Experimental Investigation of the Circulation of the Femoral Head Using a Combined Method of Intraosseous Thermometry and Phlebography

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Circulating fluid as a means of heat transfer is well recognised. The measurement of thermodilution is widely used for determining cardiac output, coronary perfusion, brain circulation and even pulmonary extracellular fluid [1]. Thermal methods such as thermography or heat measurements on the surface of extremities have often been applied to investigate bone circulation [2], but it is difficult to find references in the literature on direct heat measurements in bones.

From the clinical use of intraosseous venography [3] a great deal was learnt about the distribution and drainage of intraosseous contrast fluid, depending on the state of bone circulation. A patient with normal and impaired epiphyseal circulation is shown in Fig. 1. In order to ensure that the circulation could be followed adequately, young dogs under 2 years of age which still have persistent epiphyseal plates were used. A special needle utilized for intraosseous venography in children was inserted into the central point of the proximal femoral epiphysis. Apart from this a bimetal thermometer (medical diagnostic Rolitron-2000, which are accurate to 0.001 °C) was introduced into the weight-bearing quadrant of the same epiphysis. Cold (20°C) physiological fluid was applied through the needle to cool the femoral head from 38°C to 28°C. The rewarming was in equal time periods registered by the thermometer.

The graphic display (Fig. 2) shows gradual rewarming of the epiphyses with normal circulation. When the femoral head was resected and completely separated from the femoral neck and was then replaced between the warm soft
Fig. 1. Comparative illustration of normal and impaired epiphyseal circulation. 8 years old girl. Intraosseous venography. M. Perthes L. side

Fig. 2. Graphic display of the rewarming of cooled femoral heads. 18 months old dogs. Intraosseous thermometry. ——— Full circulation, ——- Transsection of the teres ligament, ··· Replanted avascular head