Benign esophageal strictures in infants and children: results of Savary-Gilliard bougie dilation in 107 Indian children

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Background: Little information is available regarding the safety and efficacy of dilation of esophageal strictures in children with Savary-Gilliard bougies. This is a report of our experience with this form of dilation in Indian children.

Methods: One hundred seven Indian children age 14 years or younger with benign esophageal strictures underwent dilation. Clinical information including etiology was recorded. Dilation was performed at 2- to 3-week intervals by using Savary-Gilliard bougies under ketamine sedation and was considered adequate if the esophageal lumen could be dilated to 15 mm diameter (12.8 mm in children <5 years of age) with complete relief of symptoms. Subsequently, dilation was performed on an “as needed” basis.

Results: Mean age was 4.8 ± 3.4 years; male to female ratio was 3:1. Fifty-four children had corrosive strictures (acid 34, alkali 20). Noncorrosive strictures were sclerotherapy-induced (23), postsurgical (14), congenital (10), peptic (4), and due to other causes (2). Dilation was successful in all but 3 cases. Corrosive strictures required a significantly higher number of sessions to achieve adequate initial dilation (2.4 ± 1.9 vs. 1.3 ± 0.5, p < 0.01). Patients with corrosive strictures also required a higher number of subsequent sessions for recurrence (7.3 ± 6.5 vs. 0.7 ± 1.3, p = 0.10). Dilation was also successful in patients with strictures 5 cm or more in length and/or patients with multiple corrosive strictures, although these required a higher number of sessions to achieve adequate dilation (p < 0.05) and also higher number of subsequent sessions for recurrence. Six esophageal perforations occurred during 648 dilation sessions (0.9%); 5 occurred in patients with corrosive strictures. One patient required surgery.

Conclusions: Corrosive injury is the most common cause of benign esophageal strictures in Indian children. Savary-Gilliard bougie dilation is safe and effective, even for long and/or multiple corrosive strictures. (Gastrointest Endosc 2001;54:480-4.)

Dysphagia is a common problem encountered in all age groups. In children, it is usually due to a benign cause, unlike adults, in whom it is predominantly due to malignancy. The major causes of esophageal stricture in children are congenital anomalies, caustic ingestion, esophageal surgery, and esophagitis resulting from gastroesophageal reflux.1,2 Endoscopic dilation is the treatment of choice for benign esophageal strictures in adults. The recommended treatment in children is either surgery or balloon dilation.3-8

Experience with Savary-Gilliard (Wilson-Cook Medical Inc., Winston-Salem, N.C.) bougie dilation of esophageal strictures in children is limited.9-11 This report is of our 8.5-year experience with the Savary-Gilliard bougie in a large group of children.

PATIENTS AND METHODS

Children with a history of dysphagia evaluated between June 1991 and December 1999 at our tertiary care center were included in the study. Clinical data including stricture etiology were recorded. Barium contrast radiography was obtained before endoscopy, and the location, number, and length of strictures were recorded. In cases of corrosive stricture, Savary-Gilliard bougie dilation was initiated 4 to 6 weeks after corrosive ingestion. All dilation procedures were performed under ketamine sedation (1-2 mg/kg given intravenously), initially with the patient in the hospital and subsequently on an outpatient basis. Fluoroscopy was used for the first dilation and subsequently as required (e.g., technically difficult dilation, tight stricture).

All dilations were performed with Savary-Gilliard polyvinyl bougies (7, 9, 11, 12.8, 14, and 15 mm). Dilators were passed over an endoscopically placed guidewire, and 2 to 3 dilators were passed during each session depending on the tightness of the stricture. Children were observed...
for 4 to 6 hours after dilation. Dilation was repeated at 2- to 3-week intervals until an adequate lumen was achieved.

Dilation was considered adequate if the esophageal lumen could be dilated to 15 mm (12.8 mm in children <5 years of age) with complete relief of dysphagia. Subsequent dilation was done “as needed,” that is, if and when symptoms developed. To obtain a more uniform assessment of the frequency of dilation, the periodic dilation index (PDI)\textsuperscript{12} was calculated as “the number of dilations required divided by the duration of time in months.” The PDI was calculated from the first dilation to the dilation considered to be adequate, and from that point until last follow-up. Data were analyzed with the chi-square and unpaired Student $t$ test.

### RESULTS

There were 111 children; 4 were lost to follow-up before initial adequate dilation was achieved and were excluded. Dilation was successful in 104 patients (93.7%); 3 required surgery (as primary treatment in 2 and after perforation in 1). The mean age of the 107 children was 4.8 ± 3.4 years (1 month to 14 years); the male to female ratio was 3:1. Mean follow-up was 16 months (range 1 to 99 months). Etiology of the strictures is shown in Table 1. The miscellaneous group included 1 child with mucocutaneous candidiasis and another with epidermolysis bullosa, both of whom were undergoing appropriate therapy.

All of the children presented with dysphagia and vomiting; the mean duration of symptoms was 10.4 months (range 1 month to 8 years). Five children with corrosive strictures had a history of food bolus impaction. A feeding jejunostomy had been established in 6 children before dilation. One child with corrosive ingestion had an antral stricture, and antrectomy was performed before esophageal dilation. The stomach was normal in the remainder of the patients. Children with peptic stricture were treated with long-term acid suppression along with dilation.

Almost half the children had corrosive strictures. The corrosives ingested were acid in 34 (sulfuric acid 20, hydrochloric acid 8, carbolic acid 1, citric acid 1, and indigenous medicine for topical use 4) and alkali in 20 (sodium hydroxide in all). Among the patients with corrosive strictures, dilation was successful in 52 (96%) (Fig. 1). Two children required surgery; Savary-Gilliard bougie dilation was not possible in one because the guidewire could not be placed, and the other required surgery as treatment for an esophageal perforation that occurred during dilation. The frequency of dilation, that is, the PDI before achieving initial adequate dilation, was significantly higher than the PDI after achieving adequate dilation ($p < 0.001$). A comparison of results in patients with short (<5 cm) and long (>5 cm) and/or multiple corrosive strictures is shown in Table 2. Among patients with short strictures, 3 did not require further “as needed” dilations after initial successful dilation, whereas all children with long and/or multiple strictures required further “as needed” dilations.

Successful dilation was possible in all but 1 of the children with noncorrosive strictures (98%). This child, who had a postoperative stricture after gastric

### Table 1. Etiology of esophageal strictures

<table>
<thead>
<tr>
<th>Etiology</th>
<th>No. of children (n = 107)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosive\textsuperscript{*}</td>
<td>54</td>
<td>49</td>
</tr>
<tr>
<td>Sclerotherapy induced</td>
<td>23</td>
<td>21</td>
</tr>
<tr>
<td>After surgery\textsuperscript{†}</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>Congenital</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Peptic</td>
<td>4</td>
<td>3.5</td>
</tr>
<tr>
<td>Miscellaneous\textsuperscript{‡}</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

\textsuperscript{*}Acid 34, alkali 20.

\textsuperscript{†}Esophageal atresia repair 12, gastric volvulus 2.

\textsuperscript{‡}Epidermolysis bullosa 1, mucocutaneous candidiasis 1.

### Table 2. Comparison between short, long, and/or multiple corrosive stricures

<table>
<thead>
<tr>
<th></th>
<th>Short (n = 28)</th>
<th>Long/multiple (n = 26)</th>
<th>$p$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>5.2 ± 3.6</td>
<td>4.7 ± 2.7</td>
<td>NS</td>
</tr>
<tr>
<td>Male:female</td>
<td>3.7:1</td>
<td>3.3:1</td>
<td>NS</td>
</tr>
<tr>
<td>Sessions for adequate dilation</td>
<td>1.7 ± 1.1</td>
<td>3.6 ± 2.6</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>“As needed” sessions</td>
<td>3.9 ± 3.2</td>
<td>10.6 ± 8</td>
<td>NS</td>
</tr>
<tr>
<td>Perforation</td>
<td>1</td>
<td>4</td>
<td>NS</td>
</tr>
<tr>
<td>Surgery</td>
<td>0</td>
<td>2</td>
<td>NS</td>
</tr>
</tbody>
</table>

NS, Not significant.
adults. However, gastric cicatrization was found affected by corrosive agents (either acid or alkali) in adults. The esophagus and stomach are equally in only 1 child in the present series. The volume of the

Table 3. Comparison between corrosive and noncorrosive strictures

<table>
<thead>
<tr>
<th></th>
<th>Corrosive</th>
<th>Noncorrosive</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (y)</td>
<td>4.9 ± 3.2</td>
<td>4.5 ± 3.5</td>
<td>NS</td>
</tr>
<tr>
<td>Male:female</td>
<td>3.5:1</td>
<td>2.7:1</td>
<td>NS</td>
</tr>
<tr>
<td>Session for adequate dilation</td>
<td>2.4 ± 1.9</td>
<td>1.3 ± 0.5</td>
<td>&lt; 0.01</td>
</tr>
<tr>
<td>“As needed” sessions</td>
<td>7.3 ± 6.5</td>
<td>0.7 ± 1.3</td>
<td>0.1</td>
</tr>
<tr>
<td>PDI before adequate dilation</td>
<td>1.6 ± 1.9</td>
<td>0.9 ± 1.8</td>
<td>NS</td>
</tr>
<tr>
<td>PDI after adequate dilation</td>
<td>0.7 ± 0.5</td>
<td>0.2 ± 0.4</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Recurrence of symptoms</td>
<td>49/52 (94%)</td>
<td>18/52 (35%)</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

NS, Not significant; PDI, periodic dilation index = number of dilations divided by number of months.

volvulus, required surgery. The PDI for noncorrosive strictures was also significantly higher for the period before initial adequate dilation was achieved compared with PDI during the follow-up period (p < 0.01). In this group there was no significant difference in the mean number of sessions required to achieve adequate dilation and the mean number of “as needed” sessions in relation to the various causes of noncorrosive strictures. Comparative data for patients with corrosive and noncorrosive strictures are shown in Table 3.

Six perforations occurred during 648 dilation sessions (0.9%). Five of the patients had corrosive strictures and 1 had a congenital stricture. One child required surgery; the rest had contained perforations that were managed conservatively and subsequently, dilations were continued as per schedule. There was no death.

DISCUSSION

The present series is one of the largest of esophageal strictures in children. It has shown that Savary-Gilliard bougie dilation of benign esophageal strictures in Indian children is safe and effective. The etiologic spectrum of esophageal strictures was similar to that reported from another center in India, although different from the spectrum of causes in Western countries where postoperative (anastomotic) strictures are far more common. Corrosive ingestion is the most common cause of esophageal stricture in children in the Indian subcontinent, as well as in some other parts of the world. In the present series almost half the strictures were due to corrosive ingestion. The latter is accidental in the majority of children, whereas suicide is a frequent motive in adults. The esophagus and stomach are equally affected by corrosive agents (either acid or alkali) in adults. However, gastric cicatrization was found in only 1 child in the present series. The volume of the ingested corrosive substance determines the extent of injury, and with accidental ingestion this is less than in cases of deliberate ingestion with suicidal or other intent. This probably accounts for the rarity of gastric cicatrization in children.

The second most common cause of esophageal stricture in the present series was endoscopic sclerotherapy (EST). In our center, absolute alcohol is used in EST in children with portal hypertension (mainly extrahepatic portal vein obstruction). Stricture is a common complication of EST, especially when absolute alcohol is injected. Fortunately, these strictures are short in length and require relatively few sessions to achieve dilation.

Esophageal strictures can be dilated endoscopically with either a bougie or balloon catheter. Theoretically, dilation with a balloon is better because the expansive force is applied uniformly and radially at the site of the stricture, whereas a bougie exerts a shearing axial force that results in a greater degree of trauma and thereby increases the risk of perforation. Although balloon dilation is effective, it has not been shown to be the exclusive method of choice for treating corrosive strictures. Moreover, a balloon is far more costly than a bougie and is intended for single use. A majority of patients in the present study had corrosive esophageal strictures and required multiple dilation sessions, making the bougie more cost-effective.

Bougie dilation is an accepted and effective treatment for benign esophageal strictures in adults. Pereira-Lima et al. performed 1043 bougie dilation sessions in 153 patients with benign esophageal strictures and found this method to be safe and effective in relieving dysphagia. Similar results were obtained by Broor et al. in a series of 123 adults with benign esophageal strictures.

Bougineage with Savary-Gilliard dilators was successful in a series of 30 children with benign esophageal strictures treated by Broor et al. and in a similar series of 24 children treated by Guitron et al. In both series, a significantly higher number of sessions was required to achieve adequate dilation of corrosive as opposed to noncorrosive strictures, and the former were also associated with higher numbers of recurrences with symptoms. As in the present series, Broor et al. found that long corrosive strictures (>5 cm) required a significantly higher number of sessions compared with short strictures. The results obtained by Broor et al. and Guitron et al., as well as those in the present series, indicate that bougie dilation is as effective in children as in adults. In the former two studies dilation was considered adequate when the esophageal lumen was dilated to 15 mm in children.
5 years of age or older and to 11 mm in those less than 5 years of age. However, our study showed that in children less than 5 years old, dysphagia persisted despite dilation to 11 mm; hence, 12.8 mm was taken as the end point, and complete relief of dysphagia was obtained at this luminal diameter.

Corrosive injury usually causes dense cicatrization of the esophageal wall with the result that strictures are rigid and difficult to dilate.\textsuperscript{10,23} By contrast, noncorrosive strictures are short, pliable, easy to dilate, and have a lower rate of recurrence. This was evident in the present series and has been noted by other investigators.\textsuperscript{10,11} Corrosive strictures are more likely to recur after initial adequate dilation. In the present study, recurrence of corrosive strictures was the rule rather than the exception (94% recurrence). However, recurrent strictures were easily managed by further dilations. Furthermore, the frequency of dilations decreases with time.\textsuperscript{23} In a study of 39 children with corrosive strictures, Panieri et al.\textsuperscript{3} identified the following factors as predictive of failure of dilation: delay in presentation, severe pharyngoesophageal burns, esophageal perforation, and strictures longer than 5 cm. Our findings showed that even long and/or multiple strictures, irrespective of the length of time they had been present, could be managed by bougie dilation, albeit with a higher number of sessions compared with noncorrosive strictures.

Dilation with wire-guided Savary-Gilliard bougies is as safe in children as in adults.\textsuperscript{10,11,22,23} The perforation rate in the present series (0.9%) is similar to that reported by Broor et al.\textsuperscript{10} (1.8%) and perforation rate in the present series (0.9%) is similar to that reported by Broor et al.\textsuperscript{10} (1.8%) and Guitron et al.\textsuperscript{11} (0.7%). There has been no procedure-related death in any study in which the procedure was performed in children.\textsuperscript{10,11} Perforation may occur with bougie dilation but most of these are contained, can be managed conservatively, and do not preclude further dilation. In a series of 34 cases of perforation after dilation of corrosive strictures, Karnak et al.\textsuperscript{14} found that 64% could be managed conservatively and that dilation could be resumed within 3 months of perforation.

No study has been reported in which the efficacy and safety of Savary-Gilliard bougie dilation was compared with surgical management. Moreover, surgery has an associated high immediate mortality rate (5.7% to 20%).\textsuperscript{24,25} Moreover, long-term morbidity can be appreciable, such as anastomotic stricture for which endoscopic dilation is required. Therefore, Savary-Gilliard bougie dilation should be the first line of therapy for benign esophageal strictures in children. Surgery should be reserved for those in whom endoscopic dilation is not possible and for those with complications caused by dilation.

REFERENCES