

A Risk-Benefit Analysis of Thoracic Epidural Anaesthesia and Analgesia

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Stephan Schug was previously the Professor and Chair of Anaesthesiology at the University of Auckland, New Zealand, where he lived and worked from 1989 to 2001. He moved then to Perth, where he took up his present positions with the University of Western Australia and Royal Perth Hospital in March 2001. He is a graduate of the University of Cologne, Germany, where he also obtained his MD in clinical pharmacology and his specialist qualification in anaesthesia and intensive care. His areas of research and clinical interest are in the management of acute, cancer and chronic pain, regional anaesthesia, pharmacology of anaesthetics and analgesics and quality of health care.

This paper will focus on the use of perioperative thoracic epidural anaesthesia and analgesia for major abdominal and thoracic surgery. It will briefly present the intraoperative benefits, but discuss in more detail postoperative epidural analgesia for this kind of surgery. It will also provide suggestions to maximise the benefits and reduce the risks of this technique, based on scientific evidence and practical experience.

There is now widely discussed, level 1 evidence in the form of a meta-analysis which shows significant advantages of the intraoperative use of epidural anaesthesia in comparison to general anaesthesia, with regard to perioperative morbidity and mortality.¹ This meta-analysis of 141 trials which randomised 9559 patients between neuraxial and general anaesthesia, showed not only significant reduction of perioperative morbidity (deep vein thrombosis, pulmonary embolism, transfusion requirements, pneumonia, respiratory depression, myocardial infarction and renal failure), but also about a third reduction in overall mortality using neuraxial techniques. While these results alone are a strong argument in favour of the use of epidural anaesthesia, there is now widespread evidence that continuation of epidural anaesthesia as epidural analgesia into the postoperative period can provide further benefits. However, there is also widespread concern about the risks of epidural anaesthesia and analgesia, which some regard as unacceptable.

BENEFITS

There is no doubt that appropriate usage of epidural analgesia can provide better postoperative analgesia after major abdominal surgery than any other technique. This was shown in a double-blind placebo controlled trial, where pain scores at rest and on

movement were in the range of 40-50/100 with systemic administration of opioids, but in the range of 0-10 with appropriate thoracic epidural analgesia.² Superior pain relief was also the major advantage of epidural analgesia in the MASTER trial, recently published in *Lancet*.³

This improved analgesia translates obviously into reduced pulmonary morbidity, by potentially improving respiratory function after surgery and permitting better compliance with physiotherapy. Again, reduced respiratory failure was the only morbid endpoint improved by epidural anaesthesia and analgesia in the MASTER trial.³ Such reduced pulmonary morbidity has also been shown by a meta-analysis of randomised controlled trials comparing epidural local anaesthetics with systemic opioids.⁴

Further advantages result from blockade of the sympathetic nervous system by epidural administration of local anaesthetics. These include improved gastrointestinal recovery and reduction of duration of peri-operative ileus. For example, Liu and his group showed a halving of the time until first flatus after colonic surgery by the use of thoracic epidural analgesia with a morphine-bupivacaine mixture. Such improved gastrointestinal recovery has further outcome benefits. In the same study, patients with thoracic epidural analgesia fulfilled discharge criteria at 67 hours while patients with PCA did this after 96 hours.⁵ Again, a meta-analysis for the Cochrane collaboration confirmed these results.⁶ Steinbrook has written an excellent review of this issue.⁷

Obviously, sympathetic blockade also has benefits with regard to attenuated stress response after surgery. This has been shown in a number of randomised controlled trials in high-risk patients undergoing coronary artery bypass grafting. Here, attenuated plasma epinephrine increase, attenuated troponin-T release, reduced incidence of ST changes and reduced incidence of new arrhythmias requiring treatment could be shown.⁸ Similar trends have also been shown for upper abdominal surgery in patients with high risk factors for coronary artery disease. De Leon-Casasola's group showed that, in such patients, the incidence of tachycardic episodes and subsequent ST changes were significantly reduced by thoracic epidural analgesia.⁹ These results were confirmed by a recent meta-analysis, which showed a significantly reduced perioperative myocardial infarction rate with the use of thoracic epidural techniques in comparison to general anaesthesia.¹⁰

In conclusion, there is now level-1 evidence, based on meta-analysis or multiple large randomised controlled trials, that thoracic epidural anaesthesia and analgesia reduces postoperative pain severity, respiratory failure and pulmonary complications, time to bowel recovery, perioperative myocardial infarction rate and many other types of perioperative morbidity, as well as perioperative mortality.^{1,3,4,6,10}

Maximising benefits

In accordance with the literature and from our own practical experience in more than 8000 patients receiving epidural analgesia postoperatively, the achievable benefits can be maximised by following a number of rules.¹¹

1. Thoracic epidural analgesia should always rely on the continuous administration of low concentrations of local anaesthetics. Ropivacaine might be the local anaesthetic of choice here, in view of reduced systemic toxicity and less interference with motor function.
2. Patient-controlled epidural analgesia (PCEA) might offer some slight practical advantages, in particular with regard to the number of interventions required to achieve optimal analgesia.

3. Administration of epidural analgesia for abdominal surgery by lumbar catheters results in insufficient analgesia and potentially significant problems with motor blockade; it should be avoided in favour of thoracic catheter localisation.
4. Combining local anaesthetics with very small amounts of opioids results in a reduction of the incidence of patchy or unilateral blocks and improves the overall quality of analgesia. It is therefore the recommended technique.
5. The discussion on other additives continues. While clonidine improves analgesia and reduces top-up requirements, it results in a decrease in blood pressure and heart rate and increases vasopressor requirements. In my opinion, it is not an adjuvant for routine use. All other adjuvants are in a more experimental state with the exception of adrenaline. There is now some good data which suggests that adding low concentrations of adrenaline (in the range of 2 $\mu\text{g/ml}$) to local anaesthetic opioid mixtures results in better pain relief, more widespread block and reduced systemic side effects.
6. Last and possibly most importantly, thoracic epidural analgesia for abdominal surgery needs to be integrated into an overall multi-disciplinary rehabilitation approach to the postoperative period, as has been suggested by Kehlet for many years.¹² Utilisation of excellent analgesia and improved bowel recovery provided by epidural analgesia, permits early extubation, early aggressive mobilisation and early enteral feeding. This can result in significantly improved postoperative outcome with decreased discharge times and even significant cost reduction, as shown for example by van Aken.¹³

ADVERSE OUTCOMES

While this brief summary illustrates the immense benefits thoracic epidural anaesthesia and analgesia can provide to patients after abdominal surgery, debate about this “dangerous technique” continues and polarises researchers and clinicians. The risks primarily discussed relate to damage to neural structures by needle and catheter insertion, epidural haematoma and epidural infection (with the potential to create the catastrophe of paraplegia) and hypotension as an acute complication.

Neural damage

Data from large surveys suggest a very low incidence of nerve damage. The incidence of damage to peripheral neural structures is in the range of 0.02 to 0.24%. The larger number originates from a survey of 4185 thoracic epidurals, which found 10 such incidents.¹⁴ All these neurological deficits were of a temporary nature and the authors conclude in a statistical analysis that the predicted maximum risk for permanent neurologic complications (upper bound of the 95% confidence interval) in the study is 0.07%. However, there is no doubt that extremely rare cases of spinal cord damage by epidural needle insertion in the thoracic epidural space have been reported. While this risk seems to be minimal, and possibly related to experience of the operator, it is a real risk with potentially catastrophic consequences in these rare cases.

Epidural haematoma

Fortunately, epidural haematomas as a result of epidural catheter insertion are so rare that it is impossible to perform randomised controlled trials to establish cause and effect. All we have is anecdotal evidence in the form of case reports and case series. Most of the reported cases are related to use of anticoagulants or pre-existing

coagulopathy, to the use of a catheter, or to difficult traumatic or bloody tap procedures. They can also occur after catheter removal.¹⁵

On the basis of such case series, two well known reviews calculate the risk as 1:100,000 to 1:150,000 cases, at the upper confidence interval of 95%.^{15,16} In view of the rarity of this event, it is not surprising that overall there are far more published cases of spontaneous epidural haematoma than of epidural haematoma caused by epidural anaesthesia and analgesia. This is also in line with my personal experience in running a large chronic pain clinic.

However, this positive impression has been significantly damaged by the horrifying experience of combining epidural anaesthesia with low molecular weight heparin (LMWH) in the United States. By May 1998, there were at least 50 case reports with regard to this complication known to the FDA. It is now obvious, that these complications related not so much to the respective drug or the epidural technique as to the inappropriate combination of both. In contrast to Europe, where such complications were extremely rare, the Americans routinely used low molecular weight heparin twice daily, commonly in too high a dose. This situation has now been brought under control by very well developed guidelines of the American Society of Regional Anesthesia. A simplified version of these guidelines has been used successfully at Auckland Hospital for the last six years.

“LMWH requires an interval of at least 12 hours between last injection of a standard prophylactic dose and insertion or removal of epidural catheters; the next dose should be given at least two hours later.”

“To permit this approach, low molecular weight heparin should be prescribed only once daily in the evening in a standard dose in patients on epidural infusions.”

While epidural haematomas will hopefully remain a rare complication and most of us will never see such a case, once one has developed extreme vigilance and urgency are the main factors in preventing permanent damage. Available data suggests emergency laminectomy within eight hours has a very good prognosis with regard to recovery of neurological function, while laminectomy more than 24 hours after the initial event has an extremely poor prognosis and permanent paraplegia commonly ensues. Symptoms to look for are sharp back pain, developing motor weakness, urinary retention and sensory loss, as complete paraplegia develops usually only after 12 hours and more. The best diagnostic technique is immediate MRI scan, as computer tomography is not as sensitive.

Epidural infection

In the past, epidural infection was regarded as extremely rare. Reports of an incidence in the range of 1:100,000 and more were common. However, a very careful study of all epidural catheters inserted in Denmark in the year 1998, showed an incidence of 1:2000 leading to neurological deficit in 1:4000.¹⁷ It is obvious that quality of care must have played a role here as the incidence of epidural infections was more than seven times lower in university hospitals than in community hospitals. It is also of note that most of the patients who developed an epidural abscess in this study were immune compromised; some having epidural catheters not for postoperative but for cancer pain relief. Finally, no case occurred in patients with less than two days of catheterisation; the mean duration of catheterisation in patients with epidural infections was eleven days.

Reducing the risk of epidural infection requires a number of procedural and organisational guidelines for the pain service providing epidural analgesia. Again, literature and experience suggest that aseptic insertion technique, standardised dressing technique, regular review of dressing and entry site and preparation of infusion solutions under sterile conditions in a pharmacy or pharmaceutical production facility reduce the risks significantly. Furthermore, in patients with large infected cutaneous wounds and/or generalised septicaemia, the risk of epidural infection seems to be increased. However, these patients very often benefit most from epidural analgesia and one needs to make a risk/benefit assessment in each individual patient.

Acute hypotension

Hypotension as an acute problem is often discussed in the literature. Because of inconsistent criteria for its definition, the incidence is reported to be in the range of 2.6-8%. In our experience, hypotension with epidural analgesia is commonly caused by unmasking of hypovolemia, more than by the epidural technique itself. It is of interest that, in a comparison of cholecystectomy patients with thoracic epidural and systemic opioid analgesia, one study could not show significant differences in haemodynamic responses during rest, orthostatic stress or after walking. As well, there were no significant differences in the number of episodes of dizziness, nausea or vomiting during mobilisation.¹⁸

In our own experience, thoracic epidural analgesia can be provided safely by an anaesthesiology-based acute pain service. Over the last eleven years, the acute pain services under my supervision looked after more than 8000 patients receiving continuous epidural analgesia on normal surgical wards. Over this period, no mortality and no case of severe morbidity could be attributed to the use of this technique. No patient developed an epidural infection and no patient had significant permanent neurological deficit because of epidural analgesia. Potentially severe complications without consequences, collected by a continuous safety audit, occurred in 0.2% of the patients on epidural analgesia — an incidence similar to that we observed with systemic opioid analgesia.¹⁹

In conclusion, the risks of epidural analgesia, provided by a well organised anaesthesiology-based acute pain service on normal hospital wards, are minimal and are by far outweighed by the benefits this technique offers patients, in particular those at high risk.

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