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Effects of preexisting depression and anxiety on postoperative outcomes following arthroscopic rotator cuff repair

Andrea H. Johnson, MSN, CRNP^a, James J. York, MD^b, Cyrus J. Lashgari, MD^b, Benjamin M. Petre, MD^b, Justin J. Turcotte, PhD, MBA^{c,*}, Daniel E. Redziniak, MD^b

^aResearch Fellow, Anne Arundel Medical Center Orthopedics, Annapolis, MD, USA

^bAttending Orthopedic Surgeon, Anne Arundel Medical Center Orthopedics, Annapolis, MD, USA

^cDirector, Orthopedic and Surgical Research, Anne Arundel Medical Center Orthopedics, Annapolis, MD, USA

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Background: Rotator cuff repairs (RCRs) are one of the most commonly performed shoulder surgeries in the United States. Psychological health has been shown to influence postoperative outcomes in orthopedic procedures. The purpose of this study is to evaluate the relationship between depression and anxiety (DA) and psychotropic medication and postoperative outcomes following RCR.

Methods: A single institution retrospective observational cohort study of 816 patients undergoing arthroscopic RCR from January 2014 to October 2020 was conducted. Univariate statistics were used to assess differences in demographics, operative characteristics, and postoperative outcomes; multivariate analysis was used to evaluate risk factors for postoperative complications.

Results: Patients with DA were more likely to have a higher first (3.60 vs. 3.00, $P = .004$) and last (1.23 vs. 0.96, $P = .042$) postoperative pain scores, lower first (18.67 vs. 21.85, $P = .008$) and last (61.87 vs. 64.71, $P = .014$) Upper Extremity Functional Score (UEFS), more likely to experience an emergency department visit postoperatively (9.1 vs. 5.0%, $P = .028$), have a symptomatic recurrent tear (8.2 vs. 3.3%, $P = .003$), and persistent pain (4.3 vs. 1.2%, $P = .011$). After controlling for age, sex, body mass index, American Society of Anesthesiologists score, diabetes, smoking, coronary artery disease, asthma, hypertension, psychotropic medication and DA, having DA at the time of surgery was independently predictive of any complication (odds ratio, 2.033; $P = .028$) and persistent pain (odds ratio, 8.232; $P \leq .001$). Patients with and without DA showed significant improvement in postoperative pain and UEFS from the first to the last measurement ($P < .001$).

Conclusion: DA is not a deterrent for RCR but targeted interventions may be needed to decrease the occurrence of complications.

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Mental health disorders affect a significant portion of the adult population in the United States; in 2019 approximately 20% of adults had a diagnosed mental illness, nearly 8% reported a depressive episode, and 19% reported an anxiety episode within the past year.¹⁷ Psychiatric comorbidities, particularly anxiety and depression, have been associated with poorer outcomes in patients undergoing a wide variety of orthopedic procedures including joint replacement, spine surgery, and sports medicine procedures.^{1,3,13,24} When looking specifically at patients undergoing rotator cuff repair (RCR), rates of anxiety and depression as high as 25% of the patients

undergoing this procedure have been reported.^{5,6} The presence of mental illness in patients undergoing RCR has been shown to increase the cost of care both to the patient and the health system and this is a concern with the increased focus on value-based care.^{1,7} Patients with anxiety and depression who undergo RCR have also been shown to have increased risk of postoperative complications, persistent pain, and decreased functional scores.^{13,14,18}

Rotator cuff tears are a common injury in the adult population with some studies reporting more than 30% of adults over 60 years old have a full thickness rotator cuff tear.⁹ Rotator cuff tears have also been shown to be an economic burden on society and with the aging of the baby boomer population, the economic effects will likely continue to increase over time.¹⁵ Rotator cuff repair has been shown to decrease the economic burden and improve pain and function in patients that undergo this procedure.^{9,15} Identifying patient factors that contribute to poor postoperative outcomes is

This project was determined to be IRB exempt by our institution's clinical research committee.

*Corresponding author: Justin J. Turcotte, PhD, MBA, Anne Arundel Medical Center Orthopedics, 2000 Medical Parkway Suite 503, Annapolis, MD 21401, USA.

E-mail address: Jturcotte@aahs.org (J.J. Turcotte).

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important in order to improve the success of the surgical procedure and reduce the economic impact on patients and the health care system as a whole. The purpose of this study is to evaluate the influence of anxiety and depression on postoperative complications, postoperative pain, and functional scores in patients undergoing primary arthroscopic RCR surgery.

Materials and methods

Study population and setting

This study was deemed institutional review board exempt by the institution's clinical research committee. A retrospective observational study was conducted of patients undergoing arthroscopic primary RCR from January 1, 2016, to September 30, 2020. Procedures were performed by one of nine board certified orthopedic surgeons in a single hospital based outpatient surgery center. Patients were excluded from the study if they underwent open RCR, revision RCR or if they did postoperative physical therapy at a nonhospital affiliated physical therapy office; no other exclusion criteria were used.

Perioperative protocol

All surgeries were performed on an outpatient basis under general anesthesia; regional anesthesia for postoperative pain control was used at the discretion of the surgeon and anesthesiologist. Patients receive instruction for a home exercise program including hand, wrist, and elbow range of motion (ROM) and shoulder pendulums to begin the day after surgery and formal physical therapy begins 10–14 days after surgery; formal physical therapy may be delayed based on intraoperative findings (large or massive tear or poor tissue quality). Rehabilitation protocols advance from passive shoulder ROM starting at 2 weeks, active assist ROM starting between 4 and 6 weeks, and active ROM starting between 6 and 8 weeks postoperatively. All patients are discharged with a sling/shoulder immobilizer which is used at least for the first 6 weeks postoperatively. No lifting > 5 pounds for at least the first 6 weeks following surgery.

Upper Extremity Functional Score

The Upper Extremity Functional Score (UEFS) is an eight item tool that asks patients to evaluate their amount of difficulty performing each item on the list on a scale of 1–10.²⁰ It is used primarily by physical and occupational therapists to monitor progression through a rehabilitation program. At this institution, physical and occupational therapists administer this tool upon first evaluation of the patient and then repeat the measurement every 4 weeks until the patient is discharged. We recorded the first postoperative and the last postoperative UEFS.

Data collection and analysis

Demographics, comorbidities, presence of a diagnosis or depression or anxiety (DA) and use of psychotropic medication (PM) at the time of surgery, postoperative emergency department (ED) visits and hospital admissions in the first 90 days, any complication, and the first and last postoperative pain score and UEFS from the physical therapy documentation were manually recorded from the electronic medical record. The minimum clinically important difference (MCID) of the change in postoperative pain scores and UEFS was calculated and the rate of patients achieving MCID was compared between groups. The MCID of pain scores was decreased by 2 points on the numeric rating scale and/or

a pain score of 0 at the last postoperative PT evaluation.^{22,23} The MCID of the UEFS was an improvement of 9.4 points.⁴ ED and hospital admissions were obtained using the Chesapeake Regional Information System for our Patients (CRISP) and accounted for visits to our institution and all regional institutions. Complications were manually retrieved from the narrative providers' notes in the electronic medical record. Infection was defined as any superficial or deep wound infection, postoperative stiffness was diagnosed by the provider based on clinical presentation, symptomatic recurrent tear was diagnosed by repeat imaging or intraoperative findings, persistent pain was defined as pain out of proportion to expected pain during recovery and reoperation was any reoperation performed on the ipsilateral shoulder at our institution. The primary endpoint was the relationship between DA and postoperative outcomes and complications. Subgroup analysis of patients with DA on or off PM at the time of surgery and between the different psychiatric diagnoses was performed. Bivariate statistics (two-sided independent and paired samples t-tests and chi-square tests) were used to evaluate differences in demographics, comorbidities, and complications between patients who had DA and those that did not and between patients with DA on PM or not. Multivariable logistic regression was performed to evaluate the effect of DA on complications after controlling for potentially confounding variables. All statistical analysis was performed in SPSS version 27 (IBM, Armonk, NY, USA) and statistical significance was assessed at $\alpha = 0.05$.

Results

Eight hundred and sixteen patients were included in this study. The average age of patients was 58.6 ± 9.3 years, with a body mass index of 30.7 ± 5.9 kg/m², 39.1% of patients were female and 28.4% had at least one psychiatric diagnosis at the time of surgery. Mean time to last physical therapy or physician office visit was 7.23 ± 5.85 months and charts were reviewed at a mean of 3.45 ± 1.31 years. Of the patients with DA, 71 (30.6%) had a diagnosis of depression only, 70 (30.2%) had a diagnosis of anxiety only, and 85 (36.6%) had diagnoses of both depression and anxiety. Patients with DA were more likely to be female (56.9 vs. 32.0%, $P < .001$), have an American Society of Anesthesiologists score ≥ 3 (36.2 vs. 22.9%, $P < .001$), have a diagnosis of diabetes (21.1 vs. 14.6%, $P = .022$), have coronary artery disease (8.6 vs. 4.1%, $P = .010$), have asthma (12.5 vs. 7.0%, $P = .012$), have hypertension (55.2 vs. 35.6%, $P < .001$), and be on PM (70.7 vs. 0%, $P < .001$) (Table I).

Table II compares the physical therapy pain scores and UEFS between patients with DA and those with no DA. Patients with DA had higher first (3.60 vs. 3.00, $P = .004$) and last (1.23 vs. 0.96, $P = .042$) postoperative pain scores. These patients also had lower first (18.67 vs. 21.85, $P = .008$) and last (61.87 vs. 64.71, $P = .014$) UEFS when compared to patients without DA. Paired samples t-tests showed that patients with DA had significant improvements in both postoperative pain score ($P < .001$) and UEFS ($P < .001$) from first to last measurement and patients without DA also showed significant improvements in postoperative pain score ($P < .001$) and UEFS ($P < .001$). When evaluating the MCID of the improvement of pain scores and UEFS, 76% of patients achieved MCID in pain scores and 90% of patients achieved MCID in UEFS. There were no significant differences in the rate of patients achieving MCID for either measure between groups.

Table III evaluates the differences in complications between patients with DA and those without DA. Patients with DA have a higher rate of any complication (22.4 vs. 13.0%, $P < .001$), a higher rate of reoperation (6.0 vs. 3.1%, $P = .050$), a higher rate of symptomatic recurrent tear (8.2 vs. 3.3%, $P = .003$) and a higher incidence of persistent pain (4.3 vs. 1.2%, $P = .011$). Patients with DA were also more likely to experience an ED visit in the first 90 days

Table I
Demographics and operative factors.

Demographics	No depression/ anxiety N = 584	Depression/ Anxiety N = 232	P value
Age	58.20 ± 9.16	59.54 ± 9.76	.066
Female sex	187 (32.0)	132 (56.9)	<.001
Body mass index, kg/m ²	30.40 ± 5.68	31.61 ± 6.28	.008
ASA 3 or 4	134 (22.9)	84 (36.2)	<.001
Diabetes	85 (14.6)	49 (21.1)	.022
Overweight/Obese	123 (21.1)	64 (27.6)	.045
COPD	11 (1.9)	7 (3.0)	.320
Current or former smoker	51 (8.7)	24 (10.3)	.472
Coronary artery disease	24 (4.1)	20 (8.6)	.010
Asthma	41 (7.0)	29 (12.5)	.012
Atrial fibrillation	15 (2.6)	8 (3.4)	.493
Congestive heart failure	4 (0.7)	2 (0.9)	.679
Hypertension	208 (35.6)	128 (55.2)	<.001
On psych meds	0	164 (70.7)	<.001
Time in operating room, min	116.64 ± 26.84	116.81 ± 26.83	.932
Time in recovery, min	62.88 ± 31.36	68.09 ± 32.98	.046
Time to last follow-up, mo	7.18 ± 6.03	7.21 ± 5.11	.954
Workers compensation	53 (9.1)	17 (7.3)	.421

ASA, American Society of Anesthesiologists; COPD, chronic obstructive pulmonary disease.

P < .05 in bold; all data listed as n (%) or mean ± standard deviation.

Table II
Physical therapy pain scores and outcomes.

Outcome scores	No depression/ anxiety N = 584	Depression/ Anxiety N = 232	P value
First PT pain score	3.00 ± 2.60	3.60 ± 2.58	.004
Last PT pain score	0.96 ± 1.49	1.23 ± 1.69	.042
Change in pain score	-2.02 ± 2.58	-2.39 ± 2.73	.075
Achieved MCID pain score	445 (76.2)	171 (73.7)	.455
First PT UEFS	21.85 ± 16.43	18.67 ± 14.51	.008
Time to first UEFS, d	14.59 ± 9.52	14.86 ± 8.59	.714
Last PT UEFS	64.71 ± 14.46	61.87 ± 14.71	.014
Time to last UEFS, d	127.35 ± 65.90	120.01 ± 54.09	.143
Change in UEFS	39.98 ± 25.46	40.88 ± 24.40	.645
Achieved MCID UEFS	524 (89.7)	207 (89.2)	.832

PT, physical therapy; UEFS, Upper Extremity Functional Score; MCID, minimum clinically important difference.

P < .05 in bold; all data presented as mean ± standard deviation or n (%).

postoperatively (9.1 vs. 5.0%, P = .028), but there was no significant difference in the rate of hospital admissions in the first 90 days. **Table IV** lists the reasons for ED visits and admissions with the mean time of return.

Table V contains the multivariate analysis of the effect of DA on postoperative complications. All models controlled for age, sex, body mass index, American Society of Anesthesiologists score ≥ 3, diabetes, smoking, coronary artery disease, asthma, hypertension, DA, and PM. Patients with DA were twice as likely to experience any complication after controlling for potential confounders (odds ratio (OR), 2.033; P = .028) and were more than 8 times more likely to experience persistent pain (OR, 8.232; P < .001). DA was not an independent predictor for any other complication.

Subgroup analysis (**Appendix**) was performed on patients with DA who were on medication compared with those who were not on medication. There were no significant differences between groups in postoperative pain scores, UEFS, or complications (**Table A1**). Patients on PM experienced a protective effect against persistent pain after controlling for other variables (OR, 0.197; P = .028). Subgroup analysis comparing patients with depression only, anxiety only, and both anxiety and depression was performed and there

Table III
Postoperative complications.

Complications	No depression/ anxiety N = 584	Depression/ Anxiety N = 232	P value
Any complication	76 (13.0)	52 (22.4)	<.001
Time to complication, d	96.99 ± 89.15	123.81 ± 145.53	.239
Reoperation	18 (3.1)	14 (6.0)	.050
Time to reoperation, mo	10.77 ± 9.23	7.25 ± 2.21	.135
ED visit in first 90 d	29 (5.0)	21 (9.1)	.028
Time to ED visit, d	36.28 ± 28.98	28.57 ± 26.32	.340
Admission in first 90 d	15 (2.6)	7 (3.0)	.721
Time to admission, d	27.73 ± 34.79	20.57 ± 31.04	.648
Infection	2 (0.3)	0	1.000*
Postoperative stiffness	22 (3.8)	8 (3.4)	.827
Symptomatic recurrent tear	19 (3.3)	19 (8.2)	.003
Persistent pain	7 (1.2)	10 (4.3)	.011*

ED, emergency department.

P < .05 in bold; all data presented as n (%) or mean ± standard deviation.

*Indicates Fisher's exact test.

were no significant differences in postoperative pain scores, UEFS, or complications (**Table A2**).

Discussion

Similar to a study recently published by Kuo et al, patients with DA in this study had a higher preoperative comorbidity burden including higher rates of diabetes, obesity, coronary artery disease, asthma, and hypertension.¹³ Several of these comorbidities, including diabetes, hypertension, and smoking, have been identified as placing patients at a higher risk of symptomatic rotator cuff tear and increased complications following RCR.^{2,8,28,29} While postoperative outcome measures were worse in patients with DA when compared to those without DA, both groups showed significant improvement from the first to the last measurement in both pain score and UEFS, with a high percentage of patients reaching the MCID for both measures; there were no differences in the rate of patients achieving MCID between groups. Patients with DA did experience a higher rate of a number of complications, although DA was only an independent predictor of persistent postoperative pain. Our overall rate of DA in this study at 28% is consistent with other population-based studies; Baron et al found that 28% of patients undergoing RCR and 25% of patients undergoing meniscectomy had at least one psychiatric comorbidity and Stone et al found that 32% of patients undergoing total hip or total knee arthroplasty had a psychiatric disorder.^{1,24} We also found an increased prevalence of DA among female patients, lower scores on outcome measures, and increased complications which are consistent with other studies in the literature.^{1,14,18}

Patients in this study with DA did show increased rates of certain complications during the postoperative period; however, they also showed significant improvements in UEFS and pain scores. This is consistent with recent studies published by Hessburg et al and Lau et al which found patients with DA undergoing RCR show significant improvements in both pain and functional scores.^{10,14} This study categorized patients by the presence of a diagnosis of depression or anxiety at the time of surgery; we were unable to assess the severity or clinical significance of symptoms in individual patients, although we did attempt to correct for this somewhat based on the use of PM at the time of surgery and found no differences in outcomes between patients with DA on or off medication. A recent study by Park et al categorized patients based on the results of the Hospital Anxiety and Depression Score (HADS) performed preoperatively and found that patients with psychological distress at the time of surgery had increased pain and slower improvements in ROM,

Table IV
Reasons for emergency department visits and admission in the first 90 days.

Emergency department visits	N (%)	Mean time to visit, days (range)
Surgery related (surgical site pain, urinary retention, adverse drug reaction)	3 (6.0)	17.3 (0-50)
DVT/PE (rule out DVT, PE)	6 (12.0)	19.3 (4-51)
Cardiovascular (SOB, chest pain, hypertension, syncope)	10 (20.0)	19.0 (1-77)
Medical (abdominal pain, fever, foreign body, hematuria)	18 (36.0)	42.8 (2-84)
Psychiatric/substance abuse (panic attack, overdose, alcohol intoxication)	3 (6.0)	15.7 (5-25)
Unrelated injury (leg pain, assault, fall, motor vehicle accident)	10 (20.0)	51.0 (1-87)
Hospital admission		
Anesthetic/surgical complication (hypoxia, pain, confusion)	6 (27.3)	0
Pulmonary embolism	3 (13.6)	7.0 (4-12)
Cardiovascular (chest pain, angina, atrial fibrillation, MI)	5 (22.7)	30.6 (1-77)
Medical (urinary retention, pneumonia, weakness, leukocytosis)	7 (31.8)	42.7 (3-84)
Unrelated injury (assault)	1 (4.5)	87

DVT, deep vein thrombosis; PE, pulmonary embolus; SOB, shortness of breath; MI, myocardial infarction.

Table V
Risk adjusted effect of depression and anxiety on postoperative outcomes.

Outcome	Odds ratio	95% confidence interval		P value
		Lower bound	Upper bound	
Any complication	2.033	1.078	3.836	.028
Reoperation	1.991	0.615	6.449	.251
Emergency department visit	1.828	0.711	4.669	.210
Admission	1.378	0.296	6.419	.683
Postoperative stiffness	0.659	0.141	3.083	.596
Symptomatic recurrent tear	2.297	0.724	7.291	.158
Persistent pain	8.232	2.379	28.489	<.001

DA, depression and anxiety; BMI, body mass index; ASA, American Society of Anesthesiologists; PM, psychotropic medication. Odds ratio for DA is presented after controlling for age, sex, BMI, ASA, diabetes, smoking, CAD, asthma, HTN, and PM; $P \leq .05$ in bold.

although the long-term outcomes of RCR were similar to the group with healthy psychological status.¹⁹ It may also be useful to identify patients with disease specific feelings of DA related to the rotator cuff tear, as these patients may be at even greater risk of poor postoperative outcomes when compared to patients with a history of DA and no increased psychological distress related to the RCR itself.¹⁴ This is in contrast to a study by Cho et al that found patients' symptoms of depression and anxiety improved following surgery for RCR and the presence of DA at the time of surgery did not affect outcomes at one year postoperatively.⁶

In this study, the only individual complication that was independently predicted by comorbid DA was persistent pain. There is a documented link between patients with psychological disorders and increased perception of pain and pain catastrophization.^{16,21,26} A study by Wylie et al found that a patient's mental health had a stronger influence on shoulder pain and function than the size of the rotator cuff tear.²⁷ It is vitally important that a patient's psychosocial health is taken into account when deciding to proceed with surgery and in managing patient expectations for postoperative healing and functional return.^{12,25} Interestingly, we did find that PM was independently predictive of a decreased risk of persistent pain postoperatively. Presumably these patients were actively being treated for DA which may have resulted in a somewhat protective effect for this specific complication; this supports the recommendations in the literature that patients with DA should not be discouraged from surgical intervention for RCR but may benefit from additional mental health support or treatment during the perioperative period.^{14,18}

A recent study by Cronin et al found that in patients undergoing RCR, comorbid DA was associated with increased healthcare costs.⁷ While the study did not identify a source of the increased cost, our study did demonstrate a higher rate of complications and decreased functional scores in patients with DA both of which may contribute to increased cost. Two complications that directly affect

the cost of care were an increased rate of reoperation and increased ED visits in patients with DA. We also noted an increased rate of symptomatic recurrent tear and persistent pain, although we were unable to determine if this resulted in a need for additional treatment thereby increasing healthcare costs. The most common reasons for ED visits in this study were medical issues, cardiovascular issues, and unrelated injury; surgery related and mental health related ED visits accounted for a very small proportion of overall visits. Several studies have found a link between increased ED utilization for any reason in patients with mental health comorbidities which would have a direct impact on healthcare costs.^{1,11} While decreasing ED visits may be a more difficult area to intervene in, knowledge of the existing disparity may help direct education and intervention in this population.

This study does have a number of limitations. Firstly, it is a retrospective study and there is an inherent selection bias, although we attempted to correct for that by using multivariate analysis to control for some of these factors. Because of the retrospective nature we were also limited in our ability to verify the significance of a diagnosis of DA and how it affected patients' function at the time of surgery; we relied on the clinical diagnosis rather than an objective measure of DA. We also did not collect data on the size of the tear and quality or type of repair; both factors which may contribute to postoperative complications. Secondly, the study was performed at a single institution and therefore the findings may not be generalizable to the larger patient population, although the large sample size may counteract some of that effect. We were also unable to obtain any preoperative patient-reported outcomes and the only postoperative patient-reported outcome available for the entire study population was the UEFS. Further studies should investigate patient-reported outcomes, mental health, and quality of life both preoperatively and postoperatively using validated tools in patients undergoing these procedures.

Conclusion

Patients with depression and anxiety undergoing arthroscopic RCR surgery have higher postoperative pain scores, lower Upper Extremity Functional Scores and are at higher risk of complications following surgery; preoperative DA was an independent predictor of persistent pain postoperatively. While DA is not a deterrent for proceeding with RCR, targeted interventions may be needed to improve outcomes and decrease postoperative complications and healthcare utilization. Further study is needed to validate these findings.

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Supplementary Data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jseint.2022.07.005>.

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