

Asphyxia.

BY * * *

Doubtless hundreds of children die annually during their advent into the world, or a very few moments after birth. This early death without any organic lesion, is seldom necessarily final; or to speak more clearly, it is a temporary death, if the child is restored, and perpetual if it is not. Yet the child that is born with the heart still is dead, and will stay dead if left to the care of nature only. If the heart is beating at birth, but from any cause whatever the infant does not breathe soon after pulsation ceases in the cord, or after the latter is divided, its heart will cease beating, and will not *sua sponte* resume its pulsations. I think it may be asserted without argument, and that it will be believed without proof, that if the heart of a new-born child ceases to beat for a single minute after the cord is divided before respiration has been established, that of itself it will never beat again, that spontaneously respiration will never begin, and hence that the infant in this condition is really dead.

Some pretend to say if respiration can be restored, and consequently the heart set in motion, the child has not been dead; but life has been merely suspended. Now this is subtlety without sense.

The circulation of the blood is essential to life. If the heart beats ever so little there is still some circulation and life, but if it stops the definition of life is imperfect, it is no longer life, but something else, and this something else is the absence of life which is death.

This is sometimes the first care of the physician. He is expected to try to restore life to the child; he is not expected to succeed by the friends after it is known the heart no longer beats, the cord being divided. But it is doubtless in most cases possible to restore the child, if the heart has not been so long still as to allow the blood to coagulate in the larger vessels and cavities of the heart itself. The period at which this should take place must constantly vary in different cases, in consequence of many conditions on which the fluidity of the blood depends, which conditions are not likely to be the same in two consecutive cases.

The causes of the child being born "still," when at the commencement of labor it was living, as ascertained by the usual certain signs, is not clearly understood.

It may occur if the labor is protracted, if the forceps is employed, and much and long continued traction has been requisite, or if after the head has passed the vulva much time elapses before the shoulders are delivered. This latter accident may happen in the best hands from lack of uterine contraction, from inability to get the finger in the child's axilla, or from pulling on the head of the child to perfect the delivery.

Why the child should be still born, from even half an hour's compression and traction with forceps is not very clear.

The origin of the pneumogastric is scarcely affected by any compressing force ever exercised upon the head of the fœtus, and the sympathetic still less. But the constrictor vaginae muscle, encircling the neck after the head has passed and the forceps have been removed, may cause apoplectic asphyxia. This tendency we constantly see, even in a natural labor, in the minute interval between the passage of the head and shoulders of the child. In this short period the face of the infant often becomes more or less colored. It is not easy to understand how labor, however prolonged, could cut off the circulation in the cord, unless the latter should happen to be resting upon some solid part of the fœtus, applied against a constantly contracting uterus, which could hardly occur. I am of course speaking of head presentations. If the feet present, still birth is not difficult to be accounted for, tension and pressure being on the cord itself, the moment the navel of the child has passed the uterine orifice. In such cases, cessation of motion in the fetal heart readily takes place, and is as readily accounted for.

But whatever may be the cause of asphyxia, the first indication is to restore the pulsation of the heart and respiration. If this can be done by the application of heat to the cord, or placing the child and cord in hot water, and by the employment of the "ready method" of Marshall Hall, to induce respiration, very well, the indication is accomplished; but if after a moment or two lost in these efforts, pulsation does not return, I would tie and divide the cord as quickly as possible, and having placed the infant in a convenient place, I would not waste time in slapping it in the face, or dashing cold water on it, or pouring brandy in its throat, which would most likely run into the trachea, nor in tickling the nose with spirits of ammonia, nor in any of the thousand vulgarities suggested by over officious assistants. If the asphyxia is nearly complete, the child will be insensible to all such manipulation; if total, it would be simply absurd.

After a few efforts by the "ready method," if I should not succeed, I would resort to artificial inflation of the lungs. This I would not attempt to accomplish by applying my mouth to that of the fœtus and blowing, for I should expect to have to inflate the alimentary apparatus before the air would pass into the trachea, and this every time I wished to inflate the lungs. It would be about as well to tightly close the mouth of the fœtus, and try the method made classic by the memorable suggestion of Cervantes, in one of his prefaces.

Neglecting all these indirect and uncertain processes, I would seize a gum elastic tube, the size of a No. 6 catheter, with a hole in the end instead of the

sides, if I had it or could get it, and if not, any No. 6 catheter, or any other, not quite as large as the infant's trachea, (I mention a No. 6, because it is large enough; a much smaller one would do, perhaps equally well) and having caught the epiglottis cartilage with the nail of the index finger of the left hand, I would with the right, pass the tube into the larynx and trachea a couple of inches, and then withdrawing my left finger, inflate gradually the child's lungs. Before the expiration was completed, I should expect to see the beating of the foetal heart at the rate of one hundred and twenty times in a minute. I would then continue to press the air out of the chest, and inflate again and again, and after a few such efforts, I should expect to see a spasmodic inspiration performed by the child itself, followed by the usual rattling expiration, which I should aid by pressure on the chest.

At first there may be only one of these inspirations per minute, for four or five minutes, then two, and finally six or eight, and in a bad case we may succeed in obtaining eighteen respirations a minute within an hour from the first inflation of the lungs. There may be no motion of the voluntary muscles till after the respirations become more frequent, and not the least sign of sensation. The catheter in the larynx causes no irritation, it would be a good sign if it should. But up to this time or later, there is complete anaesthesia. During all this period I would keep the child in a vessel of water as near blood heat as possible, not to secure the stimulating effect on the cutaneous surface of hot water, but to preserve the temperature of the little creature as it was in the womb of its mother. If the respiration were now tolerably uniform, that is, if they took place at nearly equal intervals, though even no more than eight or twelve to the minute, provided they occurred by aid of the inter-costal muscles, as they usually will by the time they have reached eight per minute, I would withdraw the catheter or tube, and depend upon slowly turning the child from side to back in the water, to sustain respiration and increase its frequency. If no accident occurs, in the course of two hours or a little less, respiration may be expected to become of natural frequency and smoothness, the pulse at the wrist of the usual strength, and slight voluntary motions may be expected.

The first sign of the return of sensation, is the mobility of the pupils, on raising and depressing the motionless eyelids. I think when this sign is observed, it may be expected that the tube will soon need to be removed from the trachea.

A very late author on diseases of women and children, Dr. Bedford, recommends the usual treatment. Insert the child in water at 50 degrees, then in the same fluid at 100. Inflate the lungs by applying the mouth to that of the foetus, dashing water in the face, free current of air, etc. Not a word of direct inflation by the use of a tube.

Bedford, Davis, Mitchell, Condie, Churchill, Berton, Billard, and numberless other authors on diseases of children, say nothing of direct inflation of the lungs.

Bouchut, in his work on diseases of children, remarks, after he has been recommending cold and hot water, cold air, flagellation on the buttocks, bleeding by leeches at the axillæ and at the cord, when blood will flow from the latter, inflation by applying the mouth to the mouth of the child, and holding its nose: "Il pourrait y en avoir si, prenant le tube laryngien, et dans le bout d'envoyer un air plus epure, dans le poumon, on voulait pratiquer cette insufflation avec un soufflet. C'est ainsi que, pour remedier a un accident deja fort grave, [that of inflating the lungs with air already once respired, as is done in case of inflation by mouth to mouth.] on en determine un autre qui est l'emphysme des poumons."

Bouchut suggests direct inflation of the lungs by means of a tube and bellows, but dreads emphysema, or rupture of the pulmonary vesicles. This accident would be much more likely to occur by employing bellows, than by

applying the mouth to the tube. True, in the latter case the air conveyed to the fetal lungs would not be so pure as if derived immediately from the atmosphere, but this defect would be more than compensated by the physician being able to control the amount of air blown in, and to appreciate the resistance to its entrance into the lungs, and thereby regulate the force of insufflation. Of course a physician of judgment would not exhaust his own lungs in inflating an infant's, but only blow into the tube sufficient to cause the fetal thorax to dilate slightly. I cannot conceive how rupture of the vesicles should take place, if any degree of intelligent moderation in the force and quantity of the insufflation is employed. How authors can reconcile the application of three leeches to the axillæ, and the encouragement of the flow of blood from the unligated cord, even to syncope, with the low animal heat and slight ability of the new-born to generate animal warmth, and renew a loss of blood, is inconceivable to me.

They* say there is congestion when there is cyanosis; that is, pulmonary and cerebral apoplexia, and the flow of blood will relieve it. This latter is more easily asserted than proved. There either is or is not an abnormal quantity, that is too much blood in the circulatory apparatus. If there is not an abnormal quantity, evidently it is dangerous to abstract any. If there is too much how came it there? Did it keep flowing in through the umbilical arteries without being able to return to the placenta by the corresponding veins? This is not plausible, for the same causes that would arrest the return of blood from the fœtus, should also prevent its access to it.

Dr. Tyler Smith says the principal cause of congenital asphyxia is the want of a due supply of blood to the maternal side of the placenta, from continuous uterine contraction, or from partial or entire placental detachment, or continued pressure on the umbilical cord. Blood is not supplied, and the cord is compressed at the same time; hence the blood in the fœtus at the time compression begins, remains there in a state of partial or total stasis, not in diminished or excessive quantity, whatever Dr. King, (*Lancet*, 1859, p. 170.) may say about the suction of the placenta causing syncope, if respiration does not begin immediately after the child is born, or if the cord is not immediately tied to prevent the effect of the suction. If then the apoplectic asphyxia is merely a stasis of the blood from arrest of circulation, how will leeches at the axillæ, acting only on the capillaries, act on the great vessels and set the heart in motion? And if it is already in motion, how will the abstraction of blood by leeches set up respiration? Such a hope appears to have no rational basis. There is infinitely more rationality in spanking as proposed by Bouchut, for this, if it does not excite respiration, does not abstract the only medium of an already dubious vitality—blood. Dr. Tyler Smith, evidently doubted the propriety of abstracting blood, but was deterred by a laudable deference for the opinion of his predecessors, from absolutely proscribing it; hence he says if the child is *very black*, a *small* quantity of blood should be allowed to flow from the umbilicus, before tying. He recommends inflation by mouth to mouth, or through a tube inserted in the mouth or nostrils, (not carried into the larynx); last he recommends the trial of the method of Marshall Hall,—“ready method.”

Marshall Hall himself, with his characteristic rationality, entirely ignores blood-letting, either by the cord or leeches, in congenital asphyxia. He says in the still-born it is impossible to decide except upon autopsy, whether there is meningeal apoplexia with extravasation or not, and consequently the indication is always the same—to establish respiration as *soon as possible*. Then he goes on to say that respiration is an excited function, and is brought about through the medium of the *tri-facial*, *spinal* or *pneumo-gastric* nerves, or all of them. Hence with necessary sequence, he proposes dashing cold

* Billard, De wees, Mitchell, Bouchut, etc.

water with force in the face, to excite the tri-facial, on the chest and back to excite the spinal, or for the same object to tickle the soles of the feet, irritate the thighs and legs in any manner, even by pricking with pins: he thinks the application of one pole of an electric machine to the mouth, and the other to the verge of the anus, should be a powerful means of exciting the pneumogastric. On the same principle stimulating mixtures are applied to the nasal and faucial lining. He says nothing of direct inflation by means of a tube in the trachea. He resorts to all the usual remedies except bleeding, and also of course would have employed his "ready method," upon occasion.

There occurs in the *Dict. de Med. Art.* "Asphixie," this very definite and concise notice of the origin of pulmonary insufflation. "In consequence of the experiments of Visale, and the suggestions of Godwin, (*The Connection of Life with Respiration*; London, 1788), pulmonary insufflation has long been employed. The first attempts were made by mouth to mouth; but afterwards the propriety of allowing respired air to be blown into the lungs of the asphyxiated individual was doubted; still later it was ascertained that only a very small quantity of air reached the lungs. Then the application of more exact means was advised. Chaussier proposed a copper tube called *tube laryngien*. After having placed the individual upon an inclined plane so that the head should be a little elevated, the tube was introduced into the larynx through the mouth or nasal fossae; one assures himself by the aid of the finger that the tube has entered the orifice of the trachea; it is secured in this position, and to the mouth of the tube an ordinary bellows is adapted and insufflation of small quantities of air is accomplished by slight pressure on the bellows, being careful to perform it in an intermittent manner, imitating natural respiration. The elasticity of the lung is sufficient for the expulsion of the air. M. Leroy d'Étiolles, (*Arch. gener de Med.*, t. xx, p. 302.) demonstrated by a series of experiments, that the artificial distension of the lungs in sheep, caused rupture of the pulmonary vesicles, and fatal interstitial emphysema. MM. Magendie and Dumeril, reporters upon his memoir, also confirmed these facts, but showed that air impelled with a great deal of force into the trachea of infants and of fetuses, would not cause rupture as in adults. These facts were moreover, known to Halle and Bichat, and the experiments of M. Leroy proved only that pulmonary insufflation should be moderate. M. Divergie regards its employment as extremely advantageous.

It will be perceived that though recognized and favorably considered by Chaussier, Magendie, Dumeril and Divergie, as a valuable means of resuscitation, the *laryngien tube* has fallen into disuse, which can clearly be traced to the memoir of Leroy d'Étiolles, on its employment causing rupture of the vesicle in sheep. And though Magendie and Dumeril denied the facility of rupturing the vesicles of fetuses and infants, still the profession have steadily ignored comments, and adhered to the first suggestions of danger, and we find in all later authors who speak of artificial inflation, the most careful warnings against this danger. Even Marshall Hall recommends covering the child's mouth with a *fold* of linen to prevent the too violent inflation of its lungs, and at the same time appreciating the liability of the air to enter the stomach instead of the lungs, he tells the physician to press the child's trachea against the œsophagus, to prevent the air taking that course. Inflation by the bellows must be objectionable, because of the inconvenience of having a bellows always at hand, the time lost in adapting it to the tube, and the inability to appreciate quality and force, as when blowing from the mouth.

The principal objection to blowing from one's own mouth is, that the air blown out has already been once employed, and must consequently be vitiated. This is readily remedied by the physician making a few forcible and rapid respirations, for it has already been shown by the experiments of Faraday, that the expired air contains much more oxygen and less carbonic

acid after a few such respirations, than during the usual respirations. This scarcely needed any experiments, for it is evident without reflection.

Having examined the modes of exciting respiration in congenital asphyxia, and there being the utmost harmony among authors as to the first and imperative indication, namely, to excite respiration as soon as possible, I submit that the means which will most certainly and speedily accomplish this is the best means, if it is not attended with a paramount danger. The danger of the direct insufflation we have examined and found comparatively small. Indeed, I apprehend it would be impossible to rupture the vesicles, if a tube is employed with a diameter considerably less than that of the trachea; for evidently, as soon as there is any resistance to the further introduction of air by the distension of the lungs, it would find its way out by the sides of the tube, and through the mouth, which remains wide open, or even through the nares. One can inflate a bladder of the most delicate texture by means of a tube inserted into its neck, even though the tube does not fill the aperture of the bladder, but we cannot cause any appreciable distensive force on the bladder, because, from the mobility of the air and the patent orifice, it of course would escape into the ambient atmosphere, before it ruptured a vesicle of cobweb delicacy. For this reason I have recommended a small tube two or three lines in diameter.

In the *Gaz. des Hopitaux*, 1857, No. 136, will be found a concise, and not satisfactory report of a case of tubing the larynx in congenital asphyxia. The case is by Delfrayse, and was suggested to him by hearing of Bouchut's tubing the larynx in croup. But this is another thing from the mode I propose. Delfrayse did not inflate the lungs through the tube, but excited the act of respiration by pressing on the child's thorax; this latter act, not the insertion of the tube, was followed by respiration; from which we would infer that the tube merely removed a mechanical obstacle, (mucous spasm of the larynx, or something of the sort.) After respiration began, he withdrew the tube by the thread which retained it, one end of which hung out of the mouth. With this exception, I have not read of any case in Europe or America, in which the tube and insufflation have been employed or recommended. Yet it precisely fulfills the indication on which all agree—the prompt establishment of respiration.

With the concise report of a single case, I close this paper.

CASE. A woman had been in labor more than 24 hours. The head of fœtus would not engage in superior strait: presentation was occipitoposterior. Forceps applied above superior strait. After one hour's traction without removing forceps, the child was extracted. The asphyxia was complete. The cord was pale and pulseless, the fetal heart was absolutely still. The child and cord were placed in hot water, but the cord not pulsing, it was divided before tying, when it emptied itself of the blood contained in the fetal portion, perhaps half an ounce; it was immediately grasped and tied. The child was then removed, and subjected to all the usual means of resuscitation, for at least ten minutes, without any result. The skin was cold, the under jaw relaxed, the whole body perfectly "limpy." All present said it was dead. It did seem a hopeless case.

Inflation mouth to mouth was tried, by which the stomach was inflated but not the lungs, as was easily perceived by the absence of mucous rattle on pressing out the air. This sound is of course well marked when the air is pressed out of the fetal lungs. The fœtus was thus repeatedly blown up without result.

A small gum-elastic catheter was now substituted. Two or three attempts at getting it into the trachea failed, because it became so flexible in the heat of the hand and mouth as to be unmanageable. Another effort was made by the "ready method," but no respiration. Now the experimenter seized the epiglottis cartilage with finger nail, and gliding the limber catheter to that point, pressed its point into the laryngeal orifice: it was then pushed

down an inch or a little more, and the experimenter having first made two or three rapid respirations, applied his mouth to the end of the catheter and gradually inflated the lungs of the child. Here was a beautiful example of the effect of atmospheric air in setting the heart in motion. The child was naked, and the eye of the experimenter was fixed upon the portion of the thorax where the pulsation of the heart would be visible. The lungs were almost distended, when the tap, tap, tap, of the hidden little controller of life became visible in the inter-costal space. When the eyes of the "assistants" were directed to this little palpitating spot, they all uttered exclamations of surprise, and the joy of the mother and father at the restoration of their only child, was unbounded. They had considered it dead, had not expected it to be born alive, or with sufficient vitality to be resuscitated.

Not long since I was called to the bed of one in the prime of life, who was in the shadow of death. When I entered the room his respirations were 12 to the minute; each inspiration was semi-spasmodic, and the corresponding expiration was attended with the mucous death rattle. In a few moments the respirations were eight, then six, then three, then several of two to the minute, then three of one to the minute or minute and a half, violently spasmodic and abdominal, and the heart continuing to flutter and oscillate a moment longer, then subsided into eternal quiet. Reverse this picture and we have the gradations by which the dead fetus becomes the living child.

The lungs of this child were inflated about fifteen times per minute: about the expiration of one minute it had a spasmodic inspiration, and then there was the characteristic prolonged rattling expiration as the thorax gradually subsided. This was repeated once in a minute and a half or two minutes. The child was now placed in hot water in a sitting position, and insufflation continued. There was still no sign of sensation, nor the least motion of the voluntary muscles, the eyes closed and pupils motionless on lifting the lid. The catheter was kept in the trachea about ten minutes, when the spasmodic respirations having reached four or six a minute, it was withdrawn, and respiration kept up by turning and raising and depressing the arms. Still purple lips, ears, nose and extremities, capillaries of the upper eye-lids began to look scarlet. Fifteen minutes after removing catheter there were eight spasmodic respirations per minute. A little more than one hour after delivery there were twelve respirations per minute. Soon after eighteen, still spasmodic. At seven minutes past two o'clock, p. m., or one hour and fifty minutes after the child was delivered, respiration suddenly became of normal frequency, but more labored than in the healthy state. There were not, up to this time any muscular movements, except those concerned in respiration. Just at this time the eye-lids were lifted again, and the pupils were seen to be mobile for the first time; but there was still complete anaesthesia, verified by slapping the face with the corner of a cold wet towel, pinching the inside of the thighs, tickling the soles of the feet, etc., none of which were followed by the least sign of sensation. The lower jaw was still relaxed and drooping; the whole body still completely flaccid. Child now removed from the hot water, and wrapped in dry hot flannels. It opens its eyes for the first time at a quarter before three, or about two hours and a quarter after delivery. It next moves its legs and arms feebly. Its eyes again close, no crying. In the evening it has convulsions. These occur at intervals without much violence, for two days, after which the child is apparently well. The child is now a month old, and in excellent health.

I leave this case without comment, satisfied that every physician of experience in obstetrics, will recognize it as belonging to that class of cases which hardly ever survive; the asphyxia having reached such a degree, that resuscitation seems almost incredible.

I would remark before leaving this subject finally, that during the preparation of this paper, I have repeatedly inflated the lungs of fetuses of four

and six months, which have been some time preserved in alcohol, and I find myself utterly unable to rupture the vesicles by blowing through a tube two lines in diameter, inserted loosely in the trachea; the air after the lung is inflated rushes back by the sides of the tube as fast as I can blow it in. This corresponds with the report of Magendie and Dumeril, mentioned before, from all of which we may reasonably infer, that the danger of producing interstitial emphysema, by insufflation of the lungs of the new-born child in a state of asphyxia, is habitually exaggerated.

CONCLUSION. A most expeditious and eminently safe means of establishing respiration in congenital asphyxia, is direct insufflation through a tube smaller than the aperture of the larynx.

The insufflation is most readily and safely performed, by applying the mouth to the tube, after having made several rapid respirations for the purpose of purifying the expired air. This last precaution should be repeated from time to time, if the resuscitation is prolonged.