LA DISPNEA

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UNIVERSITÀ DI TORINO

XIII congresso nazionale simeu
GENOVA 30 MAG - 1 GIU 2024

Medicina d'urgenza - MECAU
Università degli studi di Torino
Città della Salute e della Scienza di Torino

Disclosures

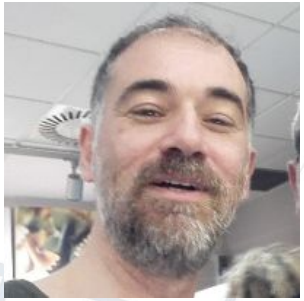
Master in **Epidemiologia**, Università di Torino

R. Fellowship in **emergency ultrasound**, Dept. Of Emergency Medicine, Brigham and Women's Hospital, Harvard University, Boston, Massachusetts

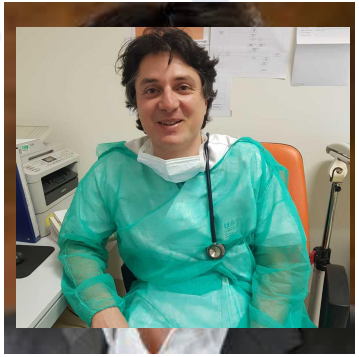
Coordinatore Università di Torino master in **ecografia point-of-care** in medicina d'urgenza e degli stati critici

Butterfly Network, prestito a scopo di ricerca e didattica di butterfly iQ e iQ+

ARDS



shock



dispnea

Dispnea

...

..is the term generally applied to sensations experienced by individuals who complain of unpleasant or uncomfortable respiratory sensations

BLUE Journal, 1999

...but we emphasize strongly that dyspnea [...] can only be perceived by the person experiencing it.

BLUE Journal, 2012

Dispnea

..

≠

signs typically evidence of respiratory distress, such as tachypnea, use of accessory muscles, and intercostal retractions

Dispnea

#1 Ask an unscripted question.
#2 Don't whine.
#3 Count something.
#4 Write something.
#5 Change.

(Atul Gawande, "Better: A Surgeon's Notes on Performance ", 2007

muscles, and intercostal retractions

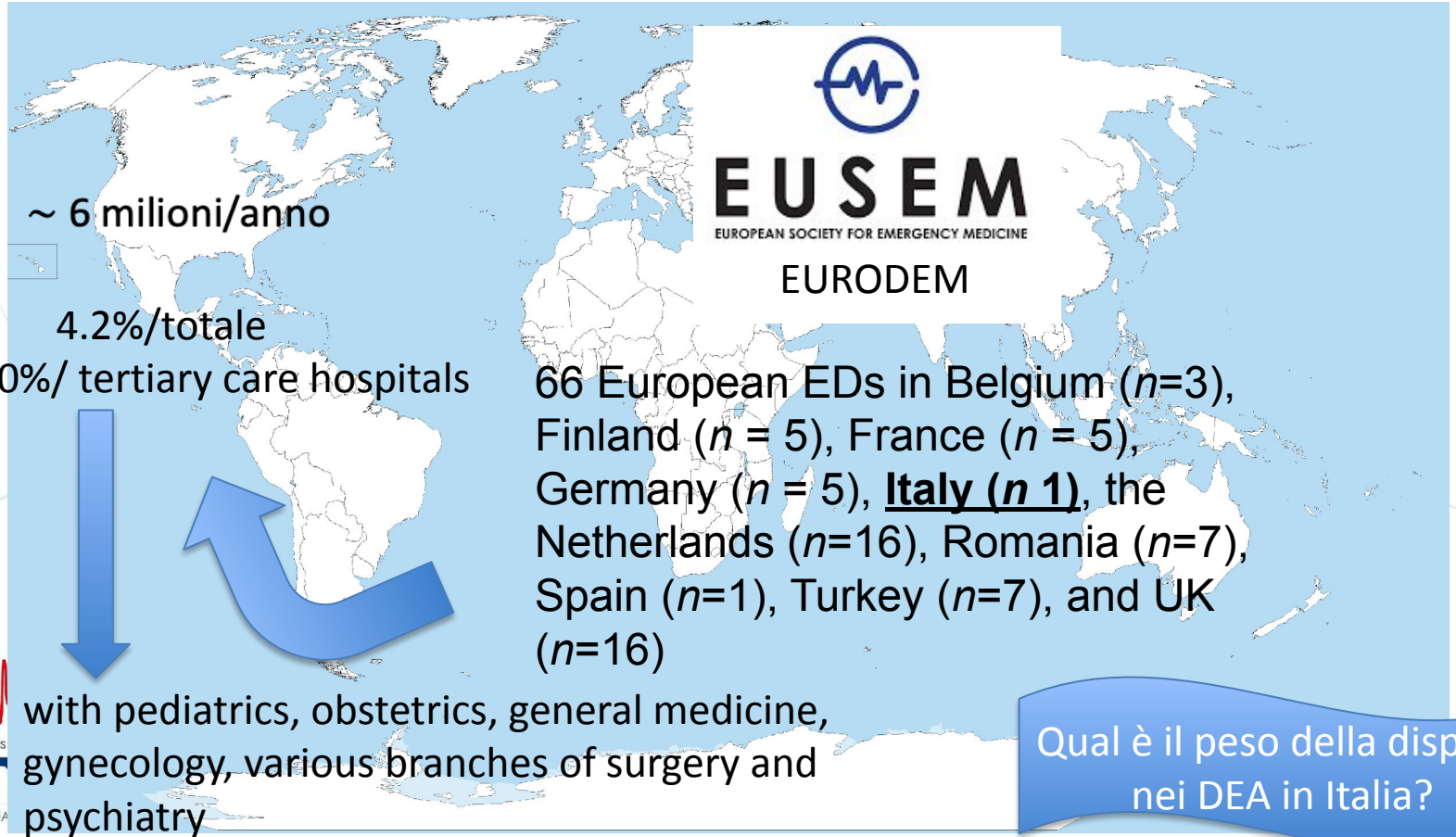
When a patient presents with dyspnea, the **primary task** of the emergency physician is to assess for **and ensure stability of the patient's airway, breathing, and circulation.** In the case of dyspnea, presentations may range from minor symptoms to extremis.

Emerg Med Clin N Am 34, 2016

BWH website

Torinotoday website

Ambulatory Medical Care Survey: 2021 emergency department



~ 6 milioni/anno

4.2%/totale

fino al 50%/ tertiary care hospitals

EUSEM

EUROPEAN SOCIETY FOR EMERGENCY MEDICINE

EURODEM

66 European EDs in Belgium (*n*=3), Finland (*n* = 5), France (*n* = 5), Germany (*n* = 5), **Italy (*n* 1)**, the Netherlands (*n*=16), Romania (*n*=7), Spain (*n*=1), Turkey (*n*=7), and UK (*n*=16)

with pediatrics, obstetrics, general medicine, gynecology, various branches of surgery and psychiatry

Qual è il peso della dispnea nei DEA in Italia?

Ambulatory Medical Care Survey: 2021 emergency department

SYSTEM	TYPE OF PROCESS	EXAMPLE OF DISEASE PROCESS	POSSIBLE PRESENTING DYSPNEA SYMPTOMS	POSSIBLE PHYSICAL FINDINGS	POSSIBLE MECHANISMS UNDERLYING DYSPNEA	INITIAL DIAGNOSTIC STUDIES (AND POSSIBLE FINDINGS)
Pulmonary	Airways disease	Asthma, COPD, upper airway obstruction	Chest tightness, tachypnea, increased WOB, air hunger, inability to get a deep breath	Wheezing, accessory muscle use, exertional hypoxemia (especially with COPD)	Increased WOB, hypoxemia, hypercapnia, stimulation of pulmonary receptors	Peak flow (reduced); spirometry (OVD); CXR (hyperinflation; loss of lung parenchyma in COPD), chest CT and airway examination for upper airway obstruction
	Parenchymal disease	Interstitial lung disease[a]	Air hunger, inability to get a deep breath	Dry end-inspiratory crackles, clubbing, exertional hypoxemia	Increased WOB, increased respiratory drive, hypoxemia, hypercapnia, stimulation of pulmonary receptors	Spirometry and lung volumes (RVD); CXR and chest CT (interstitial lung disease)
	Chest wall disease	Kyphoscoliosis, neuromuscular (NM) weakness	Increased WOB, inability to get a deep breath	Decreased diaphragm excursion; atelectasis	Increased WOB; stimulation of pulmonary receptors (if atelectasis is present)	Spirometry and lung volumes (RVD); MIP and MEPs (reduced in NM weakness)
Pulmonary and cardiac	Pulmonary vasculature	Pulmonary hypertension	Tachypnea	Elevated right heart pressures, exertional hypoxemia	Increased respiratory drive, hypoxemia, stimulation of vascular receptors	Diffusion capacity (reduced); ECG; ECHO (to evaluate pulmonary artery pressures)[b]
Cardiac	Left heart failure ——— Pericardial disease	Coronary artery disease, cardiomyopathy[c] ——— Constrictive pericarditis; cardiac tamponade	Chest tightness, air hunger	Elevated left heart pressures; wet crackles on lung examination; pulsus paradoxus (pericardial disease)	Increased WOB and drive, hypoxemia, stimulation of vascular and pulmonary receptors[d]	Consider BNP testing, especially in the acute setting; ECG, ECHO, may need stress testing and/or LHC
Other	Variable	Anemia Deconditioning Psychological Metabolic disturbances Gastrointestinal (e.g., gastroesophageal reflux disease [GERD], aspiration pneumonitis)	Exertional breathlessness Poor fitness Anxiety	Variable	Metaboreceptors (anemia, poor fitness); chemoreceptors (anaerobic metabolism from poor fitness); some subjects may have increased sensitivity to hypercapnia	Hematocrit for anemia; laboratory studies (e.g., metabolic panel, thyroid hormone testing for metabolic disturbances); consider upper gastrointestinal endoscopy and/or esophageal pH probe testing for GERD and concerns for aspiration; exclude other causes

Harrison's Principles of Internal Medicine, 21e

Point-of-Care Ultrasonography
Visually Satisfying Medicine or Evidence-Based Medicine?

Eden Bernstein, MD; Tracy Y. Wang, MD, MHS, MSc

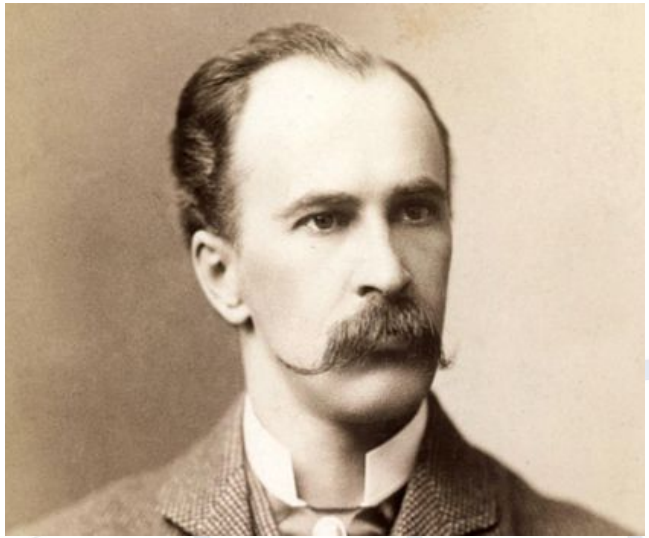
JAMA Int Med 2021

«We recommend making POCUS use more evidence-based» for dyspneic Patients


30 min

When a patient presents with dyspnea, the **primary task** of the emergency physician is to assess for **and ensure stability of the patient's airway, breathing, and circulation.** In the case of dyspnea, presentations may range from minor symptoms to extremis.

Emerg Med Clin N Am 34, 2016



https://www.mcgill.ca/about/article/

Best treatment
is…
Diagnosis, diagnosis, diagnosis!

"medicine is a science of uncertainty and an art of probability"

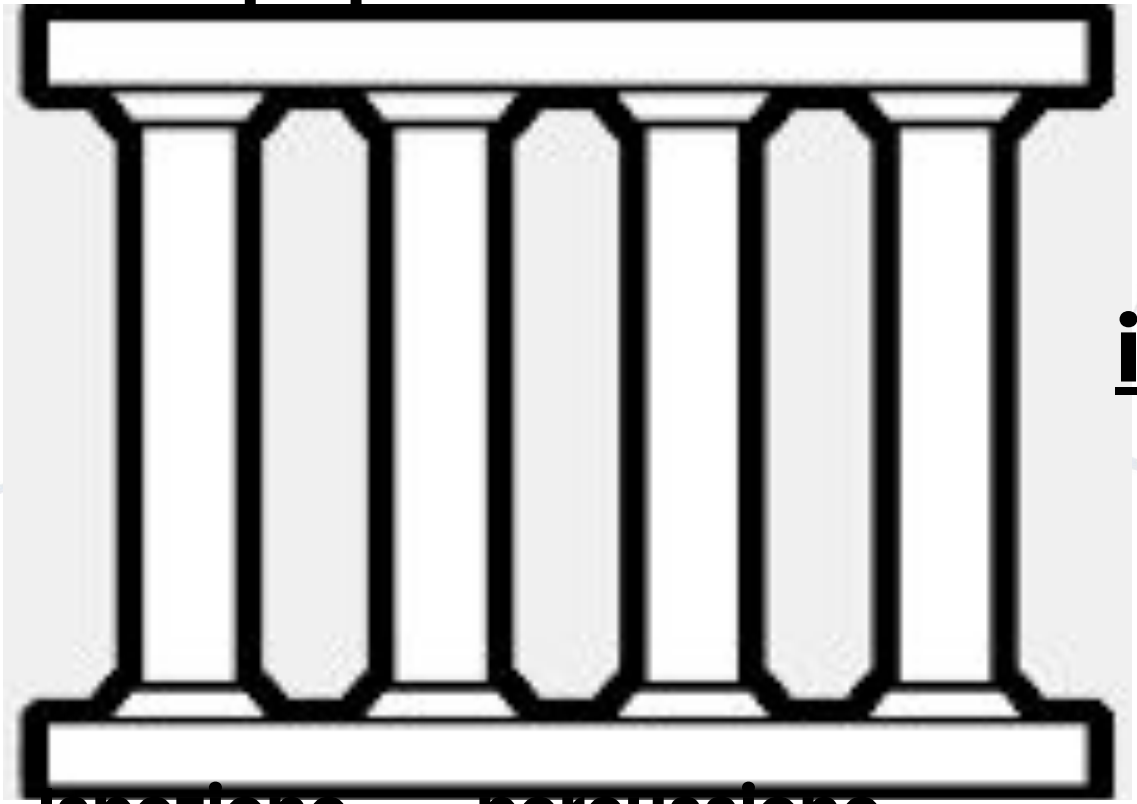
William Osler

Da Wikipedia, l'enciclopedia libera.

William Osler (Bond Head, 12 luglio 1849 – Oxford, 29 dicembre 1919) è stato un medico canadese, definito come il padre della medicina moderna. Patologo, educatore, grande bibliofilo, storico e scrittore. Osler è stato anche un rinomato burlone.

Osler è considerato il creatore dei moderni sistemi di formazione delle specializzazioni mediche.[1]

palpazione auscultazione



ispezione percussione

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J. Narula, Y. Chandrashekhar, E. Braunwald, JAMA Cardiology 2018

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Part	Description	Manifestations	Examples
Controller	Malfunction presents as abnormal respiratory rate or depth. Often related to abnormal feedback to brain from other parts of the system	Air hunger, need to breathe	Abnormal feedback to brain from other systems. Metabolic acidosis, anxiety
Ventilatory pump	Composed of muscles, nerves that signal the controller, chest wall, and pleura that create negative thoracic pressure, airways and alveoli allowing flow from atmosphere and gas exchange	Increased work of breathing, low tidal volumes	Neuromuscular problems (eg, Guillain-Barré), decreased chest wall compliance, pneumothorax, pneumonia, bronchospasm (COPD, asthma)
Gas exchanger	Oxygen and carbon dioxide cross the pulmonary capillaries in the alveoli. Membrane destruction or interruption of the interface between the gas and capillaries by fluid or inflammatory cells limit gas exchange	Increased respiratory drive, hypoxemia, chronic hypercapnia	Emphysema, pneumonia, pulmonary edema, pleural effusion, hemothorax

Emerg Med Clin N Am, 2016

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Hypercapnia/hypoxia

acute increase of PaCO2, potentially contributing to dyspnea

common in ARDS, COPD, asthma, acute

HF

ED diagnoses					
Lower respiratory tract infection	1389 (24.9)	616 (20.2)	773 (30.6)	<0.001	0.58 (0.51–0.65)
Heart failure	962 (17.3)	455 (14.9)	507 (20.1)	<0.001	0.63 (0.55–0.73)
COPD exacerbation	882 (15.8)	415 (13.6)	467 (18.5)	<0.001	0.70 (0.60–0.81)
Asthma	584 (10.5)	387 (12.7)	197 (7.8)	<0.001	1.52 (1.27–1.82)
Other	2022 (36.3)	1171 (38.5)	851 (33.7)	<0.001	1.24 (1.10–1.38)

~ 50%

J Emerg Med, 2018

Mechanical loading

hyperinflation (COPD)

Torinoto day website

Int Emerg Med, 2023

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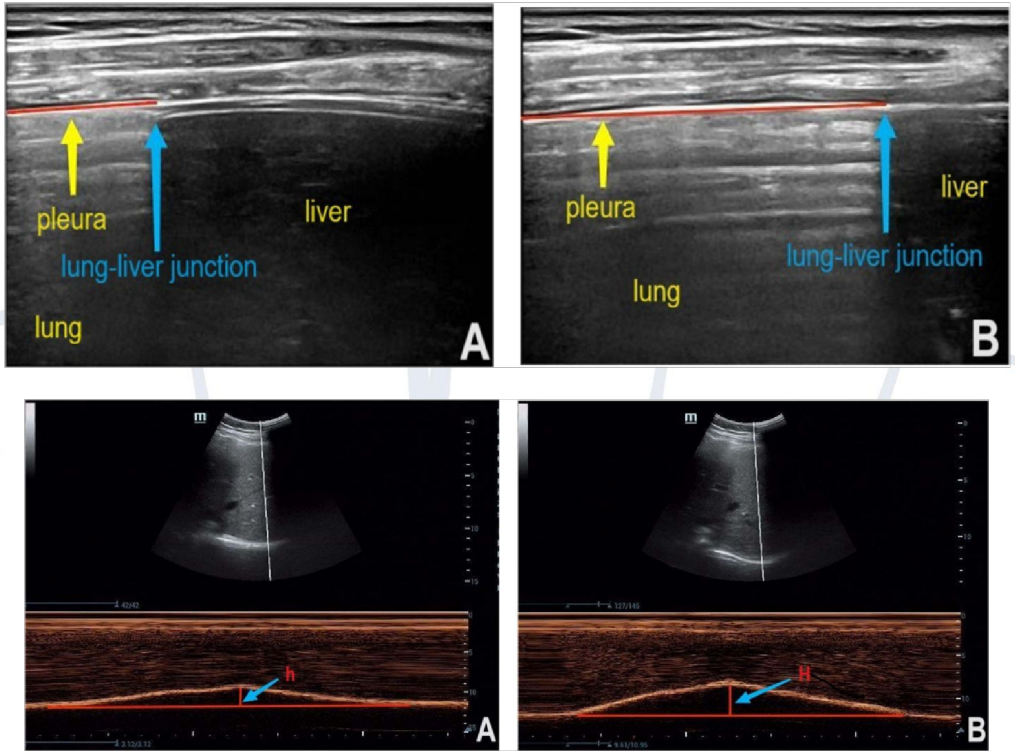
hyperinflation (COPD)



Int J Chr Obs Pulm Dis, 2024

L’utilizzo dell’ecografia del diaframma in PS?

Semplice! Non si usa!

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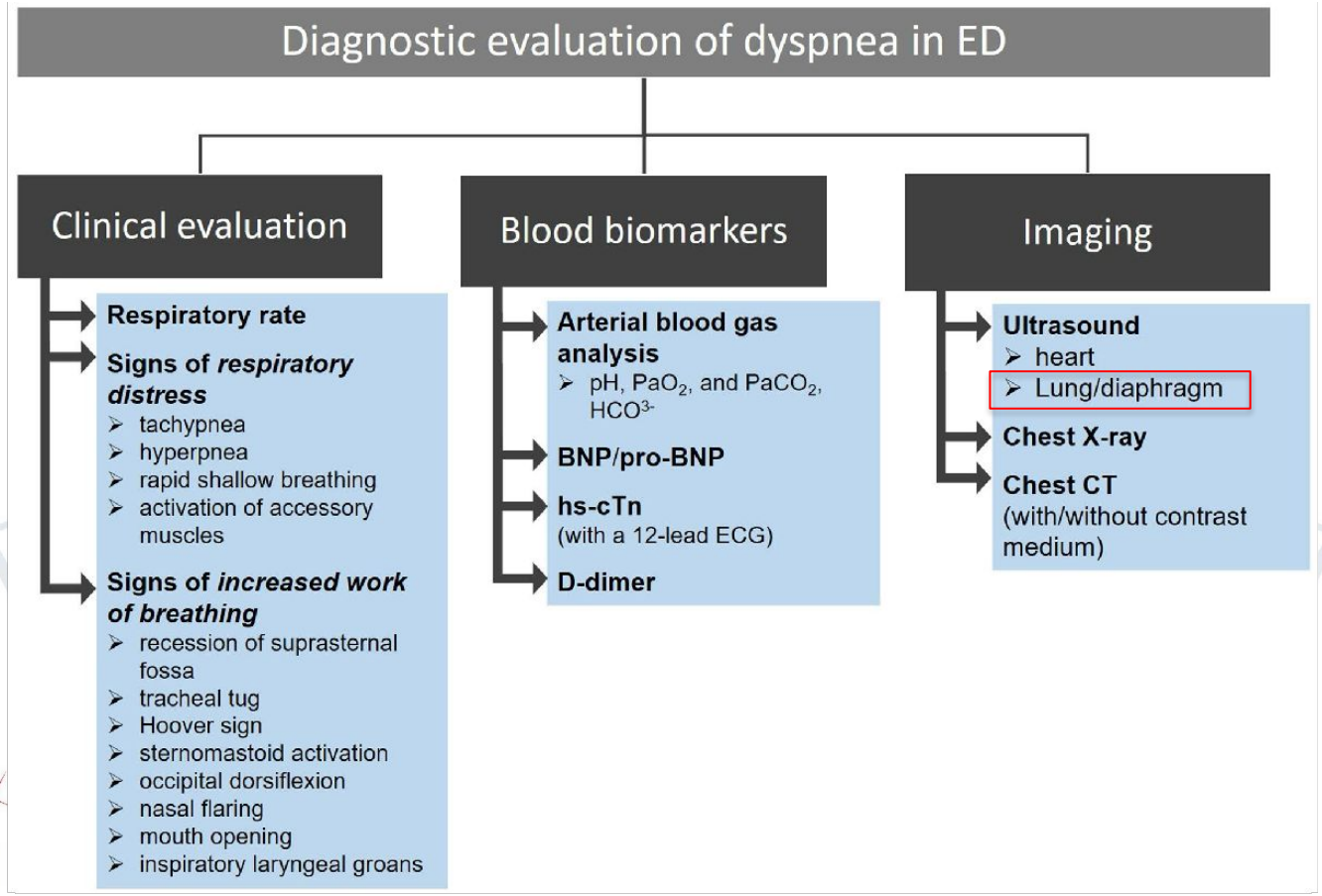

Int Emerg Med, 2023

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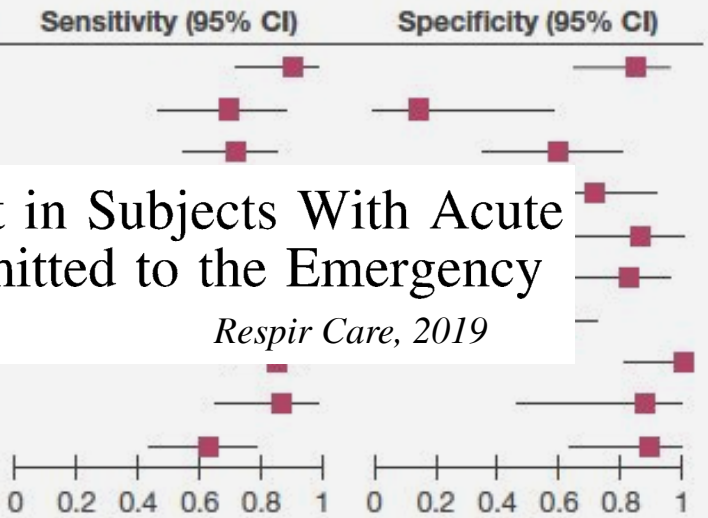
Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Ali 2016	25	4	3	22	0.89 [0.72-0.98]	0.85 [0.65-0.96]
Baess 2016	16	6	7	1	0.70 [0.47-0.87]	0.14 [0.00-0.58]
Carrie 2017	32	9	13	13	0.71 [0.56-0.84]	0.59 [0.36-0.79]
Farghaly 2016						
Flevari 2016						
Jiang 2004						
Kim 2011						
Osman 2017						
Saeed 2016	19	1	3	7	0.86 [0.65-0.97]	0.88 [0.47-1.00]
Spadaro 2016	21	2	13	15	0.62 [0.44-0.78]	0.88 [0.64-0.99]



Diaphragmatic Ultrasound Assessment in Subjects With Acute Hypercapnic Respiratory Failure Admitted to the Emergency Department

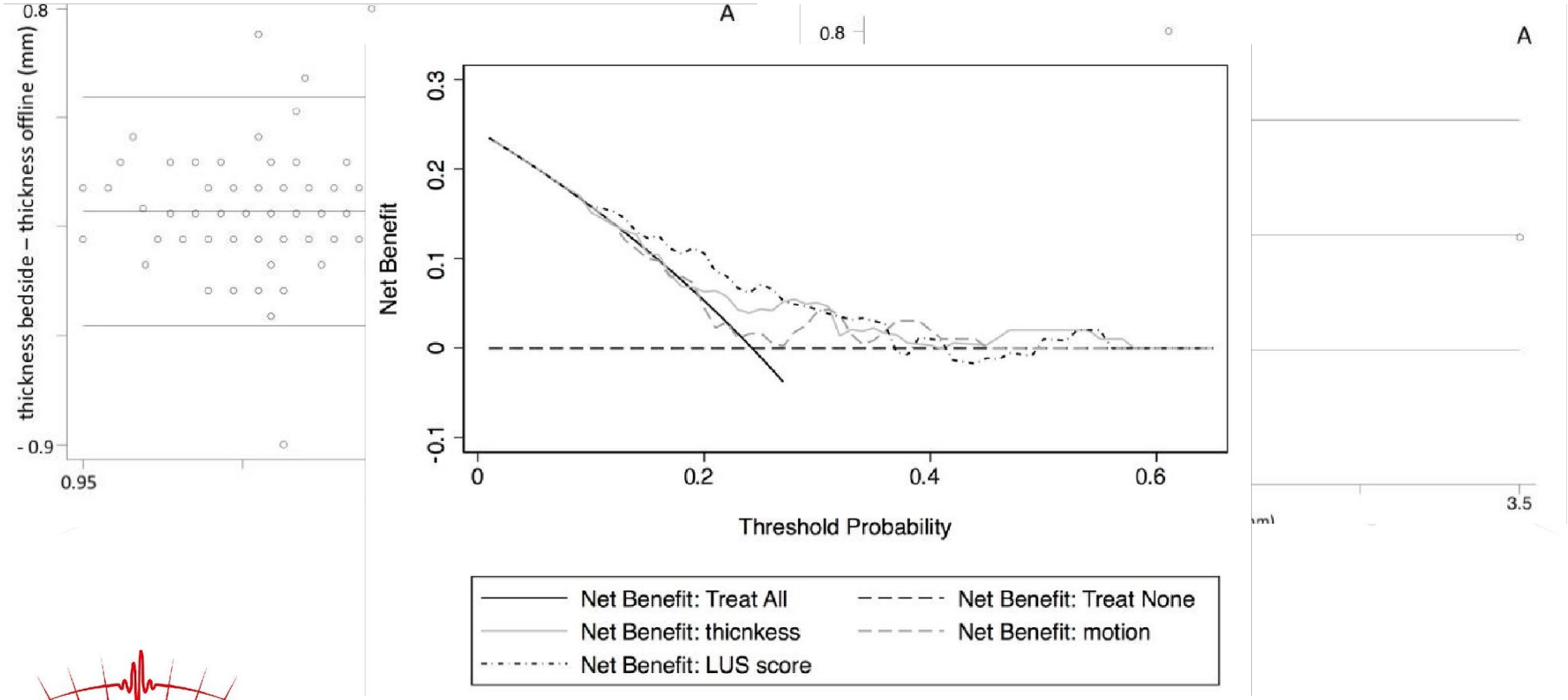
Respir Care, 2019

hypercapnic AHRF related to COPD exacerbation or pneumonia and requiring NIV

Motion T0-T1-T2 NIV successes > NIV failures

D-US per la gestione della NIV?

Chest, 2017



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JCM, 2021

Potrebbe servire implementare D-US in PS nel Pz. Disponoico?

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acute increase of PaCO2, potentially contributing to dyspnea

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~ 50%

J Emerg Med, 2018

Mechanical loading

hyperinflation (COPD)

Torinoto day website

Activation of pulmonary receptors

rapid onset dyspnea of unknown origin, disproportionate to the level of blood gases alteration (PE)

Int Emerg Med, 2023

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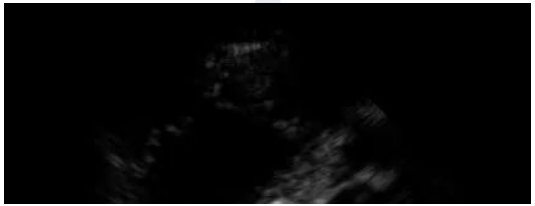
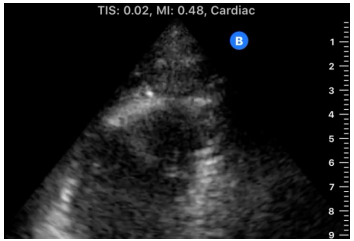
rapid onset dyspnea of unknown origin, disproportionate to the level of blood gases alteration (PE)





Diagnostic Test Characteristics of FOCUS and Its Components for PE in Subjects With a HR ≥ 100 beats/min and/or sBP < 90 mm Hg (n = 136)

	Sensitivity, % (95% CI)	Specificity, % (95% CI)	Positive Likelihood Ratio (95% CI)	Negative Likelihood Ratio (95% CI)
FOCUS	92 (78–98)	64 (53–73)	2.5 (1.9–3.3)	0.13 (0.04–0.38)
TAPSE threshold (cm)				
2.0	88 (72–97)	73 (63–82)	3.3 (2.3–4.7)	0.17 (0.07–0.42)
1.7	66 (48–82)	85 (76–91)	4.5 (2.6–7.6)	0.39 (0.24–0.64)
RVE	51 (34–68)	86 (77–92)	3.6 (2.0–6.3)	0.57 (0.40–0.80)
Septal flattening*	43 (27 61)	93 (86 97)	5.9 (2.7 13.2)	0.61 (0.46 0.82)
TR	50 (26–74)	75 (62–86)	2.0 (1.1–3.8)	0.67 (0.41–1.08)
McConnell's sign†	35 (20–53)	99 (94–100)	33.7 (4.6–249)	0.66 (0.52–0.83)

Acad Em Med, 2019
2017

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Variable	qSOFA		SIRS	
	Cut-off	*Points*	*Cut-off*	*Points*
Altered mental status (GCS <15)	Yes	1	—	—
Heart rate (beats/min)	—	—	>90	1
Respiratory rate (breaths/min)	≥22	1	>20	1
Systolic blood pressure (mm Hg)	≤100	1	—	—
Temperature (°C)	—	—	<36 or >38	1
White blood cells count (x10^9/µL)	—	—	<4 or >12 or >10% bands	1
	Maximum score	3	**Maximum score**	4

Symptom	Differential Diagnosis
Edema	Acute heart failure, pulmonary e
pulmonary edema	Acute and chronic heart failure, e (sepsis)
Tachypnea alone	pulmonary embolism, acidosis (including aspirin toxicity), anxiety

RDS

MEWS & NEWS

Modified Early Warning Score

Score	3	2	1	0	1	2	3
Respiratory rate (min^{-1})		≤ 8		9–14	15–20	21–29	> 29
Heart rate (min^{-1})		≤ 40	41–50	51–100	101–110	111–129	> 129
Systolic BP (mmHg)	≤ 70	71–80	81–100	101–199		≥ 200	
Urine output (ml/kg/h)	Nil	< 0.5					
Temperature (°C)		≤ 35	35.1–36	36.1–38	38.1–38.5	≥ 38.6	
Neurological				Alert	Reacting to voice	Reacting to pain	Unresponsive

Chart 1: National Early Warning Score (NEWS)*

PHYSIOLOGICAL PARAMETERS	3	2	1	0	1	2	3
Respiration Rate	≤8		9 - 11	12 - 20		21 - 24	≥25
Oxygen Saturations	≤91	92 - 93	94 - 95	≥96			
Any Supplemental Oxygen		Yes		No			
Temperature	≤35.0		35.1 - 36.0	36.1 - 38.0	38.1 - 39.0	≥39.1	
Systolic BP	≤90	91 - 100	101 - 110	111 - 219			≥220
Heart Rate	≤40		41 - 50	51 - 90	91 - 110	111 - 130	≥131
Level of Consciousness				A			V, P, or U

*The NEWS initiative flowed from the Royal College of Physicians' NEWSDIG, and was jointly developed and funded in collaboration with the Royal College of Physicians, Royal College of Nursing, National Outreach Forum and NHS Training for Innovation.

Royal College of Physicians · NHS Training for Innovation

Respiratory rate

Emerg Med Clin N Am, 2016

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	No. of Studies	No. of Patients	% AHF (95% CI)	Sensitivity, % (95% CI)	Specificity, % (95% CI)	LR+ (95% CI)	LR (95% CI)
Symptoms							
Orthopnea[7,8,14,16,19,21,36,48,49,53 55,58,60,65]	15	5,430	45.5 (44.2 46.9)	52.1 (50.1 54.0)	70.5 (68.8 72.1)	1.9 (1.4 2.5)	0.74 (0.64 0.85)
PND[7,8,14,35,48,51,53,59,64]	9	2,216	44.8 (42.8 46.9)	46.2 (43.7 48.6)	73.9 (71.9 75.9)	1.6 (1.2 2.1)	0.79 (0.71 0.88)
Dyspnea at rest[20,51,55,61]	4	2,038	37.9 (35.9 40.0)	54.6 (51.2 58.0)	49.6 (46.9 52.3)	1.1 (0.9 1.4)	0.88 (0.74 1.04)
Absence of productive cough[7,8,12,36,49,59,62]	7	2,414	43.0 (41.0 45.0)	82.0 (79.6 84.4)	25.8 (23.5 28.2)	1.13 (1.02 1.26)	0.6 (0.5 0.8)
History							
CRI[25,49,55,57,59,61]	6	3,009	42.8 (41.0–44.6)	32.0 (29.4–34.6)	91.4 (90.0–92.7)	3.4 (2.7–4.5)	0.75 (0.71–0.80)
Arrhythmia[7,12,18,55,62]	5	3,469	40.2 (38.6–41.9)	38.0 (36.1–40.0)	85.1 (83.9–86.2)	2.7 (2.2–3.4)	0.75 (0.68–0.83)
CHF[7,8,14,15,19 21,23,25,35,36,48 50,55,57 61,63,65]	22	8,493	46.0 (44.9–47.0)	55.5 (53.9–57.1)	80.2 (79.0–81.3)	2.7 (2.0–3.7)	0.58 (0.49–0.68)
Renal failure[15,18,36,48,50]	5	2,840	40.9 (39.1–42.7)	15.1 (13.1–17.3)	95.1 (94–96.1)	2.3 (1.3–3.9)	0.9 (0.73–1.11)
MI, history of[7,15,19,48,49,52,54,55,65]	9	4,208	40.5 (39.1–42.0)	31.8 (29.7–33.9)	87.1 (85.8–88.3)	2.1 (1.8–2.5)	0.82 (0.76–0.89)
AFIB[36,49,52 54,65]	6	1,935	51.9 (49.8–54.2)	30.2 (27.4–33.2)	85.3 (82.8–87.5)	2.1 (1.6–2.9)	0.82 (0.71–0.93)
CAD[7,14,18,20,21,25,49,55,57–61,63]	14	4,983	42.9 (41.5–44.3)	46.6 (44.5–48.7)	76.2 (74.6–77.7)	2.0 (1.7–2.4)	0.71 (0.64–0.79)
Hyperlipidemia[8,49,53,55,68]	5	2,923	39.8 (38.1–41.6)	33.8 (31.1–36.6)	75.3 (73.2–77.3)	1.6 (1.3–1.9)	0.85 (0.82–0.90)
DM[8,16,18,19,21,23,25,49,50,52 55,57,59 61,64,65]	19	7,707	47.3 (46.2–48.4)	28.8 (27.4–30.4)	81.7 (80.4–82.8)	1.5 (1.3–1.7)	0.89 (0.84–0.94)
HTN[7,8,12,14–16,18,19,21,23,25,36,48–50,53–55,57,58,60,61, 63–65]	25	10,137	45.6 (44.6–46.6)	66.9 (65.5–68.3)	50.7 (49.4–52.1)	1.3 (1.3–1.4)	0.62 (0.53–0.73)
No history of COPD[7,8,15,18,20,21,23,25,36,48, 50,53,55,57–59,61,63]	18	8,053	42.8 (41.7–43.9)	78.9 (77.4–80.3)	34.1 (32.6–35.6)	1.22 (1.11–1.36)	0.7 (0.6–0.8)
Examination findings							
S3[7,8,14,15,20,53–55,57–60,64,65]	14	5,900	45.2 (44.0–46.5)	12.7 (11.5–14.0)	97.7 (97.2–98.2)	4.0 (2.7–5.9)	0.91 (0.88–0.95)
JVD[7,8,12,14–16,18,19,21,25,36,48,51,53–55,57–61,64,65]	23	8,012	47.8 (46.7 48.9)	37.2 (35.7 38.7)	87.0 (85.9 88.0)	2.8 (1.7 4.5)	0.76 (0.69 0.84)
Hepatojugular reflex[56,59,61,65]	4	1,209	60.4 (57.6 63.1)	14.1 (11.9 16.6)	93.4 (91.2 95.2)	2.2 (1.3 3.7)	0.91 (0.88 0.94)
Leg edema[7,8,10,12,14,15,16,18,19 21,23,25,48,49,51,53 55,57 62,65]	26	9,626	47.2 (46.2 48.2)	51.9 (50.5- 53.4)	75.2 (74.0 76.4)	1.9 (1.6 2.3)	0.68 (0.61 0.75)
Murmur[7,12,51,54,55,58,62,65]	8	4,004	45.3 (43.8 46.8)	27.8 (25.8 29.9)	83.2 (81.6 84.8)	1.9 (0.9 3.9)	0.93 (0.79 1.08)
Rales[7,8,10,12,15,18 21,23,25,36,48,51,53 55,58 61,65]	22	8,775	48.2 (47.1 49.2)	62.3 (60.8 63.7)	68.1 (66.7 69.4)	1.8 (1.5 2.1)	0.60 (0.51 0.69)
Wheezing[7,8,12,15,20,23,36,48,53,55,58,59,65]	13	6,970	44.2 (43.0 45.3)	22.3 (20.9 23.8)	64.0 (62.5 65.4)	0.6 (0.5 0.8)	1.19 (1.10 1.30)
Absent fever[7,23,36,49,59,62,63]	7	3,197	43.6 (41.9 45.3)	92.4 (90.9 93.8)	20.6 (18.8 22.5)	1.14 (1.02 1.27)	0.4 (0.3 0.6)

AFIB = atrial fibrillation; CAD = coronary artery disease; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; CRI = chronic renal insufficiency; DM = diabetes mellitus; HTN = hypertension; JVD = jugular venous distension; LR = positive likelihood ratio; LR– = negative likelihood ratio; MI = myocardial infarction; PND = paroxysmal nocturnal dyspnea.

Acad Emerg Med, 2016

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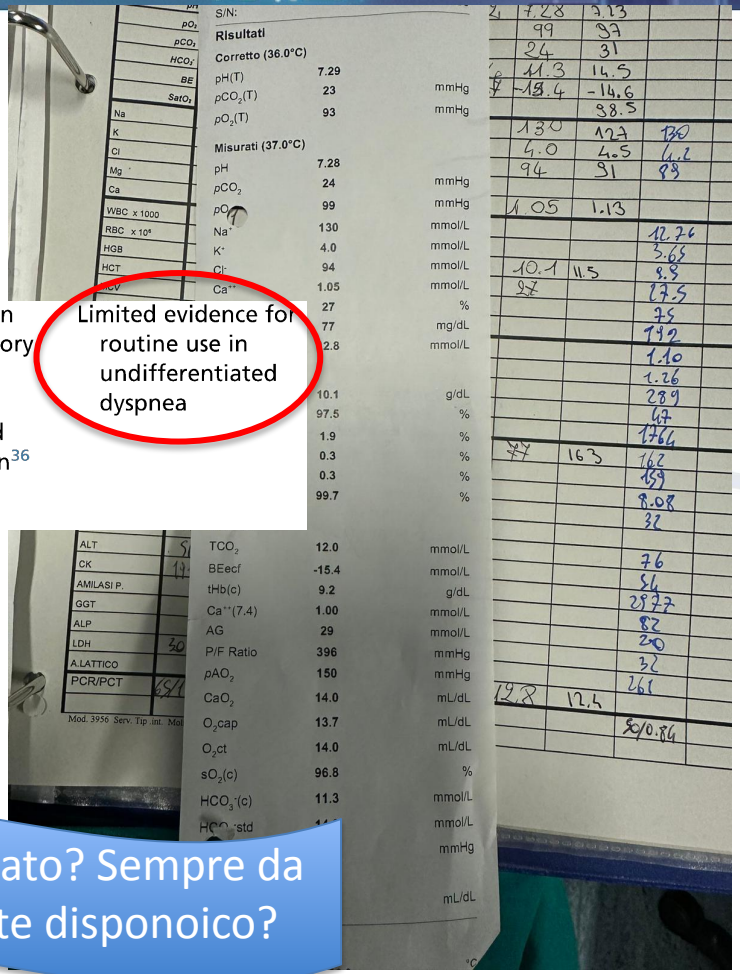
Provides additional information about ventilation ($Paco_2$) to patients with reliable pulse oximetry and bicarbonate level available on BMP

May be faster than general laboratory tests. Useful in assessing anxiety-induced hyperventilation[36]

Limited evidence for routine use in undifferentiated dyspnea

Emerg Med Clin N Am, 2016



«From a diagnostic point of view, […], should be always performed in patients with acute dyspnea in the ED»

Int Emerg Med, 2023

EGA sopravvalutato? Sempre da fare nel Paziente disponoico?

BNP Value (pg/mL)	Interval LR	*N* (%)	NT-pr
0–100	0.14 (0.12–0.18)	617 (28)	
100–200	0.29 (0.23–0.38)	308 (14)	
200–300	0.89 (0.67–1.17)	188 (9)	
300–400	1.34 (0.98–1.83)	148 (7)	
400–500	2.05 (1.47–2.84)	148 (7)	
500–600	3.50 (2.30–5.35)	115 (5)	1,
600–800	4.13 (3.01–5.68)	218 (10)	3,
800–1,000	5.00 (3.21–7.89)	130 (6)	5,
1,000–1,500	7.12 (4.53–11.18)	160 (7)	10,
			15,
			30,

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am Find

	%	(95
	42.6 (3	
	69.4 (6	
	55.8 (5	
	60.8 (5	
	39.6 (3	
	61.2 (5	
	46.8 (4	
Interstitial edema[15,66,72]	48.3 (4	
Cephalization[8,57,64,66,72]	54.0 (5	
Alveolar edema[16,66,72]	48.3 (4	
Pulmonary edema*[7,8,12,14,16,18–21,23,36,54,57,58,64]	46.6 (4	
Pleural effusion[12,20,58,60,72]	55.1 (5	
Enlarged cardiac silhouette[8,12,15,18,20,21,54,58,60,64 66]	51.7 (4	

Interstitial edema[15,66,72]	3	2,001	0.84)
Cephalization[8,57,64,66,72]	3	1,338	0.98)
Alveolar edema[16,66,72]	5	2,001	0.91)
Pulmonary edema*[7,8,12,14,16,18–21,23,36,54,57,58,64]	15	4,393	1.00)
Pleural effusion[12,20,58,60,72]	5	1,326	6.57)
Enlarged cardiac silhouette[8,12,15,18,20,21,54,58,60,64 66]	12	3,515	1.11)

Interstitial edema[15,66,72]	3	2,001	1.13)
Cephalization[8,57,64,66,72]	3	1,338	0.78)
Alveolar edema[16,66,72]	5	2,001	0.72)
Pulmonary edema*[7,8,12,14,16,18–21,23,36,54,57,58,64]	15	4,393	0.97)
Pleural effusion[12,20,58,60,72]	5	1,326	0.58)
Enlarged cardiac silhouette[8,12,15,18,20,21,54,58,60,64 66]	12	3,515	0.99)
			0.51)

LR+ – positive likelihood ratio; LR– – negative likelihood ratio.
*Refers to generalized pulmonary edema in studies that did not report specifically on both "alveolar edema" and "interstitial edema."

Recommendations	Class[a]	Level[b]
BNP/NT-proBNP[c]	I	B
12-lead ECG	I	C
Transthoracic echocardiography	I	C
Chest radiography (X-ray)	I	C
Routine blood tests for comorbidities, including full blood count, urea and electrolytes, thyroid function, fasting glucose and HbA1c, lipids, iron status (TSAT and ferritin)	I	C

Cardiac	Heart failure
	ACS
	Pulmonary embolism
	Myocarditis
	Left ventricular hypertrophy
	Hypertrophic or restrictive cardiomyopathy
	Valvular heart disease
	Congenital heart disease
	Atrial and ventricular tachyarrhythmias
	Heart contusion
	Cardioversion, ICD shock
	Surgical procedures involving the heart
	Pulmonary hypertension
Non-cardiac	Advanced age
	Ischaemic stroke
	Subarachnoid haemorrhage
	Renal dysfunction
	Liver dysfunction (mainly liver cirrhosis with ascites)
	Paraneoplastic syndrome
	COPD
	Severe infections (including pneumonia and sepsis)
	Severe burns
	Anaemia
	Severe metabolic and hormone abnormalities (e.g. thyrotoxicosis, diabetic ketosis)

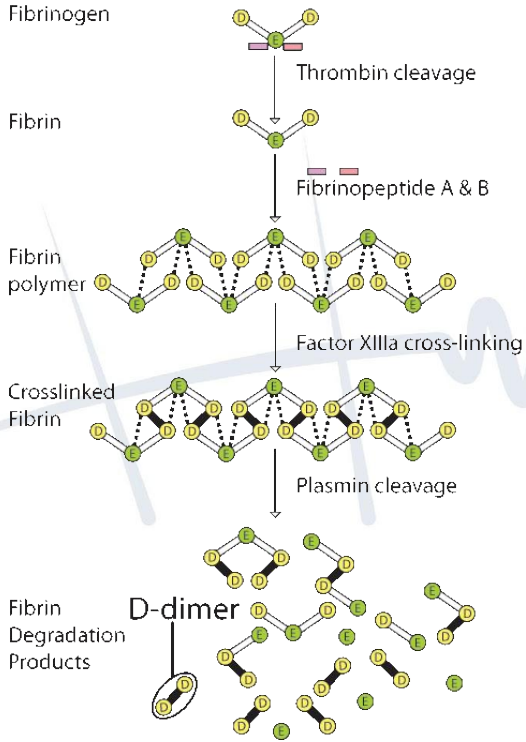
€ 15,40

EHF, 2021

Acad Emerg Med, 2016

XIII congresso nazionale simeu
GENOVA 30 MAG - 1 GIU 2024

Generation of D-dimer from cross-linked fibrin



Requires risk assessment and clear clinical question. Also increased in consumptive coagulopathy, infection, malignancy, trauma, dissection, preeclampsia, and other cardiovascular disorders

Emerg Med Clin N Am, 2016

Sensitivity ≥95%

EJH, 2019

Caren G. Solomon, M.D., M.P.H., *Editor*

Heart Failure with Preserved Ejection Fraction

A 73-year-old woman with a history of dyspnea on exertion presents for a follow-up visit after hospitalization for acute worsening of dyspnea and orthopnea.

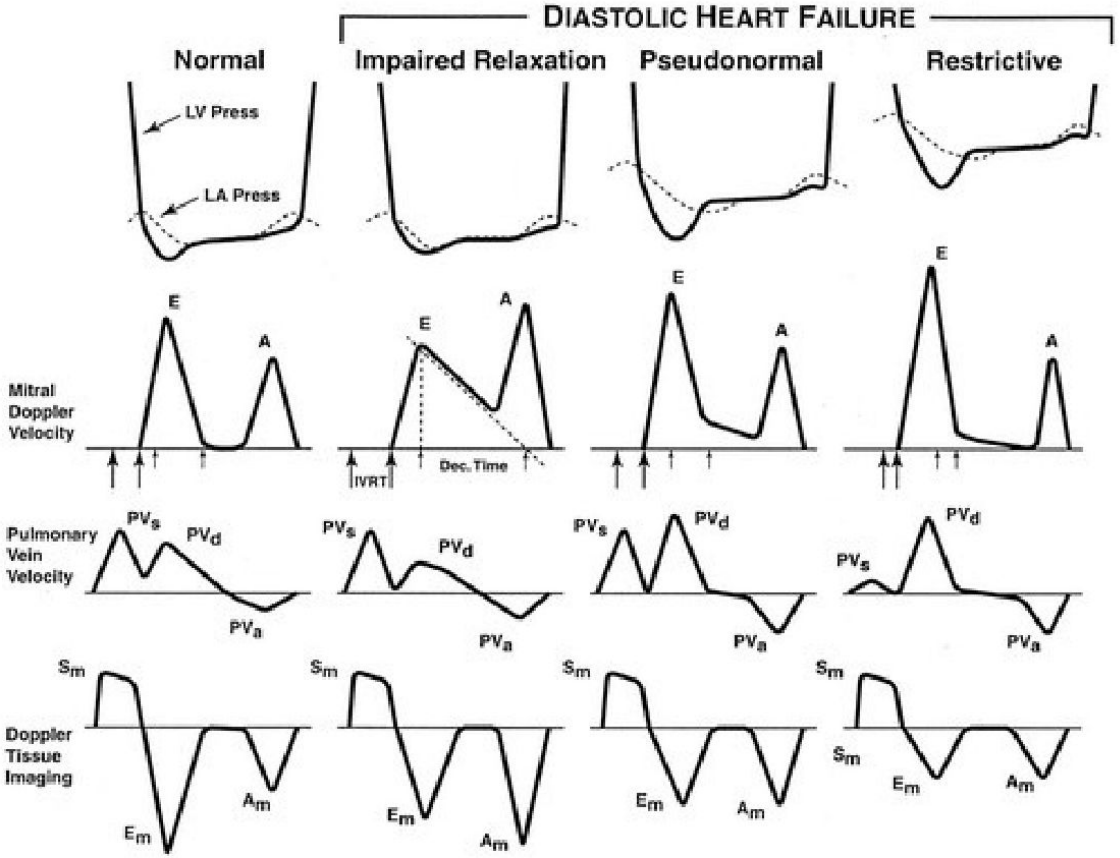
HF with normal natriretic peptides

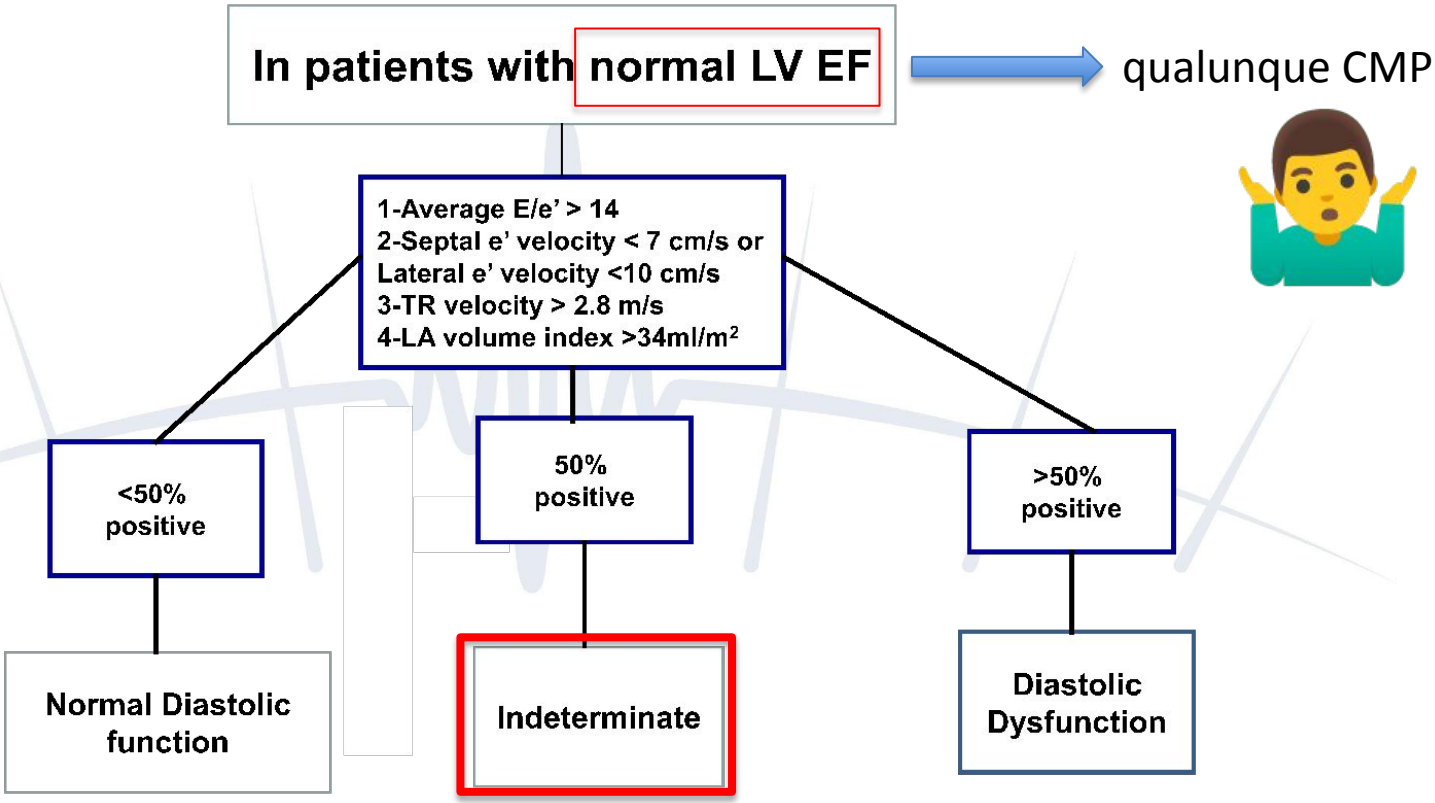
Up to 50% of patients with HF have preserved EF

Diastolic dysfunction

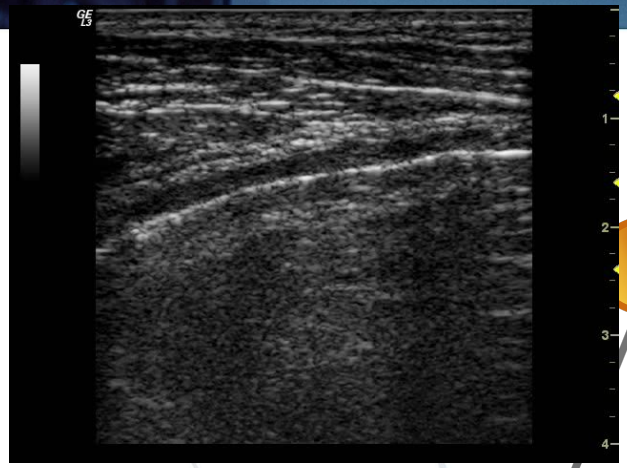
Valutare la disfunzione diastolica ci può servire in PS?

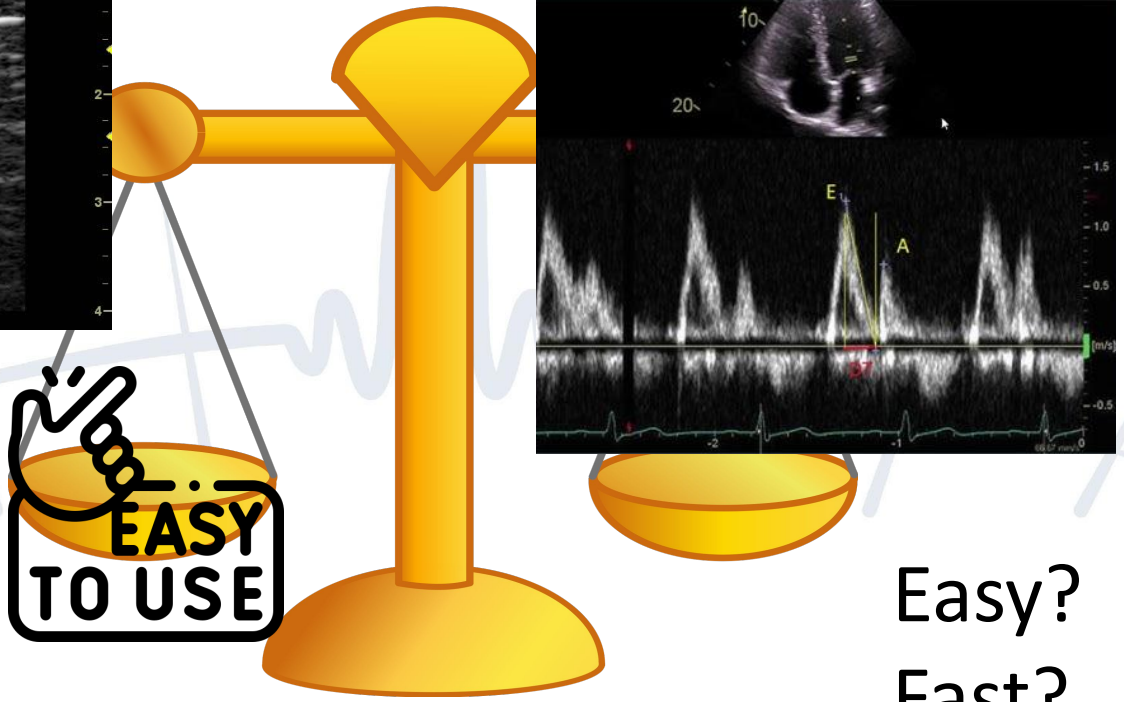
NEJM, 2016





ASE/EACVI, 2016





Easy?

Fast?

… e se ho un Paziente con insufficienza mitralica …?

Beaubien-Souligny *et al. Ultrasound J* (2020) 12:16
https://doi.org/10.1186/s13089-020-00163-w

The Ultrasound Journal

ORIGINAL ARTICLE Open Access

Quantifying systemic congestion with Point-Of-Care ultrasound: development of the venous excess ultrasound grading system

William Beaubien-Souligny[1,2*], Philippe Rola[3], Korbin Haycock[4], Josée Bouchard[5], Yoan Lamarche[6], Rory Spiegel[7] and André Y. Denault[1,8]

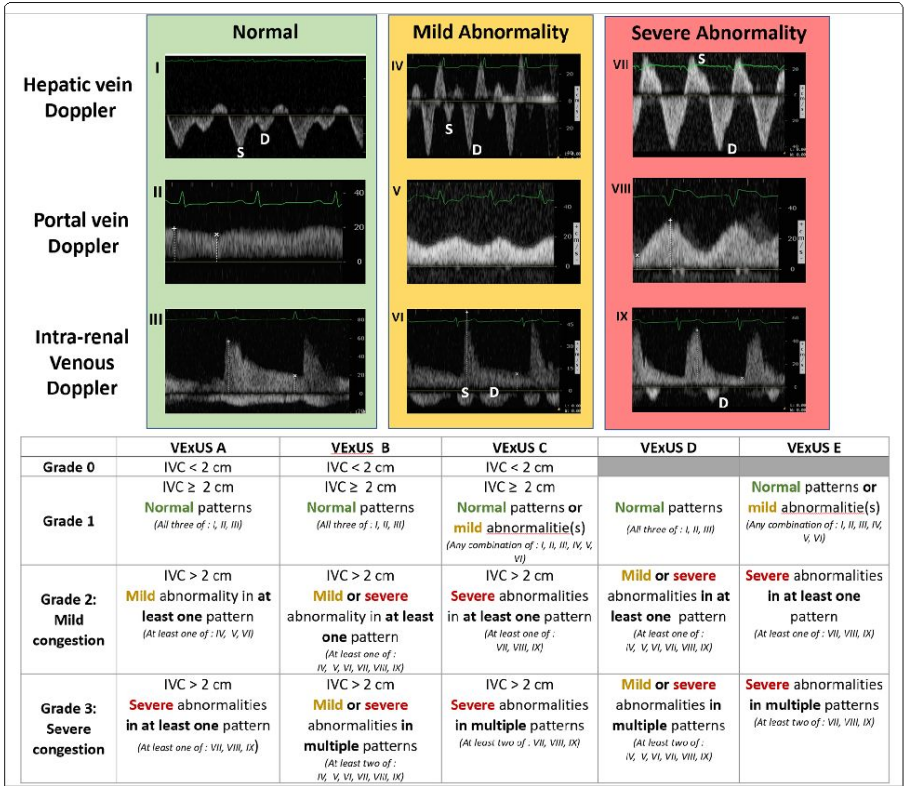
Table 2 Multivariable proportional hazards models to predict acute kidney injury in 145 patients after cardiac surgery using the Venous EXcess UltraSound (VExUS) C grading system

	Crude hazard ratio			Model 1 Adjusted hazard ratio[a]			Model 2 Adjusted hazard ratio[b]		
	HR	CI	*p*	HR	CI	*p*	HR	CI	*p*
VExUS C Grade 0	Reference category			Reference category			Reference category		
VExUS C Grade 1	1.25	0.58–2.66	0.57	1.13	0.52–2.43	0.76	1.13	0.52–2.43	0.76
VExUS C Grade 2	2.65	1.07–6.60	0.036	2.31	0.92–5.80	0.074	2.32	0.92–5.83	0.073
VExUS C Grade 3	3.69	1.65–8.24	0.001	2.83	1.22–6.55	0.015	2.82	1.21–6.55	0.016
Pre-operative AKI risk score [30]	1.02	1.01–1.04	0.001	1.02	1.003–1.03	0.019	1.02	1.003–1.033	0.02
Vasopressor–inotrope score	1.01	0.99–1.03	0.51				1.001	0.98–1.03	0.93

Multivariable proportional hazard regression model (Cox) with the VExUS grade considered as a time-varying covariate (i.e., VExUS grade at day 0 is used to predict AKI at day 1, VExUS grade at day 1 is used for AKI at day 2 and so on). *HR* hazard ratio, *CI 95%* confidence intervals

[a] Variables included in the multivariate model were the VExUS C grade (segmented time-dependant) and pre-operative AKI risk score [30]

[b] Variables included in the multivariate model were the VExUS C grade (segmented time-dependant), vasopressor–inotrope score (segmented time-dependant) and pre-operative AKI risk score [30]



	VExUS A	VExUS B	VExUS C	VExUS D	VExUS E
Grade 0	IVC < 2 cm	IVC < 2 cm	IVC < 2 cm		
Grade 1	IVC ≥ 2 cm **Normal** patterns *(All three of : I, II, III)*	IVC ≥ 2 cm **Normal** patterns *(All three of : I, II, III)*	IVC ≥ 2 cm **Normal** patterns **or mild** abnormalitie(s) *(Any combination of : I, II, III, IV, V, VI)*	**Normal** patterns *(All three of : I, II, III)*	**Normal** patterns **or mild** abnormalitie(s) *(Any combination of : I, II, III, IV, V, VI)*
Grade 2: Mild congestion	IVC > 2 cm **Mild** abnormality in **at least one** pattern *(At least one of : IV, V, VI)*	IVC > 2 cm **Mild or severe** abnormality in **at least one** pattern *(At least one of : IV, V, VI, VII, VIII, IX)*	IVC > 2 cm **Severe** abnormalities **in at least one** pattern *(At least one of : VII, VIII, IX)*	**Mild or severe** abnormalities **in at least one** pattern *(At least one of : IV, V, VI, VII, VIII, IX)*	**Severe** abnormalities **in at least one** pattern *(At least one of : VII, VIII, IX)*
Grade 3: Severe congestion	IVC > 2 cm **Severe** abnormalities **in at least one** pattern *(At least one of : VII, VIII, IX)*	IVC > 2 cm **Mild or severe** abnormalities **in multiple** patterns *(At least two of : IV, V, VI, VII, VIII, IX)*	IVC > 2 cm **Severe** abnormalities **in multiple** patterns *(At least two of : VII, VIII, IX)*	**Mild or severe** abnormalities **in multiple** patterns *(At least two of : IV, V, VI, VII, VIII, IX)*	**Severe** abnormalities **in multiple** patterns *(At least two of : VII, VIII, IX)*

Fig. 1 The Venous Excess UltraSound (VExUS) grading system: prototypes combining inferior vena cava (IVC) diameter and venous Doppler waveform of the portal, hepatic and interlobular renal veins. Hepatic Doppler is considered mildly abnormal when the systolic (S) component is lower in magnitude than the diastolic (D) component, but still toward the liver while it is considered severely abnormal when the S component is reversed (toward the heart). Portal Doppler is considered mildly abnormal when a variation in the velocities during the cardiac cycle of 30 to < 50% are observed, while is considered severely abnormal when a variation of ≥ 50% is seen. Intra-renal venous Doppler is considered mildly abnormal when it is discontinuous with a systolic (S) and diastolic (D) phase, while is it considered severely abnormal when it is discontinuous with only a diastolic phase seen during the cardiac cycle

Beaubien-Souligny *et al. Ultrasound J* (2020) 12:16
https://doi.org/10.1186/s13089-020-00163-w

The Ultrasound Journal

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ORIGINAL ARTICLE Open Access

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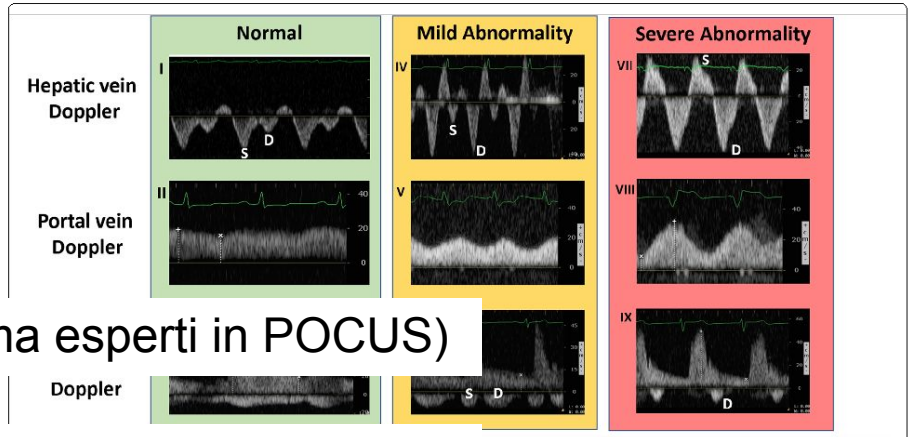

Operatori neoformati (ma esperti in POCUS)

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	Crude hazard ratio								
	HR	CI	*p*	....	....	*p*	....	....	*p*
VExUS C Grade 0	Reference category			Reference category			Reference category		
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Pre-operative AKI risk score [30]	1.02	1.01–1.04	0.0						
Vasopressor–inotrope score	1.01	0.99–1.03	0.5						

Multivariable proportional hazard regression model (Cox) with the VExUS g
at day 1, VExUS grade at day 1 is used for AKI at day 2 and so on). *HR* hazard

[a] Variables included in the multivariate model were the VExUS C grade (seg

[b] Variables included in the multivariate model were the VExUS C grade (seg
pre-operative AKI risk score [30]

30 Pazienti

	VExUS C	VExUS D	VExUS E
	IVC < 2 cm		
Grade 1	Normal patterns (All three of : I, II, III)	Normal patterns (All three of : I, II, III)	IVC ≥ 2 cm Normal patterns or mild abnormalitie(s) (Any combination of : I, II, III, IV, V, VI)	Normal patterns (All three of : I, II, III)	Normal patterns or mild abnormalitie(s) (Any combination of : I, II, III, IV, V, VI)
	IVC > 2 cm Severe abnormalities in at least one pattern (At least one of : VII, VIII, IX)	Mild or severe abnormalities in at least one pattern (At least one of : IV, V, VI, VII, VIII, IX)	Severe abnormalities in at least one pattern (At least one of : VII, VIII, IX)
	IVC > 2 cm Severe abnormalities in multiple patterns (At least two of : VII, VIII, IX)	Mild or severe abnormalities in multiple patterns (At least two of : IV, V, VI, VII, VIII, IX)	Severe abnormalities in multiple patterns (At least two of : VII, VIII, IX)

mediana del tempo di durata dell'esame:

34 minuti (IQR 18

La VExUs è la panacea per tutti (o quasi) i dubbi nella dispnea?

are observed, while is consider
when it is discontinuous with a systolic (S) and diastolic (D) phase, while is it considere
diastolic phase seen during the cardiac cycle

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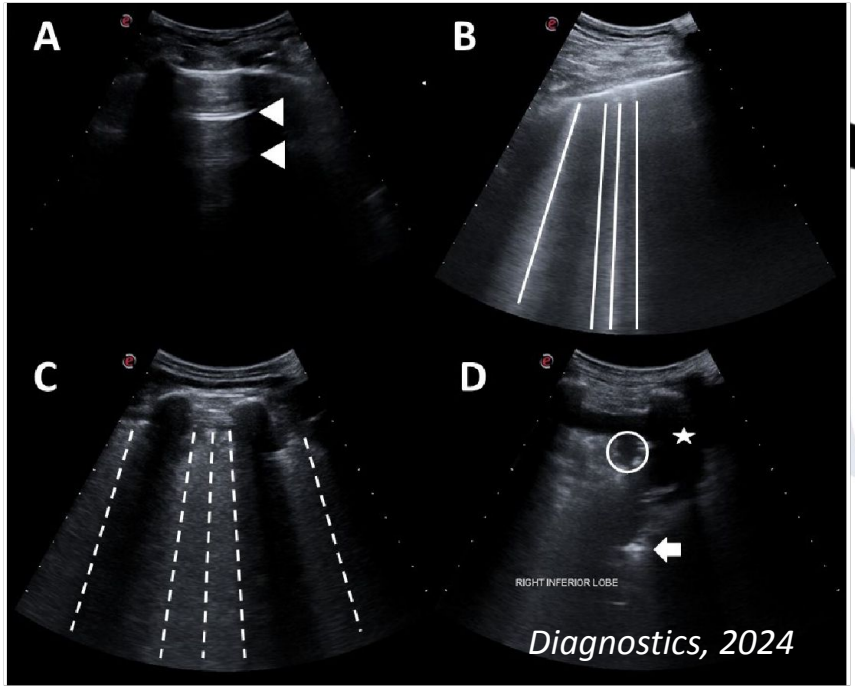
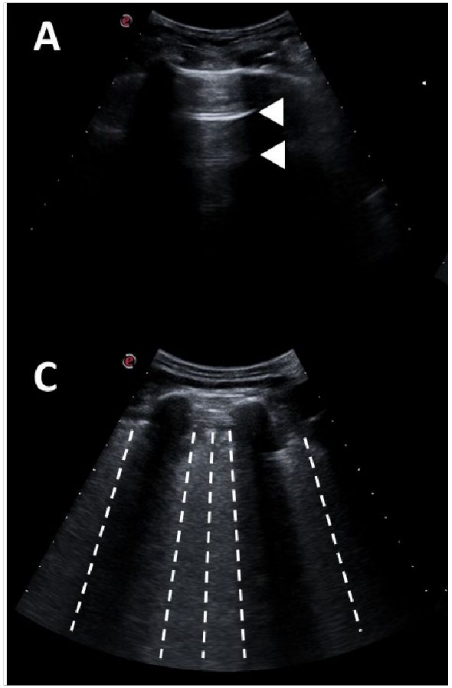


Diagnostics, 2024



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♀

78 aa.

Dispnea acuta

…e dolore epigastrico.

Inviata da servizio di emergenza territoriale per sospetta SCA