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ORIGINAL RESEARCH

To determine, using ultrasound, where the tongue is located during the process of inducing anaesthesia

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Abstract
Aim: To determine, using ultrasound, where the tongue is located during the process of inducing anaesthesia.
Material and methods: Comparing the movement of the tongue within the same participant while anaesthesia was being induced was the focus of this observer-blind investigation. Consent to receive general anaesthesia for minor gynaecological procedures was given by 50 female patients with ASA physical status I or II who were going to undergo general anaesthesia for the procedures. As a premedication, temazepam at the dose of 20 mg was taken orally by each patient. A single cushion was used to support the patient's head while she rested on the trolley prior to the induction of anaesthesia.
Results: In 20 (40%) of the patients, it was not possible to determine whether the apnea was due to a central cause or an obstruction in the airway, whereas sufficient data were obtained in 50 cases (table 1). The ultrasound pictures of the other patients did not demonstrate an appropriate degree of sectoring of the tongue. Because of the acoustic shadow that was formed by the hyoid bone, it was often more difficult to image the back portion of the tongue than the front portion. 37 of the 50 patients whose data are given had an angle of sector analysis that was more than 56 degrees (the mean angle of sector analysis for all 50 patients was $59^0 \pm 2^0$). Among patients who were awake, there was no movement of the tongue in connection to the breathing process. The patient was seen to have only very little movement when the anaesthesia was being administered. The most significant shift, which was 9 millimetres caudad, took place at the front of the tongue.
Conclusion: The observed motions did not provide any evidence to support the hypothesis that the tongue is a significant factor in the blockage of the airway during the induction of anaesthesia.
Keywords: Airway, obstruction, tongue, Measurement techniques, ultrasound

Introduction

In general anaesthesia, keeping a patient's airway open may be a regular challenge, and in certain cases it can be rather challenging. It is common practise to ascribe airway blockage to the tongue 'falling back', which results in occlusion of the oropharynx [1.] Nevertheless, investigations in men and animals reveal that obstruction may be induced by other methods, such as collapse of the pharynx or by the epiglottis [2, 3]. In the current investigation, real-time ultrasound scanning was used to evaluate the movement of the tongue during the induction of anaesthesia. This was done so that researchers could determine how likely it was that tongue displacement would result in blockage.

Material and methods

Comparing the movement of the tongue within the same participant while anaesthesia was being induced was the focus of this observer-blind investigation. Consent to receive general anaesthesia for minor gynaecological procedures was given by 50 female patients with ASA physical status I or II who were going to undergo general anaesthesia for the procedures. As a premedication, temazepam at the dose of 20 mg was taken orally by each patient. A single cushion was used to support the patient's head while she rested on the trolley prior to the induction of anaesthesia. Her head was in a normal posture and was not stretched. A cannula for intravenous access was put in place. A mechanical sectorscanning transducer operating at 3.5 MHz was used in order to acquire a continuous ultrasound picture in real-time of the tongue's surface (Siemens Sonoline SX). The transducer was positioned below the chin in order to get a decent sagittal picture of the tongue. This was accomplished without making any adjustments to the position of the head or lengthening the length of the neck. Over the course of the investigation, no further adjustments to the location of the probe were done since it had

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already been secured in place using a universal clamp that had been attached to the trolley. In order to achieve anaesthesia, an intravenous infusion of thiopentone or propofol was administered slowly over the course of roughly 30 seconds until the lash reflex was lost. The ultrasound picture of the patient's tongue was captured in real time and recorded on camera beginning before the injection and continuing for at least one minute after the patient lost consciousness. If it was feasible to do so, clinical symptoms of airway blockage as well as the presence of apnea in the absence of any ventilatory effort were documented.

The following interpretation of the photos was used in order to evaluate the movement of the tongue without introducing any observer bias. One of the observers saw the whole event as it was played back on the video tape recording. The researchers chose individual shots that provided a clear representation of the tongue in its entirety. We chose two frames from each patient's medical history before the induction, and we chose two frames from their medical history after the induction. If there was tongue movement that occurred at the same time as breathing, the frames were chosen near the end of the exhalation because they were easier to see. Photos were taken of each of these frames, and a random code number was assigned to each pair of images that represented a specific patient in a particular condition. The images were shown to a second person, who then traced a single average shape of the tongue using each pair of frames to depict the tongue's top and posterior surface as an arc. Direct comparison of the tracings of the pictures recorded before and after induction was used to determine the amount of tongue movement. This was possible due to the fact that the tracings for each condition had varied lengths of the arc. The observer who conducted this comparison did not take into account the current condition of the patient in any of the tracings. Marking the common sector along which the tongue surface could be detected clearly in both tracings, measurements were taken along the radius of the sector to its anterior, middle, and posterior locations, with the accuracy of the measurements rounded to the closest 0.5 mm. After then, the code was cracked, and measures were connected to the status of the patient. After taking into account the scale parameters of the imaging equipment, the amount of tongue movement was determined by subtracting the radius measurements taken at each position from one another. The binomial distribution was used in the statistical analysis of the data [4]. When there was a decrease in the radius, this was known as a caudal movement, and when there was an increase in the radius, this was known as a cranial movement. Having said that, they are radial measures that also include a vector in the anterior-posterior dimension. "Caudal" movements of the anterior segment of the tongue include a component from the posterior segment, and "caudal" movements of the posterior segment of the tongue include a component from the anterior segment. This is because the centre of the field of view of the transducer was generally close to the cranio-caudal axis of the head.

Results

In 20 (40%) of the patients, it was not possible to determine whether the apnea was due to a central cause or an obstruction in the airway, whereas sufficient data were obtained in 50 cases (table 1). The ultrasound pictures of the other patients did not demonstrate an appropriate degree of sectoring of the tongue. Because of the acoustic shadow that was formed by the hyoid bone, it was often more difficult to image the back portion of the tongue than the front portion. 37 of the 50 patients whose data are given had an angle of sector analysis that was more than 56 degrees (the mean angle of sector analysis for all 50 patients was $59^0 \pm 2^0$). Among patients who were awake, there was no movement of the tongue in connection to the breathing process. The patient was seen to have only very little movement when the anaesthesia was being administered. The most significant shift, which was 9 millimetres caudad, took place at the front of the tongue.

Table 1: Basic parameter

Basic parameter	
Age	39.85±6.37
Height	157.85±3.25
Weight (kg)	59.89±4.19
Agent	
Thiopentone	28(56%)
Propofol	22(44%)
Airway patency	
Obstructed	13(26%)
Patent	13(26%)
Apnoea	4(8%)
Uncertain	20(40%)
Sector studied (degrees)	$59^0 \pm 2^0$

There was not a predetermined path that the movement followed. The confidence interval for the chance of any movement of more than 9 mm is between 0 and 30%, based on a binomial distribution (95% confidence limits). During the induction of anaesthesia, there was no consistent movement of the tongue in any of the patients in whom clinical symptoms of airway blockage were found. Yet, in other individuals, airway blockage was coupled with a caudad migration of the posterior tongue towards the hypopharynx with each attempt to inspire air. This movement occurred every time the patient breathed in. There was no discernible difference in the alterations that were seen that could be credited to either of the two induction agents that were used (table 2).

Table 2: Mean of tongue movements in patients given thiopentone (n = 28) and propofol (n = 22)

	Anterior	Middle	Posterior
Thiopentone	0	-0.44	-0.89
Propofol	2.33	0.44	0.31

Discussion

Tongue position during anaesthesia has been investigated previously using radiography [1]. We have used ultrasound to image the tongue, principally to avoid the use of ionising radiation. In addition, ultrasonography may be utilised to produce a continuous, real-time picture of the tongue across the duration of induction. The ultrasonic transducer was fastened below the chin to establish mild contact with the skin, so that the patient's head remained in a natural, relaxed posture. However, it is possible that the transducer may have restrained jaw position to some extent, as muscle tone changed with loss of consciousness. Ultrasound scanning produces a sagittal, crosssectional image without the problem of overlapping structures produced on a lateral radiograph. The magnification and geometric distortion associated with conventional radiography are also avoided. There are, however, disadvantages in the use of ultrasound: ultrasound is reflected almost completely at an air tissue interface, and so the position of the soft palate, epiglottis and posterior wall of the pharynx cannot be determined, and thus the dimensions of the airway itself cannot be judged. A thick acoustic shadow is formed by the hyoid bone, which in certain cases inhibits imaging of the posterior tongue. Ultrasonic scanning of the tongue has been used in a similar fashion to examine tongue movement during speaking [5] and swallowing [6]. The tongue picture acquired was frequently in the shape indicated in figure 1, with a curvature convex in the cranial direction. The portion of the tongue viewed was in the midline sagittal plane, however the direction of sight of the transducer was adjusted in this plane to acquire the best picture. No effort was made to quantify the precise orientation of this direction, but normally it stayed about parallel with the craniocaudal axis of the head. Thus, measurements were performed of motions of the tongue surface towards or away from the transducer, and they do not suggest a perfect link to body \saxes. For example, it is obvious that a caudad movement in the posterior tongue likewise reflects a movement anteriorly. The precise distribution of these vectors is not an option at this time. In addition, the measurement was only taken at the point where the surface of the tongue intersected with the radius that was selected; in the case that the position of the tongue was altered, this junction may no longer represent the same location on the surface of the tongue. Attempts to portray tongue movement in specific anatomical directions were not thought to be practicable for these reasons. Just the midline sagittal region of the tongue was shown in the photograph that was taken into consideration. A little decrease in the degree to which the tongue is bent in the coronal plane might result in an apparent movement of the image in the caudal direction, even though there would be no actual movement of the mass of the whole tongue.

It's possible that the pressure from the transducer caused the tongue to become misshapen and restricted its range of motion. Nevertheless, the impact of the transducer pressure on the form of the tongue could be readily evaluated by watching the movement of the tongue as the transducer system was modified. Caution was taken to reduce the impact of this factor. The highest movement of the tongue that was observed while the patient was being inducted was 9 millimetres caudad in the front region of the tongue in three different patients. The posterior tongue moved a maximum of 7 mm in each direction. When compared, these findings correspond to maximal movements of around 16-22 mm during swallowing that were detected using radiography [7] or ultrasonography. In general, the findings did not point in any particular direction consistent with mobility. While there was a clear clinical indication of airway blockage in two individuals, a caudad shift of the posterior tongue was seen with each attempt at inspiratory breathing. This finding would not be predicted if the blockage of the airway were caused by posterior migration of the tongue; instead, it is consistent with inspiratory effort being made against an airway that is obstructed caudal to the tongue. Current research [3] using fiberoptic endoscopy has led researchers to believe that this is a rather regular occurrence. Some people experience blockage of the airway at the soft palate, while others experience it in the hypopharynx. This may happen in normal subjects when they are sleeping naturally as well as in patients who have sleep apnea syndrome [8, 9]. Under anaesthesia, it is probable that the location of blockage will vary in a manner that is comparable from person to person. While our patients were awake, we did not detect any movement of the tongue in connection to the respiratory process. There have been some investigations on the electrophysiology of the tongue that have indicated phasic activity [10, 11], whereas in other studies the action in the genioglossus was mostly tonic [12, 13]. Moreover, the use of premedicant or sedative medicines has the potential to lessen the activity of the tongue's muscles [14]. However, it is possible that even if phasic muscle activity were present, this could only

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act to maintain the position of the tongue against the changing pressure within the mouth. This is something that needs to be investigated further.

It is most likely that obstruction of the pharynx will be caused by movement of the tongue in the posterior portion of its own anatomy. An increase in the distance measured along a radius from the centre of the image sector would be caused by posterior movement of the posterior tongue in our study. This increase in distance would be expressed in our results as cranially directed movement, despite the fact that the direction has both cranial and posterior components. Only five patients experienced this type of movement, with the greatest movement measuring 4.1 millimeters. The direct posterior component of this movement would be only a fraction of this, and it is less than what would be expected to cause obstruction based on previous measurements. In other words, this movement would not cause any obstruction. For instance, the distance between the back wall of the tongue and the back wall of the pharynx in awake supine subjects is approximately 11 millimetres [15]. When the patient is in the supine position, the anteroposterior dimension of the pharynx posterior to the tongue is approximately 14 millimetres [16]. This is the case for patients who have sleep apnea, in whom the pharyngeal dimensions may be smaller than normal. On induction of anaesthesia in elderly male subjects, posterior movement of the tongue of 6.6 mm was insufficient to cause contact with the posterior pharyngeal wall [17]. Consequently, we believe that the small, inconsistent changes in tongue position which we noted were unlikely to contribute significantly to airway obstruction after induction of anaesthesia.

Conclusion

The observed motions did not provide any evidence to support the hypothesis that the tongue is a significant factor in the blockage of the airway during the induction of anaesthesia.

References

1. Yadav NK, Rudingwa P, Mishra SK, Pannerselvam S. Ultrasound measurement of anterior neck soft tissue and tongue thickness to predict difficult laryngoscopy - An observational analytical study. Indian J Anaesth. 2019 Aug;63(8):629-634.
2. Rana S, Verma V, Bhandari S, Sharma S, Koundal V, Chaudhary S. Point-of-care ultrasound in the airway assessment: A correlation of ultrasonography-guided parameters to the Cormack–Lehane classification. *Saudi J Anaesth.* 2018;12:292–6.
3. Gupta D, Srirajakalidindi A, Ittiara B, Apple L, Toshniwal G, Haber H. Ultrasonographic modification of Cormack Lehane classification for pre-anesthetic airway assessment. *Middle East J Anaesthesiology.* 2012;21:835–42.
4. Parameswari A, Govind M, Vakamudi M. Correlation between preoperative ultrasonographic airway assessment and laryngoscopic view in adult patients: A prospective study. *J Anaesthesiol Clin Pharmacol.* 2017;33:353–8.
5. Sonies BC, Shawker TH, Hall TE, Gerber LH, Leighton SB. Ultrasonic visualisation of tongue movement during speech**.** Journal of the Acoustical Society of America 1981; 70: 683-686.
6. Shawker TH, Sonies BC, Stone M, Baum BJ. Real-time ultrasound visualisation of tongue movement during swallowing. Journal of Clinical Ultrasound 1983; 11**:** 485-490.
7. Dormer MW. Radiologic evaluation of swallowing. American Review of Respiratory Disease 1985; 131**:** S20-S23.
8. Hudgcl DW, Hendricks C. Palate and hypopharynx—sites of inspiratory narrowing of the upper airway during sleep.American Review of Respiratory Disease 1988; 138**:**1542-1547.
9. Chaban R, Cole P, Hoffstein V. Site of airway obstruction in patients with idiopathic obstructive sleep apnea. Laryngoscope 1988; 98: 641-647.
10. BroutUette RT, Thach BT. A neuromuscular mechanism maintaining extrathoracic airway patency. Journal of Applied Physiology 1979; 46: 772-779.
11. Sauerland EK, Harper RM. The human tongue during sleep: electromyographic activity of the genioglossus muscle. Experimental Neurology 1976; 51: 160-170.
12. Kuna ST, Smickley J. Response of genioglossus muscle activity to nasal airway occlusion in normal sleeping adults. Journal of Applied Physiology 1988; 64: 347-353.
13. Haxhiu MA, Van Luntren E, Mitra J, Cherniack WS. Responses to chemical stimulation of upper airway muscles and diaphragm in awake cats. Journal of Applied Physiology 1984; 56: 397-403.
14. Krol RC, Knuth SL, Bartlett D. Selective reduction of genioglossal muscle activity by alcohol in normal subjects. American Review of Respiratory Disease 1984; **129:** 247-250.
15. Kundra P, Ramesh A, Mishra S. Ultrasound of the airway. *Indian J Anaesth.* 2011;55:456–62.
16. Yildirim N, Fitzpatrick MF, Jalleh R, Wightman AJ, Douglas NJ. Cephalometric measurements in erect and supine postures on patients with sleep apnoea. Thorax 1990;45:338P.
17. Shiga T, Wajima Z, Inoue T, Sakamoto A. Predicting difficult intubation in apparently normal patients: A meta-analysis of bedside screening test performance. *Anesthesiology.* 2005;103:429–37.