Wrapped in controversy: trends in fundoplication at myotomy for achalasia in Christchurch, New Zealand

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Abstract

Aim A surgical approach to the management of achalasia involves myotomy, typically with added anti-reflux procedure. The most appropriate fundoplication in this setting (total Nissen, partial anterior Dor, or partial posterior Toupet) remains controversial. We present the trends in fundoplication procedures performed at myotomy in Christchurch between 1997 and 2009, and compare this with the literature.

Methods 34 cases of achalasia managed with myotomy and various types of fundoplication in Christchurch between 1997 and 2009 were separated into two temporal groups, and the type of surgery in each group analysed. Data was obtained from the clinical records on specific short and long-term postoperative complications.

Results There is a decrease over time in myotomy without fundoplication and in total Nissen fundoplications performed. The number of posterior fundoplications remains equal over both time periods; however the proportion of anterior fundoplications is significantly increased in the later group. Three cases of mucosal perforation occurred during myotomy associated with anterior fundoplication, and reintervention rates were highest in myotomy only and anterior fundoplication patients.

Conclusion Trends in anti-reflux surgery in Christchurch reflect the development of the evidence base in the literature. The change in fundoplication procedure is not clearly explained by the complication rates.

Achalasia is characterised by the absence of oesophageal peristalsis and an inability of the lower oesophageal sphincter (LES) to relax normally during the initiation of swallowing. Whilst the underlying pathophysiology is incompletely understood, the most commonly postulated hypothesis is of neurodegeneration: an irreversible loss of ganglion cells in the myenteric plexus of the oesophagus due to autoimmune or infectious mechanisms. The ensuing absence of peristalsis, failure of LES relaxation, and elevated LES pressures cause oesophageal stasis and progressive dilation.

Incidence in western populations is estimated at one to three per 100,000 people. Typical presentation is with progressive dysphagia, although regurgitation, weight loss, vomiting, and chest pain have been reported.

The primary management principle of achalasia is resolution of the functional obstruction of the LES, allowing food to enter the stomach under gravity, whilst avoiding iatrogenic gastro-oesophageal reflux disease (GORD) by rendering the LES too loose. Management may involve pharmacotherapy such as sublingual calcium channel blockers and isosorbide dinitrates, endoscopic techniques such as botox injection and pneumatic dilatation, and surgical management.
The first myotomy for achalasia was performed in 1913 by German surgeon Ernest Heller as combined anterior and posterior myotomies, and later modified by Zaaijer to a single anterior myotomy. Whilst this technique successfully treated dysphagia, it was subsequently noted that patients suffered reflux on long-term follow-up, and hence various anti-reflux procedures have been added: total 360-degree fundoplication, and anterior and posterior hemi-fundoplications.

Methods
This case series includes 34 patients undergoing myotomy for oesophageal achalasia in Christchurch between 1997 and 2009. Data was collected retrospectively from both Christchurch Hospital and private clinics within Christchurch, where cases were identified by clinical coding including the words/phrases: achalasia, myotomy, and oesophageal dilatation.

This case series does not include all patients undergoing myotomy in Christchurch during this time period: paediatric patients were excluded, not all private clinics were incorporated, and patients lost to follow up (e.g. left the district) were excluded.

Cases involving surgical management were extracted, and categorised into two groups by year of surgical procedure: 1997–2002 and 2003–2009.

Anti-reflux procedures performed were categorised into one of the following types: 360 degree total (Nissen) fundoplication, anterior (Dor) fundoplication including wraps of 90–180 degrees, posterior (Toupet) fundoplication including 180–270 degree wraps, and myotomy without anti-reflux procedure.

Comparisons were drawn between the raw numbers and proportions of varying types of anti-reflux procedure performed during each time period.

Information was then obtained from the clinical notes on specific short and long-term perioperative complications. Short term complications analysed included: mortality, inadvertent intraoperative mucosal perforation, postoperative leak, and conversion to open surgery.

Long-term complications analysed were the need for reintervention in the form of repeat myotomy, subsequent balloon dilatation, or redo of fundoplication. Ethical approval was granted.

Results
The procedures in this series were performed by two surgeons during both time periods. Despite being a small case series, there were appreciable differences in the frequency of procedures conducted in each temporal group.

In 1997–2002 there were three total fundoplications completed (at 20% of all myotomies), compared with none during 2003–2009 (Table 1). The number of posterior fundoplications is equal between the groups, however in 2003-2009 there was a greater percentage of anterior wraps (13 anterior wraps; at 68% of all myotomies) completed than in 1997-2002 (four anterior wraps; at 27% of all myotomies).

It was more common during 1997–2002 to complete no anti-reflux procedure than during 2003–2009 (Table 1). These trends are presented graphically in Figure 1.
Table 1. Anti-reflux procedures performed at myotomy during 1997–2002 and 2003–2009

<table>
<thead>
<tr>
<th>Years</th>
<th>n</th>
<th>No anti-reflux procedure (%)</th>
<th>Total fundoplication (%)</th>
<th>Posterior fundoplication (%)</th>
<th>Anterior fundoplication (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997–2002</td>
<td>15</td>
<td>2 (13)</td>
<td>3 (20)</td>
<td>6 (40)</td>
<td>4 (27)</td>
</tr>
<tr>
<td>2003–2009</td>
<td>19</td>
<td>0</td>
<td>0</td>
<td>6 (32)</td>
<td>13 (68)</td>
</tr>
</tbody>
</table>

Note: Numbers are raw data, followed in brackets by percentage of all myotomies performed within that period.

Figure 1. Graph showing types of fundoplication performed at myotomy during 1997–2002 and 2003–2009, as a percentage of all myotomies performed in each temporal group

Intraoperative or postoperative complications occurred in 10 patients (29%). Short-term complications were few: mucosal perforation affected three patients undergoing myotomy with anterior fundoplication (18% of all anterior fundoplications) (Table 2). No patients with alternative fundoplication types were affected; the overall perforation rate was 9%. There were no perioperative deaths or postoperative leaks amongst the case series, and no cases required conversion from laparoscopic to open surgery.

Surgical reintervention rates were also low. Both myotomy only patients subsequently underwent revision fundoplication, with one additionally undergoing repeat myotomy. One posterior fundoplication was converted to Nissen fundoplication for persistent reflux.
Several patients underwent balloon dilatation postoperatively: three anterior fundoplication patients (18%), one posterior fundoplication patient (8%), and one myotomy only patient (Table 2).

Table 2. Short and long-term complications following Heller myotomy and various fundoplication procedures

<table>
<thead>
<tr>
<th>Variables</th>
<th>n</th>
<th>Short term</th>
<th></th>
<th></th>
<th>Long term</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mucosal perforation (%)</td>
<td>Repeat myotomy (%)</td>
<td>Revision fundoplication (%)</td>
<td>Balloon dilatation (%)</td>
<td></td>
</tr>
<tr>
<td>No anti-reflux procedure</td>
<td>2</td>
<td>0</td>
<td>1 (50)</td>
<td>0</td>
<td>2 (100)</td>
<td>1 (50)</td>
</tr>
<tr>
<td>Total fundoplication</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Posterior fundoplication</td>
<td>12</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1 (8)</td>
<td>1 (8)</td>
</tr>
<tr>
<td>Anterior fundoplication</td>
<td>17</td>
<td>3 (18)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3 (18)</td>
</tr>
</tbody>
</table>

Note: Data are raw numbers followed in brackets by percentage within each type of fundoplication across both temporal groups.

Discussion

Today a laparoscopic Heller myotomy is considered the primary treatment modality for achalasia.\(^6\),\(^7\) However, the addition of an anti-reflux procedure, and more specifically which type, has long been a topic of controversy.

Myotomy involves a 6–8 cm longitudinal division of the longitudinal and circular muscle fibres of the oesophagus, typically extended onto the proximal stomach, via a laparoscopic approach, thereby exposing the submucosa beneath.\(^8\)

The oesophagus is rendered vulnerable and without the protection against gastric content normally provided by an intact LES. Stricture, dysplasia, and in the most severe cases Barrett’s oesophagus and adenocarcinoma can result,\(^7\) and hence most myotomies have an anti-reflux procedure added.\(^9\)

Several studies have shown a high incidence of reflux when myotomy is performed without fundoplication.\(^3\),\(^10\)–\(^12\) Burpee and colleagues\(^10\) conducted a retrospective review of 54 patients undergoing Heller myotomy without fundoplication. They found that 30% reported significant heartburn, while 60% had objective evidence of reflux: either oesophagitis observed on gastroscopy or positive 24-hour pH recordings.

A significant proportion of those with objective evidence of reflux reported no symptoms, demonstrating the often silent nature of reflux, a concerning feature also raised by other authors.\(^6\),\(^9\)

In a prospective follow up of 40 patients also undergoing myotomy without fundoplication, Lindenmann et al\(^3\) found that 45% had objective evidence of postoperative reflux on pH monitoring, however fewer than 5% reported clinical symptoms of reflux.

In following up 21 similar patients, Kjellin et al\(^13\) found that 57% had reflux on pH monitoring when no fundoplication was added, 62% of whom were asymptomatic. In contrast with these findings, an early meta-analysis comparing the incidence of
GORD in myotomy patients with and without an anti-reflux procedure, found no statistically significant difference in either reflux symptoms or pH studies.\(^9\)

Falkenback and colleagues\(^{12}\) conducted a randomised controlled trial of 20 patients, comparing Heller myotomy alone and in combination with 360-degree Nissen fundoplication. No patients receiving fundoplication required acid-reducing medications postoperatively, whilst more than half of the myotomy only group did. 24 hour oesophageal pH monitoring at 3-year follow up showed pathological acid reflux in 13\% of the myotomy only group, compared with 0.15\% of the myotomy plus fundoplication group.

An unacceptable rate of reflux occurs in patients undergoing myotomy without fundoplication,\(^{10}\) and Heller myotomy plus Nissen fundoplication relieves dysphagia whilst providing superior reflux control.\(^{12}\)

Richards and colleagues\(^{14}\) published results of a randomised controlled trial of 43 patients comparing myotomy alone with myotomy plus Dor anterior fundoplication. They found pathological reflux on 24 hour pH monitoring in 48\% of myotomy only patients, compared with 9\% of myotomy plus Dor patients,\(^{14}\) corresponding to a significant reduction in the risk of reflux with the addition of a Dor procedure (relative risk 0.11). The incidence of dysphagia postoperatively was similar between the two groups, suggesting that oesophageal emptying was not impaired by anterior fundoplication.

A recent systematic review and meta-analysis of 64 articles reporting the outcomes of 4871 achalasia patients managed surgically\(^{15}\) found that the addition of an anti-reflux procedure decreased the incidence of reflux symptoms from 31\% to 9\%, without altering the resolution of dysphagia. pH monitoring revealed the incidence of reflux after myotomy without fundoplication was 42\% versus 15\% after myotomy plus fundoplication.

The incidence of postoperative GORD measured either subjectively or objectively was lower when a fundoplication was added, whilst conferring no increased morbidity.\(^{15}\)

Other authors argue against the necessity of an anti-reflux procedure in this setting, citing that fundoplication is only required in poorly performed myotomy.\(^{16}\) Cade\(^{17}\) carried out a prospective single-surgeon case series on 124 patients undergoing Heller myotomy without anti-reflux procedure, and found 8\% of patients report reflux significant enough to warrant proton pump inhibitor (PPI) treatment. He argues that the commonest symptom postoperatively is not reflux, but dysphagia—a symptom which even partial fundoplication will amplify rather than treat, and hence a fundoplication is contraindicated.\(^{17}\)

The author attributes the low incidence of reflux in his series to surgical technique: limited extension of myotomy onto the stomach and limited hiatal dissection.

However, fewer than half of patients in this series underwent gastroscopy. A significant proportion of reflux is silent, with poor correlation of symptoms with severity of GORD on objective assessment.\(^6,9,10\)

Whilst subjectively rated as mild, 49\% of patients nonetheless complained of some degree of reflux postoperatively, and follow-up was for 6 months. Therefore the
possibility remains that significant GORD was missed either because it was asymptomatic or developed beyond the follow up period.

Diamantis et al also argue that the need for fundoplication can be circumvented by surgical technique. Their prospective observational study of 33 patients followed up for 2 years post myotomy without anti-reflux procedure found no GORD, either symptomatically or on gastroscopy.

Their technique involved extension of the myotomy for only 5 mm onto the stomach compared with up to 2–3 cm by other surgeons, which like Cade, they argue is important in avoidance of reflux.

While our case series includes only two myotomy only patients, the subsequent addition of a fundoplication procedure in both is consistent with evidence from the literature of persistent reflux in myotomy without fundoplication.

If one accepts the most reliable evidence from randomised controlled trials and meta-analysis suggesting a fundoplication after Heller myotomy is fundamental in reducing the incidence of reflux, the question remains: which type of fundoplication offers the best outcome?

As the propulsive action of the oesophagus is already impaired in achalasia, the addition of a mechanical obstacle to the LES in the form of a total fundoplication carries the risk of inducing dysphagia, the very symptom which myotomy aims to relieve. A partial wrap creates less resistance to oesophageal emptying than total fundoplication.

Zhu et al followed 64 patients undergoing myotomy with either total or partial fundoplication for 6 years. A higher incidence of symptomatic dysphagia was found in the Nissen group compared with the partial fundoplication group, as well as increased oesophageal dilation on both endoscopy and radiologically.

A total fundoplication is thought to add too much resistance at the LES, while a partial wrap confers the desired anti-reflux benefit without causing oesophageal emptying difficulty. Other observational studies also show increased rates of dysphagia following Nissen fundoplication, and the re-operation rate may be as high as 29%.

The results of several prospective observational studies contradict this theory, reporting good outcomes after total fundoplication in achalasia. However, duration of follow up is medium term and variable (3 to 6 years), and concern remains that dysphagia may arise as a late complication.

Topart et al found recurrence of dysphagia on long-term follow up (10 years) of patients undergoing total fundoplication, despite excellent early symptom relief. They concluded that a Dor fundoplication should be utilised to avoid causing oesophageal dysfunction secondary to outflow obstruction.

Of interest, in our series no total fundoplication patients underwent subsequent balloon dilatation, unlike 14% of partial fundoplication patients. Whilst the number of total fundoplications is small (n = 3), this may reflect an absence of recurrence of dysphagia.
Rebecchi and colleagues\textsuperscript{26} investigated this controversy in a randomised controlled trial comparing Heller myotomy with Nissen fundoplication versus Heller myotomy with Dor fundoplication.

A total of 144 patients were followed up for 5 years and rates of reflux symptoms were low overall: 5.6\% in the Dor fundoplication group and 0\% in the Nissen group. No patients in either group had evidence of oesophagitis on gastroscopy, and neither clinical nor objective evidence of difference in reflux between the groups reached statistical significance.\textsuperscript{26}

Symptomatic dysphagia at 5 years was higher in the Nissen group (15\%) than in the Dor group (2.8\%). Hence both procedures achieved acceptable control of reflux, yet recurrence of dysphagia was considerably increased in the Nissen group. Thus the best level of evidence available demonstrates that partial fundoplication is superior to total fundoplication as an anti-reflux procedure in conjunction with myotomy.\textsuperscript{26}

Proponents of the Toupet posterior wrap claim it is a more effective anti-reflux procedure than anterior fundoplication, that the myotomy is prevented from closing by suturing the fundoplication into its edges,\textsuperscript{6,8,27} and that full mobilisation of the oesophagus allows for easier myotomy under improved vision.\textsuperscript{6,8} Other authors argue that leaving the myotomy exposed may result in development of oesophageal diverticulae over the long term.\textsuperscript{28}

Advocates of the Dor anterior wrap highlight the lack of posterior dissection required, making it a simpler operation in which the posterior oesophageal attachments remain intact. It has the added advantage of providing a covering over the exposed mucosa of the myotomy,\textsuperscript{6,8,14} preventing diverticulae formation.

Given a mucosal perforation rate of 5\% to 10\% with myotomy,\textsuperscript{29,30} some authors argue an anterior fundoplication occludes any unrecognised perforation.\textsuperscript{31} Others claim that a Dor procedure is inferior as it may lead to adhesion formation between the myotomy and fundoplication.\textsuperscript{32}

The mucosal perforation rate in our series is 9\%, consistent with rates reported in the literature. All perforations occurred during myotomy with anterior fundoplication; however it is unclear whether anterior fundoplication was planned as the original procedure or added to provide additional protection once perforation was recognised.

Hunter et al\textsuperscript{27} reviewed 37 patients undergoing partial fundoplication at one centre: 80\% posterior and 20\% anterior. They report good results overall with 90\% relief of dysphagia, and no difference in symptom resolution between the two groups. Other observational studies compare Dor with Toupet, however performing different length myotomies in the two groups, rendering any conclusion of superiority subject to bias.\textsuperscript{33,34}

Richardson et al\textsuperscript{19} followed up postoperative symptoms of 44 patients receiving Heller myotomy with various anti-reflux procedures for a mean duration of 37 months: without fundoplication, posterior Toupet, anterior Dor, and modified Dor (suturing the fundus onto the crus of the diaphragm rather than oesophagus only). Whilst the modified Dor group had better reflux control and the Toupet group had the worst dysphagia and reflux scores, these findings did not reach statistical significance.
Other authors of observational studies have found no statistically significant difference between outcomes following Dor and Toupet.\(^{32}\)

A recent randomised controlled trial of anterior Dor versus posterior Toupet hemi-fundoplication including 85 patients showed no significant difference in oesophageal symptoms between the two groups. Dor fundoplication was associated with a higher rate of abnormal reflux at pH monitoring when compared with Toupet, however this difference did not reach statistical significance.\(^{35}\)

The rarity of achalasia makes such randomised controlled trials difficult to conduct, and hence evidence based management principles have been slow to emerge. Both partial fundoplications are currently being used, and further high level evidence is required before a firm recommendation can be made regarding the superiority of either. Despite the lack of quality evidence, several authors strongly recommend an anterior fundoplication over posterior.\(^{7,19,20}\)

Between 1997 and 2009 anti-reflux surgery at myotomy in Christchurch has shown a trend of decreasing total and increasing anterior fundoplications, and a decrease in myotomy performed without fundoplication. There was no change in surgeons performing the procedures to explain the change in technique. Nor do the complication rates explain the change in practice, with the greatest number of complications occurring in the most commonly performed procedure during the later period.

The observed trend reflects the development of the evidence base in the literature: early myotomy was conducted without fundoplication, with later addition of total fundoplication, a subsequent move in favour of partial fundoplication, and a more recent emergence in popularity of the Dor anterior fundoplication. The most commonly advocated operation for achalasia today is a Heller myotomy combined with a Dor anterior hemi-fundoplication,\(^{7,8}\) and trends in Christchurch are in keeping with this.

This is a small case series and ongoing surveillance of anti-reflux surgery is required to thoroughly investigate the robustness of the aforementioned trends and exclude effect due to chance. By nature of retrospective study design, the follow-up period is longer for the 1997–2002 patients, and long-term complications may be yet to develop in the more recently operated group.

Categorisation into types of fundoplication (total, anterior and posterior) herein does not take into account the variation in surgical technique within each category. A larger case series would allow further detailed categorisation and more comprehensive examination of both the trends in fundoplication and complication rates.

**Competing interests:** Nil.

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**Acknowledgements:** Database of achalasia patients collated by Mr Steve Kelly and Kim King (Department of Surgery, Christchurch Hospital) as well as Alex Heulson (Gastroenterology Department, Christchurch Hospital).
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References: