Prevalence of Non-Cardiac Pathology on Clinical Transthoracic Echocardiography

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Background: Non-cardiac findings (NCFs) are seen in more than a third of cardiac computed tomographic and cardiac magnetic resonance imaging studies. The prevalence and importance of NCFs in transthoracic echocardiographic (TTE) imaging is unknown. The aim of this study was to determine the prevalence of NCFs on TTE imaging.

Methods: The subcostal images of all comprehensive adult TTE studies performed at one institution in December 2008 were retrospectively reviewed for NCFs by a radiologist with fellowship training in cardiovascular and abdominal radiology and blinded to the TTE report findings and clinical histories. Additional TTE image orientations were assessed in a subset of 300 studies. NCFs were categorized as benign (e.g., simple hepatic cyst), indeterminate (e.g., ascites), or worrisome (e.g., liver metastases). If an indeterminate or worrisome NCF was identified, the patient's electronic medical record was reviewed to determine if the NCF was previously known.

Results: Of 1,008 TTE studies (443 inpatient, 565 outpatient) in 922 patients, 77 NCFs were identified in 69 patients (7.5%). These included 20 benign (26%), 52 indeterminate (67%), and five worrisome (7%) NCFs. Intermediate and worrisome NCFs were more common in inpatient TTE studies (9% vs 3% outpatient, $P = .002$). The additional views demonstrated 2% more NCFs. Record review demonstrated that 60% of worrisome and 67% of indeterminate NCFs were previously known. No unknown NCF ultimately led to a change in patient management.

Conclusions: Clinical TTE studies demonstrate NCFs in 7.5% of all patients, with an increased prevalence on inpatient studies. Although 75% of NCFs were potentially management changing, the majority of these were previously known and very unlikely to lead to management changes. Further study is needed to validate these findings in other populations and to assess their clinical impact. (J Am Soc Echocardiogr 2012;25:553-7.)

Keywords: Transthoracic echocardiography, Noncardiac findings

Transthoracic echocardiographic (TTE) imaging is a commonly used diagnostic tool, with an estimated 25 million studies performed annually worldwide.[1] Although most TTE imaging planes provide focused views of cardiac structures, the subcostal views often include extracardiac structures, including the liver and pleural spaces. The prevalence of non-cardiac findings (NCFs) has been described for several cardiac imaging modalities including cardiac magnetic resonance imaging,[2] cardiac computed tomography (CT),[3-7] and myocardial perfusion imaging.[8] However, there are few data regarding the prevalence of NCFs on TTE imaging. Furthermore, current training guidelines of clinical competence in TTE imaging do not specifically address the identification of NCFs.[9] Accordingly, we sought to assess the prevalence and significance of NCFs on clinical TTE studies performed at our tertiary care hospital.

METHODS

This study was conducted with institutional review board approval and was compliant with the Health Insurance Portability and Accountability Act. The requirement for written informed consent was waived.

Patient Population

Our electronic TTE database was queried to identify all complete or comprehensive clinical adult TTE studies performed at our institution in December 2008. Both inpatient and outpatient TTE studies were identified. Focused TTE studies (e.g., follow-up pericardial effusion) were excluded.

Subcostal TTE Imaging

TTE studies had been performed by experienced sonographers and interpreted by level 2 or level 3 echocardiography-trained physicians

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Abbreviations
CT = Computed tomography
IVC = Inferior vena cava
MRI = Magnetic resonance imaging
NCF = Noncardiac finding
TTE = Transthoracic echocardiographic

who had successfully completed the Examination of Special Competence in Adult Echocardiography, conducted by the National Board of Echocardiography. Subcostal images typically included two-dimensional imaging in the four-chamber view without and with color flow Doppler across the interatrial septum and the mitral and tricuspid valves, inferior vena cava (IVC) inflow with quiet respiration and with the "sniff maneuver" to estimate right atrial pressure, and a long-axis view of the descending thoracic and proximal abdominal aorta. A randomly selected subset of 300 studies was chosen for review of NCFs on a wider range of TTE views, including the parasternal long-axis, apical four-chamber, and apical two-chamber views.

Image Review for NCFs

A cardiovascular and abdominal imaging fellowship–trained radiologist (F.K.) with 13 years of experience retrospectively reviewed all subcostal archived digital image clips, with a particular focus on NCFs and without prior knowledge of the patients' TTE reports or medical histories. Identified NCFs were confirmed with another experienced radiologist (M.E.C.). For each NCF, a database entry was created that included the subject's age, gender, date of TTE study, inpatient and outpatient status, indication for TTE imaging, and body mass index.

Classification of NCFs

NCFs were classified as benign, indeterminate, or worrisome on the basis of a previous study of NCFs on cardiac MRI conducted by our group.[2] Benign NCFs included those findings that would not be expected to alter patient management or require follow-up assessment. These included simple hepatic cysts, hemangioma, and cholelithiasis. Indeterminate NCFs were those that might require some form of follow-up assessment. These included pleural effusions, ascites, or cholecystitis. Worrisome NCFs included those that could potentially have a major impact on patient management. These included metastases and venous thromboses. We categorized both indeterminate and worrisome findings as potential management-altering findings.

Electronic Medical Record Review

The medical center's comprehensive electronic medical records, including discharge summaries, outpatient notes, imaging reports, and radiographic images of all patients with indeterminate and worrisome NCFs, were accessed to determine if the NCFs were included in the clinical TTE reports and if they were previously noted on imaging studies (e.g., chest x-ray, CT, MRI, abdominal ultrasound). Records up to 1 year before the TTE study were reviewed by an investigator blinded to the findings on NCF review. NCFs were then classified as previously known or as unknown. A downstream analysis of the electronic medical records was conducted for indeterminate and worrisome NCFs detected on TTE review that were not reported on previous imaging.

Statistical Analysis

Statistical analyses were performed using Stata\MP version 10.0 (StataCorp LP, College Station, TX). Continuous variables are expressed as mean ± SD and categorical variables as frequencies or percentages. Continuous variables within two patient groups were compared using independent-samples t tests, while categorical variables were compared using Fisher's exact tests, with a statistical significance level of $P \leq .05$.

RESULTS

In December 2008, 1,008 clinical comprehensive adult TTE studies (443 inpatient, 565 outpatient) were performed in 922 patients (Figure 1). Digital or archival images were available for review of all (100%) TTE studies. Left ventricular dysfunction and congestive heart failure were the most common referral indications (Table 1). There were 77 NCFs identified in 69 patients (7.5%). These included 26% ($n = 20$; Figure 2) benign, 67% ($n = 52$; Figure 3) indeterminate, and 7% ($n = 5$; Figure 4) worrisome NCFs (Table 2). The majority of benign NCFs (75% [$n = 15$]) were simple hepatic cysts. Ascites and pleural effusions constituted 52% ($n = 40$) of all NCFs and 70% ($n = 40$) of indeterminate and worrisome NCFs. Most cases of ascites (63%) were found on TTE studies performed to assess left ventricular dysfunction.

Both total NCFs (10.6% vs 5.3%, $P = .003$) and potentially management-altering NCFs (9.0% vs 3.0%, $P = .002$) were more frequent on inpatient TTE studies (Table 3). There were no differences in age, gender, or body mass index between inpatients and outpatients with NCFs (Table 4). The majority of NCFs (66% of total and 63% of indeterminate and worrisome) had been reported on other imaging modalities, such as CT ($n = 35$), MRI ($n = 5$), or abdominal ultrasound ($n = 5$) and thus were previously known (Table 5). Only 22% ($n = 17$) of identified NCFs had been included in the clinical TTE reports, including ascites ($n = 5$), pleural effusion ($n = 9$), and simple hepatic cysts ($n = 3$).

There were six patients with seven indeterminate or worrisome NCFs identified on TTE review that were not seen on prior imaging studies. Two of these had worrisome findings (IVC filling defect and IVC stenosis) but did not have any further imaging study that would be able to evaluate these findings. Two patients had pleural effusions, one of whom had a chest x-ray 1 year later that showed no effusion, while the other patient had no follow-up imaging. There were two patients with ascites, one of whom underwent abdominal ultrasound that confirmed the finding. The other patient, also noted to have cholelithiasis, did not have any follow-up imaging. None of these NCFs affected patient outcome.

A random subset of the population ($n = 300$) underwent NCF analysis of additional views, including the parasternal long-axis, apical four-chamber, and apical two-chamber views. These analyses identified additional NCFs in six patients (2.0%) in this cohort, including four pleural effusions and two hiatal hernias.

DISCUSSION

In this retrospective study of >1,000 consecutive clinical comprehensive TTE studies performed during a calendar month at a tertiary academic medical center, source image review identified NCFs in the subcostal view in 7.5% of patients, with increased prevalence of all levels of NCFs among inpatient TTE studies. The incidence of potentially management-altering NCFs was only 3.8%, of which the majority were previously known. An additional 2% (all indeterminate) NCFs were found in other views. The majority of NCFs were previously known. None of those not previously known had an