Acta Clin Croat (Suppl. 1) 2023; 62:142-148
doi: 10.20471/acc.2023.62.s1.19

Case Report

AIRWAY MANAGEMENT WITH RIGID BRONCHOSCOPE IN ADULT PATIENT DURING CERVICAL SPINE SURGERY: A CASE REPORT

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SUMMARY – SCIWOCTET is a cervical spine injury (CSI) with objective signs of myelopathy, due to trauma, without evidence of ligament injury or bone fractures on x-ray and computed tomography (CT) images. It is rare, found in about 3% of patients with CSI. Perioperative manipulation of these patients may cause secondary spinal cord injury. The challenge for the anesthesiologist is to manage an airway with as little movement of the patient's head and neck as possible. A patient is presented after a fall from a motorbike. At hospital admission, he had neurological deficit in the innervation area of the cervical spinal cord. Multi-slice CT of the head and cervical spine was without signs of acute bone trauma. Magnetic resonance imaging was performed and the diagnosis met the criteria defining SCIWOCTET. Elective cervical spine surgery under general anesthesia was performed, the patient was intubated with a rigid bronchoscope using manual in-line immobilization. The selection of instruments and procedures is emphasized. Other procedures, techniques and instruments that can be used for airway management and their influence on the movement of the patient's head and neck are listed. It is concluded that rigid bronchoscopy with the application of manual in-line immobilization is suitable for emergency and elective intubation of patients with cervical spine pathology.

Key words: *Anesthesia; Cervical spinal cord injury; SCIWOCTET; Airway; Rigid bronchoscope; Bonfils*

Introduction

Each anesthesiologist's procedure when managing patient airway leads to movement of the head and neck, which is especially important if there is suspicion of a cervical spine injury (CSI). When performing airway management for an elective surgical procedure, as well as in the emergency treatment of a traumatized patient with suspected CSI, all professional staff engaged in airway care (anesthesiologist, ambulance or emergency department physician) most often perform a direct laryngoscopy procedure. Awake fiber-optic bronchoscopy intubation (FOBI) is mostly considered the gold standard of airway management under these circumstances[1]. With this approach, the problem is cooperation and the inability to prevent coughing and uncontrolled movement of the patient, but also the need for a high level of expertise of the person performing intubation. Through presentation of this case, we show how all of the above can be avoided by using a rigid bronchoscope (Bonfils).

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Case Report

A 43-year-old patient with injuries after falling from a motorcycle into a canal was admitted through the hospital emergency department. At the scene of the accident, passers-by took off his helmet. He was brought in by ambulance, fixed on a long board with a collar with a fixator. The patient was assessed as the American Society of Anesthesiologists Physical Status classification system, grade I (ASA I); elevated ethyl alcohol in the blood was found.

On admission, he was conscious, Glasgow Coma Score 15, without neurological deficits in the area of the head and cranial nerves. The neck was painful at the slightest movement and palpation. There was subtotal loss of sensation and no motility of the arms from the shoulders down, and hyperalgesia in the area of the plexus brachialis. Weakened muscle power on both legs, preserved more to the left, preserved sensation, were recorded. On the second day of hospital stay, spastic paresis of the left leg and limp biparesis of both arms with hypoesthesia developed.

Multi-slice computed tomography (MSCT) of the head and cervical spine on the day of admission showed no signs of acute bone trauma of the neurocranium and vertebral spines, maintained posterior intercorporeal line, and bony spinal canal maintained width (Fig. 1).

After MSCT, the patient was treated with methylprednisolone 2 g/45 min in the hospital emergency department.

Magnetic resonance imaging (MRI) of the cervical spine on the second day of hospital stay revealed fracture-dislocation through the i.v. disc C3-C4 with progression of dorsal dislocation of the C3 vertebra by 4 mm compared to the CT from the day before; longitudinal ligament anterior (LLA) rupture and prevertebral hematoma C1-C5; and signs of cervical spine contusion at C3-C4 level (Fig. 2).

The injury was defined as SCIWOCTET[2]. The following injuries were found in the patient:

- traumatic lesion of LLA and C3-C4 intervertebral disks;
- contusion of cervical spinal cord; and
- central cord syndrome.

After treatment, the patient was scheduled for elective cervical spine surgery to stabilize the cervical spine. The surgery was performed under general anesthesia on day 6 of his hospital stay (repositio aperta, anterior spondylodesis C3-C4).

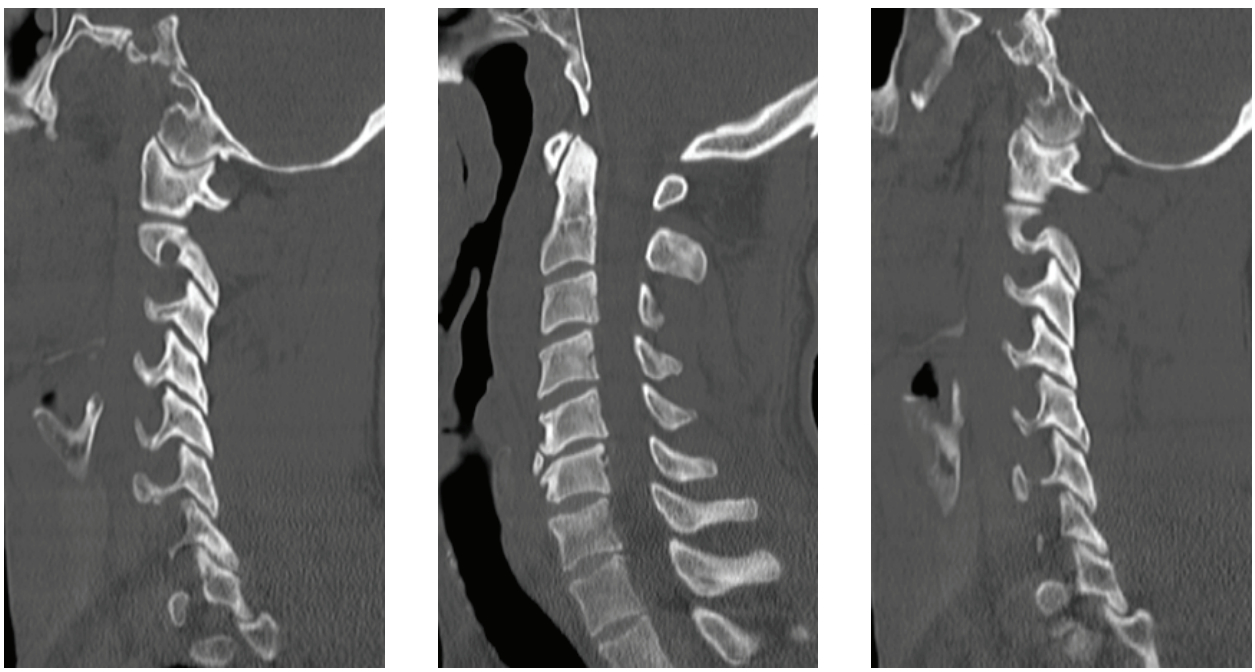

Fig. 1. Sagittal MSCT scans through the left and right facet joints and midsagittal view showing no subtle signs of fracture or dislocation.

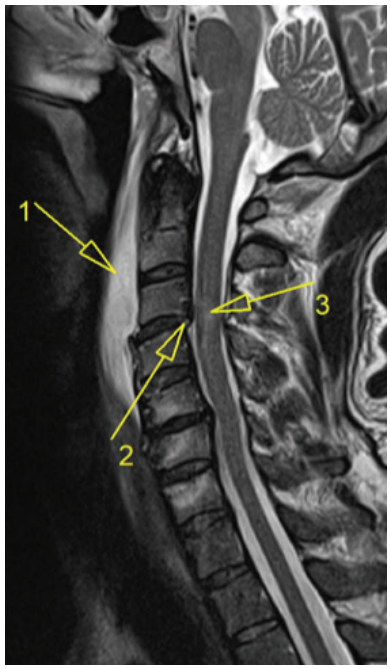

Fig. 2. T2 weighted midsagittal MRI image: 1 – prevertebral hematoma; 2 – retrolisthesis of C3 on C4 with obliteration of anterior CSF space; 3 – increased signal intensity signifying contused spinal cord zone.

A ring-shaped silicone pillow was placed under the patient's head (edge 3 cm, bottom empty). The head was stabilized by manual in-line immobilization (MILI) with the help of an assistant standing in front of the patient and the anterior part of the Shantz collar was opened. Before induction, preoxygenation with oxygen through a mask was performed at 15 L/min for 3 minutes. Rapid sequence induction (RSI) was performed with 5 mcg sufentanil, 200 mg propofol and 100 mg Esmeron i.v.

The patient was intubated with a rigid bronchoscope (Bonfils) (Fig. 3). With neutral position of the head during intubation with a rigid bronchoscope, the need for a 'sniffing' position is avoided. With the left hand, the lower jaw was opened and slightly raised, and a passage for the bronchoscope was provided with an ideal view of the airway (no laryngoscope, rapid intubation).

After intubation, Shantz collar was closed again and MILI was removed. The patient was then mechanically ventilated in the supine position. Intraoperatively, noradrenaline 0.05 mcg/kg/min was applied continuously for 2 hours (*via* perfusor) to maintain perfusion pressure (MAP ≥85 mm Hg).

After the surgery, the patient was extubated in the operation theater. He was breathing independently, hemodynamically stable. Postoperative neurological examination showed improvement of neurological deficit, with inpatient rehabilitation recommended.

The patient reported significant improvement in hand movements, predominantly the left hand.

He was discharged from the hospital on day 18 of hospital stay at his own request (with recommenda-

Fig. 3. The patient was intubated with a rigid bronchoscope (Bonfils).

tion to wear Shantz collar, except in the supine position).

Discussion

Patients with blunt trauma should always be treated with special care because cervical spine injuries are found in 0.9%-3% of these patients[3]. As a result of injury to the ligaments of the cervical spine without a radiologically proven fracture, there is instability of the neck and possible injury to the spinal cord, as well as possible hemodynamic instability of the patient. This injury does not occur often but may be undiagnosed due to associated severe head injuries, patient intoxication, or absence of neurological deficit on admission. If the usual radiological diagnosis and CT do not show pathological findings, the only evidence for injury to the ligaments of the cervical spine resulting in damage to the cervical spinal cord is provided by MRI. MRI is indicated in patients in whom there is suspicion, that is, clinical proof of myelopathy without radiological evidence.

According to a study[4] on 14,755 patients with blunt trauma, injury of the cervical spine was found in 2% of patients. Of these patients with CSI, vertebral fracture was found in 85%, subluxation without fracture in 10.6%, and isolated spinal cord injury without fracture or subluxation in 3.8% (11 patients; 0.07% of all patients with blunt trauma). Of the 11 patients with isolated CSI only, 5 (45.5%) were recognized on admission, 3 patients developed a neurological deficit several hours later, and 3 patients were not recognized clinically or radiologically (2 intubated, 1 intoxicated). According to another study[5] on 14,577 patients with blunt trauma, dislocation without proven fracture was found in 0.6% of patients, while fracture was recorded in 14 of the 18% of patients who could not be diagnosed based on symptoms (0.7% of all patients with blunt trauma had damage to the cervical spinal cord without a proven fracture).

Although extreme caution is warranted in patients with blunt injury, even in patients with a diagnosed CSI, secondary neurological deterioration is rare, with an incidence of 0.03%[6].

Failure to immobilize the spine in cases of unrecognized CSI on admission is considered the leading cause of secondary injury[3]. Secondary injury is more likely in CSI in patients with a pre-existing pathology (ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis), which can result in a catastrophic outcome such as quadriplegia[7].

When we treat a patient with CSI, it is always possible to cause an unwanted movement and thereby worsen the existing injury. Every medical professional including the anesthesiologist who is responsible for airway management aims to prevent worsening of an existing injury and the possible occurrence of secondary injuries due to manipulation. At the same time, intubation is made difficult by the minimal possibilities of moving the patient's head and neck, along with the much-needed stabilization of the spine. Access to the airway is limited by the collar, straps and restraints, and it is difficult to open the patient's mouth. In 64% of patients, the airway is poorly visualized by the laryngoscope (Cormack-Lehane grading system: C-L grade 3-4)[8]. Movements in the cervical spine are reduced to 5% of the normal range, and the collar alone does not immobilize the neck effectively enough for airway management.

The aim of MILI is to limit movements that can occur during airway management, and is more effective than collars[9]. After the application of MILI, the front part of the collar can be removed, and thus facilitate mouth opening and improve the view during laryngoscopy (C-L grade 3-4 in 22% of patients)[8]. With the help of MILI, the patient's head is kept in a neutral position during laryngoscopy by applying a force that is equal and opposite to the force created during laryngoscopy.

All basic and advanced airway management leads to displacement of the cervical spine. Of these procedures, manual mask ventilation causes the most pronounced movements of the head and neck[10,11]. In the presented patient, rapid induction avoided the need for mask ventilation.

Anterior pressure on the neck (cricoid pressure, backward, upward and rightward pressure of larynx [BURP] maneuver) is used to prevent aspiration, improve the view of the larynx, and stabilize the airway. The above, as well as the placement of a laryngeal mask, can lead to posterior displacement of the cervical spine[12]. To achieve an optimal view of the larynx during direct laryngoscopy, it is necessary to align the oral, pharyngeal and laryngeal axes. This requires a pad under the head, flexion of the neck, and great extension of the head. Visibility of the glottis is not

always optimal, and movements of the head and neck are quite extensive[13]. With a combination with MILI, all movements are reduced but the quality of the presentation of the glottis is also reduced and the time required for intubation is increased.

In indirect rigid laryngoscopy with a video laryngoscope, a significantly better view of the glottis is obtained without the need for greater alignment of the airway axis. Head movements are slightly smaller than direct laryngoscopy, and the intubation time is longer but less force is applied[14]. During rigid laryngoscopy with the application of MILI, the movements are smaller, but equal to direct laryngoscopy with MILI. The presentation of the glottis is better[15].

Fiberoptic bronchoscopic intubation (FOBI) is often used in elective surgeries of patients with cervical spine pathology.

Awake FOBI is achieved by topicalization of the airway with local anesthetic (direct application of local anesthetic to the mucous membrane of the respiratory tract) and/or sedation. It requires a certain amount of time, patient cooperation, and a high level of skill of the anesthesiologist. There is always the risk of coughing and uncontrollable patient movement caused by poor topicalization or patient agitation. The success of intubation of traumatized patients using awake FOBI is estimated at about 83.3%[16].

With nasal FOBI, the smallest movements of the patient's head and neck are achieved[11].

In case of using FOBI to open the posterior pharyngeal space under general anesthesia, the procedures of pulling the tongue and raising the lower jaw are applied. At the same time, tongue retraction procedures cause less, and mandibular lifting causes greater movements of the patient's neck compared to FOBI alone[14].

If a direct laryngoscope or video laryngoscope is used in combination with FOBI, the movements of the cervical spine are equal to the movements of direct laryngoscopy without FOBI[14].

Indirect rigid fiberoptic laryngoscope (Bullard) ensures intubation with less movements of the cervical spine, equal to direct laryngoscopy with MILI, and enables better visualization of the glottis but prolongs the duration of intubation. In combination with MILI, intubation time is further extended but spinal movements are significantly reduced, which are then equal to FOBI[17].

With a rigid bronchoscope (Bonfils), the view of the glottis is clear (C-L grade 1), the time from the introduction of the instrument and obtaining an optimal view is equal to that of intubation with a direct laryngoscope, and head and neck movements are significantly smaller compared to direct laryngoscopy. When Bonfils is applied without MILI, displacements are equal to direct or videolaryngoscopy with MILI, and when Bonfils is applied with MILI, displacements are at the FOBI level[13,14].

After the introduction of videolaryngoscopes, rigid bronchoscopes were unjustifiably neglected, and thus became less available. Most professional staff who need to manage patient airway are not yet sufficiently familiar with the possibilities of their application and continue with the usual practice of intubation, without leaving the 'comfort zone'.

Conclusion

In the case of spinal cord injury, it is important that the procedures applied significantly reduce manipulation of the patient's head and neck, and thus the possibility of developing a secondary injury to the cervical spinal cord.

In the presented case, intubation was performed with a rigid bronchoscope, and in addition to MILI, control of unwanted movements of the patient's head and neck due to airway management (raising the lower jaw) was additionally ensured.

It is important to use a strategy to maximize the success of laryngoscopy on the first attempt (such as optimal positioning and use of additional equipment to manage the airway), in order to reduce complications related to endotracheal intubation[18]. The use of preoxygenation provided additional time before the onset of hypoxia, and the use of RSI avoided the need for mask ventilation.

Based on the above, we can conclude that the use of a rigid bronchoscope with MILI is suitable for emergency and elective intubation of patients with injury or pathology of the cervical spine (ankylosing spondylitis, diffuse idiopathic skeletal hyperostosis).

All those who manage patient airway must be familiar with the possibilities of using instruments and the probability of cervical spine displacement due to the use of different approaches and different instruments. This should be the main motivating factor in

their choice, not just adherence to common, well-known approaches to intubation.

This way of thinking creates the possibility of a wider use of rigid bronchoscope, of course, with the need for additional education of all those involved in airway management of patients with suspected CSI, in terms of information about rigid bronchoscopy as a technique that can be mastered without problems with some effort and time.

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Sažetak

ZBRINJAVANJE DIŠNOGA PUTA RIGIDNIM BRONHOSKOPOM U ODRASLOG BOLESNIKA TIJEKOM KIRURGIJE VRATNE KRALJEŽNICE: PRIKAZ SLUČAJA

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SCIWOCTET je ozljeda vratne kralježnice s objektivnim znakovima mijelopatije uslijed traume, bez dokaza ozljede ligamenata ili prijeloma kostiju na prikazima rtg i kompjutorizirane tomografije (CT). Navedena ozljeda je rijetka, nađena je kod 3% bolesnika s ozljedom vratne kralježnice. Svako postupanje s ovim bolesnicima može izazvati sekundarnu ozljedu kralježnične moždine. Izazov za anesteziologa je zbrinjavanje dišnoga puta, uz što manji pomak glave i vrata bolesnika. Prikazuje se bolesnik nakon tupe ozljede uslijed pada s motora. Kod prijma Glasgowska ljestvica kome (GCS) bila 15, uz neurološki ispad iz inervacijskog područja vratne kralježnične moždine. *Multi-slice* CT glave i vratne kralježnice nije pokazala znakova akutne koštane traume. Naknadno je učinjena magnetska rezonanca, a dijagnoza je ispunjavala kriterije koji definiraju SCIWOCTET. Na bolesniku je izvedena elektivna kirurgija vratne kralježnice u općoj anesteziji. Intubiran je rigidnim bronhoskopom uz primjenu manualne *in-line* imobilizacije (MILI). Poslijeoperacijski dolazi do poboljšanja neurološkog deficita. U prikazu slučaja naglašen je odabir instrumenata i postupaka (rigidni bronhoskop uz MILI), u cilju što manjeg pomicanja glave i vratne kralježnice bolesnika. Navedeni su drugi postupci, tehnike i instrumenti koje je moguće rabiti za zbrinjavanje dišnoga puta i njihov utjecaj na pomak glave i vrata bolesnika. Može se zaključiti da je rigidna bronhoskopija uz MILI prikladna za hitnu i elektivnu intubaciju bolesnika s patologijom vratne kralježnice.

Ključne riječi: *Anestezija; Ozljeda vratne kralježnice; SCIWOCTET; Dišni put; Rigidni bronhoskop; Bonfils*