Hypothesis: Two groups of patients with inadequate therapeutic success after surgical treatment for achalasia can be identified, patients with type 1 recurrence (early recurrence after incomplete failure of myotomy or a scarring process requiring remyotomy) and patients with type 2 recurrence (late recurrence with irreversible progression of the disease and development of megaesophagus requiring esophagectomy).

Design: Prospective study.

Setting: University-based tertiary care center.

Patients: One hundred sixty-three patients undergoing surgery for achalasia during 20.3 years.

Interventions: Conventional remyotomy for type 1 recurrence (group 1) and esophagectomy (transhiatal or transthoracic) for type 2 recurrence (group 2).

Main Outcome Measures: Long-term results after reoperation, including Eckardt score, body mass index, reflux esophagitis, manometric lower esophageal sphincter resting pressure, and radiologic maximum diameter of the esophageal body and minimum diameter of the cardia.

Results: After reoperation, a postoperative Eckardt score of 1 (corresponding to clinical stages 1 to 2) was calculated in 92.3% of group 1 patients and in 80.0% of group 2 patients. In group 1 patients, the maximum diameter of the esophagus decreased to a median value of 25 mm (range, 20-60 mm), while the minimum diameter of the cardiac sphincter increased to a median value of 10.0 mm (range, 5.0-12.0 mm). After surgery, the resting pressure of the lower esophageal sphincter was reduced to a median value of 8.3 mm Hg (range, 4.0-10.0 mm Hg).

Conclusions: Reoperation for achalasia yields good long-term symptomatic outcomes, with relief of dysphagia. Subjective, radiographic, and manometric findings after remyotomy duplicate the good results reported for primary open myotomy.

Arch Surg. 2007;142(11):1093-1097

In 90% of patients with achalasia, good to excellent long-term results have been reported after Heller cardiomiotomy with semifundoplication using an open or a laparoscopic approach. Therefore, this surgical procedure has been advocated as the primary treatment for achalasia, particularly in patients younger than 40 years. However, controversy exists regarding the therapy of patients with failed success after myotomy. The fact that the use of endoscopic measures (eg, pneumatic dilatation or botulinum toxin injection) is frequently preferred in the diagnosis of recurrence, rendering reoperation a secondary therapeutic option, serves to explain the limited number of published studies on long-term results after surgery for recurrence of achalasia.

On the basis of cause, the following 2 groups of patients with inadequate therapeutic success after surgical treatment for achalasia can be identified: patients with type 1 recurrence (early recurrence after incomplete myotomy or alteration of muscle fibers due to scarring, or scar formation at the cuff of the gastric fundus with persistent or recurrent hypertension of the lower esophageal sphincter (LES)) and patients with type 2 recurrence (late recurrence with irreversible progression of the disease and the development of megaesophagus requiring reoperation, frequently in the form of esophagectomy). The objective of this study was to perform a differentiated analysis of patients with type 1 recurrence (group 1) and type 2 recurrence (group 2) after unsuccessful Heller myotomy, as well as an evaluation of the long-term outcomes in the 2 patient groups after surgery for recurrence.
METHODS

PATIENTS

During 20.3 years (September 1, 1985, to January 31, 2006), 163 patients underwent surgery for achalasia at the Department of General and Abdominal Surgery, Johannes Gutenberg University of Mainz, Mainz, Germany. An open procedure was performed in 130 patients, a laparoscopic cardiomyotomy in combination with an anterior semifundoplication was performed in 24 patients, and an esophagectomy or esophageal reconstruction was performed in 9 patients. The diagnosis was established on the basis of manometric, endoscopic, and radiographic findings. Included in the present study were 18 surgical interventions for recurrence in patients with achalasia, which were performed by the same surgeon (T.J.). In 12 of the patients (corresponding to 13 procedures) with prior Heller myotomy and an inadequate therapeutic result, persistent or recurrent high resting pressure of the LES was identified, which necessitated the performance of an open remyotomy. The 13 operations were preceded by 12 laparoscopic procedures and 1 open procedure. In 5 additional patients, reoperation consisted of esophagectomy for megaeosophagus in decompensated achalasia.

All patients were followed up prospectively and were investigated by the treating gastroenterologist (V.F.E.) regarding their clinical symptoms using a structured interview. Patients who had procedures without esophageal resection underwent additional manometric and radiographic follow-up studies of the esophagus. The patients were followed up until the time of their death or until the end of the study period; a final checkup was performed in January 2006. At that time, follow-up data for 100.0% of the patients were available for evaluation.

The median age of the patients at the time of reoperation for recurrence was 56 years (age range, 19-77 years). Forty-four percent of the patients were male. The median interval from the initial surgical intervention to reoperation was 27 months (range, 4-347 months) for all patients. Before the initial operation, 13 patients underwent pneumatic dilatation, with a median number of 2 dilatations (range, 0-15 dilatations).

SYMPTOMS

Symptom evaluations were performed at the time of the initial examination and throughout the follow-up period using the symptom score by Eckardt et al. A symptom score of 3 or less for a minimum period of 6 months was regarded as an indicator of clinical remission.

MANOMETRIC STUDIES

The patients were examined using a capillary perfusion system according to the method previously described. In addition to the resting pressure and relaxation of the LES, the contraction amplitudes in the tubular esophageal body were measured after 10 bolus swallows. Manometric criteria in the diagnosis of achalasia included the absence of peristalsis in the esophageal body, a hypertensive nonrelaxing LES, and simultaneous or repetitive contractions. Patients for whom only data on esophageal body motility were available (because the manometry catheter could not be passed into the LES due to constriction or tortuous configuration of the distal esophagus) were excluded from further evaluation.

RADIOGRAPHIC STUDIES

The radiographic investigations were performed with the patient in a supine semiupright or upright position. Measurements of the maximum diameter of the esophageal body and the gastroesophageal junction at its narrowest point were obtained.

OPERATIVE TECHNIQUE

Patients underwent open transabdominal remyotomy in combination with anterior Dor semifundoplication (n=13); the procedures were performed by the same surgeon (T.J.). Eleven patients had an anterior remyotomy, and 2 patients had a posterior remyotomy. The minimum length of the myotomy was 6 to 7 cm and extended caudally approximately 1.5 to 2 cm onto the anterior gastric wall. Subtotal esophagectomy (n=5) was performed using a transhiatal (n=4) or transthoracic (n=1) technique and using gastric tube pull-up (n=4) or colon interposition (n=1), as well as cervical esophagogastrectomy or esophagogastrocolostomy; these procedures were also performed by the same surgeon (T.J.).

STATISTICAL ANALYSIS

A software package was used for statistical data analysis (SPSS 11.0; SPSS Inc, Chicago, Illinois). Continuous variables are expressed as median values and ranges and as percentages. Because of the small sample size, the data obtained for group 1 (early recurrence) and group 2 (late recurrence) were not analyzed using comparative test procedures; comparison of the variables was performed descriptively.

PATIENT CHARACTERISTICS

In group 1, the age of patients undergoing open remyotomy (13 procedures in 12 patients) was 40 years (age range, 19-70 years) at the time of reoperation. This was markedly lower than the age of 63 years (age range, 43-77 years) in group 2 receiving esophagectomy. There was no statistically significant difference between the 2 groups in the percentages of male sex (46.2% in group 1 vs 40.0% in group 2). The duration of symptoms (interval from initial diagnosis of achalasia to initial treatment) was shorter in group 1 (8 years [range, 1-53 years] in group 1 vs 25 years [range, 5.5-42 years] in group 2). The time from the initial surgical intervention to open remyotomy was 15 months (range, 4-156 months) in group 1, while the time from the initial surgical procedure to esophagectomy was 227 months (range, 32-347 months) in group 2 (Table 1).

Table 1. Characteristics of Patients With Reoperation for Achalasia

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Group 1</th>
<th>Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at reoperation, y</td>
<td>40 (19-70)</td>
<td>63 (43-77)</td>
</tr>
<tr>
<td>Male sex</td>
<td>46.2</td>
<td>40</td>
</tr>
<tr>
<td>Duration of symptoms, y</td>
<td>8 (1-53)</td>
<td>25 (5.5-42.0)</td>
</tr>
<tr>
<td>Interval between first operation and reoperation, mo</td>
<td>15 (4-156)</td>
<td>227 (32-347)</td>
</tr>
</tbody>
</table>

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CLINICAL SYMPTOMS BEFORE REOPERATION

The Eckardt score of 8 (range, 1-9) was higher in group 2 than the Eckardt score of 5 (range, 3-10) in group 2. Among the individual symptoms, dysphagia was the principal symptom, with an Eckardt score of 3 (range, 1-3) noted for each group (Table 2).

RADIOGRAPHIC AND MANOMETRIC FINDINGS BEFORE REOPERATION

The maximum esophageal diameter of 38 mm (range, 23-80 mm) measured in group 1 was lower than that of 50 mm (range, 35-85 mm) measured in group 2 (Table 3). The minimum diameter of the gastric cardia in group 1 was 4.5 mm (range, 1-8 mm) compared with 6.0 mm (range, 3-10 mm) in group 2. The resting pressure of the LES was 26.0 mm Hg (range, 13.0-44.9 mm Hg) in group 1. A manometric assessment of the LES before reoperation in group 2 was available for only one patient, who had a resting pressure of 12.0 mm Hg. Passage of the catheter into the LES was not possible in the remaining 4 patients in group 2.

PERIOPERATIVE COURSE

The duration of the operation was statistically significantly shorter in group 1 (120 minutes [range, 80-155 minutes]) compared with that in group 2 (275 minutes [range, 215-505 minutes]). In 2 patients, perforation of the gastric mucosa occurred during remyotomy and was repaired in both cases using an interrupted suture. The postoperative length of hospital stay ranged from 8 days (group 1) to 15 days (group 2). No patient died during the postoperative course. None of the patients in group 1 developed postoperative complications. Morbidity observed during the postoperative course in group 2 included (in one patient each) an intrathoracic abscess, recurrent laryngeal nerve paralysis, and a fistula with subsequent stenosis of the cervical esophagogastronomy, which was treated conservatively with endoscopic bougienage.

LONG-TERM RESULTS AFTER SURGERY FOR RECURRENCE

The follow-up period (interval from surgery for recurrence to final checkup) was 38.0 months (range, 2-206 months) for group 1 and 57.0 months (range, 4-86 months) for group 2. Follow-up data were available for evaluation in 100.0% of patients. A postoperative Eckardt score of 1 (corresponding to clinical stages 1 to 2) was calculated in 92.3% of group 1 patients and in 80.0% of group 2 patients.

During the postoperative course, there was an increase in the body mass index (calculated as weight in kilograms divided by height in meters squared) of group 1 patients from 23.2 (range, 19.2-35.4) before surgery to 27.3 (range, 22.2-35.3) after surgery, while the change in group 2 patients was less pronounced (from 24.2 [range, 22.4-29.9] before surgery to 22.7 [range, 19.0-23.8] after surgery). Results of radiographic and manometric follow-up examinations were available for group 1 patients only. In these patients, the maximum diameter of the esophagus decreased to 25 mm (range, 20-60 mm), while the minimum diameter of the cardiac sphincter increased to 10.0 mm (range, 5.0-12.0 mm). After surgery, the resting pressure of the LES was reduced to 8.3 mm Hg (range, 4.0-10.0 mm Hg) (Figure). Therefore, the long-term findings in group 1 after remyotomy are in accord with the results obtained after primary open Heller myotomy for achalasia in a previous patient cohort (n=108) (Table 4). The postoperative presence of reflux esophagitis with clinical indications of heartburn was confirmed endoscopically in 2 patients in group 1. Both patients had Savary and Miller grades 1 to 2 esophagitis and were treated conservatively with proton pump inhibitors.
The failure of surgical therapy in the treatment of achalasia is related to different causes that have not yet been conclusively defined in the literature. The causes cited by Ellis' include gastroesophageal reflux, late development of carcinoma, excessively tight fundoplication, pre-existence of a decompenated sigmoid-shaped megaesophagus, and inadequate myotomy (due to incomplete division of muscle fibers or healing with fibrosis at the distal site of the myotomy). The development of carcinoma was of secondary importance in our patients with achalasia because of its low incidence rate (3 carcinomas in 700 patient-years). In agreement with data reported by Zaninotto et al., the primary causes of the recurrence of symptoms in our patient cohort included development of a dolichomegaesophagus with or without peptic stenosis, scar formation at the myotomy or fundoplication edges with persistent or recurrent hypertension of the lower esophagus, and incomplete myotomy (possibly explained by the learning curve phenomenon among group 1 patients whose operations were performed laparoscopically). On the basis of the respective intervals from the primary surgical procedure to recurrence, we divided our patient population into 2 groups with different types of recurrence necessitating specific therapeutic concepts, patients with type 1 early recurrence and open remyotomy with anterior semifundoplication and patients with type 2 late recurrence and esophagectomy for irreversible progressive disease.

Because few patients are not amenable to cardiomyotomy, no validated and uniform recommendations for the therapy of patients with type 1 recurrence based on results of studies with large sample sizes are available, to our knowledge. Comparable to findings in a previous study by Palmer, Zaninotto et al. obtained good results in 7 of 10 patients with unsuccessful therapy after laparoscopic myotomy after a median of 2 pneumatic dilata-tions, with only 2 of their patients requiring remyotomy (1 refused to undergo further treatment). However, Guardino et al. reported less favorable results in their patients undergoing pneumatic dilatation after unsuccessful Heller myotomy (despite the presence of low resting pressure of the LES) compared with untreated patients with achalasia. Botulinum toxin injections or stent implantations have been applied infrequently and with questionable success.

Comparable to primary open myotomy, open remyotomy yielded good long-term symptomatic results in our group 1 patients (Table 4). The respective objective findings (diameters of the esophageal body and the cardia and resting pressure of the LES), analogous to results obtained in 108 patients with primary open Heller myotomy, lend support to the concept of surgical revision that we developed for the therapy of patients with type 1 recurrence. In 10 of 13 of these operations, scarring processes, remnant muscle fibers, or insufficiently long myotomies were found. In 2 of these patients, a posterior myotomy had to be performed in addition to the scheduled anterior myotomy, and a new semifundoplication was constructed because of a symptomatic slipped fundoplication in 1 patient with a sufficient myotomy. In all of the described cases, reoperation was performed primarily because of a technical surgical problem associated with the primary operation that was deemed to be remediable by reoperation only. Therefore, other endoscopic alternatives with known potential complications (eg, an increased risk of gastrointestinal perforation) were excluded from consideration. In addition to reports of good results associated with open remyotomy after failed surgical therapy, a recent study reported successful treatment using laparoscopic remyotomy. However, these results have to be viewed in the context of small sample sizes and short follow-up periods. Furthermore, an extended myotomy, which is continued distally to the fundus of the stomach and enables more efficient disruption of the high-pressure zone of the LES, has been propagated as the method of choice for the prevention of type 1 recurrence. Oelschlager et al. combined this technique with a Toupet antireflux procedure and found no statistically significant increase in the incidence of gastroesophageal reflux.

Although the functional result after primary myotomy in patients with a dilated sigmoid-shaped esophagus continues to be controversially discussed in the literature, general consensus exists regarding the surgical procedure for advanced megaesophagus after prior myotomy (ie, type 2 late recurrence). This stage of decompenated achalasia is irreversible and cannot be moderated by endoscopic measures or by nonresecting surgical therapy. In these patients, esophagectomy was associated with a low morbidity rate and good long-term symptomatic outcomes and led to the relief of dysphagia. Although transhiatal resection with gastric tube pull-up was the procedure of choice, which supports the findings reported by Orringer and Stirling and by Devaney et al., the use of colon interposition described by other authors yielded similarly good results.

The therapeutic concept advocated by this study for patients after unsuccessful Heller cardiomyotomy consists of open remyotomy in patients with type 1 (early) recurrence and esophagectomy in patients with type 2 (late) recurrence with the manifestation of progressing disease and a sigmoid-shaped esophagus. Reoperation for achalasia yields good long-term symptomatic out-

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1</th>
<th>Patient With Primary Conventional Heller Myotomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eckardt score</td>
<td>1 (0-5)</td>
<td>1 (0-7)</td>
</tr>
<tr>
<td>Maximum esophageal diameter, mm</td>
<td>25.0 (20.0-60.0)</td>
<td>28.5 (20.0-60.0)</td>
</tr>
<tr>
<td>Minimum diameter of the cardiac, mm</td>
<td>10.0 (5.0-12.0)</td>
<td>10.0 (5.0-15.0)</td>
</tr>
<tr>
<td>Resting pressure of the lower esophageal sphincter, mm Hg</td>
<td>8.3 (4.0-10.4)</td>
<td>8.6 (3.25)</td>
</tr>
</tbody>
</table>

a Data are given as median (range).

b From Junginger et al.
comes, with relief of dysphagia. Subjective, radiographic, and manometric findings after remyotomy duplicate the good results reported for primary open myotomy. A reduction of the esophageal sphincter resting pressure to 10 mm Hg or less was achieved in all patients with type 1 recurrence at the time of the final measurement, serving as an indicator of successful long-term outcomes.

Accepted for Publication: May 16, 2006.

Correspondence: Ines Gockel, MD, PhD, Department of General and Abdominal Surgery, Johannes Gutenberg University of Mainz, Langenbeckstrasse 1, 55101 Mainz, Germany (gockel@ach.klinik.uni-mainz.de).

Author Contributions: Study concept and design: Gockel, Junginger, and Eckardt. Analysis and interpretation of data: Gockel. Drafting of the manuscript: Junginger, and Eckardt. Critical revision of the manuscript for important intellectual content: Junginger and Eckardt. Statistical analysis: Gockel. Study supervision: Junginger and Eckardt.

Financial Disclosure: None reported.

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