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BRIEF REPORT

Clinical Reasoning of Infectious Diseases Physicians Behind the Use or Nonuse of Transesophageal Echocardiography in *Staphylococcus aureus* Bacteremia

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In this prospective cohort with *Staphylococcus aureus* bacteremia, transesophageal echocardiography (TEE) was performed in 24% of cases. Consulting Infectious Diseases physicians most frequently cited low suspicion for endocarditis due to rapid clearance of blood cultures and the presence of a secondary focus requiring an extended treatment duration as reasons for foregoing TEE.

Keywords. echocardiography; *Staphylococcus aureus*; *Staphylococcus aureus* bacteremia; transesophageal echocardiography.

Whether transesophageal echocardiography (TEE) is necessary in all cases of *Staphylococcus aureus* bacteremia (SAB) remains controversial [1–4]. Infective endocarditis occurs in up to 28% of patients with SAB [1]. Because TEE is more sensitive than transthoracic echocardiography (TTE) for the diagnosis of endocarditis and its complications [5], national guidelines recommend the routine use of TEE in cases of SAB [6, 7]. Despite this, a number of institutions have reported use of TEE in less than 25% of cases [3, 8, 9]. The underlying reasons for this infrequent TEE use have not been established. Understanding why physicians choose to perform or forego TEE in cases of SAB would both provide additional context for research in this area and inform future national guidelines. The objective of this study was to characterize the clinical reasoning behind why Infectious Diseases (ID) physicians perform or forego TEE during the management of SAB.

METHODS

This was a prospective cohort study of adults with SAB incorporating a survey of the consulting ID physicians. Consecutive patients ≥18 years old with SAB occurring between June 1, 2013 and August 31, 2014 were included. For each patient, clinical, microbiological, and echocardiography data were collected prospectively. Twelve weeks after the completion of antibiotics, patients who survived to hospital discharge were contacted by telephone and their medical records were reviewed to determine clinical outcomes.

Denver Health Medical Center is an academic, safety net hospital. All patients with SAB are formally evaluated by the ID consultation service [8], which is staffed by 11 ID attending physicians. To determine the rationale for why a TEE was performed or omitted in each case, the ID physician was contacted within 2 weeks of the initial consultation via standard form electronic mail. In cases in which a TEE was not performed, the ID physician was asked to provide the clinical reasoning behind the decision, either by free text response or by selecting from the following list of responses provided: (1) identification of an indication for a prolonged course of therapy (eg, osteomyelitis); (2) clinical features that suggest lower risk of endocarditis (eg, rapid clearance of blood cultures); (3) contraindication to TEE; (4) patient refusal; (5) imminent death of patient; (6) valves well visualized on TTE; or (7) other. Similarly, in cases in which TEE was performed, the ID physician was asked to provide the clinical reasoning by free text or by selecting from the following list of responses provided: (1) high clinical suspicion for endocarditis (eg, left-sided emboli); (2) persistent bacteremia of unclear etiology; (3) definitively exclude endocarditis to treat for a short duration; (4) known vegetation and desire to evaluate further; (5) presence of a prosthetic valve; (6) poor visualization of valves on TTE; or (7) other.

The primary endpoints of interest were the frequency of TEE and the ID physicians' clinical reasoning behind use or omission of this test. For the evaluation of clinical outcomes, treatment failure was defined as relapsed SAB, *S aureus* isolated from a sterile site culture, or death from sequela of *S aureus* infection within 12 weeks after completion of antibiotic therapy. Patients who died during treatment for SAB were included in the analysis of TEE utilization; however, they were excluded from the analysis of treatment failure. The Colorado Multiple Institutional Review Board approved this study.

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RESULTS

One hundered eighteen consecutive cases of SAB during the prespecified study period were included in the analysis. Ninety-four cases (80%) were community-onset bacteremia, whereas the remaining 24 (20%) were hospital-onset. The most common etiologies of bacteremia were vascular catheter (n = 26, 22%), skin and soft tissue infection (n = 23, 19%), unknown source (n = 12, 10%), and injection drug use (n = 7, 6%). Of the 118 cases, a transthoracic echocardiogram was performed in 106 (90%), a TEE was performed in 28 (24%), and neither test was performed in 11 (9%). Transesophageal echocardiography demonstrated a valvular vegetation in 9 of the 28 cases (32%) where this test was performed. Methicillin-resistant *S aureus* was the infecting pathogen in 32 (27%) cases. Compared with patients in whom TEE was not performed, those who underwent TEE were older (median 62 vs 54 years, $P = .03$), and there were statistical trends toward longer durations of bacteremia (median 5 vs 3 days, $P = .06$) and a higher prevalence of indwelling intravascular prosthetic devices (14% vs 3%, $P = .06$).

The consulting ID physicians responded to the electronic mail survey question in 117 cases. Their responses are summarized in Table 1. The most frequently cited 2 reasons for foregoing TEE were low clinical suspicion for endocarditis due to rapid clearance of blood cultures (52%) and the identification of a secondary focus requiring an extended treatment duration (38%). Each of the other reasons was cited in less than 15% of cases. Multiple reasons were cited in 27 (30%) cases. In the 28 cases in which TEE was performed, the rationale for performing this test varied. The most commonly cited reasons were a suspected valvular abnormality seen on TTE (21%) and persistent bacteremia of unclear etiology (18%).

Among patients who underwent TEE, treatment durations were longer compared with those who did not undergo TEE, although this difference was not statistically significant (median, 36 days [interquartile range, 20–43] vs 27 days [interquartile range, 14–42]; $P = .21$). Only 17 total patients received short-course therapy (≤17 days), and, of these, 1 underwent TEE (online Supplement Table). Two of the patients treated with short-course therapy experienced treatment failure; both of these patients were recommended to receive longer treatment courses, which were not completed. In total, 8 (13%) patients experienced treatment failure. Four patients had *S aureus* cultured from a sterile site, 2 had relapsed SAB, 1 had *S aureus* cultured from a sterile site and relapsed SAB, and 1 died of sequelae related to *S aureus* infection. Of the 3 patients with relapsed SAB, 2 were evaluated for endocarditis with TTE and 1 with TEE; there was no evidence of endocarditis by these studies.

DISCUSSION

To our knowledge, this is the first study to explore the clinical reasoning behind why ID physicians perform or forego TEE in patients with SAB. Consistent with prior reports, use of TEE was infrequent, and it was performed in less than one quarter of cases. Infectious Diseases physicians most commonly cited a low suspicion for endocarditis due to rapid clearance of blood cultures as the reason for not pursuing TEE. Although it is well established that negative follow-up blood cultures are associated with a lower risk of endocarditis [1, 10, 11], TEE may identify subclinical endocarditis in a subset of these cases [5]. Despite this, our data suggest that when clinical and microbiological data are not indicative of endocarditis, ID physicians do not routinely feel compelled to pursue a diagnosis of subclinical endocarditis using TEE. This may be appropriate because the standard of care for SAB is a minimum of 2 weeks of therapy [7], a treatment duration that has been shown to be effective even for established right-sided endocarditis [12, 13]. This practice is also consistent with a growing body of evidence that suggests TEE may not be necessary in cases of SAB with low-risk clinical features [1, 3, 10, 11, 14]. The recent update to the national guideline for the management of endocarditis acknowledged that "further work is needed to better define

Table 1. Clinical Reasoning of Infectious Diseases Physicians in the Decision to Perform or Forego TEE[a]

TEE Not Obtained		TEE Obtained	
Clinical Reasoning	N = 89	Clinical Reasoning	N = 28
Low clinical suspicion for endocarditis due to rapid clearance of blood cultures	46 (52)	Valve abnormality on transthoracic echocardiogram	6 (21)
Identification of a secondary focus requiring an extended treatment duration	34 (38)	Persistent bacteremia of unclear etiology	5 (18)
Contraindication to TEE	10 (11)	Evidence of left-sided embolic disease	4 (14)
Valves well visualized by transthoracic echocardiogram	9 (10)	Intravascular prosthetic device	4 (14)
Imminent death	8 (9)	Primary team's request without ID physician's endorsement	4 (14)
Patient declined	4 (4)	Definitively exclude endocarditis to treat for a short duration	3 (11)
Cardiology or primary service declined	4 (4)	Other	3 (11)
Removable source of infection	3 (3)		
Positive blood culture believed to be contaminant	2 (2)		
Other	1 (1)		

Abbreviations: ID, infectious diseases; TEE, transesophageal echocardiography.

[a]Data presented as n (%).

the subgroup of patients with bloodstream infection caused by *S aureus* who need only TTE to evaluate for infective endocarditis." However, given the discordance between clinical practice and the recommendation to routinely perform TEE and the emerging evidence that TEE may not be necessary in all cases, this controversy should be more fully addressed in future guideline revisions.

Infectious Diseases physicians also commonly cited the identification of a secondary focus (eg, vertebral osteomyelitis) requiring an extended duration of therapy that would be sufficient for the treatment of endocarditis as a reason for not pursuing TEE. Although it is clear that TEE is more sensitive than TTE for the detection of complications of endocarditis [6], such complications often become clinically apparent, such as in the form of heart failure, persistent bacteremia, or electrocardiogram changes. Our data demonstrate that when an indication for extended therapy already existed, in the absence of clinical evidence for a complication of endocarditis, ID physicians believed that TEE would not change their management. It is not known whether this treatment approach has the potential to miss developing complications of endocarditis; however, in this cohort, no patients with recurrent infections had endocarditis or complications of endocarditis. In addition, using this strategy, ID physicians may miss subclinical cases of endocarditis and therefore may not accurately advise patients on the need for prophylactic antibiotic treatment when undergoing invasive procedures.

The sample size in this study was insufficient to make conclusions about the impact of TEE on clinical outcomes. The decision to prolong antibiotic therapy to 4 or 6 weeks is not without risks including the potential for antibiotic adverse events and vascular catheter-related complications. We suggest that clinicians carefully select patients for short durations of antibiotics on day 14 of treatment, after the patient has demonstrated both a rapid response to treatment and no evidence of a secondary focus of infection.

This study had important limitations. The findings are not generalizable given they represent the practice of a single group of ID physicians at an academic medical center; however, the rate of TEE use was similar to previous reports [2, 3, 9], suggesting that clinical reasoning with respect to TEE use may be similar elsewhere. The small sample size precluded our ability to evaluate whether the selective use of TEE had an impact on clinical outcomes. Despite these limitations, this study provides novel data that further inform the debate regarding the optimal use of TEE.

CONCLUSIONS

In summary, despite national guideline recommendations for routine use of TEE in cases of SAB, TEE was not performed in the majority of cases due to a low clinical suspicion for endocarditis or the identification of an indication for a course of antibiotic therapy that would be sufficient for endocarditis. Additional research is needed to determine whether clinical outcomes with a selective TEE approach are equivalent to a routine TEE approach. Given the discordance between the use of TEE in clinical practice, as observed in this study and others, and national guideline recommendations, this issue should be specifically addressed in future guideline revisions.

Supplementary Data

Supplementary material is available online at *Open Forum Infectious Diseases* online (http://OpenForumInfectiousDiseases.oxfordjournals.org/).

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