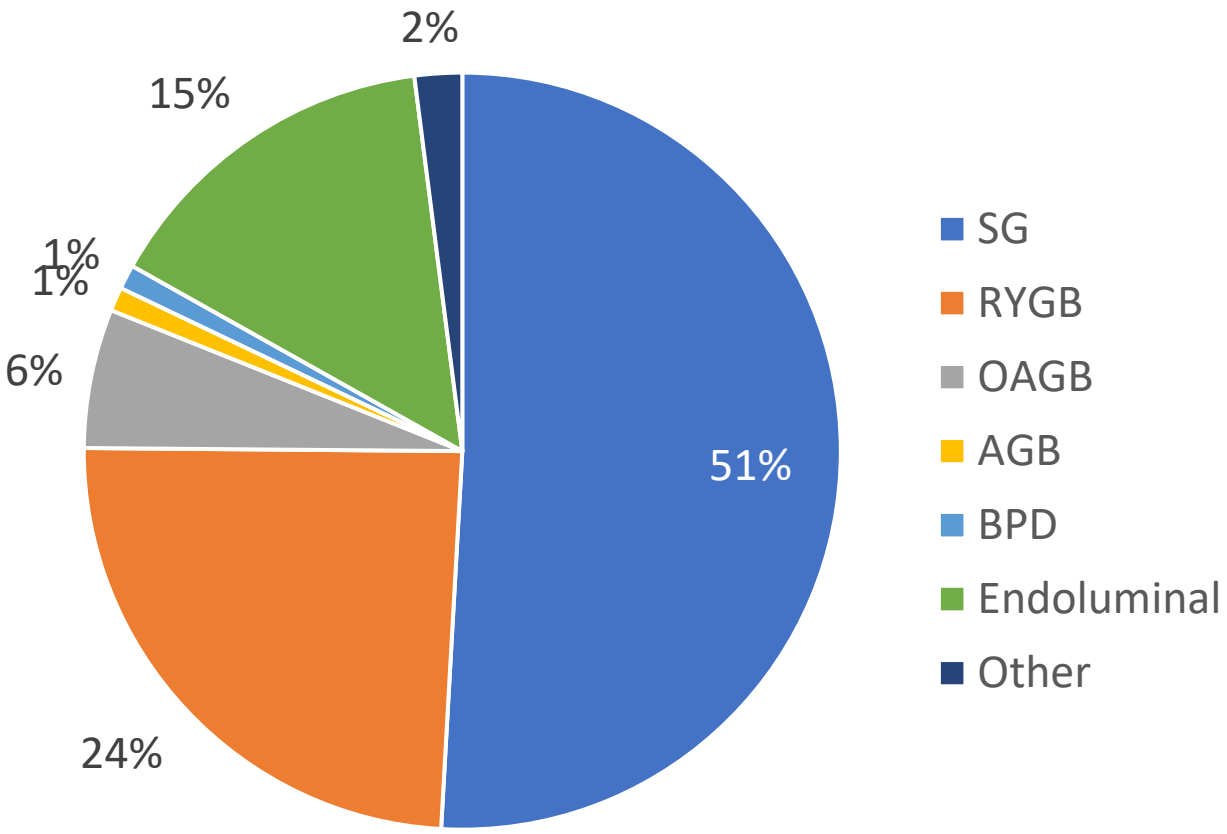
What does “normal” look like after bariatric surgery?

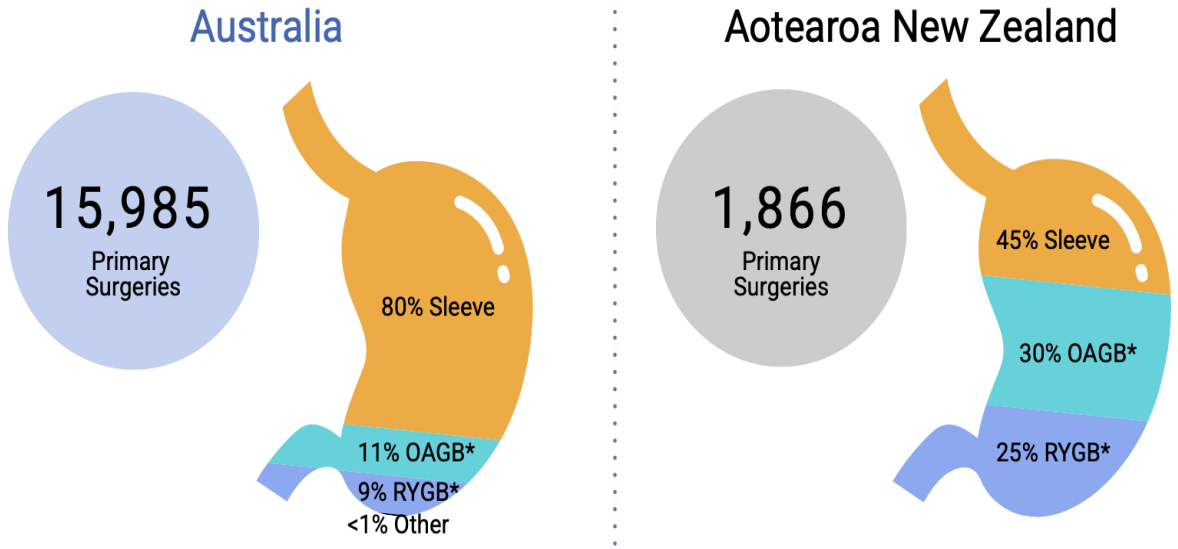
Yazmin Johari
MBBS (Hons), PhD
Oesophago-gastric and Bariatric Unit, Alfred Health
Department of Surgery, Central Clinical School, Monash University
Melbourne, Australia

In accordance with «EACCME criteria for the Accreditation of Live Educational Events», please disclose whether you have or not any conflict of interest with the companies:

[X] I have no potential conflict of interest to report

IFSO worldwide survey - Bariatric procedure 2018-2021





Primary bariatric surgery in Australia and Aotearoa New Zealand 2023

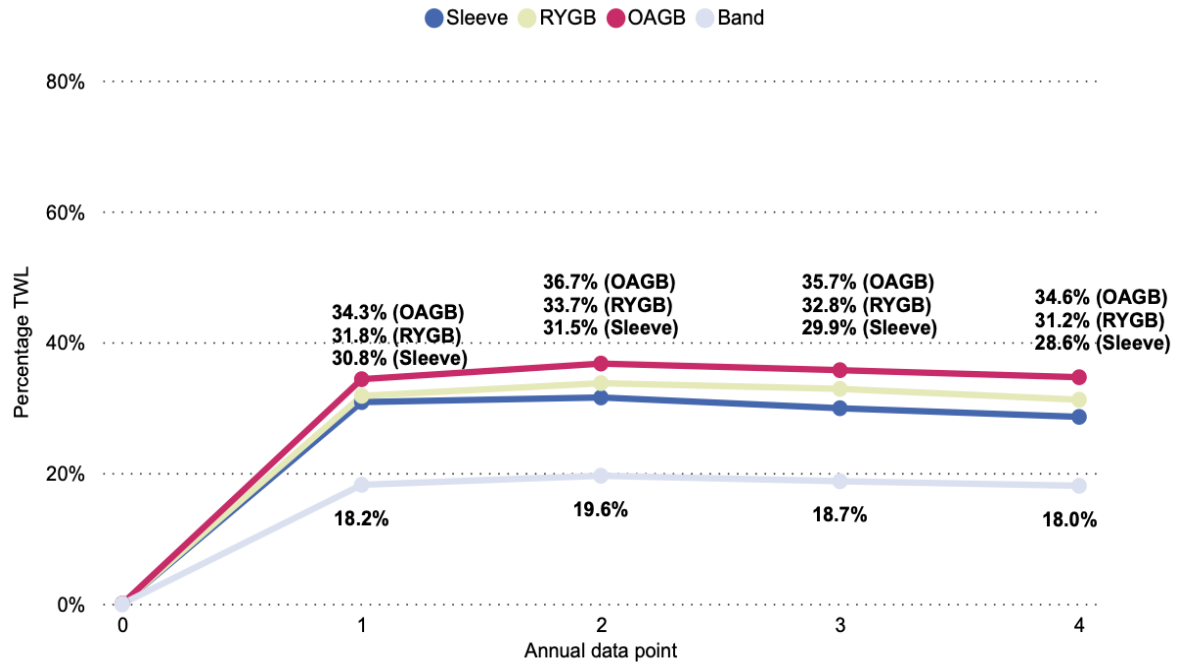
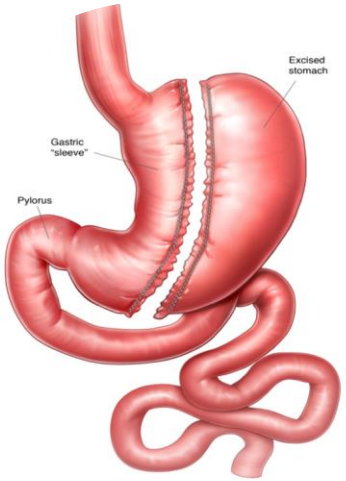
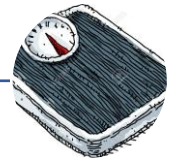


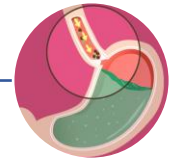
Figure 22 - Average percentage total weight loss (%TWL) for adult primary participants who have annual weight data for the first four years by procedure type in Australia, n= 6,229

Potential issues with sleeve gastrectomy





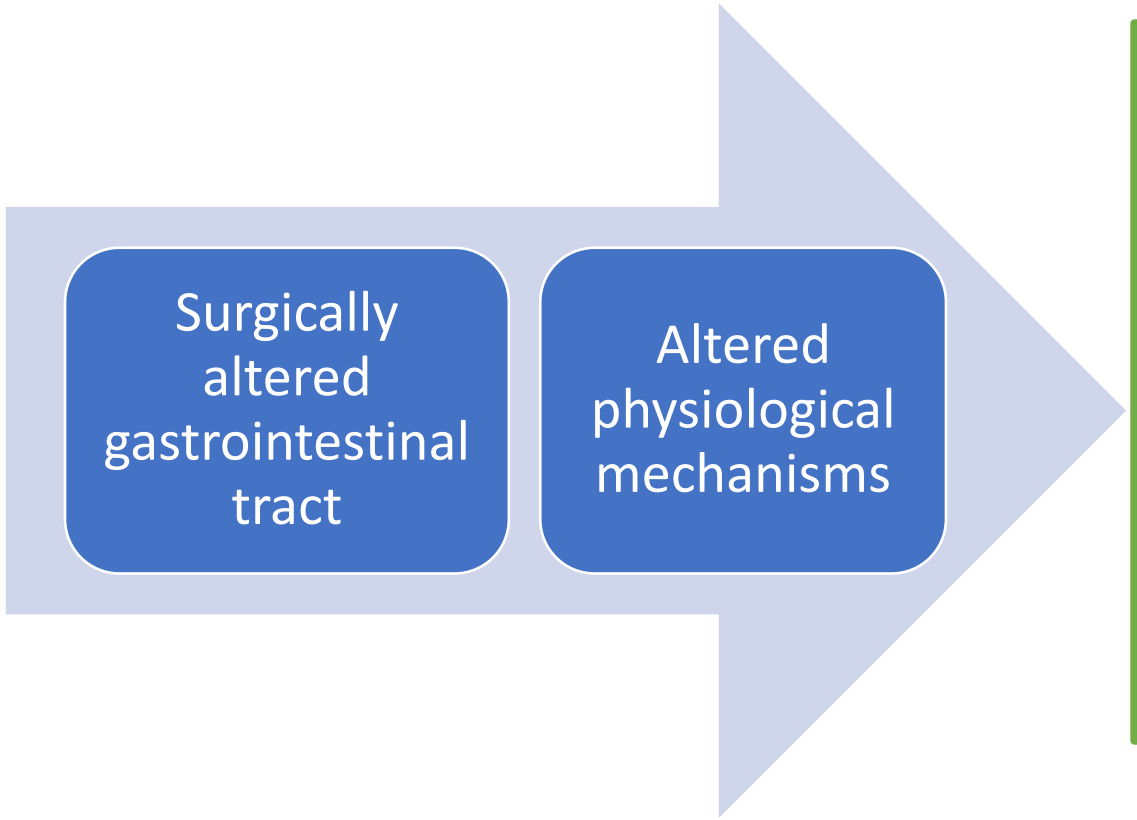
Weight regain/ poor weight loss



Gastro-oesophageal reflux

Staple line leak

Why do we need to understand what is normal after sleeve gastrectomy?



IMPLICATIONS

- Interpret signs and symptoms
- Interpret diagnostic test to make important decisions - ?reoperation
- Communicate
- Utilise outcome measures in research trial
- Measure outcome post-intervention and treatment

Define normal physiology processes

Define pathophysiology

Establish ‘normal/ optimal’ threshold of candidate variables of diagnostic tests

Apply findings in clinical trials

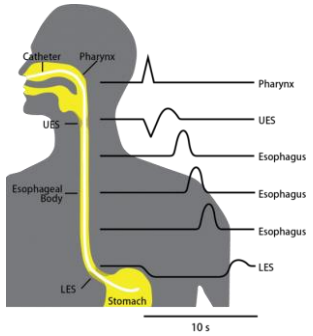
Translation to clinical setting - Measure outcome of intervention

STEP 1 - What is “normal” physiology look like after sleeve gastrectomy?

Optimal patients greater than 4 months post-operative

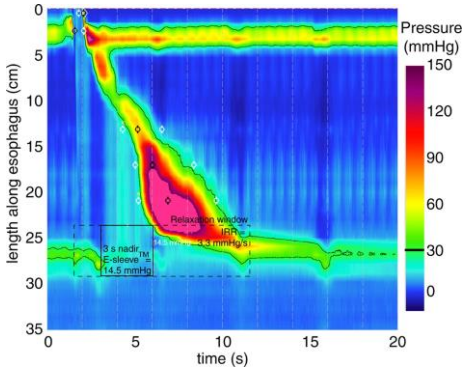
Obese laboratory controls (N=11)

Nuclear scintigraphy (N=26)



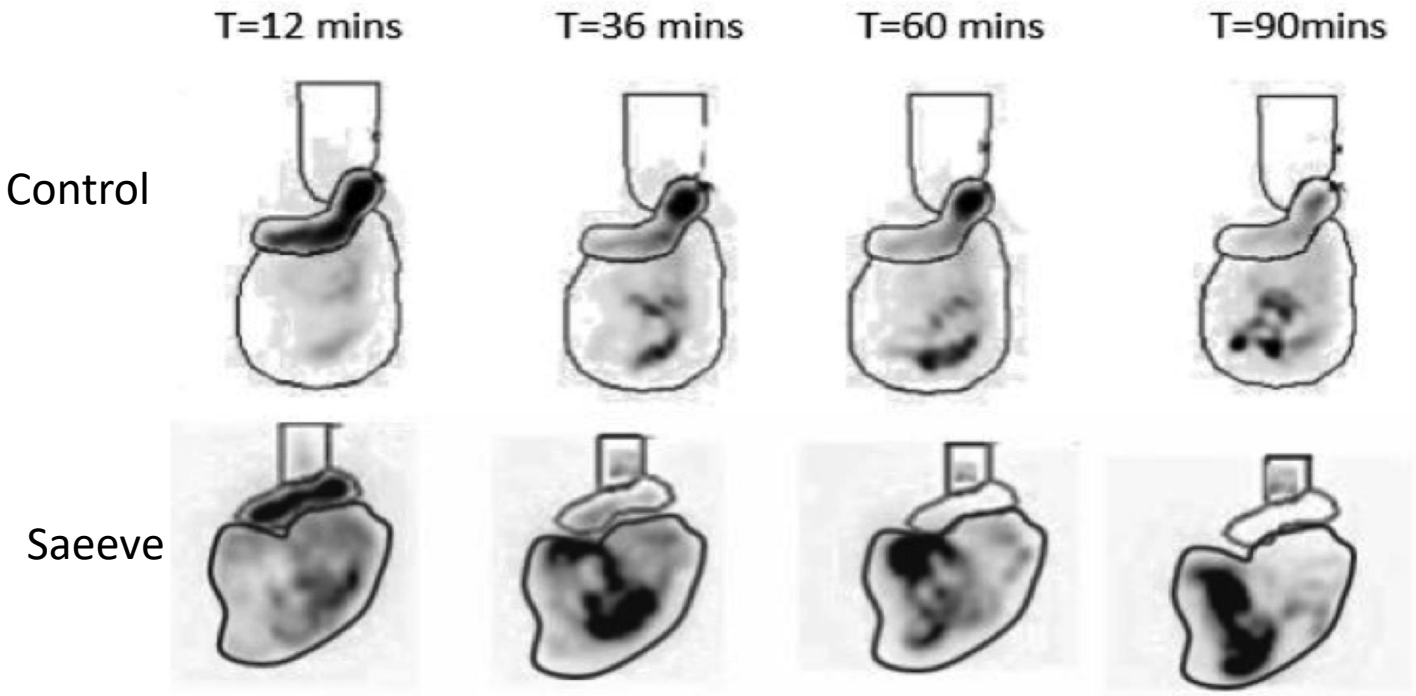
Stationery oesophageal manometry (N=26)

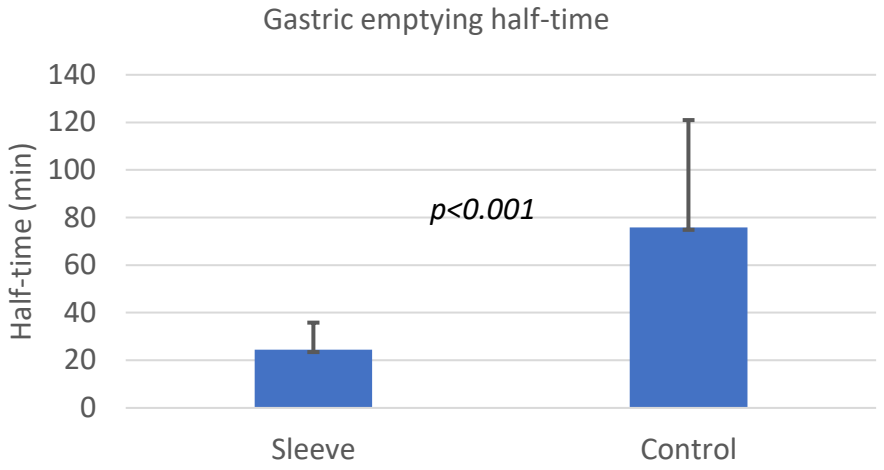
Semi solid stress barium (N=14)

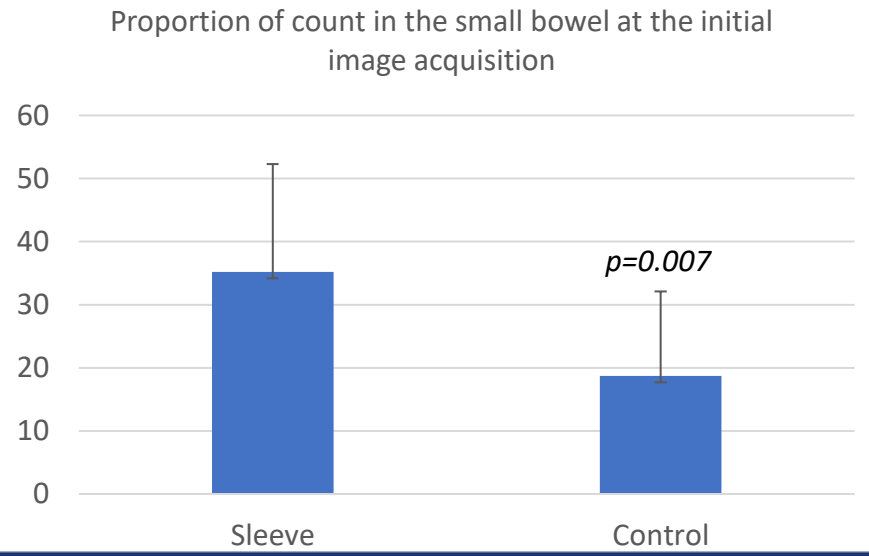


High resolution video fluoroscopy with concurrent manometry (N=7)

Nuclear scintigraphy – **Gastric transit**

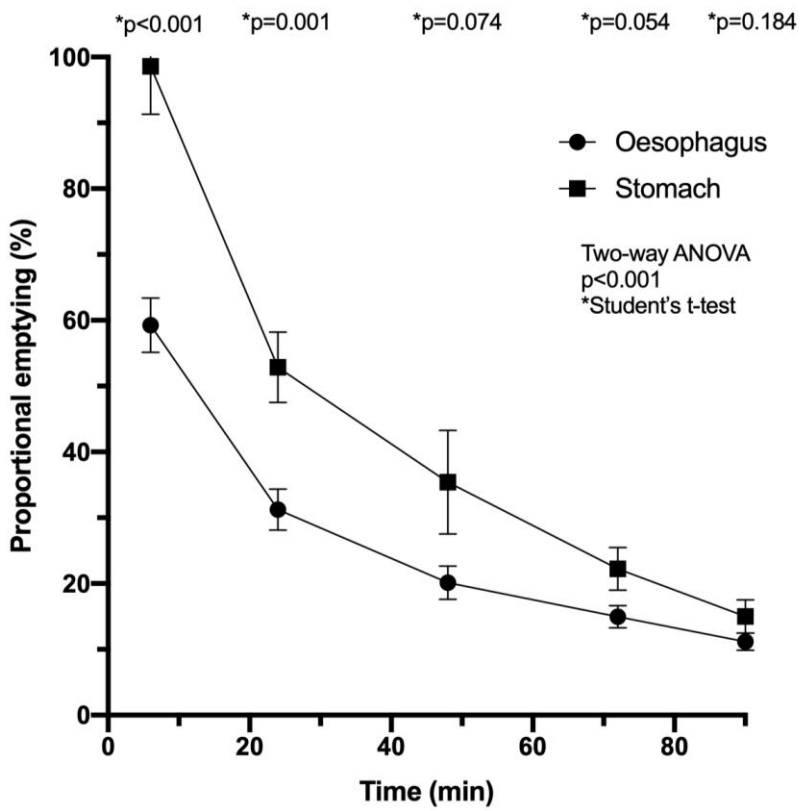




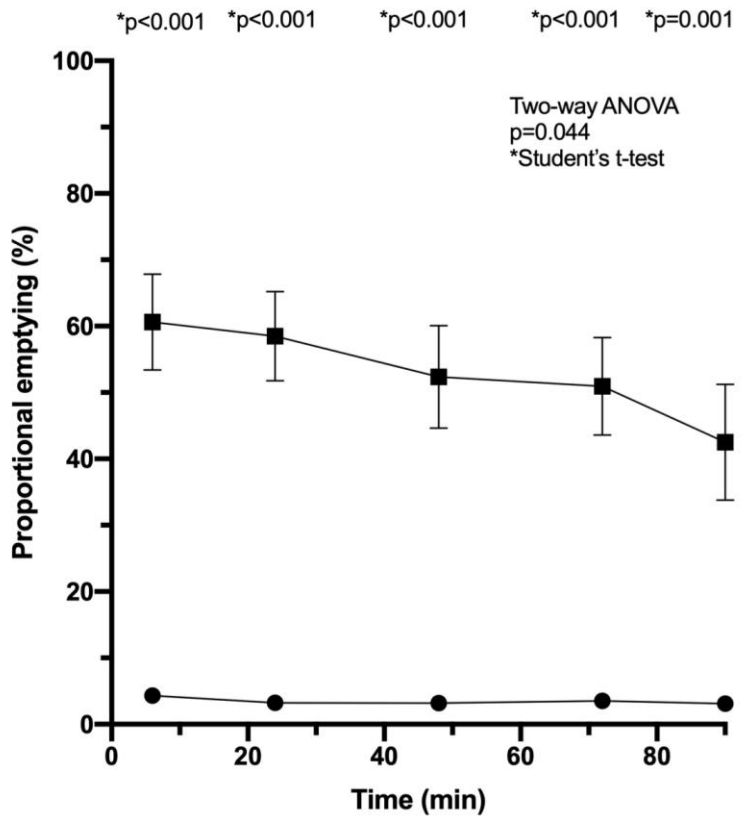


Nuclear scintigraphy – **Proportional emptying**

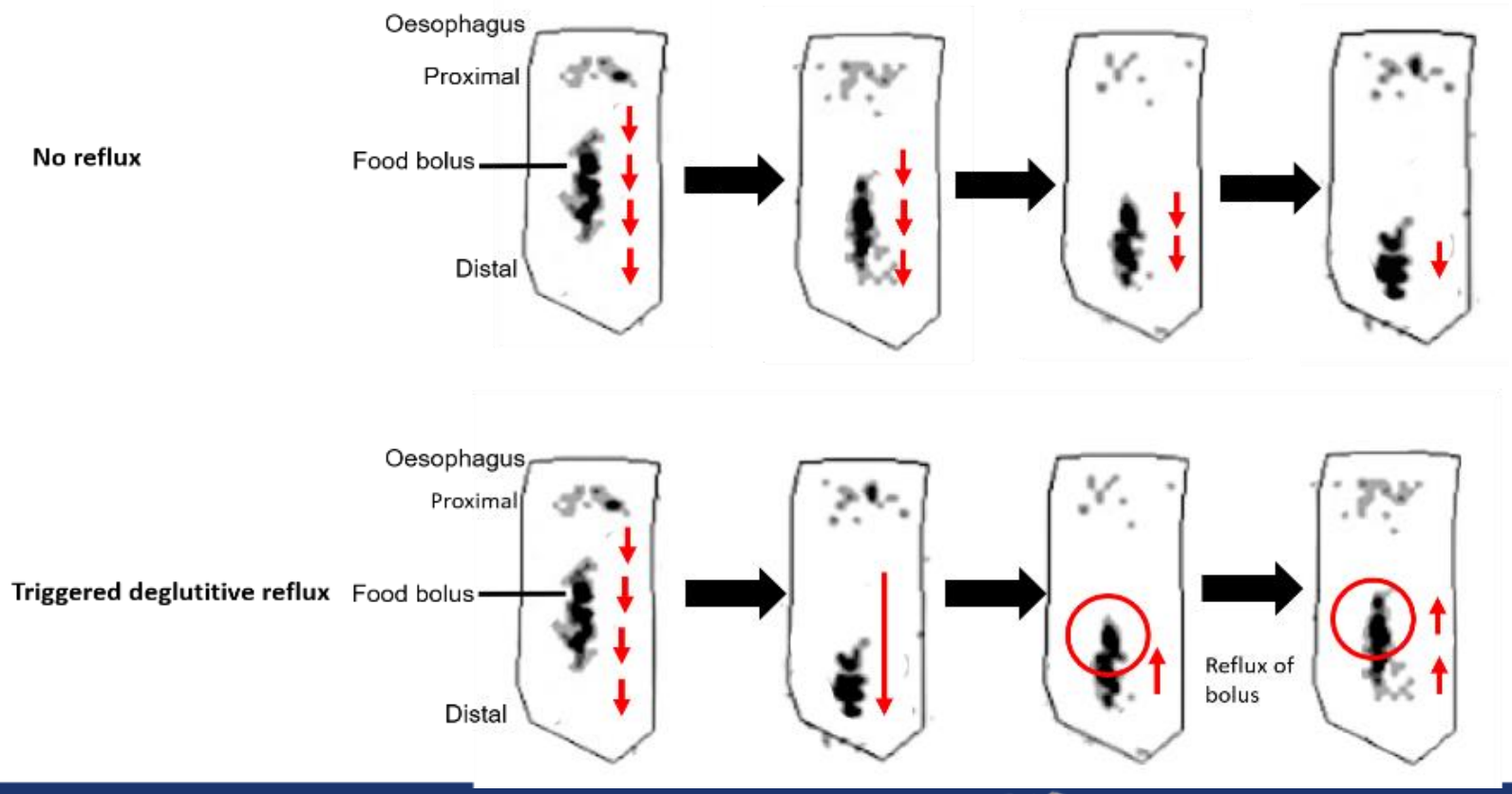
Sleeve

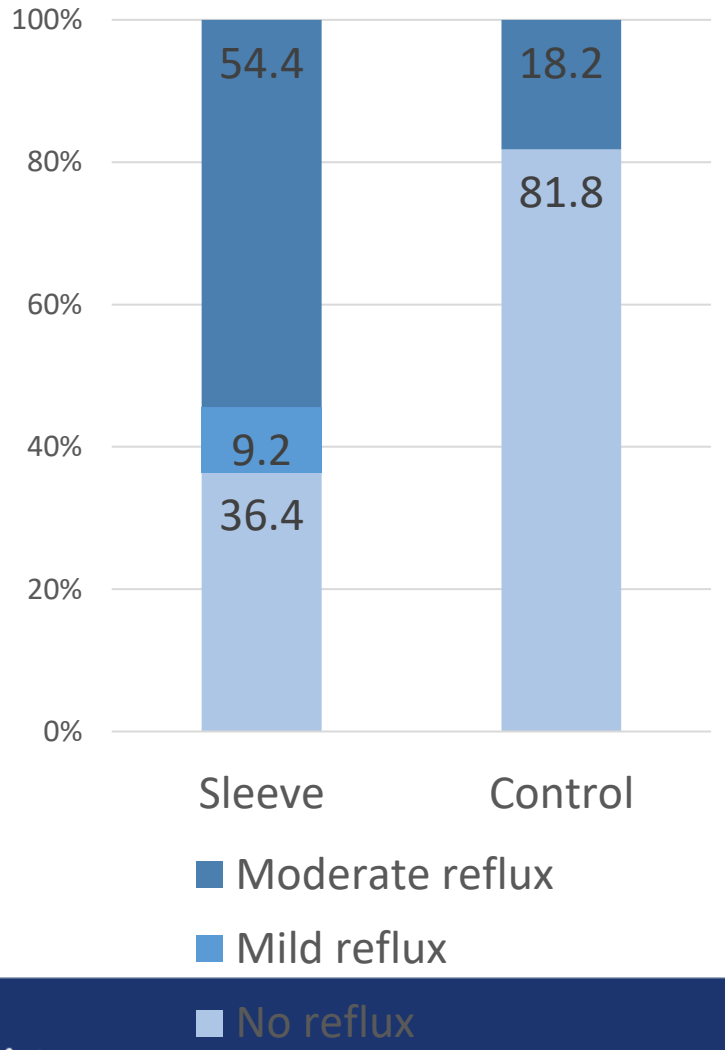


Control



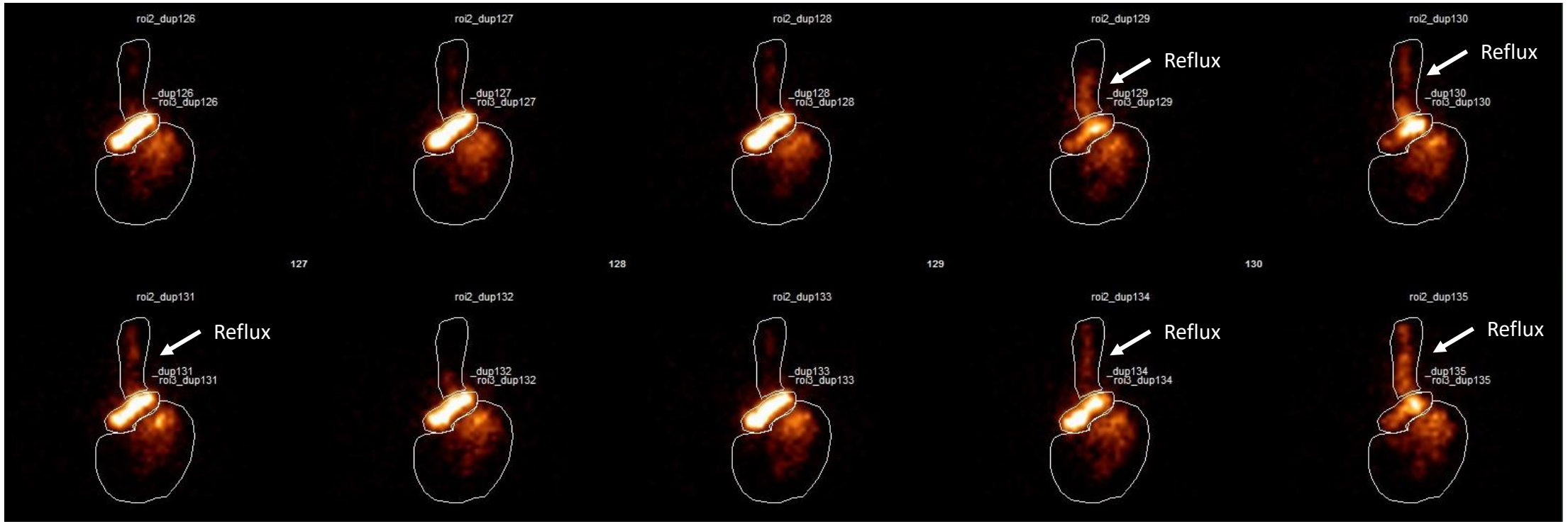
Nuclear scintigraphy - **Oesophageal transit**
Triggered deglutitive reflux





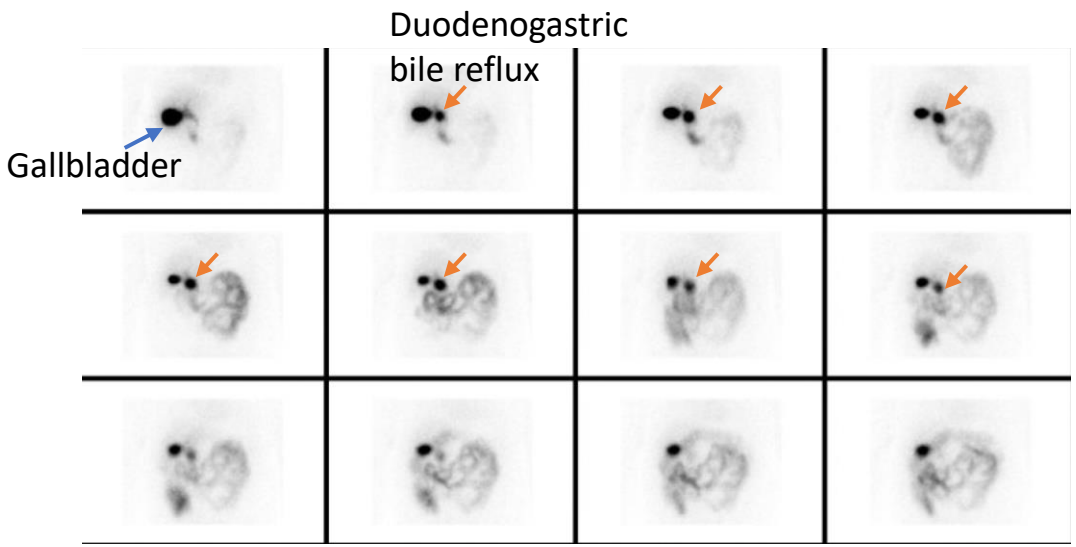
p=0.017

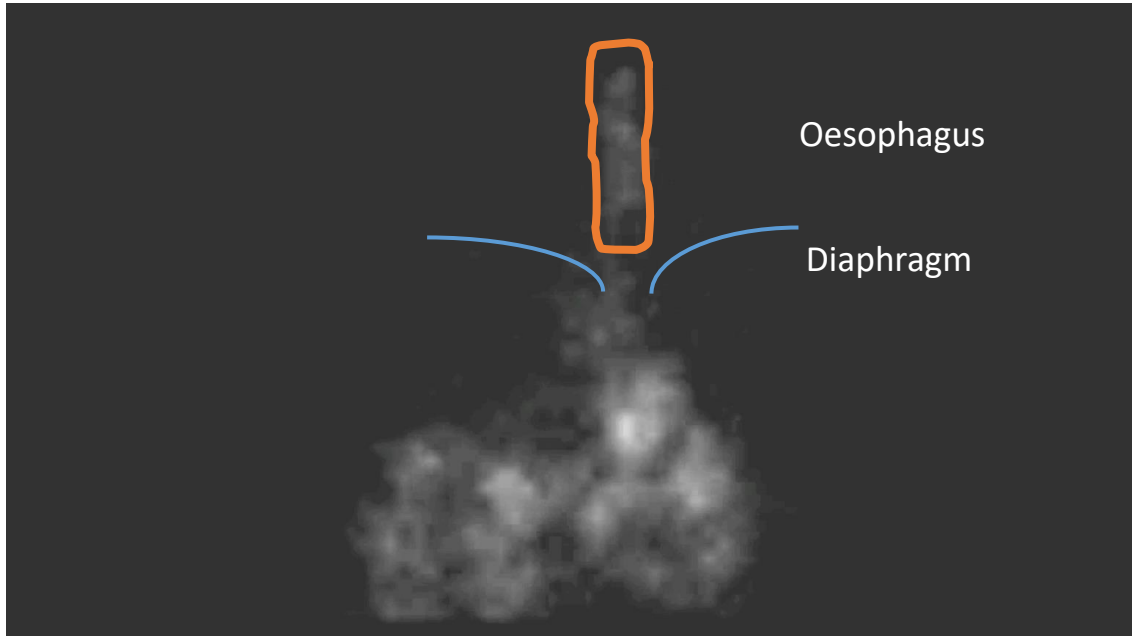
Nuclear scintigraphy – **Post-prandial reflux**



5 sec per frame

Bile reflux following sleeve gastrectomy



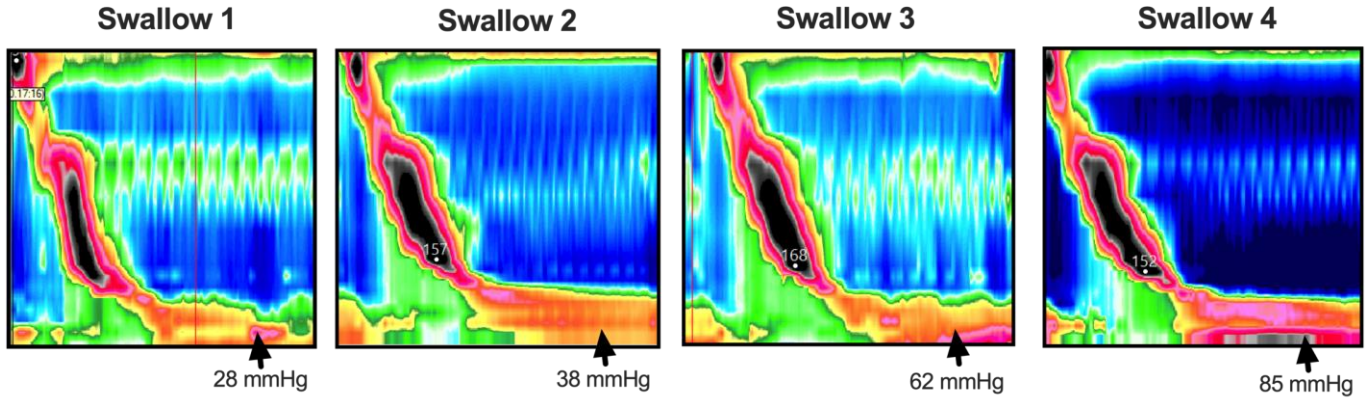


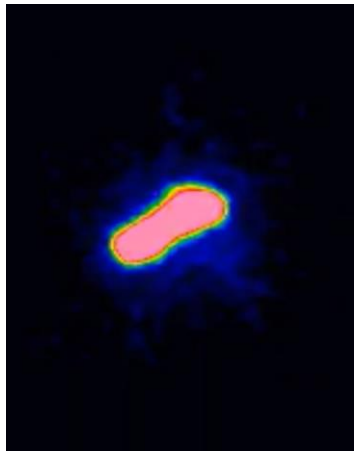
HIDA - 1 hr with an oral fatty meal using Ensure Plus to stimulate gallbladder contraction with dynamic imaging performed for the next 60 minutes.

Technique that allows for the detection and quantification of oesophageal bile reflux

Intraluminal pressurisations post sleeve gastrectomy

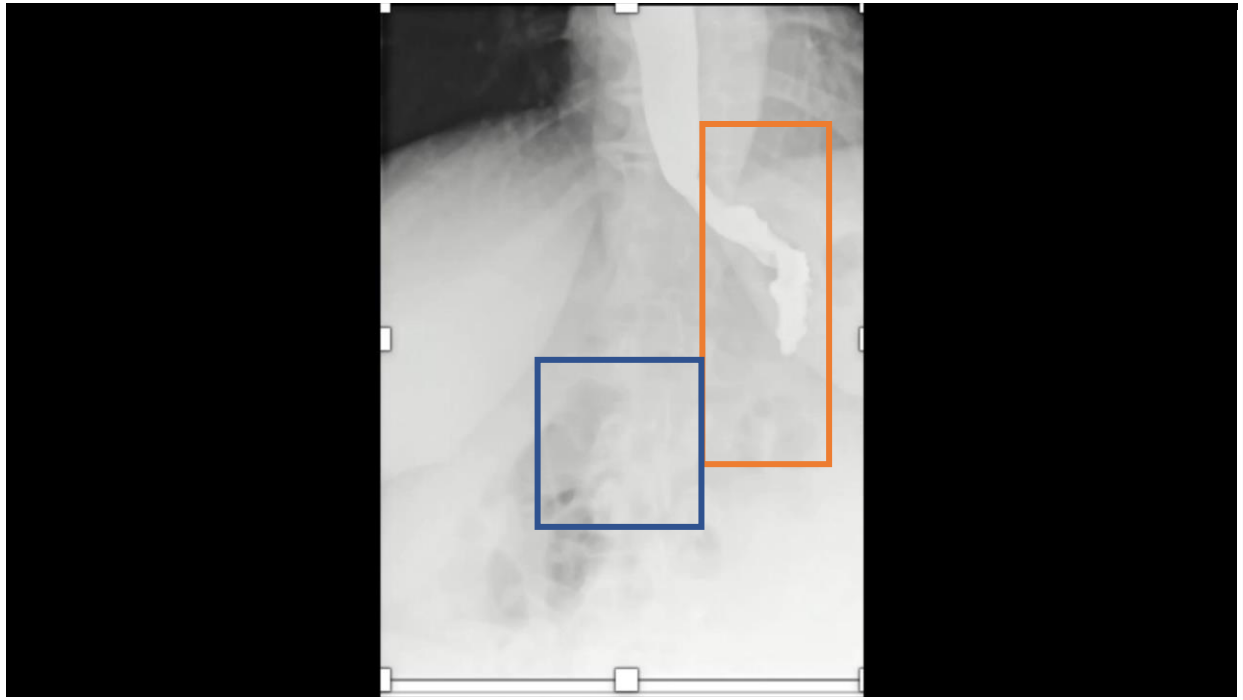
Proximal intragastric pressure sequential increment (5 rapid succession swallow of 10ml water)

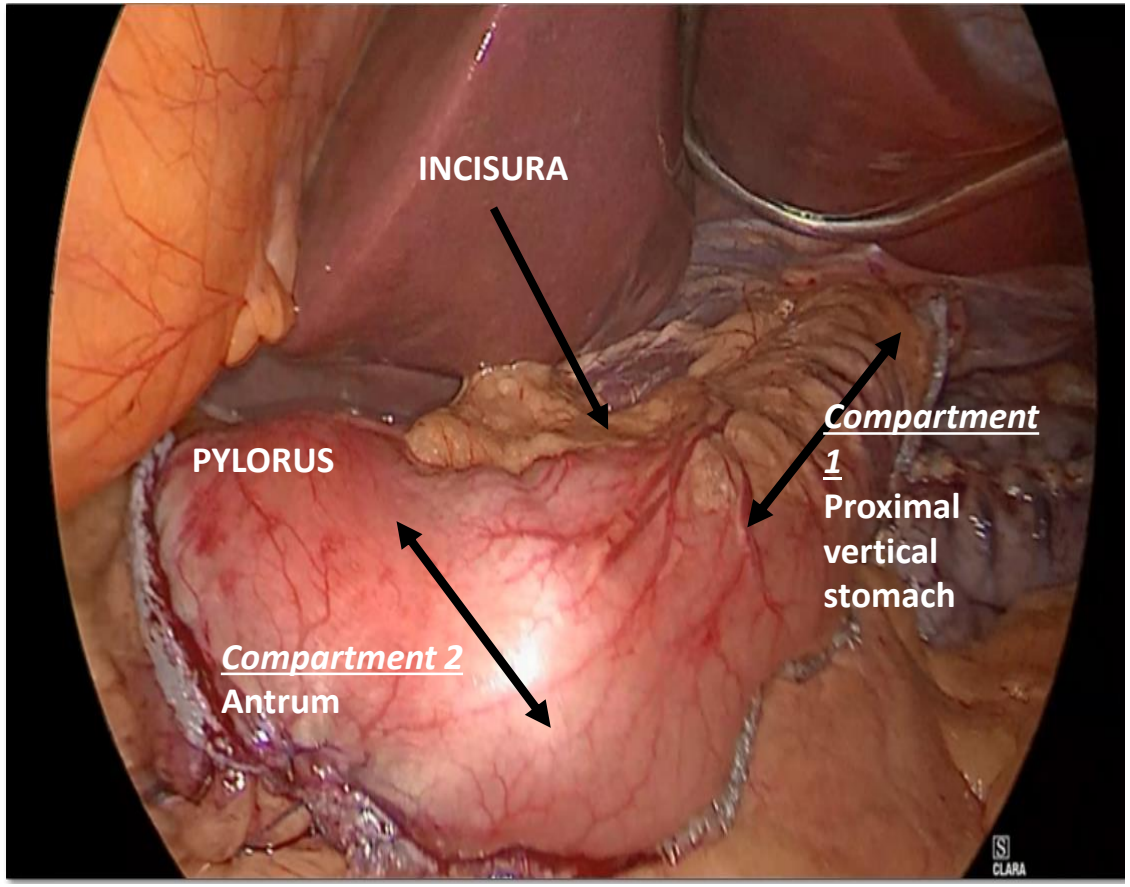




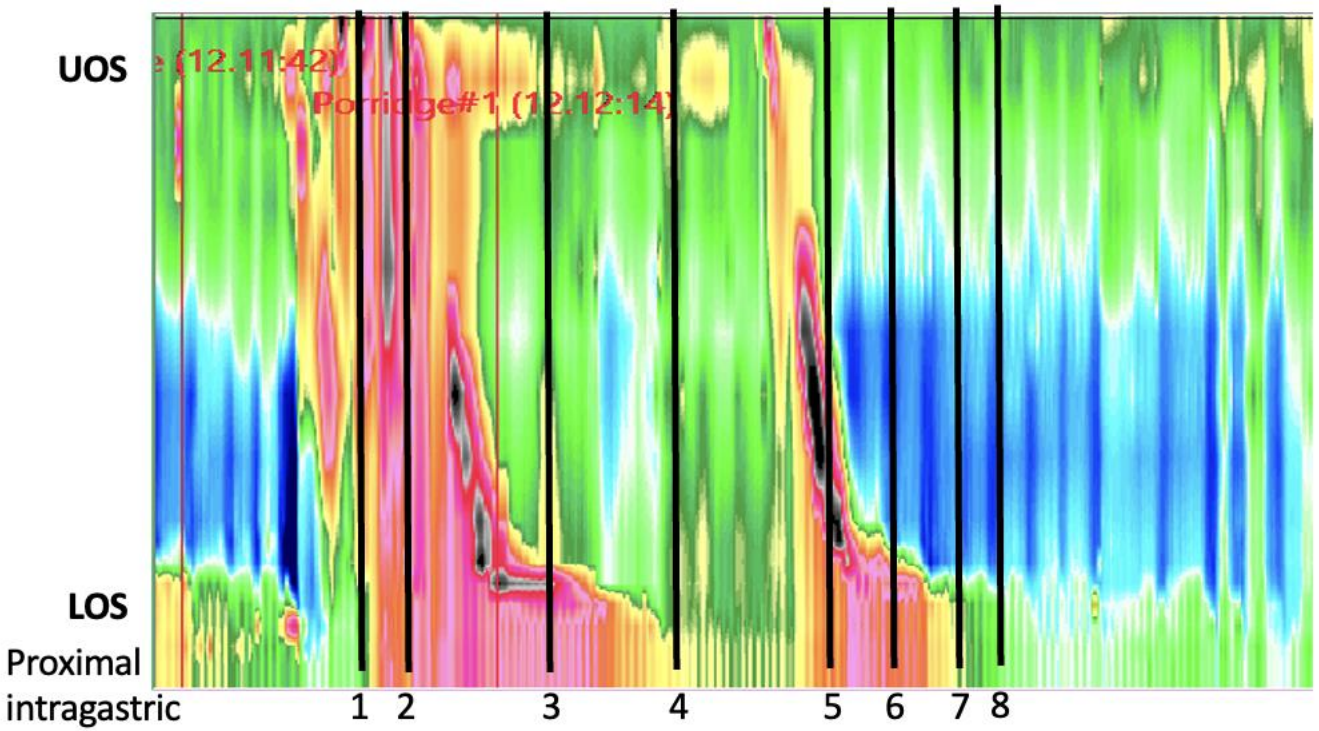
Johari Y, Wickremasinghe A, Kiswandono P, Yue H, Ooi G, Laurie C, Hebbard G, Beech P, Yap K, Brown W, Burton P. Mechanisms of esophageal and gastric transit following sleeve gastrectomy. Obesity Surgery. 2021 Feb;31:725-37.

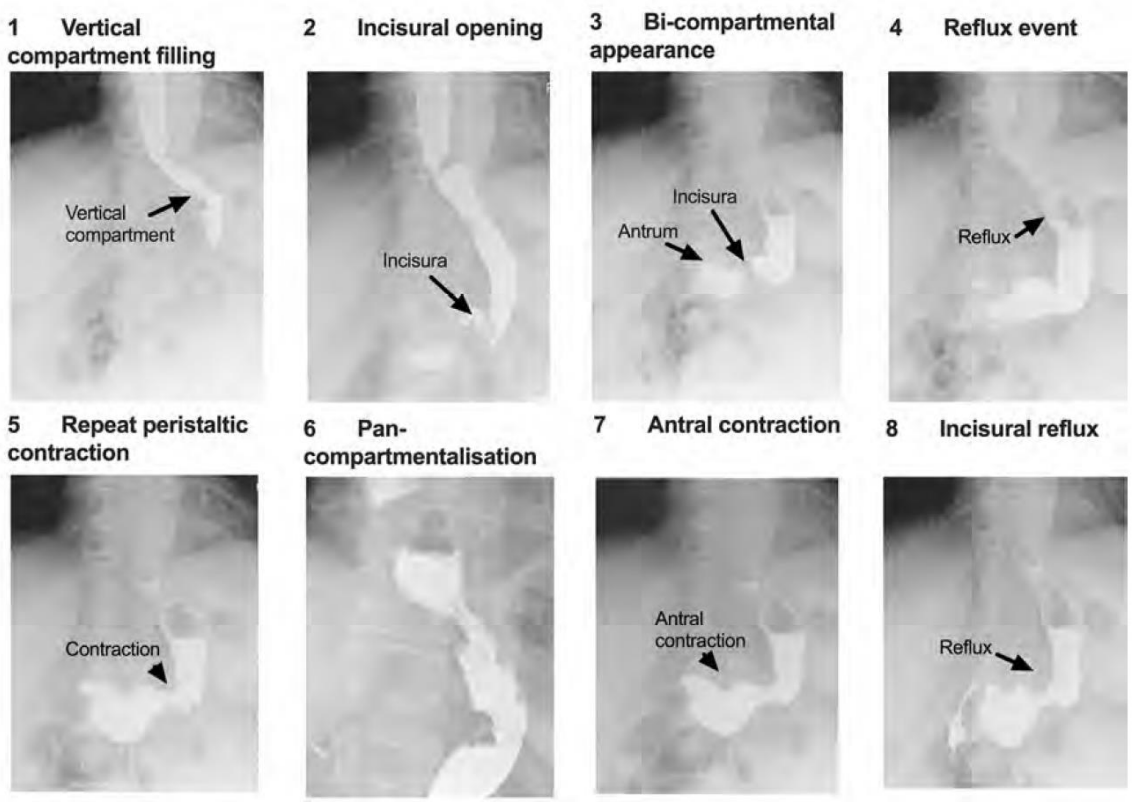
Stress barium – Bi compartmental model

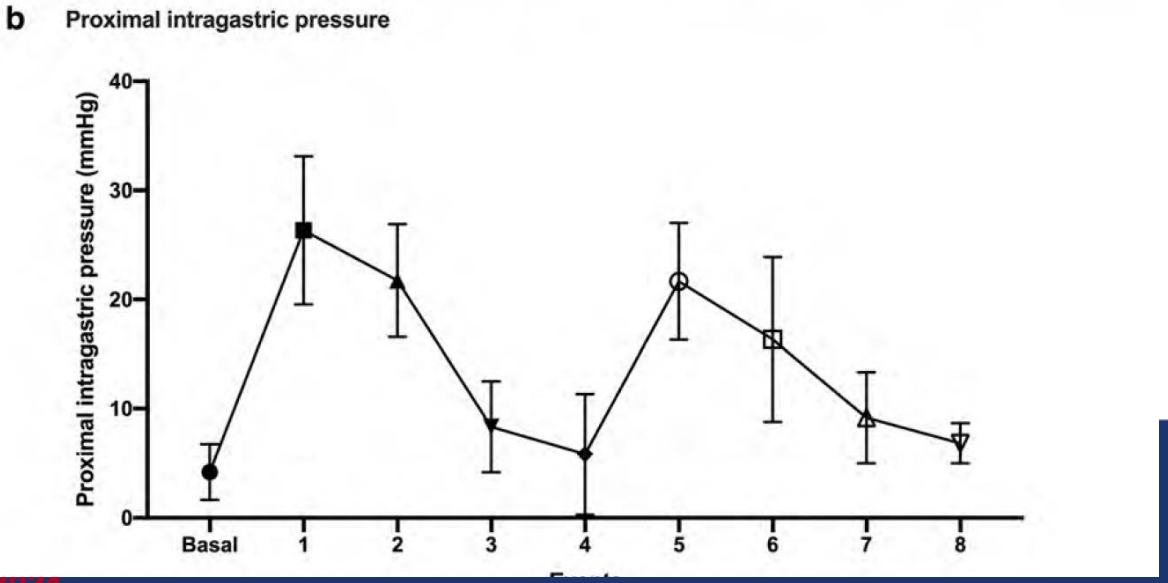




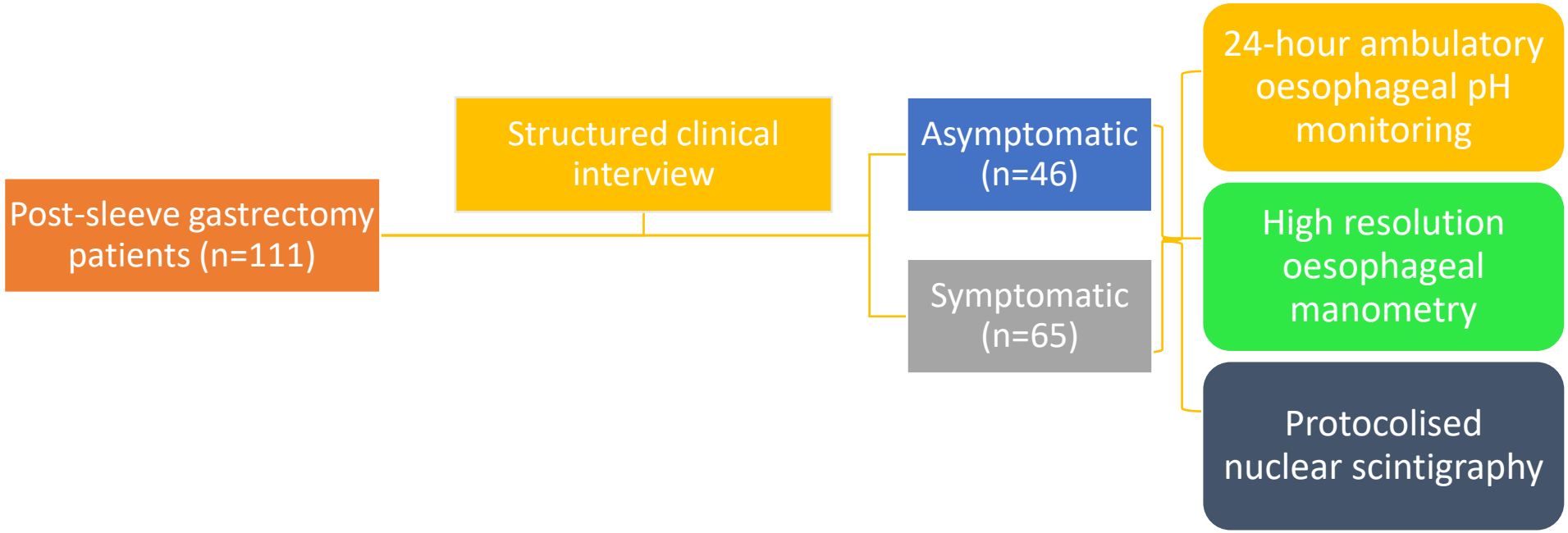
Concurrent fluoroscopy and manometry





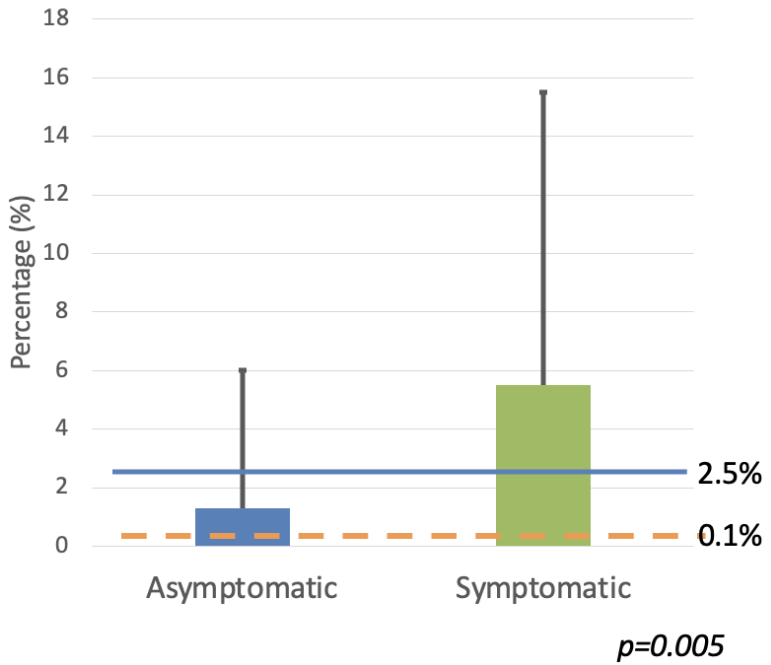


STEP 2 - Defining pathophysiology


Post-sleeve gastrectomy patients (n=111)
Structured clinical interview
Asymptomatic (n=46)
Symptomatic (n=65)
24-hour ambulatory oesophageal pH monitoring
High resolution oesophageal manometry
Protocolised nuclear scintigraphy

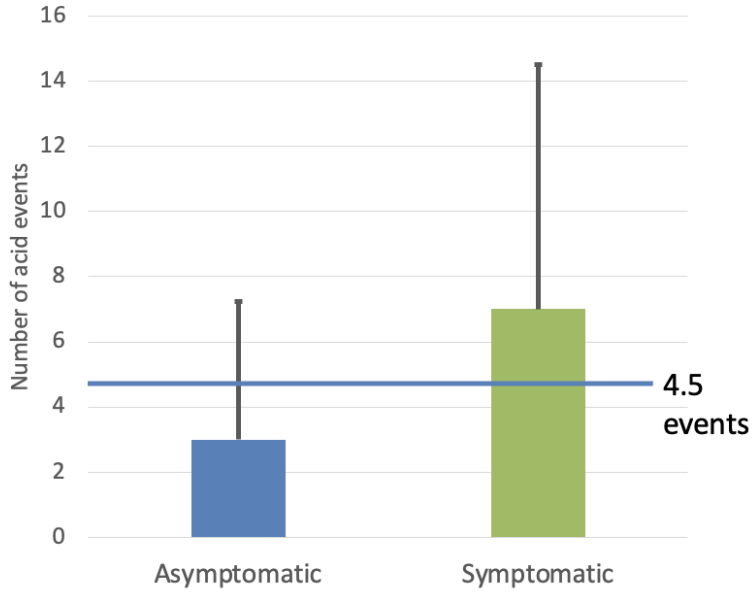
24hr pH study

Supine acid exposure



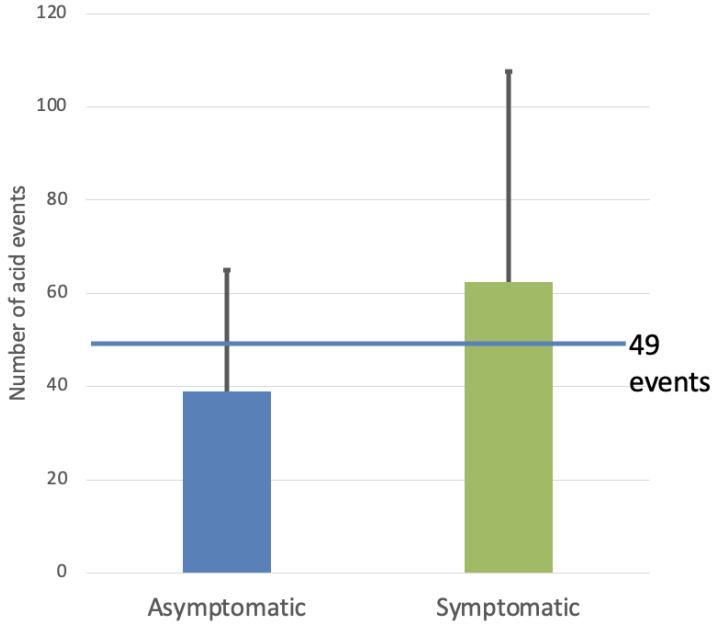
p=0.005

Supine reflux events



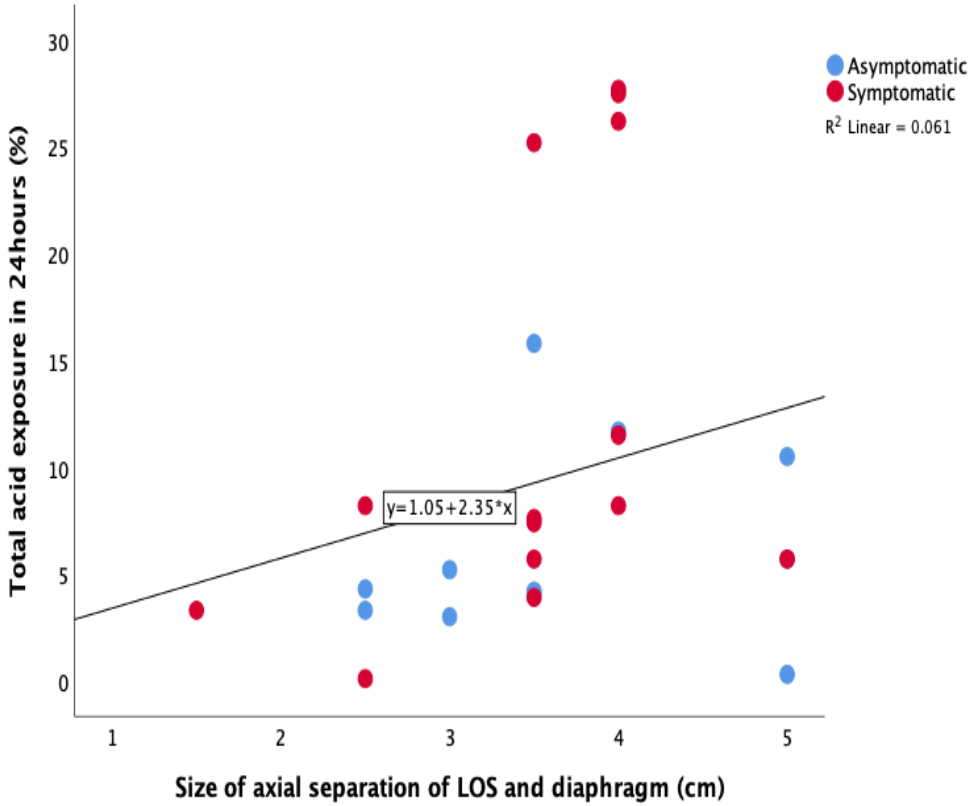
p=0.019

Number of acid events in 24 hours



p=0.002

Axial separation of LOS and diaphragm

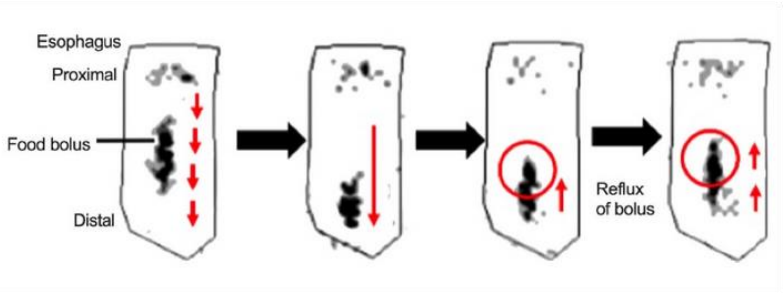


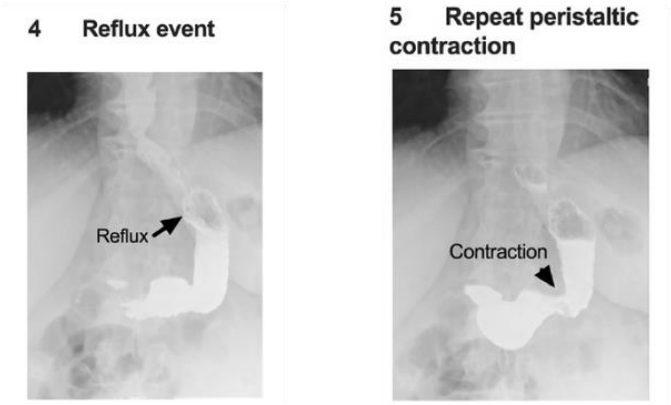
	Asymptomatic	Symptomatic	p-value
Size of axial separation (cm)	3.5 (IQR 1.8)	3.5 (IQR 1.0)	0.805

*>5cm is considered large hiatus hernias by manometric criteria

Defining pathophysiology of reflux - Different to established reflux mechanisms

Type I: Triggered deglutitive



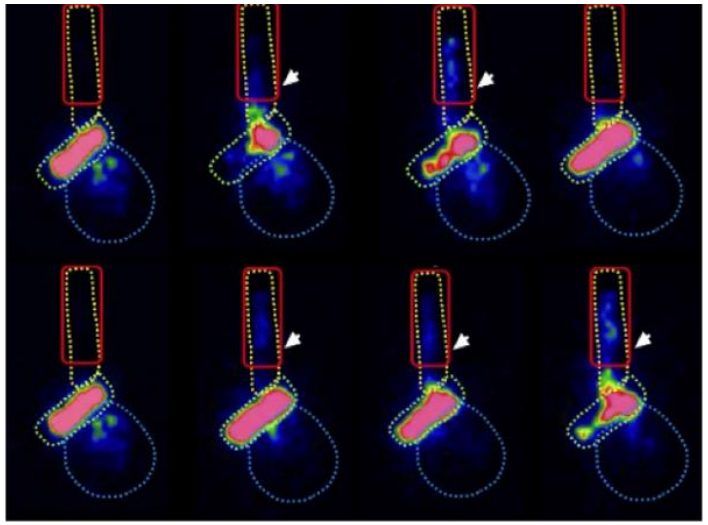


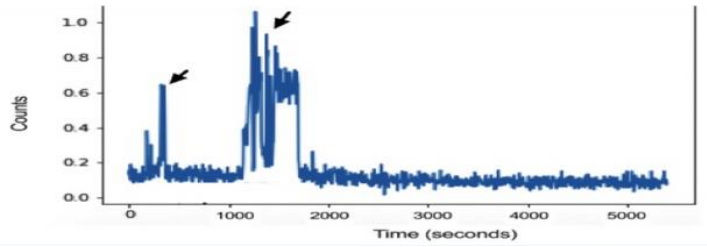
PATHOPHYSIOLOGICAL MECHANISMS OF GASTRO-ESOPHAGEAL REFLUX FOLLOWING SLEEVE GASTRECTOMY

Annals of Surgery

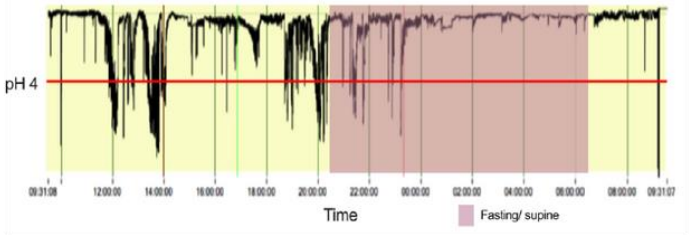
DOI: 10.1097/SLA.0000000000004637

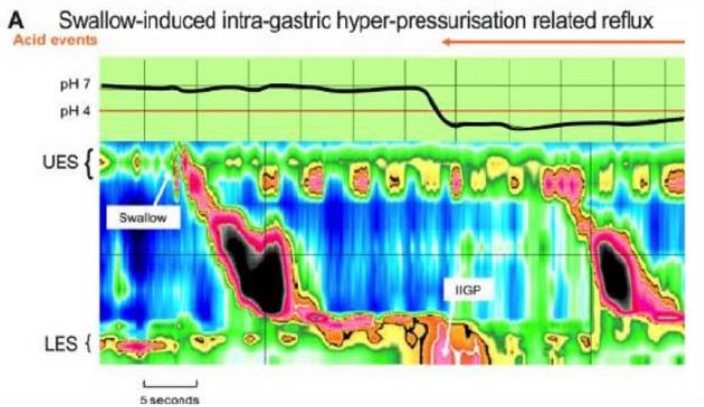
Type II: Post prandial





Type III: Irritant

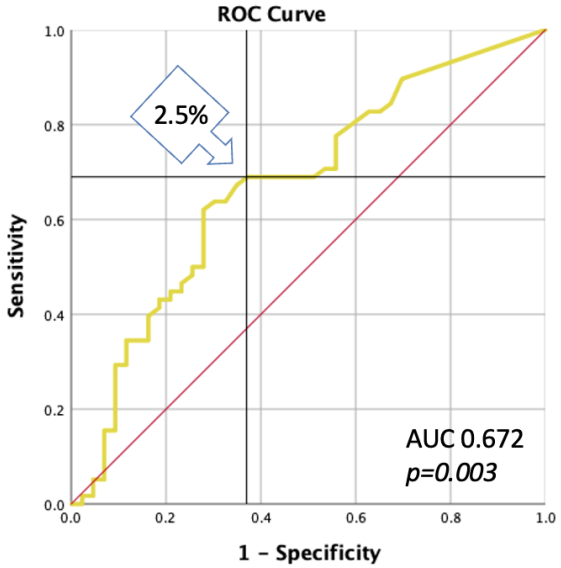




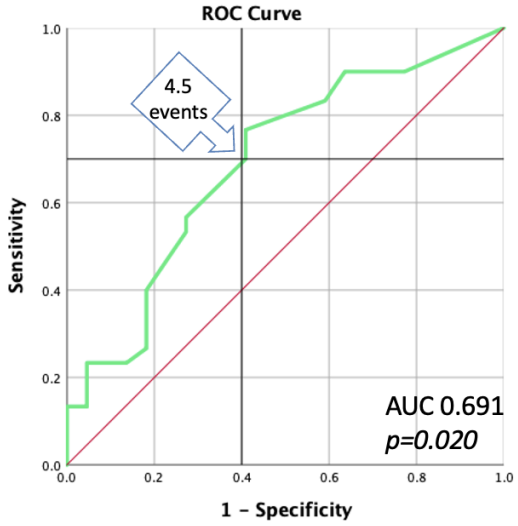
STEP 3 - Defining ‘optimal/normal’ threshold of candidate variable of a diagnostic tests

24hr pH study

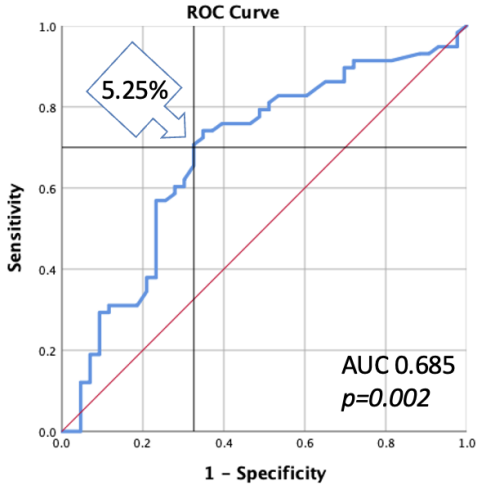
Supine acid exposure



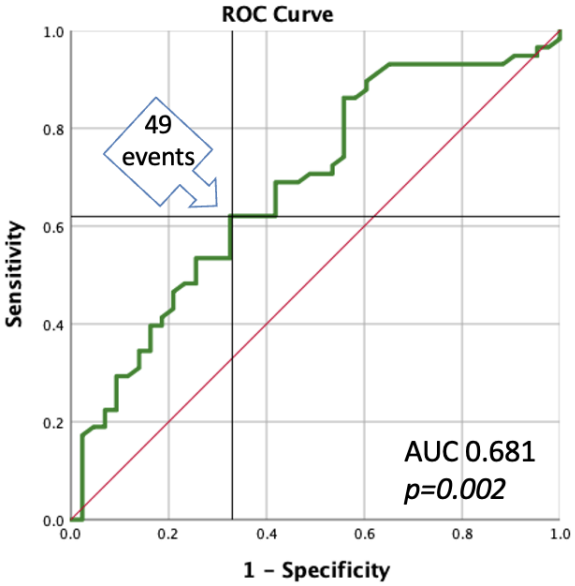
Supine reflux events



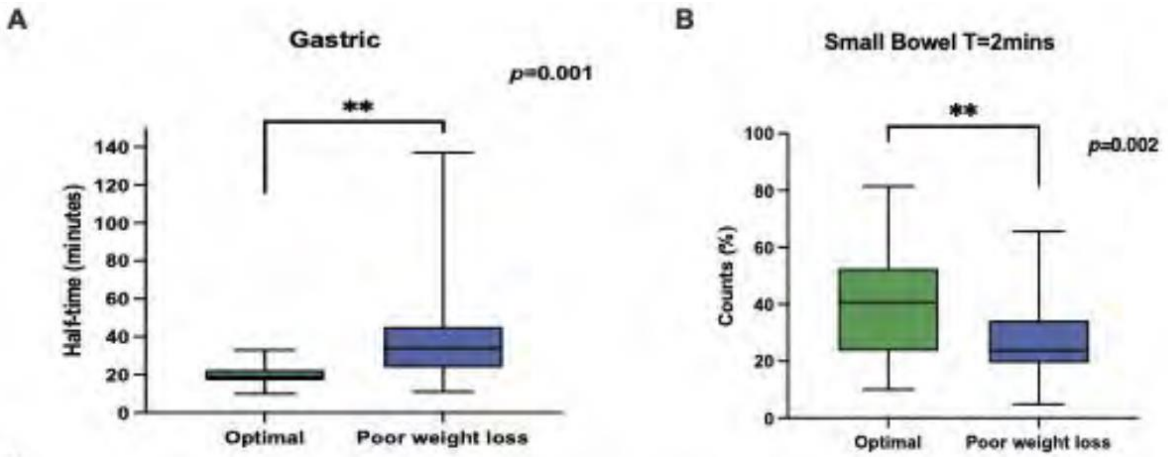
Total acid exposure in 24 hours



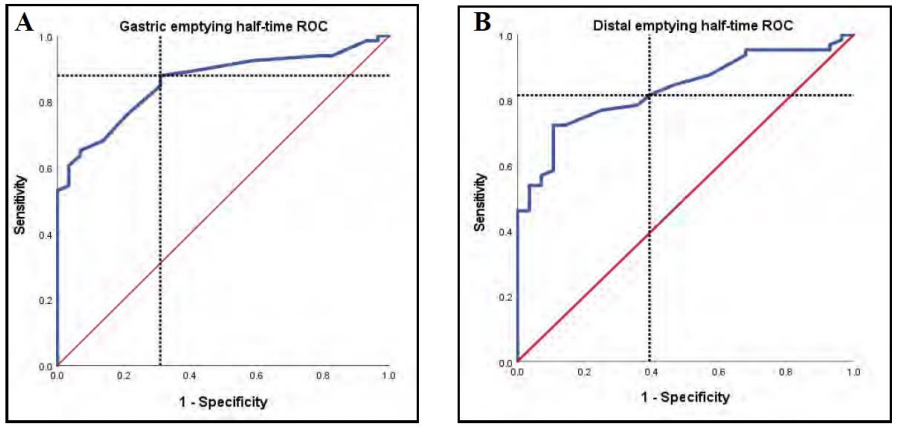
Number of acid events in 24 hours

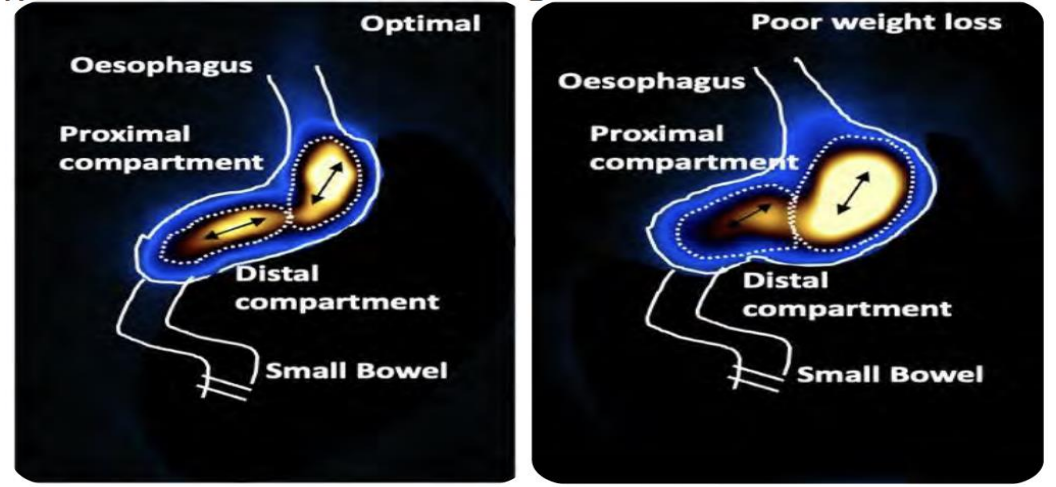


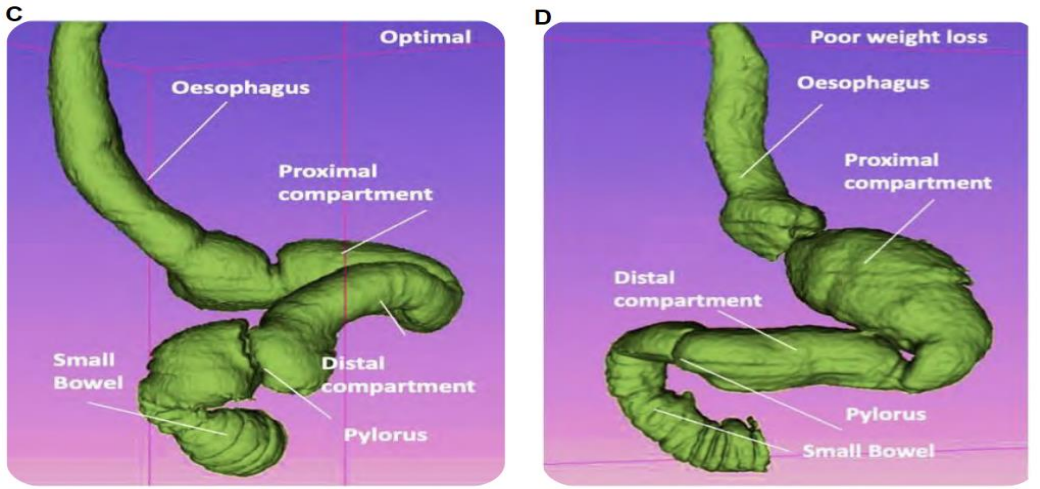
Gastric emptying half-time and poor weight loss

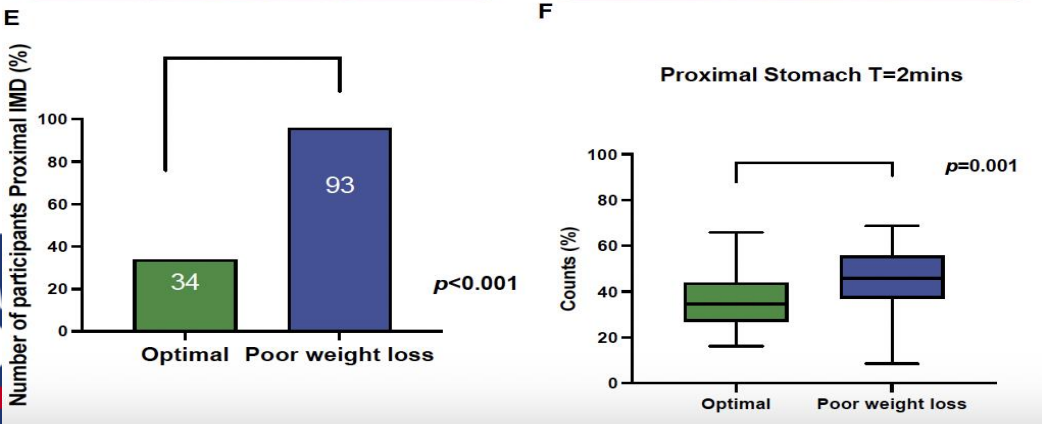


Sensitivity and specificity illustrated by dotted line intersection. **A**) ROC curve for gastric emptying half-time. AUC=0.860 (95% confidence interval 0.787 – 0.933), *p<0.0001*. Threshold set at 20.50mins, sensitivity = 87.9% and specificity = 69% **B**) ROC curve for proximal emptying half-time. AUC=0.796 (95% confidence interval 0.706 – 0.886), *p<0.0001*. Threshold set at 20.50mins, sensitivity = 80% and specificity = 60.7.



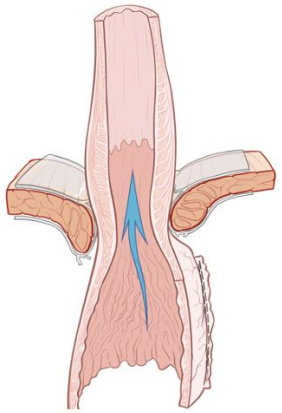




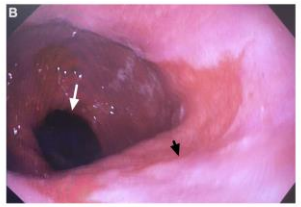


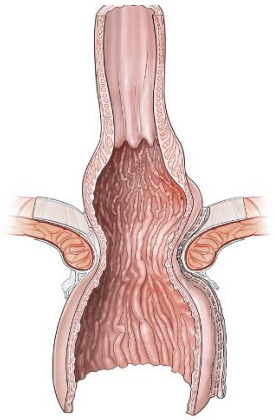
Tubular effacement of the cardia vs Barrett oesophagus

Potential changes to Z-line post sleeve gastrectomy

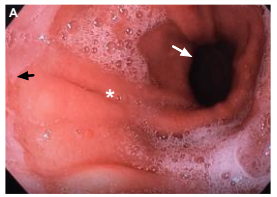


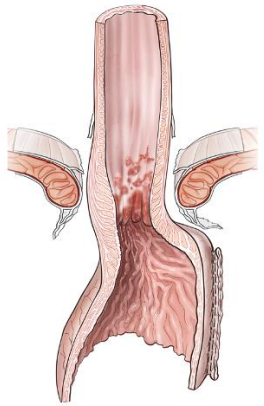
Tubularised and effaced cardia



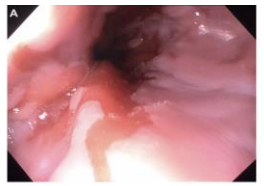


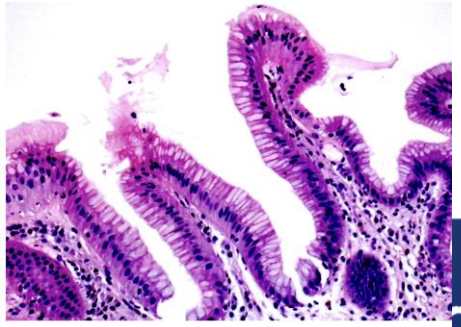
Hiatus hernia



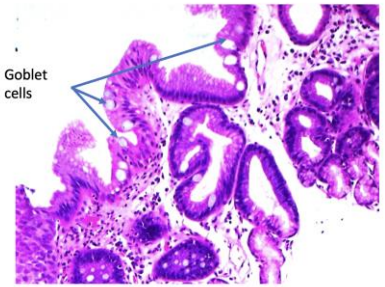


Barrett oesophagus





Tubularized and effaced cardia – gastric type glandular mucosa



Barrett oesophagus

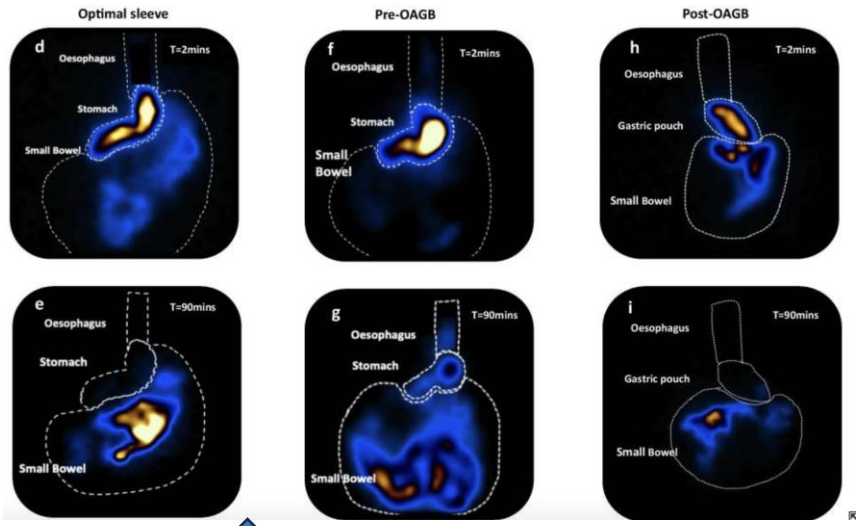
TABLE 2. Endoscopic findings pre- and post-sleeve gastrectomy

	Pre-operative	Post-operative	p-value
N	320	567	
Z-line distance, cm	38.7 ± 2.3	37.4 ± 2.0	<0.001*
Diaphragmatic impression distance, cm	40.2 ± 1.6	39.9 ± 1.6	0.055*
Hiatus hernia, n (%)	127 (39.7)	459 (81.0)	<0.001†
Hiatus hernia size, median (IQR), cm	2.0 (1.0)	3.0 (1.0)	0.026§
Esophagitis, n (%)	83 (25.9)	182 (32.1)	0.056†
The Los Angeles classification of esophagitis, n (%)	Grade A – 77 (92.8) Grade B – 5 (6.0) Grade C – 1 (1.2)	Grade A – 144 (79.1) Grade B – 34 (18.7) Grade C – 4 (2.2)	0.017‡
Barrett esophagus, n (%)	13 (4.1)	19 (3.4)	0.756†
Tubularized cardia herniation, n (%)	2 (0.6)	151 (26.6)	<0.001†
Bile in the stomach, n (%)	43 (13.4)	222 (39.2)	<0.001†

*Student t-test.
†Chi-square test.
‡Fisher's exact test.
§Mann-Whitney U test.

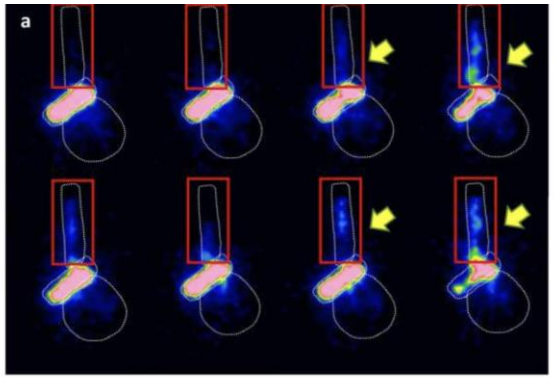
STEP 4 – Applying normative values of diagnostic test in clinical trials

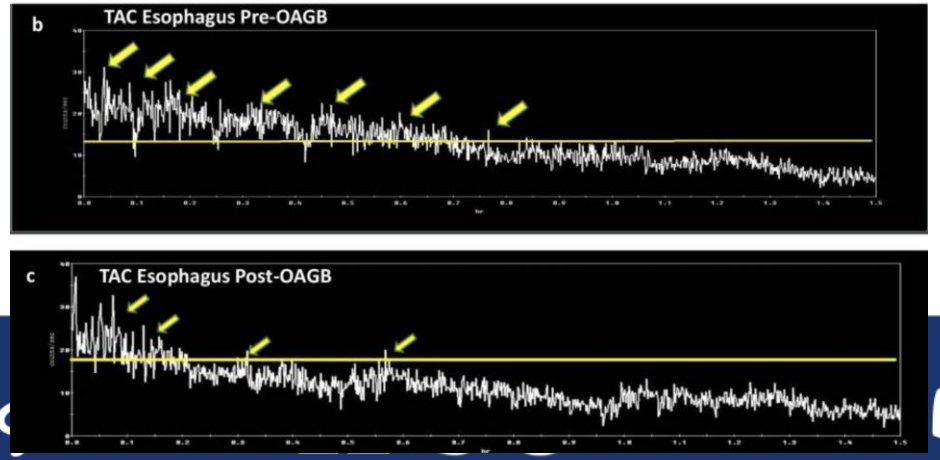
Conversion of sleeve gastrectomy to OAGB for severe reflux

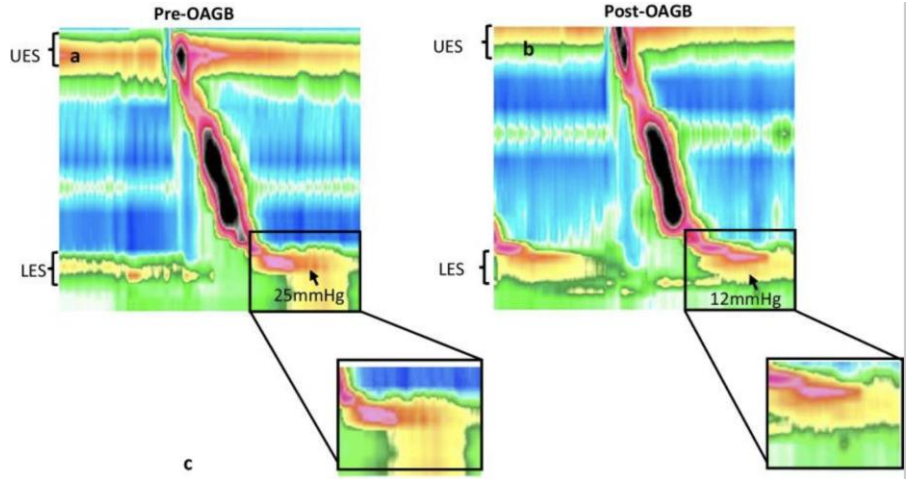


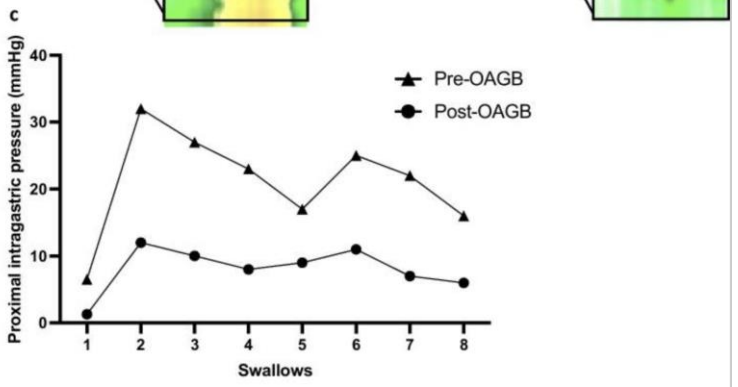
- Slower gastric emptying post sleeve with reflux compared to optimal sleeve (median 34 min vs 21 min)
- Increase gastric emptying post conversion to OAGB (median 24min)

Decreased number of reflux events post-prandially (median 39 vs 26)





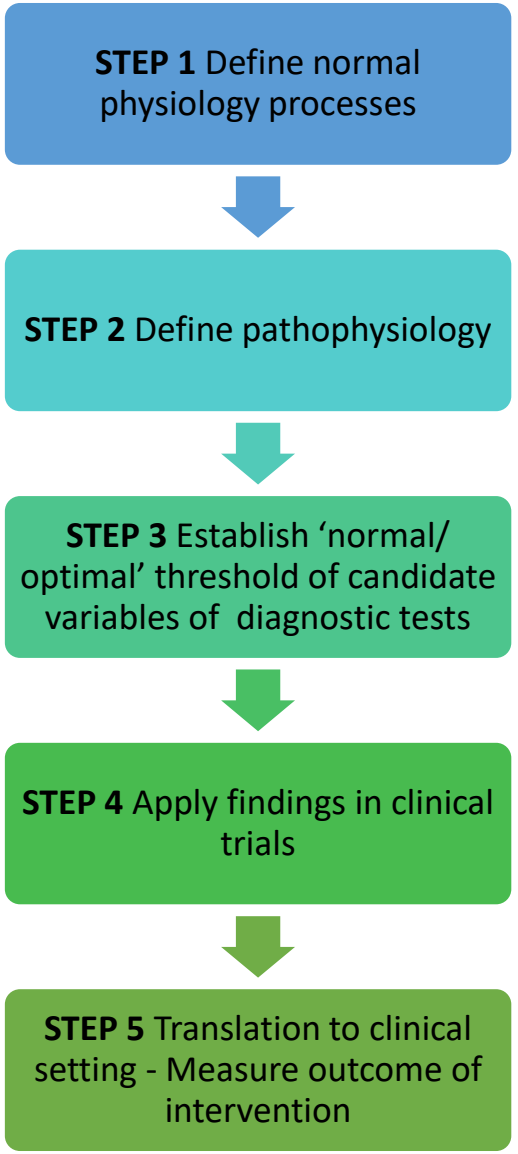




Decreased proximal intragastric isobaric pressure

Conclusions

- *Step 1* - Delineated fundamental altered mechanical physiology post sleeve gastrectomy
  - Emptying is cyclical and oesophageal mediated
  - Physiological reflux, proximal stomach hyperpressurisation are common and integral to emptying
  - Axial separation of LOS and diaphragm, and hypotensive LOS basal tone are also ubiquitous – giving the appearance of pseudo-Barretts or pseudo-hiatus hernia
- *Step 2* – Established 3 mechanisms of pathophysiological reflux
  - Triggered deglutitive reflux, post-prandial reflux, irritant reflux and higher acid exposure.
- *Step 3* – Defined normative values of pH studies and nuclear medicine scans
- *Step 4* – Applied normative values in clinical trial
  - Conversion of sleeve gastrectomy to OAGB for severe reflux
- *Step 5* – *R*outine use of normative values of sleeve gastrectomy in nuclear medicine, pH studies, gastroscopy post sleeve gastrectomy in clinical practice



Take home messages

- It is important to define normal physiology for different procedures.
- A structured multifaceted approach of simple and complex tests is required to achieve this.
- Findings of complex tests and the defined normal physiology translates to improving interpretation of simpler clinical tests eg barium swallow and gastroscopy.
- Significant caution is required before incorporation into clinical practice as normative values for each procedure are quite different, and more clinical trials/observational data is required.

Acknowledgement

- Monash University Department of Surgery
  - Prof Wendy Brown
  - Mr Paul Burton
  - Ms Anagi Wickremasinghe
  - Dr Gillian Lim
  - Ms Cheryl Laurie
  - Ms Julie Playfair
- Alfred Hospital Oesophagogastric-Bariatric Unit
  - Prof Wendy Brown
  - Mr Paul Burton
  - Mr Richard Chen
  - Mr Damien Loh
  - Mr Andrew Smith
  - Mr Andrew Packiyanathan
  - A/Prof Peter Nottle
- Royal Melbourne Hospital Department of Gastroenterology
  - Prof Geoff Hebbard
- Alfred Hospital Nuclear Medicine Department
  - Dr Paul Beech
  - Dr Ken Yap
  - Dr Martin Cherk
  - Ms Helen Yue