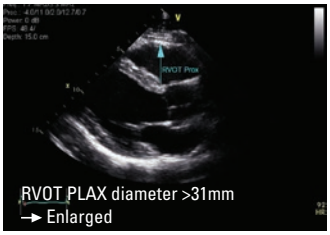
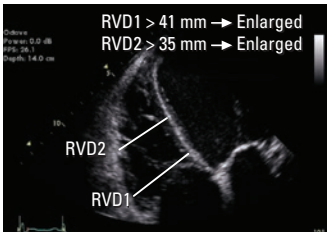
# Echocardiographic Assessment of Right Heart for Screening of Pulmonary Hypertension[1-3]

EchoRight™

## Assessment of Right Atrial and Ventricular Size



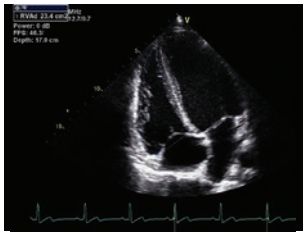


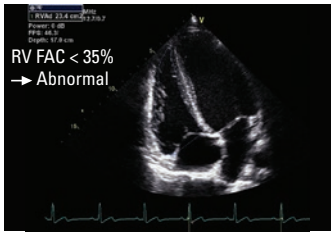


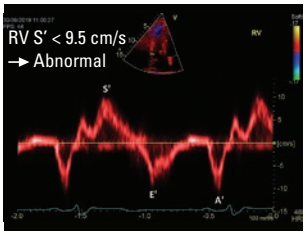


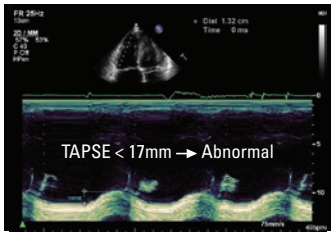
| | Enlarged |
|---|---|
| RVOT PLAX diameter | > 31 mm |
| RVOT PSAX diameter | > 35 mm |
| RV basal diameter | > 41 mm |
| RV mid diameter | > 35 mm |
| RA area | > 18 cm² |

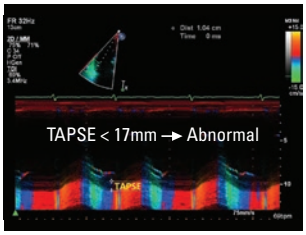
## Assessment of Right Ventricular Function





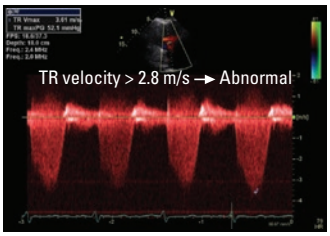



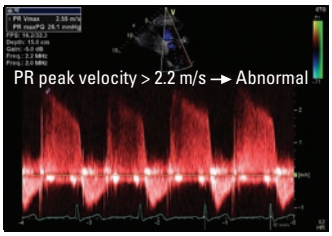



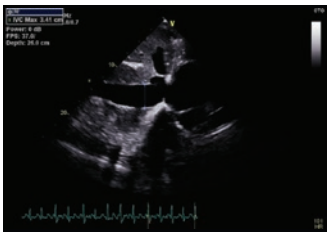




| | Abnormal |
|---|---|
| RV FAC | < 35 % |
| TAPSE | < 17 mm |
| RV S' | < 9.5 (cm/s) |

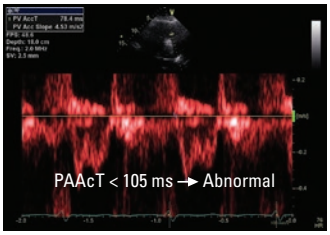
## Assessment of Right Ventricular Pressures

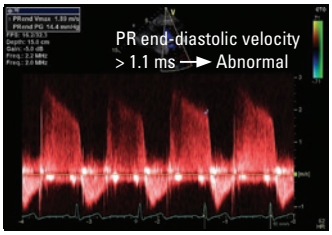


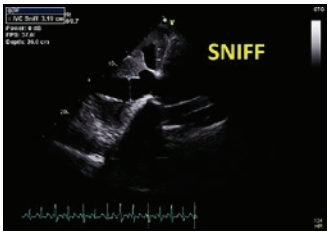



| | IVC diameter | Collapse with sniff |
|---|---|---|
| Normal RAP 3 mmHg | ≤ 2.1 cm | > 50% |
| Intermediate RAP 8 mmHg | ≤ 2.1 cm<br>> 2.1 cm | < 50%<br>> 50% |
| High RAP 15 mmHg | > 2.1 cm | < 50% |




| | Abnormal |
|---|---|
| TR velocity | > 2.8 m/s |
| PAAcT | < 105 ms |
| Mean PAP | > 20 mmHg*[4] |
| PAEDP | > 12 mmHg |
| PASP | > 30 mmHg†[5] |
| PR peak velocity | > 2.2 m/s |
| PR end-diastolic velocity | > 1.1 m/s |

Mean PAP = 4 x $(PR_{peak\ velocity})^2$ + RAP

Mean PAP = 79 – (0.45 x PAAcT)

Mean PAP = 90 – (0.62 x PAAcT)

PAEDP = 4 x $(PR_{end\ velocity})^2$ + RAP

* proposed in the 6th World Symposium on pulmonary hypertension[4], but it has not been adopted by Australian guidelines
† proposed in the 6th World Symposium on pulmonary hypertension[5], but it has not been adopted by Australian guidelines

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**Abbreviations:** RIMP=Right index of myocardial performance; PLAX=Parasternal long axis; PSAX=Parasternal short axis; PAEDP=Pulmonary end-diastolic pressure; PASP=Pulmonary artery systolic pressure; PR=Pulmonary regurgitation; PAAcT=Pulmonary artery acceleration time; RA=Right atrium; RVFAC=Right ventricular fractional area change; RV=Right ventricle; RVOT=Right ventricular outflow tract; S'=Myocardial systolic velocity; TAPSE=Tricuspid annular plane systolic excursion; TR=Tricuspid regurgitation

**References: 1.** Recommendations for Cardiac Chamber Quantification by Echocardiography in Adults. *J Am Soc Echocardiogr* 2015;28:1-392. **2.** 2015 ESC/ERS Guidelines for the diagnosis and treatment of pulmonary hypertension. *European Heart Journal* 2016;37:67-119. **3.** Pulmonary Regurgitation End-diastolic Gradient Is a Doppler Marker of Cardiac Status: Data from the Heart and Soul Study. *J Am Soc Echocardiogr* 2005;18:885-891. **4.** Haemodynamic definitions and updated clinical classification of pulmonary hypertension. *Eur Respir J* 2019;53:1801913. **5.** Threshold of Pulmonary Hypertension Associated With Increased Mortality. *J Am Coll Cardiol* 2019;73:2660-2672.

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# Echocardiographic Features and Measurements for Differentiation of Precapillary from Postcapillary Pulmonary Hypertension

| Parameter | Ref | Precapillary pulmonary hypertension | Postcapillary pulmonary hypertension |
|---|---|---|---|
| LV Ejection Fraction | | Mostly normal | Variable |
| LV size | | Normal or small | Normal or dilated |
| LV wall thickening (> 11 mm) | | Usually no LVH | LVH possible, depends on cause |
| RV size | | Enlarged | Normal or may be enlarged |
| RV/LV basal diameter ratio > 1 (A4C view) | 1 | Yes | Not in early disease |
| RV apex forms the heart apex in A4C view | | Yes (Excluding shunting) | No |
| RV systolic function (RVFAC) | | Reduced | Normal early, reduced in late stage |
| LA size | 2 | Normal | Increased |
| RA size | | Increased | Normal |
| RA/LA area ratio > 1 | | Yes (Excluding shunting) | No |
| Interatrial septum | | Bowing into LA | Bowing into RA |
| Interventricular septal flattening (systolic + diastolic) | | Yes | Not in early disease |
| Eccentricity index > 1.2 | 3 | Yes | No |
| Pulmonary artery dilatation (> 3cm diameter) | | Yes | No |
| Presence of RVH | | Yes | No |
| IVC | | Congested (Dilated with or without inspiratory collapse) | May be normal or congested |
| Pericardial effusion | | Usually present in severe cases | Usually absent |
| Mitral regurgitation | | Usually not severe | Likely to be present (variable severity) |
| Significant MV (or AV) disease | | No | Yes (depends on cause) |
| Transmitral Doppler (diastolic dysfunction) | | No or grade I diastolic dysfunction | Grade II/III diastolic dysfunction |
| Systolic notching in RVOT PW Doppler | | Yes | Rare |
| PAAcT of RVOT PW Doppler | 1 | < 70 msec | > 95 msec |
| Mitral E/A ratio | | < 1.0 | > 1.0 |
| Lateral e' | | Normal | Decreased |
| Lateral E/e' | 3 | < 8 | ≥ 10 |
| ePLAR | 4 | > 0.30 | < 0.30 |
| PASP | | Variable (Typically ≥ 70mmHg) | Variable (Typically < 70mmHg) |
| Echo derived PVR (Wood Unit) | | ≥ 3 usually severely elevated | ≤ 3 may be mildly elevated in late stage |
| TAPSE (mm) | 1 | Reduced | Normal |
| RV S' (cm/s) | 1 | Reduced | Normal |

**Abbreviations:** AV=Aortic valve; e'= Myocardial early diastolic velocity; ePLAR=echocardiographic Pulmonary to Left Atrial Ratio; IVC=Inferior vena cava; LA=Left atrium; LV=Left ventricle/left ventricular; MV=Mitral valve; PAAcT=Pulmonary artery acceleration time; PASP=pulmonary artery systolic pressure; PVR=pulmonary vascular resistance; PW=Pulsed-wave; RA=Right atrium; RV=Right ventricle/right ventricular; RVH=Right ventricular hypertrophy; RVOT=Right ventricular outflow tract; RVFAC=Right ventricular fractional area change; S'= Myocardial systolic velocity; TAPSE=Tricuspid annular plane systolic excursion; TRV=Tricuspid regurgitation velocity; VTI=velocity time integral

ePLAR=TR $V_{max}$ /(E/$e'_{sep}$); Eccentricity index was measured at the papillary muscle level at end-diastole in the parasternal short axis view

2 formulae can be used in the calculation of PVR by echocardiographic method.

i) PVR = 0.16 + (10 x TRV/RVOT VTI) Abbas et al JACC 2003; 41:1021-7 ii) PVR = (RVSP – E/$e'_{sep}$)/RVOT VTI Dahiya et al Heart 2010; 96:2005-9

Formula ii) is more accurate in assessment of higher PVR

**References: 1.** Diagnosis and assessment of pulmonary vascular disease by Doppler echocardiography. *Pulmonary Circulation* 2011;1:161-181. **2.** Echocardiographic prediction of Pre- versus Postcapillary pulmonary hypertension. *Journal of American Society of Echocardiography* 2015; 28:108-15. **3.** A simple echocardiographic prediction rule for haemodynamics in pulmonary hypertension. *Circulation Cardiovascular Imaging* 2012; 5:765-775. **4.** ePLAR — The echocardiographic Pulmonary to Left Atrial Ratio — A novel non-invasive parameter to differentiate pre-capillary and post-capillary pulmonary hypertension. *International Journal of Cardiology* 2016; 212:379-386

**Suggested articles for reading: 1.** Pulmonary hypertension due to left heart disease. *Archives of Cardiovascular Disease* 2017;110:420-431 **2.** Noninvasive differentiation of pulmonary arterial and venous hypertension using conventional and Doppler tissue imaging echocardiography. *Journal of American Society of Echocardiography* 2008; 21:715-9 **3.** Clinical application of tissue Doppler imaging in patients with idiopathic pulmonary hypertension. *Chest* 2007; 131:395-401 **4.** 2015 ESC/ERS Guidelines for the diagnosis and treatment of pulmonary hypertension. *European Heart Journal* 2016. 37: 67-119