A MULTICOUPLE PROBE FOR GRADIENT TEMPERATURE MEASUREMENT IN BIOLOGICAL MATERIALS.

Michel B. Ducharme and John Frim.
Department of Physiology, Faculty of Medicine, University of Toronto, Toronto,
and Defence and Civil Institute of Environmental Medicine, Downsview.

Address for reprints:
Defence and Civil Institute of Environmental Medicine
Biosciences Division
1133 Sheppard Av. West
Downsview, Ontario, Canada M3M 3B9

An easy-to-make, sensitive, thin flexible multi-sensor probe for *in-vivo* tissue temperature profile measurement is described. It is essentially a multi-junction thermocouple (i.e. a multicouple) of type T composition. Enamel insulated copper wires (38 gauge) were soldered 5 mm apart to one common uninsulated constantan wire (36 gauge) and introduced into a polyethylene tube sealed at one end. The total outside diameter of the multicouple probe is less than 1 mm and the maximum number of junctions using the specified wire sizes is approximately sixteen. This design permits the instantaneous measurement of a tissue temperature profile at 5 mm intervals over a distance of about 8 cm. An extensive calibration for the thermal conductivity effect (R-effect) along the multicouple wires using a limb model is presented. The results show that the temperature readings of the individual junctions are significantly affected by the R-effect when a thermal gradient exists along the multicouple, as is usually the case during tissue temperature measurement. However, calibration of the multicouple for the R-effect yields a measurement accuracy of ±0.1°C under a wide range of gradients. This probe can be implanted in tissue to measure thermal gradients under different physiological conditions.