Benefits, Risks and Complications of Perioperative Use of Epidural Anesthesia

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Use of thoracic epidurals is widespread for intraoperative and postoperative analgesia. Thoracic epidural anaesthesia (TEA) reduces sympathetic activity and thereby influences perioperative function of vital organ systems. A results of recent studies suggest that TEA decreases postoperative morbidity and mortality. There is better pain control with TEA in a wide range of surgical procedures. Use of TEA is associated with the risk of harm, but also the other methods used to control perioperative pain and stress response carry specific risks. Timely diagnosis and treatment of spinal compression or infection are crucial to ensure patient safety with TEA. The benefits of TEA outweigh the risks with respect to the perioperative outcome and organ protection, if basic guidelines are followed. Key words: epidural anesthesia, epidural analgesia, outcomes, complications.

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1. INTRODUCTION

Epidural anesthesia/analgesia is commonly used as a analgesic technique for major surgery. Most currently published studies lack definitive answers to the question, “Does intraoperative use of epidural anesthesia improve outcome?”, although more and more published papers indicates a benefits of thoracic epidural anesthesia and analgesia on the cardiac, respiratory, and immune systems as well as on the surgical stress response.

This review aims to outline benefits and risks of epidural anesthesia with respect to the perioperative pathophysiology, outcome and organ protection, citing the latest findings from published reports.

2. CARDIOVASCULAR SYSTEM

Cardiovascular causes account for 63% of perioperative mortality in a high-risk patient population and for 30% of perioperative mortality in low-risk patients (1). Thoracic epidural anaesthesia (TEA) with local anesthetics can produce a selective segmental blockade of the cardiac sympathetic innervations (T1-T5)(2) and reduce the major determinants of myocardial oxygen demand, such as blood pressure, heart rate, and contractility (3). It improves the balance between cardiac supply and demand (3). By blocking sympathetically mediated coronary constriction, endocardial to epicardial blood flow ratio is improved, thus optimizing the regional distribution of myocardial blood flow. Blood flow to ischemic regions of myocardium, with TEA, may increase (4, 5, 6). Compared with TEA, lumbar epidural anesthesia with local anesthetics does not provide the same physiologic benefits (7, 8, 9).

The meta-analysis by Popping et al. (10) in abdominal and thoracic procedures showed a significant reduction in myocardial infarction (MI) with primarily TEA. Similar, the VACS trial (n=1021) shown that the abdominal aortic surgery subgroup (n=374) had significantly lower incidences of cardiovascular complications (9.8 vs 17.9%, p=0.03) primarily due to reduction in IM (2.7 vs 7.9%, p=0.05) (11). The beneficial effects of TEA on cardiac morbidity in high risk patients (like aortic reconstructions) may require several days of postoperative epidural analgesia (3, 12).

The maximum cardiac benefits are seen with continuing postoperative thoracic epidural analgesia for 48-72 hours. In addition, Beattie et al. (13) reported a 4-fold reduction in the incidence of postoperative congestive heart failure, MI and death in patients treated with 24-h postoperative epidural analgesia compared to systemic analgesia.
3. PULMONARY SYSTEM

The pathophysiology of postoperative pulmonary complications after surgery is multifactorial and includes disruption of normal respiratory muscle activity from either surgery or anesthesia, a reflex inhibition of phrenic nerve activity with subsequent decrease in diaphragmatic function, and uncontrolled postoperative pain (14). The improvements of pulmonary function related to epidural anesthesia/analgesia (EAA) may be result of: (1) blocking of reflexes inhibiting diaphragmatic function demonstrable after abdominal and thoracic surgery, with a beneficial effect on pulmonary mechanics (15); (2) effective pain relief allowing the patient to take deep breaths, cough and cooperate with physiotherapy (15, 16); (3) avoidance of high-dose systemic opioids that reduces respiratory depression; and (4) reduction of the stress response to surgery with reducing the level of postoperative immunosuppression, which may contribute to decreasing in pulmonary infection (17, 18).

Well-conducted studies have found no significant correlation between postoperative pulmonary function tests (PFTs) and the incidence of pulmonary complications (19, 20). But, recent study reported a benefit of postoperative PFTs (FVC and FEV1) on postoperative days 1 and 4, in chronic obstructive pulmonary disease (COPD) patients operated under combined general and epidural anesthesia and postoperative epidural analgesia compared with COPD patients with general anesthesia and intravenous analgesia 820). However, there is not improved overall clinical outcome, probably owing to the small number of patients included in the study (20).

There is significant reduction in the incidence of pulmonary infection (7,10,21,22), respiratory failure (16), reintubation (11), prolonged ventilation (23) and prolonged ICU stays (11) with TEA in patients undergoing abdominal or thoracic surgery (7,10,21). The strongest preventive effect was seen in patients with the most severe type of COPD (22). However, other studies have failed to demonstrate a beneficial effect of EA on postoperative pneumonia, probably of a small number of patient involved in analysis (24).

Although postoperative pain management is enhanced by the use of epidural anesthesia, the use of EA in patients with COPD has been controversial because of ongoing fears that it may acutely reduce lung function. For example, the use of high thoracic epidurals has been associated with decreased spirometric values by possibly blocking intercostal muscle innervation (25, 22). However, several studies have failed to show any deleterious respiratory effects from EA (25, 26).

4. COAGULATION AND ANTI-INFLAMMATORY EFFECTS

A combination of indirect and direct mechanisms for regional anesthesia effects on blood coagulation are responsible for the antithrombotic effects of regional block. Epidural analgesia attenuates the hypercoagulable response to surgery and improves fibrinolytic function by attenuating the stress response. Tuman et al. (27) reported a significant reduction in vascular graft occlusion with use of EA (p<0.007). In addition, they found that general anesthesia patients are hypercoagulable, whereas the epidural group maintain normal coagulation. TEA has a less significant effect on lower extremity and deep pelvis blood flow; analysis that included 5 randomized trials in patients undergoing abdominal surgery, found no significantly reduction of thromboembolic complications of 22.4% to 15.7% (28). TEA provides benefits on coagulation by improved venous blood flow, attenuation of the sympathetic response to surgery, the anticoagulant properties of local anesthetics, early mobility, and lowering of mean arterial pressure MAP (3). Epidural anesthesia prevents perioperative venous stasis (29). Cochrane meta-analysis from Parker and al. (30) reported significantly reduced incidence of perioperative venous thrombosis with the use of epidural anesthesia.

Animal studies demonstrate that TEA can cause effective sympathetic block with reductions in inflammation. Liver perfusion and hepatic inflammatory response might be influenced by TEA independently from cardiac output (31,32). Despite an attenuated inflammatory response in those cases with epidural anesthesia, there is no improved outcome variables.

5. GASTROINTESTINAL FUNCTION

Postoperative ileus is very common after abdominal surgery (>90% in many series) and may increase resource utilization by prolonging hospital stay (33). TEA causes sympatholysis, depression of postoperative reflex inhibition of gastrointestinal motility, reduced the inflammatory response and opioid consumption and superior pain therapy, that contribute to reduced duration of postoperative ileus (23) and improved microcirculation with subsequent improved bowel function (34, 35, 36). Recovery of postoperative ileus occurs earlier when epidural local anesthetic is used alone compared with the use of a combination of epidural opioid and local anesthetic.

TEA exerts beneficial effects on intestinal perfusion as long as its hemodynamic consequences are adequately controlled (37). However, TEA may deteriorate intestinal perfusion in case of substantial deterioration in systemic hemodynamics (38, 39). The use of small doses of norepinephrine to maintain systemic perfusion pressure has been shown not to compromise intestinal perfusion in experimental abdominal surgery (40).

6. DECREASED POSTOPERATIVE CATABOLISM

TEA attenuates postoperative nitrogen excretion, amino acid oxidation, and decreased muscle protein synthesis while minimizing whole body protein catabolism. Muscle mass can be spared (41).

7. TEA INTRAOPERATIVE USE

The intraoperative use of epidural local anesthetics for abdominal aortic surgery have several advantages: (1) a reduced need for intraoperative inhalational and intravenous (opioid) anesthetics, which allows early extubation of the trachea; (2) reduced requirements for vasodilating agents before and during cross-clamping of the aorta; and (3) excellent postoperative analgesia, which allows for earlier recovery of pulmonary function.
or in patients with lower comorbidity indices (15). Procedure specific meta-analyses and individual RCTs have not noted an effect from epidural analgesia but lack sufficient sample size due to the relatively low incidence of mortality (0.2-5%) (11, 13, 16). The biggest prospective trial of the outcome effects, the Multicentre Australian Study of Epidural Analgesia (MASTER) trial (16) randomized 915 high risk patients to combined general/epidural analgesia followed by 72 hours of postoperative epidural analgesia (low thoracic or high lumbar placement) with local anesthetic and opioids vs general anesthesia followed by systemic opioid treatment and undergoing mixed abdominal surgical procedures) showed that overall mortality rates were similar between groups (5.1 vs 4.3%). However, the trial was underpowered to shown the moderate outcome effect of TEA, and interpretation of the results may be compromised (46).

10. COMPLICATIONS
Potential complications of EAA may decrease the acceptance and enthusiasm for these techniques. Complications may be directly related to the performance of the technique or may result from poor management of the block. Neurovascular injury during catheter placement and local anesthetic/analgesic reactions are uncommon. Sympathetic leads to hypotension and bradycardia, as important potential hemodynamic events of EAA. A prospective multicenter randomized trial showed that the incidence of hypotension is 41% after epidural combined with general anesthesia, and 23% after use of general anesthesia alone (p=0.049) (21). There are no significant differences in heart rate or episodes of bradycardia (21). In order to maintain stable hemodynamics, EAA is associated with excessive fluid administration. However, the incidence of complications associated with excess fluid administration, cardiac, pulmonary, and/or hemodilution are actually reduced with EAA (21). Adverse effects related to medications used in TEA include nausea, vomiting, pruritus, hypotension, urinary retention, sedation, and respiratory depression. Reports of dysesthesia, paresthesias, weakness, and local anesthetic toxicity are rare (47). Systemic absorption of local anesthetics at high doses can produce seizures, loss of airway protective reflexes, respiratory depression, coma and cardiac arrhythmias with hemodynamic instability (48,49). Catheter complications result from inadvertent penetration of the dural space, damage to neurovascular structures, or infection. Accidental dural puncture during needle insertion occurred 0.16–1.3% and subsequent postdural headaches developed in 16–86% of these patients (50). Meningitis and epidural abscess are rare complications (3 cases of meningitis and no epidural abscess in a series that included 65000 epidural cases (51, 47). Factors likely influencing infection may include perioperative antibioticy use and duration of TEA use. The risk of infection appears to increase after the second day of epidural catheterization, and a longer duration of use has an incidence of local infection that approaches that of intravascular devices (47). Paraplegia, the most feared complication of epidural anesthesia, is usually the result of an epidural hematoma during catheter placement or removal (52). Rarely, a spinal abscess or anterior spinal artery syndrome will cause paraplegia.

11. EPIDURAL HEMATOMA
The incidence of epidural hematoma formation was estimated to be less than 1 in 150 000 in one study and found to be none in a second series of 100 000 (14,53). Injury to the spinal vasculature during catheter placement occurs in approximately 3–12% of cases, yet this rarely results in symptomatic epidural hematomas. Symptomatic epidural hematomas are usually associated with anticoagulation, catheter placement/removal during anticoagulation, and/or trauma during catheter placement. There are a number of case reports of spontaneous spinal hematomas during dual antplatelet therapy without any anesthetic manipulation (54, 55, 56). Additionally, spontaneous spinal hematomas have been described both with clopidogrel and acetysalicylic acid alone (57). A review of 61 cases of symptomatic epidural hematomas found that 41 (68%) patients
had coagulation defects (58). This association has led to one of the contro-
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