

# TEE for ECLS

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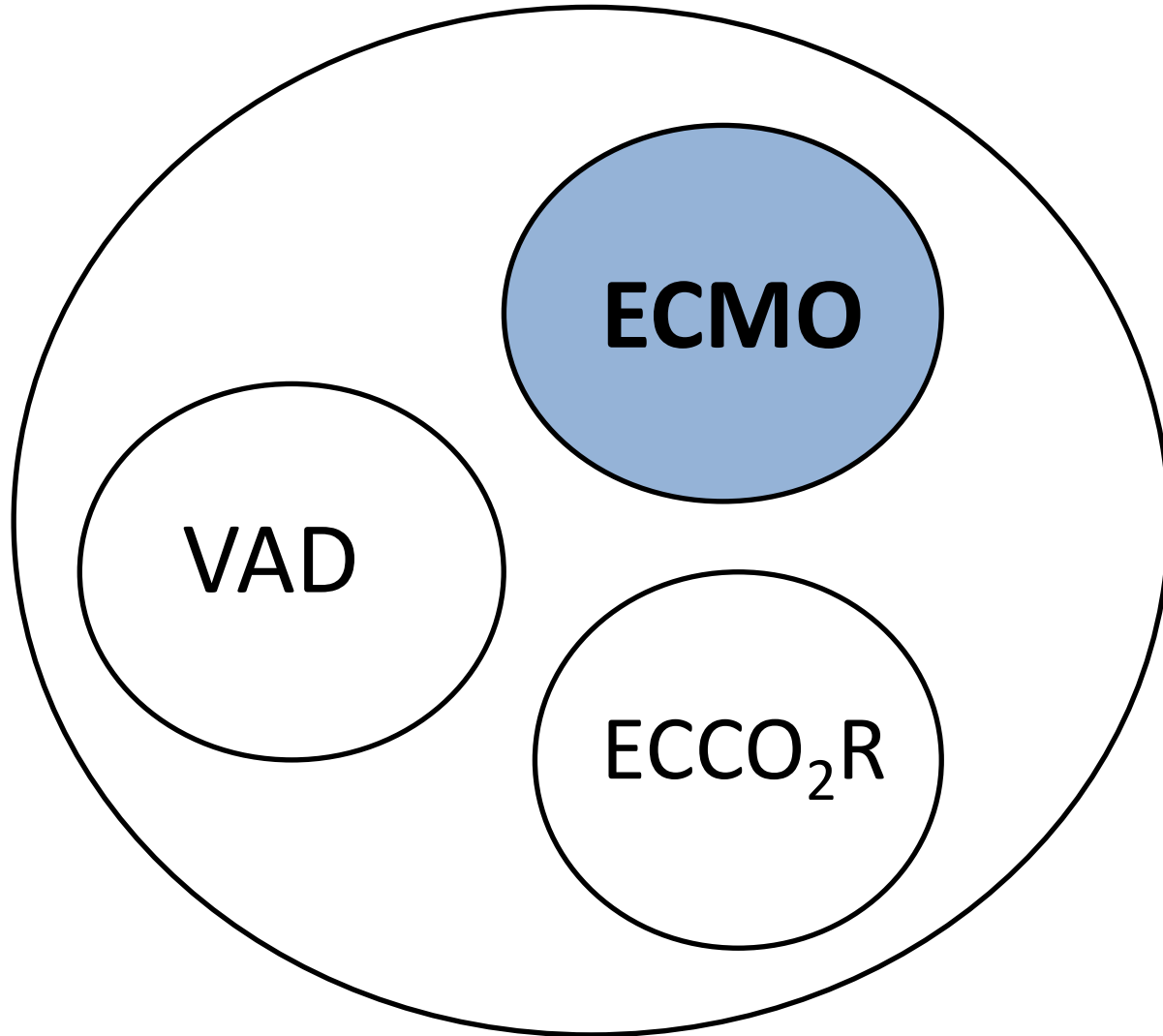
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# Outline

- ECMO
- Role of TEE
  - Pre ECMO
  - Monitoring on ECMO
  - Weaning from ECMO

# ECLS

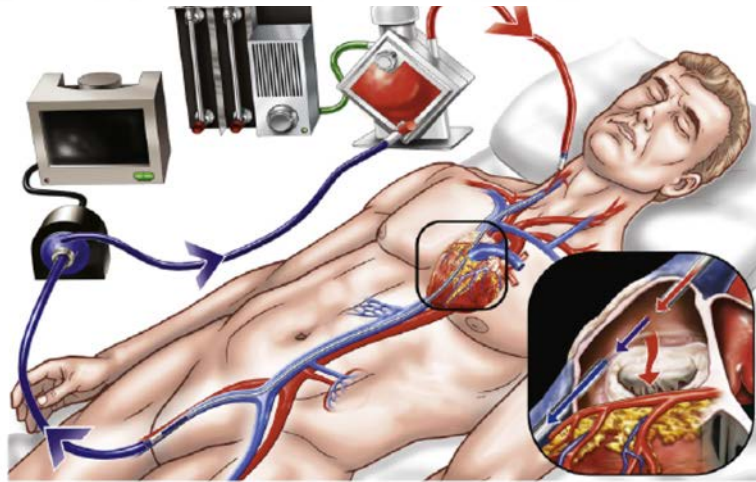
Extracorporeal Life Support



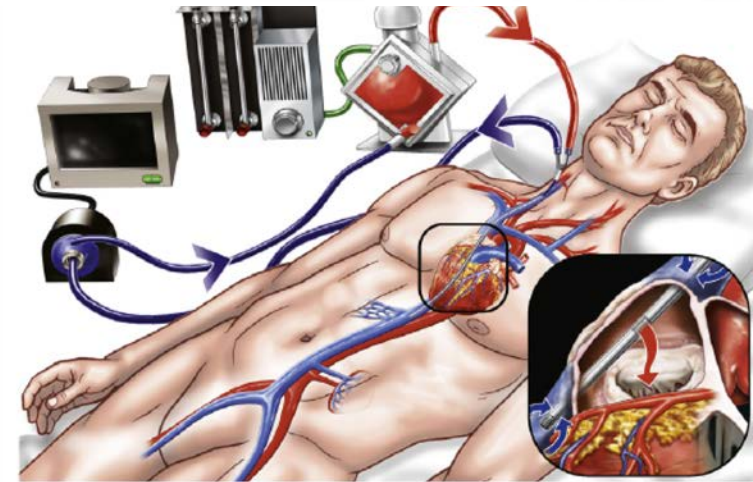
# Extracorporeal Membrane Oxygenation in Cardiopulmonary Disease in Adults



Darryl Abrams, MD,\* Alain Combes, MD,† Daniel Brodie, MD\*



**Figure 1** Two-Site Venovenous Extracorporeal Membrane Oxygenation



**Figure 2** Single-Site Venovenous Extracorporeal Membrane Oxygenation

J Am Coll Cardiol 2014;63:2769–78

## Veno-Venous ECMO : Respiratory Support

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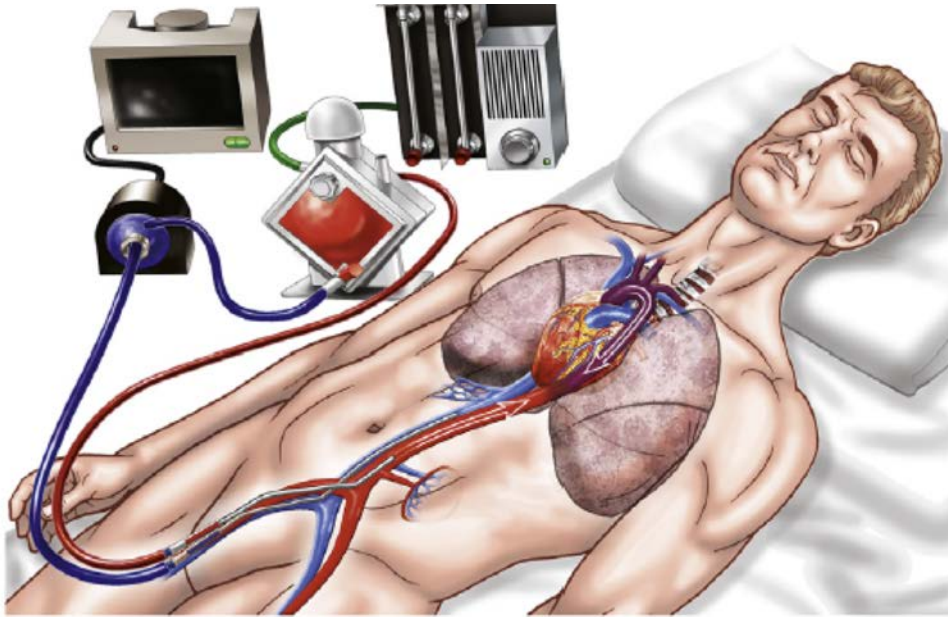
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# Extracorporeal Membrane Oxygenation in Cardiopulmonary Disease in Adults



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Veno- Arterial ECMO :  
Hemodynamic support

**Figure 3** Femoral Venous Arterial ECMO

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## STATE-OF-THE-ART REVIEW ARTICLES

# The Role of Echocardiography in the Management of Patients Supported by Extracorporeal Membrane Oxygenation

David Gerard Platts, MBBS, MD, FRACP, FCSANZ, FESC, John Francis Sedgwick, MBBS, FRACP, Darryl John Burstow, MBBS, FRACP, FCSANZ, Daniel Vincent Mullany, MBBS, MMedSc, FANZCA, FCICM, and John Francis Fraser, MB, ChB, PhD, MRCP, FRCA, FFARCSI, FCICM, *Brisbane, Australia*

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REVIEW

Open Access



# Echocardiography for adult patients supported with extracorporeal membrane oxygenation

Ghislaine Douflé<sup>1,2\*</sup>, Andrew Roscoe<sup>3</sup>, Filio Billia<sup>2,4</sup> and Eddy Fan<sup>1,2</sup>

Douflé et al. *Critical Care* (2015) 19:326

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# PRE ECMO

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# Extracorporeal Membrane Oxygenation in Cardiopulmonary Disease in Adults



Darryl Abrams, MD,\* Alain Combes, MD,† Daniel Brodie, MD\*

**Table 1** Indications and Highest Level of Evidence for ECMO in Cardiopulmonary Disease

## Respiratory

ARDS	Randomized controlled trials
Hypercapnic respiratory failure	Prospective feasibility studies
Bridge to lung transplantation	Cohort studies
Primary graft dysfunction after lung transplantation	Cohort studies

Abrams, J Am Coll Cardiol 2014;63:2769–78

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**Table 3 Indications for venoarterial ECMO and quality of evidence**

**Indications**

- Myocardial infarction-associated cardiogenic shock
- Fulminant myocarditis
- Sepsis-associated cardiomyopathy
- Adult congenital heart disease with acute decompensated heart failure
- Post-cardiotomy cardiogenic shock
- RV support during LVAD implantation
- Bridge to VAD or heart transplantation
- Post-transplantation graft failure
- ECPR
- Cardiogenic shock post-cardiac arrest
- Refractory ventricular arrhythmia
- Pulmonary hypertension with RV failure
- Massive pulmonary embolism

**Contraindications**

**Absolute**

- Severe irreversible non-cardiac organ failure limiting survival (e.g., severe anoxic brain injury)
- Irreversible cardiac failure if transplantation or long-term VAD will not be considered

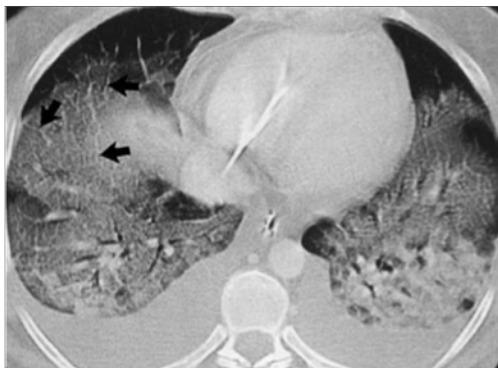
- Severe aortic insufficiency
- Aortic dissection

**Relative**

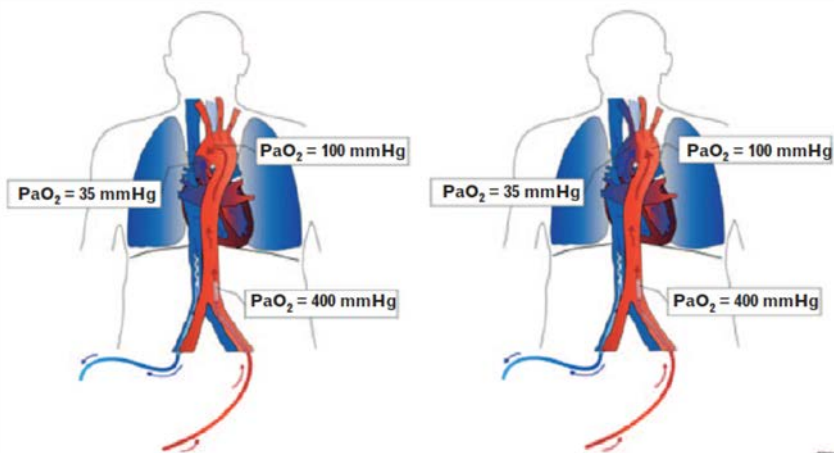
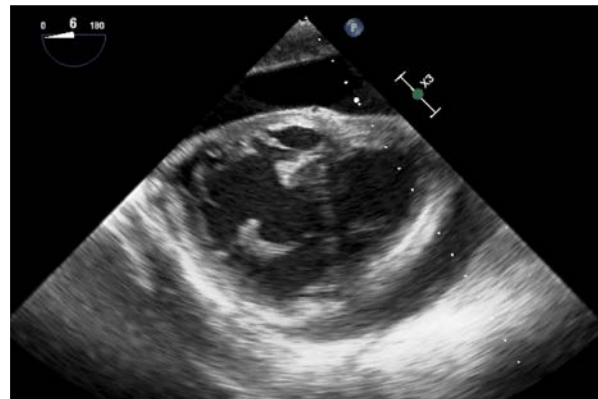
- Severe coagulopathy or contraindication to anticoagulation
- Limited vascular access
- Severe peripheral arterial disease



## Monitoring during extracorporeal membrane oxygenation



## Extracorporeal life support as a bridge to lung transplantation—experience of a high-volume transplant center



	<b>IPAH: decompensated RV</b>
Pumpless AV Novalung	No
Hemolung	No
VV ECMO (single dual-lumen cannula)	No
VV ECMO	No
PA/LA Novalung	Yes
VA ECMO	Yes (temporary)

Douflé, Curr Opin Crit Care 2016, 22: 230-238

Hoetzenecker, Journal of Thoracic and Cardiovascular Surgery, Volume 155, Number 3, 1316-1326

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# Echo parameters PRE ECMO

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## Contre-indications VA ECMO

Aortic Dissection

Aortic Insufficiency

Severe atheromatous disease

## Appropriate configuration

Septic cardiomyopathy + ARDS = VA or V-VA

ARDS and Acute RV failure = VV ECMO

Decompensated PH = VA ECMO or PA/LA

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# ECMO INSERTION

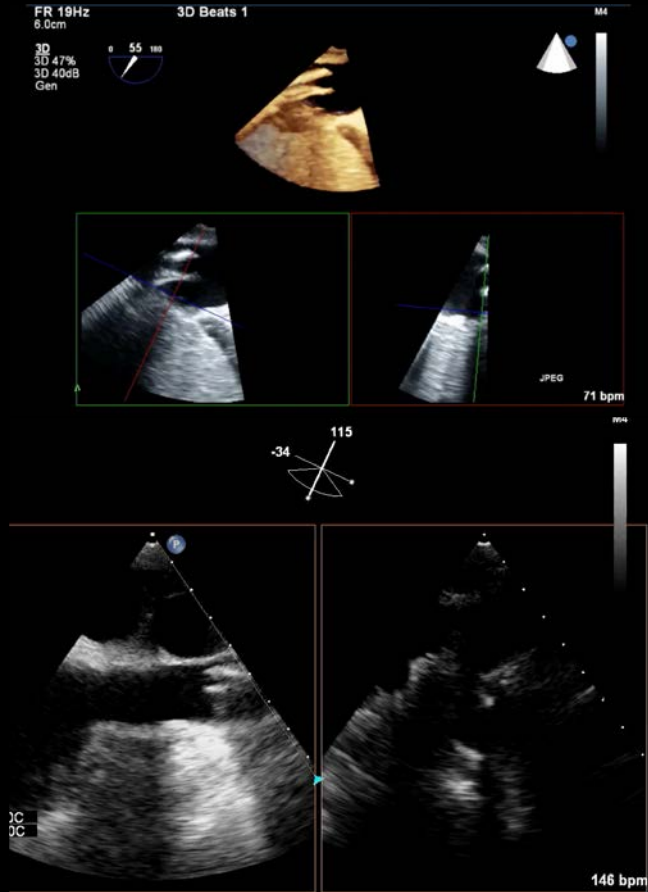
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# Cannula position

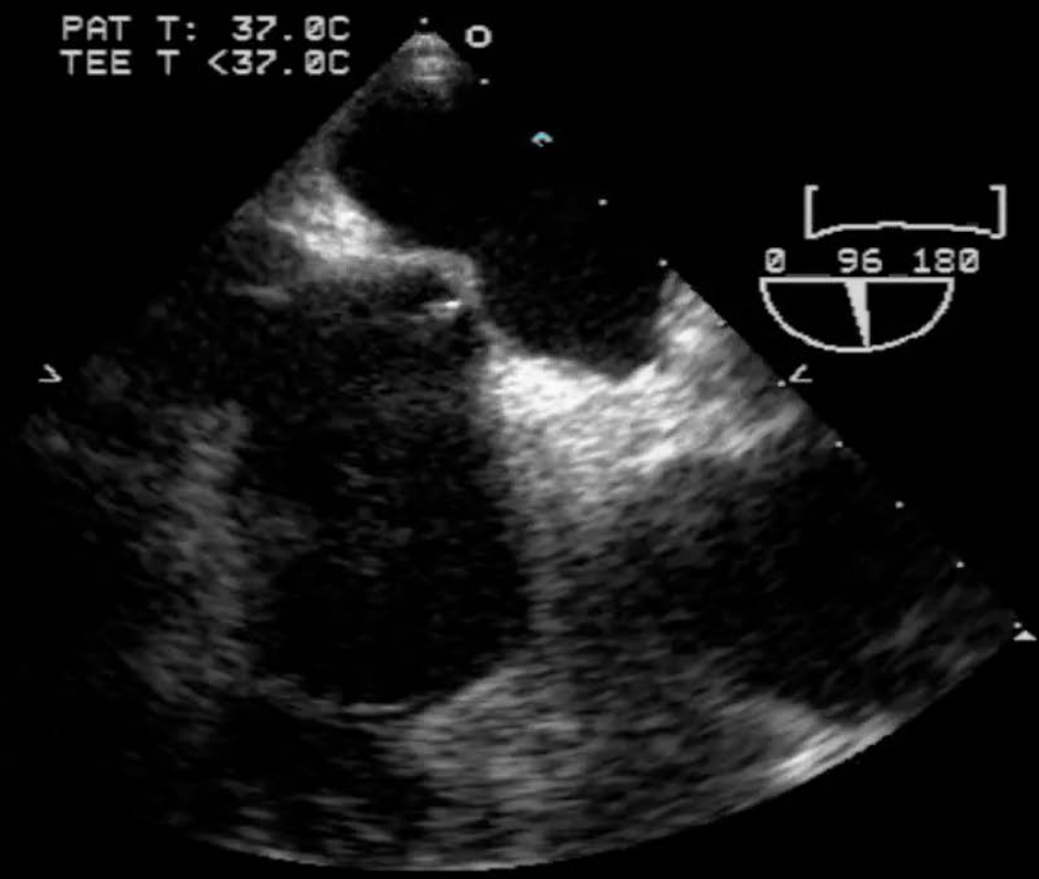
## VV ECMO



## VA ECMO

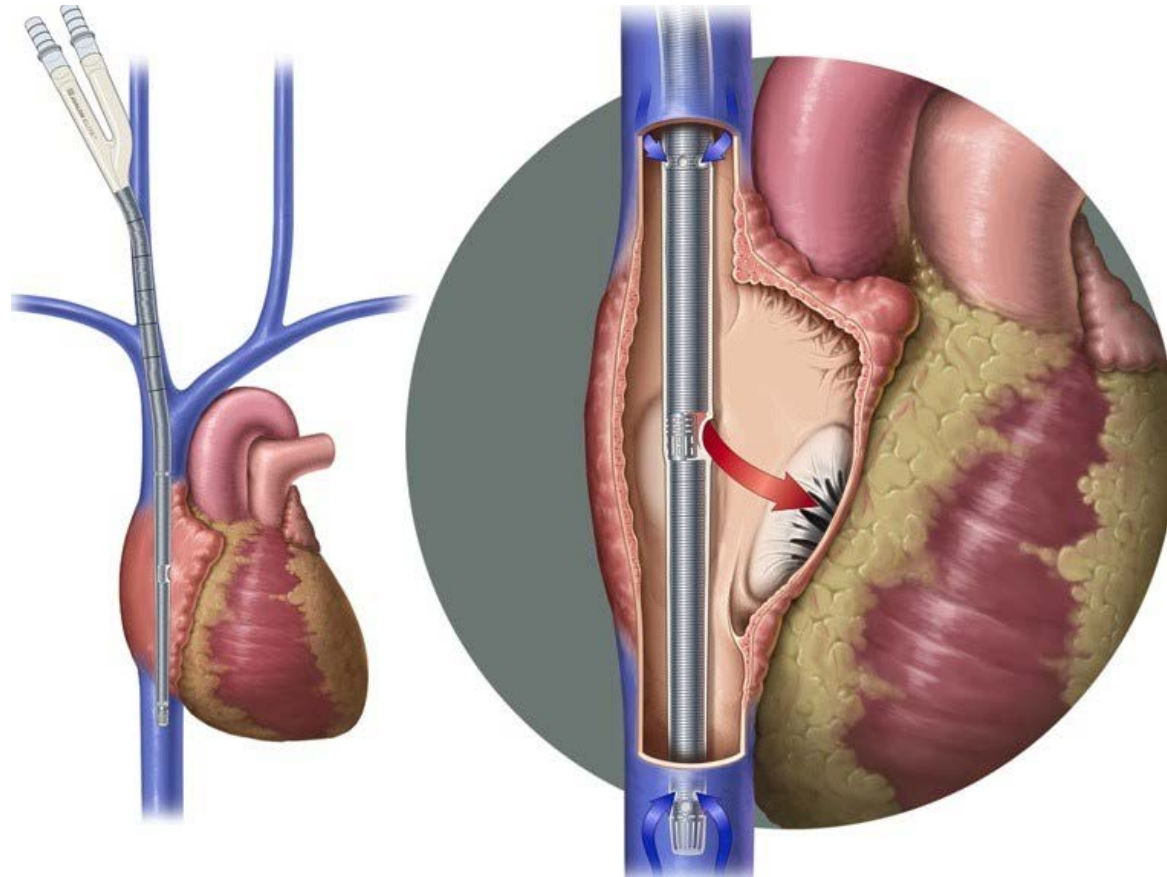


PAT T: 37.0C  
TEE T: <37.0C





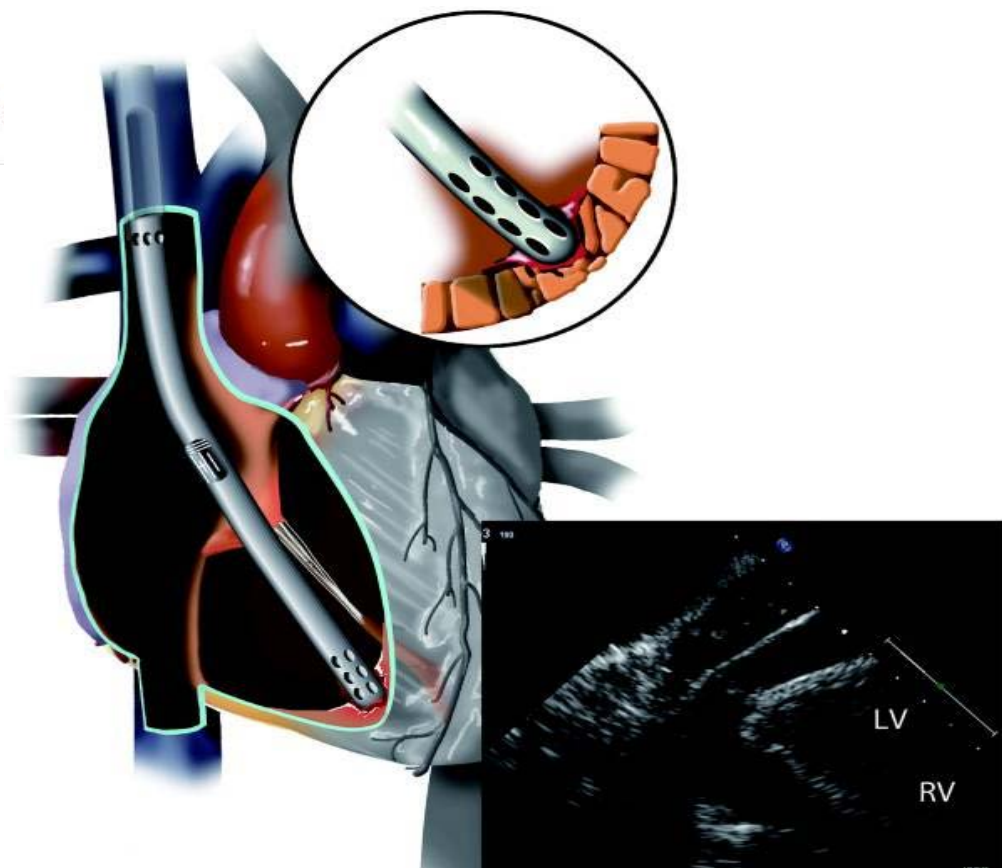
# Avalon Cannula for VV ECLS

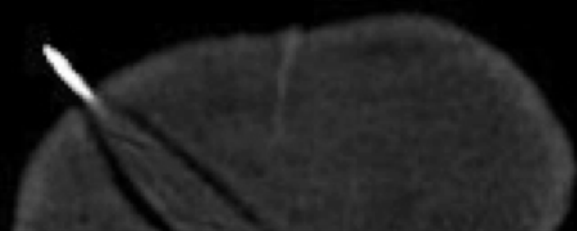


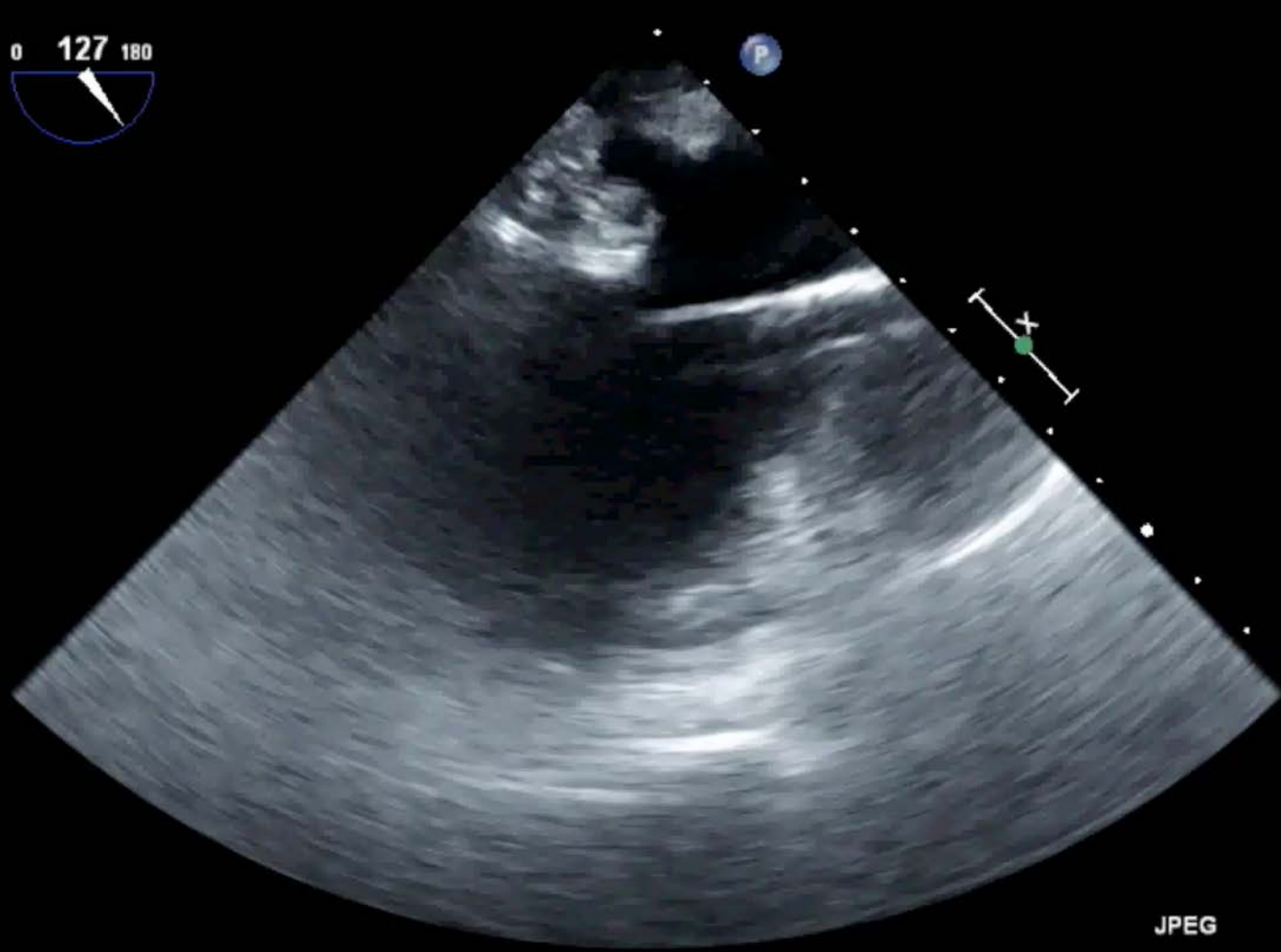
# Right ventricular rupture and tamponade caused by malposition of the Avalon cannula for venovenous extracorporeal membrane oxygenation

Hitoshi Hirose<sup>1\*</sup>, Kentaro Yamane<sup>1</sup>, Gregory Marhefka<sup>2</sup>

J Cardiothorac Surg. 2012; 7: 36.







JPEG

174 b

# Avalon<sup>®</sup> Bicaval Dual-Lumen Cannula for Venovenous Extracorporeal Membrane Oxygenation: Survey of Cannula Use in France

LOIC CHIMOT,\*† SOPHIE MARQUÉ,\* ANTOINE GROS,\* ARNAUD GACQUIN,\* SYLVAIN LAVOUÉ,\*  
CHRISTOPHE CAMUS,\* AND YVES LE TULZO\*

ASAIO Journal 2013;59:157–161.

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# Transesophageal Echocardiography-Guided Technique for Extracorporeal Membrane Oxygenation Dual-Lumen Catheter Placement

MICHAEL E. DOLCH, LORENZ FREY, MARTIN A. BUERKLE, THOMAS WEIG, DIETMAR WASSILOWSKY, AND MICHAEL IRLBECK

ASAIO Journal 2011; 57:341–343.

Intensive Care Med (2011) 37:1036–1037  
DOI 10.1007/s00134-011-2213-5

PHYSIOLOGICAL AND TECHNICAL NOTES

Richard H. Trimlett  
Jeremy J. Cordingley  
Mark J. Griffiths  
Susanna Price  
David N. Hunter  
Simon J. Finney

**A modified technique for insertion of dual lumen bicaval cannulae for venovenous extracorporeal membrane oxygenation**



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FR 39Hz  
10cm

2D  
39%  
C 50  
P Off  
Gen



M3



JPEG

110 bpm

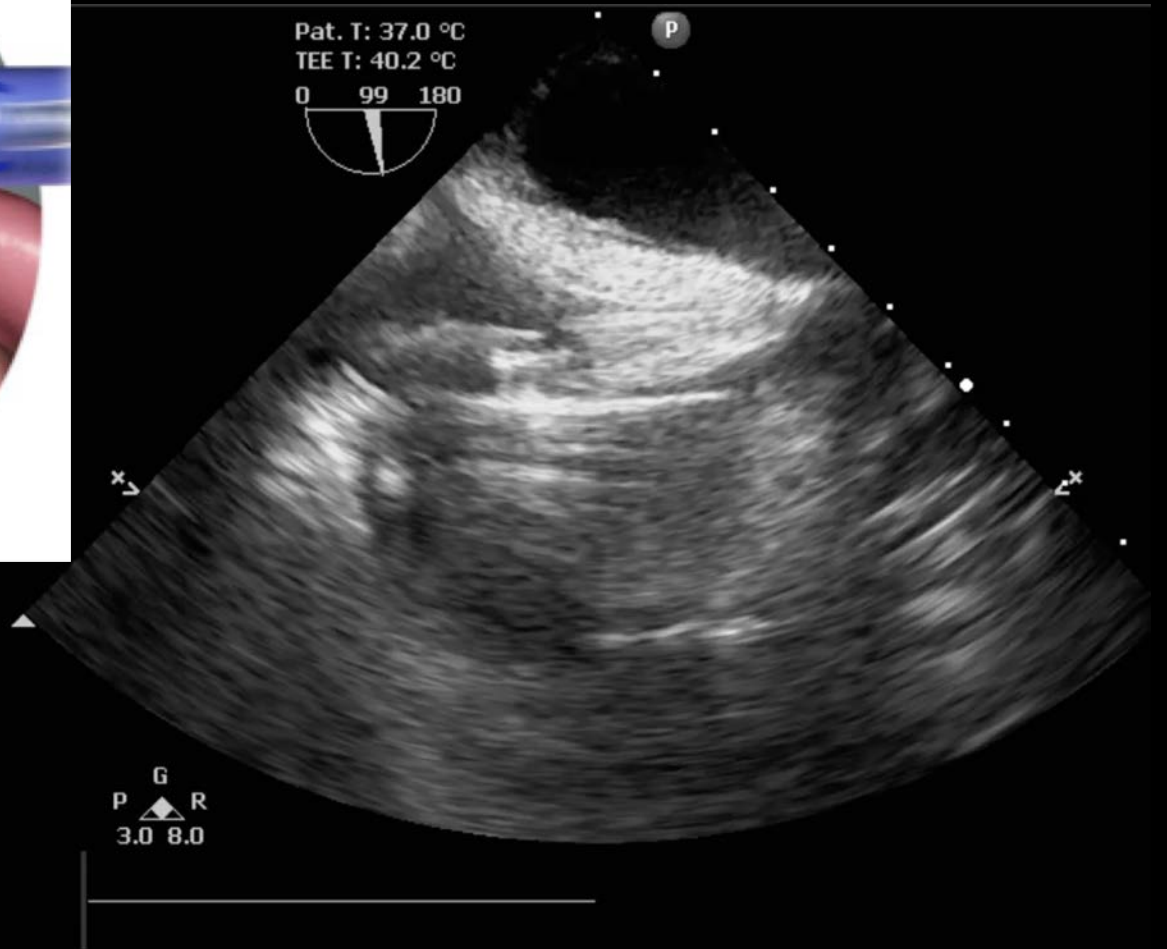
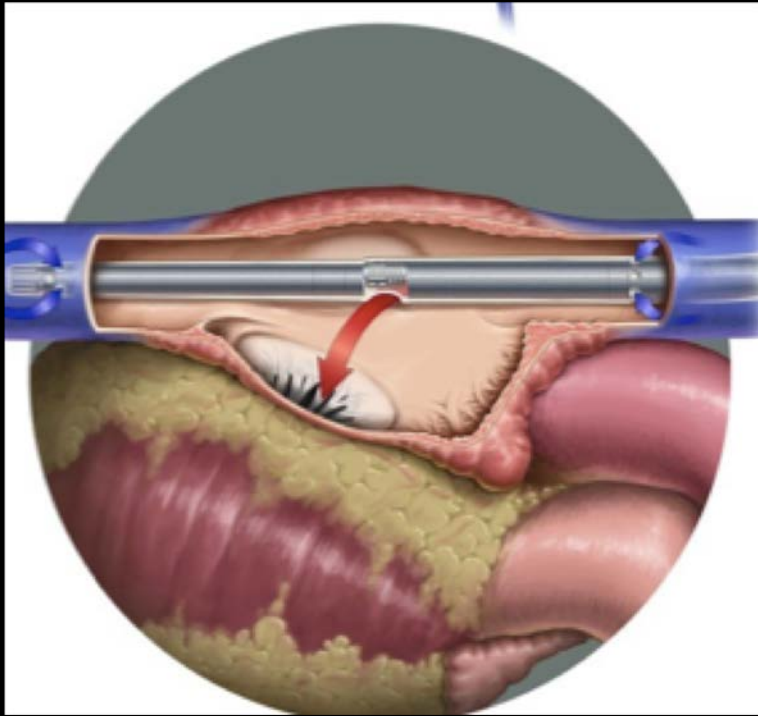
PAT T: 37.0C  
TEE T: 40.7C

JPEG  
: 37.0C  
: 40.8C  
110

# Fluoroscopy Guided Insertion ~ Guidewire + TEE





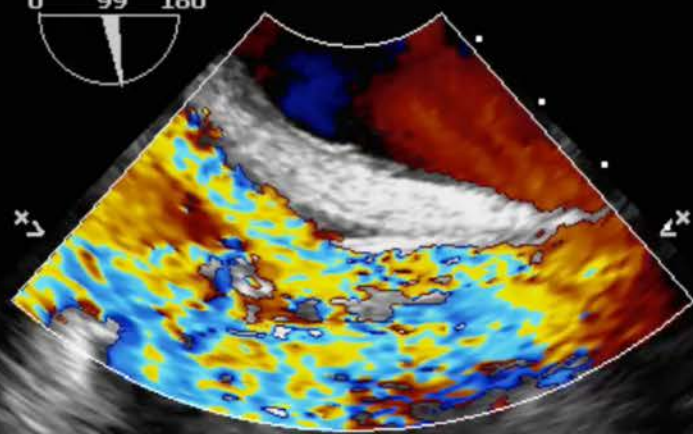


TEE  
X7-2t  
13 Hz  
10.0cm

2D  
Gen  
Gn 50  
C 48  
4/4/0  
50 mm/s

Color  
4.0 MHz  
Gn 60  
4/4/0  
Fltr Med

Pat. T: 37.0 °C  
TEE T: 40.2 °C  
0 99 180



G  
P R  
3.0 8.0



Pat. T: 37.0 °C

TEE T: 40.1 °C

0 121 180



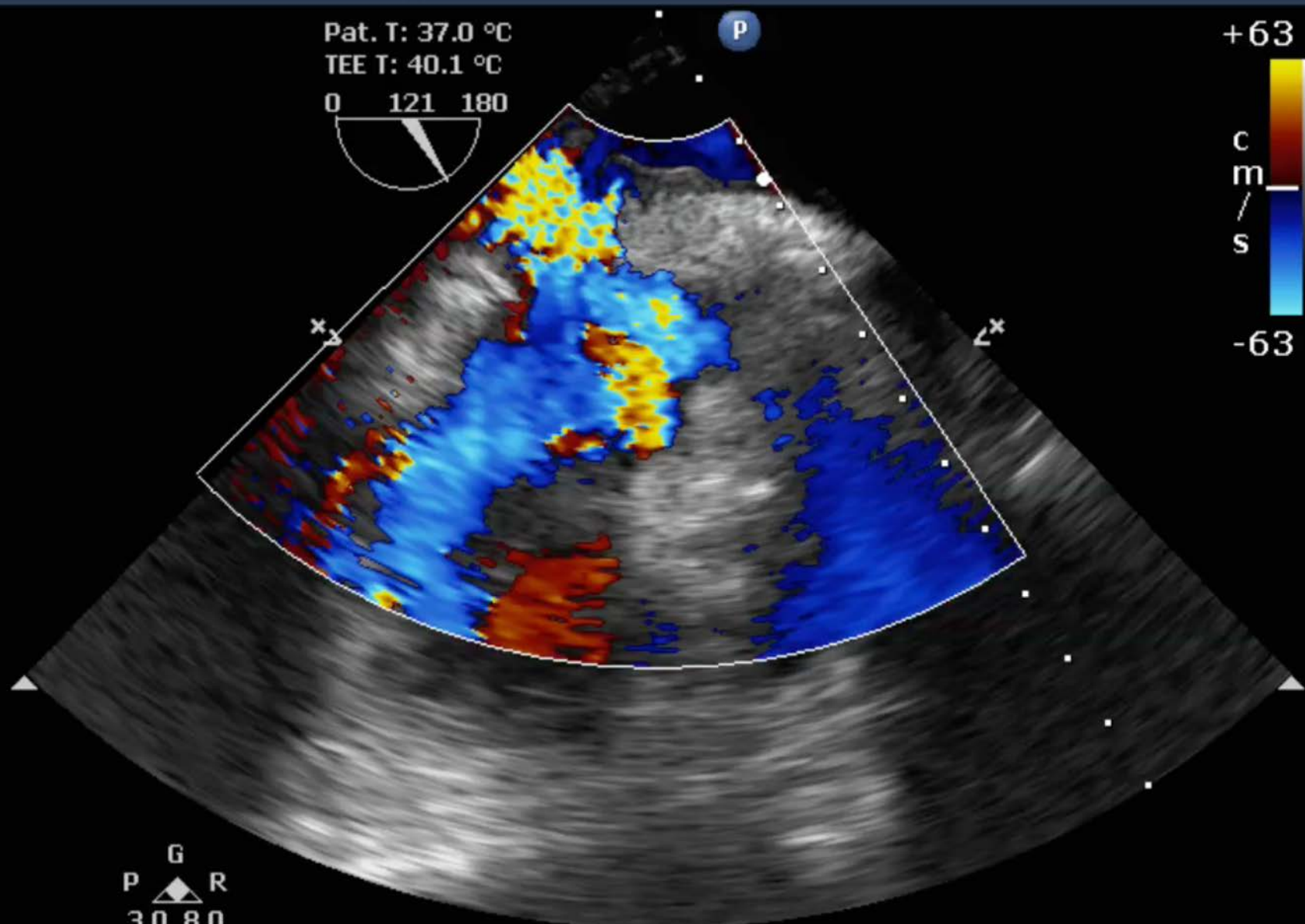
P

+63



cm/s

-63



G  
P R  
3.0 8.0



FR 46Hz  
22cm

M3

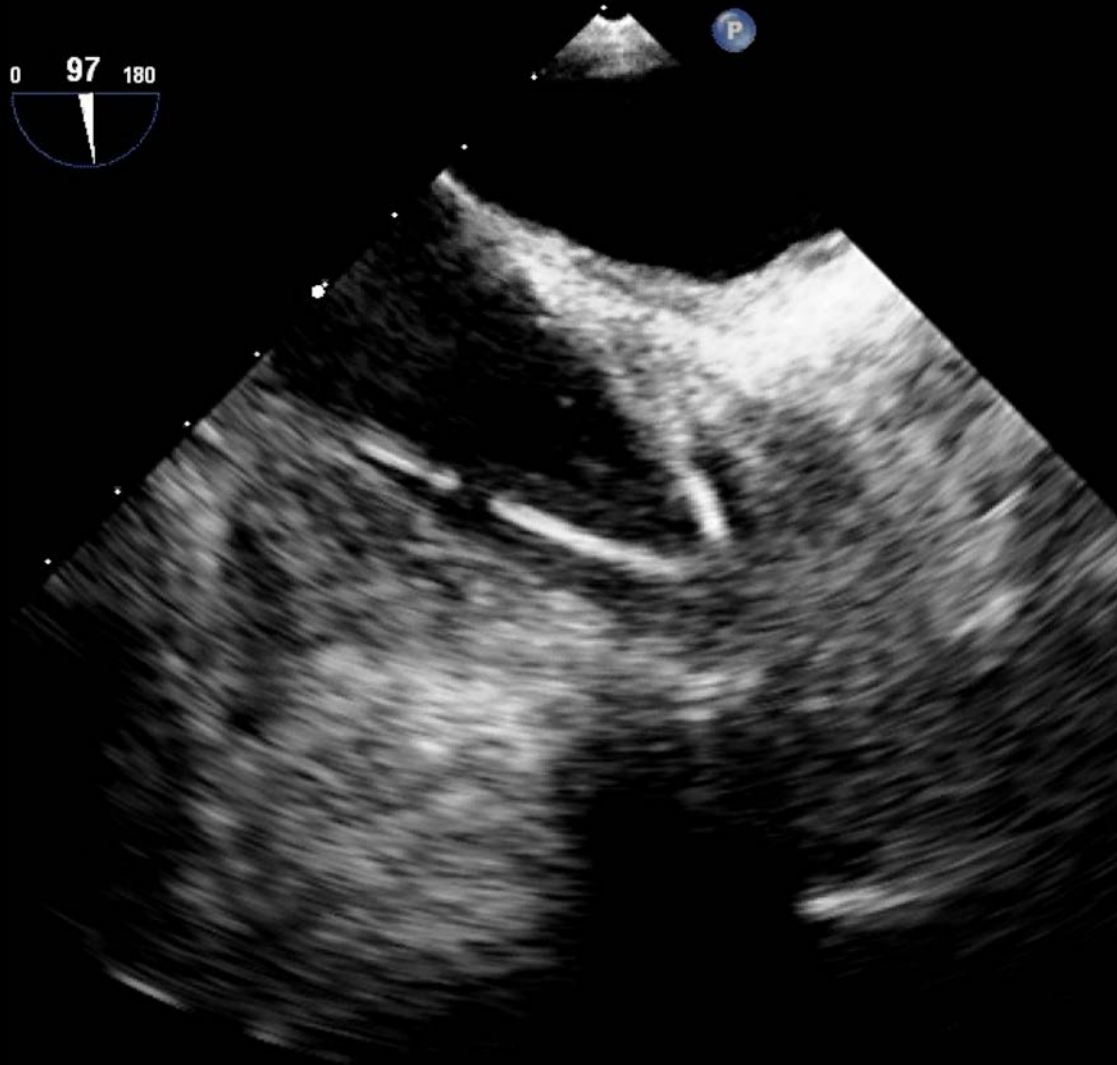
2D  
72%  
C 41  
P Low  
HPen



JPEG

64 bpm

# Troubleshooting



Adult Echo

TIS0.2 MI 0.6

X7-2t  
53Hz  
9.0cm

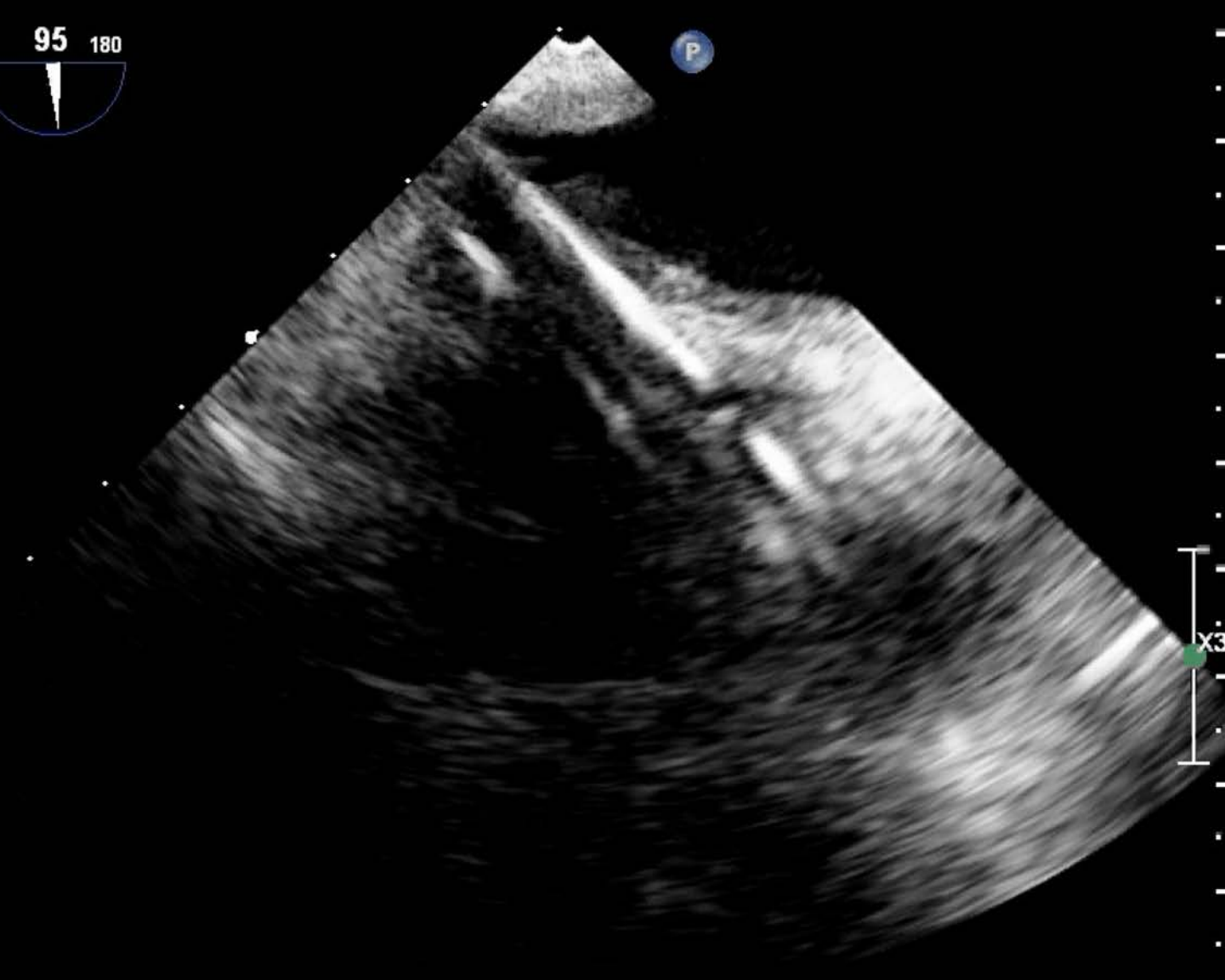


2D  
58%  
C 47  
P Off  
HPen



PAT T: 37.0C  
TEE T: 39.7C

/



110 bpm

# MONITORING ON ECMO

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# Monitoring on ECMO

**Table 2** Echocardiographic parameters on ECMO

	Venovenous ECMO	Venoarterial ECMO
Monitoring on ECMO	Biventricular size and function	Biventricular size and function
	Biatrial size and volume	Biatrial size and volume
	Follow up of any pre-existing pathology	Follow up of any pre-existing pathology
	Cannula position	Mitral/aortic regurgitation
	Pericardial effusion	Opening of aortic valve
	IVC size and collapsibility	Intracavitary spontaneous echo contrast/ intracavitary thrombus
		Aortic thrombus
		Cannula position
		Pericardial effusion
		IVC size and collapsibility

*ECMO* extracorporeal membrane oxygenation, *FAC* fractional area change, *IVC* inferior vena cava, *LVEF* left ventricular ejection fraction, *LVOT VTI* left ventricular outflow tract velocity time integral, *RV* right ventricle, *RVSP* right ventricular systolic pressure, *TAPSE* tricuspid annular plane systolic excursion, *TR* tricuspid regurgitation

Douflé et al. Critical Care (2015) 19:326



# Aortic valve opening: Flow adjustment?



4000rpm  
5.11/min



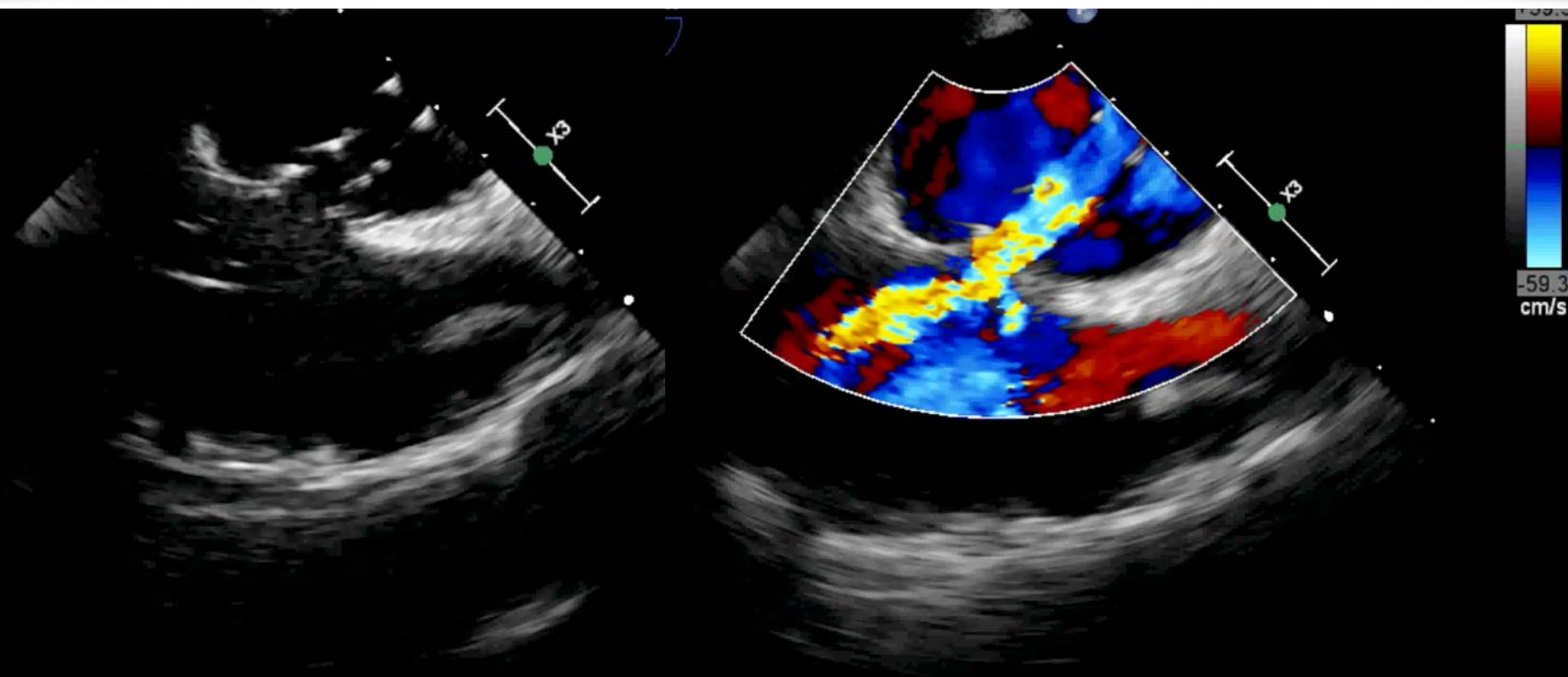
3500rpm  
4.3 l/min



IMPORTANCE OF INDICATING FLOWS DURING ACQUISITION

# Percutaneous left ventricular “vent” insertion for left heart decompression during extracorporeal membrane oxygenation

Michael M. H. Cheung, MBChB, MRCP; Allan P. Goldman, MD, MRCP; Lara S. Shekerdemian, MD, MRCP; Kate L. Brown, MD, MRCP; Gordon A. Cohen, MD, PhD; Andrew N. Redington, MD, FRCP

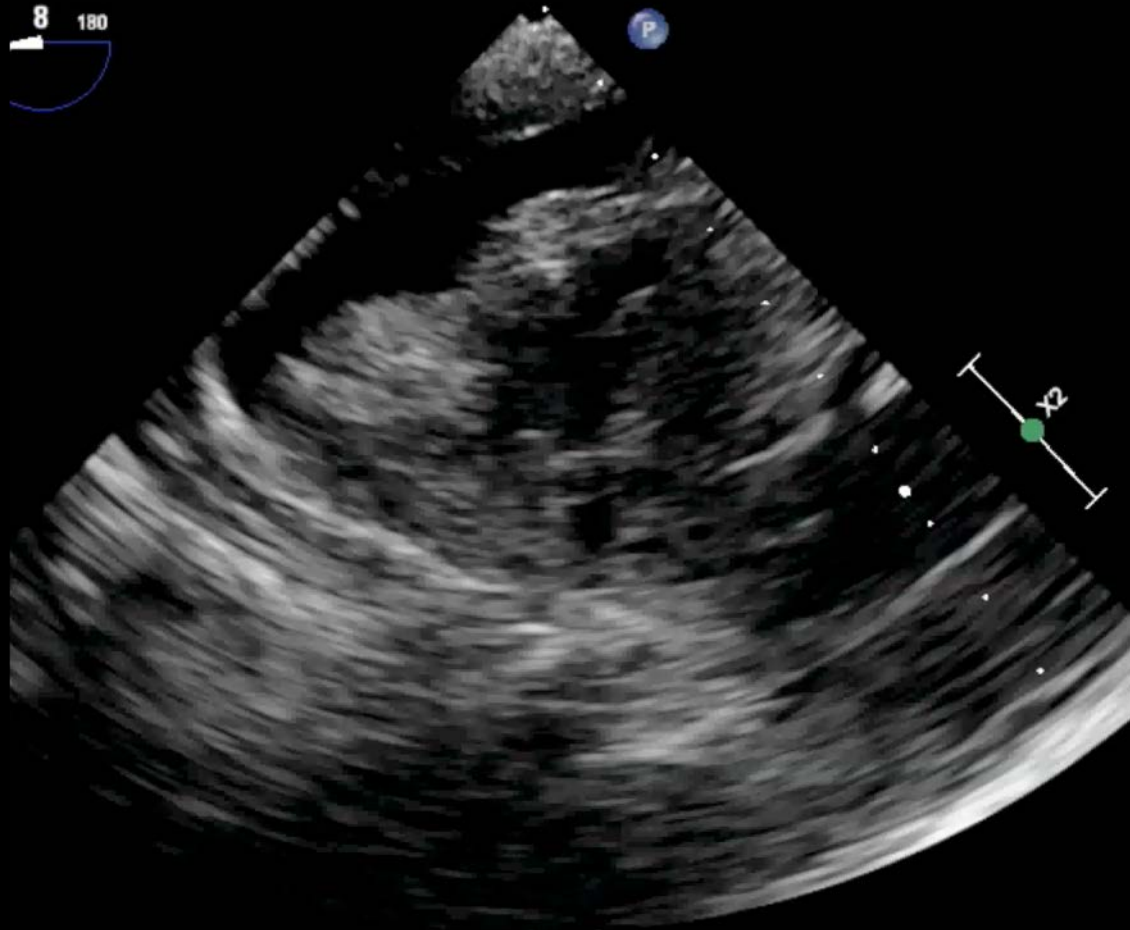


# FLOWS?

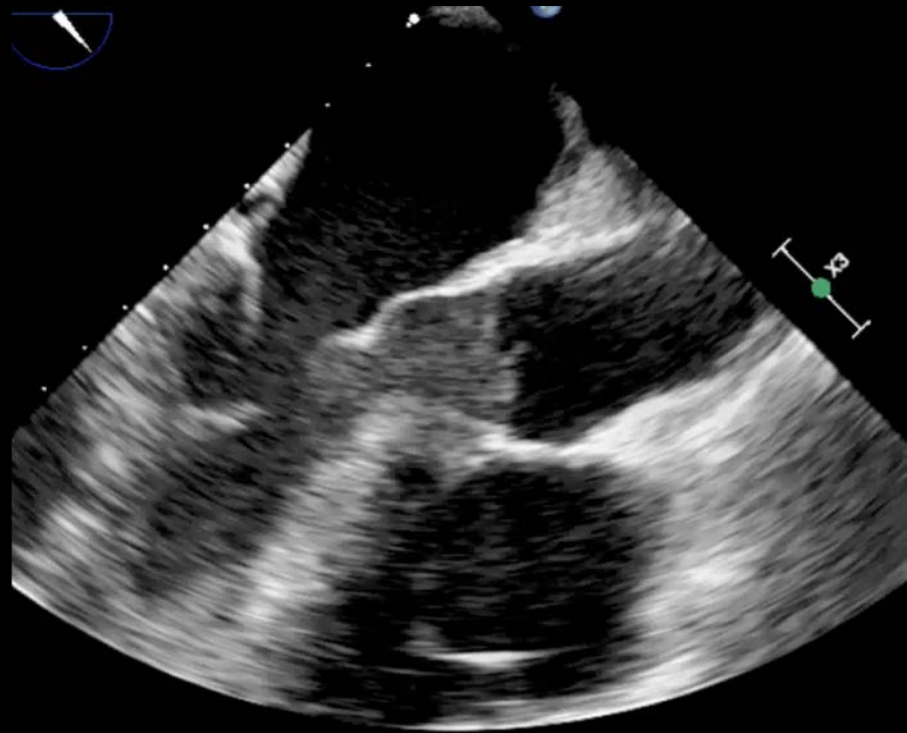
TIS0.1



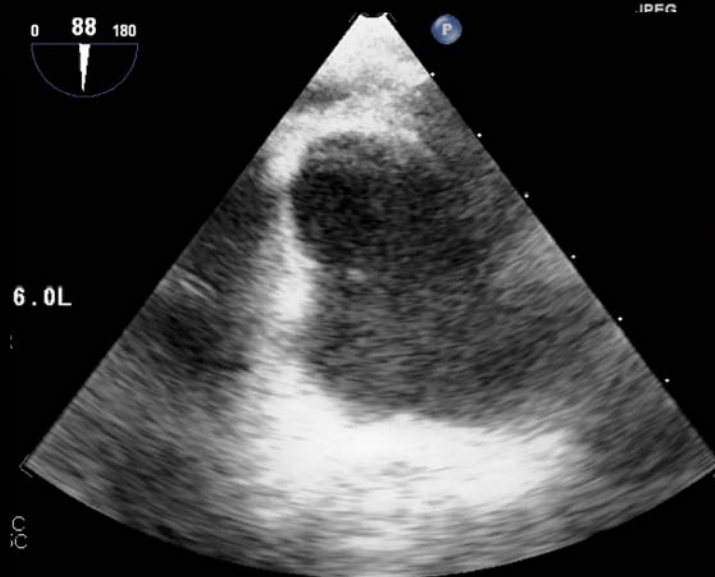
P



# THROMBUS FORMATION



M4

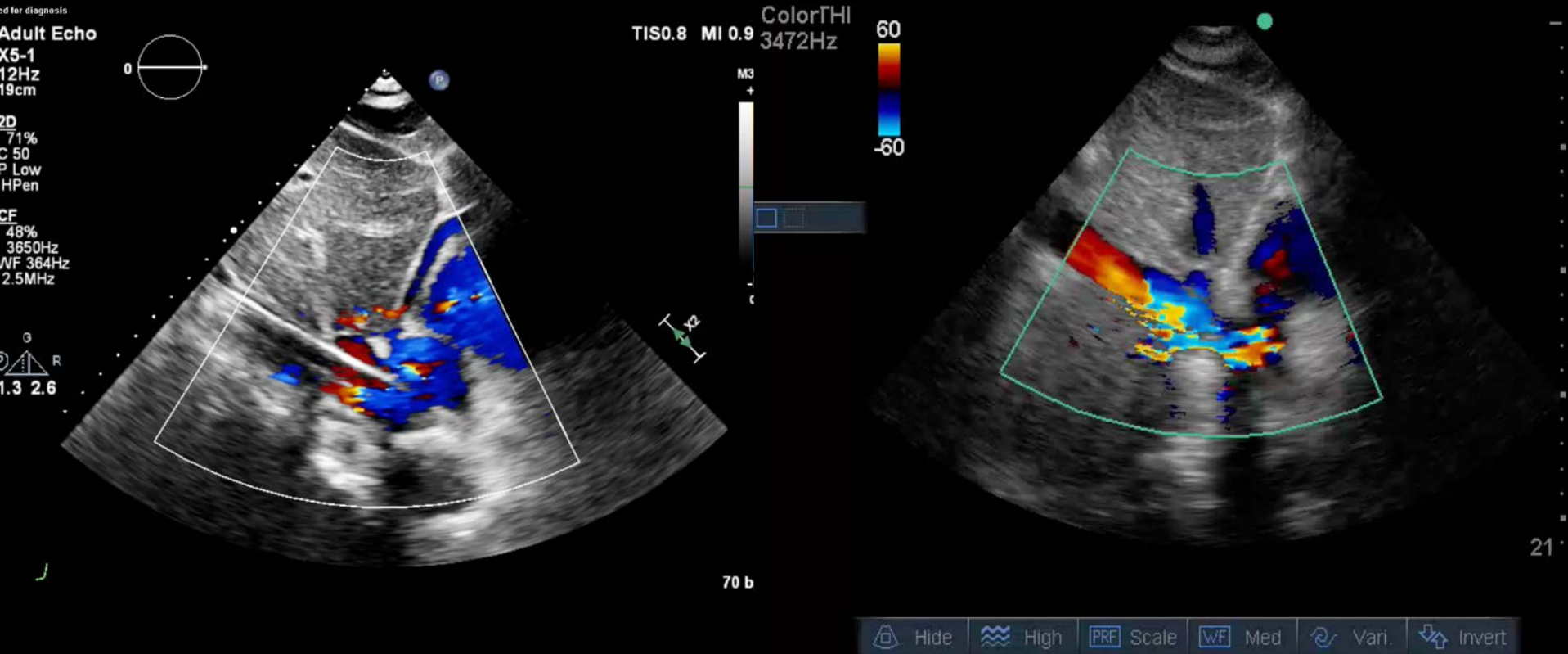


1 bp

6.0L

0.0

# HYPOXEMIA WITH DUAL LUMEN CANNULA

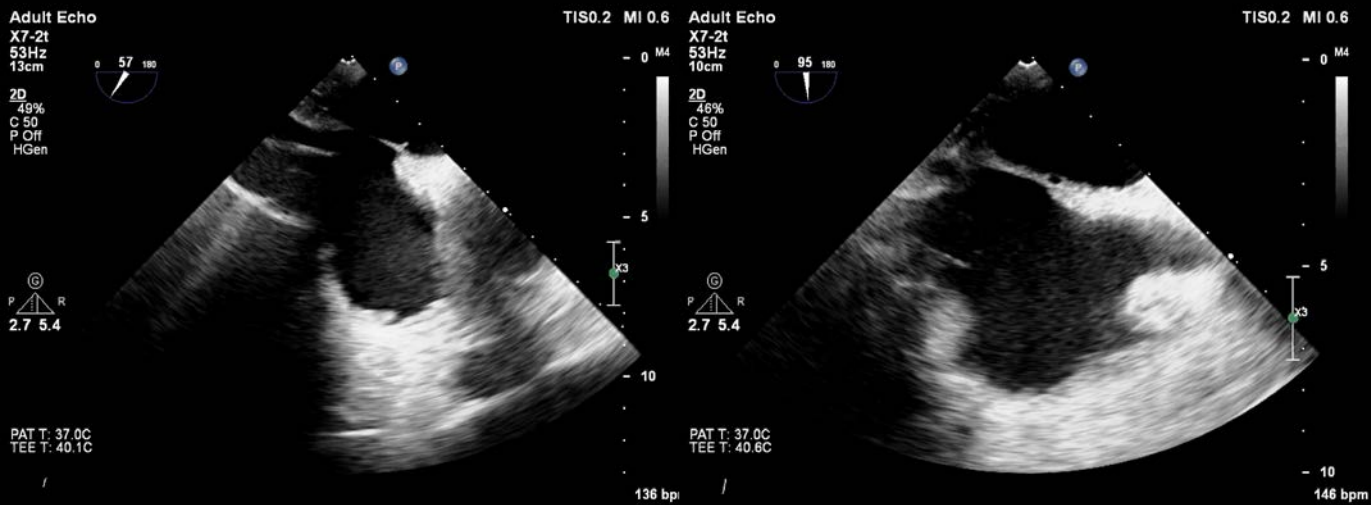


Subcostal IVC

# Recirculation



Desaturation despite  
Increase in ECMO flows



Immediate  
improvement in  
oxygenation



# WEANING FROM ECMO

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Nadia Aissaoui  
Aly El-Banayosy  
Alain Combes

## How to wean a patient from veno-arterial extracorporeal membrane oxygenation

**Table 2** Echocardiographic parameters on ECMO

	Venovenous ECMO	Venoarterial ECMO
Weaning from ECMO: measurements at baseline and with stepwise decrement on flows	LVEF	LVEF
	RV size and function (TAPSE, FAC, S at tricuspid annulus)	LVOT VTI
	Paradoxical septum	S wave at lateral annulus
	TR and RVSP	RV size and function TR and RVSP

ECMO extracorporeal membrane oxygenation, FAC fractional area change, IVC inferior vena cava, LVEF left ventricular ejection fraction, LVOT VTI left ventricular outflow tract velocity time integral, RV right ventricle, RVSP right ventricular systolic pressure, TAPSE tricuspid annular plane systolic excursion, TR tricuspid regurgitation

Douflé et al. Critical Care (2015) 19:326

Nadia Aissaoui  
Charles-Edouard Luyt  
Pascal Leprince  
Jean-Louis Trouillet  
Philippe Léger  
Alain Pavie  
Benoit Diebold  
Jean Chastre  
Alain Combes

## **Predictors of successful extracorporeal membrane oxygenation (ECMO) weaning after assistance for refractory cardiogenic shock**

**VTI > 10 cm**

**LVEF > 20-25%**

**TD Sa > 6cm/s**

# SUMMARY

## Echo parameters PRE ECMO

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### **Contre-indications VA ECMO**

Aortic Dissection

Aortic Insufficiency

Severe atheromatous disease

### **Appropriate configuration**

Septic cardiomyopathy + ARDS = VA or V-VA

ARDS and Acute RV failure = VV ECMO

Decompensated PH = VA ECMO or PA/LA

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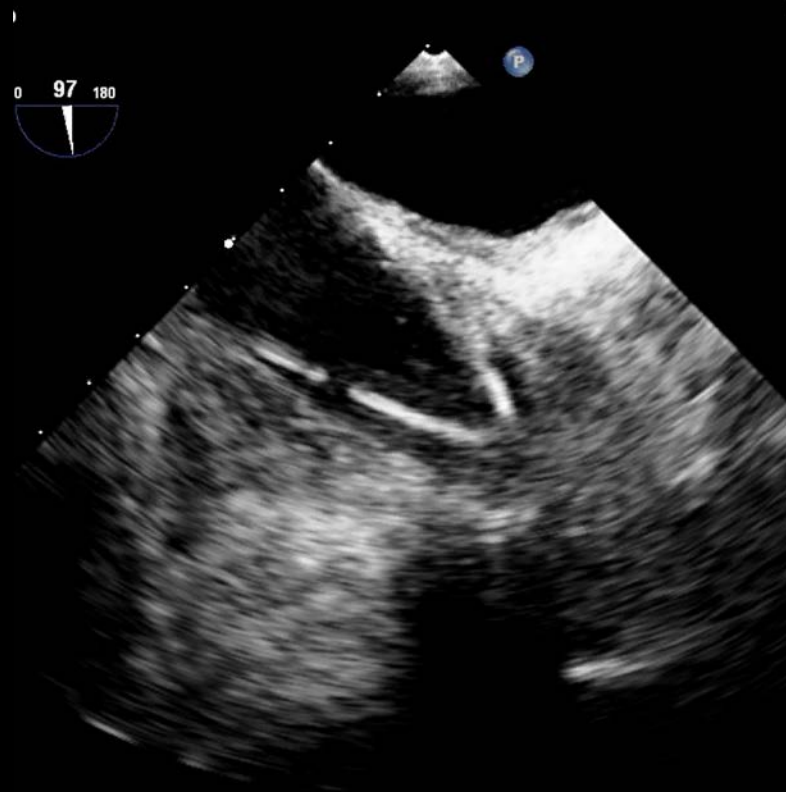
# SUMMARY

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	Paradoxical septum	S wave at lateral annulus
	TR and RVSP	RV size and function
		TR and RVSP

*ECMO* extracorporeal membrane oxygenation, *FAC* fractional area change, *IVC* inferior vena cava, *LVEF* left ventricular ejection fraction, *LVOT VTI* left ventricular outflow tract velocity time integral, *RV* right ventricle, *RVSP* right ventricular systolic pressure, *TAPSE* tricuspid annular plane systolic excursion, *TR* tricuspid regurgitation

# BEWARE of 2D and Echo guidance



**INDICATE THE FLOWS DURING ACQUISITION**

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