

Title: COMPARISON OF CARDIAC OUTPUTS DETERMINED BY IMPEDANCE CARDIOGRAPHY AND THERMODILUTION IN CARDIAC TRANSPLANT PATIENTS

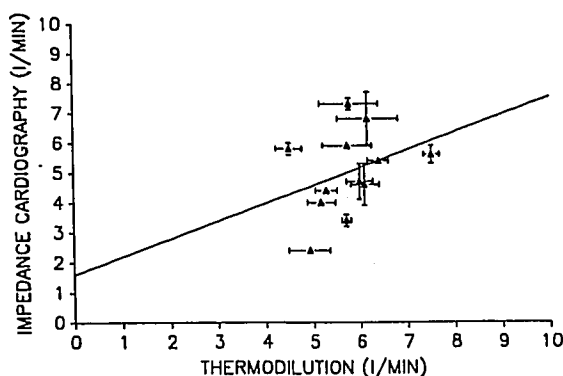
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**Introduction.** Impedance cardiography is a non-invasive means of measuring cardiac output, which has undergone several comparative studies with thermo- or dye dilution in the past with variable results (1,2). This study was performed to compare cardiac outputs obtained from a commercially available impedance cardiograph (Bomed-NCCOM3) with those obtained using thermodilution in cardiac transplant patients.

**Methods.** This protocol was reviewed and approved from the Investigational Review Board was not required. Twelve patients requiring thermodilution pulmonary artery catheters for endomyocardial biopsies were entered into the study. Eight silver/silver chloride ECG pads were placed according to manufacturer's recommendations. Impedance values were obtained using the averages of all signals over a ten second period. Recordings were made of the values immediately preceding, during and immediately after thermodilution cardiac output measurements. Pulmonary capillary wedge pressure was also recorded. Three determinations were made with thermodilution as well as with each impedance period. Regression analysis was performed on the cardiac outputs of all three time periods in comparison with thermodilution and with pulmonary capillary wedge pressures in comparison with thoracic fluid index. Paired t tests were performed to evaluate inpatient differences between impedance values during the three time periods as well as to compare impedance values with thermodilution. A p value of less than 0.05 was considered the minimum level of significance.

#### DURING



**Results.** Regression analysis of thermodilution versus impedance obtained pre-, during and post-thermodilution showed correlation coefficients (r) of 0.22, 0.35, 0.22 respectively (Figure 1). Regression analysis of pulmonary capillary wedge

pressure versus thoracic fluid index (TFI) showed an r value of 0.74. Paired t tests to compare the impedance values showed no difference among the pre-, during, and post-thermodilution time periods. Statistical significance also was not reached in the comparison of thermodilution versus the (during) impedance values. Additionally, regression analysis was performed using (0,0) as a data point, as seen in previous studies. The correlation coefficient (r) for pre-, during, and post were 0.74, 0.75, and 0.72 respectively.

**Discussion.** The anesthesiologist is being implored to use an increasing number of monitors in the operating room. Each of these monitors is designed to help make a safe technique (i.e. anesthesia) even safer. The anesthesiologist, however, must have confidence in the values the monitor is presenting. We found the NCCOM3 to be a monitor which is easy to use in the operating room and wanted to compare its accuracy with the more accepted thermodilution method. Although thermodilution catheters have given variable results in the past with standard deviations of 10-20 percent, it is the most commonly used cardiac output method in the operating room.

This study shows that impedance values of cardiac output as determined by the NCCOM3 do not correlate well with thermodilution measurements. The thoracic fluid index also did not correlate well with the pulmonary capillary wedge pressures. However, statistical significance was not reached with any of the groups. Power analysis shows that with the correlation coefficients and inpatient differences we obtained, more than 400 patients would be needed to determine whether a significant difference between the methods exists. Improved correlations can be obtained when using (0,0) as a data point. However, we do not believe this is a valid assumption because the correlation of impedance may be different at low cardiac outputs. The addition of (0,0) as a data point provided us with correlations similar to those seen in previous studies.

#### References

1. Judy W, Weinberger M: A comparison of cardiac output as simultaneously measured by indicator dilution and impedance cardiography in normal and hypertensive humans. Biomed Clin Aspects Coenzyme Q 3:207-220, 1981.
2. Donovan K, Hockings B: Comparison of transthoracic electrical impedance and thermodilution methods for measuring cardiac output. Crit Care Med 14:1038-1044, 1986.