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The Role of the Timed Barium Esophagram in the Assessment of Dysphagia

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Historical Perspectives of the Timed Barium Esophagram

- Prior tests using barium emptying within 24 hr of pneumatic dilation-Cohen test

- Idea originated with Bob Koehler at UAB to identify a better objective test to assess symptom improvement and esophageal emptying—at time just following symptoms

- Originally considered a nuclear medicine emptying test—Larry Johnson oatmeal test

- In real life, barium is easier and more similar to liquid retention in achalasia

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Timed Barium Swallow: A Simple Technique for Evaluating Esophageal Emptying in Patients with Achalasia

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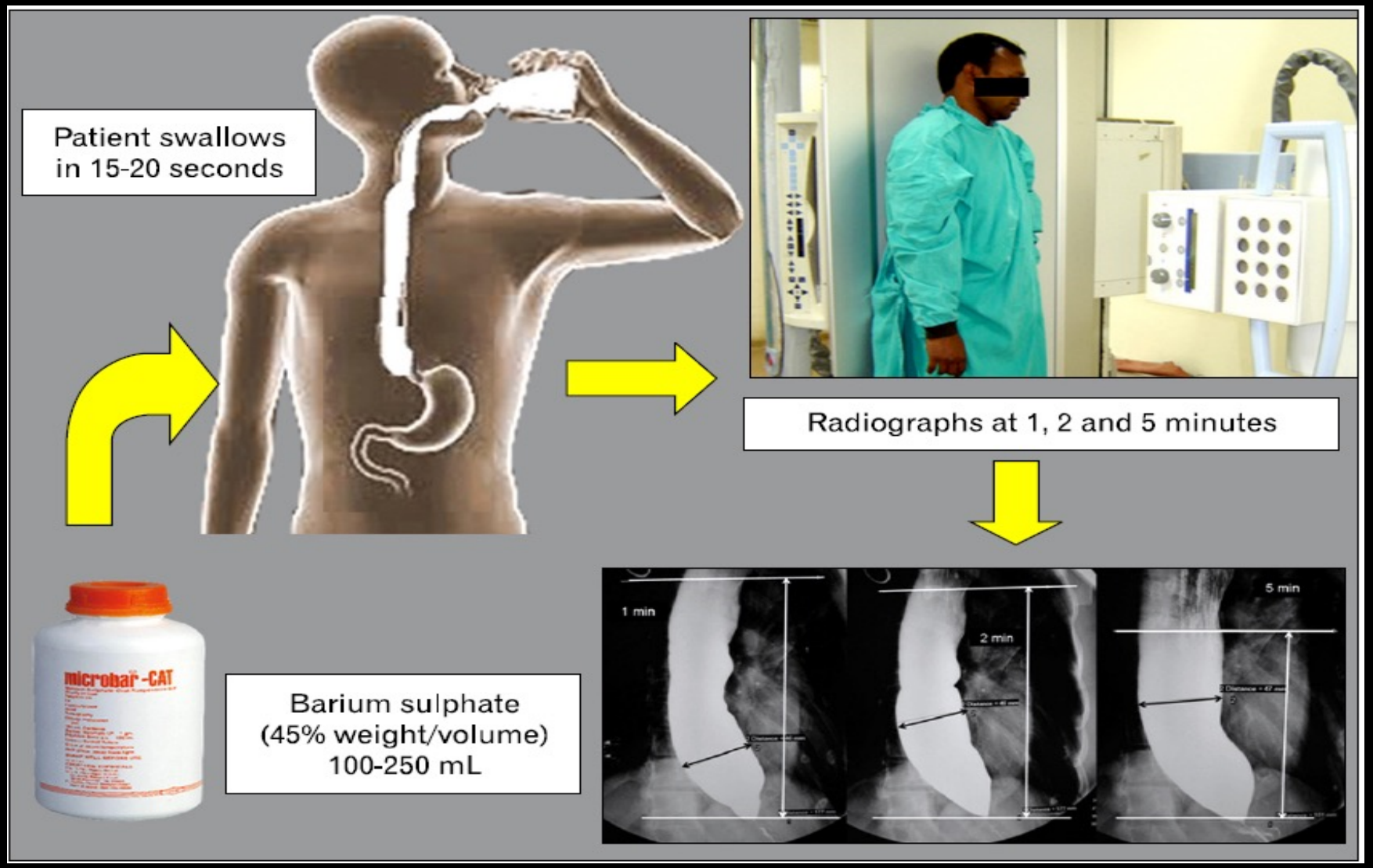
OBJECTIVE. Our purpose was to define a simple technique for timing a barium swallow by which radiologists can assess esophageal emptying in patients with achalasia before and after minimally invasive therapy. Our purpose was also to determine the best method of quantifying the degree of emptying using this timed technique.

MATERIALS AND METHODS. In the barium swallow technique, upright frontal spot films of the esophagus are obtained at 1, 2, and 5 min after ingestion of 100–200 ml of low-density (45% weight in volume) barium sulfate (volume of barium determined by patient tolerance). Forty-two of these barium swallows done by 23 patients with achalasia were retrospectively reviewed. The examination served either as a baseline study or as a 1-month follow-up study after patients had undergone pneumatic dilatation or *Clostridium botulinum* toxin injection. The spot films were digitized, and a region of interest was drawn around the column of barium by two observers. The change in area seen in the region of interest on the 1- and 5-min films served as the gold standard for percentage of emptying. The spot films were then analyzed by four other observers, each of whom independently, subjectively, and qualitatively estimated the percentage of emptying between the 1- and 5-min spot films. Percentages were divided into quintiles. On a separate occasion, each of these four observers also independently measured the height and width of the barium column on the 1- and 5-min spot films. The product of height times width seen on the 1- and 5-min films became the quantitative estimate for percentage of emptying.

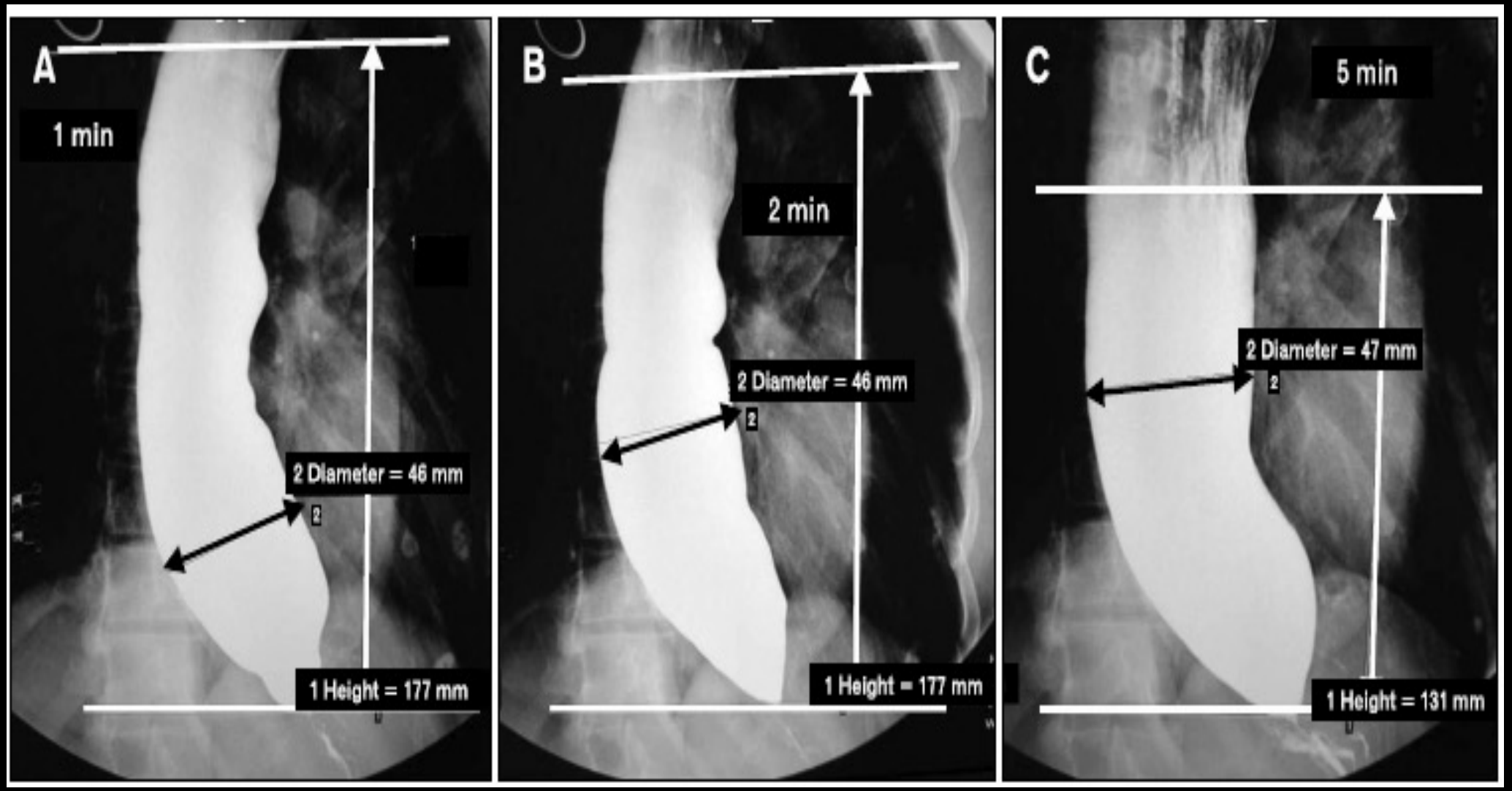
American Journal of Radiology 1997;169:473-479

Technique of Timed Barium Esophagram

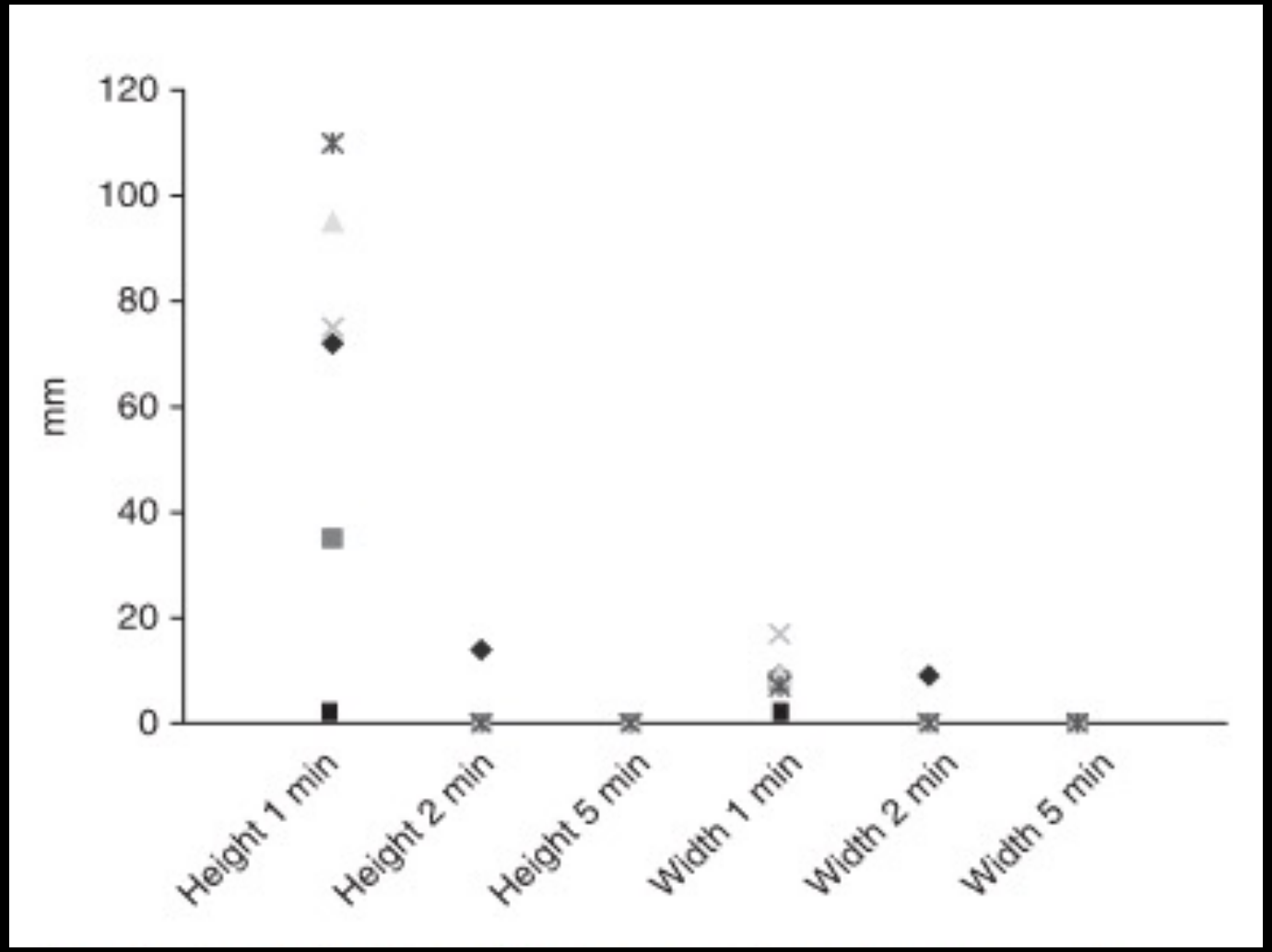


Neyaz Z et al J Neurgoastroenterol Motil 2013

How to Analyze—Height, Width, Cross-Sectional Area or Percent Emptying?

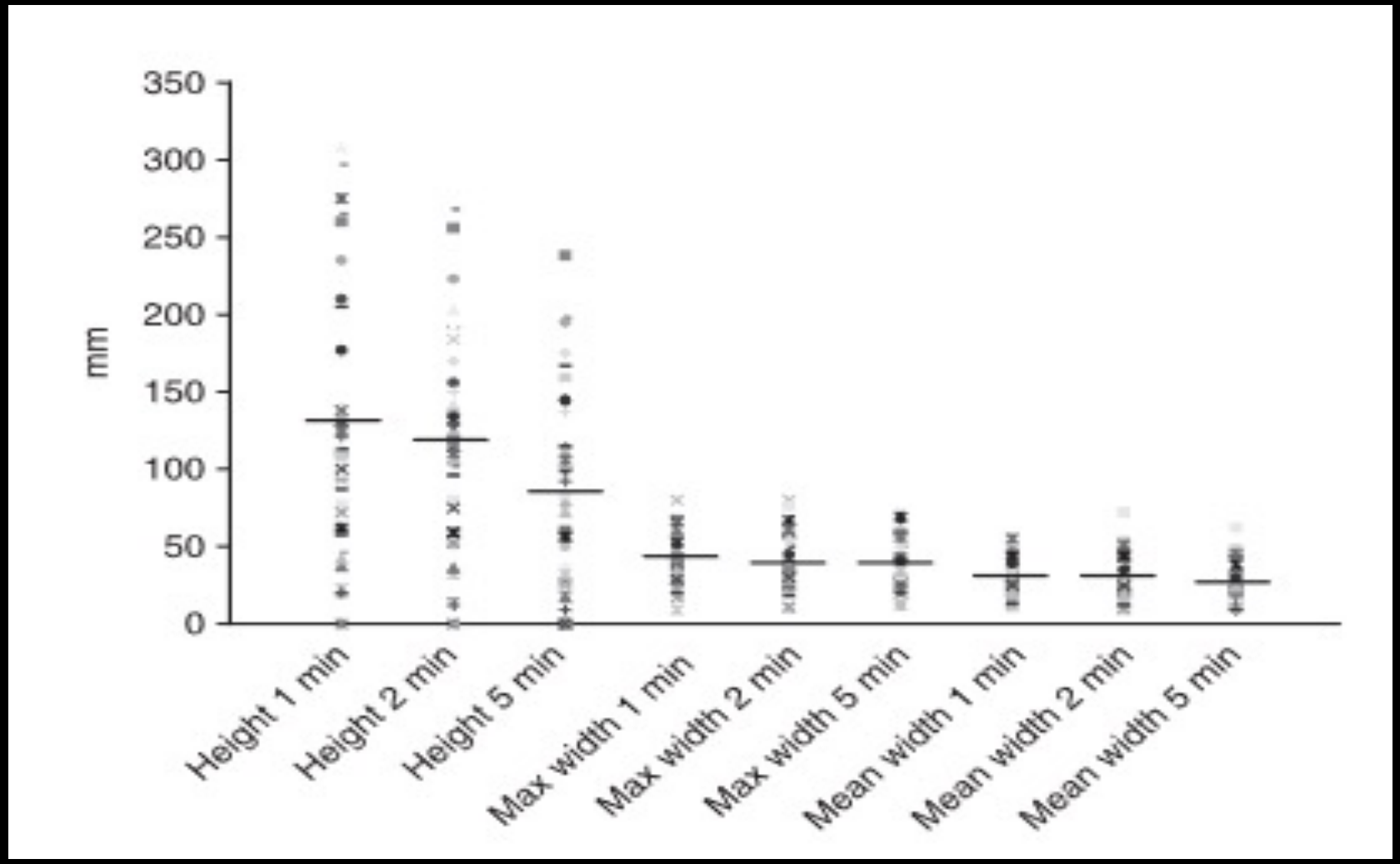


Individual TBE Parameters in 14 Healthy Volunteers



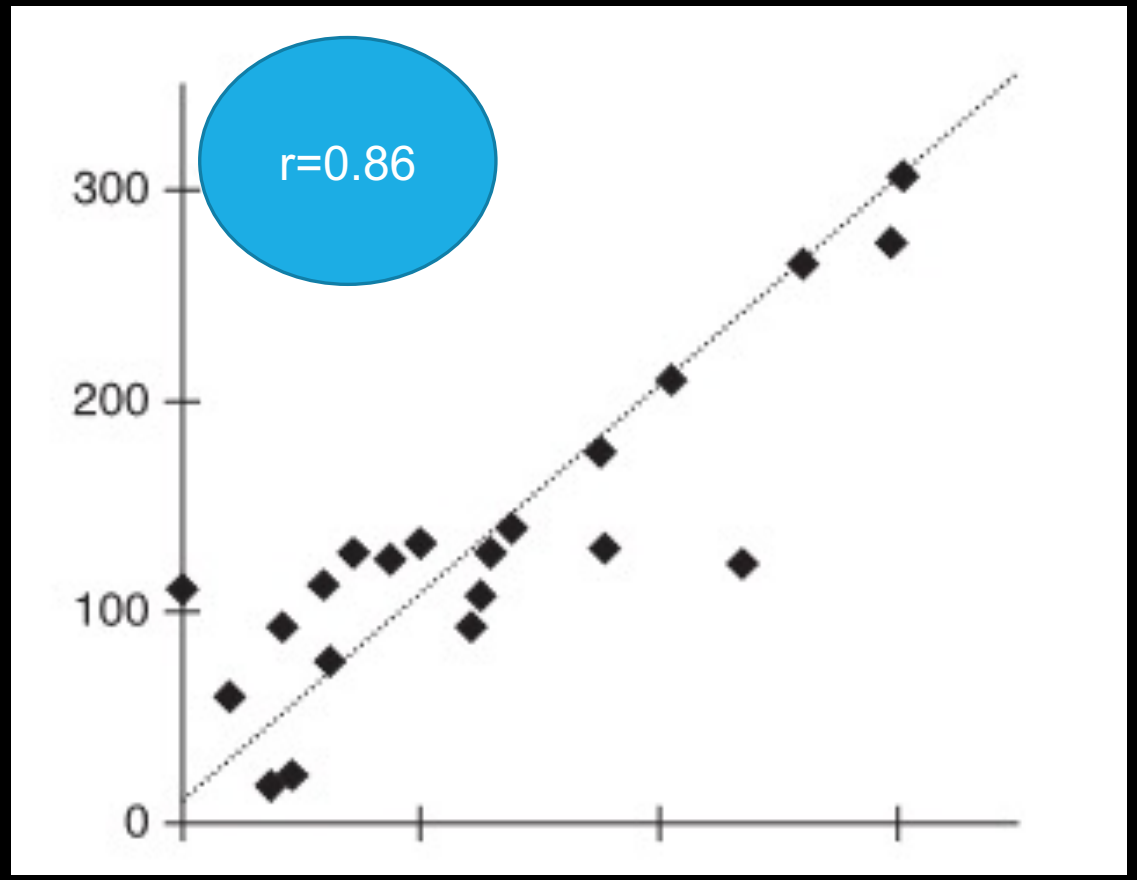
Kostic S et al Diseases of Esophagus 2005

Individual TBE Parameters in 14 Achalasia Patients on Two Examinations

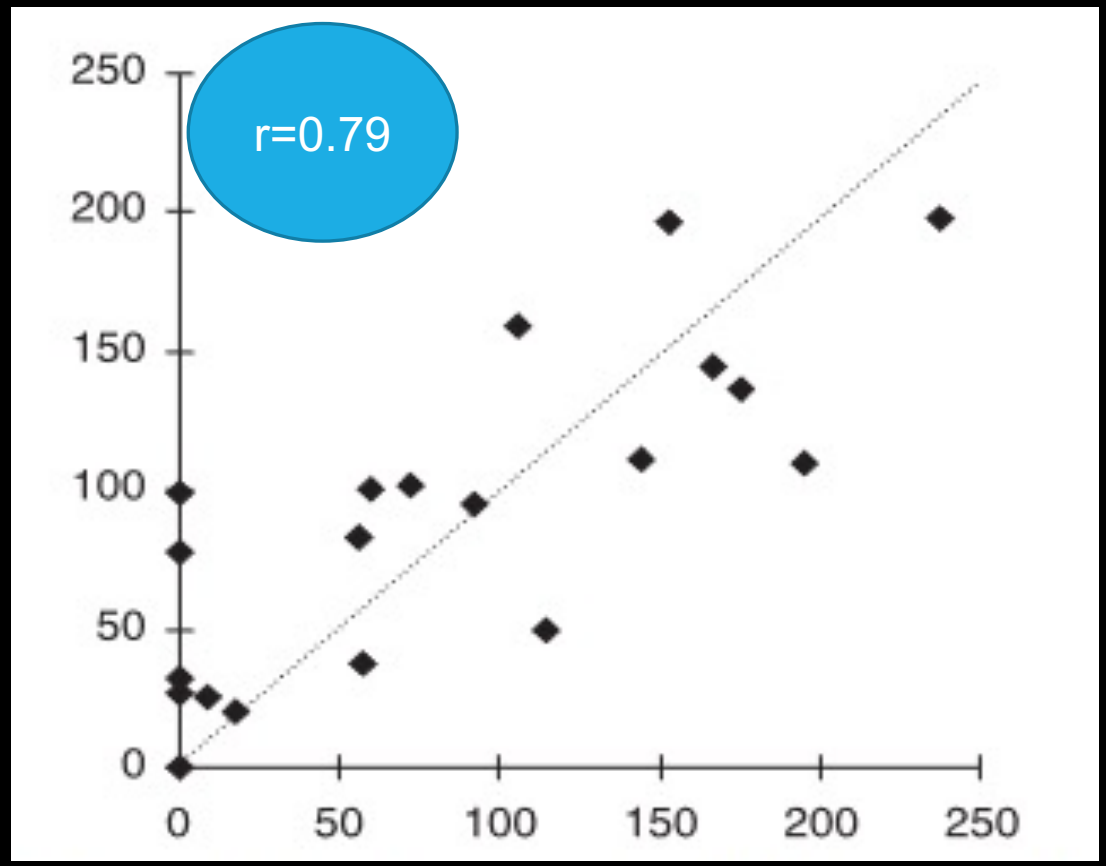


Kostic S et al. Diseases of Esophagus 2005

Correlation Coefficient of Barium Column Height on Repeated Exams



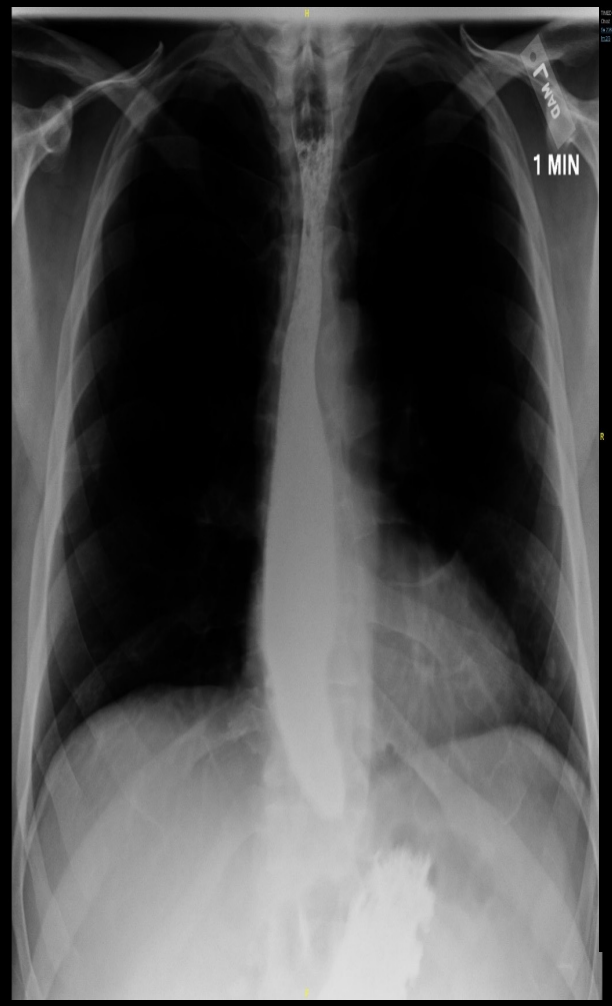
One Minute



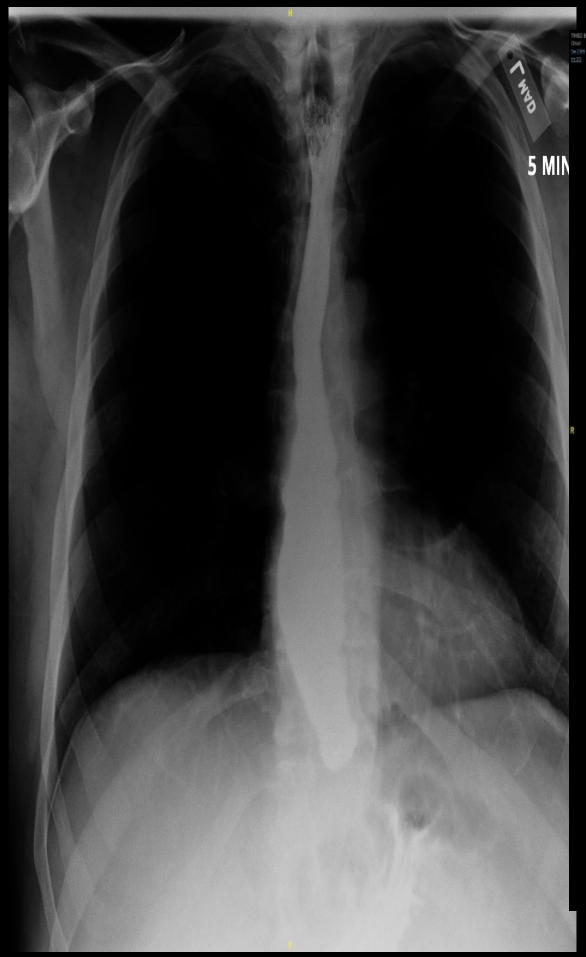
Five Minutes

Kostic S et al. Diseases of Esophagus 2005

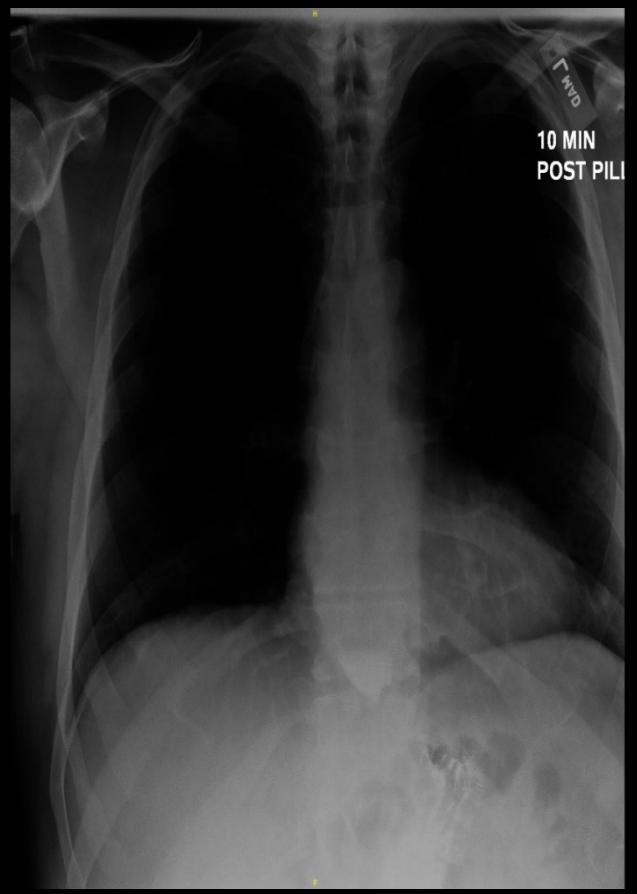
Current TBE Protocol at the University of South Florida



One Minute



Five Minutes



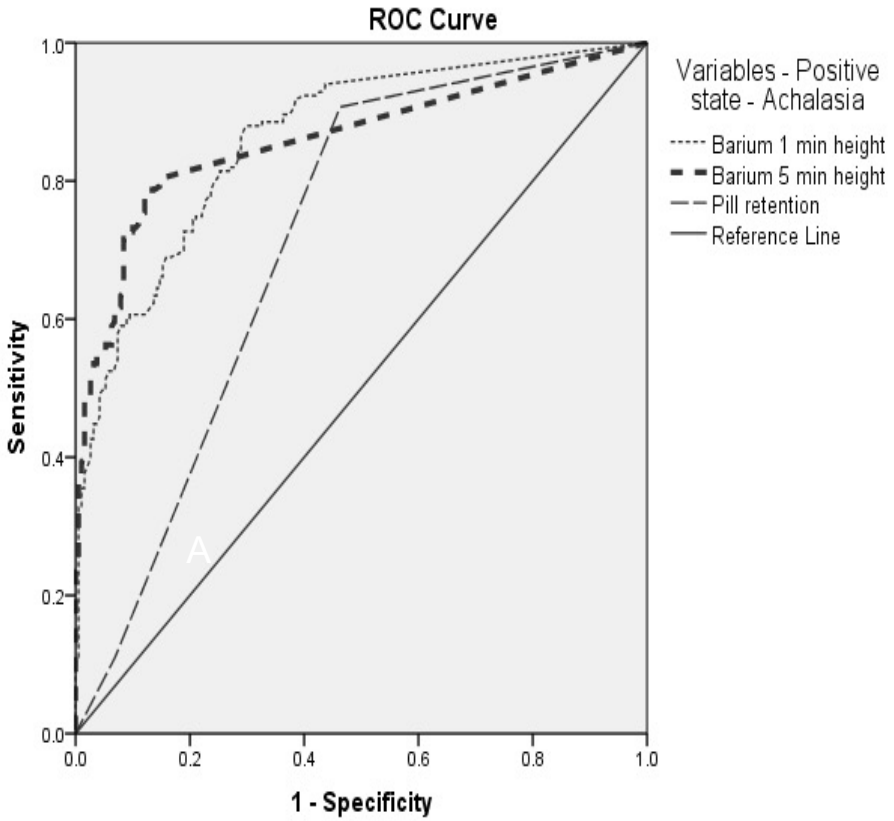
13 mm Tablet after 5 Minutes

What are We Actually Assessing with the Timed Barium Esophagram??

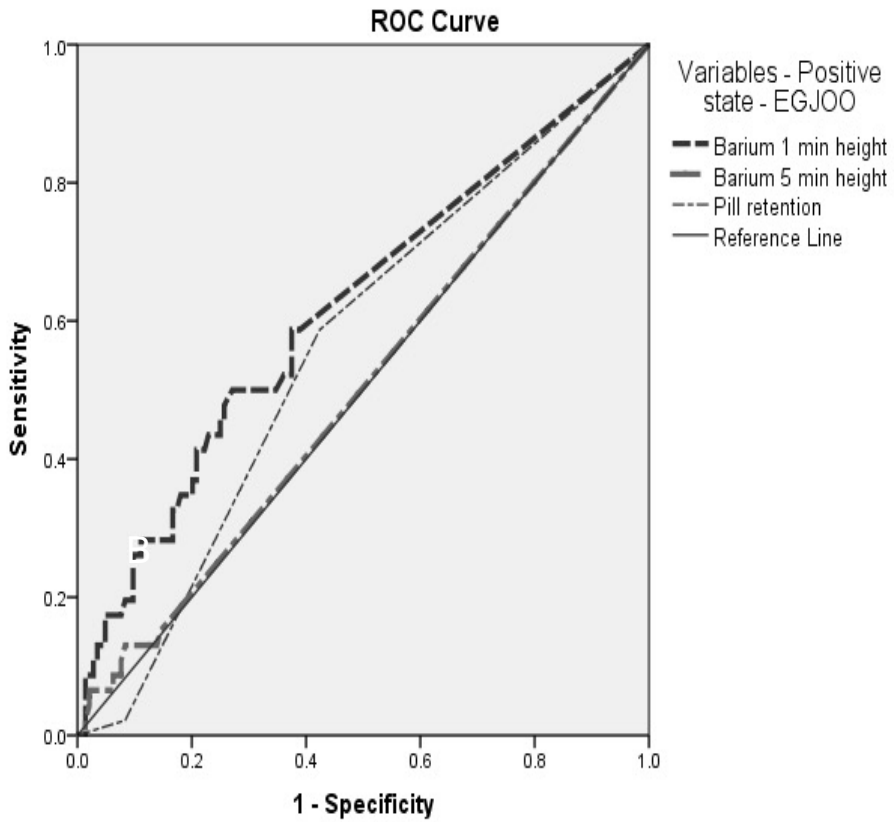
- Rate (degree) of esophageal empty=compliance of EGJ
- Anatomy of the esophagus especially with obstruction

Accuracy of Identifying Achalasia in 107 Patients

Identifying Achalasia vs EJGOO vs non-Achalasia



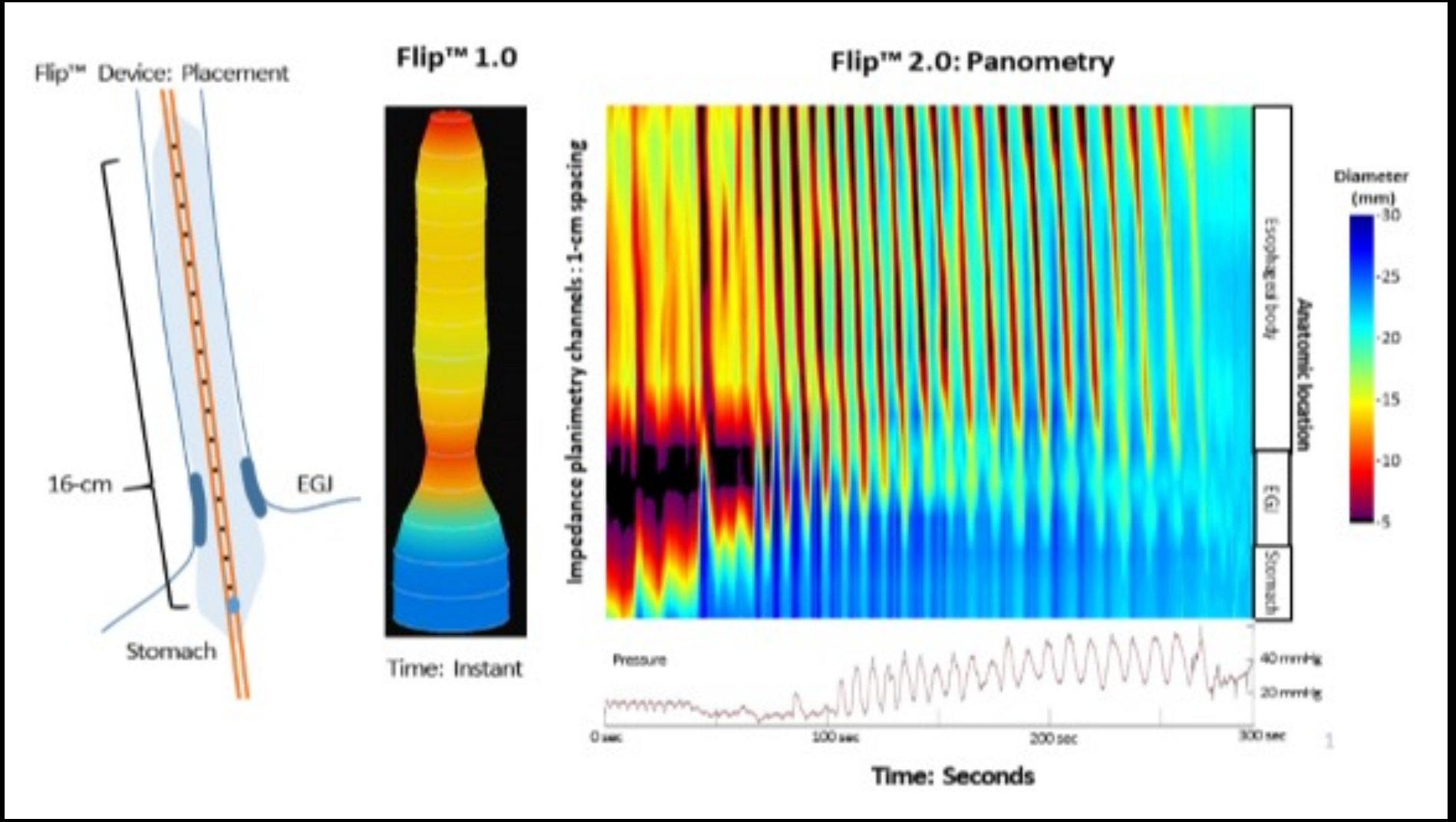
Identifying EJGOO vs non-Achalasia



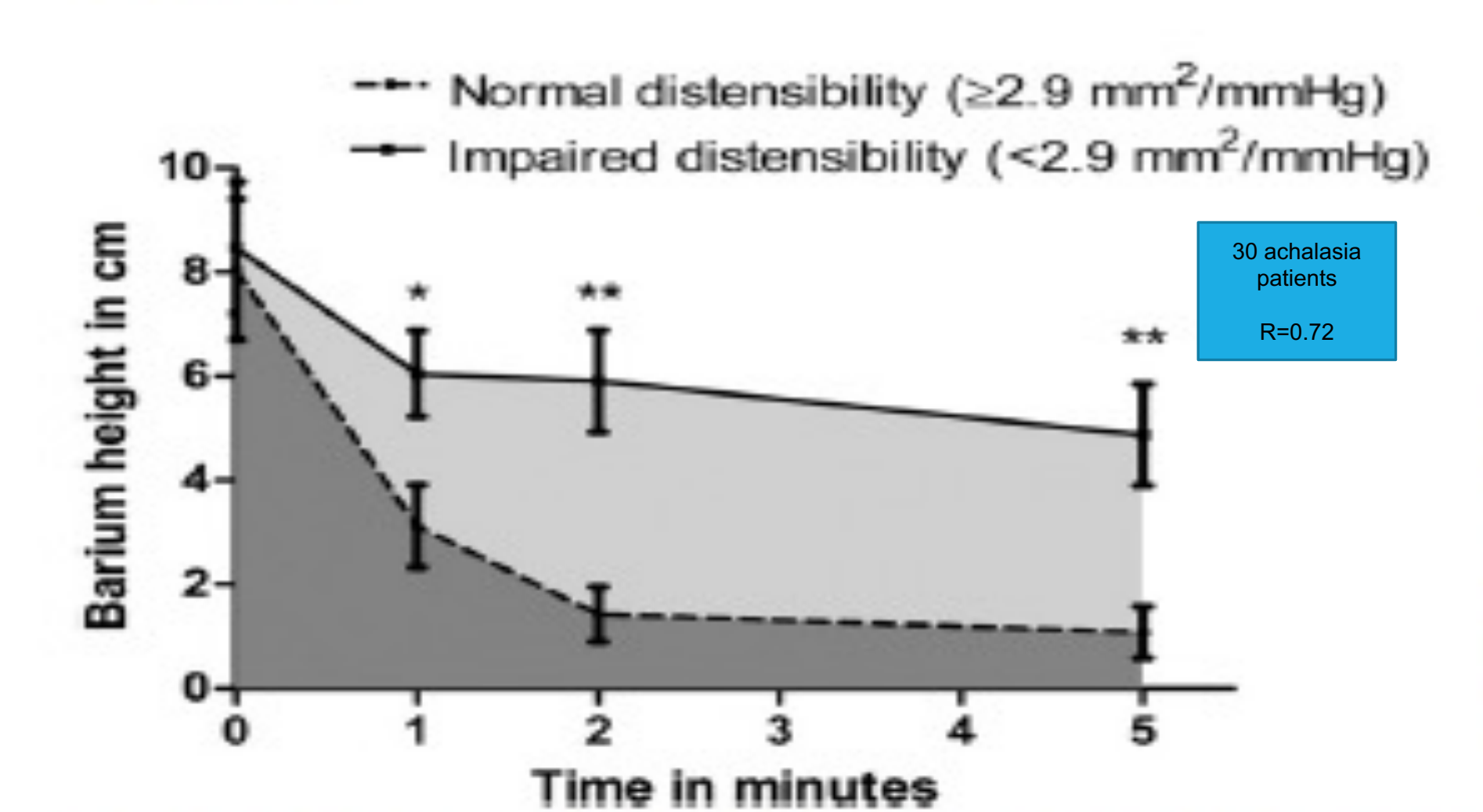
Barium Ht >2 cm at 5 mins—85% sensitivity and 86% specificity

Blonski W, Richter JR Am J Gastroenterology 1998

Functional Lumen Imaging Probe--FLIP

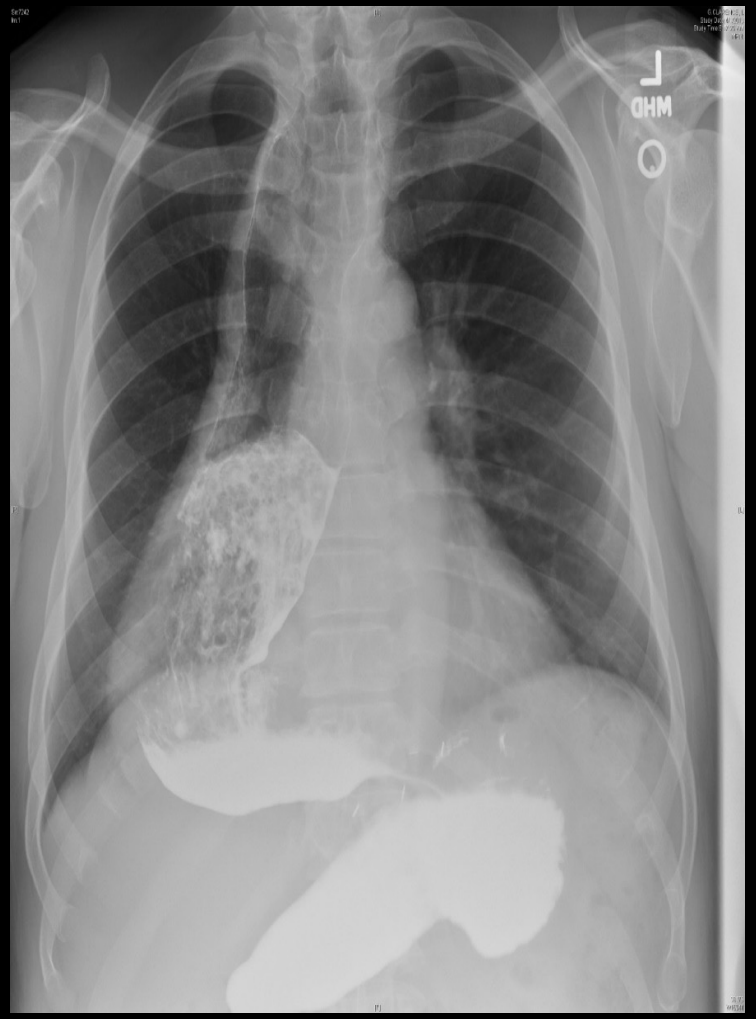


Height of Barium Column over Time as Measure of LES Compliance by EndoFLIP



Rohof WO et al. Gastroenterology 2012

Excellent Barium Images of all Types of Achalasia



Type I Achalasia

Type III Achalasia

Epiphrenic diverticulum

Clinical Applications of the Timed Barium Esophagram

- Achalasia
  - --Supporting HRM diagnosis of achalasia
  - --Resolving the up to 20% of inconclusive HRM diagnoses of achalasia with IRP< 15 mmHg (new Chicago 4.0)
  - --Short and long term predictors of improvement post treatment
- EGJ outflow obstruction
- Non-achalasia dysphagia

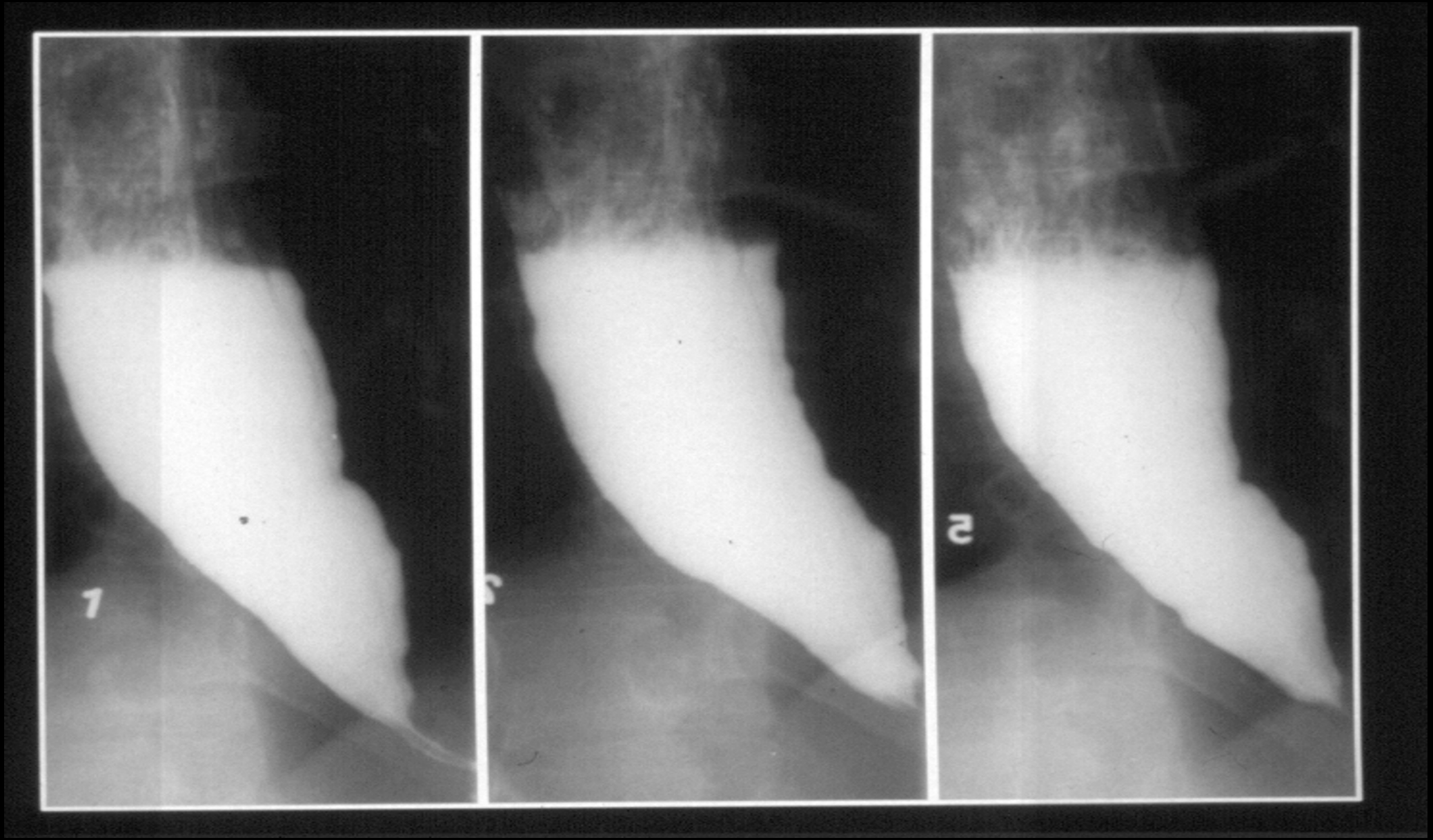
Accuracy of Time Barium Esophagram with 13 mmTablet for Diagnosis of Achalasia

Table 2. Frequency of combined emptying of liquid barium and 13-mm barium tablet passage across groups

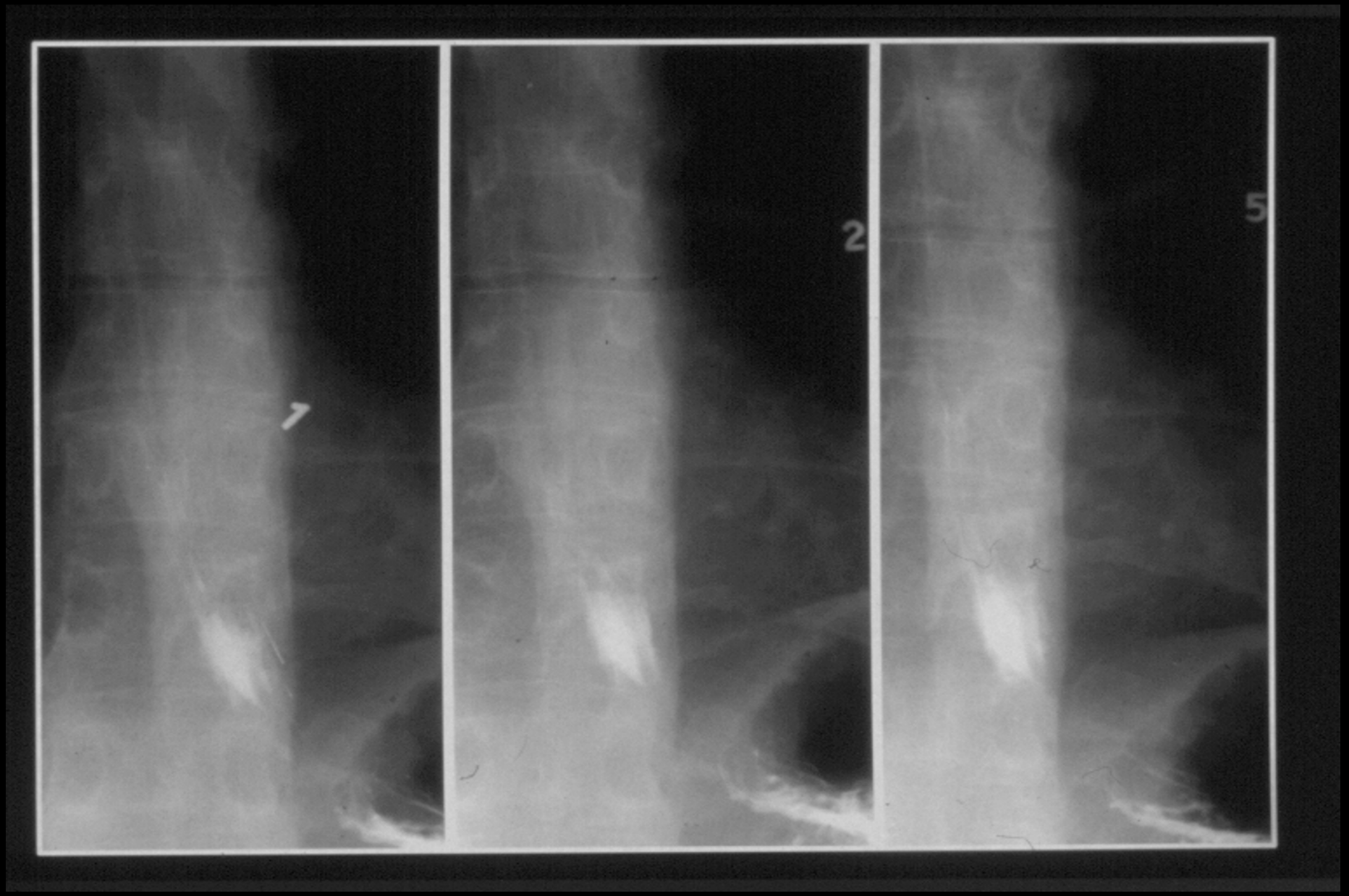
TBS variable	Achalasia, *N*=107	*P* value achalasia vs. EGJOO	EGJOO, *N*=45	Non-achalasia, *N*=132	*P* value	
					EGJOO vs. non-achalasia	Achalasia vs. non-achalasia
Liquid barium normal +tablet lodged	22 (20.5%)	0.001	22 (48.9%)	42 (31.8%)	0.049	0.057
Liquid barium abnormal+tablet lodged	80 (74.8%)	<0.0001	4 (8.9%)	7 (5.3%)	0.474	<0.0001
Liquid barium abnormal+tablet passed	5 (4.7%)	0.801	1 (2.2%)	3 (2.3%)	0.984	0.472
Liquid barium normal+tablet passed	0 (0%)	<0.0001	18 (40%)	80 (60.6%)	0.023	<0.0001
Liquid barium abnormal and/or tablet lodged	107 (100%)	<0.0001	27 (60%)	52 (39.3%)	0.0161	<0.0001

EGJOO, esophagogastric junction outflow obstruction; TBS, timed barium swallow.

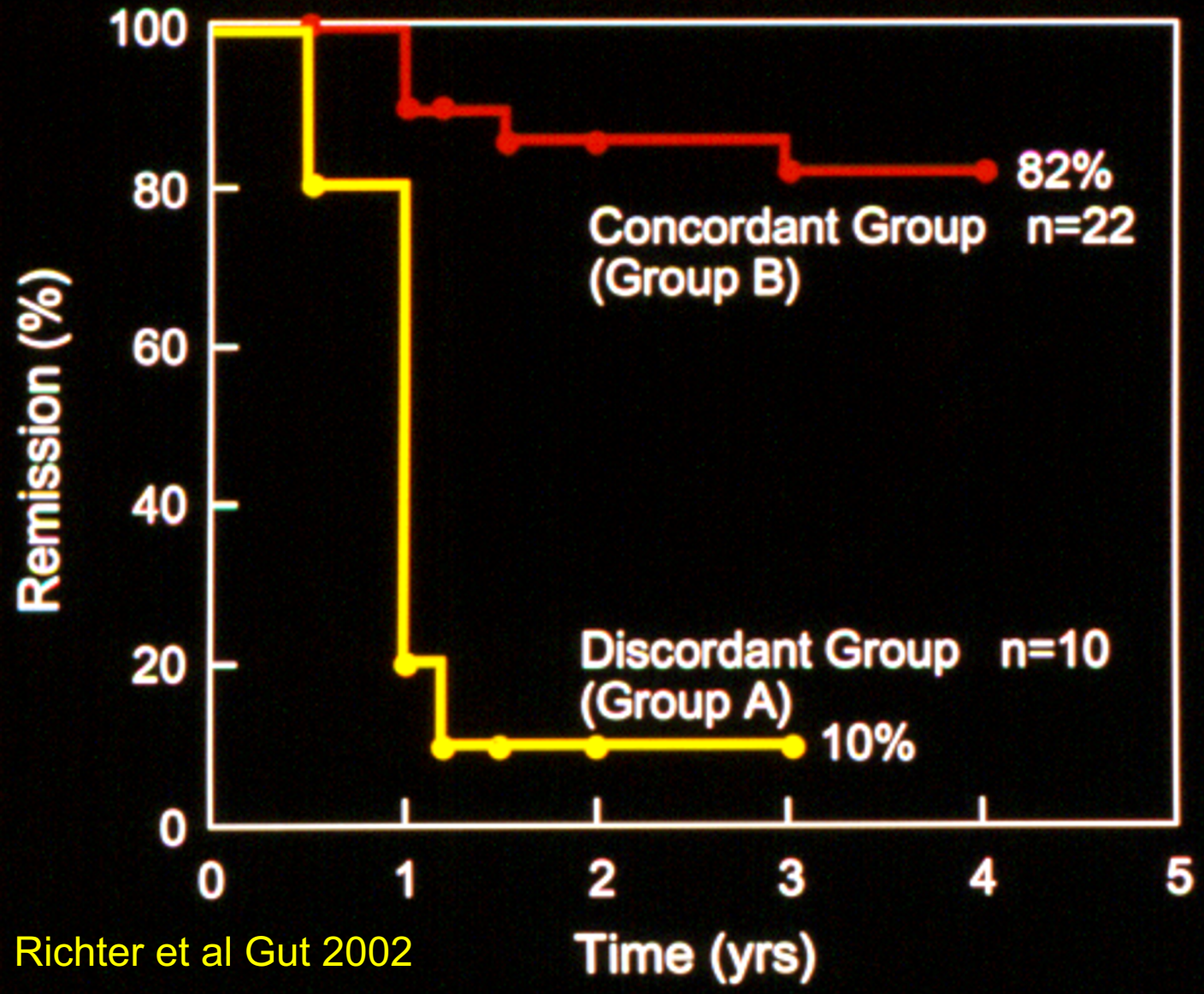
Timed Barium Esophagram before Treatment



Timed Barium Swallow after Successful Treatment



REMISSION RATE OF DISCORDANT AND CONCORDANT GROUPS

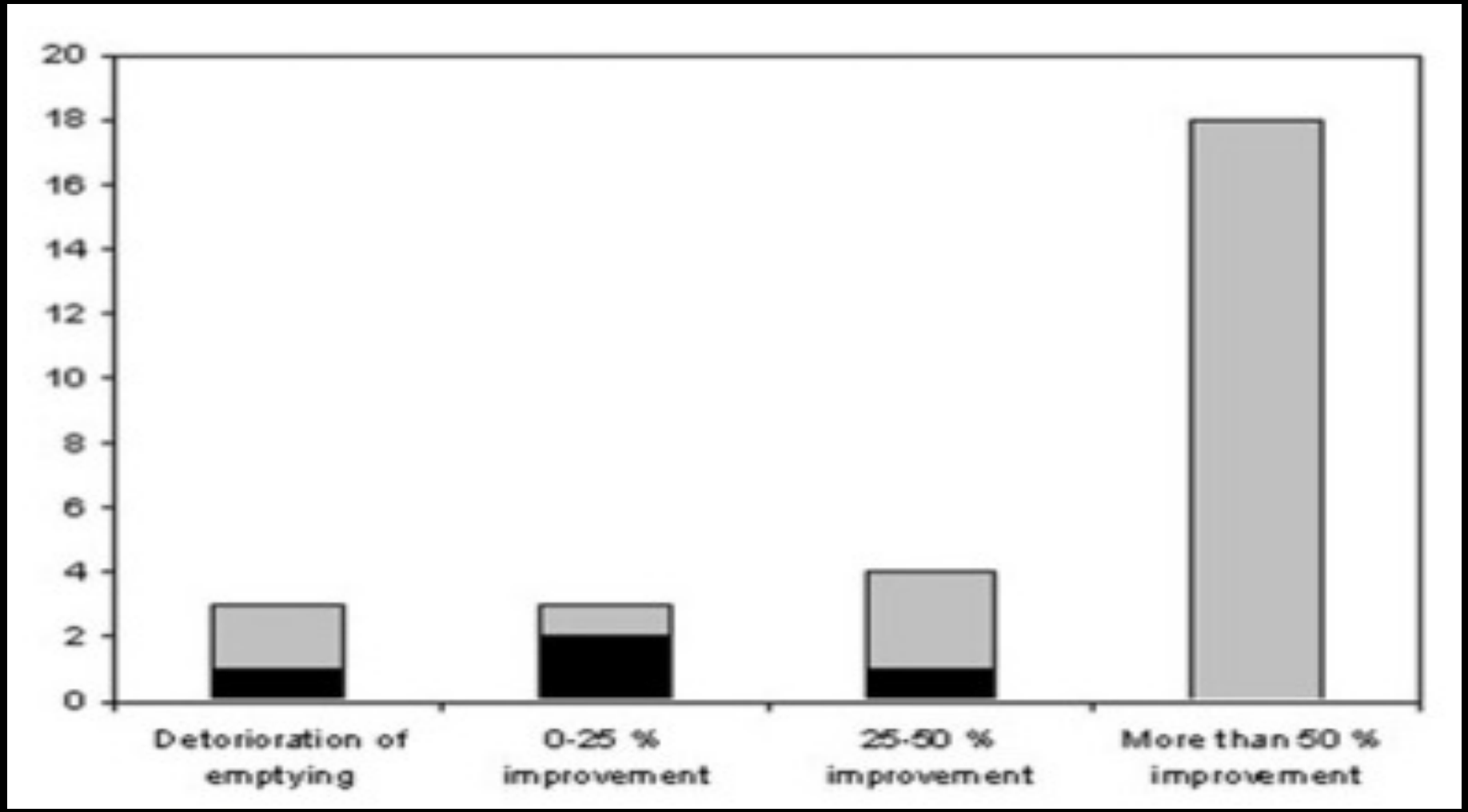


Vaezi , Richter et al Gut 2002

Definition of Remission

No symptoms
90% empty
<5 cm barium ht at 5 min
on post treatment

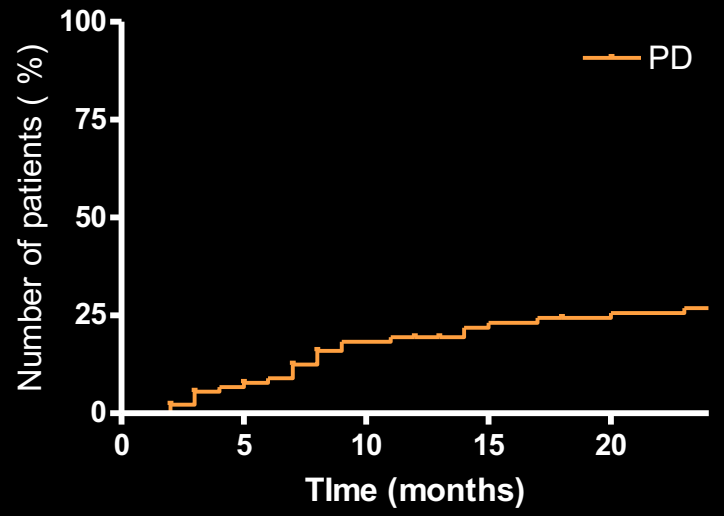
Frequency of Surgical Failure Parrallels Improvement at 1 Minute in Barium Height



Anderson M et al. Diseases of Esophagus 2009

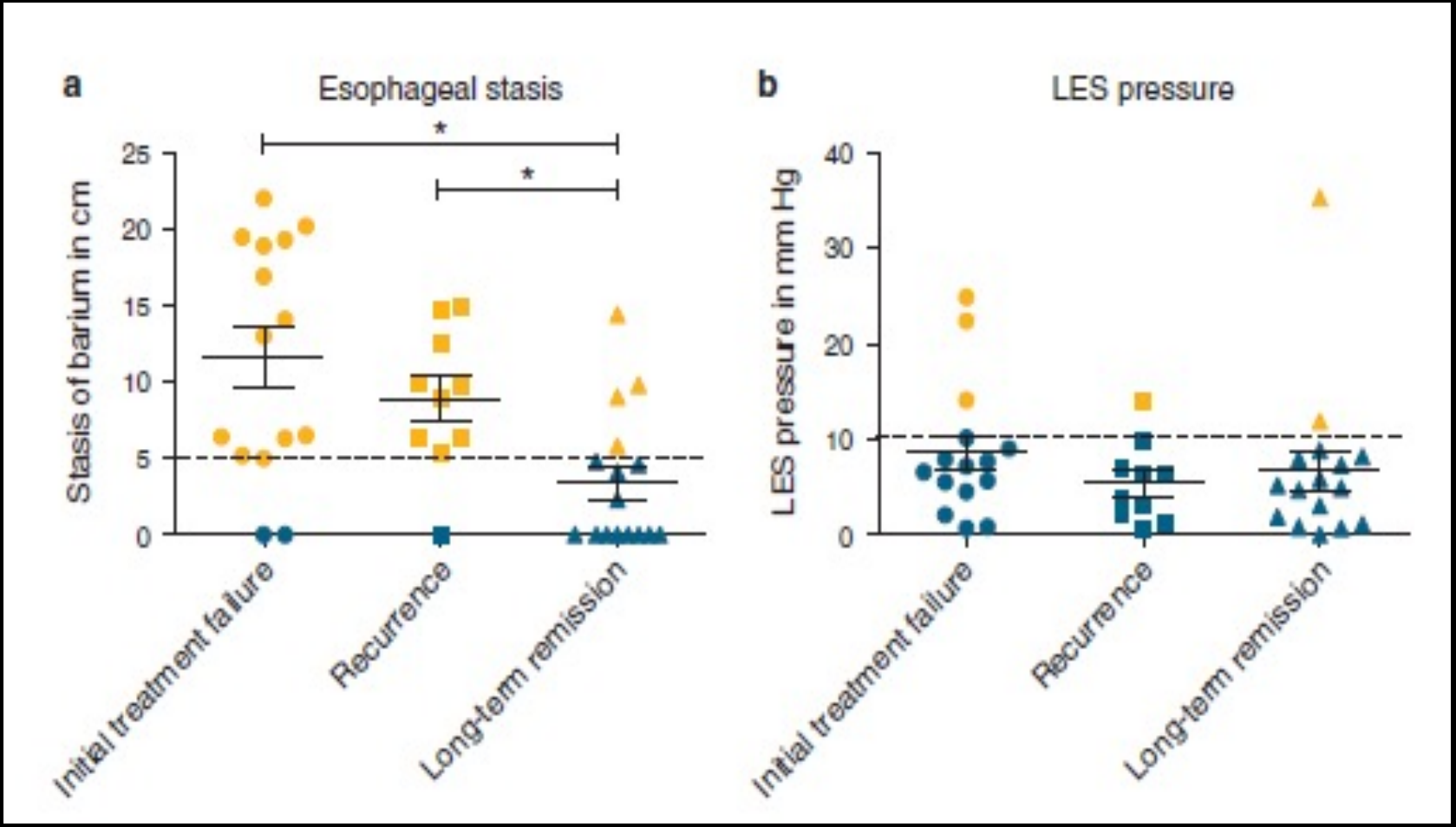
SECONDARY OUTCOME PARAMETERS NEED FOR REDILATION IN PD GROUP

Factor	Hazard Ratio
Age > 40:	0.23 (0.09-0.56)
Daily chest pain:	4.3 (1.6-11.4)
Posttreatment (3 months)	
>10cm stasis (5 min)	5.3 (1.3-22)



Boeckxstaens GE et al NEJM 2011

Esophageal Stasis on TBE Predicts Recurrent Symptoms in Long-Standing Achalasia-41 Patients



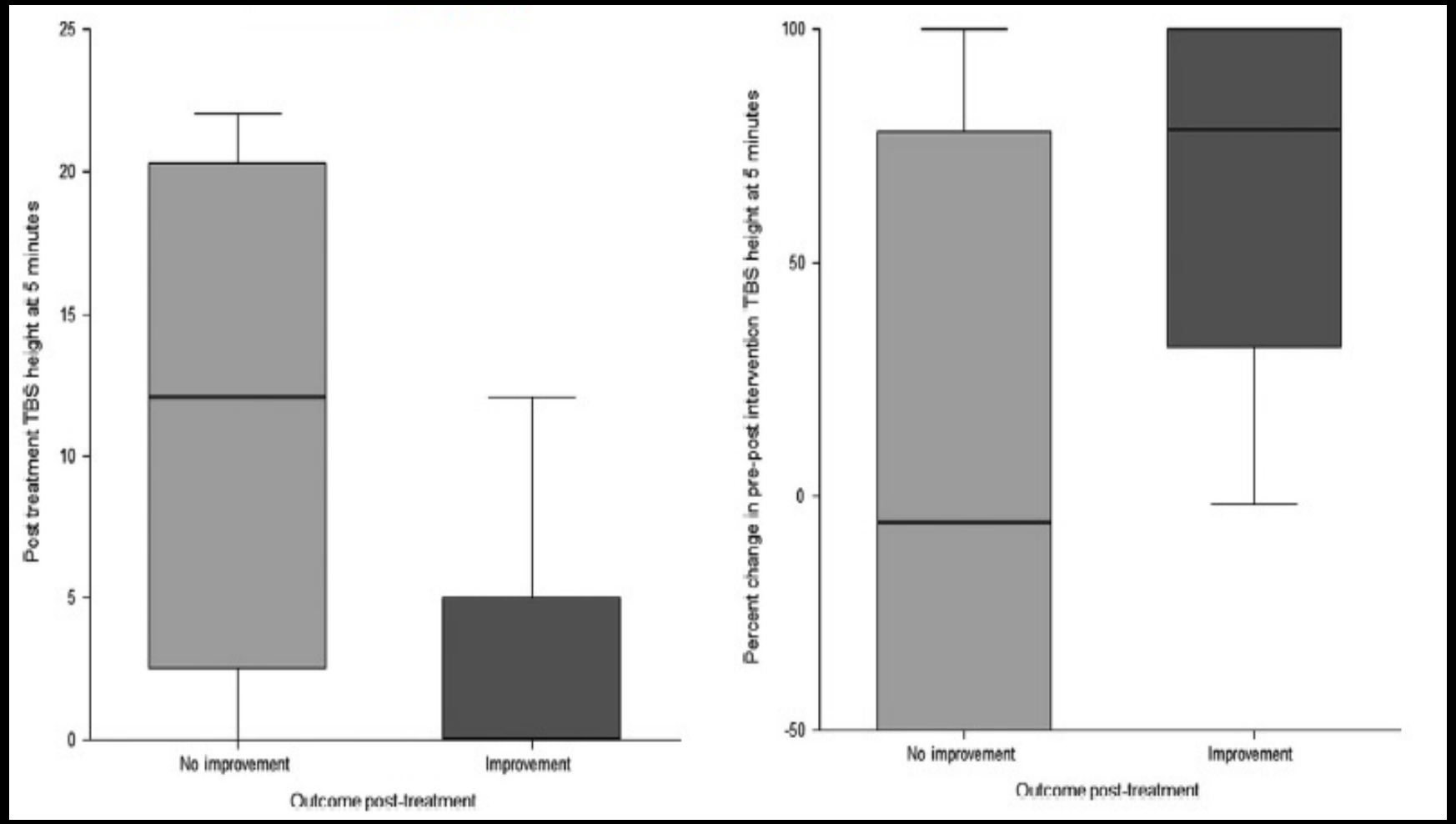
Average fu—17 yrs

Recurrent sx—25 pts
--5 elevated LES
--22 esophageal stasis

Sensitivity to predict need for retreatment
--20% elevated LESP
--88% esophageal stasis

Rohf WO et al American Journal of Gastrornterology 2013

TBE for Assessing Long-Term Response in Achalasia
Absolute Cutoff vs Percent Change



81 patients
Average fu—2.2 yrs

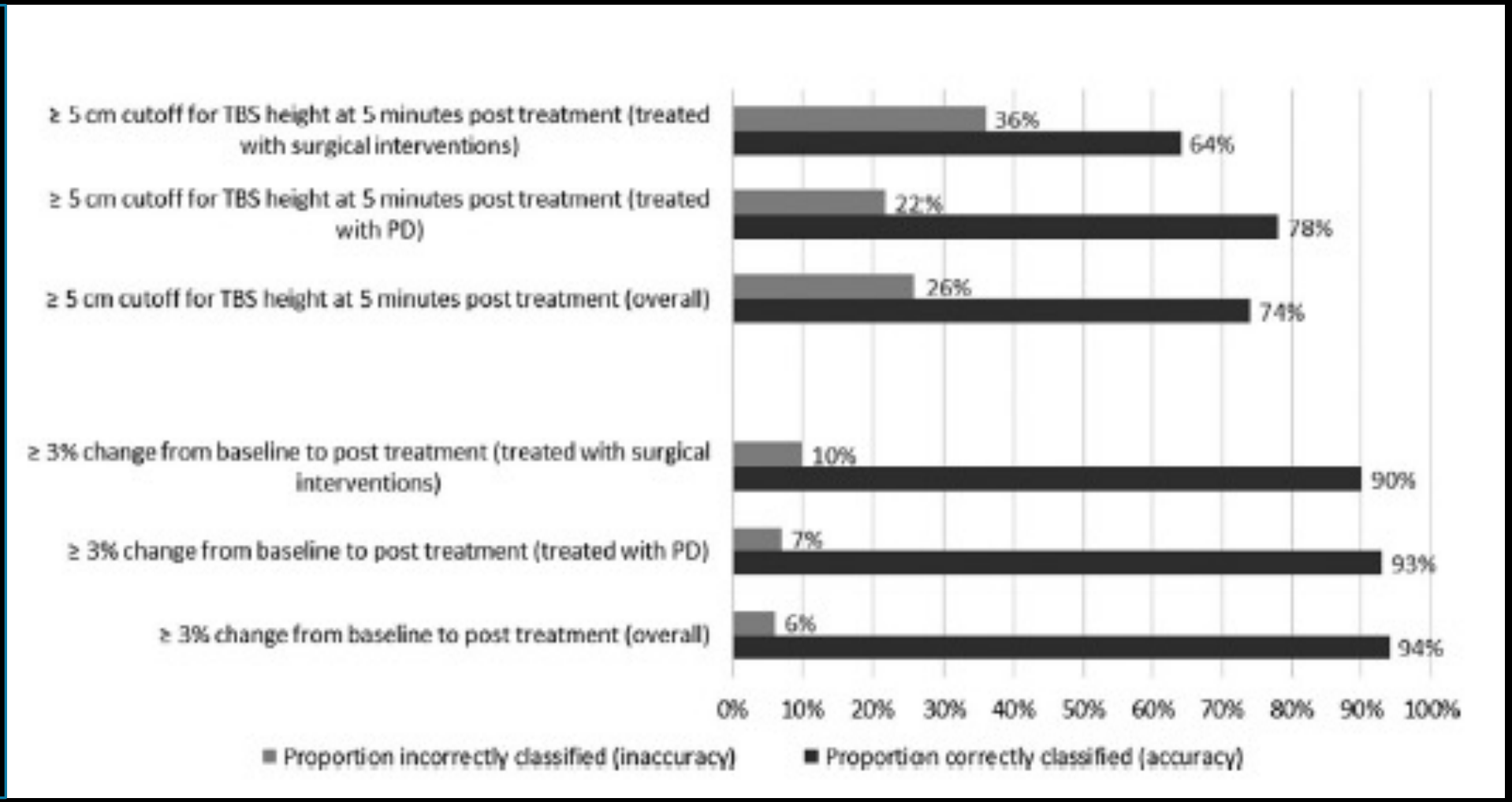
Treatments
--57 pneumatic dilation
--24 myotomy

Blonski W et al Neurogastroent Motil 2020

Post Treatment Barium Height at 5 min

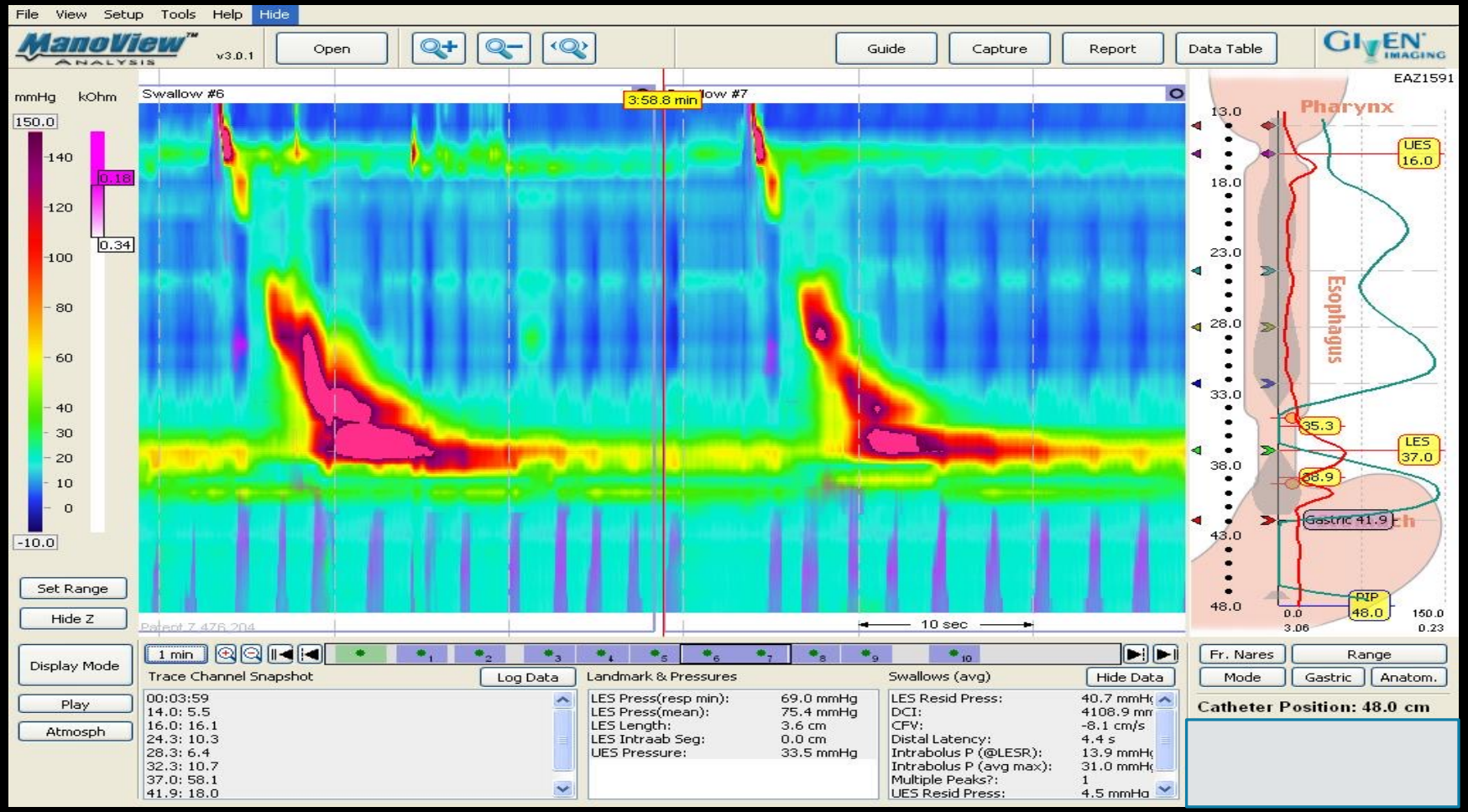
% Change Pre vs Post at 5 min Height

Accuracy of Classifying Success vs Failure Using TBE Height at 5 Minutes Versus % Changes

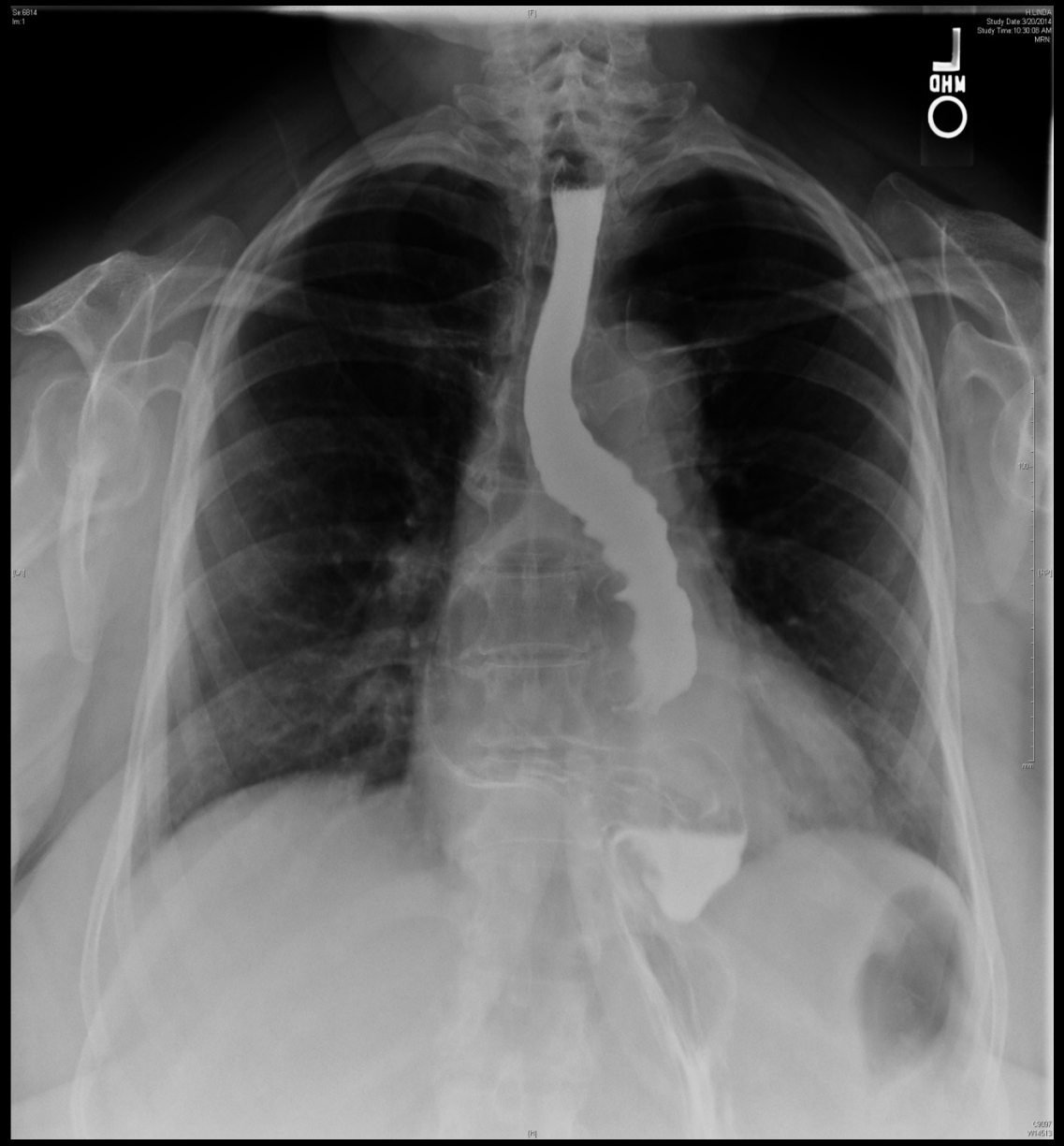


Blonski W et al Neurogastroenterol Motil 2020

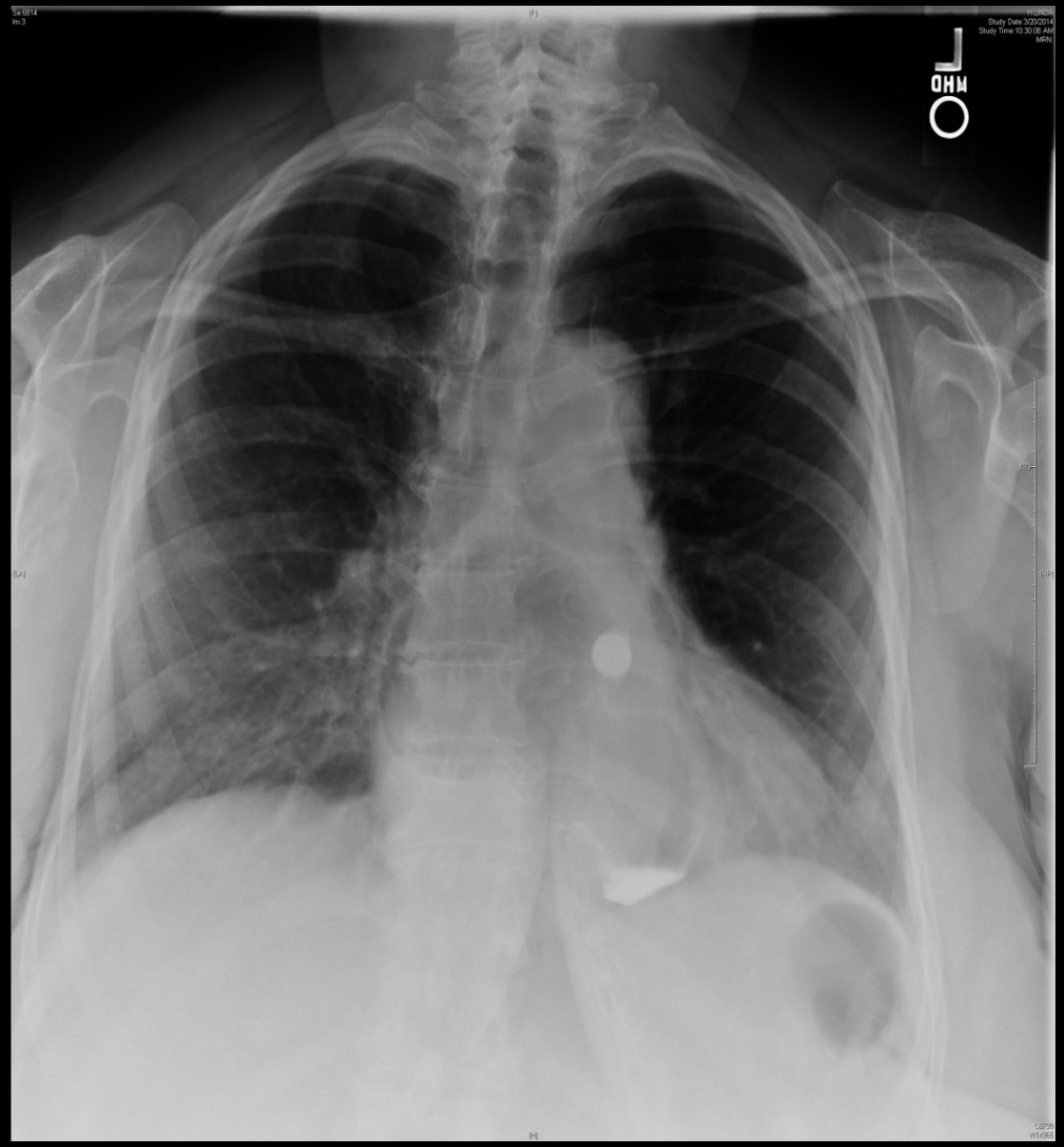
EGJ Outlet Obstruction



Chicago 4.0: Clinically relevant **conclusive diagnosis of EGJOO** requires supportive evidence of obstruction by TBE with tablet and/or FLIP



One Minute



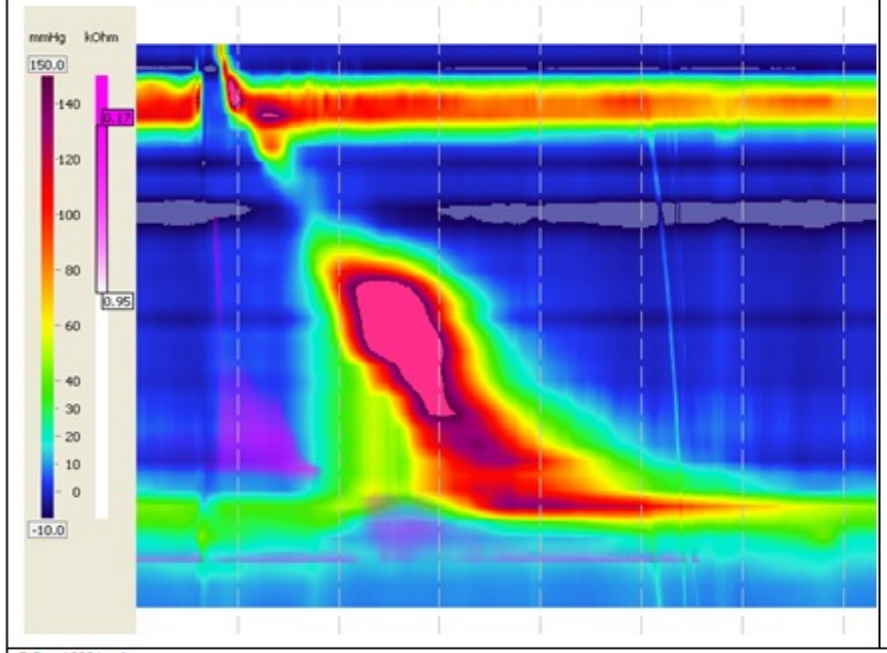
13 mm tablet after 5 minute

FUNCTIONAL EGJ OUTFLOW OBSTRUCTION

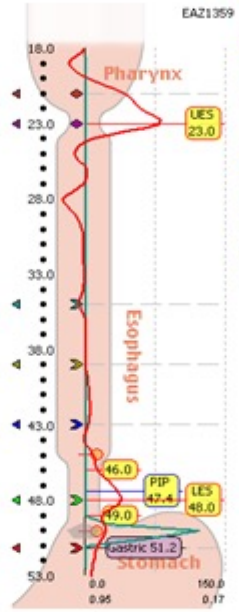
Patient: [redacted]

Gender:	Male	Physician:	Joel Richter, MD
DOB / Age:	04/05/1939	Operator:	B. Lamoy, RN
Height:	6 ft	Referring Physician:	Keith Hussey, MD
Procedure:	Esophageal Manometry with Impedance	Examination Date:	04/30/2014

Swallow Composite (mean of 10 swallows)



Resting Pressure Profile & Anatomy



Basal Pressures*

LES, respiratory mean(mmHg)	27.0 (13-43)
UES mean(mmHg)	78.8 (34-104)

Anatomy*

LES proximal(cm)	46.0
LES intraabdominal(cm)	1.6
Esophageal length(cm)	25.0
Hiatal hernia	No

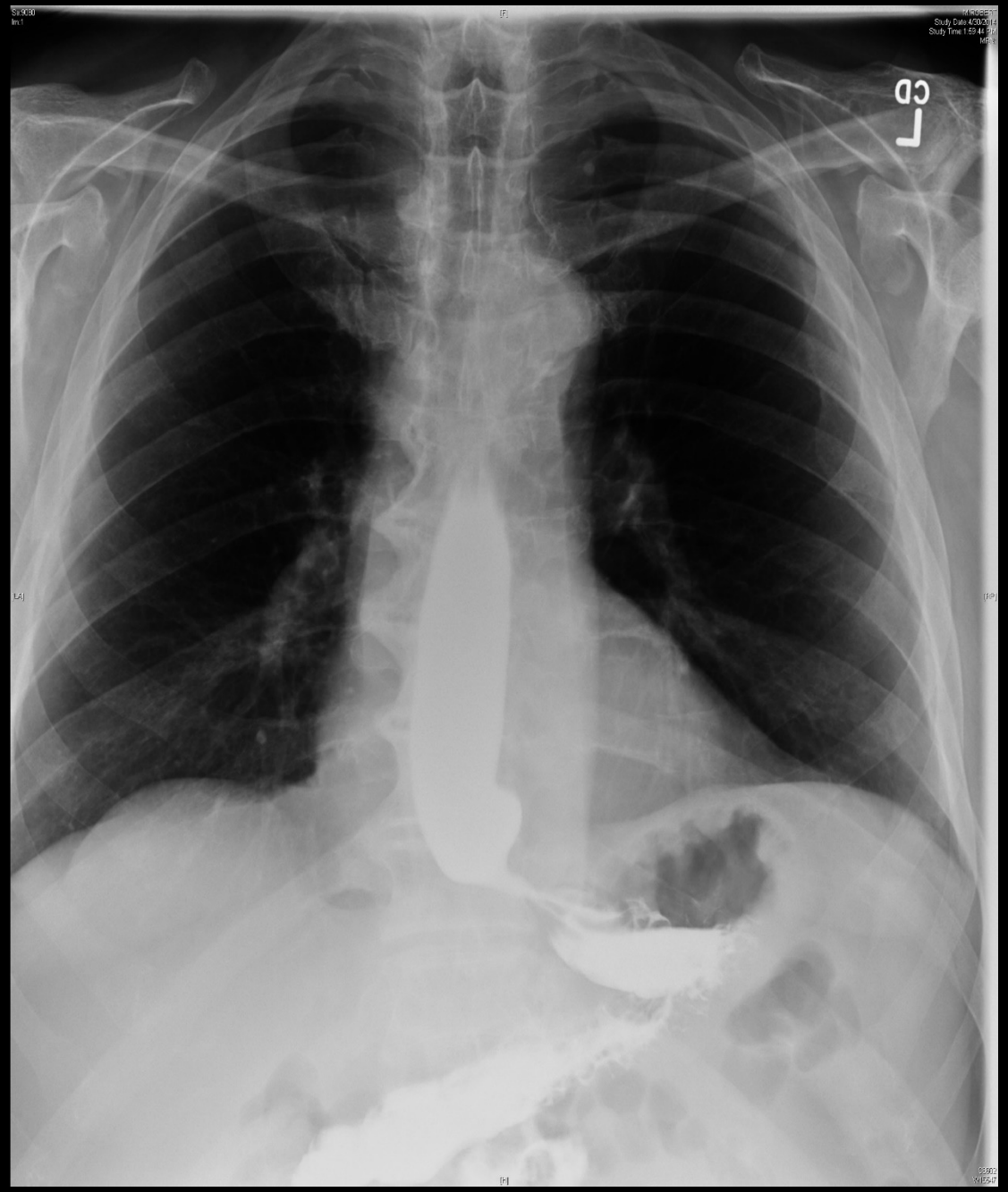
Motility*

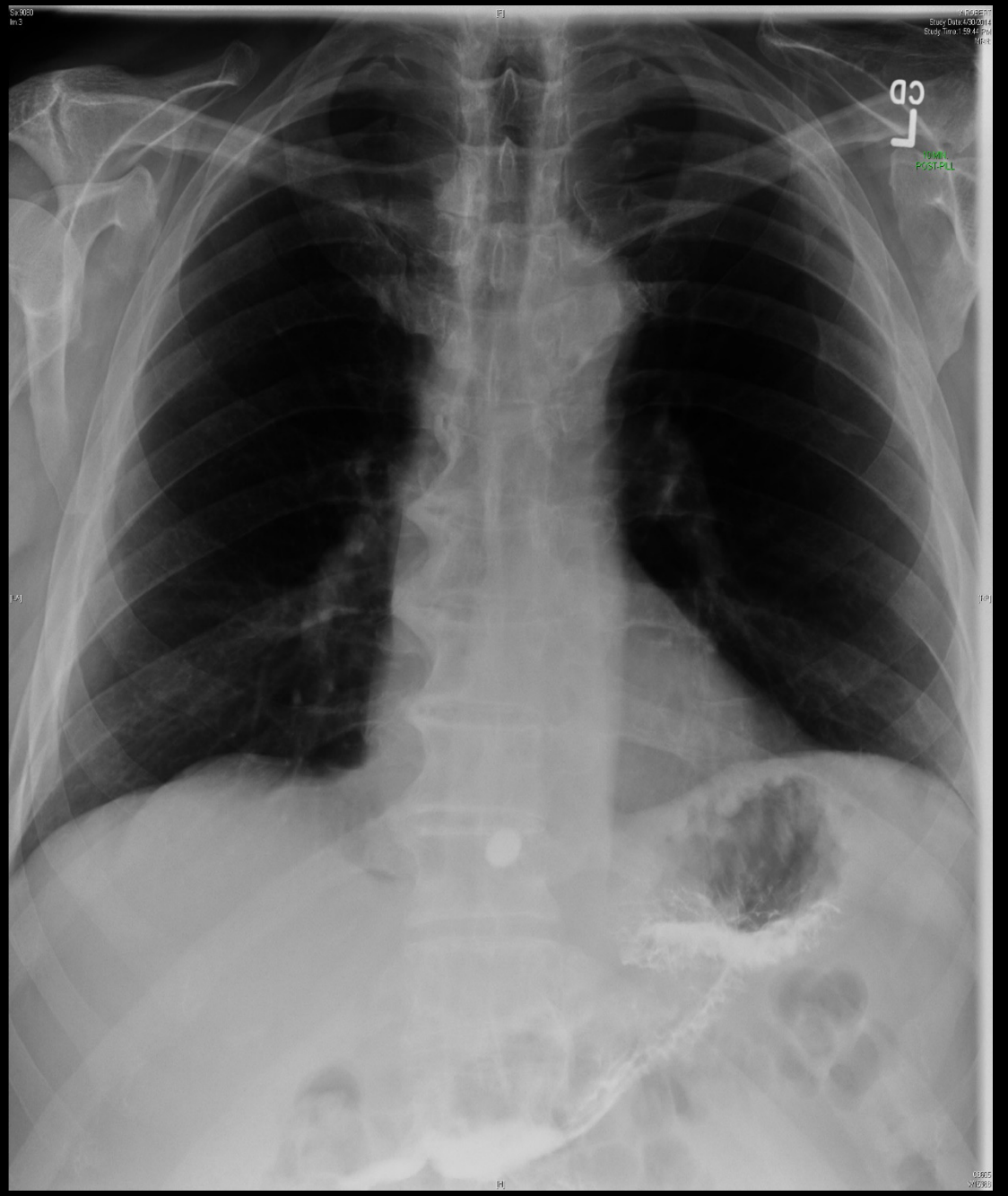
Dist. wave amplitude(mmHg)	**195.7** (43-152)
Distal contr. integral(mmHg-cm-s)	**6842.2** (500-5000)
Incomplete bolus clearance(%)	0

Residual Pressures*

LES (mean)(mmHg)	**22.0** (<15.0)
UES (mean)(mmHg)	1.3 (<12.0)

Type IV Achalasia



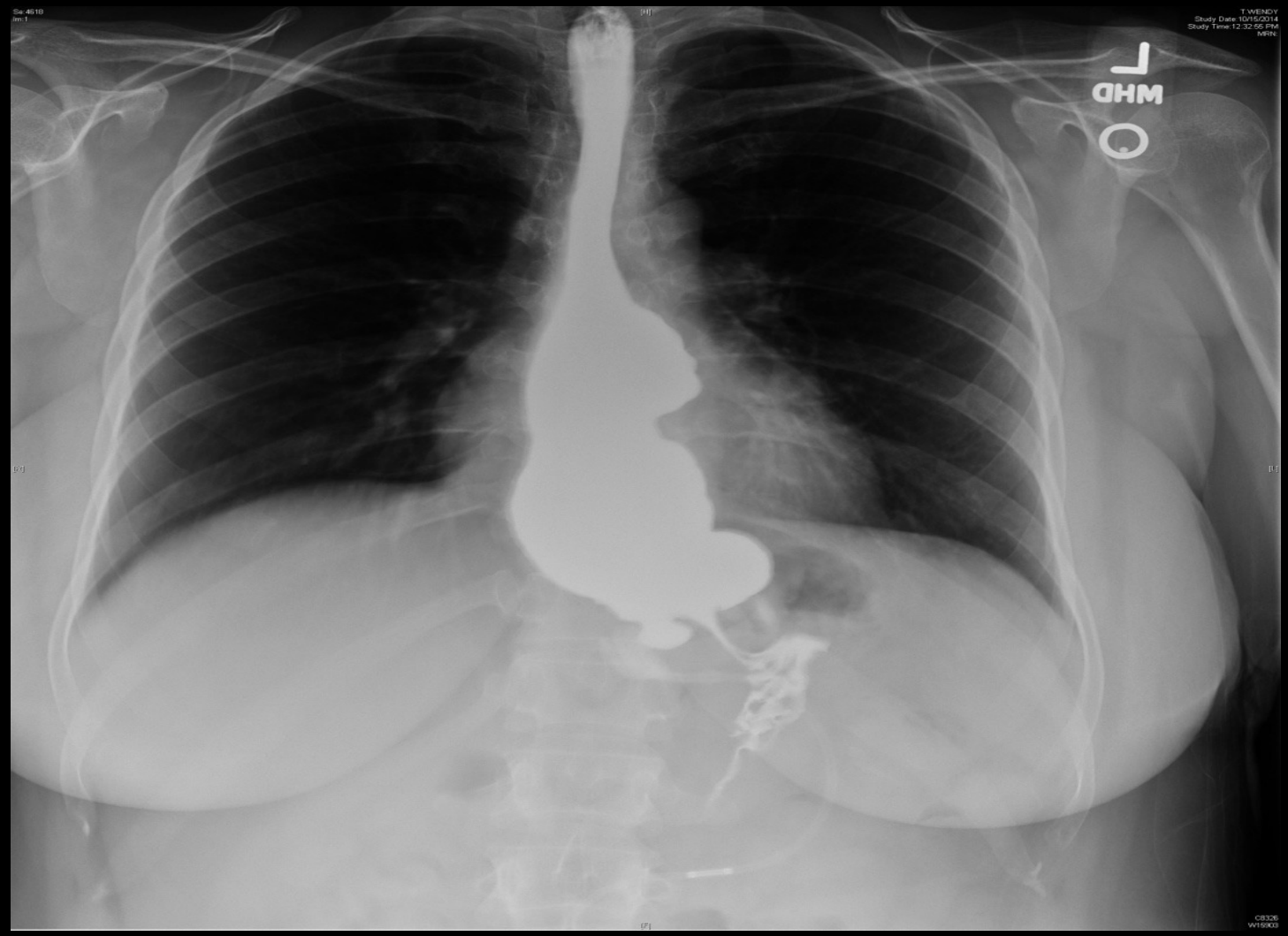


Pneumatic Dilation Improves Symptoms and Esophageal Emptying in Patients with EGJ Outflow Obstruction

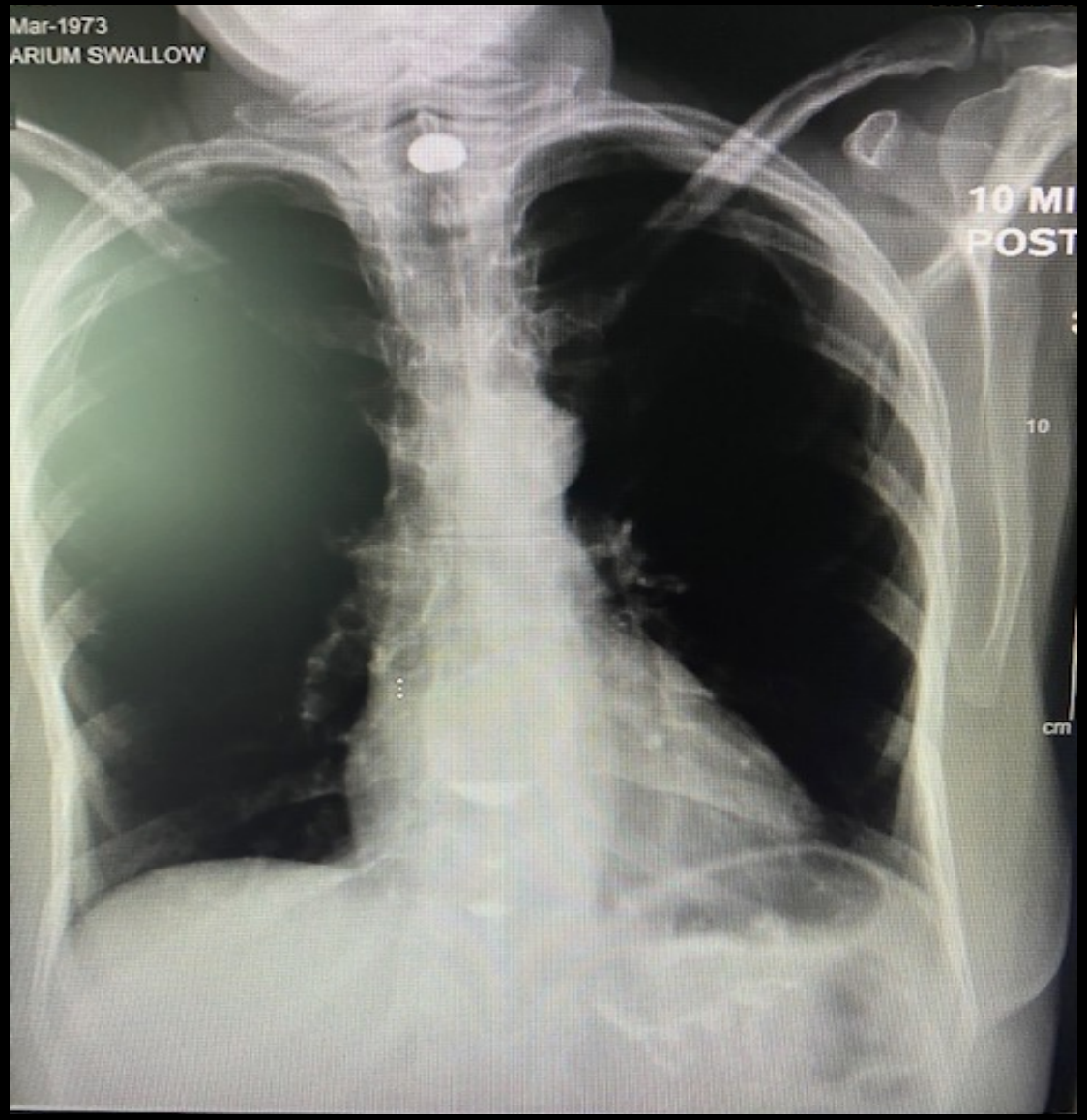
N = 33	Pre-pneumatic dilation	Post-pneumatic dilation	P-value
1 min height in cm, Median (IQR)	11.0 (4.9, 15.2)	0 (0, 4.8)	<0.001
1 min width in cm, Median (IQR)	1.7 (0.6, 2.3)	0 (0, 1.1)	<0.001
5 min height in cm, Median (IQR)	0 (0, 0)	0 (0, 0)	0.107
5 min width in cm, Median (IQR)	0 (0, 0)	0 (0, 0)	0.419
Pill retained, N (%)	25 (76%)	13 (40%)	0.006
Post-PD symptom relief, N (%)			
Unchanged	3 (9.1%)		
Good	22 (66.7%)		
Worse	0 (0%)		
Unknown	2 (6.1%)		
Good and then recurrence	6 (18.18%)		

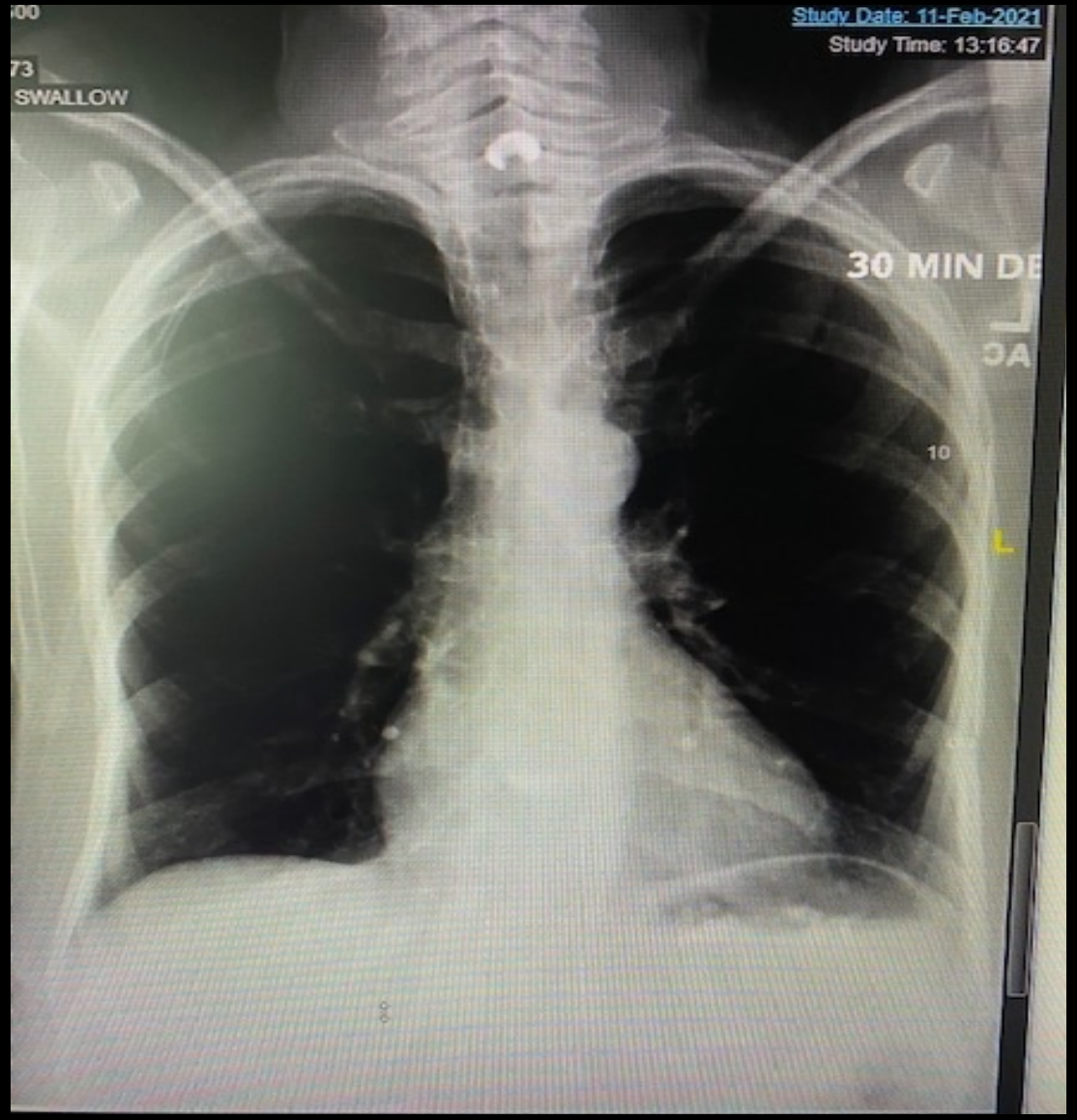
Clayton SB, Richter JE et al. Neurogastroenterology and Motility 2019

Obstructing Lap Band

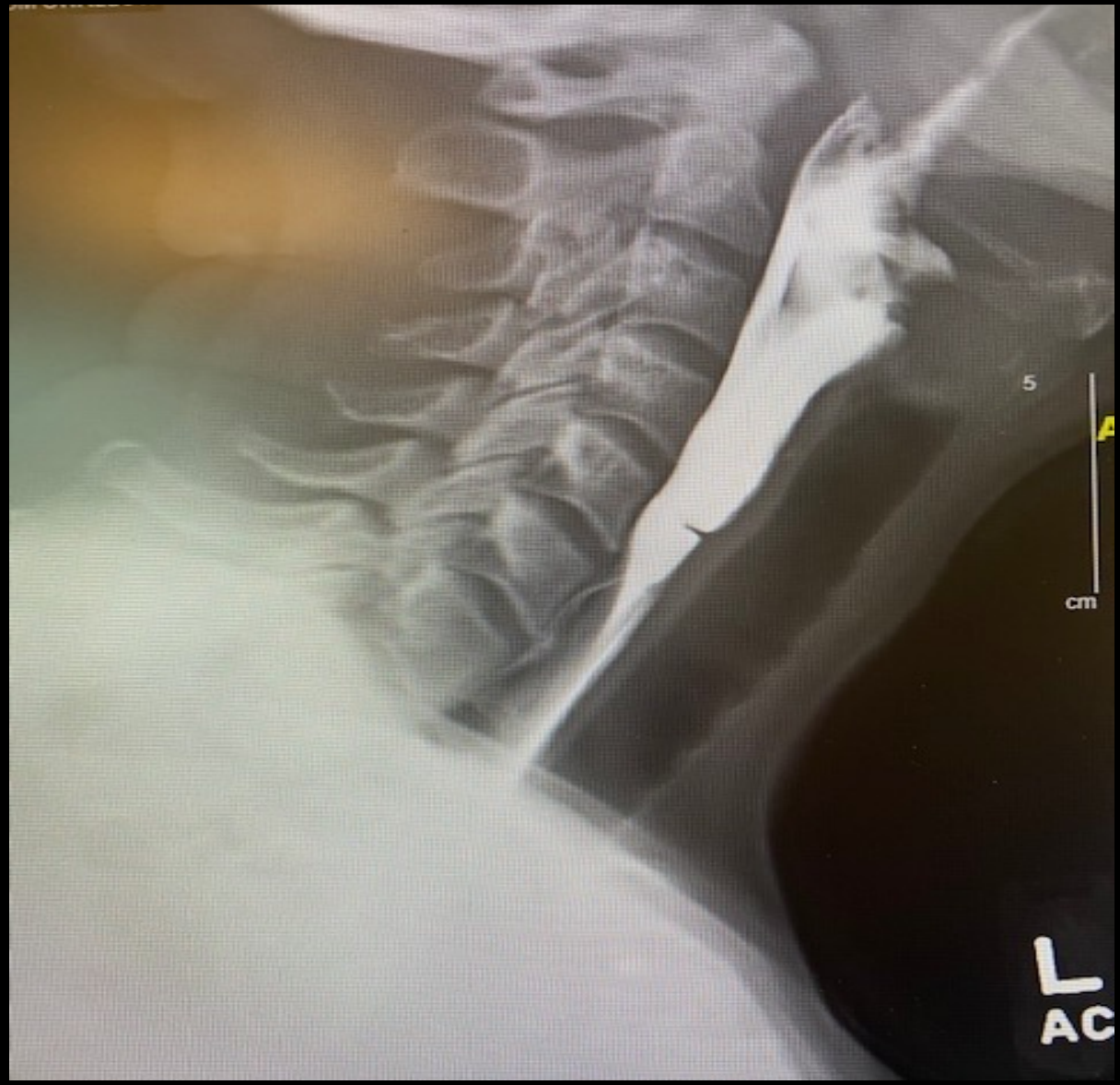


Cervical Web held up Tablet at 10 and 30 Minutes





Classic Cervical Web



Why Should the Esophageal Community Embrace The Timed Barium Esophagram?

- Everyone can do it, cheap, easy, reliable and easy to start
- Not expensive, doesn't require another endoscopy
- USF—do HRM and TBE –then see the patient
- **"Old is not bad and sometimes better than new"**

Thank you