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A CONTRIBUTION TO THE STUDY OF CILIARY MOVEMENT

By A. E. BARCLAY, K. J. FRANKLIN and R. G. MACBETH

From the Nuffield Institute for Medical Research, Oxford

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In a chance experiment, during studies of dust excretion, we observed a tendency of the tracheal cilia of the cat to carry foreign bodies spirally upwards to the larynx; the direction of the spiral was clockwise, viewed from the oral end of the trachea. The matter seemed worthy of further investigation. We also wished for information as to the direction of movement of the cilia where smaller bronchi unite into larger ones, or the main bronchi into the trachea.

Methods

We attempted first the solution of the second problem. The specimens used were taken from a slaughterhouse sheep and from a dog shot with the humane killer. They were warmed before use in Ringer's solution at body temperature, and the ciliary movement was tested by observing the carriage of indian ink, placed upon the epithelial surface.

The direction of movement in the trachea was also studied by observations of the passage of indian ink. It was an incidental sequel to the study of the movement at the bifurcation in the dog's lungs, and it was also specially studied in the respiratory tracts of three cats.

Whereas the sheep and dog's lungs had of necessity to be cut in order to expose the surfaces of union of bronchi, the tracheæ and lungs of the cats were removed as entities and remained intact during the experiments. Except for the terminal portions of trachea, they were kept immersed in Ringer's solution at body temperature, once the indian ink had been injected with a hypodermic syringe and fine needle into the left bronchus. The passage of the ink was not only visible inside the tracheæ, but could also be followed, and that with greater precision, from the outside.

A more normal experiment than could be provided by injection of indian ink was fortunately made possible in a fourth cat, for some fine

particles of soot were being carried up with the mucus in its trachea in the natural course of excretion.

The advantage of using whole lungs and tracheæ, as in the cases of these cats, is that one does not damage the continuous blanket of mucus described by Proetz [1934]; in the fourth cat we could see the mucus being extruded, as a result of ciliary action, all round the cut end of the trachea.

Results

In the sheep's lung, ink placed on the surface of one bronchus not far from the tracheal bifurcation was carried to either side at the bifurcation without invading the actual edge of the junction. A similar process occurred at the junction of two smaller bronchi; in this case, while the ink was moving, a shimmering was visible through a lens at a point on the epithelium that reflected the light. The shimmering ceased with the cessation of the movement of the ink, and was doubtless due to the cilia.

In the dog's lung, the movement of cilia at the bifurcation was studied after successive and simultaneous deposition of ink on the adjacent surfaces of the two main bronchi. The streams in each bronchus divided at the bifurcation, as in the sheep, and passed to right and left to gain the trachea.

Here, on opposite sides, the twin pairs of streams from the two bronchi passed upwards, the individual components of the pairs remaining very close together but not actually mingling. They moved spirally, in one case turning through 180° in 4·4 cm.; the direction of rotation was clockwise, viewed from above.

There was a similar drift in the cats' tracheæ, though it varied in amount with the individual. In the first cat it was 135° in 5·7 cm., in the second 180° in 8 cm., in the third 450° in 7 cm. In the fourth cat no measurement was made, as the track of the soot particles was not sufficiently clear from the outside. The direction of rotation in all the cats was as in the dog.

Summary

1. At the junction of bronchi, the movement of cilia is such that mucus will be directed to either side.

2. In the trachea, the movement of cilia is such that mucus moves spirally upwards. The direction of rotation is clockwise, viewed from above.

REFERENCE

Proetz, A. W. (1934). *J. Laryng.* **49**, 557.