Postoperative pain assessment and its proper management has become a health care prerogative as more patients are opting for surgical treatment and surgical time lengths are decreasing. Throughout health care institutes, providers and administrators are pushing for a decrease in postoperative hospital stays, for which pain is one of the top reasons of prolonged inpatient care. Nonetheless, pain management has improved significantly, but assessment to prevent and care for pain postoperatively requires further research. Surveys demonstrated undermanaged postoperative pain in patients undergoing various surgeries. Patients are at an increased risk for inadequate pain control, especially after orthopedic procedures.
surgeries, which Chung et al showed had the highest incidence of pain compared with other types of procedures. This study aimed to determine if a preoperative pain survey, the Short-Form McGill Pain Questionnaire (SF-MPQ), could be significantly predictive of postoperative pain in patients undergoing shoulder and elbow operations.

Shoulder and elbow surgeries, ranging from debridement to arthroplasties, have a significant effect on functional ability postoperatively, and pain experienced postoperatively further affects patient functionality, rehabilitation, and long-term functional outcomes. To better control pain, predictive factors need to be used, among which are weight, surgical site, sex, depression, smoking, alcohol, preoperative catastrophizing tendency, pain, age, type of surgery, prediction rules, Spielberger’s State Trait Anxiety Inventory, health-related quality of life (Medical Outcomes Study Short-Form 35-item Health Survey), chronic sleeping difficulties, fear, and the MPQ.

Many of these predictive factors have been significant in determining postoperative pain intensity; however, to focus on anticipated and preoperative pain as predictive factors we used the SF-MPQ. We had hypothesized that anticipated postoperative pain (APP) and preoperative pain (PP) would be predictors of postoperative pain and thereby effect pain management and control. This preoperative pain assessment can improve postoperative pain management thereby decrease morbidity rates that may be associated to the postoperative pain and discomfort.

Many patients are at risk of inadequate postoperative care, and since January 2001, the Joint Commission on Accreditation of Healthcare Organizations set the standard for pain assessment and management: patients have a right to have their pain assessed and treated properly. Patients who were admitted to the hospital were treated with patient-controlled analgesia using morphine or hydromorphone, general anesthesia was used in 47 patients and regional anesthesia included 1 rotator cuff repair with biceps tenodesis, 2 distal clavicle excisions. Four were combined arthroscopic and open procedures, which included arthroscopic rotator cuff repairs converted to open repairs, 8 were total shoulder arthroplasties, and 1 was a hardware removal.

Conditions were chronic in 51 patients and acute in 27. General anesthesia was used in 47 patients and regional anesthesia in 31. There were no biases or exclusion criteria, except for the ones stated.

The SF-MPQ was used to assess pain. The patients completed the present pain intensity (PPI) score part of the SF-MPQ preoperatively. They were then asked to complete the entire SF-MPQ for their APP and again were asked to do the same postoperatively at 3 days (3dpd) and 6 weeks (6wpd). Included were a PPI scale, a visual analog scale (VAS), a sensory pain scale, and an affective pain scale. The PP, APP, and 3dpd surveys were conducted with direct patient assessments within the clinic after consent. Of the 6wpd surveys, 43 were done in the clinic, and 35 patients were surveyed over the phone by one of the authors. Conducting the SF-MPQ survey over the phone has not been validated formally through comparative studies; however, results obtained by phone were used and applied in reports by Brennan et al and Ekdahl and Petersson.

The surveys, whether conducted in person on the phone, had few variations because they were simple “yes” and “no” questions or a number rating. However, the VAS over the phone might have introduced errors because it requires a physical mark of pain on a line that is 10.5 cm long. To determine this value over the phone, the 43 patients were told to determine their pain during the 6-week postoperative period on a scale of 0 to 10.5. The answer was then used as the VAS value. The preoperative assessments were conducted between 1 and 7 days before surgery.

Patients who were treated in an outpatient setting were given oral hydrocodone/acetaminophen or oxycodone/acetaminophen. Patients who were admitted to the hospital were treated with patient-controlled analgesia using morphine or hydromorphone, with standard pain control regulations according to institutional policy.

Patients were discharged with similar analgesia regimens as outpatients.
Statistical analysis was conducted using Excel data analysis software (Microsoft Corp, Redmond, WA, USA).

Histograms for PP using the PPI scale were made as well as for the APP, 3dpp, and 6wpp for the SF-MPQ PPI, VAS, sensory pain score, and affective pain score. The PPI is scored on a scale of 0 to 5 as no pain (0), mild (1), discomforting (2), distressing (3), horrible (4), and excruciating (5). The VAS is measured in centimeters with a minimum score of 1 cm and a maximum of 10.5 cm. The maximum sensory pain score is 33 and is scored on a scale of 0 to 3 with 11 descriptions of throbbing, shooting, stabbing, sharp, cramping, gnawing, hot-burning, aching, heavy, tender, and splitting. The maximum affective pain score 12, also using a scale of 0 to 3, with a description of tiring-exhausting, sickening, fearful, and punishing-cruel. These were created to visualize distribution variations of pain intensities experienced by patients.

Means, standard deviations (SD), and 95% confidence intervals (CI) for each type of pain score at each respective interval were calculated. A Pearson correlation was calculated to determine the predictive value of the PP and APP with the 3dpp and 6wpp. It was used to also calculate the P values to better determine their significance.

Two-sample t statistics were stratified to determine the relationship between sex, age, chronicity (chronic vs acute), type of anesthesia and type of surgery with 3dpp on the 4 pain scales. To determine the power of the population-specific factors and their relationship to the outcomes, a Bonferroni adjustment was used. These comparisons were not powered appropriately. There were 20 comparisons made, thereby giving a Bonferroni corrected value of 0.0025. The surgical types for shoulders were categorized into 6 types: (1) open reduction and internal fixation, (2) arthroscopic, (3) open surgeries for rotator cuff repair, biceps tenodesis, distal clay excision, or others, (4) combined arthroscopic and open, (5) epicondylitis, and (6) other. The surgical types for elbows were categorized into 6 types: (1) open reduction and internal fixation, (2) arthroscopic, (3) open surgeries for rotator cuff repair, biceps tenodesis, distal clay excision, or others, (4) combined arthroscopic and open, (5) arthroplasty and joint replacements, and (6) other.

**Results**

**PPI scale**

On the PPI scale, PP was compared with APP, 3dpp, and 6wpp. APP was also compared with 3dpp and 6wpp. The PP demonstrated a bimodal distribution, with most pain experienced peaking between 2 and 3 of 5 points and another peak between 0 and 1 of 5 points (Fig. 1). Its mean was 2.8 (SD, 1.4; 95% CI, 2.5-3.1; Table I). However, the APP showed a monomodal peak between 2 and 3 points, with a shift to the left end and a mean of 2.4 points (SD, 1.2; 95% CI, 2.1-2.7; Fig. 1, Table I). The 3dpp showed a peak distribution between 0 and —1, which then progressively decreased and had a mean of 1.7 (SD, 1.2; 95% CI, 1.4-2.0; Fig. 1, Table I). There were no pain intensities reported between 4 and 5. The 6wpp demonstrated a peak, with most patients reporting pain intensity of between 0 and 1 and no pain between 3 and 5 (Fig. 1). Only 17 patients reported pain greater than 1. The mean was 0.8 (SD, 0.9; 95% CI, 0.6-1.0; Table I). The least amount of pain experienced by patients was at the 6wpp score. The 3dpp was significantly higher than the 6wpp but less than the APP and PP.

The Pearson correlation coefficients were as follows on this PPI scale: between PP and APP, 0.4 (P = .001); between PP and 3dpp, 0.3 (P = .006); between PP and 6wpp, 0.2 (P = .096); between APP and 3dpp, 0.4 (P < .001); and between APP and 6wpp, 0.2 (P = .05; Table II). The P value of the APP and 3dpp on the PPI scale was <.0045, which was the Bonferroni adjustment, thereby having the most significant power.

**VAS scores**

The APP on the VAS demonstrated a peak between 5 and 6, with a relatively bell-shaped distribution (Fig. 2). The mean was 4.9 (SD, 2.7; 95% CI, 4.3-5.5; Table III). The 3dpp showed a peak between 0 and 1 and a gradual decrease in reported pain intensity (Fig. 2); however, the mean was 3.2 (SD, 2.7; 95% CI, 2.6-3.8; Table III). The 6wpp also peaked at 0 to 1 but with a larger majority (Fig. 2) producing a mean of 1.6 (SD, 2.2; 95% CI, 1.1-2.1).

The Pearson correlation coefficient between APP and 3dpp on the VAS was 0.2 (P = .08). The APP and 6wpp came to 0.3 (P = .02; Table IV). Both P values were greater than the Bonferroni adjustment of 0.0045.

**SF-MPQ sensory pain**

The APP on the sensory pain portion of the SF-MPQ showed a trimodal distribution, with peaks between 0 and 5, 10 and 15, and 25 and 33 (Fig. 3); however, the mean was 14.1 (SD, 10.4; 95% CI, 11.8-16.4; Table V). The 3dpp had a peak of between 0 and 5, followed by a steep drop, after which it fluctuated between the 5 and 33 range (Fig. 3). The mean was 9.4 (SD, 8.7; 95% CI, 7.4-11.4; Table V). The 6wpp peak was between 0 and 5, with only 14 patients reporting pain greater than 5 (Fig. 3). The mean was 2.5 (SD, 3.9; 95% CI, 1.6-3.4; Table V).

The Pearson correlation coefficient between APP and 3dpp on the sensory pain scale was 0.6 (P < .001). This P value is less than the 0.0045 Bonferroni adjustment, thereby demonstrating its significant power. It was 0.2 between APP and 6wpp (P = 0.04; Table VI), which was greater than the Bonferroni adjustment.

**SF-MPQ affective pain**

The APP on the affective scale of the SF-MPQ (maximum 12) demonstrated a monomodal peak between 0 and 3 and a steady drop after, with only 22 patients reporting APP greater than 3 (Fig. 4). The mean was 2.5 (SD, 2.8; 95% CI, 1.9-3.1; Table VII). The 3dpp had a peak between 0 and —3, with only 11 patients reporting pain greater than 3...
The mean was 1.5 (SD, 2.2; 95% CI, 1.0-2.0) (Table VII). The 6wpp histogram demonstrated that most scores were between 0 and 3, with only 1 patient with pain greater than 3 (Fig. 4). The mean was 0.2 (SD, 0.7; 95% CI, 0.0-0.4; Table VII).

The Pearson correlation coefficient between APP and 3dpp was 0.5 ($P < .001$), which is lower than Bonferroni adjustment and thus demonstrates significant power, and was 0.1 between APP and 6wpp ($P = .34$), which is higher than the Bonferroni adjustment (Table VIII).

**Table I** Outcome scores for pain on the present pain intensity scale

<table>
<thead>
<tr>
<th>Time of score</th>
<th>Mean</th>
<th>SD</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative pain</td>
<td>2.8</td>
<td>1.4</td>
<td>2.5-3.1</td>
</tr>
<tr>
<td>Anticipated postoperative pain</td>
<td>2.4</td>
<td>1.2</td>
<td>2.1-2.7</td>
</tr>
<tr>
<td>3-day postoperative pain</td>
<td>1.7</td>
<td>1.2</td>
<td>1.4-2.0</td>
</tr>
<tr>
<td>6-week postoperative pain</td>
<td>0.8</td>
<td>0.9</td>
<td>0.6-1.0</td>
</tr>
</tbody>
</table>

CI, confidence interval; SD, standard deviation.

Age, sex, surgery type, chronicity of pain, and anesthesia type and 3dpp

The mean age in this study was 51. Age and 3dpp showed a correlation coefficient of 0.3 ($P = .02$) on the VAS, 0.3 ($P = 0.01$) on the PPI scale, 0.3 ($P = .01$) on the sensory pain scale, and 0.1 ($P = .33$) on the affective pain scale. Most of the increased reported pain was demonstrated in the population aged younger than 40 years. For 3dpp for ages 18 to 39, the average pain score was 4.1 on the VAS, 2.0 on the PPI scale, 2.7 on the sensory pain scale, and 1.7 on the affective pain. For 3dpp for ages 40 to 89, the average pain score was 2.8 on the VAS; 1.5 on the PPI scale; 7.8 on the sensory pain scale; and 1.2 on the affective pain scale. All $P$ values exceeded the Bonferroni adjustment of .0025. When sex, type of surgery, acute vs chronic pain, and regional vs general anesthesia were compared with 3dpp on all four scales, they produced $P$ values >.05.

**Table II** Pearson correlation coefficients between time intervals on the present pain intensity scale

<table>
<thead>
<tr>
<th>Correlations</th>
<th>Pearson coefficient</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative pain vs</td>
<td>Anticipated postoperative pain</td>
<td>0.4</td>
</tr>
<tr>
<td>3-day postoperative pain</td>
<td>0.3</td>
<td>.006</td>
</tr>
<tr>
<td>6-week postoperative pain</td>
<td>0.2</td>
<td>.096</td>
</tr>
<tr>
<td>Anticipated postoperative pain vs</td>
<td>3-day postoperative pain</td>
<td>0.4</td>
</tr>
<tr>
<td>6-week postoperative pain</td>
<td>0.2</td>
<td>.05</td>
</tr>
</tbody>
</table>

The data showed that the strongest predictive factors for postoperative pain were PP and APP in the 3dpp period.
When measured on the SF-MPQ, PP was also a strong predictor of APP. APP was a strong predictor when measured on the SF-MPQ's PPI, sensory, and affective scales, but not the VAS. The predictability of PP was only measured and was deemed a significant predictive factor only on the PPI scale of the SF-MPQ.

The significant correlation between the APP and 3dpp can be deemed from the following correlation coefficients and their $P$ values: 0.4 ($P < .001$) on the PPI scale, 0.6 ($P < .001$) on the sensory pain scale, and 0.5 ($P < .001$) on the affective pain scale. Each of these $P$ values had increased significant power because their values were less than 0.0045, the Bonferroni adjustment.

However, the APP was not a strong predictor for the 6wpp. Overall, patients had little pain at 6 weeks and significantly less than they anticipated. The postoperative pain scores were 1.7/5, 3.2/10.5, 9.4/33, and 1.5/12 at 3 days and 0.8/5, 1.6/10.5, 2.5/33, and 0.2/12 at 6 weeks, respectively, on the PPI, VAS, sensory, and affective pain scales. Pain management not only been greatly refined, but the interval from surgery was also 6 weeks. We had predicted that this would be the case. The APP and 6wpp correlation coefficient and $P$ values were 0.2 ($P = .05$) on the PPI scale, 0.02 ($P = .04$) on the sensory scale, which although significant had little power, and 0.1 ($P = .34$) on the affective pain scale (Tables II, IV, VI, and VIII).

The Pearson correlation coefficient between APP and PP was 0.4, with a significant $P = .001$, which also proves to have significant power due to its value being less than the Bonferroni coefficient (Table II). Because APP was dependent on the PP, the APP was higher than the actual postoperative pain. However, normalization of the values demonstrated that APP and PP are both significant.
predictive values for postoperative pain, especially during the 3-day postoperative period. On the PPI scale, the correlation between PP and 3dpp was 0.3, with a significant $P = 0.006$; but between PP and 6wpp, the correlation was 0.2, with an insignificant $P = 0.096$ (Table II). Therefore, the correlation coefficients showed preoperative pain was a predictor of APP and also a strong predictor for 3dpp.

The results for the VAS were different than the results and trends on other scales. All produced low correlation coefficients and insignificant $P$ values. These may have been due to the nature of the scale, because some data were retrieved over the phone and patients were asked to give pain ratings on a 1- to -10.5-cm measure similar to a pain intensity of 1 to 10, but without an actual visual form to mark, which may have introduced an error. Further investigation is needed.

By using the 2-sample $t$ statistics to determine the significance of age, sex, surgery type, chronicity, and anesthesia applied, we found that age had a significant correlation of 0.3 ($P = .01$) on the sensory and PPI scale and a significant correlation of 0.3 ($P = .02$) on VAS. The increased intensity of pain reported on the 3-day postoperative period was found in the younger age group aged 18 to 39 years, who had an average pain of 2 of 5 on the PPI scale and 12.7 of 33 on the sensory scale vs the 40 to 89 age group, who reported pain of 1.5 of 5 on the PPI scale and 7.7 of 33 on the sensory scale. On the VAS, patients aged 18 to 39 years reported pain of 4.1 of 10.5, and patients aged 40 to 89 years reported 2.8 of 10.5. The affective pain and age correlation was insignificant. The correlation between age and 3dpp needs further investigation.

None of these correlations was of significant power because their $P$ values exceeded the Bonferroni coefficient of 0.0025 in this comparison. The greater pain intensities reported in the younger population may be because the older generation has had previous experiences of pain, increased tolerance, and decreased sensitivity of

**Figure 3**  Histogram shows the number of patients surveyed on the sensory pain scale from the Short-Form McGill Pain Questionnaire (range, 0-33) for their anticipated postoperative pain (APP) and postoperative pain at 3 days (3dpp) and at 6 weeks (6wpp).

**Table V**  Outcomes for scores for the Short-Form McGill Pain Questionnaire Sensory Pain Scale

<table>
<thead>
<tr>
<th>Time of score</th>
<th>Mean</th>
<th>SD</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anticipated postoperative pain</td>
<td>14.1</td>
<td>10.4</td>
<td>11.8-16.4</td>
</tr>
<tr>
<td>3-day postoperative pain</td>
<td>9.4</td>
<td>8.7</td>
<td>7.4-11.4</td>
</tr>
<tr>
<td>6-week postoperative pain</td>
<td>2.5</td>
<td>3.9</td>
<td>1.6-3.4</td>
</tr>
</tbody>
</table>

CI, confidence interval; SD, standard deviation.

**Table VI**  Pearson correlation coefficients between time intervals on the Short-Form McGill Pain Questionnaire Sensory Pain Scale

<table>
<thead>
<tr>
<th>Correlations</th>
<th>Pearson coefficient</th>
<th>$P$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anticipated postoperative pain vs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3-day postoperative pain</td>
<td>0.6</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>6-week postoperative pain</td>
<td>0.2</td>
<td>.04</td>
</tr>
</tbody>
</table>

CI, confidence interval; SD, standard deviation.
neuropathic pain due to neuronal degeneration and desensitization. This would need further investigation if age may also have a predictive value for postoperative pain. Sex, type of surgery, chronicity, and anesthesia type were not significant (all \( P > .05 \)).

The study introduced errors due to the variety of surgical types previously listed, but due to the small population pool, the numbers within each category type were not significant. There may be significant correlations between postoperative pain and specific surgical procedures, but this was not assessed.

APP is a strong predictor for postoperative pain, especially for the 3-day postoperative period (immediate postoperative period) when measured on the SF-MPQ PPI scale, sensory pain scale, and affective pain scale. Although many pain scores have been used for shoulder and elbow surgery, each with varying significance and population sample sizes, the MPQ seemed to be comprehensive as well as concise in order to provide significant data results.\(^{14,25,27,37,49,52}\) As a pain measure, the VAS was not as strong in this study, probably due to an error when conducted over the phone. The telephone assessment may have also introduced an overall error amongst all of the various scales for the 6wpp period for the 35 of 78 patients who were surveyed over the phone.

PP was a strong predictor for APP and 3dpp on the PPI scale, it may also be on the VAS, sensory, and affective pain scale, but they were not measured. The APP was the highest overall pain score on all other scales, most likely because it was dependent on preoperative pain, at least on the PPI scale. The 6wpp was not significantly predictable when APP or PP were used as factors due to low correlation coefficients as well as insignificant \( P \) values. In addition, age also seemed to be a predictor of pain, with an increase pain intensity reported by the younger group aged 18 to 39 years, but this needs further evaluation because the power was insignificant when the Bonferroni adjustment was used.\(^{31}\)

Figure 4  Histogram shows the number of patients surveyed on the affective pain scale from the Short-Form McGill Pain Questionnaire (range, 0-12) for their anticipated postoperative pain (APP) and postoperative pain at 3 days (3dpp) and 6 weeks (6wpp).

<table>
<thead>
<tr>
<th>Table VII</th>
<th>Outcome scores for the Short-Form McGill Pain Questionnaire Affective Pain Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time of score</td>
<td>Mean</td>
</tr>
<tr>
<td>Anticipated postoperative pain</td>
<td>2.5</td>
</tr>
<tr>
<td>3-day postoperative pain</td>
<td>1.5</td>
</tr>
<tr>
<td>6-week postoperative pain</td>
<td>0.2</td>
</tr>
</tbody>
</table>

CI, confidence interval; SD, standard deviation.

<table>
<thead>
<tr>
<th>Table VIII</th>
<th>Pearson correlation coefficients between time intervals on the Short-Form McGill Pain Questionnaire Affective Pain Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correlations</td>
<td>Pearson coefficient</td>
</tr>
<tr>
<td>Anticipated postoperative pain vs 3-day postoperative pain</td>
<td>0.5</td>
</tr>
<tr>
<td>6-week postoperative pain</td>
<td>0.1</td>
</tr>
</tbody>
</table>
Nonetheless, postoperative pain management must be better assessed by considering strong predictive factors such as anticipated pain and preoperative pain. This can significantly decrease patient discomfort, postoperative chronic pain and morbidity, and hospital stay, and may increase the postoperative ambulatory rate and rate of compliance to therapy. Overall, it will benefit patient satisfaction as well as benefit the entire health care system now that proper pain assessment and management has become a priority.

Conclusion

Pain management in the perioperative period is very crucial in managing morbidities in patients. Orthopedic procedures have been reported to be the most painful postoperatively, but patient pain continues to be poorly managed.1,3,64 Despite the use of opioids and patient controlled analgesia after elbow and shoulder surgery, patients continue to have uncontrolled pain. Our work demonstrates that there are other reasons for this, such as anticipated postoperative pain and preoperative pain, which can be assessed by a pain questionnaire. It was evident, when patients undergoing elbow and shoulder surgeries were surveyed preoperatively using the SF-MPQ's various pain scales, one could better predict their postoperative pain. Thereby, surgeons can modify pain management of their patients through use of postoperative pain predictors, which can significantly decrease the morbidity associated with elbow and shoulder surgery.

Disclaimer

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References


