MDCT imaging of calcinosis in systemic sclerosis

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Learning objectives

• This poster will answer:

- What is the role of multidetector CT (MDCT) in calcinosis assessment?

- What are the possible patterns that calcinosis may take in systemic sclerosis (SSc) patients

- What are the most frequent locations of calcinosis?

Background

• Calcinosis is a general term used to describe deposits of calcium salts in tissues, most commonly hydroxyapatite calcium crystals.

• It can affect normal tissues: idiopathic tumoural calcinosis or abnormal phosphocalcic metabolism (metastatic calcinosis).

• However, calcium is most commonly deposited in injured tissues (dystrophic calcifications).

• Calcinosis is not specific of systemic sclerosis (SSc) and can be found in degenerative, metabolic and inflammatory disorders.

• Calcinosis is present in 10-30% of SSc patients and, together with acroosteolysis, is a characteristic of the disease on imaging

• Calcinosis can be painful and cause functional limitations, particularly when occurring in the hand and fingers

• Initial assessment usually consists of a plain frontal radiograph of the hands at time of diagnosis and thereafter when there is clinical concern.

• In specific circumstances, MDCT can be useful, when calcinosis becomes disabling and to direct clinical management by accurately assessing the extent of the disease.

Imaging findings OR Procedure details

PROCEDURE DETAILS
• The best imaging modality to assess calcinosis is CT
  - MRI lacks spatial resolution as well as contrast resolution for small calcifications
  - Ultrasound lacks penetration to assess deep calcifications
  - Radiographs are sensitive but are a 2D summation of a 3D information

• CT allows:
  - Quantitative and qualitative assessment of calcinosis (size, pattern, density,…)
  - Exact location assessment and presence of involvement of surrounding tissues
  - Multiplanar reformat (MPR) and 3D capability

• Role of MDCT:
  - Not use routinely in SSc
  - Extension assessment and mapping
  - Pre-interventional assessment in front of a disabling calcinosis
  - Follow up of treatment response

IMAGING FINDINGS

Superficial soft tissues
• Calcinosis virtually always affects the superficial soft tissues
• 3 patterns are seen mainly:
  - Grouped and punctuated pattern (Figure 1)
  - Linear or infiltrating pattern: follows the shape of the involved structure (Figure 2)
  - Pseudotumoral pattern (Figure 3)

• Pseudotumoral pattern
  - Multiple case reports in the literature
  - Contours are often lobulated
-We can sometimes detect a fluid level if enough time is given to sediment (Figure 4)

-Surgical treatment to consider if disabling

• Distribution

-Hand is the most frequent location (~80%), particularly in the thumb and palmar and radial side of second and third finger (opposing surfaces) (figure 5)

-Pressure zones and bony prominences: ulnar side of forearm, olecranon, acromion, ischium, iliac spines (figure 6)

-Less frequent: face, axilla, leg, foot

-Absent in an un paretic limb

• Cutaneous edema with thickening of the demis (figure 7)

• Often located in the epidermis, with possible ulceration and chalky discharge (Figure 1)

Periarticular and articular

• Second most frequent location after superficial soft tissues

• Mostly capsular and ligamentous (figures 8-9-10)

• Paraspinal: periarticular location near the facet joints or atlanto-axial joint: multiple case report (figure 11)

-Neurologic compression risk

• Bursae: friction zone (figure 12)

• Intra-articular possible but much less frequent

-Several case reports in the literature, infiltrating the synovium or intra-articular

-MDCT is helpful for locating precisely the calcinosis since potential treatment for intra-articular calcinosis is joint lavage to avoid a crystal-induced destructive arthropathy

Musculotendinous unit

Intramuscular
• Sometimes linear: differential diagnosis polymyositis/dermatomyositis (clinical findings and serology allow right diagnosis) (figure 13)

• Sometimes pseudotumoral: differential diagnosis with myositis ossificans (texture analysis of the density: ossified vs calcified)

• Intermuscular, fascia, aponeurosis

- The calcinosis will draw the contour of the muscle, infiltrating de fascial planes and the fascicle contours (figure 14)

• Peritendinous and intratendinous: Frequent, especially in tendonsheath, can be responsible for crepitus (Figures 15-16)

- Pulleys can be involved (arrows: A2 pulley) (Figure 17)

• Less frequently: intratendinous: Relative sparing of the tendon noted in some of our patients, not described in the literature (arrowheads, supra-spinatus)

Miscellaneous

• Perineural calcinosis-Polio\(^*\) reported a perineural involvement with sensitive deficits, successfully treated with microsurgery removal

• Erosive bone involvement

- intra-osseus resorption of calcinosis: carpal bones, distal radius and ulna (figure 18-19)

- Erosive arthropathy mimicking rheumatoid arthritis or psoriatic arthritis with preferential involvement of first carpometacarpal joint. (differential diagnosis: Jaccoud's arthropyathy, systemic lupus)

- Bone resorption: acromion, radius, ulna, distal clavicle, humerus, 3rd - 6th postero-superior ribs

• Other associated findings:

- Acro-osteolysis : Most often distal, rarely band-like acroosteolysis. (figure 20)

- Soft tissue atrophy (Figures 21-22)

- Flexion contracture: can be problematic when trying to image longitudinally the finger, MPR becomes useful in those cases.

• Increase morbidity associated : When calcinosis is present, patients more frequently sustain vascular complications and digital ulcers
DISCUSSION

• MDCT is not used routinely but is the best imaging tool for some specific situations:
  - Extension mapping
  - Pre-intervention assessment
  - Follow-up of treatment response

• MDCT allows precise location of calcium deposits and help for treatment choice

• Few studies include treatment evaluation in SSc since it is disappointing. No medical treatment is proved effective to date

• In cases of disabling calcinosis, surgery can be considered with intermediate results

• Surgical options are
  - Excision, while limiting size of incision
  - Vaporisation with carbon dioxide laser
  - Dental burr: fragmentation of calcinosis followed by generous irrigation

• Surgery is performed under local or regional anaesthesia when possible, since there is occasionally a cardiac and/or pulmonary impairment in SSc.

Images for this section:
**Fig. 1:** Axial MDCT image of the forearm showing grouped punctuated calcinosis, both in hypodermis (arrows) et epidermis (arrowheads)
Fig. 3: Pseudotumoral pattern involving de radial side of index and thumb, pressure zones being frequent location for calcinosis. Note the mass effect created on the surface of the skin from this calcinosis (arrows)
Fig. 4: Axial MDCT image showing a pseudotumoral pattern of calcinosis in the thenar eminence of the hand with sedimentation (arrows)
**Fig. 5:** Volume-rendered MDCT image of the left hand displays calcinosis involving the thumb, the index, and the middle finger.

![Image of the left hand showing calcinosis](image)

**Fig. 6:** Sagittal MDCT image of the shoulder showing a calcinosis focus over a bony prominence, the acromion (arrows).
Fig. 7: Axial image of the hand, centered on the thumb, showing thickening of the dermis (arrowheads)
Fig. 8: Coronal MDCT image of the hand showing linear calcinosis in the capsule of the first metacarpo-phalangeal joint (arrows) Arrowhead: acroosteolysis
Fig. 9: Coronal oblique (A) MPR of the shoulder showing intraligamentous calcinosis in the inferior glenohumeral ligament (arrows)
**Fig. 10:** Axial MDCT image of the wrist showing linear calcinosis in the dorsal and palmar fibres of the scapho-lunate ligament (arrows)
Fig. 11: Axial MDCT image of the cervical spine centred on C2 illustrates periarticular tumefactive calcinosis involving the left articular and transverse processes of the vertebra. Note also the extent in the central canal (arrowhead) and the prevertebral soft tissues (arrows)
Fig. 12: Coronal oblique MDCT image showing calcinosis in the subacromial-subdeltoide bursa (arrows). Calcinosis in the inferior glenohumeral ligament (arrowhead) is also shown.
Fig. 13: Sagittal oblique reformatted MDCT views of the right shoulder demonstrate intramuscular calcinosis. Cl, clavicle; Co, coracoid process; H, humerus; IS, infraspinatus; S, scapula; Sc, subscapularis; SS, supraspinatus
**Fig. 14:** Axial MDCT image of the right shoulder accurately depicts linear calcinosis extending in the intermuscular fascia of the deltoid muscle (arrows).
Fig. 15: Axial MDCT image of the right hand shows extensive linear calcinosis in the tendon sheaths of the extensor (arrowheads) and flexor (arrow) tendons, as well as of the flexor pollicis longus (curved arrow).
**Fig. 16:** Axial MDCT of the same hand of figure 15, more distally, shows calcinosis involving the tendonsheaths of deep and superficial flexor tendons of third finger (arrowheads)
Fig. 17: Sagittal reformatted MDCT view of the index finger demonstrates calcinosis involving the A2 pulley (arrow). Punctate, grouped calcium deposits are also seen in the volar subcutaneous tissues and the pulp (arrowheads).

Fig. 18: Initial (19) and 1-year follow up (20) sagittal MDCT of the wrist showing erosive bone involvement of the carpal bones from pseudotumoral calcinosis. M: metacarpal bone, R: radius, S: scaphoid, T: trapezium
Fig. 19: Initial (19) and 1-year follow up (20) sagittal MDCT of the wrist showing erosive bone involvement of the carpal bones from pseudotumoral calcinosis. M: metacarpal bone, R: radius, S: scaphoid, T: trapezium
Fig. 20: Coronal reformatted MDCT image of the right thumb shows acro-osteolysis (arrows) of the distal phalanx, together with calcinosis of the pulp and the subcutaneous tissues (arrowheads)
Fig. 21: Coronal oblique MDCT reformat of the index fingers showing normal (22) and abnormal (23) Measurement of Yune's Index, Yune index: normal thickness of distal soft tissues must be > 20% of the width at the base of the distal phalanx.
Fig. 22: Coronal oblique MDCT reformat of the index fingers showing normal (22) and abnormal (23) Measurement of Yune's Index, Yune index: normal thickness of distal soft tissues must be > 20% of the width at the base of the distal phalanx.
Fig. 2: Axial MDCT image of the hand showing linear pattern of calcinosis in an intermuscular fascia of the hand (arrowheads). M: metacarpal
Conclusion

TAKE HOME MESSAGES

• Most frequent location of calcinosis is within superficial soft tissues, especially the thumb and opposing fingers

• The second most frequent location is the periarticular soft tissues, within capsule and ligaments.

• Calcinosis may take a linear infiltrating pattern or a pseudotumoral pattern

• Calcinosis is associated with increased frequency of acroosteolysis and vascular complications such as digital ulcers

References


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