EFFECT OF FAT EMULSIONS ON ERYTHROCYTE RIGIDITY

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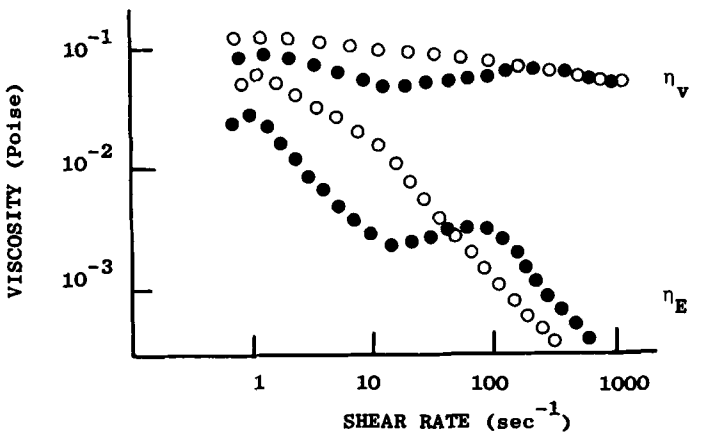
Emulsions of soybean oil stabilised by egg lecithin (1.2%) have been used successfully as a source of calories in parenteral nutrition. The clearance of the emulsions from the circulation and their subsequent tissue deposition and metabolism have been studied extensively. However, little is known about the effects of fat emulsions on the microcirculation (Kroeger et al 1970). Blood flow in the human circulation is pulsatile and it follows that the rheological properties of blood in time-varying flows are of the greatest physiological significance. The viscoelasticity of blood is strongly dependent upon the mechanical properties of erythrocytes, in particular their elastic deformation.

The effects of a fat emulsion (Intralipid 20%) on the rigidity of human erythrocytes has been studied at 20°C using an oscillatory flow apparatus at a frequency of 2 Hz (Thurston 1979). The dilution of whole blood by isotonic saline is as expected, a lowering of haematocrit lowers the viscous (η_v) and elastic contribution (η_E) to the complex modulus (η^*) (Figure). The erythrocytes remain flexible and η_E decreases rapidly with shear. The dilution of whole blood with fat emulsion (1:1) causes the onset of viscoelastic dilatency which can be associated with an increase in the rigidity of the erythrocytes. This is evidenced by the upturn of η_E and inflexion of η_v near a shear rate of 10 sec^{-1} rms (Thurston 1979). This dilatency could have an adverse effect on the microcirculation. Observation of blood under the microscope showed normal cell-cell aggregation with rouleau slowly forming. However, with added fat emulsion this ceased completely. The mixture of plasma with Intralipid (1:1) showed no unusual effects. The elastic component (η_E) is small compared to η_v. Thus the dilatency effect seen with whole blood appears to be cell related and not plasma determined. Larger amounts of plasma when mixed with Intralipid (3:1) gave rise to the flocculation of the fat emulsion. This flocculation is reversible and will cause an increase in both η_E and η_v (Thurston and Davis 1979).



Figure

Viscous and elastic components versus shear rate at 2 Hz. for erythrocytes mixed with a fat emulsion (1:1)● (0.44 haematocrit blood)

Kroeger, A., Heisig, N. and Horders, H. (1970) Klin. Wschr. 48:723.
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