Case Report

C-arm fluoroscopy for tracheal intubation in a patient with severe cervical spine pathology

ABSTRACT

Tracheal intubation is challenging in patients with severe cervical spine pathology. In such cases, awake fiberoptic intubation is the gold standard and safest option for tracheal intubation. However, this technique requires the patient's understanding and cooperation, and therefore, may be contraindicated in patients with refusal or poor tolerance. Herein, we report successful orotracheal intubation in a patient with limited mouth opening and severe cervical spine rigidity under general anesthesia using an extraglottic airway device and a gum-elastic bougie under C-arm fluoroscopic guidance.

Key words: C-arm fluoroscopic guidance; severe cervical spine pathology; tracheal intubation

Introduction

Tracheal intubation in patients with severe cervical spine rigidity is of great concern and challenge to anesthesiologists. In such patients, awake fiberoptic intubation is the gold standard and safest option for tracheal intubation. However, this technique requires the patient's understanding and cooperation, and therefore may be contraindicated in patients who refuse to undergo the procedure or have poor tolerance. Furthermore, quality and success of this technique depends on the practitioner's experience and proper patient preparation,[1] limiting its application. Herein, we report successful orotracheal intubation in a patient with limited mouth opening and severe cervical spine rigidity due to diffuse idiopathic skeletal hyperostosis (DISH) under general anesthesia using an extraglottic airway device and a gum-elastic bougie under C-arm fluoroscopic guidance.

Access this article online	
Website: www.saudija.org	Quick Response Code
DOI: 10.4103/sja.SJA_782_19	

Case Report

A 72-year-old man, 68 kg in weight and 163 cm in height, presented with DISH. He was scheduled for occipital–cervical fusion under general anesthesia. Despite partial instability of his upper cervical spine, his neck was almost immobilized because of severe cervical spine rigidity caused by DISH. Furthermore, his mouth opening was limited, with an interincisal distance of 25 mm. Because of severe cervical spine rigidity, he could lie only with his head elevated at an angle of approximately 30° and not in the supine position. Based on his spinal pathology and preanesthetic physical examination, tracheal intubation with conventional techniques was estimated to be extremely difficult. Furthermore, we could not exclude the possibility that tracheal intubation using direct laryngoscopes or

How to cite this article: Koyama Y, Tsuzaki K, Ohmori K, Ono K, Suzuki T. C-arm fluoroscopy for tracheal intubation in a patient with severe cervical spine pathology. Saudi J Anaesth 2020;14:390-3.

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Submitted: 15-Dec-2019, **Revised:** 18-Dec-2019, **Accepted:** 30-Dec-2019, **Publication:** 30-May-2020

videolaryngoscopes could cause unexpected neurological sequelae because of partial instability of the cervical spine. Fiberoptic intubation also appeared difficult, as manipulating a fiberoptic bronchoscope with the patient's head elevated at an angle of 30° would be required for tracheal intubation. However, we estimated that the Proseal® laryngeal mask airway (PLMA; Teleflex, Morrisville, NC, USA) could be easily placed in the patient's oropharyngeal space and the patient could be ventilated via the PLMA. At preanesthetic interview, the patient strongly preferred tracheal intubation under general anesthesia to awake intubation. Therefore, to minimize the risks and avoid the patient's suffering, we finally decided to use fluoroscopic-guided intubation under general anesthesia.

In the operating room, the patient was positioned with his head elevated at an angle of 30°. Conventional preoxygenation was performed with 100% oxygen administered at 6 L/min. In addition, we insufflated oxygen at 5 L/min via a 14-Fr nasopharyngeal catheter to enhance apneic oxygenation [Figure 1a]. Anesthesia was induced through propofol infusion at a target blood concentration of 3.0 μg/mL using a target-controlled infusion (TCI) device (TCI pump TE-371; Terumo, Tokyo, Japan), followed by intravenous administration of 100 μg of fentanyl. After confirming loss of consciousness, PLMA was placed in the patient's oropharyngeal space, and the cuff was inflated with air [Figure 1b]. After establishing effective ventilation with PLMA confirmed with capnography, 50 mg of rocuronium was administered intravenously, and ventilation with 100% oxygen was continued for 3 minutes. The upper trachea and the esophagus were identified under C-arm fluoroscopy (OEC 9900 Elite; GE Healthcare, Salt Lake City, UT, USA) guidance. Subsequently, a gum-elastic bougie was inserted in the patient's trachea via PLMA under C-arm fluoroscopy guidance [Figures 1c and 2a], and PLMA was removed while the gum-elastic bougie was left in the trachea. Subsequently, the 7.0-mm Parker-Flex-Tip® tracheal tube (Parker Medical, Englewood, CO, USA) was advanced over the gum-elastic bougie into the trachea under fluoroscopic guidance [Figures 1d and 2b]. Finally, the gum-elastic bougie was removed while the tracheal tube was left in place, and the patient's lungs were mechanically ventilated via the tracheal tube. The total procedure time was less than 10 min, with a total fluoroscopic exposure of approximately 10 s using the one-shot imaging method, which can reduce more radiation exposure compared to the continuous imaging method. At the end of the surgery, his trachea was extubated uneventfully. The duration of anaesthesia was 6 h and 25 min. The patient had no complaints against the anesthesia induction at the postoperative interview.

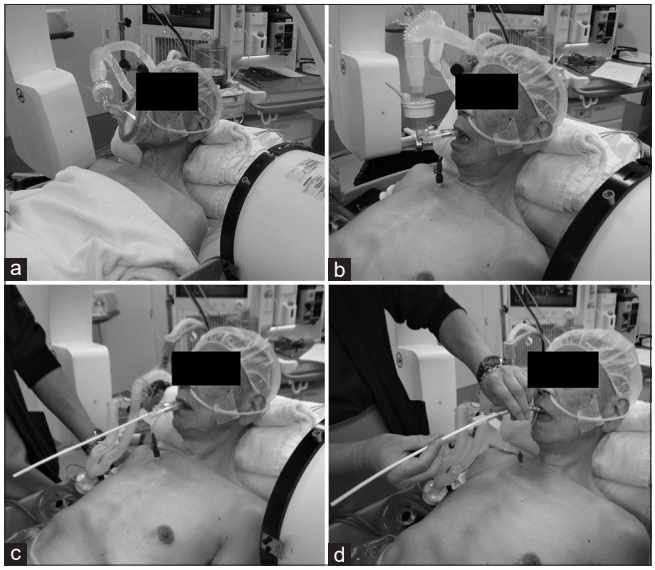

Figure 1: These four photographs show anesthesia induction procedures over time in this case. Photographs (a, b, c, and d) represent preoxygenation with nasopharyngeal oxygen insufflation in the position with head elevated, Proseal® laryngeal mask airway (PLMA) inserted in the patient, a gum-elastic bougie inserted in the trachea via PLMA, and the 7.0-mm Parker-Flex-Tip® tracheal tube inserted in the trachea over the gum-elastic bougie, respectively. A 14-Fr nasopharyngeal catheter was inserted to insufflate oxygen at 5 L/min. Note that the patient's head and neck positions were maintained throughout the procedure

Discussion

Severe cervical spine rigidity, often observed in patients with DISH, AS, posterior occipitocervical fusion, and halo-vest causes neck immobilization, and therefore tracheal intubation with direct laryngoscopy becomes difficult or impossible.[2] Lai *et al*. demonstrated that the GlideScope® videolaryngoscope (Saturn Biomedical Systems Inc, Burnaby, British Columbia, Canada) showed better intubation performance in patients with severe cervical spine rigidity caused by AS compared to the direct laryngoscope.[2] However, videolaryngoscopes may be inappropriate in patients with limited mouth opening as insertion of their blade may lead to oral injuries. Furthermore, Lai *et al*. reported that failure

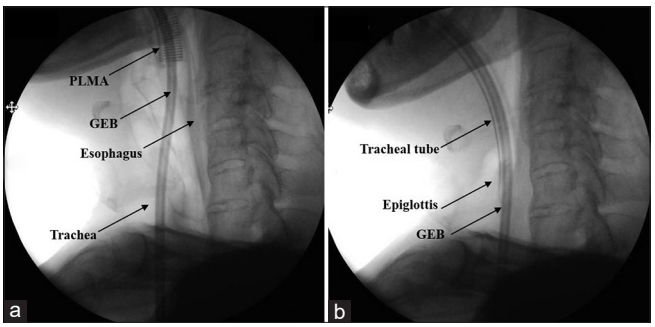

Figure 2: Photographs (a and b) show C-arm fluoroscopic images of the patient's airway and cervical spine from the lateral view during tracheal intubation, respectively. PLMA, Proseal® laryngeal mask airway; GEB, gum-elastic bougie

of the blade tip of Pentax AWS® (Hoya, Tokyo, Japan) to reach the larynx made intubation impossible in many cases.[3] Therefore, videolaryngoscopes may be inappropriate in some patients with difficult airways. Regarding the cervical spine movement during intubation, significant motion of the cervical spine with direct laryngoscopy has been well-documented.[4] Pentax AWS® also produces significant extension of the craniocervical junction during tracheal intubation, although Pentax AWS® exerts less extension compared to the conventional laryngoscope.[4] Therefore, in such cases, awake fiberoptic intubation is the gold standard and safest option. Awake tracheal intubation is a safe method for airway management in patients with cervical spine injuries.[5]

However, awake fiber optic intubation requires the patient's understanding, optimal tolerance, and cooperation. Therefore, it may be inappropriate in patients with refusal, poor understanding, dementia or mental disorders. Furthermore, oral secretions and bleeding and the patient's movement often prevent smooth fiberoptic intubation, resulting in a prolonged procedure. Anesthesiologists are generally trained to perform fiberoptic intubation from the head end of the operation table with the patient in the supine position. In our case, fiberoptic intubation would have been attempted with the anesthesiologist standing in front of the patient and facing the patient. Thus, the image obtained while performing fiberoptic intubation from the front of the patient would be rotated by 180° from the image visualized with a fiberoptic bronchoscope from the head end of the patient in the supine position. Therefore, in our case, fiberoptic intubation under general anesthesia proved difficult because of the positioning which might lead to an extremely prolonged intubation time. Owing to easy visualization of the upper airways under C-arm fluoroscopic guidance, we chose fluoroscopy-assisted intubation rather than fiberoptic intubation. Thus, airway management and tracheal intubation in patients with severe cervical spine rigidity and/or unstable cervical spine can be challenging.

We have identified clinical reports on fluoroscopy-assisted tracheal intubation for difficult airways.[6,7] Reier *et al*. reported awake tracheal intubation under C-arm fluoroscopic guidance in a patient with severe cervical spine pathology.[6] Aruvelan *et al*. also reported awake fiberoptic intubation under fluoroscopic guidance performed because of unexpected failure of the light source.[7] In contrast, in our case, to avoid patient suffering caused by awake intubation, we used PLMA and a gum-elastic bougie for tracheal intubation under general anesthesia and C-arm fluoroscopic guidance. PLMA allows a more effective seal compared to the classic LMA (Teleflex, Morrisville, NC, USA) and i-gel (Intersurgical, Wokingham, UK). Moreover, it can facilitate effective ventilation of patients in positions other than the supine position.[8] For our patient, whose head was elevated at an angle of 30°, establishing effective ventilation after anesthesia induction was a priority. Therefore, we chose PLMA. To the best of our knowledge, this is the first report on fluoroscopy-guided tracheal intubation performed in a patient with severe cervical spine pathology under general anesthesia.

Baraka *et al*. reported that nasopharyngeal oxygen insufflation following preoxygenation significantly delays the onset of oxygen desaturation during subsequent apnea.[9] Consequently, in addition to conventional preoxygenation in the position with head elevated, we performed Baraka's method using nasopharyngeal oxygen insufflation (5 L/min) to enhance apneic oxygenation and subsequently prolong the safe apnea period. Compared to the conventional low-flow nasal cannula oxygen therapy, high-flow nasal cannula (HFNC) oxygen therapy enhances both oxygenation and CO_2 clearance more.[10] Therefore, if available, the HFNC system would have been a better choice for preoxygenation in our case. After confirming loss of consciousness with propofol and fentanyl, PLMA was inserted. In our case, rocuronium was administered after establishing effective ventilation with PLMA to ensure the patient's safety. Ahmed *et al*. reported that blind placement of a gum-elastic bougie via an intubating LMA was extremely difficult.[11] In contrast, the C-arm fluoroscopic guidance enabled the operator to insert the gum-elastic bougie into the trachea via PLMA, and subsequently, introduce the tracheal tube over the gum-elastic bougie into the trachea easily, owing to the external visualization of the procedure for the personnel in the room.

Regarding practitioners' exposure to radiation, Funao *et al*. described that appropriate fluoroscopic techniques, such as the one-shot imaging method, an adequate distance from the X-ray tube, and the use of a lead apron, can effectively reduce radiation exposure.[12] Therefore, we used the one-shot imaging method to reduce radiation exposure during the procedure, resulting in a total radiation exposure duration of approximately 10s in our case.

Conclusion

Tracheal intubation using an extraglottic airway device and a gum-elastic bougie under general anesthesia and fluoroscopic guidance may be beneficial in patients with severe cervical spine pathology and refusal for awake fiberoptic intubation

because of poor understanding or predicted difficulty of fiber optic intubation.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that name and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

Acknowledgements

The authors are grateful to the radiological technologist Mr. Toshiaki Segawa for maintaining and uploading the fluoroscopic X-ray images appropriately.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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