Right Atrial Pacing to Improve Acute Hemodynamics in Pulmonary Arterial Hypertension

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Relevant Financial Relationship Disclosure Statement

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I will/will not discuss off label use and/or investigational use of the following drugs/devices:

None

The following relevant financial relationships exist related to this presentation:

Dr. Tedford reports no direct conflicts pertinent to the development of this manuscript. Other general conflicts include consulting relationships with Medtronic, Aria CV Inc., Arena Pharmaceuticals and United Therapeutics. Dr. Tedford is on a steering committee for Medtronic and the research advisory board for Abiomed. He also does hemodynamic core lab work for Actelion and Merck.

Background

Right atrial (RA) pacing in Right Ventricular infarct and cardiac surgeries (i.e. CABG)

- Decrease in RA pressure
- Increase in CO/CI
- Increase in systemic BP

RA pacing in subjects with normal LV function with or without significant LVH:

- Decrease in SV and no change in CO/CI

Unknown effect in populations with RV dysfunction/failure in setting of elevated pulmonary arterial pressure.

We investigated acute hemodynamic impact of RA pacing in subjects with PAH.

Study Design

- Single center prospective, non-randomized, cohort design
- 32 patients age ≥ 18 years old referred for RHC for known or suspected PAH
  - 9 excluded due to incomplete hemodynamic data, 7 excluded for not meeting PAH criteria
  - 16 subjects included in analysis
- Cardiac MRI for RV volume calibration
- RHC and then PV catheter for baseline measurements
- Bipolar pacing wire positioned in RA
- Incremental pacing from initial 80-99 bpm by steps of 20bpm with repeat PV data at each step

	PAH subjects (n = 16)
Age, years	53±14
Race	
White, n (%)	14 (88)
Black, n (%)	2 (12)
Disease type	
IPAH, n (%)	8 (50)
Systemic Sclerosis PAH, n (%)	7 (44)
Systemic Sclerosis ILD-PH, n (%)	1 (6)
NTpro-BNP, pg/dL	403±483
NYHA Functional Class	
Class I, n (%)	2 (13)
Class II, n (%)	5 (31)
Class III, n (%)	9 (56)
Class IV, n (%)	0
Heart rate, bpm	71±10
Right atrial pressure, mmHg	8±4
Mean pulmonary artery pressure, mmHg	39±14
Pulmonary artery wedge pressure, mmHg	11±4
Pulmonary vascular resistance, woods-units	6.6±4.2
Cardiac output by thermodilution, L/min	4.8±1.1
End-systolic elastance (Ees), mmHg/mL	0.84±0.46
Pulmonary arterial elastance (Ea), mmHg/mL	0.92±0.47
RV-PA Coupling (Ees/Ea)	1.06±0.60
Therapies	
Loop diuretic use, n (%)	9 (56)
Mineralocorticoid antagonist use, n (%)	4 (25)
Calcium channel blocker use, n (%)	8 (50)
Phosphodiesterase-5 inhibitor use, n (%)	5 (31)
Prostanoid use, n (%)	0
Endothelin receptor antagonist use, n (%)	4 (25)

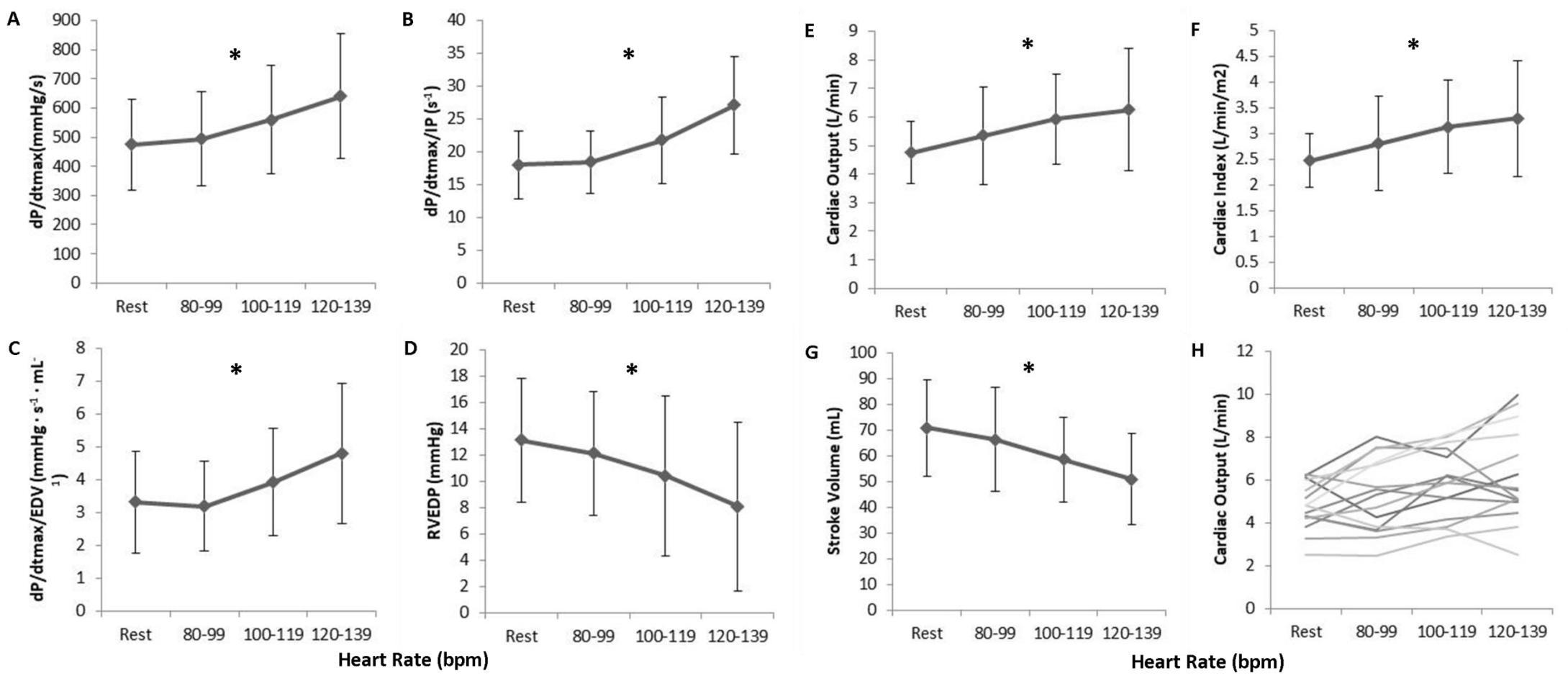
Elevated mean baseline NTpro-BNP

Most patients had NYHA class III heart failure symptoms

High mean PVR in the cohort

Mean Ees/Ea indicates preserved RV-PA coupling

Most subjects were on some PAH therapies at time of study



- All subjects, including those with Systemic Sclerosis-PAH, improved in CO/CI despite prior evidence for reduced contractile reserve in this group of PAH subjects.
- Disparate findings to prior investigation with LV: dP/dT_{max} and CO did not increase significantly
- Decline in RVEDP may be telling of effect on RV-LV interdependence yielding the observed CO increase

PAH subjects (n = 16)	
Analysis of baseline parameters for effect modification of relationship of cardiac output with RA pacing	p-value
Baseline RV end-diastolic volume	0.27
Baseline RV stroke volume	0.37
Baseline right atrial pressure	0.25
Baseline RV end-diastolic pressure	0.18
Baseline cardiac output	0.67
Baseline pulmonary vascular resistance	0.89
Baseline Ees/Ea	0.84
Diagnosis (SSc vs IPAH)	0.95

- None of the above baseline hemodynamic parameters or type of PAH modified the effect of pacing on CO
- Including subjects without PAH (n = 7) did not significantly alter these findings
- This suggests, the results from our study may be generalizable to other forms of RV dysfunction/failure

Limitations:

- Small sample size
- No healthy controls to compare against
- No acutely decompensated subjects
- Short time interval between intervention and measurement

Conclusion:

- Acute RA pacing in PAH patients produces acute improvement in CO/CI by increase in RV contractility
- This warrants further investigation as a therapeutic strategy for RV dysfunction/failure