FOURTH COMMUNICATION
ON
ARTIFICIAL RESPIRATION IN STILL-
BORN CHILDREN.
CERTAIN MINOR POINTS.
AN EXPERIMENTAL INQUIRY.

BY
FRANCIS HENRY CHAMPNEYS, M.A., M.B. OXON.,
F.R.C.P.,
ASSISTANT LECTURER ON MIDWIFERY AND ASSISTANT OBSTETRIC PHYSICIAN
TO ST. GEORGE'S HOSPITAL.

Received December 11th, 1883—Read March 11th, 1884.

THE following communication concerns certain minor details in the mode of performing artificial respiration in stillborn children, which it has been thought well to test by experiment.

i. It was decided to test the effect produced by the presence of air in the abdominal viscera on the amount of air capable of being drawn into the lungs by the manipulative methods.

Experiment 1.—In a female child ('Med.-Chir. Trans.,' vol. lxiv, 1881, p. 71, Exp. 19, (L.)), in which the manipulative methods (Silvester, Pacini, Bain, Schultze) succeeded in effecting considerable inspiration, a cannula was passed through the abdominal walls at the navel, and

tied in; attached to the cannula was an india-rubber tube with a clip, so that the abdominal cavity could be inflated and the air let out.

The quantity of air inspired by these methods was noted.

It was found that moderate inflation of the abdominal cavity produced no effect on the amount of air changed by Silvester's method, and its modifications by Pacini and Bain. When the abdomen was very tensely inflated, the amount of air inspired was very slightly diminished.

Experiment 2.—In a male child (see experiments above quoted, No. 20 (M), p. 73), the same method of experiment was adopted.

(a) The *Pacini-Bain* modification of Silvester's method was repeated six times.

In each case 6 inches (*i. e.* 6 inches on the water manometer) was indicated as the inspiratory value.

The abdomen was then inflated as tightly as possible, and the same method repeated six times.

In each case 6 inches was indicated as the inspiratory value.

(b) *Schultze's* method gave 7 inches as the inspiratory value on six repetitions.

The abdomen was then inflated as tightly as possible, and the same method repeated six times.

In each case 7 inches was indicated as the inspiratory value.

Remarks.—The question here was not whether air in the stomach and abdominal viscera impedes respiration when naturally conducted, but whether it impedes *artificial respiration*. These experiments answer the question decidedly in the negative.

The very slight difference noticed in Experiment 1 was probably due to the impeded movements of the thoracic walls, produced by great distension of the abdominal walls.

It must of course be remembered (*loc. cit.*, vol. lxiv, p. 79), that: "This group of manipulations (Silvester's and its modifications), which produces the greatest amount of

ventilation, in no way resembles the normal respiration of a child, which is almost purely diaphragmatic;" and that the presence of air in the abdominal viscera would certainly impede the descent of the diaphragm in a child breathing normally. This, however, is not the question, which really concerns the resuscitation of a stillborn child by artificial respiration.

It must also be remembered that nothing is easier than to empty such a child's stomach of air by gentle pressure.

Conclusion.—The presence of air in the abdomen in no way impedes the ventilation of the lungs by artificial respiration.

ii. It was next determined to test simple methods usually recommended to prevent the entrance of air into the stomach in mouth-to-mouth inflation.

A. It has been recommended to press the larynx, and especially the cricoid cartilage, against the vertebræ, with the idea that the complete cartilaginous ring of the cricoid cartilage will be strong enough to compress the œsophagus without itself collapsing.

This method has been recommended by *Paul Scheel* in 1800, *Herholdt* in 1803, *Olshausen* in 1864, and also by the Committee of the Royal Medical and Chirurgical Society in 1862, who declared that it was competent to effect its object; this, however, applied to adults.

B. It has also been recommended to bend the head strongly backwards, apparently with the idea that the soft œsophagus, lying posteriorly, might become bent in such a way as to be impervious, while the trachea provided with its rings would remain patent.

These points were tested in two experiments.

Experiment 3.—A tube was connected with the pylorus and placed under water, so that bubbles might announce the repletion of the stomach with air. The trachea was connected with a manometer.

A. Mouth-to-mouth inflation was then tried, pressure being put on the cricoid. This was repeated many times.

It was found only occasionally possible to put pressure on the cricoid so as to occlude the œsophagus, without also occluding the trachea.

B. Bending the head back was found to produce no effect in preventing the entrance of air into the œsophagus.

Experiment 4.—A similar method was adopted.

A. Pressure on the cricoid cartilage occluded either œsophagus and trachea or neither. No graduation of the pressure on the cricoid was able to effect a closure of the œsophagus alone.

B. Bending the head back produced no effect.

Conclusions.—Pressure on the cricoid and bending the head back are powerless to prevent air from passing into the stomach if the lungs are inflated.

iii. The next experiment concerned the patency of the upper part of the air passages.

Howard had already shown that the common measure of pulling the tongue forward with forceps is useless, as it does not affect the structures at the base of the tongue, and does not raise the epiglottis.

His manœuvre of tilting up the chin with the mouth closed, however useful in adults, permitting respiration solely through the nose as it does, cannot be of the same use in stillborn children, whose pharynx and air passages are filled with mucus, and in whom the removal of this mucus is one of the great desiderata.

It had also frequently been recommended to lay the head over a table, to allow the head to fall back, away from the lower jaw and the structures connected with it, in order to render the mouth and upper air-passages patent.

It was decided to test this by the frozen section of a foetus in this position.

Experiment 5.—A stillborn full-time foetus which had never breathed was consequently frozen in the above position, its head being thrown as far back as it would go. It was then cut in a sagittal plane.

I have to thank Dr. Garson, of the Royal College of Surgeons, for this operation. His saw passed almost mathematically through the middle line of both the front and back of the body.

The result showed that the soft palate lay against the back of the tongue over a large extent, and did not fall away from it.

Conclusion.—Hanging the head backwards over the edge of a table does not provide for the patency of the upper air-passages.

This accords with my own clinical experience. The greatest difficulty occurs in children in the pale stage of asphyxia and probably depends on inaction of the divaricators of the glottis, which are flabby and useless, like all the other muscles during this stage.

This question of the patency of the upper air-passages is often the great difficulty to overcome. It frequently happens (especially in premature children, but by no means exclusively in them) that Silvester's method and its modifications entirely fail from this cause to introduce any air into the lungs. The difficulty is chiefly met with in children in the stage of pale (flabby) asphyxia, and probably for the reason mentioned above.

The method of Schultze certainly succeeds in introducing air under these circumstances in many cases in which Silvester's method and its modifications have failed. The reason of this is not at present clear to me, but I have observed the fact too often to be mistaken.

I have adopted the plan (which I have not seen advocated) of introducing a catheter into the trachea and leaving it there during the respiratory manipulations, and with satisfactory results.

While in the trachea it serves for various purposes, the principal one of which is the removal of mucus, but not in the manner usually recommended. It is advantageous to secure the catheter at the proper length within the trachea, so that it may not slip too far in, or slip out, if the Schultze method is adopted.

I have measured the length along a catheter from the lips to the glottis, and find it $2\frac{1}{2}$ inches in a foetus.

A catheter which measures $3\frac{1}{2}$ inches from the lips of the foetus is within the glottis, but above the bifurcation of the trachea.

This then is the proper length, and it is easy to secure the catheter by a soft bandage or by a piece of elastic passed round the head, with which there is no fear of the catheter slipping out or too far in.

The removal of the mucus is best effected in the following manner, and if used should precede all attempts at respiration, in order that the mucus, meconium, and other matters found in the child's mouth may not be inhaled.

1. Lay the child on its back, with the head hanging over the edge of the table, and a little lower than the rest of its body.

2. Wipe out the mouth with a soft handkerchief.

3. Press the thorax gently with one hand, stroking the trachea upwards with the other, and retain the finger at the top of the trachea until the next manœuvre is complete. (The mucus will gravitate towards the posterior nares.)

4. Put a handkerchief over the child's mouth, blow gently, and the mucus will be blown out of the nostrils (but not into the operator's face).

5. If necessary, introduce a catheter $3\frac{1}{2}$ inches from the lips and secure it.

6. Press the thorax gently with one hand (to prevent the entrance of air), and *blow* through the catheter. The opening being low down in the trachea, the air and mucus with it being unable to pass into the lungs on account of its compression by the hand, will rush up through the glottis, and the mucus will be blown into the pharynx. This can be repeated as often as necessary, the general tendency of fluids in the air-tubes being to ascend during respiration, whether natural or artificial, towards the mouth.

This manœuvre is more efficient and far pleasanter than the suction usually recommended ; it has answered well in practice.

During artificial respiration fluid will often pour from the catheter, especially if it is held over the edge of the table like a syphon.

N.B.—The plan of *holding the nostrils* during inflation of the lungs is altogether to be condemned; it retains mucus which might be expelled, and the nostrils are a *valuable safety-valve* guarding the lungs from over-distension.

iv. I have thought it worth while to describe some of the progressive signs of returning life in a case in which I had good opportunities of observing them.

A very large male child was delivered on April 14, 1878, in a state of pale (flabby) asphyxia after turning, indicated by a hand presentation. There was exomphalos, and mouth-to-mouth inflation showed the air to pass freely into the intestines, which protruded considerably.

The child was born at 3.20 p.m., the only sign of life being a very feeble and slow beating of the heart.

Artificial respiration was begun by mouth-to-mouth inflation, and continued by the methods of Silvester and Schultze, assisted by alternate hot and cold baths. Under this treatment the heart's action became stronger and more rapid.

The first breath was drawn at 3.50 p.m., but breathing was not spontaneous till 4.30 p.m. and was then very feeble. When it was at length established, expiration was assisted by pressure on the thorax and abdomen.

The breaths were not equally drawn, but about every third breath was deeper, the intermediate breaths being light and shallow.

Breathing was fairly established at 5.15 p.m.

The first sign of muscular action was seen about 4.45 p.m., and consisted in a quivering of the tongue; then the alæ of the nose dilated, then the mouth quivered. About this time the expirations began to be tremulous as in crying. About 5 p.m. there was "sobbing," i.e. the diaphragm produced irregular inspirations without consentaneous opening of the glottis.

General Conclusions.

1. The presence of air in the abdominal viscera in no way impedes the ventilation of the lungs by artificial respiration.

2. Pressure on the cricoid cartilage, and bending the head back are powerless to prevent the passage of air into the stomach, during mouth-to-mouth inflation.

3. Hanging the head backwards over the edge of a table does not provide for the patency of the upper air-passages.

A plan of providing for the patency of the air-passages and the removal of mucus is here related in detail.

Notes of the signs of returning life in a deeply asphyxiated child are given from a careful observation.

Works quoted.

Scheel (Paul). Ueber Beschaffenheit und Nutzen des Fruchtwassers in der Luftröhre der menschlichen Früchte. Aus dem Latein. mit Anmerkungen. Erlangen, 1800, S. 53.

Herholdt (Johann Daniel). Commentation über das Leben, vorzüglich der Frucht im Menschen, und über den Tod unter der Geburt. Kopenhagen, 1803, S. 164.

Report of the Committee appointed by the Royal Medical and Chirurgical Society to investigate the subject of Suspended Animation. Med.-Chir. Trans., vol. xlv, 1862, p. 490.

Olshausen (R). Die Behandlung scheinodter Neugeborener durch künstliche Respiration. Deutsche Klinik, 1864, Band xvi, S. 346, 357, 365.

Howard (Benjamin). Observations on the Upper Air-passages in the Anæsthetic State. Lancet, 1880, vol. i, p. 796.

Champneys (F. H.). Artificial Respiration in Stillborn Children. Med.-Chir. Trans., vol. lxiv, 1881, p. 41.