Preliminary notice on the treatment of emphysema of the lungs by artificial expiration / by J.B. Berkart.

PRELIMINARY NOTICE ON THE TREATMENT

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Emphysema of the lungs, whatever cause may have produced it, chiefly consists of a permanent morbid dilatation of the air vesicles, and consequent increase of the residual air within them. It is attended by the so-called asthmatic attacks, habitual dyspnœa, and cough, due to a catarrh of the bronchi, and has moreover a pronounced tendency to lead to organic disease of the heart. Whilst under normal conditions (according to Donders), the pressure

on the inner surface of the thorax is in the different stages of respiration from 7½ to 30 millimetres of mercury less than that on its outer surface, on account of the loss of elasticity of the lung-tissue, this difference is considerably lessened—nay, almost entirely abolished. The immediate consequence is "the permanent inspiratory condition" of the thorax, in which the diaphragm is prevented from reascending to its expiratory position, because the co-operation of the most potent factor—namely, the traction of the elastic lungs on its upper surface—is lost. Thus ensue the disturbances of respiration and circulation.

When the mechanisms of the pathology of emphysema began to be understood, manual compression of the chest, as well as that by the act of vomiting and the application of electricity to the diaphragm, were used in the treatment of emphysema.

But the result of that treatment is not at all satisfactory; because the pressure exerted acts at the same time on the outlets also of the dilated alveoli, and the mucous membrane of the bronchi being in a state of catarrhal swelling, the outflow of the air from the alveoli is prevented rather than facilitated. Better results were obtained by the inhalation of compressed air. The patients who have tried it do not cease praising its beneficial influence on their sufferings. But, apart from the costly apparatus, which is not within the reach of everybody, the inhalation of compressed air has only a temporary influence, by supplying a greater quantity of oxygen in a smaller volume of air. By it the intravesicular pressure is in no way diminished, nor is the residual air renovated to any considerable extent. A current of air from the greater (intra-) to the lesser (extra-

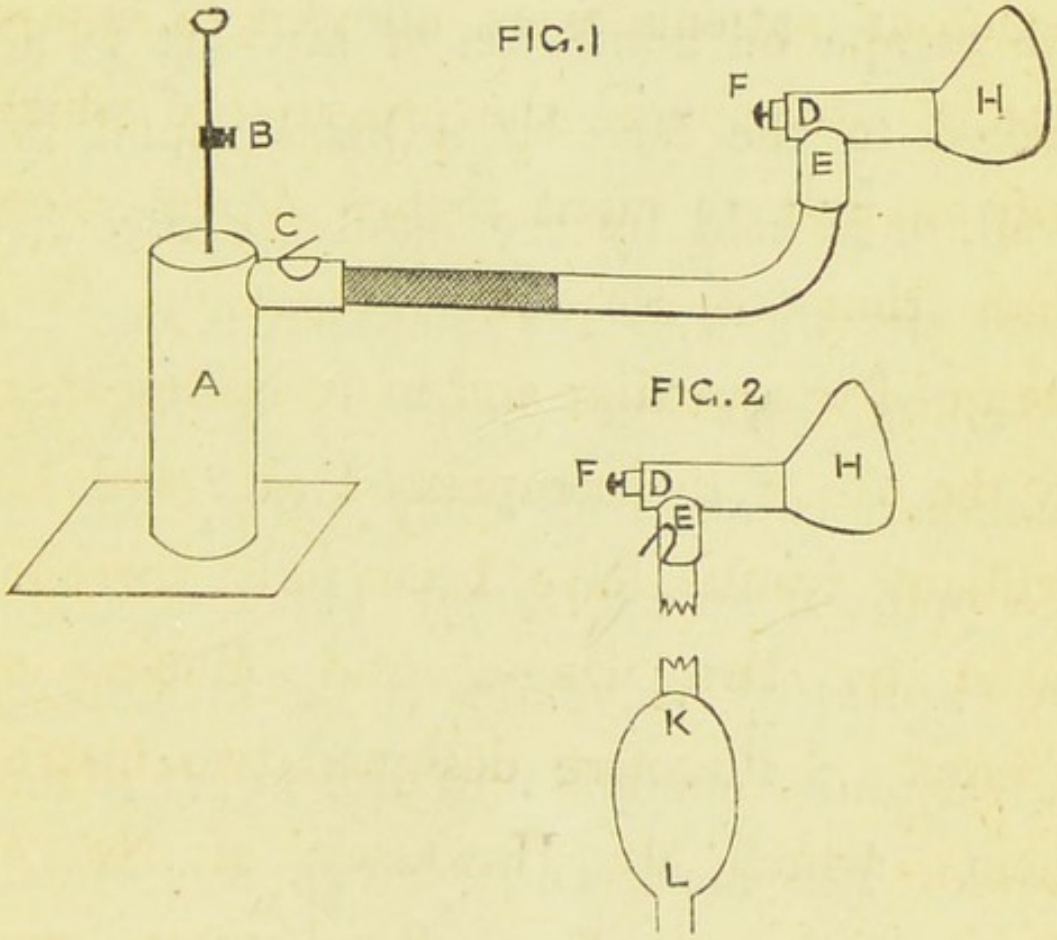
thoracic) pressure soon establishes a balance; and if any difference of pressure previously existed, it now ceases, for the reasons just indicated.

The idea naturally suggested itself that, if it were possible to reduce the intra-vesicular pressure, and that also resulting from it on the thoracic surface of the diaphragm, by some mechanical contrivance, not only the want of oxygen would be satisfied, the emptied space being retaken by the influx of fresh air, but the compressed healthy air-vesicles might re-expand, and by a methodical application of that contrivance, a part at least of the functional activity of the diaphragm might be saved. For the long-continued contraction of the diaphragm must ultimately lead to fatty degeneration of its muscular fibres, just as it does in other muscles. The catarrh of the bronchi, also due to the

stasis in the remaining capillaries, must be benefited by it. The pressure being taken off from the venæ cavæ and the heart, the return of the venous blood from the greater and lesser circuit would be facilitated. Now in each ordinary quiet respiration 500 cubic centimetres of air are inspired, and as many expired. In emphysema, in spite of the long duration of expiration, which is three times that in health (F. Riegel), a much smaller amount than 500 cubic centimetres is expired, and consequently inspired also. It is therefore perfectly safe to use a contrivance by means of which up to 500 cubic centimetres can be withdrawn at each expiratory act; and, on considering the nature of emphysema, it must be equally safe to withdraw as much at the *end* of each natural expiration. My views on this subject have been confirmed by the experiments of Dr. Hank of

Vienna. With a somewhat bulky instrument, a modified Hutchinson's spirometer, which, if safety is to be ensured, has to be worked by two assistants, he first used compressed air in croup and in emphysema. Subsequently he found that, if emphysematous patients were allowed to expire into an atmosphere the pressure of which is from four to eight inches of water less than that of the air, the relief they obtained was greater and more lasting than by the use of the compressed air: and his brilliant results have been fully corroborated by Drs. Hagel and Mader, of Vienna. I therefore designed two instruments, which Mr. Hawksley, of No. 4, Blenheim-street, New Bond-street, constructed for me; and I have been using them for some time with the best results. The annexed woodcuts represent the instruments.

Fig. 1: A is an exhausting syringe, the piston-rod of which is divided to represent cubic centimetres, so that by means of the adjusting stud, B, the amount of action of the piston may be measured and regulated.



The piston-rod is always raised by means of a helical spring fixed in the upper part of the cylinder, and exhaustion is produced by depressing it with the hand. The capacity

of this syringe is known. H is a mask of metal, shaped so as to be readily adapted to the face, and enclosing both mouth and nose. The juncture of the edge of the mask and the face is effected by a cushion of india-rubber, which effectually prevents the escape or admission of air. It is attached to the face by a band round the head, or is held by the hand. Proceeding from the mask is the chamber, D, and the tube, E. At the point D, within the chamber, is an inspiratory valve, and at the point E an expiratory one. C is also an expiratory valve. F is an inspiratory valve, under command of the finger of one hand. The mask and syringe are united by about eighteen inches of stout tubing.

Fig. 2 represents the mask and valve detached from the syringe. The expiratory valve, C, in Fig. 1, is placed at E, in Fig. 2. The necessary exhaustion is produced by

an India-rubber ovoid, holding about 15 cub. in., and is compressed one or more times at the end of each expiration. The mask, H, is carefully fitted, and attached firmly to the face. On inspiration taking place air enters at F and D ; upon expiring the valve, D, closes, while E and C open. The last feeble flutter of the valve, C, indicates the end of expiration ; then the spring valve, F, is closed with the finger, and the piston depressed the required amount, producing a further expiration. On removing the hand from the piston-rod, it rises as shown in the woodcut; and upon releasing the valve, F, inspiration again takes place. In using the instrument shown in Fig. 2, at the end of expiration the ovoid is rapidly compressed, and as rapidly released when artificial expiration is produced. This way may be repeated as required.

The instruments are to be used twice a

day, for a quarter of an hour each time, and to be continued for some weeks. Patients of average intelligence are, after a few sittings, able to use the instruments themselves. Even after the first application of the instrument the patients experience great relief, and delight in showing that they are now able to take a deeper breath, and their oppression gradually ceases. The respiration becomes deeper, its frequency diminishes from 25 to 16 per minute. The expectoration is at first increased, but easy, and soon ceases entirely.

Bronchorrhœa and great dyspnœa are no contra-indications; only in the latter condition the operation is frequently to be interrupted. As regards the amount of air to be withdrawn, the feeling of every patient is carefully to be consulted. I defer the analysis of my observations for some time; and I hope shortly to be able to lay down a

series of rules, based on exact measurements and calculations, for the use of the instruments in individual cases.

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