Background: Patients with gastroesophageal reflux and Barrett esophagus may represent a group of patients with poorer postoperative outcomes. It has been suggested that such patients should undergo open rather than laparoscopic antireflux surgery.

Hypothesis: The laparoscopic approach to antireflux surgery is appropriate treatment for patients with Barrett esophagus who have symptomatic gastroesophageal reflux disease.

Methods: The outcome of 757 patients undergoing laparoscopic surgery for gastroesophageal reflux disease from January 1, 1992, through December 31, 1998, was prospectively examined. Barrett esophagus was present in 81 (10.7%) of these patients (58 men and 23 women). The outcome for this group of patients was compared with that of patients undergoing surgery who did not have Barrett esophagus.

Results: The types of operation performed were similar for the 2 patient groups. The mean ± SD length of columnar mucosa was 47.4 ± 43.6 mm. The average ± SD operation time was 79.0 ± 33.4 minutes. Conversion to open surgery occurred in 6 patients. Postoperative outcomes were as follows. Esophageal manometry and 24-hour pH studies before and after laparoscopic fundoplication demonstrated a significant increase in lower esophageal sphincter resting and residual relaxation pressures and a significant decrease in distal esophageal acid exposure. Four patients have developed high-grade dysplasia or invasive cancer within 4 years of their antireflux surgery, and all of these have subsequently undergone esophageal resection.

Conclusions: The outcome of laparoscopic antireflux surgery is similar for patients with Barrett esophagus compared with other patients with gastroesophageal reflux disease. This suggests that laparoscopic surgery is appropriate treatment for this patient group.


Gastroesophageal reflux disease (GERD) is a common disorder occurring daily in up to 7% of persons surveyed in a recent population study.1 Complications of reflux disease include esophagitis, Barrett esophagus, pulmonary complications, or strictures, and these may occur in up to 50% of patients with GERD.1-3 Barrett esophagus is an acquired condition in which severe mucosal injury leads to a replacement of the native squamous cell epithelium with a metaplastic columnar epithelium. This specialized epithelium that develops has been linked to a substantially increased risk of esophageal adenocarcinoma.7

Previous studies5-7 have documented the success of laparoscopic antireflux procedures for various grades of GERD, with good control of heartburn symptoms and high patient satisfaction scores. This study examines the postoperative outcomes of laparoscopic antireflux procedures in patients who presented to our center with an endoscopic diagnosis of Barrett esophagus during the past 7 years. These results were then compared with outcomes for patients with reflux, but without this complication, who underwent laparoscopic antireflux surgery during the same period.

The outcome of 757 patients undergoing a laparoscopic antireflux procedure from January 1, 1992, through December 31, 1998, for GERD was prospectively examined. Barrett esophagus was diagnosed by preoperative endoscopy in 81 (10.7%) of these patients. No patients had dysplastic mucosal changes identified preoperatively (in particular those patients who subsequently developed neoplastic
PATIENTS AND METHODS

Eighty-one patients who presented with a preoperative diagnosis of Barrett esophagus to the Royal Adelaide Centre for Endoscopic Surgery, Adelaide, Australia, were included in this study. The criterion for inclusion was a preoperative endoscopic diagnosis of Barrett esophagus made by either the referring gastroenterologist or the operating surgeon (D.I.W., P.G.D., P.A.G., or G.G.J.), according to conventional clinical practice (ie, at endoscopy, a columnar lining was visible above the gastroesophageal junction to some extent). If this exceeded 3 cm in length, then this was regarded to be long-segment Barrett esophagus, whereas less than 3 cm of columnar-lined esophagus was defined as short-segment Barrett esophagus. Whereas biopsy confirmation of the diagnosis was always obtained if the endoscopy was performed by the operating surgeon (D.I.W., P.G.D., or P.A.G.), the constraints of conventional clinical practice meant that when biopsies had not been performed by the referring gastroenterologist, endoscopy was not repeated purely to confirm the histological features. Furthermore, patients with intestinal metaplasia and patients with gastric metaplasia were all included in this study, although the potential for subsequent malignant neoplasms differs according to the type of metaplasia identified. Esophageal manometry was performed preoperatively in 77 patients. It was not tolerated in the remaining 4 patients.

Operative details and subsequent follow-up information were collected prospectively and maintained on a computerized database. Follow-up was standardized, with a clinical questionnaire administered by an independent investigator 3 months after surgery, and then yearly thereafter. The questionnaire included the following:

1. Assessment of dysphagia using a score that was determined according to the patient’s ability to swallow a range of solids and liquids (0 indicates no dysphagia; and 45, total dysphagia).9
2. Direct questioning about symptoms of gas bloating, ability to belch, and ability to relieve abdominal distention by belching.
3. Assessment of overall satisfaction with the surgical outcome using a visual analog scale (0 indicates totally unsatisfied; and 10, totally satisfied).

Postoperative investigation with endoscopy or esophageal manometry was undertaken according to clinical indications, unless patients had been enrolled into one of several concurrent randomized clinical trials.9,10 Further information about the timing, indications, and method of any surgical reinterventions was also recorded.

Endoscopic follow-up of the Barrett esophagus was organized by either the referring gastroenterologist or the operating surgeon (D.I.W., P.G.D., P.A.G., or G.G.J.) if this was not feasible.

As part of 2 concurrent randomized clinical trials,9,10 the results of postoperative 24-hour pH and esophageal manometric studies performed between 3 and 6 months after surgery were available for some patients. Details of the methods used for esophageal manometry and 24-hour pH monitoring have been described previously.9,10 For statistical analysis, the Mann-Whitney test was used. P<.05 was considered to be significant. Where appropriate, data are presented as mean±SD.

disease). The average age for this group was 48.3 years; 58 patients were men and 23 were women. The mean length of Barrett esophagus was 47.4±3.6 mm. Nine of these patients also had a large hiatal hernia at the time of surgery, although 5 underwent surgery primarily for reflux control and 4 presented with symptoms of intermittent gastric volvulus. A similar proportion of our overall group also had a large hiatal hernia at the time of surgery.11 Patients with Barrett esophagus had symptoms of gastroesophageal reflux for a median of 10 years (range, 6 months to 45 years) before they underwent surgery, whereas the other patients undergoing fundoplication in our overall group had symptoms of reflux for a median of 5½ years (range, 6 months to 50 years) before surgery.

The types of fundoplication performed in the patients with Barrett esophagus were as follows: a total fundoplication was undertaken in 63 (78%) of the patients, while 18 (22%) underwent an anterior 180° partial fundoplication. The indications for total fundoplication included absent or poor esophageal motility, as determined at preoperative manometry; the surgeon’s preference (later in the experience); or enrollment in a randomized, controlled, clinical trial.10 In comparison, 95 (14%) of the patients without Barrett esophagus underwent a partial fundoplication for similar reasons. No esophageal lengthening procedures were undertaken. Short gastric division was completed in 11 patients as part of another randomized trial study protocol.9 The average operation time was 79.0±33.4 minutes. Conversion to open surgery occurred in 6 patients (7%). This was due to a large intrathoracic stomach in 3, obesity obscuring the hiatal anatomical features in 2, and dense peri-esophagitis in 1. These patients were not excluded from subsequent data analysis. There was no perioperative mortality in any of the 81 patients with Barrett esophagus, while morbidity consisted of deep vein thrombosis (n=1), pneumonia (n=2), pulmonary embolism (n=1), asthma (n=1), and postoperative hemorrhage (n=1). The median hospital stay for this cohort of patients was 3 days (range, 2-14 days).

Postoperative follow-up ranged from 3 months to 5 years (median, 2 years). No follow-up data were available for 6 (7%) of the patients, and from the overall group, follow-up data were also not available for 7% of the series. In some instances, this was because insufficient time had elapsed between surgery and the first standardized follow-up point. Eleven further operations were required in 10 patients. Indications were postoperative hemorrhage (n=1), hiatal stenosis (n=1),12 intrathoracic migration or postoperative hiatal hernia (n=2), recurrent reflux (n=3), and progression of Barrett metaplasia to either high-grade dysplasia (n=1) or esophageal carcinoma (n=3). While 2 of the patients who underwent a subsequent operation for recurrent reflux had undergone a partial fundoplication initially, no other subsequent operations were required for the patients who underwent partial fundoplications for Barrett esophagus. A
A total fundoplication is the most commonly performed antireflux procedure for the successful treatment of GERD. Long-term success rates of 85% to 90% have been reported, with an operative mortality quoted to be less than 1%. Recurrent reflux requiring a subsequent operation has been reported slightly worse in patients with Barrett esophagus treated surgically, whereas the other has no reflux symptoms at 2-year follow-up. An early failure rate of more than 25% was seen at 31 months. From these reports, a preoperative diagnosis of Barrett esophagus appears to predict high recurrence rates and poor postoperative outcomes.

As a result of these studies, some researchers have advocated a tailored approach to antireflux surgery whereby patients with GERD complicated by the development of anatomical or functional abnormalities, including Barrett esophagus, should undergo an open thoracic approach with intraoperative assessment of esophageal length to determine the best treatment option. These researchers reserve a transabdominal open or laparoscopic approach for patients with uncomplicated Barrett esophagus. Early failure at 3 years was greater than 20%. Even poorer results were seen in patients with Barrett esophagus associated with a Barrett ulcer or a peptic stricture, with a 64% failure rate reported at the 106-month follow-up. An early failure rate of more than 25% was seen at 31 months. From these reports, a preoperative diagnosis of Barrett esophagus appears to predict high recurrence rates and poor postoperative outcomes.

Open antireflux surgery is a well-established surgical procedure for the successful treatment of GERD. Long-term success rates of 85% to 90% have been reported, with an operative mortality quoted to be less than 1%. Recurrent reflux requiring a subsequent operation has been seen in 5% to 9% of patients undergoing Nissen fundoplication. A total fundoplication is the most commonly applied surgical treatment for patients with gastroesophageal reflux.

Studies examining the postoperative outcomes after open antireflux surgery have reported slightly worse results in patients in whom Barrett esophagus was diagnosed preoperatively. Attwood et al reported that of 19 patients with Barrett esophagus treated surgically, symp-

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**Table 1. Postoperative Outcomes**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Patients With Barrett Esophagus</th>
<th>Patients Without Barrett Esophagus</th>
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</thead>
<tbody>
<tr>
<td>Symptom score</td>
<td>5.7 ± 4.0</td>
<td>7.1 ± 3.2</td>
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<tr>
<td>Preoperative</td>
<td>0.8 ± 2.0</td>
<td>1.0 ± 2.1</td>
</tr>
<tr>
<td>Dysphagia score</td>
<td>9.5 ± 10.9</td>
<td>10.6 ± 10.7</td>
</tr>
<tr>
<td>Satisfaction index</td>
<td>8.8 ± 2.3</td>
<td>8.1 ± 2.6</td>
</tr>
</tbody>
</table>

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**Table 2. Results of Esophageal Manometry and 24-Hour pH Studies Before and After Laparoscopic Fundoplication**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Before†</th>
<th>After‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Esophageal manometric variables, mm Hg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOS resting pressure</td>
<td>3.3 ± 6.5</td>
<td>16.7 ± 8.7</td>
</tr>
<tr>
<td>LOS residual relaxation pressure</td>
<td>0.9 ± 1.8</td>
<td>6.5 ± 4.6</td>
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<tr>
<td>24-h pH studies</td>
<td></td>
<td></td>
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<tr>
<td>No. of episodes lasting &gt;5 min</td>
<td>74.8 ± 51.0</td>
<td>12.4 ± 15.1</td>
</tr>
<tr>
<td>% of time pH &lt;4</td>
<td>17.5 ± 14.5</td>
<td>3.3 ± 5.9</td>
</tr>
</tbody>
</table>

*Data are given as mean ± SD. There was a significant (P < .001) difference on all variables before vs after laparoscopic fundoplication. LOS indicates lower esophageal sphincter.
†n = 77 for esophageal manometric variables, and n = 21 for 24-hour pH studies.
‡n = 31 for esophageal manometric variables, and n = 26 for 24-hour pH studies.
ever, studies specifically targeting the outcomes within this cohort of patients have been lacking.

The results of open surgery, previously discussed, suggest that patients with Barrett esophagus might be expected also to do poorly after laparoscopic antireflux surgery. This does not appear to be the case. Our study shows that the preoperative diagnosis of Barrett esophagus does not appear to predispose patients to poorer outcomes and higher recurrent reflux rates. We found that nearly all patients, even those with a preoperative diagnosis of Barrett esophagus, could be successfully treated with a laparoscopic antireflux procedure. The rate of subsequent operations of 3.7% for recurrent reflux is also in keeping with other reports of patients without Barrett esophagus. Postoperative outcome measures of control of symptoms and residual dysphagia in our study were also excellent, with the low patient symptom scores being no different from those of patients without Barrett esophagus. Overall patient satisfaction was excellent, with no difference detected between the groups. Although objective variables, such as 24-hour pH monitoring and esophageal manometric results, were not assessed in most patients with Barrett esophagus who were undergoing antireflux surgery, a statistically significant difference between preoperative and 3-month postoperative results was found in this study.

We are not sure why there is such a discrepancy between these results and those discussed previously from open surgery. It is possible, perhaps even likely, that our patients represent a less severe end of the Barrett spectrum, with patients being referred earlier with the undoubted success of the laparoscopic approach for antireflux surgery. The other important difference is the longer follow-up in some of the studies from the open era. Nevertheless, even at shorter follow-up times, the failure rates were high in these studies (data described earlier).

A possible criticism of the method used for the study is related to our inclusion criteria. We accepted the diagnosis made at endoscopy by the referring physician and did not deliberately repeat the endoscopy studies previously performed. This meant that for some patients a histological diagnosis was not obtained, and we were unable to ascertain whether intestinal metaplasia was present. Despite this, we believe that our study does replicate the reality of clinical practice, as patients usually present to surgeons having already had an endoscopy performed elsewhere, and they are rarely keen to repeat this investigation unnecessarily. Most clinicians do base their ongoing management decisions to at least some extent on information obtained from investigations performed before they assess the patient for surgery.

We acknowledge that laparoscopic antireflux surgery should not be considered the panacea for the treatment of all patients with gastroesophageal reflux, and that there are indications for an open abdominal and a transthoracic approach. However, there is no conclusive evidence to suggest that all patients with Barrett esophagus should be treated differently from patients without columnar change. There is a continuing need for the study of factors that predict poor outcomes following laparoscopic antireflux surgery. Barrett esophagus in isolation, however, does not appear to be one of these factors, and so we do not alter our approach to patients undergoing antireflux surgery based on their Barrett esophagus status.

There is little convincing evidence that either acid suppression therapy or an antireflux procedure results in significant regression of Barrett epithelium once it is established, and it is not known whether such therapies will stop or slow down progression to adenocarcinoma. Four (5%) of our 81 patients (all symptomatically reflux free, although one patient required 2 operations to become so) had evidence of progression of disease, with 1 developing high-grade dysplasia and 3 developing adenocarcinoma. Three of these patients underwent an esophagectomy; one patient presented with metastatic disease and was treated with chemoradiation therapy. Isolated cases of progression of Barrett esophagus after antireflux surgery have been reported as well.24-26 This suggests that even when treatment has led to cure of symptoms, continued surveillance of columnar mucosa is required. It is hoped that studies of ablative therapy of metaplastic epithelium will provide us with a means of preventing the malignant degeneration associated with this disease.

This study suggests that proscription of laparoscopic antireflux surgery solely on the grounds of columnar metaplasia in the esophagus is not appropriate. Whether longer follow-up will cause us to alter this opinion is debatable, but we think it is unlikely, based on the few patients who have been followed up for longer than 4 years.

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REFERENCES


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Surgical Anatomy

The meandering mesenteric artery is a tortuous, enlarged, and dilated arch of Riolan that results with increased blood flow through this collateral.