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Preoperative corticosteroid joint injections within 2 weeks of shoulder arthroscopies increase postoperative infection risk

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Background: There is currently no consensus regarding the safe timing interval between corticosteroid shoulder injections and future shoulder arthroscopies. Our study assessed the relationship between preoperative corticosteroid injection timing and shoulder arthroscopy infectious outcomes.
Methods: We used an insurance database to identify and sort all shoulder arthroscopy patients by corticosteroid shoulder injection history within 6 months before surgery. Patients who received injections were stratified by the timing of their most recent preoperative injection. The overall infection rate and rate of severe infections requiring treatment through intravenous antibiotics or surgical débridement in the 6-month postoperative period were compared using χ^2 tests between the injection cohorts and a control group of patients defined as those with no injection history.
Results: We identified 50,478 shoulder arthroscopy patients, of whom 4115 received injections in the 6-month preoperative period. We found a significant increase in both the overall infection rate ($P < .0001$) and severe infection rate ($P < .0001$) in patients who received injections within 2 weeks before surgery (n = 79; 8.86% and 6.33%, respectively) compared with those who received no injections in the 6-month preoperative period (n = 46,363; 1.56% and 0.55%, respectively). No other significant differences were observed.
Conclusions: Our results suggest that in patients who have received corticosteroid injections, shoulder arthroscopic procedures may be safely performed after at least 2 weeks has passed since the most recent injection to minimize the risk of postoperative infection. In addition, procedures performed within 2 weeks of an injection may increase the risk of postoperative infection.
Level of evidence: Level III; Retrospective Cohort Comparison Using Large Database; Treatment Study

Keywords: Shoulder arthroscopy; corticosteroid injection; infectious outcomes; joint injection; injection timing; postoperative infection

Institutional review board approval was not required for this retrospective study.

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Shoulder pain is the third leading cause of musculoskeletal consultation in primary care, with a self-reported prevalence estimated to range from 16% to 26%.[17] Because reduced shoulder movement due to pain, weakness, or stiffness can have a substantial debilitating effect on a patient's quality of life,[3,17] the management of symptoms is of obvious concern.

Currently, there are a number of options for the treatment of shoulder pain. Should nonsteroidal anti-inflammatory drugs, activity modification, and physical therapy not help improve functionality, current clinical guidelines recommend corticosteroid joint injections as the next line of treatment.[23] Corticosteroid injections have demonstrated short-term benefits for shoulder pain[7,9] and are used in a therapeutic manner for a variety of injuries and inflammatory conditions that affect the shoulder joint.[2,11,15,23] These include osteoarthritis, adhesive capsulitis, rheumatoid arthritis, rotator cuff tendinosis, subdeltoid bursitis, impingement syndrome, and distal clavicular osteolysis.[23]

Despite their documented short-term benefits, corticosteroid joint injections are not without risks. Adverse effects have been reported, including articular cartilage damage, tendon rupture, and attenuation of the host immune response.[20] In addition, Cancienne et al[8] (2016) performed a study using a large Medicare population and found that corticosteroid injections at the time of knee arthroscopy were associated with increased postoperative infection rates.

Surgical intervention is often considered after nonsurgical treatment measures, including corticosteroid injections, fail.[1,17,19,25] Over the past 2 decades, arthroscopic procedures have become common treatment methods for shoulder-related conditions.[1,19,25] Arthroscopic techniques offer the advantages of earlier rehabilitation, reduced postoperative pain, and less restriction of movement in comparison with open procedures, as the wide dissection and scarring characteristic of open procedures are avoided in the arthroscopic approach.[12,13,19,24] Several studies have reported very low subsequent postoperative infection rates around 0.009% to 3.4% collectively for arthroscopic procedures. Although risk factors for infection in shoulder arthroscopies have not been well documented in the literature, numerous risk factors have been identified in knee arthroscopy patients, including longer operating times, increased numbers of procedures during surgery, prior procedures, and performance of chondroplasty or soft-tissue débridement.[4] Furthermore, there is a commonly held belief that corticosteroid joint injections may affect the outcomes of arthroscopic procedures in general.[5,6,14,21]

However, with the exception of these studies, limited data are available regarding infectious complication rates after shoulder arthroscopies, and at present, there is notably no well-defined consensus regarding the effects of preoperative corticosteroid injections on future shoulder arthroscopy infectious outcomes. Further research looking into this relationship is necessary to establish a safe interval between corticosteroid injections and arthroscopic procedures.

In this study, we examined the effects of the timing of preoperative corticosteroid injections on the infectious outcomes of shoulder arthroscopies. We hypothesized that receiving injections closer to the surgical date would be associated with an increased rate of postoperative infection.

Methods

Database

We used the PearlDiver database (PearlDiver, Colorado Springs, CO, USA), a national insurance claims database consisting of over 25 million patient records. PearlDiver contains all Humana insurance (Humana, Louisville, KY, USA) patient records from 2007-2017, and these records are searchable by *International Classification of Diseases, Ninth Revision, Clinical Modification* and *International Classification of Diseases, Tenth Revision, Clinical Modification* diagnosis and procedure coding, as well as Current Procedural Terminology (CPT) codes.

Data collection

We identified all patients who underwent shoulder arthroscopy (CPT codes 29805-29807 and 29819-29828) and included only those who were continuously active in the database for 6 months before and 6 months after surgery (Supplementary Table S1). Among these patients, we identified those who underwent a shoulder injection (CPT code 20610) within the 6-month preoperative period. To ensure the injections were administered in the same joint as that undergoing the ensuing surgical procedure, we matched the laterality of the CPT codes for the injections and the surgical procedure and excluded any patients whose codes lacked laterality modifiers. As joint injections are not limited to corticosteroids and are also used to treat disorders of the hip and knee,[9] we identified corticosteroid shoulder injections by the presence of both corticosteroid CPT codes (J codes found in Supplementary Table S2) and a shoulder-related diagnosis code (shoulder pain or effusion) on the same date.

The injection group was then analyzed based on the timing of the injection relative to the date of surgery. We stratified patients into 3 bimonthly cohorts: injections received within the first two months prior to surgery (0-2 months), injections within the third or fourth month prior to surgery (3-4 months), and injections within the fifth or sixth month prior to surgery (5-6 months). Furthermore, we subdivided the 0- to 2-month cohort into 4 biweekly groups. Each of these injection cohorts was then compared with a control group of patients who had no history of corticosteroid injections in the 6-month period prior to surgery.

All patients were assessed for the presence of infection in the operative shoulder within 6 months after surgery. This was

Table I Rate of overall postoperative infection in injection cohorts and control group (N = 50,478)

	Injection, % (n)	No injection, % (n)	*P* value
0-2 mo	1.96 (28 of 1431)	1.56 (724 of 46,363)	.2309
0-2 weeks	8.86 (7 of 79)	1.56 (724 of 46,363)	<.0001*
3-4 weeks	0.76 (2 of 263)	1.56 (724 of 46,363)	.2958
5-6 weeks	2.04 (9 of 441)	1.56 (724 of 46,363)	.4189
7-8 weeks	1.20 (6 of 499)	1.56 (724 of 46,363)	.5181
2-4 mo	1.29 (23 of 1782)	1.56 (724 of 46,363)	.3652
4-6 mo	1.33 (12 of 902)	1.56 (724 of 46,363)	.5804
Total (0-6 mo)	1.53 (63 of 4115)	1.56 (724 of 46,363)	.8816

The injection cohorts are broken down into bimonthly and biweekly groups based on the date of the most recent corticosteroid joint injection before shoulder arthroscopy.

* The χ^2 analysis was significant for the 0- to 2-week injection cohort ($P < .0001$).

achieved through the identification of *International Classification of Diseases, Ninth Revision* and *International Classification of Diseases, Tenth Revision* diagnosis codes for infection; CPT codes for antibiotics; and CPT codes for surgical débridement in the same shoulder (Supplementary Table S3). We included a subanalysis of the rates of clinically significant infections, which we defined as those that required intravenous antibiotics or surgical débridement.

Statistical analysis

The overall postoperative infectious complication rate and clinically significant infectious complication rate were compared between the control group and each of the injection cohorts using χ^2 tests with an α level of .05. For any cohort that showed a significant difference in the infectious complication rate compared with the control group, we performed proportion analysis to account for potential confounding variables including sex, history of diabetes, tobacco use, history of rheumatoid arthritis, and average Charlson Comorbidity Index.

Results

We identified 50,478 patients who underwent arthroscopic shoulder procedures within 2007-2017. Of these patients, 4115 (8.15%) received corticosteroid injections within 6 months before surgery whereas 46,363 received no such injections.

The overall 6-month infection rate as identified by *International Classification of Diseases, Ninth Revision* and *International Classification of Diseases, Tenth Revision* codes was 1.56% (724 of 46,363 patients) for the no-injection cohort and 1.53% (63 of 4115) for the injection cohort ($P = .8816$, Table I). We observed no significant differences when we divided the injection cohort into bimonthly periods based on injection timing ($P = .2309$, $P = .3652$, and $P = .5804$; Table I). When we took a biweekly approach, we observed a significantly higher rate of infection within the injection cohort if patients received injections within 2 weeks before surgery (8.86% vs. 1.56%, $P < .0001$; Table I).

We next focused on clinically significant infections requiring intravenous antibiotics or surgical treatment. The infection rate was 0.55% (256 of 46,363 patients) for the no-injection cohort and 0.56% (23 of 4115) for the injection cohort ($P = .9338$, Table II). Similarly to our findings with overall infections, we observed no significant differences in treated infections within our bimonthly cohorts ($P = .0725$, $P = .8255$, and $P = .0745$; Table II). When patients were subdivided into biweekly groups, a significant difference was again observed if the injection was received within 2 weeks before surgery (6.33% vs. 0.55%, $P < .0001$; Table II).

We examined demographic and comorbidity variables for the 2-week injection cohort and observed no differences in sex, history of diabetes, tobacco use, history of rheumatoid arthritis, or Charlson Comorbidity Index compared with the control group ($P > .05$, Table III).

Discussion

Corticosteroid joint injections are an important component of nonoperative shoulder pain treatment.[22,23] However, given their potential for adverse effects, including an attenuation of the host immune response, concern exists regarding their potential complications particularly with respect to surgery. Several studies have reported that corticosteroid injections given at the time of surgery may increase infectious outcomes in both elbow arthroscopies[18] and total knee arthroplasties,[8] although the effects of preoperative corticosteroid joint injections on the infectious outcomes of future shoulder arthroscopies remain a subject of discussion.[22]

Our study found a significantly higher rate of infection after shoulder arthroscopy in patients who had received their last corticosteroid injection within the 2 weeks leading up to their operations compared with those who received no injections before their procedures. We observed a significant difference in infection rates only for this specific period, as any other cohort within the 2-week to 6-month range of pre-arthroscopic injections showed no statistically significant difference in infection rates compared with the control group. When we narrowed our definition of infections to only those that required treatment through either intravenous antibiotics or surgical intervention, the trend persisted and was statistically significant for only the 0- to 2-week cohort.

Table II Rate of postoperative infections requiring intravenous antibiotics or surgical débridement in injection cohorts and control group (N = 50,478)

	Injection, % (n)	No injection, % (n)	*P* value
0-2 mo	0.91 (13 of 1431)	0.55 (256 of 46,363)	.0725
0-2 weeks	6.33 (5 of 79)	0.55 (256 of 46,363)	<.0001*
2-4 weeks	0.38 (1 of 263)	0.55 (256 of 46,363)	.7099
4-6 weeks	1.13 (5 of 441)	0.55 (256 of 46,363)	.1029
6-8 weeks	0.40 (2 of 499)	0.55 (256 of 46,363)	.6518
2-4 mo	0.51 (9 of 1782)	0.55 (256 of 46,363)	.8255
4-6 mo	0.11 (1 of 902)	0.55 (256 of 46,363)	.0745
Total (0-6 mo)	0.56 (23 of 4115)	0.55 (256 of 46,363)	.9338

The injection cohorts are broken down into bimonthly and biweekly groups based on the date of the most recent corticosteroid joint injection before shoulder arthroscopy.

* The χ^2 analysis was significant for the 0- to 2-week injection cohort ($P < .0001$).

Table III Proportion analysis of control group and 0- to 2-week injection cohort controlling for sex, history of diabetes, tobacco use, history of rheumatoid arthritis, and CCI (N = 50,478)

	Injection at 0-2 weeks (n = 79)	No injection (n = 46,363)	*P* value
Median age, yr	65-69	65-69	
Female, % (n)	39.24 (31)	45.11 (20,916)	.2948
Diabetes, % (n)	26.58 (21)	26.29 (12,189)	.9533
Tobacco use, % (n)	18.99 (15)	15.12 (7008)	.3375
Rheumatoid arthritis, % (n)	13.92 (11)	8.72 (4042)	.1018
CCI, mean ± SD	1.39 ± 1.95	1.61 ± 2.19	.3723

CCI, Charlson Comorbidity Index; *SD*, standard deviation.
No variables showed a statistically significant difference between the 2 groups.

Several studies have looked into the relationship between shoulder corticosteroid injections and the outcomes of future procedures. A 2018 study found that an increasing number of shoulder corticosteroid injections within a year before rotator cuff surgery may be associated with a higher rate of subsequent revision.[10] With respect to infection, it has been suggested that injections within the perioperative period may be associated with infectious outcomes of elbow and knee procedures.[8,18] Our results suggest that the risk of infection also increases when the injections are performed within 2 weeks prior to surgery, whereas injections administered more than 2 weeks before surgery appear to yield no significant difference in infection rates compared with the control group.

This study has several limitations. It is a retrospective database study reliant on the accuracy of diagnosis and procedural coding. Although no data are available regarding coding error rates in the Humana insurance population, a 2012 Medicare study reported a 1.3% error rate in the Medicare population,[16] and given the similar nature of the PearlDiver database, error rates in the Humana insurance population most likely reflect those of the Medicare analysis. The cohort studied comprised a mixture of shoulder arthroscopies with varying indications for surgery and operative times, and we were unable to take these variables into account in our analysis as they were not characterized in the database. However, given the large size of our cohort, these effects are attenuated. Furthermore, we did not control for the steroid type and dosage of the injections administered. Finally, as there are numerous confounding variables that may exist regarding postoperative infection rates, there may be variables that we were unable to account for given the database nature of this study, although we analyzed a variety of those reported in the literature (Table III).

Conclusion

This study delineated the relationship between preoperative corticosteroid shoulder joint injections and future infectious outcomes of shoulder arthroscopies. Our results suggest that in patients who have received corticosteroid injections, shoulder arthroscopic procedures may be safely performed after at least 2 weeks has passed since the most recent injection to minimize the risk of postoperative infection. In addition, procedures performed within 2 weeks of an injection may increase the risk of postoperative infection. These findings provide information to guide surgeons in terms of counseling and surgical decision making. This information helps us better understand the potential for severe deleterious effects from corticosteroid injections and suggests that they should not be used without serious consideration.

Disclaimer

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Supplementary Data

Supplementary data to this article can be found online at 10.1016/j.jse.2019.03.037.

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