PRESSURE RECOVERY RATIO (PRR) INDEX FOR REAL-TIME ASSESSMENT OF HEART FAILURE

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Technology Description

Researchers in the Cardiovascular Biophysics Laboratory at Washington University developed a patented, real-time, automated index to reliably detect delayed relaxation during cardiac catheterization diagnostics. This technique, called pressure recovery ratio (PRR), serves as the hemodynamic analogue of the E-wave "delayed relaxation" (DR) pattern, thereby informing clinical decision-making for patients with heart failure.

Doppler E-wave DR pattern is the traditional method for identifying diastolic dysfunction through non-invasive echocardiography. However, this analysis is not always reliable. Therefore, physicians could benefit from a hemodynamic equivalent that can be integrated into diagnostic cardiac catheterization procedures to evaluate left ventricular (LV) function. PRR provides this tool as a dimensionless index of LV pressure based on kinematic and fluid mechanics analysis. PRR conveys early-rapid filling related chamber relaxation pressure properties and may differentiate between patients with normal E-waves and those with a DR pattern even when isovolumic relaxation analysis cannot.
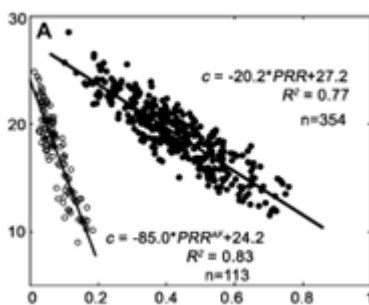
PRR (x-axis) vs. the E-wave derived relaxation/viscoelasticity parameter c (1/s, y-axis) for 40 normal sinus rhythm subjects (solid circle, 354 heart beats) and nine atrial fibrillation (AF) patients (open circle, 113 heart beats).

Stage of Research

The inventors validated the linear correlation of PRR with kinematic models of DR pattern (R^2 = 0.77, 0.83 in normal sinus rhythm and atrial fibrillation patients respectively). Furthermore, the PRR successfully differentiated subjects with a DR pattern from subjects with partial DR or normal E-wave.

Publications - Zhang, W., Shmuylovich, L., & Kovács, S. J. (2010). The E-wave delayed relaxation pattern to LV pressure contour relation: model-based prediction with in vivo validation. *Ultrasound in medicine & biology*, 36(3), 497-511.

Applications

- **Interventional cardiology** – assess/diagnose heart failure and diastolic dysfunction in cardiac catheterization lab using PRR as an additional source of information for filling-related chamber relaxation properties

Key Advantages

• Real-time, dimensionless data:

- automated analysis from pressures easily measured in a catheterization lab
- monitor patient over time and compare to other subjects

Patents - Pressure recovery index to assess cardiac function (U.S. Patent No. 8,273,029)

Related Web Links – Kovacs Profile