Feasibility of Advanced Cardiac Doppler Exam as Part of Pulmonary Embolism Response Team Point of Care Protocol (PERT POCUS Protocol)

Christopher O'Hara, MD, Lindsey Morris, MD, Michael Dong, MD, Saikou Saidy, MD, Frances Mae West, MD

Purpose

In intermediate-high risk pulmonary embolism (IHRPE), non-invasive hemodynamic surrogates, left and right ventricular outflow tract volume-time integrals (LVOT and RVOT VTI), are emerging as a potential tool to identify patients at greatest risk.

We seek to determine if advanced cardiac point of care ultrasound (POCUS) measurements obtained by pulmonary and critical care fellows in IHRPE patients can be performed accurately when compared to comprehensive echocardiography (cTTE).

Background

PE is a heterogeneous disease in regards to clinical presentation, morbidity and mortality, ranging from mild symptoms to sudden cardiac arrest. Patients in the intermediate risk category often require additional testing and risk stratification to guide therapy, and there are ongoing questions about how to better identify patients at risk of further decompensation.

Methods

Intermediate-High Risk Pulmonary Embolism patients received a cardiac "PERT POCUS" protocol performed by a Pulmonary/Critical Care fellow, as well as a cTTE performed by an echocardiographer and interpreted by a cardiologist within 12-hours of enrollment.

The protocol included parasternal long and short axis, apical four and five chamber, subxiphoid, and IVC views. We reported estimated LV ejection fraction, pericardial effusion, RV:LV ratio, LVOT and RVOT VTI, tricuspid annular plane systolic excursion (TAPSE), tissue doppler of the tricuspid valve (S'), and peak tricuspid regurgitant velocity (TRV).

Results

Ten patients have been enrolled thus far, and there is no difference in assessment of either LV function, RV function, or pulmonary artery systolic pressure (PASP). When comparing POCUS measurements with cTTE measurements.

There was agreement in estimate LV EF in all patients enrolled. POCUS vs cTTE doppler measurements were also similar, with LVOTI VTI 14.05 cm versus 11.15 cm (n=2, p=0.07) and RVOT VTI 12.43 cm versus 11.77 cm (n=3, p=0.29), respectively. TAPSE 1.85 cm versus 1.89 cm (n=7, p=0.83), S' 12.3 cm/s versus 11.5 cm/s (n=8, p=0.36), and TRV 3.14 m/s versus 2.65 m/s (n=6, p=0.14).

Figure 1: Ultrasound Data

Patient	Estimated EF		RV:LV		LVOT VTI		RVOT VTI		TAPSE		S'		TRmax	
	POCUS	cTTE	POCUS	cTTE	POCUS	cTTE	POCUS	cTTE	POCUS	cTTE	POCUS	cTTE	POCUS	cTTE
1	Hyperdynamic	Hyperdynamic	RV<LV	RV<LV	32.4	NR	18.4	NR	1.65	2	17	14	2.24	NR
2	Normal	Normal	RV<LV	RV<LV	14.4	NR	11	NR	2.32	2.3	15.2	19	NR	NR
3	Reduced	Reduced	RV>LV	RV>LV	11.8	NR	7.68	NR	1.81	1.8	10.4	9	2.08	2.93
4	Normal	Normal	RV>LV	RV>LV	13.4	NR	12.8	NR	1.59	1.5	13.7	NR	2.604	4
5	Normal	Normal	RV>LV	RV>LV	13.2	10.6	9.58	9	2.11	2	17.9	14	3.09	3.6
6	Normal	Normal	RV<LV	RV<LV	15.5	NR	17.3	NR	3.4	NR	NR	17	NR	NR
7	Normal	Normal	RV>LV	RV>LV	11.3	NR	NR	NR	2.16	1.6	9.44	9	NR	3.55
8	Normal	Normal	RV<LV	RV<LV	22.9	NR	13.2	13.3	1.71	NR	11	10	2.36	2.55
9	Normal	Normal	RV>LV	RV>LV	12.7	NR	14.5	13	1.33	2	9.33	10	2.43	3.06
10	Normal	Normal	RV>LV	RV>LV	14.9	11.7	NR	NR	1.05	NR	8.25	7	3.36	2.71
Mean (reported)					14.05	11.15	12.43	11.77	1.85	1.89	12.32	11.50	3.14	2.65
p-value					0.07		0.29		0.83		0.36		0.14	

NR=not reported

Means calculated based off patients with reported values in both POCUS and cTTE

When comparing POCUS data to comprehensive TTE data, there was complete agreement in qualitative assessment of LV EF and RV:LV ratio, and no statistically significant difference between doppler interrogations for LV function, RV function, or pulmonary artery pressures, though volume-time integrals were inconsistently traced in cTTE reports.

Conclusion

Bedside POCUS performed by PCCM fellows provides a similar assessment of biventricular function and PASP when compared to cTTE. While we have limited data at this time, this study is ongoing but this shows there may be potential implications for earlier, more accessible risk stratification in intermediate-high risk PE.