Is Measurement of Cardiac Output Using Impedance Cardiography Accurate?

To the Editor:

I believe the article by Pianosi (February 1997) concerning the measurement of cardiac output using impedance cardiography (ICG) illustrates a potentially serious defect in the evaluation of measurement techniques, related to results calculated using a formula with parameters not directly determined by the proposed measurement. Specifically, the formula for calculation of cardiac output, \( Q \) (stroke volume \( \times \) heart rate) contains variables for the resistivity of blood, \( r \); the distance between electrodes, \( L \) (which is an indirect measurement of height); ventricular ejection time, \( \text{VET} \); heart rate; and the measured parameter \( \frac{dZ}{dt}/Z_0 \). The authors compare \( Q \) determined from this formula to \( Q \) determined from \( \text{CO}_2 \) rebreathing and from oxygen consumption. I suspect that in this experiment, \( \text{VET} \) and heart rate contribute much more significantly to the described correlation between differently determined \( Q \)s than does \( \frac{dZ}{dt}/Z_0 \), the presumed basis for the measurement. Without presentation of the behavior of the impedance data related to the alternatively measured cardiac output, it is not possible to establish the contribution of the impedance measurement itself to the final result, and thus it is not possible to conclude that the ICG is any better for measuring changes in \( Q \) than, for example, a value of \( Q \) calculated on the basis of \( \text{VET} \) and heart rate alone.

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REFERENCE

1 Pianosi PT. Impedance cardiography accurately measures cardiac output during exercise in children with cystic fibrosis. Chest 1997; 111:333-37

To the Editor:

According to the protocol previously described, \( \text{VET} \) heart rate was measured by the impedance device and used to compute cardiac output by both impedance and rebreathing. Hence, one could think of our results as simply comparing stroke volume measurements by each method, multiplied by the same constant. As such, the correlations observed would not be due to heart rate.

I will address the question of the relationship of cardiac output to ventricular ejection time (\( \text{VET} \)) by saying I demonstrated that stroke volume increased with increasing exercise intensity, while \( \text{VET} \) decreased as heart rate increased. There is no direct correlation between the two, and thus one cannot postulate that \( \text{VET} \) contributes to the increasing cardiac output seen with increasing oxygen uptake. If one looks at Figure 1 in my paper (February 1997), there was a 56% reduction in \( \frac{dZ}{dt} \) from the first and second to the third heartbeat, accompanied by a 60% reduction in stroke volume; there was only a 28% difference in \( \text{VET} \). This figure was placed to show the quality-control features of the device. Although the third beat was tainted by movement artifact, Figure 1 nonetheless illustrates the relationship between stroke volume and \( \frac{dZ}{dt} \). I did not directly correlate \( \frac{dZ}{dt} \) (or changes thereof) with stroke volume, but there was a definite observable trend toward greater \( \frac{dZ}{dt} \) values with increasing stroke volume within individuals.

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REFERENCE

1 Pianosi PT. Impedance cardiography accurately measures cardiac output during exercise in children with cystic fibrosis. Chest 1997; 111:333-37

Air, By Any Other Name . . .

To the Editor:

I found the “Roentgenogram of the Month” (February 1997) showing a chordoma of the thoracic spine very interesting. Just as interesting was the statement that arterial blood gas tensions were measured while the patient breathed “room air.” The term “room air” has always confused me, since it implies that air outside the “room” is somehow different in composition! I believe that the adjective “room” is usually superfluous and that we simply should describe the usual gas mixture which we all breathe as “air.”

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REFERENCE


An Alternative to the Football Helmet

To the Editor:

Esophageal variceal hemorrhage is an all too common and difficult condition to manage in critical care practice. One treatment for this disorder, balloon tamponade with a Seng-staken-Blakemore (SB) tube, may have utility as a temporizing measure to stabilize patients pending a more definitive procedure to lower portal pressures (eg, transjugular intrahepatic portosystemic shunt, or TIPS). Unfortunately, since balloon tamponade itself is of minimal long-term benefit and is associated with considerable risk of aspiration and esophageal rupture, many centers have no recent experience in its use. Therefore, needed adjunctive equipment (eg, a football helmet with a face guard) to anchor the SB tube in place is often unavailable when urgently needed.

One improvisational anchoring tool we have used in this circumstance is the Ultra-Fit anesthesia face mask (Model #43410—600 Ultra-Fit; Baxter Healthcare Corp; Round Lake Beach, Ill), which is readily available and commonly used with Ambu-bags (Ambu Inc; Lithicum, Md) or breathing circuits. Our technique is simple. After SB tube placement, the face mask is positioned with the SB tube through the central orifice. The gastric balloon is then inflated, and the tube is pulled tight and then anchored with surgical tape to the mask. The mask itself is then taped or strapped in place on the patient. This device has a number of attributes which make it useful for this purpose: 1) it is readily available in emergency departments and ICUs; 2) it is made of transparent material to allow clear visualization of the patient; 3) it does not preclude use of an endotracheal tube for airway protection; 4) it has soft cushioning at contact points to limit tissue damage; and 5) it is easily removed when necessary.