

A COMMON MODE OF DEFERRED DEATH AFTER TRACHEOTOMY FOR LARYNGEAL DIPHTHERIA: THE RELATED TREATMENT.

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AFTER temporarily successful tracheotomy there may be a return of obstruction due to loose membrane in the trachea—an issue not necessarily dangerous and in any case outside the scope of this paper. Again, a further growth of membrane in the main air passages below the tracheal incision may be responsible for secondary obstruction of a serious kind, but antitoxin treatment has materially altered the course of laryngeal diphtheria in this respect. Under present conditions it nearly always happens in cases of deferred death that severe lobular pneumonia develops. Death is usually attributed to the pneumonia, but this view requires qualification.

In most cases of the kind, if allowed to run their ordinary course, it is more directly the outcome of suffocation by a plug of desiccated mucus and inflammatory discharge located in the neighbourhood of the tracheal bifurcation, as is proved by the immediate relief of obstruction and marked general improvement which frequently ensue when the plug is removed with forceps after such cases have become serious or are even moribund. A plug that forms early may be partly composed of loose membrane, but often none is present. In order to reach the plug a sand-bag or rolled-up towel, sufficient in size, is placed under the patient's shoulders to throw back the head and extend the neck. Inserted closed, the points of the forceps are opened as the bifurcation of the trachea is approached; they are then advanced a little farther, closed again, and withdrawn. As a makeshift, sinus forceps will serve, the points being bent on the flat to a wide angle two-thirds of an inch from the end. However, this instrument is hardly safe, as the sharp points may excoriate the tracheal mucous membrane, and it is sometimes difficult to obtain an effective hold on the plug with them. At Plaistow Hospital the forceps used are broad and bulbous at the point. With either instrument it is easy to search the whole trachea downwards, and even the entrances of the bronchi, given that the head and neck are in proper position. Only a small portion of the plug may be brought away at a first attempt; it may have to be removed piecemeal until what remains is coughed up towards the tracheal incision and can be extracted. Unfortunately the obstruction nearly always recurs; at first the interval may be as long as 12 hours, but it tends to become shorter until extraction gives less relief and then none. Failure to relieve may depend on plugging of the two main bronchi, other factors being the extension of the pulmonary affection with widespread occlusion of the bronchioles.

Many illustrative cases could be cited, but the two following will suffice.

CASE 1.—The patient, a male aged 2 years, was admitted to Plaistow Hospital on March 16th with laryngeal diphtheria and urgent obstruction. Tracheotomy relieved the latter completely, and a comfortable night resulted. Then the discharge from the tube became scanty and the child increasingly restless, with some recession. Towards evening his condition was considered sufficiently grave to justify the

use of forceps, and a mass of mucus mixed with membrane was extracted. The obstruction and distress largely subsided. An alkaline spray was prescribed. About midnight the patient expelled a large piece of membrane through the tube. In the morning his condition was evidently worse. He was restless and had some cyanosis and a poor pulse. Ground continued to be lost, and at 2 P.M. a plug of desiccated and inflammatory discharge about two-thirds of an inch in length was withdrawn bodily from the trachea with forceps. Breathing immediately became freer, but the general condition showed less improvement. Throughout the following night and day the restlessness varied in degree. At noon, and again at 6 P.M., plugs were extracted from the trachea. A better night was thereafter passed, although little discharge came away except when the child coughed after spraying. The tracheotomy tube was taken out at 11.30 A.M., and was not replaced despite some restlessness and slight recession. The discharge was becoming looser and more of it was coughed up. Having disappeared for a time the recession returned in the ensuing night, and next day a rubber tube with a dorsal opening was inserted. Four days later the tube was dispensed with. It had to be used again after two days and through the following three nights, from which time the patient made a rapid recovery.

CASE 2.—The patient, a boy aged 3 years, was admitted to Plaistow Hospital on June 17th with marked dyspnoea and recession due to diphtherial croup. The case was of the rather rare septic type. Tracheotomy did not completely relieve the obstruction. Very little discharge was expelled, and a restless night followed. At 11 P.M. a plug of the usual kind was extracted and some relief obtained. Spraying was begun. Next day the child was more comfortable and coughed up a fair amount of thick discharge. By midnight, however, distress had become marked again. On the extraction of a plug there was a change for the better, maintained on the whole through the following day, except that the discharge was offensive—an ominous sign. In the evening cyanosis, modified by pallor, became definite. At 11 P.M. recession was increasing and some thick muco-purulent discharge was extracted. Forceps had to be used again for severe obstruction after a very restless night and day. The relief was less. Oxygen inhalation was begun, but the patient did not react satisfactorily. It was plain that the heart was failing. At 1 A.M. extraction was attempted without success, as only a little discharge was brought away. The child died next day at noon.

Recovery is exceptional once obstruction develops to a degree which makes extraction vital. Nevertheless, life is occasionally saved by clearing out the trachea. Further, the fact that asphyxia largely due to the plug is likely to anticipate death from the pneumonia *per se* must give weight to measures directed against its formation. These considerations indicate a line of treatment which has been well tested at Plaistow Hospital.

1. While dry cases—those generally in which lobular pneumonia is established at the time of operation—are far more liable to tracheal plugging, the latter may take place although the patient's condition is at the outset quite satisfactory. For this reason I feel that the present system of treating straightforward cases without steam cannot be upheld. In my opinion it is safer to place every tracheotomy case in steam for at least a week if the tube is required for that time. Short of this, steam will, of course, be employed at the first sign of dryness. It hinders desiccation of the discharge and is beneficial when lobular pneumonia threatens or is established.

2. If obstruction returns after an interval and is not due to loose membrane, and at the same time the patient is not coughing up discharge freely or the discharge is very tenacious, a spray of sodium bicarbonate is prescribed (10 gr. to the ounce of water). The efficacy of this treatment depends partly on the expertness of the nurse. Using a rather coarse, intermittent spray, she

compresses the ball, say, three times with the nozzle directed into the mouth of the tracheotomy tube. This she does during successive inspirations. The patient will probably then begin to cough, and the spraying fluid mixed with more or less discharge may be driven up to the inner end of the tube or out of it. To sop up the fluid and discharge, the nurse makes a thin swab by wrapping cotton wool round the point of sinus forceps bent to the angle of the tube. New swabs are inserted until one comes away dry. Then she repeats the whole process, perhaps three or four times. Not uncommonly the patient in the end coughs up a quantity of partly desiccated discharge, so that the formation of a plug may be delayed or possibly averted. If definite plugging occurs the sodium bicarbonate is increased to 20 gr. to the ounce.

3. Extraction should be postponed until it is certain that spraying alone will not dissipate the plug and the obstruction has become immediately dangerous. Great care is needful in inserting the forceps; if they are opened too soon or too wide or force is used the wall of the trachea may be injured. Streaking of the discharge by blood not referable to the operation wound may reveal such injury, the result of which may be that obstruction returns earlier and proves less amenable to treatment. The forceps should be inserted no farther than is necessary to grip the plug. Extraction is discontinued in improving cases whenever this can be done without undue danger of suffocation. Some risk may have to be run. Throughout the spray may be serviceable.

4. Oxygen when used is always passed through water. Straight from the cylinder it rapidly absorbs moisture and thus dries up discharge.

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ARTIFICIAL PNEUMOTHORAX:

FUNDAMENTAL DEFECTS IN THE ACCEPTED TECHNIQUE OF INDUCING PNEUMOTHORAX, AND HOW TO REMEDY THEM.

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TREATMENT by means of artificial pneumothorax is still comparatively rarely applied even in suitable cases of unilateral phthisis. An obvious reason for this is to be found in the difficulties and dangers incident to the accepted method of operating. The difficulties will be appreciated when we remember that the operator is required to carry down his needle to a point at which it will separate the parietal and visceral pleuræ which are in apposition at an unknown depth, and also to verify that it has reached its proper position between these before gas is allowed to flow in. The dangers which have to be taken into account are the possibility of injuring the lung, and the risk of allowing gas to pass into places other than the pleural cavity. It has not been thought necessary to take any great precautions to prevent the puncturing of the lung, but on the other hand measures are regularly taken to verify the proper position of the needle, it being laid down that the gas shall not be allowed to flow until it has been inferred, from the estimation of the intrapleural pressure and its variations, that the needle is in the pleural cavity. Thus it is recognised that it is,

at any rate for the purpose of ensuring that the gas shall not pass anywhere except into the pleural cavity, absolutely necessary to record the intrapleural pressure and its variations. And in point of fact the problem of inducing pneumothorax with safety practically resolves itself into the problem of devising the most suitable way of arriving at the pressure at the point where the eye of the needle rests.

I propose in this paper to discuss two ways in which this can be done. The first is the one in general use. In it the intrapleural pressure is given directly by the reading of a manometer connected through a T-piece with the tube which carries gas from the reservoir to the needle. This may be called the direct method. The second is brought forward here for the first time, and is designed to remedy the defects of the direct method. In it a resistance in the form of an adjustable throttle is introduced into the tube which connects the reservoir and the needle, and the intrapleural pressure is then obtained indirectly from the readings of two manometers inserted into the connecting tube on either side of the throttle. This may be called the indirect method.

I will deal first with the direct method, and show that it is seriously defective in that it will not furnish records of the intrapleural pressures until the lung has been punctured and gas leaks into the pleural cavity.

We may begin with a discussion of the mechanics of the manometer as applied to the recording of the intrapleural pressure. It will be recollected that in the ordinary procedure, as a preliminary, the reservoir is shut off from the manometer by means of a clamp before the needle is inserted into the chest wall. The manometer will then record atmospheric pressure, and will continue to do so as the needle is passing through the tissues, but as soon as the orifice enters the pleural cavity the gas will, on account of the negative intrapleural pressure, be aspirated into the pleural cavity from the connecting tube, and in consequence water will be sucked from the open into the closed limb of the manometer. The resulting difference in the levels of the fluid in the manometer will then indicate the negative pressure. It is now presumed that, if at this point the needle is in proper position in the cavity, movements corresponding to the respiratory movements will be communicated to the manometer by the gas passing in and out through the needle. If these movements do not appear in the manometer the needle is usually pushed forward and drawn back until they do. But consideration will show that movements of respiration cannot be communicated to the manometer unless there is gas in the pleural cavity which can be driven back through the needle, and so the question presents itself whether the amount of gas which has been aspirated from the connecting tube and manometer into the pleural cavity will suffice, and whether it will be available for this purpose.

In connexion with the former issue we will recognise that, inasmuch as the intrapleural pressure never differs much from the atmospheric pressure, and since in consequence any gas drawn into the cavity will not be appreciably rarefied, the volume of gas which will have passed from the connecting tube into the pleural cavity will be practically equal to that of the fluid which will have passed from the open to the closed limb of the manometer. This volume would, when the negative