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Original article

Risk factors for postoperative pain in the first three weeks after arthroscopic or open shoulder surgery

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ABSTRACT

Introduction: Shoulder surgery is a painful procedure. Adequate postoperative pain control increases patient satisfaction. The objectives of this study were to investigate postoperative pain development in shoulder surgery and to assess risk factors for high postoperative pain.
Hypothesis: Patients who undergo rotator cuff repair are more painful than patients who undergo different kinds of shoulder surgery.
Material and methods: Four hundred and sixty five patients who underwent shoulder surgery were included in this retrospective cohort study. A linear mixed model analysis was used to compare NRS (Numeric Rating Scale) for pain between different kinds of shoulder surgery in the first three weeks postoperatively. To assess risk factors for high postoperative pain odds ratios were calculated.
Results: Pain development in the first 3 weeks differed between procedures with rotator cuff repair being the most painful procedure. Risk factors for high postoperative pain were female sex and subacromial decompression with distal clavicle resection.
Discussion: Patients who undergo rotator cuff repair are indeed more painful than patients who undergo different kinds of shoulder surgery. With identifying these differences in pain development and the risk factors for high postoperative pain after shoulder surgery, we can optimize postoperative pain treatment. However, further research is needed to support these results.
Level of evidence: IV, retrospective cohort study.

1. Introduction

Orthopedic surgery in the shoulder is known for high postoperative pain [1,2]. Postoperative pain has a negative influence on patient satisfaction, causes discomfort and can lead to cardiovascular and pulmonal complications and chronic pain syndrome syndrome [3–6]. Preoperative education about the expected pain level could improve pain management.

Several risk-factors for high postoperative pain (numeric rating scale (NRS) ≥ 7) in orthopaedic surgery were described before: high pre-operative pain, female sex, younger age, obesity, operation length and different procedure [7–10]. However, the mentioned risk-factors were described for orthopedic surgery in general. Stiglitz et al. also described postoperative pain after arthroscopic shoulder surgery [11]. No significant differences in postoperative pain after the first postoperative day were found between four groups: rotator cuff repair, decompression, instability or other procedures [11]. The experience in our clinic however, where two specialized shoulder surgeons perform a high number of procedures, is that patients who undergo rotator cuff repair are more painful than patients who undergo different kinds of shoulder surgery. Therefore, we performed a retrospective cohort study to assess postoperative pain after shoulder surgery. Our research questions were:

- does the NRS score in the first 3 weeks after surgery differ between the kind of procedure (rotator cuff repair, decompression with distal clavicle resection, instability or other [11])?
- are there any risk factors for high postoperative pain (NRS ≥ 7) in the first 3 weeks after shoulder surgery?

We hypothesized that patients who undergo rotator cuff repair are more painful than patients who undergo different kinds of shoulder surgery.

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2. Material and methods

A retrospective cohort study was performed to assess postoperative pain after shoulder surgery. We searched through our database and analyzed data and questionnaires from patients who underwent shoulder surgery between January 2012 and May 2016 in the Haga Hospital, The Hague. All patients included had surgery from one of the two senior shoulder surgeons in our hospital. Only patients who had handed in their questionnaire at the regular scheduled 3 weeks follow-up were included in the study. Pain was measured with a numeric rating scale (NRS) from 0 (no pain) till 10 (extreme painful). This is the standard way to register pain in our hospital. Incomplete forms were accepted if NRS scores were reported for at least two moments. Patients were excluded if the operation report could not be retrieved. The study is enlisted by the Medical Ethical Committee South-West Holland (16-072) and was declared not to subdue to Medical Research Involving Human Subjects Act. The board of directors of the HagaHospital agreed with the study.

Preoperatively the patient was given a form to complete NRS at different moments in time: preoperatively at the operation day, postoperative daily at day 1–7, and after 2 weeks and 3 weeks. The patient was asked to report the used pain medication. To prevent reporting bias, only the kind of the medication was reported, not the dose and/or frequency. Further questions were: brachial plexus block yes/no, peripheral nerve catheter yes/no, nerve block sufficient yes/no, outpatient pain medication sufficient yes/no, time of nerve block wear off (if applicable), the presence of nausea yes/no.

The different kinds of procedures were distributed into four groups. These groups were similar as the groups used by Stiglitz et al. [11] (Table 1). All groups had the same pain medication protocols.

For all included patients, the following patient data and operation details were retrieved from the digital patient record: age at operation, sex, BMI, side, surgeon, procedure, open or arthroscopic approach, subacromial decompression with distal clavicle resection yes/no, patient positioning (lateral vs. beach chair), biceps treatment yes/no and operation length.

3. Statistical analysis

SPSS 17.0 (IBM Co., Armonk, NY, USA) was used for statistical analysis. A P value ≤ 0.05 was considered to be statistically significant.

A linear mixed model analysis was used for the first research question: does the NRS score in the first 3 weeks after surgery differ between the kind of procedure (rotator cuff repair, decompression with distal clavicle resection, instability or other [11])? Posthoc analyses were performed in order to highlight the specific differences.

A log regression analysis was performed to determine risk-factors for high postoperative pain (NRS ≥ 7) in the first 3 weeks after shoulder surgery. Odds ratios were calculated.

Table 1
Types of interventions.

Group	Surgical procedure
Rotator cuff repair	All cases of rotator cuff repair including simultaneous procedures
Decompression with distal clavicle resection	All AC-related procedures
Instability	All instability related procedures
Other	Other procedures including arthroplasty and surgical fracture treatment

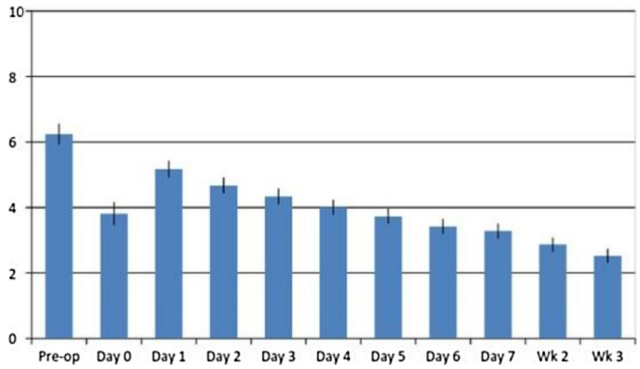

Figure 1. Mean NRS after shoulder surgery.

4. Results

Valid questionnaires were completed by 465 patients. There were 213 male and 252 female shoulders. 277 right and 188 left shoulders were operated. Mean age was 54,3 years [95% CI 53.0–55.6].

Mean postoperative NRS is at any moment in the first 3 weeks lower than pre-operatively (Fig. 1). At day 1 mean NRS is significantly higher than at day 0, when (if applied) the nerve block has not yet weared off. From day 1 to week 3, mean NRS is significantly lower at the next measurement moment, except day 4 and 7 when mean NRS is non-significantly lower than at day 6.

Two hundred and thirty nine patients had a rotator cuff procedure, 102 patients had a decompression with distal clavicle resection, 41 patients had an instability procedure and 83 patients had other shoulder surgery. In the rotator cuff group 162 patients had a acromioplasty, 5 patients had a lateral clavicular resection and 16 patients had both.

The NRS score showed a significant interaction effect between time of measurement and the kind of procedure ($P = 0.003$). This indicated that indeed the pain development in the first 3 weeks differed between procedures (Fig. 2).

In addition, there was a main effect of procedure, which indicated that patients with a rotator cuff procedure experienced higher pain levels in the first three weeks in comparison to patients with other shoulder procedures ($P < 0.001$) and patients with an instability procedure ($P < 0.05$).

Female sex and subacromial decompression with distal clavicle resection are significant risk factors for high postoperative pain in the first 3 weeks after shoulder surgery. Patient in lateral positioning, biceps tenotomy/-desis and open procedure are non-significant risk factors. See Table 2 for an overview of odds ratios.

5. Discussion

In this study, we assessed the postoperative pain during the first three weeks after shoulder surgery. We demonstrated significant differences in mean NRS scores between the kinds of procedures included in the study. In addition, we found a different pain development between the kinds of procedures. Our hypothesis that patients who undergo rotator cuff repair are more painful than other shoulder patients was confirmed. Furthermore, we found that female sex and subacromial decompression with distal clavicle resection are significant risk factors to have high postoperative pain defined as NRS ≥ 7.

There are several limitations in this study. First, this is a retrospective cohort study. A prospective, randomized study to assess the risk factors would have been superior. Second, to prevent reporting bias, the daily and total opioid intake weren't measured. Previous studies have shown that opioid consumption is significant

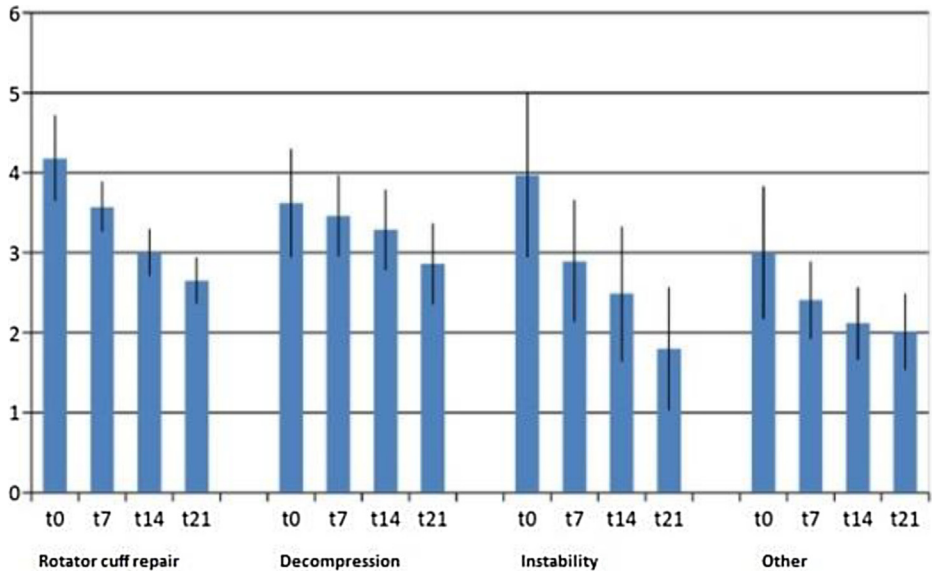

Figure 2. Mean NRS by kind of procedure [95% confidence interval].

after rotator cuff surgery [12,13]. It is possible that patients who underwent arthroscopic rotator cuff repair or had an open procedure received more opioids than the other surgical procedures. This could be an explanation why we did not find that open shoulder surgery is a significant risk factor for high postoperative pain.

Several studies have shown that rotator cuff repair is a painful procedure especially within the first 48 hours after surgery [11,12,14]. In our study the patients who underwent rotator cuff repair statistically experienced a higher level of pain compared to patients with other shoulder procedures and patients with an instability procedure. Our results were comparable to Stiglitz et al. who also concluded that the mean daily visual analogue scale (VAS) values for pain were significantly higher for the rotator cuff repair patients on day 1 [11]. Furthermore, our data showed that in the first three weeks after surgery the pain development significantly differed between the procedures with the patients who underwent decompression with distal clavicle resection surgery being the most painful on the 21st day after surgery. Stiglitz et al. did not investigate the pain development, but they also found no VAS differences for pain from day 2 to day 30 between the types of surgery.

Even though the mean postoperative pain for shoulder surgery was relatively low, we found that female sex and subacromial decompression with distal clavicle resection were significant risk factors for high postoperative pain. This outcome is opposite to Stiglitz et al. where males experienced greater postoperative pain than females in shoulder surgery [11]. Female sex as a significant risk factor for orthopedic surgery has been reported in previous studies [1,9]. Kalkman et al. made a prediction model for severe postoperative pain and used female sex as one of the predictors. With identifying these risk factors for high postoperative pain, we can optimize postoperative pain treatment. This is important because poorly treated acute postoperative pain and excessive postoperative opioid use can have adverse effects [15,16].

Table 2
Odds ratio for high postoperative pain (NRS≥7).

	Odds ratio [95% CI]
Age	0.99 [0.98–1.01]
Sex (female)	1.75 [1.21–2.53]
BMI ≥ 25	1.09 [0.70–1.70]
Operation length	1.00 [0.99–1.00]
Patient positioning(lateral vs. beach chair)	0.68 [0.46–1.02]
Biceps tenotomy/-desis	1.23 [0.84–1.80]
Subacromial decompression	1.53 [1.06–2.23]
Open vs arthroscopic	1.32 [0.88–1.99]

The data from the present study demonstrated that, on average, good postoperative pain control was achieved with a mean NRS of under 4 directly postoperatively. Also, the mean NRS was at any measurement done postoperatively significantly lower than preoperatively. We did see a significant upsurge of the mean NRS at day 1 in comparison to day 0. This could be attributed to the fact that the effect of the nerve block is finished on day 1. Because a relative high percentage of shoulder surgery is performed in a day-care setting, it is important to keep the pain increase on day one in mind so that patients receive appropriate analgesics following discharge.

6. Conclusion

This study shows that the pain development significantly differed between the various procedures in the first three weeks after shoulder surgery. We also identified risk factors for high postoperative pain. Therefore it could be important to anticipate the treatment for postoperative pain with different pain protocols for different kinds of procedures and selected patients. Future research regarding pain after shoulder surgery should focus on these differences and their optimal treatment.

Disclosure of interest

The authors declare that they have no competing interest.

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None

Authors' contribution

Roos Bazuin and Eric Boekestein were responsible for data collection.

Pol Huijsmans and Floor van Eijk were the founders of the project and included/operated the patients.

Friso de Boer, Tundi Schouten and Paulien van Kampen were responsible for analyzing the data and writing the article.

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