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Postoperative pain experience, pain treatment and recovery after lumbar fusion and fixation surgery

Eva Rutstr□m[a,*], S□ren S□ndergaard[b], Christopher Lundborg[b], %erstin Ene[a]

[a] The Sahlgrenska Academy at Gothenburg University, Institute of Health and Care Sciences, SE 41□ 4□, Gothenburg, S□eden
[b] Department of Anaesthesiology and Intensive Care □edicine, Institute of Clinical Sciences, University of Gothenburg, Sahlgrenska University Hospital, Gothenburg, S□eden

Introduction

The number of patients who undergo surgery for back pain has increased significantly in recent years. Surgical methods have evolved and the increase in fusion surgery is clear (Machado et al., 2016). According to 2erbershagen et al. (2013), fusion surgery ranks highly among the six groups of surgery causing very severe postoperative pain. The postoperative pain management of these patients must consider preoperative pain and on-going treatment with high-dose analgesics necessitating careful planning and individual ad4ustment of postoperative pain treatment.

Despite widespread understanding of the complexities of postoperative pain management, inadequate treatment in the postoperative phase is still a ubiquitous problem. A large number of studies, over a long period of time, show that many patients still suffer from moderate to severe postoperative pain (Ene et al., 2008b; 2ramke et al., 2009; Carlson, 2010; Cooney, 2016) even though focus on pain management and the development of new guidelines have increased (Boric et al., 2017; Low et al., 2015). Nurses have a key role regarding managing postoperative pain and their attitudes and knowledge are crucial to a good postoperative pain control in terms of assessment and evaluation of prescribed pain protocols (Cui et al., 2017).

Inadequate pain treatment causes suffering for the patient, can potentially impact many organ systems and leads to the development of postoperative complications. In addition, it can lead to prolonged recovery and increased costs for the healthcare providers (Brown et al., 2013). Inadequate pain treatment in the perioperative period also poses a significant risk of chronic postoperative pain. Studies have shown that between 10 and 50= of patients who have undergone surgery suffer from subsequent chronic pain (%ehlet et al., 2006; 2ilron and %ehlet, 2014). Even recovery after discharge from hospital may be adversely affected by post-operative pain issues (Rullander et al., 2016).

Effective postoperative pain control is instrumental to early mobilisation (Ba4wa and ? aldar, 2015). A commonly used method is patient-controlled analgesia (PCA), where the patients can administer intermittent bolus doses of an opioid (usually morphine or oxycodone) via a programmable pump. Pain relief may also be provided by the epidural- or intrathecal route. Epidural analgesia usually includes a combination of local anaesthetic and opioids, whilst intrathecal analgesia (ITA) may sometimes include opioids possibly in combination with clonidine (Ba4wa and ? aldar, 2015). Studies show that intrathecal analgesia therapy with an opioid is a safe and effective method for treating postoperative pain after ma4or spinal surgery (@egeler et al., 2008; ? ong et al., 2017). Furthermore, in two studies, ITA in combination with PCA proved to be more efficient than PCA alone in the treatment of post-operative pain associated with ma4or abdominal surgery (%o et al., 2009; Dichtwald et al., 2017).

Common side effects associated with intrathecal opioids include postoperative nausea and vomiting (PONV), pruritus, urinary retention, and respiratory depression (Chinachoti et al., 2013; DomingueD and ? abib, 2013). The risk of side effects increases in relation to the dosage of opiates. A low-dose of an intrathecal opioid limits the risk of serious side effects, and it has been shown that an intrathecal morphine dose less than 0.3 mg does not cause more respiratory depression than the use of systemic opioids (2ehling and Tryba, 2009; DomingueD and ? abib, 2013).

Postoperative recovery is a complex process and is generally associated with the length of stay. In a conceptual analysis, it emerged that postoperative recovery is a process including four dimensions: physical, psychological, social and habitual recovery (Allvin et al., 2007). In one study, depending on the type of surgery, orthopaedic patients rated their ability to mobilise as very important for postoperative recovery. In contrast, surgical patients ranked gastrointestinal function as a ma4or factor. Both groups ranked postoperative pain as the key factor throughout the postoperative recovery process (Allvin et al., 2011).

Aim

The purpose of this study was to compare the perception of pain intensity in the first three postoperative days in patients undergoing lumbar fusion and fixation, as well as to compare the degree of postoperative recovery between two groups of patients - one group (2roup 1) received ITA in addition to the usual pain treatment and another group (2roup 2) received conventional pain treatment. It has

* Corresponding author.The Sahlgrenska Academy at 2othenburg University, Institute of ? ealth and Care Sciences, SE 413 46, 2othenburg, Sweden.
E-mail address(eva.rutstromH vgregion.se (E. Rutstr□m).

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previously not been studied how this type of pain treatment may affect recovery after this type of surgery.

Materials and method

Design/selection

We performed a prospective randomised study. Following approval from the Regional Ethical Review Board (reference number 388-11), 35 patients at a tertiary, University hospital in Sweden were enrolled consecutively. Of these, 29 patients remained in the study, six patients were excluded, mainly for medical reasons.

Patients were informed by the admitting orthopaedic surgeon at the preoperative clinic based on the following inclusion criteria; surgery with posterior fusion and fixation below the L2, cognitively adequate, ASA class I-III, able to read and write Swedish as well as being able to manage a PCA pump and gave verbal and written consent to participate in the study. Exclusion criteria: use of an anti-epileptic medication and/or more than 40 mg of oxycodone per day, and/or previous fusion surgery below L2. Patients included were informed, verbally and in writing, signed the consent form and filled in a form with demographic data, data on preoperative pain, pain medication and the degree of mobility at home. The patients were then randomised into two groups with help from a statistician (Fig. 1).

Instruments

Pain questionnaire

Patients reported their pain score in a questionnaire at rest and during movement at 24, 48 and 72 h post-operatively and their worst pain during the previous 24 h. Pain was measured in visual analogue scale (VAS, 0–100 mm) where pain intensity was represented by a point between the extremes of “no pain at all” and “worst pain imaginable”. VAS is a simple and reliable instrument describing the experience of pain intensity (Chapman et al., 2011). A VAS-score of more than 30 mm is routinely used to indicate insufficient analgesia; a VAS-value of more than 70 mm defines severe pain (Woo et al., 2015).

In the pain questionnaire, patients also reported the presence and frequency of nausea, itching and the degree of mobility, by selecting one of the options never, sometimes, usually or never.

Quality of recovery-40 (QoR-40)

QoR-40 is a 40-question instrument for assessing the quality of the postoperative recovery (Myles et al., 2000a,b). The instrument is divided into five dimensions: *emotional state*, *physical comfort, psychological support, physical independence,* and *pain.* These dimensions correspond to various aspects of quality of recovery from anaesthesia and surgery. QoR-40 has been used for patients who have undergone diverse types of surgery and is validated and reliability-tested. Each dimension is represented by statements that the patient must consider and rate on a scale of 1–5. The highest score possible of the QoR-40 is 200. The scores from the dimensions are distributed as follows: emotional state 45, physical comfort 60, psychological support 35, physical independence 25 and pain 35.

Procedure

Patients were prescribed paracetamol 1 g x 4 from the day of surgery (day 0). Patients taking opioid analgesia prior to surgery had their dose converted to oxycodone which was prescribed throughout the hospital period (Fig. 1).

Surgery was performed under general anaesthesia (propofol, sevoflurane, oxygen, air, fentanyl and rocuronium based on clinical signs). Patients were intubated, and the procedure was performed in prone position.

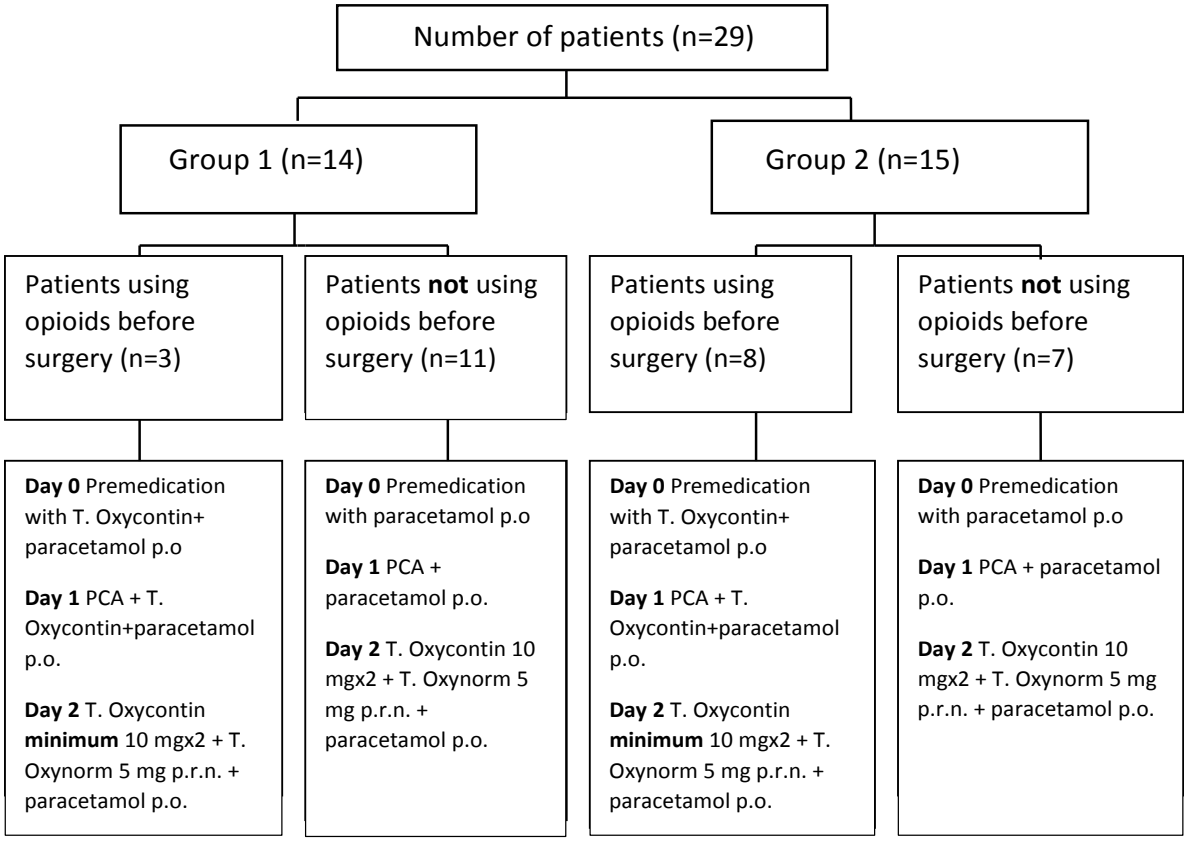

Fig. 1. Flowchart for the study.

The patients were randomised into one of two groups. Both groups were given intravenous morphine at the end of surgery according to the departmental routine. 2roup 1 was administered morphine 0.2–0.3 mg, clonidine 75 Og and sufentanil 10 Og intrathecally by the surgeon before wound closure. The smaller dose (0.2 mg) of intrathecal morphine was given to patients P 70 years old. Both groups received antiemetics (betamethasone, ondansetron and droperidol) perioperatively. Patients were monitored for vital signs (BP, P, pulse oximetry, diuresis and blood drainage) and pain intensity in a postoperative anaesthesia care unit (PACU) during the first night.

The day after surgery (day 1), patients returned to the orthopaedic ward. Both groups continued pain medication with an intravenous morphine PCA pump as well as oral paracetamol. Patients on preoperative opioid analgesia continued with this, converted to oral oxycodone, until hospital discharge (Fig. 1). At day two, the PCA-pump was ceased, and patients received oxycodone orally on a p.r.n. basis (Fig. 1).

Day 1 (24 h postoperatively) the patients reported their pain at rest, during movement, and the worst pain at rest and movement during the last 24 h, rated their degree of mobility, as well as the presence and frequency of nausea and itching in the pain protocol. On the same occasion they answered the QoR-40 protocol. Day 2 (48 h postoperatively) the patients reported their pain at rest and movement, as well as the worst pain at rest and movement during the last 24 h. Day 3 (72 h postoperatively) the patients answered the same two questionnaires as day 1.

The questionnaires were distributed at lunchtime approximately around one oQlock by the nurse on duty at the ward.

Data analysis

The statistical program SPSS version 21.0 was used to analyse the data. For comparison between groups, independent *t*-test was used for continuous variables and chi-square for categorical variables. A p-value R 0.05 was considered statistically significant. Continuous variables are presented as means and standard deviations, and category data are presented as number and per cent.

Results

Demographic data

35 patients were included consecutively. 29 patients have been the sub4ects of analysis as six patients were excluded, mainly for medical reasons. Demographic data for 2roup 1 and 2 showed no differences (Table 1).

Preoperative scenario

All patients (2roup 1 S 2) experienced pain at home. Slightly more than half of the patients used analgesics every day. When rating their pain, patients in 2roup 1 reported a mean VAS score as 84 mm as worst pain during daytime, and patients in 2roup 2 86 mm. The mean pain score during daytime was 71 mm in 2roup 1, and 81 mm in 2roup 2. There was no difference between the groups, in preoperative pain.

The ma4ority of the patients were able to sit on the edge of the bed, stand on the floor without support and walk indoors without support.

Table 1
Demographic data for 2roup 1 and 2roup 2.

	2roup 1 nT 14	2roup 2 nT 15
Age (years)	55.21 (8.2)	52.6 (14.6)
Women/men (n)	9/5	8/7
ASA class 1/2/3 (n)	7/6/1	5/10/0
Time on waiting list (Month)	4.2 (1.2)	4.5 (0.92)
Surgery time (min)	176.6 (81.2)	187, 1 (62.7)
Anaesthesia time (min)	279.3 (78.3)	282.1 (76.6)
Bleeding (ml)	464.3 (281.7)	516.7 (222.5)
Length of Stay (days)	5.1 (1.2)	5.7 (1.8)

Pain

Day 0 3 the day of surgery

All patients received an intravenous bolus dose of morphine at the end of surgery, and as required in the PACU. PCA with morphine was started as soon as the patient was awake and cooperative. There was a difference between the amount of intravenously administered morphine between group 1 and 2, (2roup 1: 10.6 mg and 2roup 2: 45.9 mg (p T 0.00).

Four hours post-surgery mean pain score for 2roup 1 was VAS 20 mm and for 2roup 2 VAS 42 mm (p T 0.024). Twelve hours post-surgery no difference was noted with regard to pain intensity.

Day 1

On day 1 there was a difference between the groups regarding the amount of morphine administered by the PCA pump. 2roup 1: 23 mg and group 2: 48 mg (p T 0.035). There was no difference in perceived pain at rest at 24 h postoperatively. ? owever, there was a difference in perceived pain during movement: 2roup 1 VAS 49 mm and 2roup 2: 71 mm (p T 0.015).

Differences were also seen regarding worst pain during the last 24 h, both at rest, 2roup 1 VAS 36 mm and 2roup 2 VAS 71 mm (p T 0.001) and during movement, group 1, VAS 54 mm and group 2 VAS 90 mm (p T 0.001).

Days 2 and 3, there were no differences between the groups in perceived pain, at rest or movement or the amount of oxycodone used (Table 2).

At an individual level, it appears that 11 patients in 2roup 2 vs three patients in 2roup1 reported VAS P 70 at movement after 24 h. Worst pain (VAS P 70) during the past 24 h was reported by two patients in 2roup 1 versus 10 patients in 2roup 2 at rest and four patients in 2roup 1 versus all patients (15) in 2roup 2 at movement.

After 48 h, 10 patients in 2roup1 reported VAS U 30 vs four patients in 2roup 2 at rest, and eight patients in 2roup 1 versus four patients in 2roup 2 at movement. Worst pain for 24–48 h (VAS P 70) was for 2roup 1 five patients versus 2roup 2, 10 patients at rest and six versus 10 patients at movement.

Postoperative recovery

The quality of postoperative recovery was measured on days 1 and 3 by using the QoR-40. Day 1, there was a difference between 2roups 1 and 2 within the dimensions emotional state (p T 0.011) and pain (p T 0.004). At day 3 there were no differences between groups regarding the different dimensions. ? owever, there was a difference in the overall QoR-40 score (p T 0.029) (Table 3).

4 ausea, itching and mobility

The patients answered questions about the presence of nausea and itching and assessed the level of movement after 24, 48 and 72 h.

Day 1

Most patients experienced no nausea or itching, and no differences were found between the groups. Slightly more than half of the patients could sit on the edge of the bed. There was no difference between the groups. The ma4rity of patients could not stand on the floor or walk indoors without support. There was a difference between the groups, in that patients in 2roup 1 could more easily stand on the floor (p T 0.05) and walk indoors without support (p T 0.035).

Table 2
Pain experience (VAS) 24, 48 and 72 h postoperatively.

Postoperatively	2roup 1 nT 14 2 nT 15	Pain at rest	Pain at movement	Worst pain at rest during the last 24 h.	Worst pain at movement during the last 24 h.
24 h	1 2	32 (23) 43 (13) n.s	49 (28) 71 (16) pT 0.015	36 (26) 71 (23) pT 0.001	54 (34) 90 (12) pT 0.001
48 h	1 2	32 ((23) 44 (17) n.s	45 (29) 59 (17) n. s	54 (30) 72 (22) n. s	56 (32) 73 (25) n. s
72 h	1 2	39 (27) 46 (16) n.s s	49 (28) 54 (15) n. s	53 (33) 64 (27) n. s	56 (31) 68 (22) n. s

Days □ and □

Nausea and itching rarely occurred after 48 h. The ma4rity of patients could sit on the edge of the bed and stand on the floor without support. ? alf of the patients could walk indoors without support. After 48 h, there was no difference between the groups with regard to mobility and nausea/itching. Identical results were found after 72 h.

Discussion

One purpose of this prospective randomised study was to compare the experiences of pain intensity in patients treated with lumbar fixation and fusion, in which one group (2roup 1) received intrathecal analgesia (ITA) in addition to conventional pain treatment, whilst the other group (2roup 2) received conventional pain treatment.

VAS P 30 is often used as a cut-off to indicate insufficient analgesia, whilst VAS P 70 is considered as a cut-off for severe pain (Woo et al., 2015). Thus, it is important to strive for VAS values U 30. No patient in this study reported severe pain (VAS P 70) during the first 12 h. This may be attributable to efficient post-procedural analgesia providing a good base for the initial postoperative period. In addition, all patients were placed in a specialised postoperative unit (PACU) during this time, with good resources and specialist nurses with a high level of knowledge and experience in postoperative pain management. Compared to the resources of a traditional ward, the PACU has a higher level of competence and level of care. Previous studies have shown that the knowledge and commitment of nurses on the ward affect the outcome of postoperative pain treatment (Ene et al., 2008a).

During the first 24 h following surgery, there was a difference in pain level between the groups, with 2roup 2 reporting a mean VAS score P 70 during movement. This level of pain may have a negative impact on the patientsVrespiratory function and the possibility of early mobilisation (Dichtwald et al., 2017). No differences in pain were found on days two and three. ? owever, neither 2roup 1 or 2 reported a mean VAS U 30. This study, like previous studies (Ene et al., 2008b; 2ramke et al., 2009; Carlson, 2010; Cooney, 2016), show that patients still suffer from moderate to severe postoperative pain.

Many patients had a pre-existing opioid requirement and the standard oral analgesic regime on days two and three may not have been sufficient even if the postoperative oral opioid regime compensated for the preoperative opioid intake (Fig. 1). Patients with preoperative chronic pain belong to a well-known risk group who may need individualised medication to treat postoperative pain (Devin et al., 2014). It is worth noting that only three of the 14 patients in 2roup 1 were treated preoperatively with opioid analgesics compared to eight out of 15 patients in 2roup 2. This may have influenced the results, as several patients in 2roup 2 may have needed a higher dose of oral oxycodone than offered by the standard regime.

At 48 h postoperatively, 2roup 2 reported a mean pain intensity of VAS P 70 both at rest and during movement for the preceding 24 h, a level of pain which can inhibit early mobilisation. It is important to remember that the mean VAS score is an expression of perceived pain intensity for the group, not for the individual patient. On the individual level, ten out of fifteen patients in 2roup 2 reported a perceived pain of VASP 70 in the preceding 24-h period both at rest and during movement. This shows that many patients experienced severe pain.

In pain management it is common to describe pain intensity as mild, moderate or severe and predetermined cut-offs have been developed to facilitate clinical treatment and evaluation (Woo et al., 2015). ? owever, the appropriateness of categorising levels of perceived pain intensity on the basis of specific limits is frequently discussed. Studies show a large variation in results when optimal cut-offs for mild, moderate and severe pain have been determined. The authors conclude that this probably depends on random variation that must be taken into account when comparing groups (? irschfeld and @rnikow, 2013).

All patients received bolus doses of morphine intravenously at the end of surgery. During day 0 (day of surgery), there was a difference between the amount of intravenously administered morphine. Similar results are described in previous studies for both spinal and abdominal surgery (Wèn et al., 2015; %im et al., 2016). During day one all patients continued with morphine via PCA pump. Even then, there was a clear difference between the groups in the amount of morphine administered. Despite a larger amount of morphine administered in 2roup 2, no side

Table 3
QoR-40 24 and 72 h postoperatively.

QoR-dimension	24 h			72 h		
	2roup 1 nT 14	2roup 2 nT 15	p-value	2roup 1 nT 14	2roup 2 nT 15	p-value
Emotional state	37.15 (4.6)	31.64 (5.7)	0.011	37.25 (6.2)	33.00 (5.8)	n. s
Physical comfort	45.92 (8.3)	43.07 (4.6)	n. s	31.46 (3.8)	29.75 (5.2)	n. s
Psychological support	29.00 (5.7)	29.50 (4.8)	n. s	31.92 (3.8)	29.58 (5.4)	n. s
Physical independence	14.23 (5.1)	12.86 (4.4)	n. s	18.38 (5.1)	16.75 (4.2)	n. s
Pain	29.69 (3.9)	25.29 (3.4)	0.004	28.08 (5.1)	25.33 (2.4)	n. s
QoR-40 total	156.00 (21.5)	142.29 (15.1)	n. s 0.065	150.17 (14.8)	134.42 (17.9)	0.029

Data for 2roup 1 and 2 are presented as mean X (SD) for each dimension, as well as for QoR-40 overall.

effects were reported in either of the groups. An important aspect from the patientQ point of view could be that the patients in 2roup 1 had a more restful nightQ sleep and did not have to wake up in pain to press the PCA pump repeatedly, an aspect that is proven to increase patientsQ satisfaction (Singh et al., 2017).

On days two and three, there was no difference in the administered amount of p.r.n oxycodone. One reason for this may be that ITA was no longer effective and both groups had an equal pain treatment. This is comparable to the findings of other studies (Wen et al., 2015; ? ong et al., 2017). Because the effect of the ITA is estimated to be 18–24 h (Rathmell et al., 2005), and is not repeated postoperatively, in this case ITA can be seen as a disadvantage compared to epidural pain treatment which can be used for several days postoperatively (? ong et al., 2017). In order to maintain good pain control, it is important to administer analgesics to compensate for the diminishing effect of the ITA. Studies advocate a multimodal approach with a combination of opioids and ad4uvant analgesics (2arcia et al., 2013; Ba4wa and ? aldar, 2015).

Nausea, vomiting and itching are known dose-dependent side effects of opioids. Even intrathecally administered morphine can cause nausea, vomiting and itching (Rathmell et al., 2005). The vast ma4rity of patients in this study rarely or never experienced problems with nausea, vomiting or itching postoperatively and there was no difference between the groups. A reason for this may be that all patients received anti-emetics.

In terms of mobility, in the first three postoperative days significant differences were observed only during day one, where 2roup 1 found it easier to stand and walk indoors without support. An explanation for this may be that 2roup 1 reported significantly lower pain levels than patients in 2roup 2. The importance of good postoperative pain management is emphasised in several studies, not the least in order to facilitate early mobilisation (Rawal, 2016). A multimodal postoperative pain management shows many benefits in terms of increased mobility and early mobilisation after extensive back surgery (Mathiesen et al., 2013). Furthermore, postoperative mobilisation has been shown to be facilitated by procedure-specific pain management and planning (Joshi et al., 2014). ITA in con4unction with spinal surgery may have an important role here.

The quality of the postoperative recovery was measured with the QoR-40 on days one and three. 24 h postoperatively, there was a significant difference in the dimensions YpainVand YemotionsV a result that can confirm that 2roup 1 experienced a lower degree of pain during the first postoperative day. Probably the difference in the dimension YemotionsVwas linked to higher pain levels in 2roup 2 during day one. The overall QoR-40 score showed some difference, but not at a significant level. After 72 h, there was only a difference in the overall score, positive for 2roup 1. This was possibly due to good postoperative analgesia in the early stages, which is of great importance for the quality of the recovery (Allvin et al., 2011; Myles et al., 2000a,b; Moro et al., 2016; Cohn et al., 2016).

QoR-40 has been used to identify possible predictive factors that can affect the quality of postoperative recovery in various surgical disciplines. Pain, male sex and nausea/vomiting have been shown to contribute to low total scores (Moro et al., 2016; 2uimaraes-Pereira et al., 2016), studies with comparable results to this one. Myles, ? unt, Fletcher et al. (2001) showed that a low QoR-40 score day 3 postoperatively after heart surgery can predict a low score even at follow-up three months later.

There are several aspects of the concept of postoperative recovery and how they affect time to hospital discharge (Allvin et al., 2007). The length of hospital stay did not differ between the groups, although 2roup 1 experienced less pain and better ability to mobilise during the first postoperative period. The reason for this may be that time to hospital discharge not only depends on factors such as post-operative pain and mobility but is also influenced by the patientsVpreoperative condition and domestic situation (Wen et al., 2015). Even early transition to oral analgesics and removal of urinary catheters have been proven to shorten the length of stay (? ong et al., 2017).

6imitations

This study has a limited number of participants. The small number of enrolled patients can be explained by rigid inclusion criteria which were difficult to meet, especially the requirement that no patient could be treated with gabapentin preoperatively. This excluded many potential participants. In addition, the study was conducted at a University ? ospital where spinal fusion and fixation is often performed above the level that this study intended to investigate (under L2). Other limitations was that perioperative intravenous analgesia was not given as a standardised dose according to body weight and age but was based on physician choice, and that the ITA treatment was blinded for the patients but was not possible to blind for the staff.

Conclusion

It is not possible to draw any general conclusions from the results of the present study. ? owever, it was clear that many patients in 2roup 1 experienced less postoperative pain during the day of surgery and on postoperative day one. These results may confirm health professionalsV clinical experience that supplementing the postoperative pain treatment with (Intrathecal Analgesia) ITA has a positive effect on early postoperative recovery. Further studies are needed to determine if supplementation with ITA has an effect on the later part of the postoperative recovery or the risk of chronic pain. To measure the quality of postoperative recovery by using the QoR-40 on a larger number of spinal surgery patients, both preoperatively and postoperatively over a longer period could be helpful to develop, understand and improve recovery after ma4r spinal surgery.

Ethical considerations

The study was approved by the Regional Ethical Review Board (reference number 388-11) at 2othenburg University, Sweden.

Conf icts of interest

There were no conflicts of interest.

Financial disclosure

There were no financial disclosure.

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