

CMEARTICLE

Clinics in diagnostic imaging (151)

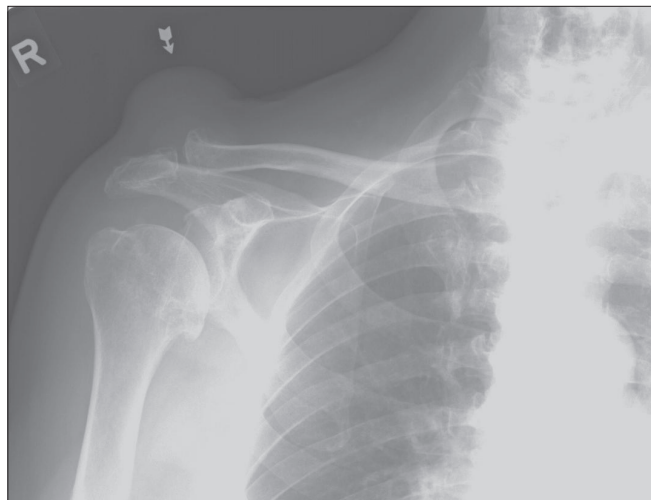
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Fig. 1 Frontal radiographic view of the right shoulder joint.

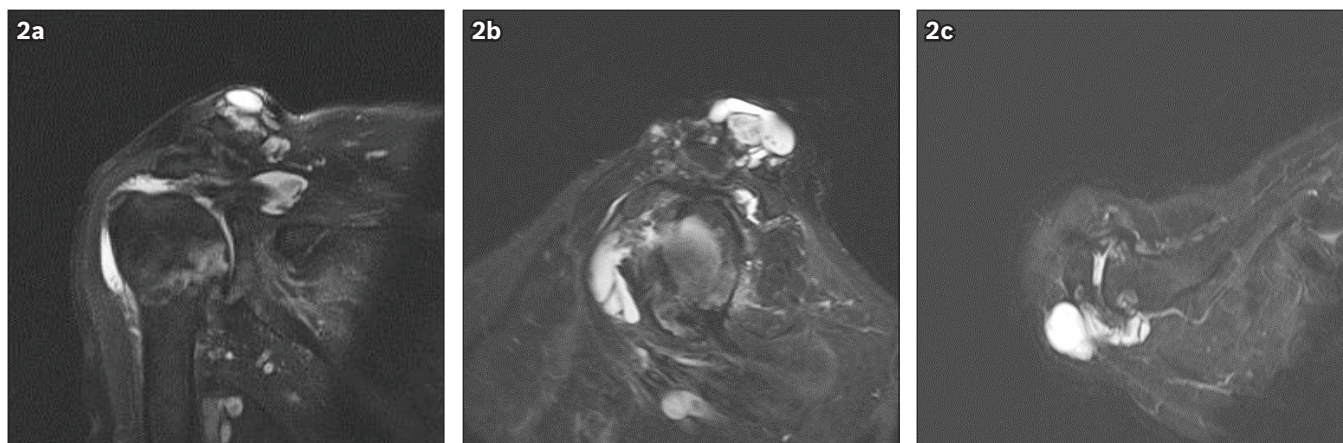


Fig. 2 (a) Coronal, (b) sagittal and (c) axial T2-W turbo inversion recovery magnitude MR images of the right shoulder joint.

CASE PRESENTATION

An 82-year-old man presented with neck pain, right upper limb radiculopathy and right shoulder pain. His medical history was significant for multiple comorbidities, including osteoarthritis of the left hip joint and both knee joints, as well as cervical degenerative disc disease. Relevant surgical history included right total knee replacement arthroplasty, left total hip replacement arthroplasty and C3–C6 cervical laminectomy. The patient had previously worked as a manual labourer, but presently had difficulty moving his upper limbs.

On physical examination, we noted a soft lump over his right shoulder joint. The lump was compressible, non-mobile

and non-tender. Although the patient could not remember when the lump had first appeared, he noted that it had slowly enlarged over the past two years. He also had reduced ipsilateral shoulder movements, particularly in abduction, but showed no painful arc sign. Plain radiographs of the right shoulder joint (Fig. 1), obtained at the clinic visit, were compared with that taken two years prior. Based on the radiographic findings, magnetic resonance (MR) imaging of the right shoulder joint (Fig. 2) was requested. What do the images (Figs. 1 & 2) show? What is the final diagnosis and what are the underlying conditions?

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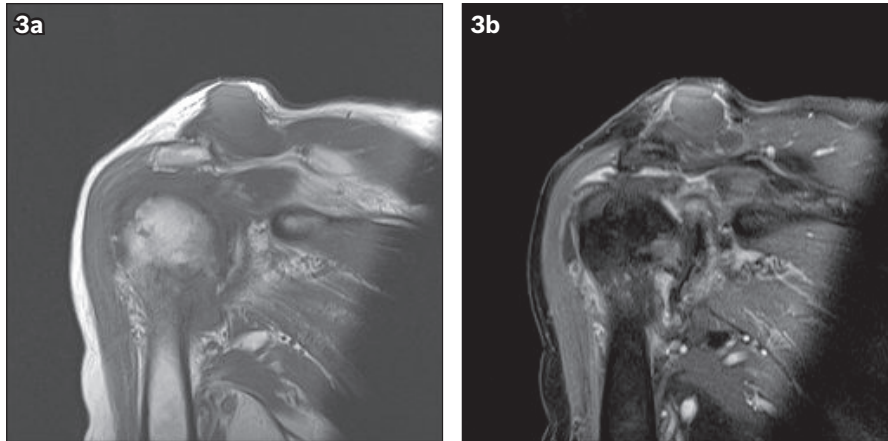


Fig. 3 (a) Pre- and (b) post-intravenous contrast-enhanced coronal T1-W turbo spin echo images of the right shoulder joint.

DIAGNOSIS

Acromioclavicular joint geysers with chronic full-thickness supraspinatus tendon (SST) tear.

IMAGE INTERPRETATION

The plain radiograph (Fig. 1) of the right shoulder joint shows a soft tissue density mass over the osteoarthritic right acromioclavicular (AC) joint. The soft tissue mass has a fairly smooth outline and a homogeneous appearance with no underlying bony destruction. Osteoarthritic changes are noted at both the right AC and the glenohumeral joints, including marginal osteophytes, articular surface irregularity and joint space narrowing. The right humeral head shows slight caudal migration relative to the glenoid process. Non-arthrographic MR images (Figs. 2a–c) of the right shoulder joint reveal a full-thickness tear of the SST, with the remnant tendon retracted to a position just proximal to the glenoid process. Synovial fluid is seen in the subacromial space, communicating with the right AC joint, and within the mass over the right AC joint. The mass shows T2-weighted hyperintense and T1-weighted hypointense signal characteristics of fluid. The multilobulated and multi-septated cystic mass can be traced to the posterior superior aspect of the right AC joint and the subacromial bursal effusion. No enhancement with intravenous contrast medium is detected (Fig. 3). This is the classic geysers sign of a large cyst overlying and communicating with the AC joint in the setting of a torn SST.

CLINICAL COURSE

Owing to the benign nature of the cystic mass and the marked, chronically retracted status of the patient's right SST, no treatment was instigated despite the reduced range of movement in his right shoulder joint.

DISCUSSION

The geysers sign is an infrequently encountered imaging sign that was originally described on conventional fluoroscopy-guided shoulder arthrography. With the increased use of MR imaging

for the evaluation of shoulder joint disorders, the ability to recognise the presence of the geysers sign on both conventional and arthrographic MR images is essential. The sign derives its name from its geysers-like appearance. On imaging, owing to a full-thickness SST tear, synovial fluid or intra-articular contrast extravasates from the glenohumeral joint into the subacromial bursa. The fluid, which then passes through the AC joint into an overlying cystic mass, is said to resemble a geysers spouting upwards.

Originally described by Craig in 1984,⁽¹⁾ no other study has documented the prevalence of the geysers sign in the setting of a chronic SST tear to date. In an analysis of nine cases of AC joint cyst, Tshering Vogel et al reported positive geysers sign, with conventional shoulder arthrograms that showed SST tears, in three cases.⁽²⁾ A study by Chalian et al reported that only 1 out of 56 (1.8%) patients who had MR imaging post shoulder trauma showed findings suggestive of a geysers sign.⁽³⁾

The signs and symptoms of SST disease are highly variable, ranging from asymptomatic patients with a full range of shoulder movements to those who are unable to lift their arms due to constant shoulder pain.⁽⁴⁾ This may depend on several factors, including the degree of the SST tear, the patient's age, and the presence of other comorbidities such as rheumatoid arthritis, osteoarthritis and septic arthritis. While the supraspinatus muscle works with the deltoid muscle during abduction of the arm, patients with massive SST tears are often unable to lift their arms fully due to pain or weakness. Physical examination tests such as the drop arm test and Jobe's test, as well as isometric strength testing of the supraspinatus, may help in the evaluation of disease severity.

The causes of SST tears are multifactorial, with mechanical impingement and joint degeneration postulated as possible contributory factors. Craig proposed that as an SST tear progresses, the loss of external rotation power results in relatively unopposed internal rotation, causing the arc of elevation to move medially, centring beneath the coracoacromial ligament and AC joint, exposing the remaining intact tendon to further impingement.⁽¹⁾ With a very large tendon



Fig. 4 (a) Fluoroscopic spot image from arthrography of the shoulder of a 48-year-old female patient shows entry of the contrast mixture into the left acromioclavicular joint (arrow). Note the large quantity of contrast mixture within the subacromial bursa (arrowheads). (b) Sagittal and (c) coronal T1-W turbo spin echo images from subsequent MR arthrography in the same patient confirm the presence of contrast mixture within the acromioclavicular joint and subacromial bursa (arrowheads). Small, focal, minimally retracted full-thickness tears of the left supraspinatus tendon are seen close to the greater tuberosity insertion site (arrow).

tear, repeated trauma may lead to gradual erosion of the inferior/deep AC joint capsule, resulting in the production of the geyser sign on arthrography.⁽²⁾

Cystic masses over the AC joint can occur in the setting of a massive rotator cuff tear. These cysts, which are usually painless and enlarge progressively, can be mistaken for malignancy.⁽⁵⁾ The mass is usually firm but compressible, non-mobile and non-tender to touch. The size of the cyst varies and is unrelated to the size of the SST tear. While the growth of the cyst is typically insidious and progressive, it may occasionally regress in size.

The actual pathogenesis of AC joint cysts is not fully understood. They are thought to occur when the synovial fluid in the glenohumeral joint escapes via the full-thickness SST tear into the subacromial bursa, and then decompresses across an osteoarthritic AC joint. The increased intra-articular fluid pressure eventually causes distension, outpouching, and possibly, rupture of the superior capsule of the AC joint, leading to the formation of a cystic mass.⁽⁶⁾ Plain radiograph evaluations are nonspecific, thus requiring a high index of suspicion and prior knowledge of existing SST tears. On plain radiography, a focal soft tissue swelling may be seen over the superior/superficial aspect of the AC joint, isodense to adjacent soft tissue. There may be associated AC joint osteoarthritis with joint widening and marginal osteophytes. This was the case with our patient. Calcification within the soft tissue mass is seldom seen. With conventional shoulder arthrography, leakage of contrast medium from the glenohumeral joint into the subacromial bursa will outline the passage through the AC joint and fill the centre of the cyst, leading to the classical geyser sign. This is illustrated in the arthrography (Fig. 4a) and MR images (Figs. 4b & c) of another case.

Ultrasonography (US) may be requested to evaluate the shoulder lump or rotator cuff. On US, cysts over the AC joint appear anechoic or hypoechoic. One should look out for communication with the AC joint and confirm the presence of

an SST tear. Communication with a subacromial bursa related to the SST tear may not be demonstrable due to the presence of bone. SST tears, readily detected during US, are seen as a hypoechoic defect within the tendon and as a dip in the normal convex contour. The tendon may be retracted in the case of full-thickness complete tears. Thus, a high index of suspicion is required when evaluating using US. The effectiveness of US is severely reduced due to the inability of the US beam to penetrate the bony cortex for evaluation of the SST deep to the acromion.

There have been few reported cases of geyser signs on computed tomography (CT), likely because CT is infrequently used to evaluate lumps in the shoulder region. While CT can detect full-thickness SST tears, partial tears may not be evident due to the inherent poor tissue resolution of the tendons on CT.⁽⁷⁾ As such, a negative CT does not rule out a possible tendon tear, and further evaluation with US or MR imaging may be warranted. Secondary signs on CT include retracted SST, the presence of AC joint osteophytes or subacromial bony spurs. The cyst over the AC joint may show a homogeneous hypodense appearance with fluid attenuation values. Calcification may be seen at the margins of the cyst.

Mohana-Borges et al have described the geyser sign on postoperative MR imaging secondary to injury of the acromial undersurface during surgery.⁽⁸⁾ MR imaging can accurately depict the cystic nature of the mass over the AC joint. On T2-weighted sequences, the geyser sign is seen as hyperintense synovial fluid extending across the subacromial space and through the AC joint into the overlying cyst.⁽⁶⁾ A membranous capsule, if present, is depicted as a thin hypointense surrounding layer on T1- and T2-weighted sequences. Internal septations or multiple lobulations are more clearly shown on MR imaging. Rupture of the AC joint cyst may be seen as free fluid in the surrounding soft tissue planes. Additionally, MR imaging may demonstrate associated SST tears, seen as discontinuity in the tendon at, or proximal to, the insertion site at the humeral

greater tuberosity. The tendon defect/tear site may be filled with T2-weighted hyperintense synovial fluid. Note that MR arthrography is not commonly performed for the evaluation of shoulder masses. In the absence of inflammation, enhancement of the capsule of the AC joint cyst is rarely seen, while the fluid within the AC joint cyst generally shows no enhancement. Intravenous contrast medium may, however, indicate the presence of a leak or rupture of the AC joint cyst.

CONCLUSION

When present, the geyser sign can provide invaluable information regarding the integrity of the SST. Full-thickness SST tear, complete or partial, may not be suspected prior to imaging examination. Such an examination can help in prognostication and the evaluation of treatment options, as the geyser sign usually results from a chronic, and possibly large, full-thickness SST tear.⁽¹⁾ The demonstration of the geyser sign during the assessment of a shoulder lump for presence of malignancy indicates a benign process.⁽⁶⁾

ABSTRACT An 82-year-old man presented with neck pain, right upper limb radiculopathy and right shoulder pain. Physical examination revealed a soft lump over the right shoulder joint, as well as reduced range of shoulder movements. On magnetic resonance imaging, the soft lump was shown to be a cystic mass over the acromioclavicular joint and was related to a full-thickness supraspinatus tendon tear. This is the classic geyser sign. The pathophysiology and clinical features of the geyser sign, and its imaging features with various imaging modalities, are discussed.

Keywords: acromioclavicular joint cyst, geyser sign, magnetic resonance imaging, rotator cuff tears

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SINGAPORE MEDICAL COUNCIL CATEGORY 3B CME PROGRAMME

(Code SMJ 201402A)

| | True | False |
|---|--------------------------|--------------------------|
| Question 1. The geyser sign is related to: | | |
| (a) Subacromial bursa containing synovial fluid. | <input type="checkbox"/> | <input type="checkbox"/> |
| (b) Acromioclavicular joint space widening and degeneration. | <input type="checkbox"/> | <input type="checkbox"/> |
| (c) Full-thickness tears of the supraspinatus tendon. | <input type="checkbox"/> | <input type="checkbox"/> |
| (d) A malignant lesion eroding the lateral clavicle. | <input type="checkbox"/> | <input type="checkbox"/> |
| Question 2. The geyser sign is associated with: | | |
| (a) A recent acute injury to the shoulder joint. | <input type="checkbox"/> | <input type="checkbox"/> |
| (b) A bursal-sided partial-thickness tear of the supraspinatus tendon. | <input type="checkbox"/> | <input type="checkbox"/> |
| (c) A better prognosis after surgical management. | <input type="checkbox"/> | <input type="checkbox"/> |
| (d) Defects or injury to the acromioclavicular joint capsule. | <input type="checkbox"/> | <input type="checkbox"/> |
| Question 3. Regarding the imaging aspects of the geyser sign: | | |
| (a) It is diagnosable on plain radiography. | <input type="checkbox"/> | <input type="checkbox"/> |
| (b) Intra-articular contrast medium (arthrography) is not required to visualise the geyser sign on magnetic resonance (MR) imaging. | <input type="checkbox"/> | <input type="checkbox"/> |
| (c) Computed tomography (CT) is superior to ultrasonography (US) in evaluating the presence or absence of a geyser sign. | <input type="checkbox"/> | <input type="checkbox"/> |
| (d) MR imaging is less sensitive if no intravenous contrast medium is administered. | <input type="checkbox"/> | <input type="checkbox"/> |
| Question 4. Regarding the supraspinatus tendon: | | |
| (a) CT and US are equally effective in detecting supraspinatus tendon tears. | <input type="checkbox"/> | <input type="checkbox"/> |
| (b) Full-thickness supraspinatus tendon tears frequently present with the geyser sign. | <input type="checkbox"/> | <input type="checkbox"/> |
| (c) Tears are easily detected on conventional arthrography. | <input type="checkbox"/> | <input type="checkbox"/> |
| (d) Tears of the tendon are seen as hyperechoic lesions on US. | <input type="checkbox"/> | <input type="checkbox"/> |
| Question 5. Regarding the geyser sign: | | |
| (a) It is commonly detected after trauma to the shoulder joint. | <input type="checkbox"/> | <input type="checkbox"/> |
| (b) It differentiates a benign lesion from a malignant one. | <input type="checkbox"/> | <input type="checkbox"/> |
| (c) It is of little relevance to the surgical treatment of the patient. | <input type="checkbox"/> | <input type="checkbox"/> |
| (d) Degenerative changes in the acromioclavicular joint are a prerequisite. | <input type="checkbox"/> | <input type="checkbox"/> |

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