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ORIGINAL ARTICLE

Shoulder adhesive capsulitis: epidemiology and predictors of surgery

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Background: Adhesive capsulitis is characterized by a gradual, painful loss of shoulder motion. This study evaluated patient variables significantly associated with developing adhesive capsulitis compared with a sex-matched control group without adhesive capsulitis. We also sought to determine those factors associated with adhesive capsulitis patients requiring surgical intervention.

Methods: All patients presenting to our hospital with adhesive capsulitis between 2004 and 2014 were identified. Demographic characteristics were collected, and a sex-matched control group was randomly generated from the electronic medical record and used for comparison. Patients who underwent surgical intervention for adhesive capsulitis were also identified, and factors associated with surgical intervention were identified with logistic regression analysis.

Results: Included were 2190 adhesive capsulitis patients with a normal age distribution of 56.4 ± 13.1 years. Most were classified as overweight (30.7%) or obese (27.0%). Compared with controls, adhesive capsulitis patients were more likely to be younger (<50 vs. ≥50 years; odds ratio [OR], 0.69; $P < .001$), obese (OR, 1.26; $P < .001$), black/African American (OR, 1.71; $P < .001$), Hispanic/Latino (OR, 4.85; $P < .001$), or diabetic (OR, 1.12; $P < .001$) and less likely to have hypertension (OR, 0.93; $P = .006$). Overall, 361 subsequently underwent surgical intervention. Older patients, racial minorities, and government-sponsored/uninsured patients were significantly less likely to have surgery for adhesive capsulitis ($P < .01$), whereas workers' compensation patients were 8 times more likely to receive surgery compared with privately insured patients ($P < .001$).

Conclusions: Obesity and diabetes were significantly associated with adhesive capsulitis and should be considered modifiable patient factors. Additionally, younger patients and racial minorities were also significantly more likely to be diagnosed with adhesive capsulitis. Younger, white, and workers' compensation patients were more likely to receive surgery, whereas patients with government-sponsored or no insurance status were more likely to receive nonoperative treatment.

Level of evidence: Level III; Retrospective Cohort Design; Prognosis Study

Keywords: Adhesive capsulitis; frozen shoulder; diabetes; workers' compensation; racial disparities; surgical intervention; obesity

Adhesive capsulitis of the shoulder is characterized by a progressive painful loss of passive and active shoulder range of motion. The condition, which affects 2% to 5% of the general population, is due to chronic inflammation of the capsular subsynovial layer leading to thickening, fibrosis,

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contracture, and loss of the normal axillary recess.[15] Although commonly referred to as "frozen shoulder," which encompasses the end result of a number of etiologies, adhesive capsulitis is its own distinct pathologic entity.[10,16] Most patients are successfully managed with physical therapy and gentle range of motion exercises. However, surgical intervention is indicated in patients when conservative treatment fails, including physical therapy, home exercises, intra-articular injections, and oral anti-inflammatory medications, with continued pain and limitation in activities of daily living.[3,6,17]

Adhesive capsulitis most commonly affects women between the ages of 40 and 60.[3,11,20,23] Systemic conditions, such as obesity, thyroid dysfunction, cardiac disease, Dupuytren contracture, breast cancer treatment, and neurologic disorders, are thought to increase the risk for developing adhesive capsulitis.[2,3,7,12,18-20,22-24] Furthermore, several studies have shown that the diagnosis is 2 to 4 times more common in diabetic patients than in the general population.[3,19,20] Few studies have examined the epidemiology of adhesive capsulitis in a large urban population compared with a matched control group or determined patient factors associated with requiring surgical intervention.

The purpose of this study was to evaluate patient variables significantly associated with developing adhesive capsulitis compared with a sex-matched control group without adhesive capsulitis. We also sought to determine those factors associated with adhesive capsulitis patients requiring surgical intervention.

Materials and methods

We performed a retrospective comparative study to identify all patients presenting to a large tertiary referral academic medical center between June 5, 2004, and June 5, 2014, with a diagnosis of adhesive capsulitis (International Classification of Diseases, Ninth Edition) based on diagnosis codes adhesive capsulitis (726.0) with or without shoulder pain (719.41). We also used the Clinical Data Warehouse to identify a randomly generated, sex-matched control group of patients from the electronic medical record without adhesive capsulitis. The Clinical Data Warehouse is a relational database that collects data from our institution's major electronic data systems, including the software systems used for inpatient, outpatient, emergency department, operating room, and billing services. All patient encounters in the electronic medical record were reviewed to confirm the diagnosis.

Demographic information, including sex, age, body mass index (BMI), race, and ethnicity were collected for all patients. The presence of concurrent medical comorbidities was also documented and verified by review of primary care physician notes, which included diabetes mellitus, hypothyroidism, hypertension, lupus, Sjögren syndrome, dermatomyositis, polymyositis, connective tissue disorder, and rheumatoid arthritis. Shoulder pain status, medications, appointment history, and insurance information were collected. Whether the patient underwent surgical intervention for adhesive capsulitis was also recorded based on the following Current Procedural Terminology (American Medical Association, Chicago, IL, USA) codes, which are medical codes used for describing the medical, surgical, and diagnostic services rendered: 29825 (arthroscopic capsular release/lysis of adhesions), 23020 (capsular contracture release), and 23700 (shoulder manipulation under anesthesia). A sex-matched control group of patients without adhesive capsulitis (Table I) was identified to compare demographic and patient-based variables.

Summary statistics were calculated for continuous variables and are reported as means, standard deviations (SD), and ranges. Categoric variables are reported in frequencies and percentages. Group differences for categoric variables were compared using χ^2 tests. In addition, logistic regression was used to determine significant associations between patient-based variables and a diagnosis of adhesive capsulitis and was also used to determine significant associations between patient factors and the need for surgical treatment of adhesive capsulitis. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. All statistical analyses were performed using SAS 9.3 software (SAS Institute Inc., Cary, NC, USA). A P value of <.05 was deemed statistically significant.

Results

Demographic characteristics

Adhesive capsulitis vs. control group

We identified 2,190 patients with adhesive capsulitis and 2,190 control patients without adhesive capsulitis during the 10-year period. The groups were sex-matched, with women comprising 1279 of 2190 patients (58.4%). The average patient age of the adhesive capsulitis group was 56.4 (SD, 13.1) years, with most patients aged 40 to 70 years old (Table I).

Compared with controls, there was a statistically significant higher rate of obesity in patients with adhesive capsulitis ($P < .001$). This was particularly evident, with class 1 obesity (BMI 30-34.9 kg/m^2) documented in 435 patients (27%) vs. 216 controls (20.3%). Black/African American race and Hispanic/Latino ethnicity were also significantly associated with a diagnosis of adhesive capsulitis compared with controls, respectively (OR, 1.71; 95% CI, 1.60-1.84 [$P < .001$]; OR, 4.85; 95% CI, 3.90-6.04 [$P < .001$]).

Diabetes mellitus (55.3%) and hypertension (33.5%) were the most common medical comorbidities in the population. Diabetes was significantly more common in the adhesive capsulitis group, whereas hypertension was less common compared with the control group. Both of these results were statistically significant ($P = .007$).

Operative vs. nonoperative management of adhesive capsulitis

Of the 2190 patients with adhesive capsulitis, 361 patients underwent surgical intervention. The mean annual number of operations was 32.8, with no clear trend in surgical intervention during the 10-year study period and no seasonal variation. Patients aged >70 years and nonwhite patients were less likely to undergo surgical intervention for their adhesive capsulitis (Table II). Most notably, black/African American patients were 59.2% less likely and Hispanic/Latino pa-