

RESPIRATORY DISPLACEMENT OF LARYNX, HYOID BONE AND TONGUE

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The present brief study of laryngeal movement during respiration arose out of a consideration of the movements of the heart and diaphragm in respiration. During deep inspiration the central tendon of the diaphragm may often be seen to descend 1-1½ in., and sometimes as much as 2 in. In man the pericardium is firmly attached to the central tendon, and therefore must descend at the same time, and the heart with it. But the heart does not descend as a whole, for while the lower part of the heart descends within the pericardium, the upper part, with the great vessels, remains relatively fixed. The aortic arch, for instance, undergoes in the majority of cases scarcely any vertical displacement on deep breathing. The reason for this fixation is not altogether clear. Strong sterno-pericardiac ligaments could be responsible in part, but not infrequently these ligaments are poorly developed. The hooking of the great vessels round the bronchi, the aorta round the left, and the pulmonary arteries round both right and left, might be effective, but only if the lung root were relatively fixed.

But, is the lung root fixed? According to Macklin (1925) the extent of the vertical movement of the lung roots is about ½ in., which must mean either a corresponding descent or actual stretching of the trachea by that amount. But descent of the trachea would involve descent of the larynx also, and the purpose of the present study was to find out whether such displacement of the larynx does normally occur. In aortic aneurysm the diseased vessel can certainly displace the trachea and larynx, giving rise to the well-known 'tracheal tug'.

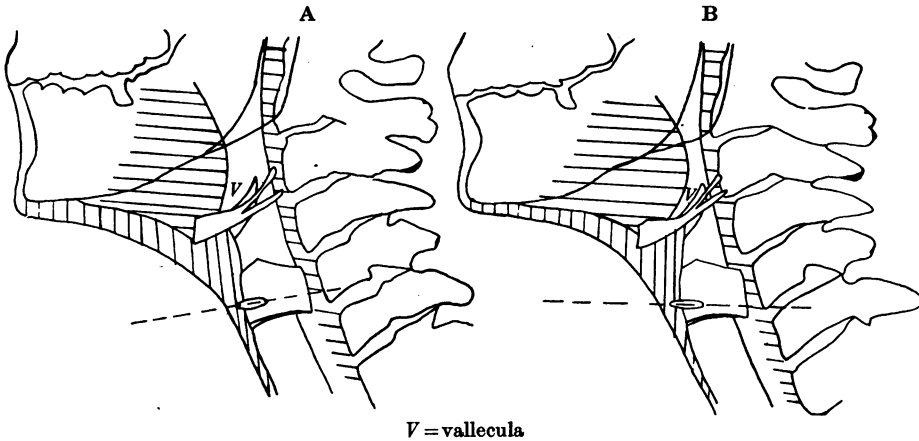
Twenty-three subjects from 15 to 45 years of age, and of both sexes (fifteen male, eight female) were X-rayed in extremes of inspiration and expiration. The subjects were standing, the head being clamped, jaws closed, and the back resting against a wooden board, so that there should be no movement of head and vertebral column. In spite of these precautions it was found difficult in a few cases completely to avoid movement, but such movement was never very marked. The distance from tube to subject was 5 ft.

RESULTS

In five cases there was elevation of the larynx during inspiration, in four cases descent, the maximum movement being ¼ in., and in the remaining fourteen cases there was no appreciable vertical displacement. The hyoid bone underwent a vertical displacement corresponding to that of the larynx (Pl. 1).

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Presumably the non-descent of the larynx during inspiration is due to contraction of the supra-hyoid muscles (mylo-hyoid, stylo-hyoid, posterior belly of digastric) as well as stylo-pharyngeus and thyro-hyoid. Digital examination seems sometimes to indicate that this contraction occurs on deep inspiration. If this is so the trachea during inspiration is subjected to traction at both ends, and after an initial elongation of about $\frac{1}{2}$ in. should become more tense during inspiration. The supra-hyoid muscles might thus be regarded as important accessory muscles of inspiration, and through them and the stylo-pharyngeus and the muscles and ligaments connecting hyoid bone, laryngeal cartilages and trachea to one another, the trachea is slung from the base of the skull. Strong stylo-hyoid ligaments would reinforce the sling in its upper part, while the middle and inferior constrictors could also assist. If this interpretation be correct, then ultimately it is the contraction of the supra-hyoid and



Text-fig. 1. Female aet. 18. Tracing from X-ray photograph. A=full inspiration, B=full expiration.

Note. (a) Forward movement of the tongue and hyoid bone in deep inspiration. (b) Practically no vertical displacement of the larynx. (c) Forward rotation of the larynx in deep inspiration, as indicated by the dotted line which passes through the laryngeal sinus. (d) Change in outline of epiglottis and widening of vallecula.

other muscles mentioned above that is responsible to a variable extent for preventing the root of the lung and the trachea from descending after its elasticity has been expended. This contraction might be in the nature of a stretch reflex.

The trachea as seen in the dissecting room in fixed subjects, has usually lost its elasticity. But a fresh trachea obtained in the post-mortem room is elastic, and can be easily elongated by about $\frac{1}{2}$ in., but not more even when considerable force is applied. Its extensibility appears to possess a fairly sharp end-point, after which the trachea undergoes no further increase in length.

Though in the present study there was no constant vertical displacement of the larynx, an unexpected movement of the tongue and hyoid bone was encountered during respiration. In the majority of cases (18 out of 23, 78%) there was a forward movement of the tongue and hyoid bone in full inspiration, averaging $\frac{3}{8}$ in. The purpose of this hyolingual displacement is doubtless to facilitate the ingress of air into the respiratory passages (Text-fig. 1 and Pl. 1) particularly during deep inspiration. The genio-hyoid and genio-glossus would thus become in many persons accessory muscles of inspiration.

It was also found (a) that the distance between larynx and hyoid increased by an average of only $\frac{1}{16}$ in. in full inspiration; (b) that in ten of the subjects there was a forward tilting of the larynx in full inspiration, the average movement being 8° (Text-fig. 1); and (c) that the epiglottis underwent a characteristic movement. The part attached by the hyo-epiglottic ligament to the hyoid bone moves forwards with that bone, but the margins above that are fixed by the ary-epiglottic folds. Hence the vallecula becomes wider (Text-fig. 1 and Pl. 1).

SUMMARY

In twenty-three persons the larynx was X-rayed in extremes of inspiration and expiration. In five cases there was elevation of the larynx during inspiration, in four cases descent, the maximum movement being about $\frac{1}{4}$ in., and in the remaining fourteen there was no appreciable vertical displacement. The hyoid bone underwent a vertical displacement like the larynx. In eighteen cases out of twenty-three, appreciable forward movement of the hyoid bone and tongue and epiglottis occurred in deep inspiration.

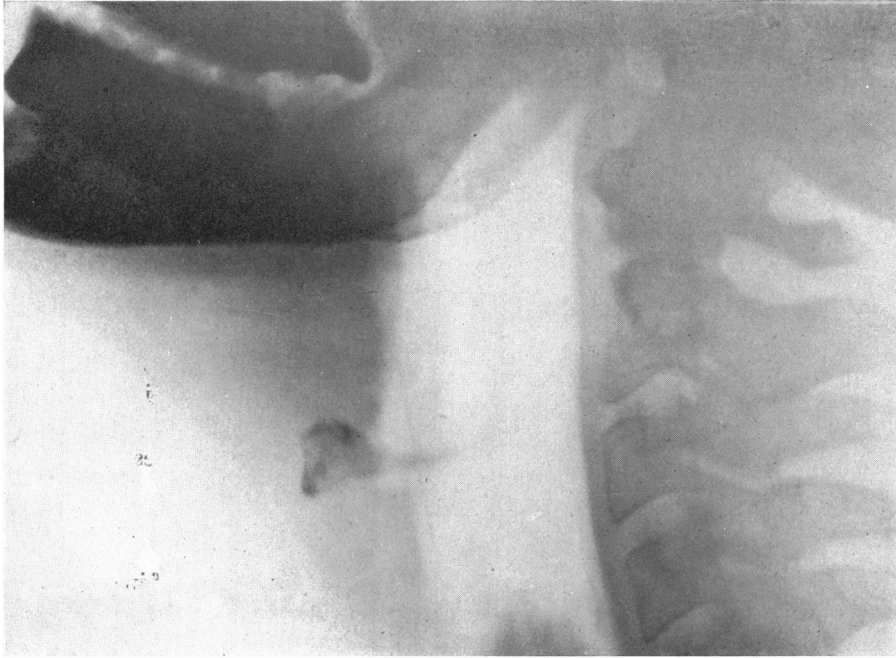
REFERENCE

MACKLIN, C. C. (1925). X-ray studies on bronchial movements. *Amer. J. Anat.* 35, 303-329.

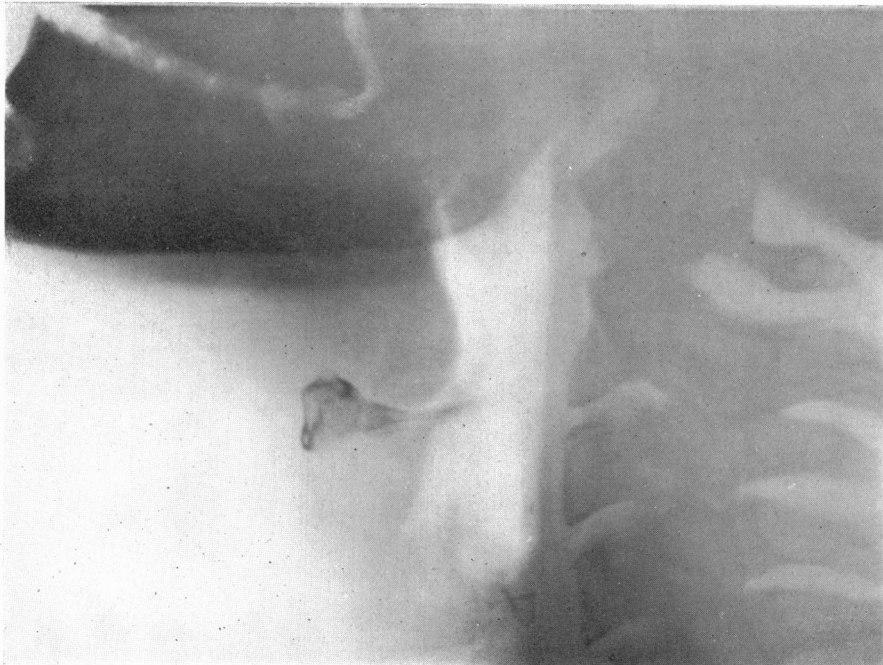
EXPLANATION OF PLATE

Female aet. 28. A = full inspiration, B = full expiration.

Note. (a) Forward movement of tongue and hyoid bone in deep inspiration. (b) Hyoid bone and larynx $\frac{1}{4}$ in. lower in deep inspiration probably due to downward pull of lung root.



A



B