

Does an acute pain service influence surgical outcome?

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The traditional intramuscular injection of opioids does not provide adequate pain relief for patients who have undergone major surgery. An acute pain service that provides patient-controlled analgesia and epidural analgesia can not only provide superior analgesia but may improve surgical outcome. However, a review of the current literature does not clearly define the relationship between the quality of analgesia and post-operative outcome. This is due to limitations in study design and methodology. On the other hand, several studies quite convincingly demonstrate a beneficial effect in high risk patients undergoing major surgery. Further studies are necessary to define the full extent of potential benefits and optimal techniques. The integration of an acute pain service with surgical and nursing care may give patients the best outcome.

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Introduction

The traditional intramuscular injection of opioids does not provide adequate pain relief. After major surgery, 75% to 100% of patients complain of moderate to severe pain.¹ It is important to provide adequate pain relief not only for humanitarian reasons, but also because post-operative pain may potentially aggravate morbidity and mortality after major surgery.² A painful incision in the chest or epigastrium prevents patients from taking deep breaths and participating in chest physiotherapy, leading to sputum retention, atelectasis, and hypoxaemia. Sympathetic outflow is increased, leading to tachycardia and peripheral vasoconstriction. Myocardial oxygen consumption is increased. Hypoxaemia decreases myocardial oxygen supply and the chances of developing ischaemic episodes are increased. Pain also aggravates adverse neuro-endocrine responses leading to glucose intolerance and increased catabolism. By providing adequate pain relief, it may be possible to attenuate these detrimental physiological responses and decrease morbidity.

The link between patient-controlled analgesia and surgical outcome

The use of patient-controlled analgesia (PCA) allows patients to titrate to their own analgesic requirements. Patients have a sense of control and PCA provides pain relief that is superior to conventional intramuscular opioid analgesia.^{3,4}

The effects of PCA on surgical outcome were studied in detail by Wasylak et al.⁵ Thirty-eight women who underwent hysterectomy were randomised to receive either intramuscular morphine as needed or PCA morphine. The PCA patients recovered their minute ventilation faster and oral temperatures became normal one day earlier. Recovery of ambulation as measured by stride length and width occurred earlier in PCA patients, who were also discharged from hospital sooner.

A meta-analysis of 15 randomised controlled trials involving a total of 787 patients confirmed the superior efficacy of PCA and strong patient preference for it.⁶ Most of these trials did not study the effect of PCA on outcome in detail. Despite this shortcoming, a trend towards shortening of hospital stay with PCA use was shown. A larger number of patients should be studied using more sensitive measures of morbidity to confirm the impression of a beneficial effect from PCA use.

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Clinical effects of epidural analgesia

The pulmonary system

Post-operative pulmonary dysfunction results from surgical insult and post-operative pain. It remains a major cause of post-operative morbidity. If post-operative pulmonary dysfunction could be reduced, clinical outcomes might improve.

Upper abdominal and thoracic incisions lead to the most severe pain. The most important effect is the reduction in functional residual capacity, which begins approximately 16 hours post-operatively and reaches a nadir at 24 to 48 hours.⁷ Recovery usually takes about one week.⁸ Decreased functional residual capacity may result in atelectasis and ventilation-perfusion abnormalities leading to hypoxaemia and pneumonia. Hypoxaemic episodes can be associated with myocardial ischaemia. Patients who are especially at risk include those with pre-existing pulmonary disease, advanced age, obesity, and those in severe pain.⁹

The post-operative use of epidural analgesia employing local anaesthetics,⁹ opioids,¹⁰ and especially both^{11,12} provides excellent analgesia. Relief of post-operative pain may lead to attenuation of pulmonary complications. This is supported by studies that assessed high risk patients undergoing major surgery. The use of intra-operative epidural anaesthesia with continuation into the post-operative period is associated with a decreased incidence of pneumonia and respiratory failure.^{9,13-15} Local experience also shows a marked reduction in respiratory complications in patients who have undergone oesophageal surgery.¹⁶

The cardiovascular system

Post-operative myocardial ischaemia occurs more frequently and is more severe than any that occurs during the intra-operative period. Cardiac morbidity is increased in high risk patients undergoing non-cardiac surgery.¹⁷ This could be explained by the activation of the sympathetic nervous system during the peri-operative period leading to coronary vasoconstriction. The decreased perfusion together with the post-operative hypercoagulable state cause an increased chance of coronary thrombosis;¹⁸ the myocardial oxygen supply could be jeopardised. On the other hand, sympathetically-mediated increases in heart rate, inotropy, and blood pressure lead to increases in myocardial oxygen consumption. These could result in episodes of myocardial ischaemia or myocardial infarction. The attenuation of post-operative pain may reduce such morbidity. Specifically, a selective blockade of the cardiac sympathetic system by the administration of local

anaesthetics to the thoracic epidural space may prevent the reduction in myocardial oxygen supply.¹⁹

In a study of high risk patients undergoing intrathoracic, intra-abdominal, and major non-cerebral vascular surgery, Yeager et al found a significantly lower incidence of cardiovascular failure in the group that received post-operative epidural analgesia compared with patients who received parenteral opioids (4/28 vs 13/25).¹³ Tuman et al also found that post-operative epidural analgesia was associated with a significant reduction in cardiac morbidity in his study of 80 patients undergoing major vascular surgery.¹⁴ In contrast, Christopherson et al studied a high risk population having a less invasive surgical procedure (infrainguinal revascularisation).²⁰ There was no significant difference in cardiac morbidity, but the incidence was very low in both groups. It seems that epidural analgesia makes the biggest difference in high risk patients having major procedures.

Coagulation problems associated with surgery

Major surgery is associated with a hypercoagulable state that persists into the post-operative period.²⁰ The post-operative stress response leads to increased concentrations of coagulation factors,²¹ decreased concentrations of coagulation inhibitors,²² enhanced platelet activity,²³ and impaired fibrinolysis.²⁴ General anaesthesia with parenteral opioid analgesia has little effect on this hypercoagulable state.^{14,19} However, epidural anaesthesia and analgesia appear to have a beneficial effect. The mechanisms involved are complex; sympathetic blockade caused by the epidural administration of local anaesthetics leads to increased blood flow to the lower extremities.²⁵ Fibrinolytic activity is enhanced^{26,27} and the systemic absorption of local anaesthetic during epidural anaesthesia impairs platelet aggregation.²⁸ Clinically, this is reflected by the reduced graft occlusion rate in patients undergoing lower extremity revascularisation. In the study by Tuman et al, use of epidural anaesthesia was associated with a nine-fold reduction in incidence of vascular graft occlusion.¹⁴ Christopherson et al also compared the effects of general and epidural anaesthesia in patients having lower extremity vascular reconstruction and found that the epidural group had five times fewer re-operations for graft failure within one month of the surgery.²⁰ Therefore, epidural anaesthesia and analgesia are useful in reducing thromboembolic phenomena in patients at high risk of developing thrombosis.

Epidural analgesia—surgical outcome and cost-effectiveness

It is generally agreed that epidural analgesia with local

anaesthetics, opioids, or both can provide analgesia as good as or better than parenteral opioids. There is, however, much less consensus on the effect of epidural analgesia on the outcome of surgery and its cost-effectiveness. This is largely due to limitations imposed by study design. Less than two per cent of published anaesthetic literature contains useful cost information.²⁹ Many studies focus primarily on analgesia and opioid requirements. Few studies specifically look at improvements in morbidity and the short duration of many studies does not allow the beneficial effects to be fully appreciated. The patient populations that have been studied are also different.

In the few studies that concentrated on high risk patients having major procedures, there is a tendency to demonstrate beneficial effects of epidural analgesia. Yeager et al had to terminate their study after 53 patients, because of a markedly lower incidence of cardiovascular morbidity, major infections, and overall complication rates in the epidural group.¹³ The duration of intensive care unit stay and hospitalisation was considerably shorter in this group. Consequently, the physician cost (US\$3801 vs US\$5134) and hospital cost (US\$11 218 vs US\$20 380) were correspondingly lower. Tuman et al, using very similar methodology but avoiding high dose opioids in the general anaesthesia group to eliminate bias towards prolonged ventilation, studied 80 patients undergoing major vascular surgery (45% were aortoiliac procedures).¹⁴ They found a lower incidence of chest infection and prolonged mechanical ventilation in the epidural group. Cardiovascular and infectious complication rates as well as graft occlusions, were also lower. In contrast, Hjortso et al studied 100 patients undergoing major abdominal surgery and found no improvement in outcome in the epidural group.³⁰ The patients were all ASA class 1 or 2 and vascular and thoracic procedures were excluded. The incidence of post-operative complications in both groups was low. Thus it seems that post-operative morbidity in high risk patients who are prone to develop morbidity can be reduced by epidural analgesia.

The cost of providing an acute pain service includes equipment, drugs, consumables, and manpower. Setting up an epidural may involve extra operating theatre time. The cost of managing complications is difficult to estimate. On the other hand, potential savings are made possible by the reduced morbidity that lowers the intensity level of care needed and shortens the hospital stay. There may be indirect savings and long-term benefits in terms of improved survival and quality of life. These long lasting benefits may outweigh the total cost

of providing epidural analgesia. While some data that reflect all these factors have been published,³¹ more are required.

Conclusions and future directions

This review indicates that an acute pain service, providing PCA and epidural analgesia, may be associated with a reduction in the incidence and severity of many post-operative physiological disturbances. This may lead to improved patient outcomes. The strong patient preference of PCA to conventional intramuscular analgesia has been well documented. The effect of epidural analgesia on high risk patients undergoing major procedures is convincing, while that on lower risk patients is less so. It is clear that epidural analgesia with local anaesthetics significantly reduces the peri-operative increase in hypercoagulability. Further studies are urgently needed to define the full extent of potential benefits from an acute pain service and the population that will benefit most. Optimal techniques or combination of techniques remain to be identified. We should also be aware that improved analgesia may not be the only mechanism for improving outcome. The pain relief achieved has to be fully used to enhance mobilisation and food intake to achieve improvement in post-operative convalescence. The integration of an acute pain service, surgical care, and nursing care is probably the most promising approach to improving surgical outcome.

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