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In situ identification of human physiological fluids by nuclear magnetism in the Earth's field

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To make *in situ* identification of human physiological fluids by nuclear magnetism, we use the well known technique of free precession of water protons in the magnetic field of the Earth after prepolarization in a perpendicular (H_p) field (Packard & Varian 1954). The central part of the apparatus is the coil used for generating the polarizing field (maximum values 50–100 Oe (3979–7958 A m^{-1})) and detecting the free precession of nuclei.

To make *in situ* measurements, the coil is placed against the corresponding part of the body; thus, to pick up signals from blood in the region of the heart, the coil is placed on the anterior part of the thorax; to detect urine in the bladder, the coil is placed against the ventral part of the low abdomen (Béné *et al.* 1977).

The magnetic field of the Earth being very homogeneous and constant in the site where the experiments are performed (1 part in 10^6 during the measurement, and over the volume of the sample), the decay of the free precession gives the T_2 value in the Earth's field. The range of measured values of T_2 is limited at the lower end of the range by the damping of the circuit itself ($T_2 \approx 10$–30 ms) and at the upper end, by the residual inhomogeneity of the Earth's field ($T_2 \approx 5$ s). The sensitivity of the apparatus limits the scope of our work to physiological or imbibed liquids well localized in the body (actual minimum volume 50–100 ml).

Physiological fluids are mainly protein solutions, sometimes containing suspended cells. The concentration of solute or particles gives T_2 values between 100 and 3000 ms.

In these *in situ* measurements, we receive not only the exponential decay from the fluid explored but also that from other fluids or soft tissues in the surroundings. The information must be analysed in order to discriminate between the component exponentials and their relative importance (Borcard *et al* 1979).

Measurements in the region of the heart give, generally, two exponentials:

(*a*) $T_2 \approx 150$ ms, from blood in the heart and the surrounding large vessels (we do not discriminate venous and arterial blood);

(*b*) $T_2 = 30$ ms, from soft tissues and also damping of the coil.

After administering water, we distinguish in the stomach region:

$T_2 = 2.5$ s from the water;

$T_2 = 350$ ms and 100 ms from fluids and soft tissues in the surrounding regions.

The same measurement, made in the low abdomen, the bladder containing urine, gives the results shown in figure 1, i.e.,

$T_2 = 2.17$ s (urine),

$T_2 = 280$ ms,

$T_2 = 107$ ms.

The two smaller values are very similar to these obtained in the stomach area.

The experimental points are fitted with an HP 9854-A ordinator by three exponentials, of which the sum, weighted by amplitude, gives the curve shown (figure 1).

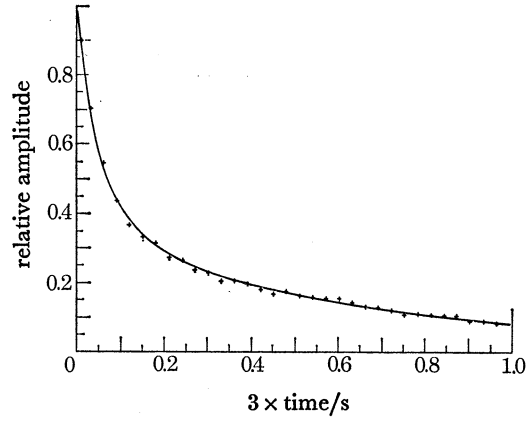

FIGURE 1. For description see text.

By this technique one is able to study other internal fluids (blood in haematoma, pleural, peritoneal, amniotic or oedema fluids, bile, urine etc.), without injury to the patient, and obtain information about their composition or their volume.

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