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CASE REPORTS/CASE SERIES

Failed videolaryngoscope intubation in a patient with diffuse idiopathic skeletal hyperostosis and spinal cord injury

Échec de l'intubation par vidéolaryngoscope chez un patient souffrant d'hyperostose vertébrale ankylosante et d'un traumatisme médullaire

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Abstract

Purpose *A case of difficult intubation in a patient with cervical spinal cord injury with diffuse idiopathic skeletal hyperostosis (DISH) is described. The trachea could not be intubated with a videolaryngoscope, and successful intubation was achieved with a laryngeal mask airway device (LMAD) and a fibreoptic bronchoscope (FOB).*

Clinical features *A 65-yr-old male developed sudden tetraplegia after a fall. Initial attempts at securing his airway were unsuccessful with a videolaryngoscope, but success was achieved with a LMAD and a FOB. Diagnostic imaging revealed no cervical spine fracture but demonstrated severe airway distortion from DISH and a spinal cord contusion accounting for his tetraplegia. Subcutaneous neck emphysema likely secondary to difficult intubation was also identified, but it did not result in additional morbidity.*

Conclusions *Although often considered to be a benign entity, DISH can predispose patients to catastrophic cervical injury and difficult airway management. Careful review of plain radiographs in the spinal cord injury patient may assist with appropriate selection of airway interventions. The videolaryngoscope is useful for difficult airways, but its effectiveness may be compromised with an anteriorly displaced airway in combination with restricted cervical movement and limited oropharyngeal airspace.*

Résumé

Objectif *Il s'agit d'un cas d'intubation difficile chez un patient souffrant d'un traumatisme médullaire cervical et d'hyperostose vertébrale ankylosante (HVA). Il a été impossible d'intuber la trachée avec un vidéolaryngoscope; l'intubation a été réussie à l'aide d'un masque laryngé (ML) et d'un bronchoscope à fibres optiques (BFO).*

Caractéristiques cliniques *Un homme de 65 ans est soudainement atteint de tétraplégie après avoir subi une chute. Les premières tentatives visant à stabiliser les voies aériennes à l'aide d'un vidéolaryngoscope ont échoué, mais l'utilisation d'un ML et d'un BFO a permis de réussir. L'imagerie diagnostique n'a révélé aucune fracture de la colonne cervicale, mais a permis de déceler une déformation grave des voies aériennes causées par la HVA, ainsi qu'une contusion médullaire responsable de la tétraplégie. On a également décelé un emphysème cervical sous-cutané probablement consécutif à l'intubation difficile, mais celui-ci n'a entraîné aucune morbidité additionnelle.*

Conclusions *Bien qu'elle soit souvent considérée comme une entité bénigne, la HVA peut prédisposer les patients à des lésions cervicales catastrophiques et à une prise en charge difficile des voies aériennes. Un examen rigoureux des radiographies simples du patient souffrant d'un traumatisme médullaire peut contribuer à choisir la méthode appropriée de prise en charge des voies aériennes. Le vidéolaryngoscope est utile en cas d'intubation difficile, mais son efficacité peut être compromise en raison d'un déplacement antérieur des voies aériennes, combiné à la restriction des mouvements cervicaux et à la réduction de l'espace oropharyngé.*

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Diffuse idiopathic skeletal hyperostosis (DISH) is a systemic skeletal disease characterized by ligamentous ossification of the anterolateral spine and the extraspinal ligaments.[1] Cervical spine involvement can lead to limited motion and difficult airway management. We present a patient with spinal cord injury who had extensive and previously unrecognized DISH in whom airway management was unsuccessful with the videolaryngoscope. Written consent from the patient was obtained for publication of this report.

Case description

A 65-yr-old man fell while getting out of bed and developed acute tetraplegia. His medical history included hypertension, hyperlipidemia, and arthritis; he did not take any medications. In the emergency room, cervical spine precautions (backboard, rigid cervical collar) were maintained. Although the lateral cervical spine radiographs demonstrated the presence of large prevertebral osteophytes, their significance was not appreciated (Figure 1). The on-call anesthesiologist was asked to assist with tracheal intubation because of deteriorating respiratory function and the need for more detailed diagnostic imaging.

Assessment revealed a Glasgow Coma Scale score of 15, absent sensory and motor function in all limbs, pupils that were equal and reactive to light, stable hemodynamics, and an oxygen saturation of 100%. Airway evaluation was considered to be reassuring, and a rapid sequence induction was planned with the patient remaining on the backboard. The anterior component of the hard collar was removed, and manual in-line stabilization was provided by an assistant; cricoid pressure was omitted. Following preoxygenation, etomidate 0.3 $mg \cdot kg^{-1}$ and succinylcholine 1.5 $mg \cdot kg^{-1}$ were given intravenously. Difficulty was encountered inserting a size 4 (18 mm height) Glidescope videolaryngoscope (GVL) (Saturn Biomedical Systems**,** Verathon®, Burnaby, BC, Canada) into the patient's mouth, but it was successfully inserted with persistence and followed by a styletted 7.5 mm endotracheal tube. The glottis was not visualized despite several attempts at repositioning the GVL. The patient's oxygen saturation decreased to 90%, at which point the GVL was removed and the patient's lungs were manually ventilated resulting in improved oxygen saturation. A #4 Classic™ laryngeal mask airway (LMA; Vitaid Ltd, Toronto, ON, Canada) was inserted easily and adequate ventilation confirmed. A fibreoptic bronchoscope (FOB) was then loaded with a 6.0 mm tube and used to intubate the patient's trachea through the LMA. The LMA was then removed, and a tube changer, Cook® Airway Exchange Catheter (Cook Critical Care Inc., Bloomington, IN, USA) was used to exchange the 6.0 mm tube for a 7.5 mm EVAC™ endotracheal tube (Mallinckrodt®, Covidien-Nellcor™, Boulder, CO, USA).

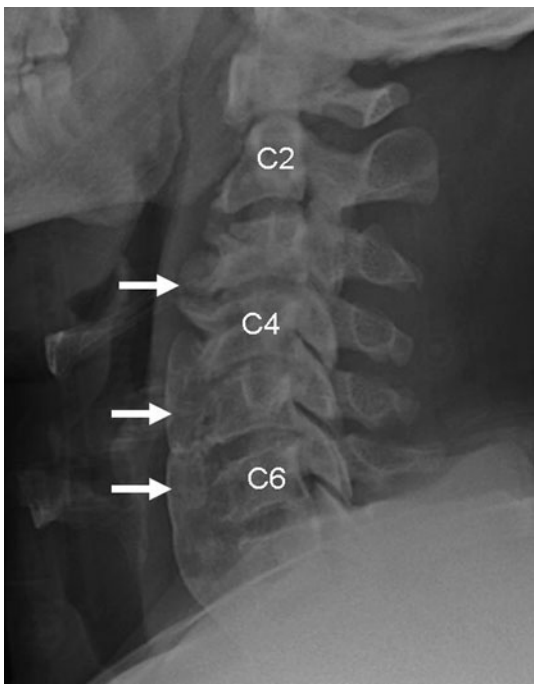

Fig. 1 Lateral cervical spine radiograph showing multilevel degenerative disc disease along with prominent flowing anterior osteophytes (white arrows)

Computerized tomography (CT) revealed no cervical spine injury but did demonstrate prominent anterior cervical osteophytes displacing the airway anteriorly as well as severe central canal stenosis associated with ossification of the posterior longitudinal ligament and the ligamentum flavum from C_3 to C_6 (Figure 2). Subsequent magnetic resonance imaging (MRI) revealed compression of the thecal sac and cord by the ossified posterior ligaments as well as an increased T_2 signal of the cord at the $C_{3–4}$ levels consistent with an acute cord contusion. The CT scan also demonstrated interstitial emphysema in the paratracheal and prevertebral spaces that was attributed to the intubation attempts. The Thoracic Surgery service was consulted; bronchoscopy was carried out and failed to reveal a significant airway injury. The patient was admitted to the intensive care unit and eventually required a tracheostomy for prolonged ventilatory support. Several months after the injury, mild improvement in motor function in the patient's upper and lower extremities was observed, and a subsequent MRI revealed myelomacia and cystic degeneration at the site of signal change in the cord. Eight months following the original injury, the patient eventually underwent a posterior cervical laminoplasty from C_3 to C_6 to decompress the spinal canal.

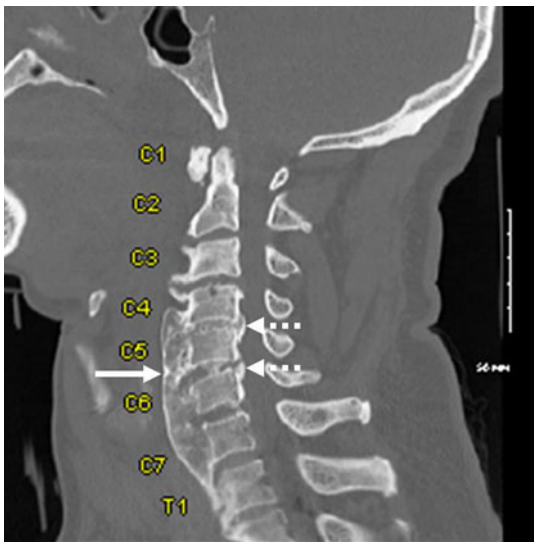

Fig. 2 Sagittal section computerized tomography (CT) of the cervical spine showing prominent anterior flowing osteophytes (bold arrow) and posterior osteophytes compromising the canal lumen (dashed arrows)

Discussion

Diffuse idiopathic skeletal hyperostosis is a systemic skeletal disease of unknown etiology characterized by ligamentous ossification of the anterolateral spine and the extraspinal ligaments, including the anterior and posterior longitudinal ligaments and the ligamentum flavum.[1] Diagnosis is based solely on radiographic abnormalities defined using the criteria of Resnick with flowing anterior osteophytes.[2] There is no classification system for severity of DISH. The extent of the disease process and the degree of ossification can vary significantly. Although asymptomatic, our patient had severe radiologic changes associated with DISH. Osteophytes may protrude into the posterior pharyngeal space resulting in anterior displacement of the larynx, as observed in our patient (Figure 2). Reports of dysphagia, acute respiratory compromise, and difficult intubation have all been reported in association with such osteophytes.[3,4] Clinically significant airway compression is rare but has been treated successfully with resection of osteophytes.[5] Diffuse idiopathic skeletal hyperostosis is more common in elderly males, its prevalence over the age of 70 being as high as 35% in males and 26% in females.[1] Metabolic disorders, such as obesity, hyperlipidemia, diabetes, and hypertension may be associated risk factors.

Extensive ossification of the posterior longitudinal ligament and ligamentum flavum resulted in a severe reduction of the spinal canal lumen in our patient. Adequacy of the cervical spinal lumen may be assessed by dividing the sagittal diameter of the spinal canal with that of the corresponding vertebral body to obtain a Pavlov Torg ratio.[6] If the calculated ratio is < 0.80, the canal is considered stenotic; our patient had a calculated ratio of < 0.80 indicating spinal stenosis. The stenosis probably predisposed our patient to cord contusion with even a limited injuring force experienced during his fall.

Diseases causing limitations in cervical spinal movement increase the potential for difficult laryngoscopy. In Calder *et al.*'s review of 253 patients presenting for surgery for cervical spine disease, the overall prevalence of difficult laryngoscopy was 20%. Patients with disease of the upper cervical complex had a higher incidence of difficulty than did those with disease of the lower cervical spine.[7] The best single predictor of difficulty on diagnostic imaging was reduced separation of the posterior elements of the first and second cervical vertebrae on lateral radiographs, and the Mallampati classification was the best single predictor on physical examination. Mashour *et al.* also reported that limitation of cervical spinal movement is associated with an increased incidence of difficult laryngoscopy and intubation.[8] Although it was not possible to assess cervical spine limitations in our patient, the severity of the anatomic changes identified by the plain radiograph would suggest some limitations of spinal movements and a probable difficult airway.

All airway interventions cause spinal movement, and strategies to limit movement during airway management in the setting of potential cervical injury are recommended. Consistent with the aim of preventing secondary neurological injury, manual in-line stabilization is generally advocated. Outcomes of care are generally very good, and they do not seem to be influenced by or dependent on the use of any particular technique.[9] However, inline immobilization has been reported to complicate airway management, increasing the difficulty of direct laryngoscopy in particular.[10] The finding that the GVL produces less spinal movement than the direct laryngoscope has not been consistent, and the reductions, when reported, are of limited magnitude and of dubious clinical importance. Compared with the direct laryngoscope, the main advantage of the GVL is the superior glottic visualization it consistently provides in both simulated and actual difficult laryngoscopy and specifically during the application of manual in-line stabilization.[11]

Greenland has proposed a model both to describe the mechanism for successful laryngoscopy and to account for the difficulties experienced in some patients.[12] Three distinct anatomical components of the airway are described and considered: the *posterior complex* composed of the skeletal elements that determine positioning of the head and neck; the *anterior complex* composed of the submandibular space and the laryngeal skeleton that determine the degree to which the tissues of the upper airway may be

displaced to facilitate development of a line of sight; and the *air passage* composed of the tissues of the distal pharynx and the supraglottic region that allows for further development of the line of sight and passage of the endotracheal tube. Our patient had significant deficiencies of the posterior complex as a result of the underlying spinal pathology and compounded by the application of manual in-line stabilization.

The effectiveness of the GVL in our patient may have been compromised as a result of its relatively large-sized flange and the limited oropharyngeal space through which to manipulate the blade and tube. This difficulty may have been compounded by the severe limitations in spinal mobility, both anatomical and imposed by the manual in-line stabilization. Similar difficulties have been reported in a small study evaluating the use of the GVL in patients with ankylosing spondylitis.[13]

The air identified in the neck in our patient was likely the result of the intubation efforts. A number of reports of injuries to pharyngeal structures, including the palatopharyngeal arches, the anterior tonsillar pillars, and the soft palate, have been described with the GVL.[14] In our patient, either the force and traction applied to the GVL during attempts to visualize the glottis, or insertion of the styletted endotracheal tube may have injured pharyngeal tissues. Although Pacey suggests that careful observation of tube passage into the pharynx will avoid such injuries, the tube cannot be observed during the entirety of the passage into the supraglottic position.[15] Placing the tube in the large midline airspace and then gently sliding it over to the right prior to insertion of the GVL may avoid injury to lateral vulnerable tissues. There seems little advantage to obtaining a glottic view with the GVL only to relinquish it to focus on the passage of the endotracheal tube into the now much more limited and less easily visualized lateral airspace.

The GVL failed to provide laryngeal view in a patient with DISH who had both limited cervical motion and an anteriorly displaced larynx due to osteophytes. Although it is a relatively common radiologic diagnosis, compared with our patient, most individuals with DISH have less extensive disease and would not be expected to pose similar intubation difficulties. It is difficult to generalize whether the GVL is a poor choice for all patients with DISH or to establish the degree to which manual in-line stabilization contributed to difficult laryngoscopy. A more careful review of the patient's imaging may have suggested an alternative, such as the FOB or intubation through an LMA as the method of choice to secure the patients airway. As we become more familiar with the introduction of new technologies, we need to remain especially vigilant and learn potential limitations of these devices to avoid patient harm.

Conflicts of interest None declared.

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