

Making Sense of Esophageal Manometry

Gregory N. Postma, MD

Disclosures

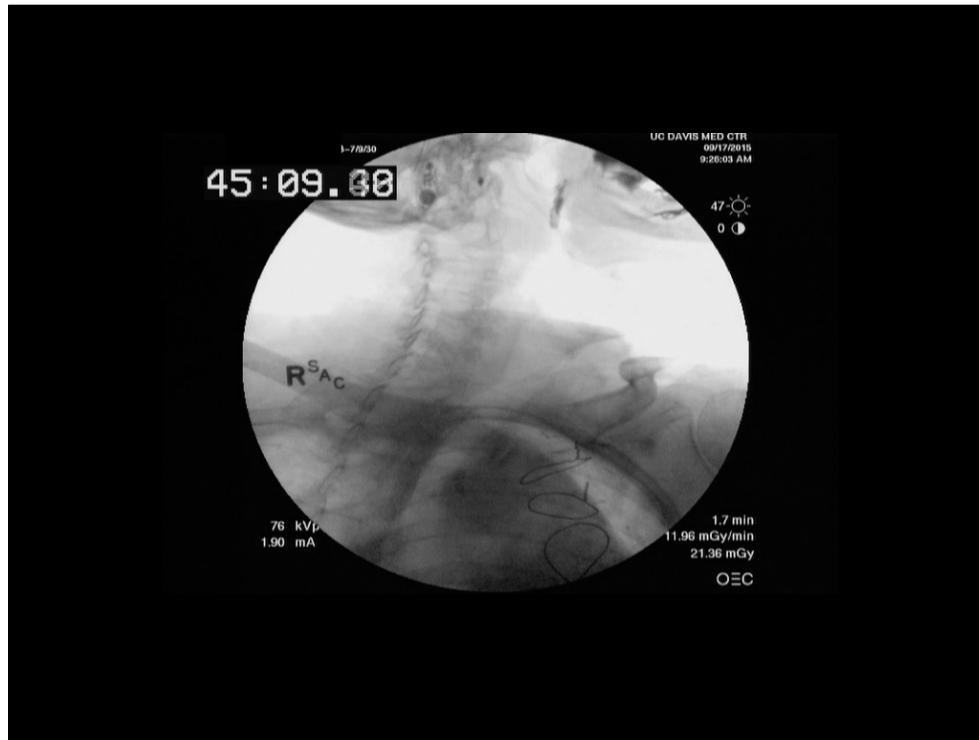
- Cook Medical
- Reflux Gourmet

Background

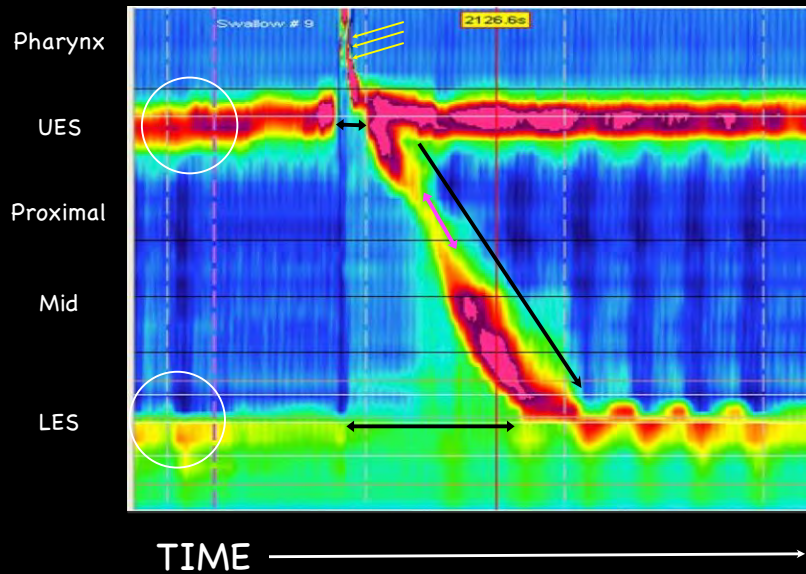
- Esophagus delivers bolus from OP - stomach
- Prevents / limits GER
- Highly integrated neuromuscular activity

Background

- Sequential, coordinated wave along entire esophagus propelling bolus
- Mechanical > Inflammatory > Dysmotility
- Must always R/O obstructive lesion



Color Pressure Topography Plots



Chicago Classification

- 1st version International HRM Working Group 2009 in SD
- 1st Updated version 2011 Ascona
- Version 3 published in 2015 Chicago (CC V3.0)
- Version 4 2021 Zoom
- “Dynamic , evolving classification”
- Is that a bug or a feature?

Chicago III

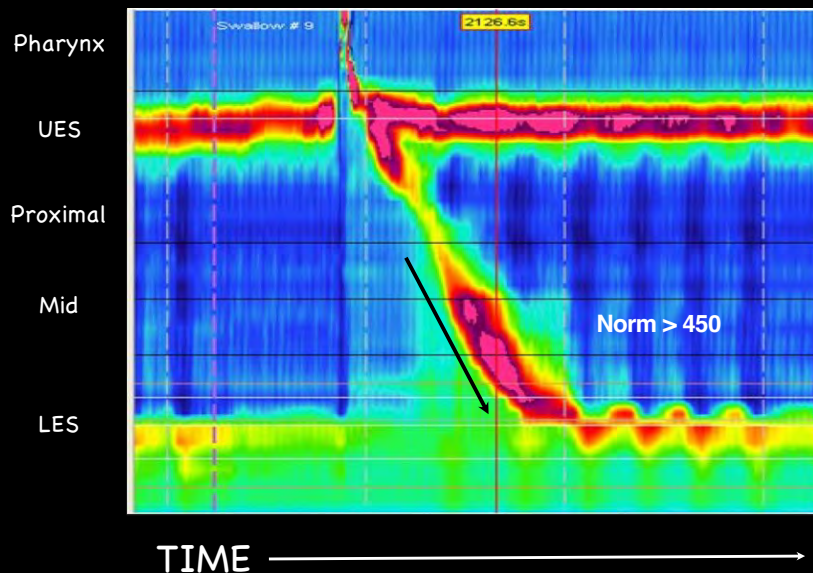
- Hierarchical Approach
 - Disorders of EGJ
 - Major disorders of peristalsis
 - Minor disorders of peristalsis

Chicago IV

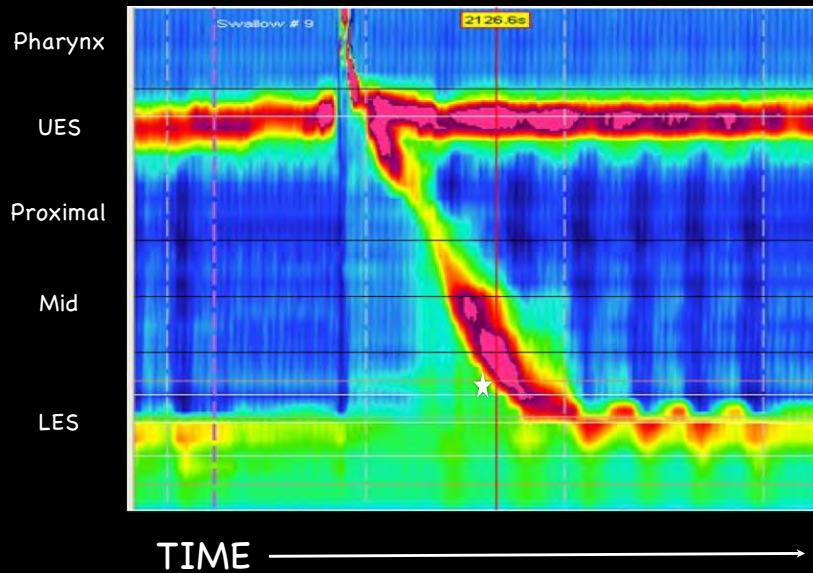
- Disorders of EGJ Outflow Obstruction - EGJOO
- Disorders of Peristalsis

Definitions

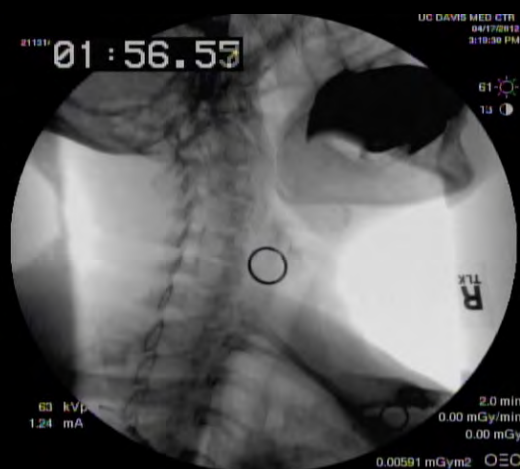
- Distal Contractile Integral - DCI
- Contractile Deceleration Point - CDP
- Distal Latency - DL
- Integrated Relaxation Pressure - IRP

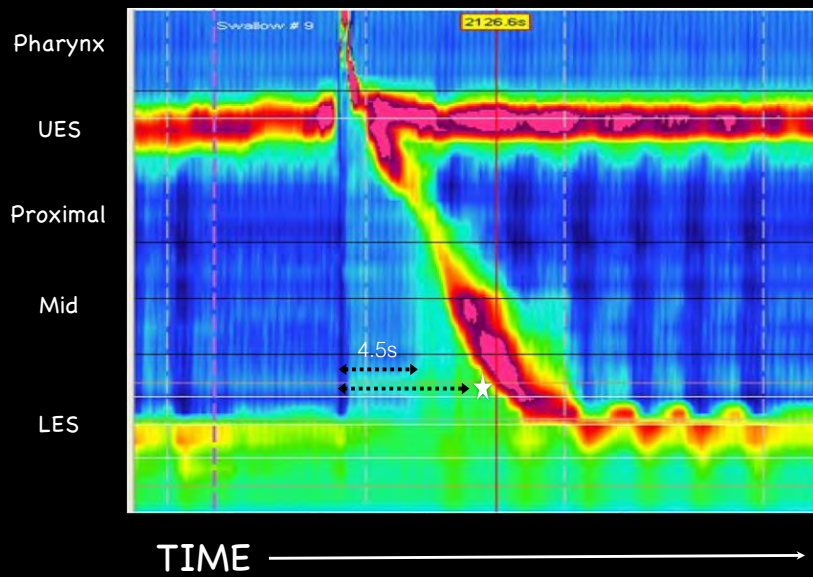


DCI - Amplitude X duration X length from TZ to proximal margin of LES
mmHg.s.cm

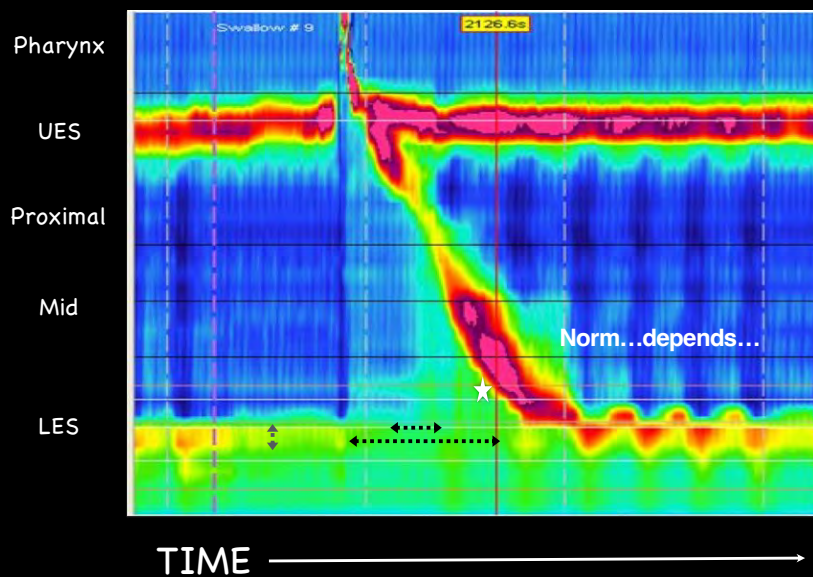


CDP - Inflection point along 30mmHg isobaric contour at which propagation velocity slows. Demarcates ampullary emptying.





DL - Interval between UES opening and CDP



IRP - Mean of 4s maximal LES relaxation in 10s window beginning at UES relaxation

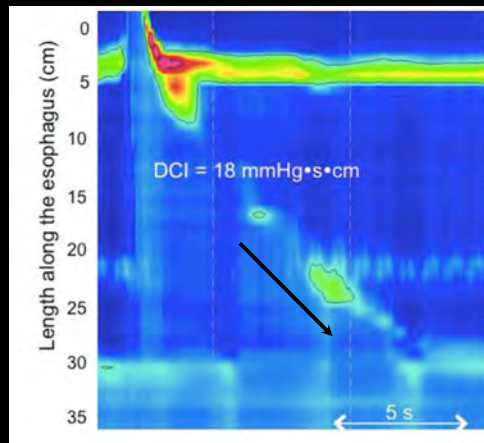
Median IRP

- Supine: Medtronic 15 mmhg / Laborie 22 mmhg
- Upright: Medtronic 12 mmhg / Laborie 15 mmhg



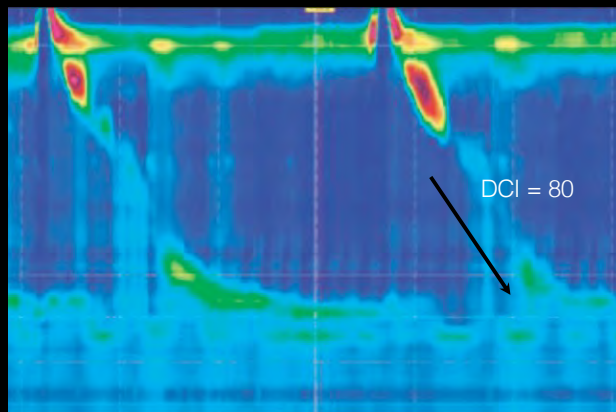
Contraction Patterns

Failed - DCI < 100mmHg



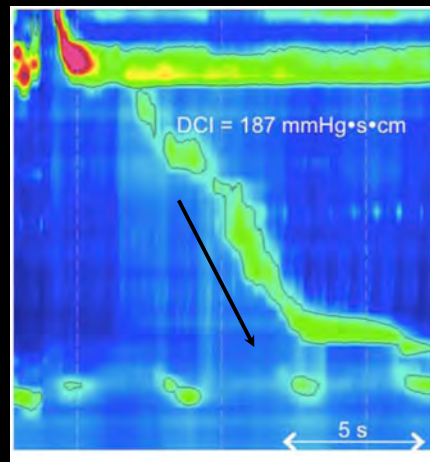
Contraction Pattern

Failed Contraction - DCI < 100mmHg



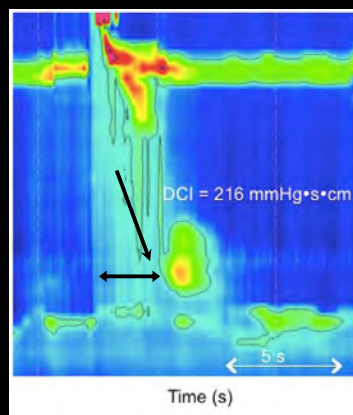
Contraction Pattern

Weak - DCI > 100 < 450mmHg



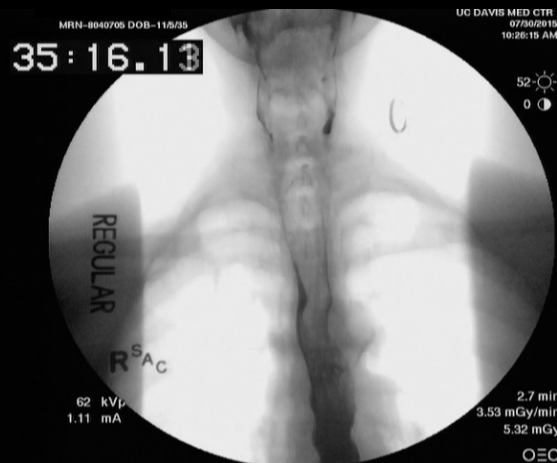
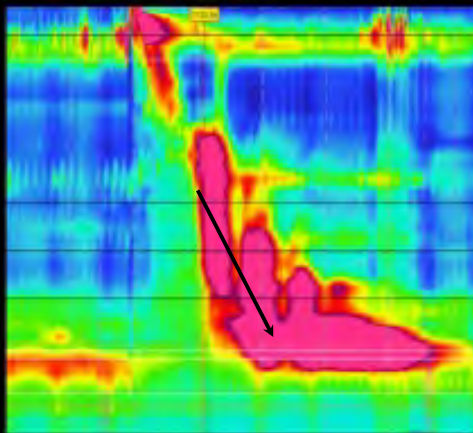
Contraction Pattern

Weak - DCI > 100 < 450mmHg



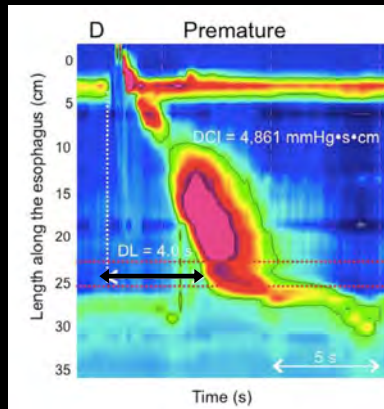
Contraction Pattern

Hypercontractile - DCI > 8,000mmHg



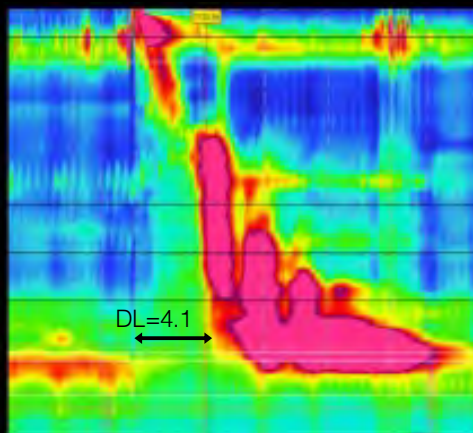
Contraction Pattern

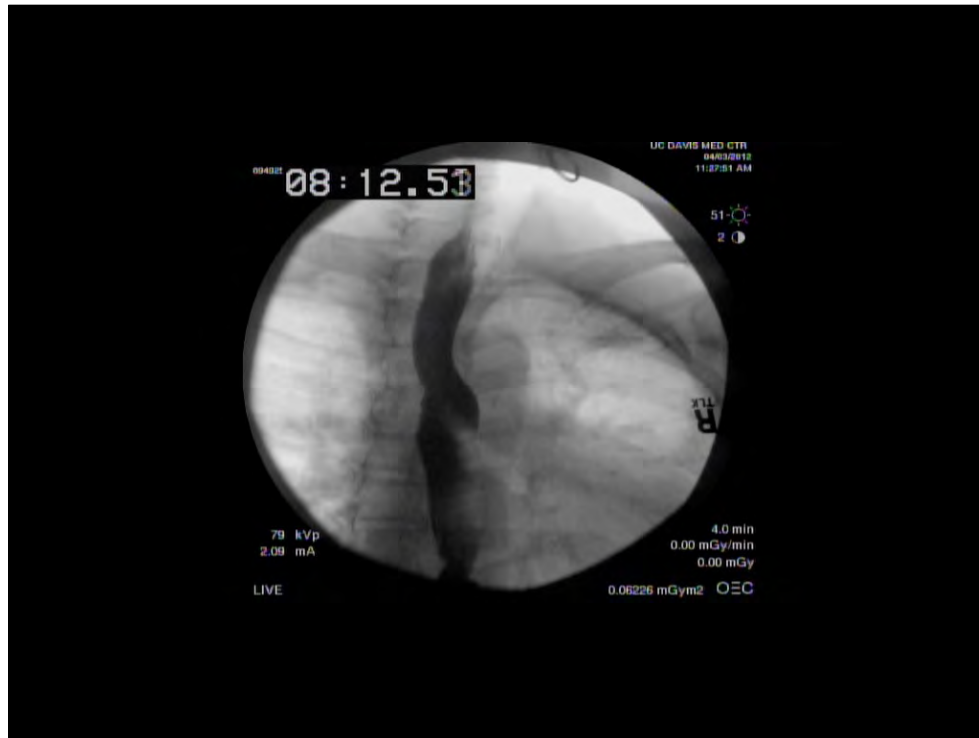
Premature Contraction - $DL < 4.5s$



Contraction Pattern

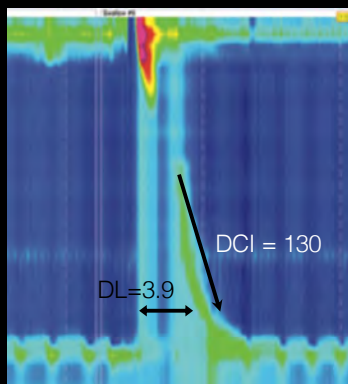
Premature Contraction - $DL < 4.5s$





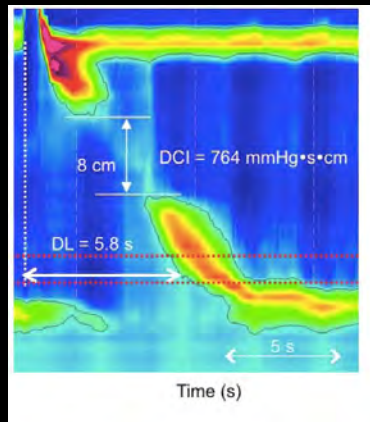
Contraction Pattern

Premature Contraction - $DL < 4.5s$



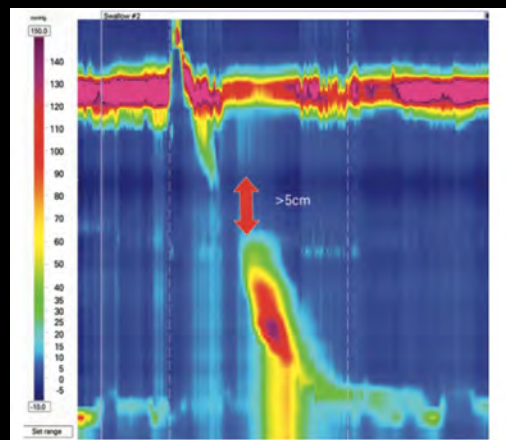
Contraction Patterns

Fragmented Contraction - Normal DCI and break > 5cm

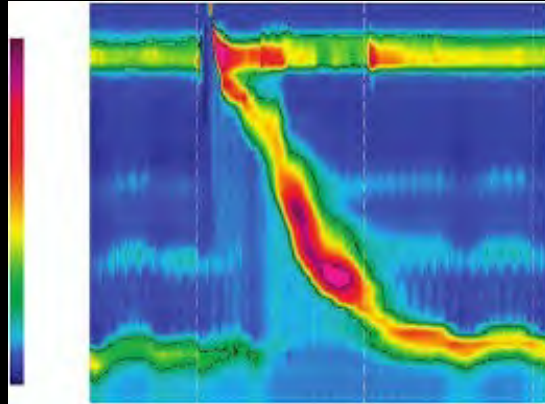


Contraction Patterns

Fragmented Contraction - Normal DCI and break > 5cm



Chicago IV Classification



Protocol

- Two Positions
- MRS: Multiple Rapid Swallow: 5 - 2ml swallows via syringe 2 – 3 secs apart
- RDC: Rapid Drink Challenge: 200 ml via straw

HIGH RESOLUTION ESOPHAGEAL MANOMETRY STANDARD PROTOCOL CHICAGO CLASSIFICATION VERSION 4.0®

STUDY PROCEDURE

Study begins in supine position [use supine normative values]

- ≥60 second adaptation period
- Document position with at least 3 deep inspirations
- ≥30 second baseline period
- 10 supine wet (5mL) swallows
- 1 multiple rapid swallow (MRS) sequence (MRS may be repeated up to 3 sequences if failed attempt or abnormal response)

Change position to upright [use upright normative values]

- ≥60 second adaptation period
- Document position with at least 3 deep inspirations
- ≥30 second baseline period
- ≥5 upright wet (5mL) swallows
- 1 rapid drink challenge

If no major motility disorder is found consider the following manometric evaluations

- For high probability of a missed EGI outflow obstruction: Solid test swallows, solid test meal, and/or pharmacologic provocation
- For suspected rumination/belching disorder: Post-prandial high-resolution impedance observation

If equivocal results are found and/or there is suspicion for an obstruction that does not fulfill criteria for achalasia, consider the following supportive tests

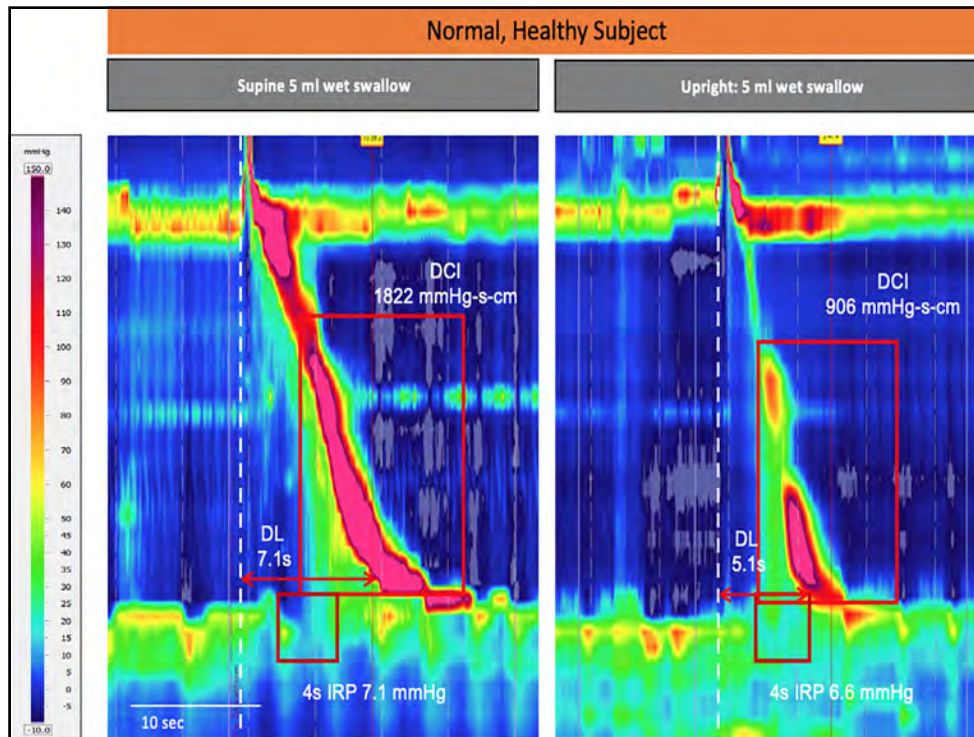
- Timed barium esophagram, preferably with tablet
- Endoluminal functional lumen imaging planimetry (FLIP)

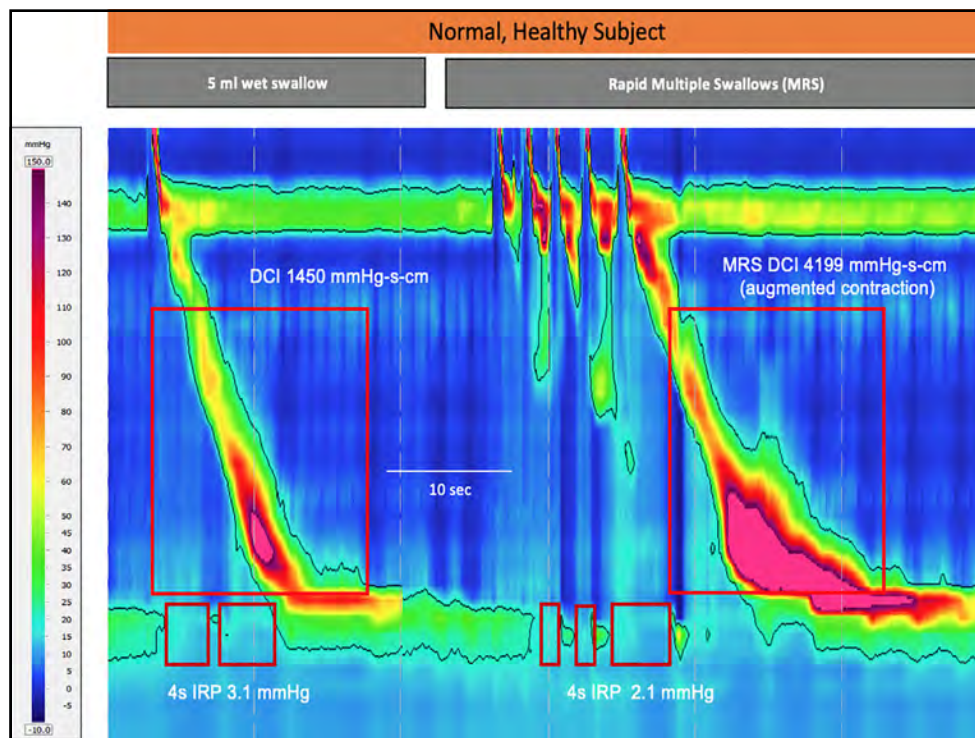
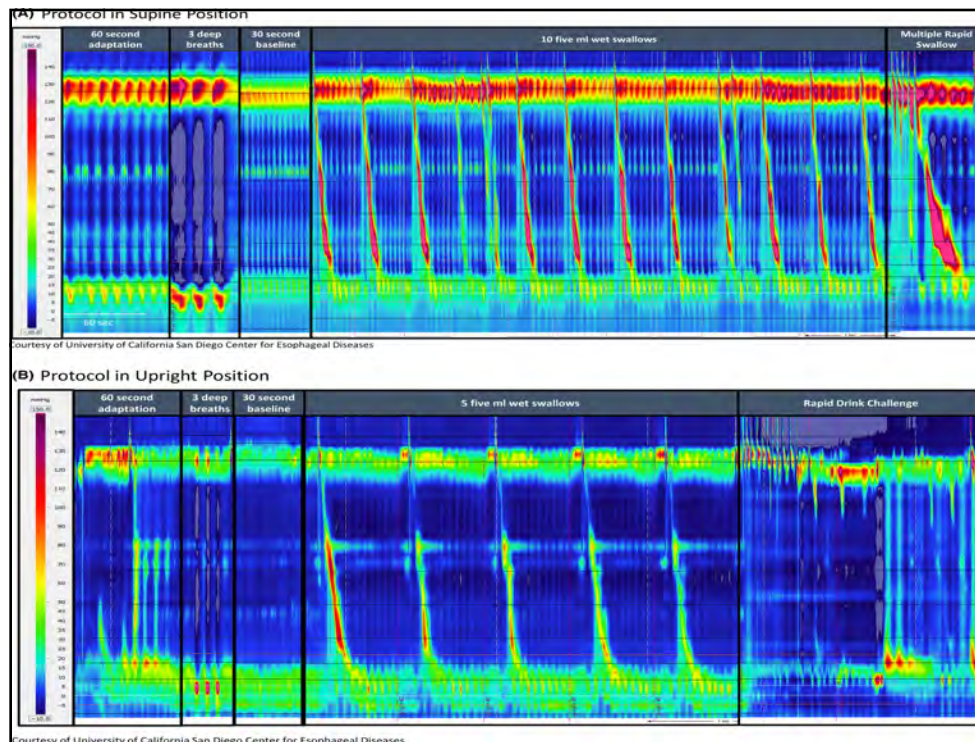
CONSIDERATIONS

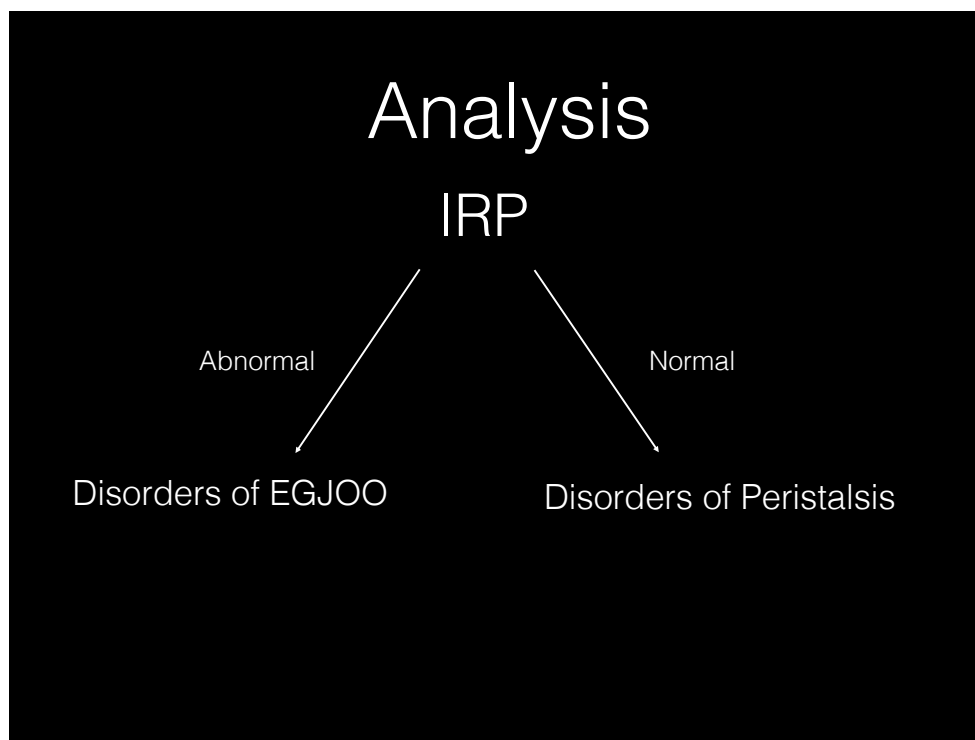
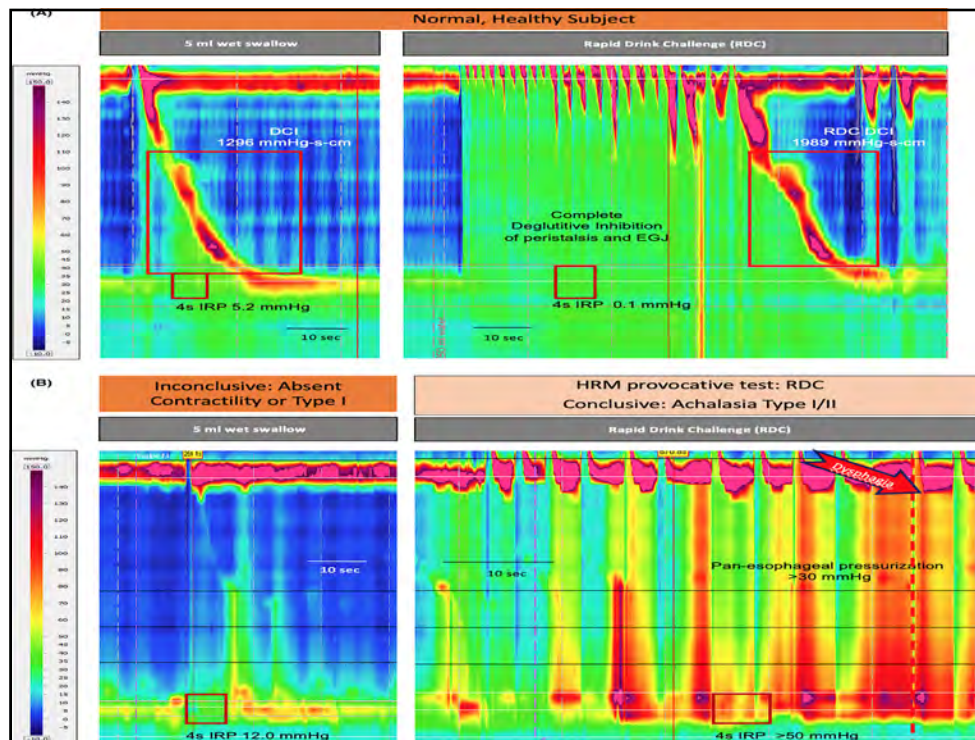
Prior to procedure patients should fast for at least 4 hours and informed consent should be obtained. The CCv4.0 Working Group recommends using a solid state high-resolution manometry catheter with less than 2cm sensor spacing with combined impedance sensors. However, the protocol and classification can be performed with water perfused catheters if appropriate normative values are used. Although the protocol designed by the CCv4.0 working group is considered to be the optimal protocol, clinicians can modify this protocol based on limited resources and time as long as normative values are applied and other positions and provocative tests are used appropriately. Physicians choosing to begin the study in the upright position should consider performing 10 upright swallows.

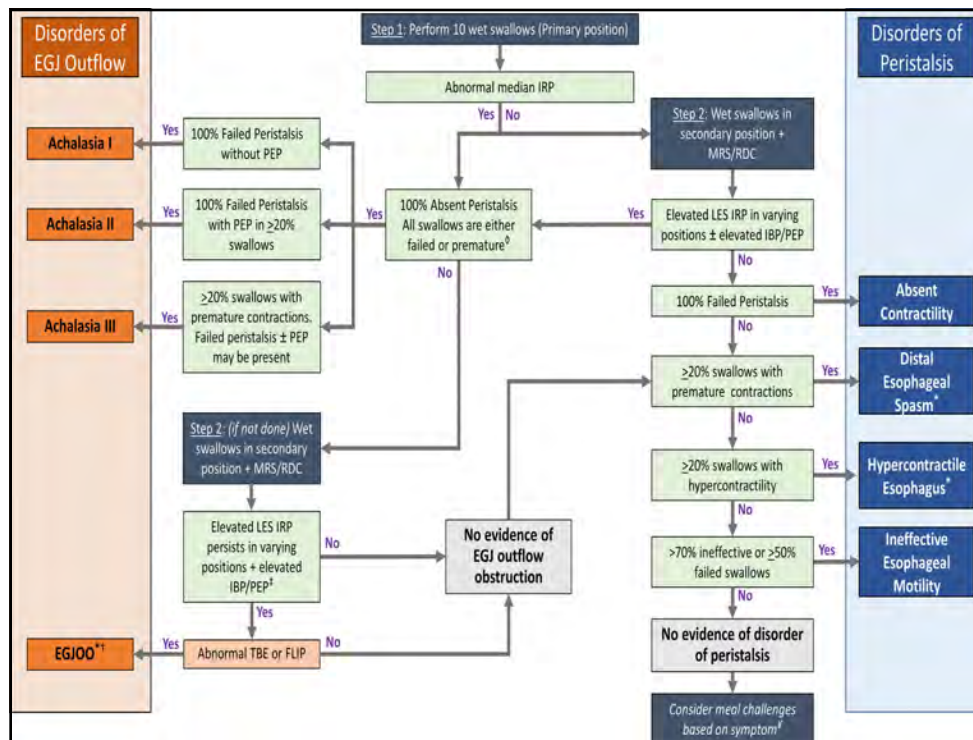
Classification is based on the primary position in which 10 wet swallows are performed, either supine or upright. Assessment of swallows in the secondary position and with provocation provide supportive data

In addition to Chicago Classification v3.0 metrics, final report should include baseline measures of the esophagogastric junction (EGJ) and symptoms experienced during the study and within 15 seconds of a motility dysfunction.









Achalasia

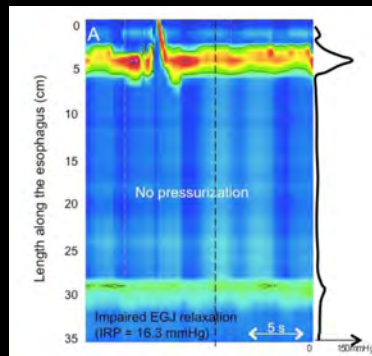
Elevated IRP
100% failed contractions

Achalasia I

Elevated IRP (>15)

100% failed contractions

No esophageal pressurization

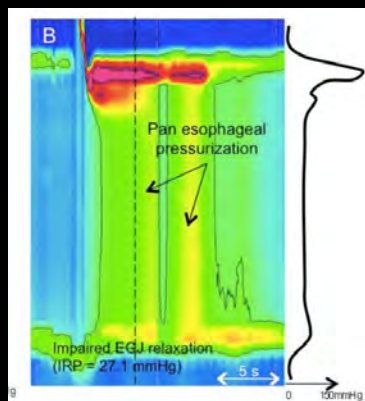


Achalasia II

Elevated IRP

100% failed contractions

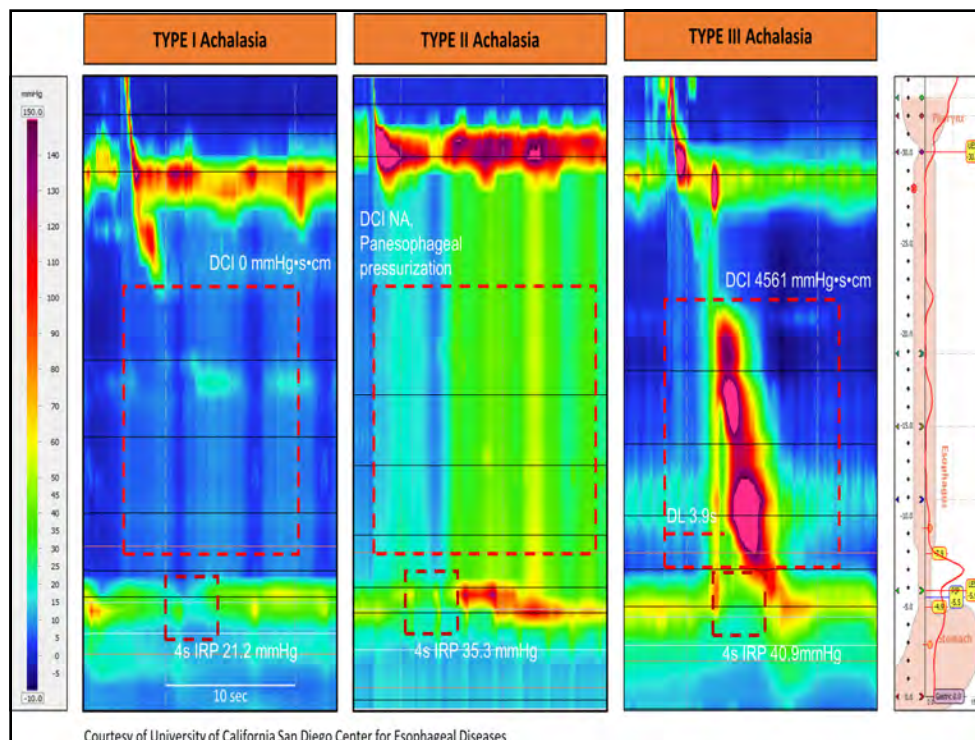
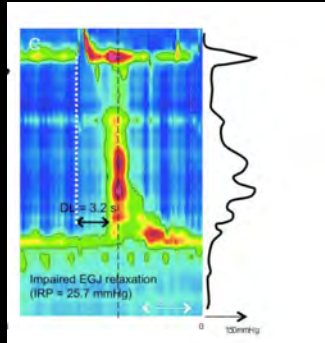
Pan-esophageal pressurization

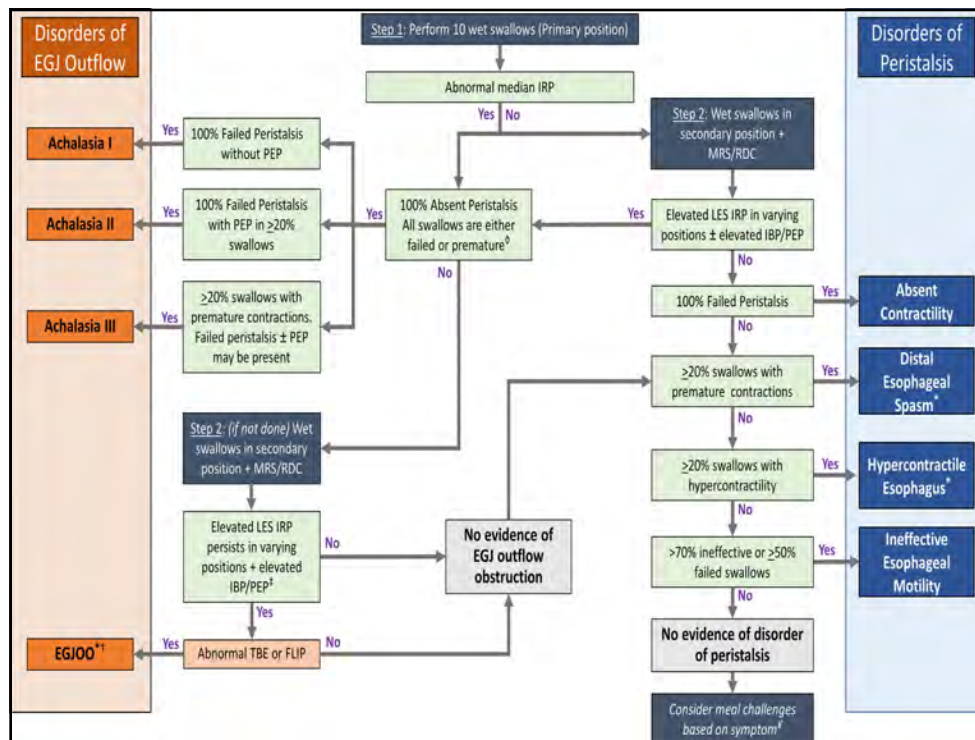


Achalasia III

Elevated IRP

Premature contractions >20% swallows

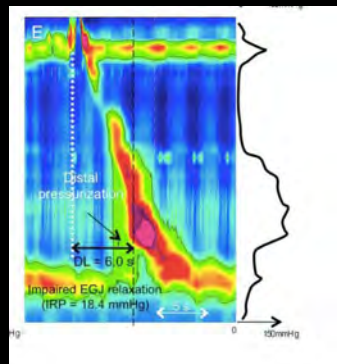




EGJ Outflow Obstruction

Elevated **median** IRP > 15mmHg

Intact or weak peristalsis



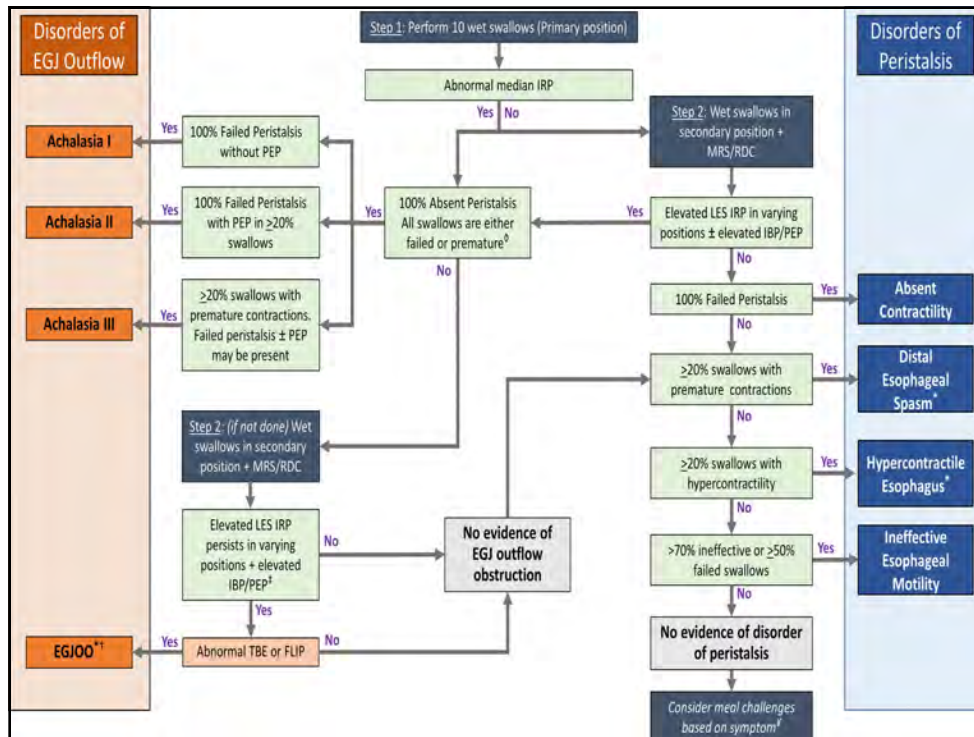
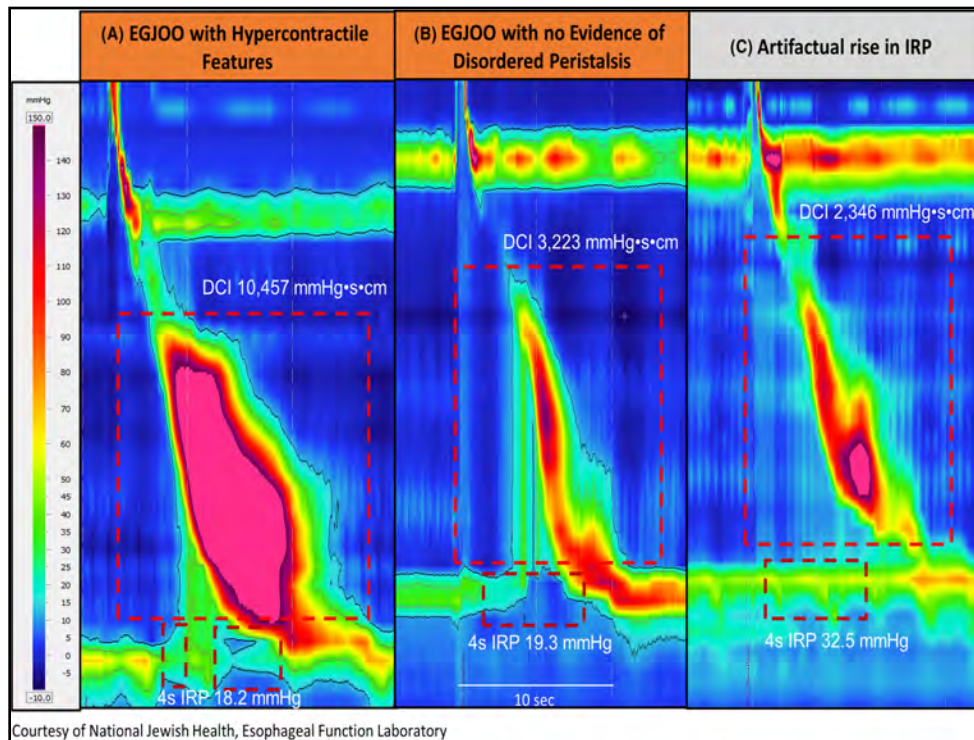
EGJOO

- Manometric DX always inconclusive
- Must have clinically relevant symptoms
- + Supportive investigations: Timed BaS, FLIP, Solid test meal, Pharmacologic provocation

EGJOO

Elevated **median** IRP > 15mmHg

- Intact or weak peristalsis
 - Early achalasia
 - Eso wall stiffness/infiltration -EUS
 - Vascular obstruction
 - HH
 - Post fundoplication
 - Stricture / EoE



Disorders of Peristalsis

- Absent contractility
- Distal Esophageal Spasm - DES
- Hypercontractile esophagus
- Ineffective Esophageal Motility - IEM

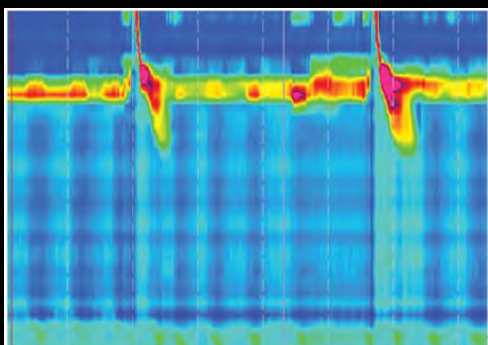
Absent Contractility

- IRP normal upright and supine
- 100 % failed peristalsis (DCI < 100)
- Beware achalasia if IRP borderline

SCLERODERMA

IRP NORMAL

DCI < 100

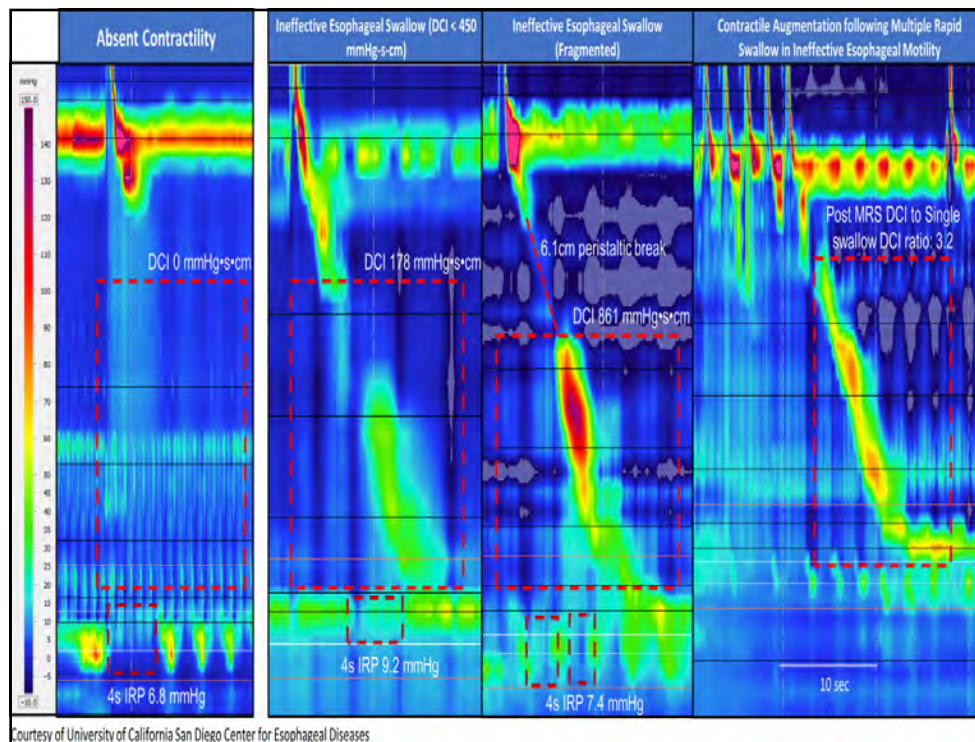


SCLERODERMA

IRP NORMAL

DCI < 100





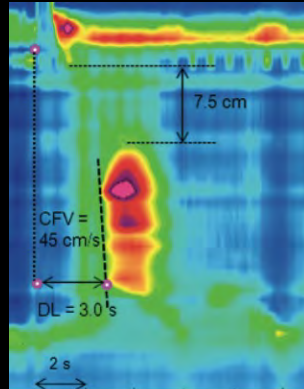
DES

- > 20 % DL < 4.5
- Must have clinical symptoms
- Must treat GERD
- Beware Type III achalasia

DES

IRP NORMAL

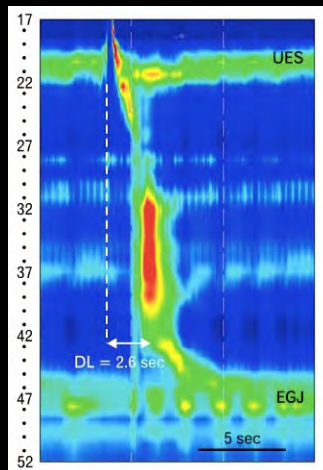
>20% premature contractions



DES

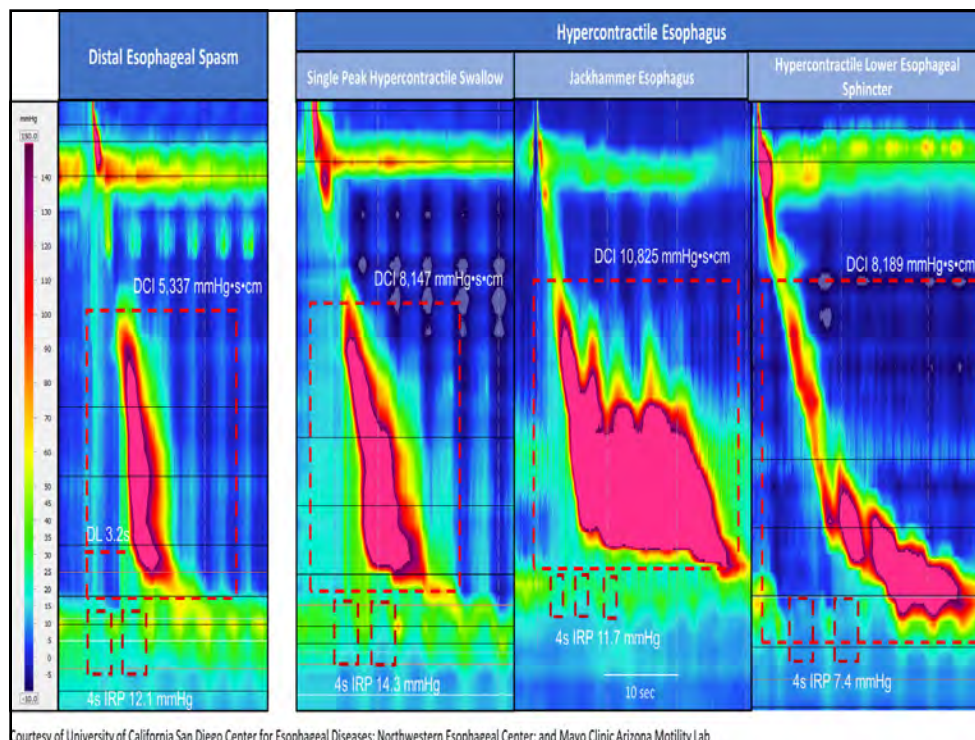
IRP NORMAL

>20% premature contractions



Hypercontractile Esophagus

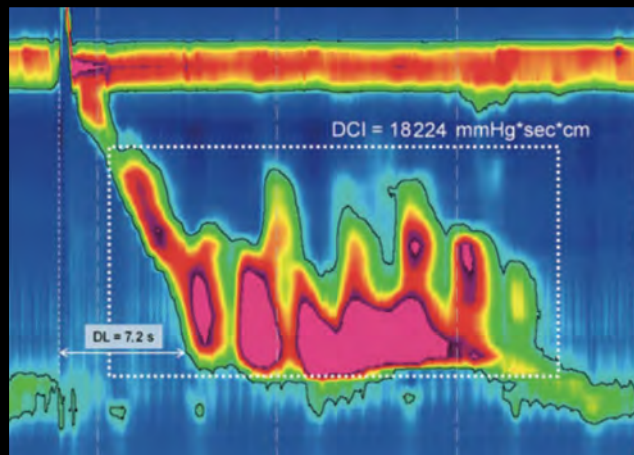
- $> 20\%$ DCI > 8000
- Must have clinical symptoms
- 3 subtypes: Single peak, Jackhammer and LES after-contraction



Jackhammer

IRP NORMAL

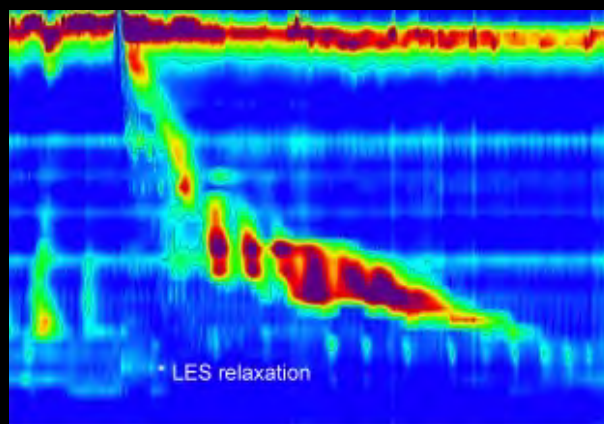
DCI > 8000



Jackhammer

IRP NORMAL

DCI > 8000



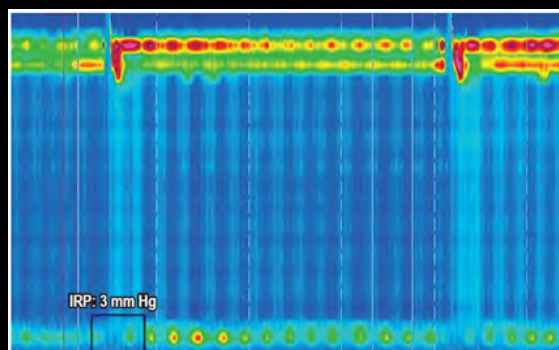
IEM

- Ineffective swallow now includes:
 - 1) weak contractions (DCI 100 – 450)
 - 2) failed peristalsis (DCI < 100)
 - 3) fragmented swallow (break > 5cm)
- Greater than 70 % ineffective swallows
OR at least 50 % failed swallows

IEM

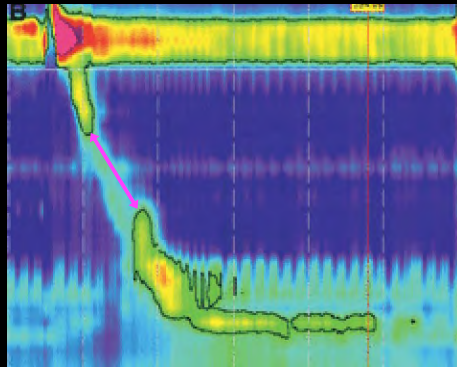
IRP NORMAL

DCI < 450mmHg in $\geq 50\%$ swallows



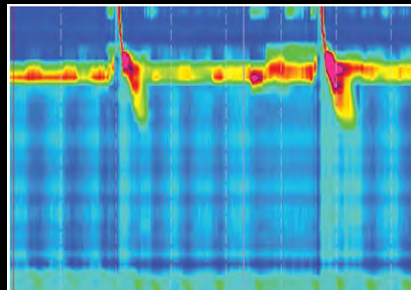
FRAGMENTED PERISTALSIS

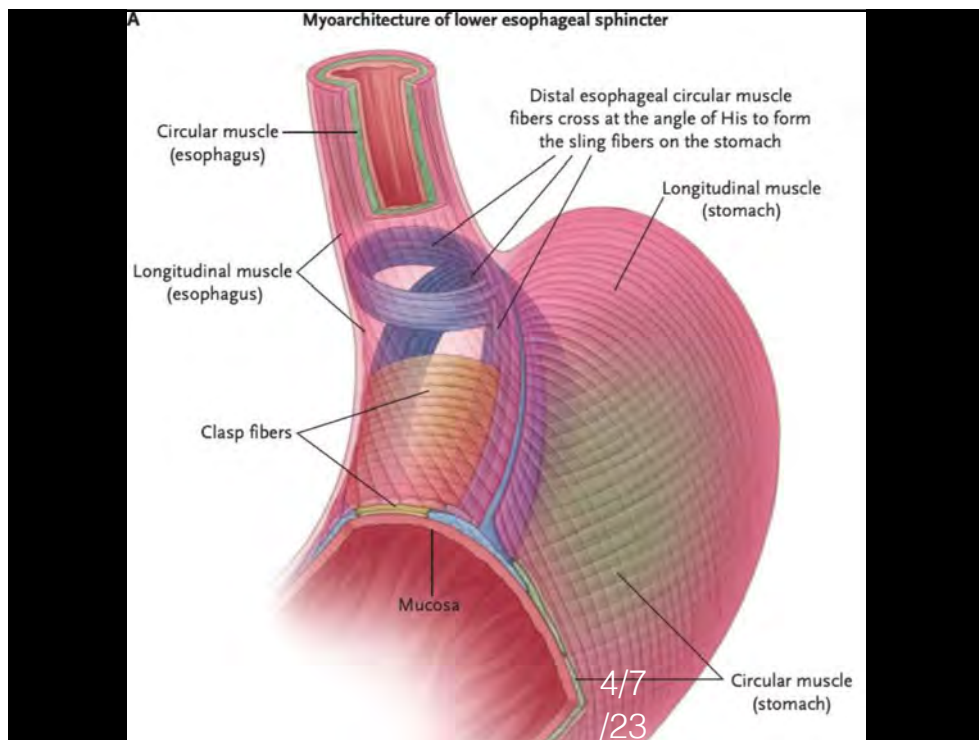
>5cm break



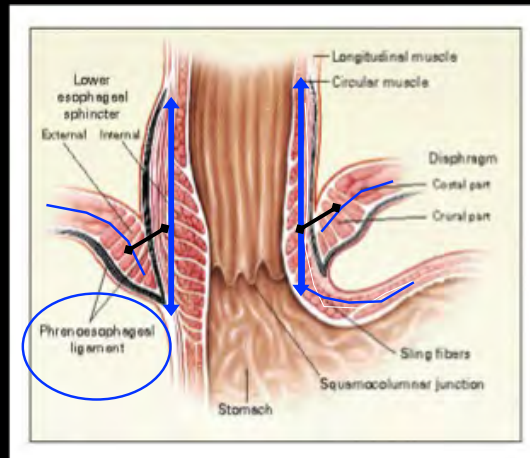
IEM

IRP NORMAL

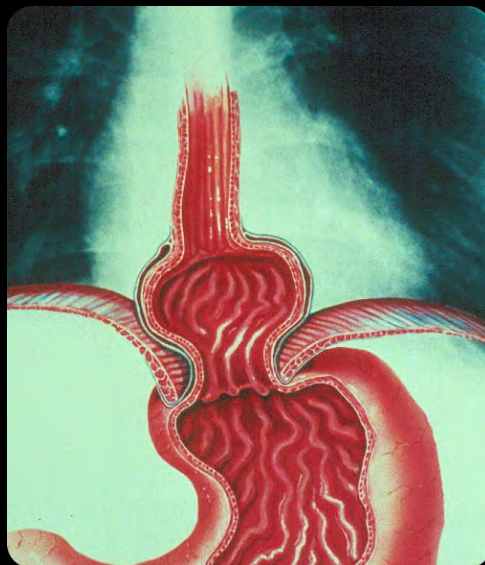


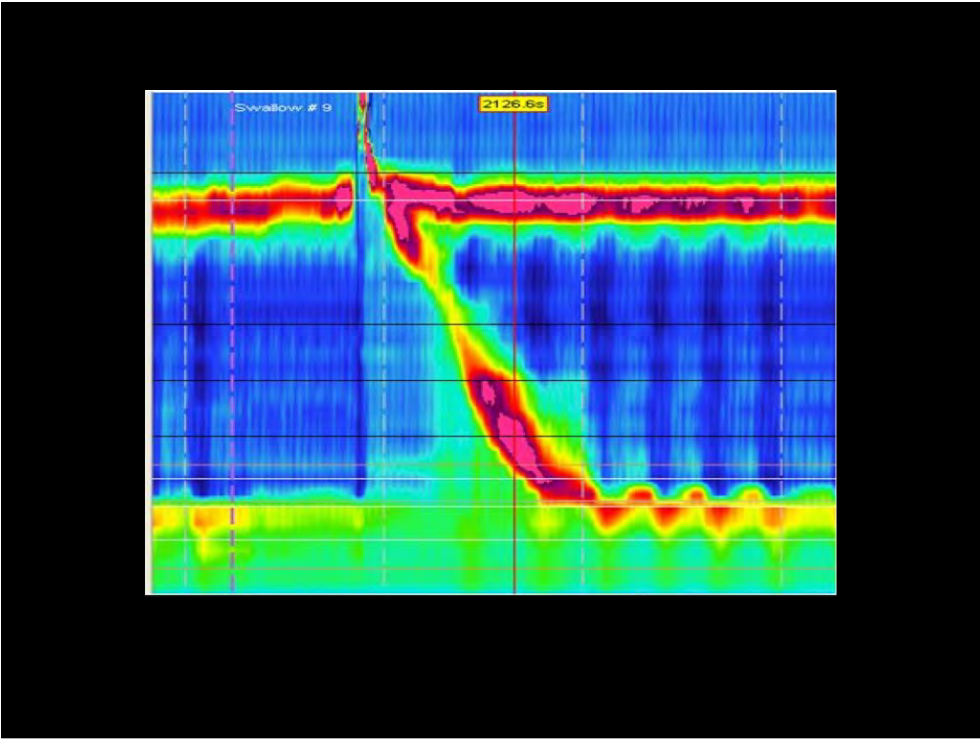
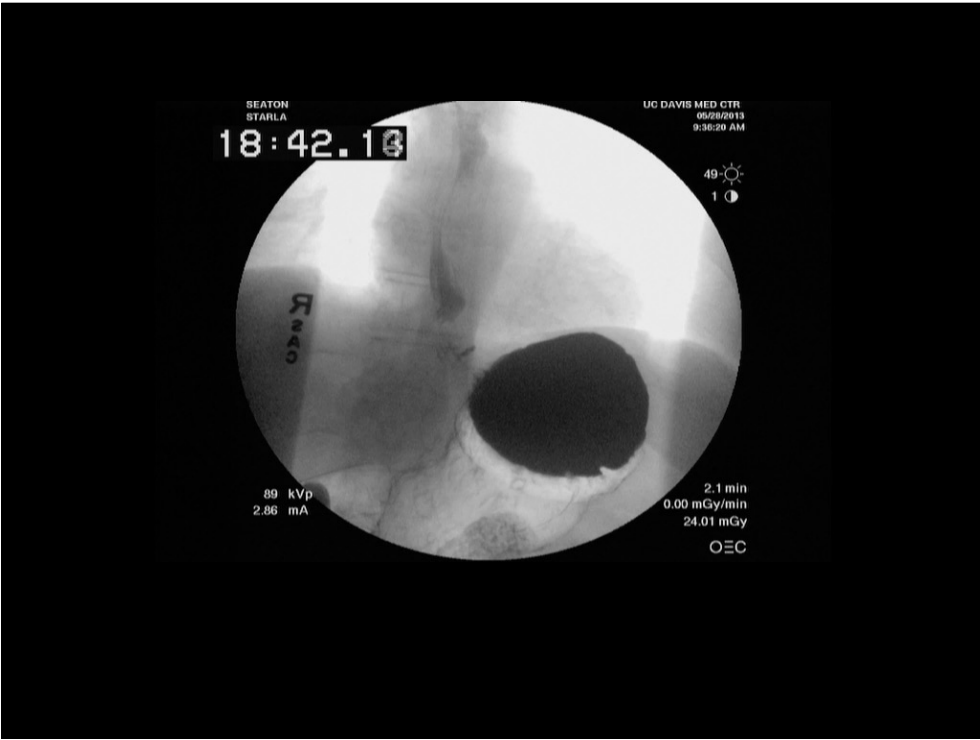


Biomechanics of EGJ and Reflux



Type I Hiatal Hernia

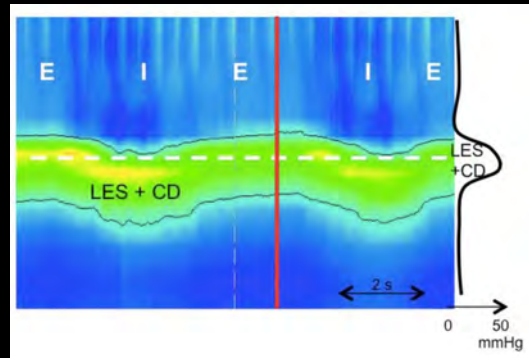




EGJ Subtypes

Based On LES and CD

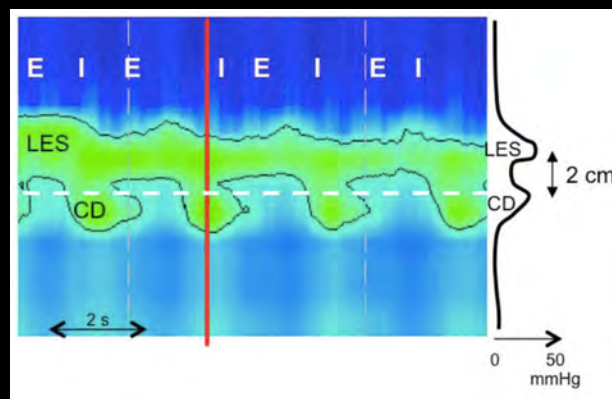
Type I - LES & CD superimposed on each other

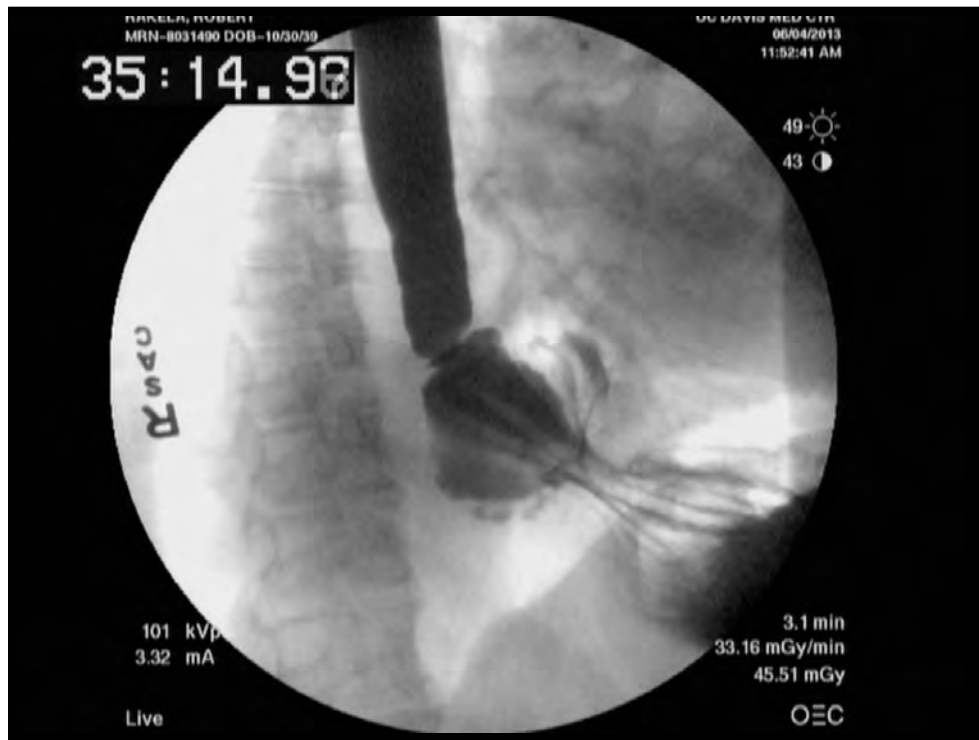


EGJ Subtypes

Based On LES and CD

Type II - LES & CD are separate but within 2cm

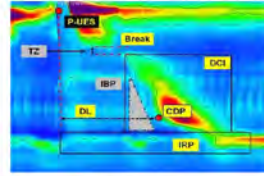




Fact sheet Chicago Classification 4.0

Patient group	
• Adults	
• Primary esophageal motility disorder	

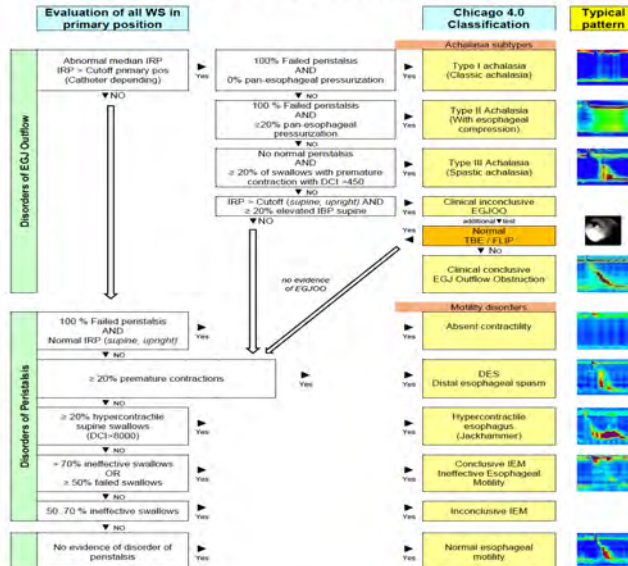
Terminology	
WS	Wet Swallow, 5 mL
MRS	Multiple Rapid Swallow, 5x2mL
RDC	Rapid Drink Challenge, 200mL
DeepB	Deep Breath
IRP4	Integrated relaxation pressure 4s
DCI	Distal Contractile Integral
CDP	Contractile Deceleration Point
DL	Distal Latency
Break	Peristaltic break size
IBP	Intra Bolus Pressure
TZ	Transition Zone
TBE	Timed barium esophagram
FLIP	Functional lumen imaging probe



Study procedure			
ACI	Adaptation 3 DeepB, check catheter pos	Baseline	10 WS MRS
Y	Adaptation 3 DeepB, check catheter pos	Baseline	5 WS RDC

Scoring of the individual swallows	
IRP4 cutoff (95th percentile)	
Criteria	Scoring
≤ 22 mmHg (supine)	Unisensor, solid state
≤ 15 mmHg (upright)	Unisensor, solid state
≤ 19 mmHg (supine)	Water catheter
Median IRP cutoff is catheter and position dependent	
Contraction Vigor (DCI at 20 mmHg)	
Criteria (mmHg·s·cm)	Scoring
DCI < 100	Failed peristalsis
DCI 100 – 450	Weak peristalsis
DCI 450 – 8000	Normal peristalsis
DCI ≥ 8000	Hypercontractile
IBP Intra Bolus Pressure Pattern (at 30 mmHg isobaric contour)	
Criteria	Scoring
Uniform pressurization of ≥ 30 mmHg extending from the UES to the EGJ (DCI cannot be calculated)	Pan-esophageal pressurization
Pressurization of ≥ 30 mmHg in advance of the contractile front to the EGJ	Compartmentalized esophageal pressurization
No bolus pressurization ≥ 30 mmHg	Normal
Scoring of the provocation tests	
MRS: 5x 2 mL, supine	Intact response (intense)
During MRS:	
• Absence DCI < 100	
• Complete relaxation LES	
Post MRS:	
• post DCI > mean DCI 10 ws	
RDC: 200 mL, upright	Intact response (intense)
During RDC:	
• DCI < 100	
• Complete relaxation LES	
Post RDC:	
• no major motility disorders	

Fact sheet Chicago Classification 4.0



History:

- 1997 Clouse Contour plot by Ray Clouse and MMS
- 2009 Chicago Classification 1
- 2012 Chicago Classification 2
- 2015 Chicago Classification 3.0
- 2020 Chicago Classification 4.0

References:

- The Chicago Classification, Neurogastroenterology & Motility 2012; 24, Suppl. 1, 1-65
- The Chicago Classification of esophageal motility disorders, v1.0, Neurogastroenterology & Motility 2012; 24, 157-174
- The Chicago Classification 4.0, Neurogastroenterology & Motility 2020; 32, e14056, 1-21

FACT sheet designed by:

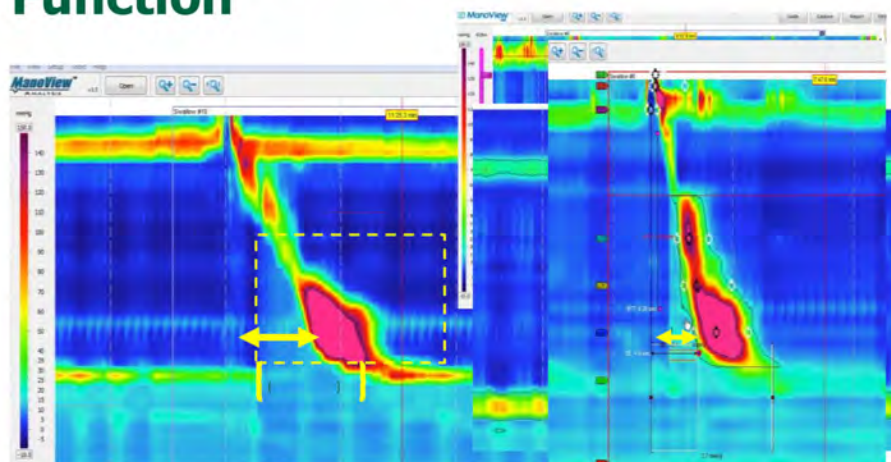
TAE department, LMU, JUV

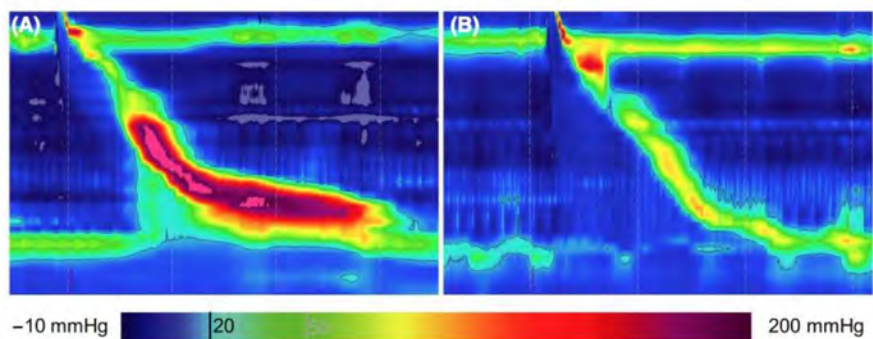
Special thanks to:

A.J. Bredermoort (Amsterdam UMC)

CASES

Opiate Effects on Esophageal Function

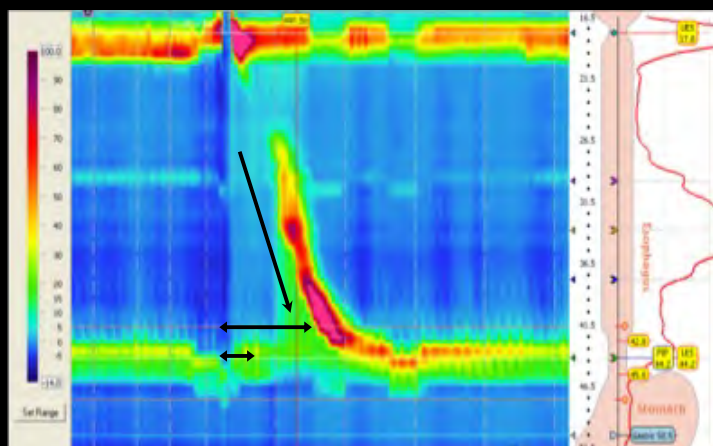




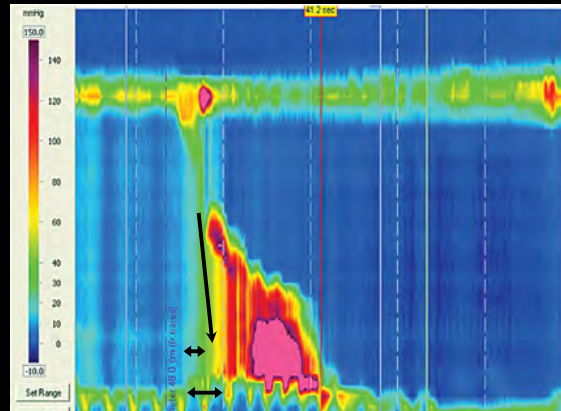
4-year time lapse after discontinuation of opioids

4/7
/23

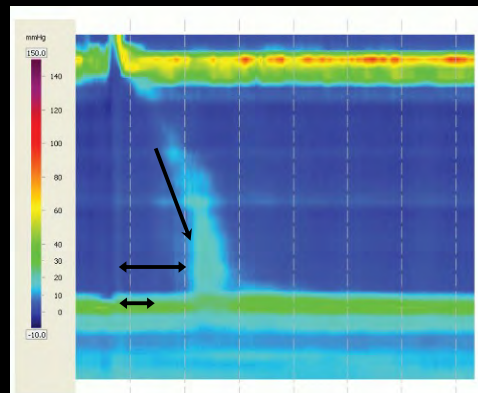
DCI = 1675
DL = 5.4
IRP = 16



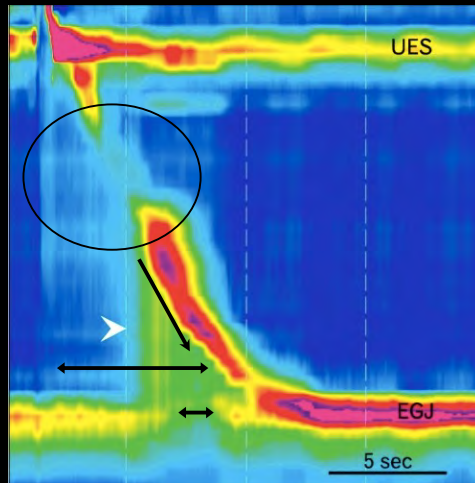
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DL = 2.5
IRP = 5.6



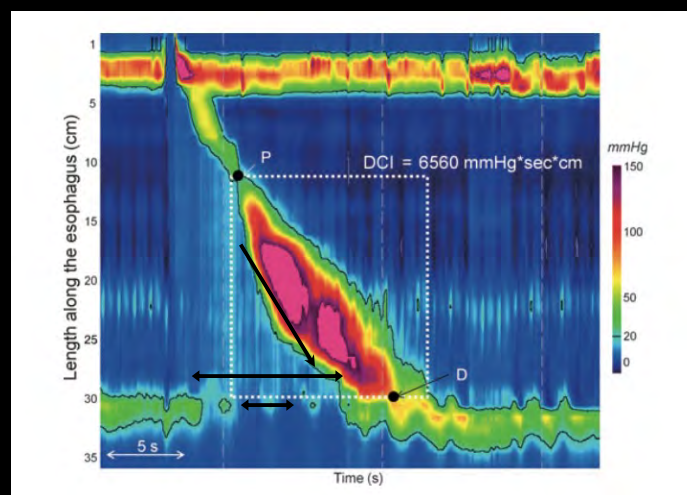
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DL = 5.1
IRP = 16



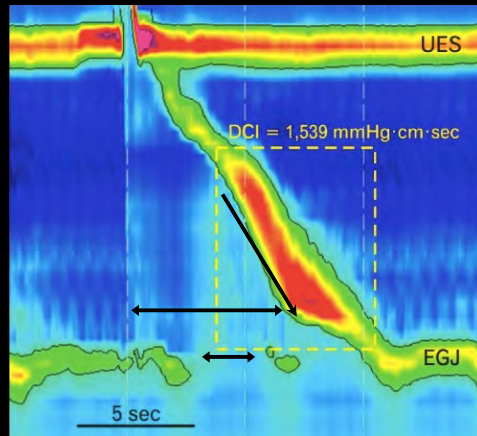
DCI = 2890
DL = 6.2
IRP = 13.7



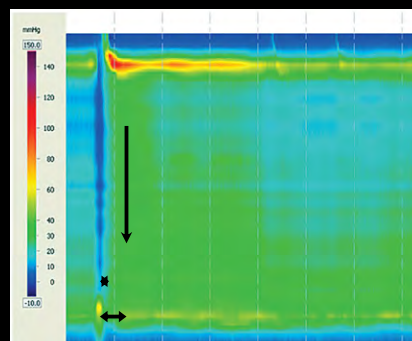
DCI = 6560
DL = 6.0
IRP = 2.0



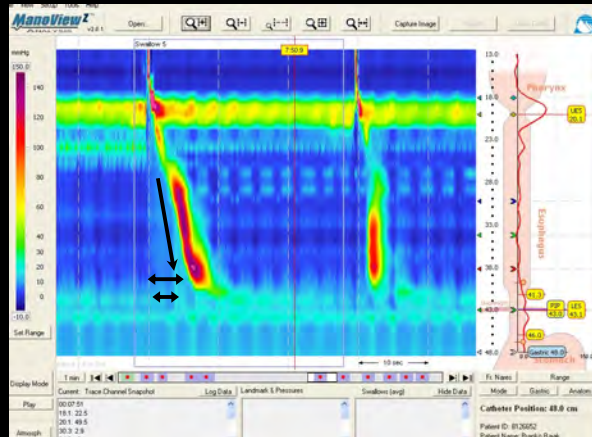
DCI = 1539
DL = 6.3
IRP = 3.5



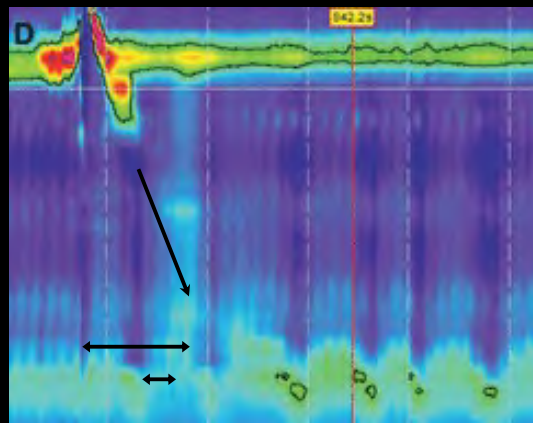
DCI = 28
DL = 0.3
IRP = 20

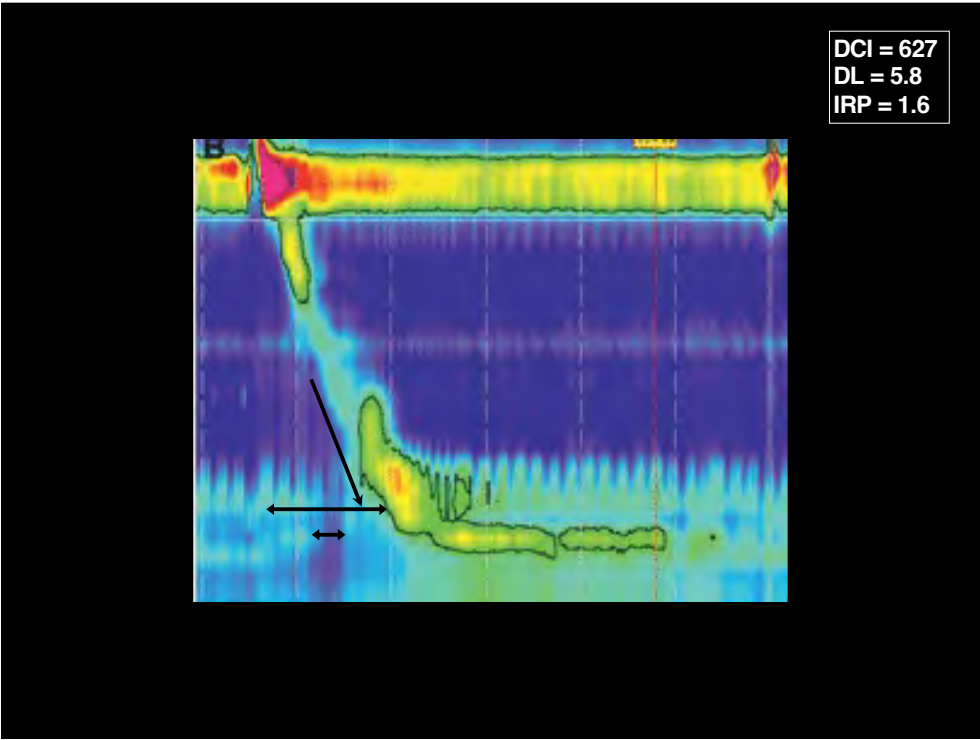


DCI = 2895
DL = 4.9
IRP = 2.6



DCI = 22
DL = 4.9
IRP = 2.6





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