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Neuraxial anesthesia for cardiac surgery: thoracic epidural and high spinal anesthesia - why is it different?

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ABSTRACT

Anesthesiologists can offer much more then stable blood pressure and heart rate in the intraoperative period. By choosing appropriate anesthetic techniques they can tremendously influence perioperative stress. This may positively impact on the overall surgical outcome. One of the most intriguing aspects of neuraxial anesthesia is its ability to attenuate the stress response to surgery.

At present there is no agreement on the clinical importance of such a response but there is substantial indirect evidence that it may play an important role in a patient's outcome. Neuraxial anesthesia supplemented by general anesthesia is justified and can be safely used in cardiac surgery.

The authors of this expert opinion prefer spinal anesthesia to thoracic epidural anesthesia and have been using it routinely for the last 20 years without any neurological complications. The risk of spinal hematoma from a 27G spinal needle prior to full heparinization is unknown but in our opinion is remote. Both epidural and spinal techniques can and should have a place in modern cardiac anesthesia practice and should be further investigated.

Keywords: *spinal, epidural, neuraxial, cardiac surgery, anesthesia, outcome, mortality, complication*

The evolution of cardiac anesthesia closely parallels technological advances in cardiac surgery. Initially, high narcotic anesthesia was introduced in an attempt to provide cardiovascular stability (1).

Later, balance anesthesia was introduced to facilitate fast tracking and perioperative cost containment (2).

With time, it was realized that anesthesia is not only about cardiovascular stability, early extubation or even post op pain control. New emphasis is now focused on the body responses to surgery and myocardial protection. It was the beginning of a new concept, a neuraxial anesthesia for cardiac surgery.

Neuraxial anesthesia, mainly thoracic epidural and high spinal anesthesia, supplemented by general anesthesia is the newest and, perhaps, the most controversial of all anesthetic techniques used for cardiac surgery. It is important to define what "neuraxial anesthesia for cardiac surgery" is and how it differs from other techniques. In the literature, the terms "epidural/spinal anesthesia" and "epidural/spinal analgesia" are commonly used incorrectly (3).

Neuraxial anesthesia results from pharma-

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cologic denervation at the level of the spinal cord by using highly concentrated local anesthetics and is usually achieved by the epidural or spinal approach. It consists of profound sensory analgesia, as well as, motor and sympathetic blockade.

Neuraxial analgesia, however, results from the use of lower concentrations of local anesthetics and/or opioids, which results in a partial sensory/motor blockade. It has been shown that spinal analgesia with opioids alone does not offer significant clinical benefits aside from better pain control (4).

In cardiac surgery, satisfactory neuraxial anesthesia is achieved with a sensory block from T-1 downward and total body sympathectomy (including cardiac sympathectomy). One group of benefits from this technique comes from denervation of the surgical site: stable hemodynamics (due to no responses to surgical stimulation), minimal humoral, metabolic, homeostatic alterations and minimal immunosupression. The other benefits come from sympathectomy: positive myocardial oxygen balance (hypodynamic circulation), protection of myocardium and abdominal organs (redistribution of blood flow within the myocardium or abdominal organs), and protection against β-receptor down regulation (5).

Neuraxial anesthesia is usually supplemented by general anesthesia (preferably with inhalation agents to take advantage of their effect on myocardial protection) just deep enough to maintain unconsciousness and amnesia. This combination of regional anesthesia supplemented by a light plain of general anesthesia facilitate early extubation and fast tracking.

Most of the benefits of neuraxial anesthesia over traditional general anesthesia are anecdotal, not studied properly or difficult to study. We can argue however, that there are numerous and substantial advantages, especially for high-risk elderly patients (6). They include benefits for both the patient and for the institution. Documented benefits of high thoracic epidural anesthesia include: decreased incidence of cardiovascular events (stroke, myocardial ischemia) (7), less respiratory complications, less renal failure, and a lower infection rate (8); as well as a shorter ICU stay, lower cost of anesthesia, and earlier hospital discharge (3,7). We believe that high spinal anesthesia can achieve similar benefits while having the advantages of being more "user friendly" and having a lower risk of epidural/spinal hematoma. One of the most intriguing aspects of neuraxial anesthesia is its ability to attenuate the stress response to surgery (including cardiac surgery) (5). At present there is no agreement on the clinical importance of such a response but there is substantial indirect evidence that it may play an important role in a patient's outcome (5,8). The recently published POISE study is an example of this controversy. In this large double-blinded prospective study it was concluded that perioperative β-blockade used for high risk surgical patients increased the risk of death from strokes and infections (9).

It is possible that this unexpected finding could be explained by the lack of surgical stress response attenuation in the setting of high dose β-blocker use. Specifically, in our every day anesthesia practice we judge the level of anesthesia by hemodynamic responses to surgical stimulation and adjust the level of anesthetic accordingly. By using aggressive perioperative β-blockade, we only attenuate the hemodynamic responses to surgery. As a result, these patients may receive a lighter level of anesthesia that fails to attenuate the neuroendocrine, metabolic and immunosuppressive stress response in the perioperative period. Perhaps this lack of surgical stress response attenuation in the POISE study may explain the higher incidence in mortality from strokes (hypercoagulability) and infectious complications (im-

munosuppression) in β-blocked patients. There are some theoretical and practical risks involved with regional anesthesia. In this discussion, we will focus only on the most controversial, the risk of epidural or spinal hematoma from the needle or catheter insertion prior to systemic heparinization. There are several well-documented reports of epidural hematomas resulting from thoracic epidural anesthesia, some with permanent neurological deficits (10).

There is a significant difference between the two commonly used regional anesthetic techniques: thoracic epidural and high spinal anesthesia. While they are almost identical from a physiological point of view, they differ in the way they are utilized (*Table 1*). The main advantage of epidural anesthesia is its ability to be continued as epidural analgesia in the postoperative period. In case of spinal anesthesia it's analgesic effect is usually limited to the first 24 hours from the spinal opioids. After the first 24 hours conventional analgesic methods could be used in the form of intravenous or oral medications. Our usual intrathecal solution consists of: 20-40 mg of 0.75 % hyperbaric bupivicaine, 0.3-0.4 mg of morphine and 10-20 ug of sufentanil for a total volume of 4-6ml. It is also important to mention that there is an unjustified perception that high level regional anesthesia with total body sympatectomy could cause profound hypotension and bradycardia leading to cardiovascular disaster. While it is true that some degree of hypotension is often present, both bradycardia and hypotension are easily managed by the use of the Trendelenburg position and/or by using small doses of vasoactive drugs such as dopamine or phenylephrine (11-14). In our practice we do not preload patients with intravenous fluids prior to spinal injection.

We have developed and introduced a high spinal anesthesia technique for cardiac surgery in adults and children in the early 1990's (11-12). Up to date, we performed over 10000 cases of spinal injections without a single case of spinal/epidural hematoma. At present, high spinal anesthesia is a routine anesthetic technique for most of our cardiac surgeries including patients with high grade left main coronary artery stenosis and patients with compromised

Table 1 - *Different characteristics of neuraxial anaesthesia techniques.*

Thoracic epidural anesthesia:
- Uses large (16 G) needles and requires insertion of epidural catheter into a vascular epidural space.
- Should be established and tested preferably the day before the surgery to ensure reliable anesthesia.
- Insertion of the epidural catheter can be complex and time consuming.
- There is a potentially high failure rate in effective epidural block (up to 20 %).
- Thoracic segmental block usually does not cover the lower part of the body (need for supplementary anesthesia for vein harvesting).
- Requires relatively large volumes of local anesthetics with the potential for cardiotoxicity.
- Has a real well documented risk of epidural hematoma; estimated risk 1:4,500. (10)

High Spinal anesthesia:
- Can be administered with small 27 G needles and a single injection of anesthetic solution.
- Is usually simple to administer and reliable to establish.
- Provides profound sensory denervation and sympathetic block to the whole body.
- Uses small doses of local anesthetics.
- Is inexpensive.
- Epidural or subarachnoid hematoma has not been reported with the use of a 27G needle in the setting of cardiac surgery.

left ventricular function undergoing complex surgical procedures. In addition, with appropriate hemodynamic support, high spinal anesthesia was safely used even for patients with severe aortic stenosis operated in our centre (13). We do not use spinal opioids alone any more, but we use them as analgesic intrathecal adjuvants on top of intrathecal local anesthetics.

We believe that as anesthesiologists we can offer to our patients much more then stable blood pressure and heart rate in the intraoperative period. By choosing appropriate anesthetic techniques we can tremendously influence the way our body responds to surgery and perioperative stress. This may positively impact on the overall surgical outcome.

CONCLUSIONS

It is the opinion of the authors, that epidural/spinal anesthesia for cardiac surgeries is justified and can be safely used.

While thoracic epidural anesthesia has a higher potential for epidural hematoma, it may be considered in selected cases after careful consideration and discussion with the patient. Its use seems to be especially beneficial when prolonged continuous postop analgesia is required. We prefer spinal anesthesia to thoracic epidural anesthesia and have been using it routinely for the last 20 years without any neurological complications (14). The risk of spinal hematoma from a 27G spinal needle prior to full heparinization is unknown but in our opinion is remote. Both techniques can and should have a place in modern cardiac anesthesia practice and should be further investigated.

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