Ann Med Res

Current issue list available at AnnMedRes

Annals of Medical Research

journal page: www.annalsmedres.org

Effectiveness of USG-guided corticosteroid injection administered into the glenohumeral joint and oral prednisone treatment in patients with adhesive capsulitis

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ARTICLE INFO

Keywords:
Adhesive capsulitis
Ultrasound
Steroid
Axillary (inferior) pouch

Received: Jan 12, 2024
Accepted: May 27, 2024
Available Online: 29.05.2024

DOI:
10.5455/annalsmedres.2024.01.012

Abstract

Aim: This study aims to compare the efficacy of ultrasonography-guided corticosteroid injection to the glenohumeral joint and oral steroid therapy on clinical response and inferior axillary pouch (AR) thickness measured by ultrasonography (USG) in patients with adhesive capsulitis (AC).

Materials and Methods: Our prospective randomized study included 48 patients (18-65 years) with a diagnosis of AC. The first group (n=24) underwent USG-guided corticosteroid injection to glenohumeral joint. In the second group (n=24), oral prednisone was started at 0.5 mg/kg dose with the dosing schedule determined by decreasing and continued for 6 weeks. Both groups were also included in a standard physical therapy program (electrotherapy+exercises). The questionnaire, active and passive shoulder joint range of motion (ROM) measurements, Shoulder Pain and Disability Index (SPADI), evaluation of the joint with USG, and AR thickness measurements were performed.

Results: There was a statistically significant increase in passive-active ROM values in all directions before and after the treatment ($p<0.05$) and decrease in AR values after the treatment ($p<0.001$) in both groups. However, there was no significant difference between the two groups. In addition, the decrease in inferior pouch thickness and the decrease in SPADI scores were positively correlated.

Conclusion: Steroid injection into the glenohumeral joint and oral steroid use significantly reduced shoulder pain and disability and increased range of motion in AC patients. Moreover, both oral steroid and steroid injection treatments improved radiologic findings (by reducing AR), consistent with clinical response. Although both treatments were effective, they were not superior to each other.

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Introduction

Adhesive capsulitis (AC), which is called aseptic joint capsule inflammation, is a common cause of orthopedic disability characterized by the limitation of passive and active shoulder ROMs and pain in the shoulder [1]. The disease often affects the advanced age and female gender. AC is divided into two types: primary (idiopathic) and secondary [2,3]. While the prevalence of primary AC is 2-5%, the incidence of secondary AC increases up to 30% due to conditions such as immobility, trauma, proximal humeral fractures, rotator cuff disorders, diabetes, cardiovascular disorders, myocardial infarction, stroke, post-vaccine, psychological disorders, or surgery [4,5].

Although the pathophysiology of AC is unclear, one hypothesis predicted based on arthroscopic observations is that inflammation initially occurs in and around the axillary fold of the joint capsule, the anterosuperior joint capsule, the coracohumeral ligament (CHL), and the rotator cuff space, followed by fibrosis and adhesions of the synovial membrane in the direction [5]. Patients complain of pain and gradually decrease their range of motion, especially at night. AC is a clinical diagnosis that can be decided by adequate history and appropriate physical examination. Nevertheless, imaging methods can be used to consolidate the diagnosis of AC, distinguish it from other pathologies, and guide the treatment. Although direct radiography and computed tomography are mostly used to exclude additional pathologies, ultrasonography (USG) and magnetic resonance imaging (MRI) have high sensitivity and specificity in diagnosis. MRI is considered an excellent diagnostic imaging method [6-8]. Typical find-

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ings in MRI images are the thickening of the joint capsule and abnormal signal intensity in the axillary recess and rotator space, as well as the thickening of CHL. In studies with USG, the thickness of the inferior axillary pouch (AR) increases in patients with AC and it is an easy and inexpensive radiological examination method like USG. It has been shown that this thickness can be measured with [9]. It was concluded that the more shoulder abduction is performed during the measurement, the less AR thickness will be [10].

Although AC is defined as a self-limiting disease, this can sometimes last for years. 10% of patients have persistent pain and mild limitations in ROM persist. Conservative treatment options are physical therapy, anti-inflammatory and analgesic drugs, and oral steroid use or corticosteroid injection [5,11]. Surgical methods are used in patients unresponsive to conservative treatment [12].

We aim to compare the efficacy of two different methods (USG-guided corticosteroid injection to the glenohumeral joint and oral steroid therapy) on clinical response and inferior axillary pouch (AR) thickness measured by USG in patients with AC.

Materials and Methods

The study included 48 patients aged between 18-65 years who were diagnosed with AC and applied to the Physical Medicine and Rehabilitation outpatient clinics between June 2020-2022. Intra-articular steroid injection or operation on the shoulder less than three months ago, with an obstacle to steroid use, with uncontrolled diabetes mellitus, with a diagnosis of RA, AS, etc. chronic rheumatic disease, or with a definite/suspected malignancy history, and with osteoarthritis, septic arthritis or rotator cuff tear in the shoulder patients were excluded from the study. Ethical approval was obtained from Local Ethics Committee (Inonu University Clinical Research Ethics Committee, decision number: 2020/112) on June 17, 2020 . Written consent was obtained from the participants. The study was conducted following the Declaration of Helsinki.

Clinical evaluation

Demographic data of the patients were recorded. In both groups, before the treatment and in the 6th week, the affected shoulder was active in the flexion, extension, abduction, adduction, internal rotation, and external rotation directions of the affected shoulder with a goniometer in the sitting position, and passive ROMs were measured. Shoulder Pain and Disability Index (SPADI) was used to assess the patient's pain and disability.

Radiological evaluation

AR thickness measurements were performed with the linear probe (6-18 MHz) of the EsaoteMylab 70 USG device in our clinic before and during the 6th week after the treatment. For measurement with USG, the patient was placed on his back with the elbow flexed to 90° and the forearm neutral. The USG probe was placed longitudinally in the mid-axillary region. The humeral head and humeral surgical neck, which are the benchmarks in the longitudinal plane, were determined. AR thickness was taken as the sum of the thickest humeral and glenoid sides perpendicular to the concavity between these two points and recorded.

Treatment applications

The patients were randomized into 2 groups using the improbable random sampling method (closed envelope method). After the glenohumeral joint space was determined by USG, sterile conditions were maintained in the first group, and 3 milliliters of 2% prilocaine and 1 ml of 20 mg of triamcinolone hexacetonide mixture were injected with a 21 Gauge x 38 mm injector with a posterior approach while the patient was in a sitting position and the hand on the shoulder side was on the thigh. In the second group, oral prednisone was started at a dose of 0.5 mg/kg, and after 5 days of use, it was gradually reduced to 4 mg doses and discontinued at the end of an average of 6 weeks.

Physical therapy (Electrotherapy: Hotpack, TENS (20 min), US (10 min) and Exercises: Codman [=pendulum], shoulder wheel, rolling pin, active/passive ROM, and isometric exercises) was started at the same time in both groups. After these applications were applied in the hospital for 15 sessions, home exercise training was given.

In the Power analysis studied, when taken with α=0.05 and 1-β (power)=0.80, it was calculated that at least 24 subjects from each group should be taken from each group so that the mean difference in thickness measurement in the injected group compared to the oral prednisone treatment group could be 0.6 mm. NCSS PASS 13 program was used to calculate the sample size.

Statistical analysis

The data of the study were evaluated with the Statistical Package for Social Sciences (SPSS 17.0 Chicago, IL, USA) program. Mean for quantitative variables, ratio, median, standard deviation, and minimum and maximum values for qualitative variables were calculated. Ratios were calculated for qualitative variables and mean, standard deviation, median, minimum and maximum for quantitative variables. Non-parametric test statistics were used for variables that did not fit a normal distribution, according to Shapiro-Wilk test statistics ($p<0.05$). Mann-Whitney U was used for the difference between the two groups and Wilcoxon test statistics for the comparison before and after the procedure. According to Shapiro-Wilk test statistics ($p>0.05$), parametric test statistics were used for variables suitable for normal distribution. Independent samples test was used for comparison between two groups, paired samples test statistics for comparison before and after the procedure. Spearman Correlation test was used to measure the relationship between two variables.

The statistical significance level $p<0.05$ was taken with 95% confidence interval.

Results

In our study, 70.8% (n=17) of the patients who received steroid injections were female, 29.2% (n=7) were male, 58.3% (n=14) were female, and 41.7% (n=10) male in the patients who were started oral steroids. According to the

Table 1. Comparison of treatment choice in patients given a steroid injection and oral steroid according to demographic characteristics.

		Steroid injection n (%)	Oral prednisone n (%)	P value
Gender	Female	17 (70.8)	14 (58.3)	0.365
	Male	7 (29.2)	10 (41.7)	
Symptom duration	<5.5 months	20 (83.3)	23 (95.8)	0.348
	>5.5 months	4 (16.6)	1 (4.1)	
Age, year		55.2±6.4	55.4±8.7	0.412
Dominant extremity involvement		4 (16.6)	2 (8.3)	0.66
Non-dominant extremity involvement		20 (83.3)	22 (91.6)	

recorded information, the age and gender distributions of both groups were similar ($p>0.05$) (Table 1).

The mean duration of symptoms of the patients was 5.5 months. While the dominant side was involved in 6 patients, non-dominant extremity involvement was present in 42 patients. According to the extremity involved, non-dominant extremity involvement was dominant in the patients (Table 1). Both active and passive ROM measurements in patients who received USG-guided injections showed statistically significant improvement after treatment ($p<0.05$). Similarly, in the group receiving oral steroid treatment, ROM measurements increased statistically in all directions except passive adduction ($p<0.05$) (Table 2).

The mean scores of passive flexion, abduction, external rotation, and extension ROM of the patients who received the injection therapy were higher than the patients who received oral steroids ($p<0.05$) (Table 2). However, there was no statistically significant difference between the two groups in terms of passive adduction and internal rotation measurement values ($p>0.05$).

There was also a statistically significant difference between the flexion, abduction, extension, internal rotation, external rotation, and SPADI values in active shoulder ROM of the patients who received a steroid injection and oral prednisone in our study ($p<0.05$) (Table 2).

The decrease in AR thickness after treatment was statistically significant in both groups ($p<0.001$). However, there was no significant difference between the two groups ($p=0.379$). There was a positive correlation between the decrease in inferior pouch thickness and the decrease in SPADI scores, $r_1=0.55$, $p_1=0.0001$ and $r_2=0.624$, $p_2=0.0002$, respectively in injection and oral steroid treatment groups).

Discussion

In our study, although the pathogenesis is not clear, we compared the efficacy of intra-articular or orally administered corticosteroid therapies in the treatment of AC, in which both inflammation and fibrosis play a role, in terms of shoulder pain scale and ROM measurements, and evaluated the thickness of the inferior axillary pouch, which is an objective parameter in response to treatment. As a result, we found that the increased inferior pouch thickness in patients with AC was reduced by steroid injection + PMR and oral steroid + PMR combination treatments, and this decrease was associated with a decrease in SPADI pain index and an increase in passive-active shoulder ROM.

Pathology in AC affects the glenohumeral capsular tissue and is localized in CHL, especially in the rotator interval. Studies have shown inflammatory changes, fibrosis, and proliferative myelofibrosis [13]. As a result of all these mechanisms, the shoulder joint capsule contracts. In MRI studies performed for clinical diagnosis, it was emphasized that findings such as CHL thickening, signal changes in the rotator interval, and inferior glenohumeral ligament thickening are important findings in the diagnosis of AC [14]. In our study, we used USG, which is easier and cheaper to use clinically, as a guide both for diagnosis and treatment. Studies have found that the axillary pouch thickness has increased significantly to the extent that it can be used in the diagnosis of AC [15]. In a recently published study, they emphasized that an experienced USG user can confirm the clinical diagnosis of AK by evaluating the thickness of the axillary pouch, CHL, and superior glenohumeral ligament, and detecting decreased slip of the infraspinatus tendon [16]. In the study of Sernik et al. the AR thickness was found to be 4 mm and it was found to be statistically yhicker than asymptomatic shoulders with an average of 1.3 mm after that the cutoff value of 2 mm was accepted for AR thickness [17]. After MRI is performed in patients with AR thickness greater than 2 mm, the diagnosis of AC was evaluated as 100% sensitivity and 96% specificity. Similarly, in our study, pre-treatment AR thickness was 3.85 (3.91±0.47) mm. Thus, we objectively recorded the clinical diagnosis of our patients with USG and supported our diagnosis.

Although adhesive capsulitis (AC) is defined as a self-limiting disease, this can sometimes last for years. Approximately 70% to 90% of patients with AC respond well to conservative treatments. In the treatment of AC, different treatment options from conservative methods can be preferred individually or in combination [18]. The use of corticosteroids in the treatment of AC helps to increase the range of motion faster and reduce pain. If exercises aggravate the symptoms, a long-acting anesthetic, and glucocorticoid injection into the joint beforehand may also help [19]. It has been stated that the effects are not sustain-

Table 2. Comparison of clinical and radiological outcomes before and after treatment between two groups.

		1nd Group (Corticosteroid injection)				2nd Group (Oral prednisone)					
		Before Treatment		After Treatment		Before Treatment		After Treatment		Z	p*
		Median (Min-Max)	IQR	Median (Min-Max)	IQR	Median (Min-Max)	IQR	Median (Min-Max)	IQR		
F-ROM	Active	107.5 (75-140)	20	160 (130-170)	20	100 (80-145)	36.25	140 (75-165)	23.75	-3.802	0.0001
		p¥=0.0001		Z=-4.29		p¥=0.0001		Z=-3.54			
	Passive	110 (90-150)	20	167.5 (140-180)	20	115 (90-150)	31.25	145 (95-170)	20	-3.46	0.0001
		p¥=0.0001		Z=-4.31		p¥=0.0001		Z=-4.29			
E-ROM	Active	32.5 (22-55)	10	55 (40-65)	10	37.5 (20-95)	17.50	47.5 (30-160)	15	-2.856	0.003
		p¥=0.0001		Z=-4.32		p¥=0.0003		Z=-3.28			
	Passive	40 (30-60)	10	60 (45-70)	5	40 (25-60)	20	52.5 (30-60)	15	-2.934	0.003
		p¥=0.0001		Z=-4.23		p¥=0.0001		Z=-3.81			
Add-ROM	Active	40 (25-40)	5	45 (45-45)	0	40 (30-45)	0	45 (45-45)	0	0	1.0
		p¥=0.0001		Z=-4.39		p¥=0.0001		Z=-4.23			
	Passive	40 (40-45)	8.75	45 (40-45)	0	45 (30-45)	0	45 (45-45)	0	-1.000	0.317
		p¥=0.0001		Z=-3.62		p¥=0.1		Z=-1.63			
Abd-ROM	Active	100 (70-145)	20	160 (130-170)	23.75	100 (70-140)	37.5	140 (100-170)	18.75	-3.944	0.0001
		p¥=0.0001		Z=- 4,29		p¥=0.0001		Z=- 4.11			
	Passive	115 (80-140)	20	162.5 (120-180)	20	140 (90-150)	30	147 (100-170)	10	-3.421	0.0001
		p¥=0.000		Z=4.30		p¥=0.0001		Z=- 4.31			
IR-ROM	Active	50 (20-70)	23.75	70 (60-80)	15	52.5 (30-80)	20	60 (40-80)	18.75	-2.198	0.028
		p¥=0.0001		Z= -4.21		p¥=0.0001		Z=-3.71			
	Passive	60 (30-70)	20	70 (60-80)	13.75	60 (35-80)	27.50	65 (45-85)	18.75	-1.764	0.078
		p¥=0.0001		Z= -4.23		p¥=0.018		Z=-2.36			
ER-ROM	Active	52.2 (20-80)	20	70 (55-85)	18.75	50 (20-80)	27.5	60 (30-85)	20	-2.597	0.009
		p¥=0.0001		Z= -4.22		p¥=0.0001		Z=-3.73			
	Passive	60 (20-80)	20	77.5 (55-85)	13.75	60 (25-80)	30	65 (45-85)	20	-2.575	0.01
		p¥=0.0001		Z=-3.79		p¥=0.0001		Z=-3.75			
SPADI reduction		83.8 (52.3-95.3)	14.6	16.50 (8.4-42.3)	12.88	75.7 (40-91)	15.25	29.55 (8.4-60)	26.97	-2,776	0.006
		p¥=0.0001		Z=-4.29		p¥=0.0001		Z=-4.29			
AR thickness		3.85 (3.1-5.1)	0.50	2.5 (1.9-3.2)	0.70	3.65 (2.4-5.7)	1.05	2.6 (2-4.1)	0.88	-0.879	0.379
		p¥=0.0001		Z=-4.30		p¥=0.0001		Z=-4.92			

ROM: Range of motion, F: Flexion, E: Ekstansion, Add: Adduction, Abd: Abduction, IR: Internal rotation, ER: External rotation, SPADI Score: AR: Inferior axillary pouch, IQR: Intequartile range.

- Z: Standart score
- Paired Samples Statistics p*<0.05
- Wilcoxon Signed Ranks Test p¥<0.05.

able beyond the 6th week [20]. In a randomized controlled study by Lorbach et al. it was shown that the use of cortisone in the treatment of idiopathic shoulder AC led to rapid relief of pain and improved range of motion [21]. At the same time, it was concluded that intra-articular glucocorticoid injections are superior to short-term oral corticosteroids in terms of objective shoulder scores, range of motion, and patient satisfaction. Oral and intra-articular steroid doses used in both clinical and experimental animal studies are variable [18-22]. There is no definite recommendation regarding the dose and duration of oral corticosteroid administration in existing reviews and studies. However, there are recommendations regarding the dose and duration that we applied in our study [18,20,23]. A recent randomised controlled trial comparing oral steroid and exercise therapy found that the oral steroid group was effective in terms of pain and functionality but had no superiority over the exercise group [18]. In our study, we found an increase in ROM and a decrease in disability index in both groups after treatment. At the same time, there was a corresponding decrease in AR thickness. However, when looked at between the two groups, the decrease in AR measurements was similar in both treatments [14]. The results of our study, it was shown that the mean values of active flexion, abduction, extension, and internal and external rotation after the treatment were higher in the patients who received injections compared to the active ROMs of the group receiving oral prednisone treatment.

Many physical therapy modalities and home exercises can be used as first-line treatment for adhesive capsulitis. It has been shown that physical therapy reduces pain and provides the return of functional movement [24]. Similarly, various studies in which intra-articular corticosteroids were used together with physiotherapy showed better results compared to intra-articular corticosteroids alone [25-27]. In addition to pharmacological treatment, we applied for a physical therapy program.

Another point we would like to draw attention to is that although the incidence of AK was reported as 2-5% in studies before the COVID-19 pandemic, it has been shown that the incidence may increase after the pandemic in recent studies [28]. In our study, we also have three patients diagnosed after vaccination, which supports the increase in incidence data.

Limitations

The patients included in our study were treated without being categorized into stages. It is one of our limitations to predict that if different methods are used in the inflammation phase or the phase of the contracture, it can be more effective as a result of the treatment. AR thickness: It can be affected by height and weight (BMI), but due to patient-based evaluation, it can be considered sufficient to show the response in treatment. Larger prospective studies are needed on this subject.

Conclusion

The use of USG is valuable for both the diagnosis and treatment of AC, which is one of the most common causes of shoulder disability. We showed that the increased AR thickness evaluated with USG in AC has an important role in supporting the diagnosis and showing the clinical and radiological response in response to treatment. Both oral and intra-articular corticosteroid treatments, which are among the options in the treatment of AC, are effective in clinical and radiological response. Further studies involving different methods in the diagnosis of AC and treatment options are needed.

Ethical approval

Ethical approval was received for this study from Inonu University Clinical Research Ethics Committee (decision no: 2020/112).

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