Compliant Submandibular Space as a Predictor for Difficult Airway in Airway Assessment

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Abstract
Safety during anaesthesia practice includes the prediction of difficult airway and appropriate airway management so that anesthetic mishaps can be avoided. In this article a structured overview of airway assessment and the importance of evaluating the submandibular space compliance as predictor of difficult airway in post radiotherapy patients is discussed.

Key words: *Submandibular space, Radiotherapy, Airway assessment*

Introduction
One among the many causes of the difficult airway is the head and neck tumours and related pathology. Other associated issues include multiple surgeries and radiotherapy to the head and neck area. These can lead to impaired lymphatic drainage, necrosis and fibrosis of the airway and submandibular region.
There are several airway assessment techniques that are used by anesthesiologists to predict difficult airway and there are flaws associated with them each of them. One among these is the compliance of the submandibular space[1].

Anatomy
Submandibular space is a potential space between two temporomandibular joints, and bounded by lower incisors anteriorly and hyoid bone and deep cervical fascia below. The space is subdivided by mylohyoid muscle[2].
The contents of the space include main portion of the submandibular gland submandibular nodes, facial artery and vein, fat and inferior loop of hypoglossal nerve[3].

Pathophysiology
There is different etiology for swelling and edema of the submandibular area which can make it non-compliant. These include lymphadenitis which can be neoplastic, vascular or inflammatory. Inflammation includes infections of the teeth, upper respiratory tract, sinuses and tonsils or diseases like infections mononucleosis and cut scratch disease Ludwig's angina, angioneurotic edema of the tongue, burns to the skin of the neck, radiotherapy to the head and neck

area, and tumours of the neck region can be other causes. Swelling of the parotid tail, ranula also can lead to non-compliant submandibular space[4].

Carcinoma of the head and neck region can cause edema, fibrosis and even be necrosis of the area due to radiotherapy depending on the dosage and duration of radiation. The changes may occur in all areas in the field of exposure, and the challenge for the anesthesiologist remains in every step of securing the airway.

Other effects of radiation include necrosis and mucositis of oral mucosa, fibrosis and trismus of TM joint leading to reduced mouth opening, orocutaneous fistulas with purulent discharge, epiglottic and glottic edema causing difficult laryngoscopy. Osteoradionecrosis and pathological fracture of mandible can lead to reduced mandibular space. Osteoradionecrosis can have occurred to the extent that the mandible can be virtually absent[5].

The physiological changes that occur during airway manipulation was explained by the following study. According to Greenland, there is a static and dynamic phase for laryngoscopy. The static phase includes the way we position the head and neck, which will be usually a sniffing position. The dynamic phase includes a posterior complex which provides atlanto–occipital mobility and an anterior complex which includes the submandibular space and laryngeal skeleton.

This submandibular space further involves submandibular space volume, compliance of submandibular space and range of movement of TM joint and stylohyoid.

During the dynamic phase of laryngoscopy, the mandible and submandibular space is anteriorly displaced and also compressed and shifted laterally. This maneuver becomes difficult if there are abnormalities near the mandible and submandibular space[6].

Discussion

Edema and noncompliance of the submandibular region can have varied effects. At the time of airway assessment, the submandibular area looks normal with adequate thyromental distance but can be non-compliant and stiff on palpation.

Even holding a mask becomes extremely difficult as we may not be able to get a proper grip of the mandible. Also during laryngoscopy, it becomes tedious to push the tongue against the mandible to get a proper view of the larynx. As a result, the laryngoscopic view of the vocal cords becomes difficult[1].

Usually, we use thyromental distance to measure this space. A thyromental distance less than 6.5 cm is considered to be a difficult airway. But this one measurement will not give adequate clues regarding DA when we consider the dynamic phase of laryngoscopy[7].
If the total volume of the space is ignored it can lead to an unidentified difficult airway. So assessment of the volume of this space requires the measurement of the following parameters,

the mandibular length, the distance between the temporomandibular joints and the mandibulohyoid distance[6].

If this compliance is low, it will be difficult to push mandibular tissue during intubation. If the mandibulohyoid distance is long, then even then, the hypoglossal tongue can cause difficult laryngoscopy.

Subsequently, under neuromuscular blockade the hypopharyngeal tongue becomes flaccid and epiglottis can fall against the posterior pharyngeal wall resulting in difficult ventilation. This phenomenon can also lead to a reduction in submandibular space and difficult intubation.

These findings were further proved by a study conducted on three thousand patients. Difficult airway was predicted by examining the submandibular space. In this study, the space was examined in a supine position and head in a neutral position with breath held in expiration. It was found that there was a strong association between non-compliant submandibular space and non-palpable hyoid bone. This was compared with the ease of intubation[6].

The term 'submental sign' was given to bulky non–compliant submandibular space. A positive submental sign was associated with hyomental distance less than 2 FB and signifies an anteriorly placed larynx. In this study of all patients with positive SMS, intubation was found difficult or impossible.

Submental sign is an easy and practical sign to predict difficult tracheal intubation and the evaluation of submandibular space by routine examination of the submental space is suggested as a lifesaving examination procedure.

Thus, this study proves how important is submandibular space compliance in the assessment of difficult airway[8].

Airway assessment

The various other assessment methods include techniques to assess difficult mask ventilation, difficult laryngoscopy and intubation and difficult supra glottis airway placement.

Among history taking some of the relevant points to include are history of head and neck surgery like laryngeal surgery, facial reconstruction, tracheostomy, history of radiotherapy to head and neck and history of previous intubations

Obstructive sleep apnea has been identified as an independent risk factor for difficult bag-mask ventilation and intubation. The predictors for DMW can be explained under the mnemonic 'BONES' which include beard, obesity, no teeth, elderly, snorer[9]. For intubation we usually consider mouth opening, mallampati classification, thyromental distance, neck mobility, upper lip bite test etc. and some group indices are also taken into account[10].

But none of these accepted predictors can be claimed reliable and foolproof. Also none of these predictors takes into consideration compliance of the submandibular space.

Assessment of submandibular space

Some other methods that are used to assess the space include.
A Combined Assessment of the Mandibular Space: This method is called as 3-3-2 rule where the airway is supposed to be adequate if inter–incisor space can accommodate 3 fingers thyromental distance is three fingers and 2 fingers between the hyoid bone and superior thyroid notch.

This combined assessment along with the warning sign of Delilkan will give us idea about the laryngopharyngeal axis during head extension[11].

The Warning Sign of Delilkan: It is performed by placing the index finger of each hand, one over the submandibular area and the other under the inferior occipital prominence with the head in the neutral position. The patient is then asked to extend their head and neck fully. If the submental finger is seen to be higher than the inferior occipital prominence finger, there should be no difficulty with intubation. If the finger on the inferior occipital prominence is still higher than the submental finger, the clinician can anticipate a difficult airway[12].
All these techniques fail to assess compliance of the space.

Airway Management

Preparation of the operation theatre is key in managing any difficult airway case. The various methods that can be applied in case of the difficult airway include direct laryngoscopy and tracheal intubation with choice for change in tube size and blade.

Video laryngoscopy provides anesthesiologists with the luxury of visualizing vocal cords through a camera and intubating without much extension of the cervical spine.
For fiberoptic bronchoscopy adequate airway preparation is required. Light wand is another safe and effective option for tackling difficult airway and visualization is not affected by blood in the airway due to tumor.

Retrograde intubation, Blind nasal intubation, bougie assisted intubation, Intubating LMA, C Trach aided intubation are other options. Bullard, Upsherscope or Wu scope aided intubation can also be considered.[13]

Summary

Proper airway assessment can be lifesaving in difficult airway situations. There is no guarantee for any method to be hundred percent successful, but submandibular compliance can be a valuable tool in diagnosing subtle airway changes to avoid catastrophic consequences in anesthesia.

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