

Central VA ECMO for Severe Pulmonary Arterial Hypertension: A Novel Cannulation Strategy

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Objectives

For patients with pulmonary arterial hypertension (PAH) refractory to medical therapy and complicated by right heart failure, extracorporeal membrane oxygenation (ECMO) is often required as a bridge to lung transplantation. To address anatomic and physiologic constraints that accompany peripheral veno-arterial (VA) ECMO, new configuration and cannulation strategies need to be implemented. We describe a novel technique of central VA ECMO (RA-LA) cannulation for PAH as a bridge to transplant (BTT).

Methods

To facilitate cannulation, exposure is obtained via median sternotomy or right mini thoracotomy. An 8mm graft is sewn onto the LA at the level of the confluence of the superior and inferior pulmonary veins and cannulated with a 22Fr EOPA. The RA is cannulated with a 30Fr Medtronic DLP single stage cannula using a 10mm graft secured in a similar fashion. (Fig. 1b,c) Cannulas are tunneled subxyphoid, connected to the ECMO circuit and cardiopulmonary bypass is weaned off.

Results

Patients (*n*=2) were extubated post-operative day 1 and had a significant reduction in need for targeted PAH therapy and decline in pro-BNP ($82\% \pm 7.5$) (Table 2). Transthoracic echocardiogram showed marked improvement in right heart size and function, which enabled improved filling of LV (Fig. 1d). Patients were able to ambulate with resolution of syncopal episodes. Both patients underwent successful bridge to transplant (BTT) after 36 and 84 days on this configuration.

	Patient 1	Patient 2
Age (yrs)	21	37
Weight (kg)	48	54
Disease	WHO Group 1 PVOD/PCH	WHO Group 1 IPAH
Flow (lpm)	3.5→ 2.5	4.5→ 3.5
BTT (days)	84	36

Table 1: Patient characteristics. WHO = World Health Organization, PVOD = pulmonary vaso-occlusive disease, IPAH = idiopathic pulmonary arterial hypertension, CO = cardiac output

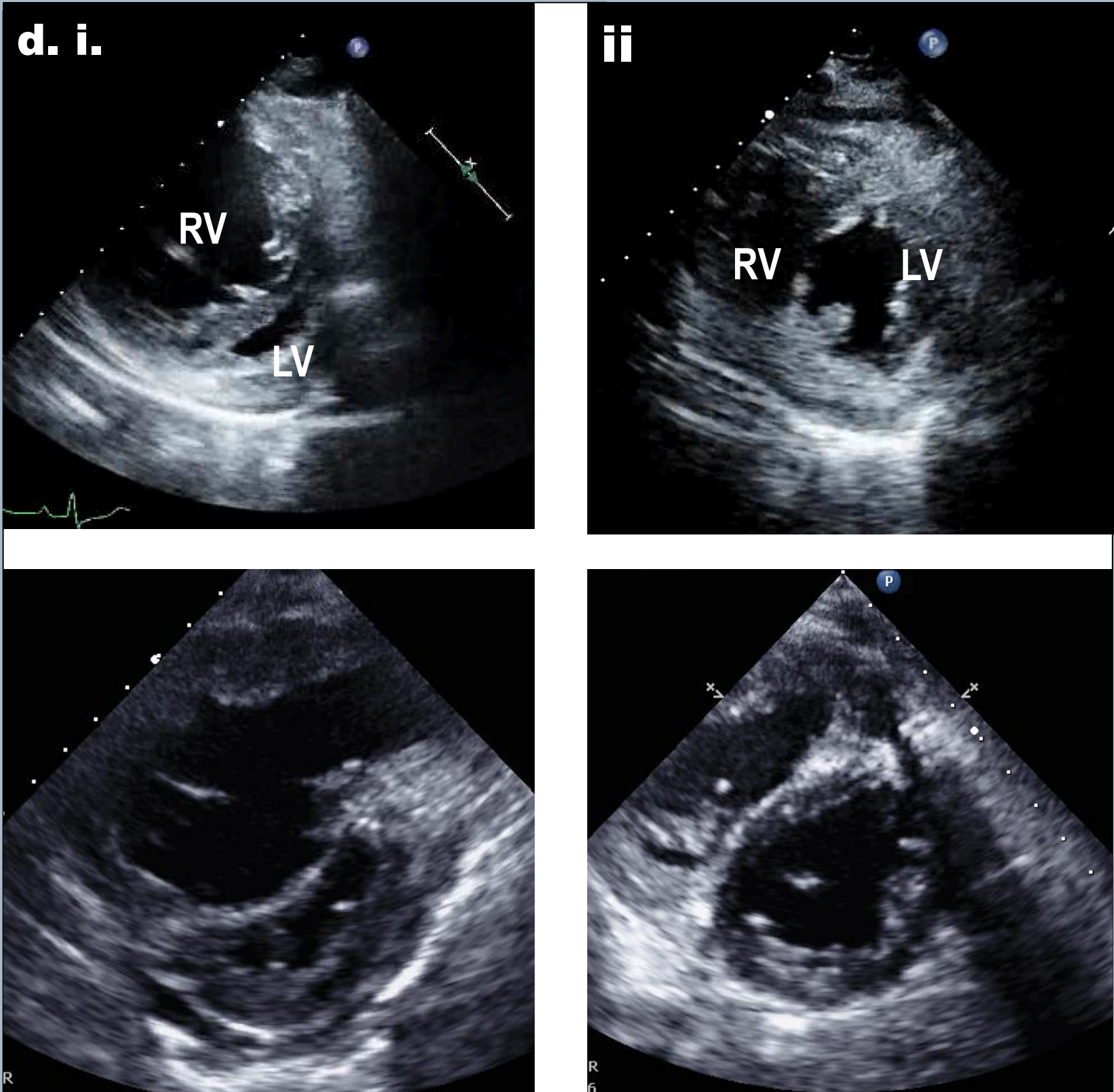
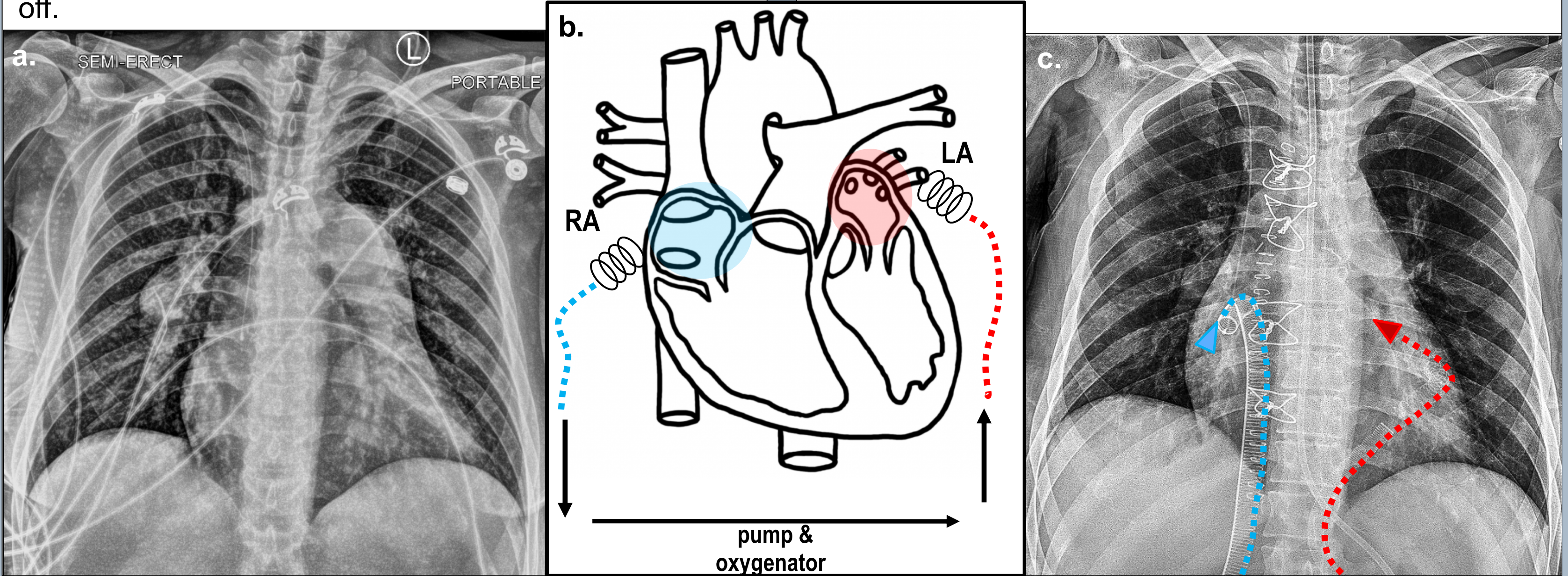


Figure 1: (a) Pre-cannulation chest radiograph demonstrates prominent main pulmonary artery (arrow) (b) Schematic of central VA ECMO (RA-LA) configuration. (c) Post-cannulation chest radiograph demonstrating marked improvement in pulmonary artery and right heart dilatation. Diagram of drainage cannula (blue) and reinfusion cannula (red) position. (d) Transthoracic echocardiogram (TTE) short axis views pre-cannulation (i) and on central VA (RA-LA) ECMO (ii) for patient 1 (superior) and patient 2 (inferior). Prior to cannulation, TTE demonstrates severe LV compression, dilation of the RV, and bowing of the septum with marked improvement after cannulation.

Disclosure Statement

I will not discuss off label use and/or investigational use of any drugs/devices. The authors have no relevant financial relationships related to this presentation.

	Patient 1		Patient 2	
Cannulation	Pre	Post	Pre	Post
IV pulmonary dilators	Treprostinil	None	Illoprost Treprostinil	Illoprost
iNO (ppm)	20	None	20	None
PAP (mmHg)	186	139	73	71
O ₂ therapy	HFNC	4L NC	NRB, HFNC	RA
pH	7.38	7.41	7.28	7.42
pCO ₂	40	39	39	41
paO ₂	61	289	60	467
Pro-BNP (pg/mL)	6,135	3,823	27,777	678

Table 2: Hemodynamics and medications before and after ECMO cannulation. Pre-ECMO = 24 hours prior to cannulation, post-cannulation = 24 hours after cannulation, iNO = inhaled nitric, PAP = pulmonary artery pressure, HFNC = high flow nasal cannula, NC = nasal cannula, NRB = non-rebreather, RA = room air

Conclusions

BTT with central VA ECMO (RA-LA) can be successfully implemented in patients with PAH complicated by right heart failure but with preserved LV function. This configuration provides appropriate physiologic fluid dynamics with antegrade pulsatile flow, thus allowing improved coronary and cerebral perfusion. Implementing this cannulation strategy may improve the patient’s ability to remain extubated and ambulatory prior to transplant. In select PAH patients with poor access for peripheral cannulation and preserved left ventricular function, this approach could be a durable option as a BTT.