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# ANAESTHESIA MANAGEMENT IN SPINAL CORD INJURY PATIENTS

## *SPINAL KORD HASARLI HASTADA ANESTEZİK YAKLAŞIM*

Elif ÇOPUROGLU[1],
Cem ÇOPUROĞLU[2],
Sevtap H. ŞAHIN[3],
Gönül SAĞIROĞLU[1],
Mert ÇIFTDEMIR[4]

[1]*Assist. Prof. of Anesthesiology and Reanimation, Department of Anesthesiology and Reanimation, Trakya University Medical Faculty, Edirne.*

[2]*Assoc. Prof. of Orthopaedics and Traumatology, Department of Orthopaedics and Traumatology, Trakya University Medical Faculty, Edirne.*

[3]*Assoc. Prof. of Anesthesiology and Reanimation, Department of Anesthesiology and Reanimation, Trakya University Medical Faculty, Edirne.*

[4]*Assist. Prof. of Orthopaedics and Traumatology, Department of Orthopaedics and Traumatology, Trakya University Medical Faculty, Edirne.*

**SUMMARY:**

Spinal cord injuries occur in 1.3% of multiple trauma patients. The most frequent reasons of death in spinal cord injured patients are aspiration and shock. The most important aim in the anesthesia management of the spinal cord injury (SCI) patients is to prevent secondary spinal damage.

In trauma patients, maintaining Airway Breathing Circulation (ABC) is a life saving procedure. In SCI patients, induction of anesthesia, maintenance of airway and anesthesia, stabilization of hemodynamic parameters are important factors affecting mortality and morbidity. In this review, we aimed to investigate the anesthesia management of spinal cord injured patient.

**Key Words:** Spinal Cord Injury, Anesthesia, Trauma

**Level of evidence:** Review article, Level V

**ÖZET:**

Multitravmalı hastaların %1,3'ünde spinal kord hasarı oluşmaktadır. Spinal kord yaralanmalarında en başta gelen ölüm sebebi aspirasyon ve şoktur. Spinal Kord Hasarlı (SKH) hastaların anestezi yönetiminde en önemli amaç sekonder spinal hasarın önlenmesi dir.

Travmada ABC (A: havayolu, B: solunum, C: dolaşım) denilen, ilk aşamada hava yolunun açık tutulması, solunum ve dolaşımın sağlanması hayati önem taşımaktadır. SKH'lı hastada anestezi indüksiyonu, havayolunun sağlanması, anestezi idamesi, hemodinaminin stabilizasyonu hastaların morbidite ve mortalitesini etkileyebilecek farklılıklar göstermektedir. Bu derlemede, spinal kord hasarlı hastaya anestezik yaklaşımlar gözden geçirilmiştir.

**Anahtar Kelimeler:** Spinal Kord Hasarı, Anestezi, Travma

**Kanıt Düzeyi:** Derleme, Düzey V

**Address:** Dr. Elif Çopuroğlu, Trakya Üniversitesi Tıp Fakültesi Anesteziyoloji ve Reanimasyon AD, 22030, Edirne
**Tel:** 0532 6331325
**E-Mail:** elifcopuroglu@hotmail.com
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## INTRODUCTION:

In multiple trauma patients cervical damage is observed 4.3%, thoraco-lumbar vertebrae damage is observed 6.3% and spinal cord injury is observed 1.3%. Every year in United States of America, 12000 spinal cord injury (SCI) patients are being operated[14]. Cervical segment is most commonly effected (42%), thoracic (31%) and lumbar (27%) regions follow it.

Trauma is the one of the common causes of death in young population. Half of the trauma patients lost their life at the time of the trauma and 30% of it in the first few hours after trauma[13]. Average age of observation is 40 and male are affected 4 times more frequently than women. Spinal cord traumas are not common in pediatric age group, and in that group when compared to head trauma rate is 1/30. In pediatric age group ligaments are damaged more than bone structures[1,7].

In vertebrae fractures without SCI, anesthesia method is similar to vertebrae instrumentation surgery but in SCI patients it includes additional precautionary approaches.

SCI following vertebrae fracture holds a risk of 50% mortality in early period. In total SCI possibility of the return of the normal neurological functions is 10% and in partial SCI this number is 75%. At the acute phase of the damage, during surgery, stability of the patients are very important for neurological sequel, morbidity, mortality, and health care costs. Most common causes of mortality in spinal cord injury are aspiration and shock[5]. In trauma, ABC (A: airway, B: breathing, C: circulation), maintaining airway, respiration and circulation is crucial.

SCI in the C3-C5 levels may cause deterioration in the pulmonary reserve due to phrenic nerve injury. Catecholamine release levels are also depending on the level of the injury. For induction of anesthesia in spinal cord injury patients, it must be keep in mind that hypotension period during depth of anesthesia maintenance at the intubation may lead to a decrease in cord perfusion.

## INTRAOPERATIVE NEUROMONITORIZATION:

In patients whom intraoperative neuromonitorization is planned, because cortical evoked potentials are affected from anesthesia agents especially from inhalation anesthetics best choice for anesthesia is total intra-venous anesthesia (TIVA). Simultaneous use of SSEP (Somato-sensory evoked potential) and MEP (Motor evoked potential) are more efficient and safe[6]. Muscle relaxants due to their effect on inhibiting muscle response, should not be administered in repetitive doses after the induction.

## AIRWAY:

It must be kept in mind that all high energy traumas might result in spinal injury. It is important to consider cervical trauma in patients with injury above clavicles. Gold standard for illustrate cervical bone damage is 3 way cervical vertebral x-rays. Even if the radiological imaging is normal, it must be kept in mind that there might be injury due to some other reasons. Complete neurological examination must be performed before anesthesia. Injuries above C5 level may accompany diaphragm paralysis and respiratory distress. Early airway control is a safe approach[10]. Due to gastric atony, these patients must considered as satiated patients and necessary precautions must be made to prevent aspiration. In the induction of anesthesia, use of succinyl choline as a muscle relaxant is not appropriate due to the risk of hyperkalemia and cardiac arrest in spinal injury patients.

If more than one colon were injured or there is collapse in more than 50% of the vertebral body it is considered as unstable vertebrae injury.

Maintenance of airway in SCI patients with stable vertebrae:

1. In patients whom direct laryngoscopy is expected to be easy, fast intubation after induction must be preferred.
2. In patients whom direct laryngoscopy is expected to be hard, awake fiber optic intubation must be planned.

Maintenance of airway in SCI patients with unstable vertebrae:

1. If direct laryngoscopy is possible without neck manipulation, fiber optic intubation under direct laryngoscopy with manual in-line stabilization (MILS) must be performed.
2. If direct laryngoscopy is not possible without neck manipulation, awake fiber optic intubation must be planned.

Manuel in-line stabilization (MILS) is a safe technique in which one person stands at the head of the patients and with his fingers holds the mastoid protuberance while with his palms support neck and tempero-parietal region and another clinician performs intubation simultaneously[15].

Interventions including mask ventilation before intubation result in more mobilization in cervical vertebrae than direct laryngoscopy intubation.

In patients with thoracic fractures, whom anterior surgery is planned, selective bronchial intubation may be required.

## BRADYCARDIA:

Bradycardia is a result of cardiac sympathetic afferent loss and unmet vagal activity and can be treated with atropine. After acute SCI distinct bradycardia (<45 beats/min) is observed in 71% of the patients. In cases where no atropine response is observed, it must be kept in mind that temporal venous pacemaker might become necessary[10]. Before anesthesia induction, in patients whom aspiration is needed application of sedation and 0.5 mg atropine iv., and procedure taking short time is very important. Under anesthesia, if aspiration is needed or patient must be positioned face down, in which injury is triggered serious bradycardia or even cardiac arrest might be observed.

## HYPOTENSION AND SPINAL SHOCK:

SCI below T6 hypotension is common, and bradycardia, hypotension, ventricular dysfunction and dysthymia is seen in injuries above T6. Spinal shock is most commonly seen in SCI patients with a level higher than C7. At the first stage of the injury, sympathetic activity is increased. Sympathetic denervation is seen in lesion above T6 and this period lasts for 8 weeks.

Episodic hypotension after acute SCI is seen in 68% of the cases, and need for vasopressor drugs are 35%. Continuous invasive blood pressure monitorization of the patients is important for deciding the intraoperative treatment scheme[11]. Hypotension if develops, generally treated with fluid replacement but in cases that the volume load increases vasopressor use might be required to keep mean arterial pressure at 60-70 mmHg. Keeping pulmonary capillary occlusion pressure at 14-18 mmHg is sufficient for spinal cord perfusion. Vasopressor of choice should have beta agonist properties. Blood deficit is sustained by the use of blood products (erythrocyte suspension or fresh frozen plasma).

After hypotension resulting from loss of vascular tonus due to sympathetic denervation, bleeding and spinal shock could be observed. This is more commonly observed with penetrating trauma[8]. Intraoperative controlled hypotension for bleeding control must be approached with precaution because in SCI patients this method may deteriorate spinal cord perfusion.

## STEROIDS:

Methylprednisolone due to its effects on increasing spinal cord circulation and decreasing lipid peroxidation resulting in free radical formation can be administered 30 mg/kg bolus and 5.4 mg/kg/h infusion for 23 hours. Even though, when reviews in the literature are considered, in acute SCI application of methylprednisolone in the first 8 h may decrease spinal injury[2], most recent studies showed high doses of methylprednisolone might be harmful and should not be administered[9].

Spinal cord injuries may mask other organ injuries below the level of lesion (like abdominal injury), and this must always be considered[3].

In patients whom head injury accompanies SCI, intracranial pressure increase, pneumothorax and ARDS, heart contusion, tamponade, and intra-abdominal hemorrhage and hemorrhagic shock in patients with accompanying abdominal trauma, fat embolus in patients with accompanying extremity fractures and multiple fractures are the problems anesthetists face in multiple trauma patients[12].

It is well known that in those patients, thermoregulatory mechanisms may be disrupted due to autonomic dysreflexes. Continuous neuromonitorization must be performed during the maintenance of anesthesia in SCI patients[4].

## CONCLUSION:

It must be kept in mind that most important aim in the anesthesia of spinal cord injury patients is preventing secondary spinal damage. Patient's airway must be ensured as early and safely as possible, and patients must be surveyed hemodynamically normovolemic, normotensive, normothermic and normo-osmolar.

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