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RICCIONE 13-15 MAGGIO 2022

RUOLO PROGNOSTICO DELL'ECOCARDIOGRAFIA TRANSTORACICA NELLA PREDIZIONE DEL DECESSO INTRAOSPEDALIERO NEI PAZIENTI CON EMBOLIA POLMONARE

MD, Andrea Portoraro (1), MD,Marcello Benedetto (1), MD, Irma Sofia Fabbri (1), MD, Teresa Pagano (1), MD, Luca D'Angelo(1), MD, Giorgio Galizia (1), Rita Previati (2), MD, Michele Domenico Spampinato (1, 2), MD e Roberto De Giorgio (1), PhD.

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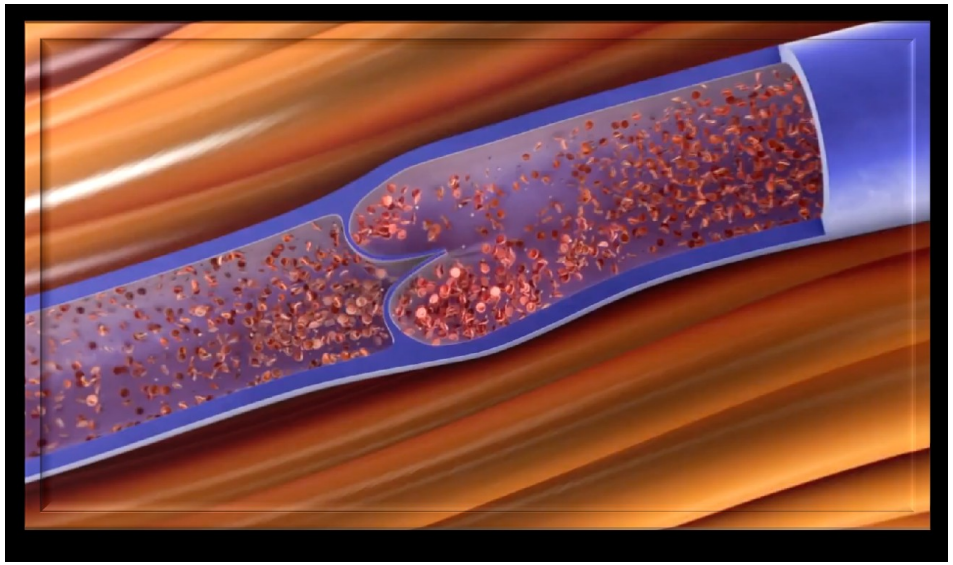
Tromboembolismo venoso (TEV)

- Il tromboembolismo venoso, clinicamente manifesto come TVP o PE, rappresenta la terza causa più frequente a livello globale di sindrome acuta cardiovascolare subito dopo infarto cardiaco e stroke
- Incidenza annuale per la PE: 39-115 casi per 100.000 persone
- Incidenza annuale per la TVP: 53-162 casi per 100.000 persone

ESC European Society of Cardiology
European Heart Journal (2019) **00**, 1–61
doi:10.1093/eurheartj/ehz405
ESC GUIDELINES

2019 ESC Guidelines for the diagnosis and management of acute pulmonary embolism developed in collaboration with the European Respiratory Society (ERS)



Epidemiologia

«Time trend analyses in European, Asian, and North American populations suggest that case fatality rates of acute PE may be decreasing. Increased use of more effective therapies and interventions, and possibly better adherence to guidelines has most likely exerted a significant positive effect on the prognosis of PE in recent years. However, there is also a tendency towards overdiagnosis of (subsegmental or even non-existent) PE in the modern era and this might in turn lead to a false drop in case fatality rates by inflating the denominator, i.e. the total number of PE cases.»

2019 ESC Guidelines for pulmonary embolism

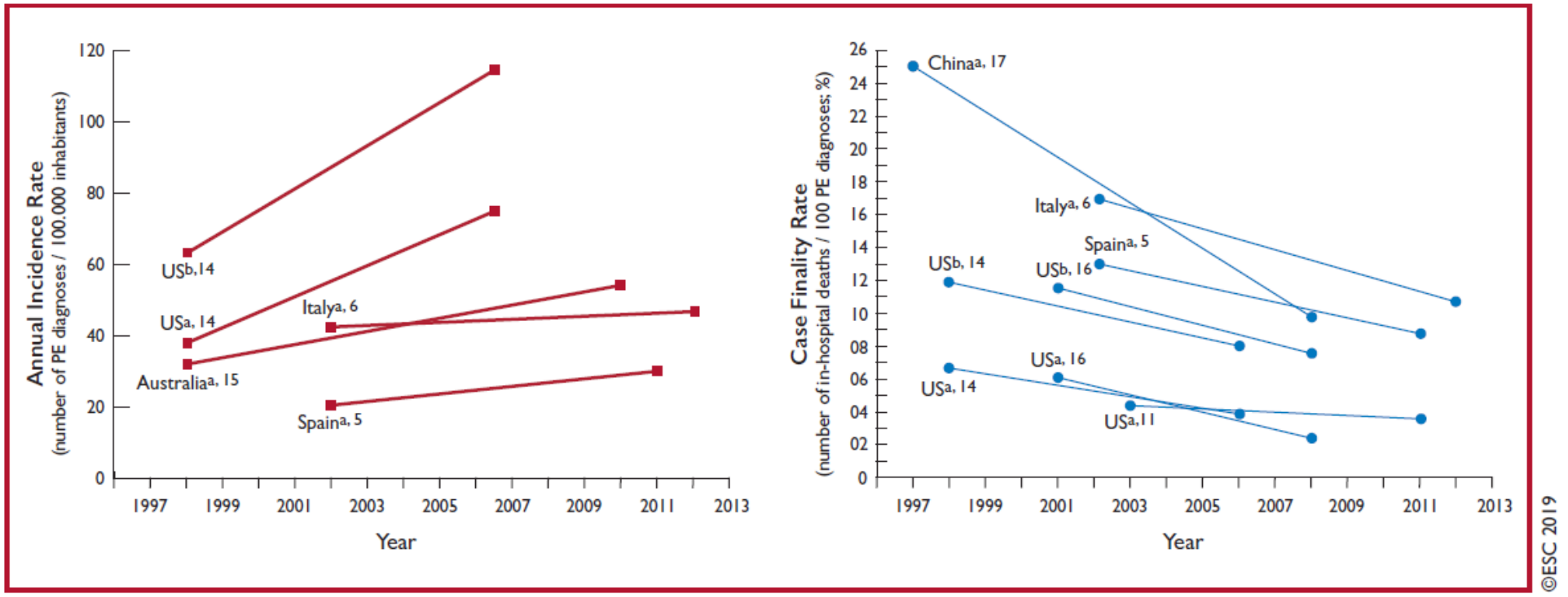


Figure 1 Trends in annual incidence rates (left panel) and case fatality rates (right panel) of pulmonary embolism around the world, based on data retrieved from various references.[5,6,11,14–17] Reproduced with permission from JACC 2016;67:976-90. PE = pulmonary embolism; US = United States.

[a]PE listed as principal diagnosis.

[b]Any listed code for PE was considered.

Stratificazione dell'embolia polmonare

5.7 Recommendations for prognostic assessment

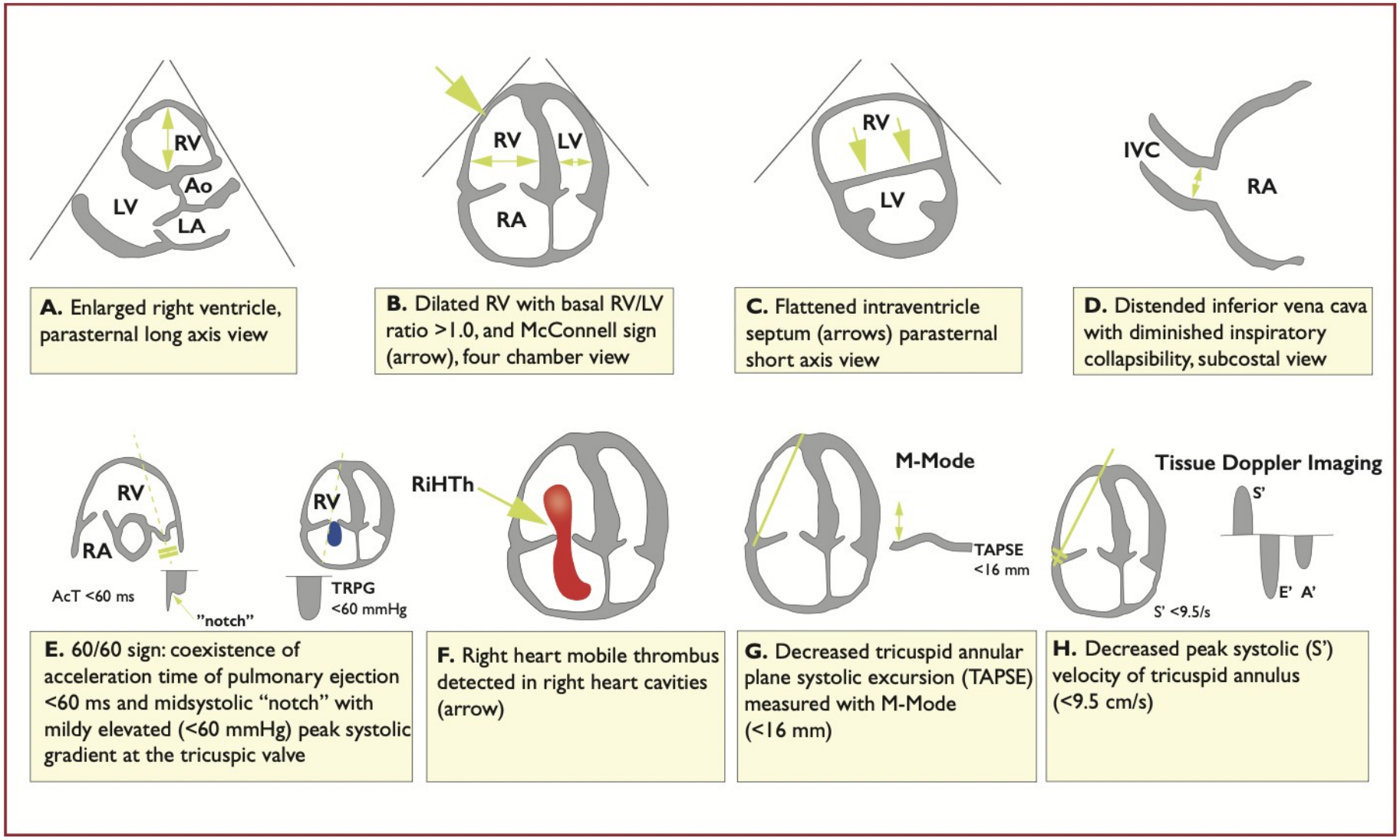
Recommendations	Class[a]	Level[b]
Initial risk stratification of suspected or confirmed PE, based on the presence of haemodynamic instability, is recommended to identify patients at high risk of early mortality.[218,219,235]	I	B
In patients without haemodynamic instability, further stratification of patients with acute PE into intermediate- and low-risk categories is recommended.[179,218,219,235]	I	B
In patients without haemodynamic instability, use of clinical prediction rules integrating PE severity and comorbidity, preferably the PESI or sPESI, should be considered for risk assessment in the acute phase of PE.[178,226,229]	IIa	B
Assessment of the RV by imaging methods[c] or laboratory biomarkers[d] should be considered, even in the presence of a low PESI or a negative sPESI.[234]	IIa	B
In patients without haemodynamic instability, use of validated scores combining clinical, imaging, and laboratory PE-related prognostic factors may be considered to further stratify the severity of the acute PE episode.[218 223]	IIb	C

Stratificazione di severità e mortalità nella TEP

Table 8 **Classification of pulmonary embolism severity and the risk of early (in-hospital or 30 day) death**

Early mortality risk		Indicators of risk			
		Haemodynamic instability[a]	Clinical parameters of PE severity and/or comorbidity: PESI class III–V or sPESI ≥I	RV dysfunction on TTE or CTPA[b]	Elevated cardiac troponin levels[c]
High		+	(+)[d]	+	(+)
Intermediate	Intermediate–high	-	+[e]	+	+
	Intermediate–low	-	+[e]	One (or none) positive	
Low		-	-	-	Assesment optional; if assessed, negative

Stratificazione di severità e mortalità nella TEP



A. Enlarged right ventricle, parasternal long axis view

B. Dilated RV with basal RV/LV ratio >1.0, and McConnell sign (arrow), four chamber view

C. Flattened intraventricle septum (arrows) parasternal short axis view

D. Distended inferior vena cava with diminished inspiratory collapsibility, subcostal view

E. 60/60 sign: coexistence of acceleration time of pulmonary ejection <60 ms and midsystolic "notch" with mildy elevated (<60 mmHg) peak systolic gradient at the tricuspic valve

F. Right heart mobile thrombus detected in right heart cavities (arrow)

G. Decreased tricuspid annular plane systolic excursion (TAPSE) measured with M-Mode (<16 mm)

H. Decreased peak systolic (S') velocity of tricuspid annulus (<9.5 cm/s)

Obiettivo dello studio

- Valutare quale tra i segni di disfunzione del ventricolo destro è maggiormente predittore di mortalità intraospedaliera.

- TAPSE in mm
- PAPS mmHg
- FE Vsn
- Rapporto VDx/VSx
- D-Shape
- Dimensioni e collassabilità V.Cava

Il nostro studio

- Studio retrospettivo monocentrico condotto presso l'Arcispedale Sant'Anna di Ferrara

- Arruolati pazienti maggiorenni ricoverati da Pronto Soccorso tra l'1/1/2018 e il 31/5/2021 con diagnosi di EP ai quali è stata eseguito l'ecocolordoppler cardiaco trans toracico nei primi 5 giorni dalla diagnosi di EP

- Sono stati registrati:
  - anamnesi;
  - parametri vitali;
  - esami laboratoristici e strumentali
  - calcolata la classe di rischio ESC

Risultati

	Pazienti totali, N=227	Pazienti sopravvissuti, N=217 (95,6)	Decesso intraospedaliero N=10 (4,4)	P-value
Uomini, N (%)	103 (45.5)	99 (45.6)	4 (40)	0,47
Età>80aa	70 (30.8)	66 (30.4)	4 (40)	0,415
Età, media (DS), years	71,13 (15,365)	71,08 (15,422)	71,42 (14,969)	0,94
Storia di neoplasia	51 (22.5)	47 (21.7)	4 (40)	0,156
Storia di scompenso cardiaco	22 (9.7)	21 (9.7)	1 (10)	0,919
Patologia cronica polmonare	26 (11.5)	25 (11.6)	1 (10)	0,658
Recente immobilità > 4 giorni	41 (18.1)	37 (17.1)	4 (40)	***0,037***
Pregressa TVP	41 (18.1)	39 (18.1)	2 (22.2)	0,961
Riscontro di contestuale TVP	131 (61.2)	125 (61)	6 (66.7)	0,436

Risultati

	Pazienti totali, N=227	Pazienti sopravvissuti, N=217 (95,6)	Decessi intraospedaliero N=10 (4,4)	P-value
FC, mediana (IQR), bpm	86 (22)	85 (22)	115 (36)	0,307
FC > 110, N (%)	35 (15.6)	30 (14)	5 (50)	***<0,001***
PAD, media (DS), mmHg	77,02 (14,968)	77,4 (14,779)	69,55 (18,091)	0,089
SBP< 100, N (%)	25 (11)	21 (9.7)	4 (40)	***0,003***
SpO2<90%, N (%)	54 (23.8)	49 (22.6)	5 (50)	***0,016***
FR, media (DS), apm	19,91 (5,948)	19,74 (5,931)	26 (2,828)	0,143
TC, mediana (IQR), C	36,4 (0,9)	36,1 (0,8)	36,75 (0,8)	0,081

Risultati

	Pazienti totali, N=227	Pazienti sopravvissuti, N=217 (95,6)	Decessi intraospedaliero N=10 (4,4)	P-value
Piastrine, media (DS), *100.000/uL	231,4 (87,096)	234,53 (86,485)	160,25 (73,235)	**0,004**
Creatinina, mediana (IQR), mg/dl	0,945 (0,5)	0,95 (0,5)	0,915 (0,6)	0,819
Urea, mediana (IQR), mg/dl	41 (23)	42 (23)	35 (38)	0,546
D-dimero, media (DS), mg/L FEU	9,4376 (9,15983)	8,7098 (8,40218)	22,0655 (12,13851)	**0,004**
troponina positiva	72 (31.7)	65 (30)	7 (70)	***0,006***
LDH, mediana (IQR), U/L	235 (109)	229,5 (91)	442 (536)	**0,026**
ALT, mediana (IQR), U/L	16,5 (13)	16 (13)	24 (45)	0,273
CPK, mediana (IQR), U/L	77 (103)	78 (103)	67 (23)	0,067

Risultati

	Pazienti totali, N=227	**Pazienti sopravvissuti, N=217 (95,6)**	**Decessi intraospedaliero N=10 (4,4)**	P-value
Rapporto VDx/Vsn: 0 se < 1, 1 se > 1	46 (20.6)	41 (19.2)	5 (50)	***0,019***
D shape	23 (12.6)	20 (11.5)	3 (33.3)	**0,054**
Collassabilità v cava 0 < 50% 1 > 50%	177 (86.8)	172 (87.8)	5 (50)	***0.039***
TAPSE in mm, mediana (IQR)	21 (5)	21 (5)	20 (11)	0,959
PAPS mmHg, mediana (IQR)	35 (25)	35 (25)	45 (10)	**0,069**
FE VSn in %, mediana (IQR)	60 (5)	60 (6)	60 (8)	0,143
TAPSE in mm, mediana (IQR)	21 (5)	21 (5)	20 (11)	0,959

Analisi univariata

Variabile	**OR**	**IC 95%**	p value
TAPSE in mm	1,10	1,01-1,20	***0,031***
PAPS mmHg	1,02	0,98-1,07	0,372
FE Vsn	0.955	0,90-1,01	0,124
Rapporto VDx/VSx	4,19	1,01-10,88	***0,029***
D-Shape	3,30	0,80-13,65	0,1
Dimensioni V.Cava	1,22	1,03-1,46	***0,023***
Collassabilità V. Cava	0,18	0,050.901--0,71	***0,014***
Troponina positiva	5,46	1,39-16,21	***0,013***

Analisi multivariata

Variabile	**OR**	**IC 95%**	p value
FC 110	4.79	1.14-20.8	***< 0,001***
PAS 100	4	1.38-18.3	***0,019***
SpO2 90%	1.88	0.44-7.9	0.38
Età 80	1.22	0.26-5.75	0,42
TAPSE	1,003	0,79-1,27	0,97
Collassabilità V. Cava	2,49	0,28-22,11	0,41
Rapporto VDx/VSn	1.53	0.31-7.66	0,59
Troponina positiva	2.78	1.03-8.21	***0,012***

Right Ventricular Echocardiographic Parameters Are Associated with Mortality after Acute Pulmonary Embolism

Danai Khemasuwan, MD, MBA, Teerapat Yingchoncharoen, MD, Pichapong Tunsupon, MD,
Kenya Kusunose, MD, Ajit Moghekar, MD, Allan Klein, MD, and Adria
Bangkok, Thailand; Cleveland, Ohio; and Buff

Table 4 Binary logistic regression for hospital mortality by simplified unadjusted and adjusted PESI score

	Unadjusted		Adjusted	
Echocardiographic parameter	OR	95% CI	OR	95% CI
LV EDD (per 1-cm change)	0.52	0.3–0.89	0.56	0.32–0.97
RV/LV EDD ratio (per 0.1 change)	1.16	1.03–1.31	1.16	1.02–1.31
Estimated RVSP (per 10 mm Hg change)	1.30	1.06–1.59	1.30	1.06–1.61
Leftward shifting of the interventricular septum (presence)	2.50	1.1–5.50	2.30	1.04–5.20
Maximum TR jet velocity (per 1 m/sec change)	1.42	1.08–1.87	1.43	1.08–1.89
IVC collapsibility ≥ 50% (presence)	0.23	0.09–0.57	0.24	0.1–0.61

CI, Confidence interval; *EDD*, end-diastolic diameter; *IVC*, inferior vena cava; *OR*, odds ratio; *LV*, left ventricular; *PESI*, Pulmonary Embolism Severity Index; *RV*, right ventricular; *RVSP*, right ventricular systolic pressure; *TR*, tricuspid regurgitation.

Table 3 Significant echocardiographic variables in unadjusted and adjusted binary logistic regression for ICU mortality by APACHE score

	Unadjusted		Adjusted	
Echocardiographic parameter	OR	95% CI	OR	95% CI
RA systolic dimension (per 1-cm change)	1.50	1.05–2.20		
LV EDD (per 1-cm change)	0.41	0.22–0.77	0.44	0.23–0.84
LVEF (per 10% change)			0.64	0.43–0.98
RV/LV EDD ratio (per 0.1 change)	1.16	1.02–1.32		
Estimated RVSP (per 10 mm Hg change)	1.40	1.1–1.80	1.35	1.05–1.74
Maximum TR jet velocity (per 1 m/sec change)	1.46	1.08–1.99		
IVC collapsibility ≥ 50% (presence)	0.25	0.1–0.67	0.20	0.07–0.58

APACHE, Acute Physiology and Chronic Health Evaluation; *CI*, confidence interval; *EDD*, end-diastolic diameter; *ICU*, intensive care unit; *IVC*, inferior vena cava; *LV*, left ventricular; *LVEF*, left ventricular ejection fraction; *OR*, odds ratio; *RA*, right atrial; *RV*, right ventricular; *RVSP*, right ventricular systolic pressure; *TR*, tricuspid regurgitation.

Clinical and echocardiographic predictors of mortality in acute pulmonary embolism

Talal Dahhan[1,6], Irfan Siddiqui[2], Victor F. Tapson[3], Eric J. Velazquez[4], Stephanie Sun[5], Clemontina A. Davenport[5], Zainab Samad[4] and Sudarshan Rajagopal[4,6*]

Table 4 Multivariable analysis of clinical and echocardiographic parameters in predicting outcome in acute PE

	OR	2.5 %	97.5 %	Estimate	SE	Z	*p*-value
Global RVLS model							
Age	0.99	0.95	1.02	−0.01	0.02	−0.74	0.46
Female Gender	1.20	0.32	4.58	0.18	0.68	0.27	0.79
Systolic Blood Pressure	1.01	0.99	1.04	0.01	0.01	0.97	0.33
Global RVLS	0.87	0.77	1.00	−0.14	0.07	−2.01	0.04
Free wall RVLS model							
Age	0.99	0.95	1.03	−0.01	0.02	−0.68	0.50
Female Gender	1.21	0.32	4.61	0.19	0.68	0.28	0.78
Systolic Blood Pressure	1.01	0.98	1.04	0.01	0.01	0.67	0.50
Free wall RVLS	0.89	0.80	1.00	−0.11	0.06	−1.95	0.05
RV Tei Index model							
Age at Diagnosis	0.99	0.95	1.03	−0.01	0.02	−0.53	0.60
Female Gender	0.78	0.17	3.47	−0.26	0.76	−0.33	0.74
Systolic Blood Pressure	1.02	0.99	1.05	0.02	0.02	1.19	0.23
RV Tei Index	0.00	0.00	0.36	−7.82	3.46	−2.26	0.02

Odds ratio (survival over non-survival), 95 % confidence interval, estimate, standard error, and *p*-value of the multivariable logistic regression models are shown

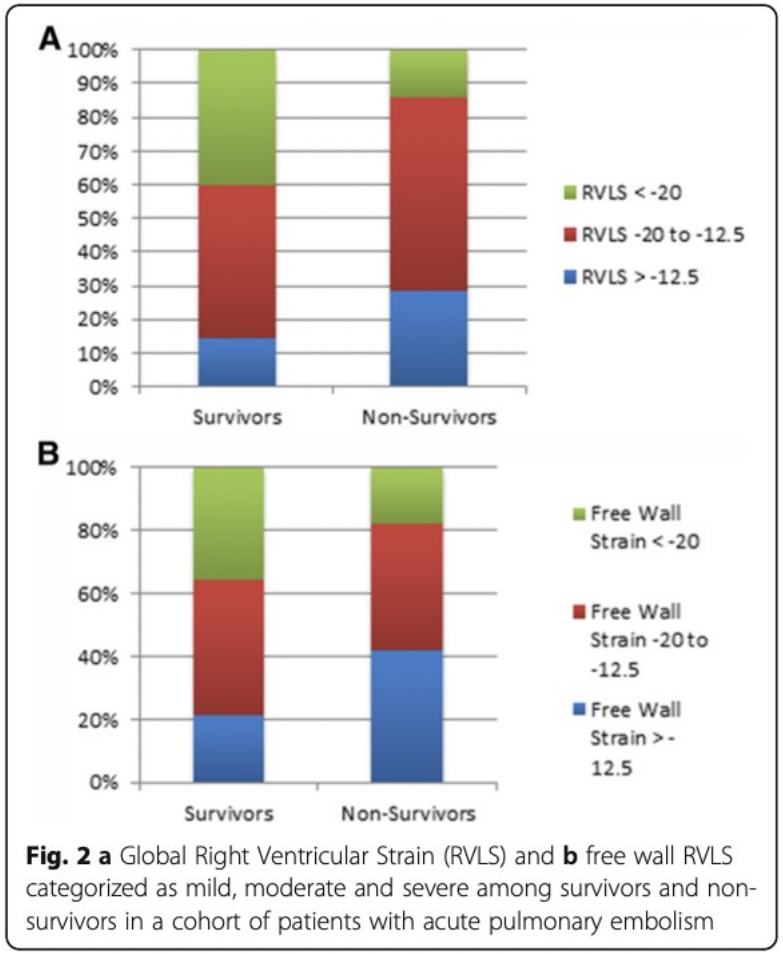


Fig. 2 a Global Right Ventricular Strain (RVLS) and **b** free wall RVLS categorized as mild, moderate and severe among survivors and non-survivors in a cohort of patients with acute pulmonary embolism

Prognostic value of echocardiographic parameters for right ventricular function in patients with acute non-massive pulmonary embolism

Kyusup Lee[1] · Osung Kwon[1] · Eun-Jeong Lee[1] · Min-Jung Sin[1] · Jae Seung Lee[2,3] · Sahmin Lee[1] · Duk-Hyun Kang[1] · Jae-Kwan Song[1] · Jong-Min Song[1,3]

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Table 4 Multivariate analyses of clinical and echocardiographic parameters in predicting in-hospital events

	Multivariable adjusted[a]		
	OR	95% CI	*p* value
PVR, wood units	1.64	1.13–2.38	0.010
TAPSE (mm)	0.80	0.69–0.91	0.001
S′ velocity (cm/s)	0.76	0.62–0.94	0.012
RV global wall strain (%)	1.20	1.07–1.35	0.002
RV free wall strain (%)	1.12	1.04–1.21	0.002
FAC (%)	0.94	0.90–0.98	0.006
Eccentricity index	0.01	0–0.42	0.015

OR odd ratio, *CI* confidence interval, *PVR* pulmonary vascular resistance, *TAPSE* tricuspid annular plane systolic excursion, *RV* right ventricular, *FAC* fractional area change

[a]Odd ratios were adjusted with age, gender, and diabetes mellitus

Discussione

- La disfunzione acuta del VDx ha un ruolo importante nella stratificazione del rischio e dovrebbe essere sempre eseguita nei pazienti con diagnosi di EP.
- L'ecocardiografia è operatore dipendente e non sempre è disponibile in regime di PS.
- La dubbia capacità prognostica della disfunzione del VDx può essere secondaria al timing di esecuzione della TTE ed al ruolo della disfunzione precedente l'insorgenza di EP, dato non noto.
- Il dosaggio della troponina sierica è facilmente accessibile e probabilmente rappresenta un marker più sensibile di impatto sul ventricolo destro rispetto alle disfunzioni ecograficamente evidenziabili.

Limiti dello studio

- Tempistica esecuzione ecocardiografia
- Popolazione eterogenea inclusa
- Assenza protocollo standard per lo studio ecocardiografico
- Difficoltà nel reperire referti in alcuni pazienti con TEP ad alto rischio

Conclusioni

In conclusione, mentre l'ecocardiografia è utile nella identificazione precoce dei pazienti con severo impatto emodinamico da EP, la troponina resta il marker principale di danno cardiaco di fondamentale valore prognostico. Potrebbe essere utile, in futuro, raccogliere nuovi casi che soddisfano il criterio esclusivo dell'esecuzione della TTE durante la visita in pronto soccorso.

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FASTTRACK CLINICAL RESEARCH

Prognostic value of right ventricular dysfunction or elevated cardiac biomarkers in patients with low-risk pulmonary embolism: a systematic review and meta-analysis

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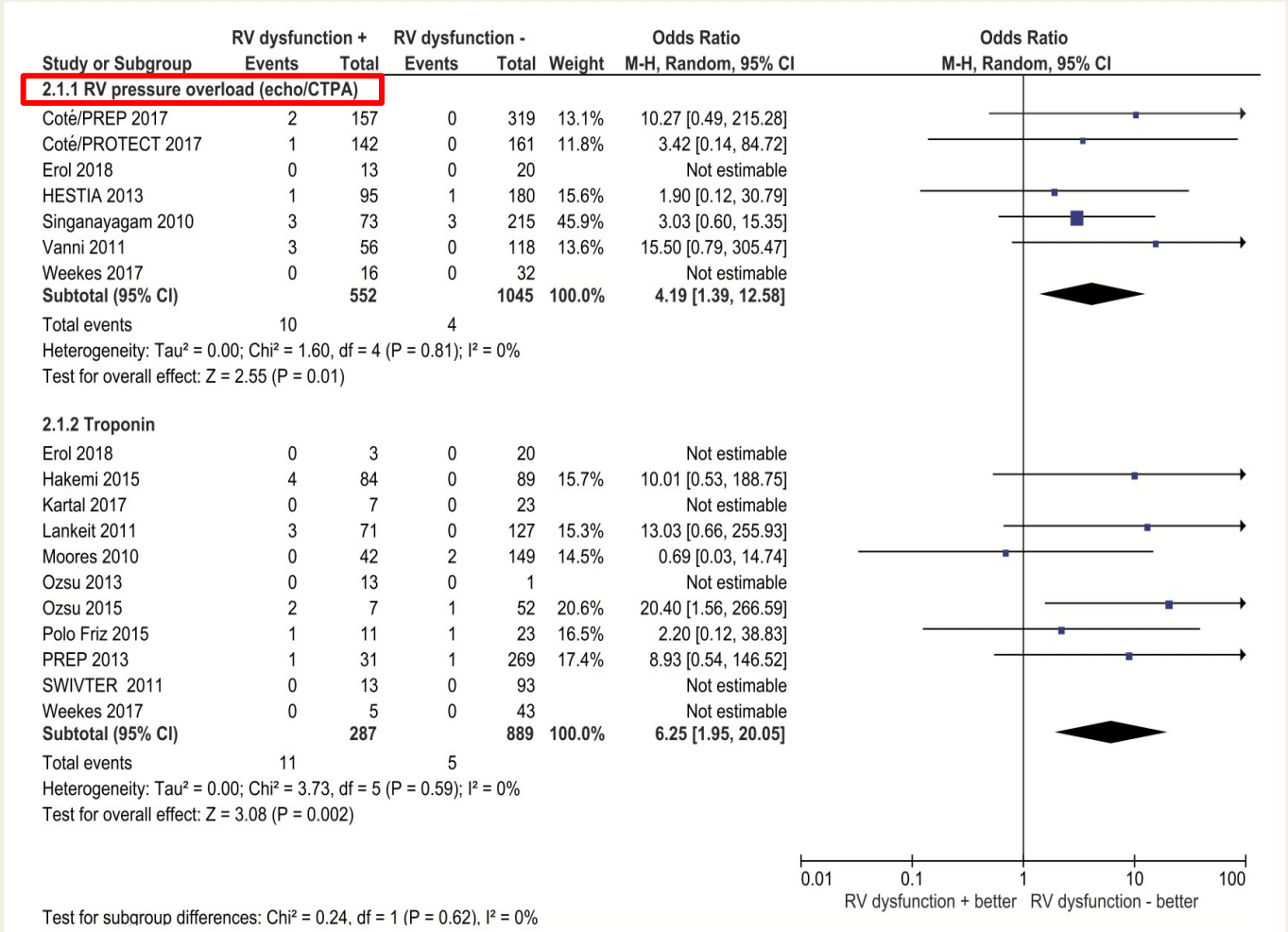

Figure 3 Prognostic value of imaging and laboratory indicators of right ventricular dysfunction or myocardial injury for early all-cause mortality in low-risk patients. CTPA, computed tomography pulmonary angiography; RV, right ventricular; 95% CI, 95% confidence interval.

Clinical value of cardiac color ultrasound and cardiac troponin T combined with dynamic electrocardiogram in treatment of acute pulmonary embolism

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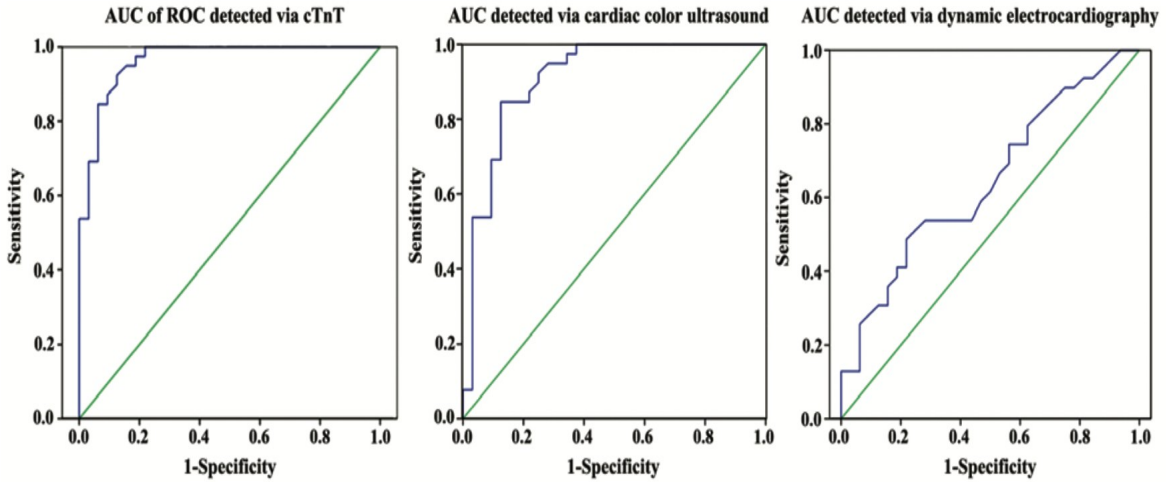

Figure 1. Prognostic prediction of acute pulmonary embolism (APE) via cardiac troponin T (cTnT), cardiac color ultrasound and dynamic electrocardiogram. receiver operating characteristic (ROC) curve analysis shows that the areas under the curve (AUC) detected via cardiac color ultrasound and cTnT are >0.9, while that detected via dynamic electrocardiogram is <0.7.

Table V. Logistic regression analysis of influencing factors of poor prognosis of APE patients.

Factor	β	SE	Wald	OR	95% confidence interval (CI)	P-value
Age (years)	0.336	0.408	3.705	0.732	0.373-0.872	0.218
Sex	0.417	0.507	4.152	0.346	0.124-0.789	0.312
Educational level	0.269	0.608	5.027	0.273	0.156-0.658	0.174
cTnT	0.915	0.804	6.495	1.938	1.196-3.516	0.008
Right ventricular strain	0.426	0.649	5.757	0.817	0.475-0.952	0.104
Right ventricular dysfunction	1.103	0.717	8.024	1.846	1.113-2.347	0.012

cTnT, cardiac troponin ; APE, acute pulmonary embolism.