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Validation of Multi-Frequency Bioelectrical Impedance Analysis in Monitoring Fluid Balance in Geriatric Patients

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Background: Multi-Frequency Bioelectrical Impedance Analysis (MFBIA) is a simple, rapid, and novel method to assess body composition. This study aimed at determining MFBIA's responsiveness to clinically relevant changes in geriatric patients' fluid balance.

Methods: In 16 months 218 patients were admitted to the geriatric department and 53 could be included in this prospective study. Fluid balance was assessed rigorously twice a week by physical examination and laboratory tests. Changes in fluid balance were quantified by measuring total body water and extracellular fluid applying deuterium- and bromide-dilution techniques. MFBIA and weighing was performed daily and their Responsiveness Indexes (RI) for dehydration and hyperhydration were determined (Guyatt G. 1987, J. Chron. Dis, 40, 171-8).

Results: Totally, 1000 MFBIA's were performed, in which 14 transitions from dehydration to euvoema and 13 from hyperhydration to euvoema were monitored. Individual changes in MFBIA during these transitions were highly significant (P<0.001). RI of MFBIA for dehydration was 3.1 (±2.0) for all frequencies, weight loss was 2.8±1.8 kg (RI_{weighting}=2.7(±1.8)). RI of MFBIA for hyperhydration ranged from 2.0(±1.2) at 1 kHz to 2.3(±1.6) at 100 kHz; increase in weight during hyperhydration was 3.7±4.2 kg (RI_{weighting} =3.6(±4.1)).

Conclusions: Responsiveness of MFBIA to changes in fluid balance can be relied on (RI>1), but is similar to weighing. MFBIA might improve monitoring fluid balance in geriatric patients, especially if daily weights are hard to get.

Clonal Expansion of Mitochondrial DNA Mutations in Aged Human Muscle

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The accumulation of mitochondrial DNA (mtDNA) mutations during life has been proposed as a significant contributor to the ageing process. MtDNA codes for 13 polypeptides, 22 tRNAs and 23 rRNAs that are all concerned with the respiratory chain (RC), a series of enzymes that generates the majority of cellular ATP. Although mtDNA mutations do accumulate at low levels with age, there is not a corresponding decline in RC function (1). MtDNA mutations are extremely recessive. Studies on patients with mitochondrial diseases have shown that the level of a mtDNA mutation needs to be over 80% before RC function is affected. We hypothesised that for mitochondria to be involved in ageing then mtDNA mutations had to be focused to individual cells and that in skeletal muscle the likely site for this would be fibres deficient in cytochrome c oxidase (COX-ve); in mitochondrial diseases these are a pathological hallmark for mtDNA mutations. To test this hypothesis single muscle fibres were dissected out of 30um sections from 8 different normal elderly subjects. The fibre was lysed with KOH, neutralized with HCl/Tris-HCl then used directly for PCR (2).

A 3 primer PCR was used to screen and quantify mtDNA deletions between nt8273 and 13720. 89 COX-ve and 70 normal (COX+ve) fibres were examined. In all COX+ve and most COX-ve fibres 99.5-100% of the mtDNA was wild-type. However muscle from 4 individuals contained at least one COX-ve fibre that contained >85% mutated mtDNA. Sequencing of the PCR product confirmed that the majority were due to the 4977bp common deletion and one was a 25117bp deletion at the site of a 10bp repeat. This suggests that the cause of the COX deficiency in these abnormal fibres is a single mitochondrial mutation that has clonally expanded with the causative mutation varying between fibres. Thus age related mitochondrial DNA mutations are not globally distributed in aged tissues but focused to individual cells within which they are causing significant dysfunction.