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Abstract

Aim. To compare different levels of self-rated pain and determine if they predict anticipated early physical recovery in patients undergoing general and orthopaedic surgery.

Background. Previous research has indicated that average self-rated pain reflects patients' ability to recover the same day. However, there is a knowledge gap about the feasibility of using average pain ratings to predict patients' physical recovery for the next day.

Design. Descriptive, quantitative repeated measures.

Methods. General and orthopaedic inpatients (n=479) completed a questionnaire (October 2012 - January 2015) about pain and recovery. Average pain intensity at rest and during activity was based on the Numeric Rating Scale and divided into three levels (0-3, 4-6, 7-10). Three out of five dimensions from the tool "Postoperative Recovery Profile" were used.

Because few suffered severe pain, general and orthopaedic patients were analysed together.

Results. Binary logistic regression analysis showed that average pain intensity postoperative day 1 significantly predicted the impact on recovery day 2, except nausea, gastrointestinal function and bladder function when pain at rest and also nausea, appetite changes, and bladder function when pain during activity. High pain ratings (NRS 7-10) demonstrated to be a better predictor for recovery compared to moderate ratings (NRS 4-6), day 2, as it significantly predicted more items in recovery.

Conclusion. Pain intensity reflected general and orthopaedic patients' physical recovery postoperative day 1 and predicted recovery for day 2. By monitoring patients' pain and impact on recovery, patients' need for support becomes visible which is valuable during hospital stays.

Keywords. Pain, Assessment, Postoperative care, Quantitative Approaches, Nurse-Patient interaction, Nurse-Patient Relationships.

Why is this research needed?

- High pain intensity is shown to interfere with early postoperative recovery leading to complications and prolonged hospital stays.
- A knowledge gap exists about the feasibility of using pain ratings to predict patients' early physical recovery.

What are the key findings?

- Patients' average pain intensity at rest and during activity on postoperative day 1 clearly reflected physical recovery for the same day.
- Patients' average pain intensity at rest on postoperative day 1 clearly predicted physical recovery the coming day, except for nausea, gastrointestinal function and bladder function.
- Patients' average pain intensity during activity on postoperative day 1 predicted physical recovery on postoperative day 2, except for nausea, appetite changes, and bladder function.

How should the findings be used to influence policy/practice/research/education?

- In clinical care, a summary of patients' daily pain assessments in an average pain value may serve as an indicator of early physical recovery for that day and as a predictor for the following day.
- Further studies with repeated measures are needed to explore whether average pain compiled from reported pain ratings in medical records provides unanimous results to predict recovery.

Introduction

Daily, a large number of patients undergo major surgery and many of them suffer moderate to severe pain during the first days afterwards (Carr et al. 2013). High pain intensity is shown to interfere with early postoperative recovery, leading to complications and prolonged hospital stays (Wells et al. 2008). Assessment of pain and other aspects of recovery is therefore of value and enables optimization of healthcare policies and guidelines worldwide (CSPMS, 2015; Gordon et al., 2016; RNAO, 2013). Furthermore, assessment of recovery also reveals patients' individual needs for support after surgery (Allvin 2009). All existing recovery assessment tools include pain as a substantial aspect. Several dimensions of recovery, such as physical, psychological, emotional and activity aspects are also included (Myles et al. 1999, Allvin et al. 2009, Royse et al. 2010, Gordon et al. 2010, Rothaug et al. 2013). These extensive tools have been primarily developed for use in research or quality improvement from the early postoperative phase up to a year after surgery. To create a better understanding of early postoperative recovery is something that engages researchers internationally in order to implement improvements in healthcare (Meissner et al., 2015). However, there is no simple tool in clinical use that routinely employs pain ratings to summarize each individual's recovery during the first postoperative day after surgery in order to predict recovery on the following day.

Background

The definition of postoperative recovery varies depending on the intended postoperative phase, involved healthcare professionals and selection of patients (Feldman et al. 2015). By tradition, postoperative recovery refers to the phase during which patients stay in the care units. This phase of recovery is described as regaining control of function to enable discharge (Bowyer and Royse 2016). Pain is the most common item in recovery assessment tools

(Neville et al. 2014, Feldman et al. 2015, Allvin et al. 2009). Effective pain management is described to be an essential part of the approach to enhancing recovery after surgery and to reduce hospital stays (Spanjersberg et al. 2011, Larsen et al. 2012). In guidelines for postoperative pain management, pain is recommended to be regularly requested and when present it should be assessed with a valid self-rating scale (Gordon et al. 2010, Brantberg and Allvin 2014). Furthermore, pain ratings should be recorded on a regular basis and at breakthrough pain in order to follow pain variations throughout the day (Gordon et al. 2010, Brantberg and Allvin 2014, Scug et al. 2015). Patients' pain intensity is described to reflect the individual subjective experience of pain and the assessment is advised to be performed both at rest and during activity (Scug et al. 2015, Gordon et al. 2010, Brantberg and Allvin 2014). In addition, the American Pain Society (APS 1995) has recommended asking for average pain for the preceding 24 hours. Previous research has indicated that pain scores from monitoring records compiled to an average pain value for each patient reflect the patients' ability to recover after surgery (Eriksson et al. 2013). This enables monitoring of recovery for all patients capable of performing pain assessments with a pain scale.

Recovery assessment tools in research and in evaluation of healthcare guidelines monitor different dimensions of recovery (Bowyer et al. 2014). However, complex and comprehensive recovery tools might be difficult to use in clinical practice since healthcare professionals have other tasks (Stark et al. 2013) and many patients are fatigued (Forsberg et al. 2015). Focusing of a few items as pain ratings may help healthcare professionals to monitor recovery regarding the most important areas. The physical dimension of recovery is common in existing self-rating tools and consists of multiple items. These are: pain, nausea, mobilization (Myles et al. 2000, Allvin et al. 2009, Royse et al. 2010, Gordon et al. 2010) appetite, personal hygiene (Myles et al. 2000, Allvin et al. 2009, Royse et al. 2010) and sleep (Allvin et

al. 2009, Myles et al. 2000, Gordon et al. 2010). In the growing use of established programs for enhanced recovery after surgery, patients are requested to fill in a diary after surgery (ERAS Society 2015). During the postoperative period when patients are still hospitalized, questionnaires to follow recovery are burdensome. Avoidance of further questionnaires for patients is therefore justified. However, there is a knowledge gap in how feasible already collected pain ratings are to predict patients' recovery. According to available knowledge, orthopaedic patients experience higher pain intensity and greater impact on their early recovery compared to general surgery patients (Forsberg et al. 2015, Rothaug et al. 2013). How this difference between general and orthopaedic surgery affects the possibility to predict recovery is uncertain. Furthermore, recovery may be influenced by prehospital pain, which is described as common among orthopaedic patients (Eriksson et al. 2013). If feasible, pain intensity from monitoring records compiled to a median value could in the future be used to predict which patients are in need of enhanced support for their recovery. The use of already collected data, such as pain ratings to reflect as well as predict patients' recovery would be beneficial for both patients and healthcare professionals. Even though pain intensity does not appear to affect all aspects of physical recovery, pain assessments may be an easy way to follow early postoperative recovery, both at individual and group levels. However, no study has been found proving this hypothesis.

The study

Aim

The aim of this study was to compare different levels of self-rated pain and determine if they could predict anticipated early physical recovery in patients undergoing general and orthopaedic surgery.

Design

Descriptive, quantitative repeated measures.

Sample and setting

The study was conducted at six care units at three different county hospitals in southern Sweden. The number of beds in the three hospitals varied between 300 and 400. The catchment areas for the included hospitals were both rural and urban, with 130,000 to 150,000 inhabitants. A convenience sample of patients scheduled for major surgery was invited to participate in the study in connection with the enrolment call before surgery. As in an earlier study by Weiser et al. (2008), major surgery is defined as surgery performed during regional or anaesthetic treatment. The inclusion criteria were: patients who had undergone major general or orthopaedic surgery which implied a hospital stay of at least two days, age of 18 years or older, and ability to read and understand the Swedish language. Exclusion criteria were pre- or postoperative cognitive dysfunction or being in need of intensive care. In total, 541 patients agreed to participate, of which 62 did not complete the study. Reasons for drop-out were: questionnaires not returned (n=30), patients declined to continue the study (n=20), confusion (n=3), care in the intensive care unit (n=5), postponed surgery (n=4). Of the remaining patients (n=479), 38 were discharged on postoperative day 2 and could not complete the third and last questionnaire but were included and completed the first two questionnaires i.e. for prehospital and postoperative day 1 (Figure 1).

Instruments

Patients completed a questionnaire with 11 items, two about pain and nine about physical recovery. Average pain intensity for the previous day (Sadosky et al. 2016) was requested at rest and during activity. Data on pain were collected using the Numeric Rating Scale (NRS),

where 0 means no pain and 10 worst pain. The NRS is the most common pain scale in clinical practice (Hjermstad et al. 2011) and is shown to have good validity and reliability (Ferreira-Valente et al. 2011). The average pain based on the NRS scoring from postoperative days 1 and 2 was divided into three levels (i.e. 0-3, 4-6, 7-10) to make the results clearer for the reader of the study. These levels are also used in previous research (Couceiro et al. 2009, Eriksson et al. 2013, Sadosky et al. 2016) making it easier to identify a pattern of clinical relevance.

Postoperative physical recovery was measured by nine items covering three of five dimensions of the questionnaire the Postoperative Recovery Profile (PRP) developed by Allvin et al. (2009). The PRP was developed and tested in a Swedish context. It has been proved to be valid, reliable (Allvin et al. 2009) and is used in several studies (Jakobsson et al. 2014, Le et al. 2014, Forsberg et al. 2015). The questionnaire consists of five dimensions: physical symptoms, physical function, psychological, social and activity. Originally, the five dimensions were composed of 19 items, but Allvin et al. (2008) recommended dropping two items (i.e. sexual activity and re-establishing everyday life) at the hospital stay as they are not relevant at the time. Since pain in the present study was measured with the NRS, the pain item was also excluded from the PRP questionnaire. In accordance with the study aim three dimensions were used from the PRP questionnaire. These consisted of the following dimensions: physical symptoms, physical function and activity. Physical symptoms comprised four items: nausea, fatigue, appetite changes and sleeping difficulties. Physical function contained four items: gastrointestinal function, bladder function, mobilization and muscle weakness. Activity consisted of one item: personal hygiene. The items in the PRP questionnaire have four response alternatives reflecting the degree of recovery, ranging between 0-3; none, mild, moderate and severe. To compare average pain and impact on

recovery, the PRP was dichotomized as none/mild or moderate/severe. This approach is also used in a previous study by Forsberg et al. (2015).

Data collection

Data was collected between October 2012 and January 2015. A research nurse at each care unit asked patients about participation during the enrolment call one to two weeks before elective surgery. At the enrolment, patients completed a questionnaire that contained self-reported background and clinical data: gender, age, country of birth, education, intake of analgesia, preoperative average pain intensity, and baseline values regarding physical symptoms, physical functions and activity. The research nurse also collected additional data on the following: American Society of Anesthesiologists' (ASA) classification of physical status, motion sickness, smoking condition, pharmaceutical treatment for anxiety, depression or sleeping difficulties, type of surgery and analgesia from the medical records during patients' hospital stay. At the beginning of postoperative days 2 and 3, patients answered the complete questionnaire each day with 11 retrospective questions regarding details of the previous day's pain (NRS) and recovery (PRP), i.e. postoperative days 1 and 2.

Ethical considerations

The study was conducted in accordance with the Helsinki Declaration principles (WMA 2013). All invited to participate in the study received a patient information sheet describing the study aim, the target group, the procedures, and stating that participation was voluntary and approval could be withdrawn. Patients gave verbal informed consent which was reconfirmed when the questionnaires were handed over postoperatively. Ethical approval was received from the Regional Ethical Review Board in Linköping, Sweden (No. M249-08).

Data analysis

Descriptive statistics were used to present background and clinical data. Differences in age between general and orthopaedic surgery were analysed with Mann-Whitney U test. Pearson chi-square test or Fisher's exact test were used to compare general and orthopaedic surgery regarding background data. Mann-Whitney U test was used to compare average pain intensity between the two surgical groups as well as to compare impact on the different items in physical symptoms, physical functions and activity (i.e. physical recovery) between the three time points. Friedman's test was employed to compare average pain intensity and recovery between the three time points (i.e. prehospital, postoperative days 1 and 2) and mean rank is presented between the three time points. A Wilcoxon signed-rank test with Bonferroni corrected P-values was used as a post-hoc-test.

Binary logistic regression analyses were used to determine the association between average pain intensity and impact on the different recovery items and presented with odds ratio and confidence interval. Recovery from days 1 and 2 were used as outcome variables, dichotomized as recovered (none/mild) or not recovered (moderate/severe). Average pain intensity from day 1 was entered as predictor variable, divided into three levels, NRS 0-3, 4-6, 7-10. Since general surgery contained few patients with severe pain, general and orthopaedic surgeries were merged into one group to determine if pain intensity could predict recovery.

A significance level of 5% was overall considered as statistically significant. For the post-hoc analyses, the Bonferroni corrected p-values were set at $P < .017$. All analyses were conducted using IBM SPSS Statistics 21 (IBM Corporation, Armonk, NY, USA).

Reliability and validity

The NRS and PRP instruments have earlier proved to be valid and reliable measures (Ferreira-Valente et al. 2011; Allvin et al. 2009). Items from three dimensions (i.e. physical symptoms, physical function and activity) in the PRP were used in the present study. The face validity for the reduction of items and dimensions was based primarily on descriptions made by patients before discharge collected by Allvin et al. (2011) in an initial validation study of the PRP instrument. A second reason for the reduction was that the physical dimensions are described to have the greatest significance during the first days after surgery (Bowyer & Royse, 2016). Data were collected at six different wards to strengthen external validity.

Results

Background and clinical characteristics

All included patients underwent elective surgery, either general (n=190) or orthopaedic (n=289). The mean age was 65 years and there were slightly more men (56%). Almost all orthopaedic patients (96%) and half in the group of general surgery (49%) received opioids postoperatively. In the latter group more than half (57%) received treatment with epidural analgesia. Few had preoperative pharmacological treatment for anxiety (2%), depression (7%) or sleeping difficulties (3%). Further descriptions of the patients are shown in Table 1.

Self-reported pain experiences

Prehospital, general surgery patients reported lower average pain intensity at rest ($P < .001$) and during activity ($P < .001$) compared to orthopaedic patients. These differences also remained during the first two postoperative days. Postoperatively, general surgery patients had lower average pain intensity on day 1 at rest ($P < .001$) and during activity ($P < .001$) and also on day 2 during activity ($P < .001$).

In general surgery, the average pain intensity increased significantly between the prehospital period and postoperative day 1. Although the average pain intensity postoperative day 2 was significantly lower than day 1, it was still significantly higher than prehospital. This was the case both at rest and during activity. Orthopedic surgery had, on the contrary, an average pain intensity that was worst before surgery and then decreased significantly until postoperative day 2, both at rest and during activity (Table 2). The proportion of patients with average pain intensity (NRS ≥ 4) at rest postoperative days 1 and 2 was 42% and 28%, respectively, of which 9% had NRS ≥ 7 on day 1 and 4% on day 2. During postoperative day 1, the proportion of patients with average pain intensity during activity was 72% of which 36% had NRS ≥ 7 , and on postoperative day 2 the corresponding proportions were 61% and 20% respectively.

Self-rated physical recovery

Compared to general surgery, orthopaedic surgery had a significantly greater impact on the dimensions of physical symptoms, physical functions and activity at all time points.

Prehospital differences between the groups were found regarding fatigue, sleeping difficulties, mobilization, muscle weakness and personal hygiene ($P < .001$). Corresponding differences on postoperative day 1 were found concerning sleeping difficulties ($P = .003$), mobilization ($P = .006$) and muscle weakness ($P < .001$). Furthermore, differences on postoperative day 2 were found in appetite changes ($P = .040$), mobilization ($P = .001$) and muscle weakness ($P < .001$).

Table 3 shows the impact of pain intensity on the recovery dimensions i.e. physical symptoms, physical functions and activity prehospital and postoperatively for each surgery group in relation to the different time points. General surgery had highest impact on recovery postoperative day 1 in all items except gastrointestinal function, where highest impact was shown postoperative day 2. No significant difference was found between postoperative days 1

and 2 regarding nausea, appetite changes and sleeping difficulties. Furthermore, no significant difference was found concerning bladder function between the three time points. Recovery had increased significantly day 2, but was still lower compared to prehospital. Similar results were found for all variables in the orthopedic group, the highest impact of pain intensity on recovery were overall demonstrated postoperative day 1. However, no significant difference was found regarding sleeping difficulties between the prehospital period and postoperative day 1. A significant increased recovery had occurred postoperative day 2 in all variables, except mobilization.

Association between pain on postoperative day 1 and recovery on days 1 and 2

The logistic regression analysis showed that average pain ratings at rest postoperative day 1 significantly reflected all types of recovery the same day and predicted most items of recovery day 2 (Table 4). For postoperative day 2, nausea, gastrointestinal function and bladder function was not significantly predicted by average pain at rest day 1. High pain ratings (NRS 7-10) was a better predictor for recovery compared to moderate ratings (NRS 4-6), both at postoperative day 1 and day 2, as it significantly reflected and predicted more items of recovery.

Average pain ratings at activity demonstrated similar findings but somewhat poorer ability to predict recovery (Table 5). For postoperative day 1, all items of recovery were significantly reflected by average pain ratings. For postoperative day 2, nausea, appetite changes, and bladder function were not significantly predicted by average pain intensity day 1. As for pain

ratings at rest, high pain intensity (NRS 7-10) was a better predictor for recovery compared to moderate ratings (NRS 4-6).

Discussion

Average pain intensity on postoperative day 1 predicted recovery in different items for the coming day. However, the use of average pain intensity was a measure that reflected recovery to an even greater extent for the same day. In both general and orthopaedic patients the prevalence of pain intensity > 4 was high on postoperative day 1, but orthopaedic patients reported less pain intensity compared to their prehospital experiences.

Average pain intensity at rest and during activity on postoperative day 1 partially predicted patients' recovery for the following day. By predicting which patients have the greatest need of support to recover, the prioritization of tasks is facilitated for healthcare professionals. The interference of pain intensity in different recovery items is asked about in a variety of tools. However, none has explored if only measuring average pain intensity enables prediction of postoperative recovery. Stark et al. (2013) argue that a comprehensive tool has limited use in everyday practice, claiming that the simpler the tool the greater the number of patients that can be included and monitored. Following recovery by using already collected pain ratings does not increase the burden on patients; instead, it allows patients to concentrate on what is of relevance for their recovery. Guidelines for pain assessment recommend that data on pain intensity at rest and during activity should be requested and recorded (Brantberg and Allvin 2014, Gordon et al. 2010, Scug et al. 2015). This, together with the found predictability of certain recovery items for postoperative day 2, both at rest and during activity on postoperative day 1, is a good reason to follow both. The main goal of pain management is to reduce suffering by reaching an acceptable pain level from the patient's point of view. Low

pain levels, however, do not always imply increased recovery but provide conditions for mobilization (Kehlet 2004). High pain intensity is a warning that the recovery is suppressed and it is up to healthcare professionals to give pain management priority.

One important finding was that average pain intensity both at rest and during activity on postoperative day 1 clearly reflected patients' recovery. In contrast to the present study, an earlier study showed that average pain intensity significantly impacted recovery only regarding walking, ability to sleep and food intake (Eriksson et al. 2013). The reason why the relationship between pain and recovery did not occur in more items in that study may be due to the limited sample size or because the questionnaire used did not have the same validity as the PRP. The incidence of pain (i.e. 72 % rated average pain NRS ≥ 4 during activity) shows the need to visualize pain for healthcare professionals - both the individual patient's pain and at group level. This is in line with other studies showing a corresponding presence of pain intensity of 75% (Gan et al. 2014, Wadensten et al. 2011). Moreover, the incidence of severe pain in these studies was between 32-42 %, similar to the experience of severe pain in the present study (i.e. NRS ≥ 7 ; 36 %). This indicates that pain is prevalent, and that there is a potential for accelerated recovery by improving postoperative pain management. Pain intensity is not the only item interfering with recovery, but it has great impact according to several studies (Feldman et al. 2015, Neville et al. 2014, Allvin et al. 2009) as well as in the present study. Another item is gastrointestinal symptoms, which is also a part of the enhanced recovery programs after surgery (Kehlet 2011). In the actual study, pain intensity on postoperative day 1 showed less ability to predict impact on nausea, appetite changes or gastrointestinal function on postoperative day 2 (Tables 4 and 5). An alternative way to cover this part of recovery is to follow nausea in the same way as pain intensity, with regular

assessments of nausea using the NRS 0-10. However, research is needed to determine if nausea on postoperative day 1 predicts these recovery items for the next day.

Following recovery with a pain scale has a weakness. Pain is a subjective experience and the assessment of pain intensity varies between individuals (Scug et al. 2015). The level at which patients consider that pain restricts their ability to be active and mobilized differs (Eriksson et al. 2014, van Dijk et al. 2012). Furthermore, van Dijk et al. (2012) found patients take into account the response their pain assessments will have on their pain treatment or whether they will be perceived as whining. Postoperative pain intensity is also found to be influenced by the presence of preoperative pain, younger age, anxiety and type of surgery (Ip et al. 2009). Recovery in turn is influenced by co-morbidity, where higher ASA levels increase the risk of postoperative complications delaying the recovery (Tevis et al. 2016). In addition to pain and gastrointestinal symptoms, recovery is also affected by the presence of factors such as drainage tubes and catheters (Kehlet 2011). Despite this, monitoring of recovery is moving towards subjective patient-reported outcomes (Feldman et al. 2015). By using already collected data (i.e. pain ratings) this is possible without the need for healthcare professionals to ask patients to complete a lengthy questionnaire. However, pain is shown to be requested and recorded at specific times and not tailored to patients' needs (Carr et al. 2014). This implies that in addition to asking about pain intensity at regular intervals, pain assessments must be performed more frequently following breakthrough pain. Adjusting the intervals between pain assessments based on the patients' needs may enable healthcare professionals to use average pain intensity from postoperative day 1 to predict pain the following day. Carr et al. (2014) consider pain assessments as a patient safety issue since high pain intensity after surgery may cause chronic pain. Although there can be difficulties in obtaining pain ratings there are numerous benefits to optimizing pain assessments and documenting them. By

identifying pain, the chance that it will be addressed increases and as a consequence patients suffering will be reduced. Another benefit of making pain visible is to reduce the risk of complications related to high pain intensity. A compilation of patients' pain intensity in an average value on postoperative day 1 highlights patients' pain and enables prediction of recovery for the next day. A parallel study examines how many documented pain ratings are needed to enable summarizing average pain intensity as a median value. Since following patient-reported outcomes are internationally considered a basis for implementing improvements in healthcare (Meissner et al 2015) monitoring pain intensity and thereby early physical recovery is valuable.

One interesting finding in the current study was that orthopaedic patients experienced less pain intensity postoperatively compared with the prehospital period. Their pain decreased gradually although the proportion of patients with moderate to severe pain (i.e. NRS ≥ 4) was considerably higher compared with general surgery. Patients undergoing orthopaedic surgery have previously been described to have higher pain intensity compared to other types of surgery (Gerbershagen et al. 2013, Carr et al. 2014). According to Swedish guidelines, it is not realistic to expect patients with prehospital moderate to severe chronic pain to achieve a lower level of pain during the first days postoperatively (SFAI 2011). Consequently, many patients in this study achieved the goal of their pain management, which was for their pain level not to exceed the prehospital pain level. We, as well as Forsberg et al., (2015) found that orthopaedic patients had a poorer recovery during the first few days after surgery compared to general surgical patients. However, in the current study, orthopaedic patients had less impact on mobilization postoperatively compared to the prehospital period. For all enrolled patients a reduction of impact was found in several of the recovery items depending on rated pain intensity at rest or during activity e.g. fatigue, mobilization, sleeping difficulties, personal

hygiene between postoperative days 1 and 2. As in previous studies, the relationship between pain intensity and recovery did not change in the presence of chronic pain (Hansson et al. 2006, Eriksson et al. 2013). Including these patients appeared neither to affect reflection or prediction of recovery.

In clinical practice, our findings may enable prediction of patients' recovery from postoperative day 1 to day 2. According to guidelines, it is recommended that pain should be asked about regularly and recorded in medical records (Gordon et al. 2010, Brantberg and Allvin 2014). Despite the present study's promising results, further studies with repeated measures is needed to explore whether average pain intensity compiled from patients' reported pain ratings in the medical records provides unanimous results. In the future, compiled average pain values can enable monitoring groups of patients during the first few days after surgery without patients having to complete a questionnaire. The findings also showed that patients with prehospital pain reported a decline in pain postoperatively compared with prehospital period even though pain levels still were high. This highlights the need to ask about average pain intensity at rest and during activity at the enrolment call, and together with the patient set a realistic goal for pain management.

Limitation

Consistent with the aim of the study, we focused exclusively on the physical dimensions and activity; therefore, only three of five dimensions of the PRP questionnaire were used.

Removing pain from the PRP questionnaire was based on the recommended use of NRS in guidelines. NRS also provides a more nuanced response to pain intensity compared to pain rating scales with fewer answer options (Ferreira-Valente et al. 2011). Omitting dimensions and items from the PRP can be considered as a weakness. However, the purpose was not to

compare PRP scores but to use relevant items for early physical recovery. The limitation of items in the questionnaire was done to avoid burdening patients with an excessively comprehensive questionnaire early after major surgery. Another limitation is that general and orthopaedic surgery was merged in the analyses because our data set contained few patients with severe pain. The outcome between the two groups may differ since patients undergoing general surgery often experience less pain both pre- and postoperatively compared to those undergoing orthopaedic surgery. Further studies with a larger number of patients in the general surgery group are required to determine whether the ability to reflect recovery for that day and predict the recovery for the next day differs between the two groups.

Conclusions

Patients undergoing general surgery experienced less pain and were less influenced in their recovery compared with those undergoing orthopaedic surgery. However, many orthopaedic patients stated they had reduced pain and impact on mobilization compared to the prehospital period. Using average pain ratings at rest and during activity enabled prediction of recovery. Since enhanced recovery after surgery has been proven effective in reducing hospital stay, and morbidity, it is useful to be able to monitor, predict and document the recovery using an average pain value. However, pain did not predict all items of recovery such as nausea, gastrointestinal function or bladder function. By following patients' pain intensity and thereby indirectly impact on recovery, patients' need of support becomes visible, which is valuable during hospital stays but also allows groups of patients to be compared.

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Figure 1. Flowchart of patients and data collection.

Table 1. Background and clinical data for general and orthopaedic surgery (n=479).

Variables, n (%)	n	Total n=479		General surgery n=190		Orthopaedic surgery n=289		P-value
Age, mean, (sd) [range]	479	65.2 (11.0) [22-93]		65.6 (10.6) [23-93]		65.0 (11.3) [22-92]		.890 ^a
Women, n (%)	479	211 (44.1)		54 (28.4)		157 (54.3)		<.001 ^b
Country of birth, n (%)	478							.764 ^b
Sweden	451	(94.4)		177 (93.2)		274 (94.8)		
Others	27	(5.6)		13 (6.8)		14 (4.8)		
Education n (%)	475							.873 ^b
Up to elementary school		197 (41.1)		79 (41.8)		118 (41.3)		
Gymnasium		166 (34.6)		69 (36.5)		97 (33.9)		
University		112 (23.4)		41 (21.7)		71 (24.8)		
Preoperative conditions, n (%)								
Smoker	457	28 (5.8)		22 (12.4)		6 (2.1)		<.001 ^b
Motion sickness	460	34 (7.1)		19 (11.2)		15 (5.6)		.032 ^b
ASA, n (%)	467							.760 ^a
I		143 (29.9)		58 (30.5)		85 (29.4)		
II		264 (55.1)		99 (52.1)		165 (57.1)		
III		59 (12.3)		23 (12.1)		36 (12.5)		
IV		1 (0.2)		1 (0.5)		- -		
Daily intake of analgesia 6 months prior to surgery, n (%)								
Daily intake	477	210 (44.0)		28 (14.7)		182 (63.4)		<.001 ^b
Only non-opioids	475	136 (28.6)		14 (7.4)		122 (42.2)		<.001 ^b
Opioids with or without non- opioids	475	66 (13.9)		9 (4.8)		57 (19.9)		<.001 ^b
Type of surgery, n (%)	479							n/a
Cystectomy and nephrectomy		22 (4.6)		22 (11.6)		- -		
Prostatectomy		67 (14.0)		67 (35.3)		- -		
Other urology		4 (0.8)		4 (2.1)		- -		
Lower abdominal		89 (18.6)		90 (47.4)		- -		
Vascular		6 (1.3)		6 (3.2)		- -		
Other general surgery		2 (0.4)		1 (0.5)		- -		
Knee replacement		76 (15.9)		- -		76 (26.3)		
Hip replacement		149 (31.1)		- -		149 (51.6)		
Neck and back		49 (10.2)		- -		49 (17.0)		
Other orthopaedic surgery		15 (3.1)		- -		15 (5.2)		
Postoperative analgesia day 1,								

n (%)								
Paracetamol	473	464	(98.1)	179	(96.7)	285	(99.0)	<.001 ^b
NSAID	469	59	(12.6)	1	(0.5)	58	(20.4)	<.001 ^c
Opioids	467	362	(77.5)	90	(49.2)	272	(95.8)	<.001 ^b
Postoperative analgesia day 2,								
n (%)								
Paracetamol	446	426	(95.5)	174	(95.1)	252	(95.8)	.712 ^b
NSAID	436	54	(11.9)	3	(1.7)	51	(19.7)	<.001 ^c
Opioids	442	351	(79.4)	108	(60.0)	243	(92.7)	<.001 ^b

^a Mann-Whitney U test, ^b Pearson Chi-square test, ^c Fisher's exact test

Table 2. Comparisons of average pain intensity (NRS) prehospital and postoperatively.

Average pain intensity		Prehospital			Postoperative day 1			Postoperative day 2			P-value ^a	Post-hoc test ^b
NRS 0-10		mean rank	Mdn	q1-q3	mean rank	Mdn	q1-q3	mean rank	Mdn	q1-q3		
General surgery												
	Rest	1.50	0	0-1	2.36	2	1-3	2.14	2	1-3	<.001	A B C
	Activity	1.37	0	0-2	2.51	2	4-6	2.12	3	2-5	<.001	A B C
Orthopedic surgery												
	Rest	2.23	4	2-7	2.21	4	3-5	1.57	3	1-4	<.001	A B C
	Activity	2.35	7	6-8	2.16	7	5-8	1.49	5	3.5-7	<.001	A B C

^a Friedman test. Post-hoc test based on Wilcoxon Sign Rank test with Bonferroni corrected p-values ($P < 0.017$) are reported with: A= Prehospital-Postoperative day 1, B= Prehospital -Postoperative day 2, C= Postoperative day 1- Postoperative day 2.

Table 3. Comparison of self-rated impact on physical symptoms, physical functions and activity between prehospital assessment and postoperative day 1 and 2.

	Prehospital			Postoperative day 1			Postoperative day 2			P-value ^a	Post-hoc test ^b
	mean rank	Mdn	q1-q3	mean rank	Mdn	q1-q3	mean rank	Mdn	q1-q3		
General surgery,											
<i>Physical symptoms</i>											
Nausea	1.58	0	0-0	2.22	1	0-1	2.20	0	0-1	<.001	A B -
Fatigue	1.41	0	0-1	2.39	1	1-2	2.20	1	1-2	<.001	A B C
Appetite changes	1.41	0	0-0	2.33	1	0-2	2.25	1	0-2	<.001	A B -
Sleeping difficulties	1.61	0	0-1	2.23	1	0-2	2.15	1	0-2	<.001	A B -
<i>Physical functions</i>											
Gastrointestinal function	1.63	0	0-1	2.09	1	0-2	2.28	1	0-2	<.001	A B C
Bladder function	1.86	0	0-0	2.21		0-0	1.93	0	0-1	.230	- - -
Mobilization	1.29	0	0-0	2.50	1	1-2	2.21	1	0-2	<.001	A B C
Muscle weakness	1.44	0	0-0	2.34	1	0-2	2.21	1	0-1	<.001	A B C
<i>Activity</i>											
Personal hygiene	1.35	0	0-0	2.62	1	0-1	2.04	1	0-1	<.001	A B C
Orthopedic surgery,											
<i>Physical symptoms</i>											
Nausea	1.68	0	0-0	2.32	1	0-1	1.99	0	0-1	<.001	A B C
Fatigue	1.83	1	0-2	2.30	1	1-2	1.88	1	0-2	<.001	A B C
Appetite changes	1.62	0	0-0	2.40	1	0-2	1.98	1	0-1		A B C
Sleeping difficulties	2.07	[1]	0-2	2.23	1	1-2	1.70	1	0-2	<.001	- B C
<i>Physical function</i>											
Gastrointestinal function	1.61	0	0-1	2.23	1	0-2	2.15	1	0-2	<.001	A B C
Bladder function	1.86	0	0-0	2.27	0	0-1	1.86	0	0-1	<.001	A B C
Mobilization	2.03	1	1-2	2.26	2	1-2	1.71	1	0-2	<.001	- B -
Muscle weakness	1.84	1	0-1	2.27	1	1-2	1.89	1	0-2	<.001	A B C
<i>Activity</i>											
Personal hygiene	1.64	0	0-0	2.45	1	1-2	1.92	1	0-1	<.001	A B C

^a Friedman test. ^b Post-hoc test based on Wilcoxon Sign Rank test with Bonferroni corrected p-values ($P < 0.017$) are reported with:

A= Prehospital-Postoperative day 1, B= Prehospital -Postoperative day 2, C= Postoperative day 1- Postoperative day 2.

Answers options for the different items were, 0-3; none, mild, moderate, severe.

Table 4. Associations between average pain rating at rest postoperative day 1 and recovery items day 1 and 2, based on logistic regression analyses.

Recovery	Average pain day 1 ^a	Recovery day 1			Recovery day 2		
		OR	95% CI	P-value	OR	95% CI	P-value
Nausea	NRS 4-6	2.07	1.25-3.42	.004	1.30	0.74-2.29	.364
	NRS 7-10	5.66	2.81-11.43	<.001	1.48	0.64-3.40	.349
Fatigue	NRS 4-6	2.07	1.38-3.10	<.001	1.68	1.05-2.70	.031
	NRS 7-10	7.67	3.41-17.29	<.001	4.30	2.08-8.86	<.001
Appetite changes	NRS 4-6	1.35	0.88-2.07	.165	0.99	0.60-1.64	.974
	NRS 7-10	4.87	2.42-9.79	<.001	2.27	1.13-4.59	.022
Sleeping difficulties	NRS 4-6	3.84	5.51-5.87	<.001	1.77	1.08-2.89	.023
	NRS 7-10	12.82	5.64-29.15	<.001	5.48	2.64-11.37	<.001
Gastrointestinal function	NRS 4-6	1.48	0.97-2.25	.068	0.92	0.58-1.46	.730
	NRS 7-10	2.40	1.22-4.75	.012	1.81	0.89-3.69	.101
Bladder function	NRS 4-6	2.04	0.98-4.24	.054	1.44	0.44-4.73	.550
	NRS 7-10	3.85	1.46-10.22	.007	2.90	0.71-11.75	.137
Mobilization	NRS 4-6	3.24	2.14-4.91	<.001	1.92	1.19-3.07	.007
	NRS 7-10	4.99	2.38-10.43	<.001	3.02	1.48-6.15	.002
Muscle weakness	NRS 4-6	2.54	1.67-3.88	<.001	1.72	1.03-2.87	.039
	NRS 7-10	5.53	3.74-11.16	<.001	4.30	2.09-8.80	<.001
Personal hygiene	NRS 4-6	2.591	1.65-4.05	<.001	1.71	0.97-2.99	.063
	NRS 7-10	7.27	3.59-14.72	<.001	4.94	2.36-10.31	<.001

^a NRS ratings 0-3 is used as reference category

Table 5. Associations between average pain rating during activity postoperative day 1 and recovery day 1 and 2, based on logistic regression analyses.

Recovery	Average pain day 1 ^a	Recovery day 1			Recovery day 2		
		OR	95% CI	P-value	OR	95% CI	P-value
Nausea	NRS 4-6	1.23	0.66-2.28	.511	1.14	0.58-2.22	.075
	NRS 7-10	1.88	1.04-3.38	.037	1.02	0.51-2.01	.096
Fatigue	NRS 4-6	2.25	1.36-3.73	.002	1.84	1.01-3.35	.046
	NRS 7-10	4.59	2.76-7.63	<.001	2.96	1.64-5.35	<.001
Appetite changes	NRS 4-6	1.85	1.09-3.13	.023	1.23	0.69-2.19	.075
	NRS 7-10	2.43	1.44-4.09	<.001	1.08	0.60-1.95	.784
Sleeping difficulties	NRS 4-6	4.01	2.25-7.15	<.001	1.40	0.76-2.61	.282
	NRS 7-10	7.28	4.09-12.97	<.001	2.54	1.38-4.60	.003
Gastrointestinal function	NRS 4-6	1.78	1.06-2.99	.028	1.36	0.78-2.35	.277
	NRS 7-10	2.09	1.25-3.49	.005	1.85	1.07-3.20	.028
Bladder function	NRS 4-6	0.96	0.39-2.39	.930	0.46	0.12-1.69	.243
	NRS 7-10	1.48	0.65-3.38	.351	0.93	0.31-2.80	.898
Mobilization	NRS 4-6	2.24	1.34-3.75	.002	2.56	1.30-4.85	.006
	NRS 7-10	7.50	4.42-12.73	<.001	5.69	2.97-10.88	<.001
Muscle weakness	NRS 4-6	2.41	1.36-4.26	<.001	1.95	0.96-3.95	.063
	NRS 7-10	6.01	3.43-10.52	<.001	3.93	1.99-7.76	<.001
Personal hygiene	NRS 4-6	2.62	1.36-5.06	.004	1.10	0.52-2.33	.794
	NRS 7-10	6.63	3.52-12.5	<.001	2.94	1.48-5.85	.002

^a NRS ratings 0-3 is used as reference category