

# Esophageal Motility Disorders: An Overview

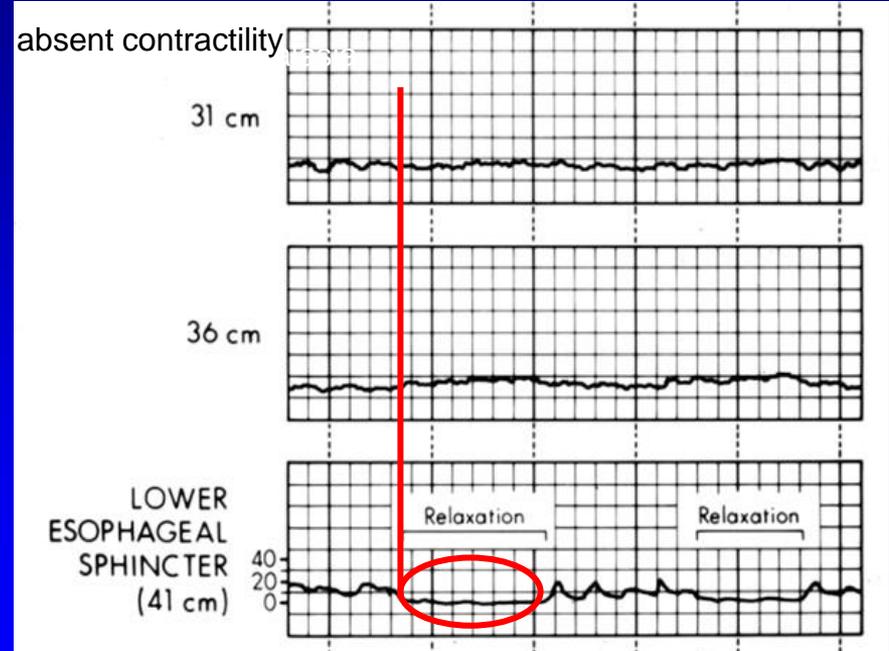
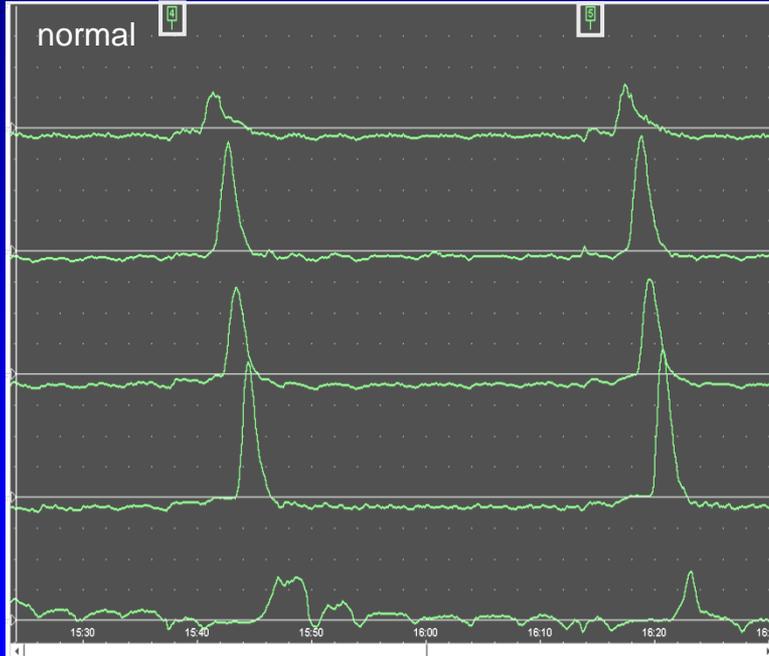
C. Prakash Gyawali, MD, MRCP  
Washington University in St. Louis

# Disclosures

The background of the slide features a collage of medical and scientific icons. These include a heart with a cross, a microscope, a pill, a stethoscope, a virus particle, a DNA helix, a bar chart, and a line graph. The icons are rendered in a light, semi-transparent style against a light blue and white background.

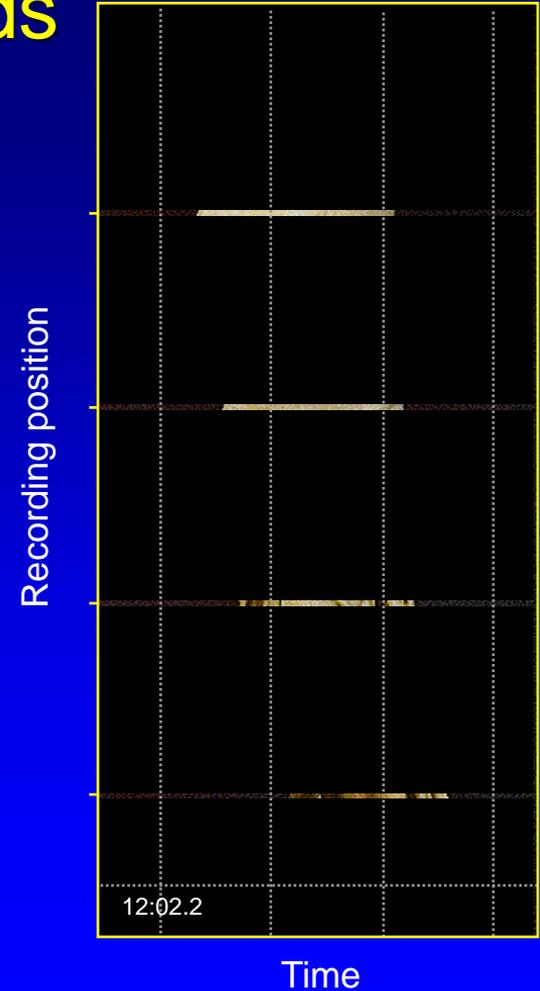
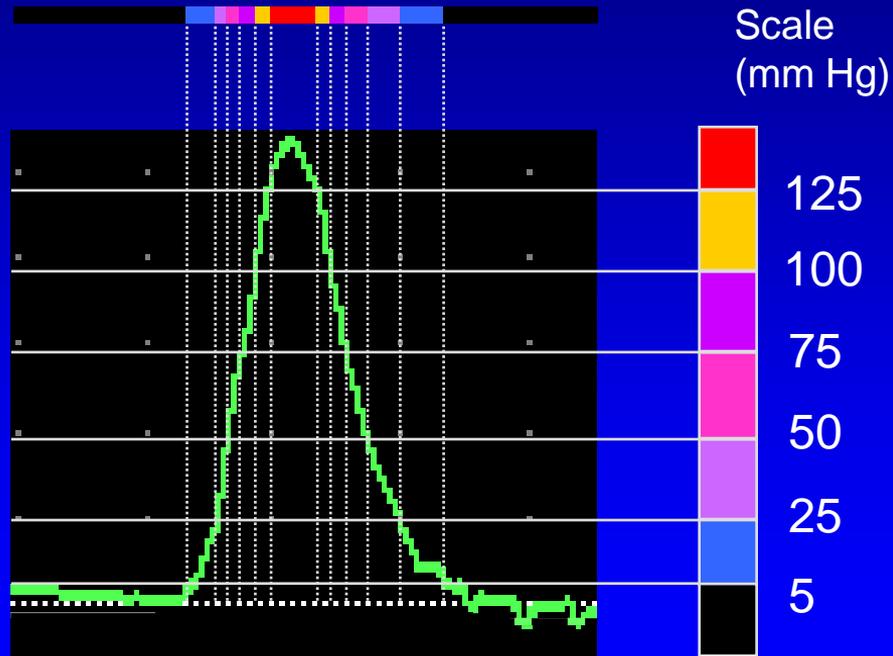
- Consultant for Medtronic, Diversatek, Ironwood, Takeda, and Iso-Thrive

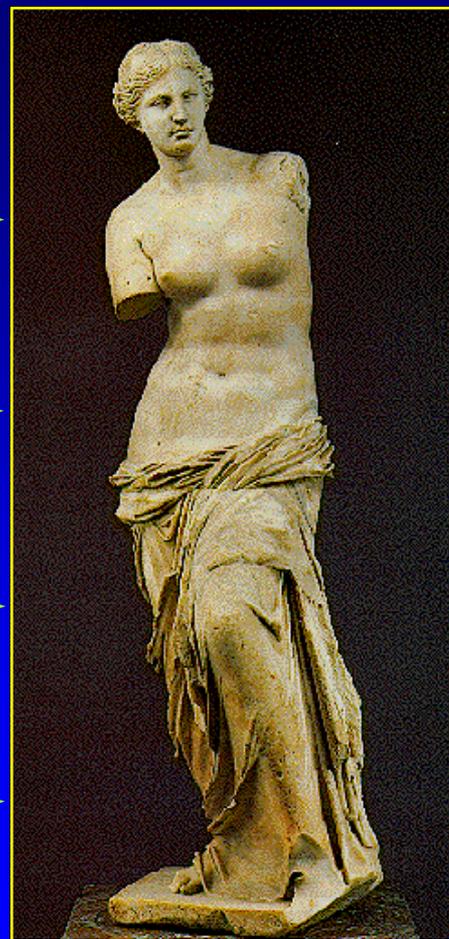
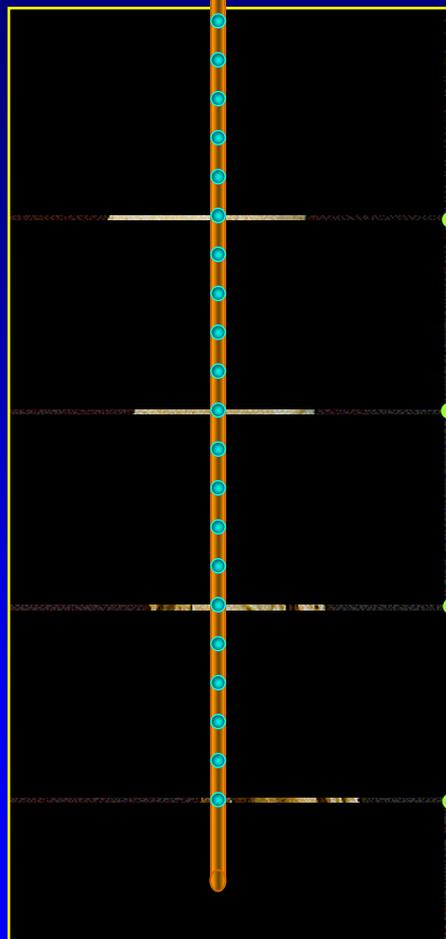
# Conventional Manometry



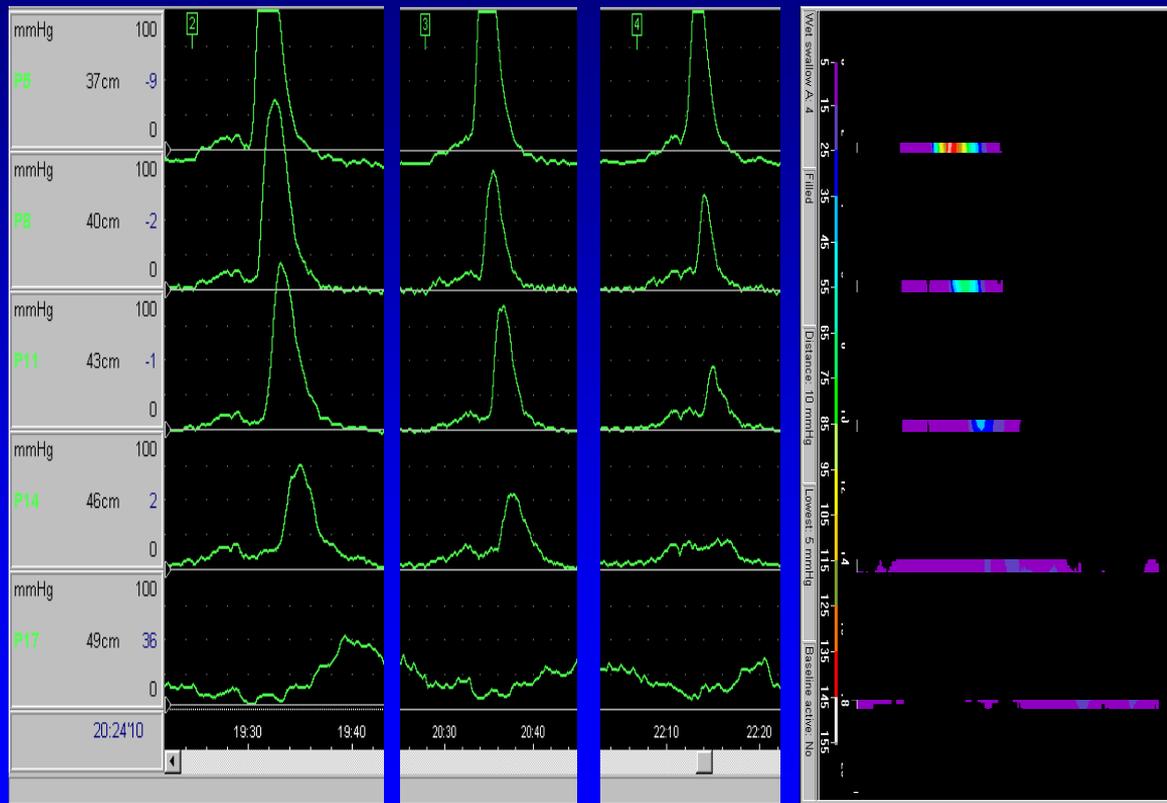
# High-Resolution Manometric Methods

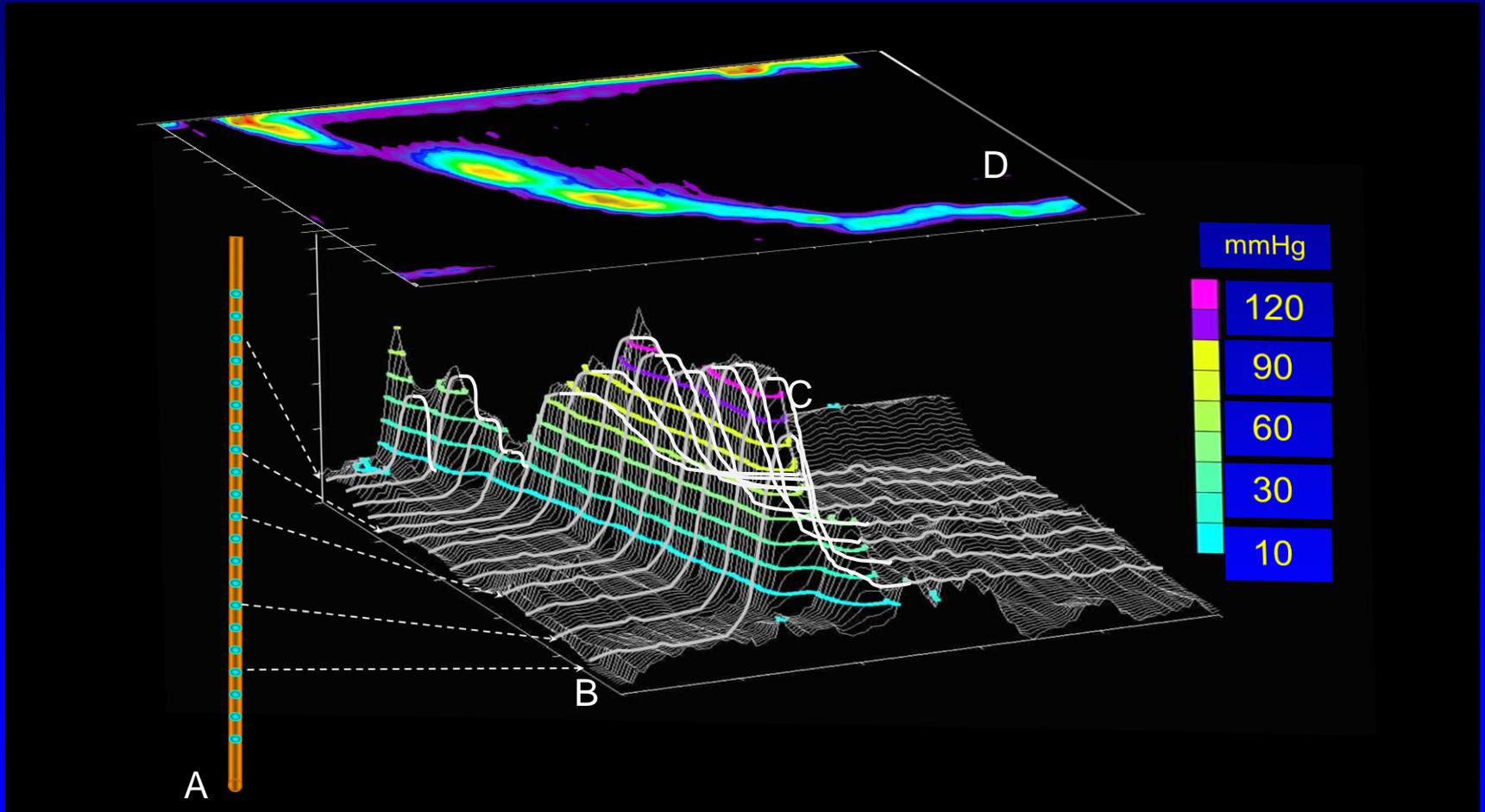
## Assignment of Colors to Pressure Levels

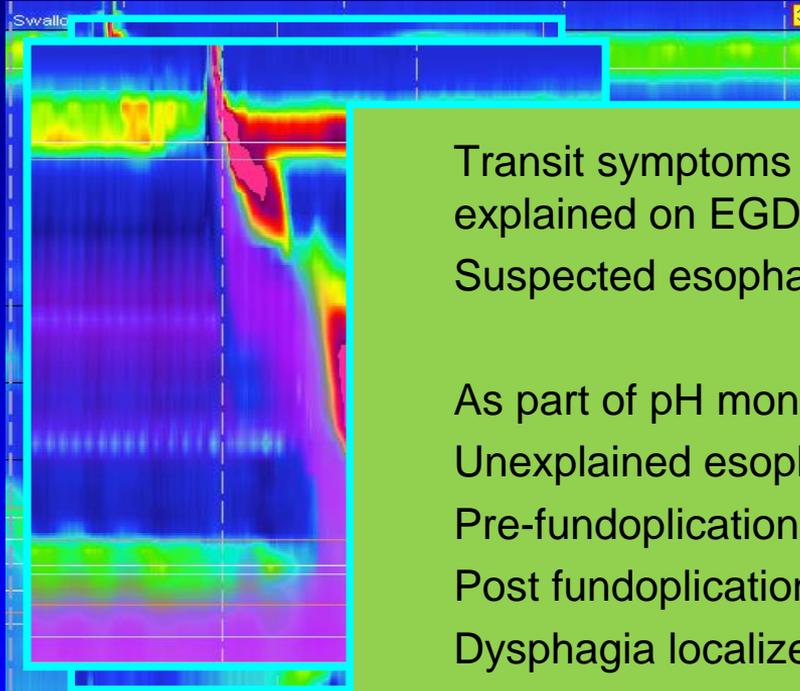




E.C. 2/17/99







UES and LES visible in the same window

Real time visualization of catheter position

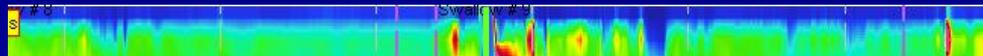
Transit symptoms (dysphagia, regurgitation) not explained on EGD and/or barium swallow  
Suspected esophageal motor disorder

As part of pH monitoring  
Unexplained esophageal symptoms  
Pre-fundoplication peristaltic assessment  
Post fundoplication dysphagia  
Dysphagia localized to upper esophageal sphincter

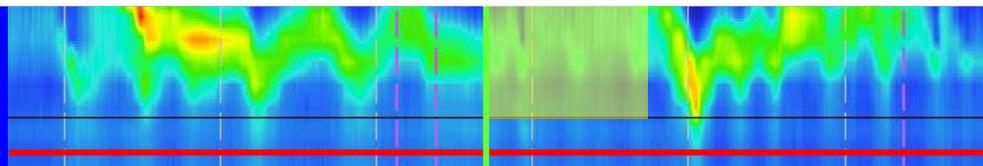
ctified  
hageal peristalsis  
sily recognized  
hincter function  
ssessed  
on of bolus  
d for pH probe

placement

# Electronic eSleeve for High-Resolution Manometry



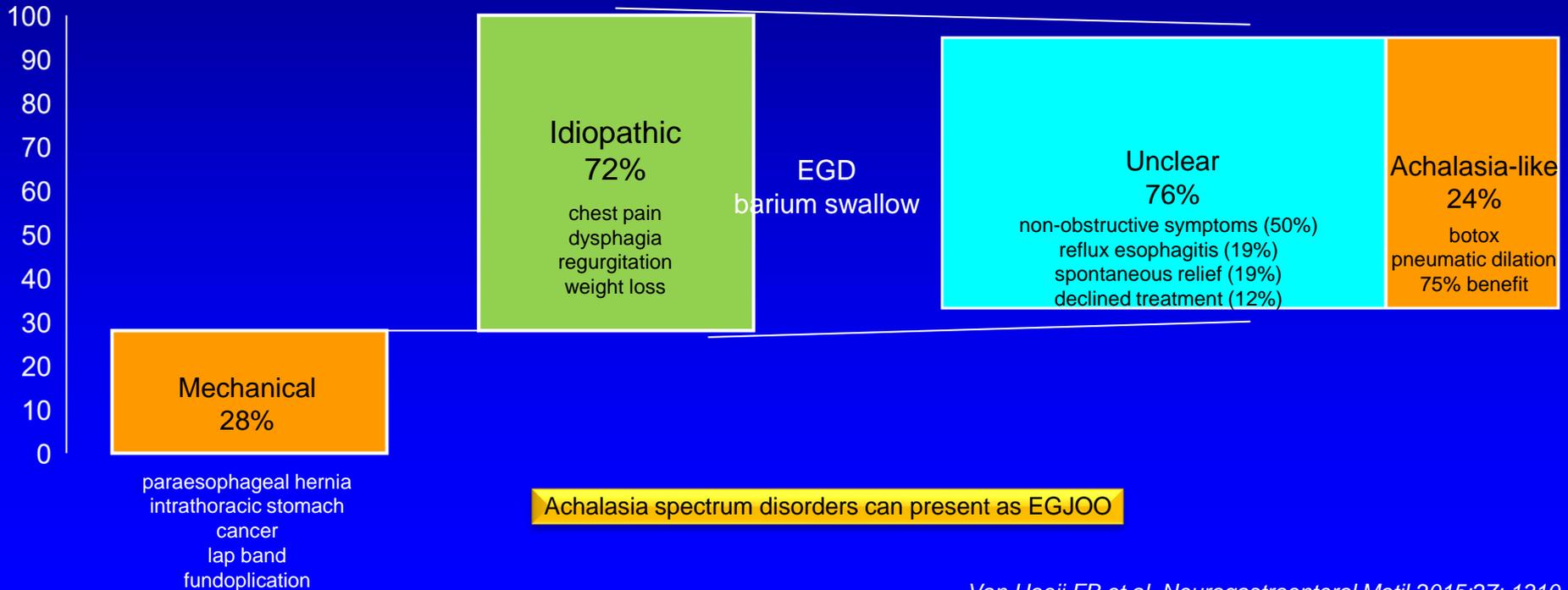
	Achalasia sensitivity (n=62)	False negative
Single sensor nadir (<7 mmHg)	52%	48%
High resolution nadir (<10 mmHg)	69%	31%
3s nadir (<15 mmHg)	94%	6%
4s Integrated Relaxation Pressure (<15 mmHg)	97%	3%



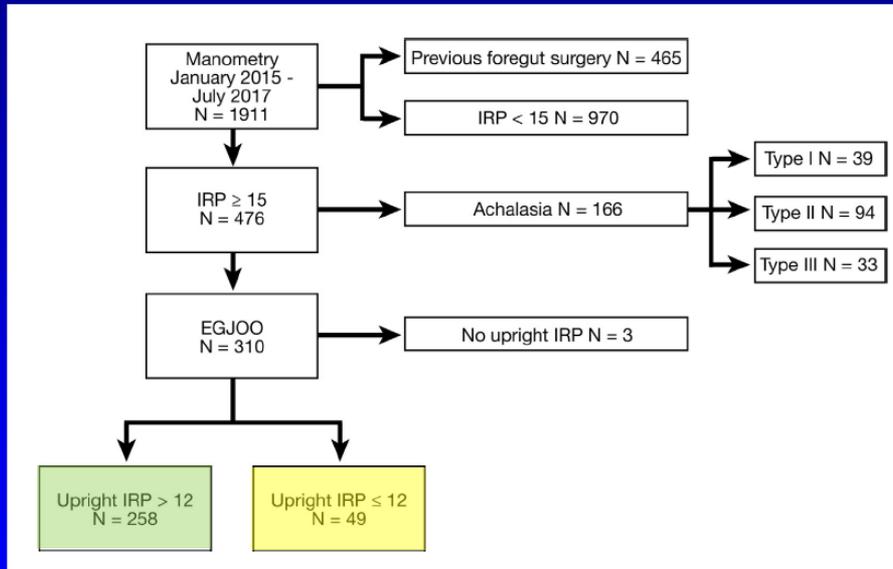


# EGJOO Etiology

Of 1142 HRM studies in 3 years, EGJOO diagnosed in 47 (4%)



# Preventing Over-diagnosis: Upright Swallows



Upright IRP > 12 mmHg

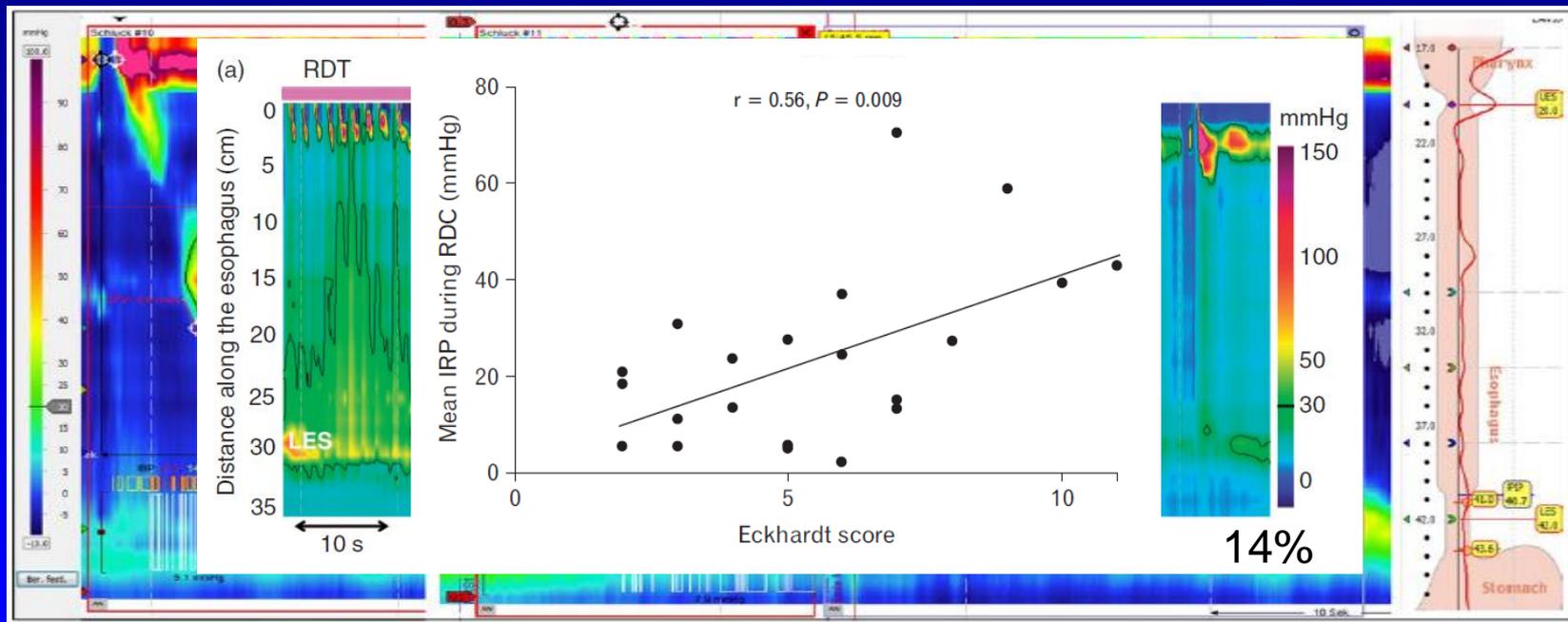
sensitivity 97.9% for radiographic EJGOO  
specificity 15.7% for radiographic EGJOO

negative predictive value 94.4%

Radiographic EGJOO	33.6%	2.0%
Abnormal BEDQ	55.9%	35.9%

# Preventing Under-Diagnosis: Provocative Maneuvers

Rapid Drink Challenge: 100-200 mL water



Rapid Drink Challenge  
identifies outflow obstruction

Woodland P et al, *J Neurogastroenterol Motil* 2018;24:410-4

Biasutto D et al, *UEG Journal* 2018;6:1323-30

Marin I & Serra J, *NGM* 2016;28:543-53

Ang D et al, *NGM* 2017;

# Barium Swallow

## When to Order Barium Studies

Transit symptoms (dysphagia, regurgitation) without conclusive diagnosis after endoscopy, HRM

Follow up of symptomatic achalasia patients after therapy

Evaluation of esophago-gastric junction anatomy

Evaluation and management of complex strictures

## Performance characteristics of barium esophagram for detection of esophageal dysmotility

Sensitivity: 0.69

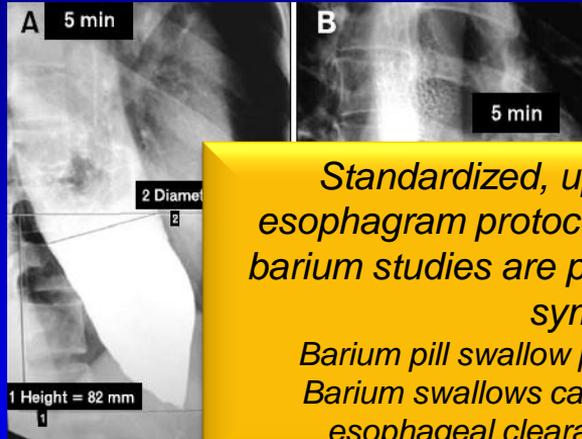
Specificity: 0.50

Allen et al. *Cleveland Clin J Med* 2009;76:105-11

O'Rourke AK et al, *Otolaryngol Head Neck Surg* 2016;154:888-91.

Blonski W et al, *Am J Gastroenterol* 2018;113:196-203

# Timed Upright Barium Swallow



*Standardized, upright, timed barium esophagram protocol should be used when barium studies are performed for obstructive symptoms*

*Barium pill swallow provides additional value  
Barium swallows can provide information on esophageal clearance vs bolus retention*

8 oz of thin barium in upright position

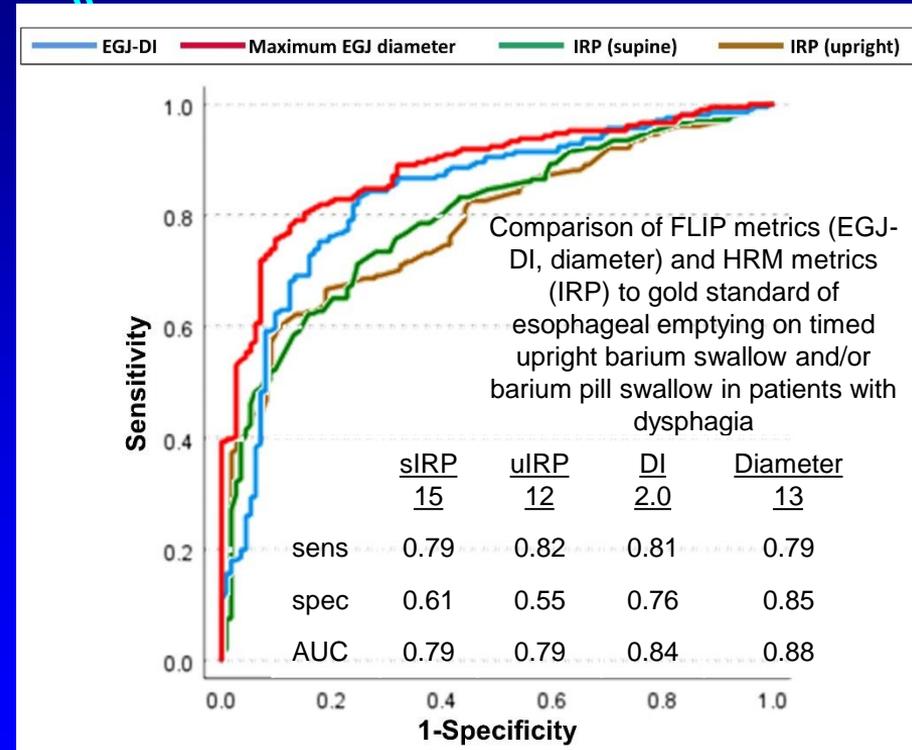
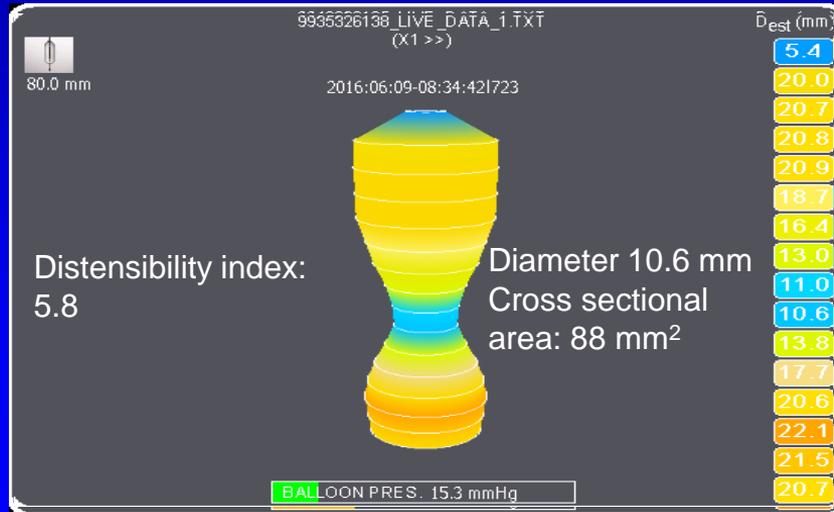
*Normal: no retention of barium in the esophagus*

*Abnormal: >5 cm barium column in 1 min*

*>2 cm barium column in 5 min*

# Functional Lumen Imaging Probe

- Placed trans-orally during sedated upper endoscopy
- Positioned with 2-3 channels beyond the waist identified as the EGJ
- Step-wise volumetric distension from 20 to 70 ml



# Refining Diagnosis of Obstruction

**HIGH RESOLUTION MANOMETRY, HIGH RESOLUTION IMPEDANCE MANOMETRY**

*Intrabolus pressure, compartmentalization of pressure, impedance height, UES nadir residual pressure*



**PROVOCATIVE HRM:OBSTRUCTIVE**

*Upright swallows, rapid drink challenge, standardized test meal to evaluate for outflow obstruction*

Consider opioid-induced EGJOO

Investigate further (barium, EGD)  
Treat conclusive EGJOO



**Achalasia and pseudoachalasia need to be considered**

**Routine endoscopic ultrasound or cross sectional imaging are not recommended**

**'Observe and follow' is a viable option in EGJOO**

EGD, FLIP)  
EGJOO



**SECOND OPINION ENDOSCOPY**

*to evaluate for mucosal and mechanical processes to treat structural and motor disorders*

Observe  
Behavioral therapy

Therapeutic trials:  
Simple dilation, Botulinum toxin

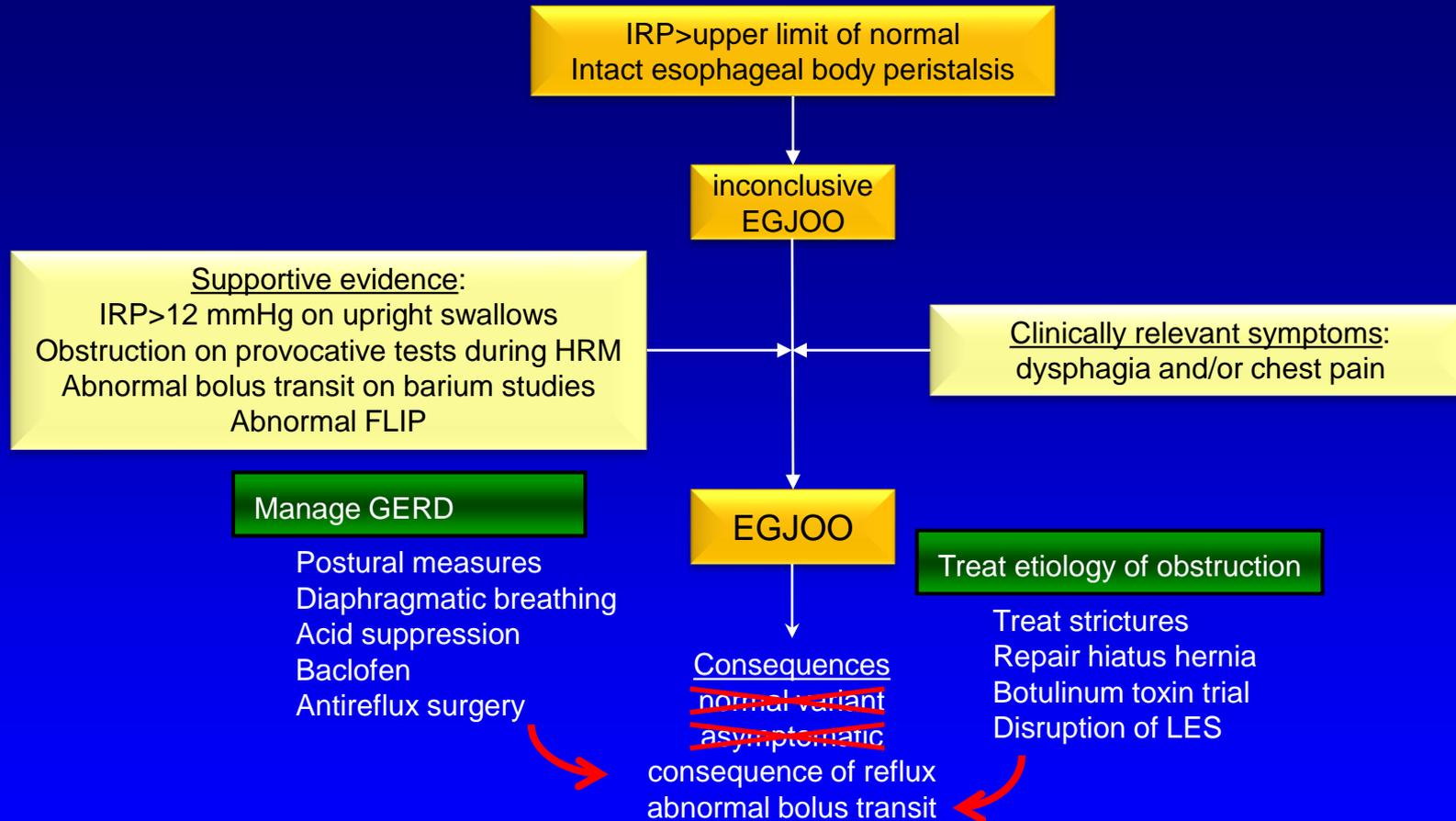


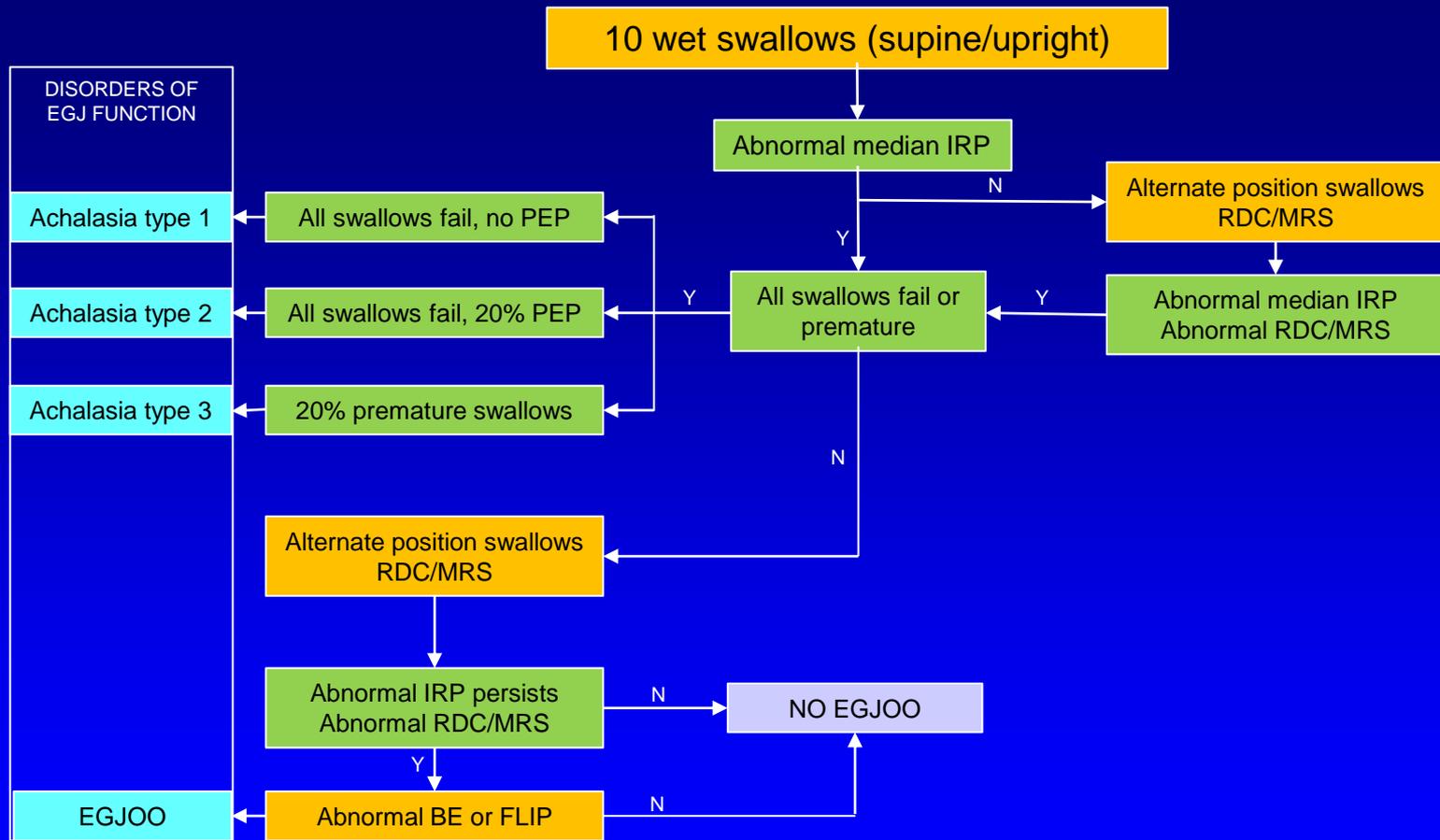
**FUNCTIONAL LUMEN IMAGING PROBE**

*alternative or complementary approach to diagnosis of motor and structural disorders*

Observe  
Behavioral therapy

Therapeutic trials:  
Simple dilation, Botulinum toxin





# Treatment of Achalasia, Spastic Disorders

Calcium Channel Blockers

Nitrates

Botulinum toxin

PDE - sildenafil

Pneumatic dilation

Surgical myotomy

POEM

} temporizing measures  
nitrates >> calcium blockers

poor surgical risk, elderly  
therapeutic trial

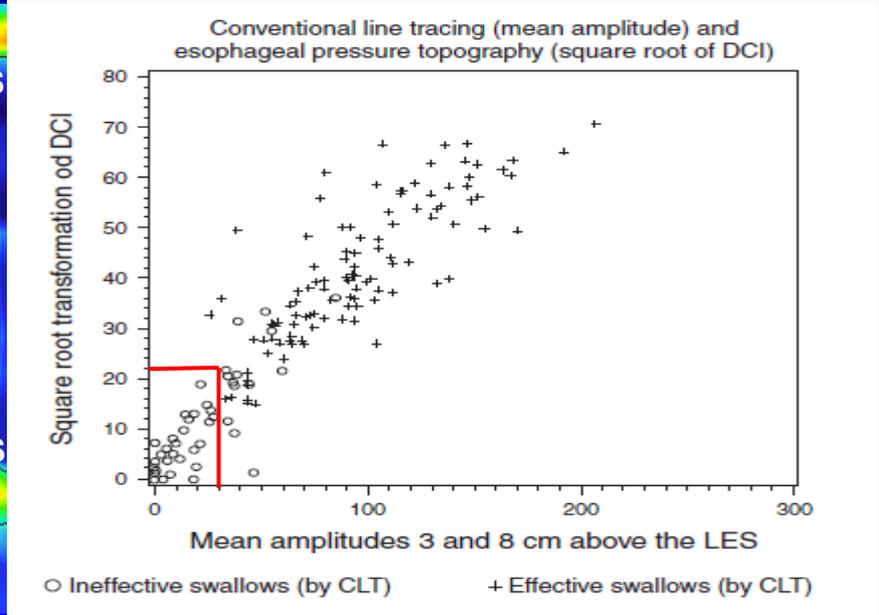
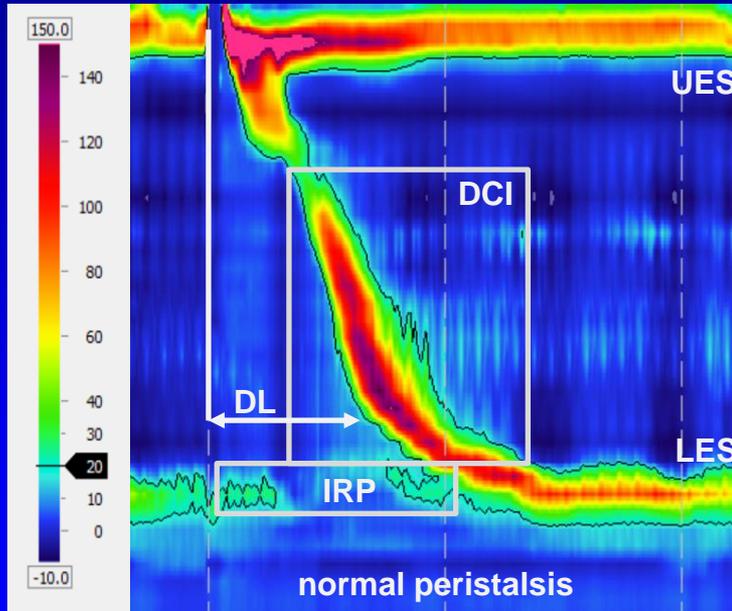
unclear niche

type 2 >> type 1

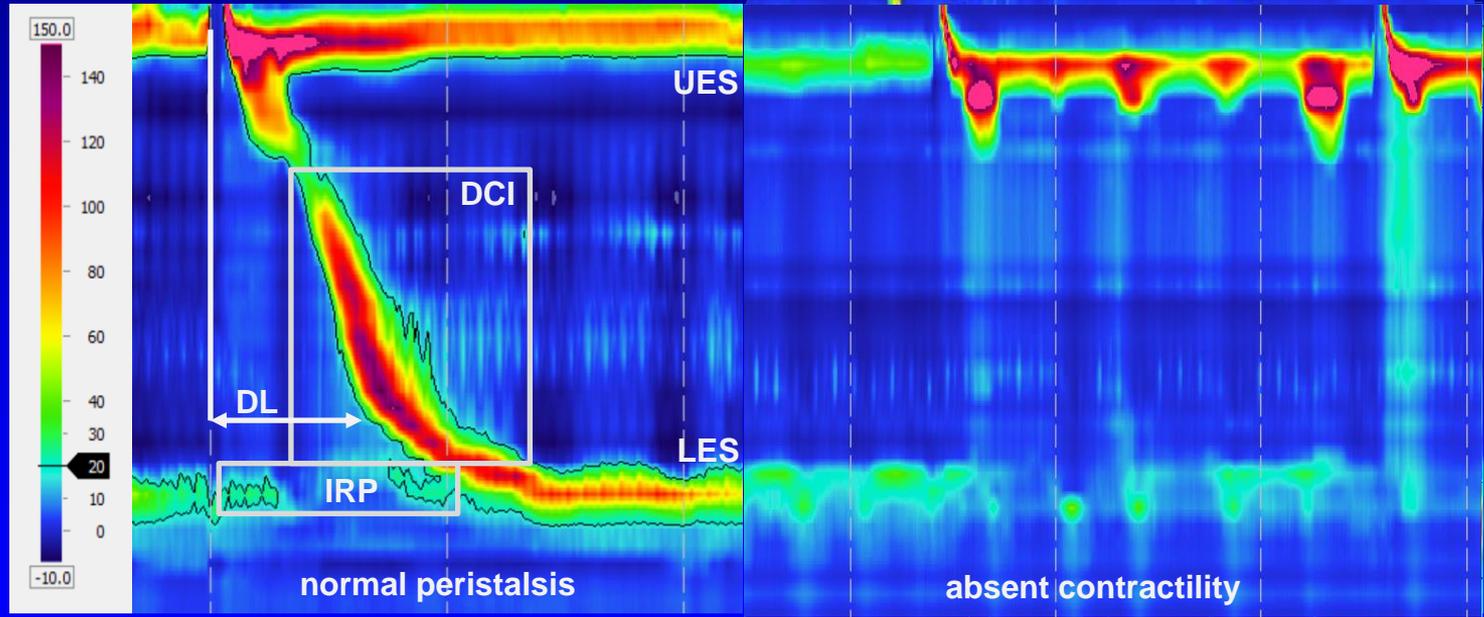
type 1 >> type 2

type 3, spastic disorders (tailored)

# High Resolution Manometry



# High Resolution Manometry



Normal IRP  
DCI > 8000 mmHg.cm.s in ≥ 20%: hypercontractile esophagus  
DL < 4.5 s in ≥ 20%: distal esophageal spasm

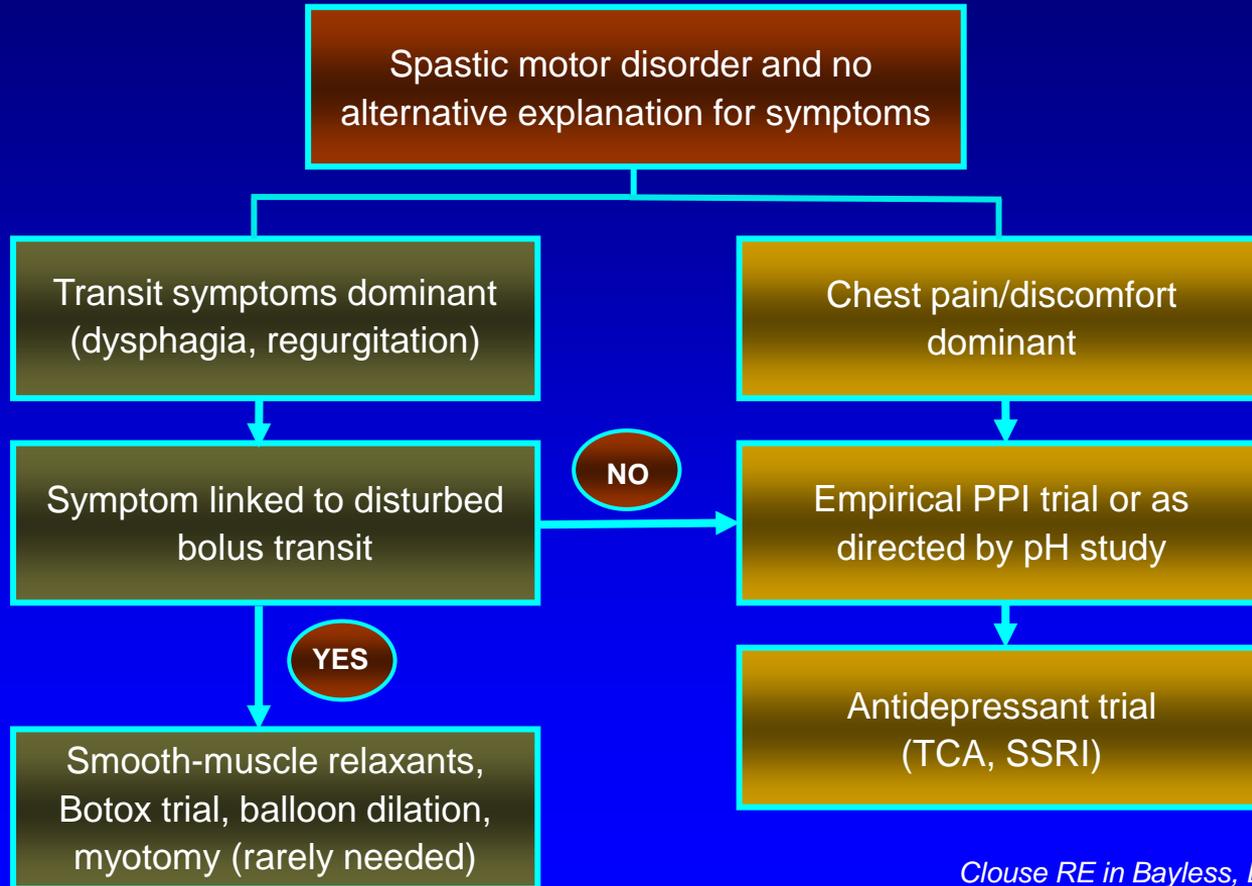
Supportive evidence:  
criteria for achalasia are not met  
obstruction is carefully ruled out  
For DES: DCI is > 450 mmHg.cm.s  
DL is measured correctly to contraction front

Clinically relevant symptoms:  
dysphagia and/or chest pain

Conclusive  
Hypercontractile Esophagus  
Distal Esophageal Spasm

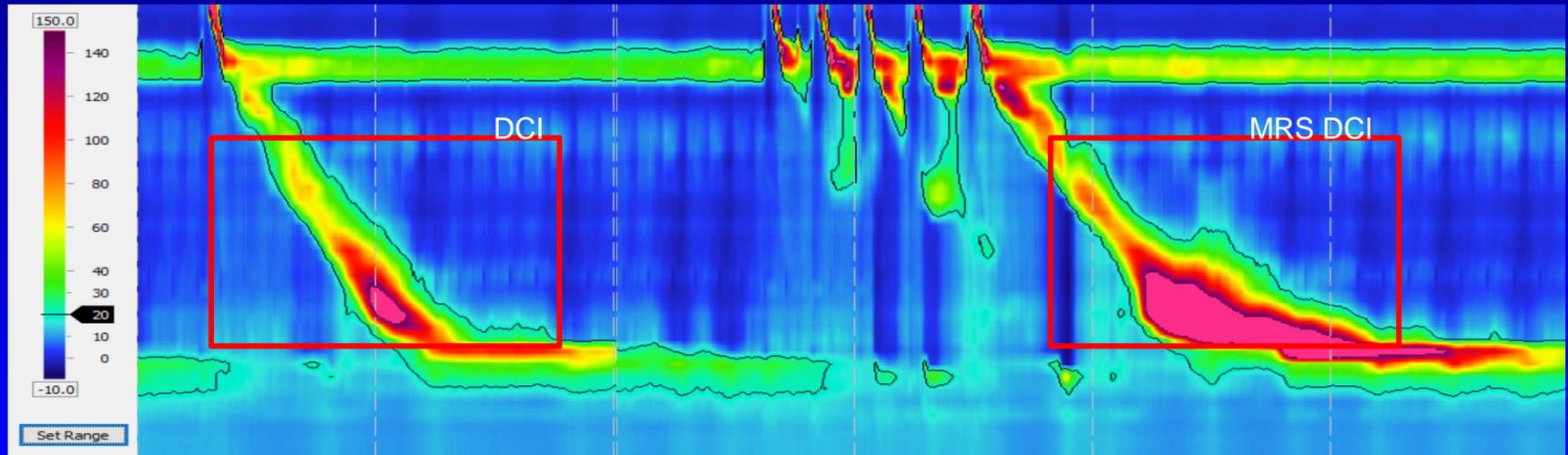
Consequences  
~~normal variant~~  
~~asymptomatic~~  
associated with reflux  
abnormal bolus transit  
marker for esophageal hypersensitivity

# Treatment of Spastic Motor Disorders



# CC 4.0: Provocative Measures

Multiple Rapid Swallows: 5 rapid swallows of 2 mL water



normal response:

MRS DCI > DCI wet swallows

# Contraction Reserve and Post-Fundoplication Dysphagia

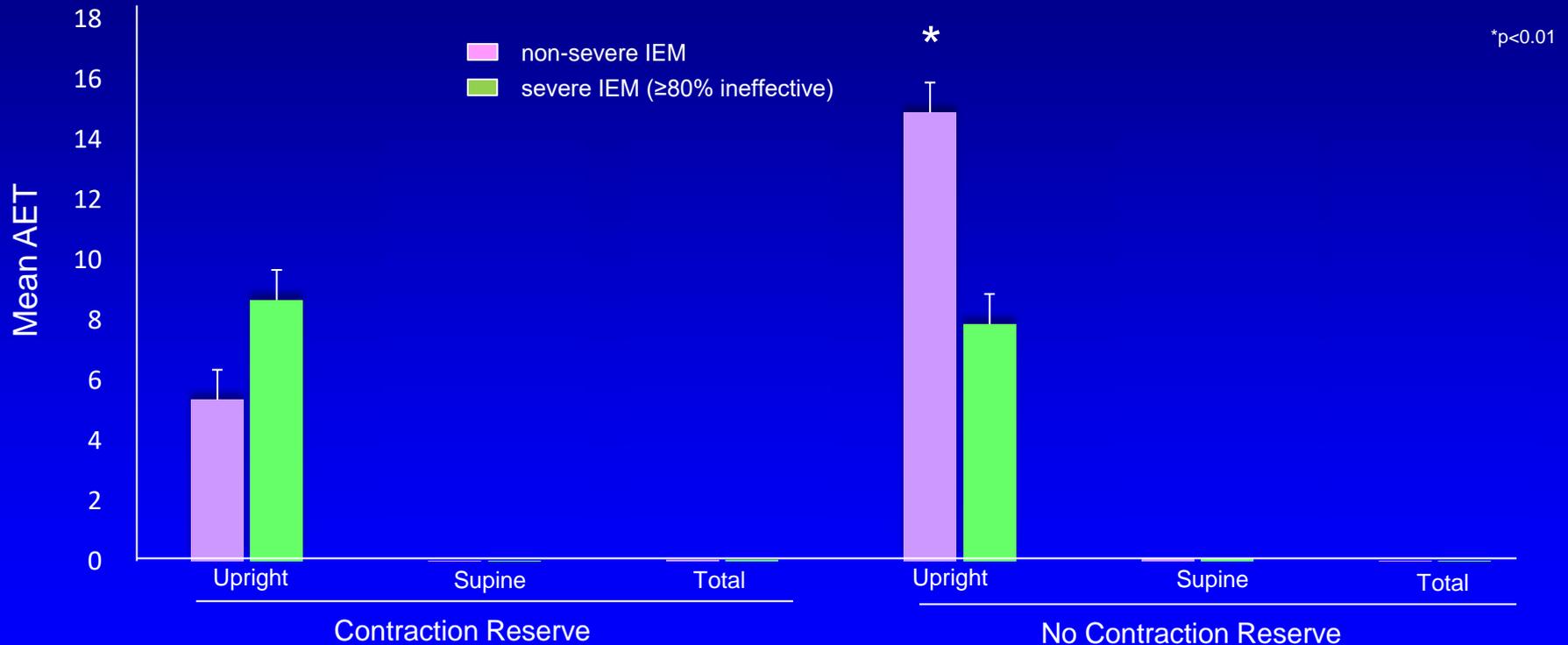
157 patients with 2.1 ±0.2 yr follow up

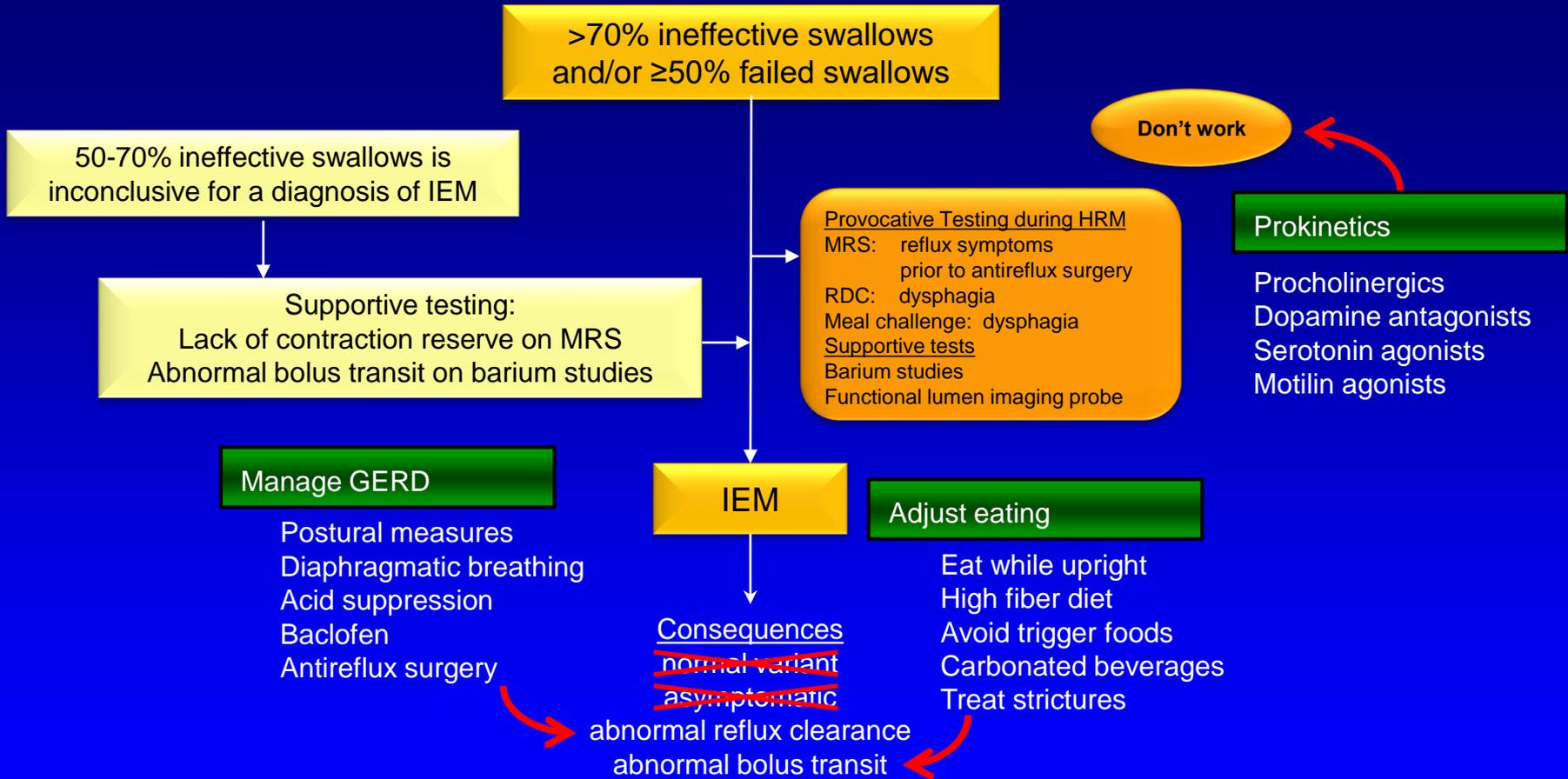
54.8% had early post-fundoplication dysphagia

18.5% had late post-fundoplication dysphagia (lasting >6 weeks post surgery)

	Univariate		Multivariate	
	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	3.45	1.12, 10.63	3.37	0.36, 31.50
Absent contraction reserve	3.37	1.12, 10.59	3.73	1.11, 12.56

# Contraction Reserve Influences Acid Burden





Gyawali CP et al, Stanford IEM Symposium, Neurogastroenterol Motil 2019  
 Gyawali CP et al, IEM Technical Note, Neurogastroenterol Motil 2021  
 Yadlapati R et al, Chicago Classification 4.0, Neurogastroenterol Motil 2021

100% failed swallows  
Normal IRP

Supportive testing: Rule out achalasia  
Rapid drink challenge during HRM  
Assess bolus transit on barium studies  
Assess EGJ function using FLIP

Don't work

Prokinetics

Procholinergics  
Dopamine antagonists  
Serotonin agonists  
Motilin agonists

Manage GERD

Postural measures  
Diaphragmatic breathing  
Acid suppression  
Baclofen  
Antireflux surgery

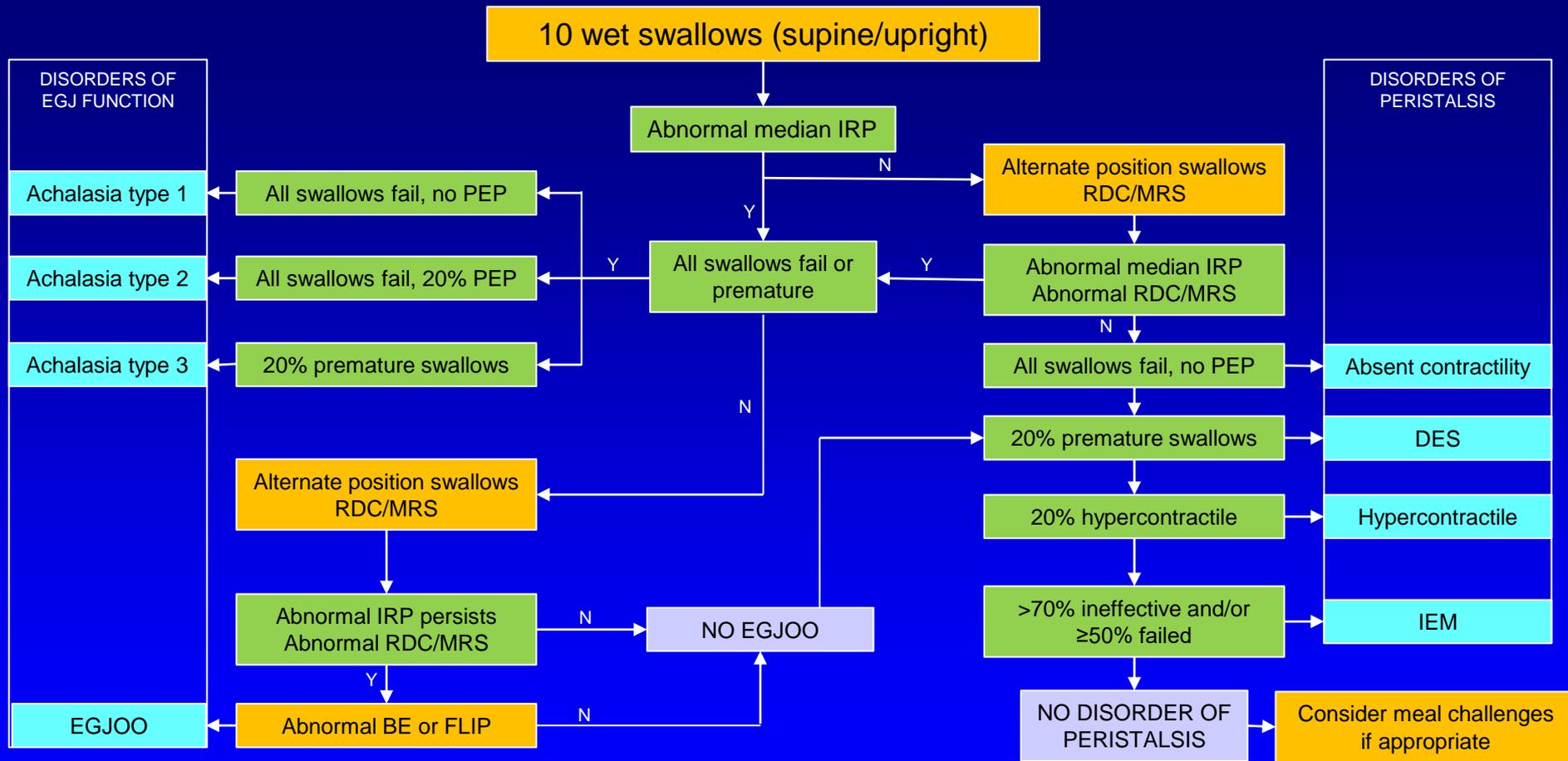
Absent  
contractility

Adjust eating

Eat while upright  
High fiber diet  
Avoid trigger foods  
Carbonated beverages  
Treat strictures

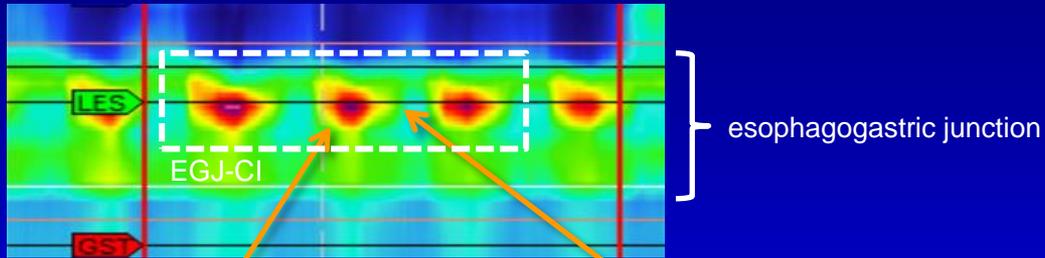
Consequences  
~~normal variant~~  
~~asymptomatic~~

abnormal reflux clearance  
abnormal bolus transit



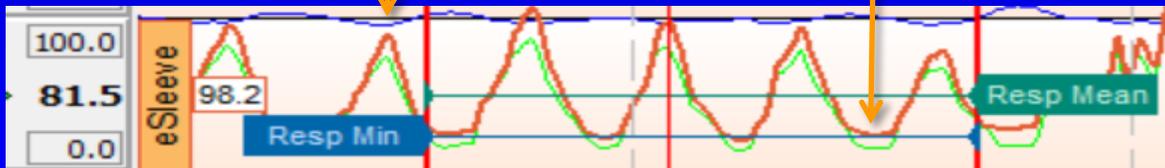
# Changes with Chicago Classification 4.0

- Standard protocol includes upright swallows and provocative maneuvers
- Two categories of disorders
  - Disorders of EGJ function
  - Disorders of peristalsis
- Esophagogastric junction outflow obstruction is not a conclusive diagnosis without additional evidence
- Clinical relevance of DES, hypercontractile disorder requires additional confirmation
- IEM diagnosis is now more stringent

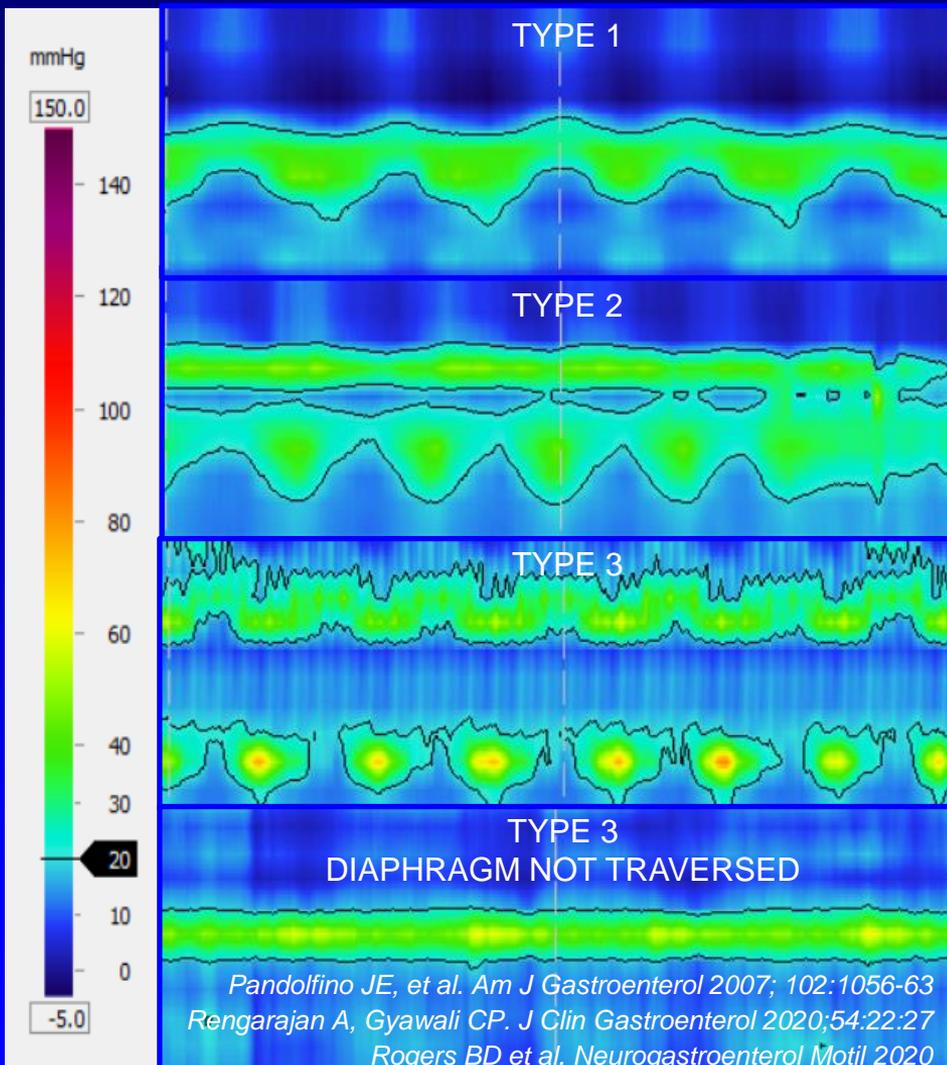
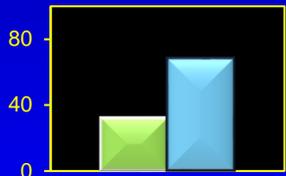
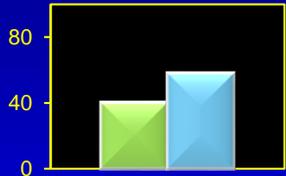
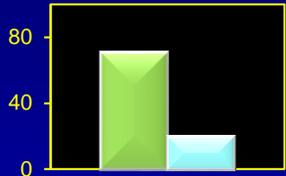


inspiratory diaphragmatic crural contraction

intrinsic lower esophageal sphincter



Reflux burden: ■ normal ■ abnormal



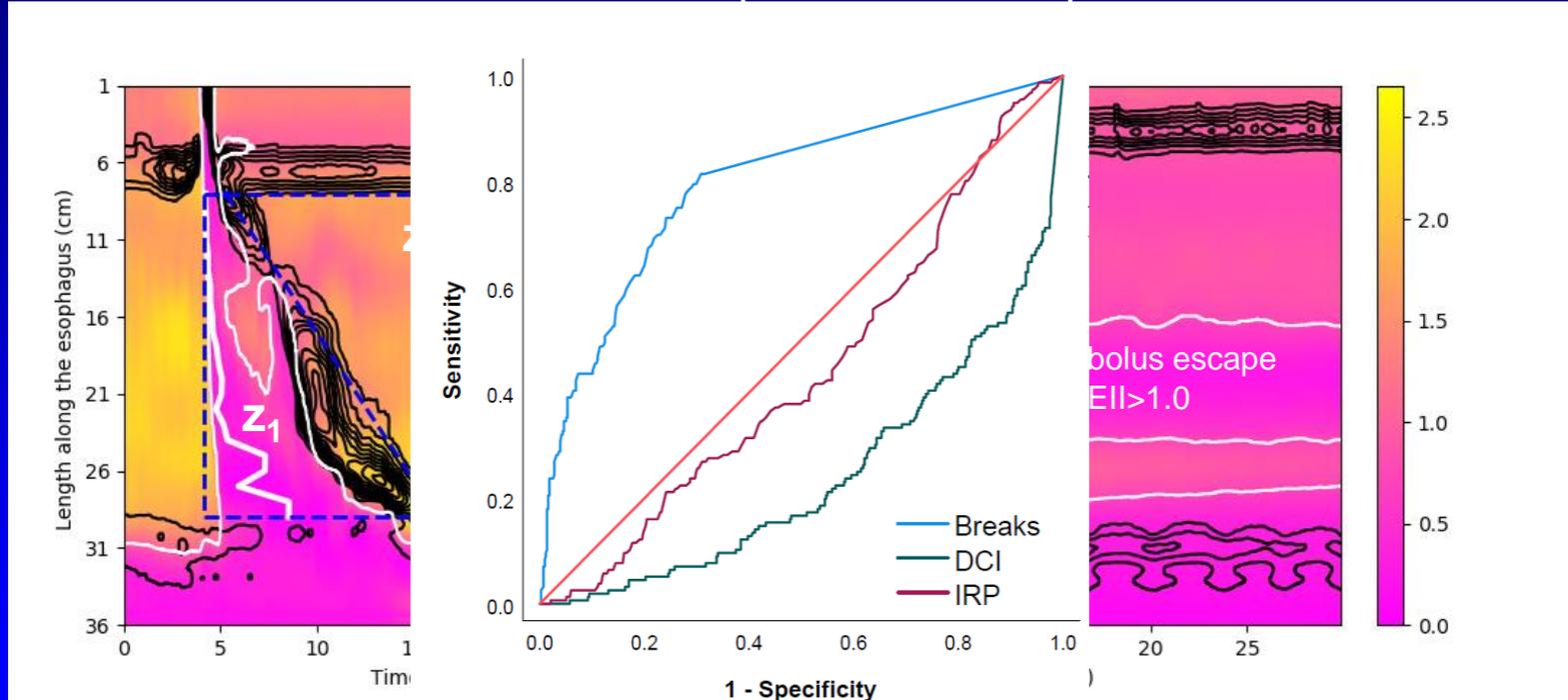
Healthy controls <i>n</i> =484	GERD patients <i>n</i> =482
97.1%	61.8%
2.9%	25.9%
0	12.2%

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*

# Esophageal Impedance Integral (EII)

Quantification of impedance bolus presence



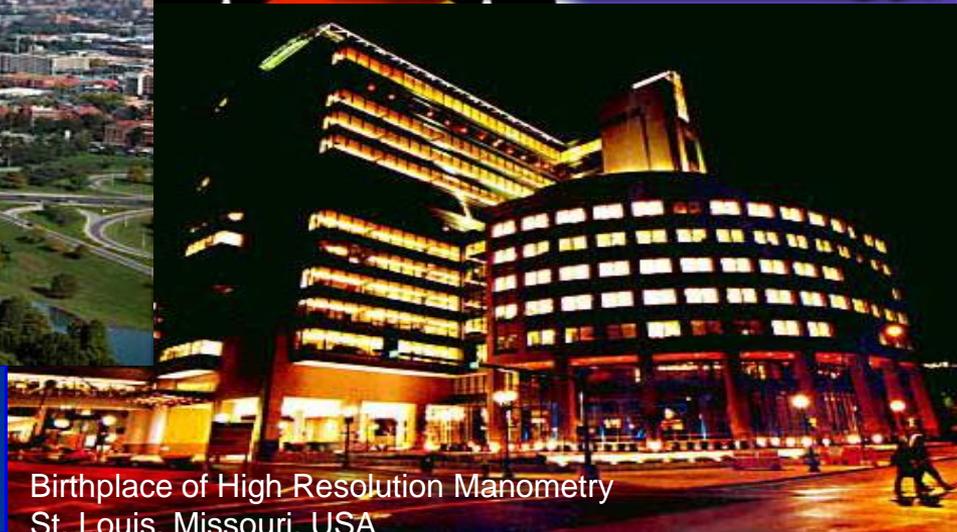
Predictors of abnormal EII (bolus presence)  
in healthy volunteers

# Summary

- Manometry has evolved over the past three decades from water-perfused conventional manometry to solid state HRM
- HRM is the current standard for assessment of esophageal motility and sphincter function
- Impedance combined with HRM provides bolus transit information that can be quantified using novel software tools
- FLIP has potential to complement, and in some clinical settings, replace HRM
- Artificial intelligence and machine learning may further enhance motility diagnostic algorithms



Division of **Gastroenterology**



 **Washington**  
University in St. Louis  
SCHOOL OF MEDICINE

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

The background is a light blue, futuristic aesthetic. It features a central human figure, possibly a doctor or scientist, with glowing hexagonal panels overlaid on their body. These panels contain various icons and data visualizations. The icons include a heart with an ECG line, a water drop, pills, a first aid kit, a stethoscope, a virus, a globe, and various charts and graphs. The overall theme is medical, scientific, and technological.

# Q&A/Panel Discussion



Lunch