

## Case Report

# Managing difficult airway in patients with post-burn mentosternal and circumoral scar contractures

Tae-Hyung Han<sup>1</sup>, Hana Teissler<sup>1</sup>, Richard J Han<sup>2</sup>, Joshua D Gaines<sup>3</sup>, Tho Qynh Nguyen<sup>3</sup>

<sup>1</sup>Department of Anesthesiology, Paul L Foster School of Medicine, Texas Tech University Health Science Center, El Paso, Texas, USA; <sup>2</sup>Department of International Health Science, Yonsei University Graduate School of Public Health, Seoul, Korea; <sup>3</sup>Paul L Foster School of Medicine, Texas Tech University Health Science Center, El Paso, Texas, USA

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**Abstract:** Securing the airway is a crucial aspect during reconstructive surgeries of patients with extensive post-burn mentosternal scar contractures; however, the American Society of Anesthesiologists Difficult Airway Management Algorithm recommendation of initial direct laryngoscopy may not be appropriate for these complicated patients. Consequently, there is a significant risk for failure of intubation and airway emergency. We suggest that initial attempts at securing the airway be made with indirect laryngoscopy. Many airway techniques have been effectively used in burn patients, but the role of awake blind or fiberoptic bronchoscopy, although well established in the non-burn population, has yet to be evaluated in burn patients. We report a case series of successful management of difficult airways with fiberoptic bronchoscopy in patients with varying degrees of post-burn head and neck scar contractures.

**Keywords:** Burn airway, neck contracture, fiberoptic bronchoscopy, laryngeal mask airway

## Introduction

Secure airway management is crucial in reconstructive surgeries involving patients with major burns. In these patients, anatomical variation may be profound and difficult intubation should be expected. As mortality and morbidity are directly related to the ability to deliver oxygen to the patient, the airway must be managed with particular care in these patients. We may classify airway issues in burns into two distinctive recovery stages: acute burn injury and chronic post-burn scar reconstruction. Each stage involves different airway issues, carries different risks, and requires different evaluation methods and approach strategies. *Vis a vis* the acute burn injury phase, particular attention must be paid to extra- as well as intra-oral soft tissue changes. For post-burn scar reconstruction, the focus should be on extra-oral scar contracture.

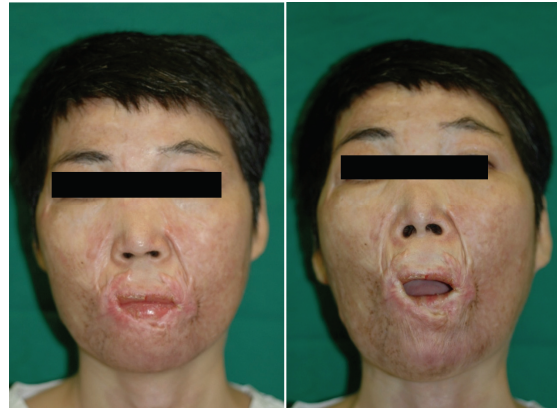
Post-burn scar contractures of the head and neck region can lead to failed intubation and airway emergency. Because many patients disguise their disfigurement and the presence of subcutaneous contractures may not be obvi-

ously apparent under the mature scar, prediction of difficult airway in burn patients is not always straight forward [1]. Both of these factors contribute to anatomic variation that is not readily appreciated even during preoperative evaluation. In burn patients, functional anomalies can be easily missed when providers fail to address the dynamics of post-burn pathological changes in the neck region. Furthermore, the use of muscle relaxants can aggravate scar retraction due to the elasticity of scar tissue and the loss of pulling action by the surrounding tissues.

Historically, the intubating laryngeal mask airway, lightwand, esophageal tracheal Combitube™, and retrograde wire technique, have all been used successfully in intubating burn patients [2, 3]. Additionally, surgical release of the circumoral and mentosternal contractures, while maintaining spontaneous ventilation under general anesthesia has been described [4]. However, the use of awake blind or fiberoptic assisted bronchoscopy, although well recognized as an airway management technique, is yet to establish its role in the burn patient popu-



**Figure 1.** Perinasal burn scar contractures. The size of nasal orifices should be carefully inspected during the preop airway evaluation as it may serve as potential backup airway access. Use of smaller than regular sized endotracheal tube, gel, and stylet allows successful passage through the nasal orifice.



**Figure 2.** Circumoral burn scar contractures. The distances of inter-incisional gap and mouth opening are limited. As long as one can pass the spoon through the mouth, the laryngoscope blade, and therefore, endotracheal tube can be entered into the oral cavity. Oftentimes, however, patients require elective surgical reconstruction due to inability to pass the spoon through the mouth opening.

lation [5]. We report a case series of five patients with extensive post-burn head and neck scar contractures in whom the fiberoptic bronchoscopy successfully managed difficult airway during anesthesia induction.

#### Case series

From January to November 2005, we enrolled five otherwise healthy, ranging in age from 27 to 55, patients with full thickness post-burn scar contractures in the head and neck region (**Table 1**). These patients were previously scheduled for elective scar release and reconstruction of circumoral (**Figure 1, 2**) and mentosternal contractures (**Figure 3-5**). Data were prospectively collected in a consecutive manner.

The following conventional criteria for difficult intubation were applied to screen the patients: Mallampati class greater than 3, mentosternal distance less than 12.5 cm, and inter-incisor gap less than 4 cm. Based on the location of the scarring and the proposed surgery, either oral or nasal route was selected for the approach. Midazolam, fentanyl, and/or incremental propofol were administered intravenously for sedation. Upper airway was anesthetized with orally instilled 1% lidocaine gel or with nebulized lidocaine aerosol. Flexible fiberoptic bronchoscopy was successful in all patients and



**Figure 3.** Mentosternal scar contracture characterized by receding jaw and mandible severely limits cervical range of motion and hyperextension. Aggravated contractures after muscle relaxation can make exposure of the vocal cords difficult.

none required preoperative surgical scar release.

#### Discussion

Airway management for patients with post-burn scar contractures of the face and neck region faces a unique challenge. The larynx and mandi-

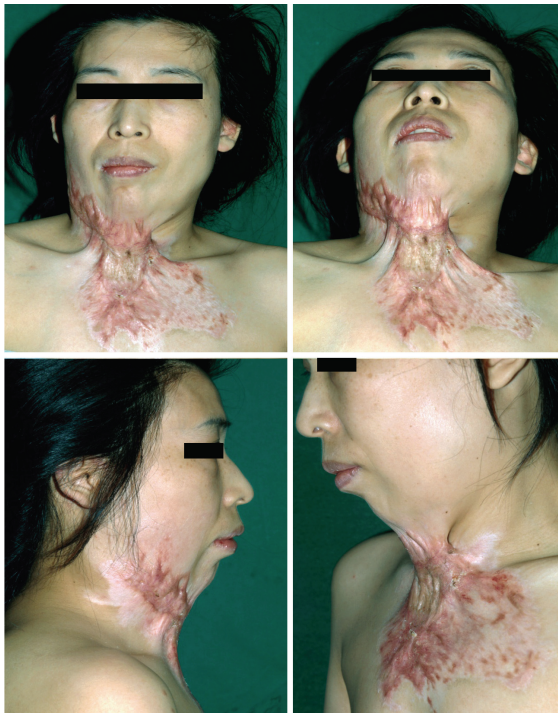
## Airway in post-burn scar contracture

**Table 1.** Patient Characteristics, Burn Injury and Airway Evaluation Data

	Age (years)	Gender	Height (cm)	Weight (kg)	ASA	TBSA (%)	Days after the injury (months)	Mallampati classification	Inter-incisional distance (cm)	Mentosternal distance (cm)	Intubation route
1	36	M	167	65	2	25	36	4	3	7	Nasal
2	27	M	172	68	1	15	24	4	2	9	Nasal
3	55	F	154	55	2	30	28	4	3	8	Oral
4	43	F	158	62	2	27	30	4	4	10	Oral
5	32	M	172	72	1	18	18	4	3	6	Oral
Median	36		167	65		25	28		3	8	
(min-max)	(27-55)		(154-172)	(55-72)		(15-30)	(18-36)		(2-4)	(6-10)	

M, male; F, female; ASA, American Society of Anesthesiologists physical status classification; TBSA, total body surface area burn.

## Airway in post-burn scar contracture



**Figure 4.** Difficult intubation is frequently encountered in patients with oro-maxillo-facial skeletal deformities following burns to the upper torso and face. Concomitant micrognathia requires more upward and forward advancement of the laryngoscope to expose the epiglottis and lift up the surrounding tissues.

ble may be distorted by underlying dense fibrous and hypertrophic sheets of scar. Cervical range of motion may be limited in all directions and the sniffing position may be unobtainable due to severe mentosternal contracture. The mandible may be displaced posteriorly with accompanying restrictions in mobility. Facial burns during early childhood can cause underdevelopment of the jaw (micrognathia), leading to further distortion of the upper airway [1]. Finally, a history of inhalational injury may suggest tracheal stenosis which could hamper advance of endotracheal tube. For these reasons, attempts at direct laryngoscopy may be unsuccessful. In the burn patient with head and neck contractures, following the American Society of Anesthesiologists Difficult (ASA) Airway Management Algorithm may, in fact, hinder the timely securing of the airway. The ASA Difficult Airway Algorithm recommends that alternative means of securing an airway be tried only after standard attempts at direct laryngoscopy have failed [6]. While appropriate in most cases of suspected difficult airway, the exceptional nature of the airway in patients with face and neck contracture dictates that alternative means may have to be pursued as the first option. Given this condition, it would be prudent to recommend that all post-burn patients with face and neck contractures be considered for initial intubation via indirect methods of laryngoscopy.



**Figure 5.** Limited cervical extension due to extensive burn scar contracture in anterior thorax.



The airway should be evaluated in sitting position, not supine or semi-Fowler's. In addition to the routine assessment, the anesthesiologist should carefully examine the scar and contracture, paying special attention to the perinasal and circumoral regions and the size of the nasal and oral orifices. Mentosternal contractures may limit the mouth opening and cervical range of motion. Oro-maxillo-facial burn scars may accompany skeletal deformities resulting in a small receding jaw. The directions and formations of scar patterns may determine the intubation route of choice. Finally, the epiglottis and vocal cords may be anteriorly placed and pulled toward the side of the scar. If a laryngoscope is used, it should be advanced ipsilaterally towards the direction of the scar.

If muscle relaxants are given, the elasticity of scar tissue and loss of pulling action by the surrounding tissues will further aggravate scar retraction, making preop airway evaluation obsolete. Limited mouth opening may become so aggravated that neither oral airway nor laryngoscope blade can be passed through the mouth. The nasal orifices, as a potential alternative access, may also close down, leading to the inability to advance a nasal airway.

Each intubation technique has potential benefits and drawbacks. For example, the laryngeal mask airway has proven to be an excellent airway adjunct for the burn patient [7]. It may not, however, firmly situate in the larynx due to external anatomical abnormalities and frequent intra-operative position changes and topical medication to burn sites may make it vulnerable to displacement. Blind nasal intubation may also be tried; however, it relies on the tongue being fixed anteriorly by the contracture. This carries its own limitations such as restricted head and neck positioning and the possibility of nasal bleeding which can completely obscure any further instrumentation. The lightwand has the advantage of placement with little cervical motion; however, thick scar tissue may obscure light and limit tracheal visibility causing inadvertent esophageal intubation. Bronchoscopy may prove difficult if the airway anatomy is too distorted due to soft tissue retraction. Furthermore, with repeated attempts, bleeding and secretion into the oropharynx may result. Fiberoptic intubation may be the least traumatic and most efficient alternative to direct laryngoscopy in patients with post-burn scar contractures of

the neck [8, 9]. Real-time maneuvering around anatomic distortion is easily performed and the procedure can be done in a spontaneously breathing patient. Video assisted laryngoscope can also be a good alternative for airway management in post-burn head and neck scar contracture. Compared to fiberoptic scope, it has a similar degree of cervical spine motion and mouth opening as well as requiring minimal preparation [10, 11].

Vigilance and preparedness is the key to success. In the post-burn patient, judicious preoperative airway and scar evaluation is mandatory. Spontaneous ventilation may have to be maintained at all times and muscle relaxants avoided. The anesthesiologist should have multi-layered contingency plan to handle the airway. As attempts at direct laryngoscopy are extremely likely to fail in these patients, indirect attempts should be tried first. In patients with extreme deformity, the underlying functional and anatomical alteration may be such that all intubation attempts fail. A surgeon should stand by and be ready to intervene for possible surgical release or emergent tracheotomy placement. It is the ventilation that saves the life, not the intubation.

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**Address correspondence to:** Dr. Tae-Hyung Han, Department of Anesthesiology, Paul L Foster School of Medicine, Texas Tech University Health Science Center, 4800 Alberta Avenue, El Paso, Texas USA, 79905. Tel: 1-915-545-6560; Fax: 1-915-545-6984; E-mail: AnthonyHan3@gmail.com

### References

- [1] Nahlieli O, Kelly JP, Baruchin AM, Ben-Meir P, Shapira Y. Oro-maxillofacial skeletal deformities

## Airway in post-burn scar contracture

- resulting from burn scar contractures of the face and neck. *Burns* 1995; 21: 65-69.
- [2] Hagberg C, Johnson S, Pillai D. Effective use of the esophageal tracheal Combitube™ following severe burn injury. *J Clin Anesth* 2003; 15: 463-466.
- [3] Kumar R, Prashast, Wadhwa A, Akhtar S. The upside down intubating laryngeal mask airway: A technique for cases of fixed flexed neck deformity. *Anesth Analg* 2002; 95: 1454-1458.
- [4] Kreulen M, Mackie DP, Kreis RW, Groenevelt F. Surgical release for intubation purposes in post-burn contractures of the neck. *Burns* 1996; 22: 310-312.
- [5] 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: 1269-1277.
- [6] Larson SM, Parks DH. Managing the difficult airway in patients with burns of the head and neck. *J Burn Care Rehabil* 1988; 9: 55-56.
- [7] McCall JE, Fischer CG, Schomaker E, Young JM. Laryngeal mask airway use in children with acute burns: Intraoperative airway management. *Paediatr Anesth* 1999; 9: 515-520.
- [8] Tsui BCH, Cunningham K. Fiberoptic endotracheal intubation after topicalization with in-circuit nebulized lidocaine in a child with a difficult airway. *Anesth Analg* 2004; 98: 1286-1288.
- [9] Xue FS, Liao X, Li CW, Xu YC, Yang QY, Liu Y, Liu JH, Luo MP, Zhang YM. Clinical experience of airway management and tracheal intubation under general anesthesia in patients with scar contracture of the neck. *Chin Med J (Engl)* 2008; 121: 989-997.
- [10] Turkstra TP, Craen RA, Pelz DM, Gelb AW. Cervical spine motion: a fluoroscopic comparison during intubation with Lighted Stylet, GlideScope, and Macintoshlaryngoscope. *Anesth Analg* 2005; 101: 910-915.
- [11] Brimacombe J, Keller C, Künzel KH, Gaber O, Boehler M, Pühringer F. Cervical spine motion during airway management: A cinefluoroscopic study of the posteriorly displaced third cervical vertebrae in human cadavers. *Anesth Analg* 2000; 91: 1274-1278.