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CASE REPORT

An optimized "sTOP" strategy-based awake fiberoptic intubation for a patient with severe scoliosis after halo-pelvic traction

Hansheng Liang | **Fei Huo** | **Liang Sun** | **Yi Feng**

Department of Anesthesiology, Peking University People's Hospital, Beijing, China

Correspondence
Yi Feng, Department of Anesthesiology, Peking University People's Hospital, Beijing 100044, China.
Email: doctor_yifeng@sina.com

Abstract

Difficult Airway Society launched the new guideline for awake tracheal intubation (ATI) in adults with the goal of standardizing and promoting ATI techniques to protect the airway in 2020 (*Anaesthesia*, 2020;**75**:509). Specifically, the guideline highlighted that the key components of ATI are sedation, topicalization, oxygenation, and performance, coined "sTOP." To the best of our knowledge, anticipated difficult airway is the best indication for ATI. Patients with severe scoliosis undergoing halo-pelvic traction (HPT) are often with head and neck fixation, thereby contributing to the anticipated difficult airways. HPT was first used to fix unstable cervical vertebra segments in 1959, and gradually applied in the treatment of scoliosis (scoliosis or kyphosis Angle greater than 90 degrees is usually considered as severe scoliosis), with favorable efficacy and safety profile, and thus widely used in clinical practice (*Clin Orthop Relat Res*, 1973;**93**:179). To date, the improved HPT device usually consists of a head ring composed of 6 ~ 8 cranial nails, a pelvic ring composed of 6 ~ 8 iliac bone nails and 4 telescopic connecting rods, which can achieve all-day continuous traction. Usually, the average traction time was about 8 weeks (*Chin Med J (Engt)*, 2012;**125**:1297). Our case described a planned awake fiberoptic intubation (AFOI) for a patient with severe scoliosis undergoing HPT via an optimized "sTOP" strategy.

KEYWORDS

anticipated difficult airway, awake fiberoptic intubation (AFOI), halo-pelvic traction (HPT)

1 | CASE REPORT

A 37-year-old man weighting 54 kg with a BMI of 19 was scheduled for scoliosis orthopedics plus pedicle screw internal fixation under general anesthesia. The patient had severe scoliosis, and HPT had been performed for 7 weeks (Figure 1). Airway inspection showed that the head and neck were fixed, with a mouth opening of 4 cm, indicating that an anticipated difficult airway was existed, and thus, a planned AFOI should be initiated.

Noninvasive blood pressure, electrocardiography, pulse oximetry, respiratory rate, and bispectral index (BIS) were recorded during the AFOI. Our optimized strategy for "sTOP" included four abovementioned components

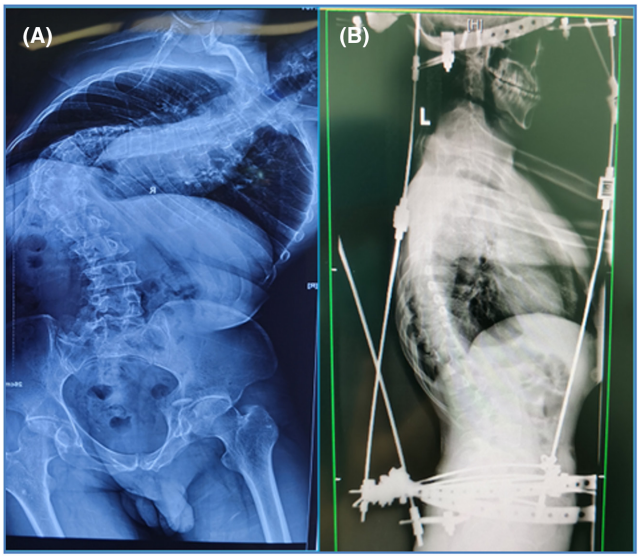

FIGURE 1 X-ray images. (A) a 37-year-old man with severe scoliosis. The radiograph image was obtained before halo-pelvic traction (anteroposterior position); (B) the head and neck of the patient was fixed, with a mouth opening of 4 cm after halo-pelvic traction for 7 weeks (lateral position).

as follows: Sedation: Midazolam 2 mg IV + remifentanil at a loading dose of 0.75 μg/kg over 10 min followed by a continuous infusion of 0.1 $\mu g \cdot kg^{-1} \cdot h^{-1}$; Topicalization: 2% lidocaine 3 mL for endotracheal surface anesthesia through thyrocricocentesis and additional 2% lidocaine 3 mL to oropharynx, tonsillar pillars, and base of tongue; Oxygenation: preoxygenation via high-flow nasal cannula (HFNC) (oxygen flow: 50 L/min); P: optimized performance including a fiber bronchoscope (Olympus LF-DP 4.2 mm, Olympus, Tokyo, Japan) loaded with a 7.0 mm reinforced endotracheal tube (ETT) with soft front end (Parker medical, Well Lead Medical Co, Ltd.), and adequately lubricating tube with paraffin oil. During the AFOI, the patient was sedated (BIS between 50 and 70) 10 min after administration of midazolam and remifentanil. Fiber bronchoscope stimulation to the throat did not cause any discomfort, and no fluctuations of blood pressure and heart rate were detected. The patient had no cough when fiber bronchoscope was passed through the glottis. Subsequently, the ETT was inserted, the $EtCO_2$ was witnessed confirming the accurate intubation, and the patient reported no painful experience. During the insertion of the EFF, blood pressure increased from 105/62 mmHg to 122/73 mmHg, and heart rate increased from 75 to 82 bpm; however, SpO_2 maintained at 100%. The whole intubation process lasted for 2 min and 30 s, immediately, intravenous injecting propofol 100 mg, oxycodone 10 mg, and rocuronium 40 mg for general anesthesia induction. After supine position, the left telescopic connecting rods of HPT were removed.

The whole operation lasted for 3 h and 20 min. Extubation was successfully performed after the operation and the rest components of HPT were removed. The patient returned to the ward and discharged 14 days later.[1–3]

2 | DISCUSSION

The advantages of preoperative HPT in patients with severe scoliosis include continuous and progressive traction for stable traction process, very good reduction of spinal stiffness and the incidence of pulmonary complications.[4] However, fixation of the head and neck of patients with HPT can result in severe difficult airway, and the head ring and connecting rods will seriously affect the endotracheal intubation.[5] Specifically, for those with HPT for longer time (8 weeks), it will seriously interfere with their normal life, leading to irritation, anxiety, and even depression. Therefore, it is necessary to strive for maximum cooperation and self-established confidence before surgery, which merits for performing a "sTOP" strategy.

Several studies have confirmed that visual intubation does not reduce the incidence of difficult intubation and "can't intubate, can't oxygenate" (CICO) in the setting of tracheal intubation.[1] Likewise, supraglottic airway device (SAD) is reported a success rate as low as 65% in difficult airway management. There are many guidelines for the unanticipated difficult airway management, but few of them are targeted for the management of anticipated difficult airway which is an indication of the ATI. Spontaneous breathing and inherent airway tension during ATI are essential factors in maintaining effective ventilation and oxygenation. Though the failure rate of ATI is reported as few as 1%–2%, ATI is used only 0.2% of all tracheal intubations in the UK.[6] Nonetheless, "sTOP" is the core of ATI. AFOI is usually performed in the anticipated difficult airway management. Adequate sedation with effective airway topical anesthesia for AFOI is paramount to improve intolerance, alleviate discomfort, and achieve successful intubation. Individual sedation selection should aim to improve patient's comfort and reduce respiratory depression. The risks of excessive sedation by midazolam, propofol, dexmedetomidine, and remifentanil include respiratory depression, airway loss, hypoxia, aspiration, and cardiovascular instability. Therefore, individualized and adequate sedation should be recommended in clinical settings. However, sedation is not a remedy measure for patients with inadequate airway topical anesthesia.[1] Airway topical anesthesia without causing respiratory depression is equally important. Airway topicalization measures include aerosol inhalation, laryngeal spraying anesthetics, thyrocricocentesis, and glossopharyngeal and superior laryngeal nerve block. Lidocaine is usually recommended,

which has a low risk of cardiovascular and systemic toxicity and is theoretically safer than other local anesthetics. The toxic dose is 9 mg/kg (lean body weight). Low concentrations of lidocaine are just as effective as high concentrations, but the higher the concentration, the faster the effect.[7] Local nasal sprays with vasoconstrictor are recommended before nasal intubation, and nasal drops with lidocaine combined with phenylephrine are suitable.[1] The nerve blocks that may be used if anesthesiologists have technical skills, adequate visualization techniques, and experience especially under ultrasound.[8] Using supplemental oxygen is suggested for the patients who will receive sedation. The methods to keep normal oxygenation include nasal catheter, face mask, supraglottic jet ventilation, and oxygenation (SJOV)[9] and HFNC with oxygen flow of 30–70 L/min.[1] Optimized performance includes the manipulation, lubrication, materials and front-end design of ETT, tube diameter matching the endoscope, endotracheal tube bevel, tube rotation, operator position selection, etc. The success rate and safety of ATI using video laryngoscope are comparable to that of ATI using fiber bronchoscopy.[1] The choice between these two methods depends on patients' factors, operational skill, and the effectiveness of intubation tools. However, for patients with limited mouth opening, larger tongue or fixed neck flexion deformity, AFOI may be more appropriate. According to the ASA guideline published in 2022, observational findings also reported successful awake intubation in 88% to 100% of anticipated difficult airway patients.[10]

In summary, the optimized "sTOP" strategy is the essential to improve the success rate and comfort of AFOI for patients with severe spinal deformity after halo-pelvic traction. Establishment of trust by the anesthesiologist and good emotional preparation of the patient will facilitate the process of the AFOI and achieve better outcomes.

AUTHOR CONTRIBUTIONS

Hansheng Liang: Investigation. **Fei Huo:** Conceptualization; data curation; writing – original draft; writing – review and editing. **Liang Sun:** Investigation. **Yi Feng:** Investigation.

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DATA AVAILABILITY STATEMENT

All data are fully available without restriction.

ETHICS STATEMENT

A local ethics committee ruled that no formal ethics approval was required in this particular case.

CONSENT

Written informed consent was obtained from the patient for publication.

ORCID

Fei Huo https://orcid.org/0000-0002-3402-2190

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