

Endoscopic Study of Glossopharyngeal Insufflation and Exsufflation



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Introduction

Glossopharyngeal Insufflation (GI) is used by competitive breath-hold divers to inhale air above total lung capacity, while Glossopharyngeal Exsufflation (GE) is used to exhale air below residual volume. Here we report endoscopic description of these maneuvers.

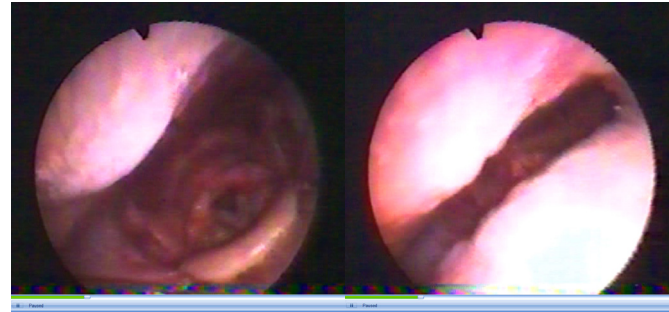
Methods

Pharyngolaryngoscopy was performed in 4 competitive breath-hold divers (1 female and 3 males) during both GI and GE maneuvers. We used an Olympus fiberoptic laryngoscope attached to an Olympus video camera, with the film recorded on a VHS video tape.

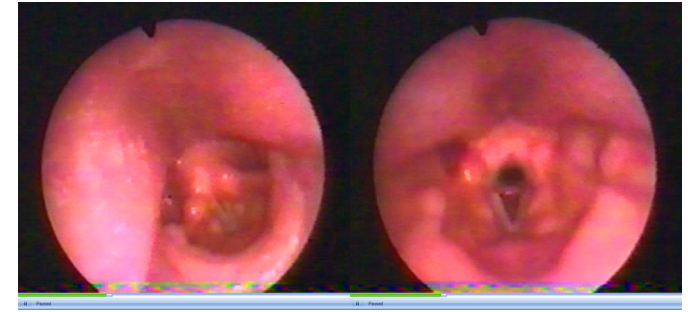
Results

During GI, following the intake of air into the mouth and pharynx, the pharyngeal lumen was initially expanded, but then it contracted in a coordinated sequence involving elevation of the larynx, opening of the glottis, posterior displacement of the tongue and elevation of the palate, as air was injected into the trachea. In contrast to normal swallowing, during which, as the larynx is elevated, the vocal cords close to prevent aspiration, it was during the elevation phase of the GI maneuver that the larynx receive the injected bolus of air through abducted cords. As the next intake of air occurred, the vocal cords closed, trapping the air within the lungs, and the larynx dropped down.

During GE, the pharynx was collapsed and the cheeks sucked in, as a negative pressure was created in the oral cavity and pharynx. Pinching the nostrils helped to maintain this negative pressure. The mouth was opened briefly to expel the air, just before another negative pressure cycle was initiated. Sequential, coordinated laryngeal elevation/descent was again noted, demonstrating vocal cord abduction during descent, and vocal cord closure during elevation. Again, in contrast to a normal swallow, the epiglottis stayed raised during the elevation of the larynx.



Glossopharyngeal insufflation, GI. Endoscopically, the palate is elevated and tends to stay elevated during the maneuver, though some subjects additionally pinched their nostrils to lessen the chance of air escape. Following the intake of air into the mouth and pharynx, the pharyngeal lumen was initially expanded, but then contracts in a coordinated sequence that involves elevation of the larynx, opening of the glottis and posterior displacement of the tongue, as air is injected into the trachea. There is a dramatic amount of laryngeal elevation and descent. In contrast to the physiology of swallowing, during which, as the larynx is elevated, the vocal cords close to prevent aspiration, it was during the elevation phase of the GI maneuver that the larynx appeared to receive the injected bolus of air through abducted cords. As the next intake of air occurs, the larynx drops down and vocal cords close. The amount of abduction of the vocal cords lessens and the duration of this cycle increases with the last few maneuvers, presumably indicating increased tracheal pressure generated by the pharynx/tongue complex. The cheeks were not puffed out during these maneuvers.



Glossopharyngeal exsufflation, GE. During GE, the pharyngeal dimension was noted to be collapsed, and cheeks sucked in, as, ostensibly a negative pressure gradient was created in the oral cavity and pharynx. Pinching the nostrils helps maintain the negative pressure in the pharynx. The mouth was opened briefly to expel the air, just before another negative pressure cycle was initiated. Sequential, coordinated laryngeal elevation/descent was again noted, demonstrating vocal cord abduction on descent, and vocal cord closure on elevation.

Summary

Both GI and GE are accomplished by a series of movements of the glossopharyngeal muscles and the larynx which moves extensively and repeatedly up and down, similar to a piston pump, to inject air into or extract it from the lungs.

Conclusion

In contrast to a normal swallow where the larynx elevated and the epiglottis folds down, during these maneuvers the epiglottis stays raised during the elevation of the larynx. During GI the cord are open (abducted) when the larynx elevates while during GE the cords are closed during elevation of the larynx and subsequently open during the descent of the larynx.