


**Anasarca and Low Electrocardiogram Voltage**

In a recent article in the Journal, Madias et al. (1) reported an inverse relationship between electrocardiogram (ECG) voltage and changes in body weight due to fluid loss or retention in patients with anasarca. The investigators could find no reference in the literature to a link between low ECG voltage and anasarca. A direct correlation has been reported, however, between ECG voltage and the concentration of serum albumin (2). Anasarca is frequently associated with a lowered serum albumin concentration (3). To ascertain how much the Madias et al. (1) study expands existing knowledge, it would be necessary to correlate the observed changes in ECG voltage with concomitant changes in serum albumin. Are the investigators able to do this?

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**REFERENCES**


**REPLY**

I am grateful to Dr. Brennan for directing me to literature describing a direct correlation of albumin and amplitude of QRS complexes (1). To his request I have modeled an analysis of our data after the study of Dr. Heaf (1). Our patients were critically ill, were followed for a long time (34.5 ± 36.7 days) (2) and inevitably experienced gradual reduction of albumin, despite our concerted efforts to use enteral and/or parenteral feeding. We had not measured albumin daily, but frequently. Thus, I was able to employ values that were the closest to the admission and peak weight albumin values of our patients. The albumin levels available for my analysis were checked on days 0.61 ± 1.71 for admission, and on days 0.43 ± 1.79 of peak weight time point.

Correlation of the sums of all 12 QRS leads (ΣQRSs) (2) from admission with the corresponding albumin values revealed an r = 0.057 and a p = 0.77. A similar analysis, carried out for the ΣQRSs obtained on the day of the peak weight and the corresponding albumin values, showed an r = 0.38 and a p = 0.04. Correlation of the percent change in the ΣQRSs between admission and points of the peak body weights, with the percent change in the corresponding albumin values, revealed an r = 0.37 and a p = 0.053.

The difference in our results from the admission time point and the time of peak weight is hard to explain. If there was a real relationship between QRS amplitude and albumin, such a discrepancy should not have been encountered. Moreover, I find it odd to correlate absolute values of albumin with absolute values of amplitude of QRS complexes, taking into consideration that the latter can vary widely among both healthy subjects and patients, while the normal range of the former is 3.3 to 5.3 g/dl in our laboratory.

I find the correlation of change in each of the two correlates more meaningful scientifically, and in our data we found an almost significant association between the drop of albumin and loss of QRS amplitudes. The correlation coefficient was much smaller than the one we reported (r = 0.61) (2) for the association of weight gain and ΣQRSs drop. However, some association may exist between albumin and QRS amplitudes, and may be confirmed in patients in whom both daily electrocardiograms and albumin measurements are implemented.

Does this mean that the hypoalbuminemia was causally related to the drop of ΣQRS in our patients, or was this biochemical abnormality “an innocent bystander”? Innocent it is not, for certainly it contributes to the extent of water retention; however, the causative mechanism for the drop in ΣQRSs must have been the weight gain (or fluid retention). Correlation of % weight gain and % albumin drop in our 28 patients was poor (r = 0.02, p = 0.9); also, correlation of the % weight loss and % albumin rise in 9 patients was poor (r = 0.5, p = 0.1). It would have been very interesting to have data on weight change in the patients reported by Heaf (1).

There is evidence that edema fluid has low resistivity (3); thus, its effect on the transfer of cardiac potentials from the heart to the body surface can be explained by Ohm’s law. I am not aware of any work ascribing any mechanistic role for albumin per se in modulating the ECG voltage. Finally, the fact that patient 26 (2) gained 122.4 lb and lost 68.3% of his ΣQRS, while his albumin increased from 1.8 g/dl to 2.7 g/dl, and subsequently lost 77.4 lb and gained 185.9% of his ΣQRS (Fig. 6 of Madias et al. [2]) while his albumin increased merely from 2.9 to 3.0 g/dl, casts serious doubt on the contention that a causative relation between albumin and QRS amplitudes really exists.
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REFERENCES


Pulse Wave Reflection in Pulmonary Hypertension

In a recent Journal study, Nakayama et al. (1) showed that patients with chronic pulmonary artery thromboembolism (CPTE) had a higher pulmonary artery augmentation index and shorter inflection time than patients with primary pulmonary hypertension (PPH). Data were obtained on a large study population using fluid-filled catheters. Their findings—that increased and anticipated pulse wave reflection may help differentiate CPTE from PPH—are consistent with our recent reports, where we used high-fidelity catheters in a smaller population (2,3). One hypothesis is that the functional reflection site could be more proximal in CPTE than in PPH (1–4). Indeed, in PPH, pulmonary obstruction involves distal, medium-to-small-sized muscular arteries, whereas in CPTE, endothelialized residua narrow and stiffen proximal, major pulmonary arteries. However, we see a number of problems in the present study (1) with regard to the recording system, calculation of pressure reflection and discussion of the data.

First, signal distortions are unavoidable when using fluid-filled catheters, especially when pulsatile pressure characteristics are studied (5,6). As a result, the numerical data reported by Nakayama et al. require careful scrutiny owing to the previously documented pressure artifacts. The markedly negative values of the augmentation index (up to −80%) (1) correspond to pulmonary artery pressure shapes and reflection characteristics that have not been previously documented in PPH using high-fidelity catheters (7–10), and that we have never observed in our PPH patients (2,3). The pressure wave shape shown in Figure 1 of their study (1) is inconsistent with the prolonged time-to-peak pressure previously documented in PPH (8).

Second, identification of both the onset of the pressure pulse and the inflection point is not as easy as their study suggests. This may sound trivial but can result in large differences in time intervals and augmentation index. Previous studies have shown that the simultaneous analysis of the pulmonary artery pressure derivative with time significantly improves the identification of the inflection point (3,11). Numerous other factors may influence the numerical results, but unfortunately the investigators gave no information as to the inter- and intraobserver reproducibility of their measurements.

Furthermore, Muro et al. (11) have shown that negative values of the augmentation index imply smaller or more diffuse reflections than other patterns. The results of the Nakayama et al. (1) study for PPH are thus inconsistent with the numerous reports demonstrating increased wave reflections in PPH (7–10).

In conclusion, the study of Nakayama et al. (1) is similar to previous studies demonstrating markedly increased wave reflection in CPTE (2–4) and suggesting that the timing and extent of wave reflection might be useful in the differential diagnosis of CPTE and PPH (2,3). The numerical values of the reflection indices calculated from fluid-filled catheters require careful scrutiny, whereas high-fidelity catheters must be preferred when attempting to obtain a reliable insight into pulmonary artery pathophysiology.

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REFERENCES