

The use of multiple frequency bioimpedance to assess fluid balance in critical illness. By I T CAMPBELL^{1,2}, HAN^{1,2}, M BOLTON³, P NIGHTINGALE¹, M O COLUMB¹ and S J BROOKES⁴. ¹Intensive Care Unit, ²University Department of Anaesthesia and ³Department of Clinical Engineering, Withington Hospital, Manchester M20 2LR and ⁴Europa Scientific, Crewe CW1 6ZA

Critically ill patients retain fluid, up to 30 litres and more. In individuals ill for prolonged periods it is virtually impossible to assess fluid balance accurately, but as a non-invasive method of doing so bioimpedance has its obvious attractions. We have previously described the use of single frequency (50kHz) impedance to assess body water in these individuals but the interindividual errors were too large to be acceptable (Foley *et al.* 1998). The correlation $\otimes$ between conductance (height²/impedance) at multiple frequencies (5-500 kHz; Multiscan 5000, Bodystat Ltd, Douglas, Isle of Man) and body water (measured using deuterium analysed by Continuous Flow Isotope Ratio Mass Spectrometry following equilibration with H₂) was investigated in ten critically ill patients; in three patients multiple measurements were made, in two on four occasions and in one on six.

Frequency		All patients (n = 10)	Patient 1 (n = 4)	Patient 2 (n = 6)	Patient 3 (n = 4)
5 kHz	<i>r</i>	0.869	0.574	0.862	0.622
	see	6.42*	4.33	5.40	9.96
50-500 kHz	<i>r</i>	0.790-0.831+	0.561-0.574	0.689-0.808	0.308-0.381
	see	7.23-7.96+	4.34-4.40	6.27-7.72	9.96-12.1
• litres		+range	<i>r</i> Pearson correlation coefficient		

Bioimpedance at 5 kHz gave a better correlation with the deuterium measurement than any other frequencies, both between and within patients. Between patients, and within one of the patients (no. 1), the correlation between conductance and frequency at frequencies between 50 and 500 kHz was not significant. Within patients 2 and 3 the correlation coefficients between conductance and frequency were -0.864 and -0.925 ($P < 0.001$) respectively. Contrary to expectation, they were both negative i.e. the higher the frequency the worse was the correlation between conductance and frequency.

The fact that 5 kHz gave the best correlation is probably a result of the expanded extracellular fluid volume normally seen in these patients. If bioimpedance is to have a role in assessing fluid balance in this group attention is probably best focused on the lower frequencies.