Spinal Opiates For Cardiac Surgery: Worth The Risk?

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Potential Benefits

Pain after cardiac surgery may be intense. It may originate from many sources, including the incision, intraoperative tissue retraction and dissection, vascular cannulation sites, vein harvesting sites, and chest tubes, among others. Patients in whom an internal mammary artery is surgically exposed may have substantially more postoperative pain. Persistent pain after cardiac surgery, while rare, can be problematic. Inadequate analgesia during the postoperative period may lead to many adverse hemodynamic (tachycardia, hypertension, and vasoconstriction), metabolic (increased catabolism), immunologic (impaired immune response), and hemostatic (platelet activation) alterations. In patients undergoing cardiac surgery, perioperative myocardial ischemia is most often observed during the immediate postoperative period and seems to be related to outcome. Intraoperatively, initiation of cardiopulmonary bypass (CPB) causes substantial increases in stress response hormones (norepinephrine, epinephrine, etc.) that persist into the immediate postoperative period and may contribute (along with inadequate analgesia) to myocardial ischemia during this time. Furthermore, postoperative myocardial ischemia may be aggravated by cardiac sympathetic nerve activation, which disrupts the balance between coronary blood flow and myocardial oxygen demand. Thus, during the pivotal immediate postoperative period after cardiac surgery, adequate analgesia (coupled with stress response attenuation) may potentially decrease morbidity and enhance health-related quality of life.

Potential Risks

The four clinically relevant undesirable drug effects of intrathecal (IT) opiates are pruritus, nausea/vomiting, urinary retention, and respiratory depression. The most common side effect is pruritus (incidence varies widely and is often identified only after direct questioning of patients). Severe pruritus is rare, occurring in only approximately 1% of patients. The incidence of nausea/vomiting is approximately 30%. Incidence of urinary retention varies widely and occurs most often in young male patients. The most important undesirable drug effect of IT opiates is respiratory depression. The incidence of respiratory depression that requires intervention after conventional doses of IT opiates is approximately 1%, the same as that after conventional doses of intramuscular/intravenous opiates. Early respiratory depression occurs within minutes of opiate injection and is only associated with IT fentanyl/sufentanil. Delayed respiratory
depression occur hours after opiate injection and is only associated with IT morphine. Delayed respiratory depression results from cephalad migration of morphine in cerebrospinal fluid and subsequent stimulation of opiate receptors located in the ventral medulla. Factors that increase risk of respiratory depression include large or repeated doses of opiates, advanced age, and concomitant use of intravenous sedatives. The magnitude of postoperative respiratory depression is profoundly influenced by the dose of IT morphine administered and the type and amount of intravenous drugs used for the intraoperative baseline anesthetic. Prolonged postoperative respiratory depression may delay tracheal extubation, and naloxone may be required in some patients. The optimal dose of IT morphine in this setting, along with the optimal intraoperative baseline anesthetic that will provide significant postoperative analgesia yet not delay tracheal extubation in the immediate postoperative period, remains to be elucidated.

IT instrumentation entails risk, the most feared complication being hematoma formation. The estimated incidence of hematoma formation is approximately 1:220,000 after IT instrumentation and usually occurs when instrumentation is performed in a patient with a coagulopathy (from any cause) or when instrumentation is difficult or traumatic. Paradoxically, IT instrumentation has been performed safely in patients with known coagulopathy. Whereas most investigators agree that the risk of hematoma is increased when IT instrumentation is performed in a patient before systemic heparinization required for cardiac surgery, the absolute degree of increased risk is somewhat controversial. An extensive mathematical analysis by Ho, et al. (2000) of the approximately 10,840 IT injections in patients subjected to systemic heparinization required for CPB (without a single episode of hematoma formation) reported in the literature as of 2000, estimated that the minimum risk of hematoma formation was 1:220,000 and the maximum risk of hematoma formation was 1:3600 (95% confidence level) yet the maximum risk may be as frequent as 1:2400 (99% confidence level). Certain precautions, however, likely decrease risk. In 2004, the first case reports describing epidural hematoma formation associated with thoracic epidural catheter insertion in patients prior to cardiac surgery were published. Since that time, others have been published as well (some with devastating complications). At the present time, no report of hematoma formation associated with IT instrumentation in a patient scheduled for cardiac surgery exists.

Clinical Utilization

Application of IT analgesia to patients undergoing cardiac surgery was initially reported by Mathews and Abrams in 1980. Other investigators have subsequently applied IT techniques to patients undergoing cardiac surgery. Most investigators have used IT morphine in hopes of providing prolonged postoperative analgesia. Some investigators have used IT fentanyl or sufentanil for intraoperative anesthesia (with stress response attenuation). Two early randomized, blinded, placebo-controlled clinical studies reveal the ability of IT morphine to induce significant postoperative analgesia after cardiac surgery. Vanstrum, et al. (1988) found
that patients receiving IT morphine (0.5 mg) required significantly less postoperative morphine than placebo controls. Likewise, Chaney, et al. (1996) found that patients receiving IT morphine (4.0 mg) required significantly less postoperative morphine than placebo controls. In both studies, despite enhanced analgesia, there were no clinical differences between groups regarding postoperative morbidity, mortality, or duration of hospital stay. The mid-1990s saw the emergence of fast-track cardiac surgery, with the goal being tracheal extubation in the immediate postoperative period. Chaney, et al. (1997, 1999) were the first to study the use of IT morphine in this setting. These initial studies revealed that IT morphine (10 mcg/kg) can produce reliable postoperative analgesia (yet no additional benefits), yet may potentially delay tracheal extubation in the immediate postoperative period because of delayed respiratory depression.

Over the last decade (2000-present), numerous clinical investigators have revealed that certain combinations of intraoperative anesthetic technique coupled with appropriate doses of IT morphine will allow both tracheal extubation after cardiac surgery within the immediate postoperative period along with moderately enhanced analgesia. However, no additional clinical benefits, beyond analgesia, are reliably obtained. The optimal dose of IT morphine for achieving postoperative analgesia with minimum undesirable drug effects is uncertain. Naturally, when larger doses of IT morphine are used, more intense and prolonged postoperative analgesia is produced at the expense of more undesirable drug effects.

Clinical Outcome?

The many clinical investigations involving IT techniques in patients undergoing cardiac surgery indicate that administration of IT morphine to patients produces reliable postoperative analgesia after cardiac surgery and nothing more. No additional clinical benefits, beyond analgesia, have been reliably obtained. A recently published meta-analysis by Liu, et al. (2004) assessed effects of perioperative central neuraxial techniques on outcome after coronary artery bypass surgery. They evaluated 17 randomized controlled trials enrolling 668 patients and found that IT techniques did not affect incidences of mortality, myocardial infarction, dysrhythmias, nor time to tracheal extubation and seemed only to modestly decrease systemic morphine use and pain scores (while increasing the incidence of pruritus). Whether IT techniques truly affect morbidity and mortality in patients undergoing cardiac surgery remains to be determined. All clinical reports involving IT techniques for cardiac surgery involve small numbers of patients, and few (if any) are well designed. Only a handful of clinical studies involving IT techniques are prospective, randomized, blinded, and placebo-controlled. Furthermore, none of these clinical studies use clinical outcome as a primary endpoint (all focus on postoperative analgesia).

Multiple factors are important during the perioperative period that substantially affect outcome and quality of life after cardiac surgery: surgical intervention, neurologic dysfunction, myocardial dysfunction, pulmonary dysfunction, renal dysfunction, coagulation abnormalities,
postoperative analgesia, and/or extent of systemic inflammatory response, among others. Obviously, depending on specific clinical situations, certain factors will be more important than others. It is extremely difficult (if not impossible) to determine the exact importance of attaining adequate postoperative analgesia in relation to all of the factors affecting outcome and quality of life in a patient undergoing cardiac surgery. Furthermore, a clear link between “adequate” or “high-quality” postoperative analgesia and improved outcome in patients after cardiac surgery has yet to be established. Preemptive analgesia, while intriguing, requires further study to determine its role in affecting postoperative analgesia and outcome.

Conclusions

Use of IT techniques in patients undergoing cardiac surgery remains extremely controversial, prompting numerous Editorials by recognized experts in the field of cardiac anesthesia. One of the main reasons for such controversy (which likely will continue for some time) is that the numerous clinical investigations regarding this topic are suboptimally designed and use a wide array of disparate techniques, preventing clinically useful conclusions with widespread agreement. When critically reviewed, the literature suggests that the only clear benefit of using IT techniques in patients undergoing cardiac surgery is moderately enhanced postoperative analgesia and they have no clinically important effect on outcome. Meylan, et al. (2009) perhaps state it best: “The usefulness of intrathecal morphine in patients undergoing cardiothoracic surgery should be questioned. In view of all these caveats, the most radical, and perhaps most appropriate, conclusion would be that this analgesic intervention that reduces postoperative morphine consumption but not morphine-related adverse effects, that only slightly improves postoperative pain intensity, that significantly increases the risk of pruritus, and that is associated with a finite risk of respiratory depression should be abandoned.”
References

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