Variation in hemodynamics among heart failure patients supported by continuous-flow left ventricular assist devices – a PILOT study

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Background

- There are minimal data available describing blood pressure (BP) variability and regulation among patients with advanced heart failure (HF) who are supported by left ventricular assist devices (LVADs).
- The purpose of this study was to characterize diurnal variations in hemodynamics and hemodynamic changes in cardiopulmonary exercise testing among HF patients supported by LVADs.

Methods

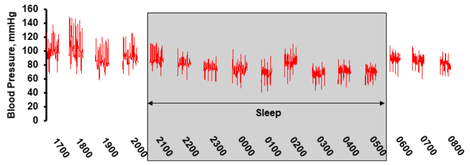
- Data were collected from four patients (61 ± 5 yrs, 100% male) with advanced heart failure supported by LVADs
- Each patient completed continuous hemodynamic assessment to monitor changes in heart rate (HR) and BP via arterial catheter
- Data were collected while awake, during overnight sleep and during cardiopulmonary exercise testing.
- Plasma norepinephrine concentration was assessed during monitoring as an index of autonomic tone.

Results

Table 1

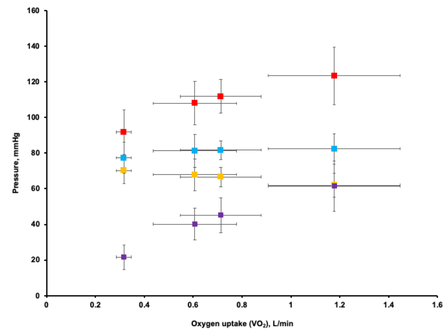
Variable	Patients (N=4)
Age, yrs	61 ± 5
Male Sex, N (%)	100
Height, cm	181 ± 9
Weight, kg	84.6 ± 10.8
Body mass index, kg/m²	28 ± 7
Ischemic Etiology, N (%)	1 (25)
LVAD Duration, months	38 ± 13
LVAD type, N (%)	
Heartware	3 (75)
Heartmate 3	1 (25)
Medications, N (%)	
Beta-blocker	2 (50)
ACE/ARB/ARNI	4 (100)
MRA	1 (25)
Diuretic	2 (50)

Figure 1



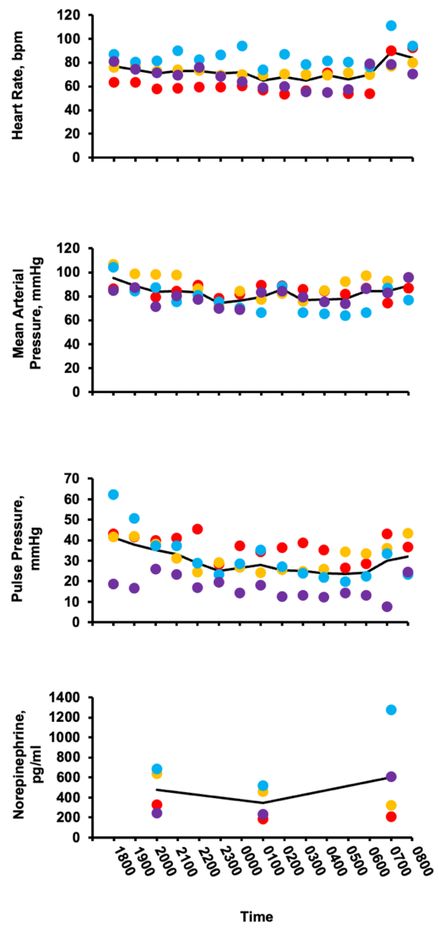
Representative tracing of a 54-year old man with history of non-ischemic HF supported by a Heartmate 3 LVAD demonstrating nocturnal dipping in blood pressure with a reduction in pulsatility, as well as an increase in blood pressure upon awakening.

Figure 3



Demonstration of longitudinal changes in blood pressure during cardiopulmonary exercise testing. Red = Systolic Blood Pressure, Blue = Mean Arterial Pressure, Yellow = Diastolic Blood Pressure, Purple = Pulse Pressure.

Figure 2



Hemodynamic waveforms demonstrating nocturnal dip and morning surge in heart rate, mean arterial pressure, pulse pressure, and norepinephrine levels in HF patients supported by LVADs. Individual patients represented by color. Line represents average values.

Results

- Nocturnal dipping was observed in HR, BP and pulse pressure (PP) (**Figure 2**).
- Norepinephrine levels were checked at 8pm, 1am, and 7am and demonstrated an overnight decline, with increase with awakening (**Figure 2**).
- During exercise, there was a large increase in PP, but an overall blunted BP response to exercise **(Figure 3).**
- Maximal oxygen uptake was severely reduced (14.1±4.3ml/kg/min, 54.3±15.4% predicted)
- Ventilatory efficiency slope was (42.5±6.0).

Conclusions

- Despite continuous-flow circulatory support with an LVAD, HF patients demonstrate nocturnal dipping in hemodynamics and catecholamines.
- However, the hemodynamic response to exercise is similar to responses typically observed among patients with advanced HF.