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ORIGINAL ARTICLE

Hyperlipidemia increases the risk of retear after arthroscopic rotator cuff repair

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Background: Hyperlipidemia (HL) has been identified as a risk factor for rotator cuff tear, but no studies have evaluated its effects on healing. The purpose of this study was to evaluate the effect of HL and statin use on rotator cuff healing after arthroscopic repair.

Methods: This was a retrospective review of 85 patients (86 shoulders) who underwent arthroscopic rotator cuff repair with postoperative ultrasound evaluation. Ultrasound findings were graded no retear, partial-thickness retear (PT), or full-thickness retear (FT).

Results: Average age was 62.1 years (45.3-74.3 years). On ultrasound evaluation, 65 shoulders (75.5%) had no retear, 14 (16.3%) had PT, and 7 (8.1%) had FT. There was no significant difference in retear rate by age, technique, or tissue quality.

There were 33 patients (38.8%) who had the diagnosis of HL, and all were taking a statin medication. Compared with patients without HL, patients with HL had significantly higher rates of FT (18.1% vs. 1.9%; $P < .001$) and PT (27.2% vs. 9.4%; $P < .001$). The total retear rate (PT and FT) for HL patients was significantly higher at 45.5% (15/33) compared with the patients without HL at 11.3% (6/53), with an odds ratio of 6.5 ($P < .001$). There was no difference in retear rate by dosage or type of statin medication.

Conclusion: After arthroscopic rotator cuff repair, HL was a risk factor for retear. Further investigation is warranted on this topic, and these results may help in managing expectations after surgery.

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

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Rotator cuff tendon tears are a common pathologic change seen by orthopedic surgeons, with up to 50% of the population older than 50 years having this diagnosis.^{22,24} Numerous factors, both extrinsic and intrinsic, have been associated with

an increased risk of rotator cuff tear. Extrinsic factors include acromial morphology and patient demographics⁸; intrinsic causes include factors such as age, smoking statuses, and activity level.^{3,9,14,15,19,25}

A less frequently studied phenomenon is the incidence of rotator cuff tear in patients with hyperlipidemia (HL). The initial study of this topic is based on the increased incidence of Achilles tendon tears in HL patients.^{17,18,20} Clinical studies have extrapolated their investigation to rotator cuff tears and found increased cholesterol levels in rotator cuff tear

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patients compared with controls.^{1,2,16} The effect of HL on the rotator cuff has been further validated by rat models, which demonstrate both decreased biomechanical and healing properties of these tendons.^{4,5,10} Whereas the focus has been on HL as a risk factor, there are many non-HL patients who develop rotator cuff tears, and further clinical study is needed to investigate whether HL affects healing after repair.

Although elevated cholesterol concentration is an important risk factor to investigate, laboratory results are often confounded as many of these patients have been prescribed hydroxymethylglutaryl-coenzyme A reductase inhibitors (statins).¹⁶ Statin medications have their own effects on tendon rupture and healing, with conflicting data. Evaluating all tendon types, studies have suggested increased rates of rupture,^{7,21} no difference,^{12,13} or decreased rupture rates.^{10,16} Only two studies have directly investigated HL with or without statin use for rotator cuff tendon.^{10,16} The clinical population study by Lin et al found decreased rates of rotator cuff tears in patients taking statins compared with untreated HL patients; however, the HL patients taking statins were still at a significantly higher risk of rotator cuff disease than the general population.¹⁶ In addition, Chung et al described similar results in a rat model in which the untreated HL rats had poorer rotator cuff tendon healing than statin-treated rats. Despite treatments, these HL statin-treated rats had significantly inferior healing compared with healthy controls.¹⁰ Whereas statin therapy may improve rotator cuff integrity in HL patients compared with untreated ones, further clinical study is needed to assess the effects of healing after repair in patients taking cholesterol-lowering medication.

Because arthroscopic rotator cuff repair is extremely prevalent,¹¹ identifying risk factors that may be detrimental to healing is essential. Given the dearth of clinical literature regarding rotator cuff repair in HL patients, additional research is needed. We hypothesized that HL patients would have a higher retear rate after arthroscopic repair.

Materials and methods

We retrospectively reviewed 85 arthroscopic rotator cuff repair patients at our institution from 2011-2013. All patients had failed to respond to nonoperative management, including a trial of physical therapy, nonsteroidal anti-inflammatory drugs, and activity modification. The primary selection criterion was a postoperative ultrasound evaluation. Of the 401 rotator cuff repairs performed at our institution during that period, only 85 had postoperative ultrasound evaluations. Exclusion criteria were <2 years of follow-up, absence of postoperative ultrasound evaluation, and revision surgery. Revision surgeries were excluded as an ultrasound read is much more difficult in these cases, which may have led to confounding results. The inclusion criterion was any isolated supraspinatus tear that required surgical treatment. Tension of repair was decided by the surgeon's interpretation of the repair, and it was graded poor, normal, or high tension.

All patients underwent postoperative ultrasound examination at approximately 6-month follow-up to evaluate tendon integrity, which was the main inclusion criterion. A musculoskeletal trained radiologist

evaluated all ultrasound studies. Partial tears were defined as <25% but less than a full tear of the previously repaired rotator cuff; a full-thickness tear was considered full if gapping at the repair site was evident with no continuity of the previously repaired tendon. Ultrasound healing was graded as no retear, partial-thickness retear (PT), or full-thickness retear (FT). An independent observer blinded to the ultrasound results evaluated all patients' medical records.

Once the 85 patients with postoperative ultrasound evaluation were identified, they were split into 2 groups, 1 with the diagnosis of HL and 1 without the diagnosis of HL (control group). Medical records were reviewed, including pertinent laboratory studies and premedical clearance. All diagnoses of HL were cross-referenced with patient charts, medical clearance, and the surgeon's preoperative clinic note. HL was defined by the primary care physician who was currently treating each patient, which was based on the patient's chart as previously described. Cholesterol levels were not used as all of these patients with the diagnosis of HL were currently being treated with statin medications and were likely to have had artificially low levels that may have excluded them. Medications were verified as well by a similar process. Any statin medication taken by the patient, including dosage, was recorded. Statin medications were converted to their equivalent doses to determine whether the dosage of the medication had any effect on clinical outcomes.²³

Outcome scores were obtained from a prospectively collected rotator cuff registry, including preoperative and final American Shoulder and Elbow Surgeons (ASES, for the operative side) and visual analog scale (VAS) scores. Intraoperative anchor configuration (double vs. single row), tear size, Harryman classification, tissue quality (normal to severely degenerative tendon), and tension of repair were also recorded from this registry.

All patients underwent similar rehabilitation protocols as defined by our sport/shoulder service department. Patients were immobilized for 2 weeks in a sling, then were allowed passive range of motion with physical therapy and at-home Codman and pendulum exercises. At 6 weeks, active range of motion was started and rotator cuff isometrics began. Full active and passive range of motion was expected by 10 weeks, when strengthening was started. Return to full activities training was started at 20 weeks with expectation of return to sport by 6 months postoperatively.

Statistics

A 1-way analysis of variance, followed by the post hoc Tukey test, was performed to compare continuous variables, and χ^2 and Fisher exact tests were used to compare categorical variables. Tests were conducted with SPSS 22.0 (IBM Corp, Armonk, NY, USA) using 2-sided hypothesis testing with statistical significance set at $P \leq .05$.

Results

Demographics

This study included 85 patients (86 shoulders). Average age was 62.1 years (45.3-74.3 years); 54 patients were male and 32 were female. On ultrasound evaluation, 65 shoulders (75.5%) had no retear, 14 (16.3%) had PT, and 7 (8.1%) had FT. Ultrasound evaluation was performed at an average of 7.2 months (4.2-9.4 months) after surgery. Average tear size was 2.8 cm (0.85-4.9 cm). There was no significant difference

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