The Application of Vascular Technology to Esophageal and Airway Strictures

By Brian F. Gilchrist, Richard Scriven, Julie Sanchez, Thomas Panetta, Donald Klotz, Minh Nguyen, and Max L. Ramenofsky
Brooklyn, New York

Background/Purpose: Strictures of the esophagus and airway tract can be dilated if the strictures can be traversed and dilators passed. Unfortunately, using standard methods, not all strictures can be traversed. The authors set out to find a safe, expeditious, and reproducible way to traverse otherwise impassable strictures of the esophagus and airway.

Methods: Eight patients (n = 8), over a 2-year period, with strictures were entered prospectively into the study. One patient (n = 1) had a main stem bronchial stricture, and 7 patients (n = 7) had esophageal strictures from the following etiologies: esophageal atresia/tracheoesophageal fistula (EA/TEF) repair, Lye ingestion (n = 2), EA/TEF with gastroesophageal reflux, esophageal atresia without fistula, lye ingestion with colon interposition (n = 2), and iron pill inhalation lodged in left main bronchus. None of the strictures could be passed with conventional maneuvers or instrumentation including endoscopy, guide wires, Fogarty catheters, and filliform and followers. Results of barium studies showed no flow into the stomach. In the bronchial case, no lumen could be identified at bronchoscopy.

Results: Utilizing the "Vascular Surgery Glidewire/Berenstein Catheter System" under fluoroscopy and utilizing the "spinning top" dynamic maneuver intrinsic to this system, all of the strictures were traversed easily. The passage of the wire/catheter system thus allowed sequential dilation of the previously impassable strictures. The mean time to cross the strictures with the wire/catheter system was 1 minute, 10 seconds. (t = 70 seconds). All of the procedures were done in the operating room under general endotracheal anesthesia by the same 2 attending pediatric surgeons.

Conclusions: The use of vascular surgical technology in difficult, otherwise impassable strictures of the esophagus and upper airway proved to be an extremely effective, easy-to-perform, and reproducible method of therapy. This procedure may obviate the need for resectional surgery in this setting.
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INDEX WORDS: Esophagus and airway stricture, glidewire, Berenstein catheters.

ESOPHAGEAL AND BRONCHIAL strictures can differ greatly in magnitude.[1,2] Some are managed easily with simple bougienage.[3] Many, however, need balloon dilation,[4] whereas others need more complex interventions such as endoscopic-guided dilation.[5-7]

There exists, however, strictures that are so profound that they are impassable.[8] Previously, the only option for these patients was resection and reconstructive surgery.[9,10] Our objective was to find a way to preserve the native conduits or to preserve a surgically placed conduit such as a colon interposition or a gastric tube. Using vascular surgical technology,[11] we have developed a technique for passing through strictures that previously were impassable.

MATERIALS AND METHODS

Seven patients with profound esophageal strictures were treated using the techniques described below. One patient with a profound left main stem bronchial stricture also was treated with our technique. The causes and the pertinent data for each child are noted in Table 1.

None of the strictures could be passed using conventional maneuvers or instrumentation including endoscopy, guide wires, fogarty catheters, or filliform and followers. Results of barium studies showed complete obstruction in all of the esophageal cases. Bronchoscopy, both rigid and flexible, in the bronchial case, could not identify a lumen.

All of the procedures were done in the operating room by the same 2 staff pediatric surgeons. The patients were placed under general endotracheal anesthesia. The equipment used to cannulate the strictures was the Glidewire/Berenstein Catheter System (Medi-Tech, Watertown, MA). The Berenstein catheter (Angio-dynamic Co, Queensboro, NY) is 5F in diameter, 65 cm in length, and has no side holes. A Microinvasive glidewire was placed within the Berenstein catheter. The glidewire is 150 cm in length and has diameter of 0.89 mm. The tip style is a 3-cm straight type.

The system is prepared first by infusing 5 mL of normal saline into the Imager Berenstein torque catheter. The infused saline decreases the coefficient of friction, thus allowing easy manipulation of the glidewire within the Berenstein catheter. Under fluoroscopy, the catheter with the glidewire within it is advanced through the mouth. When the obstruction is met, the catheter is pulled back, and 2 cm of guide wire is unsheathed. The guide wire is spun in a pill-rolling fashion between the thumb and the index finger. This creates a "spinning top" dynamic that glides the wire over the surface of the obstruction.

From the Division of Pediatric Surgery, The State University of New York, Brooklyn, NY.

Address reprint requests to Brian F. Gilchrist, MD, Pediatric Surgery, The Floating Hospital for Children, 750 Washington St, NEMC #344, Boston, MA 02111.

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Table 1. Patients With Impassable Strictures of the Esophagus and Airway, the Causes and Locations

Organ	Age of Insult	Insults	Associated Anomalies
Esophagus	15 yr	Lye/colon interposition	None
Esophagus	2 yr	Lye/Prox. esophagus	None
Esophagus	In utero	EA/TEF Crack cocaine	Cerebral anoxia
Esophagus	2.5 yr	Lye/colon interposition	None
Esophagus	Newborn	Long gap/TEF	Trisomy 21
Esophagus	Newborn	EA without fistula	Trisomy 21
Esophagus	Newborn	Pure EA	None
Bronchus	2 yr	Aspirated iron pill Left main stem bronchus	None

Abbreviations: EA, esophageal atresia; TEF, tracheoesophageal fistula.

The glidewire ultimately finds a "purchase" in what had previously been an imperceptible luminal orifice. Gentle pressure is exerted on the Berenstein catheter, and the glidewire is passed distally under fluoroscopic visualization. Once the glidewire passes, the Savory-Gilliard coronary artery dilators (Angio-dynamic Co) are passed over the glidewire sequentially to dilate the stricture.

RESULTS

All of the strictures were dilated successfully using this technique. Each patient required only one session. The Mean time for the procedure was 70 seconds. There were no complications, and each of the patients was able to tolerate a full diet by mouth after the dilation. The bronchial obstruction was dilated fully with subsequent full lung expansion.

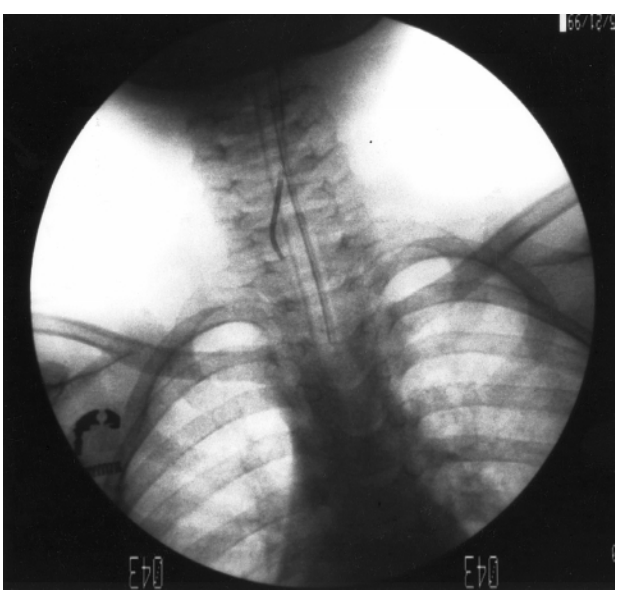

Fig 1. The glidewire probes the stricture site through the Berenstein catheter.

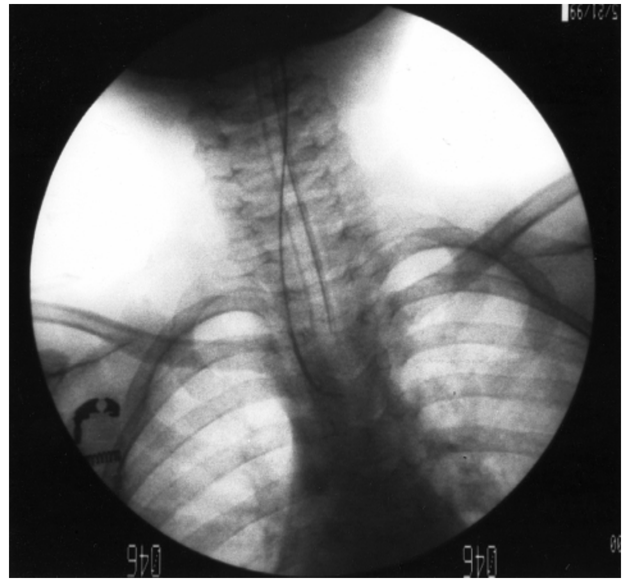

Fig 2. The Berenstein catheter and glidewire encounter the obstruction.

DISCUSSION

We have utilized vascular surgical technology and applied it to one of the most difficult problems seen in pediatric surgery. Essentially, our technique is a Seldinger[11] variant applied to upper digestive tract strictures and in one case a stricture of the airway. The unique spinning top dynamic of this system enables the surgeon to locate an opening that other approaches could not discern.

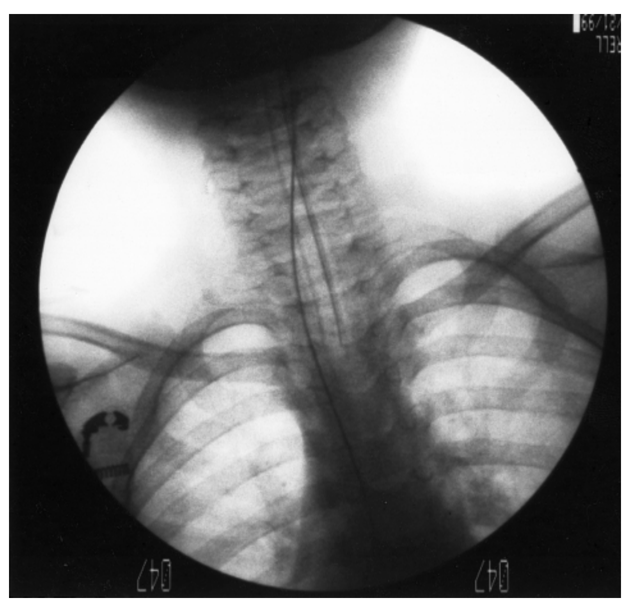

Fig 3. The glidewire has passed through the previously unpassable stricture. The Savory-Gilliard coronary dilators are then placed sequentially over the glidewire. Savory-Gilliard dilators range in size from 15F to 45F and range in length from 5 to 70 cm.

Our technique is simple in concept, execution, and reproducibility. The procedure was done by 2 staff pediatric surgeons and required almost no learning curve other than verbal coaching by our vascular surgeon. The time needed to reestablish passage was remarkably short, 1 minute, 10 seconds. It also is perfectly successful to date.

The fact that we can now pass through strictures previously found to be impassable, speaks well for the future of those with profound strictures. No one would ever choose a replaced esophagus over a native one, and this technique adds to our ability to effectuate this end.

Certainly, long-term follow-up is necessary for all of our patients. We will report on these long-term results including whether repeat dilation is necessary. We will continue to add patients to our series, and although we did not quantify the length of the stricture, certainly we will continue to apply this system to more difficult cases of longer strictures to determine if there are limitations.

Our institution is a tertiary referral center for the Caribbean Islands, where lye ingestions currently mimic the magnitude and number seen in the earliest times in the United States.[12] Thus, we are certain to have multiple opportunities to continue testing this heretofore-successful technique for profound strictures of the esophagus and airway.

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