



# Exploring the value of myocardial work in Cardiac Resynchronization Therapy

**Invaluable insights that could potentially improve outcomes**

There is a growing interest in sophisticated echocardiography methods, including myocardial work, for their potential in predicting cardiovascular outcomes. Researchers are exploring the value of myocardial work (MW) in identifying markers that could help with patient selection, and guide treatment and management across a range of indications.



Professor Jing Yao at Nanjing Drum Tower Hospital in Nanjing, China has adopted myocardial work to help assess responsiveness to Cardiac Resynchronization Therapy (CRT). These insights are particularly important because CRT has been shown to increase the quality of life and survival in patients with ventricular asynchrony and reduced left ventricular ejection fraction.<sup>1</sup> However, approximately 30% of CRT patients exhibit no improvement.<sup>2</sup>

Professor Yao's work is keeping Nanjing Drum Tower Hospital at the forefront of cardiovascular care. The

large-scale institution, with roots dating back more than a century, is known for its scientific research, medical technical excellence, and medical education. The Department of Ultrasound Medicine, which serves 400,000 patients annually, encompasses various subspecialties, including cardiovascular, abdominal, musculoskeletal, small part and superficial organs, and interventional ultrasound. The Department of Cardiothoracic Surgery performs nearly 3,000 cardiac surgeries every year.

**Professor Yao recently shared her views on the added value of myocardial work, which incorporates left ventricular afterload into global longitudinal strain analysis. She also detailed evidence that supports MW in identifying CRT responsiveness.**

**What demographic or patient population does your institution primarily serve, and are there any unique characteristics or health considerations specific to this population?**

**Prof. Yao:** *Our hospital primarily serves residents of Nanjing, a city with a population of over 9 million, as well as individuals from surrounding areas. We also attract patients from across the country. A significant portion of our patient population includes those with challenging, complex, and critical conditions. Many of them may have previously sought treatment in multiple hospitals without success before turning to our institution for*

*care. This places a considerable demand on the clinical capabilities of our medical professionals, contributing to the enhancement of our overall expertise.*

**Could you describe the range of echocardiography exams typically performed? Are these primarily diagnostic, monitoring, or post-procedural exams?**

**Prof. Yao:** *In our center, the application scope of echocardiography primarily includes routine examinations and follow-ups for patients in the departments of cardiology and cardiovascular surgery. We focus on perioperative assessment and*

*intraoperative monitoring for cardiovascular surgery, and monitoring and guidance during interventional procedures for structural heart diseases. Among these, diagnostic examinations constitute the largest proportion, but a significant amount of time is dedicated to intraoperative monitoring during thoracic surgeries and guiding interventions for structural heart diseases.*

*We also perform echocardiography exams on patients from other departments requiring cardiac assessment.*

You use myocardial work in asynchrony patients to identify potential candidates for Cardiac Resynchronization Therapy. Can you start by explaining what CRT is and how it's used in the management of patients with ventricular asynchrony?

**Prof. Yao:** Cardiac Resynchronization Therapy is a pacing intervention primarily used in the management of patients with heart failure and ventricular asynchrony.

This device has three leads that are placed in the right atrium, right ventricle, and coronary sinus respectively. The lead in the coronary sinus allows for pacing of the left ventricle. CRT is implanted to synchronize the contractions of the heart's ventricles and optimize the pumping efficiency of the heart.

“ We have also observed that parameters related to myocardial work, such as left ventricular overall myocardial work efficiency, constructive work, wasted work, as well as the difference in the mentioned parameters between the interventricular septum and the left ventricular lateral wall, demonstrate significant predictive value in assessing the responsiveness after CRT implantation.



What type ventricular asynchrony or cardiac disease typically qualifies patients for CRT? What criteria do you use to identify CRT candidates?

**Prof. Yao:** A patient displaying a left bundle branch block (LBBB) on the electrocardiogram (QRS  $\geq 150$  ms) and evidence of intraventricular and interventricular dyssynchrony on echocardiography typically qualifies for CRT. Experienced echocardiographers may identify crucial indicators through visual observation, with septal flash and apical rocking serving as significant diagnostic markers.

Can you share any studies or clinical evidence supporting the use of myocardial work in predicting the efficacy (ventricle functional restoration) after CRT in patient follow-up?

**Prof. Yao:** In recent years, with the growing recognition of the concept of myocardial work in clinical practice and the application of analytic techniques, an increasing number of clinical studies have been reported regarding the predictive role of myocardial work in the effectiveness of CRT.

For instance, Riolet et al. published a study<sup>2</sup> in 2021 in the Journal of JASE, involving a large prospective cohort of patients with heart failure (HF) and reduced ejection fraction who underwent CRT. The study aimed to assess the relationship between preprocedural global work index (GWW) and treatment outcomes. The findings indicated that a low preoperative GWW (<200 mm Hg%) is associated with the absence of CRT response in candidates and is linked to a relatively increased risk for all-cause.

Another example is the Aalen et al. report<sup>3</sup> on a prospective randomized trial, performed in 200 patients recruited in five European centers, to explore the use of regional left ventricular (LV) myocardial work differences as a predictor of response to cardiac resynchronization therapy (CRT). This investigators show that the difference between myocardial work performed by the septum (S) and LV lateral wall (LW) predicted CRT response with an area under the curve (AUC) of 0.77 [95% confidence interval (CI) 0.70–0.84].

In our clinical practice, we have also observed that parameters related to myocardial work, such as left ventricular overall myocardial work efficiency, constructive work, wasted work, as well as the difference in the mentioned parameters between the interventricular septum and the left ventricular lateral wall, demonstrate significant predictive value in assessing the responsiveness after CRT implantation.

What limitations exist in incorporating MW assessment into the follow-up of CTR patients?

**Prof. Yao:** The reproducibility of myocardial work measurements is not adequate.

What would you say to other clinicians that have not incorporated myocardial work into their practice? Would you encourage them to use it?

**Prof. Yao:** Myocardial work is an intriguing quantitative method for assessing cardiac function. Its analysis is built on two-dimensional speckle tracking with the addition of blood pressure parameters. You should give it a try in your clinical practice. You might fall in love with it.

Where do you see the future of myocardial work assessment in the context of CRT patient selection and follow-up? What about tool adoption in everyday clinical practice?

**Prof. Yao:** We look forward to additional clinical research to further clarify the use of myocardial work parameters in selecting and monitoring CRT patients. Additionally, it is crucial to establish corresponding thresholds to guide clinical diagnosis and treatment. In the future, if myocardial work analysis technique based on three-dimensional speckle tracking imaging can be developed, its parameters may be even more accurate and reliable. ■



**Professor Jing Yao** is Director of Ultrasound Medicine at Nanjing Drum Tower Hospital. For more than two decades, she has been actively engaged in clinical work, teaching, and scientific research of echocardiography. Dr. Yao's area of expertise is ultrasound diagnosis of cardiovascular diseases including valvular disease, cardiomyopathy, and coronary heart disease. She is a member of several medical committees and associations and has hosted multiple National Natural Science Foundation and Provincial Scientific Research Projects.

- 1 Liu F, Gao X, Luo J. An updated meta-analysis of cardiac resynchronization therapy with or without defibrillation in patients with nonischemic cardiomyopathy. *Front Cardiovasc Med.* 2023 Jul 12;10:1078570. doi: 10.3389/fcvm.2023.1078570. PMID: 37502189; PMCID: PMC10370697.
- 2 Riolet C, Menet A, Mailliet A, et al. Clinical Significance of Global Wasted Work in Patients with Heart Failure Receiving Cardiac Resynchronization Therapy. *J Am Soc Echocardiogr.* 2021;34(9):976-986. doi:10.1016/j.echo.2021.06.008.
- 3 Aalen JM, Donal E, Larsen CK, et al. Imaging predictors of response to cardiac resynchronization therapy: left ventricular work asymmetry by echocardiography and septal viability by cardiac magnetic resonance. *Eur Heart J.* 2020;41(39):3813-3823. doi:10.1093/eurheartj/ehaa603

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