MEASUREMENT OF THE CUTANEOUS CIRCULATION OF SHEEP USING THE LASER DOPPLER VELOCIMETER

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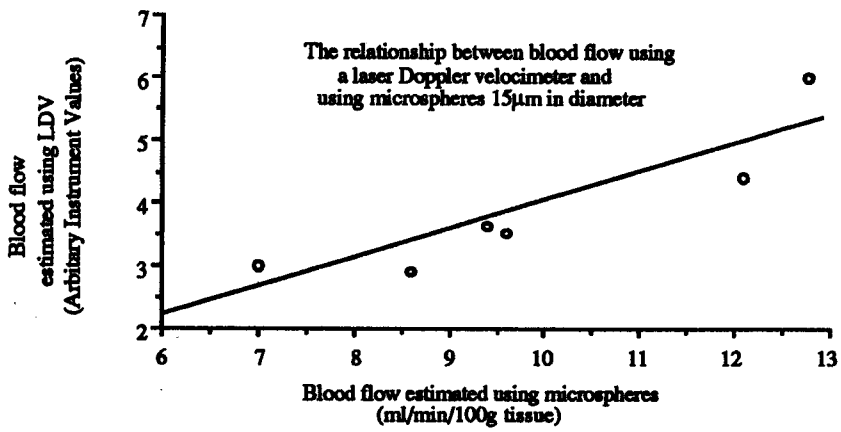
Few attempts have been made to estimate blood flow and nutrient supply to the skin and wool follicles of sheep. A non-invasive, isotope-free technique which provides continuous measurement of blood flow through the skin utilises a laser beam to determine the number and velocity of red blood cells travelling through the skin (Stern 1975). The aim of this experiment was to develop and validate this technique for the measurement of blood flow in the skin of sheep.

Blood flow through the skin of eight sheep was estimated using a laser Doppler velocimeter (LDV; Laserflo^{TM}, Blood perfusion monitor (403A) TSI Inc. St Paul USA) with a right-angle skin-probe at three sites approximately lSmm apart, along the dorsal edge of a midside tattooed patch. This particular LDV has a solid state laser diode with a wavelength of 780±20nm. Mean blood flow through the skin (arbitrary instrument values)1, after adjustment for temperature effects, did not differ over four consecutive days nor between three sites on the midside and there was no interaction between either of these parameters and individual sheep.

Six sheep underwent surgery prior to the administration of microspheres as described in detail by Hales (1973). One to two days following surgery, blood flow was estimated at three sites along the dorsal edge of the midside tattooed patch with the LDV. Approximately $2.2x10^8$ microspheres, with a diameter of 15µm and labelled with cobalt-57 (NEN-TRAC Microspheres; DuPont, Boston, USA), were injected rapidly into the left cardiac ventricle. After slaughter, skin from the sides of the sheep was dissected and placed in a gamma-counter to determine blood flow to the skin. The absolute value of blood flow estimated with microspheres was significantly greater ($P < 0.001$) than that estimated with the LDV, however the estimates obtained using the two techniques were highly correlated (see Figure; $r = 0.915$, $P < 0.02$).



The present results indicate that the LDV provides an estimate of cutaneous blood flow which is indicative of blood flow through vessels less than 15 micrometers in diameter (i.e. capillary blood flow). Thus, it is concluded that the LDV is suitable for measuring blood flow through the skin of sheep and has advantages over other techniques in that it provides a simple, non-invasive and continuous means of measurement. In particular, in the measurement of cutaneous circulation in sheep, it is preferable to other methods in that there are no problems associated with the handling and disposal of isotopes, there are no surgical and post-surgical complications and ultimately it is not necessary to slaughter the animals to obtain samples for analysis.

HALES, J.R.S. (1973). Pflugers Arch. 344: 119.
STERN M.D. (1975). Nature 254: 56.

1. Arbitrary Instrument Values; listed as ml/min/100g tissue after calibration against microspheres in gastric mucosa

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