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We retrospectively reviewed the records of patients from our institution that received CE while on ECMO support from September 2001 to March 2016. Patients were identified by searching the Echo Information Management System for "ECMO" and "contrast." There were a total of 1,996 studies of patients on ECMO and 4 (<1%) of these studies included CE. The commercially available contrast agent, Definity (Lantheus Medical Imaging, Billerica, Massachusetts), was used in all 4 cases, according to the institutional protocol (Mayo Clinic Echocardiography Laboratory Contrast Administration protocol) and the American Society of Echocardiography guidelines (1,5).

Of the 4 patients studied, 2 were during transthoracic echocardiography and 2 during TEE. Three patients were on venoarterial ECMO and 1 was on venovenous ECMO. All 4 patients were on a CARDIOHELP machine (Maquet Getinge Group, Wayne, New Jersey). Three of these studies were indicated for the assessment of possible mass or thrombus and 1 was to define the left ventricular function. CE answered the clinical question in all cases, and in 2 cases, resulted in a change in management. The findings in 1 case assisted in the titration of the ECMO settings. Another case demonstrated left atrial thrombus prompting emergent cardiac surgery. Two cases resulted in resolution of clinical concern for mass or thrombus. No complications related to CE are reported in the records. In our most recent case the integrated detector for air bubbles or thrombi alarmed, indicating engagement of the "zero-flow" mode and imminent pump shut down. Fortunately, the perfusionist was present at the bedside and had purposefully suspended the intervention. The ECMO circuit continued to function without complications. In the literature, alarms triggered by contrast microbubbles with resultant shutdown of the ECMO circuit and hemodynamic consequences have been reported in 2 patients (4). In our series, there are a few possibilities that may explain why only 1 event occurred. The interventions may have been pre-emptively suspended and/or the volume may not have been sufficient enough to trigger the alarms. Finally, if the right ventricular function is adequate, then no contrast may have entered the circuit.

In summary, we have successfully used CE to assess 4 ECMO patients without deleterious effects and with positive impact on management. However, microbubbles can result in acute, potentially catastrophic hemodynamic effects in these patients when detected as air bubbles by the ECMO circuit and trigger pump shutdown. We suggest creating a CE protocol specifically for ECMO patients. This protocol should focus on minimizing dosing and healthcare personnel communication, with requisite presence of a perfusionist or ECMO specialist at the time of CE performance. High mechanical index may be utilized to destroy the microbubbles if they persist in the circulation once the CE is complete.

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## The Public Health Service Needs to Do More


We read with interest the letter to the editor by Sachdev et al. (1). The authors present data correlating the severity of mitral regurgitation (MR) as assessed by echocardiography and magnetic resonance imaging (MRI), and compare and contrast their results with those from a prospective multicenter trial we published last year (2). We have a few comments for the readers of *iJACC*.

Sachdev et al. (1) present purely comparative data with no reference standard. Agreement between the 2 techniques does not validate either of them. In contrast, our study correlated regurgitant volumes by echo and MRI with a reference standard, namely the response to surgery (change in left ventricular end-diastolic volume), and included measurements of interobserver variation.

The authors state that "MR severity using PISA RV alone compared well with CMR." Yet, they report a correlation coefficient range of $r = 0.64$ to $r = 0.88$ ($r^2 = 0.41$ to $r^2 = 0.77$), which implies that 41% to 77% of the observed variation in the echocardiographic regurgitant volume is related to the MRI-derived regurgitant volume. That leaves a lot of room for error. It is consistent with their wide limits of agreement between echocardiography and MRI: -44 to 43 ml, which corresponds to 1.5 grades of regurgitation.

Most importantly, in their final paragraph they conclude "Our correlation between techniques was better and did not show a systematic overestimation by echo." Yet, data derived from their own table (**Table 1**) clearly show an overestimation bias. Namely, in 15 patients echo estimated MR severity to be greater than MRI and in only 3 patients was it less (**Table 1**).

The results from our prospective, blinded multicenter trial are based on echocardiographic review by nationally and internationally renowned echocardiographers (Gillam, Lang, and Chaudhry). Our results show not just poor agreement between echo and MRI, but also poor interobserver agreement with echocardiography, a finding that has been replicated by others (3). Two-thirds of the patients that had isolated mitral valve surgery did not have severe MR on MRI, and did not meet American College of Cardiology/American Heart Association guidelines for surgery.

Even if one accepts the Sachdev proximal isovelocity surface area data at face value, American Society of Echocardiography guidelines recommend an integrated approach to assessing MR severity. With that approach, Sachdev et al. (1) show that 56% (15 of 27) of their patients that have moderate-to-severe or severe MR on echo have only mild or mild-to-moderate MR by MRI. That is a bias that has real world consequences and should not be trivialized.

The misdiagnosis of severe MR is not just of academic interest. It has profound consequences in terms of patient morbidity and mortality, as well as health care costs. A claim of good correlation between proximal isovelocity surface area and echocardiography by a single site, even if true, misses the implications of our study. We live in a world where not all echocardiographers quantify MR severity by proximal isovelocity surface area, and those who do, use an integrated approach to determine its severity. More than a year has elapsed since our results were published.

The Public Health Service has an obligation to the taxpayers of this country. It could and should do more to improve the cost and quality of health care with respect to the misdiagnosis of chronic severe MR. As soon as practically possible, it should sponsor a National Institutes of Health-funded prospective multicenter trial to determine the efficacy of cardiac MRI for improving patient outcomes and decreasing healthcare costs. Our results suggest mitral valve surgeries would decrease by more than 50%, patient morbidity and mortality would decrease, and the healthcare system would save hundreds of million dollars annually. That is the kind of research that seems worthy of taxpayer support.

**TABLE 1 Comparison of Mitral Regurgitant Severity Between MRI and Echocardiography Integrated Method**

| | | Echo Integrated Method | | |
|---|---|---|---|---|
| | | Mild | Moderate | Severe |
| MRI | Mild | 8 | 11 | 1 |
| | Moderate | 2 | 14 | 3 |
| | Severe | 0 | 1 | 10 |

MRI = magnetic resonance imaging.

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