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# GIORNATE CARDIOLOGICHE TORINESI

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UNIVERSITÀ DEGLI STUDI DI TORINO



# La valutazione ecocardiografica del paziente candidato a VAD

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# Echocardiography in the Management of Patients with Left Ventricular Assist Devices: Recommendations from the American Society of Echocardiography

## Appendix B Recommended Pre-LVAD-Implantation TTE Protocol (with embedded red flags)

### Parasternal Long-Axis View Image acquisition

LV size  
**Red-flag findings:** Small LV size, particularly with increased LV trabeculations  
 Global and regional LV function  
 M-mode evaluation of left ventricle and left atrium/aorta (if lab standard)  
 2D evaluation of AV, MV, TV (TV by RV inflow tract view)  
**Red-flag finding:** any prosthetic valve  
 Color-flow Doppler evaluation of MV and AV  
 RV inflow view  
 CW Doppler (TR)  
 High left parasternal view of ascending aorta  
**Red-flag findings:** Ascending aortic aneurysm, dissection, or atheroma

### Recommended measurements

LV internal dimension at end-diastole  
 LV internal dimension at end-systole  
 Posterior wall thickness  
 Interventricular septal thickness  
 LV ejection fraction  
 LVOT diameter  
 LA dimension  
 Aortic root dimension  
 Ascending aorta dimension  
 CW Doppler TR velocity for RVSP

### Parasternal Short-Axis View Image acquisition

2D short-axis view at AV level and RVOT  
 2D short-axis view of left ventricle at basal, mid, and apical levels  
**Red-flag findings:** VSD  
 Global and regional LV function  
 Color-flow Doppler evaluation of PV, AV, and TV  
 Spectral Doppler evaluation of RVOT, PV, pulmonary trunk  
**Red-flag findings:** Moderate or greater PS or PR, PDA, prosthetic valve  
 M-mode evaluation (if lab standard)

### Recommended measurements

RVOT velocity  
 PV velocity

### Apical Four-Chamber View Image acquisition

2D imaging of the four chambers (maximizing LV length)  
**Red-flag findings:** LV thrombus, LV apical aneurysm, any congenital heart disease  
 "Dedicated RV view"  
**Red-flag findings:** RV dilatation  
 Global and regional LV and RV function  
**Red-flag findings:** RV systolic dysfunction  
**Color-flow Doppler of valvular inflow and regurgitation**  
 Color-flow Doppler interrogation of interventricular and interatrial septum  
**Red-flag findings:** VSD, PFO, or ASD  
 Pulsed Doppler of MV  
 Pulsed Doppler of pulmonary veins  
 Doppler tissue imaging  
 LV and RV strain (optional)

(Continued)

## Appendix B (Continued)

CW Doppler to evaluate valves, native or prosthetic (use multiple views to obtain highest flow velocities)  
**Red-flag findings:**  
 MV:  $\geq$  moderate MS  
 AV:  $>$  mild AR  
 TV:  $\geq$  moderate TR or  $>$  mild TS  
 PV:  $\geq$  moderate PS or PR  
 Agitated saline contrast at rest and with release of Valsalva maneuver to evaluate intracardiac or intrapulmonary shunting  
**Red-flag findings:** PFO, significant intrapulmonary shunt

### Recommended measurements

LV systolic function: 2D/3D volumetrics for EF  
 LV diastolic function: mitral E/A, DT, medial and lateral MV annulus DTI  
 RV function: RV strain, TAPSE, TV DTI  
 LA volume index/RA area

### Apical Five-Chamber View Image acquisition

2D imaging  
 Color-flow Doppler of LVOT  
 Pulsed Doppler of LVOT  
 CW Doppler of AV if aortic stenosis is present or suspected

### Recommended measurements

LV systolic function: LVOT stroke volume, cardiac output/index

### Apical Two-Chamber View Image acquisition

2D imaging  
**Red-flag findings:** LA appendage thrombus  
 Global and regional LV function  
 Color-flow Doppler of MV

### Recommended measurements

LA volume

### Apical Long-Axis View Image acquisition

2D imaging  
 Global and regional LV function  
 Color-flow Doppler of MV and AV  
 Pulsed Doppler of LVOT  
 CW Doppler of AV if aortic stenosis is present or suspected

### Recommended measurements

LV systolic function: LVOT stroke volume, cardiac output/index

### Subcostal Views

#### Four-chamber

2D imaging, including assessment of interatrial septum  
**Red-flag findings:** VSD, PFO, or ASD  
 Color-flow Doppler of valvular inflow and for regurgitation  
 Color-flow Doppler of interventricular and interatrial septum to assess for shunt

#### Short-axis

Complementary to parasternal views  
 IVC assessment to estimate RA pressure (IVC size and response to inspiration)  
 Doppler of hepatic veins, when appropriate

### Suprasternal Notch View

Long-axis view of aortic arch (short-axis view if indicated)  
 Color-flow Doppler of aortic arch and isthmus  
**Red-flag findings:** aortic pathology (PDA, coarctation)  
 Pulsed Doppler in descending aorta in cases of aortic regurgitation

(Continued)

**Table 1** Preimplantation TTE/TEE “red-flag” findings

**Left Ventricle and Interventricular Septum**

Small LV size, particularly with increased LV trabeculation  
LV thrombus  
LV apical aneurysm  
Ventricular septal defect

**Atria, Interatrial Septum, and Inferior Vena Cava**

Left atrial appendage thrombus  
PFO or atrial septal defect

**Valvular Abnormalities**

Any prosthetic valve (especially mechanical AV or MV)  
> mild AR  
≥ moderate MS  
≥ moderate TR or > mild TS  
> mild PS; ≥ moderate PR

**Other**

Any congenital heart disease  
Aortic pathology: aneurysm, dissection, atheroma, coarctation  
Mobile mass lesion  
Other shunts: patent ductus arteriosus, intrapulmonary

**Right Ventricle**

RV dilatation  
RV systolic dysfunction

# Echocardiography in the Management of Patients with Left Ventricular Assist Devices: Recommendations from the American Society of Echocardiography

## KEY POINTS

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- At this time, the literature does not support the use of any single echocardiographic RV parameter for predicting the post-LVAD prognosis or the need for biventricular support (RVAD use).
- Quantitative echocardiographic parameters of RV function (which may vary among patients, depending upon imaging conditions), should be integrated with clinical signs and symptoms to determine the degree of preoperative RV dysfunction, which may impact the operative plan and/or postoperative prognosis.

### Recommended measurements

RV function: RV strain, TAPSE, TV DTI

# Prediction of right ventricular failure after ventricular assist device implant: systematic review and meta-analysis of observational studies

Diego Bellavia<sup>1\*</sup>, Attilio Iacovoni<sup>2</sup>, Cesare Scardulla<sup>1</sup>, Lorenzo Moja<sup>3</sup>, Michele Pilato<sup>1</sup>, Sudhir S. Kushwaha<sup>4</sup>, Michele Senni<sup>2</sup>, Francesco Clemenza<sup>1</sup>, Valentina Agnese<sup>1</sup>, Calogero Falletta<sup>1</sup>, Giuseppe Romano<sup>1</sup>, Joseph Maalouf<sup>4</sup>, and Michael Dandel<sup>5</sup>

**36: articoli**

**4428: pazienti**

**995: acute right ventricular failure.**

# Prediction of right ventricular failure after ventricular assist device implant: systematic review and meta-analysis of observational studies

**Table 4** Summary of the most relevant risk factors for right ventricular failure

Predictor	Comment
Demographic and clinical characteristics	
Age	Although several studies have reported that RVF patients are younger, according to meta-analysed data, age is a non-significant predictor of RVF.
Female gender	Females have apparently higher risk of developing post-LVAD RVF compared with males; however, this is specifically true in reports where primarily PF-LVADs are implanted.
Need for mechanical ventilation	Patients needing ventilatory support have roughly threefold increase in RVF risk, independently of type of implanted LVAD or mode. This finding has not

## Echocardiography

Moderate-to-severe RVD

This relatively simple, pure qualitative assessment of RV performance is extremely predictive of RVF, and should be part of routine echocardiographic evaluation in patients considered for LVAD.

High RV/LV ratio

To date, the RV/LV ratio obtained in a four-chamber apical view is the single most significant quantitative echo measurement able to define risk of RVF in LVAD recipients.

Low longitudinal sS of the RV free wall

Although sS of the right ventricle is very promising, and probably useful, there is too much variability in measures and there are too few published studies to reach a definitive conclusion.

Echocardiography  
Moderate-to-severe RVD

specifically in patients undergoing CP-LVAD implantation.

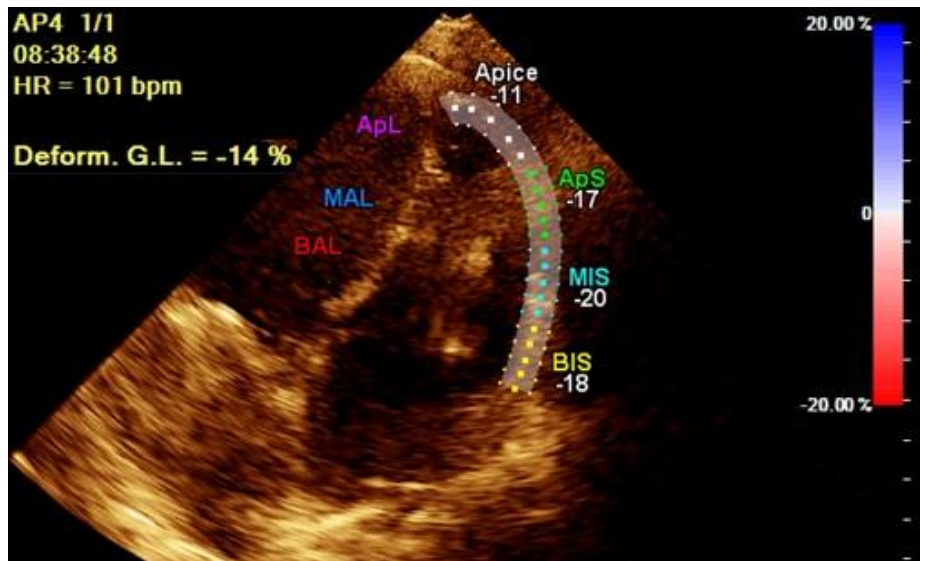
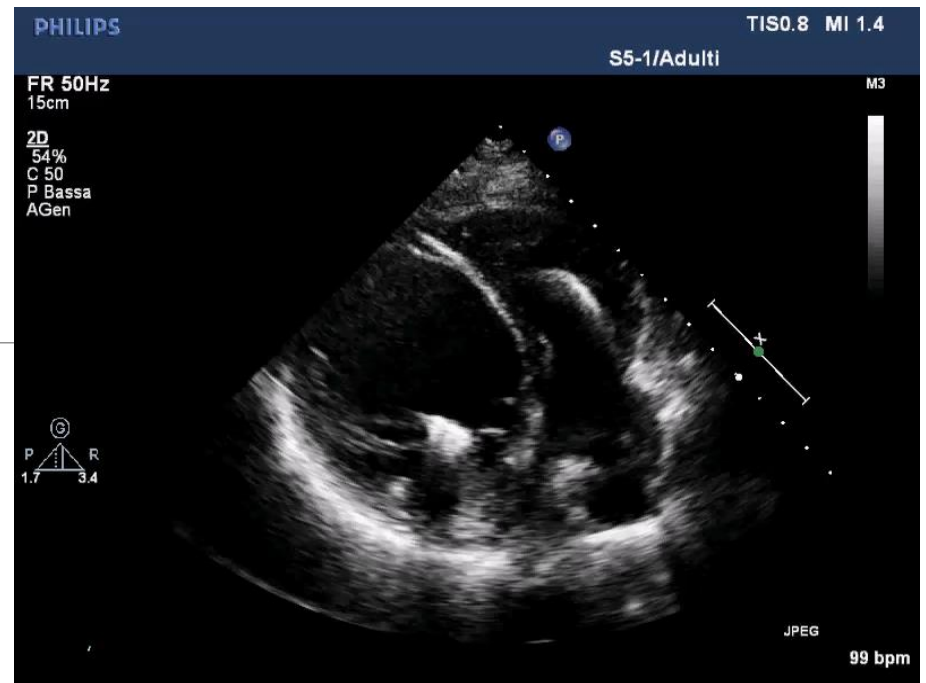
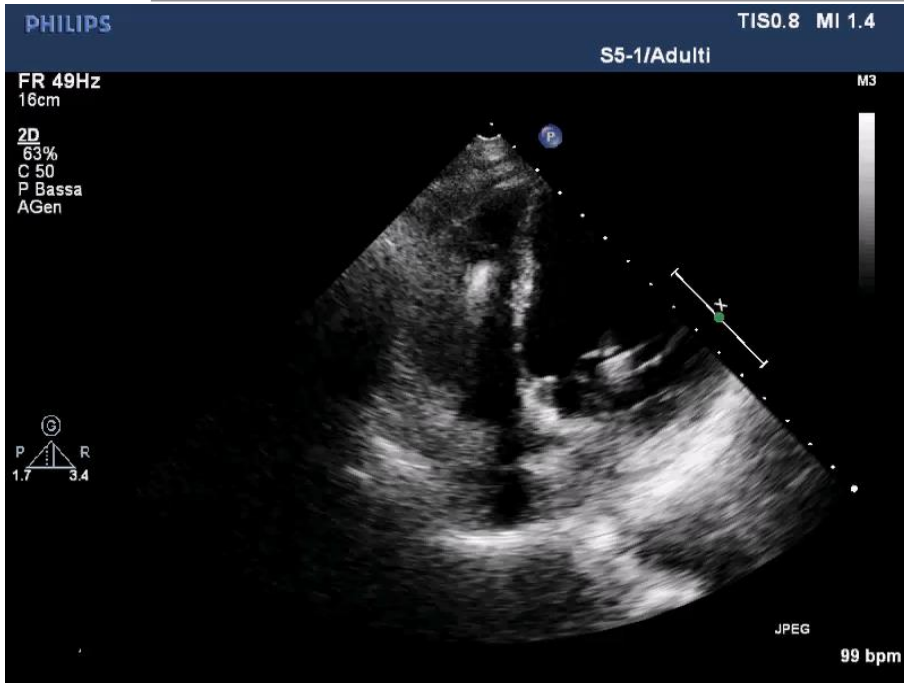
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# Valvulopatie: insufficienza aortica

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- Aortic regurgitation warrants special attention, as it can easily be underestimated in HF patients, generally worsens after LVAD activation, and impairs LV unloading due to a “blind loop” of aorta → LV → LVAD flow.

Frequente sottostima del flusso al color Doppler per basse pressioni sistemiche ed elevata pressione intraventricolare.

Raccomandato il calcolo del LVOT stroke volume e della frazione di rigurgito.

Raccomandato l'ecocardiogramma transesofageo in caso di sospetta insufficienza aortica.



# Grazie per l'attenzione

