MRI of mass lesions around the shoulder

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Learning objectives

To illustrate and review cystic and soft tissue mass lesions in and around the shoulder with relatively specific MR features, which include:

- Cysts or cyst-like mass lesions
- Fat-containing mass lesions
- Mass lesions with low signal intensity on T2-weighted images
Background

The shoulder is commonly evaluated on MRI to confirm or exclude internal derangement. Occasionally a mass lesion may be encountered by the interpreting radiologists, who must then make appropriate recommendations to the referring clinicians. The knowledge of the radiological features of the common masses in and around the shoulder will help the radiologists to characterize the masses and to narrow down the differential diagnosis.
MR Imaging Findings of Common Mass Lesions in and around the Shoulder

MR imaging was performed with a 1.5 Tesla system, which includes the following routine sequences and planes: oblique coronal images (T1WI, T2WI, STIR), oblique sagittal images (T2WI, STIR) and axial GRE images (T2*WI).

1. Cysts or cyst-like mass lesions

1.1 Paralabral cysts or ganglion

This is characterized by uni- or multiloculated cyst adjacent to the glenoid labrum (Fig. 1-5). This is clinically important for two reasons. First, it is often associated with glenoid labrum tear, which was identified on MR in 53% and on arthroscopy in 88 % of cases in one study\cite{Tung GA, et al}. Second, it may be a cause of suprascapular or axillary neuropathy by nerve entrapment (Fig. 6 on page 11). It is known that, on MRI, denervation of the muscles can be identified as edematous change in acute or subacute cases or fatty atrophy in chronic cases (Fig.1-5).

There are several options for treatment of paralabral cysts. If a cyst is minimally symptomatic the patient can be treated non-operatively with NSAID or physical therapy, because spontaneous resolution can occur in some cases. If warranted by symptoms, we can initially attempt needle aspiration (Fig. 2 on page 7), but recurrence is reported to occur in about a half (Fig. 3 on page 8). If aspiration fails, arthroscopic or open surgery is required to perform excision or decompression of the cyst and repair of labrum tear.

1.2 Bursitis

There are several bursae around the shoulder including subacromial-subdeltoid bursa, subcoracoid bursa, subscapularis bursa and coracoclavicular ligament (Supracoracoid) bursa. The Subscapular bursa frequently communicates with the glenohumeral joint space and is also called subscapular recess. Bursitis can seen as a cystic lesion in these locations. MR imaging is helpful in demonstrating cystic nature of the lesion, but hemorrhage, calcified or non calcified chondral bodies, fibrinous bodies may mimic solid mass. Contrast enhancement study may be helpful for the differentiation.
Bursa formation is a rare complication of osteochondroma (Fig. 15 on page 20, Fig. 16 on page 21). It was seen in 1.5% of cases in a large review (Unni). It is most frequently related to sites with motion where friction develops. The most common specific locations of this reactive bursa formation is the scapula, lessor trochanter of the femur and shoulder. They can present large and rapidly growing mass, simulating malignant transformation.

1.3 Acromioclavicular (AC) joint cysts (Fig. 17 on page 22, Fig. 18 on page 23)

AC joint cyst is thought to arise from leakage of synovial fluid from the GH joint through a torn rotator cuff into a degenerated AC joint. MR imaging is useful in demonstrating those lesions simultaneously.

1.4 Cysts associated with rupture of long head of biceps tendon (Fig. 19 on page 24, Fig. 20 on page 25, Fig. 21 on page 26, Fig. 22 on page 27, Fig. 22 on page 27, Fig. 23 on page 28)

Rupture of the long head of biceps tendon is commonly seen in the setting of rotator cuff pathology or impingement syndrome. The most common site of rupture is the superior labrum at the attachment of the bicipital anchor. Rupture can cause retraction of the biceps tendon, but in longstanding cases, neo-insertion or adhesion to the bicipital groove can occur. We can also see mass lesion, which is usually due to muscle retraction, but leakage of joint fluid, hematoma or granulatin tissue can also cause a mass lesion.

1.5 Solid tumors with cyst-like features (Fig. 24 on page 29, Fig. 25 on page 30, Fig. 26 on page 31)

Solid tumors may have cyst-like features by showing fluid or near-fluid signal intensity on MRI. Those lesions include hemangioma, neurogenic tumors, myxoma and malignant tumors with myxoid change.

2. Fat-containing mass lesions

2.1 Hemangioma / Lymphangioma (Fig. 27 on page 32)

MRI findings of hemangioma is fairly characteristic. It is commonly multilobulated and shows high signal intensity representing fat on T1WI and strong high signal intensity on T2WI. It often contains low signal intensity thrombus or phlebolith. Fluid-fluid levels also can be seen within the lesion.
2.2 Lipoma, Lipomatosis, Liposarcoma (Fig. 28 on page 33, Fig. 29 on page 34)

Lipoma represents the most common soft tissue tumor in the adulthood and the most common benign tumor affecting the shoulder girdle. On MRI, lipoma are generally non-enhancing homogeneous masses with same signal intensity as subcutaneous fat on all pulse sequences. Thin septa may be present.

Most liposarcomas are indistinguishable from other malignant sarcomas on MRI, but well-differentiated liposarcomas possess fat and the findings are quite similar to those of benign lipoma. T1 and T2WI show mass of predominantly fat signal intensity. Presence of linear or reticular non-fatty component within the lesion suggests the possibility of malignancy. Contrast enhancement study shows linear or reticular region in fatty mass enhances. Presence of enhancement effect is indicative of malignancy, but differentiation from atypical lipoma is difficult.

2.3 Elastofibroma dorsi (Fig. 30 on page 35)

Elastofibroma dorsi is a benign soft tissue lesion of the parascapular area with fibrous and fatty components. It is believed to be common in Okinawa and southwestern Japan. It is often bilateral and the pathogenesis may be related to mechanical friction between chest wall and the scapula. On MRI, the mass appears as a lenticular shaped mass adjacent to the rib cage. It shows low to intermediate signal intensity with interspersed linear strands of high signal intensity similar to that of fat. CT sometimes shows heterogeneous soft-tissue mass with streaky fat.

3. Low signal intensity mass lesions on T2-weighted images

Low-signal intensity areas on T2WI represent tumoral calcinosis (Fig. 31 on page 36, Fig. 32 on page 37), synovial osteochondromatosis (Fig. 33 on page 38), rice bodies (Fig. 34 on page 39, Fig. 35 on page 40, Fig. 36 on page 41), fibromatosis/desmoid (Fig. 37 on page 42), old hematoma, pigmented villonodular synovitis or amyloidosis (Fig. 38 on page 43, Fig. 39 on page 44).
Fig. 1: Case 1: A 36-year-old man who presented with shoulder pain and weakness. MR imaging was performed to rule out rotator cuff tear. T2-weighted coronal and sagittal images show a multilobulated cystic lesion adjacent to the scapula. In addition, please note that sagittal T2WI shows increased signal intensity of the infraspinatus muscle (yellow arrow), suggesting denervation of this muscle.
**Fig. 2:** Case 1: US-guided needle aspiration was performed, and about 4cc of jelly-like yellowish fluid was aspirated. The pain was improved immediately after aspiration.

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**Fig. 3:** Case 1: The patient was uneventful after aspiration, but the symptom recurred after 8 years. MRI showed recurrence of paralabral cyst (yellow arrowhead). We performed MR arthrography, which confirmed glenoid labrum tear (yellow arrow). Please note a leak of contrast into the cyst, indicating communication between a cyst and joint cavity. The patient underwent open surgery for cyst excision and glenoid labrum repair.

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**Fig. 4:** Case 2: This is a case of inferior paralabral cyst (yellow arrow). A linear high signal intensity (red arrow) suggesting a tear is noted in the inferior glenoid labrum. Please note atrophy of the teres minor muscle (green arrow), which suggests denervation of this muscle. However, it is questionable whether the finding is associated with axillary nerve compression by the cyst or an incidental finding, because the cyst is too small to compress the nerve. In one study, isolated denervation of teres minor muscle can be seen in 3% of routine shoulder MR without any pathology in the quadrilateral space (Sofka CM, et al).

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Fig. 5: Case 3: This is a case of postersuperior paralabral cyst. Interestingly, denervation is seen in both infraspinatus and teres minor muscles (yellow arrow). It may reflect a variant of innervation of the teres minor muscle by a branch of the suprascapular nerve. However, we could not find any previous description of this anomalous innervation.
**Fig. 6:** This is a picture showing posterior scapular muscles, which are supplied by the suprascapular nerve and axillary nerve. Suprascapular nerve enters suprascapular fossa through supraglenoid notch and supplies supraspinatus muscle. The nerve further enters the infraspinatus fossa through spinoglenoid notch and supplies infraspinatus muscle. Axillary nerve courses inferior to the glenohumeral joint to traverse quadrilateral space and supplies teres minor and part of deltoid muscle. Compression of suprascapular nerve at supraglenoid notch causes denervation of supraspinatus and infraspinatus muscles. Compression at spinoglenoid notch causes denervation of infraspinatus muscle. Compression of axillary nerve at quadrilateral space can cause denervation of teres minor muscle.

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Fig. 7: There are several bursae around the shoulder including subacromial-subdeltoid bursa, subcoracoid bursa, subscapularis bursa and coracoclavicular ligament (Supracoracoid) bursa. Subscapular bursa frequently communicates with the glenohumeral joint space and is also called subscapular recess. Bursitis can seen as a cystic lesion in these locations.

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Fig. 8: Subacromial-subdeltoid bursitis is commonly associated with rotator cuff pathology or inflammatory arthropathy.

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Fig. 9: Case 5: This patient has supraspinatus tendon tear (red arrow) demonstrated on coronal T2WI. Sagittal T2WI on the right shows a fluid collection in the subcoracoid bursa (yellow arrow).

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Fig. 10: Case 6: A 79-year-old woman presented with a rapidly enlarging subscapular mass. A malignant tumor was suspected clinically.

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Fig. 11: Case 6: MRI shows a cystic lesion in the subscapular area. On T2WI, low signal intensity material with fluid-fluid level is seen, that could be due to hemorrhage or debris. Contrast enhancement study shows peripheral enhancement.

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Fig. 12: Case 6: The patient underwent surgery and the cyst containing hemorrhagic fluid was excised. Histologically the cyst wall consists of fibrous connective tissue lined by vascular synovium. The findings are compatible with bursitis.

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Fig. 13: Scapulothoracic bursitis which is characterized by subscapular cystic mass located between the serratus anterior muscle and the thoracic cage. It is frequently associated with hemorrhage and presented as a rapidly growing mass simulating malignancy like this case.

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**Fig. 14:** Case 7: This is another case of scapulathoracic bursitis. CT and MRI show a cystic lesion located between the serratus anterior muscle and the thoracic cage.

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Fig. 15: Case 8: A 21-year-old woman with rapidly growing subscapular mass. An oblique radiograph of the scapula reveals a bony protrusion on the ventral surface of the scapula (orange arrow). CT also reveals osteochondroma of the scapula (orange arrow) as well as a soft tissue mass (yellow arrowhead) along the thoracic cage.

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**Fig. 16:** Case 8: MRI shows a cystic mass lesion (yellow arrow) between the osteochondroma and the ribs, but no solid lesion suggesting malignancy is seen. This is bursa formation with osteochondroma.

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**Fig. 17:** Case 9: MRI reveals a large rotator cuff tear (orange arrow). In addition, subcutaneous cystic lesion (yellow arrow) is seen adjacent to the AC joint. There appears to be some erosion in the distal clavicle.

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Fig. 18: AC joint cyst is thought to arise from leakage of synovial fluid from the glenohumeral joint through a torn rotator cuff into a degenerated AC joint (Cvitanic O, et al). MR imaging is useful in demonstrating those lesions simultaneously.

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**Fig. 19:** Case 10: A 61-year-old woman with an enlarging mass lesion in the upper arm. The patient does not recall any episode of trauma. MRI shows a cystic mass with rim enhancement. A round low signal intensity structure (orange arrow) is seen inside the cystic lesion.

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**Fig. 20:** Case 10: Sagittal T2WI shows a cystic lesion proximal to the biceps muscle as well as the low signal intensity structure (orange arrow), which appears to be a torn tendon. What is the next step to confirm the diagnosis?

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**Fig. 21:** Case 10: We performed shoulder MRI and ultrasonography. Both showed empty bicipital groove (yellow arrow), indicating rupture of long head of biceps tendon rupture.

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**Fig. 22:** Case 11: Another case of rupture of LHBT. A solid mass lesion (orange arrow) with inhomogenous signal intensity is seen in the upper arm. Again, long head of biceps tendon is noted within the mass.

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Fig. 23: Case 11: MR images show absence of long head of biceps at the bicipital anchor and bicipital groove (orange arrow), indicating rupture and retraction of biceps tendon.

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Fig. 24: Case 12: MRI show homogenous intermediate signal intensity on T2WI with strong contrast enhancement, features similar to those of other neoplasms. However, a characteristic fusiform shape oriented longitudinally along the nerve with tapered ends suggest the diagnosis.

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**Fig. 25:** Case 13: MRI show a large mass lesion with low signal intensity on T1WI and inhomogeneous high signal intensity on T2WI. Strong high signal intensity on T2WI represents highly myxoid component of this tumor. Please note a tail-like extension (yellow arrow) toward the spine, suggesting a neurogenic tumor.

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Fig. 26: Case 13: Strong contrast enhancement is seen in this tumor. However, it is difficult to make a specific diagnosis without pathological examination.

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Fig. 27: Case 14: MRI findings of hemangioma is fairly characteristic. It is commonly multilobulated and shows high signal intensity representing fat on T1WI and strong high signal intensity on T2WI. It often contains low signal intensity thrombus or phleboliths as shown in this case (orange arrow). Fluid-fluid levels also can be seen within the lesion.

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Fig. 28: Case 15: Lipoma represents the most common soft tissue tumor in the adulthood and the most common benign tumor affecting the shoulder girdle. On MRI, lipoma are generally non-enhancing homogeneous masses with same signal intensity as subcutaneous fat on all pulse sequences. Thin fibrous septa may be present as shown in this case.

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Fig. 29: Case 16: Well-differentiated liposarcomas possess fat and the findings are quite similar to those of benign lipoma. T1WI and T2WI show a mass of predominantly fat signal intensity. Presence of linear or reticular non-fatty component within the lesion suggests the possibility of malignancy. Contrast enhancement study shows linear or reticular region in fatty mass enhances. Presence of enhancement effect is indicative of malignancy, but differentiation from atypical lipoma is difficult.

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Fig. 30: Case 17: A 82-year-old male with a history of lung cancer. Chest wall mass was incidentally noted on CT. CT shows a mass lesion (yellow arrow) containing fat-density at the posterolateral aspect of the chest wall. MRI shows the mass adjacent to the thoracic cage. MRI shows linear strands of high signal intensity similar to that fat within the lesion.

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**Fig. 31:** Case 18: A 47-year-old man with chronic renal failure complicated by secondary tumoral calcinosis. Plain radiography shows a mass with amorphous calcification with osteolytic change in the distal clavicle.

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Fig. 32: Case 18: MRI shows predominantly low signal intensity mass on both T1WI and T2WI. The lesion contains cystic lesions showing fluid-fluid levels (yellow arrowhead) indicating milk of calcium, the finding often seen in tumoral calcinosis.

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Fig. 33: Case 19: The signal intensity of synovial osteochondromatosis depends on the degree of calcification: non-calcified chondral bodies show predominantly high signal intensity on T2WI and calcified osteochondral bodies shows low signal intensity on both T1WI and T2WI.

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Fig. 34: Case 20: A 52-year-old man with a history of rheumatoid arthritis. He presented with swelling of the right shoulder. On T2WI, numerous particles of low signal intensity are seen in the distended subacromial subdeltoid bursa. The findings are similar to those of synovial osteochondromatosis.

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**Fig. 35:** Case 20: On plain radiography, no calcification is seen. If this is a case of synovial osteochondromatosis, noncalcified chondral loose bodies should be hyperintense on T2WI. The patient underwent surgery. On operation, the bursa was inflamed and filled with numerous loose bodies that resemble rice grains, called rice bodies.

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Fig. 36: Case 21: A 48-year-old man with non-tuberculous mycobacterial infection of the shoulder. Multiple rice bodies (yellow arrow) are seen in the glenohumeral joint. Rice bodies are usually encountered as a complication of RA, tuberculosis, or non-tuberculous mycobacterial infection. They consist of an inner amorphous core of acidophilic material surrounded by collagen and fibrin.

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**Fig. 37:** Case 22: MRI shows an ill-defined mass lesion (yellow arrow) in the right axilla, showing inhomogeneous low signal intensity on both T1WI and T2WI.

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**Fig. 38:** Case 23: This patient had a history of chronic renal failure. T2W images show low signal intensity mass lesion (yellow arrow) with multiple bone erosions. In patients with chronic renal failure amyloid arthropathy is the most likely diagnosis, but based on the signal intensity pattern, the main differential diagnosis is pigmented villonodular synovitis (PVNS).

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**Fig. 39:** Case 23: T2*WI can be helpful to differentiate amyloid arthropathy from PVNS, because PVNS shows very low signal intensity on T2*WI due to hemosiderin deposition. In this case, the lesions show intermediate signal intensity on T2*WI. Hence, PVNS is less likely based on this finding.

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Conclusion

Cystic and soft tissue masses of the shoulder joint show relatively specific MRI features. Correlation with clinical history, radiographic findings, location of the lesions and signal intensity pattern of the lesions are important for diagnosing these lesions.
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