RESEARCH LETTER

Point-of-Care Ultrasound for Evaluation of Systolic Heart Function in Outpatient Hemodialysis Units

To the Editor:

Heart failure with reduced ejection fraction is a significant cause of morbidity and mortality in patients receiving hemodialysis. Interdialytic volume overload results in increased preload and afterload, increasing ventricular chamber size, elevating filling pressures, and worsening diastolic dysfunction. Guidelines recommend evaluating ejection fraction at the time of dialysis initiation, when patients reach dry weight, and then every 3 years. However, echocardiography is infrequently performed at these intervals, limiting the timely detection of asymmetric left ventricular (LV) dysfunction. There is growing interest from nephrologists to learn and use point-of-care ultrasound (POCUS) to assess cardiac function. In this study, we sought to determine whether focused cardiac POCUS can successfully ascertain ejection fraction in patients undergoing outpatient hemodialysis without interfering with dialysis clinic operations.

We conducted a cross-sectional study at 2 outpatient hemodialysis clinics from September to November 2018. We trained a nephrology fellow (S.L.) and a third-year medical student (S.A.; “operators”) to obtain POCUS-derived cardiac parasternal long-axis views using a Vscan device (maximum depth, 24 cm; GE healthcare). We obtained the images in the first 30 minutes of hemodialysis to avoid the risk for misinterpretation due to the potential for myocardial stunning with intradialytic hypotension. We also abstracted information from dialysis and health records. We calculated ejection fraction from the cardiac parasternal long-axis view using the E-point septal separation method and categorized patients into ejection fraction < 45% or ejection fraction ≥ 45% groups. All images were interpreted by the POCUS operator, followed by a blinded review by an echocardiographer with 30 years of experience (C.M.). A cardiologist (S.Z.) then reviewed all abnormal results and an additional 10% of random images. We compared ejection fraction assessment by the operator (index test) versus echocardiographer (reference standard) and calculated 95% CIs for the performance metrics using bootstrapping (10,000 resamples).

We completed POCUS on 57 participants; all studies were performed in the first 30 minutes of hemodialysis without interrupting patient-care tasks. Of the 57 patients, 52 (93%) had satisfactory images for interpretation and comprised the analytic cohort. The 5 patients with unsatisfactory images were due to obesity (n = 3), mitral stenosis (n = 1), and errors in saving images (n = 1). Mean age was 65 ± 13 years, 96% were Black, and 44% were women (Table 1). The average time to obtain images was 3.2 ± 1.7 minutes. Image interpretation concordance was 64% between the operator and echocardiographer and 100% between the echocardiographer and cardiologist. Operator-assessed low ejection fraction (< 45%) was 93% sensitive and 51% specific, with a positive predictive value of 44% and negative predictive value of 95% (Fig 1).

Among the 15 participants with low ejection fraction, 40% did not have a prior heart failure diagnosis and 53% were not receiving renin-angiotensin system–blocking medications. Fifty participants had undergone formal echocardiography in the prior 3 years (Table S1). Notably, 42 had an ejection fraction ≥ 45%, and of those, 8 (19%) had a low ejection fraction detected using POCUS evaluation.

The results of our study support the use of focused cardiac POCUS in patients undergoing hemodialysis in the outpatient setting. In most patients, POCUS can quickly obtain diagnostic images to screen for low ejection fraction without burdening patients or hindering care. Initial POCUS interpretation by the operator was reasonably reliable in excluding significant LV dysfunction; however, <50% of patients with abnormal findings were noted to have a low ejection fraction by the echocardiographer and cardiologist. Thus, our findings suggest that operator interpretation of POCUS is a useful screening tool for low ejection fraction, but a formal review of abnormal findings is necessary before initiating further diagnostics and cardiac treatments. Of note, POCUS imaging is helpful for more than just determining ejection fraction. It can also be used to obtain a limited echocardiogram (Current Procedural Terminology code 93308) in the hemodialysis clinic to provide information on chamber size, aortic root diameter, LV hypertrophy, pericardial and pleural effusions, and inferior vena cava. Therefore, there may be even more utility in considering POCUS in the outpatient dialysis setting, with careful oversight from...

Table 1. Baseline Characteristics of the 52 Participants

| Characteristic                        | Results                        |
|---------------------------------------|-------------------------------|
| No. of patients                       | 52                            |
| Age, y                                | 64.8 ± 13.0                   |
| Race, African American                | 50 (96.2%)                    |
| Sex, female                           | 23 (44.2%)                    |
| Body mass index, kg/m²                | 28.9 ± 7.9                    |
| Weight, kg                            | 83.7 ± 27.3                   |
| Duration of dialysis, mo              | 34.3 [11.3–56.3]              |
| Clinical diagnosis of heart failure   | 20 (38.5%)                    |
| β-Blockers                            | 38 (73.1%)                    |
| ACEi/ARB                              | 16 (30.8%)                    |
| Both β-blockers and ACEi/ARB          | 12 (23.1%)                    |
| Day of scan                           |                               |
| Monday or Tuesday                     | 27 (51.9%)                    |
| Wednesday or Thursday                 | 18 (34.6%)                    |
| Friday or Saturday                    | 7 (13.5%)                     |

Note: Data are mean ± standard deviation, median [25th-75th percentile], or number (percent), with percentages based on the total number in the corresponding column. Abbreviations: ACEi, angiotensin-converting enzyme inhibitor, ARB, angiotensin receptor blocker.
echocardiographers and imaging cardiologists. Our pilot study was potentially limited by the use of POCUS on varied days of the week, which can affect imaging parameters depending on the amount of interdialytic intravascular congestion. In addition, we used the E-point septal separation method for ejection fraction estimation, which is not accurate in the presence of mitral stenosis, aortic regurgitation, or atrial fibrillation and is less accurate than ejection fraction assessment using traditional echocardiographic parameters. Despite these limitations, our study demonstrates the potential to bring cardiac POCUS to the dialysis clinic, help detect low ejection fraction, and guide medical care in this high-risk population.

In summary, our study suggests that focused cardiac POCUS is feasible in US dialysis clinics and can be used to screen for low ejection fraction and guide management. Further studies are needed to evaluate large-scale implementation strategies and whether timely imaging can improve outcomes for patients treated with hemodialysis.

**SUPPLEMENTARY MATERIAL**

**Supplementary File (PDF)**

**Figure S1:** Flow diagram illustrates participant selection

**Figure S2:** Method of ejection fraction (EF) estimation with E-point septal separation (EPSS) on cardiac PLAX view

**Table S1:** Changes in ejection fraction since the last formal echocardiogram

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