

Imaging atlas of soft tissue masses in the backs of neonates and young children

Gayoung Choi, Young Hun Choi, Seul Bi Lee, Yeon Jin Cho,
Seunghyun Lee, Jung-Eun Cheon, Woo Sun Kim, In-One Kim

Department of Diagnostic Radiology, Seoul National University Hospital

Disclosures

- ♥ Gayoung Choi, Young Hun Choi, Seul Bi Lee, Yeon Jin Cho, Seunghyun Lee, Jung-Eun Cheon, Woo Sun Kim, and In-One Kim have no conflict of interest and nothing to disclose.

Objectives

- ♥ To summarize the list of soft tissue masses that can develop in the backs of neonates and young children
- ♥ To present key imaging findings of soft tissue masses in the backs of neonates and young children

Soft Tissue Masses in Children

♥ Common lesions

- ❖ Benign: Small, well defined, homogeneous, edema (-)
 - Vascular tumors, neurofibroma, fibromatosis, lipoma, ganglion cyst, hematoma, and abscess
- ❖ Malignant: Poorly defined, heterogeneous
 - Liposarcoma, fibrosarcoma, rhabdomyosarcoma

♥ Imaging study

- ❖ US: Initial examination of choice
 - Cystic or solid
- ❖ MRI: For large lesions to define the extent and its local relationships
- ❖ CT: More limited role

Classifications

- ♥ Pseudotumors: Fat necrosis
- ♥ Vascular lesions: Hemangiomas, vascular malformations
- ♥ Adipocytic tumors: Lipoma, lipoblastoma
- ♥ Fibroblastic/myofibroblastic tumors
 - ❖ Nodular fasciitis
 - ❖ Fibrous hamartoma of infancy
 - ❖ Myofibroma/myofibromatosis
 - ❖ Lipofibromatosis
 - ❖ Infantile fibrosarcoma
- ♥ Neurogenic tumor: Neurofibroma
- ♥ Unclassified benign tumors
 - ❖ Pilomtrcoma
 - ❖ Epidermal inclusion cyst

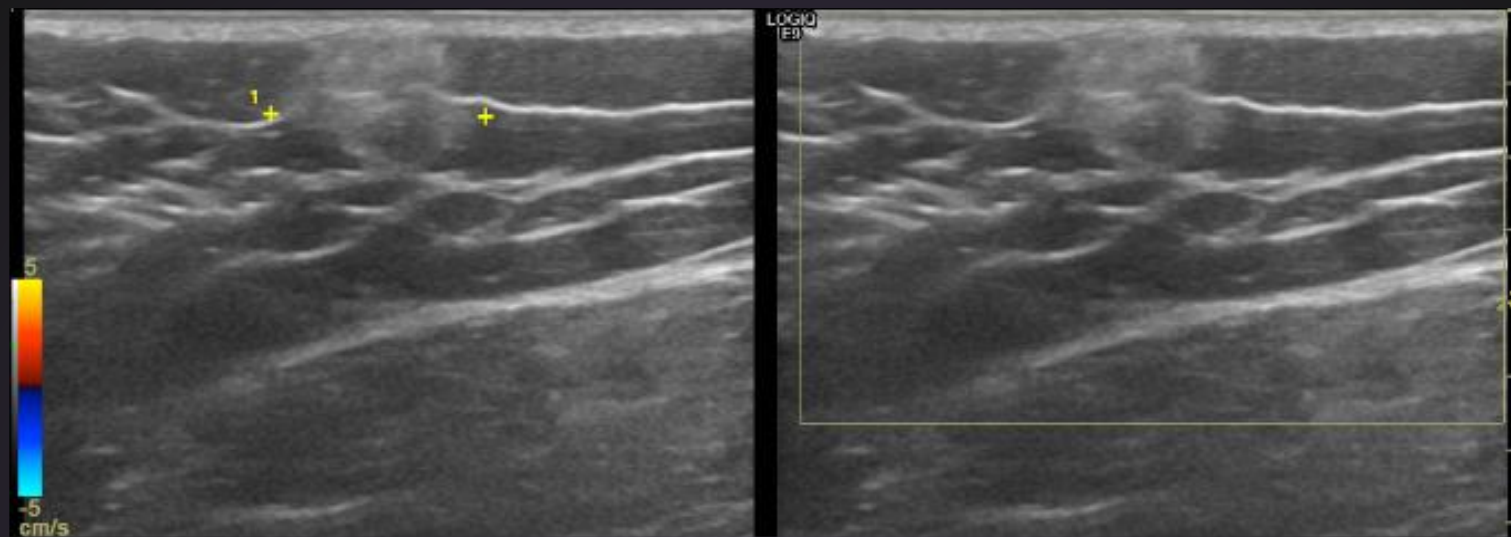
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PSEUDOTUMORS

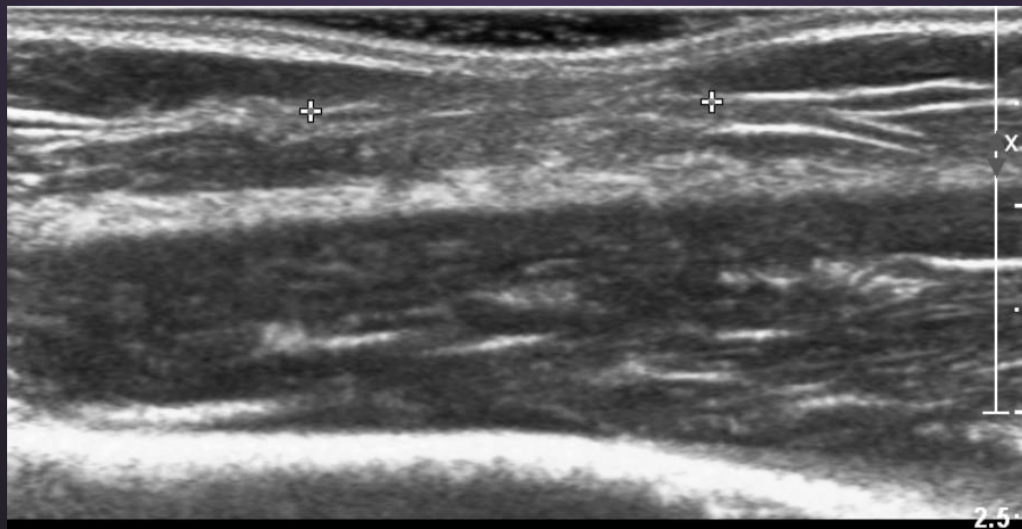
Fat Necrosis

- ♥ Usually limited to the subcutaneous soft tissues
- ♥ Overlying bony prominences
- ♥ Subacute or chronic palpable lump or deformity
- ♥ Most do not recall a specific traumatic event

- ♥ Imaging: Linear or mass-like configuration
- ♥ US: Hypoechoic to hyperechoic
- ♥ MRI: T₁ low SI, T₂ high and low SI
- ♥ Sequela: Tissue atrophy



US of a 6-year-old girl with the painful firm mass on the left lower back shows an ill defined hyperechoic lesion in the subcutaneous layer without internal vascularity suggesting fat necrosis.



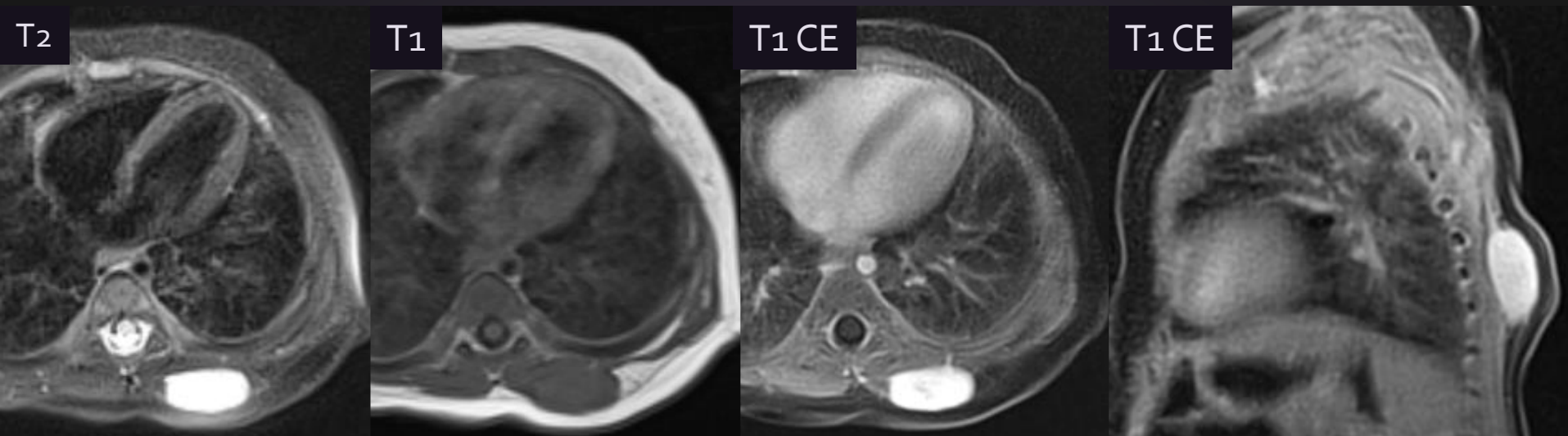
US of a 2-year-old girl with focal dimpling at right lower back shows ill defined hyperechoic lesion in subcutaneous layer with skin contraction which suggests fat necrosis with atrophic change.

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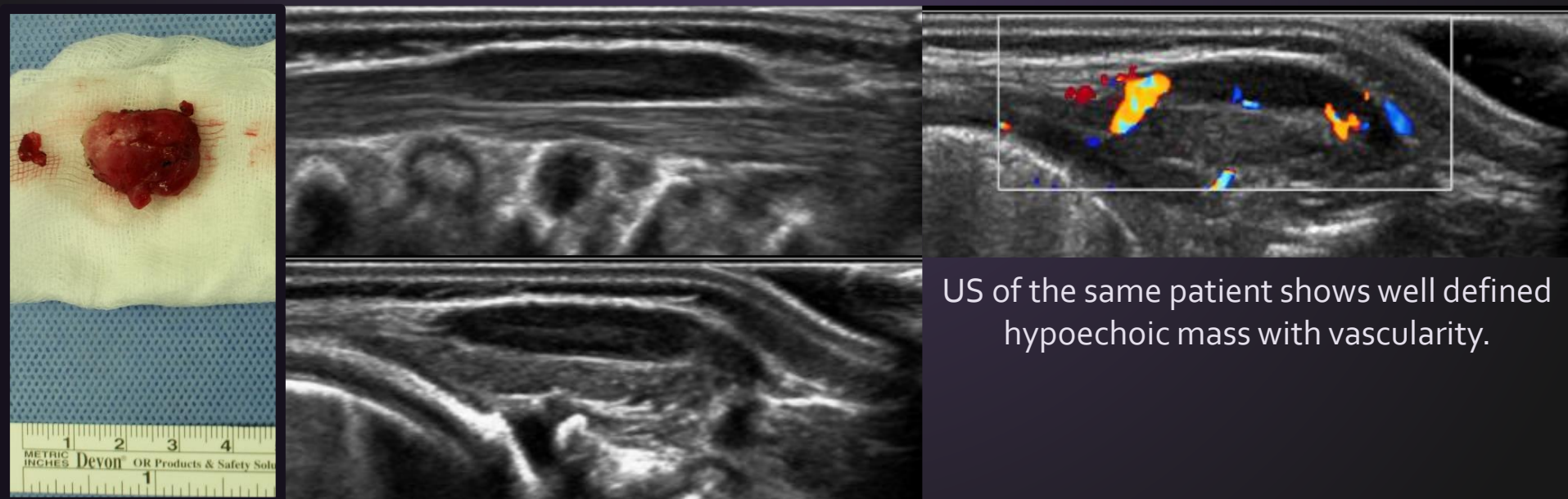
VASCULAR LESIONS

Hemangioma

- ♥ Benign, slow-growing lesion
- ♥ May also contain nonvascular elements: fat, fibrous tissue, smooth muscle
- ♥ Usually appear in the first decade of life (often 1st week)
- ♥ Rapid growth initially and then usually undergo spontaneous involution
- ♥ Imaging
 - ❖ Radiography: Soft-tissue mass with possible phleboliths
 - ❖ US: Usually hypoechoic, homogeneous or heterogeneous mass
 - ❖ Doppler US: Hypervascular
 - ❖ CT: Soft-tissue mass with vascular channels, enhancement (+)
 - ❖ MRI: T₁ low, T₂ high SI, marked enhancement (+)
 - Heterogeneity with hemosiderin deposits, fibrosis, fat, calcification, thrombosis, stagnant blood
 - Feeding or draining vessels, muscle atrophy



MRI of a 3-year-old boy with palpable back mass shows 2x0.9x2.1cm sized well defined ovoid mass at left upper back with T2 high SI, T1 iso SI, and strong enhancement, confirmed as a **hemangioma**.



US of the same patient shows well defined hypoechoic mass with vascularity.

Vascular Malformations

- ♥ Arteriovenous (AV), venous, capillary, lymphatic malformations
- ♥ Usually present at birth and grow with the patient

Vascular Malformations

♥ AV malformations: high-flow

- ❖ Enlarged feeding arteries and draining veins without an intervening capillary bed
- ❖ US: Complex mass
- ❖ Color Doppler US: High-systolic arterial flow, arterialization of the veins
- ❖ MRI: Dilated feeding and draining vessels, signal voids on T1- and T2WI, high signal on gradient echo sequences, enhancement (+)

Vascular Malformations

♥ Venous malformations: slow-flow

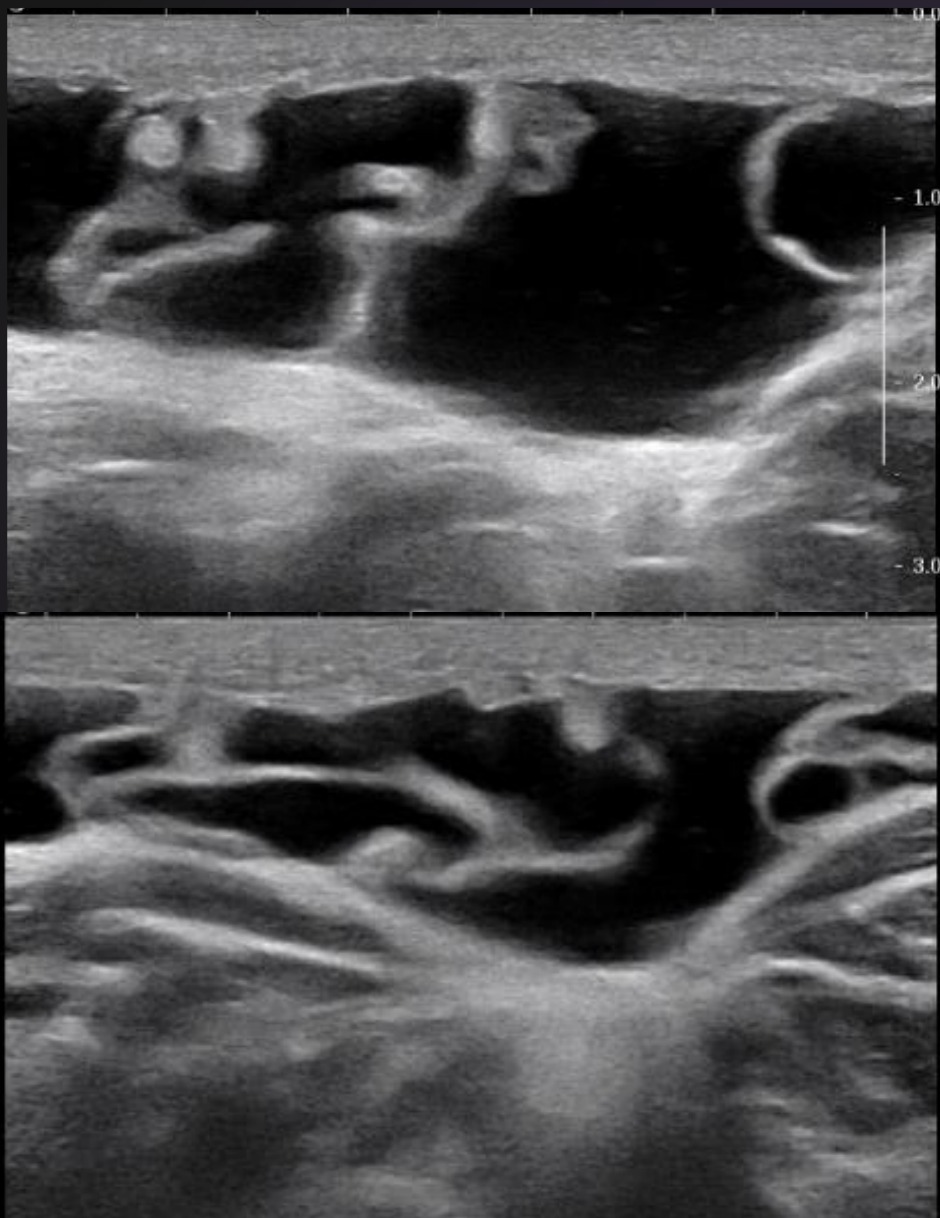
- ❖ Abnormal venous spaces and a normal arterial component
- ❖ Soft, compressible masses
- ❖ Normal or bluish color
- ❖ US: Hypoechoic or hyperechoic mass
- ❖ Doppler US: Low monophasic flow or no flow at all
- ❖ MRI: T₁ iso- or hypointense, T₂ hyperintense mass, absent signal on gradient-echo images, enhancement (+)
 - Rare signal void areas

Vascular Malformations

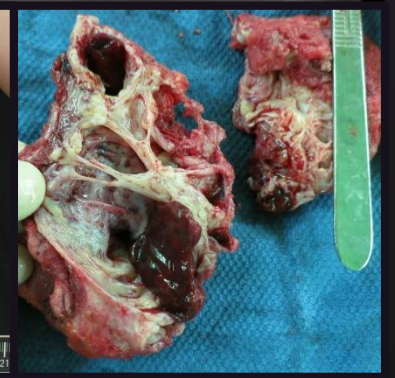
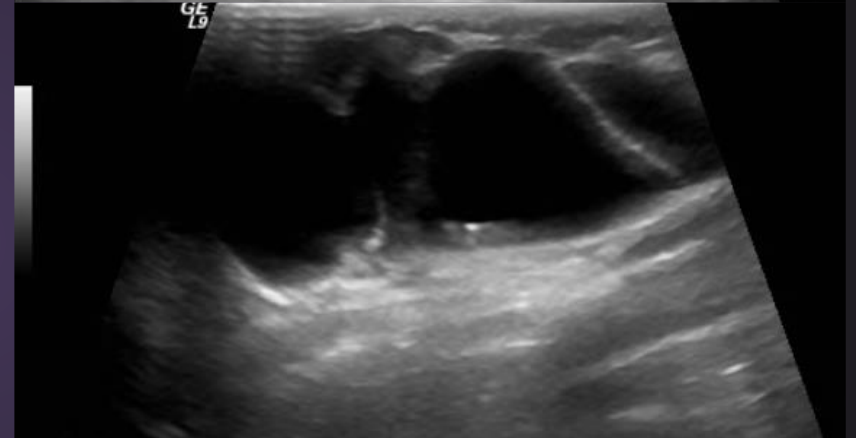
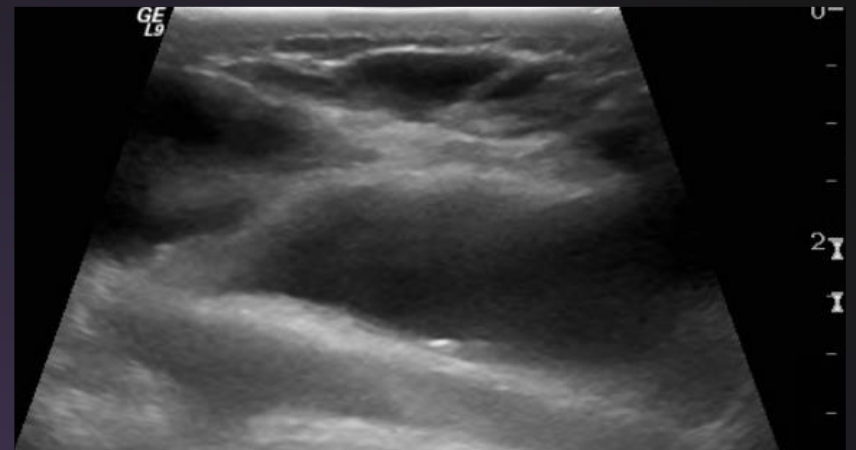
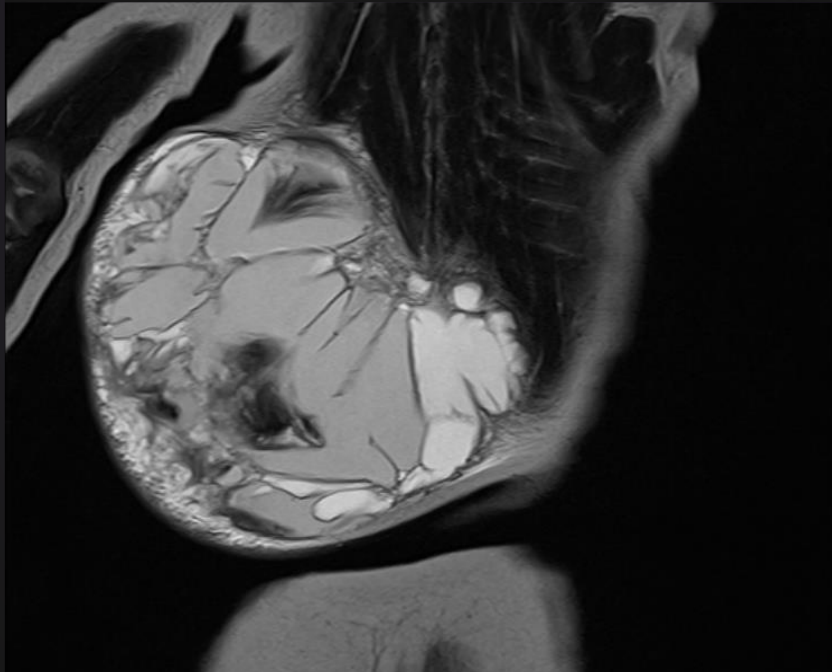
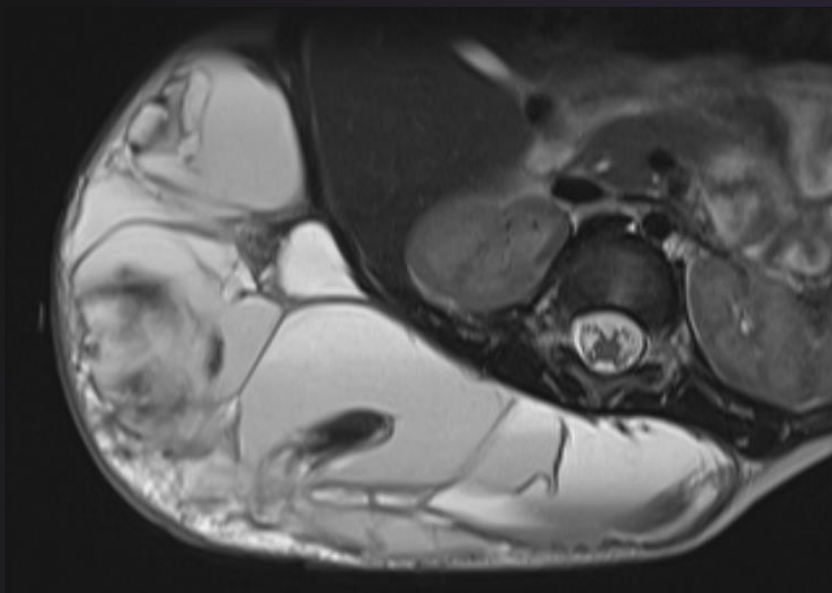
- ♥ Capillary malformations: Port-wine stain
- ♥ A collection of small vascular channels in the dermis
- ♥ Imaging: Usually normal, increased thickness of the subcutaneous fat and prominent venous channels

Vascular Malformations

- ♥ Lymphatic malformations: *Lymphangiomas, cystic hygroma*
- ♥ Congenital lesions composed of dilated lymphatic channels
- ♥ Usually present <2yrs
- ♥ Neck (75%), axilla (20%), mediastinum, retroperitoneum, bone, abdominal organs
- ♥ Imaging
 - ❖ Thin-walled, multilocular predominantly fluid filled masses
 - ❖ Fluid-fluid levels (prior hemorrhage), aneurysmal dilatation of adjacent veins
 - ❖ No enhancement of the cystic spaces, minimal/moderate septal enhancement
 - ❖ Absence of feeding vessels



US of a 2-month-old boy shows about 5.3cm sized multiseptated cystic mass at midline upper back, suggesting lymphangioma.



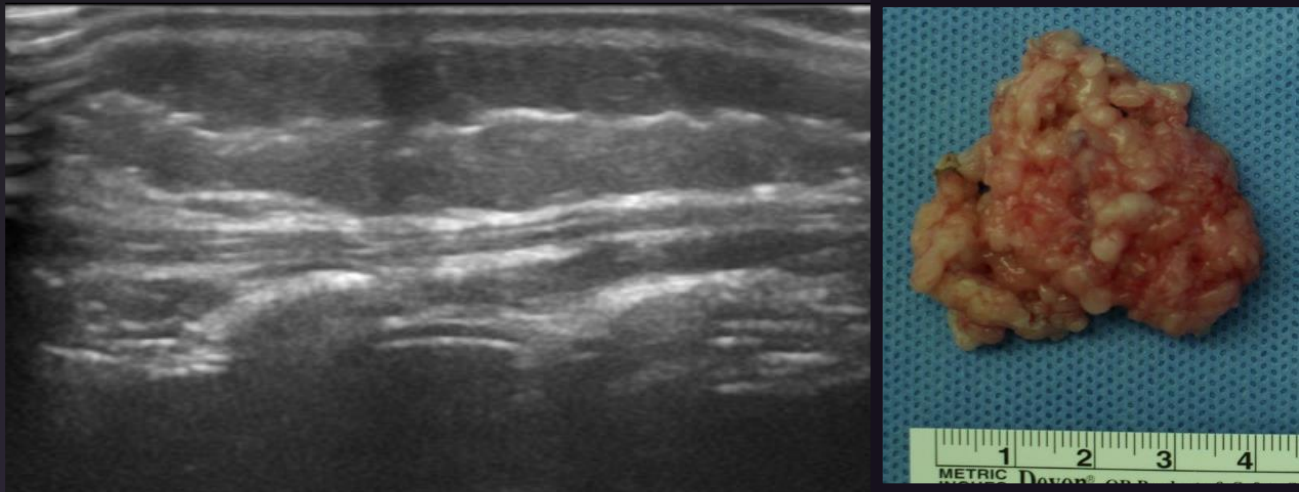
MRI and US of a 10-month-old boy shows about 15x13x10cm sized huge multiseptated cystic mass at right lateral back, confirmed as a lymphangioma.



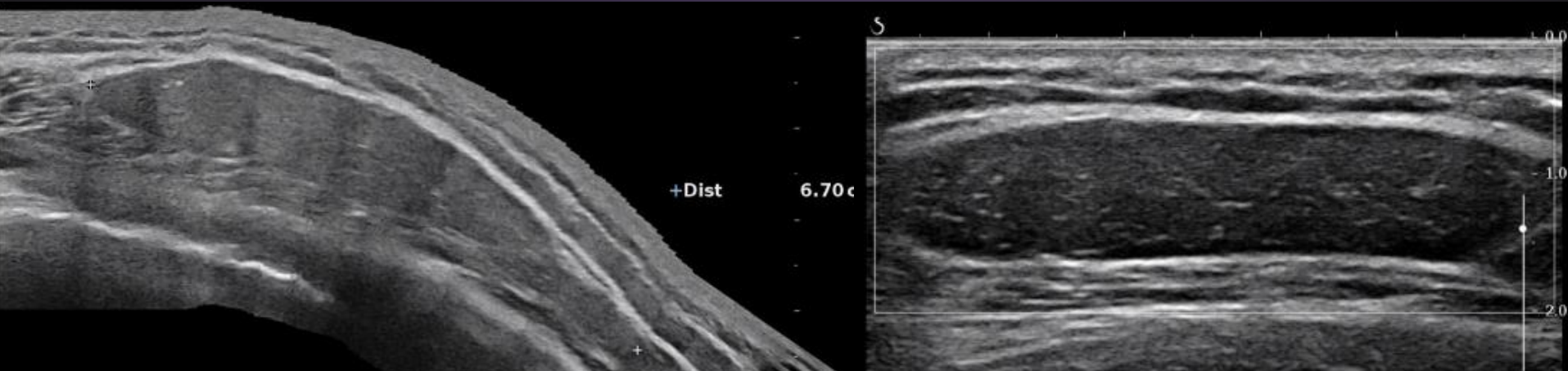
ADIPOCYTIC TUMORS

Lipoma

- ♥ M/C fat containing soft tissue mass in children
- ♥ Composed of mature adipose tissue
- ♥ Well-defined, homogeneous masses consisting almost entirely of fatty tissue
- ♥ US: Homogeneous mass of variable echogenicity
- ♥ MRI: Fatty mass, may have a few thin septations, no solid soft tissue component, enhancement (-)



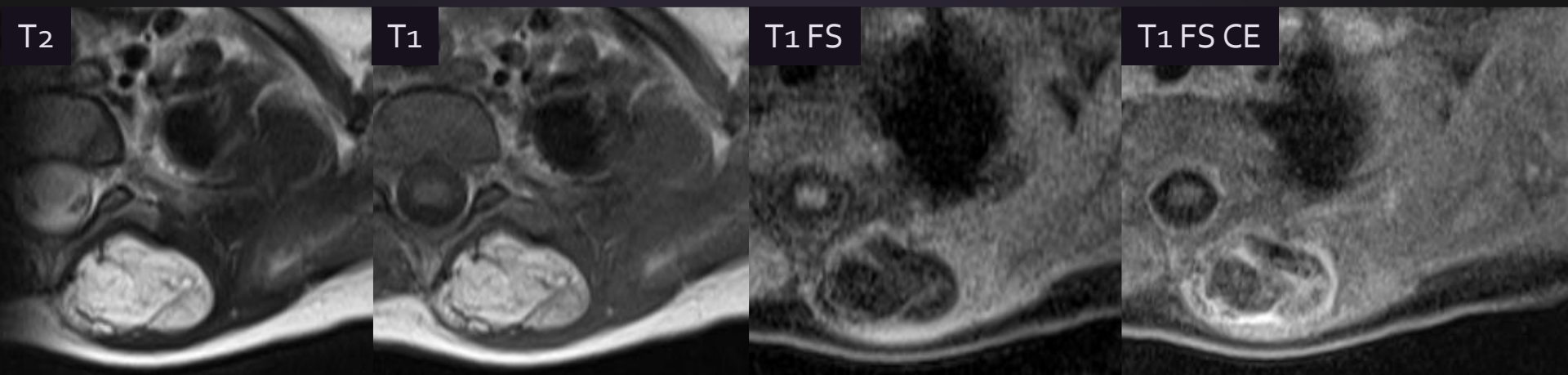
US of a 9-month-old boy shows localized thickening of subcutaneous fat layer at left back, confirmed as a lipoma.



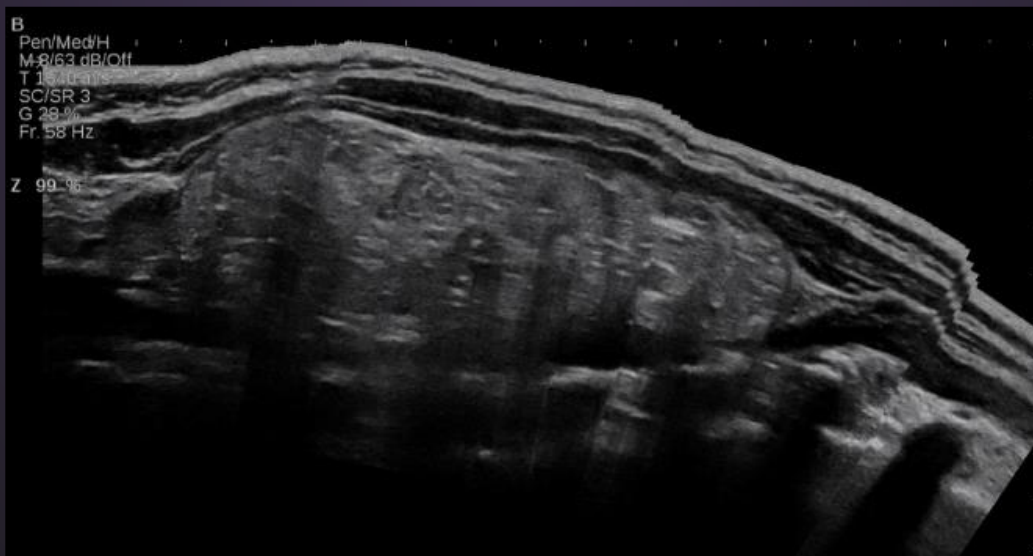
US of a 16-year-old girl shows about 6.7x5.3x1.29cm sized homogeneously hypoechoic mass in the subcutaneous fat layer of left upper back, suggesting lipoma.

Lipoblastoma

- ♥ Rare fatty tumor
- ♥ Occurs almost exclusively in young children (usually <3yrs)
- ♥ Multiple lobules of immature fatty tissue separated by fibrous septa
- ♥ Soft tissue or fatty mass
 - ❖ Depending on the relative amount of fibrous and lipomatous tissue
- ♥ c.f. Liposarcoma: Indistinguishable on imaging, but exceedingly rare in children (<1%)



MRI of a 3-year-old boy with palpable mass on left upper back shows lobulated fatty mass with enhancing septations at left paraspinal area, confirmed as a **lipoblastoma**.



US of the same patient shows heterogeneous hyperechoic fatty mass.



FIBROBLASTIC/MYOFIBROBLASTIC TUMORS

Nodular Fasciitis

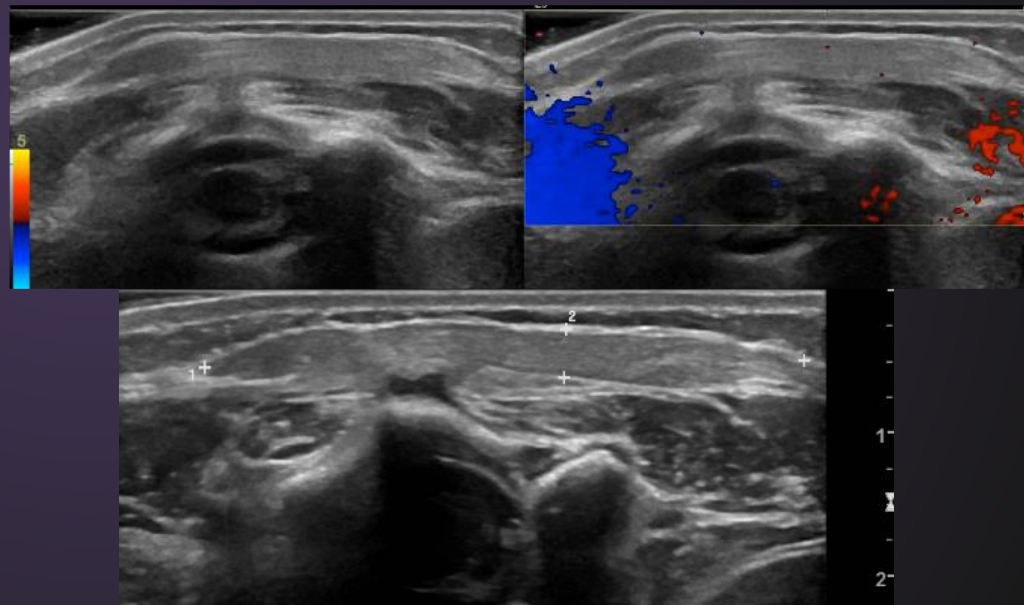
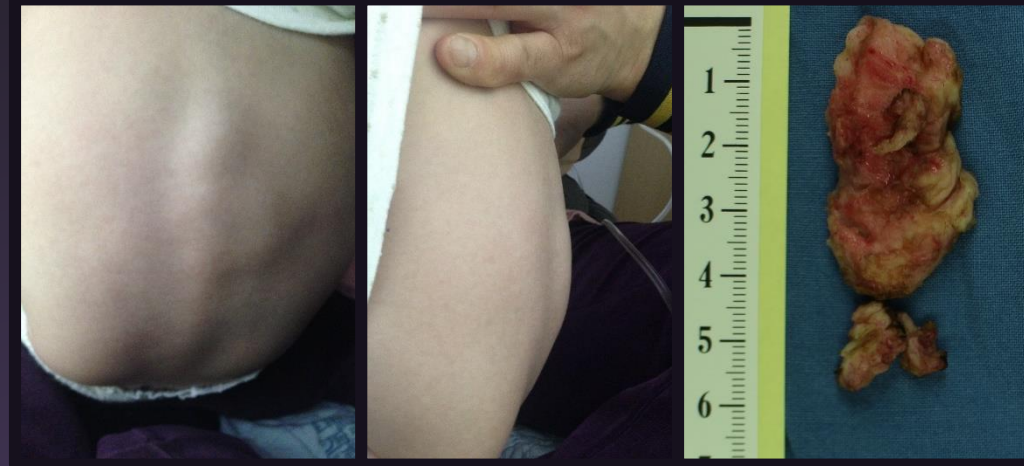
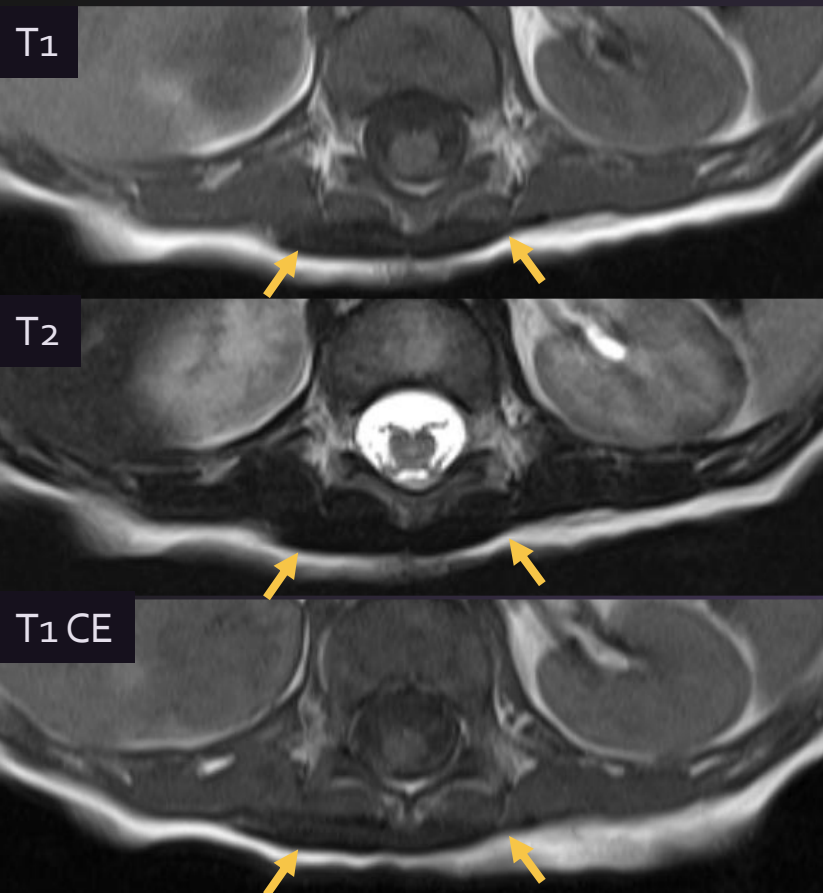
- ♥ A rapidly growing painless mass
 - ♥ Benign fibrous proliferation
 - ♥ Usually subcutaneous, sometimes intra/intermuscular locations
 - ♥ Cranial form: Almost exclusively <2yrs
-
- ♥ T1WI: Iso to slightly high SI to skeletal muscle
 - ♥ T2WI: Often high SI (> subcutaneous fat)
 - ♥ Possible central necrosis
 - ♥ Fascial tail sign (+): Linear extension along the fascia

Fibrous Hamartoma of Infancy

- ♥ Subdermal fibromatous tumor of infancy
- ♥ Benign superficial soft tissue mass composed of fibrocollagenous tissue, primitive mesenchymal cells, and mature fat
- ♥ Solitary, freely mobile, rapidly growing, usually painless, <5cm
- ♥ Anywhere in the body
 - ❖ Axilla > upper arm, shoulder > neck, thigh, back, forearm
- ♥ 25% congenital, diagnosed in the first 2 yrs of life
- ♥ M:F = 2-3:1

Fibrous Hamartoma of Infancy

- ♥ Imaging: Rapidly growing, subcutaneous mass in soft tissues adjacent to shoulder in infant
 - ❖ Usually <5cm
- ♥ Radiographs: Normal to soft tissue fullness, calcification (-)
- ♥ CT: Nonspecific soft tissue mass, usually infiltrative
- ♥ US: Lobulated/ill defined hyperechoic subcutaneous mass with a hypoechoic peripheral component/serpentine internal strands
- ♥ MRI: Variable amount of fat interspersed among heterogeneous soft tissue bands composed of mesenchymal and fibrous tissue
 - ❖ Tightly packed strands of T₁/T₂ iso-low SI and T₁ high SI fat component

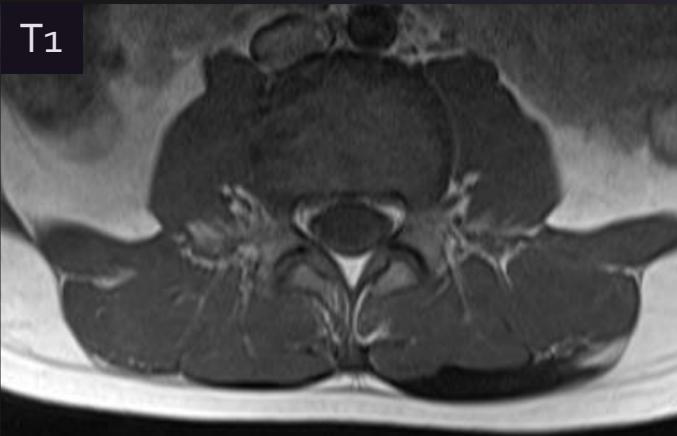


MRI of a 3-month-old boy with palpable mass on mid back shows poorly enhancing T1 and T2 low SI well defined plaque like lesion at superficial fascial layer of median to right paramedian back, confirmed as a **fibrous hamartoma of infancy**.

US of the same patient shows well defined plaque like hyperechoic lesion at the superficial layer of back.

FU MRI (2019)

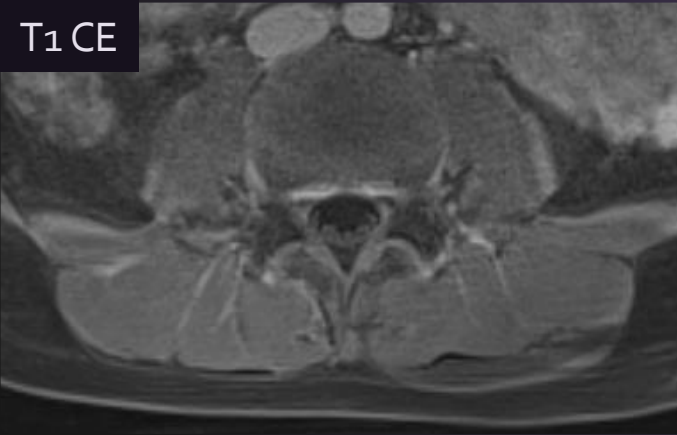
T1



T2

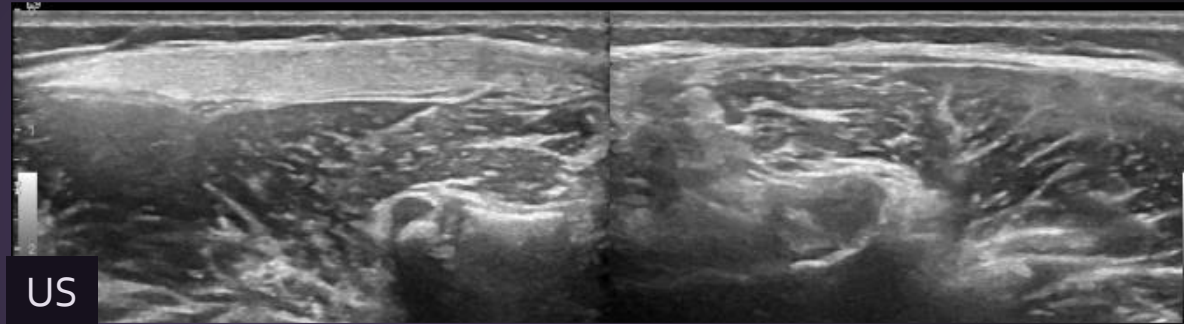
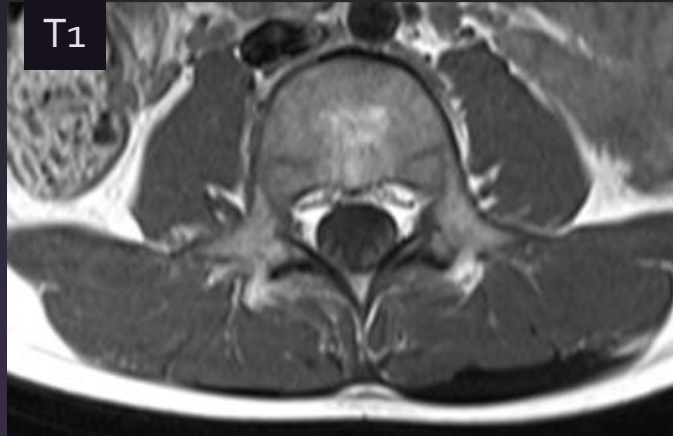


T1 CE



Initial MRI (2015)

T1



US

MRI of a 5-year-old boy with back mass shows 6.5x4.5x0.8cm sized T1 dark, T2 dark SI plaque-like lesion at left paramedian superficial fascial layer of paravertebral muscle without significant enhancement, and US of the same patient shows echogenic plaque-like lesion, suggesting benign fibrous lesion including fibrous hamartoma of infancy and paraspinal elastofibroma*. This lesion is stable for 4 years of FU.

Myofibroma/Myofibromatosis

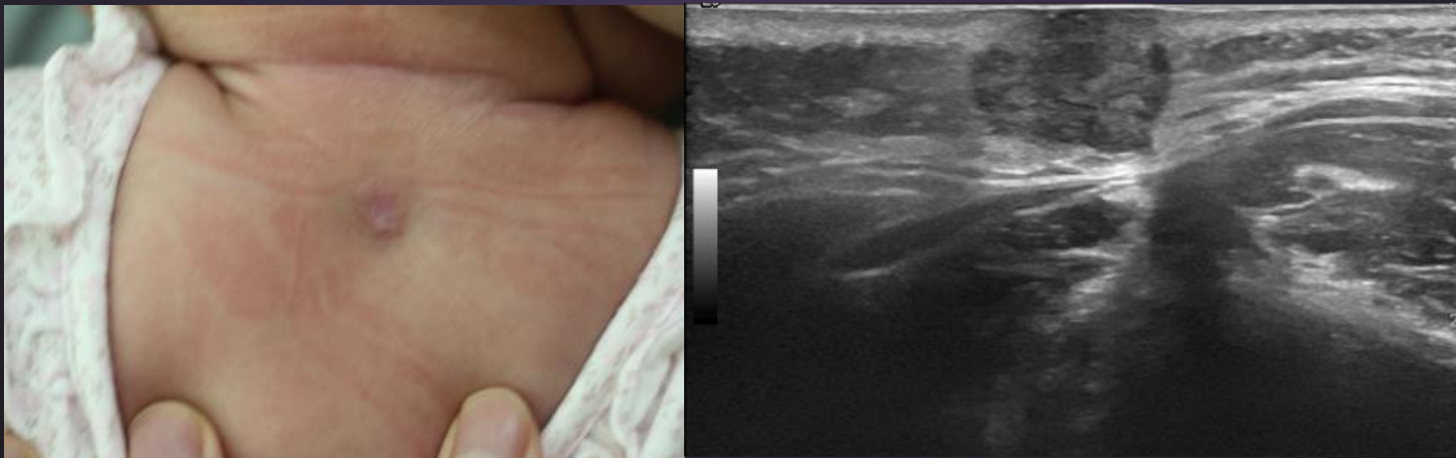
- ♥ Common benign tumors
- ♥ A solitary mass (myofibroma) or multicentric masses (myofibromatosis)
- ♥ Nodules formed by 2 components
 - ❖ Peripheral: Plump myofibroblasts arranged in short fascicles or whorls
 - ❖ Central: Less-differentiated cells usually arranged around hemangiopericytoma-like vessels
- ♥ Infantile hemangiopericytoma is part of the spectrum of myofibromas
 - ❖ Hemangiopericytomatous component predominates over the myofibroblastic component
- ♥ Cutaneous/subcutaneous, muscle, bone (skull)
- ♥ Visceral involvement (15-20%): poor prognosis, mortality rates up to 75%
- ♥ 88% <2yrs, 60% diagnosed at birth

Myofibroma/Myofibromatosis

- ♥ Variable tumor size
- ♥ Firm, reddish purple nodules
- ♥ Increase in size and number until 1yr → slow spontaneous regression
- ♥ US: Variable
 - ❖ Target sign: Well demarcated nodules with an anechoic center (necrotic) and a thick hypoechoic wall
 - ❖ Solid hypoechoic nodules with or without central calcification
 - ❖ Isoechoic nodules
- ♥ Color Doppler US: Poorly vascularized
- ♥ MRI: T₁ low, T₂ high SI nodule with a hypointense center (calcification)
 - ❖ Diffuse or peripheral enhancement



MRI of a 5-month-old girl with cherry colored nodule on upper back shows T2 high, T1 low SI nodule with enhancement at upper back, confirmed as a [myofibroma](#).



US of the same patient shows well defined hypoechoic lesion at subcutaneous layer of upper back.

Lipofibromatosis

- ♥ Rare fibrofatty tumor: abundant adipose tissue traversed by bundles of fibroblast-like cells
- ♥ Exclusively in the pediatric age (11 days – 12yrs, median 1yr)
- ♥ Ill-defined mass in subcutaneous or deep soft tissues
- ♥ Slow growing, nontender, 1-12cm

- ♥ US: Heterogeneous, predominantly hyperechoic mass
- ♥ Color Doppler: Small internal flow
- ♥ MRI: Hypointense strands in intralesional fat
 - ❖ Enhancement of the fibrous component



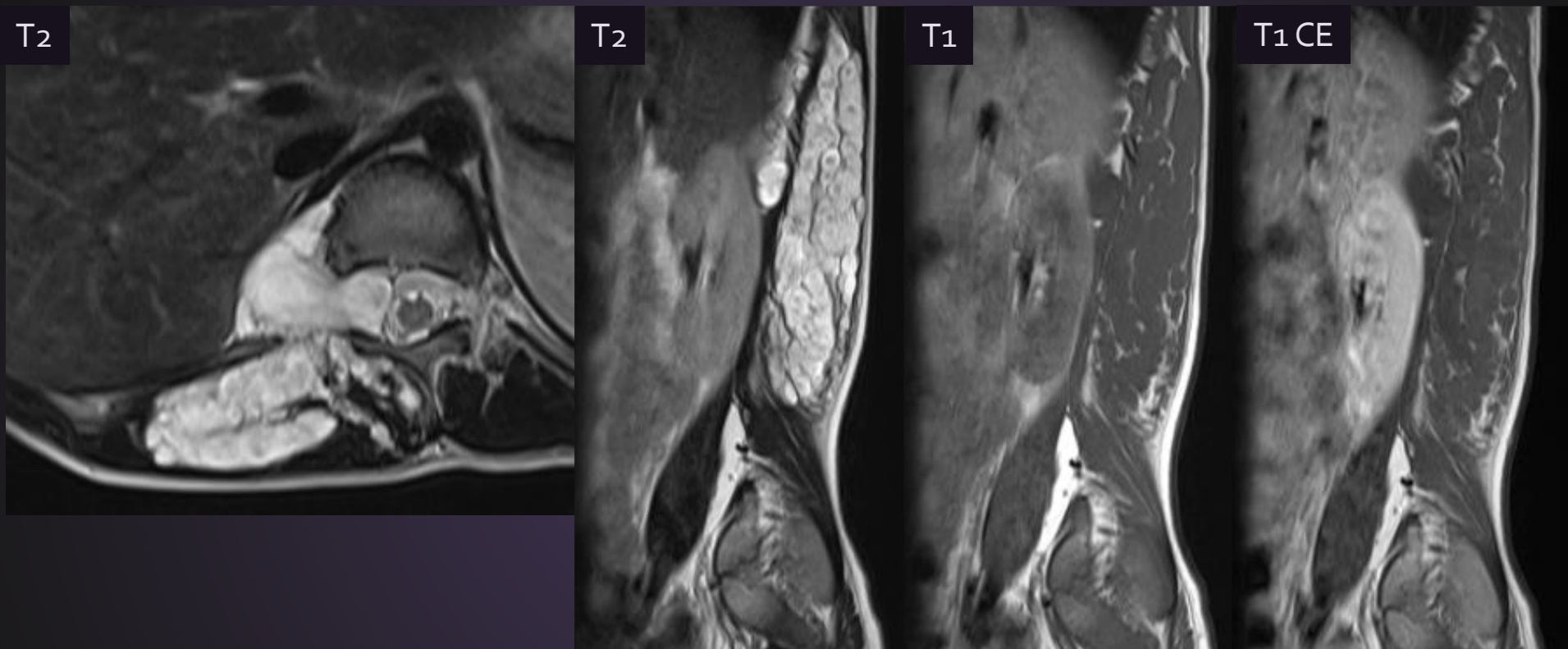
NEUROGENIC TUMOR

Neurofibroma

- ♥ Benign peripheral nerve sheath tumor with neoplastic tissue inseparable from normal nerve
- ♥ Subtypes: Localized, diffuse, plexiform
 - ❖ Localized NF: Painless, slowly growing nodule
 - ❖ Diffuse NF: Plaque-like skin elevation
 - ❖ Plexiform NF: Limb disfigurement, enlarging mass, weakness, dysesthesia, pain
 - Almost exclusively in neurofibromatosis type 1
 - Extensive plexiform neurofibromas → massive enlargement of body part (elephantiasis neuromatosa)
 - High risk of malignant transformation (8-12%)

Neurofibroma

- ♥ Localized neurofibroma (NF): Well-defined, fusiform mass
 - ❖ CT: Hypodense relative to muscle
 - ❖ MR: T₁ Iso to mildly hyper SI, T₂ hyper SI
 - Target sign: Central low signal focus
 - Fascicular sign: Multiple, small ring-like structures
 - Split-fat sign: Thin peripheral rim of fat
 - ❖ US: Homogeneous hypoechoic mass with mild posterior acoustic enhancement
- ♥ Diffuse NF: Ill-defined plaque-like or infiltrative expansion of subcutaneous tissue
 - ❖ Nonspecific MR signal characteristics
- ♥ Plexiform NF: Long segments of diffusely and irregularly enlarged nerves and nerve branches
 - ❖ Multilobulated masses with low attenuation on CT
 - ❖ Bag of worms appearance on MR



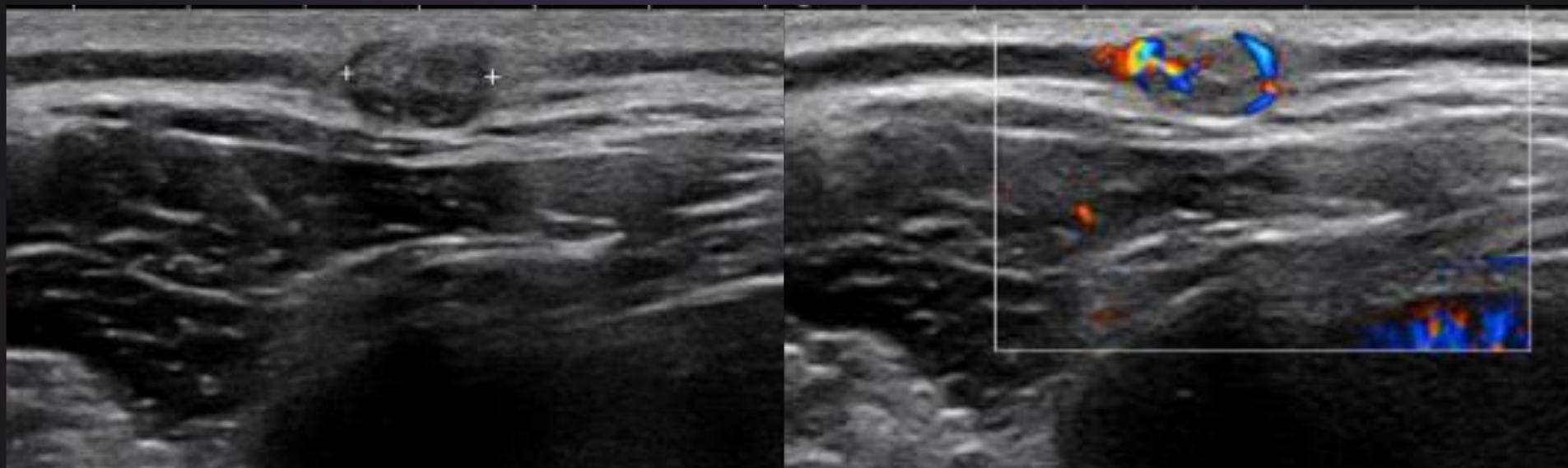
MRI of a 12-year-old boy with NF type 1 shows extensive multilobulated T2 high, T1 iso SI mass at right paraspinal area of lower T-L level, with encasing right L1 nerve root, suggesting **plexiform neurofibroma**.

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UNCLASSIFIED BENIGN TUMORS

Pilomatricoma

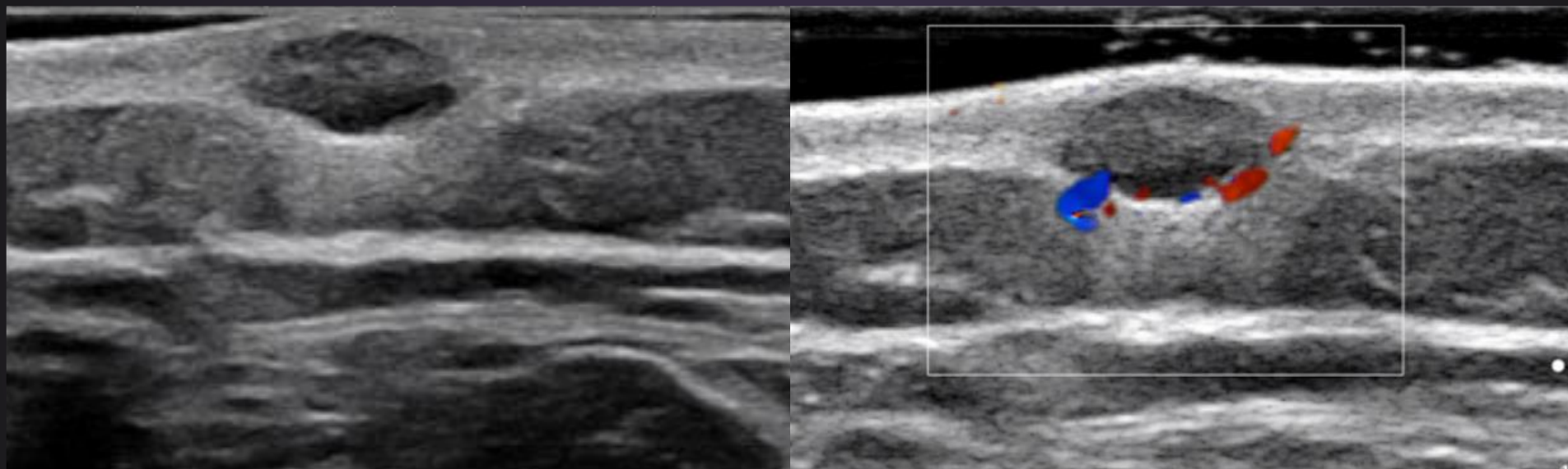
- ♥ Benign subcutaneous tumor that arises from the hair cortex cells
- ♥ Any area of hair-bearing skin
- ♥ Slowly grow over months or years, small size (<2cm)
- ♥ Nontender, freely movable, hard nodule of irregular surface, bluish discoloration of the overlying skin
- ♥ US: Well-defined hyper-/isoechoic nodule with a hypoechoic rim and variable number of internal hyperechoic punctate foci (calcification)
- ♥ Color Doppler: Some flow, mainly peripheral (70%)
- ♥ MRI: Well-demarcated T₁ iso, T₂ heterogeneous SI nodule
 - ❖ Peripheral, internal patchy/reticular enhancement



US of a 4-year-old girl with a tiny nodule on back shows about 0.6x0.4x0.9cm sized well defined ovoid mixed echoic nodule with hypoechoic rim, multiple internal hyperechoic foci, and peripheral vascularity suggesting pilomatricoma.

Epidermal Inclusion Cyst

- ♥ Common benign lesion of cutis and subcutis that arises from obstruction of hair follicle or deep implantation of epidermis
- ♥ Scalp > face > neck > trunk
- ♥ Osseous lesions appear lytic with sclerotic margin \pm soft tissue swelling
- ♥ US: Well-circumscribed, heterogeneously hypo to hyperechoic mass
- ♥ CT: Soft tissue density mass in subcutaneous fat
- ♥ MR findings
 - ❖ Isointense to muscle with mild heterogeneous signal ranging from low to high on T₁WI
 - ❖ Hyperintense signal plus \uparrow or \downarrow signal debris (cholesterol crystals or keratin) on T₂WI FS
 - Debris may be positionally dependent



US of a 12-year-old girl with a painless nodule on lower back shows 0.91x0.38x0.51cm sized well circumscribed heterogeneously hypoechoic nodule at skin layer of right paramedian lower back with focal thickening of overlying skin suggesting epidermal inclusion cyst.

References

- ♥ O.M. Navarro. Soft tissue masses in children. Radiol Clin N Am 49 (2011) 1235–1259
- ♥ O.M. Navarro et al., Pediatric soft-tissue tumors and pseudotumors: MR imaging with pathologic correlation. Part 1. Imaging approach, pseudotumors, vascular lesions, and adipocytic tumors. RadioGraphics 2009;29(3): 887–906.
- ♥ E.E. Laffan et al., Pediatric soft-tissue tumors and pseudotumors: MR imaging with pathologic correlation. Part 2. Tumors of fibroblastic/myofibroblastic, so-called fibrohistiocytic, muscular, lymphomatous, neurogenic, hair matrix, and uncertain origin. RadioGraphics 2009 29:4, e36.
- ♥ A.C. Merrow et al., Elsevier, Diagnostic imaging: Pediatrics, third edition
- ♥ B.J. Manaster et al., Elsevier, Diagnostic imaging: Musculoskeletal: Non-traumatic disease, second edition