RESEARCH ARTICLE

The Opioid Risk Tool: Can This Validated Tool Predict Post-Operative Opioid Dependence Following Arthroscopic Rotator Cuff Repair?

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Abstract

Background: Numerous attempts have been made to decrease the incidence of opioid dependence after orthopedic surgeries. However, no effective means of preoperative risk stratification currently exists. The purpose of this study was to determine the ability of the Opioid Risk Tool (ORT) to predict the rate of opioid dependence 2 years after arthroscopic rotator cuff repair (ARCR).

Methods: We prospectively evaluated all patients undergoing primary ARCR at a single institution over a 1.5 year period with a minimum of 2-year follow-up. All patients completed the ORT prior to surgery and were stratified into Low, Moderate, and High risk categories. The primary outcome was postoperative opioid dependence, defined as receiving a minimum of 6 opioid prescriptions within 2 years following surgery. Secondary outcomes included the total number of morphine milligram equivalents prescribed, total number of opioid prescriptions filled, and total number of opioid pills prescribed during this time interval. All outcome variables were compared amongst Low, Moderate, and High risk groups. Assessment of a statistical correlation between each outcome variable and individual numerical ORT scores (1-9) was performed.

Results: A total of 137 patients were included for analysis. No statistically significant difference was noted in any primary or secondary outcome variable when compared between Low, Moderate, and High risk groups. The total cohort demonstrated a 19% rate of post-operative opioid dependence. No correlation was identified between any outcome variable and individual numerical ORT scores. A greater rate of dependence and quantity of opioids prescribed was noted amongst patients with a history of prior opioid use.

Conclusion: The ORT was not predictive of the risk of opioid dependence or quantity of opioids prescribed after ARCR. Attention should be focused on alternative means of identification and management of patients at risk for opioid dependence after orthopedic procedures, including those with a history of prior opioid use.

Level of evidence: III

Keywords: Opioid; Dependence; Risk; Arthroscopy; Shoulder

Introduction

Effective prevention and treatment of opioid dependence after orthopedic surgery has been a highly sought-after goal. Attempted methods include preoperative opioid education, prescription reduction strategies, such as multimodal pain protocols and nerve blocks, and opioid monitoring programs(1,2). An additional avenue of interest is the creation of a predictive model to identify patients at risk of opioid dependence. The majority of literature dedicated to this topic has focused on patients receiving opioid medications for chronic, non-malignant pain(3,4). However, studies have found a number of factors, including orthopedic and spine surgeries, to be associated with prolonged opiate use following surgery in previously opioid-naïve patients(5–7). This literature highlights the implication of surgery as a risk factor for eventual prescription narcotic abuse.

A number of predictor scoring systems have been

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developed to identify patients at risk of prescription opioid abuse, however, many have only been validated for use in the setting of chronic pain management. For example, the Screener and Opioid Assessment for Patients with Pain (SOAPP) score and Brief Risk Questionnaire (BRQ) are self-administered screening tools that have been proven useful in the prediction of opioid misuse patterns in this population(8,9). The Opioid Risk Tool (ORT) is a screening exam designed to stratify patients by risk of opioid abuse into Low, Moderate, and High risk categories(10). The ORT has been validated for use in patients undergoing treatment of chronic pain and remains one of the most commonly used risk-stratification tools in this patient population(9–12).

The aforementioned risk stratification scores have yet to be used or validated in post-operative patients. The purpose of this study was to determine if the ORT was predictive of the rate of opioid dependence at 2 years following ARCR. The secondary goal was to determine if the ORT was predictive of the quantity of opiates prescribed within 2 years following ARCR. We hypothesized that the ORT would be predictive of opioid use and dependence in patients following ARCR.

Materials and Methods

Institutional Review Board (IRB) approval was obtained prior to initiation of this study. This was a prospective cohort study evaluating all patients that had undergone a primary ARCR from August 2015 to December 2016 by 1 of 7 Shoulder and Elbow fellowship-trained orthopedic surgeons at a single institution. Patients included in this study were at least 18 years of age, demonstrated both a subjective and objective decrease in shoulder function on physical exam, had an operative rotator cuff tear identified on MRI, and were prescribed opioid medication post-operatively. Exclusion criteria consisted of patients with irreparable rotator cuff tears, previous ipsilateral rotator cuff repair, allergy or sensitivity to prescribed pain medication, history of gastrointestinal pathology, or evidence of glenohumeral arthritis on pre-operative imaging. After undergoing ARCR, post-operative follow-up occurred via a clinic visit or telephone call at 2 weeks, 6 weeks, 3 months, and 2 years.

Data collected from the electronic medical record (EMR) included patient demographics and pre-operative ORT score. ORT scores were calculated as originally described by Webster et al. at the final pre-operative office visit(10). Patients with a score of 3 or lower were stratified into the Low-risk category, 4 to 7 into the Moderate-risk category, and 8 or higher into the High-risk category. The total number of morphine milligram equivalents (MME) prescribed, opioid prescriptions filled, and opioid pills prescribed at the 2 year post-operative interval were calculated using the Prescription Monitoring Program (PMP) Aware Drug Database. This centralized database tracks all narcotic prescriptions filled by a patient within the specified state(s). Opiate prescriptions within the states of New Jersey and Pennsylvania were searched due to the proximity of our patient population to these two regions. All narcotics were converted to MME's to establish uniformity for comparison. This was done as recommended by the Centers for Disease Control and Prevention (CDC) using the equation: Dose of Opioid Prescribed X MME conversion factor(13). History of prior opioid use, defined as any quantity of opiates prescribed by a provider within 3-months prior to surgery, as well as opioid dependence, defined as receiving 6 or more opioid prescriptions within 2 years following ARCR, were also recorded using the PMP database. The number of opioid prescriptions that may lead to opioid dependence has yet to be described in the literature. Our definition of opioid dependence was selected to reflect both the substantial number of opioids prescribed and long duration of treatment required for the management of post-operative pain in those patients exhibiting dependence.

The primary outcome measure in this study was the rate of opioid dependence 2 years following ARCR. Secondary outcome measures included the average number of MME's prescribed, opioid prescriptions filled, and opioid pills prescribed within 2 years post-operatively. The primary and secondary outcome measures were calculated and compared between Low, Moderate, and High-risk groups. Similarly, patient demographic data and prevalence of prior opioid use was compared amongst risk stratification groups. Comparisons were conducted using t-test for continuous data, Mann-Whitney U for nonparametric data, and Chi-Square testing for categorical data. Spearman's correlation test was utilized to identify a correlation between pre-operative numerical ORT score (1-9) and each primary and secondary outcome measure. Each comparison was conducted three times: amongst the entire cohort, amongst patients without history of prior opioid use, and amongst patients with a history of prior use. All statistical analysis was completed using R Studio (Version 3.5.1, Vienna, Austria).

Results

A total of 137 patients were identified having met all inclusion and exclusion criteria. Sixty-eight percent of the total cohort was male with an average BMI of 30.4 and average age of 58.9 years at the time of surgery. Twenty-seven percent (37/137) of patients demonstrated a history of opioid use prior to surgery and 87.4% of the study cohort were considered worker's compensation cases. Risk calculation by ORT score stratified 119 patients into the Low-risk category, 9 into the Moderate-risk category, and 9 into the High-risk category. A statistical comparison of demographic variables amongst risk stratification categories demonstrated a lack of significant difference in age (P=0.45), gender (P=0.778), BMI (P=0.082), worker's compensation status (P=1.00), and history of opioid use (P=0.183). No patients were noted to undergo revision surgery during the 2 year post-operative time period.

Nineteen percent of patients demonstrated opioid dependence at 2 years post-operatively [Table 1]. Of note, no significant difference in opioid dependence amongst risk stratification groups was identified in either the full cohort (P=0.222), cohort with prior opioid use (P=0.68), or cohort without prior use (P=0.449). Similarly, Spearman's test demonstrated no correlation between numerical ORT score and rate of opioid dependence in any of the 3 evaluated cohorts. [Table 1]. A significantly greater rate of opioid dependence was noted in patients with a history of prior opioid use (43.2%) than patients without a history of prior use (10.0%) (P<0.001).

Table 1. Left: Comparison of the rate of opioid dependence amongst Opioid Risk Tool categories. Data is presented as "Average (Standard Deviation)" within each cell; Right: Spearman's correlation testing of numeric Opioid Risk Tool score and rate of dependence 2 years following surgery.

FULL COHORT	Low Risk *(N=119)*	Moderate Risk *(N=9)*	High Risk *(N=9)*	P Value	Spearman's Rho	Relationship
Dependence:				0.222	0.072	No Relationship
No	96 (80.7%)	9 (100%)	6 (66.7%)			
Yes	23 (19.3%)	0 (0.00%)	3 (33.3%)			
PRIOR OPIOID USE COHORT	Low Risk *(N=30)*	Moderate Risk *(N=2)*	High Risk *(N=5)*	P Value	Spearman's Rho	Relationship
Dependence:				0.680	-0.079	No Relationship
No	16 (53.3%)	2 (100%)	3 (60.0%)			
Yes	14 (46.7%)	0 (0.00%)	2 (40.0%)			
NO PRIOR OPIOID USE COHORT	Low Risk *(N=89)*	Moderate Risk *(N=7)*	High Risk *(N=4)*	P Value	Spearman's Rho	Relationship
Dependence:				0.449	0.062	No Relationship
No	80 (89.9%)	7 (100%)	3 (75.0%)			
Yes	9 (10.1%)	0 (0.00%)	1 (25.0%)			

Evaluation of the average number of MME's prescribed within 2 years following ARCR revealed the largest quantity prescribed amongst patients in the Low risk category [Table 2]. However, no statistical difference in the average number of MME's prescribed post-operatively was noted amongst risk stratification categories within the full patient cohort (P=0.734), cohort with history of opioid use (P=0.69), and cohort without prior use (P=0.961). No statistical correlation between numerical ORT score and average number of MME's prescribed was identified in any of the evaluated cohorts [Table 2]. A significantly greater average number of MME's were prescribed to patients with a history of prior opioid use (9,373 [range, 0-135,000]) than patients without a history of prior use (824 [range, 0-21,962]) (P=0.05).

Table 2. *Left:* Comparison of the number of Morphine Milligram Equivalents prescribed at 2 years post-operatively amongst Opioid Risk Tool categories. Data is presented as "Average (Standard Deviation)" within each cell; *Right:* Spearman's correlation testing of numeric Opioid Risk Tool score and number of Morphine Milligram Equivalents prescribed within 2 years following surgery.

FULL COHORT	**Low Risk *(N=119)***	**Moderate Risk *(N=9)***	**High Risk *(N=9)***	**P Value**	**Spearman's Rho**	**Relationship**
MME	6115 (19684)	1098 (1209)	2136 (2391)	0.734	0.112	No Relationship
PRIOR OPIOID USE COHORT	**Low Risk *(N=30)***	**Moderate Risk *(N=2)***	**High Risk *(N=5)***	**P Value**	**Spearman's Rho**	**Relationship**
MME	15250 (32328)	675 (0)	2658 (2802)	0.690	-0.003	No Relationship
NO PRIOR OPIOID USE COHORT	**Low Risk *(N=89)***	**Moderate Risk *(N=7)***	**High Risk *(N=4)***	**P Value**	**Spearman's Rho**	**Relationship**
MME	1648 (4499)	1182 (1332)	1091 (1331)	0.961	0.079	No Relationship

Calculation of the average number of opioid prescriptions filled within 2 years following ARCR revealed no consistent trend amongst risk stratification categories [Table 3]. Statistical comparison revealed no significant difference in this variable amongst risk stratification categories in the full patient cohort (P=0.749), cohort with history of opioid use (P=0.593), and cohort without prior use (P=0.857). Spearman's test revealed no correlation between numerical ORT scores and the average number of post-operative prescriptions filled in any of the evaluated patient cohorts [Table 3]. A significantly greater average number of prescriptions were filled in the cohort of patients with a history of prior opioid use (11.3 [range, 0-86]) than those without a history of prior use (2.24 [range, 0-44]) (P=0.008).

No clear trend in the average number of pills prescribed over the 2 year post-operative time period was noted within risk stratification categories [Table 4]. Statistical comparison revealed no significant difference in the average number of opioid pills prescribed between risk stratification categories in the full patient cohort (P=0.660), cohort with history of opioid use (P=0.691), and cohort without prior use (P=0.814). Similarly, no statistical correlation between numerical ORT scores and average number of opioid pills prescribed was identified within any of the 3 evaluated cohorts [Table 4]. However, a significantly greater average number of opioid pills were prescribed to patients with a history of prior opioid use (780 [range, 0-7,172]) than those without history of prior use (101 [range, 0-2,525]) (P=0.013).

Table 3. ***Left:*** **Comparison of the number of opioid prescriptions filled at 2 years post-operatively amongst Opioid Risk Tool categories. Data is presented as "Average (Standard Deviation)" within each cell.** ***Right:*** **Spearman's correlation testing of numeric Opioid Risk Tool score and number of opioid prescriptions filled within 2 years following surgery.**

FULL COHORT	**Low Risk *(N=119)***	**Moderate Risk *(N=9)***	**High Risk *(N=9)***	**P Value**	**Spearman's Rho**	**Relationship**
Number of Opioid Prescriptions Filled	4.88 (12.5)	1.78 (1.72)	5.00 (6.38)	0.749	0.113	No Relationship
PRIOR OPIOID USE COHORT	**Low Risk *(N=30)***	**Moderate Risk *(N=2)***	**High Risk *(N=5)***	**P Value**	**Spearman's Rho**	**Relationship**
Number of Opioid Prescriptions Filled	12.9 (21.0)	1.50 (2.12)	6.00 (6.60)	0.593	0.033	No Relationship
NO PRIOR OPIOID USE COHORT	**Low Risk *(N=89)***	**Moderate Risk *(N=7)***	**High Risk *(N=4)***	**P Value**	**Spearman's Rho**	**Relationship**
Number of Opioid Prescriptions Filled	2.19 (5.93)	1.86 (1.77)	3.75 (6.85)	0.857	0.089	No Relationship

Table 4. Left: Comparison of the total number of pills prescribed at 2 years post-operatively amongst Opioid Risk Tool Categories. Data is presented as "Average (Standard Deviation)" within each cell. Right: Spearman's correlation testing of numeric Opioid Risk Tool score and total number of opioid pills prescribed within 2 years following surgery.

FULL COHORT	**Low Risk *(N=119)***	**Moderate Risk *(N=9)***	**High Risk *(N=9)***	**P Value**	**Spearman's Rho**	**Relationship**
Total Number of Opioid Pills Prescribed	533 (1237)	81.5 (81.6)	464 (516)	0.660	0.079	No Relationship
PRIOR OPIOID USE COHORT	**Low Risk *(N=30)***	**Moderate Risk *(N=2)***	**High Risk *(N=5)***	**P Value**	**Spearman's Rho**	**Relationship**
Total Number of Opioid Pills Prescribed	1207 (1908)	90.0 (0)	557 (607)	0.691	0.048	No Relationship
NO PRIOR OPIOID USE COHORT	**Low Risk *(N=89)***	**Moderate Risk *(N=7)***	**High Risk *(N=4)***	**P Value**	**Spearman's Rho**	**Relationship**
Total Number of Opioid Pills Prescribed	203 (469)	79.8 (91.1)	278 (350)	0.814	0.022	No Relationship

Discussion

In this study we hypothesized that the Opioid Risk Tool would be predictive of both the rate of opioid dependence and quantity of opioids used in patients 2-years following ARCR. We found no statistical difference in either the rate of opioid dependence or quantity of opioids prescribed amongst patients stratified into Low, Moderate, and High-risk categories by pre-operative ORT score. Additionally, no statistical correlation was noted between the numerical ORT score and any of the examined outcome variables. This data suggests an inability of the ORT to predict the quantity of post-operative opioid use and incidence of dependence in patients undergoing ARCR, leading us to reject our hypothesis.

Our study confirms the findings of prior research that reveal a high rate of opioid dependence following rotator cuff repair. Weekes et al. demonstrated a 32% incidence of chronic opioid use in a cohort of patients after ARCR(14). Our 2-year evaluation of 137 patients following ARCR revealed a 19% rate of opioid dependence amongst the entire cohort. When analyzing patients according to their pre-operative opioid use status, we noted a significantly greater rate of post-operative dependence and quantity of opiates prescribed in patients with a history of prior opioid use. A number of studies evaluating opioid consumption patterns after ARCR have noted similar findings. Weeks et al. discovered chronic post-operative opioid use to occur in 60% of patients with a history of pre-operative opioid exposure and 23% of previously opioid-naïve patients(14). Similarly, Williams et al. found patients with pre-operative opioid use to require both a greater quantity and duration of post-operative opioid consumption than opioid-naïve patients within 2 years following ARCR(15). Our study acts to substantiate the implication of preoperative opioid use as a risk factor for increased opioid consumption and dependence following ARCR.

Our current study is the first of its kind, as the ORT has yet to be utilized in an attempt to predict the risk of opioid dependence after orthopedic surgery. The ORT was originally validated for use in the prediction of opioid abuse amongst patients treated for chronic pain(10). In their study, Webster et al. defined abuse as demonstration of aberrant opioid-related behaviors, including the use of opioids other than those prescribed and unauthorized dose escalation. These same behaviors have been found to develop after prescription opiate utilization, which has been identified as the initiating event of illicit drug use amongst 80% of heroin abusers(16). This data demonstrates a clear association between the use of prescription opioid medications and the risk of aberrant opioid-related behaviors.

The ORT was selected for analysis in our study as it is one of the most widely used risk stratification tools amongst patients receiving chronic pain management(9,11,12). Admittedly, the sensitivity and specificity of the ORT as described in current literature is varied. A study by Moore et al. found the ORT to be less sensitive than either a clinical interview or the SOAPP score in identifying chronic pain patients at risk of opiate abuse(12). Other studies, however, have found the specificity of the ORT to be comparable to that of the SOAPP, BRQ, clinical interviews, and the Patient Medication Questionnaire (PMQ)(9,11). This indicates the efficacy of the ORT as a predictor of opioid abuse risk in comparison to many of the most commonly used questionnaires in current practice.

In this study, we did not find that the ORT was predictive of opioid dependence or the quantity of opiates prescribed after ARCR surgery, likely due to the power of this analysis. However, these results reveal the difficulty in predicting which patients may become dependent on opioids following surgery. Furthermore, our study shows the lack of sensitivity of the ORT for this purpose and demonstrates that pre-operative opioid use status is a more reliable predictor of opioid use and dependence. In addition to demonstrating a greater incidence of dependence, patients with a history of prior opioid use received a significantly greater quantity of opioids than their counterparts. Specifically, the greater number of MME's prescribed to patients with a history of prior use is alarming, as this indicates a greater cumulative post-operative opioid requirement in this group of patients with an elevated risk for dependence. This finding highlights an avenue of opportunity to utilize pre-operative interventions in this patient population in an attempt to limit the quantity of opioids prescribed post-operatively. Additionally, it is important to note the amount of variation in opioid use and dependence identified across risk stratification groups, regardless of prior opioid use status. Such variation amongst a study population as high as 137 patients indicates a lack of clinical utility of the ORT as a pre-operative predictor of patients undergoing ARCR. In spite of this, we believe that the search for an accurate pre-operative risk-stratification tool is a worthy undertaking. However, alternative methods of abuse prevention, including pre-operative education and novel perioperative pain-management protocols, have been found to be of higher yield and may be a more fruitful area of focus(1,2).

A number of limitations were noted in this study. First, the PMP databases utilized only recorded prescription opioids filled at pharmacies in New Jersey and Pennsylvania. Patients seeking illicit pain medications or receiving opioid prescriptions filled at a pharmacy outside of this region would not have been identified. However, we are confident that the prescriptions identified in our search are an accurate representation of our patient cohort as the specified states include the majority of the referral base of the study institution. Second, this study may have benefitted from a greater patient population size in order to identify a statistical difference in outcome variables amongst risk stratification categories. However, if the ORT is unable to identify at-risk individuals in a cohort of 137 patients with a 19% rate of dependency, it is likely not sensitive enough for clinical use. Similarly, a number of uncontrolled confounding variables may have influenced our results, including the number of surgeons performing ARCR, the percentage of worker's compensation patients, and the variation in rotator cuff tear size and concomitant procedures performed at the time of surgery (i.e. biceps tenodesis/tenotomy, distal clavicle excision, subacromial decompression, etc.). Additionally, our definition of opioid dependence consisted of receiving 6 or more prescriptions during the study period and does not take differences in medication type or dose into consideration. However, this was accounted for by also calculating the total quantity of opioids prescribed over a 2-year period. Finally, the ORT was originally validated for use in patients receiving opioid medication for treatment of chronic pain, not for treatment of post-operative pain. It may be that another score will be more sensitive in predicting opioid dependence following ARCR. However, this study suggests that the ORT is not an appropriate tool for use in the prediction of patients at risk of opioid dependence following ARCR.

In a cohort of 137 patients followed for 2-years after ARCR with a 19% rate of post-operative opioid dependence, the Opioid Risk Tool was unable to predict which patients were at greatest risk of dependence. Similarly, the ORT was unable to predict a difference in the quantity of opiates prescribed post-operatively. We found that pre-operative opioid use status was more reliable than the ORT for predicting opioid dependence and increased opioid consumption following ARCR.

Disclosures: The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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