Congestive Heart Failure

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KEYWORDS

• Congestive heart failure • Valsalva • Jugular venous pressure

KEY POINTS

- In patients with known or suspected heart failure, physical examination findings provide important prognostic information and can guide both diagnosis and management.
- The initial examination in a patient with shortness of breath should be approached in a "head-to-toe" manner with additional special maneuvers such as the measurement of jugular venous pressure (JVP), valsalva maneuver, and hepatojugular reflux performed as needed if there is suspicion for heart failure.
- After establishing a pretest probability based on prevalence and patient history, the examiner may then use clinical examination findings in conjunction with their positive and negative likelihood ratios to determine the posttest probability of heart failure as a diagnosis.

Video content accompanies this article at http://www.medical.theclinics.com.

INTRODUCTION

Heart disease is the leading cause of death in the United States and has been estimated to affect 26 million people worldwide with greater than 1 million hospitalizations annually in both the United States and Europe.[1] It is estimated that approximately 6 million adults over the age of 20 in the United States are currently living with heart failure.[2] This prevalence has been increasing since the 1970s, largely attributed to an aging population, therapeutic advances in the treatment of heart failure which have improved the prognosis of the disease, as well as a rise in associated conditions which include hypertension and coronary artery disease.[3]

Many modern-day physicians rely heavily on imaging and laboratory testing to guide their diagnosis and medical management of heart failure rather than on physical examination skills. This has led some clinicians to question the utility of the physical examination in today's practice, at least as it applies to congestive heart failure.[4,5] Despite this skepticism, the medical literature indicates that examination findings continue to provide important prognostic information and can guide management in patients with

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congestive heart failure independently of laboratory tests and imaging.[4,6] The physical examination can aid in determining the need for hospitalization versus outpatient management and is a cost-effective method of guiding additional testing and interpretation of test results.[7]

One example of the value of the physical examination is in the setting of patients who present with shortness of breath, a common issue prompting patients to seek medical advice. The differential diagnosis is very broad for this chief complaint and includes cardiac, pulmonary, renal, and hepatic causes, among others. Congestive heart failure is frequently a major consideration in the adult patient, and the constellation of physical examination findings present in this disorder provides information on the posttest probability of the diagnosis and can guide targeted diagnostic workup and treatment regardless of the availability of echocardiography or other laboratory testing. Though echocardiogram and brain-type natriuretic peptide (BNP) are commonly used in the evaluation of suspected heart failure, the initial physical examination and subsequent focused, serial examination aids in the initial diagnosis and further monitoring and adjustment of medications and treatment. In fact, despite medical advances, laboratory and technology-driven guidance in the treatment of heart failure can sometimes prove dubious as a randomized clinical trial showed that BNP-guided therapy did not improve time to first hospitalization or decrease cardiovascular mortality in patients with reduced ejection fraction (EF).[8]

This article will focus on the approach to the physical examination in patients with suspected or known heart failure. Of note, there are 2 types of heart failure categories based on left ventricular ejection fraction (LVEF): heart failure with reduced ejection fraction (HFrEF) which is diagnosed based on an LVEF of less than or equal to 40% and heart failure with preserved ejection fraction (HFpEF) which is characterized by an LVEF of greater than or equal to 50%.[9] Both types of heart failure present with similar symptoms and physical examination findings, but determining the type of heart failure has important implications in medical management. Further discussion of the 2 types of heart failure other than as they apply to the physical examination is outside the scope of this review.

SYMPTOMS OF HEART FAILURE

Patients with heart failure may present with a variety of symptoms. Common complaints include:

1. Dyspnea or dyspnea on exertion (DOE)
2. Peripheral edema
3. Orthopnea: This is positional dyspnea that occurs when the patient is in the supine position and is often relieved with sitting or standing.[10] Orthopnea in the setting of heart failure is usually associated with an elevated pulmonary capillary wedge pressure (PCWP) and can assist with evaluating whether left ventricular filling pressures are elevated.[6]
4. Paroxysmal nocturnal dyspnea (PND): This is a sensation of shortness of breath during sleep that can awaken a patient and often resolves once the patient is upright.
5. Bendopnea: This is a recently described symptom whereby patients have shortness of breath with bending forward. It is associated with elevated filling pressures[11] and can be elicited by having the patient bend forward and touch their feet while sitting in a chair. Bendopnea is present if shortness of breath occurs within 30 seconds of bending.[6]

Nonspecific symptoms include fatigue, nausea, cough, wheezing (cardiac asthma), anorexia, and weight gain.

Given the prevalence of heart failure in the United States, it should be always be considered in the differential diagnosis for adult patients presenting with any of the above symptoms. In this article, we will discuss the general approach to the physical examination in the patient presenting with symptoms commonly associated with heart failure, with a particular focus on special maneuvers that may be performed if there is a strong suspicion for congestive heart failure.

APPROACH TO THE PHYSICAL EXAM

As with most disease-based physical examination, the physical examination for patients presenting with known or suspected heart failure should be approached in a systematic head-to-toe manner and is summarized in **Table 1**.

General

First, the patient should be assessed for general appearance; does the patient seem stable or unstable? Vital signs should be completed as with any encounter, specifically blood pressure, heart rate, respiratory rate, and oxygen saturation. Tachycardia may be indicative of heart failure, especially if decompensated, as it is a mechanism for the heart to compensate for both reduced stroke volume and cardiac output.[12] Hypotension during hospitalization for acute heart failure has been associated with poor short-term outcomes.[13]

Neck

Examination of the neck should be performed to evaluate the JVP (*see"Special Maneuvers" below)*. Testing for hepatojugular reflux is another maneuver that can be performed and is indicative of ventricular dysfunction when present (*see "Special Maneuvers" below)*.

Pulmonary

The pulmonary examination is a vital component in the assessment of heart failure as it can provide information on both the patient's respiratory and volume status. The examiner should auscultate the lungs for crackles, which may indicate the presence

Table 1
Summary of the physical examination assessment for heart failure

System	Examination
General	Appearance Vitals
Neck	Jugular venous pressure Assessment for hepatojugular reflux (or abdominojugular test)
Pulmonary	Auscultation for: Crackles Diminished breath sounds Wheezing
Cardiac	Palpation for PMI Auscultation for cardiac murmurs and/or S3
Abdomen	Assessment for hepatomegaly and ascites
Extremities	Evaluate for edema, pulses, and coolness of extremities

of pulmonary edema as well as for diminished breath sounds which may indicate the presence of pleural effusion(s). Wheezing from heart failure may be heard during either inspiration or expiration. The term "cardiac asthma" has been used to refer to wheezing and coughing associated with heart failure and is thought to be secondary to pulmonary edema and pulmonary vascular congestion.[6,12,14]

Cardiac

Examination of the precordium includes the observation of the chest wall and palpation of the point of maximal impulse (PMI). The PMI is typically palpated at the 5th intercostal space in the mid-clavicular line, but is shifted laterally in dilated cardiomyopathy.[15] As the pads of the fingers are more sensitive than the fingertips, it is generally recommended that the finger pads be used when palpating the PMI. (See Video 1 for a demonstration on locating and assessing the cardiac PMI.)

During cardiac auscultation, attention should be paid to any cardiac murmurs, which can indicate valvular pathology as the potential etiology of heart failure as well as, vice versa, the functional result of dilatation of the heart from various cardiomyopathies. An "extra" heart sound (S3 or S4) can provide additional information. An S3 heart sound may be heard in patients with ventricular dysfunction and elevated left-sided ventricular filling pressures.[16] The S3 heart sound is very specific but has low sensitivity in systolic heart failure[12] (**Table 2**). Of note, an S3 heart sound is less frequently heard in patients prescribed beta-blocker medications.[15,17] An S4 heart sound may be heard in patients with heart failure and left ventricular hypertrophy.[12]

Abdomen

The abdominal examination includes the assessment of liver size, as hepatomegaly may occur due to congestion in the hepatic veins from right-sided heart failure.[12] If the patient reports increased abdominal girth or if bulging flanks are noted on examination, the examiner should consider performing maneuvers to assess for the presence of ascites due to right heart failure. These maneuvers include palpating for a

Table 2
Sensitivity, specificity, and likelihood ratios for physical examination findings in detecting left ventricular dysfunction - HFrEF

			Likelihood Ratio	
Finding	Sensitivity (%)	Specificity (%)	Finding Present	Finding Absent
Abnormal Valsalva Response[30]	69–88	90–91	7.6	0.3
Crackles[25]	29	77	1.3	0.9
Elevated JVP[25]	24	99	27.0	0.8
Positive HJR[25]	33	94	6.0	0.7
S3 gallop[30]	11–51	85–98	3.4	0.7
S4 gallop[30]	31–67	55–68	Not significant	Not significant
Displaced Cardiac Apex[25]	66	95	16.0	0.4
Murmur of Mitral Regurgitation[30]	25	89	Not significant	Not significant
Hepatomegaly[30]	3	97	Not significant	Not significant
Dependent Edema[30]	20	86	1.4	0.9

*modified from Steve McGee's Evidence-Based Physical Diagnosis[30] and AAFP Diagnosis of Heart Failure in Adults[25].

fluid wave, percussion for flank dullness, and for shifting dullness. Though ascites is not commonly caused by heart failure (approximately 5% of cases),[18] it can occur due to liver congestion with resulting portal hypertension.[19]

Extremities

The extremities should be examined for pitting edema, which is a common sign of heart failure and fluid overload (as opposed to nonpitting edema which is often due to lymphedema). Pitting edema is an indicator of increased extracellular volume, but may also be found in other conditions aside from heart failure, such as renal and hepatic disease as well as chronic venous stasis and is therefore a helpful but nonspecific physical finding in heart failure. Diminished peripheral pulses and cool extremities are both signs of decreased circulation and may indicate severe decompensated heart failure and cardiogenic shock.

Special Maneuvers

If congestive heart failure is suspected based on the patient history and the above described general physical examination, the following maneuvers may be performed to further guide diagnosis and/or treatment. These maneuvers are also summarized in **Table 3**.

Jugular Venous Pressure

JVP is an approximation of right atrial pressure[20] and an indirect measurement of central venous pressure which can be estimated on physical examination by the inspection of the internal jugular vein in the neck. A normal JVP is 6 to 8 cm H2O above the right atrium.[21] Elevated JVP ($\geq$10 cm H2O) is the most useful finding for assessing ventricular filling pressures.[22,23] When present, it is indicative of volume overload and may guide further medical management, such as the adjustment of the dose and frequency of diuretic medications.

Measurement of JVP is performed with the examiner standing to the patient's right and assessing the right internal jugular venous pulse. The JVP will have a biphasic waveform in which a double pulsation is seen for each cardiac cycle, as opposed to the carotid artery which has a single pulsation per cardiac cycle. If there is difficulty visualizing the internal jugular waveform, assessment of the external jugular vein may also be used as an estimate of JVP.[6] However, the internal jugular is generally preferable as it is in direct connection with the superior vena cava and the right atrium. The examination may also be performed on the patient's left neck if the right is difficult to visualize (due to jugular vein thrombosis or the presence of a central venous catheter); however, the right internal jugular is preferred given its more direct line to the superior vena cava and thus the right atrium.[21]

When measuring JVP, the patient should be reclined at approximately 45° of elevation in the hospital bed or on the clinic room examination table with the neck slightly extended, head turned away from the examiner and chin tilted slightly upward. Using tangential lighting with a penlight or other bright light source pointed across the neck from anterior to posterior in direction, the examiner should visualize the double waveform pulsation of the JVP that reflects the pressure changes of the right atrium. Another useful method is to shine the light tangentially across the skin from anterior to posterior in a room with dim lighting to cast a shadow on the bedsheet; this may facilitate the visualization of vein motion.[24] The head of bed should be lowered until the top of the waveform of the internal jugular pulsation ("venous meniscus") is seen about halfway up the neck (this should be with the head of bed between a 0° and

Table 3
Summary of special physical examination maneuvers for heart failure

	Normal Result	Positive Finding
Jugular Venous Pressure (JVP)	6–8 cm H2O above the right atrium	≥ 10 cm H2O above the right atrium
Hepatojugular Reflux (HJR)	JVP elevation of 1–3 cm	Sustained (>10–15 s) increase of JVP > 4 cm
Valsalva Maneuver	Korotkoff sounds in phases I & IV	Korotkoff sounds in phase I ± phase II

90° angle from the horizontal axis). The venous meniscus is used to measure and calculate the JVP.

To measure the JVP, the top of the waveform of the internal jugular venous pulsation is used. A horizontal line (parallel to the floor) is then envisioned from this point and also a separate horizontal line is envisioned from the level of the sternal angle. The vertical distance between these 2 points is then measured in centimeters and added to the distance between the sternal angle and right atrium (which is estimated to be 5 cm) to determine the JVP (**Fig. 1**).

Elevated JVP has a high specificity (90%) but low sensitivity (30%) in determining elevated left ventricular filling.[12] Though locating and estimating the JVP is one of the most challenging aspects of the entire physical examination, if it is elevated, it has a high positive likelihood ratio (LR) of 27 in the detection of left ventricular dysfunction and thus is a very useful finding for diagnosing heart failure.[25]

A common pitfall in evaluating the JVP is to mistake the carotid artery for the internal jugular vein. While the carotid upstroke only has a single pulsation as compared with 2 for the JVP, another method to differentiate them is to apply pressure 1 to 2 inches below the impulse. If the pulsation remains visible then it is the carotid artery, but if it disappears with pressure below the impulse then it is the jugular vein. Another technique is to apply pressure to the right upper quadrant of the abdomen. In most patients, the JVP will rise initially with this increased abdominal pressure, while the carotid pulsation will remain the same without changing in location.[6] (See Video 2 for a demonstration of locating the internal jugular vein.)

If heart failure is present, the examination for JVP may need to take place with the patient in the fully upright position as the JVP may be so elevated that it is not visible at 45° elevation. Similarly, if heart failure is not present or if the patient's heart failure is well controlled, the head of the bed may need to be lowered below 45° to visualize the JVP. A common mistake for the novice examiner to make is to fail to adjust the examination table or bed control elevation to best accentuate the JVP.

Hepatojugular Reflux and Abdominojugular Test

Checking for hepatojugular reflux is another adjunctive physical examination maneuver in assessing the JVP for physical examination evidence of congestive heart failure.[26] This test is done with the patient in the supine position with the head of bed raised to a 30° to 45° angle. After visualizing the JVP, mild to moderate pressure (20–35 mm Hg) is applied to the right upper quadrant or the middle of the abdomen for 30 to 60 seconds,[12,27] which increases venous return to the heart. In the presence of heart failure, the right ventricle is unable to adjust to the increased blood volume, which is reflected in an increase in JVP.[26]

A positive HJR is considered to be an increase in the JVP 4 cm or greater and sustained for at least 10 to 15 seconds when abdominal pressure is applied and a subsequent decrease in JVP after pressure is released.[6,26,28] HJR is indicative of ventricular dysfunction, which may be right, left or both ventricles in origin. In the absence of right ventricular or mitral valve pathology, a positive HJR is suggestive of elevated left ventricular pressure and predicts a PCWP of greater than 15 mm Hg.[26]

The abdominojugular test involves exerting pressure in the epigastrium with the same intensity and length of time and is believed to cause similar pathophysiologic changes in the patient with heart failure (*see Video 3 for demonstration)*. Either HJR or the abdominojugular test can be performed but it is not necessary to use both techniques.

Valsalva Maneuver

The Valsalva maneuver is useful for assessing for elevated left-sided filling pressures and is a predictor of elevated PCWP.[6] Though it is rarely used in clinical practice (likely due to a lack of physician familiarity with the technique), it has reasonable specificity of 91% and sensitivity of 69% for the presence of heart failure.[12]

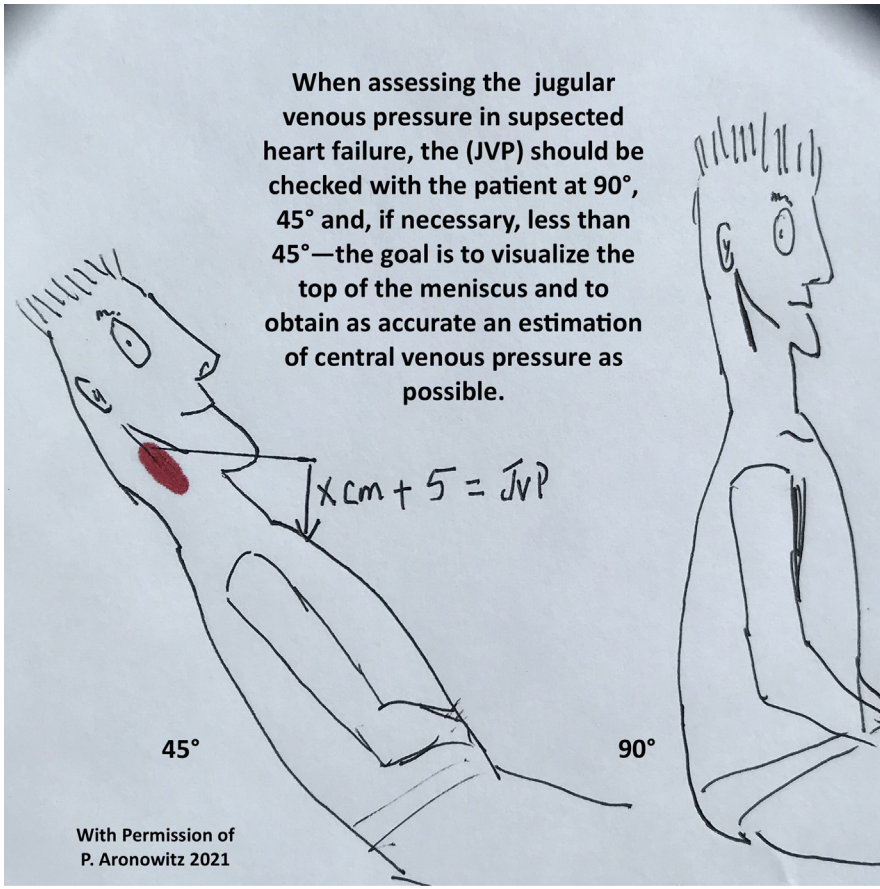

Fig. 1. When assessing the jugular venous pressure in supsected heart failure, the (JVP) should be checked with the patient at 90, 45° and, if necessary, less than 45°

Table 4
Phases of the Valsalva maneuver

	Korotkoff Sounds	
Phase	Normal	Congestive Heart Failure
I (Onset of strain)	Present	Present
II (Maintenance of strain)	Absent	Present OR Absent
III (Release of strain)	Absent	Absent
IV (After release of strain)	Present	Absent

To perform the Valsalva maneuver in assessing for the presence of heart failure the patient's baseline blood pressure is first measured. Next, the blood pressure cuff is inflated to 15 mm Hg above the systolic blood pressure. While auscultating over the brachial artery, the patient is asked to bear down (forced expiration against a closed glottis).[29]

There are 4 phases with the Valsalva maneuver which correspond to the following findings in **Table 4**.

In *phase I*, the onset of strain, there is a transient increase in systolic blood pressure due to the emptying of blood from the pulmonary veins and Korotkoff sounds are heard in both the healthy patient and patient with heart failure.[12]

In *phase II*, the maintenance of strain, an increase in intrathoracic pressure leads to a decrease in venous return and cardiac preload. In the healthy patient, the blood pressure decreases during this phase back to baseline and Korotkoff sounds are no longer heard.[12] However, in patients with heart failure, there may not be a decrease in blood pressure during this phase because the left ventricle remains filled due to elevated left ventricular pressures before straining.[6] Therefore, Korotkoff sounds may be present or absent in phase II for patients with heart failure.

In *phase III*, the release of strain, healthy individuals respond with an overshoot of blood pressure above baseline (*phase IV*) due to the return of normal venous blood flow to the heart and Korotkoff sounds are heard again.[12,29] In the healthy patient, Korotkoff sounds are heard in both phase I and IV.[30] In the patient with heart failure, Korotkoff sounds are not heard in phase IV due to the inability of the heart to respond with an increase in the cardiac output.

To summarize, in patients with congestive heart failure, there are 2 potentially abnormal Valsalva responses[30]:

1. *Korotkoff sounds are only present in phase I.* Korotkoff sounds do not reappear in phase IV because the heart is unable to increase cardiac output to respond to the blood pressure decrease in phase II.[30]
2. *Korotkoff sounds are present in phases I and II.* Korotkoff sounds remain in phase II but are not present in phases III and IV. This is hypothesized to occur due to increased volume maintaining blood supply to the right and left heart.[30]

It is important to note that the use of beta-blocking medications may result in a false-positive result by preventing the phase IV overshoot of blood pressure.[30]

DISCUSSION

As previously mentioned, the physical examination is helpful to the examiner in determining the diagnosis of heart failure and for subsequently monitoring treatment effects.

To maximize the utility of the physical examination, it is important to recognize the relevance of each clinical finding when considering the diagnosis of heart failure. **Table 2** provides information on the sensitivity, specificity, and LR of the physical examination findings discussed in this article. Having knowledge of these values allows for a better understanding of the posttest probability of heart failure as a diagnosis based on a combination of known prevalence of heart failure in the population being assessed, examination findings and their positive and negative LR and the pretest probability of heart failure based on the clinical history obtained.

As noted in **Table 2**, of the numerous examination findings that may be present in heart failure, the Valsalva maneuver has one of the better combinations of sensitivity, specificity, and positive and negative LR, but is rarely checked.[12] Given these values, it may be judicious to use this examination maneuver when there is the question of the diagnosis of heart failure. A displaced cardiac apex on examination is also useful in the diagnosis of congestive heart failure with a high positive LR when the finding is present and is the most accurate predictor of reduced EF.[31]

In addition to guiding diagnosis and treatment, the physical examination can also provide important prognostic information. For example, an elevated JVP has been found to be associated with an increased risk of hospitalization for heart failure, progression of heart failure, and death from all causes.[17] A study examining over 2000 patients admitted for acute heart failure found an association between elevated JVP and an increase in short- and long-term mortality.[23] Similarly, the presence of a third heart sound (S3 gallop) with or without an elevated jugular venous pressure has been found to be associated with progression of heart failure as well as an increased risk of death from all causes.[17] The presence of HJR is also clinically significant in hospitalized patients as it is an important prognostic indicator for postdischarge outcomes. Patients with persistent HJR on discharge were noted to have a higher 6-month mortality based on the data from the ESCAPE trial.[26]

Understanding the prognostic implications of the physical examination findings found in patients with heart failure can identify patients who may need more cautious and frequent follow-up after hospital discharge.

CLINICS CARE POINTS

- Bendopnea is a symptom recently described in heart failure in which patients have shortness of breath while bending forward.[11]
- To assess for jugular venous pressure in heart failure, the clinician should examine the patient in the upright position to exclude a markedly elevated JVP which may be missed if the patient is not adequately elevated.
- When examining JVP, a common pitfall is to mistake the carotid artery for the internal jugular vein. There are several methods to distinguish between the 2[6]. The carotid pulsation has a single pulsation, does not disappear with proximal compression, and does not increase in height when checking for the presence of hepatojugular reflux.
- Elevated JVP has been found to be associated with increased short- and long-term mortality in patients hospitalized for acute heart failure.[23]
- The Valsalva maneuver has one of the best combinations of sensitivity, specificity, and LR for diagnosing heart failure but is an underused examination maneuver.
- Recent eye surgery and acute coronary ischemia are contraindications to the Valsalva maneuver as it increases intraocular pressure and there have also been reported arrhythmias with the maneuver.[27,30]

- When the Valsalva maneuver is performed on a healthy patient, Korotkoff sounds are heard in phase I (onset of strain) and phase IV (after the release of strain).
- When the Valsalva maneuver is performed on a patient with congestive heart failure, there are 2 potential abnormal responses[30]:
  1. Korotkoff sounds in phase I only (onset of strain)
  2. Korotkoff sounds in phase I (onset of strain) and II (maintenance of strain) only
- Use of a beta-blocker may result in a false-positive result with the Valsalva maneuver by preventing the phase IV overshoot of blood pressure.[30] Use of beta-blockers may also result in a false negative S3 heart sound.
- The presence of hepatojugular reflux on discharge in patients hospitalized for heart failure is associated with an increase in 6-month mortality[26]

SUMMARY

The clinical examination continues to be very important in the assessment and management of congestive heart failure and provides useful and cost-effective information which can then be used to guide more extensive as well as expensive diagnostic imaging and laboratory testing. Patients with heart failure may present with a variety of symptoms. Classic symptoms include dyspnea, PND, orthopnea, edema, and weight gain, but symptoms may also be nonspecific such as fatigue and anorexia. The physical examination can help guide the need for further workup, particularly when there is a general understanding of the positive and negative likelihood ratios for various physical findings and examination maneuvers.

It is recommended that the initial examination in the patient with shortness of breath be approached in a head-to-toe manner and special maneuvers such as the measurement of the JVP, Valsalva maneuver, and hepatojugular reflux done as needed when there is suspicion for heart failure. These physical examination findings not only assist with diagnosis and treatment but also have prognostic implications for hospitalized patients.

Despite physician inclination to frequently jump directly to costly diagnostic testing for the diagnosis and evaluation of heart failure, this article has demonstrated the continued utility of a disease-based physical examination for heart failure.

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DISCLOSURE

The authors have nothing to disclose.

SUPPLEMENTARY DATA

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