Rotator Cuff Tear in an Elderly Woman Performing Progressive Resistance Training: Case Report from a Randomized Controlled Trial

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The purpose of this article is to document a rotator cuff tear sustained by an elderly woman performing progressive resistance training (PRT) in a recent randomized controlled clinical trial. The patient was a sedentary 73-y-old Caucasian woman. Investigation revealed an acute, full-thickness tear of the right supraspinatus secondary to performing a shoulder press exercise. Further investigation via MRI revealed degenerative disease of the acromioclavicular joint including lateral downsloping of the acromion and an anteroinferior acromial spur, which would predispose to impingement. Conservative management was implemented in this case for over 6 months with minimal success. The patient remained functionally limited in virtually all activities of daily living. Given the medical history, health status, physical condition, and age of our patient, it is probable that degenerative changes predisposed the patient to the injury. To our knowledge this is the first published report of an older adult sustaining a rotator cuff tear during PRT.

Key Words: geriatric, exercise, risk, supraspinatus, end-stage renal disease, adverse event, shoulder

Over the past several decades, with the prevailing demographic shift, greater efforts have been directed toward promoting exercise in older adults. Progressive resistance training (PRT) in particular has become widely recognized as an important exercise modality in aging given its efficacy in targeting age-related sarcopenia and associated health impairments. To date, research evaluating the efficacy of PRT in both diseased and non-diseased elderly cohorts has overwhelmingly demonstrated that this modality of training is feasible, beneficial, and safe. However, given its increasing prescription and popularity among older adults there is an ongoing need...
to report on the safety of PRT interventions which includes thorough documentation of adverse events encountered during clinical trials.

The rotator cuff consists of four muscles: the subscapularis, supraspinatus, infraspinatus, and teres minor, which function in concert to dynamically stabilize the glenohumeral joint. Disorders of the shoulder joint commonly involve the rotator cuff musculature. Rotator cuff tears during exercise are typically the end product of microtrauma incurred by chronic, repetitive movement of the shoulder joint. These injuries have been observed in athletes engaging in a variety of sports involving repetitive overhead arm motion, including tennis, swimming, baseball, and PRT. Rotator cuff tears can be precipitated by degenerative anatomical adaptations within the impingement interval, including the development of subacromial spurs.

Symptoms of rotator cuff lesions may include pain, loss of strength and range of motion, and impairments in activities of daily living (ADL). Older adults may be more susceptible to rotator cuff tears due to the degenerative changes that typically accrue with age. Shoulder pain involving rotator cuff pathology is recognized as a significant cause of disability in middle-age and elderly cohorts. The incidence of partial and full-thickness rotator cuff tears increases with age, and such injuries have been known to occur spontaneously in older individuals. At present however, there has been minimal investigation into the susceptibility of elderly individuals to rotator cuff lesions during PRT.

The purpose of our present report is to describe the events surrounding a rotator cuff tear in an elderly woman performing PRT in a recent clinical trial, and discuss potential etiological factors predisposing the patient to this injury. Investigation of the underlying pathology in this case may be necessary to minimize the occurrence of such adverse events in future clinical trials and maintain the favorable risk to benefit ratio in the elderly suggested by the majority of PRT literature.

Case Report of an Elderly Woman Performing PRT

The Progressive Exercise for Anabolism in Kidney Disease (PEAK) randomized controlled trial was conducted to evaluate the efficacy of prescribing PRT during hemodialysis treatment. The South Eastern Sydney Area Health Service and the University of Sydney Human Research Ethics Committees approved all procedures and written informed consent was obtained from all patients enrolled in the trial.

Medical History of the Patient

One of 49 patients enrolled in the PEAK trial was a 73-y-old Caucasian woman with end-stage renal disease (ESRD) resulting from diabetic nephropathy. The patient had been receiving hemodialysis treatment three times per week, 4.5 h per session, for approximately 3.8 y prior to her involvement in the trial. Patient medical history was notable for osteoarthritis of both knees, hypertension, type 2 diabetes, thyroid disease, obesity (BMI = 32.3), depression, restless legs syndrome, transient atrial fibrillation related to hyperkalemia, and mitral regurgitation. Past surgical history
included a hysterectomy and right nipple removal, negative for malignancy. The patient was prescribed a four-wheel walker for ambulation and reported poor balance and several falls while walking previously with a cane. Medications included insulin, erythropoietin, amitriptyline hydrochloride, clonazepam, simvastatin, folic acid, vitamin B forte, thyroxine sodium, amiodarone, calcium carbonate, and aspirin. The patient did not drink alcohol or have a history of tobacco use. The patient performed all ADL independently prior to enrolling in the trial.

### Onset of Shoulder Pain

The PRT intervention was prescribed according to best practice. The patient completed all PRT sessions (100%) until the second training session of week 4 (session 11). Progressive overload of each PRT exercise was well tolerated and appropriately progressed to this point for a sedentary and chronically diseased individual of this age.

The patient performed the upper body component of the exercise regimen in a seated, semi-recumbent position on a hospital bed. Session 11 began with the shoulder press exercise using a 5 kg dumbbell unilaterally, the only exercise of the regimen to involve any overhead movement. During the first few repetitions of the first set, the patient noticed a sharp twinge in her right shoulder. The patient was able to complete the remainder of the set and the remaining upper body exercises with appropriate loading without noticing any pain. The patient adhered to proper lifting technique throughout the session while being fully supervised by a qualified exercise physiologist (B.C.). Just prior to the next training session the patient mentioned that she had been experiencing pain over the past few days. The pain was localized to the right anterior shoulder, and extended distally along the biceps brachii muscle. The pain had not affected her sleep over the previous evenings, but did limit her ability to use her right arm to cook, feed herself, and perform other ADL.

Upper body PRT was ceased at this point for the remainder of the trial; however, the patient continued to perform lower body PRT without incident. Compliance to the lower body training regimen (sessions attempted/sessions offered × 100%) in this patient was 79.8%. No other adverse events related to exercise training were reported in this patient for the remainder of the study.

### Medical Investigation and Management

For the first 2 wk following the onset of shoulder pain, the patient self-medicated with arthritis cream and heat packs. Medical examination 2 wk from the date of injury reported no obvious deformity or swelling, with pain on palpation of the acromioclavicular joint. Pain was evident between 90 and 180 degrees of active arm flexion and abduction. Analgesics were prescribed. Radiographic examination of the shoulder revealed degenerative disease and possible chondrocalcinosis affecting the acromioclavicular joint and the insertion of the rotator cuff. No rotator cuff calcification, subacromial spur, fracture, or dislocation was present. The patient reported no history of chronic shoulder pain or previous injury/abnormality.

The patient met with a rheumatologist (M.L.) 6 wk from the onset of shoulder pain. Her pain, which was very severe (8 out of 10, where 10 is severe pain), had
improved to 3/10. The history and examination was consistent with an acute rotator cuff tear, which was confirmed on ultrasound 1 wk later. A bilateral ultrasound revealed a large full thickness tear of the right supraspinatus tendon in its mid and posterior portions (1.3 cm long) associated with a probable tear of the insertion of the infraspinatus tendon, as well as a large associated subdeltoid bursal effusion.

As the symptoms were slowly improving the patient refused specific therapy offered, including physiotherapy and/or corticosteroid injection into the subacromial bursa to reduce any associated inflammation.

Eleven weeks post injury, symptoms became worse with increased pain and limitation of shoulder joint range of motion (active abduction reduced to 30 degrees) and a 40 mg cortisone (Depo-Medrol) injection was administered into the subdeltoid bursa. Subsequently, the patient did experience relief of pain symptoms until week 13, but thereafter the pain returned and became worse. At week 15, the rheumatologist (M.L.) reexamined the patient. Active abduction was limited to just 30 degrees with negligible internal and external rotation. However, on passive movement, the rheumatologist was able to abduct the arm of the patient to between 120 and 140 degrees, with almost full internal and external rotation, suggesting that there was no evidence of frozen shoulder syndrome. Clinically, there was no evidence of biceps pathology. The rheumatologist (M.L.) administered 2 mL of Kenacort and a small amount of lignocaine into the subdeltoid bursa, and an orthopedic surgeon was consulted.

MRI at this time revealed degenerative disease of the acromioclavicular joint including lateral downsloping of the acromion and an anteroinferior acromial spur, which would predispose to impingement (Figure 1). Other findings included: 1) a full thickness supraspinatus tendon tear with approximately 3 cm of medial retraction of the tendon; 2) minor atrophy affecting the supraspinatus muscle belly; 3) a tear of the supraspinatus insertion to the greater tuberosity; 4) swelling of the subscapular tendon at its insertion in keeping with tendinopathy and a probable partial tear; 5) a fairly extensive anterior labral tear; and 6) focal cartilage thinning anteroinferiorly involving the glenoid with some subcortical cysts having formed. The consulting radiologist (R.S.) reported diagnoses according to the images presented in Figure 1.

Approximately 32 wk following the adverse event, the patient remained functionally limited. The patient required the assistance of her husband with all ADL, including cooking and dressing, compensating for her injury by using her non-dominant (left) upper extremity as much as possible. The patient had ongoing pain on active movement of her right arm due to the rotator cuff tear. Use of her walker resulted in pain 6/10 in severity. On examination, the patient did not have frozen shoulder syndrome and the consulting rheumatologist (M.L.) believed that physiotherapy would not be of any value at this stage.

As surgery is rarely indicated in the management of full-thickness rotator cuff tears in older adults, such injuries are typically managed conservatively. Surgical repair may be plagued with recurrent tears, peri-operative complications, prolonged recovery periods, and elevated mortality risk. Thus, non-operative management as described in the literature has been implemented in this case for over 6 months with minimal success, and referral to an orthopedic surgeon is currently under consideration.


Discussion

The supraspinatus tendon is the most commonly involved tendon in rotator cuff tears.\(^a\)\(^b\) Pathogenesis of this injury in older adults is typically regarded as multifactorial. The supraspinatus is biomechanically prone to impingement with overhead exercise\(^a\)\(^b\) and becomes more hypovascular with age,\(^c\) predisposing this tendon to greater microtrauma and intrinsic degeneration over time versus other rotator cuff tendons. It has also been postulated that histological degeneration induced by

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Figure 1—MRI Images: 1) lateral downsloping of the acromion and an anteroinferior acromial spur, which would predispose to impingement; 2) a full thickness tear of the supraspinatus to the greater tuberosity with approximately 3 cm of medial retraction of the tendon; 3) minor atrophy affecting the supraspinatus muscle belly; 4) swelling of the subscapular tendon at its insertion in keeping with tendinopathy and a probable partial tear; 5) a fairly extensive anterior labral tear and focal cartilage thinning anteroinferiorly involving the glenoid with some subcortical cysts having formed.
chronic acidosis and hyperparathyroidism secondary to ESRD can predispose a patient to tendon rupture.26

Given the medical history, health status, physical condition, and age of our patient it is likely that degenerative histological changes predisposed this patient to the full-thickness supraspinatus tear during the overhead exercise (i.e., shoulder press). Diagnosed degenerative changes in our patient included: degeneration of the acromioclavicular joint, development of an anteroinferior acromial spur, and focal cartilage thinning anteroinferiorly involving the glenoid with some subcortical cysts. All of these degenerative changes may have contributed to the risk of supraspinatus tear in our patient, along with histological intrinsic degeneration of the tendon itself. According to Sano et al10 degenerative histological changes of the supraspinatus tendon are negatively correlated with ultimate tensile strength. In older, sedentary individuals even minor straining of the tendon may induce a tear.27

The shoulder press exercise, which the patient was performing when she noted a sharp twinge in her arm, involves the activation of the deltoid, triceps, and all four rotator cuff muscles, either as prime movers in abduction (i.e., supraspinatus) and external rotation of the humerus (i.e., teres minor, infraspinatus) and/or as stabilizers of the glenohumeral joint (supraspinatus, teres minor, infraspinatus, subscapularis). It is possible that as the patient extended her arm up upward to complete a repetition of the shoulder press exercise, the supraspinatus became impinged within the coracoacromial arch resulting in the full-thickness tear.

After an extensive search of review articles and randomized controlled trials of PRT in older adults, we were able to document only one rotator cuff tear,28 and three other musculoskeletal injuries involving the shoulder joint26-30 reported as adverse events. In a recent meta-analysis, Latham et al.31 concluded that it is difficult to determine the risks and benefits of PRT in the elderly because adverse events have been poorly reported in the majority of trials to date. Of 66 randomized controlled trials reviewed,31 only 7 (10.6%) provided a priori definition of “adverse event” in the methods section. Of these 7 trials, there was minimal consistency in defining the term, with some studies reporting only serious events that the investigators considered attributable to the training program, while others reported all adverse events in each group.

To our knowledge, this is the first published case report of an older adult sustaining a rotator cuff tear during PRT. The present case likely represents a case of underlying risk factors predisposing the individual to an acute traumatic event. It is likely that chronic inactivity and a greater burden of chronic disease and frailty predisposed our patient to this injury. The patient had 7 chronic diseases, 11 prescribed medications, used a walker for ambulation, had a history of falls, and scored 1.5 to > 2 standard deviations below the mean for measures of lower body strength and exercise capacity in our trial.18,19 Six-minute walk distance was only 158 m in this patient compared with to a mean of 470 m in our sample cohort (>2 standard deviations difference).

Maintenance of rotator cuff muscle strength, mobility, and specific exercise throughout life may prevent atrophy, histological degeneration, and rotator cuff tears. Predisposing factors should be investigated and delineated so that the movements and loading involved in standard PRT regimens can be modified to offset injury risk and perhaps induce some preventative adaptations in vulnerable
individuals. For example, the avoidance of overhead loading and the substitution of alternate exercises to target the deltoid muscle group may have prevented the present case altogether had the risk factors been clearly described in the literature. Adequate, thorough reporting of adverse events during clinical trials is necessary to delineate the relative risk of rotator cuff tears among the elderly with all modalities of exercise. To improve reporting, development of a standardized instrument for documenting adverse events encountered during randomized controlled trials should be considered. Adherence to “best practice” PRT guidelines (e.g., speed of contractions, appropriate loading, incremental and controlled progression of loading, and vigilance in detecting new or changing symptoms) and adjustment of the PRT regimen according to any detected risk factors, which may include the avoidance of overhead movements in this case, is necessary to minimize such events and maintain the favorable risk to benefit ratio suggested by the majority of PRT literature in the elderly.

Acknowledgments

We sincerely appreciate the efforts of Ms. Jane Gregory and Ms. Haifa Abas in the preparation of this manuscript.

References


