



Società Italiana di Ecografia Cardiovascolare

WWW.SIEC.IT



**ECOCARDIOGRAFIA 2015**  
**XVII Congresso Nazionale SIEC**

**Hotel Royal Continental**

**Napoli, 16-18 Aprile 2015**

*Imaging e Clinica nell'Embolia Polmonare*

**Pregi e difetti della TC**

*Fiore Manganelli, MD, FESC*

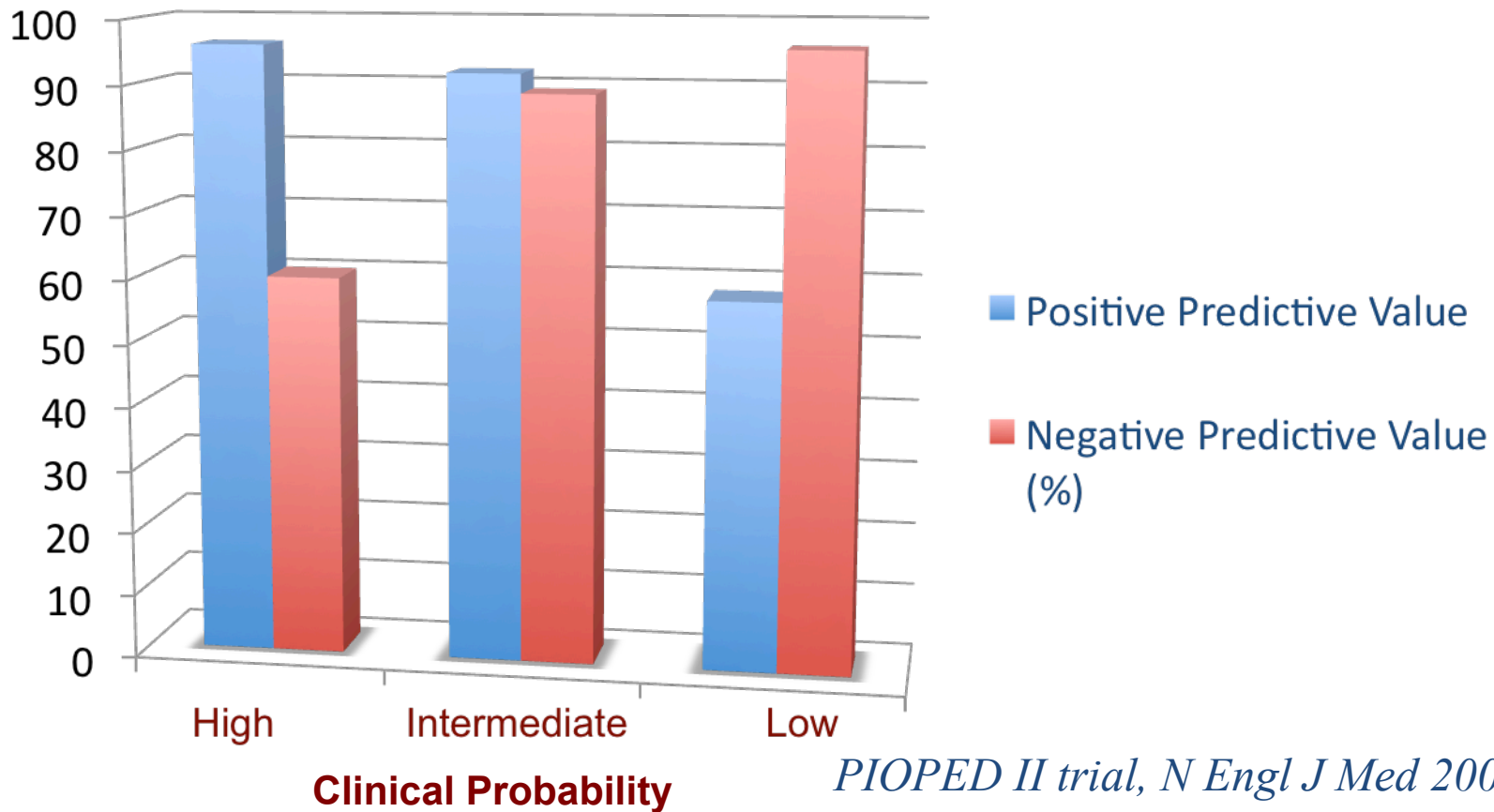
*U.O. Cardiologia-UTIC  
AORN "San G. Moscati"  
Avellino*

# Patient Pretest Probability for Pulmonary Embolism

- Clinical signs and symptoms of deep vein thrombosis (3.0 points)
- PE as more likely than an alternative diagnosis (3.0 points)
- Heart rate > 100/min (1.5 points)
- Immobilization or surgery in the previous 4 weeks (1.5 points)
- Previous DVT or PE (1.5 points)
- Hemoptysis (1.0 points)
- Malignancy (1.0 points)

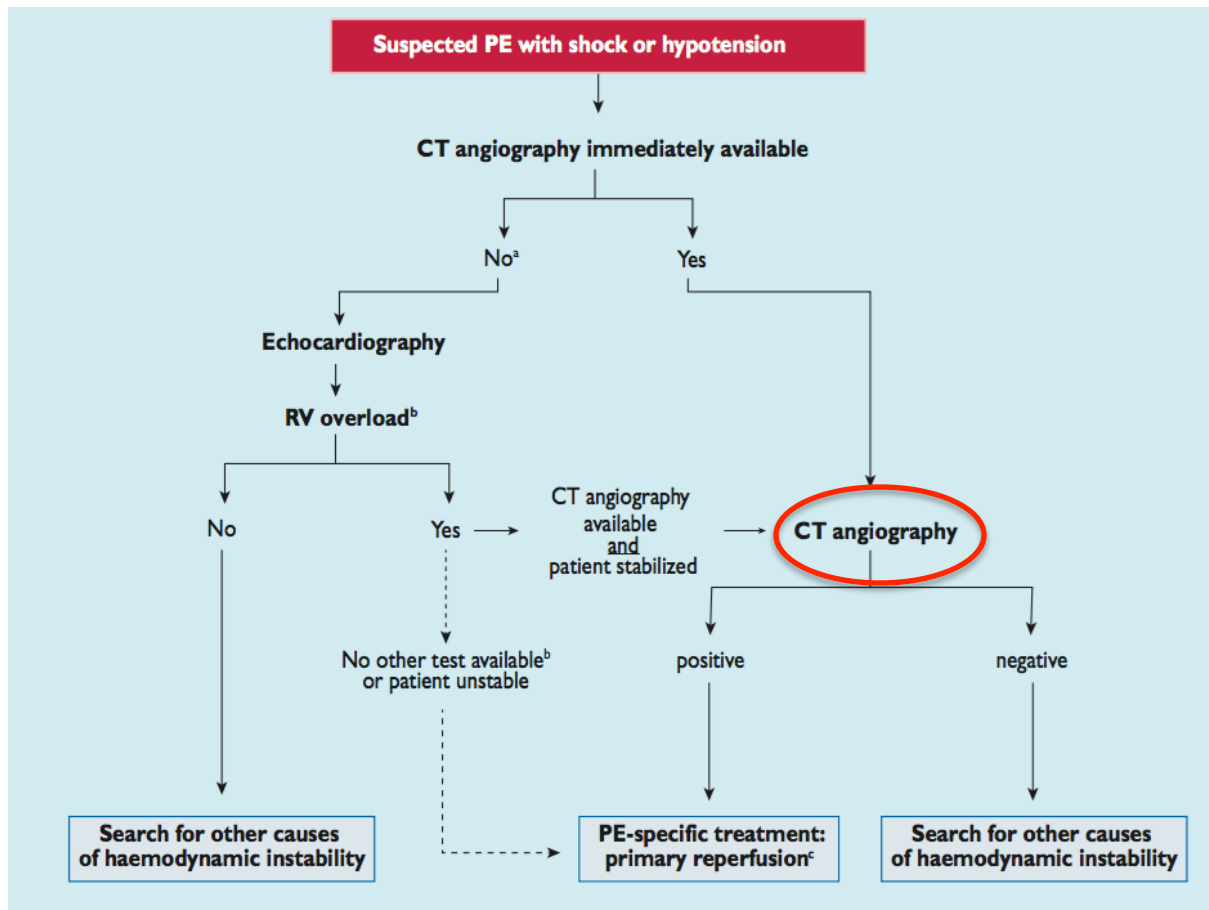
***PE unlikely if Wells score < 4.5; likely if Wells score  $\geq$  4.5***

# Influence of Clinical Assessment on Performance Diagnostic of Computed Tomographic Pulmonary Angiography

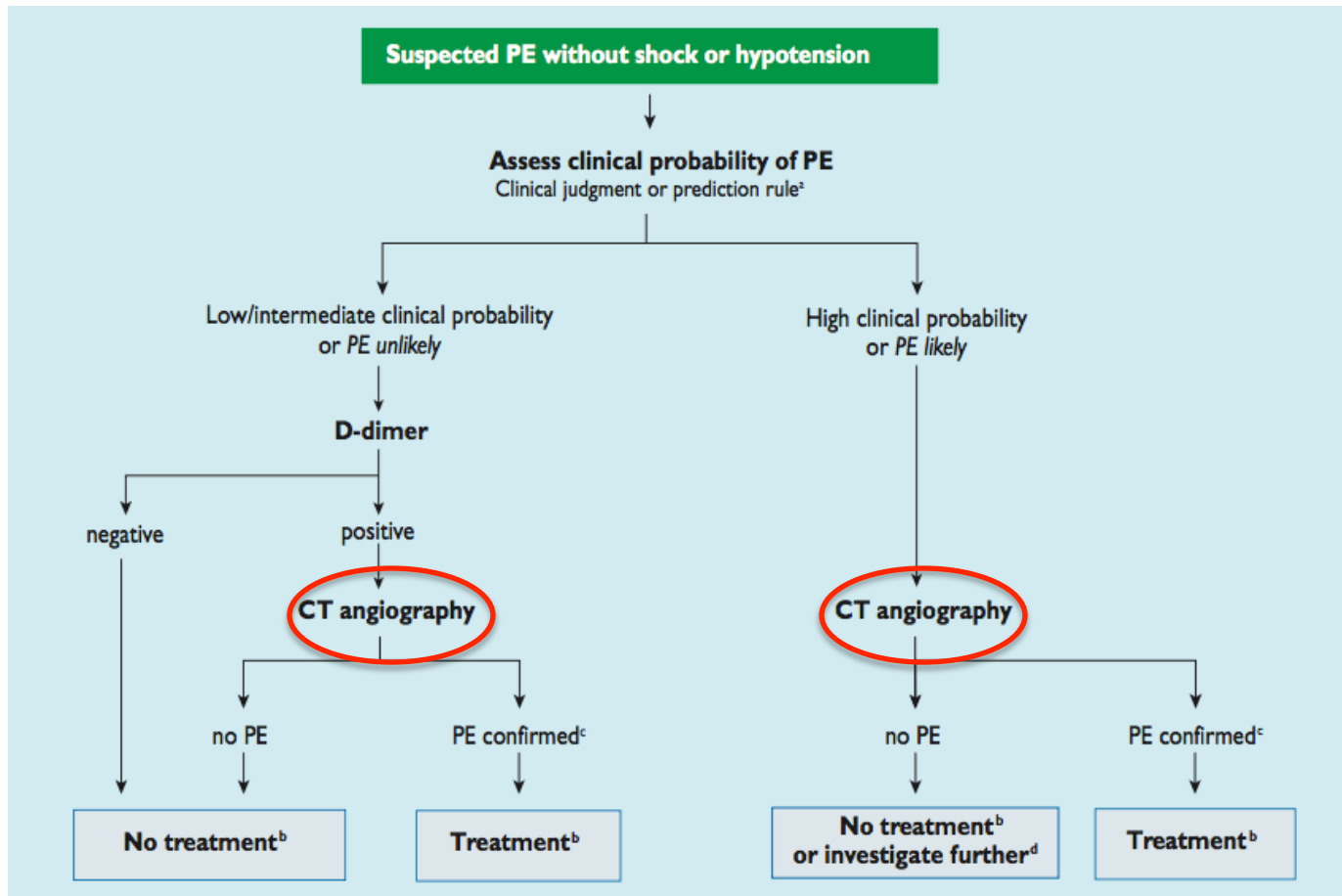


*PIOPED II trial, N Engl J Med 2006;354:2317*

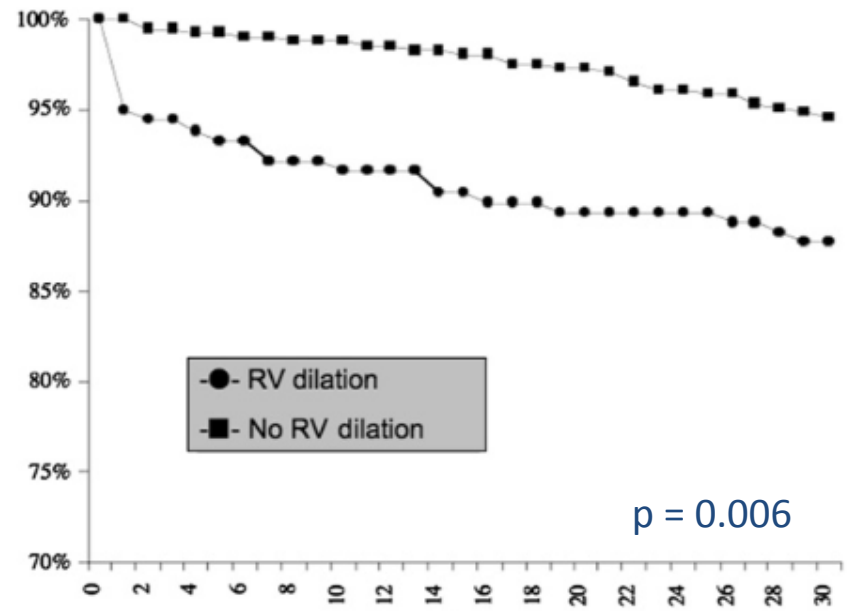
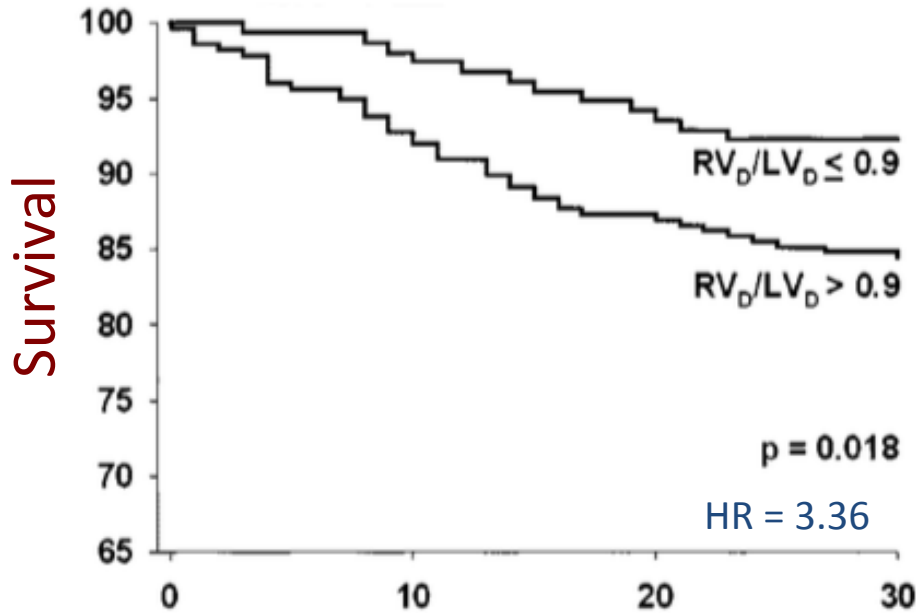
# Diagnostic algorithm for patients with suspected *high-risk* PE



# Diagnostic algorithm for patients with suspected *not high-risk* PE



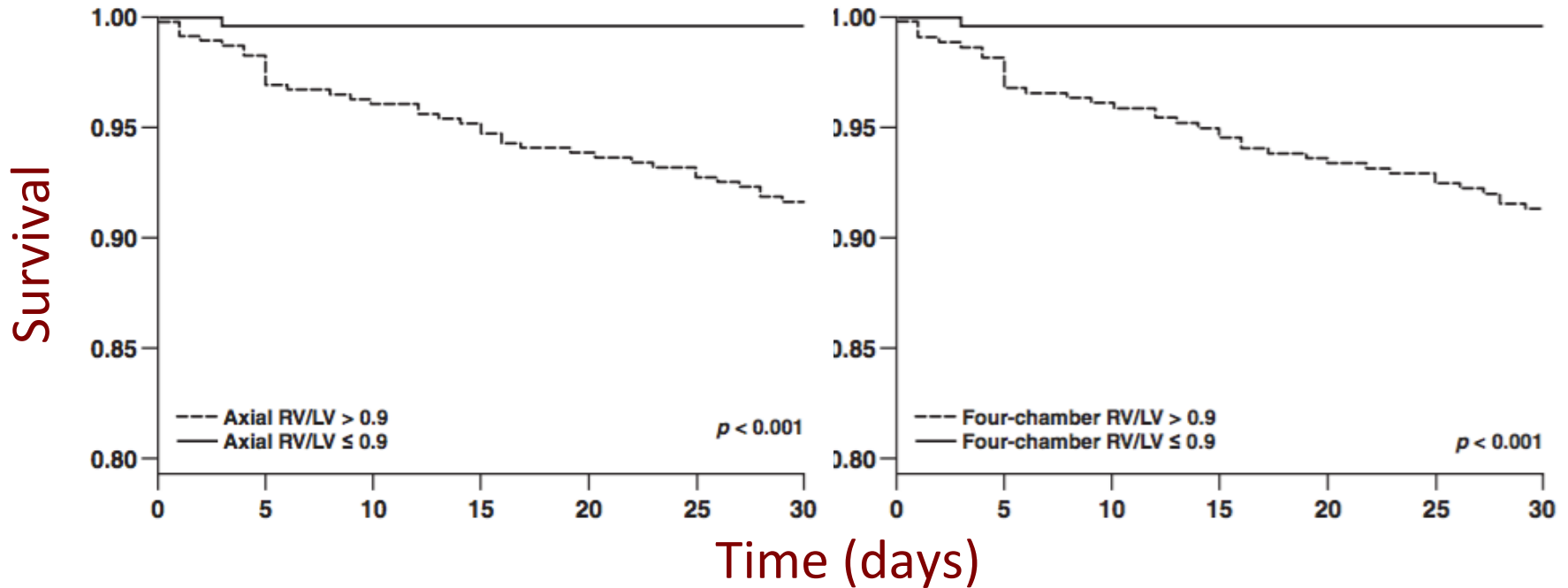
# Prognostic Value of Right Ventricular Dilatation on CTA



Time (days)

*Schoepf UJ et al, Circulation 2004;110:3276*  
*Singanayagam A et al, Respiratory Medicine 2010; 104:1057*

# Righ-to-Left Ventricle Diameter Ratios as Predictors of Early Death

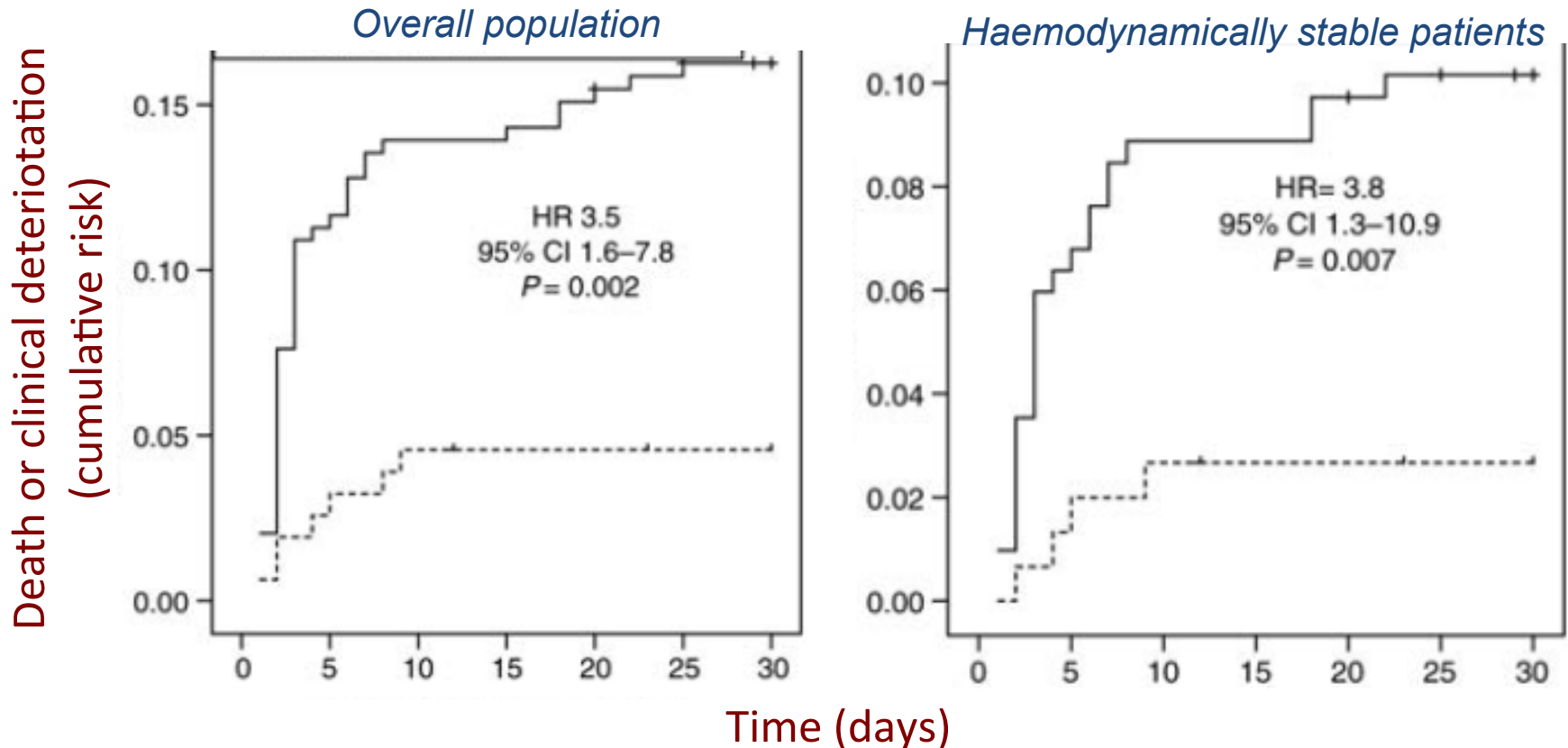


Retrospective study of 674 patients: 97 (14%) died within 30 days, 39 PE related. There were non significant differences in the univariate HR of axial and 4-ch RV/LV diameter ratios >0.9 for both for all-cause (2.13 vs 3.51) and PE-related (19.6 vs 21.8) mortality.

The axial RV/LV diameter ratio has a similar accuracy to the reformatted 4-ch RV/LV diameter ratio for predicting 30-day mortality.

## Multidetector computed tomography for acute pulmonary embolism: diagnosis and risk stratification in a single test

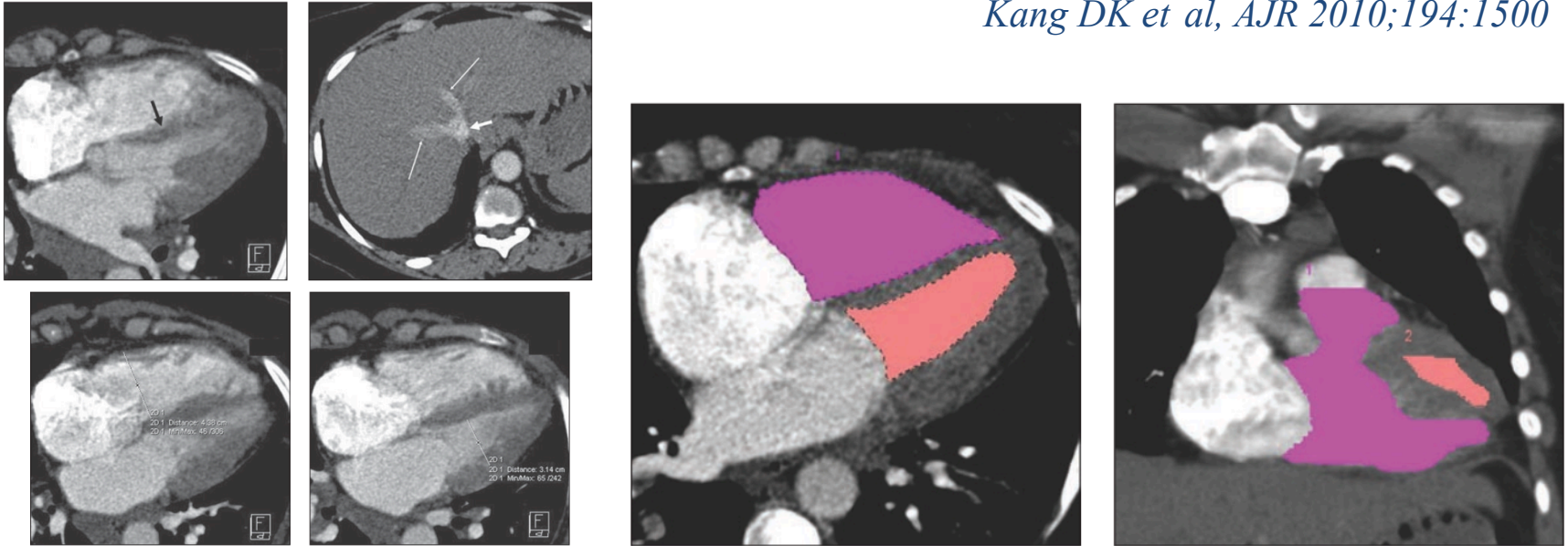
Cecilia Becattini<sup>1\*</sup>, Giancarlo Agnelli<sup>1</sup>, Maria Cristina Vedovati<sup>1</sup>, Piotr Pruszczyk<sup>2</sup>, Franco Casazza<sup>3</sup>, Stefano Grifoni<sup>4</sup>, Aldo Salvi<sup>5</sup>, Marina Bianchi<sup>6</sup>, Renée Douma<sup>7</sup>, Stavros Konstantinides<sup>8</sup>, Mareike Lankeit<sup>9</sup>, and Michele Durante<sup>10</sup>





# Reproducibility of CT Signs of Right Ventricular Dysfunction in acute PE

*Kang DK et al, AJR 2010;194:1500*



- Considerable differences exist in the interobserver reproducibility of CT findings of RV dysfunction in patients with acute PE.
- Cardiac chamber measurements are more reproducible than septal bowing and IVC reflux. Determination of the RVV/LVV ratio is the most reproducible.

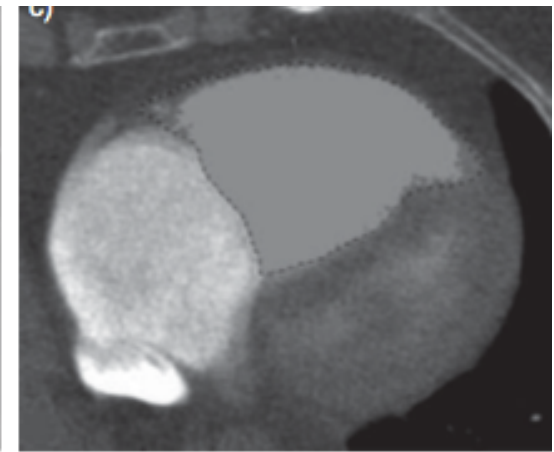
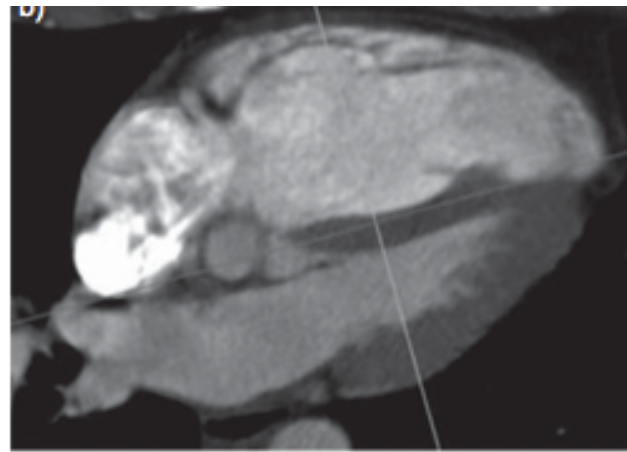
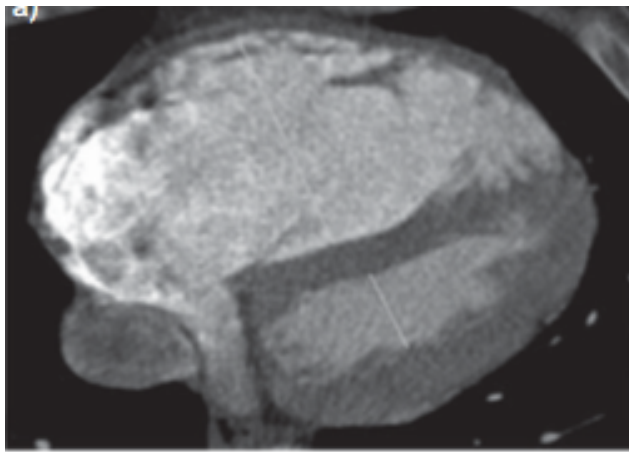
# CT Signs of Right Ventricular Dysfunction

## Prognostic Role in Acute Pulmonary Embolism

Doo Kyoung Kang, MD,\*†‡ Christian Thilo, MD,\*†§ U. Joseph Schoepf, MD,\*†  
J. Michael Barraza, JR, BS\*† John W. Nance, JR, MD\*† Gorka Bastarrika, MD, PHD,\*†||  
Joseph A. Abro, MA,\*† James G. Ravenel, MD,† Philip Costello, MD,†  
Samuel Z. Goldhaber, MD¶

*Charleston, South Carolina; Suwon, South Korea; Augsburg, Germany; Pamplona, Spain;  
and Boston, Massachusetts*

- 260 consecutive patients (21.9% adverse clinical outcome, 7.7% deaths)
- Abnormal position of the interventricular septum, inferior vena cava contrast reflux, RV/LV diameter ratio on axial sections and 4-CH views, and 3-D RV/LV volume ratio.
- Three-D *RV/LV volume ratio*  $> 1.2$  was the best independent predictor of early death (HR 6.49).

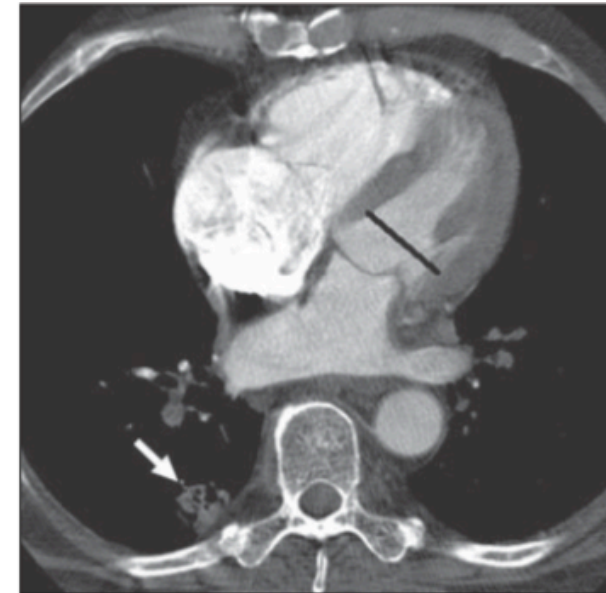
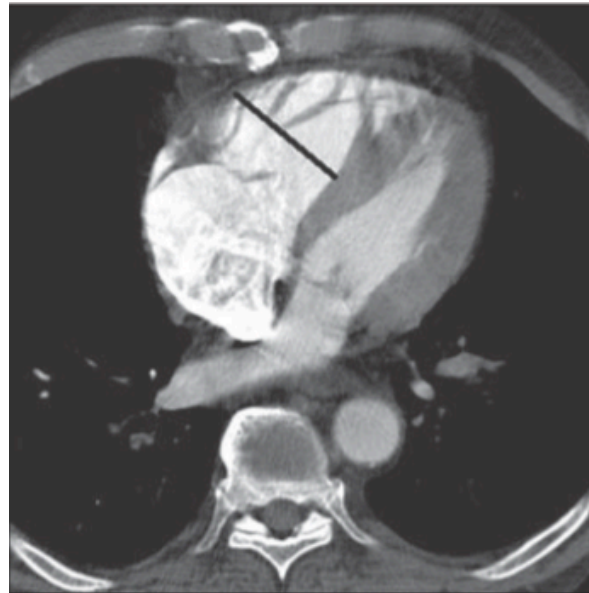
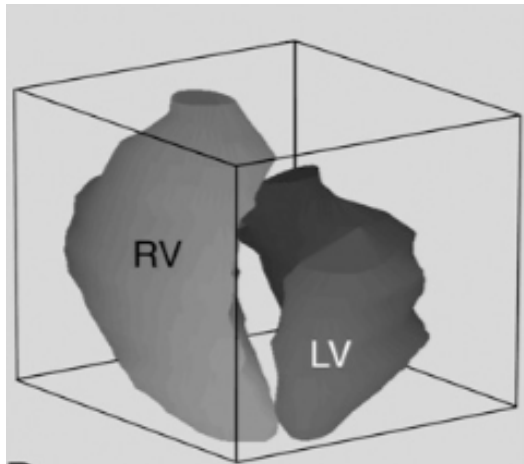
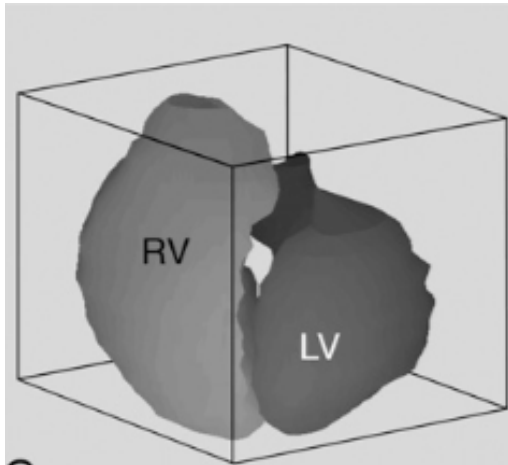


|                 | Sensitivity % | Specificity % | PPV % | NPV % | AUC  | Cut-off |
|-----------------|---------------|---------------|-------|-------|------|---------|
| RV/LV axial     | 82            | 83            | 68    | 92    | 0.84 | 1.18    |
| RV/LV 4 -ch     | 88            | 83            | 71    | 92    | 0.87 | 1.29    |
| RV/LV volume    | 88            | 85            | 82    | 95    | 0.93 | 1.34    |
| NT pro BNP ng/L | 75            | 80            | 60    | 88    | 0.83 | 1617    |
| Troponin I ng/L | 67            | 72            | 56    | 80    | 0.70 | 0.07    |

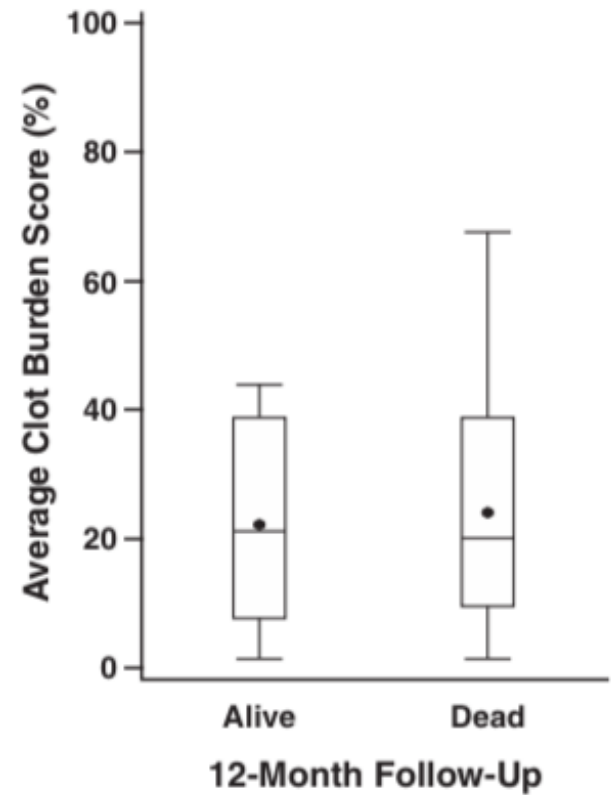
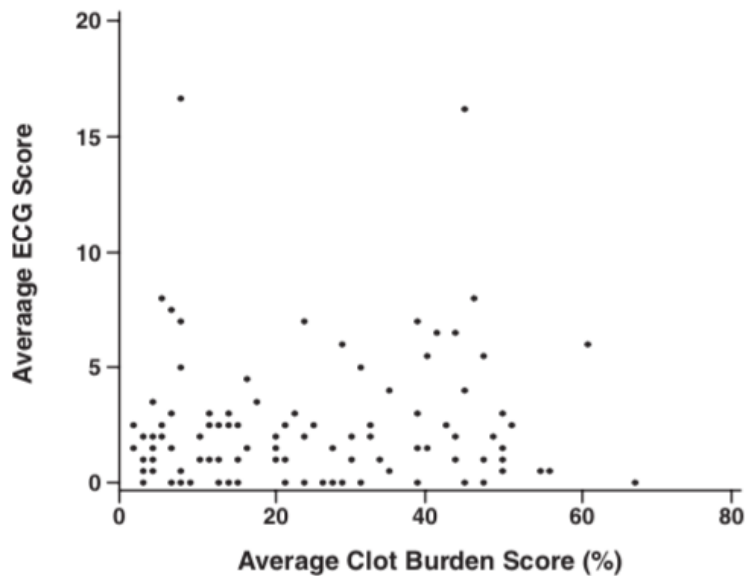
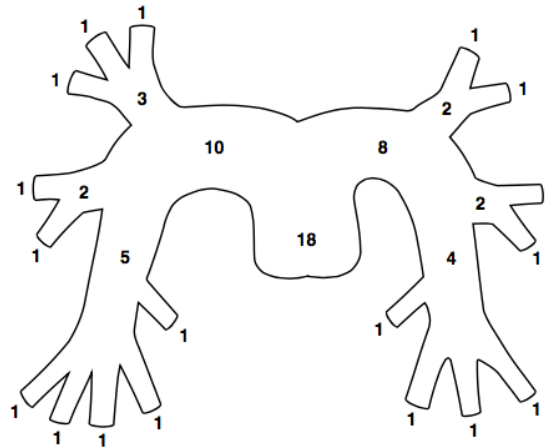
- RV/LV volume is the most accurate index for identifying RVD
- A combination of RV/LV volume with NT-pro-BNP or troponin I improves the diagnostic accuracy of either test alone

# Measurement of RV function by ECG-synchronized CT scan

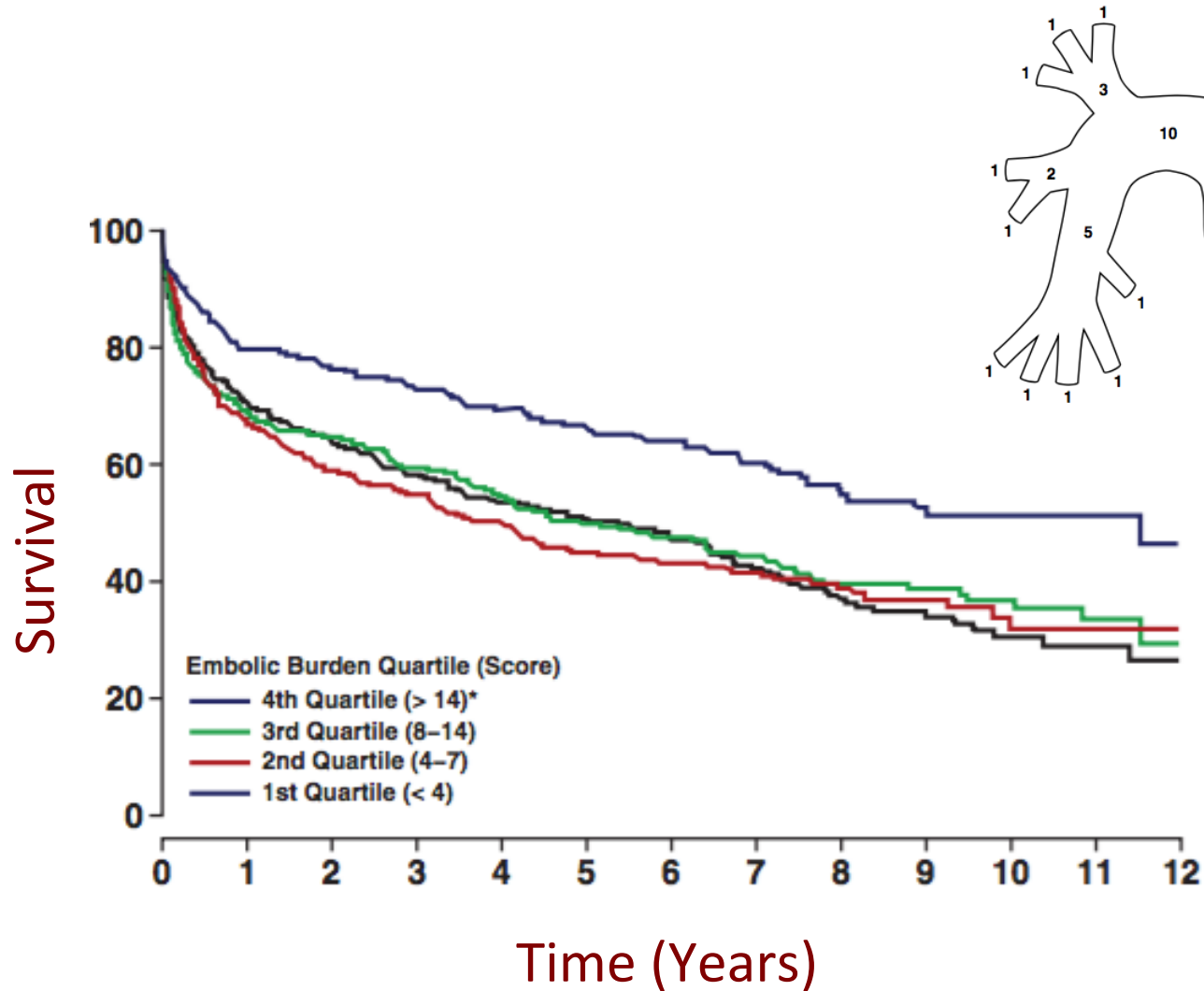
## Impact on short-term outcome



# A Prospective Evaluation of CT Clot Burden Score and ECG Score

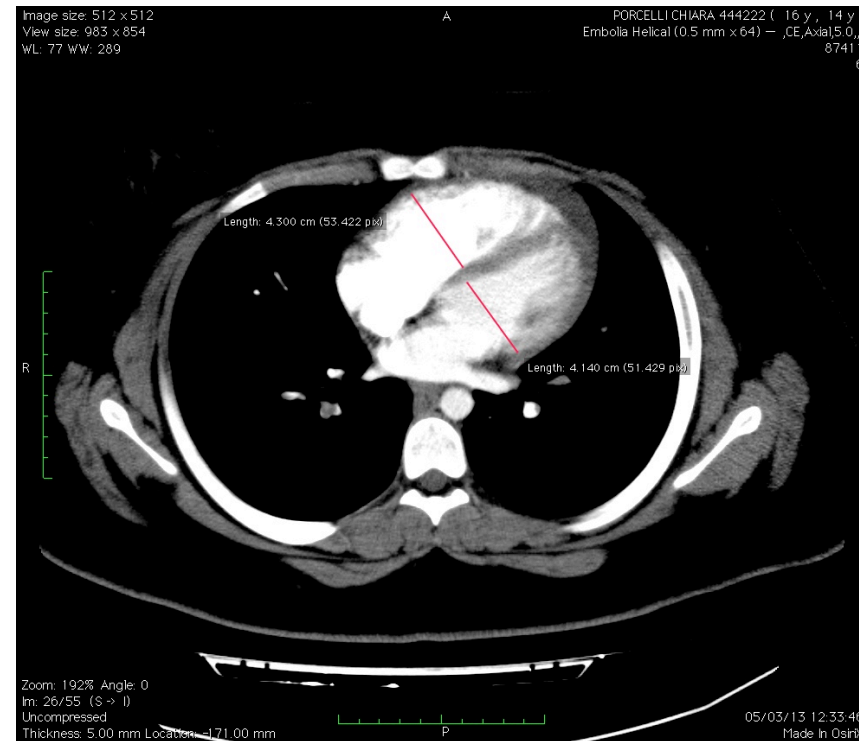


# Embololic Burden and Survival



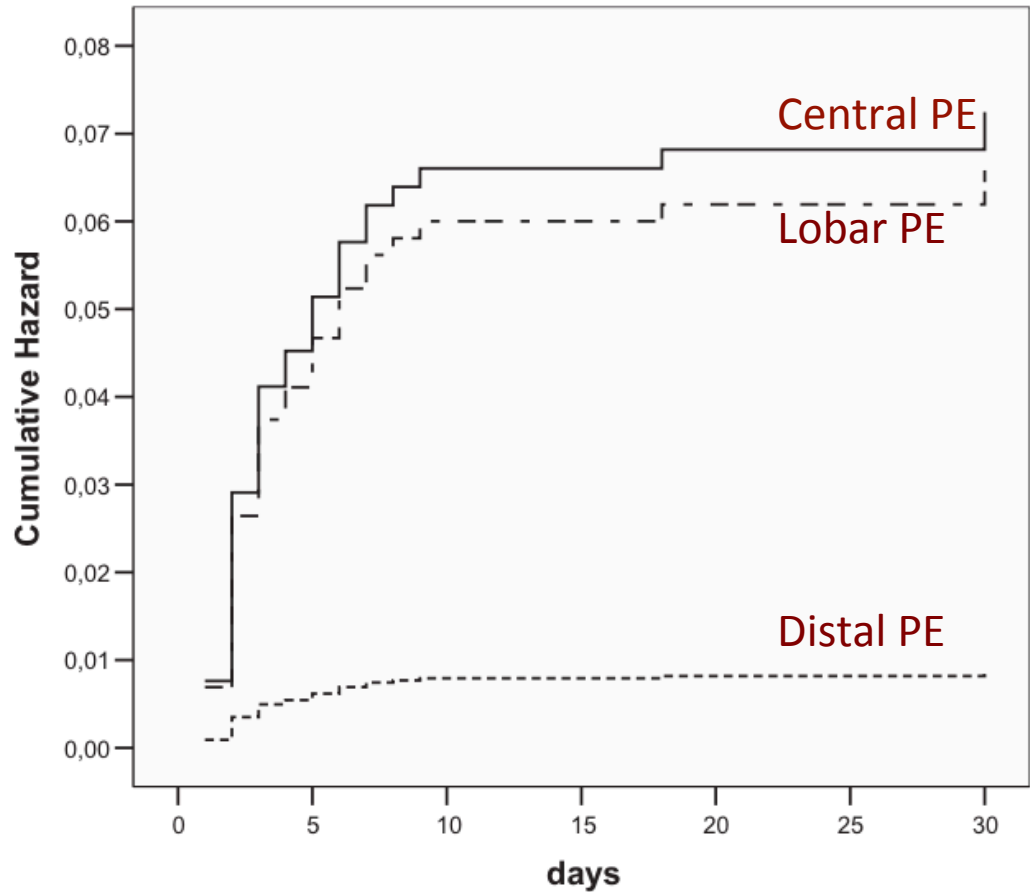
# Short-term Mortality in Acute Pulmonary Embolism: Clot Burden and Signs of Right Heart Dysfunction

- Retrospective study (635 patients)
- Mortality at 30 days: 39 pts (6%)
- There was no significant association between Quanadli score, Mastora score, blood clot volume and short-term mortality
- Only the increase in *RV/LV ratio* was independently associated with short-term mortality (cut-off value > 1)



# Prognostic role of embolic burden assessed by MDCT

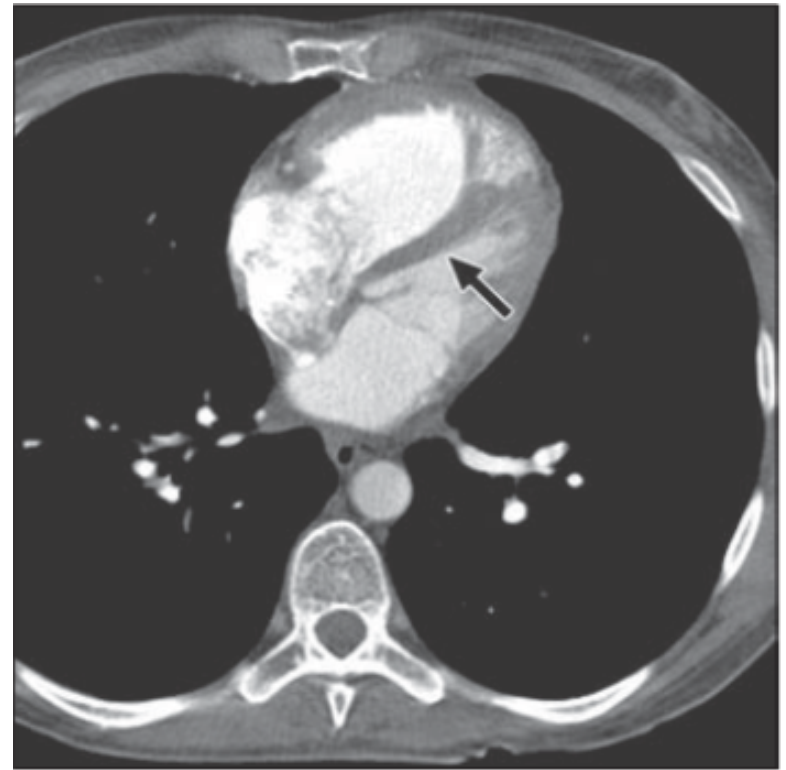
Of 579 patients, 60 (10.4%) died or had clinical deterioration at 30 days. In 516 hemodynamically stable patients, central localization of emboli (HR, 8.3; 95% CI, 1.0-67;  $P = .047$ ) was an independent predictor of all-cause death or clinical deterioration, whereas distal emboli were inversely associated with these outcome events (HR, 0.12; 95% CI, 0.015-0.97;  $P = .047$ ). *No correlation was found between obstruction index and outcome.*





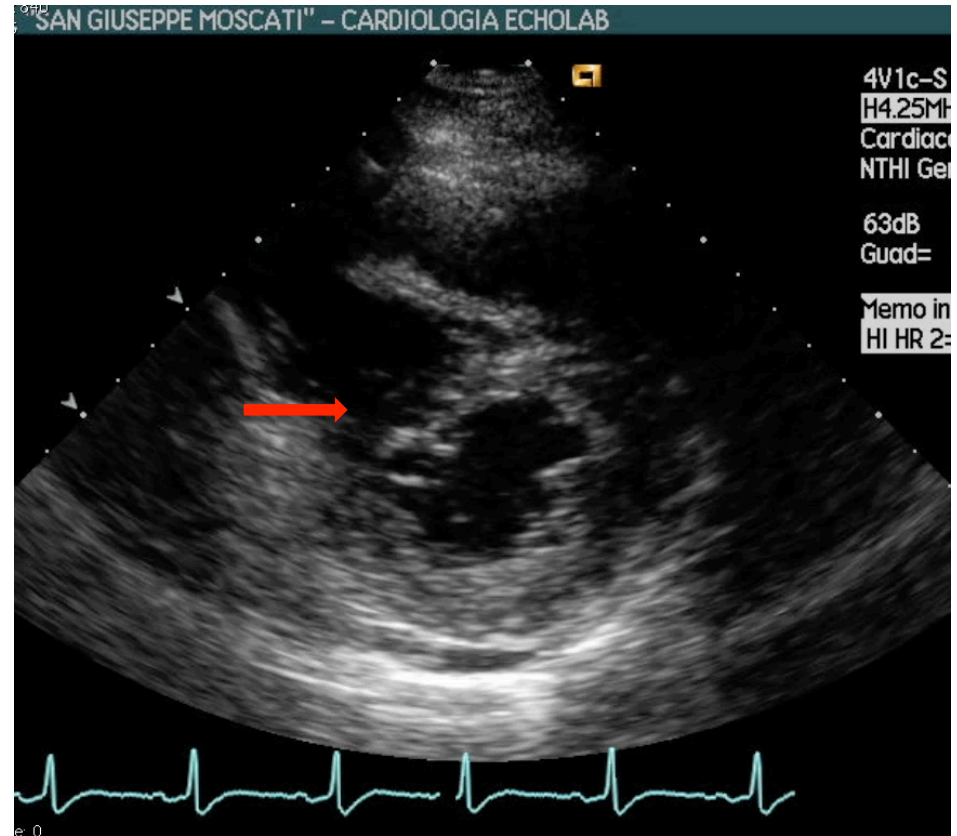
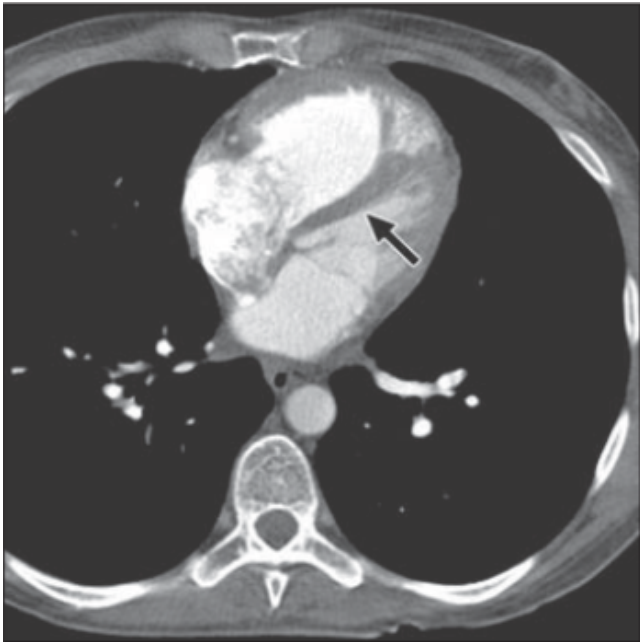
# Correlation of CT pulmonary artery obstruction scores with RV dysfunction and clinical outcome

- *Pulmonary artery obstruction scores can be an indicator of the severity of a current PE episode or of treatment effectiveness, but that they cannot be used as a predictor of RV failure and death.*
- Pulmonary artery obstruction scores are time consuming and unlikely to be justified in daily clinical practice.
- There is no uniformly accepted standard for evaluation of RV dysfunction on CT.



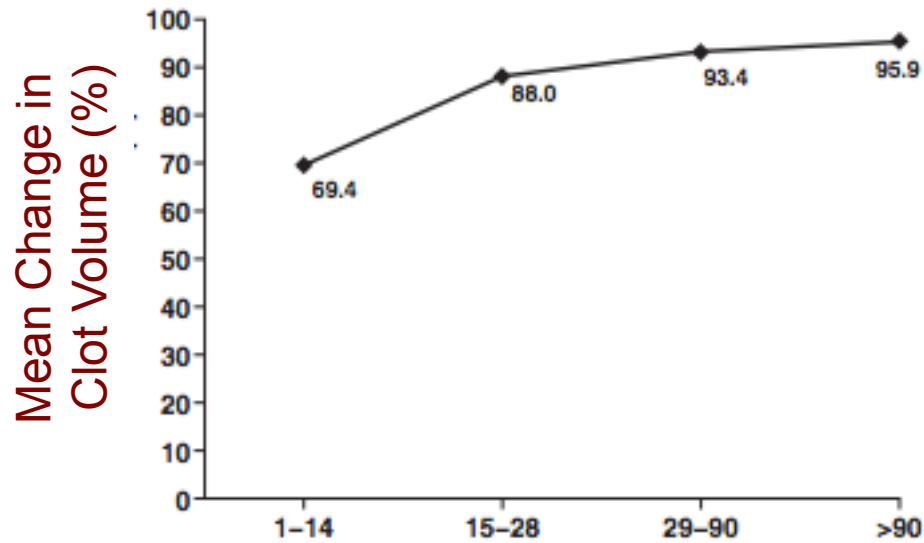
*Mansecal J et al, Am J Cardiol 2005; 95: 1260*  
*Apfaltrer P et al, Eur J Radiol 2012; 81: 2867*

# Lesson from echocardiography!

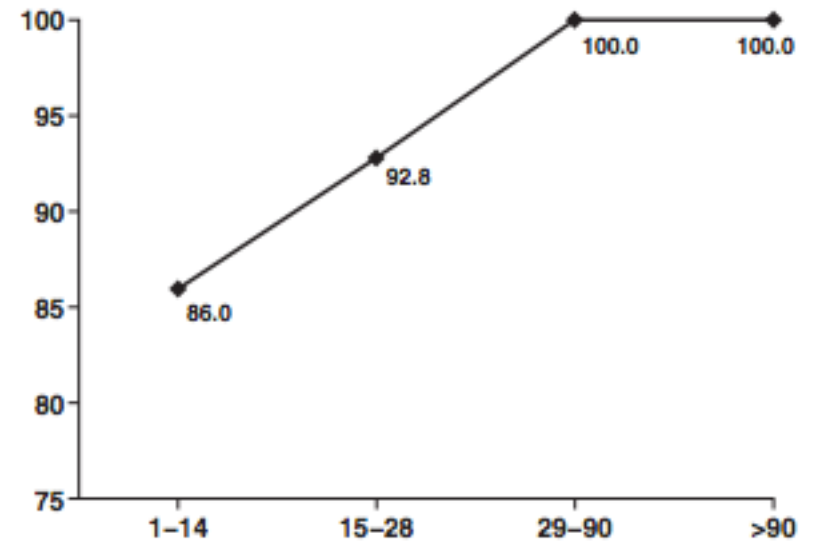


# The Rate of Resolution of Clot Burden Measured by Pulmonary CT Angiography

*Central Emboli*

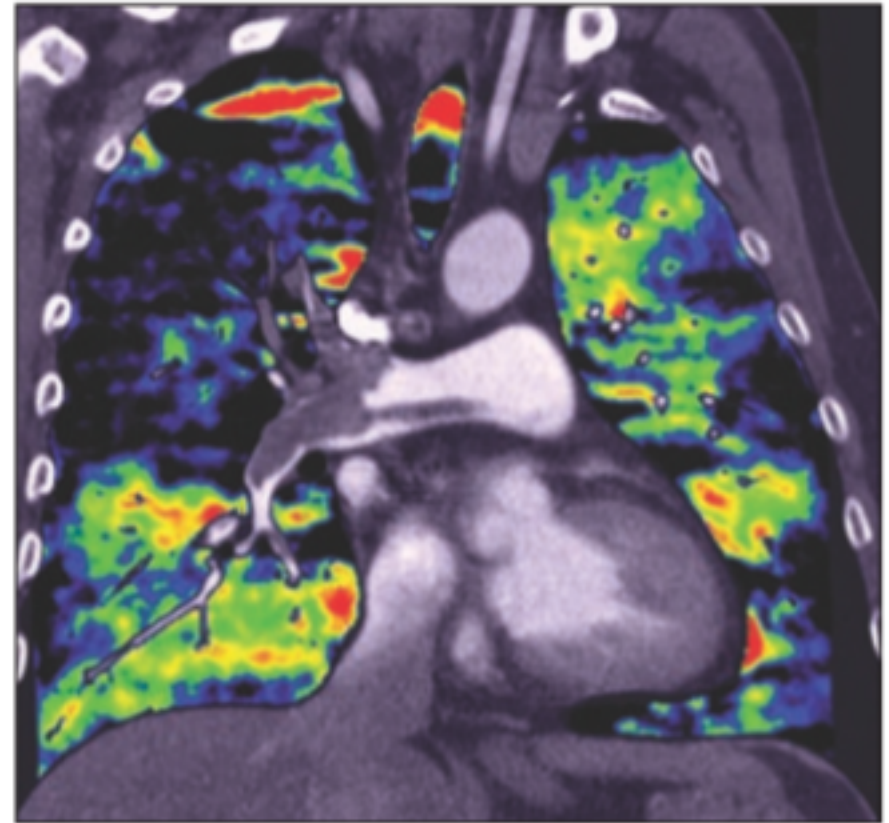
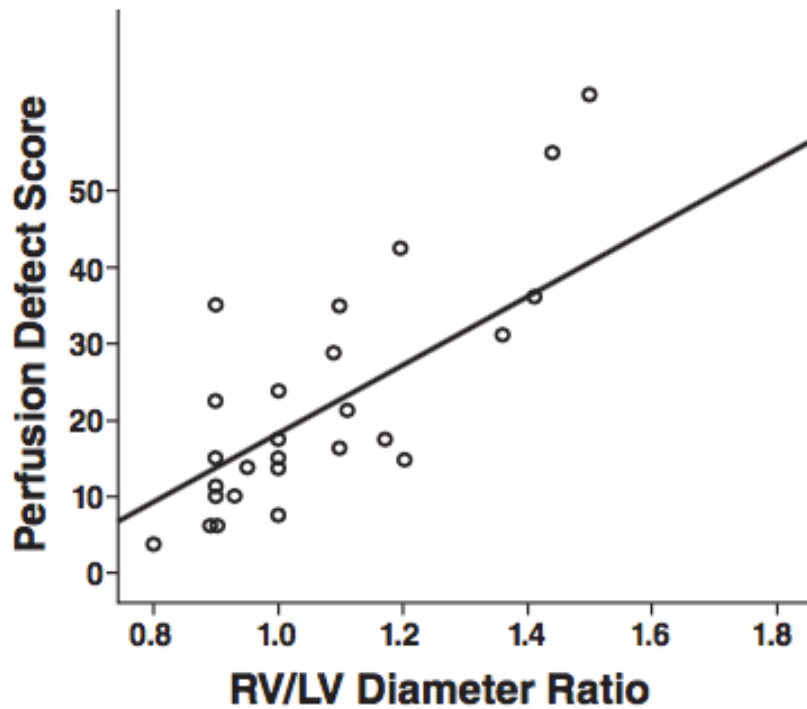


*Peripheral Emboli*

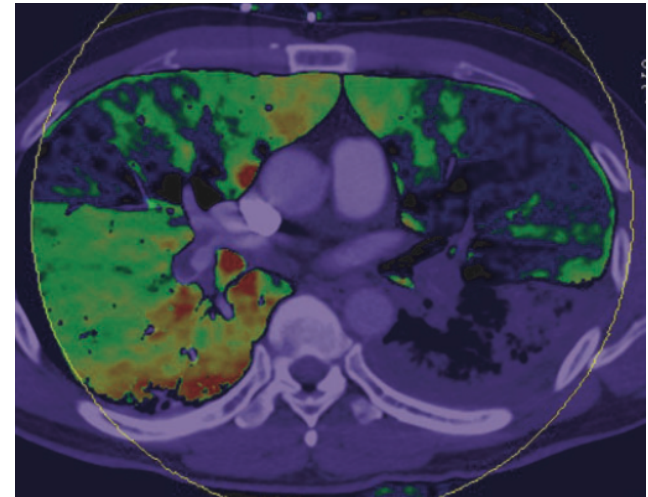


Time (Days)

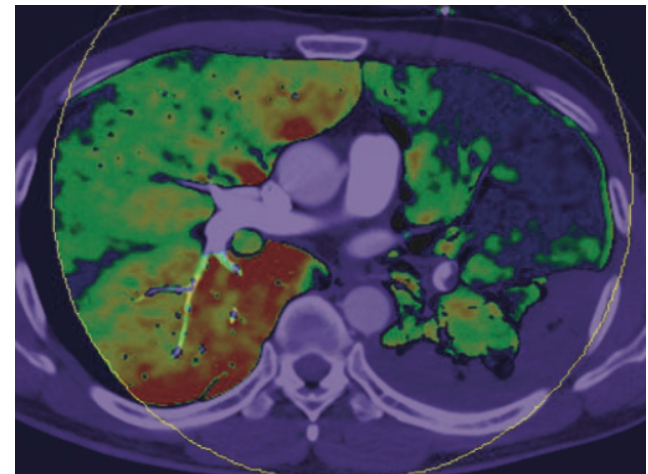
# Correlation between pulmonary perfusion defect score, obstruction angiographic score and RV/LV diameter ratio with dual-energy CT



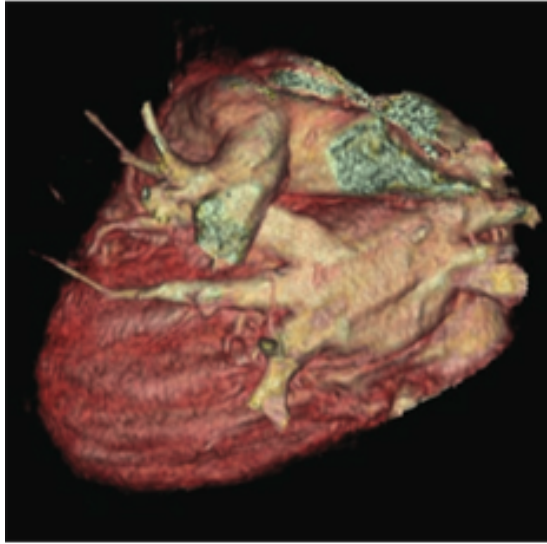
# Correlation between clot load score, pulmonary perfusion defect score and global right ventricular function with dual-source CT



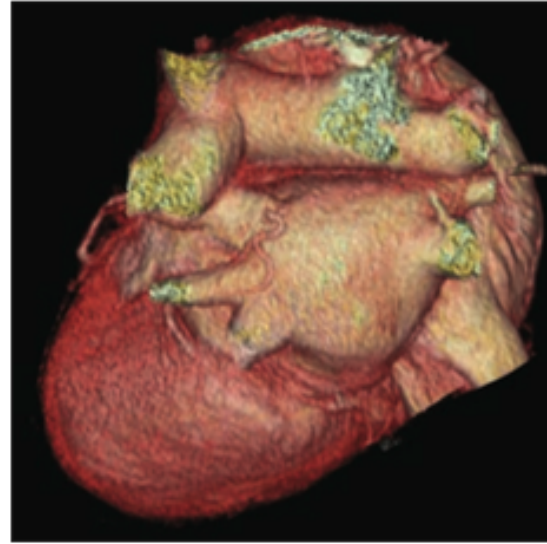
Post-thrombolysis



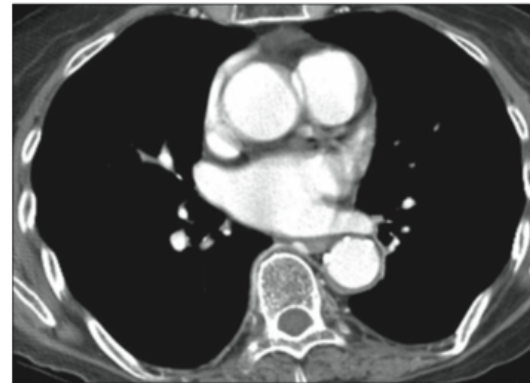
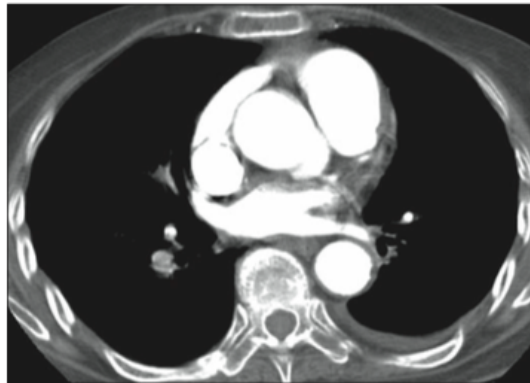
# CT evaluation of the left atrium, left atrial appendage, and pulmonary veins



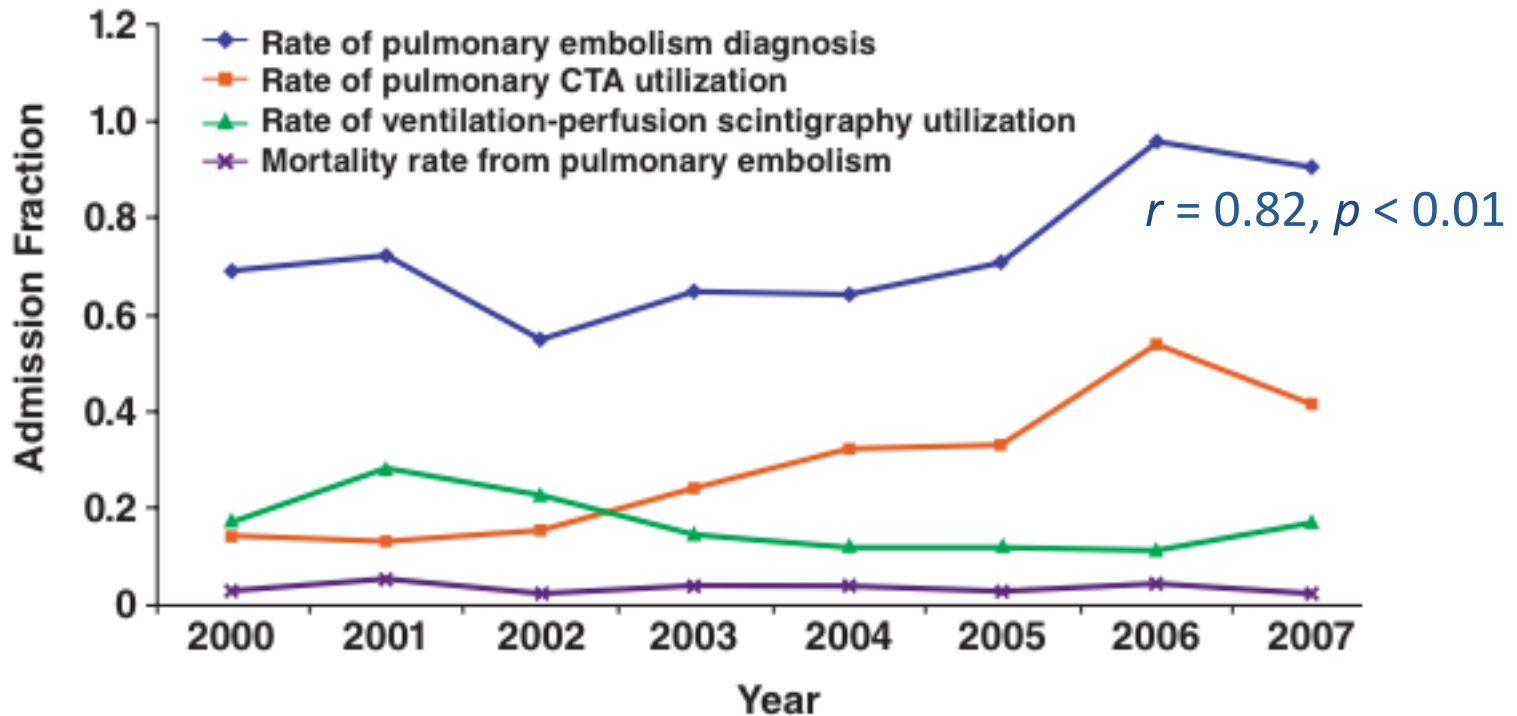
Massive PE

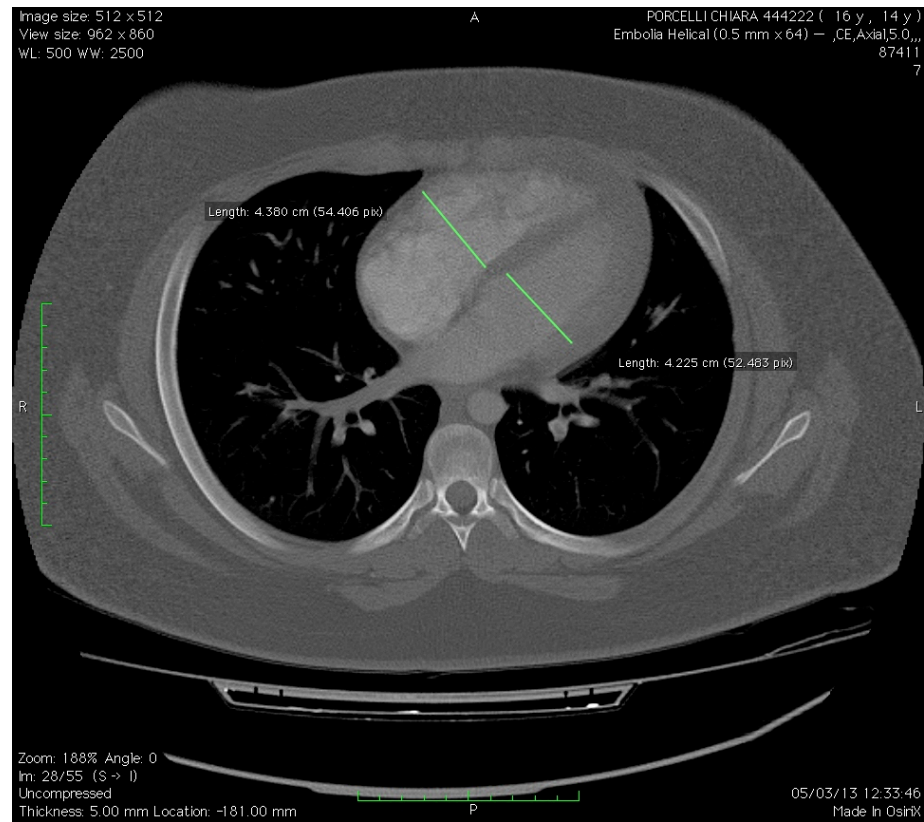
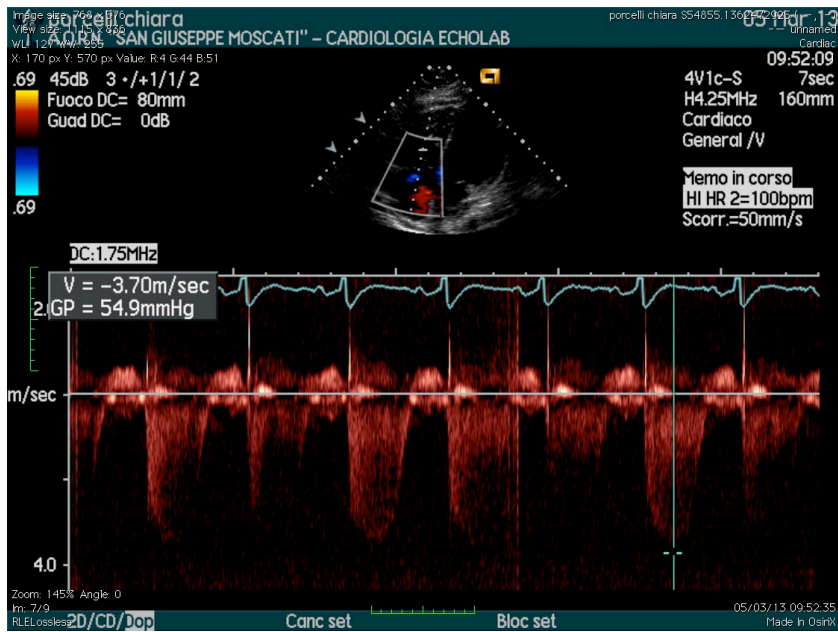
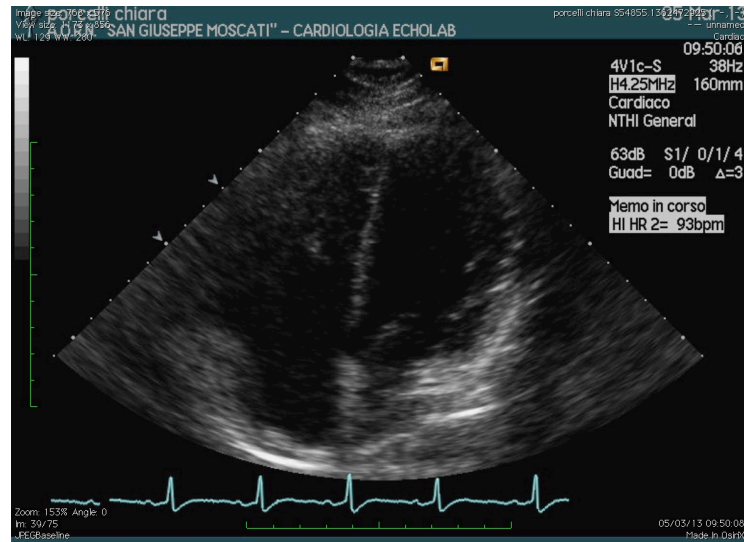
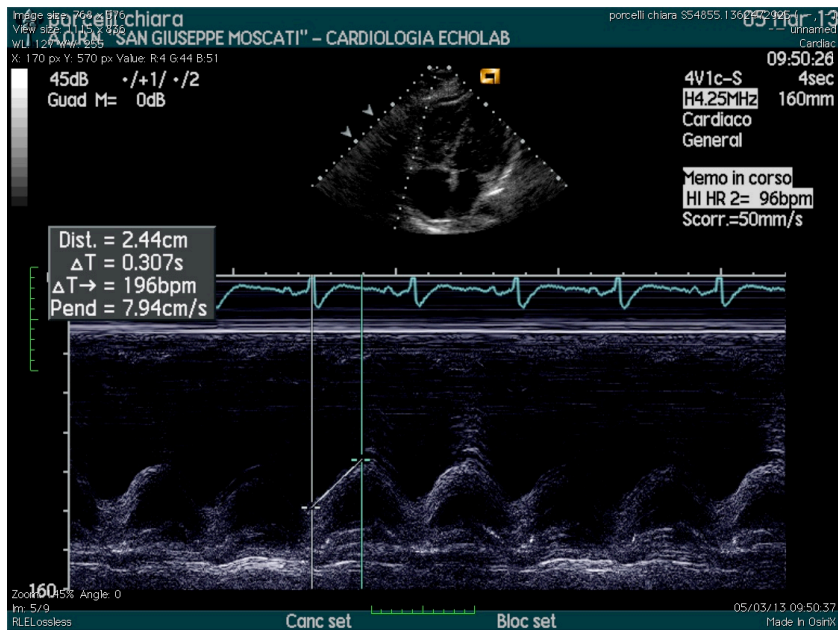


After thrombolysis



# Pulmonary Embolism Diagnosis and Mortality With Pulmonary CT Versus V/P Scintigraphy: Evidence of Overdiagnosis With CT?







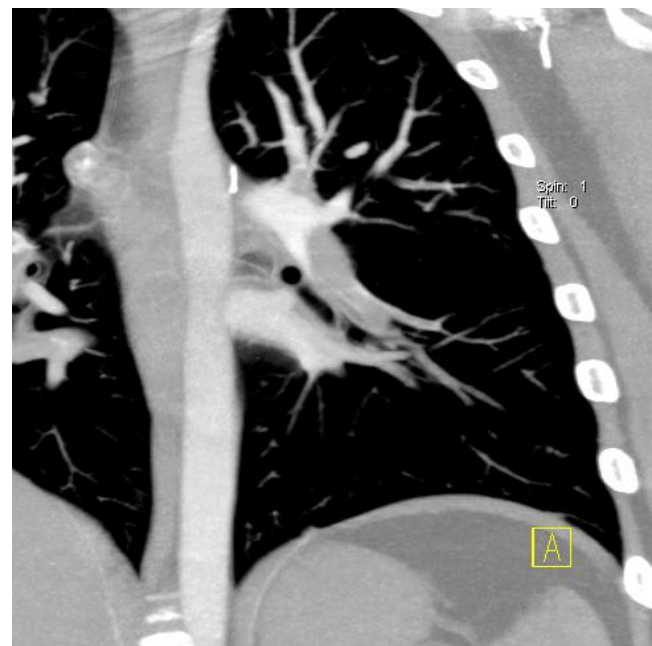
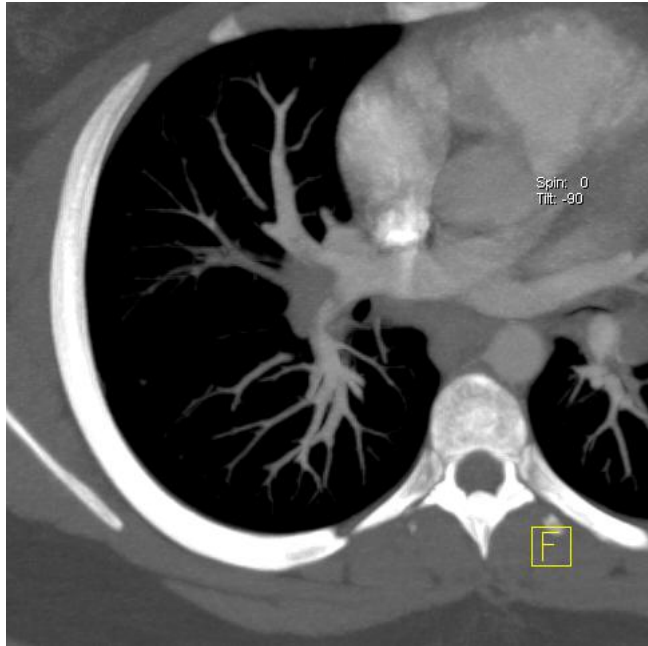
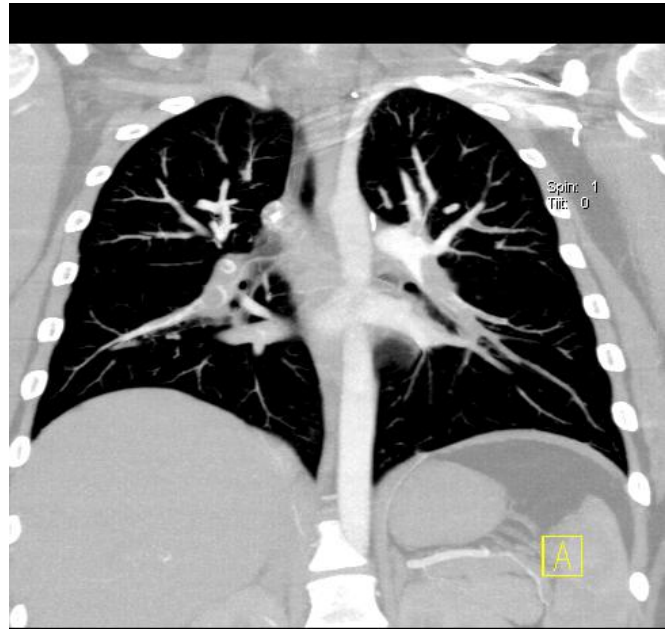
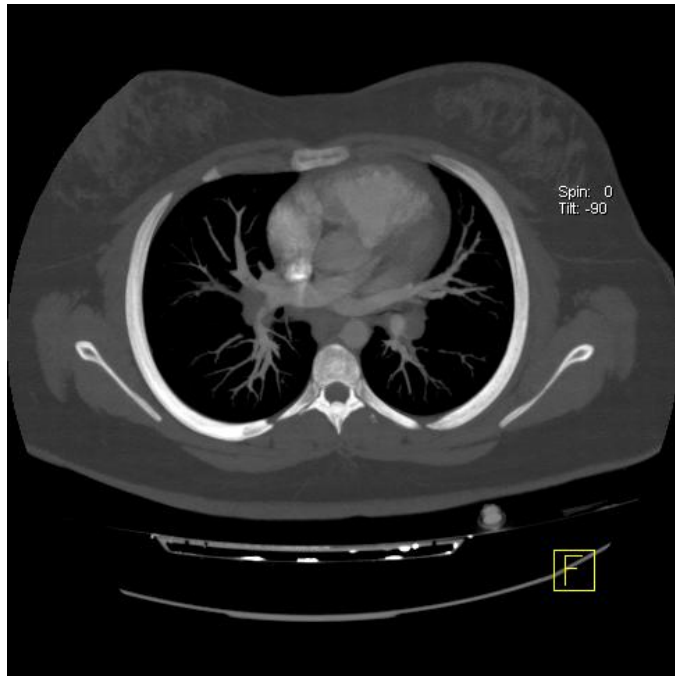


Image size: 512 x 512  
View size: 856 x 856  
WL: 72 WW: 451

S

PARZIALE SERGIO 627656 ( 73 y , 73 y )  
Embolia SureStart — ,CE,Cor+1P,5.0,Cor+1P,Cor+1P,  
87411

11



Zoom: 167% Angle: 0  
Im: 64/112 (A -> P)  
Uncompressed  
Thickness: 5.00 mm Location: 37.07 mm

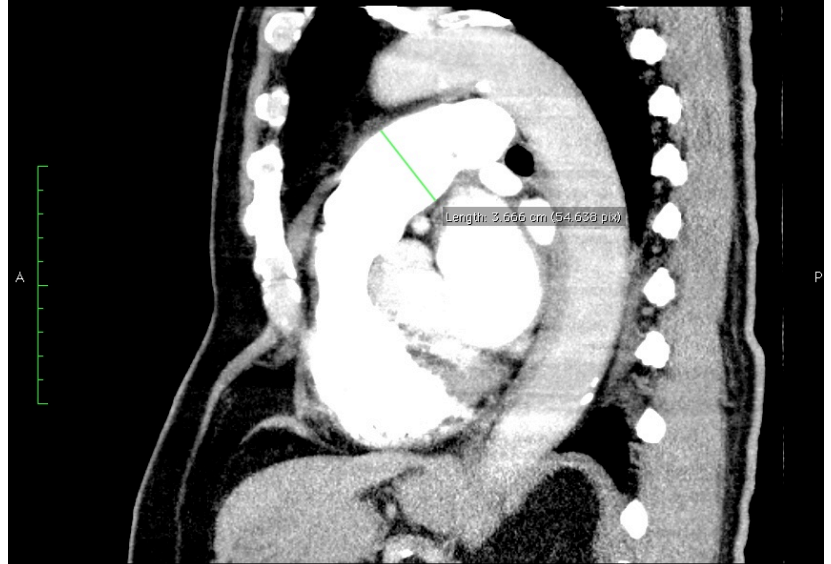
01/04/15 10:22:05  
Made In OsiriX

Image size: 512 x 512  
View size: 856 x 856  
WL: 50 WW: 250

S

PARZIALE SERGIO 627656 ( 73 y , 73 y )  
Embolia SureStart — ,CE,Sag+1P,5.0,Sag+1P,Sag+1P,  
87411

12



Zoom: 167% Angle: 0  
Im: 53/129 (L -> R)  
Uncompressed  
Thickness: 5.00 mm Location: 5.35 mm

01/04/15 10:22:24  
Made In OsiriX

Image size: 512 x 512  
View size: 1211 x 860  
WL: 127 WW: 255

PARZIALE SERGIO 627656 ( 73 y, 73 y )  
Embolia SureStart - unnamed  
87411  
356



Image size: 512 x 512  
View size: 1265 x 860  
WL: 127 WW: 255

PARZIALE SERGIO 627656 ( 73 y, 73 y )  
Embolia SureStart - unnamed  
87411  
360



Image size: 512 x 512  
View size: 1372 x 860  
WL: 127 WW: 255

PARZIALE SERGIO 627656 ( 73 y , 73 y )  
Embolia SureStart — unnamed

87411  
362



Zoom: 268% Angle: 0  
Im: 1/1  
Uncompressed  
Position: HFS

10.00mm/div

01/04/15 09:18:49  
Made In OsiriX

# La Tac è un Gigante?



# Golia contro Davide

