

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

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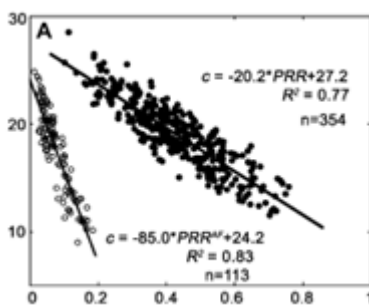
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## Technology Description

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](#)