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Understanding the shades of gray – BMI and BNP in Congestive Heart Failure

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Case presentation

A 49-year-old man with hypertension and hypothyroidism presented with a three-week history of dyspnea, chest discomfort, and lower extremity edema. He endorsed medication non-compliance. He was normotensive, heart rate of 64, afebrile, respiratory rate of 16, and oxygen saturation of 95% on 2L/min by nasal cannula. His body-mass index (BMI) was 37 kg/m^2. Lungs were clear to auscultation, heart sounds were distant, and jugular vein was distended. Troponin was 0.21ng/mL (normal <0.04ng/mL). B-type Natriuretic Peptide (BNP) was 14 pg/mL (normal <100 pg/mL). Electrocardiogram showed borderline low voltage. Chest radiograph showed cardiomegaly and pulmonary vascular congestion. He was started on diuretics and his condition worsened.

Discussion

BNP is a hormone secreted by cardiac myocytes, a process augmented in heart failure. BNP plays an important part in the evaluation of suspected heart failure and provides useful prognostic information [1-3]. Multiple variables modify BNP levels, which can complicate interpretation. BNP levels tends to be higher in patients who are female, older, have renal disease, or atrial fibrillation [4,5]. Patients with high BMI, with or without heart failure, have lower BNP levels [6]. The precise biological relationship between BMI and BNP remains elusive [5].

BNP in obese patients is thought to be less helpful given diminished sensitivity and higher false negative rates [4]. That assertion may be justified when using the test in a dichotomous manner with the conventional cutpoint of 100 pg/mL. However, dichotomizing continuous tests into “normal” and “abnormal” can lead to a waste of diagnostic information. Multi-level likelihood ratios (LR) provide valuable diagnostic information for varying degrees of test abnormalities [7]. The secondary analysis of the multinational Breathing Not Properly study demonstrated no statistical difference in the area under the receiver operating characteristic curves when the BNP is stratified by patient BMI (under 25, 25 to 35, and over 35 kg/m2) [8]. While the diagnostic utility of BNP is similar in all BMI levels, the BNP cutpoints shift downwards as BMI increases (Table).

This patient had a BMI of 37 kg/m^2, and a BNP of 14 pg/mL. The LR for BNP results under 50 pg/mL in patients with BMI over 35 kg/m^2 is 0.1 (Table). If the pretest probability of heart failure in this patient is presumed to be 80% based on his presentation, the low BNP result modifies the posttest probability to under 30%. The drastic reduction in disease probability should prompt an expedited search for alternative etiologies.

Conclusion

An echocardiogram demonstrated a large pericardial effusion with evidence of tamponade. Pulsus paradoxus was elevated to 30 mmHg, confirming clinical cardiac tamponade. An emergent pericardiocentesis was performed. Cultures and cytology results were negative. The thyroid-stimulating hormone was elevated to 34 mIU/L, which was thought to be the etiology of the pericardial effusion.

Table: Multi-level likelihood ratios for BNP, stratified by BMI

	BMI, kg/m^2		
BNP, pg/mL	< 25	25 - 35	>35
< 50	0.02	0.06	0.1
50 – 99	0.4	0.4	1
100 – 199	0.4	1	2
200 – 399	2	3	5
≥400	6	8	8

BNP = B-type natriuretic peptide; BMI = body-mass index.

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