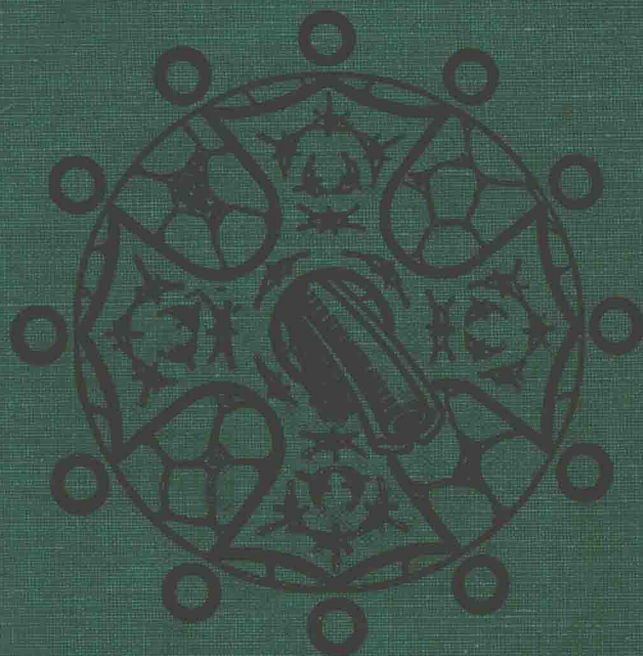


Bone Circulation

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Bone Circulation

Preface

The Third International Symposium on Circulation in Bone has come into being and has attracted the most prominent researchers in the field of bone circulation from the entire world for two fundamental reasons which I would like to recall in this introduction to our deliberations. The first reason is due to the enormous importance of the anatomical and developmental infrastructure of the bony vascular bed. The second reason concerns the vitality and dynamic aspects of this microcirculation. In addition, the tremendous increase in technical methods for evaluating bone blood flow necessitates a worldwide symposium for the purposes of exchanging not only information about the methods themselves, but also the results of their application to this fundamental area of research.

Importance of Vascular Anatomy of Bone

The blood supply of bone as all other blood supplies forms a double function; the structural maintenance of the medullary and cortical trabecular systems and the biological maintenance of their multiple functions; mechanical, hematologic, hemodynamic and calcium balance. Long bones are nourished by six arterial groups; epiphyseal, metaphyseal and diaphyseal, one set of each coming from each end. Two resplendent anastomotic systems unify the vascular entities into a continuum which bathes all the tissues. The transverse anastomoses unite the medullary with the periosteal systems and, further, even to involve muscular and cutaneous anastomoses. The longitudinal anastomoses unite the three anatomical systems, the length of the bone, and even across the articulation, via the periarticular vessels. At the venous level, a third and deep pathway for venous return exists.

This complex arterial supply with its multiple anastomotic levels is accompanied by a parallel venous system of six to eight times the volume capacity. The density of both these systems has

been magnificently demonstrated in recent years by a variety of techniques including arteriography and intraosseous venography, results of which will be documented during this symposium.

Nonetheless, anatomy alone provides us only an inert and inactive picture of the vascular network. Superimpose the dynamic pictures of vital microscopy of an intact intraosseous vascular system which Branemark showed us at the first symposium in 1973 to obtain a glimpse of the dynamic complexity.

Finally bone circulation provides unique features, particularly intraosseously, where the system is doubly closed, peripherally by the cortical mantle and in the interior, which is "spongy" in appearance only. These structures render the intraosseous circulation compartmental in nature, making it vulnerable to intrinsic pressure changes.

The Microcirculation

The entire complex of arteries, arterioles, venules and veins serves only one purpose: to get the blood into and back out of the capillary system consisting of true capillaries and the sinusoidal system. The latter is surrounded by a single and incomplete endothelial layer which facilitates the exchange of ions, soluble gases and local cells. The microcirculation is influenced by some special rheologic conditions and represents the vital and dynamic center of the circulatory tree.

From the clinical point of view, we are frequently confronted with vasomotor disturbances—primary or secondary, acute or chronic—which play an important and sometimes determinant role in the pathology of the osteoarticular system. It is necessary to keep these microcirculatory disturbances in mind if they are to be detected and treated, even if this attitude is not yet widespread.

Exploration of Bone Circulation

For a long time, our knowledge of the intraosseous circulation has suffered from a lack of means of clinical exploration, in spite of all the progress made in the anatomy, physiology and experimentation in other areas and in animal preparations. Only beginning in the 1950s and 1960s did certain procedures begin to appear applicable to human clinical problems. Since that time, Professor Arlet and I have grouped several techniques of measuring hemodynamic, metabolic and histopathologic parameters of bone which we have labeled the "functional exploration of bone." These techniques have allowed us to establish with certainty a diagnosis before any radiologic changes. These very early manifestations of pathologic processes are very likely to be reversible which gives added incentives to therapeutic intervention which may be prophylactic or preventative. Such possibilities also give a new attitude toward the diagnostic process.

The mechanically solid mineralized nature of the skeletal system, characteristics which make the radiologic image a primary requirement in orthopaedic diagnoses, has given orthopaedic surgery a natural and justifiable mechanical orientation. However, the concept of a living, biologically active, richly vascularized tissue, in which cellular and metabolic processes are taking place in a dynamic way which passes unperceived by the radiologic examination, must be added to our consciousness if we are to achieve a balanced view of what actually is taking place in bone. In fact, these two concepts, mechanical and biological, need to be fused into an inseparable whole, providing a unifying approach to the problems of the skeletal system. The inseparability of the mechanical and the biological should be at the top of the table of laws for our discipline.

However, the biological approach introduces us into a microcosm where anatomical-clinical methods are insufficient. We need an understanding of cytology, enzymology, biochemistry, i.e., the collaboration of a complete team. It is in this way that our specialty is enriched and matures to the point where disease processes and treatments can be expressed and understood in cellular and molecular terms. It appears that the current technological explosion is providing us with revolutionary means of exploration at the ultramicroscopic levels, propelling research in a direction which is unfamiliar territory for the clinician. Nonetheless, we must understand these current levels of exploration to be prepared for future debates which will certainly take place at the molecular level. These techniques will allow us to answer fundamental therapeutic questions directed at the three pillars which form the basis of all rational treatment: to know 1) the definition of cause, 2) the pathophysiological mechanisms, and 3) the mechanism of early diagnosis. The initiating mechanisms almost always rest at that critical interface between capillary and cell.

For all these reasons, the study of vascular parameters seems to us to be essential to deepening our understanding of the pathology of the osteoarticular system. Our neurological and cardiovascular colleagues at the University of Paul Sabatier have followed a similar course which is the reason that Toulouse has become a recognized center for the study of local circulation. It, therefore, seems fitting that our city should once again have the privilege and honor of hosting the Third International Symposium on Circulation in Bone.

R. PAUL FICAT
Toulouse 1982

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