CASE REPORTS


Treatment of Agenesis of the Diaphragm and Esophageal Crura
An 18-Year Follow-up

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When complete prosthetic replacement of a missing vital body part with an implant is done for the first time, serious questions arise: Will the prosthesis expand as the implant grows? If not, will bodily deformity result from the restrictions, thereby making eventual replacement of the prosthesis necessary?

In considering a prosthetic implant to replace a missing left diaphragm and esophageal crura, it was felt that a porous mesh prosthesis rather than a solid one would adapt best to an infant's growth. This hypothesis was supported by experiments in animals in which growth of surrounding tissues into mesh implants suggested that such a prosthetic implant would continue to change in size and contour in accordance with the animal's growth. Studies by Debakey and co-workers had shown that a porous Dacron graft used to replace the aorta of a patient had enlarged with the patient's own growth. It appeared that secondary replacement would not be necessary. This approach, it was hoped, could be applied to the replacement of other bodily parts. An 18-year follow-up report of such a case, examining these points, is presented.

Report of a Case

A newborn infant presented 18 years ago in a moribund cyanotic state with a scaphoid abdomen and poor chest expansion on both sides but more limited on the left. Breath sounds were absent on the left side of the chest and no masses were palpable in the abdomen. X-ray studies showed abdominal viscera in the left side of the chest, with a compression of the right lung that was consistent with a large congenital diaphragmatic hernia. An emergency laparotomy was done 12 hours after birth, and instead of a partial diaphragmatic defect, a complete absence of the left diaphragm and esophageal crura was found. Also, the stomach and large portions of the small bowel and colon were protruding into the chest, pushing the mediastinum to the right (Figure 1). With not even a remnant of diaphragm, it was apparent that some type of implant was necessary. With the use of a solid prosthesis or impermeable fine mesh, it was probable that, even with a successful implant, the prosthesis might have to be changed later as the infant grew. It was hoped that a porous mesh Dacron graft would enlarge with the child's growth, making this replacement unnecessary.

A preclotted graft was sewn to the periosteum of the ribs and the synthetic esophageal crura, sutured to the small neonatal esophagus, fashioned to keep the stomach in the abdominal cavity. An effective air-tight seal soon formed a new diaphragm, and within two weeks the rudimentary lung expanded and the infant was discharged in a satisfactory condition on the 19th postoperative day.

The mesh diaphragm and esophageal crura became a vital part of the child's own tissues and expanded with the child's normal growth pattern. Periodic x-ray studies of the chest showed that the synthetic graft was continuing to expand as the child grew; thus, deformity was prevented. At 18 months of age, x-ray studies (after oral administration of barium) showed that the synthetic mesh esophageal crura, which had now become an inherent part of the child's tissues, were continuing to function to prevent esophageal reflux (Figure...
This expansion with maintenance of function has continued to adulthood—the patient is now 18 years of age (Figure 3).

When the child was 6 years old, an operation to excise a scarred atretic testicular remnant adjacent to the left kidney permitted visualization of the new diaphragm and esophageal crura. The left diaphragm was intact and, although the area was now several times the size of the original graft, the margin of the prosthesis was not discernible on the smooth fibrous area forming the new diaphragm. Downward passive movement of the diaphragm was discernible each time the lungs were inflated by the anesthesiologist, indicating that the prosthesis was flexible and not simply a stiff partition. The synthetic esophageal crura had also expanded such that no constriction was present at the esophageal junction; instead, they appeared like normal innate crura and were acting as an efficient mechanism to keep the stomach below the diaphragm and to prevent reflux. The growth of the new diaphragm had continued as in a normal structure.

At 18 years of age the patient is 6 feet tall, has

Figure 1.—A roentgenogram of the chest taken 11 hours after birth, showing multiple viscera in the left side of the chest and compression of the right lung.

Figure 2.—A roentgenogram of the chest (following oral administration of barium) taken when the patient was 18 months of age, showing intact prosthetic diaphragm and esophageal crura expanding with the child's growth but continuing to prevent esophageal reflux.

Figure 3.—A roentgenogram of the patient's chest at 18 years of age, showing full adult growth of intact grafted diaphragm and esophageal crura from the small implant placed 12 hours after birth.
an above average exercise tolerance in a three-mile run and plays the trumpet in an orchestra. X-ray studies of the upper gastrointestinal tract, including Trendelenburg positioning, show that the Dacron esophageal crura have enlarged in correlation with the young man's normal growth and still maintain correct abdominal positioning of the stomach to prevent esophageal reflux.

Comment
The small Dacron porous graft used for the esophageal crura and diaphragm continued to enlarge in a normal growth and contour pattern over 18 years, acting as an efficient mechanism to prevent esophageal reflux. Because the graft expanded in normal stages esophageal obstruction did not occur. The gradual enlargement of the synthetic diaphragm prevented deformity of the rib margin, and the diaphragm was able to move passively as in an inherent structure without phrenic innervation.

Summary
Synthetic Dacron mesh used to replace the congenitally absent esophageal crura and diaphragm enlarged as part of a normal growth pattern over 18 years from the patient's birth to adulthood. This suggests that the growth and contour pattern of a small mesh graft in a newborn may be favorably influenced by ingrowth of the surrounding tissues, leading to a large, normally contoured graft in the adult as occurred in this first reported case of successful treatment for agenesis of the diaphragm and esophageal crura.

REFERENCES

Treatment and Prevention of Pelvic Infection
Can we start to prevent infectious processes? Yes, we can. We have to think about what we are doing. Can we lower the amount of bacteria? Yes, we can if we use a lavage in some of our patients, if we select our patients appropriately and if we drain correctly. We should not use, for example, a two-way drain (such as a Penrose). If we can use a closed vacuum system, it does lower wound infection. . . . What I use primarily is a cholecystectomy T-tube. It works very nicely. If you are doing an abdominal hysterectomy, you can use a #16 T-tube. It will fit very nicely on a Hemovac. . . . There are other closed-system drains that can be used; these are far superior to the Penrose type of drainage. Can we do other things? Yes, we can. What about shaving our patient just before the operative procedure? Here again, looking at close to 40,000 wounds has shown that shaving the night before doubles the clean-contamination rate. . . . What has been shown very recently is that the last and most important step is that the oxidating metabolic step that is required for bacterial killing is inactivated in the reducing environment of abscess and of deep soft tissue infection. But most important, we need to go back to some of the teachings of Semmelweis and Halsted: we must maintain good surgical techniques, not leave large pedicles, not leave dead space, utilize minimal amount of surgical material, understand what a foreign body (such as an IUD) really is and think about what we are doing to our patients. Then, we can start to understand infection and start to prevent it.

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Extracted from Audio-Digest Obstetrics and Gynecology, Vol. 27, No. 17, in the Audio-Digest Foundation’s subscription series of tape-recorded programs. For subscription information: 1577 East Ceyx Chase Drive, Glendale, CA 91206.