Original Article

Patient Self-Reported Allergies and Their Correlation with Thoracic Outlet Syndrome Outcomes

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Objectives: Thoracic outlet syndrome (TOS) is an uncommon neurovascular disorder that presents as neck and upper extremity pain secondary to brachial plexus trunk or subclavian vasculature compression. The orthopedic literature has correlated patient-reported allergies to postoperative patient-reported outcome (PRO) scores for a variety of surgical procedures. We sought to evaluate patient-reported allergies and PROs following surgical decompression for TOS.

Methods: A chart review was conducted after identifying patients who underwent surgical thoracic outlet decompression by a single surgeon. Patients were contacted and administered five PRO questionnaires via telephone: the QuickDASH Outcome Measure questionnaire (disabilities of the arm, shoulder, and hand [DASH]), the Cervical Brachial Symptom Questionnaire, the Single Assessment Numeric Evaluation, the 12-Item Short Form Survey, and the Numeric Rating Scale (a visual analogue scale). A bivariate analysis of Pearson's correlation coefficient (r) was used to determine the associations of allergies with questionnaires and demographic variables.

Results: Of the 393 patients (128 males and 265 females) identified in the study, 75 (24%) responded and completed all of the questionnaires, 18 (24%) males and 57 (76%) females. A significant correlation was found between the number of allergies reported and the QuickDASH Outcome Measure questionnaire ($r = 0.375$, $P < 0.001$), the Cervical Brachial Symptom Questionnaire ($r = 0.295$, $P = 0.01$), change in the Single Assessment Numeric Evaluation score ($r = -0.310$, $P < 0.01$), change in the visual analogue scale ($r = 0.244$, $P = 0.035$), sex ($r = 0.245$, $P = 0.034$), and the number of medications ($r = 0.642$, $P < 0.001$).

Conclusions: The increased frequency of patient-reported allergies is significantly associated with worse PRO scores for women undergoing TOS surgical decompression. Better understanding this association can help physicians counsel patients on expected outcomes.

Key Words: allergies, patient-reported outcomes (PROs), surgery, thoracic outlet syndrome (TOS)

Thoracic outlet syndrome (TOS) is an uncommon neurovascular disorder that presents as neck and upper extremity pain secondary to compression of the brachial plexus trunk or the subclavian vasculature. The TO is the anatomic interval between the cervical vertebrae and axillary space of the proximal upper extremity. It comprises three areas: the interscalene, costoclavicular, and subcoracoid spaces. TO compression within any of these spaces can precipitate TOS.[1–3] In patients who are unresponsive to the conservative treatment of patient education, activity modification, and physical therapy, surgical decompression is indicated, which may consist of anterior and middle scalenectomy, resection of the first rib, and neurolysis.[1,4–7]

Myriad factors correlate with outcomes in TO decompression, such as the presence of localized symptoms, whether the symptoms are neurogenic or vascular, and whether there were operative complications.[4–7] In addition to factors specific to developing TOS and its management, patient-specific characteristics can correlate with postoperative outcomes. One of the most important

Key Points

- A thoracic outlet syndrome diagnosis is based on subjective patient-reported symptoms.
- The number of patient self-reported allergies has been shown to correlate with poor outcomes in a variety of orthopedic procedures.
- Patients with more self-reported allergies also were more likely to have worse surgical outcomes from thoracic outlet decompression.
- Clinicians should be aware of this association when deciding to treat thoracic outlet syndrome symptoms.

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patient-specific factors in TOS is psychiatric well-being.[7] An increased number of patient-reported allergies have been established as a useful metric when evaluating psychiatric health, particularly in highly procedural specialties.[8–11] Previous studies have investigated the correlation between preoperative patient-reported allergies and postoperative patient-reported outcome (PRO) scores in total hip and knee arthroplasty,[12–18] shoulder arthroplasty,[19] spine,[20–23] and foot and ankle surgery.[24] The subjective nature of PROs, combined with the lack of definitive radiographic findings or objective clinical criteria to assess the success of TOS decompression, poses significant challenges for the treating surgeon. A holistic approach, including psychiatric consultation, may be necessary to examine preoperative risk factors associated with poor outcomes following TOS decompression. The purpose of this study was to determine whether a correlation exists between patient-reported allergies and postoperative PRO scores following surgical TO decompression. Our hypothesis was that those patients with a greater number of self-reported allergies will have poorer PROs.

Methods

Institutional review board approval was obtained before data collection. A retrospective case series was conducted on patients who underwent surgical TO decompression between April 2010 and November 2019 by a single fellowship-trained orthopedic hand and upper extremity surgeon (R.M.).

After identifying potential study subjects from our institution, a chart review was performed to identify self-reported allergies, age, and sex. Patients were contacted via telephone to complete the QuickDASH (Disabilities of the Arm, Shoulder), Outcome Measure questionnaire; the Cervical Brachial Symptom Questionnaire (CBSQ); the Numeric Rating Scale (a visual analogue scale); the Single Assessment Numeric Evaluation (SANE); and the 12-Item Short Form Survey. All of the questionnaires were completed at the time of contact for study postoperatively. Subjects were included in the study only if they completed all five PRO questionnaires.

All of the data analysis for this study was conducted using SAS version 9.4 (SAS Institute, Cary, NC). Bivariate correlations using Pearson correlation coefficients were performed to evaluate the association of allergies in relation to patient demographics and PRO scores. Statistical significance was designated at $P < 0.05$. After a post-hoc power analysis was performed on primary variables of interest including allergies and gender with the assumption of an anticipated correlation of $r = 0.5$, a 90% power was required (n = 38).

Results

Of the 393 patients (128 males and 265 females) who met the study criteria, 75 (24%) completed the questionnaires—18 (24%) were male and 57 (76%) were female. A total of 149 reported allergies were found among the 75 patients included in this study, averaging two allergies per person. A total of 14 respondents reported one allergy, nine had two allergies, seven had three allergies, and 14 had ≥4 allergies (range 0–23; Table 1). The most commonly reported allergies were to opioid analgesics (36; 24.2%), penicillin (15; 10.1%), nonsteroidal anti-inflammatory drugs (9; 6.0%), contact irritant allergies (12; 8.1%), and food allergies (9; 6.0%) (Table 2). No male subject reported more than two allergies.

Table 1. Patient demographics

	Male	Female	*P*
N (%)	18 (24)	57 (76)	
Age, y	38.2 ± 13.9	36.6 ± 14.5	0.676
Allergies	10	139	
Allergies per person (range)	0.56 (0–2)	2.44 (1–23)	<0.001
Preoperative VAS	8.17 ± 2.33	7.60 ± 2.33	0.375
Postoperative VAS	3.3 ± 1.7	3.2 ± 2.4	0.776
P	<0.001	<0.001	
Preoperative SANE	33.67 ± 27.20	29.23 ± 25.49	0.528
Postoperative SANE	67.3 ± 27.1	65.0 ± 28.8	0.762
P	<0.001	<0.001	

SANE, Single Assessment Numeric Evaluation; VAS, visual analogue scale.

The number of allergies was significantly correlated with age ($r = 0.365$, $P < 0.001$), sex ($r = 0.3245$, $P = 0.034$), number of current medications ($r = 0.624$, $P < 0.001$), DASH ($r = 0.398$, $P < 0.001$), CBSQ ($r = 0.298$, $P = 0.009$), change in SANE ($r = -0.310$, $P = 0.007$), and change in visual analogue scale ($r = 0.244$, $P = 0.035$) (Tables 3 and 4). Among males, the number of allergies was not significantly correlated with any of the PROs (Table 5).

Age was found to have a positive correlation with the number of medications ($r = 0.51$, $P < 0.001$), DASH ($r = 0.52$, $P < 0.001$), and CBSQ ($r = 0.424$, $P < 0.001$), and was found to be negatively correlated with preoperative to postoperative change in SANE score (preoperative SANE $r = -0.228$, $P = 0.05$) (Tables 3 and 4).

Discussion

This study investigated the relationship of patient-reported allergies with outcomes following TOS decompression. This is the first investigation relating allergies and outcomes after TOS surgery and can influence surgical decision making. Within this study, we demonstrated that women with more patient-reported allergies had poorer postoperative PRO measures. Studies have suggested that patient-reported allergies also may be a reliable measure of psychiatric well-being.[8–11] As such, PRO scores may be affected by patient-reported allergies. Multiple studies have suggested that psychiatric well-being can influence PROs.[25,26] Given that the most common allergy reported in our study was opiates (n = 36), a known source of pseudoallergy and nonallergy self-diagnoses, it is possible that a large portion

Table 2. Allergy frequency

Patient-reported allergy	Frequency reported
Opioid analgesics	36
Penicillin	15
Food	9
NSAIDs (oral)	9
Tape	7
Macrolides	7
Sulfonamides	5
Latex	5
Antiepileptics	5
Antihistamine	5
Cephalosporins	4
SNRIs	3
Fluoroquinolones	3
GLP-1 agonists	3
Contrast dye	2
Antiseptic	2
5-H3T antagonist	2
Steroids	2
Vaccine	2
Combination (antihistamine/antitussive/α-sympathomimetic)	2
Anticholinergics	1
Animals	1
Steroids	1
NSAIDs (topical)	1
ACE inhibitor	1
Azole antifungals	1
Benzodiazepines	1
Tetracyclines	1
SSRIs	1
Trace metals	1
Antipsychotic	1
Nitromidazoles	1
Monoclonal antibodies	1
Anti-TNF	1
Local anesthetic	1
Sedative hypnotics	1
CGRP	1
Triptan	1
DMARD	1
Anti-IBS	1
Anticonvulsant	1
Total	149

ACE, angiotensin-converting enzyme; anti-IBS, anti-irritable bowel syndrome; anti-TNF, antitumor necrosis factor; CGRP, calcitonin gene-related peptide; DMARD, disease-modifying antirheumatic drugs; GLP-1 agonists; glucagon-like peptide-1 agonists; NSAIDs, nonsteroidal anti-inflammatory drugs; SNRIs, serotonin-norepinephrine reuptake inhibitors; SSRIs, selective serotonin reuptake inhibitors.

of these patient-reported allergies do not meet the criteria for true allergies.

Patient-reported allergies as a predictive tool for outcomes in orthopedic surgical interventions demonstrate inconsistent results across orthopedic subspecialties. It is imperative that healthcare providers identify any patient factors that may negatively affect outcomes for any intervention, especially for subjective surgical outcomes. Other studies in the field of orthopedics have examined the relationship between patient-reported allergies and outcome scores in relation to a variety of orthopedic surgical interventions.[12–19,27,28] Several studies have found significant associations between both patient-reported allergy pre- and postoperative PRO scores in various spinal and pelvic orthopedic surgeries.[20–23] Patient-reported allergies also have been associated with total hip and total knee arthroplasty outcomes.[15,28,29]

Surgical procedures from several orthopedic subspecialties demonstrated no correlation between allergies and surgical outcomes. The total shoulder arthroplasty literature suggests no association between patient-reported allergies and postoperative outcomes, even when considering metal allergies.[19,27] Similarly, in foot and ankle surgery, patient-reported allergies were not associated with postoperative pain, depression, and PRO scores or with preoperative PRO scores in hip arthroscopy, respectively.[24,30] This would suggest that the correlation between patient-reported allergies and surgical outcomes is specific to certain orthopedic procedures or patient populations.

Within this study, the number of self-reported allergies was found to have a high positive correlation to DASH and CBSQ and a negative correlation to change in SANE scores (Table 3). Age also was negatively correlated with changes in SANE scores and highly positively correlated to DASH, CBSQ, and number of medications, suggesting that increased age is associated with a higher number of comorbidities and worse outcomes (Table 3). Poor patient reported outcomes following TOS were highly correlated to gender, and the relationship between allergies and poor surgical outcomes may be exclusive to female TOS patients. Future research should examine TOS and allergies while controlling for age, sex, and comorbidities in a larger, more uniform sample population.

Outcomes following TOS decompression continue to be widely varied. For this reason, it is important to have predictive capability for outcomes of surgical intervention in an effort to have more informed discussion preoperatively with patients who may be undergoing surgery for TOS. A challenge in the preoperative decision-making discussions is the lack of definitive radiographic findings or objective clinical criteria to assess the success of the surgery. Although imaging and neurovascular testing may be done, there are no clear parameters for truly diagnosing TOS. For this reason, the treating surgeon needs all of the predictive factors at his or her disposal. Maximizing patient satisfaction involves predicting preoperative factors known to correlate with worse postoperative outcomes. Identifying preoperative risk factors for poor outcomes can help better anticipate patient needs and tailor patient care. This points to the necessity of evaluating patient-reported allergies to

Table 3. Bivariate correlation with age

	Correlation coefficient	*P*
DASH	**0.473**	**<0.001**
CBSQ	**0.392**	**<0.001**
Preoperative VAS	0.161	0.168
Postoperative VAS now	0.220	0.058
Preoperative SANE	**−0.253**	**0.029**
Postoperative SANE	**−0.441**	**<0.001**
PCS12	**−0.603**	**<0.001**
MCS12	−0.150	0.198
No. allergies	**0.451**	**<0.001**

Values expressed in boldface type are statistically significant. CBSQ, Cervical Brachial Symptom Questionnaire; DASH, Disabilities of the Arm, Shoulder, and Hand questionnaire; MCS12, mental component summary; PCS12, physical component summary; SANE, Single Assessment Numeric Evaluation; VAS, visual analogue scale.

have a more informed discussion with patients with TOS and increased realization of surgical outcomes.

This study is not without its limitations. Although we found a correlation, the overall sample size is relatively small. The high nonresponse rate introduces the potential for response bias. A larger proportion of female patients completed the questionnaires than did male patients, making the sex ratio in the final included patients different from that of the original patient pool who met the inclusion criteria. Despite this, the results closely resemble those of other PRO allergy studies, suggesting that the consistency in this relationship found in this study is accurate. In addition, patient-reported allergies were not fully confirmed as true allergies. The multitude of perceived allergies and poor subjective outcome measures highlight the nuances of this difficult patient population.

Table 4. Bivariate correlation with number of allergies

	Correlation coefficient	*P*
Age	**0.451**	**<0.001**
Female sex	**0.307**	**0.007**
DASH	**0.398**	**<0.001**
CBSQ	**0.298**	**0.009**
Preoperative VAS	−0.109	0.350
Postoperative VAS	0.093	0.430
Preoperative SANE	−0.017	0.883
Postoperative SANE	**−0.324**	**0.005**
PCS12	**−0.405**	**<0.001**
MCS12	−0.170	0.145

Values expressed in boldface type are statistically significant. CBSQ, Cervical Brachial Symptom Questionnaire; DASH, Disabilities of the Arm, Shoulder, and Hand questionnaire; MCS12, mental component summary; PCS12, physical component summary; SANE, Single Assessment Numeric Evaluation; VAS, visual analogue scale.

Table 5. Correlation of allergies and patient-reported outcomes between sexes

	Female	*P*	Male	*P*
QuickDASH	**0.391**	**0.003**	0.003	0.992
Preoperative VAS	−0.121	0.370	0.236	0.346
Postoperative VAS	−0.121	0.370	−0.014	0.955
CBSQ	**0.373**	**0.004**	−0.087	0.730
SF12	−0.111	0.413	−0.188	0.456
Preoperative SANE	0.175	0.193	−0.170	0.500
Postoperative SANE	**−0.292**	**0.028**	0.013	0.959

Values expressed in boldface type are statistically significant. CBSQ, Cervical Brachial Symptom Questionnaire; DASH, Disabilities of the Arm, Shoulder, and Hand questionnaire; SANE, Single Assessment Numeric Evaluation; SF-12, 12-Item Short Form Survey; VAS, visual analogue scale.

Conclusions

This is the first study to evaluate patient-reported allergies and the impact that they have on PROs after TO decompression surgery. The study found that in female patients undergoing surgical decompression for TOS, patient-reported allergies are associated with worse PROs. These findings may help surgeons counsel patients on expectations.

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