FURTHER NOTES ON THE USE OF THE NASO-PHARYNGEAL TUBE FOR PROLONGED NITROUS OXIDE ANÆSTHESIA.

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ON May 7th, 1898, p. 1244, I published in THE LANCET a short paper on a method of prolonging nitrous oxide anæsthesia for dental operations by administering the gas through a naso-pharyngeal tube apparatus which I had devised. Further observations of this method were prevented by an absence of two years in Ceylon, which deprived me of the opportunity of bringing it more prominently to the notice of the profession, but since that time the more extended employment of the apparatus then described, in all kinds of cases in dental surgery, has convinced me that the use of ether, with all its objections, need practically never be resorted to, and this fact will assure the welcome of this method not only by dental surgeons and anæsthetists but in even greater measure by the public when it becomes more widely known, for all are agreed that N_2O is the most

perfect anæsthetic at our disposal. This, then, must be my excuse for referring again to the subject and it renders further apology needless.

The apparatus, which has been most carefully made to my design by Messrs. Barth and Co., consists of a two-way stopcock, the inlet tube of which screws into the union connecting the gas cylinders in such a manner that the

whole stopcock lies between them and is thus out of the way; the tap of the stopcock is an elongated broad arm so that it can be easily turned by the foot. From the stopcock chamber lead two tubes of exit, and the tap is so arranged that when it is turned on to either of the two exit tubes the arm lies over that tube through which the gas will flow when liberated from the cylinders by means of the ordinary foot-key. The whole gas-supply can thus be entirely controlled by the administrator's foot. The exit tubes, like the other parts of the stopcock, are made of brass, are placed at an angle, and are an inch long, with bulbous ends so that the rubber tubing can be easily slipped over them; to the left hand one, which is of the same calibre as the union connecting the cylinders, is attached a Hewitt's gas-inhaling apparatus, to the other—the right-hand one—which is marked with the letter "N" and has a very fine calibre in order to reduce greatly the rapidity of the gas flow, is attached the other connexions of the nasal tube—viz., a small stout rubber "expansion bag" (vide diagram D) which is connected at one end with the stopcock exit, the other extremity being continued by tubing to a thinner and smaller rubber bag, B, also netted and which I have called the "pressure bag," as it shows the degree of pressure at which the gas is being supplied; it is fixed to the headpiece of the dental chair by a safety-pin hook, C. This bag is continued as a small rubber tube inclosed in a spiral of steel wire to prevent kinking, and terminates in a conical vulcanite nozzle *a*, fitting into the funnel-shaped extremity of the naso-pharyngeal tube proper, A. These tubes are made for me by Messrs. Stevens and Sons in three sizes—corresponding to numbers 7, 8, and 9 male English catheters—and consist of soft silk gum-elastic; they are six inches in length with the distal end made "*à boule*" and solid up to the orifice, which is situated half an inch from the point, the proximal end being expanded to receive the conical vulcanite attachment of the tubing.

Having occasionally experienced difficulty during a prolonged administration with the original apparatus, owing to the intermittent and irregular evaporation of the fluid nitrous oxide from the cylinders, which was not sufficiently compensated by the expansion bag provided to prevent it and which became in consequence over-distended, I found it necessary to make certain alterations in the construction of the apparatus, thereby eliminating these evils and making the administration more easy. To prevent too rapid a flow of gas the right-hand nozzle of the stopcock—to which the rest of the apparatus is attached—has been made with a very much finer orifice; this allows a much more delicate adjustment of the gas-supply and prevents those sudden escapes from the cylinders which not infrequently arise owing to a partial occlusion of the valve from frost suddenly giving way. In addition, also, the "expansion bag" is now made of half the thickness and double the capacity, which much more effectually regulates the flow by converting an intermittent stream into a continuous one; this bag is inclosed in a net of stout silk to prevent over-expansion, any tendency to which after maximum distension is at once seen in the pressure bag. This pressure bag is small and is made of thin rubber which easily stretches under slight pressure, it is inclosed in a loose net. Its object is to show, approximately, under what pressure the gas is being supplied and to act as a danger signal when this becomes too great, it also enhances the action of the expansion bag in regulating the flow of gas; for this reason it is placed well in view, next to the hook which fixes the apparatus to the headpiece of the dental chair; from it comes off the small rubber tube which terminates in a vulcanite nozzle made to fit into the naso-pharyngeal tube and which is protected from kinking or compression by a spiral coil of steel wire.

With these modifications I have been able to obtain much quieter and more satisfactory anæsthesia, without that tendency to over-dosage which was one of the disadvantages of the first apparatus. Now, too, since certain dental surgeons have become accustomed to its use they have undertaken more extensive operations, have worked with greater calmness and precision, and in consequence the periods of anæsthesia have been necessarily prolonged, the maximum hitherto being seven and a half minutes. The average anæsthesia reckoned from the last 100 consecutive cases of which I have made notes is 2.75 minutes; these cases were selected for treatment with the tube on account of the necessary operation being unusually extensive or of great difficulty.

Some objections have been raised to the employment of

the naso-pharyngeal tube on the following grounds: 1. That it is inadmissible in cases of nasal obstruction. As a theoretical objection this is valid enough, but practically it is very trivial, for in over 300 cases I have not met with a single case in which I could not rapidly pass my tube down one or other nostril; cases of complete nasal obstruction are extremely rare. 2. That the passage of the tube gives rise to hæmorrhage. In the 300 cases before-mentioned I have not in a single instance met with anything approaching troublesome bleeding; in six cases only among the last 100 there was slight oozing for a few minutes, and these cases suffered from hypertrophied and very vascular turbinal mucosa, which is not a common condition and is no contra-indication to the careful passage of a soft gum elastic tube no larger than a No. 9 catheter. 3. That the method cannot be used in cases of adenoids. When I had less experience of these cases I believed this to be true and therefore I did not employ my apparatus in children suffering from adenoids, but latterly, to meet objectors, I have been on the look-out for them and have not met with difficulty or unpleasant after-effects. A little blood must be expected, but as a rule the growths are soft and not very vascular and are easily pushed aside by the tube. One word of caution, however, is necessary with regard to adenoid cases—these are almost always in children; children at any time are rapidly anæsthetised with N_2O and show jactitation early when no air is administered with the gas, but, owing to the obstructed nasal respiration and the relatively small mouth, so little air is inspired in proportion to the anæsthetic, when administered continuously with the tube, that there is a danger of over-dosage. The greatest care and attention are therefore imperative in treating these cases and the gas should be allowed to flow into the pharynx as gently as possible; indeed, in all cases of impeded nasal respiration and in the anæmic the difficulty is not to keep the patient under but to give sufficiently little. 4. That the method is septic because the nasal tubes may convey disease germs from one case to another. This may occur in the hands of those ignorant of the elements of aseptic surgery, in spite of the fact that the tubes are easily sterilised and that furthermore their interior is never soiled, since the full stream of gas emerging from them effectually prevents any foreign matter entering; it is as easy to convey sepsis by an ordinary facepiece or a dental forceps.

I have here quoted the objections that have been raised by theorists and those who have had little or no experience of the method, but on the other hand, operators have never complained that the apparatus has impeded their manipulations or that their time has been taken up assisting the anæsthetist by having to use a mason's gag—a duty for which he is entirely responsible. Indeed, with this apparatus not only can the administrator easily perform all his legitimate duties but he can further aid the operator by helping to sponge out the mouth, for both hands are not occupied in managing the apparatus. Some other advantages of this apparatus over other methods for prolonging N_2O anæsthesia are that it leaves the mouth entirely unobstructed to the operator, whereas the nose-piece considerably hampers his manipulations in the front of the mouth by pressing upon the upper lip. The disadvantage of any form of mouth tube is obvious in this connexion. The tube is easily kept in place by the thumb of either hand while supporting the head, and the prop or mason's gag can be manipulated with the greatest ease without preventing the anæsthetist giving his assistance in sponging. With the nose-piece, on the other hand, it is sometimes a matter of difficulty to keep the apparatus in place; while one hand is occupied in doing so, the other is necessary to work the air valve. Again, with the nose-piece the success of the anæsthesia largely depends upon whether or not the patient is a persistent mouth-breather, whereas with the nasal tube the ordinary respiratory rhythm is not interfered with and the patient is bound to get the gas whether he breathes through the mouth or through the nose, since the gas is supplied in the naso-pharyngeal space, the stream being directed downwards upon the upper opening of the larynx.

In only one case have I been unable to maintain the anæsthesia sufficiently to keep the patient quiet for longer than one minute. In this case the patient was a very neurotic girl with a highly arched palate and very little naso-pharyngeal space. She had had gas on three previous occasions and each time she screamed and fought, the anæsthesia being too short to permit of the operation being accomplished. Anæsthesia was obtained with the tube, but

having pushed the gas to its limit of safety, with resulting extreme cyanosis, I was obliged to stop the administration for a few moments, during which the patient recovered so quickly that before sufficient gas could again be administered she fought so much that I was forced to discontinue the administration altogether.

In the vast majority of cases one could easily give a lethal dose with this apparatus by closing the patient's nostrils with the fingers. I was obliged to resort to this practice in the case of an alcoholic patient who stated that on a previous occasion an unsuccessful attempt had been made to anæsthetise him; he had taken a glass of whisky on his way to the dentist, but with the tube and compression of the nares anæsthesia was easily maintained for one and half minutes; there was some rigidity throughout.

It is needless to multiply cases here; the average anæsthesia in 200 consecutive administrations is sufficient to show the capabilities of the method. They were selected on account of the operation being likely to prove unusually protracted. But even in an ordinary case it is an obvious advantage to the surgeon to be able to operate with deliberation, in the full confidence that there is no probability of the patient coming round before he has finished his manipulations. To the patient the advantage is two-fold: first, he is spared the necessity for either several distinct operations on several distinct days or the alternative of ether anæsthesia, and secondly, the risk of damage to the mouth from a hurried operation.

With regard to the administration itself, the gas is turned on to the ordinary apparatus and the administration is conducted in the usual way to the stage of light anæsthesia; with a full bag the facepiece is then momentarily removed and the tube is passed during an expiration; by so doing the patient inhales no air during this proceeding. It is important not to pass the tube until the patient is unconscious, for otherwise its presence in the nares causes lacrymation, phonation, or other signs of irritation and excitement. When the point of the tube is felt to impinge on the posterior pharyngeal wall the facepiece is re-applied over it, the two-way stopcock is turned so that the gas now flows through the nasal tube, and the administration is continued to full anæsthesia by means of both apparatus in order to see that everything is working properly. Before passage of the tube its point should be slightly bent downwards so that it is the more easily directed along the floor of the inferior meatus of the nose; unless this is done it is not difficult to pass it into the middle meatus, where obstruction is sure to be met with and bleeding is likely to arise. When its point is felt to impinge on the posterior pharyngeal wall the tube should be passed no further for fear of inflating the œsophagus and of causing swallowing movements or even vomiting.

The best and safest position in which to place the patient is sitting straight up in the chair with the head erect—i.e., tilted neither forwards nor backwards—in this posture there is no embarrassment of the respiration from stretching of the muscles of the neck and it is the best position for the surgeon when operating upon the lower jaw, while the head can always easily be tilted back after anæsthesia is complete for operations upon the upper jaw. What is far more important, however, is the fact that the bleeding caused by the operation does not gravitate backwards into the pharynx with the attendant risk of being inhaled and causing asphyxia, but it collects in the floor of the mouth whence it is removed easily with a sponge. The advantage of this posture is felt with those patients who salivate freely under gas and in whom troublesome coughing or retching is caused during induction by the saliva trickling backwards into the pharynx.

In cases requiring prolonged nitrous oxide anæsthesia it is more important than usual to have the bladder empty before the operation and the patient should abstain from food for at least three hours before the time fixed for operation, as subsequent nausea is less uncommon than after an ordinary administration. Loose clothing is imperative.

Since I first introduced this apparatus in 1898 I have been able in my own practice to make good the claim which I then made for it—viz., that it would render the employment of ether in dental surgery unnecessary; that owing to its small bulk and great portability it is more convenient and economical, as regards the quantity of N_2O used, than any other apparatus employed with the same object; and, finally, that it is free from risk of damage to the nose, naso-pharynx, and mouth, and is without danger to the patient.

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