An observational audit of pain scores post-orthopaedic surgery at a level two state hospital in Cape Town

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Abstract

Objectives: The aim was to determine whether postoperative pain is satisfactorily controlled in patients undergoing orthopaedic surgery at a level two state hospital in Cape Town.

Design: Two observational audits were performed 12 months apart as part of a full audit cycle.

Setting and subjects*:* In view of perceived poor postoperative pain control, an audit was performed of acute postoperative pain scores, anaesthesia techniques, and patient satisfaction with pain control. Orthopaedics patients undergoing surgical procedures at a level two state hospital in Cape Town were enrolled in the two audits. Patient groups included both patients admitted to the hospital and day-cases.

Outcome measures: Patients admitted to hospital following major surgery, rated their perceived pain over 48 hours, using a visual analogue scale (VAS). Day-case patients scored their pain in hospital, and were then contacted telephonically after 24 hours, and if required, after 48 hours. A VAS score ≥ 4 was regarded as unacceptable. The interventions employed after the first audit were: pain rounds, staff education and training, increased postoperative epidural time, patient-controlled analgesia pumps and indwelling femoral catheters following total knee replacement.

Results: Data were analysed from 71 patients in each audit. Mean VAS scores were unacceptable 12 and 24 hours after major surgery (range 4 - 5.1 in audit 1). Following the introduction of the aforementioned interventions, the mean pain scores were < 4 at every time point measurement, and significantly lower than in audit 1 at most assessment times ($p < 0.05$). Patient satisfaction with pain control improved from 32.4% in audit 1 to 54.9% in audit 2.

Conclusion: Acute postoperative pain is an important clinical problem in orthopaedic surgery. Following the demonstration of unacceptable postoperative pain scores in the first audit, specific interventions were shown to significantly improve pain control in the follow-up audit.

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Introduction

Pain is defined as "an unpleasant sensory and emotional experience, associated with actual or potential tissue damage, or described in terms of such damage".[1] Pain is feared by many people because of its unpredictable nature and the knowledge that the potential to experience severe and uncontrolled pain exists within all of us.[2] Severe pain has the potential to "force people to close their eyes to the world, and reduce them to a single experience dominated by a single desire: for it to stop".[2] Therefore, it is no surprise that pain is one of the concerns most frequently raised by patients prior to surgery.[3,4]

The control of acute perioperative pain is gaining increasing prominence in the literature, locally and internationally. Consensus data from the last 40 years indicate that 50-75% of patients experience moderate to severe pain postoperatively.[1,5,6] This is despite knowledge that the control of postoperative pain is physiologically important in terms of limiting stress and cardiovascular response, decreasing tissue breakdown and limiting immune impairment, limiting

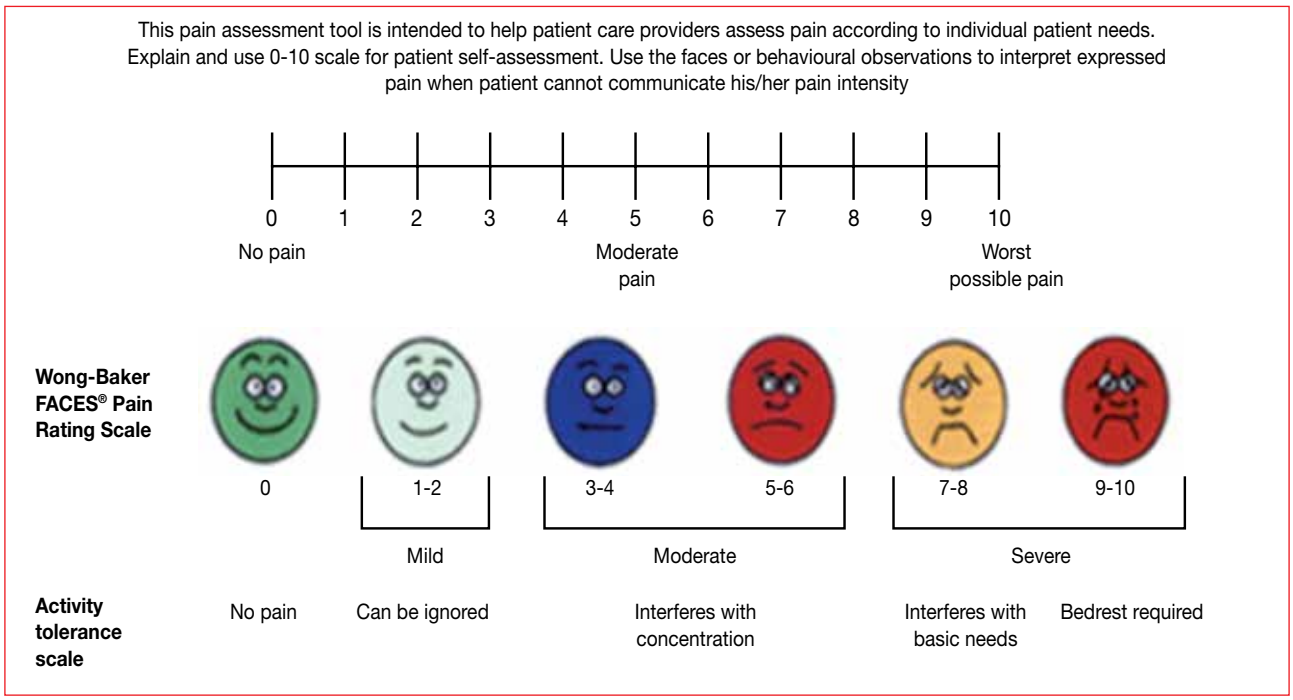


Figure 1: Universal Pain Assessment Tool

fluid retention, and potentially shortening hospital stay, and thus postoperative health cost expenditure.[7-9]

A change in the perception of postoperative pain management has occurred, with patients expecting a care plan that includes aggressive postoperative pain control.[1] There are limited data available on the levels of postoperative pain in South Africa. With this in mind, an audit cycle was performed to score postoperative pain in patients undergoing orthopaedic surgery at a level two state hospital in Cape Town. This study population was chosen because pain associated with orthopaedic surgery, as shown by meta-analyses, is rated as very severe by patients.[10] Some reports indicate that pain associated with bone and joint surgery is more intense than that experienced by patients undergoing abdominal or visceral surgery.[11] A considerable number and variety of orthopaedic surgery cases are performed each month at Victoria Hospital, Wynberg. The latter provides access to a relatively large study population. All surgical patients at Victoria Hospital are managed together in the same surgical wards. It was hoped that by auditing a specific surgical group that was shown to rate their pain as high, this could translate into improved pain scores in this and other surgical disciplines.

Method

Approval was obtained for both observational audits from the Human Research Ethics Committee of the University of Cape Town. Audit 1 took place between April and June 2011. Consenting patients older than 18 years and undergoing elective and emergency orthopaedic surgery were enrolled during office hours. Anaesthesia technique was at the discretion of the attending anaesthesiologist, after discussion with the consultant anaesthesiologist, taking into consideration the co-morbidities of the patient and the nature of the surgery. Regional and general anaesthesia techniques were used in combination in appropriate cases. The administration of intraoperative analgesia, determined by the clinical response of the patient to surgery, was also at the discretion of the attending anaesthesiologist.

Surgical procedures were divided into major or minor surgery, and patients were analysed separately as either hospital or day cases. The primary outcome was a comparison of mean postoperative pain scores in audit 1 and audit 2. Comparisons were made at each measured time point for enrolled patients. Patients were divided into major and minor surgical cases for analysis, and patients who did or did not receive central and/or peripheral nerve blockade. Patient demographics, pre- and intraoperative analgesia, postoperative orders, and side-effects to medication were also recorded for analysis. The take-home analgesia for day cases was similar to that administered in the postoperative orders of hospital cases. An audit of anaesthesia technique was performed using the information obtained from the data sheets. Total postoperative analgesia consumed by patients was also noted, but was not used in the analysis.

Postoperatively, patients were asked to rate their pain scores using a visual analogue scale (VAS) (Figure 1) at four time points, both at rest and during movement. Patients were asked to attempt to move the affected area to assess pain during movement. The four measured time points were

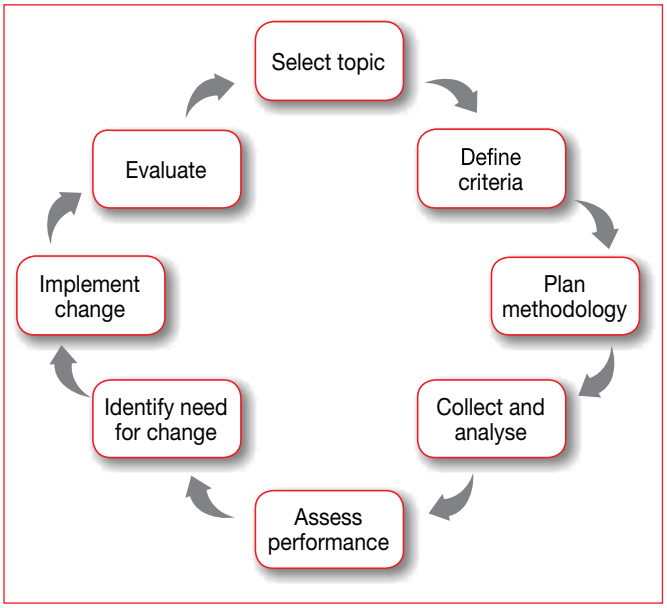


Figure 2: The audit cycle

0 hours, defined as the time at which the patient was ready for discharge from the recovery area to the ward, and then again at 12, 24, and 48 hours postoperatively. The 12-hour time point for day-case patients was defined as the point at which the patient was ready for discharge from the hospital. Telephonic contact was made with the day-case patients to establish their 24-hour pain score. Depending on the 24-hour response, some day cases were contacted again at 48 hours. Patients were also asked to report their satisfaction with pain control as one of four options: "very good", "good", "adequate" and "poor". Data were collected by members of the Department of Anaesthesia, and by surgical interns for the 12-hour score when the anaesthesiologist was unavailable. This helped limit inter-rater variability.

Consensus was that a VAS ≥ 4 (scale 0-10) would be determined as an unacceptable level of pain, based upon the Universal Pain Assessment Tool (Figure 1). If the average pain score in audit 1 was greater than 4 at any measured time point, an intervention and repeat assessment was carried out in order to assess the effectiveness of the employed interventions, thereby completing the audit cycle (Figure 2).

The five interventions employed after audit 1 were:

- Daily pain rounds in the surgical wards, in the form of a multidisciplinary ward round.
- Staff education and training, including a regional anaesthesia workshop for the anaesthesia department staff.
- Increased duration of epidural care from the previous 24-hour, to a 48-hour protocol, as a standard of care.
- The introduction of patient-controlled analgesia (PCA) pumps containing a standard mixture of morphine (100 mg), ketamine (25 mg) and droperidol (2.5 mg), diluted to a total volume of 100 ml, delivering 1 ml on demand every eight minutes.
- The placement of indwelling catheters for femoral nerve blocks in patients undergoing total knee replacement.

These interventions were introduced at Victoria Hospital, Wynberg, from July 2011-July 2012, and became the standard of postoperative care during that time. Audit 2 was then completed between August 2012 and October 2012. Audit 2 was identical to audit 1 in terms of format and structure.

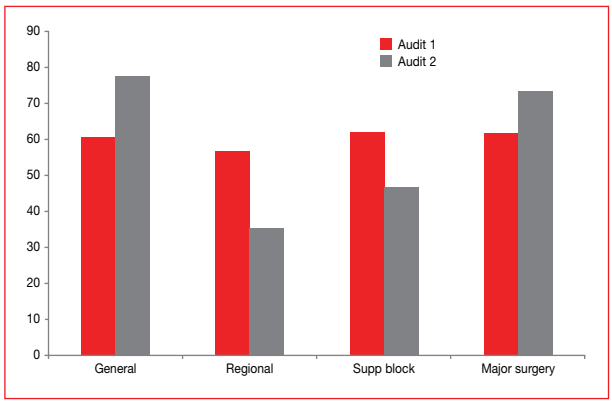
Although both audits are observational, there was an ethical obligation to intervene if a patient rated their VAS score as ≥ 7 at any time point. The investigator was obliged to check that all prescribed analgesia had been administered appropriately, and then to order additional analgesia as required.

The data from both audits were analysed as follows: One-sided t-tests, assuming unequal variances, were used to determine if there was a reduction in the pain scores from audit 1 to audit 2. In addition, Wilcoxon rank-sum tests were performed as normality of the data was not formally tested. Since the at-rest and during movement VAS scores per patient were positively correlated, the two scores per patient per time point were combined into one by calculating the average, giving a more accurate and precise estimate of overall pain scores. The means and medians of these average scores were used to test for a reduction in pain scores from audit 1 to audit 2. In addition to the overall pain scores per time point, the at-rest and during-movement scores were also analysed separately. Statistical significance was assumed at a p-value < 0.05. All statistical calculations were performed using the R language and programming environment.[12]

Results

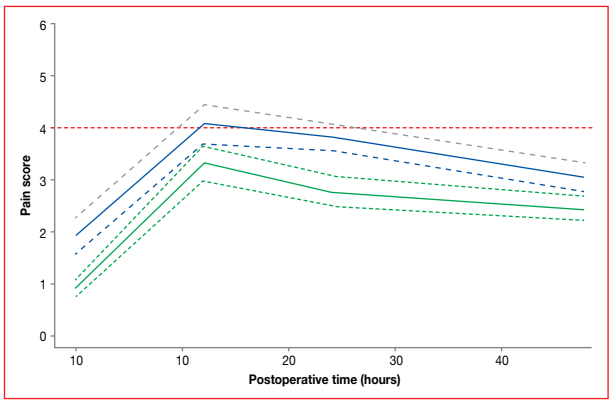
One hundred and fifty-nine patients were enrolled in the two observational audits. There were 84 patients (52 in-patients, 19 day cases and 13 who were lost to follow-up) in audit 1. There were 75 patients (55 in-patients, 16 day cases and four lost to follow-up) in audit 2. Thus, the total number of patients included in the final analysis was 142 (71 in each audit cycle). The demographic details of the patients in audit 1 and 2 were similar in terms of age and gender. Typically, major surgical procedures necessitated admission to the wards, classifying patients as in-patients, and minor procedures were performed on day cases.

Sixty-two per cent of patients in audit 1 underwent a major orthopaedic surgical procedure, and 38% underwent a minor procedure. Seventy-three per cent of patients in audit 2 underwent major surgery. Minor surgery was performed in 27% of patients. The anaesthesia techniques employed in



Supp block: supplementary block

Figure 3: Anaesthetic technique as a percentage



The solid black and green lines indicate the average pain scores for audit 1 and 2, respectively
The dashed lines indicate the standard errors of the means
The dotted red line indicates the VAS score of 4, corresponding to an unacceptable pain score

Figure 4: Combined mean visual analogue scale for audit 1 and 2

the two audits are shown in Figure 3. A general anaesthesia technique was performed in 61% of patients in audit 1 and in 78% of patients in audit 2. Regional anaesthesia was administered in 56% of patients in audit 1, and in 35% of patients in audit 2. Fifteen patients in audit 1 received a combination of a general anaesthesia technique and a peripheral nerve block, three of whom were day cases and 12 in-patients. Sixteen patients in audit 2 received a combination of general anaesthesia and a peripheral nerve block, of whom one was a day case and 15 in-patients.

A lower number of supplementary blocks, including neuraxial techniques, were performed in audit 2 (47%) vs 62% in audit 1. Spinal anaesthesia was performed in 15 patients in audit 1 and 13 in audit 2. Epidural catheters were inserted in 10 patients in audit 1, and six in audit 2. No indwelling femoral catheters were placed in audit 1, while nine were placed in audit 2, five together with general anaesthesia and four in conjunction with a neuraxial block. Thus, no comparison could be made between audit 1 and 2 with respect to the use of indwelling femoral catheters. Four single-shot femoral blocks were performed in both audits. A summary of the blocks performed is shown in Table I.

Table I: Summary of supplementary blocks

Block type	Audit 1 (n)	Audit 2 (n)
Spinal	15	9
Epidural	10	6
Biers	4	-
Femoral catheter	-	5
Single-shot femoral	4	4
Spinal and femoral catheter	-	4
Wrist	3	-
Other	8	5

The overall mean pain scores at rest and during movement were calculated for each time point in both audits. The results of the parametric t-test and non-parametric Wilcoxon rank-sum tests were shown to concur for all the analyses made. The mean VAS scores per audit at each time point are shown in Table II.

An average pain score was calculated for pain at rest and during movement for each patient, and the mean of these averages is given. The mean VAS pain scores for audit 2 were significantly lower than those in audit 1, with the effect most pronounced in two groups, namely those who underwent major surgery and those who received a supplementary block. A similar trend was observed for the mean pain scores over the 48-hour period in both audits (Figure 4). A peak in the mean VAS scores occurred at 12 hours, followed by a progressive decrease in scores towards 48 hours.

The mean VAS scores were significantly lower in audit 2 for most groups at the 0-, 12- and 24-hour measured time points, while there was a significant decrease in the mean score at 48 hours in the major surgery group only. There were no significant between-audit differences in the minor

Table II: Mean visual analogue scale score per time point, and the overall mean of the 48 hours

Audit	0 hours		12 hours		24 hours		48 hours		Overall	
	1	2	1	2	1	2	1	2	1	2
Major surgery	2.2	1	5.1	3.7	4.3	3.2	3.3	2.5	3.8	2.6
Minor surgery	1.4	0.5	2.4	2.2	3	1.7	1.8	2.1	2.2	1.4
Block	1	0.4	4.1	2.9	3.8	2.7	3.1	2.4	3	2
No block	3.4	1.3	4	3.6	3.8	2.8	2.9	2.4	3.5	2.5
Total	**1.9**	**0.9**	**4**	**3.3**	**3.8**	**2.8**	**3**	**2.4**	**3.2**	**2.3**

Table III: Differences between audit 1 to 2 in the mean visual analogue scale scores (at rest and during movement)

Audit	0 hours	12 hours	24 hours	48 hours	Overall
Major surgery	-1.2 (0.0100)	-1.4 (0.0097)	-1.1 (0.0081)	-0.9 (0.0207)	-1.2 (0.0003)
Minor surgery	-0.9 (0.0571)	-0.2 (0.4027)	-1.3 (0.0463)	0.3 (0.6140)	-0.8 (0.0541)
Block	-0.6 (0.0397)	-1.2 (0.0533)	-1.1 (0.0294)	-0.7 (0.0864)	-0.9 (0.0111)
No block	-2 (0.0036)	-0.4 (0.3065)	-0.9 (0.0548)	-0.4 (0.2274)	-1 (0.0133)
Total	**-1 (0.0042)**	**-0.8 (0.0651)**	**-1 (0.0056)**	**-0.6 (0.0590)**	**-0.9 (0.0012)**

The one-sided p-values for t-tests are given in brackets

Table IV: Differences between audit 1 and audit 2 in mean visual analogue scale scores at rest

Audit	0 hours	12 hours	24 hours	48 hours
Major surgery	-1.1 (0.0131)	-1.6 (0.0032)	-1.2 (0.0020)	-1.1 (0.0036)
Minor surgery	-0.9 (0.0536)	-0.3 (0.3503)	-1.2 (0.0506)	0.1 (0.5411)
Block	-0.7 (0.0237)	-1.2 (0.0470)	-1.2 (0.0153)	-1.1 (0.0106)
No block	-1.7 (0.0076)	-0.7 (0.1585)	-1 (0.0296)	-0.4 (0.2232)
Total	**-1 (0.0043)**	**-0.9 (0.0237)**	**-1.1 (0.0016)**	**-0.8 (0.009)**

The one-sided p-values for t-tests are given in brackets

Table V: Differences between audit 1 and audit 2 in mean visual analogue scale scores during movement

Audit	0 hours	12 hours	24 hours	48 hours
Major surgery	-1.4 (0.0120)	-1.2 (0.0317)	-1 (0.0315)	-0.6 (0.1015)
Minor surgery	-0.9 (0.0622)	-0.1 (0.4477)	-1.4 (0.0555)	0.6 (0.6572)
Block	-0.6 (0.0662)	-1.2 (0.0646)	-1.1 (0.0577)	-0.3 (0.3244)
No block	-2.3 (0.0034)	0 (0.4771)	-0.8 (0.1088)	-0.4 (0.2659)
Total	**-1.1 (0.006)**	**-0.6 (0.1497)**	**-1 (0.0213)**	**-0.3 (0.2238)**

The one-sided p-values for t-tests are given in brackets

surgery group, except at 24 hours, and in patients receiving no nerve block, except at 0 hours postoperatively (Table III).

Calculation of the mean VAS scores of patients at rest reflected similar significant differences between audits 1 and 2. The change in mean VAS scores at rest from the first to the second audit, as well as differences from zero, are shown in Table IV. With the exception of patients undergoing minor surgery and those not receiving a nerve block, most of the between-audit differences in mean VAS scores at rest differed significantly.

The differences in mean VAS scores during movement between the first and the second audit are shown in Table V. Overall, the change in mean VAS scores during movement were significant at the 0- and 24-hour, but not at the 12- and 48-hour, measured time points. The greatest significance in mean score decrease was again seen in the major surgery group. Overall, a negative change in mean pain scores was noted (decreased mean scores for all time points during the 48-hour period) between the two audits.

Table VI: Overall patient satisfaction

Overall satisfaction	Audit 1 (%)	Audit 2 (%)
Poor	2.8	1.4
Adequate	22.5	7.0
Good	42.3	36.6
Very good	32.4	54.9

Table VI shows a comparison of the overall satisfaction levels of patients between the two audits. There was an improvement in patient satisfaction in the "adequate" and "very good" groups, of which the last made up the majority of patients in the second audit.

Discussion

These two observational audits carried out in 2011 and 2012 at a level two state hospital in Cape Town have shown that simple, achievable interventions can decrease pain scores after orthopaedic surgery in adult patients.

There was a significant decrease in pain scores from audit 1 to audit 2 in the following groups:

- Major surgery at 0-, 12-, 24- and 48-hour time point measurements, and overall.
- Minor surgery at the 24-hour time point measurement.
- Patients receiving either a central neuraxial or peripheral nerve block at the 0- and 24-hour time point measurements and overall.
- Patients in whom no neuraxial or peripheral nerve block was performed, at the 0-hour time point measurement and overall.

It was observed that significant differences in pain scores did not extend to 48 hours, but this was expected since generally pain levels post-orthopaedic surgery decrease significantly by this time.[13] In addition to this, the insignificant decrease in pain scores across the audits in the minor surgery group was also expected. This group already rated their pain levels to be low in audit 1, making a significant decrease difficult to achieve.

Not only did patients in the second audit rate their pain scores lower than those in the first, but the percentage number of patients rating their pain control as "very

good" increased markedly in the audit performed after the interventions were introduced. Thus, both pain scores and patient satisfaction of pain control were improved.

The significant decrease in pain scores in audit 2 was achieved despite the higher number of patients undergoing major surgery in the repeat audit (73% vs 62%). This indicates it was likely that the ability to control pain would have improved after the introduction of the interventions, as it was assumed that the pain experienced by patients following major surgery would be rated as higher.

Employed interventions

The employed interventions were not analysed separately to determine each individual contribution, but were rather seen as an overall process for improved pain control.

Daily pain ward rounds

Daily multidisciplinary ward rounds took place in the male and female surgical wards. Organised management of acute pain is a relatively recent phenomenon, which has gained increased awareness since its beginnings in the 1980's when anaesthesiologists started organising acute pain services.[14-16] Acute pain ward rounds provide an ideal opportunity to teach service providers, address misconceptions, discuss pain-related issues with patients, and adapt prescription charts to improve pain control, as needed.

Staff education, including a regional anaesthesia workshop for the anaesthesia department staff

Education and training of staff and patients is key to improved pain control.[17] Goodacre and Roden were able to demonstrate improved pain control in patients with just a few hours of focused teaching.[17] Several aspects of staff education were addressed following audit 1. Informal lectures, together with question and answer sessions, were held at the weekly hospital academic meetings. Members of staff from the various disciplines were invited to these sessions. Topics covered included the physiology of pain, "step-wise" analgesia, the results of audit 1, and discussions around the proposed interventions. Attendance at a regional anaesthesia workshop by anaesthesiologists working in the Department of Anaesthesia at Victoria Hospital, Wynberg, formed part of the education process, and is believed to have contributed to the improved scores seen in patients receiving regional anaesthesia during audit 2.

Management of epidural analgesia

A longer duration of epidural analgesia in audit 2 was shown to be a highly effective means of decreasing the pain scores. By simply increasing the duration of the epidural analgesia from 24 to 48 hours, there was a clinically significant decrease in the pain scores.

Epidural anaesthesia is an ideal technique for lower limb total joint and regional orthopaedic surgery. This method effectively provides good postoperative analgesia, and may reduce venous thromboembolism, respiratory morbidity, and blood loss, as well as facilitating rehabilitation.[18-20]

Although fewer epidural catheters were placed in audit 2, the total epidural time increased from 240 to 288 hours, ensuring adequate pain relief for the entire investigation period.

Patient-controlled analgesia pumps

Unfortunately, owing to the size of the wards and the limited number of staff, medication is not always administered as prescribed. One international study estimated that up to 25% of prescribed analgesic medication was not given postoperatively.[21] Interrogation of the prescription charts on the wards after audit 1 showed that often either the oral medication or intramuscular morphine was given without the other. This results in an unintentional unimodal analgesic strategy. During the present audits, this became a focus of staff education, as well as a motivation for the introduction of PCA pumps.

PCA affords patients control of their own analgesic administration, meaning that patients no longer depend upon nursing staff to administer opioids. Research has consistently shown that patients with intravenous PCA pumps use less opioid than that used in standard intramuscular regimens,[22-24] potentially decreasing side-effects. The use of PCA pumps consistently improves patient satisfaction with regard to pain control. However, there is conflicting evidence as to whether or not they produce significantly lower VAS scores.[25] It is most likely that the institution of PCA pumps will have contributed to the increased patient satisfaction seen in audit 2, with an indeterminate contribution to lowered pain scores.

Catheter placement for femoral nerve blocks

The placement of catheters for continuous femoral nerve local anaesthetic infiltration was an intervention that was introduced during the period between the two audits. These were primarily used for patients undergoing total knee replacement. Patients with a femoral catheter were not required to be admitted to the high care unit postoperatively. Femoral catheters were used as part of a multimodal approach to analgesia, and not as a unimodal technique. The scores obtained in patients receiving indwelling femoral catheters showed them to be a consistently effective means of controlling postoperative pain during the investigation period. Single-shot regional blocks are notorious for their "wear-off" phenomenon, and this effect may be eliminated by the use of indwelling catheters with a continuous infiltration of local anaesthetic.[26]

The development of continuous perineural local anaesthetic infiltrating devices has been described as one of the most important advances in the management of postoperative pain following orthopaedic surgery.[26] A continuous perineural infiltration of local anaesthetic eliminates the relatively short duration of a single-shot femoral nerve block. By incorporating a local anaesthetic agent as part of the multimodal strategy, it is possible to significantly reduce opioid consumption and side-effects.[27] Local anaesthetic agents have been shown to provide both effective analgesia and inhibition of the inflammatory response produced by surgical trauma.[27]

Conclusion

Pain remains a problem in surgical wards throughout the world, yet little research has been carried out to evaluate the magnitude of this problem in our patient population. This audit cycle showed that pain following orthopaedic surgery at a level two hospital in Cape Town was not well controlled, with unacceptable postoperative pain scores recorded at measured time points in audit 1. Encouragingly, the introduction of five simple interventions aimed at decreasing postoperative pain was shown to result in a significant improvement in postoperative VAS scores in audit 2. In order for strategies that aim to decrease pain to be effective, agreement on the implementation of the intervention strategies is required, as well as ongoing commitment from health workers involved in the postoperative care of patients.

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