Perioperative Precision Medicine
eISSN: 2957-5443

Zentime

Case Report https://doi.org/10.61189/109678mkmeds

Difficult airway management in patients with laryngeal tumor: Case series and systematic review

Chenglong Zhu[1,3*], Miao Zhou[1,4*], Yongchu Hu[2], Wenyun Xu[2], Zui Zou[1,2]

[1]School of Anesthesiology, Naval Medical University, Shanghai 200433, China. [2]Department of Anesthesiology, Second Affiliated Hospital of Naval Medical University, Shanghai 200003, China. [3]Faculty of Anesthesiology, Changhai Hospital, Naval Medical University, Shanghai 200433, China. [4]Department of Anesthesiology, the Affiliated Cancer Hospital of Nanjing Medical University, Jiangsu Cancer Hospital, Jiangsu Institute of Cancer Research, Nanjing Medical University, Nanjing 210009, Jiangsu, China.
*The authors have contributed equally to this work.

Corresponding authors: Zui Zou and Wenyun Xu.

Acknowledgement: This study was funded by the National Natural Science Foundation of China (81670072), the Shanghai Municipal Committee of Science and Technology (20XD1434400) and Special Project on Incubation of Civil-Military Integration Achievements of the Naval Medical University (2022-RH10).

Declaration of conflict of interest: None.

Ethics approval and consent to participate: Chinese Clinical Trial Registry approved this study (ChiCTR2200060783). All procedures and research activities performed in the study were in accordance with the ethical standards of the institutional research committee. Consent was obtained from a legally authorized representative.

Received November 29, 2023; Accepted January 16, 2024; Published June 30, 2024

Highlights

- SEEK^{flex} (Safe Easy Endotracheal Kit-flexible) is a modified introducer, which provides a simple and rapid way for intubating patients with laryngeal tumors.
- With its non-invasive and gentle approach, SEEK^{flex} minimizes patient discomfort, enhancing the overall patient experience.
- Flexible fiberoptic bronchoscope remains the most frequently used tool for managing difficult airways.

Abstract

Airway management in patients with laryngeal tumor presents significant challenges and risks. SEEK^{flex} (Safe Easy Endotracheal Kit-flexible) is a modified introducer developed by our team for the intubation in severe COVID-19 patients. Here, we present 4 cases where SEEK^{flex} facilitated tracheal intubation in patients with laryngeal tumors underwent surgeries and achieved a definitive airway. A systematic review of MEDLINE, EMBASE, CINAHL, and Web of Science databases was also performed using the keywords such as “laryngeal tumor”, “airway management” and “anesthesia” to identify the reports on airway management techniques for patients with laryngeal tumors. 14 papers involving 17 patients were retrieved. All the cases reported positive patient outcomes, though there were instances of intubation failure after general anesthesia. Despite increased availability of basic airway management techniques and various types of intubation tools, challenges persist, especially in patients with pre-existing severe airway obstruction. SEEK^{flex} provides a simple and rapid solution for intubating patients with laryngeal tumors, which ensures a clear airway for patient safety.

Keywords: SEEK^{flex}, laryngeal tumor, airway management, anesthesia

Introduction

Laryngeal tumors include cancers, papillomas, sarcomas, chondromas, hemangiomas and other lesions, and the patients with laryngeal tumors who undergo surgery (such as a tracheotomy, laser resection, tumor excision or biopsy) may experience difficulty airway [1]. In addition, cysts may be encountered in the glottic area, which may complicate tracheal intubation. In

Address correspondence to: Zui Zou, School of Anesthesiology, Naval Medical University, 168 Changhai Road, Yangpu District, Shanghai 200433, China. Email: zouzui@smmu.edu.cn. **Wenyun Xu**, Second Affiliated Hospital of Naval Medical University, 415 Fengyang Road, Huangpu District, Shanghai 200003, China. Email: xuwenyun@smmu.edu.cn.

the patients with laryngeal tumors, ventilation or intubation difficulties should be anticipated. The risk of acute airway emergencies, often referred to as "Can't Intubate, Can't Oxygenate" scenarios, is particularly high during the postoperative period [2]. According to a survey, unanticipated difficult airways could account for up to 25% of anesthesia-related fatalities [3, 4]. Therefore, anesthesiologist should conduct a thorough preoperative assessment and plan for complete airway obstruction upon the induction of general anesthesia [5, 6].

Prior to surgery, anesthesiologists need to design a tailored airway management plan based on the patient's condition and their proficiency with airway tools [7]. There is a wide variety of tools used for tracheal intubation for the patients with laryngeal tumors, with flexible fiberoptic bronchoscope guided intubation as the most widely used technique (**Table 1**). However, flexible fiberoptic bronchoscopy has many drawbacks, such as patient intolerance, poor visualization due to airway secretions or blood, haemodynamic instability, high demands on the anesthesiologist 's operating skills and long learning cycles, which limit its widespread application in clinical practice [8-10].

Our group has developed a new intubation tool - Safe Easy Endotracheal Kit-flexible (SEEK^{flex}) - a modified introducer initially for the intubation of critically ill patients with COVID-19 [11]. SEEK^{flex} is a new type of disposable tracheal introducer, and its features and advantages and comparison with other tools have been summarized [12, 13]. We have successfully demonstrated the efficacy of SEEK^{flex} in managing difficult airway during awake tracheal intubation and bronchoscopic balloon dilation [12, 13]. The purpose of this report is to present 4 cases where SEEK^{flex} was utilized for patients with severe vocal and proximal tracheal obstruction due to laryngeal tumors in the awake state. Moreover, this report provides a systematic review of the tracheal intubation approaches for managing difficult airways attributed to laryngeal tumors.

Case presentation

Case 1

A 29-year-old male, weighing 70 kg, with no history of smoking or alcohol consumption, underwent an extended local excision for laryngeal cancer 10 months ago. He was scheduled for radical laryngeal cancer resection and neck debridement. Preoperative evaluations revealed no abnormalities or metastases in the surrounding lymph nodes. The patient was classified as Malampatti class II, exhibited no apnoea or major depressive symptoms, and had normal neck flexibility. Routine non-invasive blood pressure, ECG and SPO_2 monitoring was performed. Dexamethasone (5 mg), midazolam (1 mg), sufentanil (20 μg), dezocine (5 mg), propofol (80 mg), cis-atracurium (15 mg) were administered for general anaesthesia, followed by preoxygenation and routine intubation using video laryngoscopy (Zhejiang UE Medical Corp) and endotracheal tube with stylet. The glottis was not seen on video laryngoscop and conventional intubation failed, followed by a drop in SPO_2 from 100% to 89% and an increase in heart rate from 65 to 120 beats/min. At the same time, the anesthesiologist immediately performed face mask ventilation and called other physicians, which was effective. After SPO_2 returned to 100%, intubation was successfully performed using video laryngoscopy combined with intubation using SEEK^{flex} [12]. Following this, SPO_2 and heart rate were stabilized after oxygen delivery via a 5.0 mm diameter tracheal tube. Anaesthesia was continued with inhaled sevoflurane and infusions of propofol and remifentanil. The patient regained consciousness at the end of the procedure with no adverse effects or sequelae, and the postoperative follow-up was normal. Refer to **Supplementary video 1**.

Case 2

A 68-year-old male, weighing 65 kg, with a 40-year history of smoking and a 4-year history of hoarseness, was scheduled for a vocal cord tumour resection. The preoperative physical examination was unremarkable. The patient was classified as Malampatti class III and exhibited no apnoea or major depressive symptoms. Routine non-invasive blood pressure, ECG and SPO_2 monitoring were carried out. Dexamethasone (5 mg), midazolam (1 mg), sufentanil (15 μg), dezocine (3 mg), propofol (65 mg), and cis-atracurium (12 mg) were administered as general anesthesia, followed with preoxygenation and intubation by video laryngoscopy (Zhejiang UE Medical Corp) combined with intubation using SEEK^{flex} [12]. Although the glottis was not visible with the video laryngoscope, SEEK^{flex} facilitated access to the airway. A 6.0 mm diameter tracheal tube was successfully inserted into the airway along the SEEK^{flex}. SPO_2 was maintained above 96% throughout the surgical procedure. Anaesthesia was continued at the end of induction with inhalation of sevoflurane and infusion of propofol and remifentanil. The patient regained consciousness at the end of the procedure without any adverse effects or sequelae, and postoperative follow-up was normal. Refer

Table 1. Case reports of airway management in patients with laryngeal tumours

First author	Year	Age	Condition before surgery	Laryngeal tumor type	Airway management	Result
Wehner [16]	1982	M/55	Dyspnea	Laryngeal tumor	Awake blind nasal intubation	Successful but possibility of obstruction
North [17]	1986	F/65	Respiratory failure	Laryngeal tumor	Trans-nasal fiberscopy monitoring-guiding oro-tracheal fiber	Successful
Humle [23]	1999	F/51	Pronounced acromegalic features	Multiple papillomata	Cook Airway Exchange Catheter	Successful but having difficulty
Matsumoto [14]	2001	M/69	Dyspnea	Huge laryngeal cyst	Trans-nasal fiberscopy monitoring-guiding oro-tracheal fiber	Successful but having difficulty
Kale [24]	2014	M/64	Worsening shortness of breath	Obstructing laryngeal chondrosarcoma	Supraglottic jet ventilation	Successful
Tange [15]	2014	F/21-day-old	Dyspnea	Jawbone medullary hemangioma	A spiral tube using a guide wire and bronchofiber	Successful
Nakahira [25]	2014	F/20	Hoarseness	Laryngeal granulomas	Airway Scope® and video laryngoscope	Successful
Uzawa [19]	2016	F/93	Altered mental status	Subglottic tumor	Tracheal tube and tube introducer were difficult to insert	General anesthesia was failed
Zhang [18]	2018	M/54	Primary partial laryngectomy	Laryngeal cancer	Macintosh laryngoscopy	Fail, urgent tracheostomy, finally
Zhang [18]	2018	M/57	Inspirational apnea	Total laryngectomy	Fibroscope-guided conscious intubation	Successful
Zhang [18]	2018	M/63	Neck immobility	Recurrent laryngeal cancer	Fibroscope-guided nasal intubation	Failed, finally tracheostomy
Constable [20]	2018	M/52	Acute breathing difficulty	Advanced glottic cancer	'Over bougie' technique	Successful
Tsay [26]	2019	F/46	Hoarseness	Vocal Cord Granuloma	Oro-tracheal intubation (Shikani video-assisted intubating stylet technique)	Successful
Hewage [27]	2020	M/48	Progressive hoarseness, dyspnoea and dysphagia	Pedunculated vocal cord nodule	Awake fibreoptic intubation	Successful
Warnakulasuriya [21]	2020	M/52	Dyspnoea, stridor and loss of voice	Large obstructing trans-glottic tumour	Awake tracheal intubation with a videolaryngoscope	
Tsay [26]	2021	M/63	Hoarseness	Hypopharyngeal Cancer	Oro-tracheal intubation (Shikani video-assisted intubating stylet technique)	Successful
Bailey [22]	2021	M/43	Worsening shortness of breath	Transglottic squamous cell carcinoma	The TriTube® and Evone® ventilator	Successful

to **Supplementary video 2**.

Case 3

A 59-year-old male, weighing 70 kg and with a smoking history for over 30 years, was diagnosed with laryngeal cancer with vocal stenosis. He was scheduled to undergo radical laryngectomy for laryngeal cancer. Preoperative evaluation showed no abnormalities and no metastases in the surrounding lymph nodes. The patient was classified with Malampatti class II, exhibited no apnoea or major depressive symptoms. Routine non-invasive blood pressure, ECG and SPO_2 monitoring were carried out. Dexamethasone (5 mg), midazolam

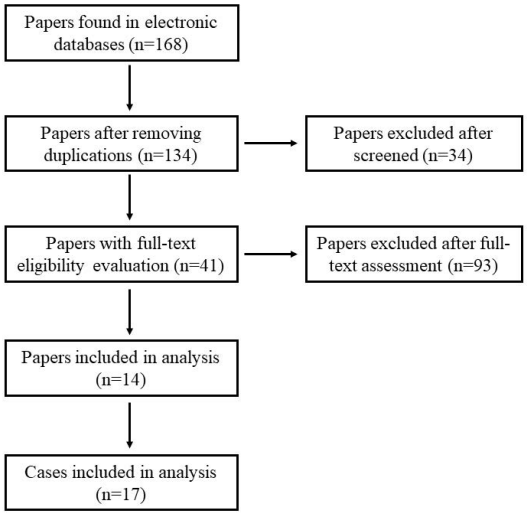

Figure 1. Bibliographic search of literature.

(1 mg), sufentanil (20 μg), dezocine (5 mg), propofol (80 mg), cis-atracurium (15 mg) were administered for general anaesthesia, followed with preoxygenation and intubation using video laryngoscopy (Zhejiang UE Medical Corp) and intubation using SEEK^{flex} [12]. The glottis was visible under the video laryngoscope and the SEEK^{flex} reached the airway. A 6.0 mm diameter tracheal tube was successfully inserted along the SEEK^{flex} into the airway. SPO_2 was maintained above 98% throughout the surgery. Anaesthesia was continued after induction with inhalation of sevoflurane and infusion of propofol and remifentanil. The patient regained consciousness at the end of the procedure, with no adverse effects or sequelae and, and postoperative follow-up showed no abnormality. Refer to **Supplementary video 3**.

Case 4

A 66-year-old woman, weighing 40 kg, with dysphagia for one year, was scheduled for radical tonsillectomy following the discovery of a tonsillar tumour by electronic laryngoscopy. The preoperative physical examination showed no significant findings. The patient was classified as Malampatti class II with apnoea symptoms. Routine non-invasive blood pressure, ECG and SPO_2 monitoring were performed. General anesthesia was administered with dexamethasone (5 mg), midazolam (1 mg), sufentanil (10 μg), dezocine (3 mg), propofol (40 mg), cis-atracurium (8 mg), followed by preoxygenation and intubation via video laryngoscope (Zhejiang UE Medical Corp) in combination with the intubation using SEEK^{flex} [12]. The glottis was visible under the video laryngoscope, and the SEEK^{flex} reached the airway. A 6.0 mm diameter tracheal tube was successfully inserted into the airway along the SEEK^{flex}. SPO_2 was maintained above 96% throughout the surgery. Anaesthesia was continued at the end of induction with inhalation of sevoflurane and infusion of propofol and remifentanil. The patient regained consciousness at the end of the procedure without experiencing adverse effects or sequelae, and the postoperative follow-up was normal. Refer to **Supplementary video 4**.

Results

Literature search

In our search, we identified 168 articles. After removal of duplications, 134 records were reviewed based on inclusion criteria (**Figure 1**). After removing 93 duplications, 41 abstracts were determined suitable for full-text evaluation.

Study characteristics

14 papers including 17 cases published between 1982 and 2022 discussing the airway management of laryngeal tumors were included in the review. Two of the included papers were in Japanese, but their abstracts revealed sufficient clinical information to be included in the review [14, 15]. The most frequent reasons for exclusion were failing the predetermined inclusion criteria, and inability to obtain detailed patient information. A total of 17 patients were included in this review. Results are summarized in **Table 1**.

The patients with difficult airway had different kinds of laryngeal tumors, including: laryngeal tumor (5 patients), glottic tumor (4 patients), multiple papillomata (1 patient), huge laryngeal cyst (1 patient), laryngeal chondrosarcoma (1 patient), jawbone medullary hemangioma (1 patient), laryngeal granulomas (1 patient), vocal cord granuloma (1 patient), pedunculated vocal cord nodule (1 patient), and hypopharyngeal cancer (1 patient) [16-27]. The techniques used for intubating these patients fell into three categories: flexible fiberoptic bronchoscope (5 patients), laryngoscope (11 patients), and jet ventilation (1 patient) [14-27]. Among the patients who were incubated with laryngoscope, various introducers were applied, including exchange catheter and over bougie [20, 23]. Most of the published cases reported that the patients were successfully intubated, except three patients had failed intubation and two had difficult intubation [14, 18, 19, 23]. In 2018, Zhang et al. reported two cases where patients experienced ventilation difficulties with decreased oxygen saturation after the induction of general anesthesia, who were eventually resuscitated

with a tracheostomy [18]. In addition, Uzawa et al. reported one case where patient got into the "cannot ventilate, cannot intubate" situation after the induction of general anesthesia, and finally the patient regained consciousness after airway maintenance efforts [19]. The use of flexible fiberoptic bronchoscope and video laryngoscopy in these failed intubation cases implies that these intubation tools have certain shortcomings and underscores the need for improved methods. Possible reasons for failure include inadequate handling skills, obscured visual fields, and inability to visualize the glottis.

Discussion

In otorhinolaryngology head and neck surgery, ensuring airway safety is the key to anaesthetic management, necessitating comprehensive preoperative airway assessment [28-30]. Laryngeal tumors can lead to vocal stenosis, difficult vocal exposure and scar contracture of previous incisions, often resulting in a challenging airway [31-34]. Therefore, it's imperative to devise a safe airway management plan in anticipation of these difficulties. There are many tools available for difficult airway management, including video laryngoscopes, flexible fiberoptic bronchoscopes, lighted or optical stylets, supraglottic airway devices, and assisted introducers [28, 29]. However, in clinical practice, all these tools have their own certain disadvantages and limitations.

The role of the fiberoptic bronchoscope in the management of difficult and failed intubations has been widely recognized [35]. However, several drawbacks of fiberoptic bronchoscopy hinder its wide application, including high operational proficiency skill requirements, poor visibility due to secretions or blood, time-consuming multiple-attempt procedures, poor patient tolerance, and hemodynamic instability caused by repeated disturbance of the vocal cords and nearby tissues. Such excessive stimulation may lead to significant psychiatric distress and additional cardiovascular issues for patients [8-10]. The use of supraglottic airway devices in airway management for patients with laryngeal tumors is somewhat limited, as tumors may prevent the supraglottic airway device from providing oxygen to the patient [36]. Another intubation tool, the video laryngoscope, usually paired with a stylet for tracheal intubation, makes it difficult to insert a tracheal tube after several attempts, particularly when the epiglottis is visible but not the vocal canal, or when the vocal canal is too narrow [28]. Subsequently, introducers emerged as an aid, such as the Frova intubation introducer, offering a high first-attempt success rate of intubation due to the stiffer material of the catheter [37, 38].

SEEK^{flex}, a novel disposable probe intubation kit developed from our initial intubation kit for COVID-19 patients, is an easy intubation and extubation device that can aid the intubation of any tracheal tube [11]. SEEK^{flex} is structurally and functionally similar to the Airway Exchange Catheter and the Frova Intubating Introducer, but has its own advantages. Its flexible design not only accommodates a broader range of functions but also offers a more cost-effective solution compared to the aforementioned devices; additionally, SEEK^{flex}'s user-friendly nature allows for operation by a single individual and facilitates ease of learning, marking it as a valuable tool for medical practice [12, 13, 39, 40]. Furthermore, based on the features and functions of SEEK^{flex}, we have designed a novel "Twelve-Step" strategy for awake tracheal intubation with video laryngoscope and SEEK^{flex}, which was effectively applied in patients with cervical spinal tumor [12]. This strategy integrates various approaches to manages difficult airway in tracheal, enhancing the success rate of intubation in patients with foreseeable airway complications and is recommended for challenging airway scenarios [29, 41-43].

We report 4 patients with laryngeal tumors who were successfully intubated using video laryngoscope and SEEK^{flex} in this review. This method not only ensured successful intubation but also resulted in more stable haemodynamics and less injury during induction of anaesthesia, due to the softer and slimmer profile of SEEK^{flex} compared to that of fiberoptic bronchoscopes, offering better patient tolerance [10, 12]. According to literature review, 3 patients of the 17 screened cases had failed intubation with fiberoptic bronchoscopes and video laryngoscopy, leading to a transient oxygenation failure. Guidelines by the American Society of Anesthesiologists, the Difficult Airway Society of Great Britain and Ireland, and the Canadian Airway Focus Group emphasize the importance of sustaining adequate tissue oxygenation [7, 44-49]. The Canadian Airway Focus Group difficult airway guidelines state underscore the critical importance of maintaining adequate tissue oxygenation, advising that airway management strategies should prioritize ensuring sufficient oxygenation and ventilation over tracheal intubation alone [46]. Notably, SEEK^{flex} not only facilitates rapid and secure endotracheal intubation but its outer catheter, equipped with multiple small vents, can serve temporarily as a mini-tracheal tube to sustain oxygenation [12, 13].

Awake tracheotomy is a frequently utilized technique for patients with laryngeal tumors [18]. This technique is associated with increased harm and discomfort for the patient, in addition to being more hemodynamically provocative. During elective surgery for laryngeal tumor, jet ventilation is sometimes used to maintain oxygenation [24]. However, in the case of near-complete airway blockage, jet ventilation poses an unacceptable risk of volutrauma, barotrauma, pneumothorax, hyperventilation, and stomach insufflation [50].

SEEK^{flex} offers a less invasive approach, minimizing patient discomfort through its gentle handling. Recent reports suggest that video laryngoscopy combined with introducer-guide enhances the success rate of first-attempt intubation due to the rigidity of the catheter material [29, 51, 52]. Compared to Frova intubating introducer and Airway Exchange Catheter, SEEK^{flex} mitigates some of their limitations, such as operational complexity, long learning curve and high cost [12, 13].

SEEK^{flex} also has its limitations. Structurally, lacks an integrated light source or a miniature camera, necessitating its use alongside a video laryngoscope for tracheal intubation. From a practical standpoint, if the patient's mouth opening is too small to accommodate video laryngoscope, SEEK^{flex} cannot be used for tracheal intubation either. In terms of safety and feasibility, there is a lack of randomized controlled trials comparing SEEK^{flex} with other intubation tools, leaving room for further research to establish its comparative effectiveness.

Conclusions

In this review, we have examined traditional tracheal intubation techniques for patients with laryngeal tumors and present a novel tool designed to facilitate intubation in difficult airway scenarios associated with laryngeal tumors. The tool is easy to use and has a high success rate of intubation, low airway irritation, and a low incidence of adverse effects. However, this study has its limitations, and as a new device, it still requires comprehensive testing to substantiate its effectiveness. Future efforts will focus on refining the trial design, building upon previous research, conducting additional studies, and evaluating its potential for clinical use.

Supplementary Material: Four videos of tracheal intubation in four cases.

Availability of data and material: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author contributions: Conception and design of the study: Zui Zou, Wenyun Xu, Chenglong Zhu. Conduct of the study and data collection: Chenglong Zhu, Wenyun Xu, Miao Zhou. Writing and review of the manuscript: Chenglong Zhu, Yongchu Chu. Study supervision: Zui Zou, Wenyun Xu.

References

[1] Moorthy SS, Gupta S, Laurent B, et al. Management of airway in patients with laryngeal tumors. J Clin Anesth 2005;17(8):604-609.
[2] Mosier JM, Sakles JC, Law JA, et al. Tracheal Intubation in the Critically Ill. Where We Came from and Where We Should Go. Am J Respir Crit Care Med 2020;201(7):775-788.
[3] Detsky ME, Jivraj N, Adhikari NK, et al. Will This Patient Be Difficult to Intubate? : The Rational Clinical Examination Systematic Review. JAMA 2019;321(5):493-503.
[4] Cook TM, Woodall N, Frerk C. Major complications of airway management in the UK: results of the Fourth National Audit Project of the Royal College of Anaesthetists and the Difficult Airway Society. Part 1: anaesthesia. Br J Anaesth 2011;106(5):617-631.
[5] Bradley PJ. Treatment of the patient with upper airway obstruction caused by cancer of the larynx. Otolaryngol Head Neck Surg 1999;120(5):737-741.
[6] Burtner DD, Goodman M. Anesthetic and operative management of potential upper airway obstruction. Arch Otolaryngol 1978;104(11):657-661.
[7] Apfelbaum JL, Hagberg CA, Caplan RA, et al. Practice guidelines for management of the difficult airway: an updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Anesthesiology 2013;118(2):251-270.
[8] El-Boghdadly K, Onwochei DN, Cuddihy J, et al. A prospective cohort study of awake fibreoptic intubation practice at a tertiary centre. Anaesthesia 2017;72(6):694-703.
[9] Metz S, Straker T. Is video laryngoscopy easier to learn than fiberoptic intubation? Anesthesiology 2013;118(2):461.
[10] Xue FS, Cheng Y, Li RP. Awake intubation with video laryngoscope and fiberoptic bronchoscope in difficult airway patients. Anesthesiology 2013;118(2):462-463.
[11] Song L, Tan L, Ma N, et al. Reintubation during COVID-19 pandemic: a simple self-

made guiding device facilitates reintubation and minimizes transmission. Am J Transl Res 2021;13(12):13811-13814.
[12] Xu W, Tan L, Xu S, et al. Application of "twelve-step" approach based on SEEK(flex) for difficult awake tracheal intubation in patients with cervical spinal tumor. Am J Cancer Res 2022;12(12):5684-5691.
[13] Lin C, Yu Y, Wu Q, et al. Application of a new tracheal inducer to therapeutic flexible bronchoscopy for airway management: a case report. Am J Transl Res 2023;15(2):1469-1472.
[14] Matsumoto K. [Fiberoptic nasal intubation in a patient with huge laryngeal cyst]. Masui 2001;50(7):786-788.
[15] Tange K, Masaki M, Nakata R, et al. [Anesthesia in a neonate with capillary hemangioma of the maxilla: a case report]. Masui 2014;63(1):94-97.
[16] Wehner RJ, McKennett RJ. A case study: management of the patient with laryngeal tumor and airway compromise. AANA J 1982;50(1):81-83.
[17] North C, Marsh B, Hirshman CA. Anesthetic management of a patient with reactive airway disease for carbon dioxide laser debulking of a laryngeal tumor. Anesth Analg 1986;65(11):1225-1226.
[18] Zhang X, Cavus O, Zhou Y, et al. Airway Management During Anesthetic Induction of Secondary Laryngectomy for Recurrent Laryngeal Cancer: Three Cases of Report and Analysis. Front Med (Lausanne) 2018;5:264.
[19] Uzawa K, Tokumine J, Lefor AK, et al. Difficult Airway Due to an Undiagnosed Subglottic Tumor: A Case Report. Medicine (Baltimore) 2016;95(15):e3383.
[20] Constable N, Thomas C, Jones M, et al. Acute presentation of a partially obstructing laryngeal tumour: adjuvant agents to gaseous induction of anaesthesia. BMJ Case Rep 2018;2018:bcr2018224700.
[21] Warnakulasuriya S, Nixon I, McNarry A. Repeated videolaryngoscopic awake tracheal intubation in a patient with laryngeal tumour. Trends Anaesth Crit Care 2020;30:e102.
[22] Bailey JR, Lee C, Nouraei R, et al. Laryngectomy with a Tritube(®) and flow-controlled ventilation. Anaesth Rep 2021;9(1):86-89.
[23] Hulme GJ, Blues CM. Acromegaly and papillomatosis: difficult intubation and use of the airway exchange catheter. Anaesthesia 1999;54(8):787-789.
[24] Kale V, Mir F, O'Flynn P, et al. Airway management of obstructing chondrosarcoma of the larynx. Anaesthesia 2014;69:16.
[25] Nakahira J, Sawai T, Matsunami S, et al. Worst-case scenario intubation of laryngeal granuloma: a case report. BMC Res Notes 2014;7:74.
[26] Tsay PJ, Yang CP, Luk HN, et al. Video-Assisted Intubating Stylet Technique for Difficult Intubation: A Case Series Report. Healthcare (Basel) 2022;10(4):741.
[27] Hewage S, Jayathileke S, Arambepola A, et al. Anaesthetic dilemma: airway management of a patient with a large pedunculated vocal cord tumour. Trends Anaesth Crit Care 2020;30:e7.
[28] Heidegger T. Management of the Difficult Airway. N Engl J Med 2021;384(19):1836-1847.
[29] Apfelbaum JL, Hagberg CA, Connis RT, et al. 2022 American Society of Anesthesiologists Practice Guidelines for Management of the Difficult Airway. Anesthesiology 2022;136(1):31-81.
[30] Ahmad I, El-Boghdadly K, Bhagrath R, et al. Difficult Airway Society guidelines for awake tracheal intubation (ATI) in adults. Anaesthesia 2020;75(4):509-528.
[31] Sperry SM, Rassekh CH, Laccourreye O, et al. Supracricoid partial laryngectomy for primary and recurrent laryngeal cancer. JAMA Otolaryngol Head Neck Surg 2013;139(11):1226-1235.
[32] Demizu Y, Fujii O, Nagano F, et al. Unexpected radiation laryngeal necrosis after carbon ion therapy using conventional dose fractionation for laryngeal cancer. Jpn J Clin Oncol 2015;45(11):1076-1081.
[33] Iseli TA, Iseli CE, Golden JB, et al. Outcomes of intubation in difficult airways due to head and neck pathology. Ear Nose Throat J 2012;91(3):E1-E5.
[34] Mercante G, Grammatica A, Battaglia P, et al. Supracricoid partial laryngectomy in the management of t3 laryngeal cancer. Otolaryngol Head Neck Surg 2013;149(5):714-720.
[35] Ovassapian A, Randel GI. The role of the fiberscope in the critically ill patient. Crit Care Clin 1995;11(1):29-51.
[36] Williams A, Patel A, Ferguson C. High frequency jet ventilation through the laryngeal mask airway in a critically obstructed airway. Anaesthesia 2008;63(12):1369-1371.
[37] Vinayagam S, Dhanger S, Tilak P, et al. C-MAC(®) video laryngoscope with D-BLADE™ and Frova introducer for awake intubation in a patient with parapharyngeal mass. Saudi J Anaesth 2016;10(4):471-473.
[38] Sharma R. A new maneuver for endotracheal tube insertion during difficult GlideScope® intubation: a suggestion. J Emerg Med 2011;40(4):443; author reply 444-445.
[39] Budde AO, Pott LM. Endotracheal tube as a guide for an Eschmann gum elastic bougie to aid tracheal intubation using the McGrath or

GlideScope videolaryngoscopes. J Clin Anesth 2008;20(7):560.

[40] Hodzovic I, Wilkes AR, Stacey M, et al. Evaluation of clinical effectiveness of the Frova single-use tracheal tube introducer. Anaesthesia 2008;63(2):189-194.

[41] Khan MU. Endotracheal intubation in patients with unstable cervical spine using LMA-Fastrach and gum elastic bogie. J Coll Physicians Surg Pak 2014;24(1):4-7.

[42] Rogers SN, Benumof JL. New and easy techniques for fiberoptic endoscopy-aided tracheal intubation. Anesthesiology 1983;59(6):569-572.

[43] Lenhardt R, Burkhart MT, Brock GN, et al. Is video laryngoscope-assisted flexible tracheoscope intubation feasible for patients with predicted difficult airway? A prospective, randomized clinical trial. Anesth Analg 2014;118(6):1259-1265.

[44] Practice guidelines for management of the difficult airway. A report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Anesthesiology 1993;78(3):597-602.

[45] American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Practice guidelines for management of the difficult airway: an updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Anesthesiology 2003;98(5):1269-1277.

[46] Frerk C, Mitchell VS, McNarry AF, et al. Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults. Br J Anaesth 2015;115(6):827-848.

[47] Segal R. A response to 'Difficult Airway Society guidelines for management of the unanticipated difficult intubation', Henderson JJ, Popat MT, Latto IP and Pearce AC, Anaesthesia 2004; 59: 675-94. Anaesthesia 2004;59(11):1150-1151.

[48] Law JA, Broemling N, Cooper RM, et al. The difficult airway with recommendations for management--part 1--difficult tracheal intubation encountered in an unconscious/induced patient. Can J Anaesth 2013;60(11):1089-1118.

[49] Law JA, Broemling N, Cooper RM, et al. The difficult airway with recommendations for management--part 2--the anticipated difficult airway. Can J Anaesth 2013;60(11):1119-1138.

[50] Malpas G, Hung O, Gilchrist A, et al. The use of extracorporeal membrane oxygenation in the anticipated difficult airway: a case report and systematic review. Can J Anaesth 2018;65(6):685-697.

[51] Ångerman S, Kirves H, Nurmi J. A before-and-after observational study of a protocol for use of the C-MAC videolaryngoscope with a Frova introducer in pre-hospital rapid sequence intubation. Anaesthesia 2018;73(3):348-355.

[52] Sparrow R, Oliver MA. Are bougies gaining favour in videolaryngoscopy? Anaesthesia 2018;73(8):1032-1033.