

Atrioventricular Interval Optimization Technique: Impedance Measurements vs. Echo/Doppler

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Presentation at the North American Society for Pacing & Electrophysiology's 19th Annual Scientific Sessions, May 9, 1998

Introduction

Optimization of the atrioventricular interval (AVI) may be critical for some patients with dual-chamber pacemakers and left ventricular dysfunction. The most widely used technique for AVI optimization, Echo/Doppler, is operator dependent, requires multiple carefully obtained measurements and may be time consuming and costly.

Purpose

To assess a new impedance-based measurement technique of cardiac output (CO) (CardioDynamics, San Diego, CA) as a tool for optimization of the AVI.

Patient Population

- 14 patients with dual-chamber pacemakers
- Mean age 64.7 years (28 to 82 years)
- Mean LVEF 42% (20 to 60%)

Methods

- Impedance technique was performed simultaneously with Echo/Doppler measurements
- 12 Patients were tested at 3 AVIs
- 2 patients with limited programmability PPM were tested at 2 AVI
- Mean AVI tested:
57 ms (50-75 ms)
108 ms (100-125 ms)
155 ms (150-175 ms)
- Echo/Doppler measures of stroke volume and diastolic function were obtained simultaneously

Worksheet for Echo Doppler Measurements

Patient Name _____

Pacemaker manufacturer _____ Model# _____

Date of Study _____

1. LVOT Diameter _____ cm

AV Delay	50 ms**	100 ms**	150 ms**
2. HR ²			
3. BP (mm Hg)			
4. LVOT vel (cm)			
5. LVOT TVI ³ (cm)			
6. Mitral E wave (m/s)			
7. Mitral A wave (m/s)			
8. DT ⁴ (ms)			
9. DFT ⁵ (ms)			
10. SV ⁶ (ml)			
11. CO ⁷ (l/m)			

$$SV = 0.785 \times \text{LVOT diameter}^2 \times \text{LVOT TVI}$$

* LVOT is only measured once/study

** Indicates if different AVI due to programmable options

¹LVOT= Left Ventricular Outflow Tract

²HR= Heart Rate

³TVI= Time Velocity Integral

⁴DT = Deceleration Time

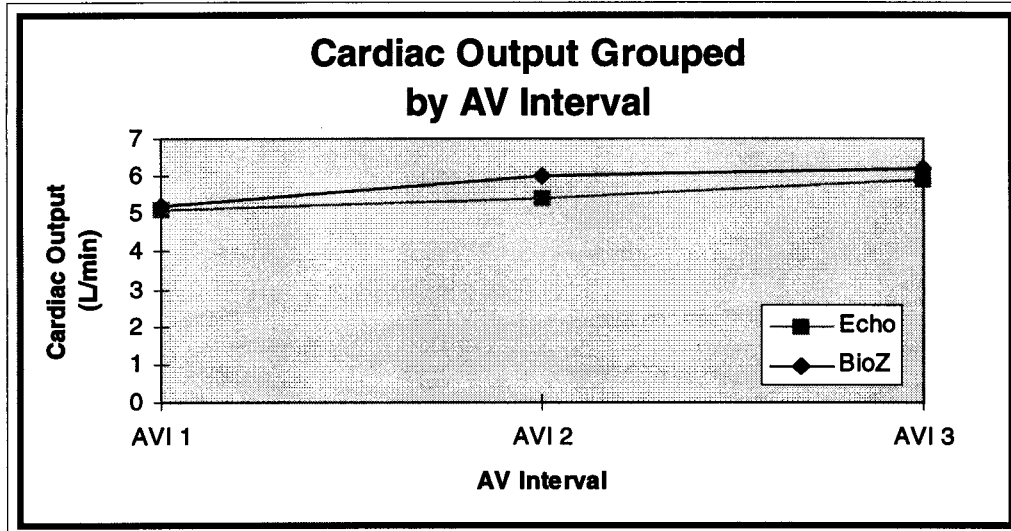
⁵DFT= Diastolic Filling Time

⁶SV= Stroke Volume

⁷CO = Cardiac Output

Optimal AVI

- Echo/Doppler: Optimal AVI was determined primarily by stroke volume
- If stroke volume calculations were similar, diastolic filling pattern was considered
- Optimal AVI by impedance technique was determined by highest cardiac output



Results

- When optimal AVI by these Echo/Doppler criteria were compared to optimal AVI by highest cardiac output by absolute impedance technique, there was exact correlation in 10 out of 14 patients
- In 2 patients there was no clear difference between AVIs either by Echo/Doppler or by impedance technique
- In the remaining 2 patients, optimal AVIs by echo/Doppler was 150 ms and by impedance technique was 125 ms in one patient, and 100 ms by AVIs by Echo/Doppler and 50 ms by impedance technique. In the other (cardiac output by impedance technique was minimally different in the second patient: CO @ 50ms = 5.84 L/min; @100ms = 5.46 L/min; @150ms = 5.49 L/min)
- Average time to assess 3 AVIs by Echo/Doppler was 25 min. versus 15 min. by impedance technique

Conclusions

- This study, in a very limited patient population, demonstrates feasibility and greater ease of this new impedance technique to determine CO with excellent correlation with Echo/Doppler values
- Although impedance technique lacks incidental information that may be derived from Echo/Doppler, the impedance derived cardiac output values may be adequate for AVI optimization more efficiently and potentially at a lower cost
- Larger validation studies comparing this newer technique with Echo/Doppler are needed