

Problems Related to Epidural Analgesia for Postoperative Pain Control

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Abstract

Introduction: Epidural analgesia provides excellent analgesia after major surgery but it is not without adverse effects. This retrospective study aims to evaluate the efficacy of analgesia and the problems commonly encountered postoperatively. **Materials and Methods:** Elective surgical patients who had epidural catheters inserted perioperatively intended for postoperative analgesia over a 1-year period were studied. Anaesthetic charts and daily records of patient evaluation by the Acute Pain Service (APS) for pain relief, side effects and their subsequent management were analysed. **Results:** A total of 471 patients had epidural catheters inserted for postoperative analgesia. Ninety per cent of patients received continuous local anaesthetic infusion (75% ropivacaine and 15% bupivacaine) and 10% received intermittent morphine boluses. There were few serious complications but 60% of patients required one or more interventions by the APS, mainly for inadequate analgesia. One-third of patients had their epidural analgesia terminated prematurely due to inadequate analgesia (14.2%), shortage of beds in the high-dependency unit (14%) and other complications. Only 19% of patients had no reported adverse effects. **Conclusion:** Although the incidence of serious complications was low, there was a high incidence of minor adverse effects especially during the first 48 hours. This emphasises the importance of close monitoring during the early postoperative period and the APS in the management of side effects, especially inadequate analgesia.

Ann Acad Med Singapore 2002; 31:509-15

Key words: Anaesthetic techniques, Audit, Complications, Epidural, Pain, Postoperative, Retrospective

Introduction

Epidural analgesia has been shown to provide excellent pain relief following thoracotomy,¹⁻³ abdominal⁴⁻⁶ and other surgery.^{7,8} Studies have shown improvement in specific variables⁹⁻¹² with epidural analgesia; and effective postoperative pain relief is a prerequisite to attain improved postoperative outcome.^{13,14} However, good analgesia *per se* has not been shown to improve postoperative outcome.¹³⁻¹⁵ The benefits of epidural analgesia therefore have to be weighed against its risks and complications. Although life-threatening complications are uncommon,^{16,17} there are other problems encountered in daily practice. These need to be addressed in order to allow patients to benefit fully from perioperative epidural anaesthesia and analgesia.

Our hospital is a 1600-bedded tertiary hospital, with an established Acute Pain Service (APS) set up since 1993. The number of epidural catheters inserted for postoperative pain control has remained constant over the last few years. With the aim of improving the quality of epidural analgesia and development of the APS, this study evaluates the efficacy of pain relief and the problems commonly encountered during the postoperative period.

Materials and Methods

Data were retrospectively collected from charts of patients who received epidural analgesia perioperatively over a 1-year period from May 1999 to April 2000. Exclusion criteria included epidural catheters inserted following trauma and patients with chronic cancer pain. Data were collected from records of the APS, nursing charts and patient case files. These included demographic data, type of surgery, daily verbal pain score (VPS) (0 = no pain, 1 = mild pain, 2 = moderate pain and 3 = severe pain) at rest and on movement (coughing, during deep breathing exercises or on sitting up), number of changes in regime and incidence of complications.

Intraoperative

The attending anaesthetist decided on the specific analgesia technique needed for each patient. Epidural infusions were provided via Perifix[®] catheters (Perifix[®] complete set, B. Braun Melsungen AG) inserted at an appropriate level for the surgery. The person performing the epidural, timing and site of placement and any complications during insertion were recorded. Drugs used intraoperatively and adverse events in recovery room were also noted.

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Postoperative

The initial choice and concentration of local anaesthetic and opioid was made by the attending anaesthetist, but modified by the APS as necessary. All patients were monitored in the intensive care or high-dependency units postoperatively by trained nursing staff. Blood pressure (BP), pulse rate, sedation score (0 = none, wide awake and alert; 1 = mild, occasionally drowsy, easy to arouse; 2 = moderate, frequently drowsy, easy to arouse; 3 = severe, difficult to arouse; and S = normally sleeping, easy to arouse), respiratory rate and VPS at rest and on movement were recorded hourly. The incidence of side effects and treatment instituted were noted.

Standard orders for postoperative epidural analgesia (Appendix I) included notation of intraoperative analgesia (drug, time of administration and dose), an order for subsequent analgesia, monitoring instructions and orders for the treatment of common side effects. The APS was called when there was inadequate analgesia, sedation score = 3, respiratory depression (rate <8/min), excessive motor blockade (modified Bromage score ≥ 2) or hypotension (likely related to epidural analgesia). Changes to the analgesia regime were made solely by the APS and as necessary to optimise analgesia and reduce side effects. All changes were recorded.

Information collected by the APS on twice daily rounds included rate of infusion or morphine dose and time interval between injections, VPS at rest and on movement, and an assessment of side-effects (nausea/vomiting, excessive sedation, respiratory depression, pruritus, excessive motor blockade and catheter site infection). As a large proportion of patients had urinary catheters inserted prior to surgery, no attempt was made to determine the incidence of urinary retention. If there were no contraindications, adjuvant oral analgesics (paracetamol and non-steroidal anti-inflammatory drugs) were started when the patients could take orally. No supplemental opioids were administered.

Definitions

Nausea requiring treatment, and vomiting complained about by the patient were recorded. *Sedation* was defined as excessive when the sedation score was ≥ 2 and *respiratory depression* when the respiratory rate was ≤ 8 /min in the presence of excessive sedation. *Hypotension* was defined as a systolic BP of ≤ 90 mmHg or a fall of $\geq 30\%$ of normal systolic BP. *Pruritus* was defined as itching generally limited to the upper body and not attributable to surgical dressings, tape, or other known allergens. *Excessive motor block* was defined as a modified Bromage score of ≥ 2 (0 = no motor block, 1 = inability to raise extended leg, 2 = inability to flex knee, and 3 = inability to flex ankle joint). *Skin site inflammation* was defined as an area of

erythema of ≥ 5 mm or the presence of induration or discharge from the catheter site. *Interventions* referred to changes to the infusion regime made by the APS. This consisted of either an increase/decrease in the infusion rate, change in concentration of local anaesthetic or opioid concentration or both, or switch from a local anaesthetic infusion to epidural morphine boluses. *Inadequate analgesia* was defined as VPS ≥ 2 at rest or with movement, or whenever the patient complained of pain.

Statistical Analysis

Statistical analysis was performed using contingency table analysis (χ^2) and Spearman's rank coefficient as appropriate. A level of $P < 0.05$ was considered significant.

Results

Patient and Surgery

A total of 471 patients had epidural catheters inserted for postoperative analgesia. Some data were lost due to incomplete charting and inability to locate the appropriate charts. Therefore, the total number of patients for each category of results varies. Demographic data are shown in Table I.

The distribution of patients from the 3 main ethnic groups was representative of the local ethnic population. The types of surgery performed are shown in Table II. Epidural analgesia was instituted mainly for intra-abdominal procedures and thoracotomies. Majority (87%) of surgeries were carried out under combined general and epidural anaesthesia with 13% performed under epidural anaesthesia alone.

Epidural Catheter Insertion

Majority of catheters were inserted in the mid-thoracic

TABLE I: PATIENT DEMOGRAPHICS (n = 471)

Characteristic	
Age (y)	
Mean	60.82
SD	14.75
Weight (kg)	
Mean	57.61
SD	11.57
Gender	
M:F	247:224
ASA status	
I:II:III:IV	94:282:94:1
Race	
Chinese	418
Malay	25
Indian	18
Others	9

ASA: American Society of Anesthesiologists

TABLE II: THE DISTRIBUTION OF PROCEDURES PERFORMED

Procedure	No. of patients
Intra-abdominal	285
Upper abdominal	148
Lower abdominal	77
Abdominal	60
Thoracic	101
Peripheral vascular	21
Joint replacement	43
Others	3

Abdominal—refer to cases where surgery involves both the upper and lower abdomen. These include cases like exploratory laparotomy or extensive surgery e.g. an incision from the xiphisternum to the pelvis.

region (Fig. 1), with lumbar epidural catheters inserted in only 95 patients (22.3%). Doctors of different rank and experience, from anaesthetic consultants to trainees (supervised by a specialist) inserted the catheters (Fig. 1). At the time of insertion, there were 7 cases (1.5%) of accidental dural puncture and a failure rate of 1.0%. Most (85%) of the catheters were inserted before induction of anaesthesia; however, of these, only 15% recorded that testing of adequacy of block was carried out.

Intraoperative Care

Intermittent bolus dose of bupivacaine was used in 59% of patients; 25% received ropivacaine and 9.0% lignocaine. The remainder received a combination of local anaesthetics.

Postoperative Care

Postoperatively, a continuous local anaesthetic infusion, fentanyl (0 to 4 µg/mL), was used in 90% of patients; the remaining 10% received intermittent boluses of epidural morphine. Ropivacaine 0.2% was the local anaesthetic used in 75% and bupivacaine (0.1% to 0.125%)

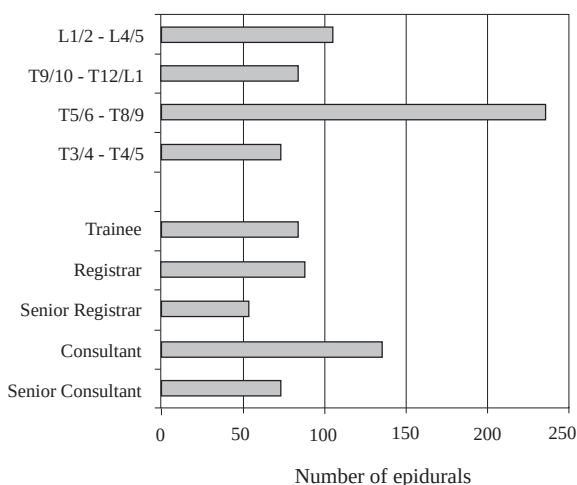


Fig. 1. The distribution of site of epidural catheter insertion and seniority of persons inserting the epidural catheters ($n = 431$).

in 15%. The fentanyl concentration of 2 µg/mL was used in 90% of those who received local anaesthetic infusions. The mean fentanyl dose infused was 0.23 ± 0.12 µg/kg/h on the first postoperative day and 0.25 ± 0.11 µg/kg/h on both the second and third postoperative days. Maximum dose was 0.84 µg/kg/h.

The median duration of epidural analgesia was 2 days [inter-quartile range, 1.5 to 3 days (range, <1 to 6 days)] and 148 (31.4%) patients had their epidural analgesia terminated prematurely. The reasons included inadequate analgesia (14.2%), shortage of beds in the high-dependency unit (14%) and complications (catheter related or side effects) in the remaining 7.2%. Figure 2 shows the reasons for termination from the day of insertion to the second postoperative day. By the end of the operative day, 7.9% of catheters inserted had been removed and at the end of the first postoperative day, a further 15% of epidural were discontinued prematurely. Figure 3 shows the distribution of pain scores recorded by the APS on the morning round during the first 3 postoperative days. Patients tended to have no pain at rest and mild pain on movement. This trend continued from the first to the third day.

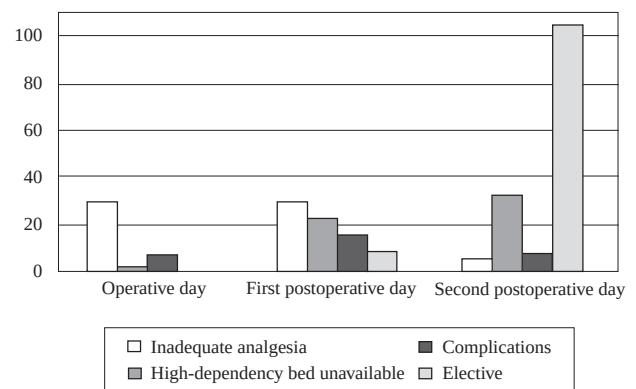


Fig. 2. Reasons for termination of epidural analgesia at the end of the operative day, first postoperative day and second postoperative day.

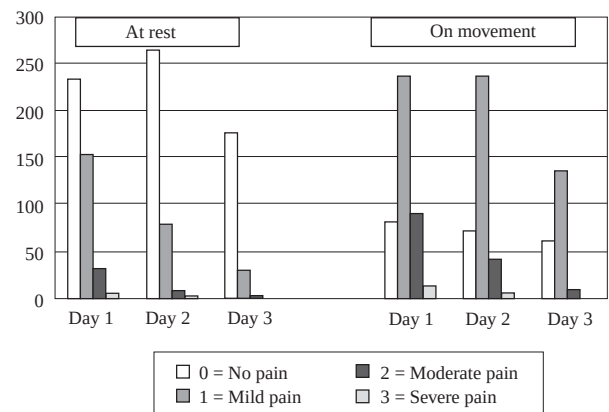


Fig. 3. Verbal pain scores during the first 3 postoperative days at rest and on movement. Day 1 is the first day after surgery.

TABLE III: ADVERSE EFFECTS (n = 471)

Effect	No. of patients (%)
None	89 (18.9)
1 adverse effect	201 (42.7)
≥ two adverse effects	181 (38.4)
Mechanical problems	27 (5.7)
Inadequate analgesia	276 (58.6)
Excessive motor block	10 (2.1)
Hypotension	81 (17.2)
Nausea/vomiting	107 (22.7)
Pruritus	70 (14.9)
Excessive sedation	13 (2.8)
Respiratory depression (requiring intervention)	0
Neurological	0
Catheter migration	1 (0.2)
Inflammation/infection	9 (1.9)

Adverse Effects

The various adverse effects are shown in Table III. Only 89 (18.9%) patients were reported not to have suffered any adverse effects. The most common problem was inadequate analgesia. During the entire period of epidural analgesia, 60.3% of patients required one or more interventions by the APS. Changes to the infusion regime were needed especially in the immediate period following surgery. During the first 24 hours, 66.5% of patients were seen by the APS (in addition to the twice-daily review) for adverse effects. Inadequate analgesia was the reason in 82.5% of these patients and 30.2% required ≥2 visits. This percentage decreased to 16.4% during the following 24 hours.

Inadequate analgesia: When patients had inadequate analgesia, successful changes to the epidural regime consisted of increasing the extent of block (61.5%), increasing the opioid concentration (0.4%), or both (3.8%), and converting from local anaesthetic infusion to intermittent morphine boluses (8.8%). One-quarter of patients who had inadequate analgesia had their catheters removed and an alternative analgesic technique prescribed. Thirteen (2.8%) catheters were removed either at the end of surgery or in the recovery room as they were not working. A further 38 (8.1%) catheters were removed within the first 24 hours due to insufficient function after one or more interventions. A total of 66 catheters were removed after failed interventions by the APS.

There was no correlation between the experience of the person who inserted the catheter and inadequate analgesia ($r = -0.067$, $P = 0.16$). Patients with upper abdominal procedures had a high incidence of inadequate analgesia compared to those with lower abdominal procedures ($P = 0.004$) and peripheral vascular surgery ($P = 0.018$). Patients who received epidural morphine were less likely to experience inadequate analgesia compared to those who

received local anaesthetic infusions ($P < 0.001$).

Mechanical problems: These included catheters which had slipped out of the epidural space and were subsequently removed (16), those which had slipped out completely (3) and catheters whose proximal end had become disconnected from its insertion into the bacterial filter (8). Most disconnected catheters were subsequently removed.

Nausea/vomiting and pruritus: There was a 22.7% incidence of nausea and/or vomiting. Only half of these patients required pharmacological treatment. Of those who complained of itch, 20% required anti-histamine therapy. Two patients had fentanyl omitted from the infusion because of severe pruritus. Patients who received epidural morphine were more likely to suffer from nausea/vomiting ($P = 0.04$) and pruritus ($P < 0.001$) than those who received local anaesthetic infusions

Sedation and respiratory depression: None of the patients had a respiratory rate < 8 /min. Patients who received epidural morphine were likely to be more sedated compared to the others ($P = 0.013$). Sedation score of 3 occurred in 13 patients, 9 (2.2%) in the local anaesthetic group and 4 (8.5%) in the morphine group. None of them required naloxone therapy as oxygen saturation was good and recovery was brisk. Fentanyl was omitted from the infusing solution and the dose of morphine reduced accordingly. These patients had received 0.2 to 0.67 $\mu\text{g/kg/h}$ of fentanyl and 8 mg of morphine in 24 hours.

Excessive motor block: This occurred in 4 (5.9%) patients who received bupivacaine and 5 (1.5%) patients who received ropivacaine. Two patients had a modified Bromage score of 2, while the remaining 7 patients had a score of 1.

Catheter site infection: Two patients had a small amount of pus from the insertion site (catheter *in situ* for 3 and 4 days) and 7 others had evidence of inflammation. All patients were afebrile and the catheters were removed.

Hypotension: All cases of hypotension were recorded, regardless of the cause. Due to haemodynamic instability in the immediate postoperative period, 18 epidural infusions were stopped due to difficulty in titration of the infusion rates during management of inadequate analgesia.

Others: There was 1 case of subarachnoid migration of the catheter, which was discovered on the first postoperative day. There were no cases of epidural abscess, permanent neurological deficits or epidural haematoma.

Discussion

This retrospective study describes the common practices and problems encountered during postoperative epidural analgesia in order to draw lessons for improvement of the APS. It does not try to answer a question concerning a clinical outcome of epidural postoperative treatment.

The goals of postoperative analgesia are to provide adequate pain relief with minimal side effects, to allow early ambulation and early restoration of function. In this study, although there was no reported mortality or major morbidity from epidural analgesia, there was a high incidence of minor adverse effects. Only 17% of patients receiving epidural analgesia were totally free from adverse effects and 38.4% experienced 2 or more. This study looked closely at the common complications and found that inadequate analgesia occurred in more than half the patients, resulting in termination of epidural analgesia in 26% of these patients. A similarly high incidence of inadequate pain relief was reported in a prospective study using bupivacaine-morphine infusions.¹⁸ This incidence is also higher than that in other studies using an infusion of bupivacaine-fentanyl^{19,20} or morphine.²⁰ Few studies have documented the actual incidence of unacceptable pain or number of times the APS had to intervene, either by giving a bolus of local anaesthetic, increasing the infusion rate or changing the content of the infusing solution. Andersen et al¹⁸ reported that 55% of patients had one or more changes of the infusion regimen during days 1 to 3. Fifty-eight per cent of the patients in this study had changes made to their infusion regimen. These changes were made mainly during the first 24 to 48 hours. This emphasises the importance of the APS in the fine-tuning of pain control during the first 24 to 48 hours postoperatively. Although pain relief was excellent at rest, a pain-free state was not achieved during movement (Fig. 3). This is similar to findings from other studies.^{18,21}

The rate of premature termination of epidural analgesia due to inadequate pain relief (15.1%) is higher than those reported by Scott et al¹⁹ (7.6%) and Burstal et al²⁰ (10%). However, the concentration of fentanyl was much higher¹⁹ and the concentration and type of local anaesthetic used different.²⁰ Majority of our patients received 0.2% ropivacaine with 2 µg/mL of fentanyl. Scott et al²² found that for 0.2% ropivacaine, inadequate analgesia was very high when less than 4 µg/mL of fentanyl was used. With 2 µg/mL of fentanyl, 34% of epidurals were discontinued because of inability to control pain. An increase in opioid concentration was used successfully to control pain in 3.5% of patients and a further 8.8% were converted to epidural morphine.

The increased incidence of inadequate analgesia in the local anaesthetic infusion group compared to morphine may be explained by the fact that epidural morphine was used mainly during lower abdominal procedures, and may be associated with less pain during coughing or deep breathing. More importantly, accurate placement of the epidural catheter close to the dermatome of the surgical incision is more important for a local anaesthetic/fentanyl solution.^{23,24}

Majority of the catheters were inserted before induction of general anaesthesia, but the actual number of patients who were tested for an adequate level of sensory block was not known. This practice is contrary to that in the United Kingdom where up to 60% of anaesthetists inserted epidurals while the patient was anaesthetised.^{25,26} Insertion of catheters preoperatively not only allows early detection of intrathecal placement or nerve damage, it also enables the anaesthetist to confirm epidural placement of the catheter and assess catheter tip position according to dermatomes blocked and volume of drug administered. This would decrease problems of undetected failed or inadequate blocks postoperatively, which can cause patient distress and anguish. Even if inserted after induction of general anaesthesia, ensuring that the patient is comfortable before leaving the recovery area is also just as important in reducing the incidence of inadequate analgesia postoperatively.

Ropivacaine 0.2% was the local anaesthetic of choice for many anaesthetists in our department. The choice shifted from bupivacaine (early period of study) to ropivacaine due to the availability of 0.2% ropivacaine infusion bags in our department. This decreased the labour utilised in preparation of the various concentrations of bupivacaine either by the pharmacy or anaesthetist. For postoperative analgesia, the epidural infusion of 0.2% ropivacaine had been found to provide the best balance of analgesia with minimal motor block.^{4,6} This may be one of the reasons why the incidence of excessive motor blockade in this study is much lower than that in other studies using 0.125% to 0.25% bupivacaine.^{18,20} Also, epidurals were mainly sited in the mid-thoracic region and most patients with lumbar epidurals received epidural morphine. There is increased risk of motor block when epidural catheters are placed close to lumbar spinal segments compared to more cephalad.²⁷

A large percentage of patients had epidural analgesia terminated prematurely because of unavailability of high-dependency beds. The protocol at our hospital advocates monitoring of patients with epidural catheters in either the intensive care or high-dependency units, except for post-thoracotomy patients who were located in a particular accredited ward. Epidural infusions have been safely used in the ward.^{26,28,29} The main concerns are monitoring for respiratory depression and/or excessive sedation and neurological deficits. Epidural morphine can cause delayed respiratory depression³⁰ and although life-threatening complications with fentanyl have been reported,^{31,32} they were associated with much higher doses of 30 to 125 µg/h (or >1.6 µg/kg/h) than those usually used in our setting. Appropriately-timed monitoring routines were able to identify those patients who developed respiratory depression.²⁹ Perhaps only patients at greater risk of

developing clinically significant respiratory depression,³⁰ e.g., older, sicker patients, patients with pre-existing respiratory problems and patients who received parenteral opioids peri- or postoperatively need to be monitored in the high-dependency units; all others will return to the ward. This would enable more patients to benefit from epidural analgesia. Although some patients with no apparent risk factors can develop life-threatening respiratory depression, this should be picked up if monitoring routines are appropriately timed and carried out diligently by trained nurses. However, only with significant staffing and training of nurses can epidural analgesia be managed safely in the wards.³³

The incidence of nausea and vomiting at 22.7% is similar that reported by Andersen et al¹⁸ and de Leon-Casasola et al,³⁴ but higher than 2.8% to 4.8% reported by others.^{5,19,20} This probably reflects differences in reporting. Despite our hot and humid climate, there was a low incidence of catheter site inflammation or infection. The reported incidence ranges from 0.57% to 5.3%^{20,22,34} in various prospective studies. Multiple factors from skin preparation, dressing and patient factors may influence the incidence of site inflammation. Our low incidence may be contributed by the short duration the catheter was left *in situ* and the retrospective nature of the study.

We have been using the VPS for pain assessment, as it is a useful alternative to the visual analogue scale (VAS) and more relevant in our population. Studies carried out in our hospital showed that in spite of using the language with which the patient was most comfortable with to explain the VAS and VPS scoring methods, 50% were unable to comprehend the VAS scoring method. The analysis of data collected was also compromised by the retrospective nature of the study. However, our aim was to identify practical daily problems encountered during epidural analgesia as opposed to a well-controlled prospective study population.

Although serious complications were uncommon, there was a high incidence of minor complications—a significant proportion of patients suffered from two or more complications. Inadequate analgesia resulting in premature discontinuation of epidural analgesia was not uncommon. To improve the quality of postoperative care, we should:

- 1) consider confirming the placement of the epidural catheter and adequacy of level of block pre-induction or before leaving the recovery room,
- 2) provide a 24-hour APS to fine-tune and manage any problems, and
- 3) educate and train nurses so that in future, perhaps, epidural analgesia can be managed in the general ward.

The attainment of effective pain alleviation with minimal side effects lays the foundation for positive effects on postoperative outcome.

Appendix A

Standard orders for epidural analgesia

Epidural catheter inserted by Dr _____
 Interspace _____ Length of catheter in space _____ cm
 Marking at skin _____ cm

Intraoperative analgesia

LA : Drug _____ % _____ mL Time _____
 Opioid : Drug _____ mg Time _____

Postoperative orders

Opioid : Drug _____
 Dose _____ mg
 Interval _____ hours PRN
 LA Drug : Drug _____ Opioid added _____
 Concentration _____ %
 Infusion rate _____ mL/hour

No systemic opioids or sedatives to be given, except as ordered by the anaesthetist.

Oxygen at _____ L/min via nasal specs or mask. Maintain intravenous access for 24 hours after last dose of opioid. Have naloxone available in the ward. Record pain score, sedation score and respiratory rate hourly. Omit pain score if asleep. For inadequate analgesia or other problems related to epidural analgesia, call the Acute Pain Service anaesthetist.

Treatment of side effects

Respiratory depression

If sedation score = 3 or respiratory rate less than 8/min, cease epidural infusion. Call the APS anaesthetist. Dilute naloxone 0.4 mg to 10 mL water and administer intravenously.

Nausea and vomiting

Give metaclopramide 10 mg i.v. 6-8 hourly PRN. If ineffective, ondansetron 4 mg i.v. bd PRN.

Severe itching or urinary retention

Give i.v. phenergan 12.5-25 mg 8 hourly PRN. If ineffective, inform the APS anaesthetist.

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