

The background is a light blue and white collage. It features various medical icons such as a heart, pills, a stethoscope, a virus, and a microscope. There are also circular graphics with line graphs and bar charts. A large, faint image of a human heart is visible in the center, with a white ECG line overlaid on it. The overall aesthetic is clean and professional, typical of a medical presentation.

Heartburn: Modern Diagnosis of GERD (or still the old ones)

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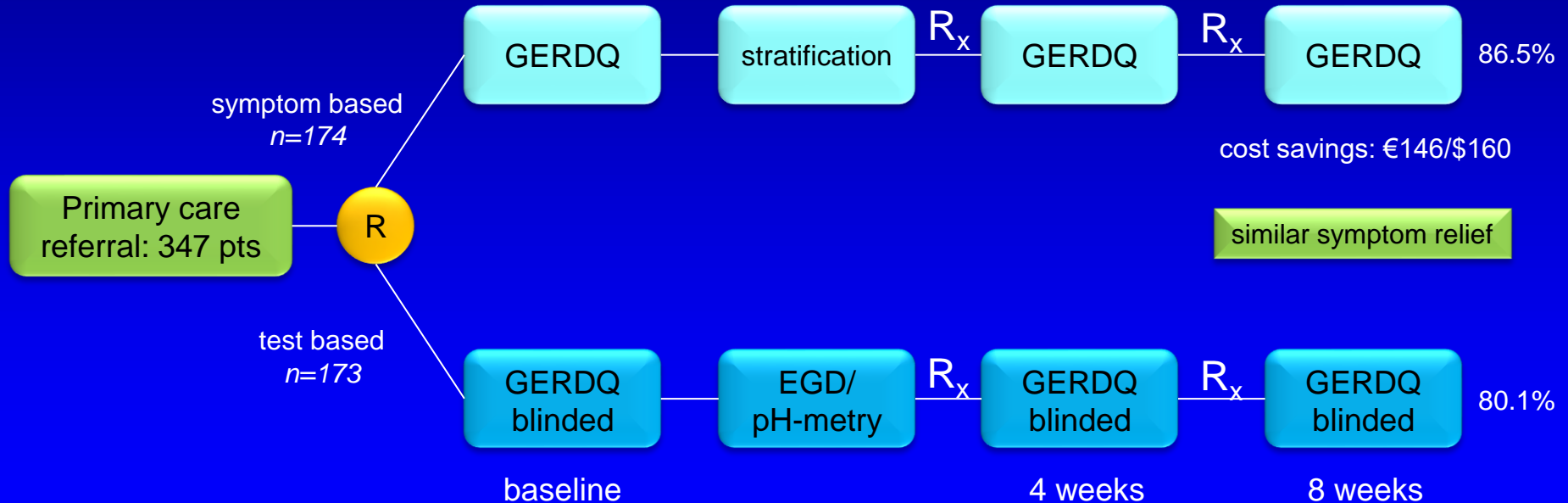


Disclosures

- Consultant for Medtronic, Diversatek, Ironwood, Takeda, and Iso-Thrive

- GERD has no gold standard for diagnosis

Symptom Based Management

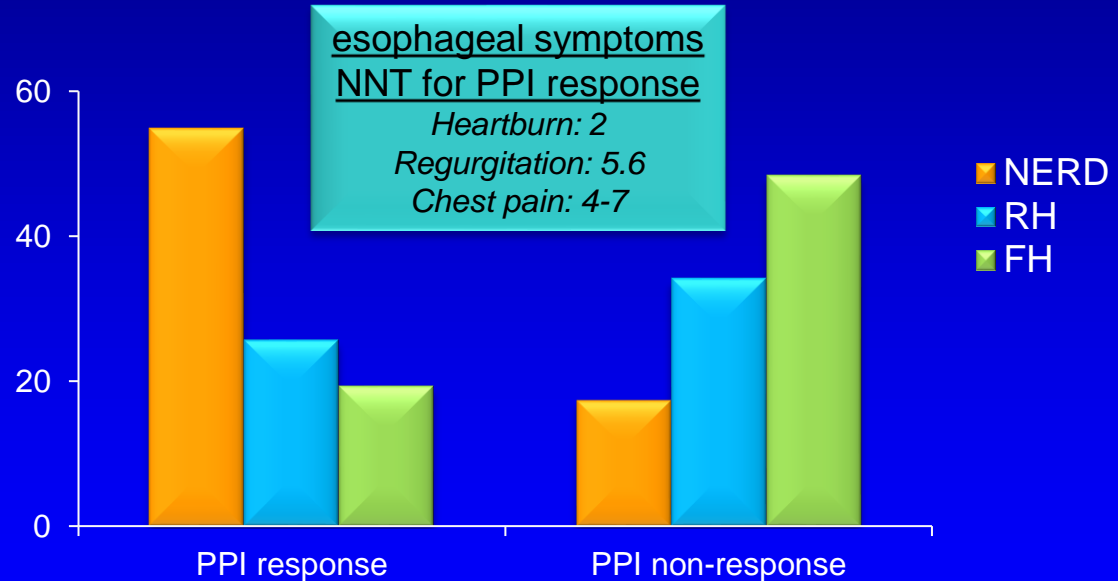


Typical Esophageal Symptoms

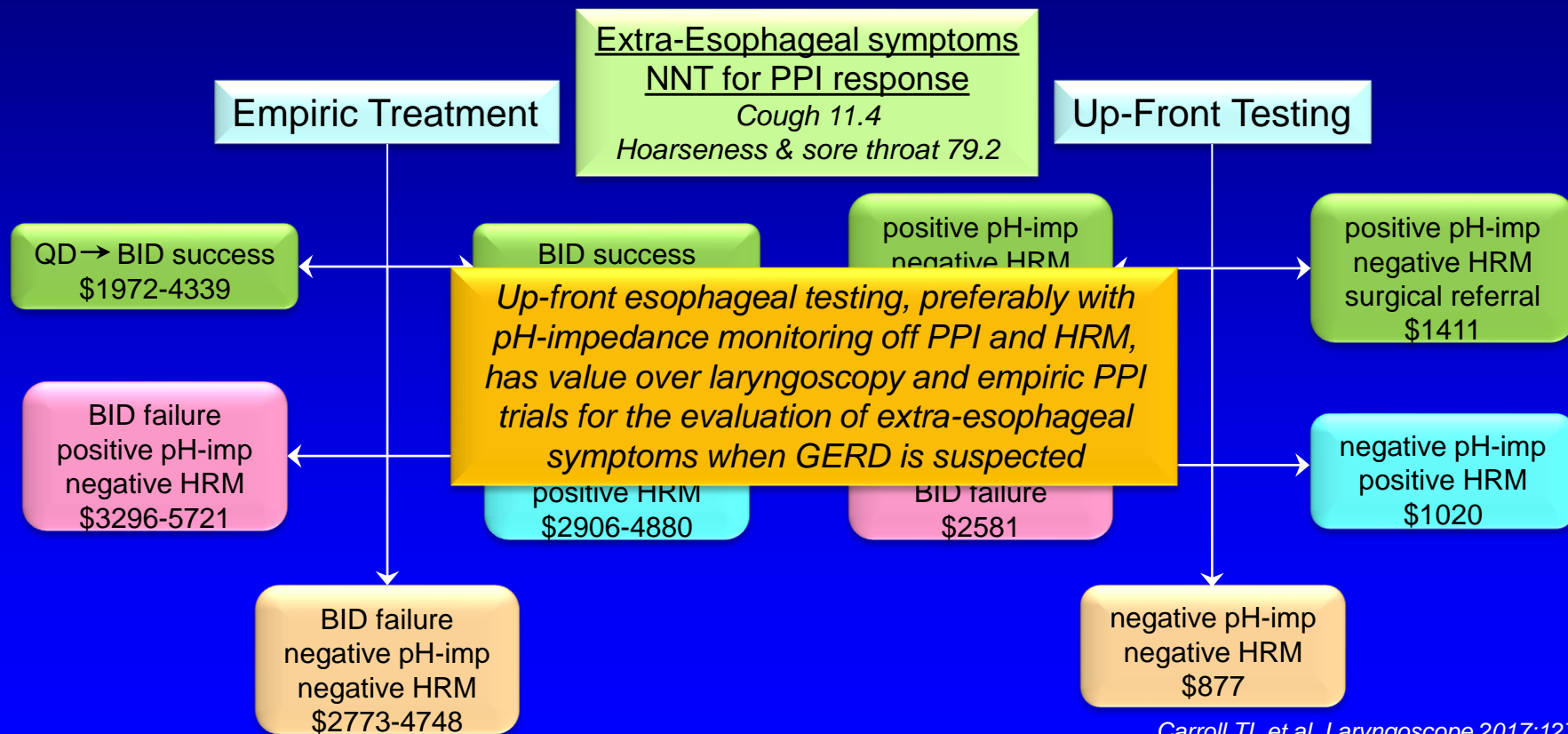
Current Standard: Empiric acid suppression

312 heartburn patients
endoscopy negative
PPI trial for 8 weeks
pH impedance testing off PPI

RH: reflux hypersensitivity
FH: functional heartburn



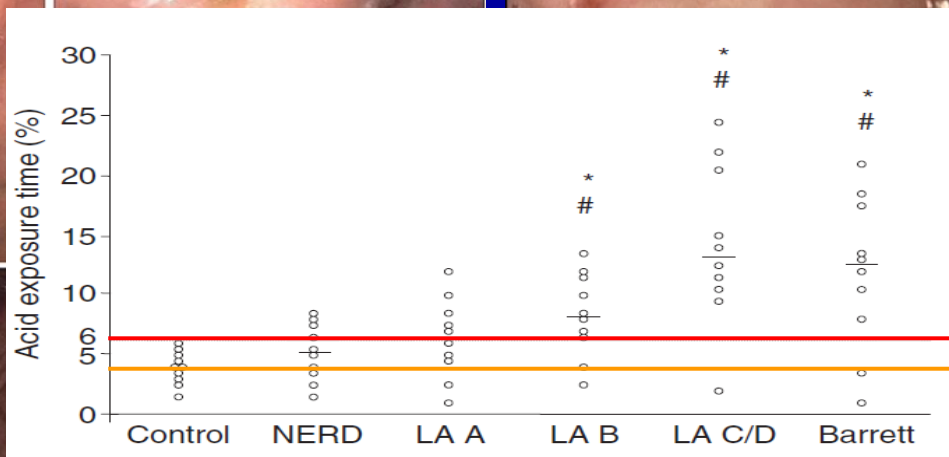
Atypical and Extra-Esophageal Symptoms



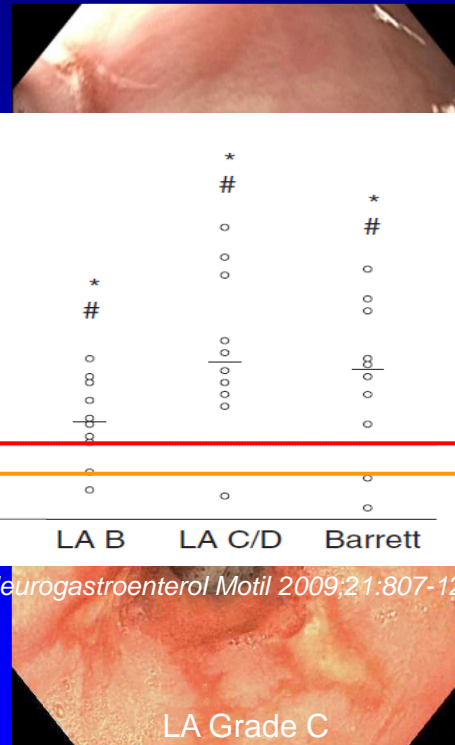
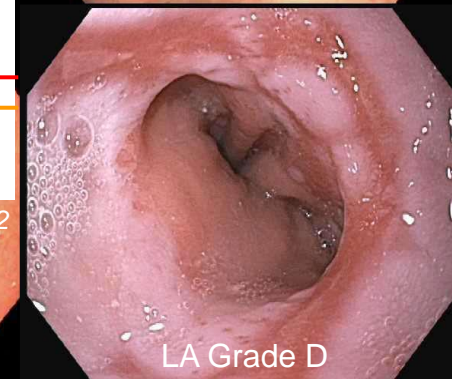
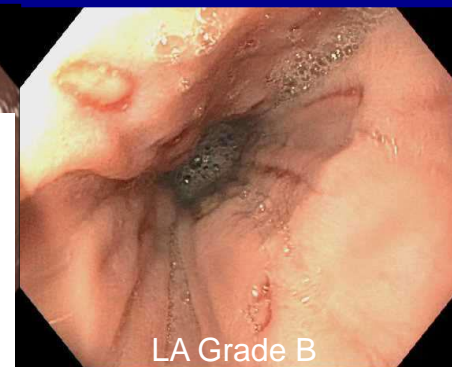
- GERD has no gold standard for diagnosis
- Clinical diagnosis is not conclusive; symptom relief is a surrogate

Yield of Endoscopy

Common Approach: Endoscopy on PPI



Bredenoord AJ et al, Neurogastroenterol Motil 2009;21:807-12

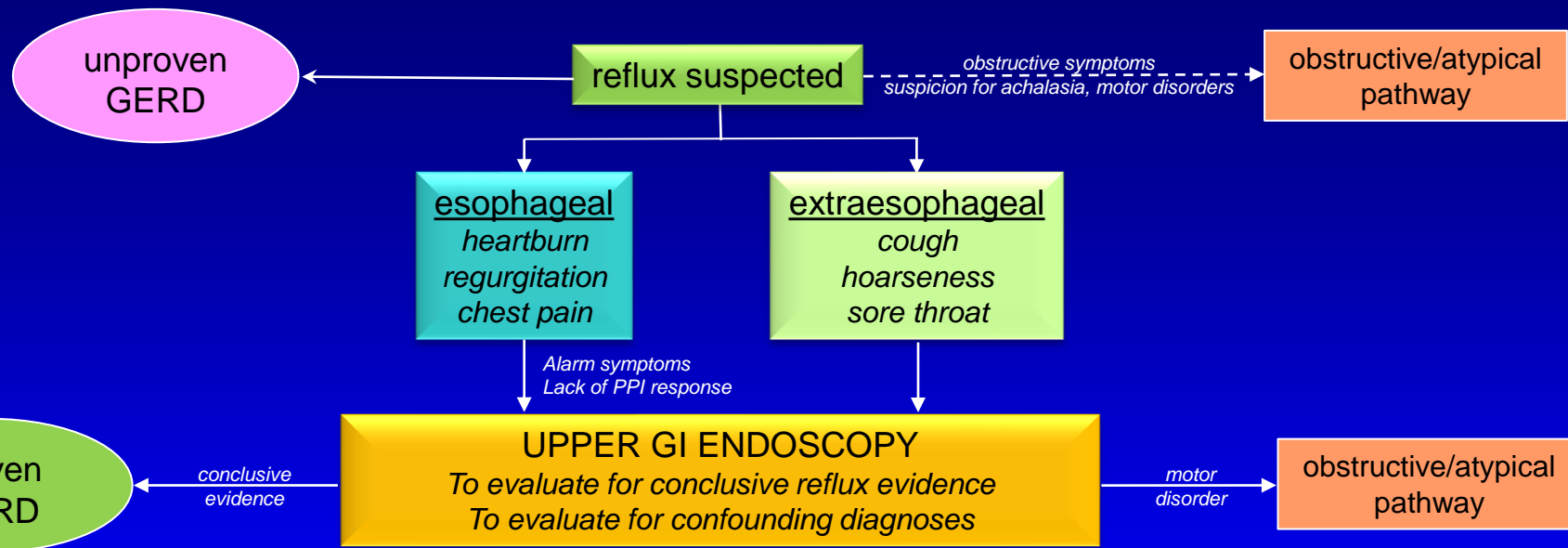


Hill grade of EGJ on retroflexion

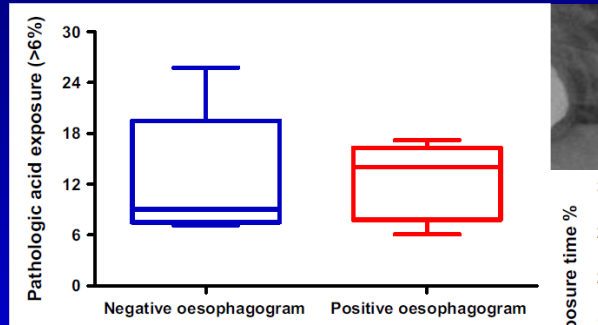
Hill LD et al, GIE 1996;44:541-4; Osman A et al, DDS 2021;66:151-5

Takahashi T et al, Digestion 2012;86:55-58
Zagari RM et al, Gut 2008;57:1354-9
Poh CH et al, Gastrointest Endosc 2010;71:28-34

Approach: Reflux Pathway

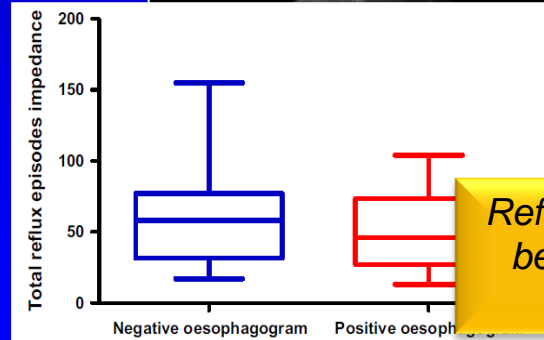
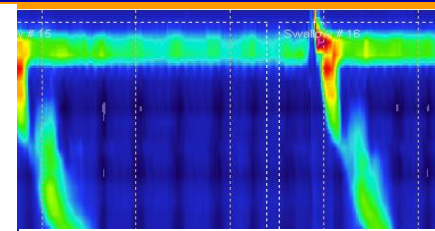
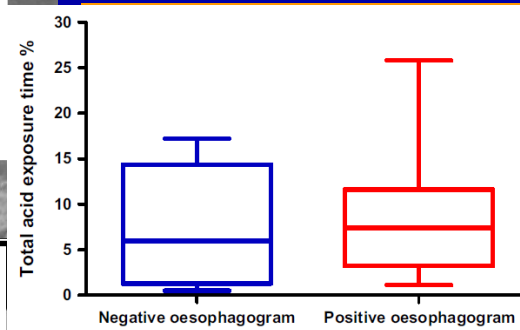


Barium Radiography

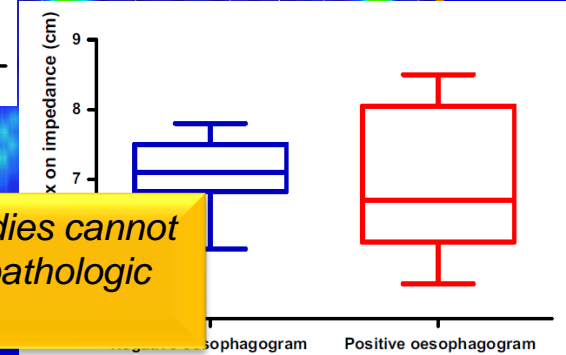


20 patients with reflux symptoms
50% had 'reflux' on esophagram
Gold standard: pH impedance

sensitivity 46%
specificity 44%
PPV: 50%, NPV: 40%



Reflux observed during barium studies cannot be used as evidence supporting pathologic reflux



- GERD has no gold standard for diagnosis
- Clinical diagnosis is not conclusive; symptom relief is a surrogate
- Endoscopy has high specificity but low sensitivity for GERD diagnosis

Esophageal Symptoms

GERD

Reflux Monitoring off
pH monitoring
pH-impedance monitoring

106 typical reflux patients
endoscopy negative
PPI refractory

AET: acid exposure time
SAP: symptom association probability

Esophageal symptoms
Prior to antireflux surgery
Persisting symptoms
Symptoms followed
POEM
Investigation completed



Functional chest pain

Achalasia

Rumination



AET

positive SAP
normal AET

Galmiche, et al, UEG Journal 2013

Kondo T, Miwa H, J Neurogastroenterol Motil 2017;51:571-8
Herregods TVK et al. Neurogastroenterol Motil 2015;27:1267

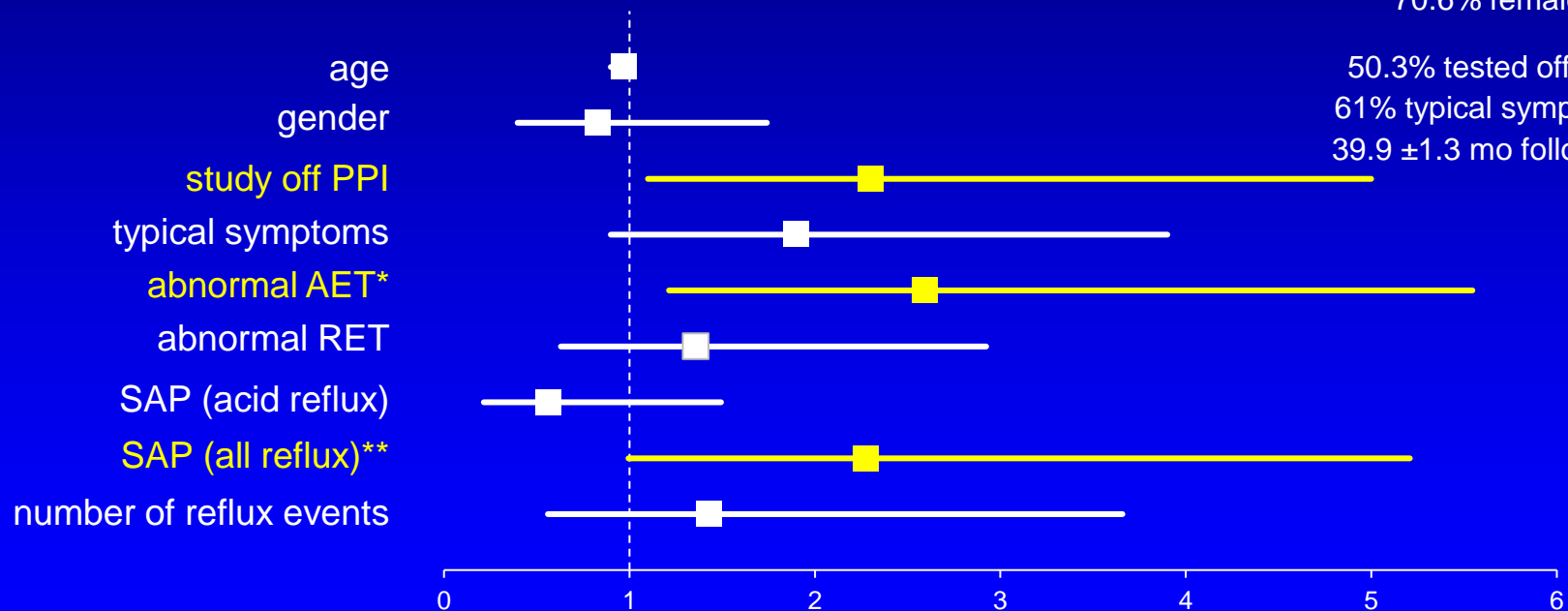
Predictors of GERD Symptom Improvement

pH-impedance in a 'real world' setting

GLOBAL SYMPTOM SEVERITY (GSS) CHANGE

n=187
53.8±0.9 yrs
70.6% female

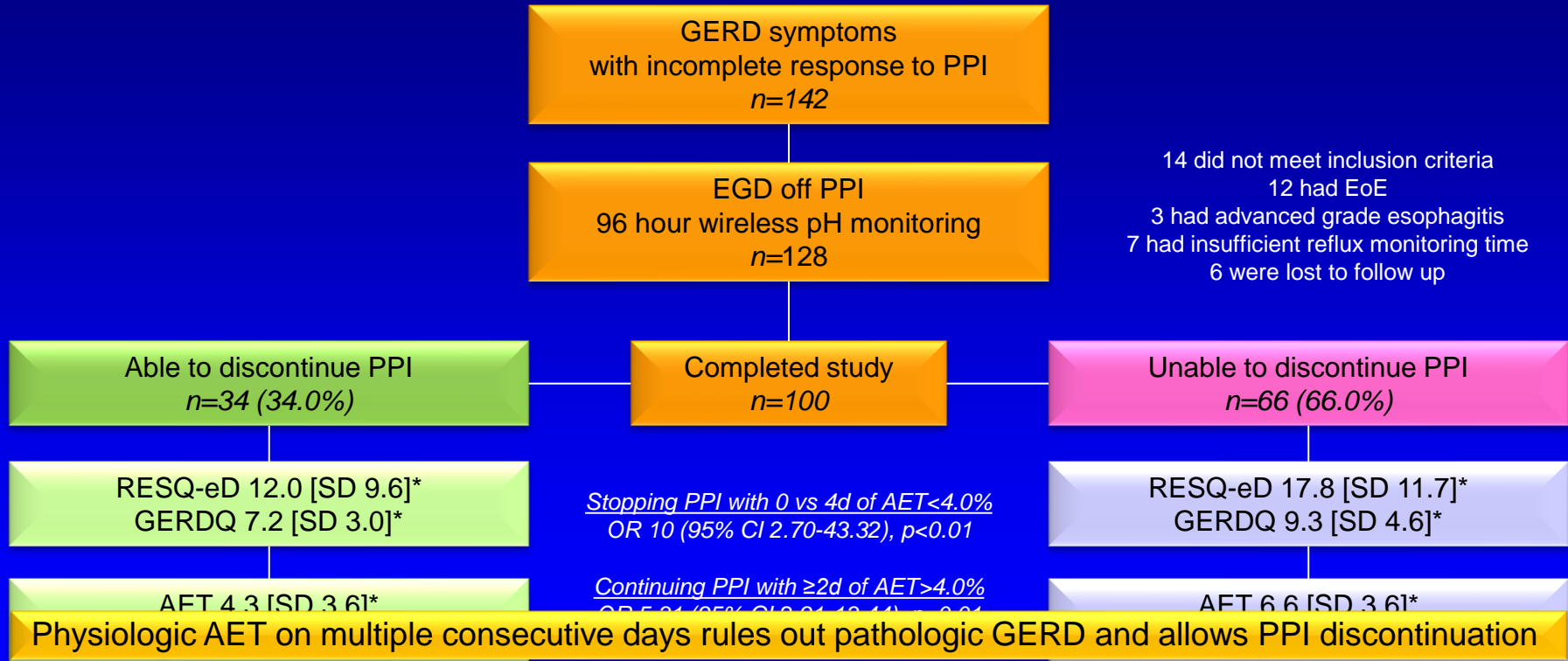
50.3% tested off PPI
61% typical symptoms
39.9 ±1.3 mo follow-up



*p=0.002-0.014

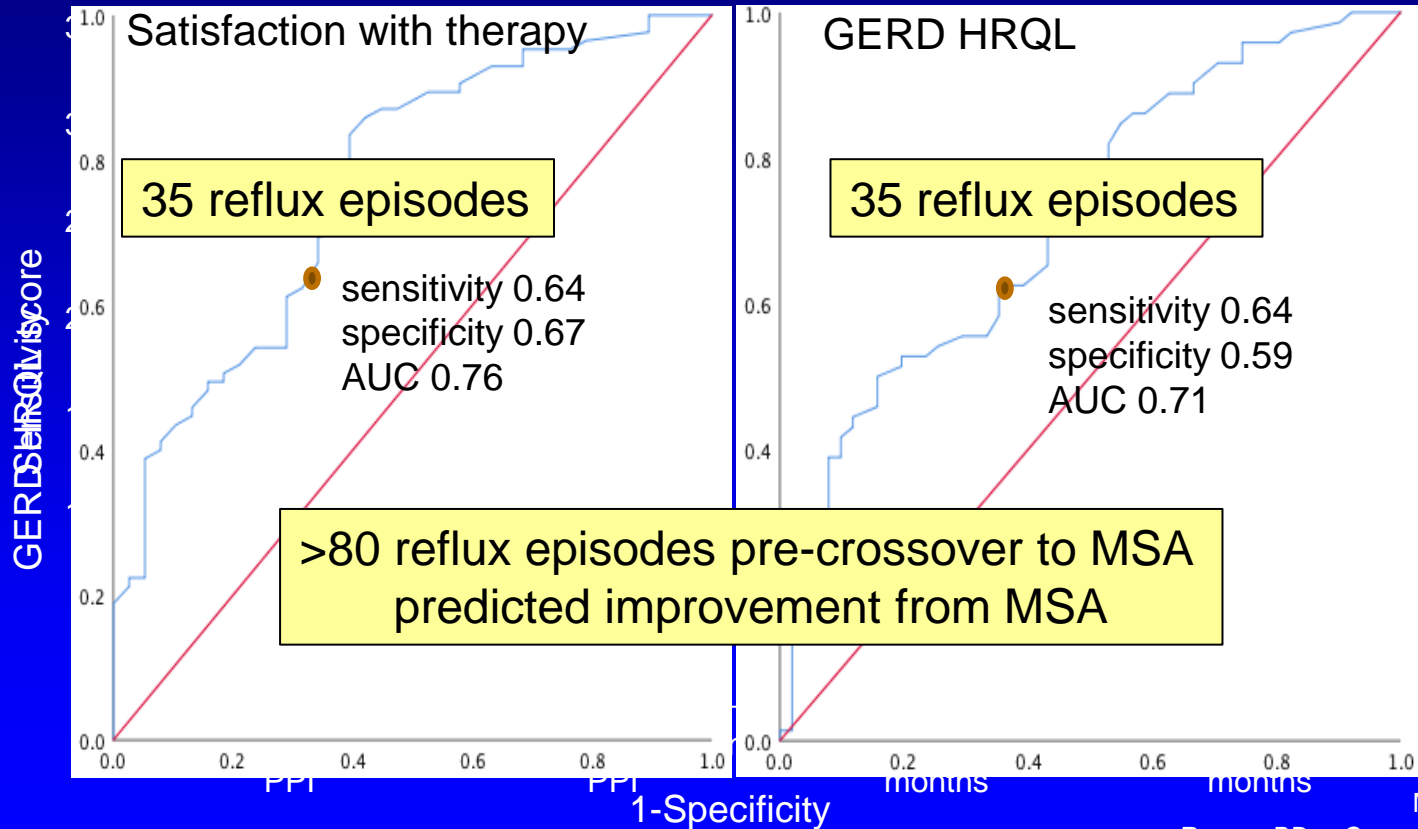
**p=0.026-0.05

Clinical Value of Prolonged pH Monitoring

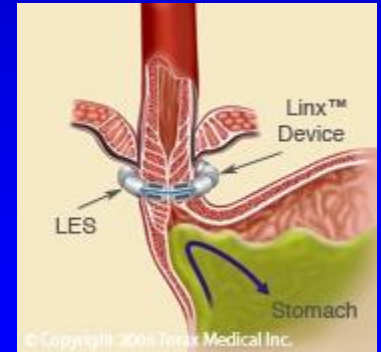


**p*<0.05

Reflux Episodes Predict GERD Response



Randomized Study
Comparing BID PPI to MSA
 Refractory regurgitation
 123 patients
 age 46.9 ± 1.2 yr
 43% female

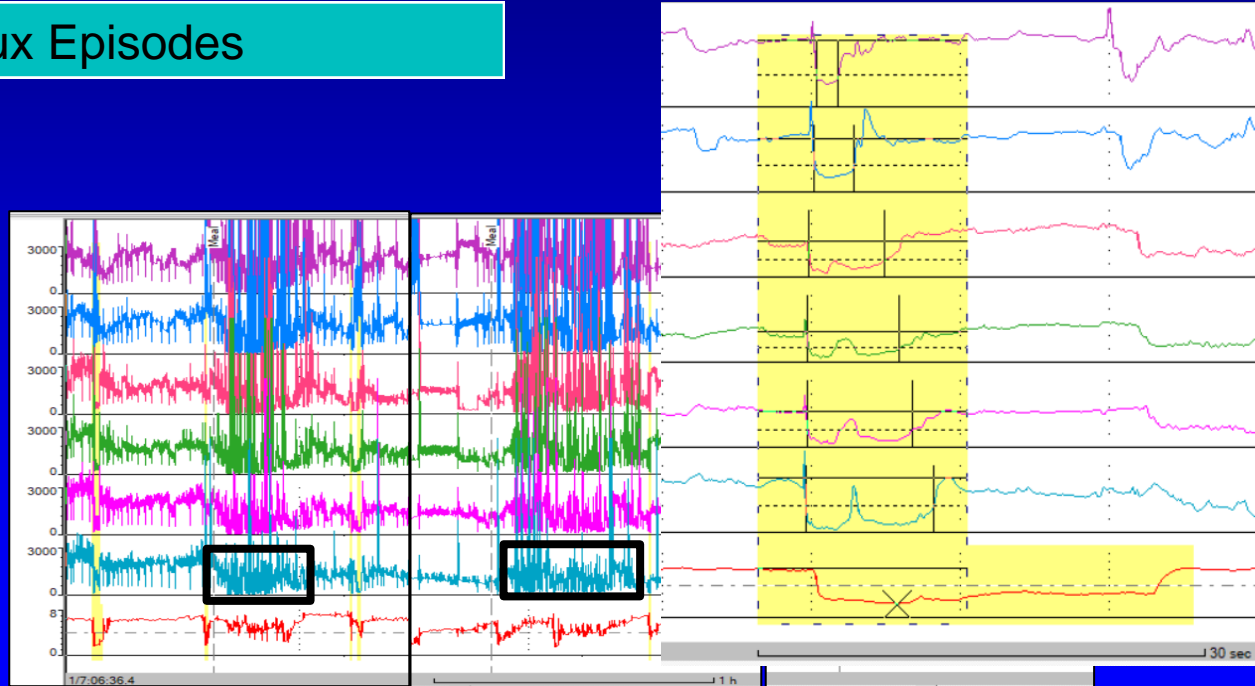


MSA: magnetic sphincter augmentation
 Rogers BD....Crowell M, Vela MF et al, Gut 2020 (in press)

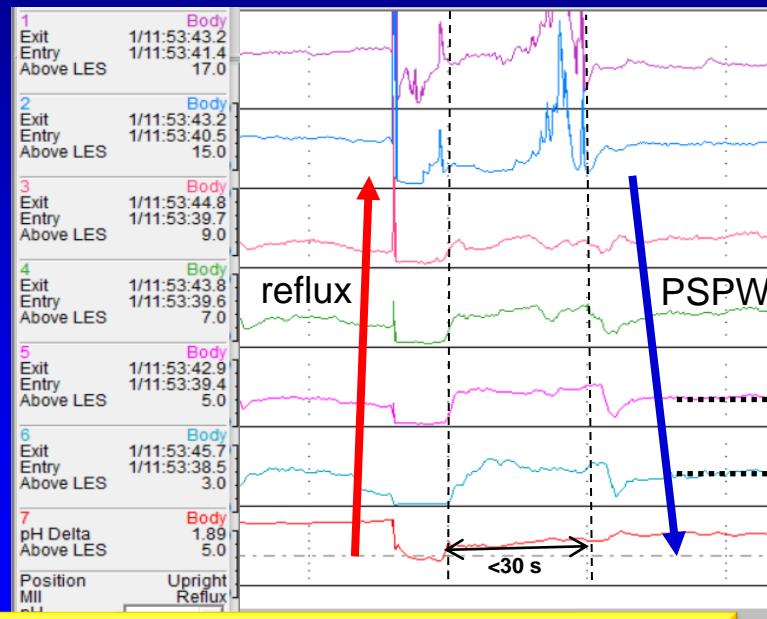
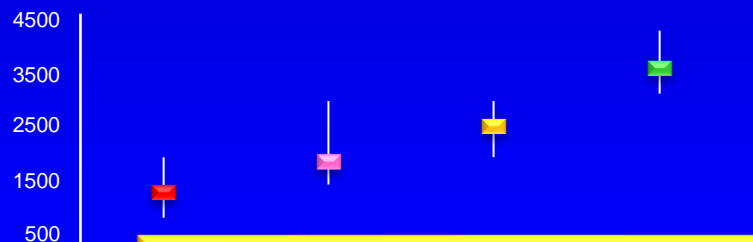
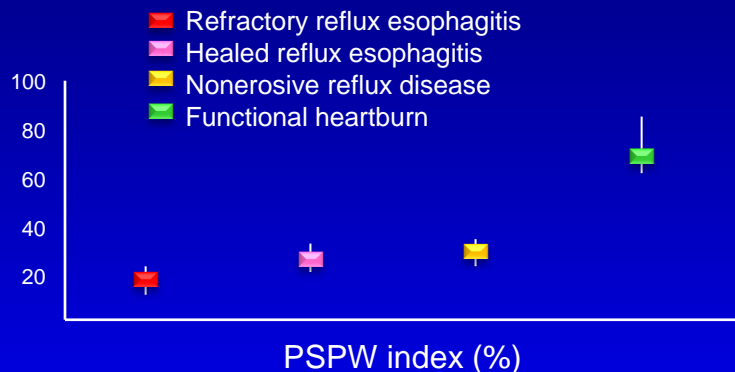
pH Impedance Monitoring

The Wingate Consensus

Reflux Episodes



Novel Impedance Parameters



New impedance-based parameters continue to be studied as adjunctive evidence for GERD

PSPW: post-reflux swallow-induced peristaltic wave

PSPW index: proportion of reflux episodes followed by a PSPW

Frazzoni M et al. *Neurogastroenterol Motil* 2017;29:epub

Frazzoni M, Savarino E et al, *CGH* 2016;14:40-6

Mean Nocturnal Baseline Impedance

MNBI

Recumbent

Nocturnal

Around 1 AM - 3 AM

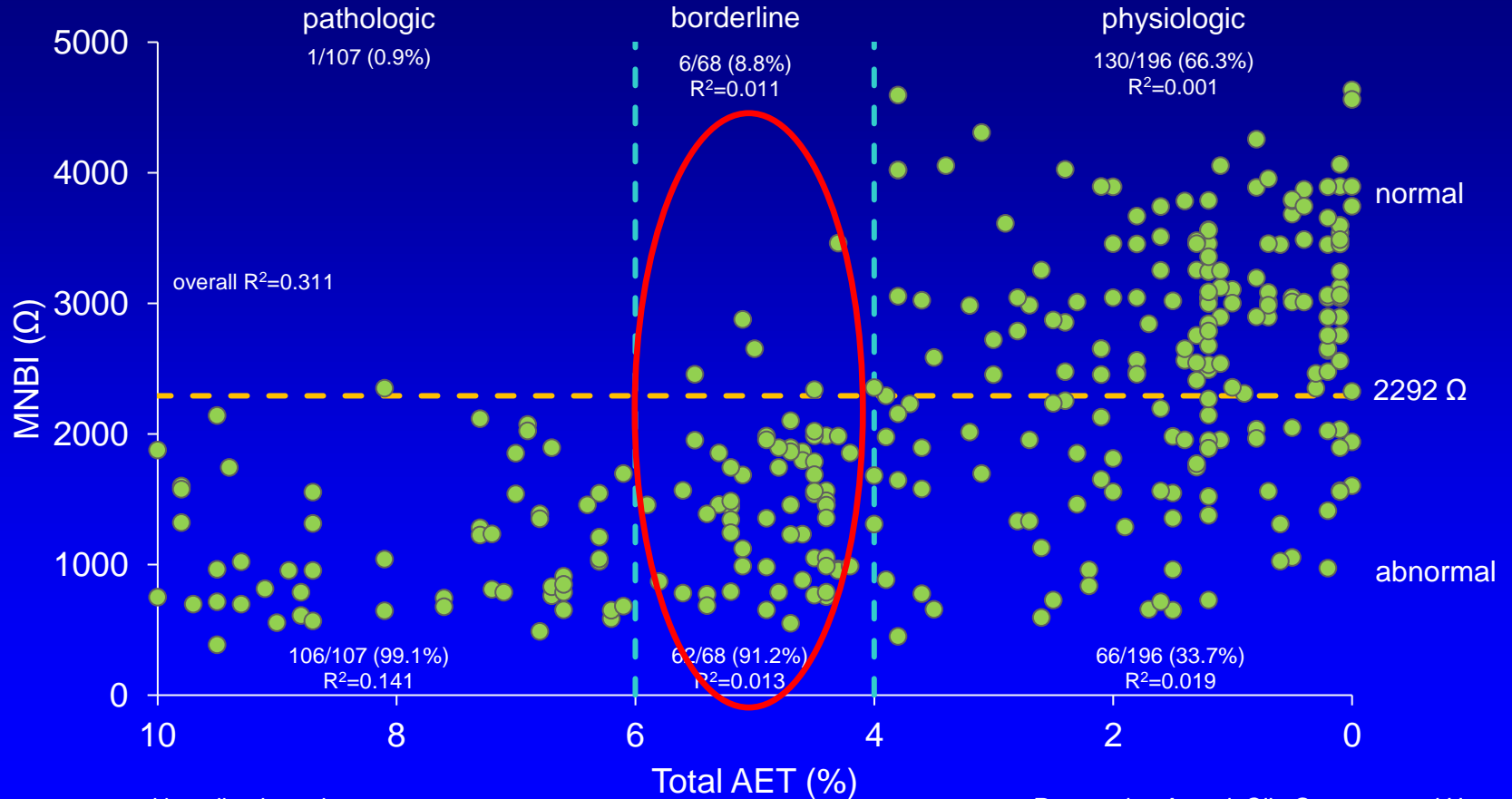
10 min periods

No artifacts or reflux

Averaged

3 and 5 cm above LES

Using MNBI in GERD Diagnosis



MNBI: mean nocturnal baseline impedance

Rengarajan A et al, Clin Gastroenterol Hepatol 2019

Wireless pH vs. pH-Impedance Testing

Optimal use: Limited by Availability and Expertise

Wireless pH (off PPI)

- Catheter intolerance
- Infrequent symptoms, needing reflux-symptom association
- High clinical suspicion of GERD with negative 24-hour reflux monitoring
- Very low clinical suspicion of GERD

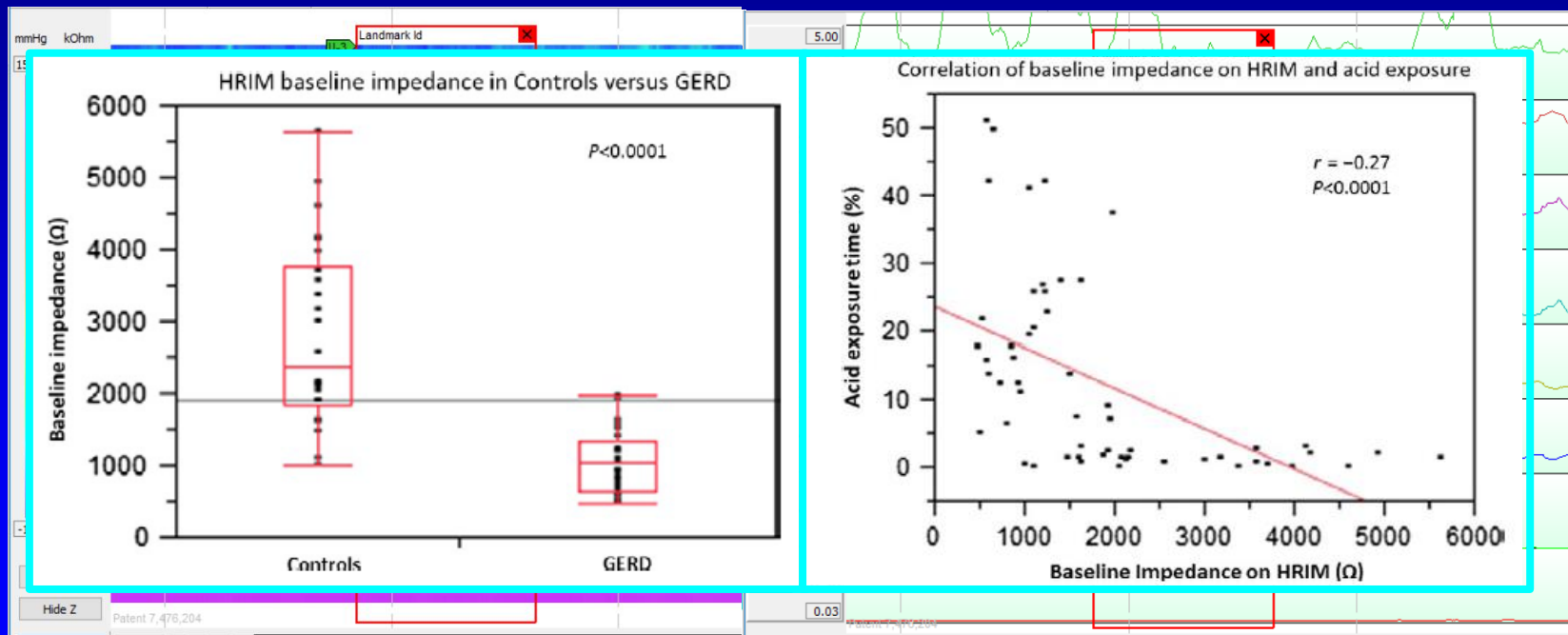
pH-impedance (off PPI, rarely on PPI)

- Refractory typical or atypical symptoms in patients with proven GERD (on PPI)
- Respiratory symptoms or cough in patients with pulmonary disease (off PPI)
- Repetitive belching in patients with and without reflux symptoms (off PPI)
- Suspicion of rumination syndrome (off PPI)
- Persistent reflux or increased belching following antireflux procedures (off PPI)

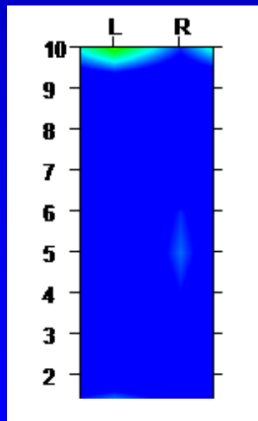
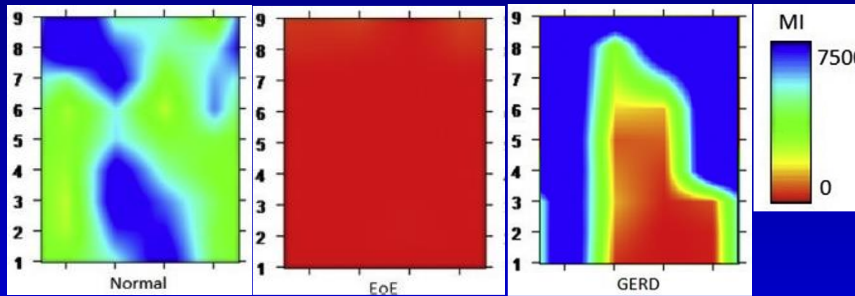
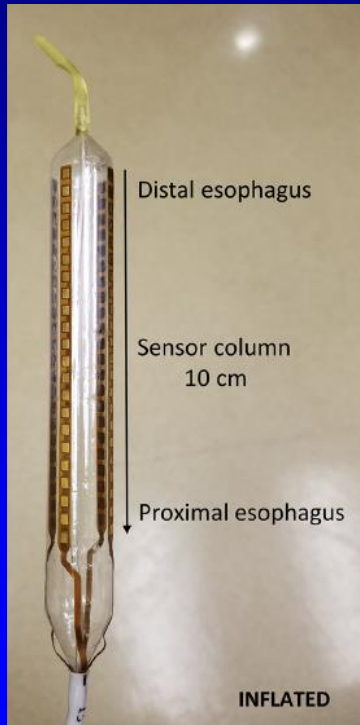
Either option (off PPI)

- High pre-test likelihood of GERD, prior to invasive antireflux procedures
- Investigation of persisting reflux symptoms despite empiric PPI trial

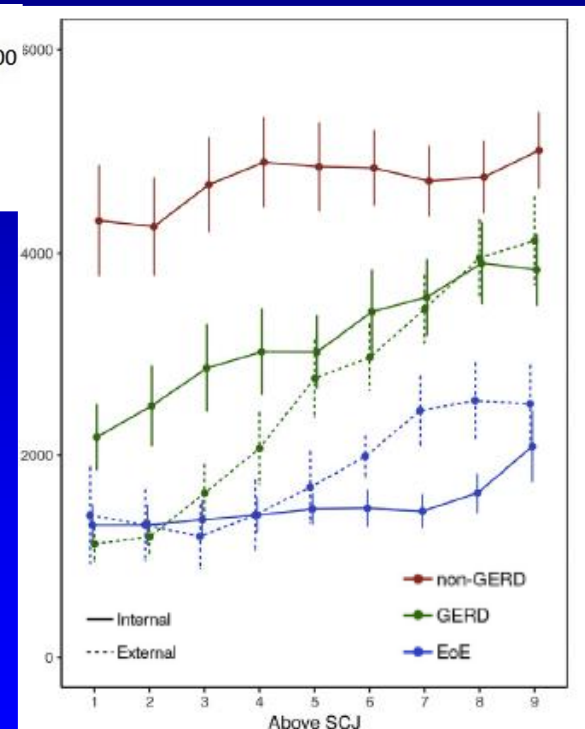
Baseline Impedance from High Resolution Impedance Manometry



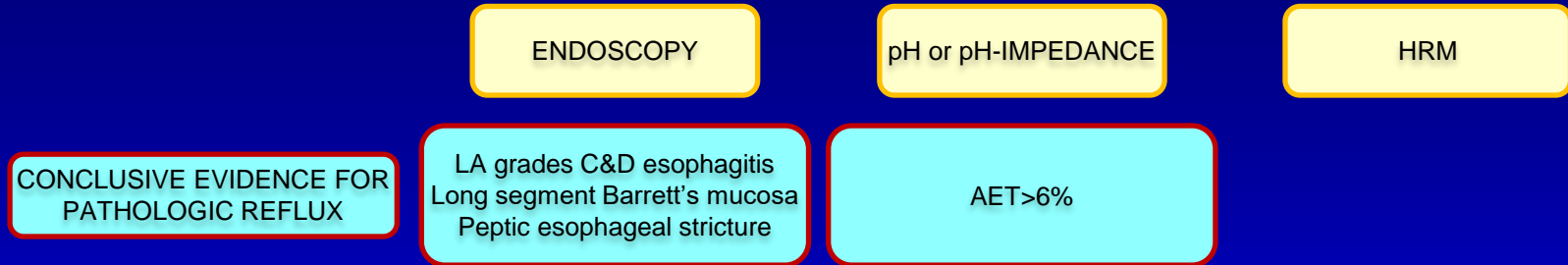
Mucosal Impedance or Mucosal Integrity



Mucosal impedance
in patient with functional heartburn

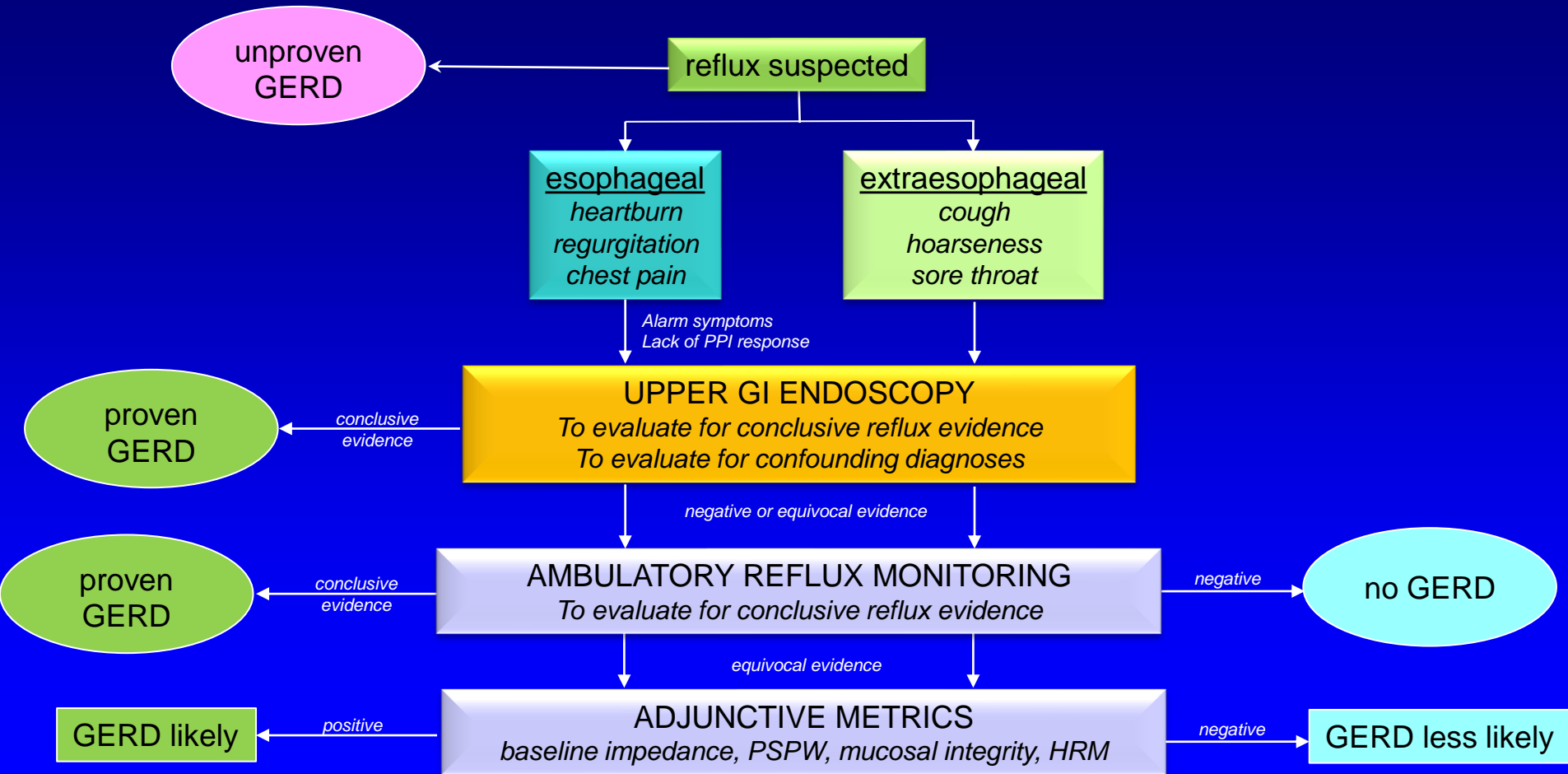


GERD Evidence: Lyon Consensus



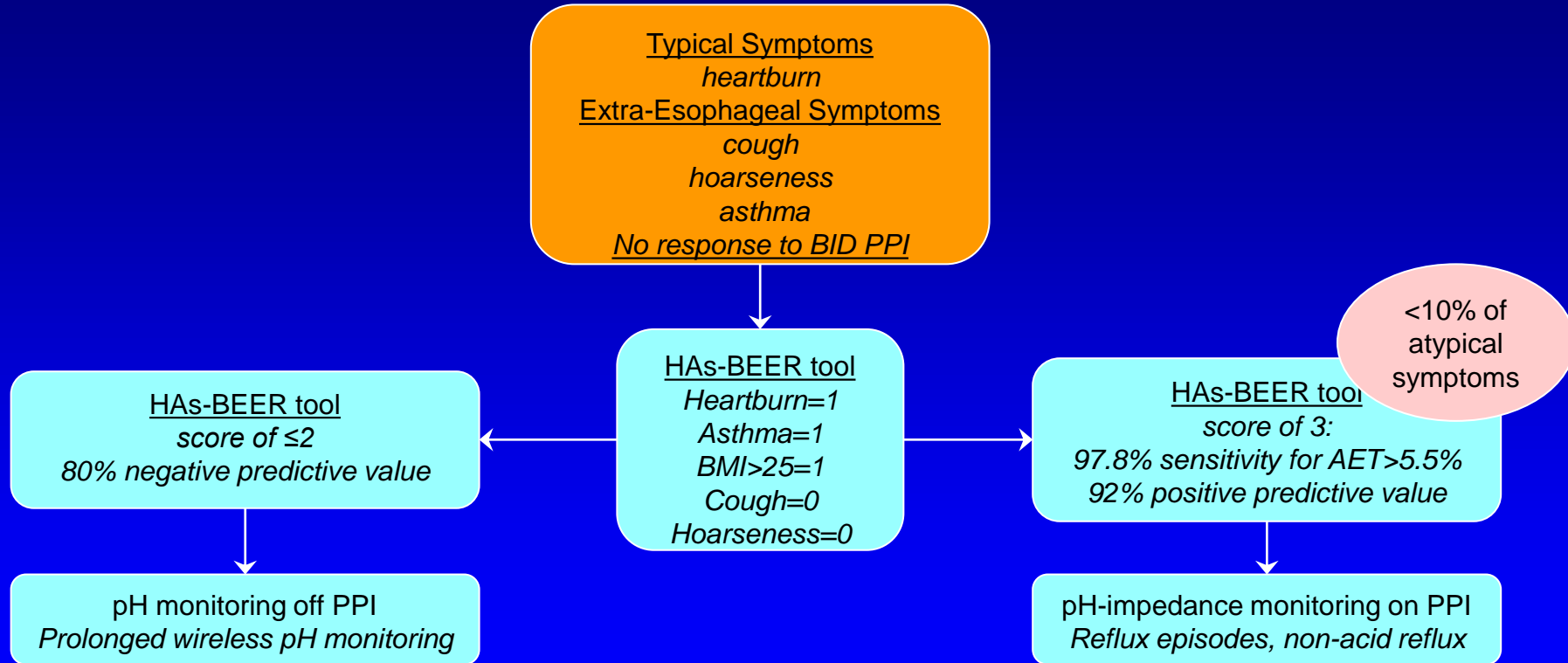
*factors that increase confidence for presence of pathologic reflux when evidence is otherwise borderline or inconclusive

Subsequent Approach



- GERD has no gold standard for diagnosis
- Clinical diagnosis is not conclusive; symptom relief is a surrogate
- Endoscopy has high specificity but low sensitivity for GERD diagnosis
- Reflux monitoring performed off PPI can phenotype unproven GERD

Using Pre-Test Probability of Reflux



Studies 'on PPI'

Real World: Inconsistent thresholds used for 'on PPI' studies

Healthy volunteers given BID PPI

n=66

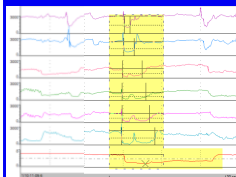


Patients with proven GERD
treated with BID PPI

European heartburn-predominant cohort
n=43



North American regurgitation-predominant cohort
n=42



pH-impedance
monitoring on
BID PPI

*In patients with proven GERD, ambulatory
reflux monitoring performed on PPI therapy
can be useful in identifying persistent GERD
that might benefit from surgical management*

values in healthy volunteers

reflux episodes 16

median 5 cm MNBI 2400 ohms

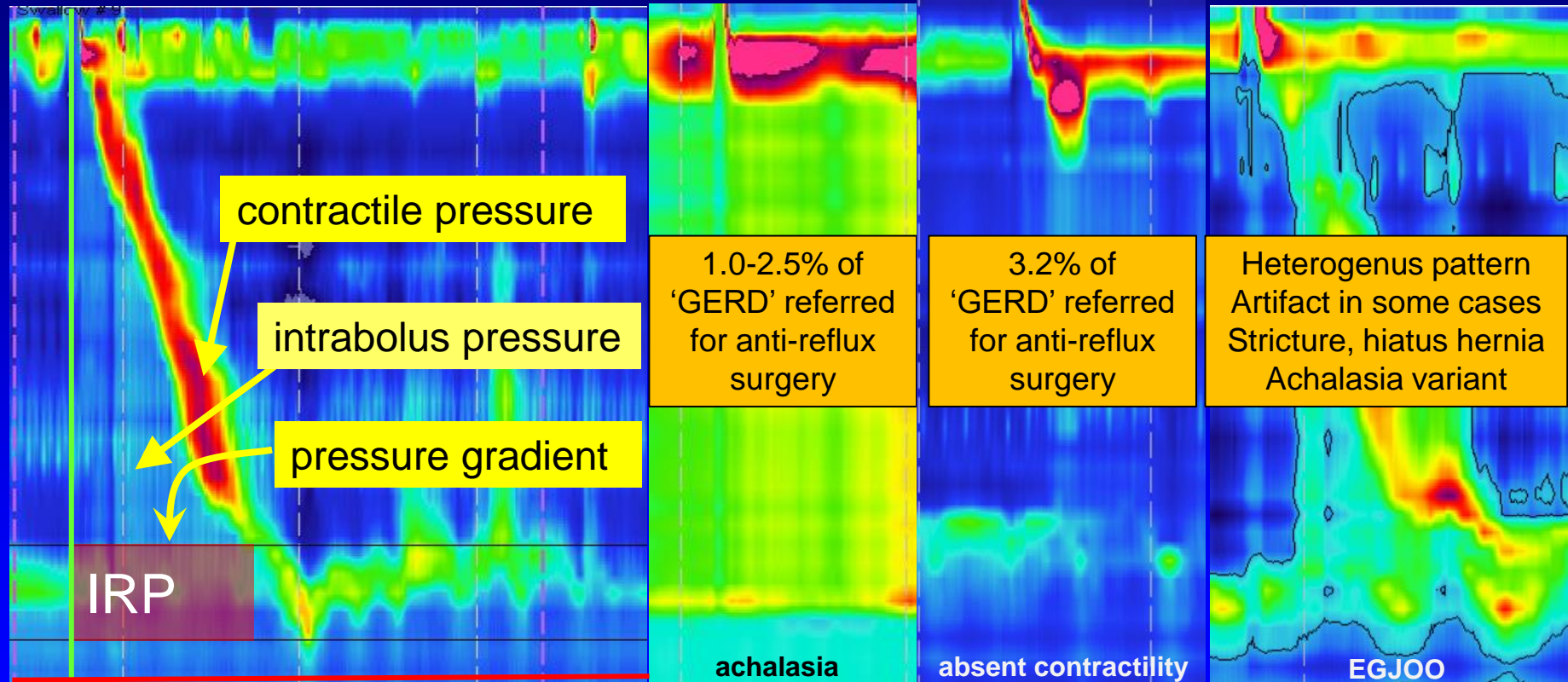
AET > 4.0%
> 80 reflux
episodes
MNBI < 1500 ohms

Response to Surgical Management

Overall 85%
Heartburn 60%
Regurgitation 93%

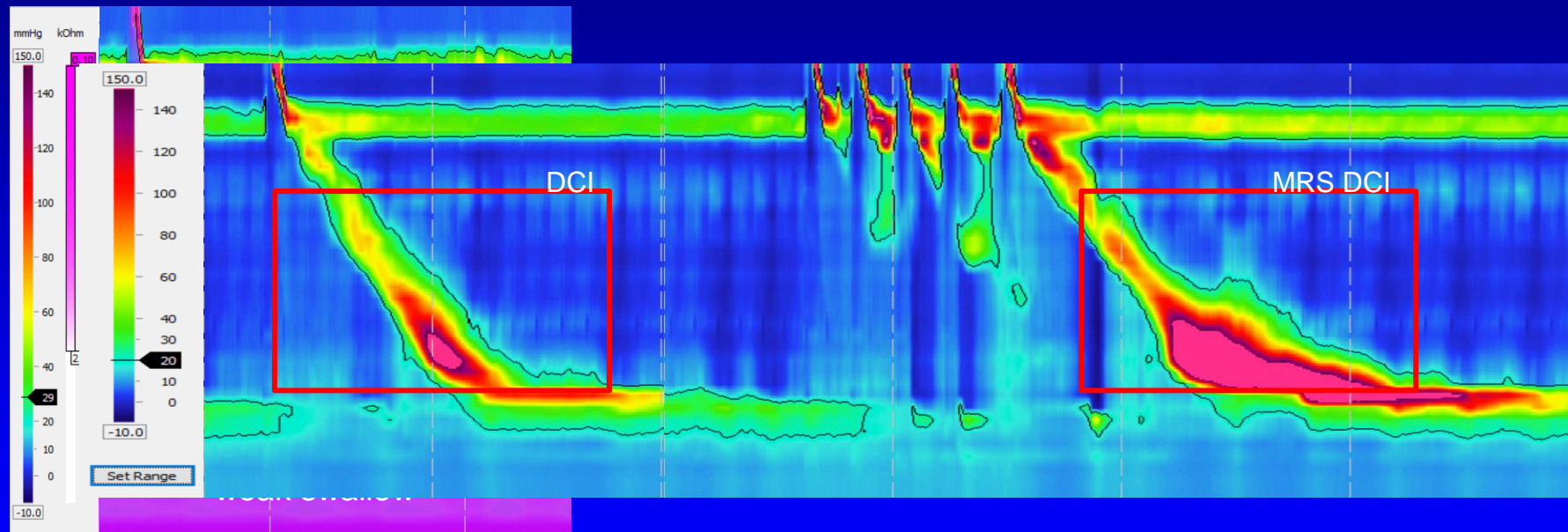
- GERD has no gold standard for diagnosis
- Clinical diagnosis is not conclusive; symptom relief is a surrogate
- Endoscopy has high specificity but low specificity for GERD diagnosis
- In unproven GERD, reflux monitoring off PPI can phenotype symptoms
- In proven GERD, pH-impedance on PPI can identify refractory GERD

HRM



Concept of Contraction Reserve

Multiple Rapid Swallows: 5 rapid swallows of 2 mL water each



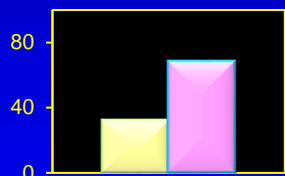
normal response: $MRS\ DCI > \text{mean DCI from single swallows}$
No contraction during multiple rapid swallows

157 patients with 2.1 ±0.2 yr follow up
 54.8% had early post-fundoplication dysphagia
 18.5% had late post-fundoplication dysphagia (lasting >6 weeks post surgery)

Predictors of post-fundoplication dysphagia	Univariate		Multivariate	
<i>n=157, 2.1 yr follow up</i>	OR	95% CI	OR	95 % CI
Age (years)	0.99	0.96, 1.02	0.97	0.92, 1.02
Gender (F)	2.10	0.75, 5.92	1.12	0.25, 4.95
Pre-fundoplication dysphagia	2.95	1.25, 6.98	1.15	0.34, 3.87
Early post-fundoplication dysphagia	3.10	1.23, 7.76	1.40	0.34, 5.83
Dysmotility on post-fundoplication barium swallow	2.17	0.89, 5.24	1.43	0.19, 10.67
Recurrent Hernia on barium swallow			3.37	0.36, 31.50
Absent contraction response			3.73	1.11, 12.56

In patients with persistent reflux symptoms, HRM rules out motor disorders, and assesses esophageal peristaltic performance

Reflux burden: ■ normal ■ abnormal



mmHg

150.0

140

120

100

80

60

40

30

20

10

0

-5.0

TYPE 1

TYPE 2

TYPE 3

HRM complements EGD and barium studies in increasing diagnostic yield of hiatus hernia

Healthy controls

n=484

GERD patients

n=482

97.1%

61.8%

2.9%

25.9%

0

12.2%

HRM had sensitivity of 94.3% and specificity of 91.5% in detecting hiatus hernia using hernia size at surgery as gold standard compared to endoscopy (96.2%, 74.5%) and barium radiography (69.8%, 97.9%)

Tolone et al, UEG Journal 2018

Pandolfino JE, et al. Am J Gastroenterol 2007; 102:1056-63

Rengarajan A, Gyawali CP. J Clin Gastroenterol 2020;54:22:27

Rogers BD et al. Neurogastroenterol Motil 2020

Other Mimickers of Esophageal Symptoms

Post prandial study: monitoring for 30-90 min following a meal

Clinical management: GERD mimickers not often identified

Behavioral Disorder

Supragastric Belching, Rumination

3 raters, 22 pH-impedance and PP HRIM studies

40

- Inter-rater agreement was higher for pH-impedance monitoring
 - Diagnostic yield was higher for post prandial HRIM
- Inter-rater agreement is higher when clinical context was provided

20

0

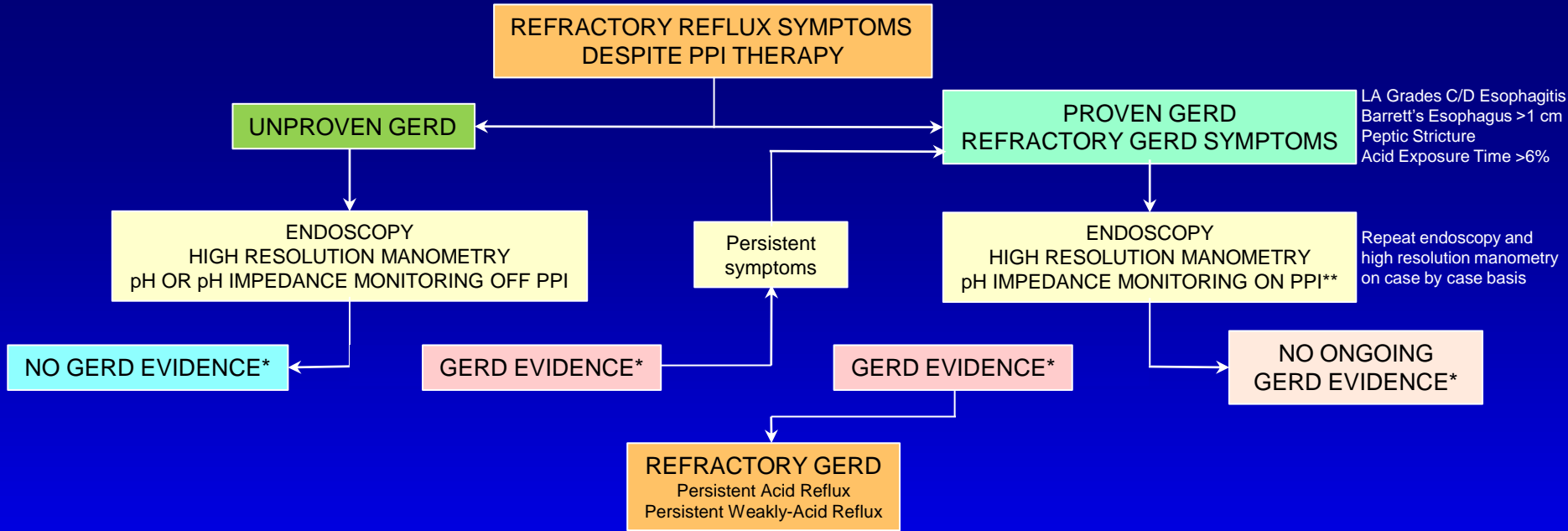
Rumination

pH-impedance monitoring can be used for investigation of excessive belching

Post-prandial HRIM can be used for investigation of suspected rumination

Normal

- GERD has no gold standard for diagnosis
- Clinical diagnosis is not conclusive; symptom relief is a surrogate
- Endoscopy has high specificity but low specificity for GERD diagnosis
- In unproven GERD, reflux monitoring off PPI can phenotype symptoms
- In proven GERD, pH-impedance on PPI can identify refractory GERD
- HRM can identify mimickers of GERD symptoms



*according to Lyon Consensus criteria

**pH impedance on PPI not essential in patients with large hiatal hernia and proven GERD with refractory GERD symptoms



Washington
University in St. Louis
SCHOOL OF MEDICINE

Division of **Gastroenterology**



Birthplace of High Resolution Manometry
St. Louis, Missouri, USA