Patients’ vs nurses’ assessments of postoperative pain and anxiety during patient- or nurse-controlled analgesia

I. Rundshagen 1 *, K. Schnabel 2, T. Standl 1 and J. Schulte am Esch 1

1 Department of Anaesthesiology, University Hospital Eppendorf, Martinistraße 52, D-20246 Hamburg, Germany. 2 Max-Planck-Institute for Human Development, Berlin, Germany

*To whom correspondence should be addressed

We have compared patients’ and nurses’ assessments of postoperative pain and anxiety after different analgesic treatments. Sixty orthopaedic patients were allocated randomly to receive i.v. piritramide (either nurse-controlled or patient-controlled) or subarachnoid bupivacaine (nurse-controlled or patient-controlled). Patients and nurses assessed pain and anxiety using a visual analogue scale (VAS; 1–100 mm). Pain and anxiety ratings of patients and nurses were significantly correlated (Spearman’s \( r \) > 0.69; \( P < 0.001 \)). In general, patients’ pain scores were higher than nurses’ scores (patients’ median VAS = 34 (range 1–76) mm; nurses VAS 21 (1–59) mm) and for all groups except the patient-controlled subarachnoid bupivacaine group, where they were significantly higher (\( P < 0.01 \)). Discrepancy in pain estimates between patients and nurses increased with the level of pain. The relationship between patients’ and nurses’ anxiety scores was less clearly defined and did not depend on the level of anxiety.

Keywords: analgesia, patient-controlled; analgesia, nurse-controlled; pain, postoperative; complications, anxiety

Accepted for publication: September 17, 1998

Assessment of pain is difficult as pain is a highly subjective and personal experience, which is hardly measurable with objective criteria. In addition to physiological responses or behavioural indices, numerical and visual analogue scales (VAS) are used widely to estimate pain because they are easy to integrate in everyday routines, even though their reliability and validity have yet to be proved.1 However, there is controversy about the relationship between pain assessment by patients, nurses or doctors. While some authors report good correlation between them, others failed to show any correlation,2 3 but patients invariable report the highest pain levels. Some authors stressed the incapability of nurses or doctors to assess patient pain adequately.4 Previous workers have investigated differences in pain assessment in relation to the experience of the observer during chronic pain or in burns patients. The influence of different postoperative analgesic treatments on the relation between patients’ and observers’ ratings has not been reported.

In this study, we have investigated patients’ and nurses’ assessments of pain and anxiety during postoperative pain treatment with four different analgesic regimens: i.v. piritramide (nurse-administered bolus application or patient-controlled) or intrathecal bupivacaine (nurse-administered or patient-controlled). We have focused on the relation between patients’ and nurses’ assessments of pain compared with assessment of anxiety by visual analogue scales.

Patients and methods

After obtaining approval from the Local Ethics Committee and written informed consent, we studied 120 patients (ASA I–III, aged 61.8 (range 13/90) yr, weighing 70.8 (SD 12.6) kg) undergoing major elective orthopaedic surgery using standardized balanced anaesthesia or continuous spinal anaesthesia. This was a prospective study during postoperative pain treatment in the post-anaesthesia care unit (PACU).

Postoperative analgesia

After general anaesthesia (isoflurane and 70% nitrous oxide in oxygen with fentanyl supplementation), 60 patients were allocated randomly to one of two groups: group P-Bolus received, on request, nurse-controlled piritramide 3.75–7.5 mg i.v. (piritramide 15 mg is equivalent to morphine 10 mg). In group P-PCA, after the same general anaesthetic, analgesia was provided by a patient-controlled analgesia (PCA) device (Lifecare 2000, Abbott, USA) with an initial bolus dose of piritramide 3.75 mg and set at a continuous i.v. rate of 1 mg h \(^{-1} \). Patients were allowed to self-administer piritramide 1.5 mg every 20 min (lockout interval). After continuous spinal anaesthesia (median lumbar approach at the L3–4 or L4–5 interspace using a 22-gauge Sprotte needle and a 28-gauge nylon catheter (Cospan, Kendall, MA, USA)) 60 patients were allocated randomly to one of
two groups: patients in group B-Bolus received, on request, nurse-administered 0.25% bupivacaine 3.75 mg every 2 h at most. In group B-PCA, continuous subarachnoid infusion of 0.125% bupivacaine 0.5 ml h\(^{-1}\) was provided by the PCA device and patients were allowed to self-administer 0.5 ml of 0.125% bupivacaine with a lockout interval of 30 min. PCA in groups P-PCA and B-PCA was started when the patient arrived in the PACU and after the first assessment of pain had been performed. The first dose of analgesic in the P-Bolus and B-Bolus groups was given when patients requested analgesics and assessment of pain was >50 mm on a visual analogue scale (VAS). Further analgesics were administered on patient request, every 2 h at most. Patients with continuous spinal anaesthesia were allowed piritramide 3.75 mg i.v. as escape medication in case of inadequate analgesia.

**Patients’ assessments**

Pain was assessed by the patients using labelled VAS (Pain-P: 0 mm = no pain, 100 mm = unbearable pain) hourly during their overnight stay in the PACU. Every 4 h, patients assessed their anxiety with a labelled VAS (Anx-P: 0 mm = not anxious, 100 mm = extremely anxious). There was no special explanation of the word anxiety; it was defined by the meaning of the word itself.\(^5\) When patients slept, assessment was performed when they woke up. The use of the VAS scales was explained to the patient the day before operation when written informed consent was obtained.

**Nurses’ assessments**

Nurses who were in charge of the patients were requested to rate pain hourly with a labelled VAS (Pain-N: 0 mm = no pain, 100 mm = unbearable pain) before patients did their ratings. Every 4 h, nurses assessed the patient’s state of anxiety with a labelled VAS (Anx-N: 0 mm = not anxious, 100 mm = extremely anxious). Nurses were taught how to use the VAS scales at the beginning of the study. No special instruction was given on how to assess the patient’s pain and anxiety in order to document the current practice in the PACU.

**Statistical analysis**

Self-reported pain and anxiety scores are often assumed to have parametric properties.\(^1\)\(^-\)\(^3\) However, as this cannot be taken for granted and univariate distributions are likely to be skewed, non-parametric rank-order statistics where used in this study. For all individual statistical analysis, the conventional level of significance (5\%) was adopted.

(a) **Correlations.** Rank autocorrelations (correlation of the same measure on adjacent measurement occasions) were calculated for Pain-P and Pain-N. For every hour, Spearman’s rank correlation coefficient between patients’ and nurses’ ratings was calculated for pain assessment (\(r\) Pain-P/Pain-N) and for every 4 h for anxiety ratings (\(r\) Anx-P/Anx-N). In addition, for every hour, the Spearman’s rank correlation coefficient between patients’ VAS scores and patient/nurse discrepancy (Pain-P–Pain-N) was computed. Every 4 h, the Spearman’s rank correlation coefficient between patients’ anxiety scores and patient/nurse discrepancy (Anx-P–Anx-N) was computed. Correlation coefficients were also calculated for the medians over 18 h (\(r\) Pain-Pm/Pain-Nm, Anx-Pm/Anx-Nm).

(b) **Mean rank comparisons.** As the choice of anaesthesia was not allocated randomly, separate analyses were performed for the i.v. and subarachnoid samples. For each time point, Mann–Whitney \(U\) tests were performed for patient/nurse discrepancies in pain and anxiety ratings comparing PCA vs bolus administration. In addition, the same tests were applied for the median scores across the observational period. In order to investigate the interactions between application (PCA vs bolus) and medication (piritra- mide vs bupivacaine) at least on a descriptive basis, a parametric two-way analysis of variance and multivariate trend analyses (using significant polynomial coefficients) were calculated for patients’ and nurses’ pain scores during the first 9 h in the PACU (for methods see Winer\(^6\)). Because of missing data, when patients slept, this analysis could not be performed for the whole surveillance time. For all other statistical tests, sleeping time was considered completely at random.\(^7\)

(c) **Iafrati criterion.** According to the criteria of Iafrati,\(^4\) observers’ ratings of pain are considered correct when the discrepancy between nurses’ and patients’ VAS ratings is lower than 1 cm. Percentages of over- and underestimations were calculated.

**Results**

Twenty-four of the 120 patients were excluded from statistical analysis because they returned to the ward after a few hours before the study was completed. Patient characteristics did not differ between groups with the exception that patients who received continuous spinal anaesthesia were slightly older than patients in the i.v. groups (Table 1). Correlation analyses did not show a significant effect of age on VAS of patients and nurses for pain or anxiety. VAS data are given as median (range).

**Patients’ and nurses’ pain scores**

Rank autocorrelations between patients’ pain ratings were higher than between nurses’ pain ratings (median \(r=0.76\) vs \(r=0.70\)), although they were not compared statistically. The Spearman’s rank correlation coefficient between the combined groups patients’ pain scores and nurses’ pain scores for each of the first 18 h after operation was 0.69–0.89 (\(P<0.001\) in each case). For each group, except group B-PCA which showed the lowest pain level during the observational period, patients’ pain scores were significantly higher than nurses’ pain estimates (Fig. 1). The patients’ and nurses’ pain ratings did not differ between groups P-Bolus and P-PCA whereas they differed significantly.
Table 1  Patient characteristics and duration of surveillance in the post-anaesthesia care unit (mean (SD or range) or number). Group P-Bolus = nurse-controlled bolus of i.v. piritramide, group P-PCA = PCA with i.v. piritramide, group B-Bolus = nurse-controlled bolus of subarachnoid bupivacaine, group B-PCA = PCA with subarachnoid bupivacaine

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Sex (M/F)</th>
<th>ASA (I/II/III)</th>
<th>Age (yr)</th>
<th>Weight (kg)</th>
<th>Height (cm)</th>
<th>PACU time (h)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-Bolus</td>
<td>23</td>
<td>15/8</td>
<td>3/14/6</td>
<td>59 (23–90)</td>
<td>67 (12)</td>
<td>167 (9)</td>
<td>17.7 (2)</td>
</tr>
<tr>
<td>P-PCA</td>
<td>21</td>
<td>10/11</td>
<td>9/6/6</td>
<td>49 (18–74)</td>
<td>71 (8)</td>
<td>171 (9)</td>
<td>17.7 (2.6)</td>
</tr>
<tr>
<td>B-Bolus</td>
<td>27</td>
<td>5/22</td>
<td>5/15/7</td>
<td>64 (43–87)</td>
<td>69 (11)</td>
<td>164 (11)</td>
<td>18.3 (1.4)</td>
</tr>
<tr>
<td>B-PCA</td>
<td>25</td>
<td></td>
<td>7/11/7</td>
<td>69 (54–83)</td>
<td>78 (17)</td>
<td>167 (9)</td>
<td>17.5 (2.2)</td>
</tr>
</tbody>
</table>

Fig 1  Pain scores assessed by patients (Pain-P) and nurses (Pain-N) over 18 h in the post-anaesthesia care unit after orthopaedic surgery, evaluated by visual analogue scale (VAS): 0 = no pain, 100 mm = unbearable pain. Group P-Bolus = nurse-controlled bolus of i.v. piritramide; group P-PCA = PCA with i.v. piritramide; group B-Bolus = nurse-controlled bolus of subarachnoid bupivacaine; and group B-PCA = PCA with subarachnoid bupivacaine. Boxes represent interquartile range, horizontal lines in the boxes represent median values and error bars the range. **P < 0.01 between Pain-P and Pain-N.

Differences between groups B-Bolus and B-PCA (Pain-P, P < 0.001; Pain-N, P = 0.002).

Fig 2  Hourly pain scores of patients over 9 h in the post-anaesthesia care unit after orthopaedic surgery: trend analysis with significant polynomial coefficients for the four different treatment groups. VAS = Visual analogue scale (0 = no pain, 100 mm = unbearable pain).

Patients’ and nurses’ anxiety scores

Spearman’s rank correlation coefficient between individual Anx-P and Anx-N scores was 0.79 (P < 0.001) while that for the calculated medians (Anx-Pm and Anx-Nm) over 18 h was low (0.22; P = 0.031). Patient/nurse discrepancies were not related to the level of anxiety. Patients’ anxiety scores were similar between the i.v. analgesia groups (group P-Bolus 6 (range 2–52) mm; group P-PCA 13 (1–52) mm) and the subarachnoid analgesia groups (group B-Bolus 14 (0–89) mm; group B-PCA 10 (1–97) mm). In addition, nurses’ anxiety scores were similar for groups P-Bolus and P-PCA (group P-Bolus 9 (1–45) mm; group P-PCA 8 (1–62) mm), but not for the subarachnoid analgesia groups (group B-Bolus 15 (2–90) mm; group B-PCA 4 (1–93) mm; P = 0.019). The discrepancy between the patients’ and nurses’ mean assessments of anxiety was smaller than that for the pain VAS, but with greater inter-individual variance (Fig. 3). There was no significant effect of analgesic treatment on differences between patients’ and nurses’ anxiety scores (between the i.v. analgesia groups for Anx-Pm–Anx-Nm: P = 0.8; between the subarachnoid analgesia groups for Anx-Pm–Anx-Nm: P = 0.3).

Discussion

We have documented the correlation between patients’ and nurses’ assessments of postoperative pain and anxiety.
According to the criteria of Iafrati, in 51% of assessments, nurses tended to underestimate the pain of their patients. In general, patients indicated their pain more consistently than nurses (higher autocorrelation). Discrepancies between patients’ and nurses’ pain scores increased with the patient’s pain level. The difference between patients’ and nurses’ pain estimates was thus related to the efficacy of the analgesic treatment, with the lowest discrepancy in the group with the best pain relief. The relationship between anxiety scores of patients and nurses was less clearly defined. There was no difference in patients’ anxiety scores for the different treatment groups. In contrast, nurses’ anxiety scores differed significantly between the two subgroups receiving intrathecal bupivacaine, while there was no difference between the i.v. piritramide groups. Compared with differences in pain scores, differences in anxiety scores were, in general, much lower, with broad inter-individual variability and did not depend on the level of anxiety.

Comparison of our findings with other studies is difficult because of differences in methods (i.e., different ‘pain’ scales, statistical evaluation) and pain conditions (burns pain, pain caused by myocardial infarction, chronic pain, etc.). Olden and colleagues reported 55% underestimation compared with 43% overestimation of pain by nurses with no significant correlation between nurses’ and patients’ scores in 26 patients receiving PCA after Caesarean section. Data were collected twice a day for 48 h using a labelled VAS and the mean difference was 20±2 mm between nurses’ and patients’ pain scores. The small sample size may limit generalization of their findings, while the criteria of Iafrati were not used. Striebel, Hackenberger and Wessel showed markedly lower pain scores determined by an independent observer in comparison with pain scores assessed using a VAS by 60 women after vaginal hysterec- tomy (P<0.001). The authors did not provide correlations.

Pain intensities assessed by the independent observer, who was not characterized in detail, were, on average, 37.7% of the patients’ self-assessments. Forrest, Hermann and Andersen demonstrated a significant correlation between pain scores made by patients and the examining doctors in acute abdominal pain. The median score for the doctors was 3.4 cm (VAS 10 cm) and for patients, 6.1 cm. Hodgkin, Albert and Daltroy showed that physicians improved their estimates of patients’ pain during a painful invasive procedure in comparison with estimates before the procedure. Webb and Kennedy described the relationship between patients’ self-assessed pain and a behavioural scale used by nurses in 36 gynaecological patients treated after operation with PCA. They stressed the importance of evaluating different aspects of pain. Everett and colleagues found patients’ and nurses’ pain ratings to be correlated during wound care in burns patients, with a 53.3% accuracy of nurses’ ratings according to the criteria of Iafrati. To summarize the cited studies, patients generally tend to rate pain scores higher than any observer in acute or postoperative pain.

The reasons for the discrepancy between patients’ and observers’ ratings are not completely understood. The relationship between nurses’ pain ratings and their nursing experience has been investigated in burns patients. Iafrati demonstrated that new graduates and new burns nurses tended to overestimate pain, while the most experienced nurses tended to underestimate it. The small sample size (15 nurses, six patients, 29 estimations) without the necessary statistical tests, limits interpretation of these results. In line with these findings, Choinère and colleagues showed an incidence of overestimation in nurses who were less experienced and, in contrast, underestimation in nurses who were more experienced. They did not find that nurses’ perceptions of pain varied as a function of patient age, socioeconomic status or burns severity. There were no correlations between patients’ and nurses’ estimations of pain relief: 57% of nurses overestimated the pain relieving effect, while 27% underestimated pain relief by VAS. However, Walkenstein failed to demonstrate a significant relationship between length of time in nursing or burns nursing and perception of patients’ pain. Teske, Daut and Cleeland showed discrepancies between observers’ and patients’ ratings, being greater in chronic than in acute pain patients. For the chronic pain sample, mean rating for patients was 53 mm and for observers, 35 mm. For the acute sample, mean rating for patients was 36 mm and for observers, 31 mm (assessed by VAS).

An interesting question that can be raised is did the nurses’ involvement (e.g. in nurse-dependent bolus administration) or not (PCA-modus) in the analgesic treatment influence the nurses’ accuracy of pain assessments. In this study, the discrepancies between patients’ and nurses’ assessments of pain were lower in the groups receiving PCA in accordance with better pain relief in those groups. As randomization was performed only in the i.v. and
themselves, whenever possible. If not, discrepancies with doctors' influence analgesic treatment. In our study, treatment groups were randomly fixed before evaluation of pain started. Weldon, Connor and White compared PCA and nurse-controlled bolus application and showed that nurses underestimated pain in children after scoliosis surgery which resulted in a reduced dose of analgesic medication. There was no difference in their patients’ pain relief. However, concurrent opioid infusion with PCA therapy may have influenced their results. Further studies are needed to evaluate the impact of observers’ pain rating on analgesic treatment.

Our study gives support to the usefulness of pain assessment using VAS, whether by nurses or patients. VAS were easy to handle by nurses and patients in the postoperative course as the assessment was not time consuming and could be integrated easily into routine practice. VAS has been shown previously to be a sufficiently sensitive technique to detect distinct differences in pain experience. Ohnhaus and Adler reported the VAS to assess more closely what a patient actually experiences with respect to changes in pain intensity compared with a verbal rating scale. Houde documented improved sensitivity with VAS measures of pain compared with a four-point categorical scale. With respect to anxiety scores, the use of VAS is less common. Shafer and colleagues documented the complexity of predicting patients’ anxiety by surgery and anaesthesia residents using VAS and brief anxiety questionnaires. Further investigations are still needed comparing VAS with other methods of pain and anxiety assessment.

In summary, we have documented a significant relationship between patients’ and nurses’ assessments of pain in the postoperative course of orthopaedic patients. The study did not support the theory that nurses (or observers in general) are unable to assess pain. There was a clearly defined relationship between nurses’ and patients’ ratings, showing a correlation that depended on intensity of pain. In general, scores of nurses appeared to be lower. Autocorrelations of pain scores showed that patients reported their pain consistently. Anxiety scores were not influenced in the same way as pain scores. From a clinical point of view, the results showed that nurses’ observations reflected the severity of patients’ pain only in part. It gives support to the definition of McCaffery ‘Pain is whatever the experiencing person says it is, existing whenever he says it does’.

As a consequence, pain should be assessed by patients themselves, whenever possible. If not, discrepancies with observers’ ratings have to be taken into consideration. Further studies are needed to define the implications of these findings on future pain treatment.

Acknowledgements
We thank the nursing staff in the post-anesthesia care unit of the Orthopaedic Department of the University Hospital Eppendorf for help and excellent co-operation in collecting the present data.

References
4 Iafirat NS. Pain on the burn unit: patient versus nurse perception. J Burn Care Rehabil 1986; 7: 413–16
16 Ohnhaus EE, Adler R. Methodological problems in the measurement of pain. A comparison between the verbal rating scale and the visual analogue scale. Pain 1975; 1: 379–84