MEDICAL METRICS BACKGROUND

MMI is an FDA-registered, ISO-certified provider of independent Imaging Core Laboratory services for multi-center clinical trials. Our services include imaging protocol development, medical image analysis, data management and scientific consulting. Since 2000, we have supported over 300 studies of Class III medical devices, biologics and surgical procedures. Over a third of these have been FDA-regulated. Another third have been international studies spanning more than 40 countries on six continents. We also support many pre-clinical and post-market studies resulting in important product advances and scientific publications.

METHODIST DEBAKEY AFFILIATION

Through partnership with the world-renowned Methodist DeBakey Heart and Vascular Center (MDHVC) in Houston, Texas, we provide access to leading experts in vascular, valvular, aortic and coronary artery disease and treatment. Our experts are recognized leaders in cardiovascular, cardiothoracic and peripheral vascular medicine. They include editors of high-impact journals, presidents of major professional societies, division chiefs of surgery, advisors to FDA and lifetime achievement awardees. Our depth and diversity of experts allows us to provide support for all major diagnostic imaging modalities in a single core lab. Our imaging expertise includes cardiac echo, duplex, angio, MRA, CTA, IVUS, OCT and nuclear medicine.

EXPERTISE IN CARDIAC ECHO

Our medical director for cardiology trials is Dr. Miguel Quiñones, Chair of the Department of Cardiology at The Methodist Hospital in Houston and an internationally-recognized expert in cardiac ultrasound. He is a pioneer of methods for quantitative assessment of left ventricular function and a Lifetime Achievement Award Winner from the ASE. Other experts include Dr. William Zoghbi and Dr. Sherif Nagueh. Dr. Zoghbi is the Chief of Cardiac Imaging at The Methodist Hospital in Houston and a former president of the ASE and ACC. Dr. Nagueh is a board member of the ASE and the International Commission for Accreditation of Echocardiography Laboratories. Short bios for these and other experts are provided on the following page.

As evidence of our clinical leadership in echocardiography, key publications authored by MDHVC experts are listed below. These articles feature published recommendations, standards and guidelines on cardiac imaging endorsed by major cardiology societies.

MEDICAL DIRECTORS & REPRESENTATIVE EXPERTS

The following cardiologists and vascular surgeons are representative of the experts and key opinion leaders available to consult on protocol design, study planning, execution, data interpretation and post-study publication through MMI:

- **Miguel Quiñones, M.D., FACC – Medical Director**
  - Chairman of the Department of Cardiology at the Methodist Hospital, Houston, Texas
  - 32 years’ experience in clinical research, practice and teaching
  - Widely recognized pioneer in the field of cardiac ultrasound
  - Recipient of national and international recognition for his contributions in the field of echocardiography
  - Developed echocardiographic methods that are now the standard of care to measure left ventricular volumes and ejection fraction, cardiac output, regurgitant fractions in mitral and aortic insufficiency, and valve area in aortic stenosis
  - More recently developed methods to evaluate diastolic function and estimate left ventricular filling pressures
  - More than 185 manuscripts in peer-reviewed journals, 12 book chapters and 225 published abstracts

- **Sherif Nagueh, M.D., FACC, FAHA, FASE**
  - Practicing cardiologist and Medical Director of the Echocardiography Laboratory at the MDHVC
  - Board certified in cardiovascular disease with subspecialty certification in echocardiography
  - Specialist in cardiac imaging and hypertrophic cardiomyopathy and an active researcher in these areas
  - Author of published guidelines and recommendations on cardiac imaging endorsed by cardiology societies
  - Board member of the International Commission for Accreditation of Echocardiography Laboratories (ICAEL)
  - Editorial board member of *Circulation*, the *Journal of the American College of Cardiology* (JACC), *JACC Imaging, Clinical Science*, *Cardiosource*, *Journal of the American Society of Echocardiography* (JASE) and others
  - Authored nearly 200 scientific articles and book chapters as well as many invited lectures internationally

- **Alan Lumsden, M.D., ChB, RVT, FACS – Medical Director**
  - Professor of Cardiothoracic Surgery, Weill Cornell Medical College
  - Chair of Cardiovascular Surgery and Medical Director of MDHVC, The Methodist Hospital
  - Past President of the Society of Clinical Vascular Surgery
  - Recognized leader in endovascular surgery and novel treatments for peripheral vascular disease
  - Expert in stent grafting, endarterectomy and minimally invasive venous disease therapies
  - 200+ publications as well as numerous abstracts, books, book chapters and presentations

- **Neil S. Kleiman, M.D., FACC**
  - Professor of Cardiothoracic Surgery, Weill Cornell Medical College
  - Director of the Cardiac Catheterization Laboratories, MDHVC, The Methodist Hospital
  - Expert in interventional cardiology, angioplasty, stenting and coronary artery disease
  - Editorial board member of many leading journals including *Circulation*, *American Heart Journal*, *JACC, Journal of Interventional Cardiology* and *European Heart Journal*
  - Principal or associate investigator on more than 125 research studies and clinical trials
  - 325 peer-reviewed journal articles, 17 book chapters, 1 book and 150 scientific abstracts

- **William Zoghbi, M.D., MACC, FAHA, FASE**
  - Director of the Cardiovascular Imaging Institute and Chief of Cardiac Imaging at The Methodist Hospital
  - Past President of the American College of Cardiology and the American Society of Echocardiography
  - Recognized leader in the field of cardiovascular imaging and echocardiography
  - Developer of numerous techniques for non-invasive evaluation of diastolic function with Doppler echo and detection of ischemic heart disease with stress and contrast echo
  - Author of key recommendations on the evaluation of prosthetic valves and native valvular regurgitation using echo
  - Associate Editor of *Circulation* and *JACC-Cardiovascular Imaging*
  - Over 200 scientific papers in major cardiovascular journals; delivered hundreds of invited lectures worldwide
SAMPLE PUBLICATIONS BY MMI-MDHVC EXPERTS FEATURING CARDIAC ECHO  [full bibliography available upon request]

- Tortoledo FA, Quinones MA, Fernandez GC, Waggoner AD, Winters WL. Quantification of left ventricular volumes by two-dimensional echocardiography: a simplified and accurate approach. Circulation 1983;67:579-84
- Zoghbi WA, Quiñones MA. Determination of cardiac output by Doppler echocardiography: a critical appraisal. Herz 1986;61:258-68
- Nagueh SF, Kopelen HA, Quiñones MA. Assessment of left ventricular filling pressures by Doppler in the presence of atrial fibrillation. Circulation 1996;94:2138-45
- Nagueh SF, Kopelen HA, Zoghbi WA. Relation of mean right atrial pressure to echocardiographic and Doppler parameters of right atrial and right ventricular function. Circulation 996;93:1160-9
- Nagueh SF. Dobutamine echocardiography versus nuclear cardiac imaging for evaluation of myocardial viability. Curr Opin Cardiol 1997;12:547-552.
- Sundereswaran L, Nagueh SF, Varden S, Middleton KJ., Zoghbi WA, Quiñones, Torre-Amione G. Estimation of left and right ventricular filling pressures after heart transplantation by tissue Doppler imaging. Am J Cardiol 1998;82:352-357

Nagueh SF. Noninvasive evaluation of hemodynamics by Doppler echocardiography. Curr Opin Cardiol 1999;14:217-224


Cwajg JM, Cwajg E, Nagueh SF, Kipelen HA, Qureshi U, Quiñones MA, Verani MS, Zoghbi WA. End-diastolic wall thickness as a predictor of recovery of function in myocardial hibernation: relation to rest-redistribution T1-201 tomography and dobutamine stress echocardiography. J Am Coll Cardiol 2000;35:1152-61


Naguel SF. Estimation of left ventricular filling pressures by Doppler echocardiography. ACC Curr J Review 2001;Jan/Feb:41-45


Yong Y, Wu D, Fernandes V, Kopelen HA, Shimoni S, Nagueh SF, Callahan JD, Burns DE, Shaw LJ, Quinones MA, Zoghbi WA. Diagnostic accuracy and cost-effectiveness of contrast echocardiography on evaluation of cardiac function in technically very difficult patients in the intensive care unit. Am J Cardiol 2002;89:711-718


Dhir M, Nagueh SF. Echocardiography and prognosis of heart failure. Curr Opin Cardiol 2002;17:253-256


Rivas-Gotz C, Manolios M, Thohan V, Nagueh SF. Impact of left ventricular ejection fraction on estimation of left ventricular filling pressures using tissue Doppler and flow propagation velocity. Am J Cardiol 2003;91:780-4


• Armstrong WF and Zoghbi WA. Stress Echocardiography: Current Methodology and Clinical Applications. JACC 2005; 45(11):1739-47


• Ruan Q, Nagueh SF. Effect of age on left ventricular systolic function in humans: A study with systolic isovolumic acceleration rate. Experimental Physiology 2005;90:527-534.

• Ruan Q, Rao L, Middleton KJ, Khoury DS, Nagueh SF. Assessment of Left Ventricular Diastolic Function by Early Diastolic Mitral Annulus Peak Acceleration Rate: Experimental Studies and Clinical Application J Appl Physiol 2006;100:679-684

• Dokainish H, Zoghbi WA, Ambriz E, Lakkis NM, Quinones MA, Nagueh SF. Comparative Cost-Effectiveness of B-type Natriuretic Peptide and Echocardiography for Predicting Outcome in Patients with Congestive Heart Failure. Am J Cardiol 2006;97:400-403.

• Ruan Q, Nagueh SF. Usefulness of isovolumic and systolic ejection signals by tissue Doppler for the assessment of left ventricular systolic function in ischemic or idiopathic dilated cardiomyopathy. Am J Cardiol 2006;97:872-875.


