolution ultrasound for diagnosis and surgical management. Eur Radiol 2010; 20: 1442-9.
9. Ablin DS, Jain K, Howell L, West DC. Ultrasound and MR imaging of fibromatosis colli (sternocleidomastoid tumor of infancy). Paediatr Radiol 1998; 28: 230-3.
10. Ying M, Lee YY, Wong KT, Leung VY, Ahuja AT. Ultrasonography of neck lymph nodes in children. HK J Paediatr (new series) 2009; 14: 29-36.
11. Papakonstantinou. O, Bakantaki. A, Paspalaki.P, Charoulakis N, Gourtsoyiannis N. High-resolution and color Doppler ultrasonography of cervical adenopathy in children. Acta Radiol 2001; 42: 470-6.
12. Leung AK, Robson WL. Childhood cervical lymphadenopathy. J Pediatr Health Care 2004; 18: 3-7.
13. Ahuja AT, King AD, Kew J, King W, Metrewell C. Head and neck lipomas: sonographic apppearance. AJNR Am J Neuroradiol 1998; 19: 505-8.
14. Inampudi P, Jacobson JA, Fessell D, et al. Soft-tissue lipomas: accuracy of sonography in diagnosis with pathologic correlation. Radiology 2004; 223: 763-7.
15. Chiou HJ, Chou YH, Chin SY, *et al.* Differentiation of benign and malignant superficial soft tissue masses using grayscale and colour doppler ultrasonongraphy. J Chin Med Assoc 2009; 72: 307-15.
16. Stuart RM, Koh ES, Breidahl WH. Sonography of peripheral nerve pathology. AJR Am J Roentgenol 2004; 182: 123-9.
17. Reynolds DL, Jacobson JA, Inampudi P, Jamadar DA, Ebrahim FS, Hayes CW. Sonographic characteristics of peripheral nerve sheath tumours. AJR Am J Roentgenol 2004; 182: 741-4.
18. Kinare A, Brahmnalkar M, D'Costa S. Ultrasound of musculoskeletal soft tissue masses. Indian J Radiol Imaging 2007; 17: 201-8.
19. Lin J, Fessell DP, Jacobson JA, Weadock WJ, Hayes CW. An illustrated tutorial of musculoskeletal sonography. AJR Am J Roentgenol 2000; 175: 637-45.
20. Wang G, Jacobson JA, Feng FY, Girish G, Caoili EM, Brandon C. Sonography of wrist ganglion cysts: variable and noncystic appearances. J Ultrasound Med 2007; 26: 1323-8.
21. Shadbolt CL, Heinze SB, Dietrich RB. Imaging of groin masses: inguinal anatomy and pathological conditions revisited. Radiographics 2001; 21: S261-71.
22. Oh SN, Jung SE, Rha SE, *et al.* Sonography of carious cystic masses of the female groin. J Ultrasound Med 2007; 26: 1735-42.
23. Chou TY, Chu CC, Diau GY, Wu CJ, Gueng MK. Inguinal hernia in children: US versus exploratory surgery and intraoperative contralateral laproscopy. Radiology 1996; 2: 385-8.
24. Jamadar DA, Jacobson JA, Morag Y, Gandikota G, Ibrahim F, Gest T et al. Sonography of Inguinal Hernias. AJR Am J Roentgenol 2006; 187: 185-190.
25. Jin W, Ryu KN, Kim GY, Kim HC, Lee JH, Park JS. Sonographic findings of ruptured epidermal inclusion cyst in superficial soft tissue: emphasis on shapes, pericystic changes, and pericystic vascularity. J Ultrasound Med 2008; 27: 171-6.
26. Wortsman X. Common applications of dermatologic Sonography. J Ultrasound Med 2012; 31: 97-111.
27. Huang CC, Ko SF, Huang HY, *et al.* Epidermal cysts in the superficial soft tissue: sonographic features with an emphasis on the pseudotestis pattern. J Ultrasound Med 2011; 30: 11-7.

## Multiple Choice Questions

1. What is the commonest location of a TDC?
   A. Suprahyoid
   B. Infrahyoid
   C. Submental
   D. Submandibular
   E. Posterior triangle

2. Which space shows the bulk of a plunging ranula on US?
   A. Submental space
   B. Submandibular space
   C. Anterior triangle
   D. Masticator space
   E. Parapharyngeal space

3. US features of benign reactive nodes include:
   A. Intranodal necrosis
   B. Intranodal calcifications
   C. Fatty hilum with hilar vascularity
   D. Peripheral vascularity
   E. Round shape

4. What is the commonest location of a ganglion cyst?
   A. Wrist
   B. Hip
   C. Shoulder
   D. Ankle
   E. Knee

5. What are the common US imaging features of a cystic hygroma?
   A. Solid hyperechoic lesion
   B. Multilocular anechoic lesion
   C. Pseudotestis appearance
   D. Shaggy walls with dirty internal echoes
   E. High vessel density