Predictors of Success of Corticosteroid Injection for the Management of Rotator Cuff Disease

Fernando Contreras, MD · Haydée C. Brown, MD · Robert G. Marx, MD, FCRSC

Received: 5 June 2012/Accepted: 2 November 2012 /Published online: 5 January 2013
© Hospital for Special Surgery 2012

Abstract *Background:* The use of subacromial corticosteroid injection (CSI) to treat rotator cuff tendinopathy is controversial. We hypothesized that characteristics such as activity level, American Shoulder and Elbow Surgeons (ASES) score, duration of symptoms, and status of the rotator cuff may be prognostic factors for resolution of symptoms postinjection. *Methods:* During a 12-month period, consecutive patients with rotator cuff disease were analyzed. Patients received subacromial CSI, oral NSAIDs, and physical therapy. Baseline ASES score, simple shoulder test, an activity scale, and demographic data were recorded. Patients who remained symptomatic and were indicated for surgery were considered failures. Patients that did not undergo surgery were reassessed after a minimum of 1 year. *Results:* Forty-nine patients met our criteria. Follow-up was obtained for 81.6%. Sixteen cases (40%) failed conservative treatment at final follow-up (22.4±11 months). CSI were successful in 76.2% of males and 45% of females ($p=0.04$). Full-thickness tears were present in 8% of the patients with symptom resolution and 25% of those that failed conservative treatment ($p=0.29$). No significant difference was found in age, hand dominance, duration of symptoms, or any of the scoring systems. *Conclusion:* It is difficult to predict outcomes after CSI. Our treatment strategy showed a 40% failure rate.

Keywords rotator cuff disease · rotator cuff tendinopathy · subacromial injection · corticosteroid injection · subacromial corticosteroid injection · subacromial impingement · shoulder pain · conservative treatment · nonoperative treatment

Level of Evidence: Level IV: Therapeutic study.

F. Contreras, MD · H. C. Brown, MD · R. G. Marx, MD, FCRSC
Hospital for Special Surgery,
535 East 70th Street,
New York, NY 10021, USA

F. Contreras, MD (✉)
Apartado 99-1000 San José, San José, Costa Rica
e-mail: fcontreras@clinicabiblica.com

Introduction

Rotator cuff disease is a common cause of shoulder pain and disability in the upper extremity [9, 15, 30, 39, 40, 44, 45]. Many nonoperative treatments have been advocated, including rest, oral nonsteroidal anti-inflammatory medication (NSAIDs), physical therapy, and subacromial corticosteroid injections (CSI) [1, 9, 15, 19, 23, 26, 28, 30, 31, 39, 43, 45, 46, 49]. While several investigators have evaluated the efficacy of subacromial CSI, the current body of literature is inconclusive regarding their effectiveness [1, 3, 4, 7, 12–14, 17, 21, 22, 25, 32, 34, 40, 41, 44–46]. There is a paucity of prospective randomized clinical trials that investigate clinical predictive variables for either a successful or poor outcome with subacromial CSI [17]. Reported independent predictors of unfavorable outcomes with nonoperative management of physical therapy, NSAIDs, and CSI include symptom duration >1 year, degree of functional impairment prior to onset of treatment, and rotator cuff tear size >1 cm [11, 15]. Other studies identify female gender, dominant-extremity rotator cuff tear, isolated infraspinatus involvement, and workers compensation claims as negative predictors of treatment outcome [11, 24, 38, 48].

Clinical disagreement on the indications for CSI in rotator cuff tendinopathy contributes to the variability of its use [18]. We performed a prospective cohort study to identify prognostic factors that predict for successful outcome of subacromial CSI in patients with rotator cuff tendinopathy. We hypothesized that patient characteristics such as age, sex, and arm dominance, duration and severity of symptoms, status of the rotator cuff (tear vs. no tear) and pre-injury level of activity may be significant prognostic factors for resolution of symptoms postinjection.

Materials and Methods

The study was approved by the institutional review board. Informed consent was obtained from all study participants.

Patients were eligible for study enrollment if they fulfilled the following criteria: (1) age over 18 years old, (2) physical exam consistent with rotator cuff tendinopathy, and (3) symptoms for over a 3-month duration or symptoms for less than 3 months that were waking the patient at night or persistent symptoms after a 6-week course of physical therapy and oral NSAIDs. The history included shoulder pain that exacerbated by overhead or resisted activity, or sleeping on the effected shoulder [20]. Patients also had physical examination findings consistent with rotator cuff disease including pain with external rotation strength testing and supraspinatus testing, as well as positive Neers and Hawkins' signs [10]. Patients with evidence of glenohumeral osteoarthritis on plain radiographs, previous corticosteroid injections, previous surgery on the affected shoulder, and worker's compensation were excluded.

There were 49 consented patients eligible to participate in the study. Follow-up was obtained for 40 (81.6%) of the 49 patients. Sixteen patients (40%) had surgery—hence, failed conservative treatment. Mean time for surgical indication after the CSI was 19.2 ± 14.5 months (range 2–60 months). Twenty-four patients had no surgical indication and were followed further with the mentioned outcome scales. Mean follow-up time for the nonsurgical group was 22.4 ± 11 months (range 13–68 months). The mean follow-up time for the entire patient population was 21.4 ± 12.2 months (range 2–68 months). The mean age for the entire study population was 50.7 ± 12.7 years old (range 26–75 years old). Nineteen patients (47.5%) were females. Twenty-seven patients (67.5%) had symptoms in their dominant side.

Patients completed the simple shoulder test, ASES scoring system, activity scale, and visual analogue scale at their initial visit [16]. Patient demographics were also recorded, along with hand dominance, duration of symptoms, status of rotator cuff tear (presence or absence of a full-thickness tear), radiographic evidence of glenohumeral osteoarthritis, any previous treatment, and current treatments.

Forty-three patients (87.7%) had an MRI evaluation. MRI evaluation of rotator cuff tendinopathy has reported sensitivity ranging from 84–96%, with some studies reporting 99% [8, 33, 35–37]. Tendinopathy was characterized by increased intra substance signal on short TE sequences that is not as bright as fluid on T2-weighted images [17]. A full-thickness tear was diagnosed when there was complete disruption of all tendon fibers or when the signal within the cuff tendons was isointense. A partial-thickness tear was diagnosed if fluid intensity was adjacent to only one of the surfaces and/or some, but not all, of tendon fibers are in discontinuity [29, 42]. An ultrasound evaluation was obtained for one patient, which documented a full-thickness tear of the supraspinatus. No imaging study was indicated in five cases, because a rotator cuff tear was not suspected and no surgical intervention was being considered at the time of evaluation. These patients were included in the “no full-thickness tear” group, because no tear was documented.

Patients enrolled in the study received 3 mL of 1% lidocaine + 3 mL of 0.25% Marcaine + 80 mg of depo-medrol [6]. All subacromial injections were performed by

the senior author via an anterolateral approach. Patients completed physical therapy and were prescribed Naproxen (Naprosyn®, Roche Laboratories, Nutley, NJ) 500 mg PO BID for a 6-week duration. All patients were prescribed a standardized program of physical therapy consisting of passive, active-assisted, and active range-of-motion exercises for the shoulder in forward elevation (sagittal plane), external rotation, and internal rotation, as well as scapular stabilization and isometric exercises for the rotator cuff and the deltoid. Thera-Band (Hygenic, Akron, OH) strengthening exercises for the rotator cuff muscles and deltoid were added once improvement of pain and range of motion were noted. Physical therapy modalities such as cryotherapy, ultrasound, and electrical stimulation were also used.

Failure was defined as an indication for surgical management at any time after the injection due to continued symptoms. Patients that were not indicated for surgery were reevaluated at a minimum a 12-month period with the simple shoulder test (SST), ASES, and activity scale. Patients were contacted for follow-up by phone, regular mail, and electronic mail. At follow-up, they reported whether they had treatment with additional corticosteroid injections or surgical interventions. Patients who did not return to the office for routine follow-up evaluations were contacted via phone, mailed questionnaires or emailed the link for an online survey, and asked if they sought surgical management or not. An online survey company was used for electronic survey collection (www.surveymonkey.com, Menlo Park, CA).

Means, standard deviations, and percentages were used as descriptive variables. For statistical comparisons, *t* tests were used for continuous data and Chi-square tests for binary variables.

Results

Patient age, sex and arm dominance were not predictive of failure of CSI in this patient population. There was no significant difference in patient age between groups: 51.5 ± 12.3 years old in the nonsurgical group and 49.5 ± 13.3 years old in the group that elected to undergo surgery ($p=0.81$). Nine (36%) of the 25 patients that had a successful outcome with the CSI were females, in contrast to 11 (68.8%) females among the 16 that failed the treatment ($p=0.04$). When adjusted for multiple comparisons, this is no longer significant. The dominant extremity was affected in 18 of 25 nonsurgical patients (72%), and in ten of 16 surgical patients (62.5%). This difference was not statistically significant ($p=0.52$).

No difference was found in the duration of symptoms ($p=0.38$) when patients successfully treated with CSI were compared to those who failed and required surgical treatment. The duration of symptoms prior to injection was variable, ranging from 1 to 180 months (mean, 12.4 ± 29 ; median, 5). Patients who had a successful treatment with the CSI were symptomatic, in average, for 9.0 ± 12.4 months (range, 1–60; median, 5). The mean duration of symptoms in the surgical group was 17.4 ± 43.7 months (range, 1–180; median, 4). It should be noted that the duration of symptoms

did not show a normal distribution in this study's population (Kolmogorov–Smirnov Z test, $p < 0.05$).

The presence of a full-thickness rotator cuff tear was not more common in the failed treatment group ($p = 0.19$). Only six patients (14.6%) had a documented full-thickness tear of the rotator cuff. Full-thickness tears were present in two (8%) patients in the nonsurgical group. In contrast, the surgical group had four (25%) patients with a full-thickness rotator cuff tear. In all, four (66.7%) of the patients with full-thickness tears elected to undergo surgery for their problem compared to 12 of 34 (35%) patients without full-thickness tears.

Baseline activity and severity of symptoms were not predictors of success or failure of the CSI. The baseline activity score was 10.4 ± 5 in the group that did not require surgery, and 11.8 ± 6.2 in the surgical group ($p = 0.44$). Mean score at follow-up in the nonsurgical group was 9.8 ± 5.3 . The change in comparison to the baseline score was not statistically significant ($p = 0.49$). The subjective shoulder scoring scales showed a normal distribution in our study population (Kolmogorov–Smirnov Z test, p values all > 0.05). Baseline ASES score in the affected side was 52.5 ± 22.6 in the nonsurgical group, and 48.2 ± 25.2 in the group that failed CSI ($p = 0.61$). Mean ASES in the affected side at follow-up in the nonsurgical group was significantly improved to 70.8 ± 22.3 ($p = 0.01$). Baseline SST score in the nonsurgical group was 60.6 ± 21.4 and 69.4 ± 31.6 in the surgical group ($p = 0.30$). Follow-up SST scores in the nonsurgical group was, in average, 65.7 ± 25.9 . This change in SST scores was not statistically significant ($p = 0.28$).

Discussion

There is a paucity of literature supporting the role of corticosteroid injection in the management of rotator cuff disease [17]. Only two out of four randomized controlled trials found a difference in pain after treatment of cuff tendinopathy: one showing improvement with NSAIDs in tendonitis and the other finding CSI beneficial for small cuff tears [2, 5, 27, 47]. The aim of this study was to assess whether patient characteristics, duration of symptoms, presence of a full-thickness tears, and baseline activity level could help identify which patients will benefit from conservative treatment modalities and which will benefit more from a surgical intervention. Over one third of the patients treated following the described strategy for conservative management of rotator cuff tendinopathy had failed the treatment and had surgery (or in one case planning to have surgery) due to persistent symptoms. Patients with full-thickness rotator cuff tears tended to have higher failure rates after this strategy for conservative management, although this did not reach statistical significance in our study. We found no correlation of age, hand dominance, or duration of symptoms with the success rate of conservative management. Similarly, symptom severity and baseline patient activity level did not have prognostic value in trying to identify which patients would have a better outcome after CSI.

One limitation of this study is the small sample size, which did not allow separate analysis of different stages of rotator cuff pathology. The classification of the rotator cuff

status as full-thickness tear vs. no full-thickness tear might be inadequate. Patients without a full-thickness tear may have a very different level of compromise of their tendon, ranging from mild inflammatory changes in a structurally intact tendon to partial-thickness tears. Also, full-thickness tears may be of different sizes, may compromise one, or several tendons, and may have variable biomechanical consequences in shoulder function. For these reasons, not all the patients with full-thickness tear should be expected to have the same response to treatment, and the same applies to the patients with no full-thickness tears. However, differentiation of these levels of pathology is often difficult before the cuff is directly assessed at the time of surgery, and the clinician faces this problem when the initial therapeutic decision has to be made. Although most patients had an imaging study to document the status of their rotator cuff, MRI being the most commonly used, a minority of the patients did not have any imaging study. Imaging was ordered only when it was considered to be helpful in guiding further treatment. Since these patients did not have a full-thickness tear documented, they were not included in the full-thickness tear group. The fact that we did not have documentation of the cuff status in these five patients is a limitation in this study. Another limitation is that all the patients were already obtaining a surgical consultation when they were included in the study, which causes selection bias. The characteristics of this population may not be comparable to the general population with rotator cuff pathology.

In this study, patients followed a standardized model of NSAIDs, physical therapy, and corticosteroid injection. We routinely inject for symptoms of over a 3-month duration that affect activities of daily living; or if less than 3 months and symptoms are very severe and waking the patient; or following failed physical therapy and NSAIDs. Wolf et al. proposes a similar algorithm of treatment after a 3-month duration [48]. In some cases, we treat non-traumatic, non-acute cuff tears nonoperatively prior to recommending surgery, so we included these patients. This report describes our results on a consecutive series of patients in order to evaluate our treatment algorithm since there is very little literature to support or refute our treatment for this very common problem. Using our indications for CSI along with physical therapy and NSAID, a successful outcome for a given patient is difficult to predict. Our treatment strategy, which included NSAIDs, physical therapy, and subacromial corticosteroid injection, showed a 40% failure rate.

Acknowledgments The authors thank Joseph Nguyen for his help with the preparation of the statistics for this manuscript.

Disclosures Each author certifies that he or she has no commercial associations (e.g., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article. One or more of the authors has or may receive funding from a biomedical entity that may be perceived as a potential conflict of interest.

Each author certifies that his or her institution has approved the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

References

- Aas JM. Local steroid injections in shoulder problems? *Tidsskr Nor Laegeforen*. 2004;124:2155.
- Adebajo AO, Nash P, Hazleman BL. A prospective double blind Dummy placebo controlled study comparing triamcinolone hexacetonide injection with oral diclofenac 50 mg TDS in patients with rotator cuff tendonitis. *J Rheumatol*. 1990;17:1207–1210.
- Akgun K, Birtane M, Akarim U. Is local subacromial corticosteroid injection beneficial in subacromial impingement syndrome? *Clin Rheumatol*. 2004;23:496–500.
- Akpınar S, Hersekli MA, Demirs H, Tandogan RN, Kayaselcuk F. Effects of methylprednisolone and betamethasone injections on the rotator cuff: an experimental study in rats. *Adv Ther*. 2002;19:194–201.
- Alvarez CM, Litchfield R, Jackowski D, Griffin S, Kirkley A. A prospective, double-blind, randomized clinical trial comparing subacromial injection of betamethasone and Xylocaine to Xylocaine alone in chronic rotator cuff tendinosis. *Am J Sports Med*. 2005;33:255–262.
- Ardic F, Kahraman Y, Kacar M, Kahraman MC, Findikoglu G, Yorgancıoğlu ZR. Shoulder impingement syndrome: relationships between clinical, functional, and radiologic findings. *Am J Phys Med Rehabil*. 2006;85:53–60.
- Arroll B, Goodyear-Smith F. Corticosteroid injections for painful shoulder: a meta-analysis. *Br J Gen Pract*. 2005;55:224–228.
- Balich SM, Sheley RC, Brown TR, Sauser DD, Quinn SF: MR imaging of the rotator cuff tendon: interobserver agreement and analysis of interpretive errors. *Radiology* 1997; 204:191–194.
- Bamji A. The painful shoulder. *Practitioner*. 2001 245:1005–7, 1009, 1011–2 passim.
- Barr KP. Rotator Cuff Disease. *Phys Med Rehabil Clin N Am* 2004;15:475–491.
- Bartolozzi A, Andreychik D, Ahmad S. Determinants of outcome in the treatment of rotator cuff disease. *Clin Orthop Relat Res*. 1994;308:90–97.
- Bell AD, Conaway D. Corticosteroid injections for painful shoulders. *Int J Clin Pract*. 2005;59:1178–1186.
- Bert J. Shoulder injections for subacromial bursitis. *Minn Med*. 1996;79:6.
- Blair B, Rokito AS, Cuomo F, Jarolem K, Zuckerman JD. Efficacy of injections of corticosteroids for subacromial impingement syndrome. *J Bone Joint Surg Am*. 1996;78:1685–1689.
- Bonafede RP, Bennett RM. Shoulder pain. Guidelines to diagnosis and management. *Postgrad Med*. 1987 82:185–9, 192–3.
- Brophy RH, Beauvais RL, Jones EC, Cordasco FA, Marx RG. Measurement of shoulder activity level. *Clin Orthop Relat Res* 2005;439:101–8.
- Buchbinder R, Green S, Youd JM. Corticosteroid injections for shoulder pain. *Cochrane Database Syst Rev*. 2008;(1):CD004016.
- Dunn WR, Schackman BR, Walsh C, et al. Variation in orthopaedic surgeons' perceptions about the indications for rotator cuff surgery. *J Bone Joint Surg Am*. 2005;87:1978–1984.
- Editorial: Injecting the painful shoulder. *Lancet*. 1976;1:27.
- Ellman H, Hanks G, Bayer M. Repair of the rotator cuff: end result study of factors influencing reconstruction. *J Bone Joint Surg [Am]* 1986;68:1136–1144.
- Esenyel CZ, Esenyel M, Yesiltepe R, et al. The correlation between the accuracy of steroid injections and subsequent shoulder pain and function in subacromial impingement syndrome. *Acta Orthop Traumatol Turc*. 2003;37:41–45.
- Fearnley ME, Vadasz I. Factors influencing the response of lesions of the rotator cuff of the shoulder to local steroid injection. *Ann Phys Med*. 1969;10:53–63.
- Ginn KA, Cohen ML. Conservative treatment for shoulder pain: prognostic indicators of outcome. *Arch Phys Med Rehabil*. 2004;85:1231–1235.
- Goldberg BA, Nowinski RJ, Matsen FA 3rd. Outcome of nonoperative management of full-thickness rotator cuff tears. *Clin Orthop*. 2001;382:99–107.
- Goupille P, Sibilia J. Local corticosteroid injections in the treatment of rotator cuff tendonitis (except for frozen shoulder and calcific tendonitis). Groupe rhumatologique français de l'épaule (G.R.E.P.). *Clin Exp Rheumatol*. 1996;14:561–566.
- Graber MA. Treating shoulder pain: a randomized trial. *J Fam Pract*. 1997;45:103–104.
- Hollingworth GR, Ellis RM, Hattersley TS. Comparison of injection techniques for shoulder pain: results of a double blind, randomized study. *Br Med J (Clin Res Ed)*. 1983;287:1339–1341.
- Johansson K, Oberg B, Adolfsson L, Foldevi M. A combination of systematic review and clinicians' beliefs in interventions for subacromial pain. *Br J Gen Pract*. 2002;52:145–152.
- Kjellin I, Ho CP, Cervilla V, et al. Alterations in the supraspinatus tendon at MR imaging: correlation with histopathologic findings in cadavers. *Radiology* 1991; 81:837–841.
- Klauser A, Frauscher F. Treatment of shoulder complaints. *Lancet*. 2004; 363:491–492.
- Local corticosteroid injections. *Br Med J*. 1969;3:102–104.
- Naredo E, Cabero F, Beneyto P, et al. A randomized comparative study of short term response to blind injection versus sonographic-guided injection of local corticosteroids in patients with painful shoulder. *J Rheumatol*. 2004;31:308–314.
- Ostor AJ, Ricards CA, Prevost AT, Hazleman BL, Speed CA. Interrater reproducibility of clinical tests for rotator cuff lesions. *Ann Rheum Dis* 2004;63:1288–1292.
- Plaffi C, Steffen R, Willburger RE, Wittenberg RH. Local anaesthetic injection with and without corticosteroids for subacromial impingement syndrome. *Int Orthop*. 2000;24:40–42.
- Quinn SF, Sheley RC, Demlow TA, Szumowski J: Rotator cuff tendon tears: evaluation with fat-suppressed MR imaging with arthroscopic correlation in 100 patients. *Radiology* 1995;195:497–500.
- Rafii M, Firooznia H, Sherman O, et al.: Rotator cuff lesions: signal patterns at MR imaging. *Radiology* 1990;177:817–823.
- Reinus WR, Shady KL, Mirowsitz SA, Totty WG: MR diagnosis of rotator cuff tears of the shoulder: value of using T2 weighted fat saturated images. *Am J Roentgenol* 1995; 164:1451–1455.
- Smith, KL, Harryman, DT., Antoniou J, Campbell, B, Sidles, JA., Matsen, FA. A prospective, multipractice study of shoulder function and health status in patients with documented rotator cuff tears. *J Shoulder Elbow Surg* 2000; 9:395–402.
- Speed CA. Disease of the rotator cuff. Consider subacromial injection therapy. *BMJ*. 1993;307:1559.
- Speed C, Hazleman B. Shoulder pain. *Clin Evid*. 2004; 11:1613–1622.
- Stitik TP, Foye PM, Fossati J. Shoulder injections for osteoarthritis and other disorders. *Phys Med Rehabil Clin N Am*. 2004;15:407–446.
- Teefey SA, Rubin DA, Middleton WD, Hildebolt CF, Leibold RA, Yamaguchi K. Detection and quantification of rotator cuff tears: comparison of ultrasonographic, magnetic resonance imaging, and arthroscopic findings in seventy-one consecutive cases. *J Bone Joint Surg Am* 2004; 86-A:708–16.
- van der Windt DA, Bouter LM. Physiotherapy or corticosteroid injection for shoulder pain? *Ann Rheum Dis*. 2003;62:385–387.
- White RH, Paull DM, Fleming KW. Rotator cuff tendonitis: Comparison of subacromial injection of a long acting corticosteroid versus oral indomethacin therapy. *J Rheumatol*. 1986;13:608–613.
- Winters JC, Jorritsma W, Groenier KH, Sobel JS, Meyboom-de Jong B, Arendzen HJ. Treatment of shoulder complaints in general practice: long term results of a tendonitis, single blind study comparing physiotherapy, manipulation, and corticosteroid injection. *BMJ*. 1999;318:1395–1396.
- Winters JC, Sobel JS, Groenier KH, Arendzen HJ, Meyboom-de Jong B. Comparison of physiotherapy, manipulation, and corticosteroid injection for treating shoulder complaints in general practice: Randomised, single blind study. *BMJ*. 1997;314:1320–1325.
- Withrington RH, Girgis FL, Seifert MH. A placebo-controlled trial of steroid injections in the treatment of supraspinatus tendonitis. *Scan J Rheumatol*. 1985;14:76–78.
- Wolf BR, Dunn WR, Wright RW. Indications for repair of full-thickness rotator cuff tears. *Am J Sports Med* 2007 35:1007–16.
- Zheng X, Simpson JA, van der Windt DA, Elliott AM. Data from a study of effectiveness suggested potential prognostic factors related to the patterns of shoulder pain. *J Clin Epidemiol*. 2005;58:823–830.