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Am J Crit Care. 2006;15: 614-616

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BRAIN NATRIURETIC PEPTIDE, CLINICAL REASONING, AND CONGESTIVE HEART FAILURE

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Dyspnea is a sensation of the need to breathe or difficult or labored breathing. It leads to 2.5 million visits to healthcare providers annually in the United States.¹ A number of abnormalities can cause dyspnea, and determining the etiology will allow institution of timely therapy and avoidance of unnecessary diagnostic tests.

Brain natriuretic peptide (BNP) is a neurohormone secreted by the left ventricle in response to pressure and volume overload. It produces natriuresis, a decrease in systemic vascular resistance, and a reduction in cardiac filling pressure. After publication of the results of the Breathing Not Properly Multinational Study,² BNP levels have increasingly been used to evaluate patients who have dyspnea; many physicians associate elevated BNP levels with congestive heart failure (CHF).³

We present a case study of an elderly woman with a known history of CHF who came to the emergency department because of dyspnea. She had markedly elevated BNP levels, and the working diagnosis was exacerbation of CHF until further investigation revealed a pulmonary embolism. This case highlights the importance of excluding other causes before attributing signs and symptoms and elevated BNP levels to CHF.

Case Report

An 86-year-old woman came to the emergency department because she had shortness of breath, chest tightness, and rapid heart rate. Physical examination revealed blood pressure 134/76 mm Hg, heart rate 73/min, and respirations 33/min. She had jugular venous distention; a chest auscultation revealed bilateral wheezing. The patient's oxygen saturation on room

air was 76%. Her medical history included CHF, paroxysmal atrial fibrillation, hypertension, diabetes mellitus, and chronic renal failure.

The patient's risk for pulmonary embolism was low according to modified Wells criteria. Blood was obtained for laboratory evaluation, and electrocardiography (ECG) revealed an s1q3 pattern (see Figure). Plain radiographs showed evidence of cardiomegaly and mild pulmonary congestion. Laboratory results included a markedly elevated level of BNP of 1200 pg/mL, elevated levels of serum urea nitrogen and creatinine, and normal levels of cardiac enzymes. Values on arterial blood gas analysis were pH 7.44, PCO₂ 39 mm Hg, PO₂ 45 mm Hg, and alveolar-arterial difference in partial pressure of oxygen 56 mm Hg. The working diagnosis was CHF and the patient was given 80 mg of intravenous furosemide. However, her condition did not improve; she required more than 16 L/min of oxygen to maintain oxygen saturation at 90%.

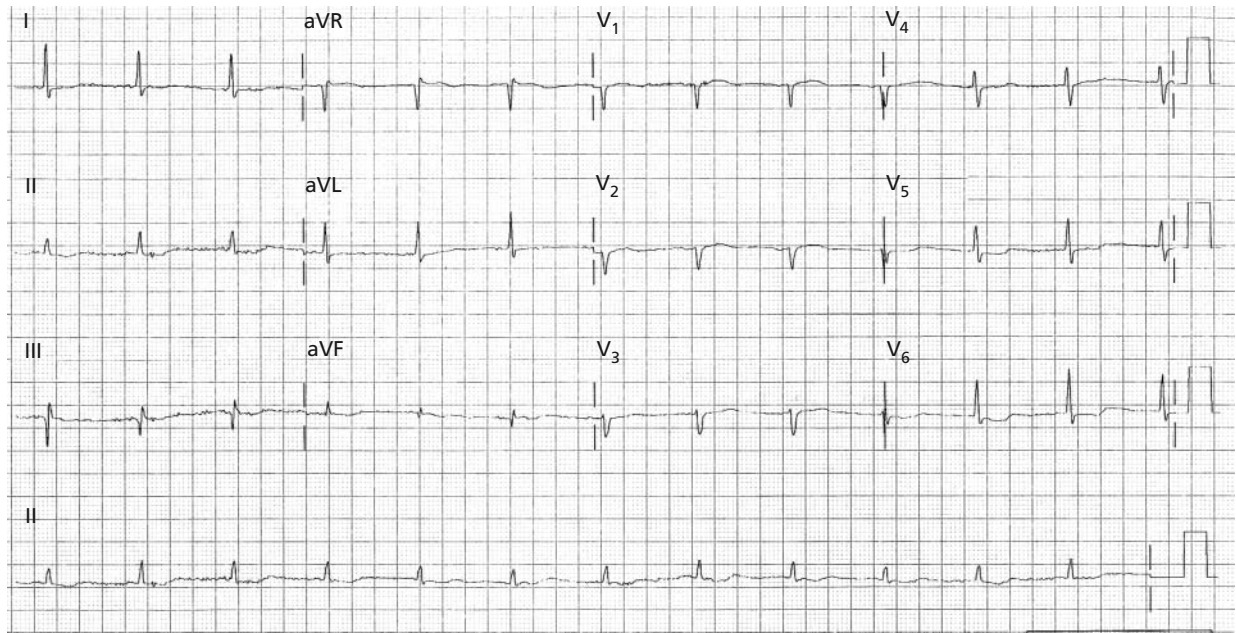
The patient's condition was reevaluated. A closer examination of the ECGs raised the possibility of pulmonary embolism. Modified Wells criteria for pulmonary embolism increased to intermediate probability because the patient was not responding to treatment. Administration of intravenous unfractionated heparin was started, and a ventilation-perfusion scan was performed. The scan showed 2 large segmental defects with ventilation-perfusion mismatch. A 2-dimensional echocardiogram revealed enlargement of the right ventricle and left ventricular hypertrophy. The patient's left ventricular function and ejection fractions were normal. Her condition steadily improved with anticoagulation. Warfarin therapy was started, and she was discharged to home.

Discussion

This case is an example of "shortcuts in reasoning."³ In this case, the shortcut led to undue emphasis on the markedly elevated BNP levels and history of

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Electrocardiogram shows an s1q3 pattern.

CHF in an elderly patient. Other possible causes were ignored, and CHF was diagnosed as the cause of the patient's dyspnea.

Studies in emergency departments indicate that as BNP levels increase, the likelihood of CHF generally increases, especially at BNP levels greater than 1000 pg/mL.⁴ Of note, however, is the fact that no BNP level is absolutely predictive of CHF.¹ Sepsis and pulmonary embolism should always be excluded when BNP levels are greater than 1000 pg/mL.⁴ This step may be difficult in patients with chronic symptomatic heart failure in whom dyspnea develops because of a pulmonary embolism. In this situation, a high BNP value can be misleading.⁵

The negative predictive value of BNP levels less than 100 pg/mL is 98%, and at these levels CHF can be ruled out.^{2,4} According to the European task force, because of the high negative predictive value, assays of BNP levels are best used as a "rule out" test. Levels greater than 400 pg/mL are moderately predictive of CHF, and levels greater than 1000 pg/mL are substantially predictive of CHF.⁴ With BNP levels between 400 and 1000 pg/mL, a variety of conditions, including CHF, asymptomatic left ventricular dysfunction, chronic pulmonary hypertension, unstable myocardial infarction, atrial fibrillation, pulmonary embolism, left ventricular hypertrophy, lung cancer, and even old age must be considered. Interestingly, 40% of participants in the Breathing Not Properly study had BNP values in this

range at least 40% of the time.² BNP levels are also higher in patients with renal failure independent of the presence or absence of CHF. In such patients, a BNP level less than 200 pg/mL should be used to exclude CHF if the estimated glomerular filtration rate is less than 60 mL/min.⁶

A known history of CHF, presence of abdomino-jugular reflux, and presence of a third heart sound are strongly predictive of CHF; conversely, the absence of pulmonary rales, pedal edema, and elevated jugular venous pressure have a strong negative predictive value. Evidence of pulmonary edema is reportedly the most useful radiological finding in CHF. Other useful findings include cardiomegaly and pleural effusion.¹

The most useful ECG finding for predicting CHF is the presence of atrial fibrillation. A pattern on ECGs that was noted but ignored in our patient is the s1q3 pattern. Although this pattern remains controversial, some investigators⁷ believe it indicates pulmonary embolism. Echocardiography is considered the gold standard for the diagnosis of left ventricular dysfunction, but the procedure is not always readily available.² According to estimates,⁸ in 20% to 50% of patients with diastolic heart failure, echocardiograms show normal left ventricular systolic function.

The diagnosis of congestive heart failure is best based on a combination of clinical features, thorough physical examination, radiological and laboratory data, and exclusion of other conditions.¹ Although BNP values

are an important part of this evaluation, they should be interpreted within the context of the entire clinical findings. Shortcuts in reasoning during evaluation of patients with dyspnea can have undesirable consequences.

Summary

BNP levels may be elevated in conditions other than CHF. At levels less than 100 pg/mL, CHF is unlikely. At levels greater than 100 pg/mL, a diagnosis of CHF should be made only after other conditions such as pulmonary embolism, asymptomatic left ventricular dysfunction, chronic pulmonary hypertension, unstable myocardial infarction, atrial fibrillation, left ventricular hypertrophy, lung cancer, and advanced age have been excluded.

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