Balloon Dilatation of Esophageal Stenosis in Children

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Balloon dilatation of benign esophageal strictures is an accepted mode of therapy in adults. This report describes balloon dilatation in 20 consecutive infants and children. The lesions treated include 11 strictures at surgical anastomotic sites, seven restrictive Nissen fundoplications, and three nonanastomotic esophageal strictures. One patient had two lesions. Most dilatations were performed on an outpatient basis without anesthesia. All strictures responded immediately to dilatation. In most cases, long-term resolution occurred after three or fewer procedures. A subgroup of patients was identified in which a prolonged course of treatment was needed. These included patients with long strictures due to esophageal atresia, patients with chronic severe esophagitis, and patients with strictures at the site of esophageal perforation. No significant complications were encountered.

Balloon dilatation of esophageal stenosis in children is effective and safe and should be considered before other methods of treatment are used.

Dilatation of esophageal stenosis by means of an inflatable balloon catheter under fluoroscopic control has been an established mode of therapy in adults [1–5], and use of this approach in children has been described [6–8]. We report our experience with 20 consecutive infants and children who received 68 dilatations for 21 esophageal stenotic lesions.

Subjects and Methods

Between October 1984 and January 1987, 20 infants and children with symptomatic esophageal stenosis were referred for balloon dilatation. In total, 68 dilatations were performed for 21 lesions using polyethylene Grüntzig balloon dilating catheters (Medi-tech, Watertown, MA). Summaries of the clinical courses of these patients are presented in Table 1.

Eleven of the strictures occurred at the site of a surgical anastomosis for the repair of esophageal atresia. In four instances, diagnosis and subsequent balloon dilatations of anastomotic strictures were precipitated by episodes of obstructive esophageal foreign body when the patients were 1–4.5 years old. In three cases, esophageal strictures were caused by esophagitis of various causes. Seven patients had restrictive Nissen fundoplications. Four patients had previous endoscopic bougienage.

Patients injested nothing orally for at least 4 hr before the procedure. All balloon dilatations were performed in the radiology suite under fluoroscopic control and were continuously monitored by ECG; frequent suction also was used. General anesthesia was used on one occasion in the early phase of the study; otherwise, no sedatives were used.

A red rubber catheter was introduced through the mouth or nose and was positioned at the proximal aspect of the stricture. An angiographic guidewire with a soft tip was then passed through the catheter and across the stricture. The tip of the guidewire was left in the stomach until the dilatation was completed. The red rubber catheter was replaced by a Grüntzig balloon dilating catheter, which was passed over the guidewire. The size of the initial dilating balloon was chosen on the basis of the estimated caliber of the esophagus, which was determined by the initial barium swallow.

In neonates, the first dilatation usually was made with a balloon that was 6–8 mm in

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TABLE 1: Balloon Dilatations in Children

Patient No.	Age[a]	Gender	Abnormalities		Balloon Catheter Dilatation				Result (follow-up period)
			Primary	Associated	Postop. Interval	Number of BCD	Maximum Diameter (mm)	Maximum Pressure (atm)	
1	1 mo	F	EA/distal TEF	None	3 wk	2	8	4	Resolved (21 mo)
2	1 mo	M	EA/double fistulae	None	3 wk	4	10	6	Resolved (12 mo)
3	2 mo	M	EA/double fistulae	Anastomotic leak	7 wk	5	12	8.5	Resolved (13 mo)
4	3 mo	F	EA	GER	2 wk	12[b]	10	10	Reanastomosed in 18 mo
5[c]	6 mo	F	EA/distal TEF	GER (Nissen)	6 mo	5	15	5	BCD at 2- to 3-mo intervals
	1.5 yr		Nissen	EA/distal TEF and GER	9 mo	1	15	3	Resolved (6 mo)
6	3 yr	M	EA	GER	9 mo	5[b]	18	5	BCD at 2- to 3-mo intervals
7	11 yr	M	EA/distal TEF	Colonic interposition	10 yr	7[b]	15		Reanastomosed in 2 yr
8	1 yr	M	EA/distal TEF	Foreign body	1 yr	1	12	4	Resolved (8 mo)
9	1 yr	F	EA/distal TEF	Foreign body	1 yr	2	18	5	Resolved (27 mo)
10	2 yr	M	EA/distal TEF	Foreign body	2 yr	3	12	3.5	Resolved (20 mo)
11	4.5 yr	M	EA/distal TEF	Foreign body	4.5 yr	1	12	3.5	Resolved (5 mo)
12	2 yr	F	Caustic esophagitis	None	1 yr	1	10	3	Endoscopic dilatation
13	5 yr	M	Radiation esophagitis	None	3 yr	7	18	3.5	Died of unrelated cause
14	7 yr	F	*Candida* esophagitis	None	5 yr	1[b]	15	3	BCD at 6-wk intervals
15	1.5 yr	M	Nissen	None	11 mo	3	15	6	Nissen removed
16	1.5 yr	M	Nissen	None	8 mo	3	12	4	Resolved (15 mo)
17	2 yr	M	Nissen	None	7 mo	1	15	3	Resolved (8 mo)
18	2.5 yr	F	Nissen	None	2 wk	1	10	3	Resolved (8 mo)
19	1.5 yr	F	Nissen	None	3 wk	1	12	9.5	Resolved (15 mo)
20	2 yr	M	Nissen	None	17 mo	1	10	3	Resolved (21 mo)

Note.—BCD = balloon catheter dilatation; atm = atmospheric pressure; EA = esophageal atresia; TEF = tracheoesophageal fistula; GER = gastroesophageal reflux; Nissen = restrictive Nissen fundoplication; wk = week; mo = month; yr = year.

[a] Age at time of the first balloon catheter dilatation.

[b] History of endoscopic dilatation.

[c] This patient had two lesions. She developed an obstruction at the site of the Nissen fundoplication, which was performed for gastroesophageal reflux.

diameter; in infants, the balloon diameter was 10–12 mm. The size of the balloon was increased in increments of 2 mm for each subsequent dilatation. With the balloon portion of the catheter at the stricture, the balloon was slowly inflated with dilute contrast material to specified pressures for each balloon; a pressure gauge was used to monitor the pressures. Balloon displacement was obviated by using a 4-cm-long balloon. The inflation was maintained for 60 sec and then repeated three times during each dilatation. After removal of the catheter and wire, the integrity of the esophageal lumen was confirmed by esophagram.

In patients with a gastrostomy who required repeated balloon dilatation, a thin Silastic catheter was retrieved through the gastrostomy by the guidewire and the ends of the line were tied for future access. The entire process was accomplished within 30 min. The patients were allowed to drink after the procedure was completed.

Results

Among 11 patients who had had anastomotic stricture after esophageal atresia repair and who had completed a course of three or fewer dilatations, seven were free of symptoms 5–27 months after the procedures. Two patients continued to need intermittent dilatation, and two required further surgical correction.

Those patients who failed to achieve long-term relief after the third balloon dilatation were readily identified as having complex abnormalities, including a missed proximal tracheoesophageal fistula (one), a proximal fistula and postoperative anastomotic leakage (one), severe gastroesophageal reflux (three), isolated esophageal atresia with a long gap (two) (Fig. 1), and a colonic interposition complicated by postoperative leakage (one).

Patients with tracheoesophageal fistula who presented with an esophageal foreign body in late infancy but who had no immediate postoperative symptoms (four) responded well to balloon dilatation (Fig. 2).

All but one of the seven patients who underwent balloon dilatation for restrictive Nissen fundoplication were free of symptoms after three or fewer balloon dilatations (Fig. 3). Two developed small, asymptomatic para-Nissen herniae after balloon dilatation. Patient 15 underwent three balloon dilatations without relief of obstructive symptoms, and the Nissen fundoplication was surgically removed.

Among three patients with chronic esophagitis from various causes, two had temporary palliation after balloon dilatation. One patient who had proximal esophageal stenosis caused by caustic ingestion could not tolerate the procedure because of the development of upper-airway obstruction. One patient who had chronic esophageal stricture from previous radiation therapy for a malignant spinal teratoma died of an unrelated cause after eight balloon dilatation procedures over a period

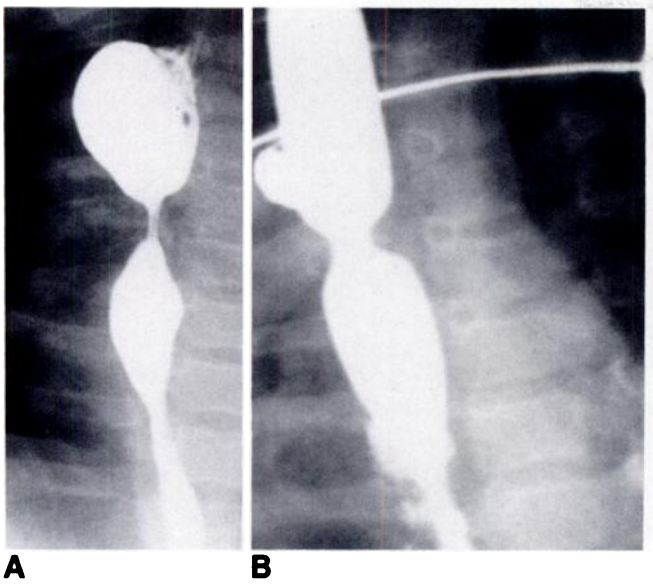

Fig. 1.—Case 4: 3-month-old girl with isolated esophageal atresia without fistula.

***A*, Barium study performed 1 month after delayed anastomosis showed severe stenosis at site of anastomosis. Despite multiple balloon catheter dilatations with temporary symptomatic relief, patient required another anastomosis at age 18 months.**

***B*, 10-mm balloon inflated to 3 atm of pressure shows persistent "waist" at stenosis.**

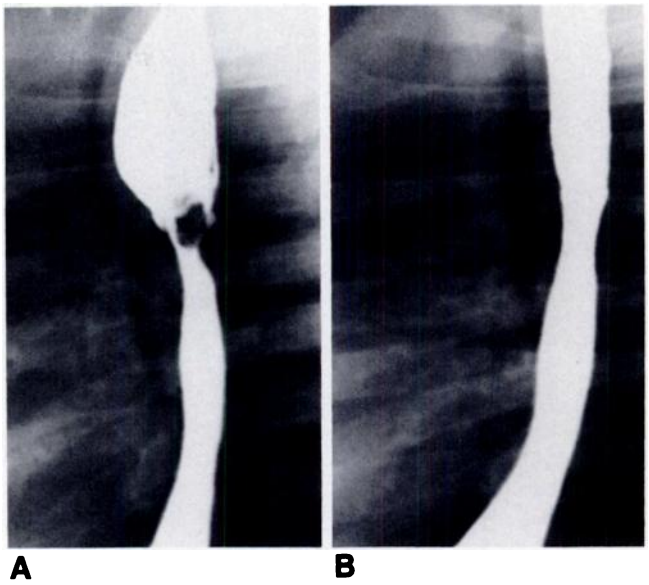

Fig. 2.—Case 8: 12-month-old boy who was surgically treated during neonatal period for esophageal atresia with distal tracheoesophageal fistula shows acute symptoms of esophageal obstruction (*A*).

***A*, Lateral esophagram showed foreign body at anastomotic site. A piece of carrot was extracted using a Foley balloon catheter.**

***B*, Postdilatation lateral esophagram. A satisfactory long-term result was obtained.**

of 15 months. At the time of his death, this patient's esophageal symptoms had decreased, and it had been 3 months since his last balloon dilatation.

In infants less than 3 months old, adequate dilatation was accomplished by using a Grüntzig catheter with a diameter of 8–10 mm. The older children required a balloon diameter of 10–15 mm. All strictures dilated with a 6-mm balloon required subsequent, larger balloon dilatation.

In summary, of the 21 lesions treated, 13 were resolved; three patients required intermittent balloon dilatation at 1.5- to 3-month intervals, three required additional surgery, one could not tolerate balloon dilatation, and one patient died from an unrelated cause. In three patients who continued to require intermittent balloon dilatation and in two who underwent additional surgery, the persistent waist on the balloon at the site of the stricture was noted even at maximal inflation of the balloon (Fig. 1).

No balloon was ruptured during inflation. However, bradycardia was observed in small infants during maximal inflation of the balloon. This resolved spontaneously on deflation of the balloon, and the procedure could be completed.

Discussion

Other reports [1–5] have described the successful use of balloon dilatation to treat esophageal stenosis in adults; however, our experience shows that this mode of treatment is also useful in infants and children. In our series, there were no major complications, and no hospitalization was required for the procedure. Balloon dilatation was successful in achieving a cure or palliation in a number of infants and children with esophageal stenosis.

Wesdorp et al. [9] reported an 8% perforation rate in 100 adult patients with benign esophageal stricture who underwent bougienage. Starck et al. [1] experienced approximately the same rate of perforation among their patients who underwent bougienage. On the other hand, there are only two reported cases of esophageal perforation caused by balloon dilatation, one in a 35-month-old infant with esophageal stricture caused by ingestion of lye [6] and the other in an adult with lung carcinoma that had invaded the distal esophagus [10].

Fluoroscopically controlled passage of the guidewire, aided by a red rubber catheter, and subsequent introduction of the balloon catheter across the stenosis (which is outlined by contrast material) is a simple procedure. Only radially directed forces are transmitted to the most narrowed esophageal segment without additional longitudinal and shearing forces of bougienage; therefore, trauma to the esophageal wall is reduced and the risk of esophageal rupture is much lower. Many strictures that are treated with bougienage recur, so it is not surprising that balloon-dilated strictures also recur. In those cases, our experience parallels that of Starck et al. [1] who, in the study comparing mean relapse-free time between bougienage and balloon dilatation, reported prolonged symptom-free intervals after balloon dilatation. They attributed this result to decreased trauma to the esophagus and to the larger luminal width available with balloon dilatation.

Most patients with complicated esophageal atresia repair and those with stricture caused by long-standing esophagitis

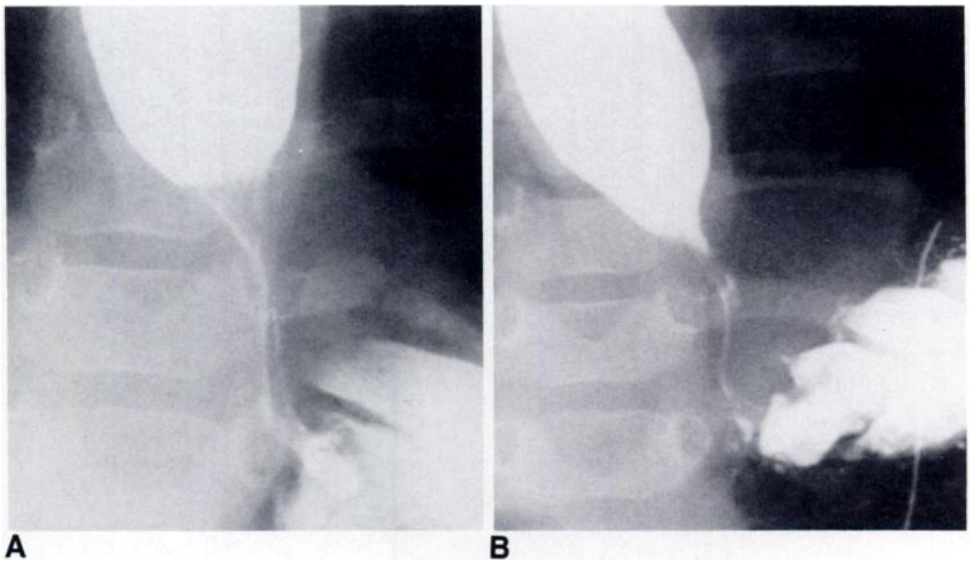

Fig. 3.—Case 19: 18-month-old girl with symptoms of progressive esophageal obstruction after Nissen fundoplication.

***A*, Anteroposterior esophagram shows narrowing of distal esophagus with proximal dilatation.**

***B*, Despite symptomatic relief, postdilatation esophagram shows little change.**

achieved good palliation with balloon dilatations, with steadily increasing intervals between dilatations. We postulate that the effect of dilatation was limited because of dense and extensive fibrosis of the stenotic area and alterations to the intrinsic blood supply to the area.

Persistence of the waist on the balloon at the site of the stricture indicates a limited response to balloon dilatation. In these cases, balloons that tolerate greater pressure may be required.

Patients with restrictive Nissen fundoplication responded well to the balloon dilatation. In these patients, immediate postdilatation esophagrams may show no change, despite significant symptomatic relief. In two patients whose condition had improved, para-Nissen hernias were induced by balloon dilatations, probably because of fractures of the suture lines. Neither of these patients had symptoms related to this complication.

Balloon dilatation in infants and children appears to be a rapid, safe, and lasting alternative to standard treatments for esophageal stenosis caused by postoperative stricture, restrictive Nissen fundoplication, and esophagitis; balloon dilatation should be considered before other modes of treatment.

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