



# HOT TOPICS IN CARDIOLOGIA 2023

13 e 14 Novembre 2023

Villa Doria D'Angri - Via F. Petrarca 80,  
Napoli

**Ruolo dell'ecocardiografia  
per la valutazione della  
disfunzione ventricolare  
sinistra da trattamenti  
oncologici**

Antonella Moreo  
**ASST GOM Niguarda  
Milano**

# Imaging e terapie cardiotoxiche: appropriatezza

## ACCF/ASE/AHA/ASNC/HFSA/HRS/SCAI/SCCM/ SCCT/SCMR 2011 Appropriate Use Criteria for Echocardiography

### Cardiomyopathies With TTE

• Initial evaluation of known or suspected cardiomyopathy (e.g., restrictive, infiltrative, dilated, hypertrophic, or genetic cardiomyopathy)	A (9)
• Re-evaluation of known cardiomyopathy with a change in clinical status or cardiac exam or to guide therapy	A (9)
• Routine surveillance (<1 y) of known cardiomyopathy without a change in clinical status or cardiac exam	I (2)
• Routine surveillance ( $\geq 1$ y) of known cardiomyopathy without a change in clinical status or cardiac exam	U (5)
• Screening evaluation for structure and function in first-degree relatives of a patient with an inherited cardiomyopathy	A (9)
• Baseline and serial re-evaluations in a patient undergoing therapy with cardiotoxic agents	A (9)

### APPROPRIATE USE CRITERIA

ACC/AATS/AHA/ASE/ASNC/HRS/SCAI/  
SCCT/SCMR/STS 2019 Appropriate Use  
Criteria for Multimodality Imaging in the  
Assessment of Cardiac Structure and  
Function in Nonvalvular Heart Disease

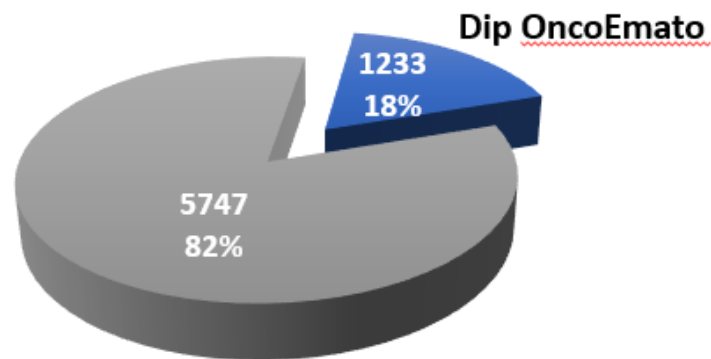
 Check for updates

Indication	TTE (With or Without 3D; With Contrast as Needed)	TEE (With or Without 3D)	Stress Echo*	Strain/Strain Rate Imaging by Speckle or Tissue Doppler	F-18 FDG PET	Tc-99m PYP	MPI (SPECT/PET)	CMR	CT†	ANG	RVG
. Evaluation of LV function in patients who are scheduled for or who have received chemotherapy	9 (A)	1 (R)	2 (R)	6 (M)	1 (R)	1 (R)	1 (R)	6 (M)	4 (M)	1 (R)	7 (A)

# Valutazioni cardiotossicità: Impatto sull'attività Lab III livello ASST GOM Niguarda anno 2022

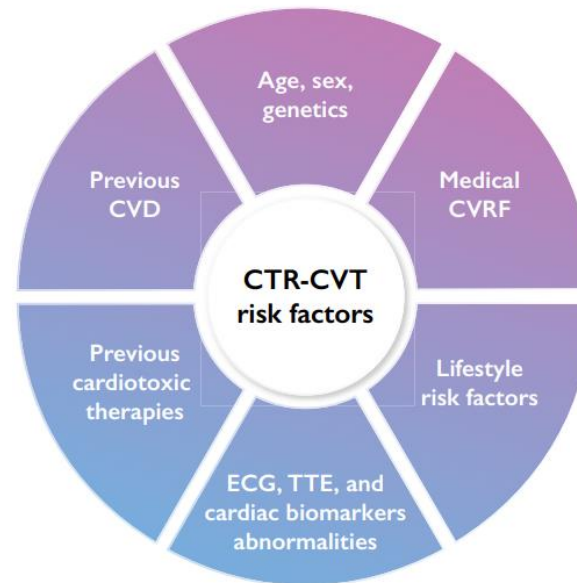
	Esami Interni	Esami Esterni	Totali
Dip OncoEmato	688	1233	1921
Altri	8051	5747	13798
<b>Totale esami</b>	<b>8739</b>	<b>6980</b>	<b>15719</b>

## Esami esterni (N. 6980)



# Baseline CV toxicity risk assessment checklist

**2022 ESC Guidelines on cardio-oncology developed in collaboration with the European Hematology Association (EHA), the European Society for Therapeutic Radiology and Oncology (ESTRO) and the International Cardio-Oncology Society (IC-OS)**



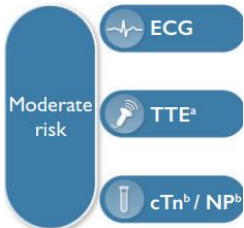
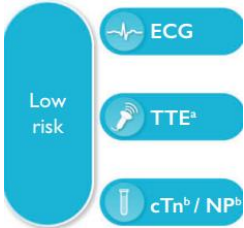
Clinical assessment

Complementary tests

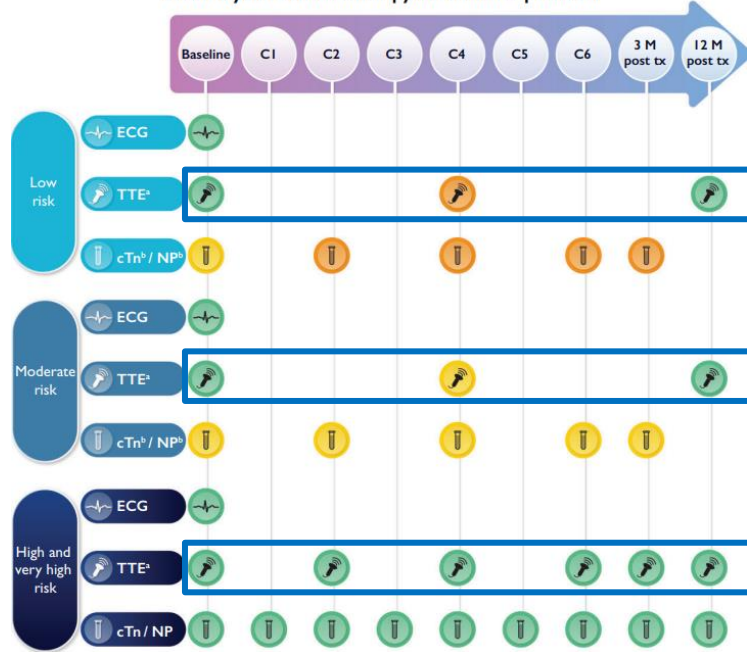
# Cardiovascular surveillance during cancer therapies

2022 ESC Guidelines on cardio-oncology developed in collaboration with the European Hematology Association (EHA), the European Society for Therapeutic Radiology and Oncology (ESTRO) and the International Cardio-Oncology Society (IC-OS)

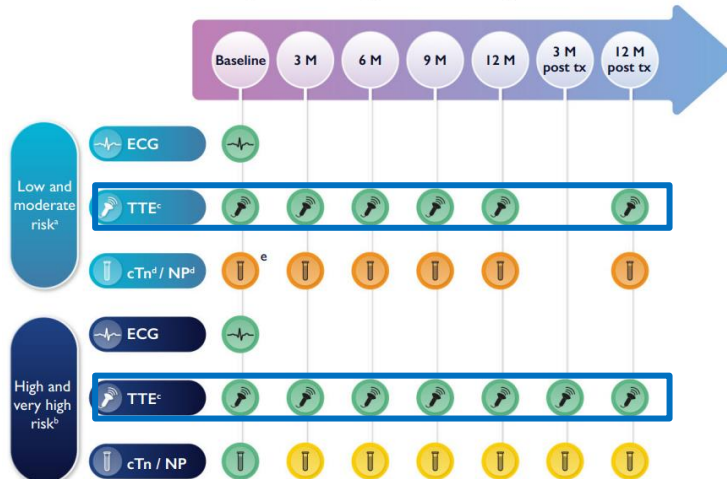
● Class I   ● Class IIa   ● Class IIb



## Anthracycline chemotherapy surveillance protocol



## HER2-targeted therapy surveillance protocol



## VEGFi surveillance protocol

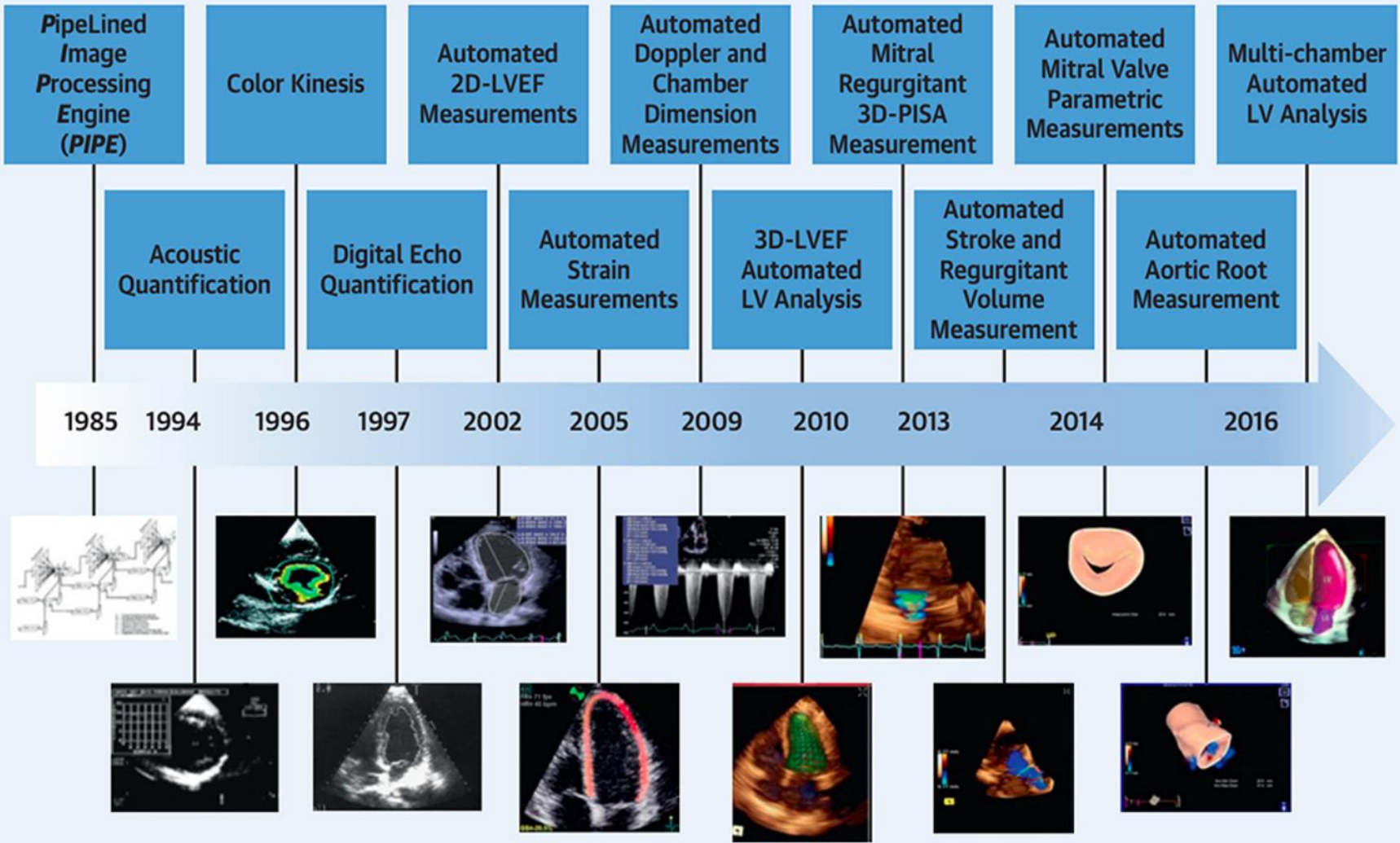


# Cardiovascular surveillance asymptomatic adult cancer survivors

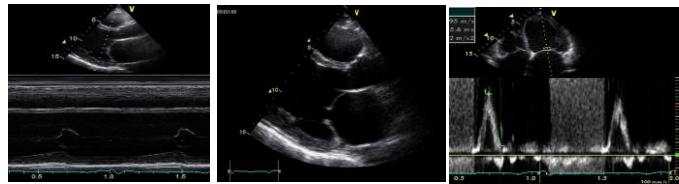
**2022 ESC Guidelines on cardio-oncology developed in collaboration with the European Hematology Association (EHA), the European Society for Therapeutic Radiology and Oncology (ESTRO) and the International Cardio-Oncology Society (IC-OS)**

Recommendations	Class <sup>a</sup>	Level <sup>b</sup>
Annual CV risk assessment, <sup>c</sup> including ECG and NP, and CVRF management is recommended in CS who were treated with a potentially cardiotoxic cancer drug or RT. <sup>d,631–633,671,672</sup>	<b>I</b>	<b>B</b>
CV toxicity risk restratification <sup>e</sup> is recommended 5 years after therapy to organize long-term follow-up.	<b>I</b>	<b>C</b>
Echocardiography at years 1, 3, and 5 after completion of cardiotoxic cancer therapy and every 5 years thereafter should be considered in asymptomatic very high- and early high-risk adult CS. <sup>f</sup>	<b>IIa</b>	<b>C</b>
Echocardiography should be considered in asymptomatic late high-risk adult CS <sup>f</sup> starting at 5 years after radiation to a volume including the heart and then every 5 years.	<b>IIa</b>	<b>C</b>

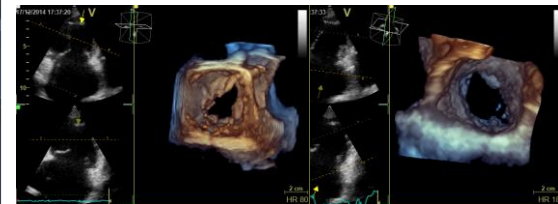
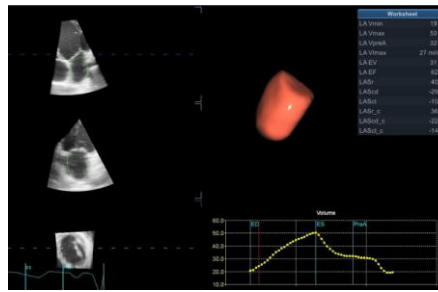
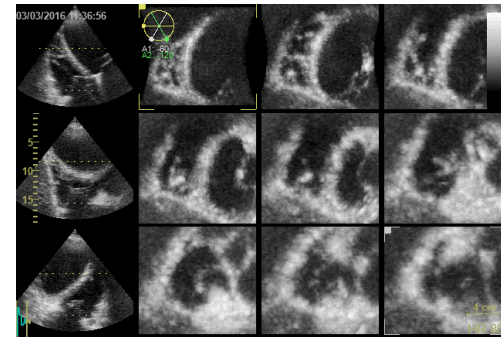
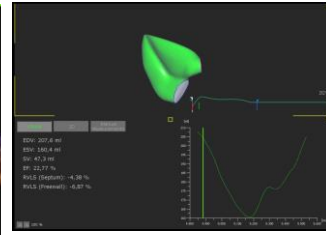
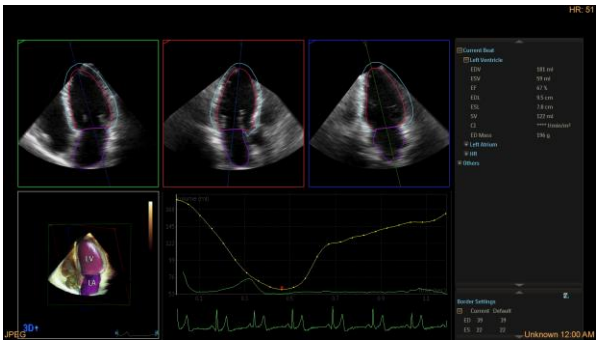
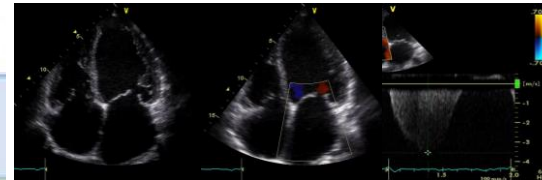
# Quale imaging ecocardiografico?



# Quale imaging ecocardiografico, in quali pazienti?



Transthoracic echocardiography	
Morphological assessment	Standard analysis
Functional assessment	
Strain	Additive analysis
3D	
Contrast	





# Ecocardiografia 3D: valutazione FE

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## Recommendation Table 4 — Recommendations for cardiac imaging modalities in patients with cancer

General	Class <sup>a</sup>	Level <sup>b</sup>
Echocardiography is recommended as the first-line modality for the assessment of cardiac function in patients with cancer. <sup>4,12,54,94</sup>	I	C
<u>3D echocardiography is recommended as the preferred echocardiographic modality to measure LVEF.</u> <sup>77–79,89</sup>	I	B
GLS is recommended in all patients with cancer having echocardiography, if available. <sup>75,80,81,89,90,92,93,102,103</sup>	I	C

# FE 3D: accuratezza e riproducibilità

## Performance of 3-Dimensional Echocardiography in Measuring Left Ventricular Volumes and Ejection Fraction

A Systematic Review and Meta-Analysis

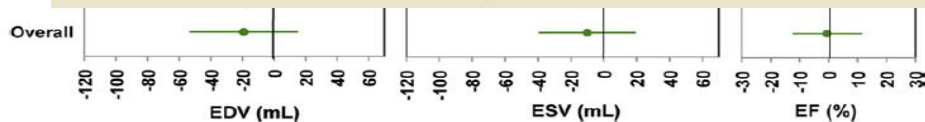
Jennifer L. Dorosz, MD,\* Dennis C. Lezotte, PhD,† David A. Weitzenkamp, PhD,† Larry A. Allen, MD, MHS,\* Ernesto E. Salcedo, MD\*

Aurora, Colorado

J Am Coll Cardiol 2012

- 1638 echocardiogrammi
- 23 studi

### Three-Dimensional Echocardiography Versus Cardiac Magnetic Resonance



## Reproducibility and Accuracy of Echocardiographic Measurements of Left Ventricular Parameters Using Real-Time Three-Dimensional Echocardiography

Carly Jenkins, BS, Kristen Bricknell, BS, Lizelle Hanekom, MD, Thomas H. Marwick, MD, PhD, FACC

Unselected patients (n = 50; 41 men; age, 64 ± 8 years) presenting for evaluation of LV function were studied with 2DE and RT-3DE. Test-retest variation was performed by a complete restudy by a separate sonographer within 1 h without alteration of hemodynamics or therapy.

Real-time 3DE is a feasible approach to reduce test-retest variation of LV volume, ejection fraction, and mass measurements in follow-up LV assessment in daily practice. (J Am Coll Cardiol 2004;44:878-86)

End-diastolic volume (172 ± 53 ml)	-4 ± 29	p = 0.31	-54 ± 33	p < 0.01
End-diastolic volume (91 ± 53 ml)	-3 ± 18	p = 0.23	-28 ± 28	p < 0.01
Ejection fraction (50 ± 14%)	0 ± 7	p = 0.74	-1 ± 13	p = 0.76
LV mass (183 ± 50 g)	0 ± 38	p = 0.94	16 ± 57	p = 0.04

## Reproducibility of Echocardiographic Techniques for Sequential Assessment of Left Ventricular Ejection Fraction and Volumes

Application to Patients Undergoing Cancer Chemotherapy

Paaladinesh Thavendiranathan, MD, MSc, Andrew D. Grant, MD, Tomoko Negishi, MD, Juan Carlos Plana, MD, Zoran B. Popović, MD, PhD, Thomas H. Marwick, MD, PhD, MPH

Cleveland, Ohio

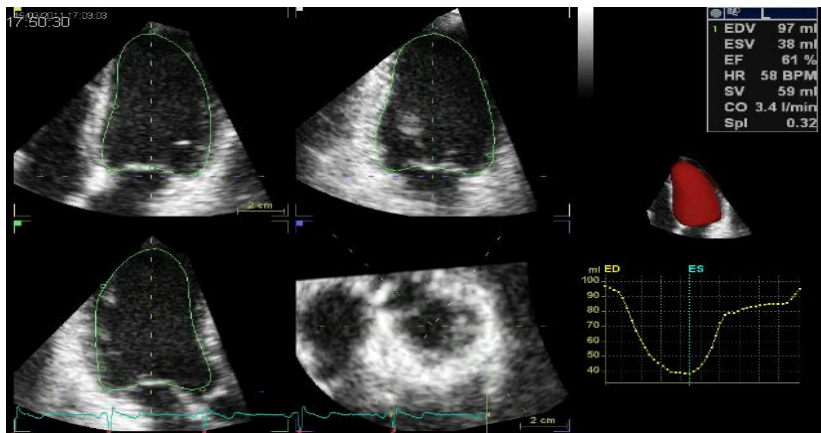
## Conclusions

Noncontrast 3DE was the most reproducible technique for LVEF and LV volume measurements over 1 year of follow-up. (J Am Coll Cardiol 2013;61:77-84) © 2013 by the American College of Cardiology Foundation

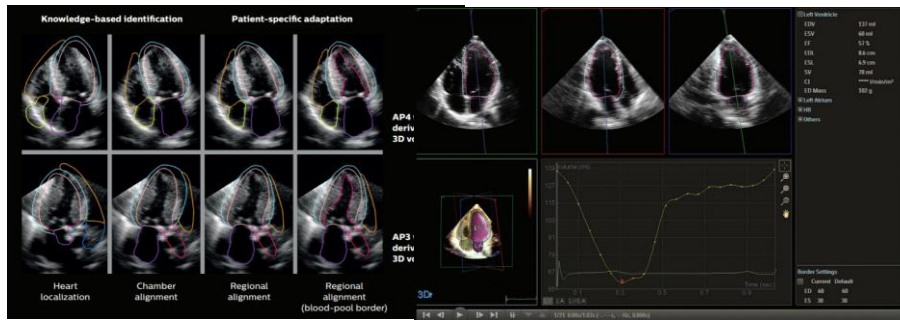
Controlli seriati

# Ecocardiografia 3D

- No time-consuming



Software per la rilevazione semiautomatica o automatica dei bordi con ricostruzione 3D del volume sistolico e diastolico



# Dal 2004 ad oggi.....

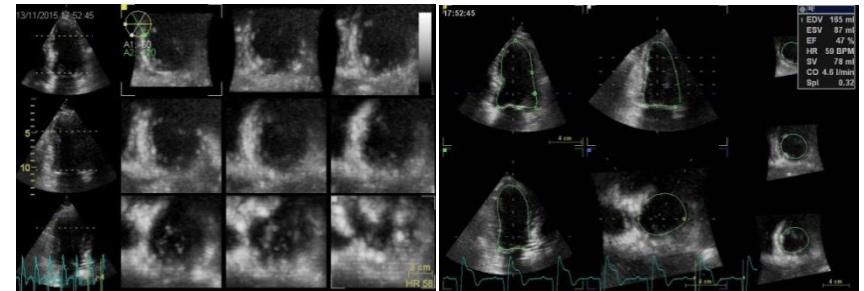
	2DE	RT-3DE
Acquisition time (s)	120 ± 60	50 ± 19
Volume calculation (s)	90 ± 27	630 ± 60
Mass calculation (s)	M-mode -30 + 10 2DE -42 + 10	360 ± 50



17:50:57

17:52:38

101sec



17:52:50

17:54:10

80 sec



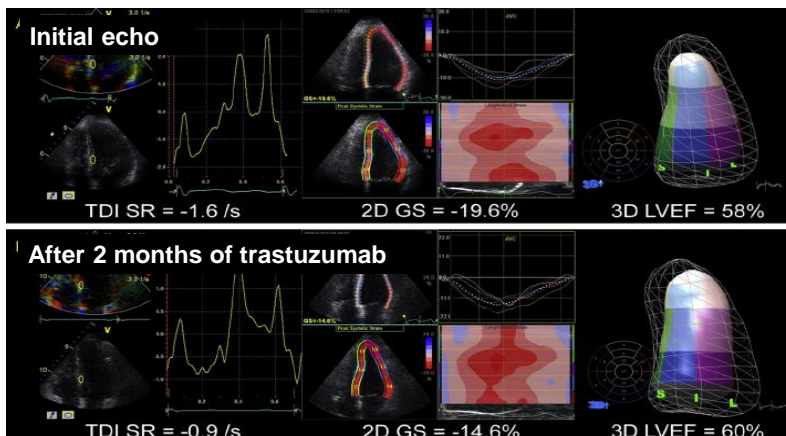
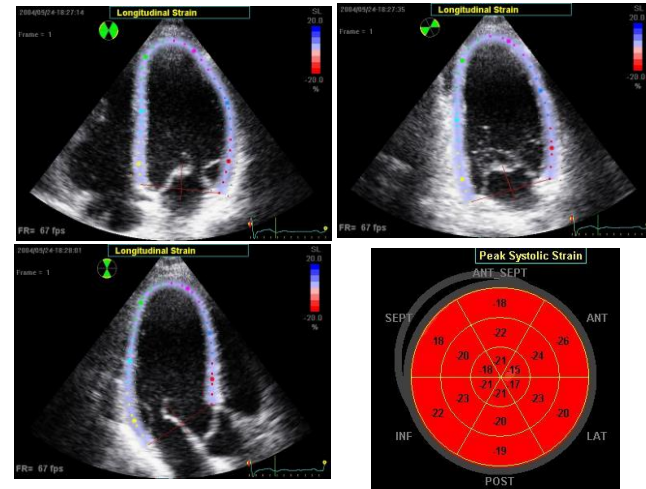
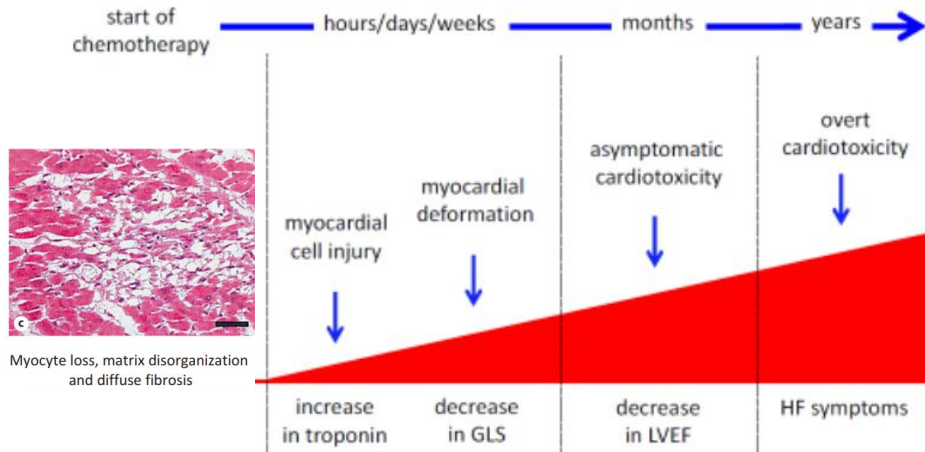
# Global Longitudinal Strain: valutazione cardiotoxicità

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# Evoluzione cardiotoxicità



**Use of myocardial deformation imaging to detect preclinical myocardial dysfunction before conventional measures in patients undergoing breast cancer treatment with trastuzumab**

James L. Hare, MBBS,<sup>a</sup> Joseph K. Brown, BSc,<sup>a</sup> Rodel Leano, BSc,<sup>a</sup> Carly Jenkins, MSc,<sup>a</sup> Natasha Woodward, MBBS,<sup>b</sup> and Thomas H. Marwick, MBBS, PhD<sup>a</sup> *Brisbane, Australia*

# Definizione cardiotoxicità



ESC

European Society  
of Cardiology

European Heart Journal (2022) 00, 1–133  
<https://doi.org/10.1093/eurheartj/ehac244>

ESC GUIDELINES

## 2022 ESC Guidelines on cardio-oncology

- **TTE is the preferred technique to detect and confirm cardiac dysfunction**
- **GLS evaluation is particularly important in patients with low-normal LVEF** to confirm or not asymptomatic myocardial damage
- A relative change in GLS has been suggested as the ideal tool to identify **asymptomatic mild** CTRCD
- Using the **15% threshold will maximize specificity and minimize overdiagnosis** of CTRCD and guide cardioprotective therapy

CTRCD		
<b>Symptomatic CTRCD (HF)<sup>a,b</sup></b>	Very severe	HF requiring inotropic support, mechanical circulatory support, or consideration of transplantation
	Severe	HF hospitalization
	Moderate	Need for outpatient intensification of diuretic and HF therapy
	Mild	Mild HF symptoms, no intensification of therapy required
<b>Asymptomatic CTRCD</b>	Severe	New LVEF reduction to <40%
	Moderate	New LVEF reduction by $\geq 10$ percentage points to an LVEF of 40–49% OR New LVEF reduction by <10 percentage points to an LVEF of 40–49% AND either new relative decline in GLS by >15% from baseline OR new rise in cardiac biomarkers <sup>c</sup>
	Mild	LVEF $\geq 50\%$ AND new relative decline in GLS by >15% from baseline AND/OR new rise in cardiac biomarkers <sup>c</sup>

# Strain: quesiti aperti



## Strain-Guided Management of Potentially Cardiotoxic Cancer Therapy

(J Am Coll Cardiol 2021;77:392-401)

### SUCCOUR randomized controlled trial

**METHODS** In this international, multicenter, prospective, randomized controlled trial, 331 anthracycline-treated patients with another heart failure risk factor were randomly allocated to CPT initiation guided by either  $\geq 12\%$  relative reduction in GLS (n = 166) or  $>10\%$  absolute reduction of LVEF (n = 165). Patients were followed for EF and development of CTRCD (symptomatic EF reduction of  $>5\%$  or  $>10\%$  asymptomatic to  $<55\%$ ) over 1 year.

	EF Guided			GLS Guided			Difference, % (95% CI)	p Value†
	n	LV Function, % (95% CI)	p Value*	n	LV Function, % (95% CI)	p Value*		
Core laboratory 3D EF, %								
Baseline	153	58 (57 to 59)		154	59 (58 to 60)		-1.2 (-2.6 to 0.2)	0.10
1 year	153	55 (54 to 56)		154	57 (56 to 58)		-1.5 (-3.0 to 0.0)	0.05
1 year - baseline	153	-3.0 (-1.8 to -4.2)	$<0.001$	154	-2.7 (-1.7 to -3.8)	$<0.001$	0.3 (-1.3 to 1.9)	0.69

**CONCLUSIONS** Although the change in LVEF was not different between the 2 arms as a whole, when patients who received CPT were compared, those in the GLS-guided arm had a significantly lower reduction in LVEF at 1 year follow-up. Furthermore, GLS-guided CPT significantly reduced a meaningful fall of LVEF to the abnormal range. The results support the use of GLS in surveillance for CTRCD. (Strain Surveillance of Chemotherapy for Improving Cardiovascular

### EDITORIAL COMMENT

## Global Longitudinal Strain in Cardio-Oncology\*

Javid J. Moselehi, MD,\* Ronald M. Witteles, MD<sup>†</sup>

- More than twice as many patients in the GLS arm taking new cardiac medications
- More patients in the GLS arm having interruptions or discontinuations of their cancer therapy (5 patients in the GLS arm, vs 2 patients in the LVEF arm)

## Cardioprotection Using Strain-Guided Management of Potentially Cardiotoxic Cancer Therapy

3-Year Results of the SUCCOUR Trial



**CONCLUSIONS** Among patients taking potentially cardiotoxic chemotherapy for cancer, the 3-year data showed improvement of LV dysfunction compared with 1 year, with no difference in  $\Delta$ EF between GLS- and EF-guided CPT. (Strain Surveillance of Chemotherapy for Improving Cardiovascular Outcomes [SUCCOUR]; [ACTRN12614000341628](https://clinicaltrials.gov/ct2/show/study/ACTRN12614000341628)) (J Am Coll Cardiol Img 2023;16:269-278) © 2023 by the American College of Cardiology Foundation.



# Funzione ventricolare destra

## RV function, pulmonary artery pressure and volaemia

Markers of systolic RV function

TAPSE <1.7 cm, FAC <35%, RV free wall strain <20%, 3D RVEF <45%

Show prognostic value in heart failure and pulmonary hypertension

Velocity of TR

Peak systolic TR velocity > 2.8 m/s

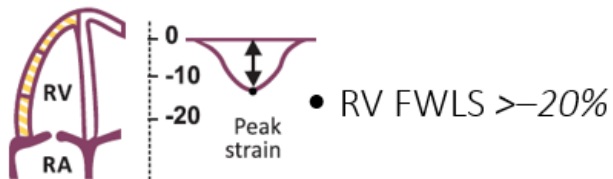
Indicates probable pulmonary hypertension

IVC diameter, collapse on inspiration

Dilatation >2.1 cm or narrowing <1.3 cm

Relates to hypervolaemia or dehydration, respectively

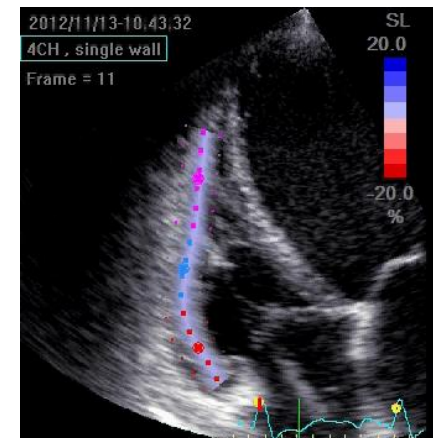
## 2022 ESC Guidelines on cardio-oncology



Right ventricle-right atrium<sup>a</sup>

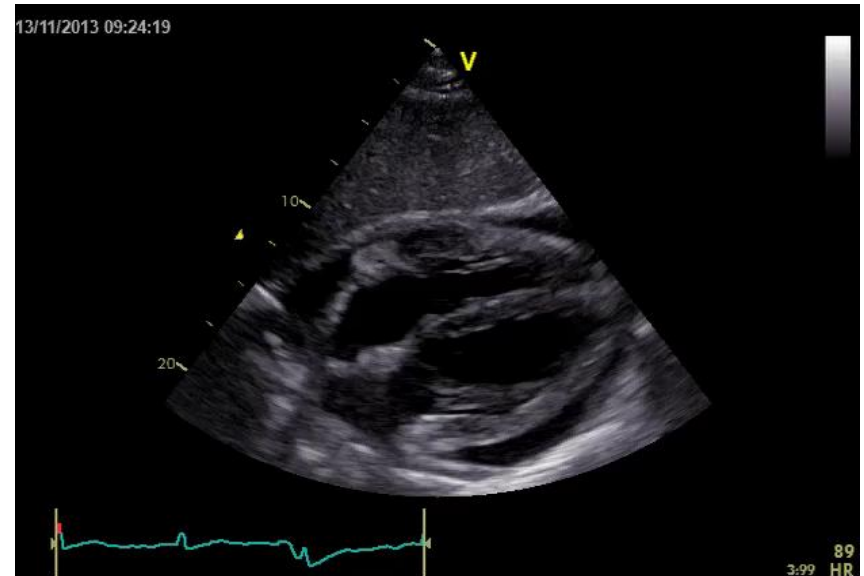
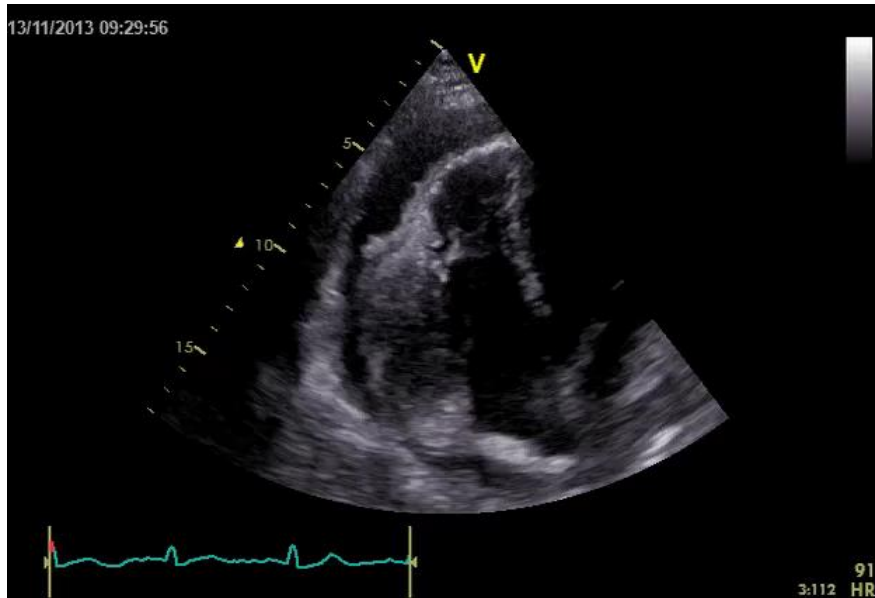
TTE

- RV dimensions
- S'
- TAPSE
- FAC
- **RV-FWLS**
- RA area
- Peak TRV

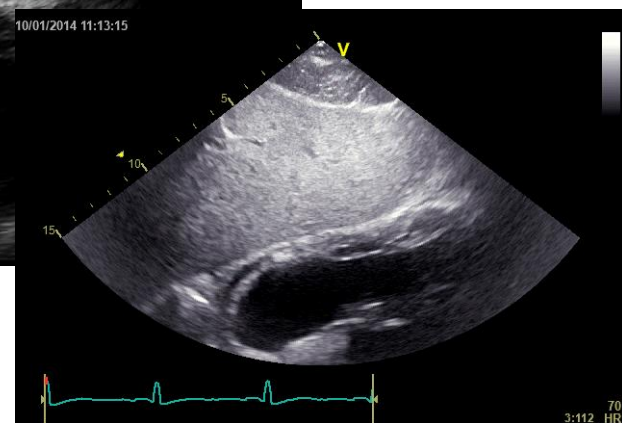
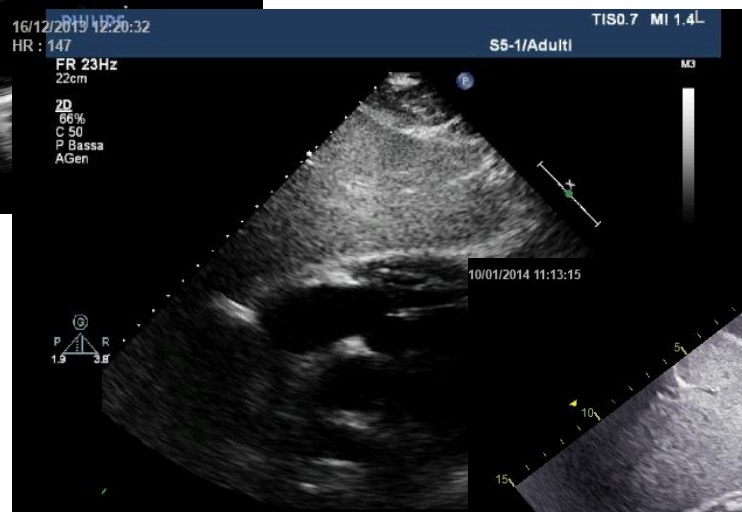
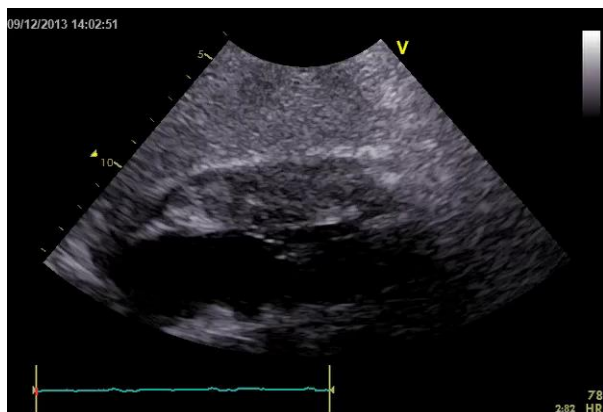


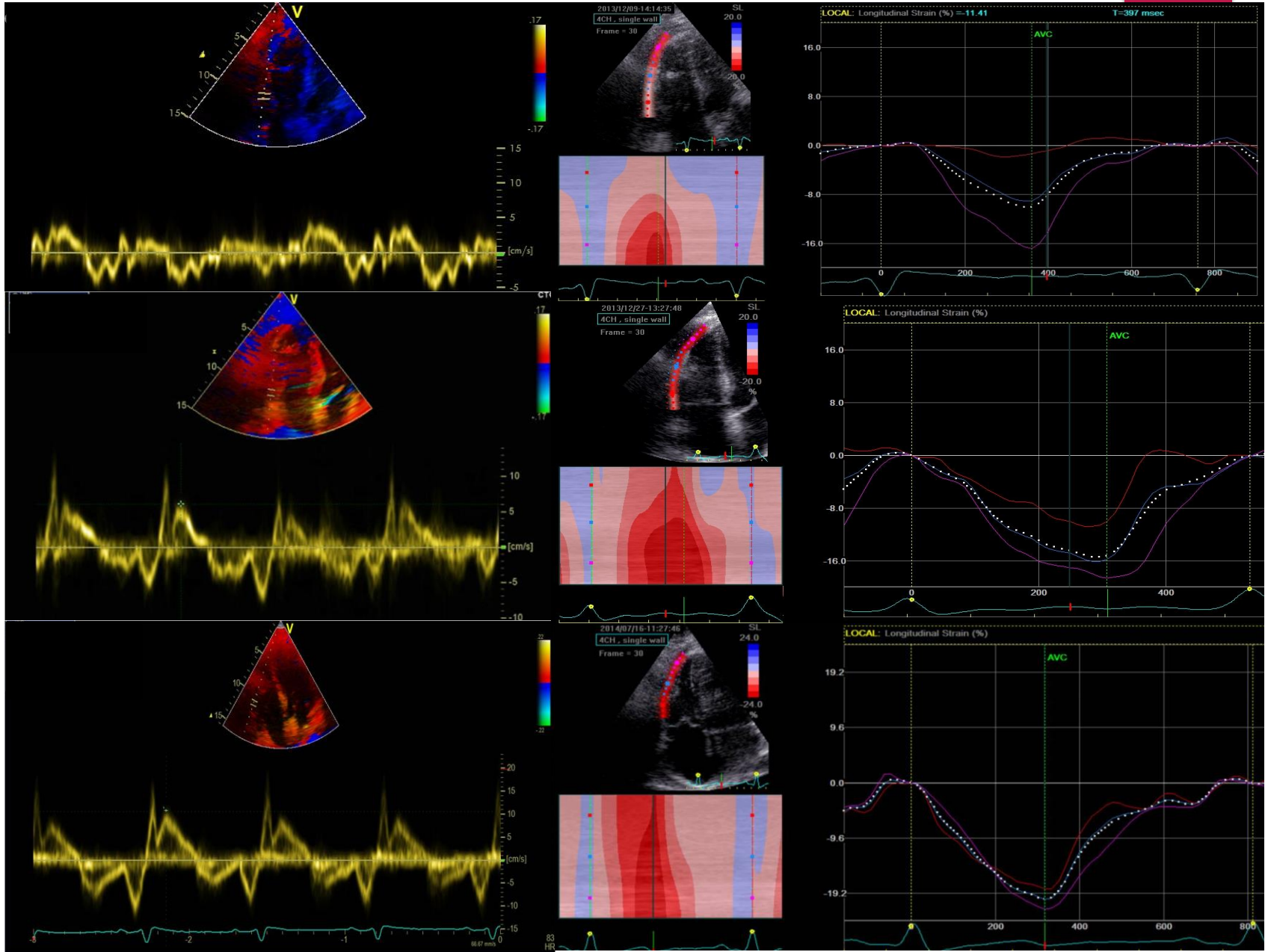
# Caso clinico

- ♂ 43 aa
- Non precedenti anamnestici di rilievo.
- Ricoverato per dispnea e tosse stizzosa
- Recente insorgenza di dispnea ingravescente
- Ecocardiogramma

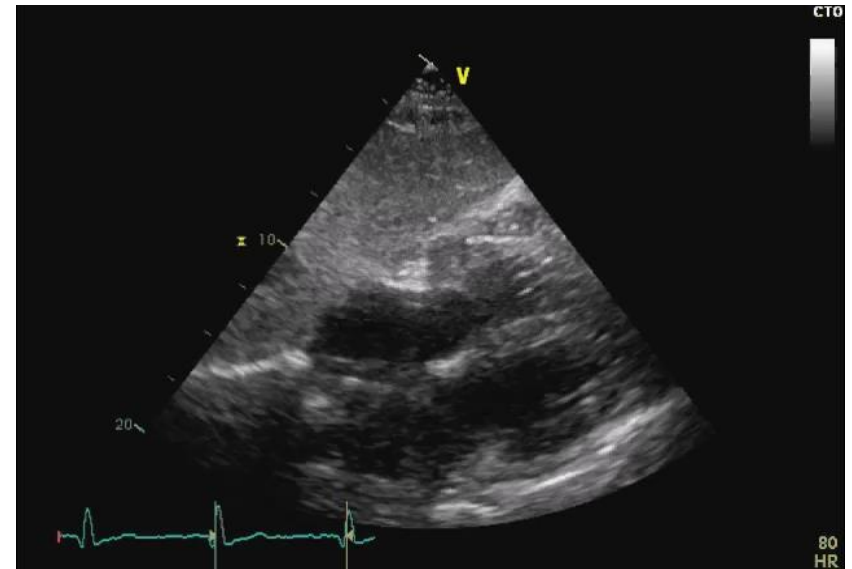
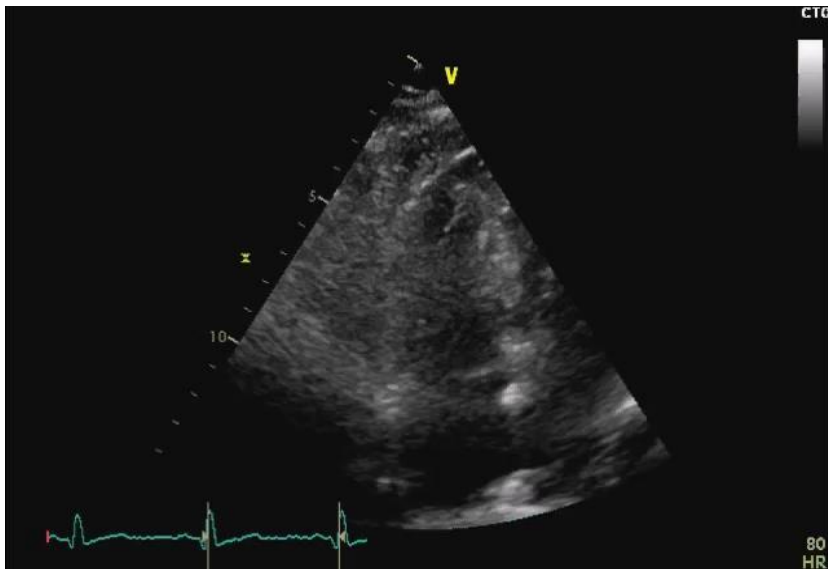
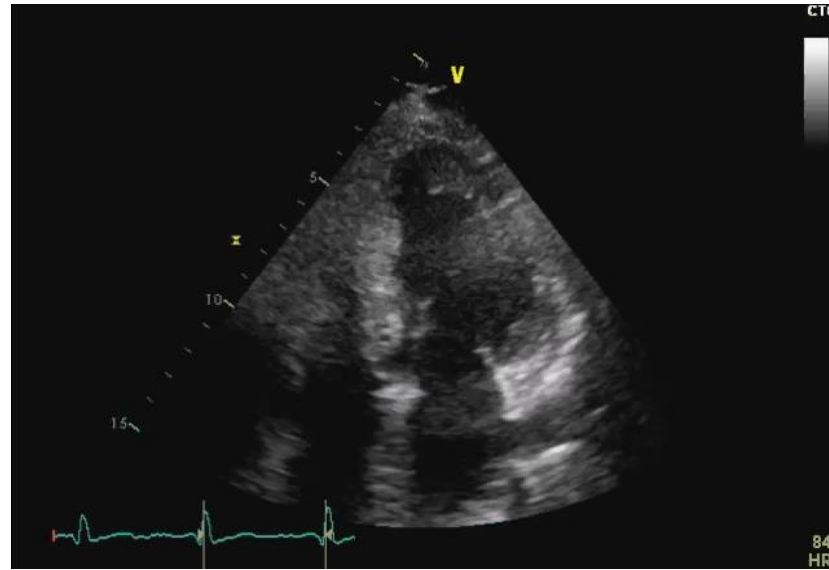
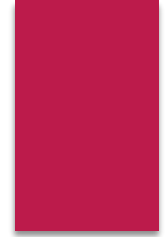


# Monitoraggio risposta alla terapia





# Monitoraggio: non solo funzione



# Monitoraggio: non solo funzione

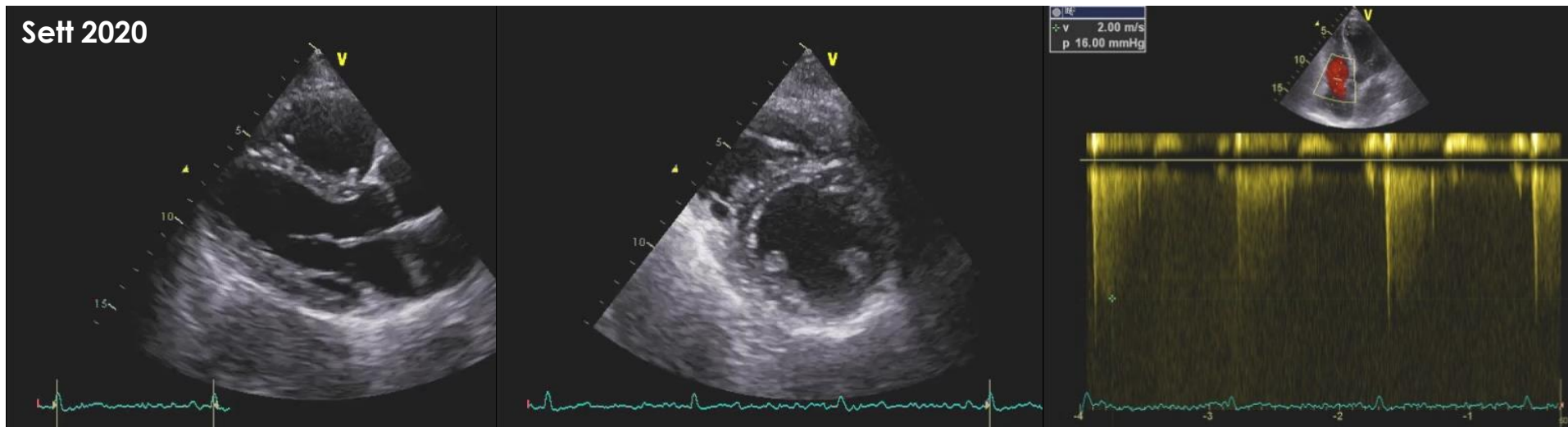
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TIPOLOGIA PRESCRIZIONE (S/H):      ALTRO:      PRIORITA' PRESCRIZIONE (U,B,D,P):      Programmabile  
**QUESITO DIAGNOSTICO: controllo FE**  
N.CONFEZIONI/PRESTAZIONI: 1      TIPO RICETTA: Assist. SSN      DATA: 24/02/2021  
CODICE AUTENTICAZIONE: 240220211327046850004172851957      COGNOME E NOME DEL MEDICO



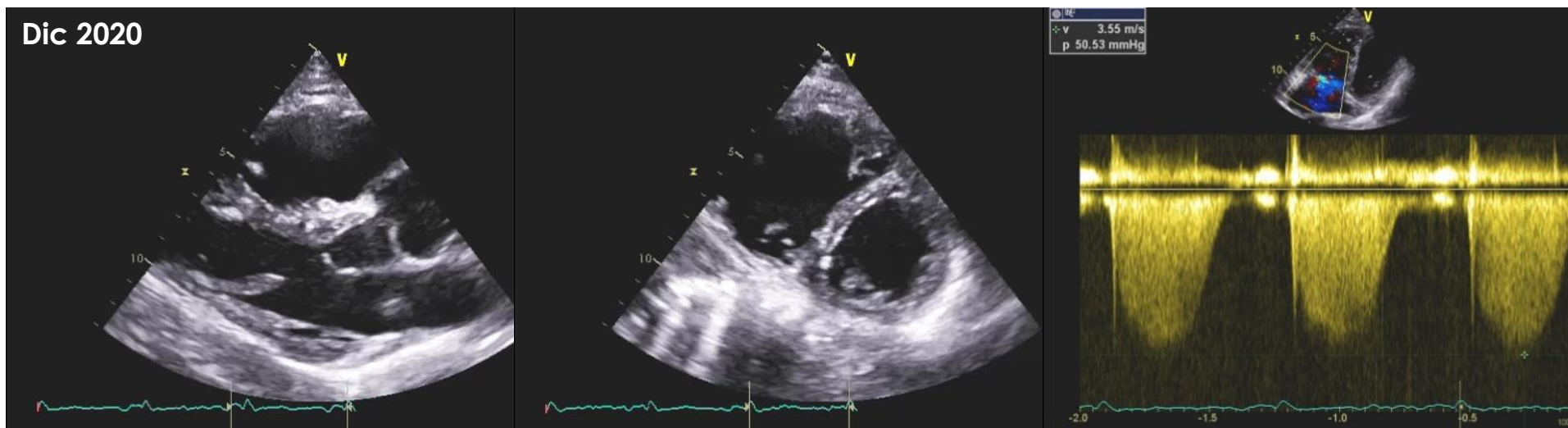
# Monitoraggio: non solo funzione



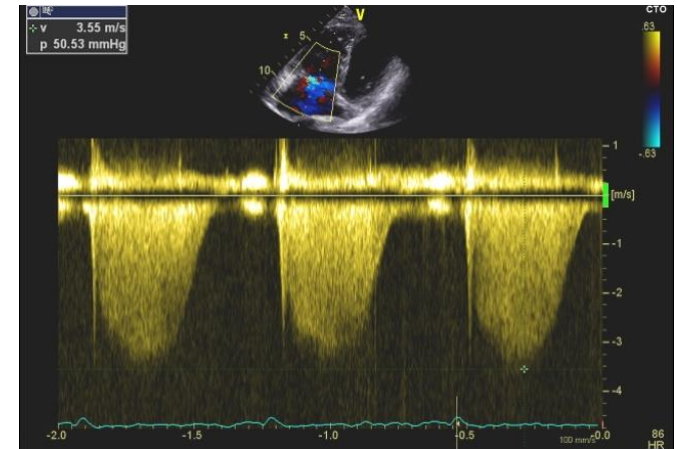
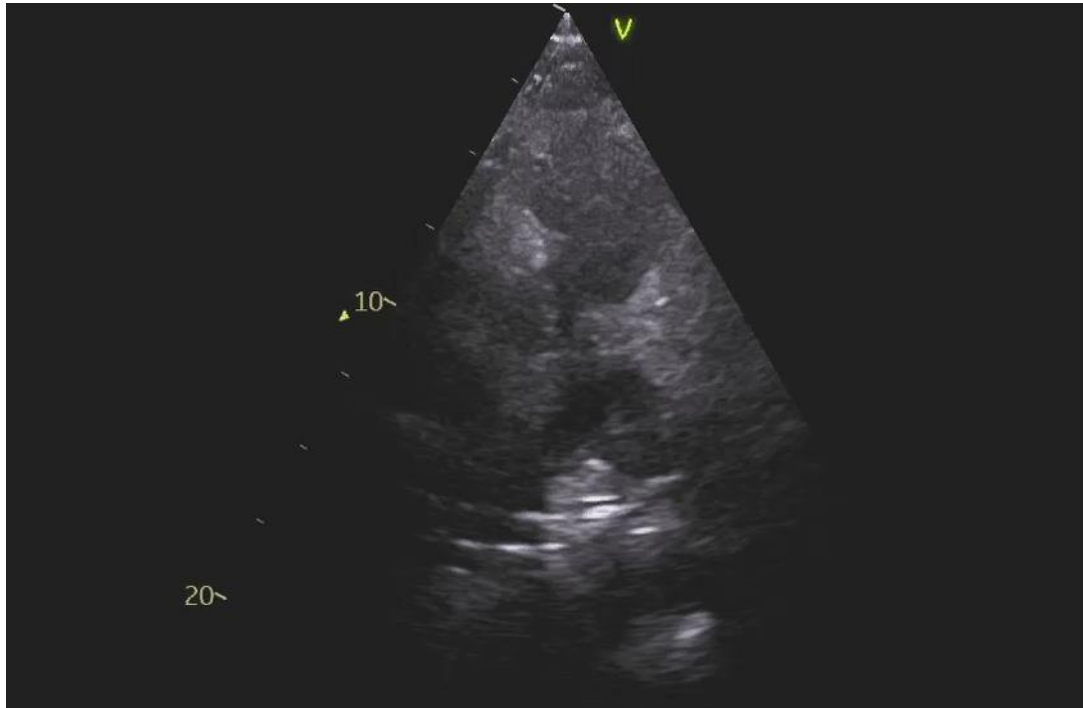
Sett 2020



Dic 2020



# Monitoraggio: non solo funzione





# Take home message



L'ecocardiografia nella valutazione della cardiotossicità

- Contribuisce nella valutazione basale del rischio di sviluppare cardiotossicità
- E' fondamentale nella sorveglianza personalizzata durante trattamento
- Permette il precoce riconoscimento e trattamento della cardiotossicità

La valutazione ecocardiografica deve essere multiparametrica e prevedere l'utilizzo di analisi avanzate per ottenere dati accurati e riproducibili della funzione ventricolare globale e longitudinale

Lo studio ecocardiografico non è limitato alla valutazione della funzione ventricolare ma può evidenziare anche altre complicanze legate alla patologia oncologica

**Grazie per l'attenzione**



**[antonella.moreo@ospedaleniguarda.it](mailto:antonella.moreo@ospedaleniguarda.it)**