



Body Water Compartment Measurements Using Bioelectrical Impedance Analysis, Tritium and Sodium Bromide Dilution: A Validation Study

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BACKGROUND

•The gold standards for measuring total body water (TBW) and extracellular water (ECW) are impractical for routine clinical use. Bioelectrical impedance analysis (BIA) estimates body water rapidly, but our previous work has demonstrated a systematic difference between estimates of TBW using single and dual frequency BIA.

AIMS

•This study was undertaken to assess the comparability of body water compartment estimates in healthy volunteers using single and dual frequency BIA with established reference methods of tritium and NaBr dilution.

SUBJECTS AND METHODS

•The age, weight, height and gender of 10 healthy volunteers were keyed into the two devices before BIA was performed.

•Total body water was estimated using single frequency (50kHz) BIA (Bodystat 1500), dual frequency (5 and 200kHz) BIA (Bodystat Dualscan 2005) and tritium dilution. Extracellular water (ECW) was measured with dual frequency BIA and NaBr dilution.

•Venous blood was sampled for measurement of background concentrations of tritium and NaBr using a beta counter and high performance liquid chromatography respectively.

•10ml tritiated water (3.7MBq) and 50ml 5% NaBr solution were then injected intravenously and blood samples taken from the opposite arm every 45min for 4.5h to estimate concentrations of tritium and NaBr.

RESULTS

•The mean (SE) age and BMI of the 8 male and 2 female volunteers were 21.9 (0.2) years and 24.8 (0.9) kgm⁻² respectively.

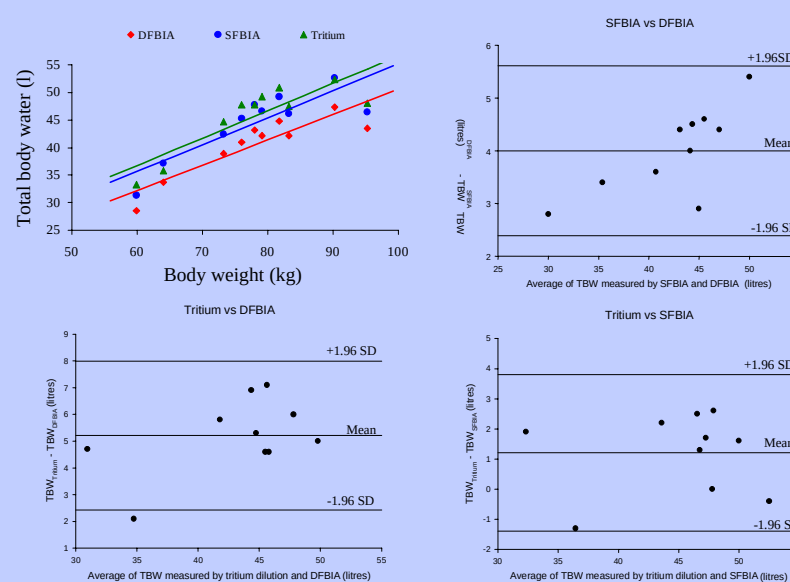


Fig. 1: Correlation between measurements of total body water using single frequency BIA (SFBIA), dual frequency BIA (DFBIA) and tritium dilution with body weight (top left). The Bland-Altman plots demonstrate agreement between the methods. The best agreement was between measurements using tritium and SFBIA (bottom right).

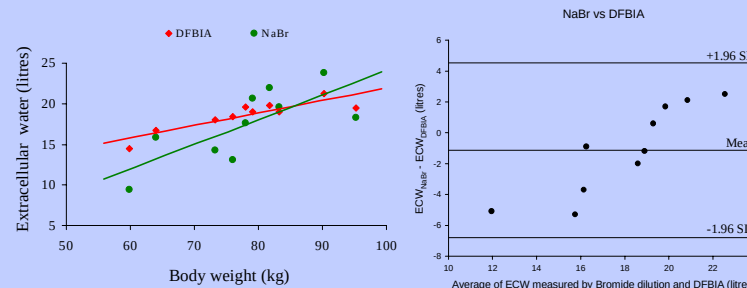


Fig. 2: Correlation between measurements extracellular water using dual frequency BIA (DFBIA) and NaBr dilution with body weight (left). Bland-Altman plot demonstrating agreement between the two methods for estimation of extracellular water (right).

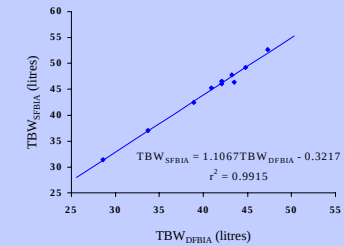


Fig. 3: Correlation between total body water measurements using single frequency BIA (TBW_{SFBIA}) and dual frequency BIA (TBW_{DFBIA}).

•There was good correlation ($r^2=0.76$) between estimates of ECW using dual frequency BIA and NaBr dilution, with the former overestimating ECW by ~1L.

•TBW measurements obtained by single and dual frequency BIA correlated excellently with estimates using tritium dilution ($r^2=0.96$ and 0.95 respectively).

•However, single frequency BIA underestimated TBW by ~1L and dual frequency BIA by ~5L when compared to tritium dilution.

CONCLUSIONS

•This study demonstrates that in healthy volunteers, SFBIA accurately measures TBW when compared with tritium dilution techniques and that estimates of ECW using DFBIA are comparable with those obtained using NaBr dilution.

•However DFBIA underestimates TBW by ~4L and ~5L when compared to SFBIA and tritium dilution respectively.

•Application of a correction factor to the regression equations for TBW calculation using DFBIA can make the estimates more accurate.

$$TBW_{SFBIA} = 1.11 TBW_{DFBIA} - 0.32$$

•The estimates obtained using DFBIA and NaBr dilution are comparable.