Does This Patient Have Congestive Heart Failure?

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RATIONAL CLINICAL EXAMINATION REVIEW SOURCE

This is a rational clinical examination abstract, a regular segment of *Annals'* Evidence-Based Emergency Medicine (EBEM) series. Each segment features an abstract of a rational clinical examination review from the *Journal of the American Medical Association* and a commentary by an emergency physician knowledgeable in the subject area.

The source for this rational clinical examination review is: Wang CS, Fitzgerald JM, Schulzer M, et al. Does this dyspneic patient in the emergency department have congestive heart failure? *JAMA*. 2005;294:1944-1956. The *Annals'* EBEM editors assisted in the preparation of the abstract of this rational clinical examination review, as well as selection of the Evidence-Based Medicine Teaching Points.

OBJECTIVE

This article reviews the diagnostic value of various medical history, physical examination, laboratory, and radiographic findings in adult emergency department (ED) patients with congestive heart failure.

DATA SOURCES

The authors conducted a comprehensive MEDLINE search from 1966 to July 2005 for articles relevant to diagnostic accuracy of components of the clinical examination and simple investigations in diagnosing patients with dyspnea. Once articles were retrieved, their reference lists were manually searched for pertinent studies. Additional information was abstracted from review articles and standard textbooks of physical examination.

STUDY SELECTION

Studies were selected for inclusion if they addressed the diagnostic accuracy of medical history, physical examination, or diagnostic tests readily available for patients presenting to the ED with undifferentiated dyspnea. Because there is no agreed-on standard criterion for the diagnosis of heart failure, the authors accepted a diagnosis of congestive heart failure that was made by a panel of physicians according to clinical data and on an appropriate measure of cardiac dysfunction (eg, echocardiogram, ventriculogram, or right-sided heart catheterization).

The authors excluded review articles without original data, studies that did not report any clinical examination findings, those that used reference standards without clinical correlation, population-based studies, those that enrolled patients younger than 18 years, and studies that did not specifically include patients reporting dyspnea. Study quality was determined on a 5-point scale, with the highest grades being assigned to studies that prospectively assessed the operating characteristics of the various clinical findings among a large number of patients with dyspnea. Lesser grades were assigned to studies with smaller numbers of patients (level 2), nonconsecutive or nonrandomized samples (level 3), retrospective designs (level 3), convenience sample of patients who obviously had the target condition (level 4), and those with a reference standard of unknown or uncertain validity (level 5). Studies of grades 4 and 5 were not included in the final analysis.

DATA EXTRACTION AND ANALYSIS

The authors extracted the data from published studies and constructed 2×2 tables for each variable. Where data for the same variable were available from 2 or more sources, meta-analytical techniques were applied to combine results across studies. They then presented their findings in terms of likelihood ratios (LRs), with 95% confidence intervals (CIs).

MAIN RESULTS

Results were divided into 7 sections (Table): Overall Clinical Gestalt, Historical Items, Symptoms, Physical Examination, Chest Radiographs, ECGs, and B-type Natriuretic Peptide (BNP). Also assessed was a similar set of results from a single subgroup analysis from the BNP study of patients with preexisting pulmonary disease.

Overall "clinical gestalt," defined as a pretest probability of greater than 80%, was associated with a positive LR (LR+) of 4.4 (95% CI 1.8 to 10.0) and a negative LR (LR−) of 0.45 (95% CI 0.28 to 0.73). When clinical gestalt was combined with an increased BNP (cutoff of 100 pg/mL), LRs were 3.1

Table. Operating characteristics of diagnostic indicators of congestive heart failure.

Finding	Sensitivity	Specificity	LR+ (95% CI)	LR− (95% CI)
Initial clinical judgment	0.61	0.86	4.4 (1.8–10.0)	0.45 (0.28–0.73)
History				
Heart failure	0.60	0.90	5.8 (4.1–8.0)	0.45 (0.38–0.53)
Myocardial infarction	0.40	0.87	3.1 (2.0–4.9)	0.69 (0.58–0.82)
Coronary artery disease	0.52	0.70	1.8 (1.1–2.8)	0.68 (0.48–0.96)
Symptoms				
Paroxysmal nocturnal dyspnea	0.41	0.84	2.6 (1.5–4.5)	0.70 (0.54–0.91)
Orthopnea	0.50	0.77	2.2 (1.2–3.9)	0.65 (0.45–0.92)
Edema	0.51	0.76	2.1 (0.92–5.00)	0.64 (0.39–1.10)
Dyspnea on exertion	0.84	0.34	1.3 (1.2–1.4)	0.48 (0.35–0.67)
Physical examination				
Third heart sound	0.13	0.99	11 (4.9–25.0)	0.88 (0.83–0.94)
Abdominojugular reflux	0.24	0.96	6.4 (0.81–51.0)	0.79 (0.62–1.00)
Jugular venous distension	0.39	0.92	5.1 (3.2–7.9)	0.66 (0.57–0.77)
Rales	0.60	0.78	2.8 (1.9–4.1)	0.51 (0.37–0.70)
Any murmur	0.27	0.90	2.6 (1.7–4.1)	0.81 (0.73–0.90)
Lower-extremity edema	0.50	0.78	2.3 (1.5–3.7)	0.64 (0.47–0.87)
Chest radiograph				
Pulmonary venous congestion	0.54	0.96	12.0 (6.8–21.0)	0.48 (0.28–0.83)
Interstitial edema	0.34	0.97	12.0 (5.2–27.0)	0.68 (0.54–0.85)
Alveolar edema	0.06	0.99	6.0 (2.2–16.0)	0.95 (0.93–0.97)
Cardiomegaly	0.74	0.78	3.3 (2.4–4.7)	0.33 (0.23–0.48)
Pleural effusions	0.26	0.92	3.2 (2.4–4.3)	0.81 (0.77–0.85)
ECG				
Atrial fibrillation	0.26	0.93	3.8 (1.7–8.8)	0.79 (0.65–0.96)
New T-wave changes	0.24	0.92	3.0 (1.7–5.3)	0.83 (0.74–0.92)
Any abnormal finding	0.50	0.78	2.2 (1.6–3.1)	0.64 (0.47–0.88)
Clinical judgment or BNP ≥100 pg/mL	0.94	0.70	3.1 (2.8–3.5)	0.09 (0.06–0.11)
BNP alone (pg/mL)				
≥250	0.89	0.81	4.6 (2.6–8.0)	0.14 (0.06–0.33)
≥200	0.92	0.75	3.7 (2.6–5.4)	0.11 (0.07–0.18)
≥150	0.89	0.71	3.1 (2.1–4.5)	0.15 (0.11–0.21)
≥100	0.93	0.66	2.7 (2.0–3.9)	0.11 (0.07–0.16)
≥80	0.96	0.71	3.3 (1.8–6.3)	0.06 (0.03–0.13)
≥50	0.97	0.44	1.7 (1.2–2.6)	0.06 (0.03–0.12)

LR−, LR of a negative test; *LR+*, LR of a positive test.

(95% CI 2.8 to 3.5) and 0.09 (95% CI 0.06 to 0.11) for positive and negative composite tests, respectively.

Of all signs and symptoms, presence of a third heart sound increased the likelihood of heart failure the most, with an LR+ of 11 (95% CI 4.9 to 25.0). Ancillary tests such as chest radiograph and ECG are also helpful in the diagnosis of dyspnea.

Several studies examined the operating characteristics of various cutoffs of serum BNP for diagnosis of congestive heart failure in the ED setting (Table). Review of these studies revealed that as the BNP cutoff increased, the positive LR generally increased; however, no BNP threshold indicated the presence of the disease with certainty. At any BNP threshold up to 250 pg/mL, values below the threshold always made heart failure less likely (LR− 0.06 to 0.15).

CONCLUSIONS

When a dyspneic patient is evaluated in the ED, multiple clinical indicators may be useful in making the diagnosis of congestive heart failure or excluding it. Operating independently, only a BNP less than 100 pg/mL can effectively rule out the diagnosis of heart failure. Medical history and physical examination findings alone cannot reliably rule out congestive heart failure. There are, however, multiple historical and clinical findings that make the diagnosis much more likely. Multiple negative findings may direct the clinician to consider other causes of dyspnea.

BNP could be used by clinicians attempting to diagnose congestive heart failure in the ED in concert with a comprehensive clinical examination, chest radiograph, and ECG.

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COMMENTARY: CLINICAL IMPLICATION

Congestive heart failure seems to be the exception when it comes to the war waged internationally on heart disease. Although other forms of heart disease, including coronary artery disease, are becoming less common, the rates of heart failure continue to increase. The rate of hospitalization for this disease increased 3- to 4-fold between 1971 and 1999.[1] It is the leading cause of hospitalization among people older than 65 years, accounting for about 20% of the hospital admissions in this group.[2]

Despite the existence of several useful clinical and laboratory markers, the diagnosis of congestive heart failure in ED patients with dyspnea remains a challenge. History-taking is important because symptoms of orthopnea or paroxysmal nocturnal dyspnea contribute to the diagnosis. A history of myocardial infarction or a previous episode of heart failure also adds to the clinical picture. Although it may be difficult to assess in a noisy ED, the third heart sound, if found, can make this diagnosis highly likely. Other findings such as cardiomegaly on chest radiograph and presence of jugular venous distention and crackles are valuable in making the diagnosis of congestive heart failure as well. A majority of signs and symptoms examined in this review such as pedal edema, abnormal heart murmurs, fourth heart sound, wheezing, and abnormal blood pressure had moderate to low predictive value. Knowledge of the positive and negative LRs of the various bedside findings and ancillary tests listed in the Table can help to generate a probability of heart failure in a particular patient.

The diagnosis of heart failure could be even more challenging when other comorbidities capable of causing dyspnea, such as chronic obstructive pulmonary disease, exist. When clinical gestalt indicates a moderate probability of heart failure and other possible diagnoses remain in the differential diagnosis, measurement of serum BNP level may help emergency physicians make an accurate diagnosis. To make matters more complicated, several clinical entities other than heart failure can increase BNP levels.[3] Pathologies increasing right-sided ventricular pressure, including pulmonary hypertension as a result of pulmonary embolus or chronic obstructive pulmonary disease, may increase the BNP in the absence of heart failure.[4] Renal disease may also increase BNP levels.[5] Additionally, patients can have both heart failure and pulmonary disease. Another challenge is the divergent management of heart failure from that of other causes of dyspnea.

A recent cost-effectiveness study by Mueller et al[6] demonstrated that the use of BNP, together with the clinical gestalt, can increase the likelihood of correct diagnosis of the cause of dyspnea in patients with coexisting pulmonary disease. In this study, a BNP value less than 100 pg/mL was used to exclude the diagnosis of congestive heart failure, and a BNP value of greater than 500 pg/mL was used to confirm this diagnosis. This strategy reduced average length of hospital stay and increased diagnostic accuracy, although overall mortality was unaffected.[6] Other studies suggest similar benefits.[3,7]

In a review of the literature on the utility of BNP, Schwam[8] developed LRs for interval values of BNP. He suggests that in patients with intermediate probability of having congestive heart failure, defined broadly as a 5% to 94% probability, BNP values are likely to yield an intermediate range as well, making BNP less useful than the previous studies would lead one to believe. According to this analysis, patients with low or high probabilities for heart failure require substantially contrary BNP values to change the final posttest probabilities.[8]

Although addressed indirectly through the concept of clinical gestalt, the authors were unable to identify any studies that defined the operating characteristics of a combination of any or all of the tests previously discussed.

TAKE-HOME MESSAGE

Examination of the evidence suggests that clinical gestalt obtained from medical history and physical examination is the best predictor of heart failure. Bayesian reasoning would further suggest that a clinician use LRs of various clinical findings with pretest probabilities to determine the likelihood of heart failure in any given patient. Additionally, very low BNP values in patients with low probability of heart failure and very high BNP values in patients with high probability of the disease can confirm clinical suspicions.

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EBEM TEACHING POINT

Pretest probability is defined as the probability that a patient has a particular disease before the initiation of testing. Pretest probability is important in emergency medicine because the pretest probability can be used to derive a posttest probability of disease according to test results (generally examination findings, laboratory testing, or diagnostic imaging), which is accomplished by multiplying the pretest probability by the LR of a given test to produce the posttest probability. Pretest probability can be generated in a number of ways; however, it is a combination of research evidence (if available), an estimate of the known prevalence of the disease in the community (if available), and physician judgment based on experience. According to this estimation of the disease probability, the practitioner may decide to perform further testing to reach a more definitive diagnosis or start the treatment without waiting for additional confirmation (Figure).[9]

The main pitfall in using the pretest probability concept in clinical practice is the large variation in pretest estimations of disease between clinicians, even when they are presented with

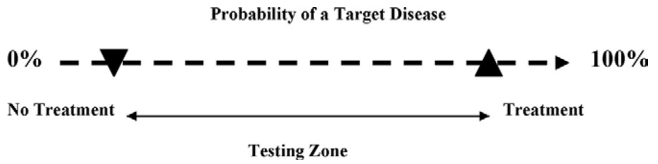

Figure. Threshold approach for diagnostic testing.

identical patient information. This inconsistency may influence decisionmaking because such variation may ultimately yield inconsistent posttest probabilities.[10] Consequently, many clinicians prefer to think of pretest probability in general terms such as "low," "moderate," or "high." Further research is needed to generate clinical decision rules for determining pretest probabilities of various disease entities that are relevant to the emergency patient.

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