ANAESTHESIA FOR SURGICAL REPAIR OF OESOPHAGEAL ATRESIA AND TRACHEO-OESOPHAGEAL FISTULA

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OESOPHAGEAL ATRESIA is a congenital anomaly found in the newborn requiring surgical correction as a life-saving measure. This anomaly is most frequently associated with tracheo-oesophageal fistula which connects the trachea to the oesophagus, either above or below the atretic portion. Tracheo-oesophageal fistula may occur without oesophageal atresia. Aspiration pneumonia frequently occurs in patients with this direct communication between the oesophagus and trachea. An early diagnosis, prior to feeding, will allow surgical correction before dehydration occurs and will reduce the amount of tracheo-bronchial contamination This is imperative if the survival rate for this anomaly is to be improved An early diagnosis can be easily accomplished in the delivery room. It is necessary for the obstetrician, anaesthesiologist, and those concerned with infant resuscitation, to be constantly aware of this anomaly. It occurs in about one in twenty five hundred births Apgar (1) has advocated the routine passing of a catheter into the stomach of the newborn to show immediately if the oesophagus is patent Obstruction to the passage is presumptive evidence of oesophageal atresia. This procedure repeated under fluoroscopy may be all that is necessary to establish the diagnosis.

Numerous techniques for the conduct of anaesthesia have been advocated for the surgical correction of this anomaly. Zindler and Deming (2) intubate the patient awake and use cyclopropane in the semi-open technique with a non-rebreathing valve. The respiration of the infant is controlled. They emphasize careful tracheal aspiration during surgery and in the postoperative period Wilton (3) advocates the use of a T-piece connected to an endotracheal tube Respiration is managed by intermittently occluding one limb of the T-piece while a continuous flow of fresh gases enters the other limb Payne (4) injects thiopental and d-tubocurare into an intravenous cutdown. Respiration is controlled using nitrous oxide–oxygen in a semi-closed system with an infant carbon dioxide absorber. He emphasizes that infant breathing is mainly diaphragmatic which tends to put a variable degree of strain on the lower segment of the oesophagus. Local anaesthesia is unsatisfactory for the surgical repair of this anomaly owing to the tension placed on the oesophagus as a result of coughing and straining of the patient.

There still remains considerable disagreement among anaesthesiologists and surgeons in regard to endotracheal intubation in these patients. Those who oppose it feel that intubation may produce laryngeal oedema. Swenson (5) advocates the administration of cyclopropane by a tight-fitting mask without endotracheal intubation. Haight and Towsley (6), in 1943, reported the first successful primary correction of oesophageal atresia and tracheo-oesophageal fistula. They used local anaesthesia for the first part of the operation. Open-c rop

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ether was given during the anastomosis to obtain quieter working conditions This same anaesthetic procedure was used at Indiana University prior to 1948.

Technique

These patients usually enter the hospital with an elevated temperature and marked dehydration. Surgery should not be performed until the patient has been given antibiotics and hydrated. An intravenous cutdown with a polyethylene tube, preferably at the ankle vein, should be performed prior to surgery.

Prior to 1948, all of these patients at the Indiana University Hospitals received local infiltration with procaine until the chest was opened and the dissection was completed Open-drop ether was given while the anastomosis was done to produce a quieter operating field. Since 1948, endotracheal intubation and general anaesthesia has been used. Intubation is accomplished while the patient is awake or after anaesthesia is induced with open drop ether. The size of the tube has varied between a 14 French and a 16 French catheter

Controlled respiration is carried out through the entire procedure in order to ensure adequate ventilation and prevent diaphragmatic movements which place a tension on the lower oesophageal segment. Controlled respiration also allows the patient to be carried in a lighter plane of anaesthesia. An infant 90-gram to-and-fro canister is connected to the endotracheal tube A 500 cc. bag is attached to the canister and the tail of the bag is used for escape of gas The gas inflow is between the endotracheal tube and the canister. With this setup, the anaesthesiologist can control respiration with one hand, leaving the other hand free for the many things that come up during this type of surgery. This type of anaesthesia can be managed by one person if the procedure is well planned in advance

Non-rebreathing valves have been used but have the disadvantage of constantly requiring both hands for the control of respiration. Fink's modification of the Stephen-Slater valve has obviated this difficulty. This valve has been used satisfactorily on recent patients having this type of surgery. The maintenance of anaesthesia consists of nitrous oxide and oxygen with a total flow of three to four litres The oxygen concentration is kept between 30 and 50 per cent. Ether is added as required Recently, intramuscular succinylcholine in 10 mg doses has been given as required to produce quiet working conditions and prevent deep planes of ether anaesthesia.

The trachea should be aspirated frequently to prevent the accumulation of secretions. Premedication with atropine has made no noticeable change in secretions of these patients and is, therefore, not used

Blood loss is determined by the measurement of blood in the suction bottle and the weighing of sponges. The loss is replaced as accurately as possible.

It has been found helpful to monitor the heart action with an electrocardiophone or an electrocardiograph with or without an oscilloscope.

Postoperatively, the infant is placed in humidified oxygen Frequent aspirations are performed to keep the pharynx free of secretions. The day after surgery, a gastrostomy is done under open-drop anaesthesia.

Case Analysis

An analysis of the cases done at Indiana University from 1940 to 1956 is summarized in Table I. There were a total of 86 newborn infants with this anomaly operated during this period. These included oesophageal atresia with tracheo-oesophageal fistula, oesophageal atresia without tracheo-oesophageal fistula, and tracheo-oesophageal fistula alone. The older patients are not included in this report since the operative risk is hardly the same. Two patients, one and three years of age respectively, had tracheo-oesophageal fistula alone, and both made uneventful recoveries following surgery.

TABLE I

	Without tube (1940-8)		With tube (1948-56)	
	No.	%	No	%
Lived	2	11 7	40	58
Died	15	88 3	29	42
During surgery	2	11.7	0	0
During first 48 hours	8	47	15	21 8
Total no. of patients	17		69	

The over-all mortality in this group was 51 per cent. A comparison of the mortality is listed in two groups since a radical change was made in the anaesthesia management in 1948. Of the 17 patients operated prior to 1948 15 died, whereas only 29 out of 69 patients failed to survive after 1948.

Although the anaesthesia management was of great importance in the increased survival rate, other factors played an important part. Early diagnosis, increased surgical experience, and better preoperative and postoperative care are but a few of the factors which have helped to lower the mortality rate in these patients.

There were 8 deaths in the 1940–8 group during the first 48 hours postoperatively, and 2 patients died on the operating table. The early death rate for this group was 47 per cent. The second group, since 1948, shows 15 early postoperative deaths giving a mortality rate of 21.8 per cent. It is thought that the early mortality rate may be a more accurate index of the effect of improved anaesthetic management.

The three types of anomalies are compared in Table II. The most favourable prognosis is in the group having tracheo-oesophageal fistula without atresia of

TABLE II

Oesophageal Anomalies

	No. of cases	Percentage of total	No. died	Percentage
Atresia with fistula	75	87	37	49
Fistula	7	8	1	14
Atresia without fistula	5	6	4	80
Total	87		42	

oesophagus There were seven of these patients operated with only one failing to survive. Patients having oesophageal atresia without a fistula had the highest mortality rate with only one of five surviving the operation. In these patients, there is insufficient oesophagus to allow for a primary repair. The reconstruction requires more extensive surgery. The most common anomaly is oesophageal atresia associated with tracheo-oesophageal fistula. Thirty-seven of seventy-five patients failed to survive the operation giving a mortality rate of 51 per cent over the entire period.

Other anomalies in addition to oesophageal atresia occurred in 23 patients and are shown in Table III. Imperforate anus was the most common anomaly in this group and occurred in 11 patients. Anomalies of the heart and great vessels were found in 7 patients. Other anomalies included duodenal atresia, absence of the kidney, skeletal deformities, and hypospadius In this group 8 patients failed to survive, giving a mortality rate of 35 per cent.

TABLE III

	Lived	Died	Total
Heart and great vessels	4	3	7
Imperforate anus	8	3	11
Absence of kidney	0	1	1
Skeletal deformities	1	0	1
Haemangioma	1	0	1
Duodenal atresia	0	1	1
Hypospadius	1	0	1
TOTAL	15	8	23

Respiratory complications were listed as the chief cause of death These complications were due to aspiration, atelectasis, pneumonitis with focal degeneration, pulmonary oedema, pneumothorax, or disruption of the anastomosis. A critical analysis of all patients failing to survive shows that there was only one death directly due to anaesthesia. This patient was given 1 mg. of curare during ether anaesthesia. Spontaneous respirations never returned, although ventilation was maintained manually for 24 hours before the patient expired. A suture was placed through the tip of the tube in one case Only slight traction was necessary to remove the tube. The suture was seen by bronchoscopy over the site of the fistula There were no laryngeal complications and, to this date, none has required tracheotomy.

SUMMARY

There appears to be no question about the advantages of endotracheal intubation in the administration of anaesthesia for the repair of oesophageal atresia and tracheo-oesophageal fistula. Controlled respirations provide ideal working conditions when every advantage is needed for working in a small space. Ventilation is maintained even though there may be severe pulmonary disease. Minimal anaesthesia is required. Laryngeal oedema cannot be held as a deterrent with all the advantages to be gained. Finally, the anaesthesiologist is in a position to aid in the early diagnosis.

Résumé

De nombreuses techniques ont été préconisées pour pratiquer l'anesthésie en vue de la correction chirurgicale de l'atrésie de l'œsophage et de la fistule trachéo-œsophagienne Les anesthésiologistes et les chirurgiens ne sont pas encore d'accord sur les avantages qu'il y aurait à pratiquer chez ces malades l'intubation endotrachéale Ceux qui s'opposent à l'intubation donnent pour raison que l'intubation peut provoquer de l'œdème laryngé.

Les auteurs ont analysé les résultats de ces opérations pratiquées chez deux groupes de malades traités pour de telles anomalies dans les hôpitaux universitaires de l'Indiana Dix-sept de ces malades ont été opérés entre les années 1940 et 1948 et seulement deux ont survécu, ce qui fait un taux de mortalité de 88 3%. Chez ces malades, on avait fait une infiltration à la procaine jusqu'à l'ouverture du thorax et, une fois la dissection terminée, on donnait de l'éther en goutte à goutte duant l'anastomose De 1948 à 1956, on a intubé tous les malades et pratiqué de la respiration contrôlée Durant ces années, 69 malades ont été opérés dont 29 sont morts soit un taux de mortalité de 42%

La principale cause de la mort a été les complications pulmonaires. Une analyse critique de ces mortalités démontre qu'il n'y a eu qu'une mort attribuable directement à l'anesthésie

Il ressort que les avantages de l'intubation endotrachéale sont évidents au cours de l'anesthésie en vue de la réparation de l'atrésie de l'œsophage et de la fistule trachéo-œsophagienne. La respiration contrôlée procure des conditions de travail idéales au moment où on a besoin de toutes les facilités pour travailler dans un petit espace Il est possible de conserver une ventilation adéquate en dépit parfois de malades pulmonaires sérieuses. Un minimum d'anesthésie est nécessaire. L'œdème laryngé ne peut pas être considéré comme un obstacle quand on songe à tous les avantages que procure l'intubation.

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