

Preliminary Interpretations of Transthoracic Echocardiograms by Cardiology Fellows

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Background: Echocardiograms are often obtained after business hours on an urgent or emergent basis to assist in the care of patients with complex presentations. Considerable variation exists among academic medical centers with regard to who performs and interprets these studies, with different levels of cardiology fellow involvement in scanning and/or interpreting. On-call echocardiographic interpretation can be educationally valuable for cardiologists in training but may come at the expense of patient care. The aim of this study was to examine the agreement of preliminary fellows' interpretations of weekend on-call transthoracic echocardiograms with official attending cardiologists' interpretations.

Methods: Cardiology fellows perform preliminary interpretations of sonographer-obtained echocardiograms obtained on weekends, with final reports performed by attending cardiologists the following business day. In this study, 358 consecutive echocardiograms obtained on weekends over a 12-month period were reviewed. Discrepancies between the preliminary and final interpretations were categorized as either major (diagnoses with implications for urgent change in management) or minor (diagnoses without such implications). All discrepancies were also categorized as a missed diagnosis, an overcall (of severity), or an undercall.

Results: No preliminary interpretation was identified in 18.4% of the studies (66 of 358). Of the remaining on-call echocardiograms ($n = 292$), the overall discrepancy rate in interpretations between fellows and attending cardiologists was 16.8%. Out of these, the minor discrepancy rate was 14.4% (42 of 292), and the major discrepancy rate was 2.4% (seven of 292). Misses, overcalls, and undercalls accounted for 29%, 31%, and 40% of all discrepancies, respectively.

Conclusions: The results indicate that although minor discrepancies between fellows' and attending cardiologists' interpretations were common (14.4%), major discrepancies were uncommon (2.4%) and similar to major discrepancy rates from the radiology literature. In general, discrepant interpretations were more likely to result from changes in severity, but misses accounted for almost all of the major discrepancies. Further research is needed to compare the clinical impact of different models of on-call echocardiographic services. (J Am Soc Echocardiogr 2017; ■:■-■.)

Keywords: Preliminary, Interpretation, Echocardiogram, Report, Fellow

Transthoracic echocardiograms are often obtained after business hours on an urgent or emergent basis to assist in the care of patients with complex presentations. Among teaching hospitals, the on-call responsibilities for acquiring and interpreting these studies vary across the country, as described in a recent survey of cardiology programs.¹ Depending on the institution, echocardiographic images are acquired by either sonographers or cardiology fellows. At some hospitals, an attending cardiologist issues a final report at the time of study acquisition, while at others, a cardiology fellow provides a

preliminary interpretation at the time of study acquisition, with subsequent formal interpretation by an attending cardiologist the following business day.

Prior studies examining preliminary imaging interpretations (radiography, ultrasonography, and computed tomography) by trainees in radiology have demonstrated minor discrepancy rates ranging from 1.6% to 20%, while major discrepancies typically occur at a rate of <2.5% but occasionally as high as 5% to 10%.²⁻¹⁴ There are no published data assessing the discrepancy between preliminary fellows' reports and final attending cardiologists' reports in the field of cardiology. We therefore sought to examine the agreement of preliminary fellows' interpretation of on-call echocardiograms with attending cardiologists' interpretations the next business day.

METHODS

This retrospective study consisted of analysis of inpatient echocardiographic examinations performed on weekends (Saturdays or Sundays) from November 1, 2014, to November 1, 2015, at a

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Abbreviation

EMR = Electronic medical record

quaternary, urban medical center with an annual volume of approximately 12,000 echocardiograms. This study was approved by the local institu-

tional review board.

All echocardiograms included in the study were acquired by sonographers and initially interpreted by cardiology fellows. Preliminary reports were generated by cardiology fellows at all levels of specialty training (first, second, or third year of fellowship). For each study, the attending cardiologists issued a final echocardiography report the following business day.

The study database was compiled using targeted weekend searches on the Syngo Dynamics (Siemens Healthcare, Erlangen, Germany) web portal. Preliminary echocardiography reports were identified and collected using direct patient searches in the electronic medical record (EMR). Studies were excluded if a preliminary interpretation was not performed or was not documented in the EMR. Discrepancies between preliminary and final reports were evaluated by five members of the research team (three cardiology fellows and two sonographers). The medical director of the echocardiography laboratory then reviewed all discrepancies.

The discrepancies were categorized in three ways: by discrepant finding, by type of discrepancy, and by severity. Discrepant findings included left ventricular dysfunction, right ventricular dysfunction, wall motion abnormalities, right-sided pressures (right atrial pressure on the basis of inferior vena cava size and collapsibility, pulmonary arterial systolic pressure calculated from the tricuspid regurgitation jet peak velocity), valvular disease (stenosis or regurgitation), pericardial effusion, cardiac tamponade, intracardiac thrombus, and left ventricular assist device–related abnormal findings. Types of discrepancy included overcalls (preliminary interpretation assessed a finding to be more severe than assessed on the final report), undercalls (preliminary interpretation assessed a finding to be less severe than assessed on the final report), and misses (finding noted on final report but not on preliminary interpretation). Consistent with prior literature, the severity of the discrepancies was regarded as either major or minor according to whether urgent communication was required because a diagnosis was made that had an implication for an acute change in management, as determined by the attending cardiologist and noted on the final report.^{5,10,15} Discrepancy rates by training year were compared using χ^2 tests. Statistical significance was indicated by a *P* value < .05.

RESULTS

A total of 358 echocardiographic examinations were identified from November 2014 to November 2015. Of these studies, 66 (18%) were excluded from analysis because of inability to locate a preliminary interpretation in the EMR, leaving 292 on-call echocardiograms available for analysis.

There was a total of 49 discrepancies, yielding an overall discrepancy rate of 16.8%. There were 42 minor (14.4%) and seven major (2.4%) discrepancies. Regarding discrepancy types (Figure 1), 14 were classified as misses (29% of the total number of discrepancies), 15 as overcalls (31% of the total number of discrepancies), and 20 as undercalls (40% of the total number of discrepancies). Misses constituted six of the seven major discrepancies.

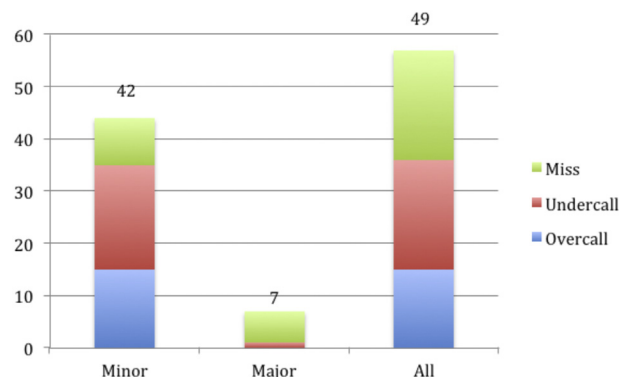


Figure 1 Discrepancies by type. Bar chart showing the breakdown of minor, major, and all discrepancies by discrepancy type (misses, overcalls, and undercalls).

Discrepancies by finding are presented in Figure 2. Left ventricular wall motion, valvular disease, and pericardial effusion severity were the most common discrepant findings. Additionally, left ventricular wall motion abnormalities or right ventricular dysfunction accounted for all of the major discrepancies.

The majority of the studies were preliminarily interpreted by first- and second-year fellows, accounting for 118 (40%) and 153 (53%) of the studies, respectively. Discrepancy rates by level of training are presented in Figure 3. First-year fellows accounted for 19 minor and two major discrepancies (43% of the total number of discrepancies), and second-year fellows accounted for 23 minor and five major discrepancies (57% of the total number of discrepancies). Third-year fellows interpreted only 21 studies (7%), none of which were discrepant. Overall discrepancy rates for first- and second-year fellows were similar ($\chi^2 = 0.689$, *P* = .708). There was no significant difference in the discrepancy rates of first- to third-year fellows ($\chi^2 = 5.31$, *P* = .257).

DISCUSSION

In this study, we investigated diagnostic discrepancies between fellows' and attending cardiologists' interpretations of on-call echocardiograms in a sonographer-acquired/fellow-read model at a major academic medical center. Independent review of on-call echocardiograms may be a valuable learning experience for cardiology fellows and facilitates rapid interpretation of echocardiograms ordered urgently in medically complex and/or unstable patients. However, formal review of these interpretations by an attending echocardiographer may not be provided until the next business day. A recent survey of chief fellows among 63 cardiology training programs across the country indicated that this model is used at approximately 28% of the institutions.¹

Our results demonstrate that minor discrepancies between preliminary and final echocardiographic interpretations were relatively common, present in 14.4% of reviewed studies. Most of the minor discrepancies were due to changes in the severity of given findings (i.e., mild vs moderate regurgitation), which may in part be the result of using different criteria for this assessment (quantitative vs qualitative). Major discrepancies were found to be rare, occurring in only 2.4% of echocardiographic interpretations. However, when analyzed in closer detail, six of the seven major discrepancies were missed findings (Table 1). We hypothesized about possible interventions that

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