

# Epidural Technique for Postoperative Pain

## Gold Standard No More?

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**Abstract:** Epidural analgesia is a well-established technique that has commonly been regarded as the gold standard in postoperative pain management. However, newer, evidence-based outcome data show that the benefits of epidural analgesia are not as significant as previously believed. There are some benefits in a decrease in the incidence of cardiovascular and pulmonary complications, but these benefits are probably limited to high-risk patients undergoing major abdominal or thoracic surgery who receive thoracic epidural analgesia with local anaesthetic drugs only. There is increasing evidence that less invasive regional analgesic techniques are as effective as epidural analgesia. These include paravertebral block for thoracotomy, femoral block for total hip and knee arthroplasty, wound catheter infusions for cesarean delivery, and local infiltration analgesia techniques for lower limb joint arthroplasty. Wound infiltration techniques and their modifications are simple and safe alternatives for a variety of other surgical procedures. Although pain relief associated with epidural analgesia can be outstanding, clinicians expect more from this invasive, high-cost, labour-intensive technique. The number of indications for the use of epidural analgesia seems to be decreasing for a variety of reasons. The decision about whether to continue using epidural techniques should be guided by regular institutional audits and careful risk-benefit assessment rather than by tradition. For routine postoperative analgesia, epidural analgesia may no longer be considered the gold standard.

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I would like to thank the Board of the European Society of Regional Anaesthesia and Pain Therapy for the prestigious Carl Koller Award. Sadly, some recent recipients have died shortly after receiving the award, leading some to call it jokingly the “Carl Killer” award. I accept the award with gratitude and pride, and I will cherish it – hopefully for a long time. I am truly honoured. For my lecture, I have selected a provocative title that addresses a technique with which all anaesthesiologists will be familiar. I hope that this article provokes debate in your institution and perhaps a reevaluation of the role of this iconic technique in postoperative pain management.

Epidural analgesia is a well-established technique for managing postoperative pain that has been in use for decades. Studies have shown that the technique has several additional benefits, such as decreased cardiovascular, pulmonary and gastrointestinal morbidity,<sup>1–3</sup> and even mortality.<sup>4</sup> These data in combination with national and international guidelines have led

epidural analgesia to be considered the gold standard for pain management after major surgery. Although epidural analgesia is invasive, labour-intensive, and expensive, the costs and potential risks have been considered justified because of the assumed benefits. Some studies have shown a shorter length of hospital stay when the technique is a component of fast-track rehabilitation routines after major abdominal surgery,<sup>5</sup> thus adding cost-effectiveness to its list of advantages. However, it seems that the popularity of epidural analgesia is waning for a number of reasons, including a more rigorous evaluation of published data, newer meta-analyses that suggest less optimistic results, the adoption of minimally invasive surgical techniques, the emergence of fast-track postoperative rehabilitation strategies, the widespread use of prophylactic anticoagulant regimens, the availability of less invasive but equally effective alternative regional analgesic techniques, the difficulty of performing detailed local audits that would provide risk-benefit data, and litigation concerns.

### EPIDURAL ANALGESIA AND POSTOPERATIVE MORTALITY

A meta-analysis of data from 141 randomized controlled trials (RCTs), which studied a total of 9559 patients, showed that the use of epidural or spinal anaesthesia was associated with a 30% decrease in 30-day mortality, in addition to other beneficial effects: a 55% decrease in the incidence of pulmonary embolism, a 44% decrease in deep venous thrombosis, a 50% decrease in transfusion requirements, and a 39% decrease in pneumonia. There was evidence of further benefits, such as a decrease in the risk of respiratory depression, myocardial infarction, and renal failure.<sup>4</sup> However, a reevaluation of this meta-analysis, which was argued to have significant flaws, and data from more recent meta-analyses and more robust studies in patients undergoing aortic, gastric, colonic, and other major surgery failed to show any decrease in mortality with perioperative epidural analgesia when compared with a combination of general anaesthesia and the use of systemic opioids.<sup>6–8</sup> It is worth noting that many published studies lack a sufficient sample size to assess rare outcomes such as death with any degree of acceptable accuracy. With anaesthesia-related mortality estimated to be as low as 8.2 per million hospital surgical discharges, it may well be impossible to detect differences in mortality in RCTs that do not study millions of patients.<sup>9</sup> Therefore, there is no definitive and widely accepted evidence for epidural analgesia being associated with a decrease in perioperative mortality.

### CARDIOVASCULAR MORBIDITY

Animal and clinical data suggest that thoracic epidural analgesia with local anaesthetics can result in increased coronary artery blood flow and an improvement of myocardial oxygen balance that may result from the effect of epidural analgesia on sympathetic nervous system activity.<sup>10</sup> However, the benefits of epidural analgesia in decreasing cardiovascular morbidity are not as clear as previously thought.<sup>4</sup> The site of epidural catheter

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placement seems important. A meta-analysis has shown that thoracic epidural analgesia is much more effective than lumbar epidural analgesia in decreasing the risk of postoperative myocardial infarction.<sup>1</sup> Current evidence suggests that thoracic epidural analgesia may decrease the risks of cardiovascular complications, such as myocardial infarction in high-risk patients undergoing major vascular surgery. However, there is little evidence that epidural analgesia decreases cardiovascular morbidity in the relatively healthy, “low-risk” surgical population.<sup>11</sup> A recent meta-analysis of 28 studies of more than 2700 patients undergoing cardiac surgery showed that the addition of epidural analgesia to general anaesthesia was associated with a decrease in the incidence of supraventricular arrhythmias and respiratory complications, but not mortality, myocardial infarction, or stroke. The authors concluded that the potential benefits of thoracic epidural analgesia in cardiac surgery may not be worth the significant risks, such as the development of neuraxial hematoma, that are involved.<sup>12</sup>

### PULMONARY MORBIDITY

There is good evidence that epidural analgesia is associated with a decreased risk of postoperative pulmonary complications, particularly in high-risk patients undergoing open abdominal aortic surgery or coronary artery bypass.<sup>10</sup> However, as with its cardiovascular and gastrointestinal advantages, these benefits are seen only when a thoracic epidural catheter is sited and only when local anaesthetics, and not opioids, are used. In clinical practice, the epidural solution commonly used is a combination of low-dose local anaesthetic and an opioid like fentanyl. A meta-analysis of 50 RCTs showed that local anaesthetic alone was used in only 4% of studies, opioids alone in 28%, and a local anaesthetic-opioid combination in 68% of studies.<sup>13</sup> In general, the protective effect of epidural analgesia against pneumonia after abdominal or thoracic surgery seems to have decreased during the last 35 years, presumably because of a decrease in the overall risk of surgery.<sup>14</sup> The debate about the pulmonary benefits of epidural analgesia may become increasingly irrelevant as surgical techniques become less invasive.

### GASTROINTESTINAL MORBIDITY

Postoperative ileus has considerable detrimental effects on recovery after major abdominal surgery. It is associated with discomfort, morbidity, and prolonged hospital stay.<sup>15</sup> Available evidence supports the view that the use of epidural local anaesthetics, but not opioids, can decrease the risk of ileus. A meta-analysis of 22 RCTs that studied patients undergoing abdominal surgery showed that epidural analgesia with local anaesthetics decreased the time to return of gastrointestinal function by 24 to 36 hours when compared with systemic or epidural opioids.<sup>3</sup> However, a meta-analysis of epidural analgesia after colorectal surgery showed that improved analgesia and a decrease in the incidence of ileus did not lead to a shorter duration of hospital stay.<sup>16</sup> There are 3 meta-analyses showing that a less invasive technique, that is, a continuous infusion of intravenous lidocaine during and after abdominal surgery was associated with several benefits, such as decreased duration of ileus, decreased pain scores, a decreased risk of postoperative nausea and vomiting (PONV), and shorter hospital stay.<sup>17–19</sup> Gum chewing may be a much simpler and safer, evidence-based method for the prevention or amelioration of postoperative ileus.<sup>20</sup> Currently, there are no comparative studies that show that epidural analgesia is superior either to an intravenous lidocaine infusion or to gum chewing in decreasing the risk of ileus. In a recent editorial, the authors stated that, “there is a significant lack of evidence

supporting the use of epidural analgesia and we question the routine use of this mode of analgesia in the postoperative period for patients having abdominal surgery.”<sup>21</sup>

### THROMBOEMBOLIC MORBIDITY

A meta-analysis published in 2000 found that neuraxial blocks used for surgery were associated with a decrease in the incidence of deep venous thrombosis and pulmonary embolism.<sup>4</sup> However, most of the studies in the meta-analysis were performed before the introduction of modern thromboprophylactic drug regimens and minimally invasive surgery. The current influence of postoperative epidural analgesia on coagulation-related outcomes is not clear. More recent, procedure-specific meta-analyses addressing open aortic surgery, abdominal surgery, total hip arthroplasty, and total knee arthroplasty fail to demonstrate that epidural analgesia is associated with a decrease in thromboembolic morbidity.<sup>22–24</sup>

A recent review of the impact of pathophysiological conditions on outcome after major surgery noted that, “in unselected patients undergoing gastrointestinal surgery, epidural analgesia does not seem to reduce anastomotic leakage, intraoperative blood loss, transfusion requirement, risk of thromboembolism, cardiac morbidity, or hospital stay compared to conventional analgesia.”<sup>25</sup>

### PATIENT SATISFACTION

In general, poor postoperative pain relief and the adverse effects of analgesia are associated with low levels of patient satisfaction. However, patient satisfaction as a primary outcome has been little studied. A systematic review showed that only 2 RCTs of 95 assessed used a validated instrument for the assessment of patient satisfaction. The authors of this review noted that, “despite the theoretical benefits of superior analgesia, there is a lack of high-quality data on the effect of different analgesic techniques and regimens on patient-reported outcomes such as health-related quality of life, quality of recovery, and patient satisfaction.”<sup>26</sup>

### LENGTH OF HOSPITAL STAY AND THE ROLE OF EPIDURAL ANALGESIA IN “ENHANCED RECOVERY”

Few studies have used prospectively defined discharge criteria for the assessment of length of hospital stay. It has been claimed that postoperative, accelerated, multimodal recovery programmes, in which epidural analgesia is allegedly a key component, decrease perioperative morbidity and length of hospital stay without compromising patient safety.<sup>27–29</sup> Enhanced recovery protocols have been proposed for a variety of surgical procedures, the programme for colorectal surgery being one of the most studied and evaluated in the last decade.<sup>30</sup> Thoracic epidural analgesia, using a mixture of low-dose local anaesthetic and opioid for 48 hours after surgery, has been recommended as one of the key elements of enhanced recovery pathways.<sup>30,31</sup> Other enhanced recovery programme elements, such as early ambulation, early feeding, decreased use of opioid analgesia, and thoracic epidural analgesia, have been shown by some investigators to lead to a considerable decrease in the duration of hospital stay,<sup>28,30,32</sup> but the results have not been consistently reproducible.<sup>33</sup>

There are a large number of enhanced recovery protocols available for colorectal surgery. The number of “evidence-based” components within such protocols ranges from 4 components<sup>34</sup> to 20 components,<sup>30,35</sup> with all claiming enhanced

recovery and shorter hospital stay when compared with “traditional care.” However, the components of traditional care also vary considerably in published studies. Furthermore, several key components of enhanced recovery, such as the omission of bowel preparation and drains, early feeding, and mobilization, have become included in “modern” traditional care.<sup>33</sup> A systematic review of enhanced recovery programmes concluded that, “despite the current enthusiasm and implementation into daily practice, this systematic review shows that, to date, there are few data available.”<sup>36</sup> A more recent meta-analysis concluded that, “the implementation of 4 or more elements of the Enhanced Recovery After Surgery (ERAS) pathway leads to a reduction in the length of hospital stay by more than 2 days and an almost 50% reduction in complication rates in patients undergoing major colonic/colorectal surgery.”<sup>37</sup> Two obvious questions arise: why use 20 interventions when 4 may be adequate and which 4 interventions are the critical ones? The specific role of epidural analgesia in the results of this meta-analysis is not clear because it was not used for all patients; furthermore, the failure rate for epidural analgesia was quoted as being 28%.<sup>37</sup> Most studies investigating the effectiveness of enhanced recovery protocols do not assess how many components are actually implemented in practice. It is well known that implementation of a multidisciplinary protocol in clinical practice is far from easy.<sup>38</sup> One review of improving outcome after major surgery omitted enhanced recovery literature because the studies were of mediocre or low quality, and there was marked heterogeneity in published results.<sup>25,39</sup> A Cochrane review concluded that, “the quality of the trials and lack of sufficient other outcome parameters do not justify implementation of fast-track surgery as the standard of care.”<sup>40</sup> There is a need for good quality, comparative studies to establish the critical components and independent predictors of faster postoperative recovery in enhanced recovery programmes.

Several groups have come to the same conclusion about enhanced recovery protocols, that is, it is not possible to determine whether any of the commonly used protocol components have an independent influence on outcome.<sup>28,34,35</sup> It is clear that all the components of enhanced recovery protocols are not equally efficacious; indeed, some may be unnecessary or even harmful, and the role of epidural analgesia must be considered in this context. Some authors consider epidural analgesia a prerequisite for the success of enhanced recovery protocols.<sup>27,29,31,34</sup> However, this is not supported by the current evidence. A review article based on well-designed RCTs did not find any benefit of epidural analgesia in length of hospital stay.<sup>41</sup> This is confirmed by the above meta-analysis of 16 RCTs of patients undergoing open colorectal surgery.<sup>16</sup> Although epidural analgesia was superior to parenteral opioid analgesia, the good pain relief and quicker return of bowel function seen with epidural techniques did not shorten hospital stay but did increase the risks of pruritus, urinary retention, and hypotension.

The debate about the role of epidural analgesia is becoming increasingly irrelevant because of changes in surgical technique. A systematic review of postoperative analgesia after laparoscopic colorectal surgery comparing epidural analgesia with intravenous opioid patient-controlled analgesia failed to demonstrate the superiority of epidural analgesia.<sup>30</sup> The PROSPECT group does not recommend epidural techniques for laparoscopic colonic surgery.<sup>42</sup>

In conclusion, despite a lack of agreement about the optimal number of components, the implementation of enhanced recovery protocols has shown impressive reductions in hospital stay without increasing morbidity. This is most likely due

to carefully protocolized perioperative care rather than the exact combination and number of applied enhanced recovery components.<sup>37</sup> Currently, there is no convincing evidence that epidural analgesia as a component of such protocols provides any additional benefits, and this applies to open as well as laparoscopic colorectal surgery.

## RISKS OF EPIDURAL TECHNIQUES

Although epidural analgesia is generally considered safe, there are undoubtedly associated risks. Most of the adverse effects are related to the drugs used, for example, hypotension and motor block from local anaesthetics and nausea and pruritus from opioids. Significant risks, such as spinal hematoma and abscess, are rare but must be taken into account. In a study of about 1,260,000 spinal and 450,000 epidurals, severe neurologic complications were noted in 127 patients, of whom 85 had permanent neurologic damage. The authors stated that the risks were greater than previously thought.<sup>43</sup> The authors of a recent report of a study based on a 2-week national census in the United Kingdom using data on 707,455 central neuraxial blocks concluded that “the data are reassuring and suggest that central neuraxial blockade has a low incidence of major complications, many of which resolve within 6 months.”<sup>44</sup> Nevertheless, the deaths (in the order of 3–6/y) and the large number of severe neurologic complications seen annually in the United Kingdom associated with neuraxial blocks must be balanced against the modest benefits of epidural analgesia.<sup>45</sup> The debate about how low an “acceptably low” risk is likely to continue, with the overall risk-benefit assessment seeming to move in favor of non-epidural techniques.<sup>46</sup> The insertion and management of epidural analgesia is also not without its complexities. Anaesthesiologists have to follow guidelines from national regional anaesthesia societies, such as the American Society of Regional Anaesthesia and Pain Medicine, when treating patients who are taking anticoagulant drugs. The timing of needle and catheter insertion and removal must be adapted to the pharmacokinetic properties of the anticoagulant or combination of anticoagulant drugs. Newer drugs like fondaparinux have a much longer half-life, and both American Society of Regional Anaesthesia and Pain Medicine and the American College of Chest Physicians recommend against its administration in association with neuraxial anaesthesia and peripheral nerve blocks.<sup>47</sup> For patients undergoing spinal or epidural anaesthesia and analgesia, there is an ongoing need for close monitoring and a high degree of suspicion about the development of a spinal hematoma because its early recognition and operative decompression may significantly improve outcome. A closed-claim analysis of medicolegal cases related to regional anaesthesia in the United Kingdom showed that the costs of claims associated with epidural techniques were far higher than those associated with peripheral nerve blocks.<sup>48</sup> A survey of Australian anaesthesiologists showed that 82% had changed their practice in recent years in that they performed fewer epidural anaesthetics. The 2 most common reasons were fear of litigation and a lack of evidence for beneficial effects.<sup>49</sup> Although serious complications are uncommon, patients should be informed about common adverse effects such as urinary retention and pruritus and should be counseled about the risks of major neurologic complications such as paralysis. The risks and benefits should be assessed on an individual patient basis.

## FAILURE RATES FOR EPIDURAL ANALGESIA

The duration of postoperative epidural analgesia may affect outcome. Typically, epidurals are inserted immediately before

surgery, and infusions are continued for 2 to 4 days after surgery. A successful epidural is one that provides good pain relief and facilitates postoperative mobilization and rehabilitation for as long as the catheter is in place. There are no reliable data on the failure rates of epidural analgesia during each of these postoperative days. One editorial notes that “up to 50% epidurals fail or give inadequate analgesia” and that “putting an epidural in is rarely a problem—it is in determining what to do with it after it is sited that the problem starts.”<sup>21</sup> Failure rates are not insignificant, and a failure rate of 32% has been reported in a database of 25,000 patients.<sup>50</sup> Only detailed institutional audits can provide cost-benefit data and guide decisions on whether to continue or stop the use of epidural analgesia in that particular institution. It is likely that very few institutions perform such regular audits, so most anaesthesiologists do not know how successful (or unsuccessful) their epidurals really are. There is very little published literature on this crucial issue.

### ALTERNATIVES TO EPIDURAL ANALGESIA

It is worth emphasizing that the benefits of epidural analgesia on cardiovascular, pulmonary, and gastrointestinal morbidity have been reported in patients undergoing open, major surgery. Most recommendations for laparoscopic procedures, such as cholecystectomy and colonic surgery, no longer include epidural analgesia.<sup>42,51</sup> Furthermore, these benefits of epidural analgesia were only evident when it was compared with the use of systemic opioids. It is also worth noting that despite the potential benefits of epidural analgesia, including excellent pain relief, there is no evidence that the quality of analgesia, irrespective of the actual analgesic technique, has any effect on the length of hospital stay.<sup>8</sup>

There is increasing evidence from meta-analyses and systematic reviews that effective and safer alternatives to epidural are now available for thoracic, abdominal, and major orthopedic surgery.<sup>52–59</sup> These analgesic alternatives include paravertebral block for thoracotomy<sup>52,53</sup>; peripheral nerve blocks for hip<sup>54</sup> and knee<sup>55,56</sup> arthroplasty; intravenous lidocaine for colorectal surgery<sup>17–19</sup>; wound catheter infusions for a wide variety of surgical procedures including abdominal, cardiothoracic, vascular, and major abdominal surgery<sup>57</sup>; and transversus abdominis plane (TAP) block for surgery involving the abdominal wall.<sup>58</sup>

### PERINEURAL TECHNIQUES

In recent years, continuous peripheral nerve blockade has gained increasing acceptance as a safe and effective technique that provides better analgesia than opioids.<sup>11,25</sup> Regardless of catheter location, continuous peripheral nerve blockade provides superior analgesia and leads to decreases in opioid use and, consequently, a decrease in the incidence of opioid adverse effects such as PONV and sedation.<sup>59</sup> There is good evidence that some perineural techniques are as effective as an epidural, but with a better adverse effect profile.<sup>54–56</sup> This is supported by the Australian and New Zealand College of Anaesthetists' evidence-based recommendations.<sup>60</sup> Indeed, the PROSPECT working group does not recommend epidural analgesia as the first choice for patients undergoing hip or knee arthroplasty.<sup>54,56</sup> Two meta-analyses concluded that peripheral nerve blocks are better than epidural analgesia after major knee surgery.<sup>55,56</sup> Interestingly, another meta-analysis based on 23 RCTs concluded that a single-shot femoral nerve block was superior to epidural analgesia and that there was no further advantage in adding a sciatic nerve block or in having a continuous infusion technique.<sup>61</sup>

In conclusion, there is increasingly strong evidence that perineural techniques are superior to epidural analgesia for patients undergoing total hip or total knee arthroplasty.

### PARAVERTEBRAL BLOCK

A systematic review showed that both epidural and paravertebral block provide comparable pain relief for up to 48 hours after thoracotomy but that paravertebral blockade was associated with a decrease in the incidence of pulmonary complications, urinary retention, hypotension, and PONV.<sup>52</sup> The PROSPECT group evaluated a variety of regional techniques for analgesia after thoracotomy based on data from 74 RCTs and concluded that paravertebral blockade was as effective as thoracic epidural analgesia but that it was associated with a lower incidence of hypotension.<sup>53</sup>

### WOUND CATHETER INFUSION

This technique is well established in the management of pain after both in-patient and ambulatory surgery.<sup>62</sup> A systematic review of 39 RCTs, including 15 RCTs of patients undergoing cardiothoracic surgery and 16 RCTs of patients undergoing major orthopedic surgery, showed that postoperative pain management by wound catheter infusion was associated with decreased pain scores at rest and activity, a decreased need for opioids, a reduced incidence of PONV, and increased patient satisfaction. The authors concluded that, “the most notable feature was the consistent evidence of these benefits across a wide range of surgical procedures, location of wound catheters, and dosing regimens accompanied by low incidences of catheter-related complications. Both the efficacy and technical simplicity of this technique encourage its widespread clinical use.”<sup>57</sup> Similar conclusions were drawn from evidence-based data presented by the Australian and New Zealand College of Anaesthetists Working Group.<sup>60</sup> A more recent meta-analysis and accompanying editorial were far less positive,<sup>63,64</sup> but these conclusions were most likely due to the exclusion of orthopedic patients and patients in whom catheters were not actually in the surgical wound.<sup>65,66</sup> In clinical practice, wound catheter infusion techniques include catheters placed through the incision into deeper layers or cavities, for example, subfascial, peritoneal, subacromial, intraosseous, and intra-articular placement.<sup>65,67</sup>

The importance of appropriate catheter positioning was demonstrated in a study of patients undergoing open colorectal surgery. Wound infusion through a catheter placed preperitoneally was associated with effective analgesia for up to 72 hours, decreased opioid consumption, earlier recovery of bowel function, and a hospital stay shorter by 30 hours.<sup>68</sup> Similarly, wound infusion with a catheter placed subfascially provided postoperative pain relief that was as effective after cesarean delivery as an epidural technique.<sup>69,70</sup> This conclusion is supported by a Cochrane review.<sup>71</sup> The evidence-based PROSPECT recommendations include wound infiltration for inguinal herniotomy, laparoscopic cholecystectomy, hysterectomy, open colon surgery (using preperitoneal infusion), total knee arthroplasty, total hip arthroplasty, and hemorrhoidectomy.<sup>72</sup> The technique is also recommended by the ASA Practice Guidelines as part of a multimodal analgesia strategy for the management of postoperative pain.<sup>73</sup> Wound catheter infusion was recommended in the second (2005) and third (2010) editions of Australian and New Zealand College of Anaesthetists' manual based on growing Level I evidence.<sup>60</sup> However, many questions remain to be addressed, including: the optimal location of catheter placement for different surgical procedures, the concentration and volume of local anaesthetic drugs, the risk of local anaesthetic toxicity, and the potential role of adjuvants.

In conclusion, infiltration techniques with and without catheters are simple, safe, and effective for many but not all procedures. They can be used alone or as part of a balanced,

multimodal analgesic pain management regimen. There is a need for detailed comparisons of alternative analgesic techniques to identify the most clinically effective and cost-effective technique for different surgical procedures.<sup>65-67</sup>

### TAP BLOCK

This is a relatively new technique that has shown promising results in the management of pain in patients undergoing major abdominal and gynecologic surgery. Several modifications of the technique, both with and without ultrasound guidance, have been reported. A recent review of published RCTs showed clinically significant decreases in opioid requirement and pain, both at rest and at movement, as well as a decrease in the adverse effects of opioids, such as sedation, nausea, and vomiting.<sup>58</sup> These benefits were demonstrated in patients undergoing surgical procedures, such as colon resection, cesarean delivery, abdominal hysterectomy, open appendectomy, and laparoscopic cholecystectomy. The authors concluded that, “postoperative pain treatment with TAP block is a promising new technique, demonstrating both a substantial reduction in morphine consumption as well as improved pain scores in surgery involving anterior abdominal wall.”<sup>58</sup> There is a need for further studies to confirm these findings.

### LOCAL INFILTRATION ANALGESIA

Kerr and Kohan<sup>74</sup> developed the local infiltration analgesia (LIA) technique as part of their strategy for managing pain after hip and knee arthroplasty. It is a 5-step procedure based on the systematic infiltration of a mixture of ropivacaine, ketorolac, and epinephrine. Using a “moving needle” technique, a large volume (up to 150 mL) of ropivacaine 0.2% is injected in the tissue areas directly subject to surgical trauma. A catheter is left in the joint for a single top-up at about 15 to 20 hours after surgery. Surgery is performed under spinal anaesthesia. In a study of 325 patients undergoing hip or knee arthroplasty, most patients had low pain scores and could be discharged after a single overnight stay. The mean time to independent mobility was less than 25 hours for the entire cohort and less than 20 hours for patients undergoing total knee arthroplasty.<sup>74</sup> The LIA technique has received much attention, particularly in Scandinavian countries, the United Kingdom, and Australia. In Sweden, 75% of all total knee arthroplasties were performed with the LIA technique in 2009.<sup>75</sup> Several studies have been published that show impressive results and shorter hospitalization times, albeit longer than those originally reported by Kerr and Kohan.<sup>76-80</sup> Local infiltration analgesia was found to be superior to epidural analgesia after total hip arthroplasty,<sup>76</sup> and superior to both femoral nerve block<sup>79</sup> and intrathecal morphine<sup>81</sup> after total knee arthroplasty. Another study showed that LIA was better than epidural analgesia after the first 24 hours after surgery; patients had better knee function, were mobilized faster, and were discharged from hospital 2 days sooner.<sup>80</sup> A recent review of LIA concluded that it has a role in total knee arthroplasty but not in total hip arthroplasty and that nonopioid, multimodal analgesia including gabapentin might be a better alternative.<sup>82</sup> An accompanying editorial disagreed and concluded that LIA might still be a better choice because of a decreased incidence of adverse effects.<sup>83</sup> However, many questions need to be addressed and answered, including: the role of the local administration of ketorolac and epinephrine, the role of compression and ice packing, and the role of the actual surgical technique.<sup>84,86</sup> Furthermore, there is a need to define what precisely is meant by the “LIA technique” because there are

almost as many modifications as there are practitioners of the technique, making a meaningful comparison of studies very difficult.<sup>82,85</sup> The role of intra-articular catheters as a component of LIA is particularly controversial. As with any new technique, further studies are needed to establish a place for this promising approach in clinical practice.

### ARE THERE NO INDICATIONS LEFT FOR EPIDURAL ANALGESIA?

Robust data clearly demonstrate that the pain relief associated with the use of epidural techniques can be excellent.<sup>11,13</sup> In patients undergoing major open vascular surgery and in high-risk patients undergoing other forms of major surgery, epidural analgesia with local anaesthetic drugs is associated with a decrease in the incidence of postoperative cardiovascular and pulmonary complications.<sup>10</sup> Currently, available evidence suggests that regional anaesthesia techniques are superior to the use of opioid analgesia. In centers where its use is well established, epidural analgesia would remain a good choice in the transitional period while alternative evidence-based regional analgesia methods such as perineural, paravertebral, LIA, wound catheter infusion, and TAP block are introduced into clinical practice.

In the future, new indications for the use of epidural analgesia may emerge. There is some evidence that the use of epidural analgesia may decrease the risk of cancer recurrence<sup>86-88</sup> and surgical site infection,<sup>89</sup> although the published data supporting these effects is not yet convincing.<sup>9</sup> A recent editorial noted that “evidence linking the use of regional anaesthesia to clinical benefits in oncology is limited to a small number of studies with conflicting results.”<sup>90</sup> Controlled studies are necessary to confirm these potentially exciting findings.

### CONCLUSIONS

Recently published evidence suggests that the benefits of epidural analgesia are not as significant as previously thought. Although the efficacy of pain relief can be outstanding, and there may be some benefits in decreased cardiovascular and pulmonary morbidity in high-risk patients undergoing major open vascular or cardiac surgery, the use of epidural techniques is generally decreasing. There are several reasons for the decline in the use of this invasive, costly and labour-intensive technique:

- little evidence of a decrease in postoperative mortality associated with the use of epidural analgesia;
- little convincing evidence of decreased morbidity in the low-to-medium-risk surgical population;
- advances in surgical techniques, such that many operations previously performed only on inpatients are now day-case or overnight-stay procedures;
- the use of fast-track, epidural-free, early mobilization, postoperative rehabilitation programmes;
- the widespread implementation of prophylactic anticoagulant regimens;
- increasing evidence that many less invasive, alternative regional analgesia techniques are as good as or even better than epidural analgesia after most major surgical procedures;
- the lack of convincing evidence of cost-effectiveness of epidural techniques despite their use for decades; and
- litigation concerns related to severe neurologic complications.

It is therefore no exaggeration to suggest that the diminishing role of epidural analgesia can be expected to diminish further. Epidural analgesia remains the gold standard for pain relief in labour because there are currently no good alternatives. This can no longer be said of the use of the epidural analgesia

after surgery, and it can therefore no longer be described as the gold standard in postoperative analgesia. The continued use of epidural techniques in your institution should be based on a careful evaluation of its risks and benefits drawn from local audit data, rather than on a tradition that is increasingly being viewed as outdated.

## REFERENCES

- Beattie WS, Badner NH, Choi P. Epidural analgesia reduces postoperative myocardial infarction: a meta-analysis. *Anesth Analg*. 2001;93:853–858.
- Ballantyne JC, Carr DB, de Ferranti S, et al. The comparative effects of postoperative analgesic therapies on pulmonary outcome: cumulative meta-analyses of randomized, controlled trials. *Analg Anesth*. 1998;86:598–612.
- Jorgensen H, Wetterslev J, Moynich S, et al. Epidural local anaesthetics versus opioid-based analgesic regimens on postoperative gastrointestinal paralysis, PONV and pain after abdominal surgery. *Cochrane Database Syst Rev*. 2000:CD001893.
- Rodgers A, Walker N, Schug S, et al. Reduction of postoperative mortality and morbidity with epidural or spinal anaesthesia: results from overview of randomized trials. *BMJ*. 2000;321:1493.
- Kehlet H, Dahl J. Epidural analgesia and postoperative outcomes—a need for a different approach. *Acta Anaesthesiol Scand*. 2008;52:1311–1312.
- Rigg JR, Jamrozik K, Myles PS, et al. Epidural anaesthesia and analgesia and outcome of major surgery: a randomized trial. *Lancet*. 2002;359:1276–1282.
- Park WY, Thompson JS, Lee KK. Effect of epidural anaesthesia and analgesia on perioperative outcome: a randomized, controlled Veterans Affairs cooperative study. *Ann Surg*. 2001;234:560–569.
- Liu SS, Block BM, Wu CL. Effects of perioperative central neuraxial analgesia on outcome after coronary artery bypass surgery: a meta-analysis. *Anesthesiology*. 2004;101:153–161.
- Kettner SC, Willschke H, Marhofer P. Does regional anaesthesia really improve outcome? *Br J Anaesth*. 2011;107:i90–i95.
- Hanna MN, Murphy JD, Kumar K, Wu CL. Regional techniques and outcome. What is the evidence? *Curr Opin Anaesthesiol*. 2009;22:672–677.
- Liu SS, Wu CL. Effect of postoperative analgesia on major postoperative complications: a systematic update of the evidence. *Anesth Analg*. 2007;104:689–702.
- Svircevic V, van Dijk D, Nierich AP, et al. Meta-analysis of thoracic epidural anaesthesia versus general anaesthesia of cardiac surgery. *Anesthesiology*. 2011;114:271–282.
- Wu CL, Cohen SR, Richman JM, et al. Efficacy of postoperative patient-controlled and continuous infusion epidural analgesia versus patient-controlled analgesia with opioids. A meta-analysis. *Anesthesiology*. 2005;103:1079–1088.
- Pöpping DM, Elia N, Marret E, et al. Protective effects of epidural analgesia on pulmonary complications after abdominal and thoracic surgery: a meta-analysis. *Arch Surg*. 2008;143:990–999.
- Holte K, Kehlet H. Postoperative ileus. A preventable event. *Br J Surg*. 2000;87:1480–1493.
- Marret E, Remy C, Bonnet F. Meta-analysis of epidural analgesia versus parenteral opioid analgesia after colorectal surgery. *Br J Surg*. 2007;94:665–673.
- McCarthy GC, Megalla SA, Habib AS. Impact of intravenous lidocaine infusion on postoperative analgesia and recovery from surgery: a systematic review of randomized controlled trials. *Drugs*. 2010;70:1149–1163.
- Marret E, Rolin M, Beaussier M, Bonnet F. Metaanalysis of intravenous lidocaine and postoperative recovery after abdominal surgery. *Br J Surg*. 2008;95:1331–1338.
- Vigneault L, Turgeon AF, Cote D, et al. Perioperative intravenous lidocaine infusion for postoperative pain control: a meta-analysis of randomized controlled trials. *Can J Anaesth*. 2011;58:22–37.
- Fitzgerald JEF, Ahmed I. Systematic review and meta-analysis of chewing-gum therapy in the reduction of postoperative ileus following gastrointestinal surgery. *World J Surg*. 2009;33:2557–2566.
- Low J, Johnston N, Morris C. Epidural analgesia: first do no harm [editorial]. *Anaesthesia*. 2008;63:1–3.
- Nishimori M, Ballantyne JC, Low JHS. Epidural pain relief versus systemic opioid based pain relief for abdominal aortic surgery. *Cochrane Database Syst Rev*. 2006:CD005059.
- Werawatganon T, Charuluxanun S. Patient controlled intravenous opioid analgesia versus continuous epidural analgesia for pain after intra-abdominal surgery. *Cochrane Database Syst Rev*. 2005:CD004088.
- Choi PT, Bhandari M, Scott J, Douketis J. Epidural analgesia for pain relief following hip or knee replacement. *Cochrane Database Syst Rev*. 2003:CD003071.
- Banz VM, Jacob SM, Inderbitzin D. Improving outcome after major surgery: pathophysiological considerations. *Anesth Analg*. 2011;112:1147–1155.
- Liu SS, Wu CL. The effect of analgesic technique on postoperative patient-reported outcomes including analgesia: a systematic review. *Anesth Analg*. 2007;105:789–808.
- Kehlet H, Dahl JB. Anaesthesia, surgery, and challenges in postoperative recovery. *Lancet*. 2003;362:1921–1928.
- Kehlet H, Wilmore DW. Evidence-based surgical care and the evolution of fast-track surgery. *Ann Surg*. 2008;248:189–198.
- Gatt M, Anderson ADG, Reddy BS, et al. Randomized clinical trial of multimodal optimization of surgical care in patients undergoing major colonic resection. *Br J Surg*. 2005;92:1354–1362.
- Carli F, Kehlet H, Baldini G, et al. Evidence basis for regional anaesthesia in multidisciplinary fast-track surgical care pathways. *Reg Anesth Pain Med*. 2011;36:63–72.
- Levy BF, Tilney HS, Dowson HMP, Rockall TA. A systematic review of postoperative analgesia following laparoscopic colorectal surgery. *Colorectal Disease*. 2010;12:5–15.
- Kehlet H, Wilmore DW. Multimodal strategies to improve surgical outcome. *Am J Surg*. 2002;183:630–641.
- Schlachta CM, Burpee SE, Fernandez C, et al. Optimizing recovery after laparoscopic colon surgery (ORAL-CS). Effect of intravenous ketorolac on length of hospital stay. *Surg Endosc*. 2007;21:2212–2219.
- Delaney CP, Zutshi M, Senagore AJ, et al. Prospective, randomized, controlled trial between a pathway of controlled rehabilitation with early ambulation and diet and traditional postoperative care after laparotomy and intestinal resection. *Dis Colon Rectum*. 2003;46:851–859.
- Maessen J, Dejong CHC, Hausel J, et al. A protocol is not enough to implement an enhanced recovery programme for colorectal resection. *Br J Surg*. 2007;94:224–231.
- Wind J, Polle SW, Fung Kon Jin PHP, et al. Systematic review of enhanced recovery programmes in colonic surgery. *Br J Surg*. 2006;93:800–809.
- Varadhan KK, Neal KR, Dejong CHC, Fearon CH, Ljungqvist O, Lobo DN. The enhanced recovery after surgery (ERAS) pathway for patients undergoing major elective open colorectal surgery: a meta-analysis of randomized controlled trials. *Clin Nutr*. 2010;29:434–440.

38. Vlug MS, Wind J, Hollman MW, et al. Laparoscopy in combination with fast track multimodal management is the best perioperative strategy in patients undergoing colonic surgery. A randomized clinical trial (LAFA study). *Ann Surg.* 2011;254:868–875.
39. Banz VM, Inderbitzin D, Jacob SM. Improving surgical outcome: combine evidence from unimodal interventions [letter response]. *Anesth Analg.* 2012;114:241–242.
40. Spanjersberg WR, Reurings J, Keus F, van Laarhoven CJ. Fast track surgery versus conventional recovery strategies for colorectal surgery. *Cochrane Database Syst Rev.* 2011;2:CD007635.
41. Gendall KA, Kennedy RR, Watson AJM, Frizelle FA. The effect of epidural analgesia on postoperative outcome after colorectal surgery. *Colorectal Disease.* 2007;9:584–600.
42. Bonnet F, Camu F, PROSPECT Working Group. Procedure-specific recommendations for pain management after colon resection (2009 update). Available at: [www.postoppain.org](http://www.postoppain.org). Accessed February 26, 2012.
43. Moen V, Dahlgren N, Irestedt L. Severe neurological complications after central neuraxial blockades in Sweden 1990–1999. *Anesthesiology.* 2004;101:950–959.
44. Cook TM, Counsell D, Wildsmith JAW. Major complications of central neuraxial blocks: report on the third national audit project of the Royal College of Anaesthetists. *Br J Anaesth.* 2009;102:179–190.
45. Grounds RM. Is the outcome for central neuraxial blockade really reassuring? [letter]. *Br J Anaesth.* 2009;102:714–715.
46. Power GE, Warden B, Cooke K. Changing patterns in acute pain service: epidural versus patient-controlled analgesia. *Anaesth Intensive Care.* 2005;33:501–505.
47. Benzon HT, Jabri RS. Neuraxial anaesthesia and peripheral nerve blocks in patients on anticoagulants in the presence of epidural catheter. In: Hadzic A, ed. *Textbook of Regional Anaesthesia and Acute Pain Management*. New York: McGraw Hill Companies; 2007:997–1012.
48. Bedford NM, Hardman JG. The hidden cost of neuraxial anaesthesia? [editorial]. *Anaesthesia.* 2010;65:435–436.
49. Chilvers CR, Nguyen MH, Robertson IK. Changing from epidural to multimodal analgesia for colorectal laparotomy: an audit. *Anaesth Intensive Care.* 2007;35:230–238.
50. Ready LB. Acute pain: lessons learned from 25,000 patients. *Reg Anesth Pain Med.* 1999;24:499–505.
51. Kehlet H, Gray AW, Bonnet F, et al. A procedure-specific systematic review and consensus recommendations for postoperative analgesia following laparoscopic cholecystectomy. *Surg Endosc.* 2005;19:396–415.
52. Davies RG, Myles PS, Graham JM. A comparison of the analgesic efficacy and side-effects of paravertebral vs epidural blockade for thoracotomy—a systematic review and meta-analysis of randomized trials. *Br J Anaesth.* 2006;96:418–426.
53. Joshi GP, Bonnet F, Shah R, et al. A systematic review of randomized trials evaluating regional techniques for postthoracotomy analgesia. *Anesth Analg.* 2008;107:1026–1040.
54. Fischer HBJ, Simanski CJP, PROSPECT Working Group. A procedure-specific systematic review and consensus recommendations for analgesia after hip replacement. *Anaesthesia.* 2005;60:1189–1202.
55. Fowler SJ, Symons J, Sabato S, Myles PS. Epidural analgesia compared with peripheral nerve blockade after major knee surgery: a systematic review and meta-analysis of randomized trials. *Br J Anaesth.* 2008;100:154–164.
56. Fischer HBJ, Simanski CJP, Sharp C, et al. A procedure-specific systematic review and consensus recommendations for postoperative analgesia following total knee arthroplasty. *Anaesthesia.* 2008;63:1105–1123.
57. Liu SS, Richman JM, Thirlby RC, Wu CL. Efficacy of continuous wound catheters delivering local anesthetic for postoperative analgesia: a quantitative and qualitative systematic review of randomized controlled trials. *J Am Coll Surg.* 2006;203:914–932.
58. Petersen PL, Mathiesen O, Torup H, Dahl JB. The transversus abdominis plane block: a valuable option for postoperative analgesia. A topical review. *Acta Anaesthesiol Scand.* 2010;54:529–535.
59. Richman JM, Liu SS, Courpas G, et al. Does continuous peripheral nerve block provide superior pain control to opioids? A meta-analysis. *Anesth Analg.* 2006;102:248–257.
60. McIntyre PE, Schug SA, Scott DA, et al. Australian and New Zealand College of Anaesthetists. 2010 *Acute Pain Management: Scientific Evidence*. 3rd ed. Melbourne, Australia: Australian and New Zealand College of Anaesthetists; 2010. Available at: <http://www.anzca.edu.au>.
61. Paul JE, Arya A, Hulburt L, et al. Femoral nerve block improves analgesia outcomes after total knee arthroplasty. A meta-analysis of randomized controlled trials. *Anesthesiology.* 2010;115:1144–1162.
62. Rawal N, Axelsson K, Hylander J, et al. Postoperative patient-controlled local anesthetic administration at home. *Anesth Analg.* 1998;86:86–89.
63. Gupta A, Favaio S, Perniola A, Magnuson A, Berggren L. A meta-analysis of the efficacy of wound catheters for post-operative pain management. *Acta Anaesthesiol Scand.* 2011;55:785–796.
64. Moiniche S, Dahl JB. Wound catheters for post-operative pain: overture or finale? [editorial]. *Acta Anaesthesiol Scand.* 2011;55:775–777.
65. Rawal N, Borgeat A, Scott N. Wound catheters for post-operative pain management: overture or finale? [letter]. *Acta Anaesthesiol Scand.* 2012;56:395–396.
66. Beaussier M, White P, Raeder J. Is a negative meta-analysis consisting of heterogenic studies on wound catheters sufficient to conclude that no additional studies are needed? [letter]. *Acta Anaesthesiol Scand.* 2012;56:396–397.
67. Rawal N. Perineural catheter analgesia as a routine method after ambulatory surgery—effective but unrealistic. *Reg Anesth Pain Med.* 2012;37:72–78.
68. Beaussier M, El Ayoubi H, Schiffer E, et al. Continuous preperitoneal infusion of ropivacaine provides effective analgesia and accelerates recovery after colorectal surgery. A randomized, double-blind, placebo-controlled study. *Anesthesiology.* 2007;107:461–418.
69. Ranta PO, Ala-Kokko TI, Kukkonen JE, et al. Incisional and epidural analgesia after caesarean delivery: a prospective, placebo-controlled, randomized clinical study. *Int J Obstet Anesth.* 2006;15:189–194.
70. O'Neill P, Duarte F, Ribeiro I, et al. Ropivacaine continuous wound infusion versus epidural morphine for postoperative analgesia after caesarean delivery: a randomized controlled trial. *Anesth Analg.* 2012;114:179–185.
71. Bamigboye AA, Hofmeyr GJ. Local anaesthetic wound infiltration and abdominal nerves block during caesarean section for postoperative pain relief. *Cochrane Database Syst Rev.* 2009:CD006954.
72. *Procedure-Specific Postoperative Pain Management (PROSPECT)*. Available at: [www.postoppain.org](http://www.postoppain.org). Accessed February 26, 2012.
73. Practice guidelines for acute pain management in the perioperative setting. An updated report by the American Society of Anesthesiologists Task Force on Acute Pain Management. *Anesthesiology.* 2012;116:248–273.
74. Kerr DR, Kohan L. Local infiltration analgesia: a technique for control of acute postoperative pain following knee and hip surgery: a case study of 325 patients. *Acta Orthop.* 2008;79:174–183.
75. The Swedish Knee Arthroplasty Register. *Annual Report 2010*. Available at: <http://www.knee.nko.se/english>. Accessed December 5, 2011.

76. Andersen KV, Pfeiffer-Jensen M, Haraldsted V, Søballe K. Reduced hospital stay and narcotic consumption, and improved mobilization with local and intraarticular infiltration after hip arthroplasty: a randomized clinical trial of an intraarticular technique versus epidural infusion in 80 patients. *Acta Orthop*. 2007;78:180–186.
77. Essving P, Axelsson K, Kjellberg J, et al. Reduced hospital stay, morphine consumption, and pain intensity with local infiltration analgesia after unicompartmental knee arthroplasty. A randomized double-blind study of 40 patients. *Acta Orthop*. 2009;80:213–219.
78. Andersen LJ, Poulsen T, Krogh B, Nielsen T. Postoperative analgesia in total hip arthroplasty: a randomized double-blinded, placebo-controlled study on preoperative and postoperative ropivacaine, ketorolac, and adrenaline wound infiltration. *Acta Orthop*. 2007;78:187–192.
79. Toftdahl K, Nikolajsen L, Haraldsted V, et al. Comparison of peri- and intraarticular analgesia with femoral nerve block after total knee arthroplasty: a randomized clinical trial. *Acta Orthop*. 2007;78:172–179.
80. Spreng UJ, Dahl V, Hjalldahl A, et al. High volume local infiltration analgesia combined with intravenous or local ketorolac + morphine compared with epidural analgesia after total knee arthroplasty. *Br J Anaesth*. 2010;105:675–682.
81. Essving P, Axelsson K, Åberg E, Spännar H, Gupta A, Lundin A. Local infiltration analgesia versus intrathecal morphine for postoperative pain management after total knee arthroplasty: a randomized controlled trial. *Anesth Analg*. 2011;113:926–933.
82. Kehlet H, Andersen LO. Local infiltration analgesia in joint replacement: the evidence and recommendations for clinical practice. *Acta Anaesthesiol Scand*. 2011;778–784.
83. Raeder J, Spreng UJ. Local-infiltration anaesthesia (LIA): post-operative pain management revisited and appraised by the surgeons? *Acta Anaesthesiol Scand*. 2011;55:772–774.
84. Röstlund T, Kehlet H. High-dose local infiltration analgesia after hip and knee replacement—what is it, why does it work, and what are the future challenges? [editorial]. *Acta Orthop*. 2007;78:159–161.
85. Rawal N. Local infiltration analgesia and other multicomponent techniques to improve postoperative outcome—are we comparing oranges and apples? *Reg Anesth Pain Med*. 2011;36:417–420.
86. Biki B, Mascha E, Moriarty DC, et al. Anesthetic technique for radical prostatectomy surgery affects cancer recurrence. A retrospective analysis. *Anesthesiology*. 2008;109:180–187.
87. Christopherson R, James KE, Tableman M, et al. Long-term survival after colon cancer surgery: a variation associated with choice of anaesthesia. *Anesth Analg*. 2008;107:325–332.
88. Yeager MP, Rosekrantz KM. Cancer recurrence after surgery. A role for regional anaesthesia? [editorial]. *Reg Anesth Pain Med*. 2010;35:483–488.
89. Chang CC, Lin HC, Lin HW, Lin HC. Anesthetic management and surgical site infections in total hip and knee replacement. A population-based study. *Anesthesiology*. 2010;113:279–285.
90. Tsui BCH, Green JS. Type of anaesthesia during cancer surgery and cancer recurrence. *BMJ*. 2011;342:d1605.