ANAESTHESIA FOR SPINAL SURGERY

Review Article

SPINAL CERRAHİDE ANESTEZİ

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ABSTRACT

Spinal surgery includes various procedures, that may involve patients of all ages. Anaesthetic management of these patients is important during perioperative period, in order to reduce and avoid potential complications.

Keywords: Anaesthesia, spinal surgery.

ÖZET

Spinal cerrahi her yaşta hastanın söz konusu olabildiği, çeşitli prosedürleri içerir. Perioperatif dönemde oluşabilecek komplikasyonları azaltmak ve önlemek için bu hastaların anestezi yönetimi özellikle arz eder.

Anahtar kelimeler: Anestezi, spinal cerrahi.

INTRODUCTION

Spinal surgical procedures have a wide variety and comprise a major subgroup of neurosurgery.

Thousands of patients undergo spinal surgery every year. Anaesthetic management of the spinal cases is directly related with perioperative morbidity and mortality.

The anaesthesiologist must determine the proper surgical anaesthesia combined with maintenance of normal respiratory and cardiovascular function and management of postoperative pain. Before the operation, the surgical team and anesthesiologists must get information and take the right decision about the patient and surgery. In this study we aim to review anaesthetic management of the spinal surgical cases.

Preoperative Assessment

Preoperative assessment is one of the most important stages of perioperative care in anaesthesia.

The anaesthesiologist must make careful assessment based on the medical history and physical examination of the patient. Preoperative considerations; evaluation of all organ systems status especially respiratory and cardiovascular, nervous system evaluation and documentation of neurological deficits, possible anatomical abnormalities leading to ‘airway limitation’, examination of the
physical status and planning of premedication is important.

Preoperative laboratory tests; full blood count, coagulation profile, electrolytes, renal and liver functions, ECG and echocardiogram (as appropriate), imaging studies (chest X-ray, cervical spine imaging) should be performed. The preoperative tests should be according to the ASA (American Society of Anaesthesiologists) recommendation. Preparation of blood and blood products and if needed intensive care organization is important to reduce the risk of intraoperative and postoperative complications (1).

Assessment of the cardiorespiratory system is crucial. Many disorders requiring spinal surgery may have cardiac involvement. Symptomatic patients require more cardiac investigations such as echocardiography or stress tests. Disease such as Scoliosis and Rheumatoid Arthritis can cause restrictive lung disease. For this cases lung spirometry is indicated preoperatively (2).

As premedication, to reduce the preoperative anxiety for the night before operation, alprazolam (oral 0.5mg) or diazepam (oral 5mg), (0.05–0.2mg/kg) is highly effective. Midazolam can only be used before the operation due to its amnestic effect.

Before the procedure, we need to get informed consent from the patient. For Mallampati I-II patients, standard airway management with endotracheal intubation can be performed.

Fiber optic intubation can be used for difficult airway or unstable spinal injuries. If we decide the fiber optic intubation, appropriate equipment and skilled staff should be made available. In certain circumstances (e.g. surgery involving maxillootomy or mandibulotomy), an elective tracheostomy may be necessary for postoperative airway management. We can choose the method of endotracheal intubation after airway and neck stability assessment (1).

Intraoperative Management

Spinal surgery is relatively lasting longer, the probability of intraoperative bleeding is higher comparing to other surgeries (due to the patient’s prone position) and the possibility of severe pain after surgery, are facts the anaesthetist should be aware.

For all spinal surgery patients standard monitoring is considered. This comprises of electrocardiography monitoring (ECG), pulse oximetry, end-tidal CO2 with capnography, non invasive arterial blood pressure, body temperature and neuromuscular block monitoring. Optimal monitoring is by additional measurement of central venous pressure measurement, invasive arterial blood pressure, urinary catheter, bispectral index (BIS) and somatosensory evoked potentials (SSEP) monitoring.

Spine surgery is mostly performed under general anaesthesia with endotracheal intubation. Anesthesia induction is by administering iv propofol (2–2.5mg/kg) or iv thiopenthal (3–5mg/kg). Fentanyl (50–150mcg/kg) iv can be used in anesthesia induction so that blood pressure changes can be kept at a minimal level. Muscle relaxation is normally achieved with a nondepolarizing neuromuscular blocking agent with TOF monitoring. Avoid succinylcholine in patients with spinal trauma and muscular dystrophy.

During the maintenance of anaesthesia, the anesthetist must pay attention to the airway preservation, by firmly securing the tube in prone position. It is important to use the appropriate agents for anaesthetic maintenance to facilitate the spinal cord monitoring. During the operation, care should be taken to prevent hypothermia, maintain the blood volume status by being aware of potential blood loss so that is promptly substituted by blood products and also antibiotic prophylaxis.
Total intravenous anesthesia (TIVA) and inhalational anesthesia is too an essential method. In total intravenous anesthesia (TIVA), following induction of anesthesia, an anesthetic agent (usually propofol 100-200mcg/kg/min) and an analgesic drug, usually an opioid derivative, (remifentanil 0.2-0.5 mcg/kg/min) i.v is given as an infusion. Remifentanil is an ultra short-acting opioid, which produces profound analgesia, has a rapid onset, excellent titrability, and a rapid offset. It can be used as a part of either an inhalation or an i.v. maintenance regime. Anaesthesia maintenance should interfere minimally with cord monitoring. Inhalational agents and high dose nitrous oxide disrupt the spinal cord evoked potential monitoring. As an antibiotic prophylaxis, single dose first generation cephalosporin (cefazolin) is recommended.

The focus of intraoperative management is minimizing spinal cord ischaemia and compression on the spinal cord. These are accomplished by maintenance of Spinal Cord Perfusion Pressure (SCPP) through control of blood pressure (BP) and minimizing venous congestion by careful positioning of the patient to prevent compression of the abdomen. We need to ensure spinal cord perfusion while producing a bloodless surgical field.

The prone position refers to a patient facing downwards, with supports placed beneath the upper chest, shoulders and iliac crests. This allows freedom of abdominal movement to facilitate ventilation and to reduce intra-abdominal pressure which consequently reduces bleeding from the epidural plexus. The head is usually placed in a headrest in the neutral position or turned to one side while resting on the pillow. A padded foam or jelly pad may be used to protect the ear and eyes (1). In the prone position body pressure points is necessary to be supported by soft manner. Neck and limbs must be in the neutral position and eyes, nose, elbows and genitalia must not be compressed.

Special care should be taken for the peripheral nerves (like elbow, ulnar, lateral femoral cutaneous nerve and the peroneal nerve) that should be padded to avoid injury. Concerning the pulmonary function, the most obvious change is the increase in functional residual capacity (FRC)(3).

Because of prolonged surgery and blood loss the risk of hypothermia is existent. Hypothermia will impact negatively on spinal cord monitoring, increase blood loss due to abnormal coagulation, delay the recovery time, increase the risk of arrhythmia and wound infection (1,9). So temperature monitoring and active warming with forced air warming devices is essential (4).

During the operation blood pressure control is important, balancing the need to ensure spinal cord perfusion with the requirement to produce a bloodless surgical field. Remifentanil or esmolol infusion have been widely used for this purpose. Blood loss is usually minimal from simple procedures, though if large laminectomies and fusions are performed, cross-matched blood should be available.

Standard monitoring is appropriate for simple procedures. However, invasive blood pressure monitoring, a central venous pressure line and a urinary catheter should be considered if controlled hypotension is used or if the procedure is likely to be prolonged and involve large fluid shifts (5).

Techniques to minimize blood transfusion during spine surgery include avoiding hypothermia, preoperative supplementation with oral iron, normovolaemic haemodilution, good surgical technique and haemostasis, correct positioning of the patient when prone, controlled hypotensive anaesthesia (only with adequate cord monitoring), use of cell saver, pharmacological agents such as tranexamic acid, intrathecal opiates and monitored use of coagulation products (4,6).
Intraoperative monitoring of spinal cord function is considered a standard care in spinal surgery (7).

(1) The wake up test
(2) Somatosensory evoked potentials (SSEP)
(3) Motor evoked potentials (MEPs)
(4) Dermatomal responses

The Wake Up Test

Because wake up test is an old method, today new methods like SSEP and MEP are preferred. A ‘wake up test’ is indicated if there is a sudden, severe deterioration of spinal cord function during surgery. Before the use of electrical monitoring, it was a method of assessing spinal cord function during corrective procedures of the spine (1). Volatile agents or propofol and muscle relaxants are stopped and the patient is allowed to wake up until they can obey commands (move feet and hands). Remifentanil can be used, patients can respond to commands but not experience pain. The major advantage is that it assesses anterior spinal cord function (i.e., motor function).

The hazards of this test include accidental extubation, air embolism on deep inspiration, and dislodgement of fixators. Its major limitation is that it assesses spinal cord function only at one specific time (i.e., during the wake up test) and not continuously during the procedure. False negatives are reported (1).

Somatosensory Evoked Potentials (SSEP)

Neurophysiological monitoring of the operative area of spinal cord uses evoked potentials, both motor (MEP) and somatosensory (SSEP). SSEP monitoring continuously stimulates a nerve in the lower limbs and detects a response in cortical or spinal electrodes (5,8).

This is a more widespread method of electrical monitoring of the spinal cord. SSEPs are a measurement of electrical potentials evoked by stimulation of the sensory system.

The response of constant current stimulation of the median, tibial and the sural nerve is recorded at the cortex using surface electrodes or a bipolar electrode placed epidurally by the surgeon. Baseline SSEPs are recorded in order to exclude neurological dysfunction and also to determine the feasibility of operative monitoring.

Neurophysiology technicians monitor the latency and amplitude of the recordings continuously during anaesthesia and surgery. Numerous anaesthetic agents interfere with the latency and amplitude of the SSEP (9).

Motor Evoked Potentials

MEPs may be either evoked EMGs or compound muscle action potentials (CMAPs). They assess function of the motor cortex and the descending motor pathways.

Surgical stimulation level and hypothermia also interfere with SSEP. Volatile agents, hypothermia, hypoxia, hypercarbia, and spinal ischaemia suppress both SSEPs and MEPs.

Postoperative Management

Postoperative complications include persistent hypotension, haemorrhage, urinary retention, nerve root damage, cauda equina syndrome (urinary/rectal incontinence, perineal sensory loss and lower-limb motor weakness), thromboembolism and airway complications.

Also the most important complication is the airway obstruction after extubation, which is potentially life-threatening if the patient has had a spinal fusion and is encased in a stabilization device. Airway compromise may result from haematoma formation or neurological deficit.

Most spinal surgery is painful and good postoperative analgesia is important. A multimodal analgesic
approach is recommended. A combination of local and regional anaesthesia, opioids, ketamine and NSAIDs can be used (10). Infiltration of the wound at the end of the surgery with local anaesthetic will provide pain relief in the immediate postoperative period. Opioids should be supplemented with regular paracetamol and non-steroidal anti-inflammatory drugs if there are no contraindications to their use (4,8).

For scoliosis surgery, this may be supplemented with the use of an epidural catheter inserted by the surgeon at the end of the procedure (5). Also local anaesthetic and opioid drugs can be instilled into the epidural space before closing. More usually, however a regimen including patient-controlled analgesia (PCA) combined with regular oral/rectal analgesics is successful (10).

The incidence of thromboembolism following spinal surgery is 0.395-15.5%. Intermittent pneumatic compression boots must be used for prophylaxis. Use of heparin must be balanced with the risk of increased bleeding, especially if regional anaesthesia have been employed (2). The routine use of compression stockings and sequential compression devices (SCD) are recommended.

After posterior spinal surgery there are some risk factors that can cause airway complications. These are; an operation time more than 5 hour, exposing more then three vertebral bodies, prone position, large blood loss during surgery and transfusion of large volumes of fluid (11,12).

Even after the patient has been successfully extubated, might still be at risk as airway oedema may develop several hours later. We have to follow these patients in intensive care unit (ICU) (13).

Extubation may be problematic and is best performed with the patient awake and able to support their own airway. If the risk of reintubation is high, a tracheal tube exchange catheter (e.g. Cook catheter) may be useful.

The catheter can be introduced into the tracheal tube and left in situ when the patient is extubated. Should urgent reintubation be necessary, the new tracheal tube can be rapidly railroaded over the exchange catheter. However, prolonged sedation and ventilation should be avoided because this may mask postoperative neurological deterioration (5). Great care should be exercised when moving and transferring patients to prevent dislodgement of spinal fixation.

CONCLUSION

The most important anaesthetic management principle, in the treatment of spine surgery, is the detailed approach on safely positioning the patient, on providing adequate spinal cord perfusion pressure by ensuring normal respiratory and cardiovascular functions together with normovolaemia and normothermia.

Spinal injury and deficit rate can be reduced by careful approach to preoperative management, good surgical technique, good haemodynamic control and intraoperative monitoring of spinal cord functions. Of crucial importance is the management of postoperative pain and the possible necessity of intensive care unit hospitalisation.

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REFERENCES


