Original Article

Rotator cuff tendon calcific tendinitis treatment algorithm for primary care musculoskeletal physicians

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Abstract

Purpose: Calcific tendinitis of the shoulder is a common pathology encountered by primary care sports medicine physicians and orthopedic surgeons. Understanding the patient demographics responsible for calcific tendinitis outcomes from various treatment modalities may lead to greater understanding of appropriate management. **Methods:** This was a retrospective study on patients who were diagnosed with calcific tendinitis by imaging (radiographs, MRIs) at our institution from 2014 to 2016. The data collection included patient demographics, clinical signs and symptoms management. Treatment outcomes were assessed by whether symptoms resolved and the number and type of treatment. **Results:** A total of 250 medical records were reviewed out of which 237 were involved in the data analysis. There were 95 male and 141 female patients with a mean age of 54.9 ± 11.5 years. In all, 120 patients complained of right shoulder pain and 117 of left shoulder pain. Smokers had a higher VAS Pain at Rest and Activity of 6.1 ± 3.5 and 8.2 ± 2.4, respectively, with non-smokers scoring a lower VAS Pain Rest score of 4.2 ± 3.1 and 7.9 ± 2.0 ($P = 0.18$). The VAS Pain Rest score after follow-up from corticosteroid injection, ultrasound-guided injection with needling, and surgery were 3.9 ± 3.0, 3.5 ± 3.0, and 0.7 ± 1.4, respectively. **Conclusion:** An algorithm constructed from our results recommends initial management with a subacromial corticosteroid injection with physical therapy followed by ultrasound-guided injection with needling and PT if the initial treatment fails. Surgical management is considered when the patient is recalcitrant to the first two forms of non-operative treatment.

Keywords: Calcific tendinitis, management, non-operative, rotator cuff

Introduction

Calcific tendinitis of the shoulder is a common condition addressed by musculoskeletal primary care health providers. It is characterized by calcific deposits in the rotator cuff tendons, most commonly the supraspinatus. As the disease progresses it involves the sub-acromial and sub-deltoid spaces.[1] Epidemiological studies have reported that calcific tendinitis of the shoulder most commonly occurs in females from the ages of 50-60 years.[2]

The pathway involves calcium deposition by chondrocytes metaplastically transformed from tenocytes or dysplastic calcium deposition due to cellular necrosis resulting from low intratendinous oxygen. Three stages have been defined, namely, precalcific stage (fibrocartilaginous metaplasia), calcific stage (calcium deposition in the formative phase followed by inflammatory changes in the resorptive phase), and post calcific stage (remodeling of tendon tissue leading to complete healing).[3]

Common modalities for diagnostic imaging are plain radiographs, ultrasound and magnetic resonance imaging (MRI).[4-6] The treatment for calcific tendinitis of the shoulder may be non-surgical or surgical. Non-surgical options include rest, physical therapy, NSAIDs, subacromial corticosteroid injections, extra-corporeal shockwave therapy, and ultrasound-guided injection and needling (barbotage).[7-10] If conservative management fails, surgical intervention in the form of arthroscopy and debridement is considered.[11]

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The natural history of the disease leads to a spontaneous resolution, which may take months. Unpredictability of the course of this disease can be confusing to primary care physicians, who encounter these patients initially and at subsequent follow-ups. There is no uniform algorithm set for management for this condition.

Methods

This was a retrospective study on patients who were diagnosed with calcific tendinitis by imaging (radiographs, CTs, and MRIs) at our institution from 2014 to 2016. The study was approved by the institution's IRB.

Patients with full rotator cuff tears in need of surgical repair, advanced glenohumeral arthritis requiring shoulder arthroplasty and fractures of the shoulder girdle were excluded from the data analysis. The data collection included patient demographics (sex, age, BMI, smoking status, and occupation), clinical signs and symptoms (shoulder pain, duration, and VAS scores at Rest and Activity), management (mode of diagnosis, treatments advised, and number of outpatient visits). Treatment outcomes were assessed by the persistence or return of shoulder pain and VAS scores at Rest and Activity. VAS pain scores were documented at baseline and follow-up after intervention. Occupation was categorized as heavy (construction), moderate (nursing, waiter, and retail), sedentary (office work, business, and law), student, retired, and not working. The duration of symptoms were defined as acute (symptoms <2 weeks), subacute (symptoms between 2 and 8 weeks), and chronic (symptoms >8 weeks).

Statistical analysis

Statistical analysis was conducted in SPSS software (IBM version 22.0, Chicago, IL, USA). Mean +/- standard deviation (SD) was used for analysis of continuous variables and percentages were calculated for categorical variables. Appropriate statistical tests were used based on the type of date for the baseline and clinical variables. For categorical variables, such as sex, smoking status, concomitant shoulder pathology, we used "Z-statistic" for testing the difference between the two sample proportions for number of interventions and VAS pain score outcomes. For the quantitative variables such as age at diagnosis, and BMI, we first tested each variable for basic assumptions of "Normality" and "Equal variances" to use the T-test for two independent samples. We used the Mann-Whitney U test, an alternate non-Parametric test for independent sample T-test. We used two-sided 95% confidence levels to assess the statistical significance.

Results

A total of 250 medical records were reviewed out of which 237 were involved in the data analysis. There were 95 male and 141 female patients with a mean age of 54.9 ± 11.5 years and BMI of 29.2 ± 7.6 kg/m^2. There were 6 male smokers and 12 female smokers. In all, 120 patients complained of right shoulder pain and 117 of left shoulder pain. Smokers had a higher VAS Pain at Rest and Activity of 6.1 ± 3.5 and 8.2 ± 2.4, respectively, with non-smokers scoring a lower VAS Pain Rest score of 4.2 ± 3.1 and 7.9 ± 2.0 ($P = 0.18$). Both smokers and non-smokers underwent two different forms of treatment ($P = 0.8$); 115 (48.5%) patients had medical co-morbidities, and 57 (24.1%) patients suffered from concomitant shoulder pathology during the course of their management [Table 1]

The treatment options included an in-clinic subacromial corticosteroid injection, ultrasound guided injection with needling, physical therapy, and surgery. The VAS Pain Rest score after follow-up from corticosteroid injection, ultrasound-guided injection, surgery were 3.9 ± 3.0, 3.5 ± 3.0, and 0.7 ± 1.4, respectively. The VAS Pain Activity score after follow-up from corticosteroid injection, ultrasound-guided injection, surgery were 7.7 ± 2.1, 6.8 ± 3.5, and 1.7 ± 2.4, respectively. There was no statistical difference in the duration of shoulder pain, number of treatment modalities, and VAS Rest and Pain scores for all the occupation categories [Table 2].

The duration of relief from a first, second and third time corticosteroid injection was a mean of 7.75 months (0-54 months), 5.73 months (1-20 months) and 4.5 months (2-9 months), respectively. The duration of relief from a first and second time ultrasound-guided injection and needling was 4.83 months (1-18 months) and 5.5 months (4-7 months).

Eighteen patients had surgery to excise the calcium deposit by debridement. If a significant defect was present after the debridement, the tendon was repaired (6/18); 55% (10 patients) presented with chronic symptoms [Table 3]. In comparison to the patients who did not have surgery, the surgical patients were younger (49 vs 55 years, $P < 0.049$), had a greater rate of a concomitant shoulder pathology (44% vs 8%), tobacco consumption (17% vs 7%), medical co-morbidities (72% vs 46%), and number of interventions.

Discussion

Calcific tendinitis of the shoulder is a difficult condition to manage with various treatment options.[12] While multiple pathways exist for management, this study is an opportunity to present guidelines and treatment. With the help of the patients smoking status, occupation, VAS pain scores, duration of treatment relief, number of patient visits, and our current management pathways, we have constructed an algorithm that may be followed as a standard by our primary care physicians for patients with suspected calcific tendinitis. There may be some cases that may vary and should be tailored to be treated as patient specific as needed.

At final follow-up, the lowest pain scores were observed in surgery, although corticosteroid injections and ultrasound-guided injections brought relief for a particular time period. With each subsequent corticosteroid joint injection, the duration of relief shortened; however, this was not the case observed for ultrasound

Table 1: Patient co-morbidities and concomitant shoulder pathology during the time of diagnosis

Co-morbidities	Number
Hypertension	29 (12.2%)
Hypothyroidism	25 (10.5%)
Diabetes mellitus	14 (5.9%)
Mood disorder	12 (5.1%)
Hyperlipidemia	10 (4.2%)
Gout	6 (2.5%)
Asthma	6 (2.5%)
CAD	4 (1.7%)
Fibromyalgia	1 (0.4%)
Osteoporosis	1 (0.4%)
RA	3 (1.3%)
Other	
Concomitant Shoulder Condition	**Number**
Mild AC Joint osteoarthritis	15 (6.3%)
Rotator cuff tear	13 (5.5%)
Subacromial bursitis	11 (4.6%)
Mild glenohumeral osteoarthritis	5 (2.1%)
Mild labral tear	3 (1.3%)
Biceps tendinopathy	1 (0.4%)
Other (paralabral cyst and so on)	4 (1.7%)

guided injection and needling. De Witte *et al.* conducted a randomized controlled trial comparing ultrasound injection and needling with subacromial corticosteroid injection.[13] Majority of the patients in the subacromial corticosteroid injection group had recurrence of symptoms between 6 weeks and 6 months, requiring another form of treatment. Some of the patients in the ultrasound injection and needling group reported recurrence of symptoms as early as 3 months. The chance of a subsequent treatment following a subacromial corticosteroid injection was also higher than an ultrasound injection and needling. In our study, there was a 55.2% and 33.3% recurrence of symptoms rate in the pathways for subacromial corticosteroid injection and ultrasound-guided injection and needling as primary forms of treatment, respectively [Table 4].

The addition of a dual treatment of physical therapy to corticosteroid injection or ultrasound-guided injection and needling resulted in a higher rate of resolution, not requiring a subsequent treatment. Pasquotti *et al.*'s study supports the long-term effectiveness of ultrasound-guided injection with physical therapy as their patient cohort demonstrated an average 35 point increase in the Constant shoulder score

Table 2: Distribution of VAS pain scores and number of intervention by demographic variables

Variable	No. of intervention	VAS Baseline Rest and Activity	VAS SACI 1 Rest and Activity	VAS SACI 2 Rest and Activity	VAS SACI 3 Rest and Activity	VAS USGIN 1 Rest and Activity	VAS USGIN 2 Rest and Activity	VAS PT Rest and Activity	VAS Surgery Rest and Activity
Gender									
Male vs Female	1.8 vs 1.9 *P*=0 0.44	4.2 vs 4.5 (R) *P*=0.46 7.7 vs 8.0 (A) *P*=0.25	3.5 vs 4.2 (R) *P*=0.32 7.7 vs 7.9 (A) *P*=0.62	2.6 vs 4.1 (R) *P*=0.1 8.3 vs 8.1 (A) *P*=0.83	4.2 vs 1.5 (R) *P*=0.11 6.2 vs 7.1 (A) *P*=0.53	4.0 vs 4.5 (R) *P*=0.13 7.7 vs 8.0 (A) *P*=0.69	4.2 vs 4.5 (R) *P*=1.0 7.7 vs 8.0 (A) *P*=0.053	4 vs 1.5 (R) *P*=0.26 8 vs 4.9 (A) *P*=0.28	0.5 vs 0.9 (R) *P*=0.61 1.2 vs 2.1 (A) *P*=0.57
BMI									
<30 vs>30	1.8 vs 1.9 *P*=0.22	4.3 vs 4.5 (R) *P*=0.61 7.7 vs 8.1 (A) *P*=0.13	3.9 vs 4.0 (R) *P*=0.32 7.4 vs 8.1 (A) *P*=0.62	3.9 vs 2.5 (R) *P*=0.83 8.1 vs 8.4 (A) *P*=0.14	1.9 vs 4.2 (R) *P*=0.19 6.7 vs 6.7 (A) *P*=0.98	3.8 vs 3.2 (R) *P*=0.66 7.5 vs 6.2 (A) *P*=0.39	1 vs 3.5 (R) *P*=0.55 9 vs 7.5 (A) *P*=1.0	2 vs 1.5 (R) *P*=0.73 4.8 vs 5.8 (A) *P*=0.62	0.9 vs 0.5 (R) *P*=0.61 2.4 vs 0.6 (A) *P*=0.17
Smoking									
Yes vs No	1.9 vs 1.8 *P*=0.76	3.8 vs 4.1 (R) *P*=0.02* 8.0 vs 7.7 (A) *P*=0.57	3.8 vs 4.1 (R) *P*=0.76 8.0 vs 7.7 (A) *P*=0.7	3.5 vs 3.5 (R) *P*=1.0 8.0 vs 8.0 (A) *P*=0.95	N/A	N/A	N/A	N/A	1.7 vs 0.36 (R) *P*=0.51 3.0 vs 1.3 (A) *P*=0.64
Concomitant Shoulder Pathology									
Yes vs No	2.2 vs 1.7 *P*=0.01*	4.4 vs 4.3 (R) *P*=0.84 7.9 vs 7.9 (A) *P*=0.9	3.5 vs 4.1 (R) *P*=0.39 7.8 vs 7.7 (A) *P*=0.92	2.8 vs 3.6 (R) *P*=0.4 7.9 vs 8.3 (A) *P*=0.9	2.0 vs 3.3 (R) *P*=0.5 8.0 vs 5.6 (A) *P*=0.46	3.8 vs 3.2 (R) *P*=0.65 7.5 vs 6.2 (A) *P*=0.63	6.3 vs 7.1 (R) *P*=0.45 1.5 vs 4.0 (A) *P*=0.6	1.6 vs 2.0 (R) *P*=0.79 5.0 vs 5.5 (A) *P*=0.79	0.1 vs 1.2 (R) *P*=0.12 0.6 vs 2.6 (A) *P*=0.08
Occupation									
Not working	1.8±1.2	5.4±3.1 (R) 8.0±2.2 (A)	5.0±3.5 (R) 8.5±2.0 (A)	4.5±1.0 (R) 8.5±1.0 (A)	0.0±0.0 (R) 8.0±0.0 (A)	4.0±1.8 (R) 9.3±1.2 (A)	N/A	N/A	N/A
Sedentary	1.8±1.1	4.1±3.0 (R) 7.7±2.1 (A)	3.5±2.7 (R) 7.5±2.2 (A)	4.8±3.6 (R) 8.0±1.7 (A)	4.0±2.7 (R) 7.8±1.5 (A)	2.3±3.0 (R) 5.8±4.2 (A)	3.0±4.4 (R) 8.3±0.6 (A)	2.7±2.5 (R) 7.0±1.0 (A)	0.6±0.9 (R) 2.1±3.1 (A)
Moderate	2.0±1.1	4.3±3.2 (R) 8.1±1.7 (A)	3.7±3.2 (R) 8.0±1.8 (A)	2.4±1.8 (R) 8.6±1.3 (A)	5.0±2.8 (R) 4.0±2.8 (A)	5.1±3.1 (R) 7.1±2.5 (A)	3.0±0.0 (R) 7.0±0.0 (A)	1.3±1.8 (R) 4.3±2.7 (A)	0.9±1.8 (R) 2.1±3.1 (A)
Heavy	2.0±1.2	4.6±4.0 (R) 7.4±2.0 (A)	3.0±3.4 (R) 5.0±2.4 (A)	2.7±1.2 (R) 6.0±1.7 (A)	2.0±2.8 (R) 5.5±2.1 (A)	N/A	N/A	N/A	N/A

R: Pain at rest; A: Pain during activity; USGIN: Ultrasound-guided injection and needling; PT: Physical therapy; SACI: Subacromial corticosteroid injection

Table 3: Relationship of duration of symptoms and treatment

Initial Presentation	Duration of Symptoms	*n*	No. of Interventions	Underwent Surgery
Acute	<2 weeks	115	1.6±0.9	1
Subacute	2-8 weeks	29	1.6±0.9	2
Chronic	>8 weeks	70	2.2±1.2	10
Not described in patient note		23		5

Table 4: Success of index intervention

Index Intervention	*n*	Resolved Cases	Unresolved Cases Requiring Subsequent Interventions
Subacromial corticosteroid injection	154	69 (45%)	85 (55%)
Subacromial corticosteroid injection with physical therapy	26	15 (67%)	11 (33%)
Ultrasound-guided injection and needling	18	12 (67%)	6 (33%)
Ultrasound-guided injection and needling with physical therapy	14	12 (86%)	2 (14%)
Physical therapy	18	7 (39%)	11 (51%)
Wait and watch	5	3 (60%)	2 (40%)

1 year post-injection.[14] Although no formal physical therapy rehabilitation protocol exists for calcific tendinitis of the shoulder, the patients from the current study underwent range of motion and strengthening exercises as needed determined by the physical therapist.

Two patients from our cohort of concomitant shoulder pathology underwent an arthroscopic rotator cuff repair for partial rotator cuff tears. There was no statistical significance in the VAS pain scores at rest (4.4 vs 4.3, $P = 0.84$) and activity pain scores (7.9 vs 7.9, $P = 0.9$) reported at baseline during the initial encounter between patients with a concomitant shoulder pathology and patients without. Pain scores were also no different statistically after treatment (non-operatively and operatively).Conversely, the number of treatment modalities (office visits) performed in the concomitant shoulder pathology group was slightly greater with statistical significance, 2.2 vs 1.7, $P = 0.014$. This may have been due to an additional intervention to address the concomitant shoulder pathology or to combat the pain originating from another source.

The VAS pain scores for the different types of occupation did not differ. A cross-sectional study of calcific tendinitis of the shoulder in cashiers with repetitive arm movements found no difference in the prevalence of shoulder calcification when compared to non-cashier controls.[15] The load and repetition of shoulder movement in certain occupations has no correlation to the formation of calcification.[15,16] Instead, an increasing age as an independent variable may have a stronger correlation as seen in the former study (mean age of 42.8-44.9 years in cashiers vs 36.2-36.4 years in non-cashiers) and the current study (mean age of 54.9 years). Other extrinsic factors such as sex, BMI and hand dominance did not show differences in pain scores and number of treatment visits.

Although a small portion of our cohort were smokers (18/237) no differences were seen in the VAS scores at rest and activity at baseline, and non-operative and operative treatments. Smoking tobacco has been found to be associated with high failure in ultrasound needling and aspiration and type II Gartner classification. Interestingly, type 2 classification required less procedures in this study but with the uncertainty if this was an incidental finding.[17] Our results in this series also found no statistical difference in the number of interventions between smoker and non-smokers.

In all, 7.6% of patients from our cohort failed non-operative management in this study. This was lower than that reported to a study of chronic calcific tendinitis in the German population, our failure rate was much lower to the 30% non-operative treatment failure reported in the aforementioned study.[18] This may relate to the difference in definition of failure. Failure was defined as the persistence of symptoms beyond 6 months whereas in our study we defined it as either an open or arthroscopic surgical intervention after 1 or more non-operative treatment. The mean duration of non-operative treatment prior to surgery was a mean of 18.3 weeks (2 weeks-15 months). All 18 surgical cases were arthroscopic procedures consisting of debridement, subacromial decompression, acromioplasty, excision of the calcification and rotator cuff tear repair if indicated. Patients reported a lower VAS pain scores up to 1 year post-operatively. Patients who had chronic symptoms, younger, tobacco consumers, with medical co-morbidity and concomitant shoulder pathology were more likely to undergo surgery.

Based on this study, an algorithm has been formulated for suspected cases of calcific tendinitis of the shoulder [Figure 1]. Most of these patients present with acute shoulder pain of non-traumatic onset. Physical examination would not reveal anything specific to calcific tendinitis of the shoulder in regards to shoulder observation, tenderness, range of motion, strength and special tests. The next step would be to proceed to a radiographic series of the shoulder that would most likely reveal some form of calcification. If the radiographs reveal no calcification, an MRI or ultrasound may be ordered, especially if supported. If the presence of calcification is noted, the first line treatment of choice to be considered is a subacromial corticosteroid injection in the clinic with formal physical therapy or home exercise therapy. Patients should be advised to return if the pain persists or returns. If the pain returns after 7 months, the same treatment as the primary treatment may be advised. In cases where the pain returns in less than 7 months, an even more aggressive treatment of ultrasound-guided injection and needling is suggested. If the pain returns after the second line of treatment, the patient is referred to a shoulder orthopedic surgeon specialist. The shoulder surgeon should order an advanced imaging modality such as an MRI to determine if simple debridement or cuff repair is required.

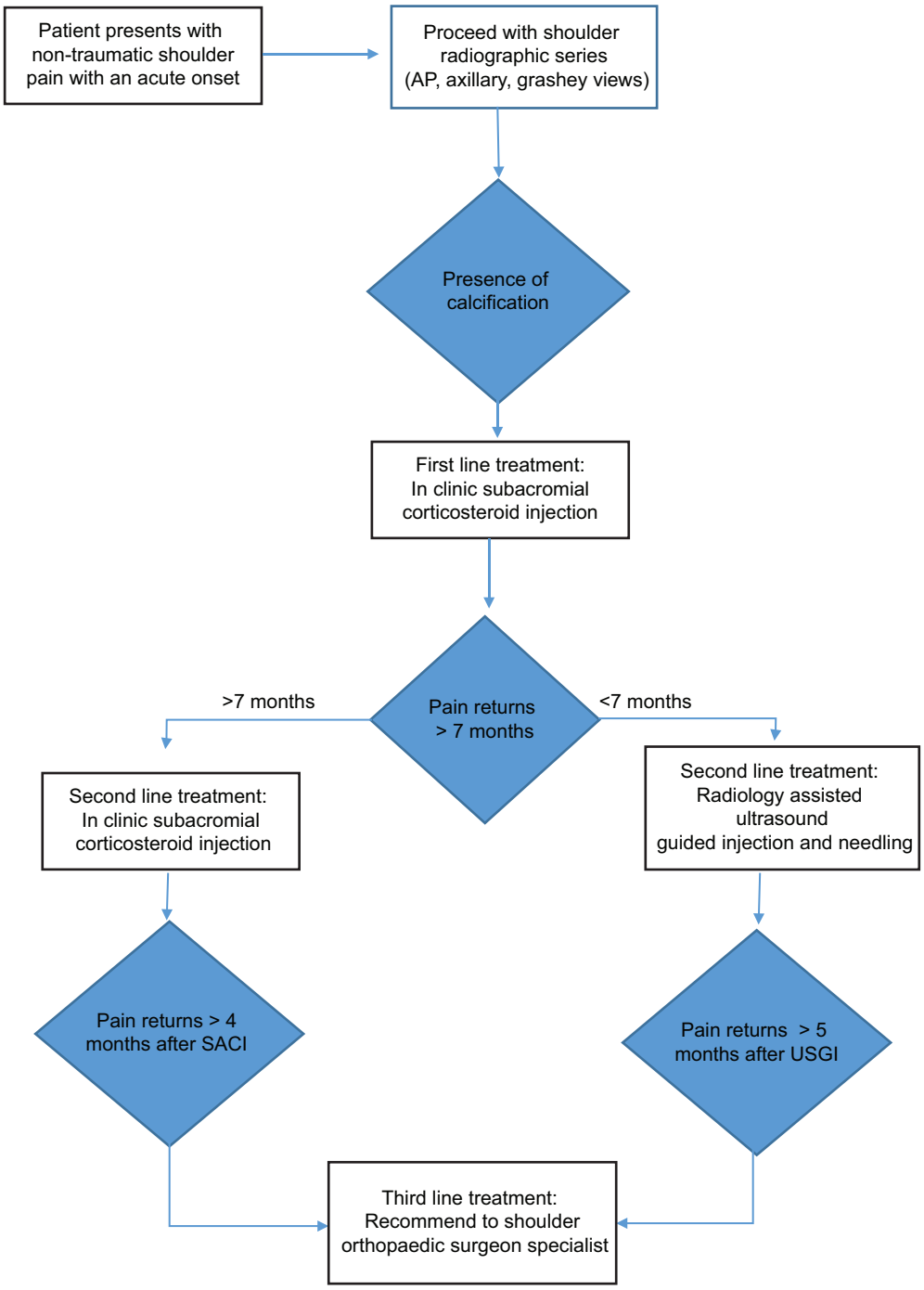

Figure 1: Algorithm for clinical management for calcific tendinitis of the shoulder

This algorithm of diagnosis and treatment of calcific tendinitis of the shoulder may be useful to treat shoulder pain of unspecified etiology. Although the choice of treatment is a shared decision between the physician and patient, the algorithm may be seen as an outline where the treatment modality progressively escalates.

This study presented with a few limitations due to its retrospective nature. Patients were not followed prospectively and variables were collected solely from medical charts. Patient reported outcome measures other than VAS pain scores were not available. The definition of treatment failure was inconsistent with the available literature. Lastly, the radiographic presentation of calcification varied from patient to patient, possibly leading to misdiagnosis of rotator cuff calcific tendinitis.

Conclusion

Calcific tendinitis of the shoulder is a condition with variable presentation courses. The goal of the algorithm we constructed was to provide the most cost-effective and efficacious treatment with gradual escalation and treatment options if pain persists.

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Conflicts of interest

There are no conflicts of interest.

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