ESOPHAGEAL ATRESIA AND TRACHEO-ESOPHAGEAL FISTULA

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ESOPHAGEAL ATRESIA and tracheo-esophageal fistula received comparatively little recognition or interest from clinicians until the last decade, or so, in spite of the fact that the condition had been described by Durston,[1] in 1670, by Gibson,[2] in 1703, and by Martin,[3] in 1821. It is now realized that the anomaly is quite common. Sir G. Gray Turner[4] has recently estimated that the malformation occurs about as frequently as hare lip and cleft palate. It is undoubtedly true that many infants still die of esophageal atresia without its having been diagnosed.

EMBRYOLOGY

It should be recalled that the esophagus and trachea in early fetal life are one tube. Between the fourth and twelfth week of fetal life this tube becomes divided into two by an ingrowth of mesoderm. During this same period the lumen of the esophagus becomes obliterated by the rapid proliferation and concrescence of its epithelial lining. Later, this solid cord becomes vacuoled, the vacuoles coalesce, and the lumen is reëstablished in the same manner as in the intestine. An arrest in development, or failure of the mesoderm completely to separate the trachea from the esophagus, results in the tracheo-esophageal fistula, while failure of the vacuoles to coalesce results in the atresia of the esophagus.

PATHOLOGY

There is a wide variation in the pathologic findings of these anomalies; in fact, it may be said that no two cases are exactly alike. However, they may be roughly divided into five types, as shown in the diagram (Fig. 1) previously published by Ladd,[5] and described as follows:

"In Type I, the upper portion of the esophagus ends in a blind pouch in the region of the body of the first or second dorsal vertebra, and the lower segment of the esophagus begins again in a blind pouch at the level of the fourth or fifth dorsal vertebra. In Type II, the upper segment of the esophagus ends in a fistulous tract entering the trachea just above its bifurcation, whereas the lower segment is much the same as in Type I. In Type III, the upper segment ends blindly as in Type I, whereas the lower segment is connected to the trachea just above its bifurcation by a fistulous tract. This type and Type

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IV are by far the most common in the reports of the literature as well as in our own experience. Type IV is similar to Type III except that the fistulous tract of the lower segment enters the trachea at its carina instead of just above its bifurcation. In Type V, both the upper and lower segments communicate with the trachea, as shown in the diagram."

CLINICAL FINDINGS

If a newborn infant becomes cyanotic and shows an excess of saliva or frothy mucus in the mouth, the diagnosis of esophageal atresia should be considered. If subsequently the infant vomits all fluid offered, almost immediately

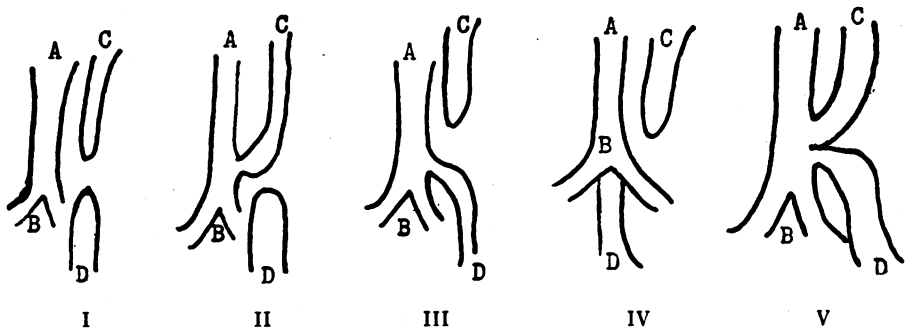

FIG 1.—Diagram showing the arrangement of the trachea and esophagus in the various types of esophageal atresia and tracheo-esophageal fistula.

The letters refer to the following structures: A—trachea; B—bifurcation of trachea; C—upper segment of esophagus; and D—lower segment of esophagus. (From New England Journal of Medicine, 230: 625–637, May 25, 1944.)

after it is given, the diagnosis should be strongly suspected and steps taken to confirm or disprove the suspicion. First, a No. 8-F. or 10-F. soft rubber catheter should be introduced into the esophagus, preferably under the fluoroscope, and if this meets obstruction 10 or 12 cm. from the lips, the diagnosis is confirmed.

ROENTGENOLOGIC EXAMINATION

The diagnosis should now be refined to differentiate between the types of the malformation. This may be done with the help of the roentgen ray. With the soft rubber catheter at the point of obstruction, not more than 0.5 cc. of lipiodol is inserted and watched under the fluoroscope, to determine whether there is any connection between the upper segment of the esophagus and the trachea. If a large amount of lipiodol is introduced into an esophagus that ends blindly, it will be regurgitated and aspirated into the trachea and lungs, and confuse the picture. Of course, this same thing would happen if barium were given, which makes its use contraindicated.

Subsequent to the fluoroscopic examination, a roentgenogram should be

taken of the chest and abdomen. The chest film will demonstrate the level of the blind end of the upper segment of the esophagus, which is an important factor in determining the plan of operation. It will also supplement the physical examination in estimating the amount of atelectasis or pneumonia, which is usually present in these patients. The examination of the abdomen roentgenologically will show the presence or absence of air in the stomach and intestines.

If the patient has a Type I or II malformation, there obviously will be no air in the stomach or intestines (Fig. 2).

Type II may be recognized by the lipiodol entering the trachea from the esophagus, and showing no air in the stomach.

Types III and IV will show air in the stomach and intestines and no lipiodol entering the trachea from the esophagus (Fig. 3).

Type V, of course, will show air in the stomach and intestines but will also show lipiodol entering the trachea from the esophagus.

Roentgenologic examination of the patient will help the surgeon to determine the preferable plan of treatment, but it should be remembered that associated anomalies may be present and should be sought for before the operation is begun.

The associated anomalies, though frequent, are only rarely of importance in the life or health of the child. Table I represents all the anomalies that have been noted in 114 cases. Although these add up to 91 malformations, in some instances more than one anomaly occurred in one patient, and many were not of a serious nature.

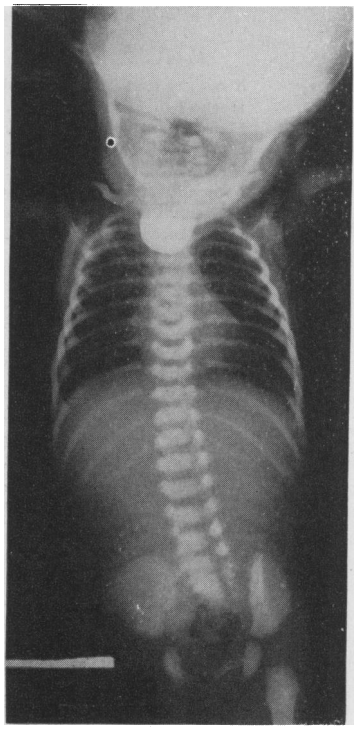

FIG. 2.—Roentgenogram.

In Table II are classified the number of serious malformations which were observed in the 82 patients who have been admitted to The Children's Hospital since 1939 with esophageal atresia. It is estimated that 18 of these malformations either made it necessary to modify the treatment, or caused the death of the baby.

PREOPERATIVE PREPARATION

The preoperative preparation of these patients is important. They almost always have respiratory difficulties (pneumonia, or atelectasis) due to aspiration of saliva and mucus. The infant should be placed in an oxygen tent for the administration of oxygen in high concentration. Then a small soft rubber

catheter is introduced into the pharynx and attached to constant suction. By this means, and keeping the infant in a slight Trendelenberg position, the air passage can be kept fairly clear and respiration made much easier. A small transfusion and parenteral fluids should be given as indicated, care being taken not to overtax the circulation and cause pulmonary edema. Such preoperative preparation will often improve the patient's condition sufficiently to make an operation successful which otherwise would certainly end in disaster.

TABLE I

ANOMALIES ASSOCIATED WITH ATRESIA OF THE ESOPHAGUS

Type	No. of Cases
Atresia or stenosis of the small intestine	7
Meckel's diverticulum	8
Malrotation	4
Imperforate anus	11
Fistula of the rectum	4
Anomalies of the heart and aorta	20
Congenital anomalies of the urinary system	13
Miscellaneous	24

TABLE II

SERIOUS ANOMALIES IN THE LAST EIGHTY-TWO CASES

Type	No. of Cases
Atresia or stenosis of intestine	5
Imperforate anus	5
Congenital heart	13
Anomalies of the urinary tract	2

OPERATIVE APPROACH

All attempts to remedy esophageal atresia with tracheo-esophageal fistula, without direct ligation of the fistula, have failed.

The direct approach to the site of the atresia and fistula may be made through the left back or the right back, and may be transpleural or retropleural. In 1941, Mr. R. H. Franklin[4] performed a primary anastomosis through a transpleural approach, but the patient unfortunately died 17 hours later. At the Children's Hospital this transpleural approach has been used on seven patients. Doctor Swenson used this approach to tie off the tracheal fistula (See Case Report No. 304556) in one patient with other malformations, and the baby survived. Doctor Gross used it on five patients with one successful primary anastomosis and four fatalities, and Doctor Ladd used it once without success.

This transpleural approach has some theoretic advantages. With the long intercostal incision or a resection of a long segment of the fifth rib an excellent

exposure may be obtained quickly with slight injury to the thoracic cage. However, while this approach is made more quickly, the closure is time-consuming and the total operating time is not diminished. Furthermore, if a leak takes place at the anastomosis the chest fills with saliva and gastric contents, and in all cases in which this complication has occurred the outcome has been fatal. If the retropleural approach is used and a similar complication arises, a fistula to the back is established, and in several such instances the baby has survived. We, therefore, prefer the retropleural approach through the right back.

Although Dr. Cameron Haight[6] has reported successful results using the route through the left back, in the two instances in which we have used that approach the result has been fatal. All but two of our favorable results, and the majority of those found in the literature, have been accomplished by retropleural operations through the right back.

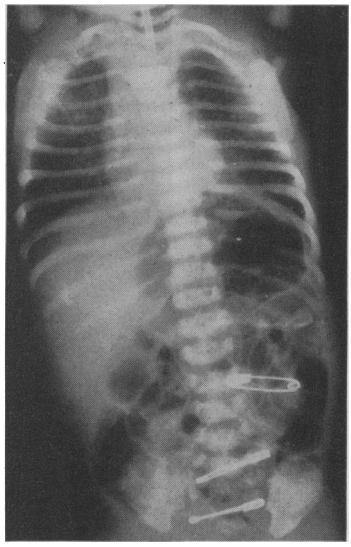

FIG. 3.—Roentgenogram.

TECHNIC OF OPERATION

Cyclopropane has been the anesthesia of choice in our experience. If local anesthesia is used it should be supplemented by a closed system with oxygen to combat collapse of the lung in case the pleura is inadvertently opened. An intravenous needle is inserted into an ankle vein for the administration of blood or fluid during the operation. The patient is placed on the operating table left side down, with a folded towel to give the spine a slight curve with the convexity upward toward the right side. The right arm is abducted to displace the scapula laterally.

An incision is now started at the level of the second rib between the internal border of the scapula and the spine. This incision is carried downward to the level of the sixth rib where it swings laterally for two or three centimeters. After the incision has been carried through the trapezius and rhomboid muscles the scapula is displaced laterally and the ribs exposed. In our earlier cases a rather long section of the fourth rib was resected and short sections of the third and fifth were resected or only cut. More recently, however, a better exposure has been obtained by resecting one to two centimeters of the second to the fifth ribs, inclusive, or the third to the sixth, according to the level of the upper blind pouch of the esophagus. This approach more closely resembles that recommended by Haight.[6]

After the small sections of rib have been resected, the intercostal muscles, with the intercostal vessels and nerves, are tied and cut. The pleura is then carefully freed from the posterior thoracic wall, toward the bodies of the vertebrae. The first anatomic landmark is the sympathetic chain, with its

ganglia. The azygos vein then comes into view, and this is isolated until its terminal trunk is exposed as it crosses the mediastinum. This is then tied and cut. When the two ends are pushed aside, the vagus nerve is readily located and this gives a direct lead to the segments of the esophagus.

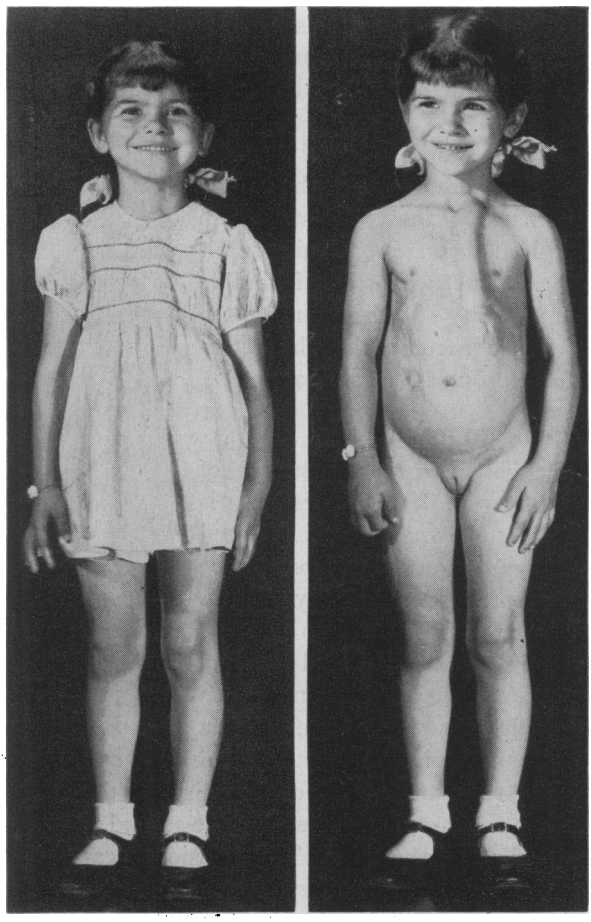

FIG. 4.—This is Doctor Ladd's oldest patient, now six and one-half years of age. She takes a normal diet by mouth, attends school, and engages in all activities of a normal child.

It is at this point that judgment and experience are of value in determining whether to attempt a primary anastomosis, or to perform the simpler operation of tying and cutting the tracheo-esophageal fistula. This decision depends on two factors, the condition of the patient, and the distance between the two ends of the esophagus. If the space between the two segments of the esophagus is much over two centimeters, the possibility of being able to do an anastomosis without tension is not good.

PRIMARY ANASTOMOSIS

When the conditions indicate the desirability of an end-to-end anastomosis, the following steps are taken: First, the upper, blind end is freed well up above the first rib, so that it can be brought to the lower end without tension. Next,

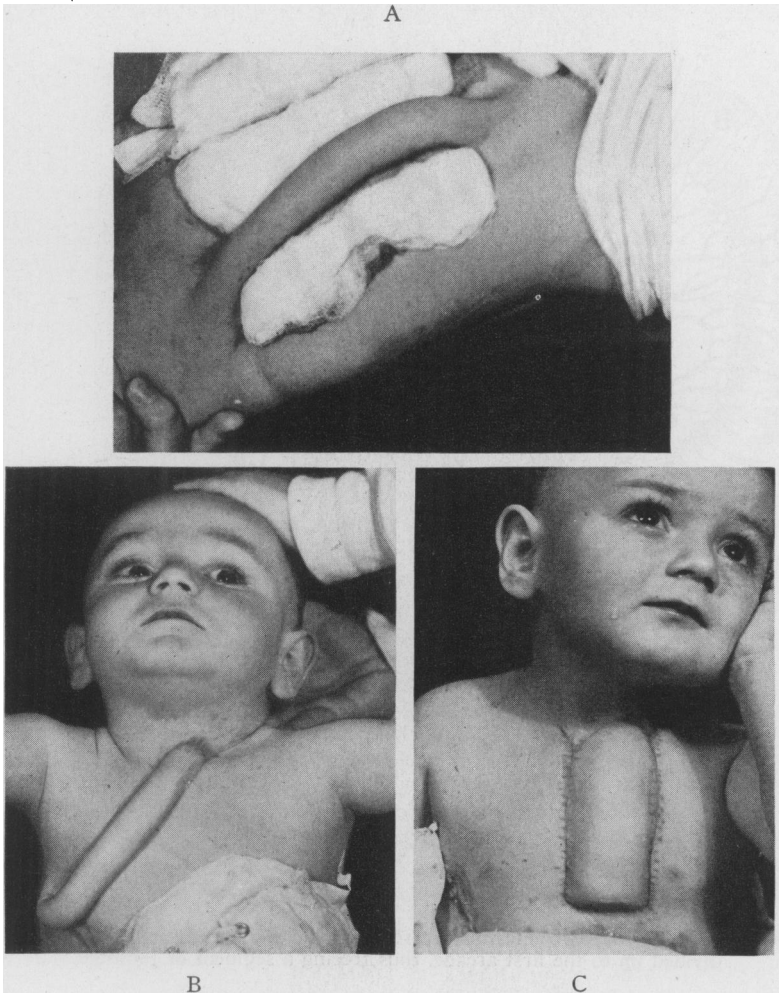

FIG. 5.—A. A rope graft has been made on the right lateral aspect of the chest and right axilla.

B. Three weeks later the lower end of the rope was swung and sutured to a point just above the esophagostomy.

C. The dermic tube has been turned in and covered with the rope graft. The patient is now ready to have a jejunal segment anastomosed to the skin tube.

the lower segment is isolated and is cut away from the trachea almost in the tracheal wall, in order to give it maximum length. As the esophagus is separated from the trachea, the opening into the trachea is closed by a running

suture of fine silk, and this row of sutures is, in turn, covered by a second layer of running sutures of the same material. The final step is the suturing together of the two ends.

In our recent cases, the musculature is first approximated on the back of the esophagus by interrupted fine silk stitches, including muscle layer only.

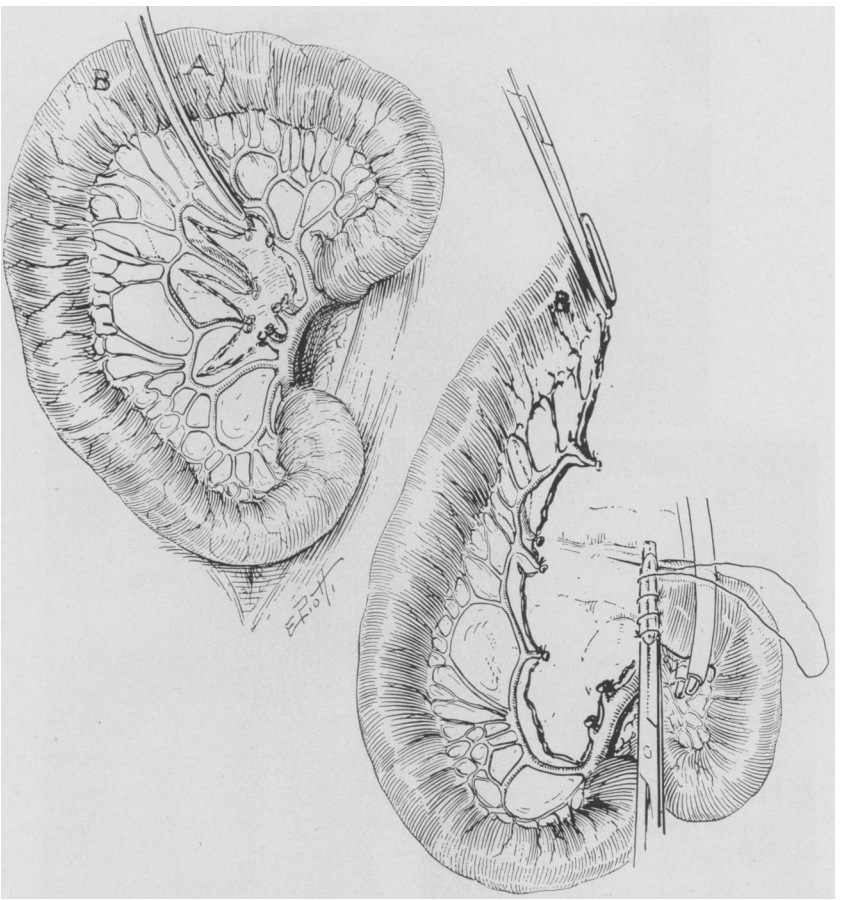

FIG. 6.—Note in drawing two intestinal vessels have been cut and the mesentery has been divided up to the first arcade, thus freeing a segment of jejunum.

Approximation stitches are then placed in the mucous membrane, likewise on the back part of the esophagus. The interrupted sutures are then applied to the front part of the esophagus to complete the closure of the mucous membrane, and following this a second layer of interrupted stitches is applied to the musculature only.

After the anastomosis has been completed, about 10 cc. of penicillin, containing 5,000 units per cc., is placed in the retropleural space, and a small rubber dam drain is inserted to the mediastinum. The opening in the chest

wall is closed to the drain by suturing together, first the intercostal bundles, then the rhomboids, and then the trapezius. Finally, the skin is closed over this with an interrupted or a running silk suture.

In our first successful cases of direct anastomosis, the catheter which was in the upper blind pouch during the operation was introduced into the stomach through the anastomosis and left in place for a week or ten days. More recently, the catheter, which it is desirable to have in the upper segment of the esophagus during the operation, has been removed at the end of the operation. We feel that this diminishes the chance of respiratory infection and of infection of the anastomosis. Postoperatively, the patient's fluid balance is maintained by transfusion of blood or plasma, and by intravenous fluids of saline or glucose. During this period, also, the patient is kept in an oxygen tent. In from 24 to 48 hours, according to the condition of the patient, gastrostomy is performed for feeding. In case there is no leakage from the anastomosis, feedings by mouth are begun at the end of the 10th to 12th day. In case of leakage, feeding by mouth is postponed until the fistula has closed.

MULTIPLE-STAGE

In patients in whom the ends are too widely separated to warrant a primary anastomosis, a multiple-stage procedure is adopted. At the first operation the site of the atresia is approached exactly as described for the operation of primary anastomosis. The lower segment of the esophagus is cut away from the trachea at the site of the fistula, both ends tied, and an over-and-over stitch placed to insure against leakage. This having been done, the chest wall is closed as before.

During the next few days the patient is kept in slight Trendelenberg position and constant suction applied to the upper segment of the esophagus to prevent aspiration of saliva and mucus. In this interim the baby's fluid balance is maintained by intravenous administration of blood or plasma, and saline or glucose solutions. At the end of two or three days, under local or cyclopropane anesthesia, a gastrostomy is performed through a high left rectus incision. This enables the infant to be fed and obviates the necessity of continuing parenteral fluids.

The third stage of the operation is performed one or two days after the gastrostomy, and consists of bringing the upper segment of the esophagus out in the neck. The procedure is to make a small inverted V-shaped incision 1.5 cm. above the clavicle, starting at the midline and carrying it laterally to the left for a distance of 3.5 cm. The trachea is displaced from the operative field by extending and rotating the head to the right. The fibrous band extending downward from the lower end of the upper segment of the esophagus into the mediastinum must be cut before the blind end can be delivered. The esophageal pouch is opened and the cut edges approximated to the skin with interrupted silk sutures. Now the patient can swallow saliva and is no longer in danger of aspiration pneumonia.

After these procedures have been completed, an indefinite period may elapse before the anterior thoracic esophagus is constructed.

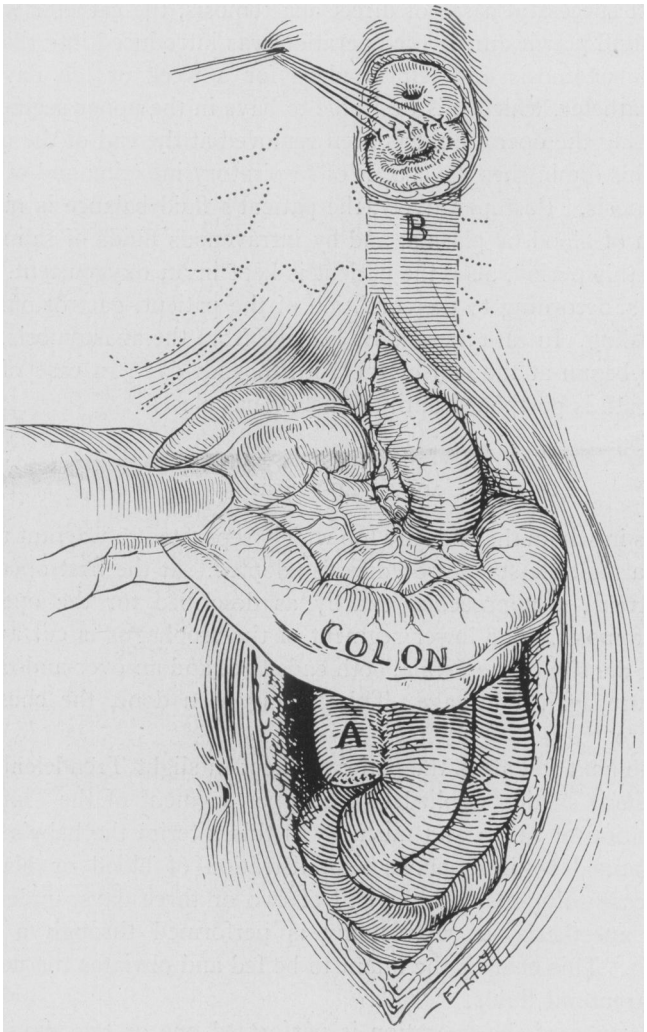

FIG. 7.—The freed segment of jejunum has been tunnelled under the skin of the lower chest wall. The jejunum is being anastomosed to the skin tube. A side-to-side anastomosis has been made between the proximal and distal segments of the jejunum.

ANTERIOR THORACIC ESOPHAGUS

Surgeons have employed many methods of constructing an anterior thoracic esophagus. In our oldest patient, now over six and one-half years old, the stomach and esophagus were connected by an epithelial-lined tube made over the left chest wall and covered by a tube graft taken from the right axilla. The

child upon whom this series of operations were performed is a happy and healthy girl, who takes a varied diet by mouth, goes to school, and leads a nearly normal life. Occasional dilatations of the anastomosis between the skin tube and the stomach are necessary. The details of this method were described in a previous communication[5] (Fig. 4).

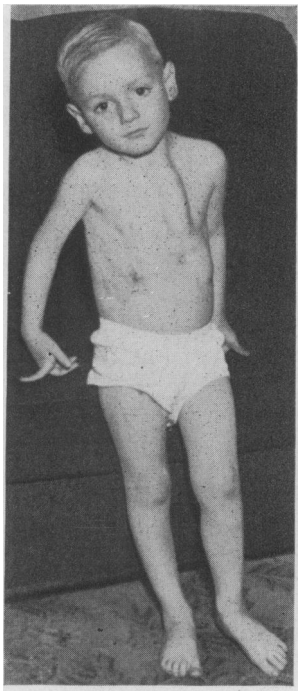

FIG. 8

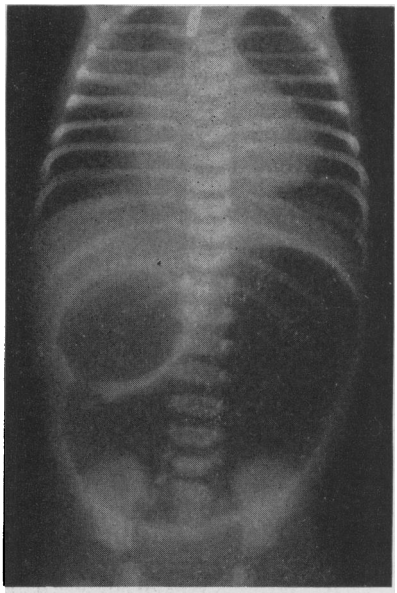

FIG. 9

FIG. 8.—A photograph of patient No. 267162, now four years of age. It is more than a year since completion of the anterior thoracic esophagus. A regular diet is taken without difficulty.

FIG. 9.—Note the catheter in the upper blind pouch, markedly dilated heart, and tremendous distention of stomach and duodenum, with no air in the intestinal tract below the duodenum.

Although anastomosis of the skin tube directly to the stomach has been successful in one case, there are obvious disadvantages. These may be obviated by uniting the skin tube to a jejunal segment. The steps in this operation are as follows: First, a tube or rope graft is elevated in the right axilla and the raw surface underlying this covered by a Thiersch graft. At the end of three weeks the lower end of this tube graft is freed, swung up to the left side of neck and implanted just above the esophagostomy. After approximately another three weeks, when it has acquired adequate circulation, the new esophagus is ready to be constructed. This is done by turning down a V-shaped flap from above the esophagostomy and under the attachment of the tube graft. Next, two parallel incisions are carried downward on the left chest wall. These

release the skin flaps which are turned toward each other and sutured together and to the V-shaped flap of skin which has been turned downward from the neck. Thus, is formed an epithelial-lined skin tube leaving a raw surface outside. The axillary end of the tube graft is now detached, the tube is unfolded and used to cover the raw surface left by making the skin-lined esophagus (Fig. 5).

After these wounds are completely healed, and any induration which may be present has subsided, the next step is to unite a segment of jejunum to this skin tube. This is done through a left rectus muscle-splitting incision extending downward from the costal margin. The proximal loop of jejunum is iden-

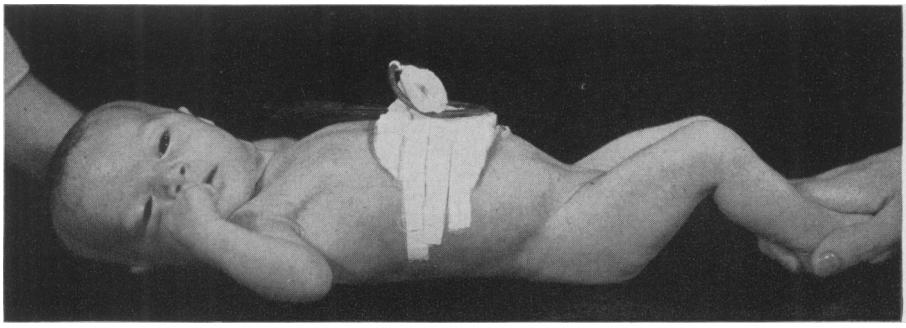

FIG. 10.—Case No. 306150: Fifteen days postoperatively. At this time all feedings were well taken by mouth.

tified and one of the first intestinal vessels is isolated, ligated, and divided as close to the mesenteric artery as possible. The jejunum is divided about six inches from the ligament of Treitz and the mesentery divided from this point on the bowel to the divided mesenteric vessel. Closure of the proximal end of the jejunum is now carried out. The distal segment is free and is usually long enough to extend 6 or 8 cm. on the chest wall above the costal margin. Should the distal segment fail to reach such a position, the mesentery can be freed further by division of a second intestinal artery and vein close to the mesenteric vessels. The avascular portion of the mesentery up to the first arcade is divided, giving sufficient length to the distal segment of jejunum (Fig. 6). The skin of the chest is tunneled under from the cephalic end of the incision to a point under the opening of the skin tube.

An incision is made across the bottom of the skin tube and the overlying skin is separated from the dermic tube. Anastomosis of the skin tube is accomplished by a posterior row of interrupted fine chromic catgut sutures through the serosa and muscular coats of the jejunum to the subcutaneous tissue of the skin tube. A row of chromic catgut sutures is placed through all layers of the jejunum and the skin of the tube. The anastomosis is completed anteriorly by a row of interrupted chromic catgut sutures through the serosa and muscular coats of the jejunum and the subcutaneous tissue (Fig. 7).

This procedure is a combination of parts of technic previously published by Wullstein,[7] Davis,[8] and Ladd.[5]

Providing there is no evidence of inflammation at the site of the dermo-jejunal anastomosis, the patient is given water by mouth on about the tenth postoperative day. In two out of five cases fistulae developed at this point, but both closed spontaneously.

FIG. 11.—This child is now eight months postoperative, and doing well. She is a perfectly normal child, taking a regular baby diet. Dilatations of the esophagus have not been necessary.

The ease with which these patients can swallow liquids and solids is gratifying. Only occasionally is it necessary to promote the emptying of the skin tube by manual pressure.

SUMMARY OF TWO UNUSUAL AND FOUR TYPICAL CASES

Case No. 267162.—Surgeon W. E. L.: This patient was first admitted October 19, 1942, and a diagnosis of esophageal atresia and tracheo-esophageal fistula was made. Exploration of the mediastinum was carried out with ligation of the fistula. Two days following this, gastrostomy and marsupialization of the esophagus were performed. He

did well until the sixteenth postoperative day, when he coughed up some material resembling formula. Reëxploration of the mediastinum demonstrated the reëstablishment of the tracheo-esophageal fistula. This was ligated and divided.

At 15 months of age an anterior dermo-esophagoplasty was performed in three stages. At the age of two years and seven months a jejunal segment was brought up and anastomosed to the skin tube. On the tenth postoperative day liquids were taken well by mouth and the patient was soon able to take solids. It is only occasionally necessary to manually decompress the skin tube. At the age of four years he continues to do well but has had one dilatation of the skin-tube-jejunal anastomosis, which was probably unnecessary (Fig. 8).

Case No. 286815.—Surgeon W. E. L.: This infant had esophageal atresia of Type III and an associated duodenal atresia and congenital heart disease. At the first operation

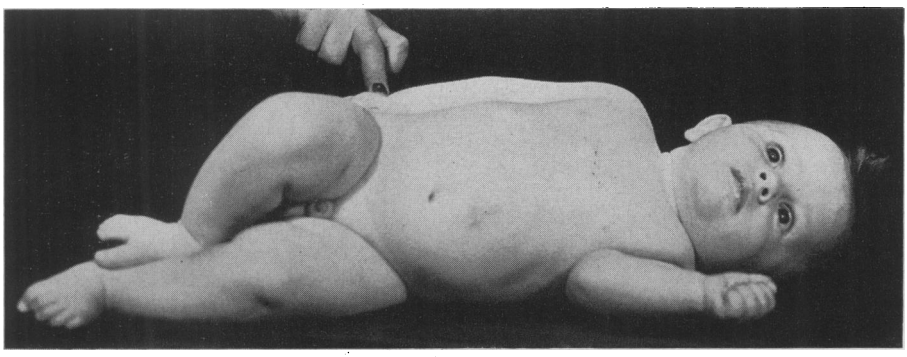

FIG. 12.—This is patient No. 298835 at six months of age, after primary anastomosis of the esophagus. He has no difficulty in taking a normal baby diet. Dilatations of the esophagus have not been necessary.

the tracheo-esophageal fistula was excised and a duodenojejunostomy and gastrostomy performed. A few days later the upper blind segment of the esophagus was marsupialized in the neck. The patient is now two years old, in excellent health, and awaiting the construction of an anterior thoracic esophagus.

Case No. 306150.—Surgeon W. E. L.: This four-day-old baby was admitted with a diagnosis of atresia of the esophagus with tracheo-esophageal fistula. After 24 hours of preparation the mediastinum was explored through a right-sided retropleural approach. A Type III fistula was found, which was ligated and divided. The upper esophageal pouch was about 0.5 cm. above the fistula and when freed could be brought down to the lower segment with little if any tension.

A primary anastomosis was made and postoperatively the baby did well. On the first postoperative day a gastrostomy was carried out under local anesthesia. Feedings by gastrostomy were well tolerated, and on the tenth postoperative day feeding by mouth in small amounts was started. By the 15th day after operation all feedings were taken orally, and the patient had gained in weight by the 16th day. The gastrostomy tube was removed. The baby was discharged on the 18th postoperative day (Fig. 10).

Case No. 297981.—Surgeon O. S.: This four-day-old baby girl was unable to take and retain even small amounts of fluid. Soon after the diagnosis of atresia of the esophagus with tracheo-esophageal fistula was made, and verified roentgenologically, the mediastinum was explored and a Type III tracheo-esophageal fistula was found. The upper esophageal

pouch was on the same level with the tracheo-esophageal fistula, so that a primary anastomosis could be made without tension on the suture line.

Postoperatively, the baby did well, in spite of evidence of congenital heart disease. Gastrostomy was performed under local anesthesia on the second postoperative day. Feedings by gastrostomy were well tolerated, and on the 10th day feedings were gradually started by mouth. By the 12th day all feedings were taken by mouth and the child was discharged home on the 19th postoperative day, where she has continued to do well, gain weight, and take her feedings without difficulty (Fig. 11).

Case No. 298835.—Surgeon O. S.: This four-pound, four-ounce baby boy was admitted to the Children's Hospital at two days of age, with the diagnosis of esophageal atresia and tracheo-esophageal fistula. A mediastinal exploration was performed through a right retropleural approach. A Type III fistula was found and divided. As the two esophageal segments were only one centimeter apart, a primary anastomosis was made.

Postoperatively, the child did well, and on the second day gastrostomy was performed under local anesthesia. He developed bilateral bronchopneumonia and was severely ill for several days. On the 10th day feedings in small amounts were given by mouth. He was discharged on the 30th postoperative day, and has continued to do well at home. He is now eight months old. (Fig. 12).

Case No. 304550.—Surgeon O. S.: This two-day-old baby was admitted with a diagnosis of esophageal atresia and tracheo-esophageal fistula. The abdomen was markedly distended and a roentgenogram demonstrated atresia of the terminal ileum. Bile-stained material was coughed up by the baby.

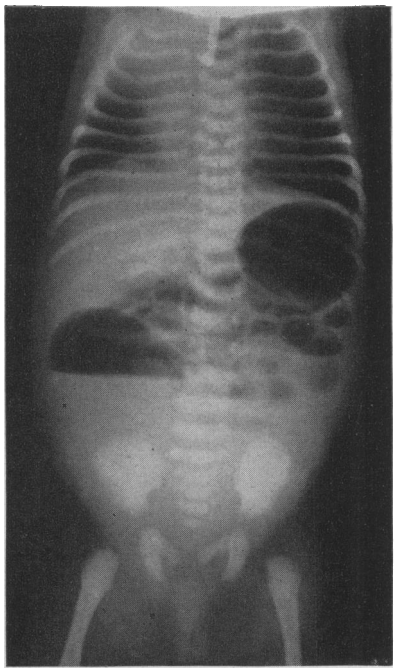

FIG. 13.—Roentgenogram of patient No. 304556. This upright film shows consolidation consistent with pneumonia or atelectasis, and evidence of atresia of the lower ileum.

Through a transthoracic approach the tracheo-esophageal fistula was ligated and divided. Although the upper esophageal segment was within 1.5 cm. of the fistula a primary anastomosis was not done, as the time consumed would have been prohibitive. A long abdominal incision was made, and a malrotation and atresia of the ileum with a minute cecum and colon were found. The terminal ileum ended in a bulbous sac about five centimeters in diameter. The malrotation was corrected and the terminal bulbous ileum was resected with a Mikulicz spur between the terminal ileum and cecum. A gastrostomy was also made. Nineteen days later the ileostomy was closed. Two weeks later a primary anastomosis of the esophagus was made through a retropleural approach. Ten days later feedings were well taken by mouth. The patient continued to do well, and was discharged taking all feedings by mouth and gaining weight (Fig. 13).

RESULTS

Since January, 1939, 82 cases of esophageal atresia have been seen at the Children's Hospital. Of this number, 76 have been operated upon by Ladd.

Gross, and Swenson. Four of the remaining six cases were moribund at the time of admission to the hospital, dying within a few hours. Two with multiple associated anomalies, operated upon by other members of the staff, will not be included in the consideration of the results. Table III shows the results obtained in this series of 76 cases.

TABLE III

SUMMARY OF CASES OF ATRESIA OF THE ESOPHAGUS WITH TRACHEOESOPHAGEAL FISTULA AT THE CHILDREN'S HOSPITAL JANUARY 1940 - JULY 1946

	NUMBER OF CASES MULTIPLE STAGE OPERATION		NUMBER OF CASES PRIMARY ANASTOMOSIS		TOTAL NUMBER OPERATIONS			
SURGEON	LIVING	DEAD	LIVING	DEAD	LIVING	DEAD	MORTALITY	REMARKS
LADD	15	21	4	7	19	28	59 %	ONE DEATH RESULTED FROM PERITONITIS AFTER THE COMPLETION OF AN UNSATISFACTORY ANTERIOR THORACIC ESOPHAGUS. ONE DEATH WAS OF UNKNOWN CAUSE FOLLOWING IMMUNIZATION FOR MEASLES, ALSO AFTER THE COMPLETION OF ANTERIOR THORACIC ESOPHAGUS.
GROSS	0	3	4	10	4	14	76% *	THREE DEATHS OCCURRED IN PRIMARY ANASTOMOSIS CASES BY THE TRANSPLEURAL ROUTE. ONE HAD OTHER SERIOUS MALFORMATIONS. *ONE PATIENT WHO HAD DUODENAL STENOSIS HAD AN ABDOMINAL OPERATION ONLY DIED AND IS NOT INCLUDED IN THE TOTAL CASES.
SWENSON	1	3	6	1	7	4	36%	ONE SURVIVING PATIENT HAD AN ILEAL ATRESIA AND FIRST THE TRACHEAL FISTULA WAS TIED OFF BY THE TRANSPLEURAL ROUTE AND LATER A PRIMARY ANASTOMOSIS BY THE EXTRAPLEURAL APPROACH WAS CARRIED OUT
TOTAL	16	27	14	18	30	45	60%	

COMMENTS

The time has obviously passed when obstetrician, or pediatrician, should advise parents of infants with esophageal atresia that nothing can be done for them. The time has now come when alertness in making an early diagnosis of this disease may lead to successful treatment. Obstetricians and pediatricians have the opportunity of seeing these patients first, and mortality in the future will depend to a large extent on their quick recognition of the condition and prompt transfer of the patient to a hospital equipped to care for the child properly.

The operation of primary anastomosis, done *via* an approach through the right back, is beyond question the operation of choice when feasible. Our recent results strongly suggest that the suturing should be done with two rows

of interrupted fine silk sutures, one to the mucous membrane and one to the musculature. This belief agrees with the experimental work done by Swenson and Magruder[9] in suturing the esophagus in animals. To avoid strain on the suture line, it may be supplemented by the whip-stitch previously described by Ladd[5] or perhaps better by fixing the upper segment of the esophagus to the fascia of the chest wall (as practiced by Swenson). The use of penicillin locally in the mediastinum, followed by the administration of penicillin and sulfadiazine, as well as elimination of the catheter through the anastomosis, have probably been factors in reducing the mortality due to infection. Our last seven cases of primary anastomosis record no deaths.*

The multiple-stage operation should be employed only in those patients in whom the two ends of the esophageal segments are so far apart that they can not be sewed together without tension, or in those patients who have serious associated anomalies, or who for some other reason are particularly bad risks. The multiple-stage procedure requires prolonged hospitalization and much patience on the part of the surgeon. However, as a method of the immediate avoidance of a fatality, it has its place. We have now five cases in which the anterior thoracic esophagus has been completed. It is functioning satisfactorily in four of them, and we feel should function well in the fifth but for the child's being mentally deficient. We have 11 other patients awaiting the construction of an anterior thoracic esophagus.

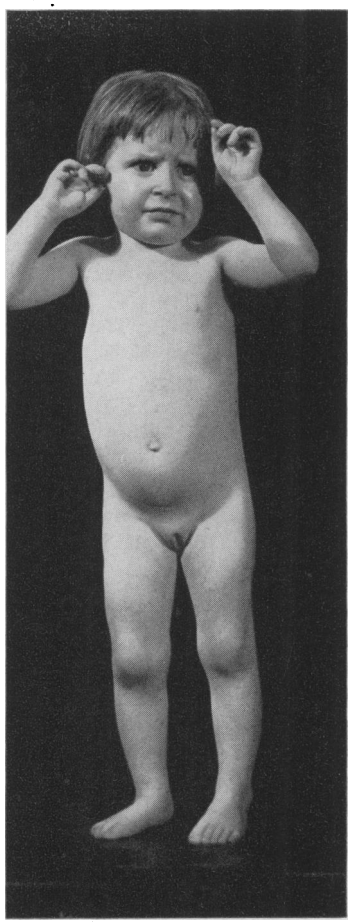

FIG. 14.—This three-year-old child is the oldest living patient of Doctor Ladd, with a primary anastomosis, in our series. She is a perfectly normal child, taking a regular diet. Dilatations were performed during the first year. They have not been necessary during the past two years.

The senior writer feels that in the early part of the series he made mistakes in both directions in the selection of plan of operative treatment. That is, he has attempted primary anastomosis in some cases where the multiple-stage procedure was indicated in view of present knowledge, and *vice versa.* In the latter part of the series, both writers have profited by early mistakes. As the result of our experience, the mortality from esophageal atresia should be still

* Since submitting this communication for publication, there have been an additional seven cases, with one death.

further reduced. There undoubtedly will continue to be an appreciable mortality due to associated anomalies incompatible with life.

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