

General

Need for intra-articular corticosteroid injections in patients with frozen shoulder

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BACKGROUND

Frozen shoulder is a condition that causes pain, stiffness, and loss of range of motion. However, little is known regarding the need for intra-articular corticosteroid injections for this condition, as well as the association between known risk factors and the need for these injections.

AIM

To evaluate the relationship between known risk factors and the need for intra-articular corticosteroid injections in patients with adhesive capsulitis.

METHODS

A retrospective cohort study was conducted to assess the association between risk factors for adhesive capsulitis and the use of intra-articular corticosteroid injections in patients treated between January and December 2022. All patients diagnosed with primary adhesive capsulitis were included. Comparative analysis between steroid users and non-users was performed using chi-square tests and linear model ANOVA variance, based on the data type and distribution. A binary logistic regression model was used to evaluate whether demographics and comorbidities predicted corticosteroid injection use.

RESULTS

In total, 138 patients were diagnosed with primary adhesive capsulitis. Patients were divided into two groups according to the need for intra-articular corticosteroid injections. No statistically significant differences were found between the two groups regarding laterality, age, sex, hypothyroidism, hypertension, ischemic heart disease, diabetes mellitus, and other risk factors.

CONCLUSION

None of the investigated factors predicted the need for intra-articular corticosteroid injections. Further research is needed to explore other potential influences and improve treatment decision-making for adhesive capsulitis.

INTRODUCTION

Frozen shoulder, also known as adhesive capsulitis, is a disorder that causes pain, stiffness, and limited range of motion in the shoulder joint.¹ It typically appears gradually and progresses through various stages, resulting in severe discomfort and functional impairment.^{1,2} The glenohumeral joint, which connects the humerus and scapula,³ is the main site affected.^{4,5}

Although the precise cause of adhesive capsulitis remains unknown, several risk factors have been investigated.⁶⁻⁸ Women are slightly more vulnerable than men, and individuals aged 40–60 years are more likely to be af-

ected.⁹ Adhesive capsulitis risk has also been associated with several medical illnesses, including diabetes mellitus (DM), thyroid disorders, and cardiovascular disease.^{9,10} Additional contributors include shoulder injuries, protracted immobilization, repeated stress injuries, and specific genetic variables.^{6,8}

Adhesive capsulitis is typically managed with a multidisciplinary approach that involves conservative therapies and, in certain situations, surgical procedures.¹¹ Treatment goals include reduce pain reduction, shoulder mobility improvement, and functional outcome enhancement. Non-surgical therapies include nonsteroidal anti-inflammatory drugs; oral or injectable corticosteroids; physical therapy;

and other modalities such as heat therapy, ultrasound, and transcutaneous electrical nerve stimulation.¹⁰ Physical therapy plays an essential role by promoting increased range of motion, shoulder muscle strengthening, and pain reduction.¹²

Intra-articular corticosteroid injections have long been used as a therapeutic option for adhesive capsulitis.¹³ These injections deliver corticosteroids directly into the afflicted shoulder joint, aiming to reduce inflammation, alleviate discomfort, and improve shoulder mobility.¹⁴ Intraarticular steroid injections may reduce swelling, relieve discomfort, and potentially improve shoulder range of motion by addressing inflammatory responses within the joint capsule.^{15,16} However, their necessity in this patient population remains controversial. Moreover, factors such as disease stage, symptom intensity, and response to conservative measures should be considered before administration.¹⁵⁻¹⁷

Saudi Arabia has distinct demographic and cultural characteristics that may influence the presentation and treatment of adhesive capsulitis.^{18,19} Differences in the prevalence, severity, and responsiveness to therapy among Saudi patients can be explained by factors such as genetic predisposition, lifestyle, cultural practices, and healthcare accessibility.²⁰ Understanding these individual traits is critical for enhancing diagnostic and treatment approaches, and ultimately, patient outcomes.

The aim of this study was to investigate demographic characteristics, risk factors, comorbidities, and the need for intra-articular steroid injections in a cohort of Saudi patients with adhesive capsulitis.

MATERIALS AND METHODS

STUDY DESIGN, POPULATION, AND SAMPLING

This retrospective cohort study included all patients diagnosed with frozen shoulder who visited our outpatient clinics between January 2022 and December 2022. Patients were asked about their use of steroids in their treatment plan to assess disease stage. Plain, oblique, axillary, and outlet radiographs, as well as magnetic resonance imaging scans, were used for diagnosis.

We included patients clinically diagnosed with frozen shoulder who visited our medical center during the specified time period, and excluded patients with secondary adhesive capsulitis due to an underlying primary pathology (full-thickness rotator cuff tears, fractures, dislocations, avascular necrosis, or tumors) and those with adhesive capsulitis who were referred from other clinics or seen outside the defined time period.

A non-probability sampling method (convenience sampling) was used to select patients based on data availability. The sample size was calculated using a 95% confidence level ($Z = 1.96$) and a margin of error (E) of 5%. Based on these parameters, the required sample size was determined to be 104 patients.

DATA COLLECTION AND VALIDATION

Baseline demographic and clinical data were extracted from patient medical records and analyzed. The data collected included demographics (age and sex), laterality (affected side), concomitant conditions, and corticosteroid use. Data entry was carried out using the Microsoft Excel version 16.0 (Microsoft Corp., Redmond, WA, USA), and the data entry templates were then exported to the SPSS software version 28.0.1 for further analysis.

Various assessments were performed during data analysis to verify data quality. First, a frequency table was created to identify any missing data. No missing data points were observed, indicating that the data acquired for the variables of interest were comprehensive. Additionally, a box plot analysis was performed to detect probable outliers in the dataset. No outliers were found, indicating that the data points were within respectable ranges and did not deviate considerably from the overall trends.

STATISTICAL ANALYSES

Data analyses were performed using SPSS® version 28.0.1 (IBM Corp., Armonk, NY, USA). Descriptive measures including mean, standard deviation, median, interquartile range (IQR), frequency, percentage, and proportion, were calculated, along with their corresponding 95% confidence intervals (CI) where applicable.

Comparative analysis between steroid users and non-users were performed using the chi-square test and linear model ANOVA, depending on the data type and distribution normality. Furthermore, a binary logistic regression model was used to assess the ability of demographic factors and comorbidities to predict steroid use. Statistical significance was determined using a P value < 0.05.

RESULTS

PATIENT CHARACTERISTICS

A total of 142 patient records were identified. After applying the data management plan, 138 patients records containing valid data were included in the analysis. The mean age of the patients was 53.6 ± 9.3 years, 56.5% were females, and the majority had DM (58.7%). Only 24 patients (17.4%) required steroid injections ([Table 1](#)).

COMPARISON BETWEEN STEROID USERS AND NON-USERS

Patients were divided into two groups according to the need for intra-articular corticosteroid injections and compared. No statistically significant differences were observed between the two groups regarding laterality, age, sex, hypothyroidism, hypertension, ischemic heart disease (IHD), DM, or other risk factors.

Despite this nonsignificant difference, the need for steroids was greater in female patients than in male patients (62.5% vs. 37.5%) ([Table 2](#)).

Table 1. Demographic characteristics of the included patients

	Overall (N=138)
Age	
Mean (SD)	53.6 (9.3)
Range	27.0 - 77.0
Gender	
Female	78 (56.5%)
Male	60 (43.5%)
Laterality	
Right	68 (49.3%)
Left	70 (50.7%)
DM	
Yes	81 (58.7%)
No	57 (41.3%)
Hypothyroidism	
No	109 (79.0%)
Yes	29 (21.0%)
Hypertension	
Yes	39 (28.3%)
No	99 (71.7%)
IHD	
Yes	7 (5.1%)
No	131 (94.9%)
Other risk factors	
Yes	8 (5.8%)
No	130 (94.2%)
Steroid injection	
Yes	24 (17.4%)
No	114 (82.6%)

IHD: ischemic heart disease; DM: diabetes mellitus. SD: standard deviation.

COMPARISON BETWEEN PATIENTS WITH AND WITHOUT DIABETES

No statistically significant differences were observed between patients with and without DM regarding laterality, hypothyroidism, hypertension, IHD, or other risk factors. However, statistically significant differences were observed in age ($P < 0.001$) and sex ($P = 0.44$): Patients with DM had a higher mean age than those without (56.2 ± 9.3 vs 49.8 ± 8), and most patients without DM were female (66.7%) (Table 3).

PREDICTORS OF STEROID INJECTION USE

Binary logistic regression analysis was performed to investigate predictors of the need for intra-articular steroid injections. Laterality, sex, DM, hypothyroidism, and hypertension were not found to be significant predictors ($P > 0.1$ all) (Table 4).

DISCUSSION

Frozen shoulder, also known as adhesive capsulitis, is a progressive inflammatory disease.^{1,21,22} This condition affects approximately 20% of individuals with DM as well

as 2–5% of the general population, with a cumulative incidence of 2.4/1000/year (95% CI, 1.9–2.9).^{23,24} In many cases, spontaneous recovery of normal function is possible, and standardized non-operative therapy regimens are a successful alternative to surgery.²⁴ Hence, no treatment approach is universally applicable. Both conservative therapy and arthroscopic surgery are currently used; however, their recovery times vary greatly.²⁵

The anti-inflammatory effects of steroids on frozen shoulder, specifically oral or intraarticular corticosteroids, have been studied, showing satisfactory results in many cases.²⁵ A Systematic review and meta-analysis by Shah et al. showed that multiple injections may be useful for up to 16 weeks after the first injection.¹³

The use of corticosteroids (oral or intra-articular) in medical practice, such is affected by several factors, such as symptom severity, diagnosis and underlying pathology, response to other treatment regimens, clinical guidelines and evidence-based practice, patient preference, and shared decision-making.^{2,26} These concerns involve both patient and clinical decision-making procedures.

The present study was focused on whether patient characteristics such as age, sex, comorbidities, and laterality of symptoms can predict the need for steroid use and help healthcare practitioners make informed judgments accordingly. However, the findings showed that none of the factors had statistically significant predictive ability. The lack of significant associations may be explained as follows.

The non-significant predictive value of age may indicate its complicated relationship with responsiveness to steroids, as well as the affect other factors. While age is frequently considered a crucial factor in medical decision-making, other characteristics such as symptom intensity, disease duration, or existence of comorbidities may have a greater influence on the choice to administer steroids. Moreover, clinical assessments by healthcare providers play a crucial role in treatment decisions, in which age is not the only determining factor. In addition, the small sample size may have limited the detection of statistical differences.

Although frozen shoulder has been reported to be more prevalent in female patients,^{27,28} no significant association was observed between sex and steroid use in the present study ($P = 0.517$). This may be explained by the underlying mechanisms of frozen shoulder. Moreover, the efficacy of steroid therapy may be similar across sexes. The lack of a significant association between symptom laterality and steroid use ($P = 0.208$) can be explained by the nature of the disease. Adhesive capsulitis affects both shoulders at the same time in 6–17% of patients. Moreover, one side can be affected first, followed by the other side a few years later.^{4,29} Therefore, laterality of frozen shoulder symptoms cannot predict steroid use.

Regarding comorbid diseases such as DM, hypertension, and IHD. The absence of significant associations with steroid use may be explained by the preference for alternate treatment strategies in these populations. Healthcare practitioners should prioritize alternative treatment techniques better suited to controlling frozen shoulder symptoms in these patients. Owing to probable interactions, contraindications

Table 2. Comparison between patients who needed and those who did not need steroids

	Need Steroid (N=24)	No need (N=14)	Total (N=138)	P value
Laterality				0.20 ^a
Right	9.0 (37.5%)	59.0 (51.8%)	68.0 (49.3 %)	
Left	15.0(62.5%)	55.0 (48.2%)	Data point	
Age				0.33 ^b
Mean (SD)	51.9 (7.2)	53.9 (9.7)	53.6(9.3)	
Range	40.0-66.0	27.0-77.0	27.0-77.0	
Gender				0.57 ^a
Female	15.0 (62.5%)	63.0 (55.3%)	78.0 (56.5%)	
Male	9.0 (37.5%)	51.0 (44.7%)	60.0 (43.5%)	
Hypothyroidism				0.98 ^a
No	19.0 (79.2%)	90.0 (78.9%)	109.0 (79.0%)	
Yes	5.0 (20.8%)	24.0 (21.1%)	29.0 (21.0%)	
Hypertension				0.27 ^a
No	9.0 (37.5%)	30.0 (26.3%)	39.0 (28.3%)	
Yes	15.0 (62.5%)	84.0 (73.7%)	99.0 (71.7%)	
IHD				0.21 ^a
Yes	0.0 (0.0%)	7.0 (6.1%)	7.0 (5.1%)	
No	24.0 (100.0%)	107.0 (93.9%)	131.0 (94.9%)	
Other risk factors				0.18 ^a
Yes	0.0 (0.0%)	8.0 (7.0%)	8.0 (5.8%)	
No	24.0 (100.0%)	106.0 (93.0%)	130.0 (94.2%)	
DM				0.34 ^a
Yes	12.0 (50.0%)	69.0 (60.5%)	81.0 (58.7%)	
No	12.0 (50.0%)	45.0 (39.5%)	57.0 (41.3%)	

^aPearson's chi-squared test.^bLinear Model ANOVA.

DM: diabetes mellitus; IHD: ischemic heart disease; N: number; SD: Standard deviation.

cations, or other concerns related to comorbid conditions, steroid administration may not be the first-line or recommended therapeutic approach in these cases.

The results of this study showed no significant differences in patient demographics or medical comorbidities associated with the use of corticosteroid therapy for adhesive capsulitis. The prevalence of frozen shoulder in patients with DM is estimated to be over 20%, compared with 2–5% in the general population.³⁰ The association between DM and adhesive capsulitis is hypothesized to be related to soft tissue thickening and proliferation, which may contribute to a greater restriction of range of motion in patients with DM.³⁰ Erickson et al. discovered that patients with DM had a less favorable response to intra-articular injections.³⁰ However, other trials, such as those by Roh et al., revealed that intra-articular injections were superior to home physical therapy in individuals with DM[32]. Further research is required to explore the lack of high-level literature on the demographic characteristics and medical comorbidities associated with steroid use to gain a better understanding of this topic. Notably, the lack of significant associations in this study did not diminish the importance of age, sex, or

co-morbidities as factors to consider in the overall management of frozen shoulder. These factors may influence treatment decisions through other mechanisms such as potential contraindications or individual patient characteristics.

This study has some limitations. First, the small sample size limits the power of the study and its generalization, necessitating caution when interpreting. Future studies should include larger sample sizes to obtain more robust and consistent results. Second, the retrospective design lacks standardization of subjective and objective measurements and the possibility of confounding. Therefore, prospective cohort studies are needed to overcome these limitations and identify predictors of steroid use for adhesive capsulitis.

In addition, retrospective cohort studies provide moderate-to-low-quality evidence owing to the inherent limitations of the study design, which include potential selection and recall bias, confounding variables, and challenges in establishing causality. Although such studies can provide valuable insights and generate hypotheses, their findings should be interpreted with caution and validated using

Table 3. Comparison between diabetic and non-diabetic groups

	Diabetic (N=81)	Non-diabetic (N=57)	Total (N=138)	P value
Laterally				0.98 ^a
Right	40.0(49.4 %)	28.0 (49.1%)	68.0 (49.3%)	
Left	41.0 (50.6%)	29.0 (50.9%)	70.0 (50.7%)	
Age				< 0.001 ^b
Mean (D)	56.2 (9.3)	49.8 (8.0)	53.6 (9.3)	
Range	27.0 - 77.0	27.0 - 70.0	27.0 - 77.0	
Gender				0.04 ^a
Female	40.0 (49.4%)	38.0 (66.7%)	78.0 (56.5%)	
Male	41.0 (50.6%)	19.0 (33.3%)	60.0 (43.5%)	
Hypothyroidism				0.691
No	63.0 (77.8%)	46.0 (80.7%)	109.0(79.0 %)	
Yes	18.0 (22.2%)	11.0 (19.3%)	29.0 (21.0%)	
Hypertension				0.12 ^a
Yes	27.0 (33.3%)	12.0 (21.1%)	39.0 (28.3%)	
No	54.0 (66.7%)	45.0 (78.9%)	99.0 (71.7%)	
IHD				0.17 ^a
yes	6.0 (7.4%)	1.0 (1.8%)	7.0 (5.1%)	
No	75.0 (92.6%)	56.0 (98.2%)	131.0 (94.9%)	
Other risk factors				0.61 ^a
Yes	4.0 (4.9%)	4.0 (7.0%)	8.0 (5.8%)	
No	77.0 (95.1%)	53.0 (93.0%)	130.0 (94.2%)	
Steroid injection				0.34 ^a
Yes	12.0 (14.8%)	12.0 (21.1%)	24.0 (17.4%)	
No	69.0 (85.2%)	45.0 (78.9%)	114.0 (82.6%)	

^aLinear Model ANOVA ^bpearson's Chi-squared test**Table 4. Predictors of the need for steroids**

Predictor	Odds ratio (95% confidence interval)	P value
Laterality (left - right)	1.79 (0.724, 4.42)	0.21 ^a
Gender (male - female)	0.74 (0.3, 1.83)	0.52 ^a
Diabetes mellitus (yes - no)	0.65 (0.27, 1.58)	0.34 ^a
Hypothyroidism (yes - no)	0.99 (0.33, 2.92)	0.98 ^a
Hypertension (yes - no)	1.68 (0.67, 4.24)	0.27 ^a

^aBinary logistic regression.

more rigorous study designs to ensure higher-quality evidence.

CONCLUSION

This study was conducted to identify predictive factors for steroid use in patients with frozen shoulder. However, none of the investigated factors, including age, sex, or comorbidities such as DM, hypertension, or IHD, showed statistically significant associations with steroid use. Therefore, further research is necessary to explore other variables that may influence treatment decisions in this patient population. Understanding the factors that guide treatment deci-

sions in this context can help improve patient care and optimize future therapeutic approaches.

INSTITUTIONAL REVIEW BOARD STATEMENT

The Institutional review Board at Prince Sultan Military Medical City provided approval for this study (IRB No. E-2079).

INFORMED CONSENT STATEMENT

Informed consent. Was waived for this study as it was a retrospective cohort study involving use of existing data.

CONFLICT-OF-INTEREST STATEMENT

The authors declare no conflict of interest.

DATA SHARING STATEMENT

Data supporting the findings of this study are available from the corresponding author upon request. All data were anonymized to protect patient confidentiality in accordance with the ethical guidelines. Due to the retrospective nature of the study and institutional policies, individual-level data were not publicly accessible. Researchers interested in collaborative work or data access may contact the corresponding author for a detailed proposal outlining the intended use of the data.

STROBE STATEMENT

The authors have read the STROBE Statement – checklist of items, and the manuscript was prepared and revised according to the STROBE Statement – checklist of items.

PROVENANCE AND PEER REVIEW

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CORRESPONDING AUTHOR'S MEMBERSHIP IN PROFESSIONAL SOCIETIES

None

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