

# Per-oral endoscopic myotomy: a multi-centre New Zealand experience

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## ABSTRACT

**BACKGROUND AND AIMS:** Per-oral endoscopic myotomy (POEM) is an established treatment for achalasia. We aim to review outcomes of all POEM cases performed in New Zealand for achalasia.

**METHODS:** A retrospective review of all POEM procedures performed in the five hospitals offering POEM between November 2015 and December 2022 was undertaken. The primary outcome was clinical success, defined as Eckardt score  $\leq 3$ . Secondary outcomes included procedural complications.

**RESULTS:** One hundred and sixty-six index and four redo POEM procedures were performed by seven clinicians. Ninety-six (58%) were male and mean age was 49.6 years (standard deviation [SD] 19.2 years). Eighty-three (50%) had a previous achalasia intervention. Median length of hospital stay was 1 day (interquartile range [IQR] 1–2 days). Median pre-POEM Eckardt score was 8 (IQR 6–9) and improved to 0 (IQR 0–2) at 6 months ( $p < 0.001$ ). Technical success was achieved in 164 (99%). Clinical success was achieved in 124 (93%) at 6 months and sustained to 12 months in 37/42 (88%) of these patients with follow-up data. Clinical success was achieved in 92% who underwent any prior intervention. There were five reported complications: tunnel leak (three), significant pain (one) and pneumothorax (one). One tunnel leak required thoracotomy for empyema debridement, all other complications were managed conservatively. Forty-seven (31%) reported symptomatic reflux after POEM.

**CONCLUSIONS:** This first review of all POEM procedures performed in New Zealand for achalasia demonstrates high 6-month clinical success and safety for the management of achalasia.

Achalasia is an idiopathic motility disorder of the oesophagus, characterised by failure of the lower oesophageal sphincter to relax and by disordered oesophageal peristalsis.<sup>1</sup> It is rare, with an incidence and prevalence of 1–5 and 7–32 per 100,000 respectively.<sup>1</sup>

Until the development of the per-oral endoscopic myotomy (POEM) procedure by Inoue in 2008,<sup>2</sup> management of achalasia had been with pneumatic dilatation (PD) or laparoscopic Heller myotomy (LHM).<sup>3</sup> Despite comparable efficacy to 2 years,<sup>4</sup> multiple PDs are required to maintain efficacy, and both are associated with considerable complications including perforation.<sup>5,6</sup>

POEM involves the creation of a submucosal tunnel and myotomy of the lower oesophageal sphincter.<sup>2,7</sup> This combines the precision myotomy of LHM in a minimally invasive endoscopic technique.<sup>8</sup> International evidence reports high technical success<sup>3</sup> and low complication rates with the POEM procedure,<sup>9</sup> and randomised control trial data have confirmed superiority of POEM over PD and non-inferiority compared with LHM.<sup>10,11</sup>

To date, most POEM research emanates from China, Japan, Europe and the United States of

America (USA).<sup>12</sup> Recent reports from Australia and Norway reported good clinical success and safety.<sup>13,14</sup> New Zealand is an island nation of 5 million people, and there are few studies of POEM from lower-population countries and low-volume centres. There are no studies describing an entire country's experience. Here we report real-world data on the first New Zealand experience with POEM for the management of achalasia with regard to clinical success and complications.

## Methods

We conducted a retrospective study of all consecutive POEM cases completed at five tertiary hospitals where POEM is offered in New Zealand—North Shore (Auckland), Middlemore (Auckland), Waikato, Wellington and Christchurch—between November 2015 and December 2022. Seven interventional endoscopists (RC, FW, RO, GL, IK, RP, CS) completed the procedures. All are gastroenterologists who also perform endoscopic submucosal dissection (ESD). Patients were excluded if the POEM procedure was completed for an indication other than achalasia.

POEM cases were identified from

procedural databases at each centre. Clinical notes were reviewed to obtain baseline demographic information, disease characteristics including achalasia subtype according to the Chicago classification,<sup>1</sup> manometry recordings, previous intervention and complete procedural data including myotomy location and length, adverse events and length of hospital stay. Eckardt scores and symptoms of gastro-oesophageal reflux disease (GORD) were obtained from follow-up clinic reviews at 6 and 12 months where available. Routine gastroscopy or pH after POEM were not performed.

POEM procedures and post-POEM management were at the discretion of the proceduralist at each individual hospital. However, consistency between all sites was in the manner described by Inuoe<sup>2</sup> with the use of general anaesthesia, gastroscope and distal attachment with CO<sub>2</sub> insufflation and submucosal injection of a lifting agent with dissection and myotomy.

The primary outcome was clinical success, defined as an Eckardt score of  $\leq 3$  at 6-month clinic review. The secondary outcome was adverse events. Reflux was defined as any retrosternal burning discomfort.

Statistical analysis was performed using IBM SPSS Statistics, version 23 (IBM Corp., New York, USA). Kolmogorov–Smirnov test was used to test normality of data. Continuous variables with normal distribution were presented as mean with standard deviation (SD) and non-normal variables were reported as median with interquartile range (IQR). Chi-squared and Fisher's exact tests were used for categorical variables and Wilcoxon Signed-Rank Test, Mann–Whitney U test or Kruskal–Wallis were used for non-parametric continuous variables. Binomial logistic regression was used for binomial categorical dependent variables.

The study received ethics exemption from the New Zealand Health And Disability Ethics Committee (ID12630).

## Results

One hundred and eighty-eight consecutive POEM cases were identified during the study period. Eighteen cases were excluded for non-achalasia indications. There were 170 POEM cases, including 166 patients undergoing their index POEM procedure and four second-attempt POEM cases, which were not included in the main analysis (three patients from the original 166 cases and one from another centre).

Baseline characteristics are described in Table 1: 96 (58%) were male with a mean age of 49.6 years (SD 19.2), and 61 (37%) were  $\geq 60$  years. Seventy percent had type 2 achalasia and 83 (50%) had had a prior intervention of any type. The median pre-POEM Eckardt score was 8 (IQR 6–9). There was no difference between pre-POEM Eckardt scores across achalasia subtypes ( $p=0.294$ ) or between those who had and had no prior intervention ( $p=0.990$ ).

The median time from first diagnosis to POEM was 299 days (IQR 94–1,412 days). The median time to POEM was significantly longer in patients with prior intervention compared to without: 1,242 days (IQR 210–2,912 days) and 146 days (IQR 54–356 days) respectively ( $p<0.01$ ).

All patients had a general anaesthetic with positive pressure ventilation. A posterior incision was used in 119 (72%) (Table 2). The median myotomy length was 11cm (IQR 9–12cm). The median length of hospital stay was 1 day (IQR 1–2 days). Technical procedural success was achieved in 164 (99%).

Follow-up Eckardt data were complete in 134/166 (81%) of patients undergoing their index POEM at 6 months and 45/166 (27%) at 12 months (Table 3). Clinical success was achieved in 124/134 (93%) and maintained to 12 months in 37/42 (88%) of those who achieved 6-month clinical success with 12-month data available (Table 4). There was overall improvement in median Eckardt score from 8 (IQR 6–9) pre-procedure to 0 (IQR 0–2) at 6 months ( $p<0.001$ ). There was no difference in success between achalasia types ( $p=0.30$ ). Ninety-two percent of patients with any prior intervention had clinical success at 6 months with a reduction of Eckardt score from 8 (IQR 6–9) to 1 (IQR 0–2). Clinical success was high in patients who had undergone both isolated PD and isolated LHM, but was considerably lower in the group who underwent both LHM and PD (Table 4).

There were five (3%) reported complications (Table 5). Four of these complications occurred within the first 20 cases at each of those centres, along with the two failed procedures. One tunnel leak that occurred in a patient with mega-oesophagus required a thoracotomy due to increasing collection despite a chest drain, with empyema debridement and lung decortication. They made a full recovery after a 2-week hospitalisation. All other complications were managed conservatively. All patients with a complication had a complete recovery. One of the failed procedures went on to have a successful redo POEM.

Median length of stay after a complication was 3 days (IQR 2–13). Forty-seven (31%) patients reported symptomatic GORD after POEM.

Of the four redo POEM cases, three achieved clinical success. Median Eckardt score improved from 9 (IQR 6–9) pre-procedure to 1 (IQR 0.5–2) post-procedure. The unsuccessful redo POEM was found to have no visible remaining muscle tissue for further myotomy.

## Discussion

We report on the first complete POEM series from New Zealand for achalasia, and the first real-life nation-wide dataset, demonstrating this procedure as safe and effective. Over the last 15 years, POEM has evolved from a novel third-space endoscopic technique to first-line endoscopic management of patients with achalasia, as reflected here with uptake at five tertiary hospitals in New Zealand.

We demonstrate 6-month clinical success in 93% of patients, comparable to recent Australian data<sup>13</sup> and consistent with international data reporting initial success of up to 95.5%.<sup>3,15</sup> There are mixed data on the long-term efficacy of POEM, with 12-month success ranging from 82–91%,<sup>2,3,13,15,16</sup> but higher long-term success reported in series with significant loss of follow-up. While our data suggest that 12-month clinical success can be maintained, data were not available for the majority and a prospective study could be done to confirm this.

Our study confirms POEM suitability for all achalasia types, with excellent clinical success seen in each group. Notably, we report success in all type 3 achalasia cases, with significant Eckardt score improvement to 1 (IQR 0–2) at 6 months. This confirms the considerable evidence for POEM in type 3 achalasia, where the extended myotomy that a POEM can provide produces superior symptom control compared to an LHM.<sup>17</sup>

The utility of POEM extends past first-line management of achalasia, with a meta-analysis showing 85% success after any prior endoscopic or surgical intervention.<sup>18</sup> Our POEM success rate of 92% across any prior intervention, including success in all prior LHM cases, confirms the efficacy of POEM as salvage therapy. The lower clinical success in the group of patients who had undergone both prior PD and LHM (57%) could reflect increased scarring or oesophageal dysmotility.

Our overall complication rate of 3% is in

keeping with international reports.<sup>9</sup> The five complications occurred at four of the participating centres, and four complications occurred within the first 20 cases at those centres, which may reflect an aspect of the learning curve: operator experience of <20 cases is noted to be a risk factor for complications.<sup>9</sup> Thus, it is likely that over time the complication rate will reduce. Our serious complication rate (1.8%), although higher than in international cohorts (0.5%),<sup>9</sup> may reflect each centre having their own learning curve, inflating our overall rates. In comparison, LHM may carry a higher complication rate of up to 7%.<sup>10</sup>

The only other New Zealand data on the management of achalasia reviewed 99 patients treated with balloon dilation (BD) and LHM between 1997 and 2010. Thirty-eight percent of the 76 patients undergoing BD required multiple procedures, with satisfactory outcomes achieved in 79%—which, when compared with our data, suggests POEM should be considered as first-line endoscopic management. In this study there was one complication (perforation) in the BD group and five in the LHM group (including perforation, splenic tear and thoracic duct injury). Six (17%) LHM patients required further treatment due to dysphagia or reflux.<sup>6</sup> However, LHM was only introduced 4 years prior to this study, and so may not accurately reflect a more modern cohort of LHM patients.<sup>6</sup>

GORD remains a concern and topic of discussion in the post-POEM cohort. A recent systematic review and meta-analysis found higher rates of symptomatic GORD (18.1% vs 8.1%), endoscopic oesophagitis (30.7% vs 8.3%) and abnormal acid exposure on pH studies (39.3% vs 14.9%) in POEM patients compared to LHM with fundoplication.<sup>19</sup> However, the majority of endoscopic oesophagitis was mild and most responsive to proton pump inhibitor therapy,<sup>19</sup> and so to date there has been limited requirement for definitive anti-reflux surgery after POEM.<sup>20</sup> There is, however, a recent description of endoscopic fundoplication during the same POEM procedure showing good efficacy to 12 months.<sup>21</sup> Our study, while having higher reported GORD symptoms, lacks follow-up data and objective investigations like endoscopy and pH studies. There may be other contributors to GORD symptoms in achalasia, including oesophageal fermentation,<sup>22</sup> and so future prospective research in New Zealand should incorporate data on post-POEM GORD using the Lyon Consensus<sup>23</sup> to help characterise and

standardise the diagnosis.

With the changing shape of the New Zealand healthcare system, the idea of centralisation of the POEM procedure could be considered—given the rarity of the condition, in particular. However, POEM is an extension of other interventional third-space endoscopy, such as ESD, which all of these clinicians also perform. We feel this shows that POEM can still be safely performed in a number of different centres to avoid inconvenience for patients, if the expertise is available.

To the best of our knowledge, we present the first complete POEM dataset for a nation. Countries with a similar population to New Zealand, like Norway, have limited patient numbers from single centres, and countries with a population of up to twice the population size of New Zealand, like Greece and Portugal, even when multi centre, are limited by patient numbers.<sup>14,15,24–27</sup>

The strengths of this study include its real-world dataset with complete case capture. There is inherent heterogeneity between centres in terms of POEM technique and follow-up, and dif-

ferences in case volume, interventional experience and training between proceduralists. A considerable limitation is lack of 12-month follow-up, confounded by a number of patients not attending further appointments, potentially reflecting the inherent geographical isolation that many patients in New Zealand face in having to travel for this procedure. While one could infer that patients who didn't reattend appointments were likely improved, we cannot definitively comment on complete clinical efficacy at 12 months. Finally, our GORD rates were only subjectively assessed and may not be a reflection of the true GORD rates. Overall, these data must be encouraging and generalisable to similar smaller-population countries and small-volume centres that POEM success and safety is possible, and we feel support the international trend that POEM be considered as first-line endoscopic management for achalasia.

In conclusion, this nation-wide review of all New Zealand data on the POEM procedure shows high clinical success at 6 months and low complication rates, comparable with international data.

**Table 1:** Baseline characteristics of the 166 index POEM cases.

Characteristic	Value
<b>Age</b>	
Mean (SD)	49.6 (19.2)
<b>Gender</b>	
Male, n (%)	96 (58)
<b>Ethnicity, n (%)</b>	
NZ European	126 (76)
Māori	17 (10)
Indian	6 (3.6)
Pacific	5 (3.0)
Chinese	4 (2.4)
Other	8 (4.8)
<b>Indication</b>	
Achalasia, n (%)	166 (100)
Type 1	12 (7)
Type 2	116 (70)
Type 3	13 (8)
Type not specified	25 (15)
<b>Prior intervention, n (%)</b>	
Any	83 (50)
Isolated botox	11 (7)
Isolated PD	45 (27)
Isolated LHM	17 (10)
PD and LHM	10 (6)
<b>Manometry pre-POEM, mmHg</b>	
Resting pressure, mean (SD)	42.7 (19.7)
Relaxation pressure, mean (SD)	34.1 (13.8)

POEM = per-oral endoscopic myotomy; SD = standard deviation; NZ = New Zealand; PD = pneumatic dilatation; LHM = laparoscopic Heller myotomy.

**Table 2:** POEM procedural technical information.

	Value
<b>Anaesthesia type, n (%)</b>	
GA	166 (100)
<b>Myotomy orientation, n (%)</b>	
Anterior	47 (28)
Posterior	119 (72)
<b>Median myotomy length, cm (IQR)</b>	
Overall	11 (9–12)
Achalasia type 1	9.5 (8–11)
Achalasia type 2	11 (9–11)
Achalasia type 3	13 (11–15)
Achalasia NOS	11 (10–11)
<b>Inpatient stay, days</b>	
Median, IQR	1 (1–2)

POEM = per-oral endoscopic myotomy; GA = general anaesthesia; IQR = interquartile range; NOS = not otherwise specified.

**Table 3:** Eckardt scores pre-POEM, at 6 months and at 12 months post-POEM.

	Value
<b>Pre-POEM Eckardt score, median (IQR)</b>	
Overall	8 (6–9)
Achalasia type 1	8 (6.8–9)
Achalasia type 2	8 (7–9)
Achalasia type 3	8 (7–9)
Achalasia NOS	6 (4.5–8)
Prior intervention	8 (6–9)
No prior intervention	8 (7–9)
<b>6-month Eckardt score, median (IQR)</b>	
Overall	0 (0–2)
Achalasia type 1	0.5 (0–2)
Achalasia type 2	0 (0–2)
Achalasia type 3	1 (0–2)
Achalasia NOS	1 (0–1)
Prior intervention	1 (0–2)
No prior intervention	0 (0–1)
<b>12-month Eckardt score, median (IQR)</b>	
Overall	1 (0–2)
Achalasia type 1	0.5 (0–1)
Achalasia type 2	1 (0–3)
Achalasia type 3	1 (0–2)
Achalasia NOS	0 (0)
Prior intervention	1 (0–3)
No prior intervention	0 (0–1)

POEM = per-oral endoscopic myotomy; IQR = interquartile range; NOS = not otherwise specified.

**Table 4:** Clinical success.

	Value
<b>6-month clinical success, n (%)</b>	
Overall	124 (93%)
Achalasia type 1	10 (91%)
Achalasia type 2	87 (88%)
Achalasia type 3	12 (100%)
Achalasia NOS	15 (100%)
Any prior intervention	60 (92%)
<b>12-month sustained clinical success, n (%)</b>	
Overall	37 (88%)
Achalasia type 1	5 (83%)
Achalasia type 2	25 (89%)
Achalasia type 3	5 (83%)
Achalasia NOS	2 (100%)
Any prior intervention	23 (82%)
<b>6-month clinical success by prior intervention, n (%)</b>	
Isolated PD	27 (96%)
Isolated LHM	11 (100%)
LHM and PD	4 (57%)

NOS = not otherwise specified; PD = pneumatic dilatation; LHM = laparoscopic Heller myotomy.

**Table 5:** Complications.

	Value
<b>Complications, n</b>	
Tunnel leak	3
Pneumothorax	1
Pain	1
<b>GORD, n (%)</b>	
Yes	47 (31%)
No	103 (69%)

GORD = gastro-oesophageal reflux disease.

**COMPETING INTERESTS**

There are no conflicts of interest to declare.

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