The Mosaic Theory 32 Years Later

IRVINE H. PAGE, M.D.

It has been 32 years since the mosaic theory was proposed. In principle it has not been widely accepted, although in practice generally employed. The principle seems not to have been clearly understood, albeit the concept that hypertension is a multifactoral, multifaceted disease is current.

Understanding the principle depends upon appreciating chemical equilibria, especially as exemplified by the Phase Rule of Willard Gibbs. Oversimplified, the principle expresses interdigitating regulatory mechanisms that form a pattern resulting in maintaining blood pressure and tissue perfusion at different levels in all organs. Since distribution of the limited amount of blood to areas with regularly changing needs is a regulating function of enormous complexity, it should not be surprising that several regulators are involved, each of which usually has a different mechanism. Since the mechanisms differ, it is possible for the body to maintain circulatory constancy even though one, or several, of the regulators may have been destroyed. For example, the nervous system may be ablated and yet, after a short period of adjustment, tissue perfusion and blood pressure remain unchanged. This does not signify that the nervous system is unimportant as a regulator; it merely indicates that it is replaceable.

At its inception, the mosaic theory was portrayed as an octagon with the then known regulators on each focal point and arrows indicating a closed system in equilibrium. As a result of the vast growth in knowledge of the circulation in the past three decades, it is now possible to express the concept in broader terms, and that is the purpose of this brief communication.

It is suggested that, while the principles are unchanged, the focal points now may be more appropriately expressed as:

1. Genetic
2. Environmental
3. Anatomical
4. Adaptive
5. Neural
6. Endocrine
7. Humoral
8. Hemodynamic

A few examples may be helpful. The genetic factor determines the pattern of the total organism, and many believe that patients with hypertension differ so greatly among themselves because of genetic disposition. The importance of the environment has been differently interpreted, some believing that the salt content of the diet is critical while others would add stress, trace metals and the "risk factors." Anatomical factors have also been implicated, including abnormalities such as coarctation of the aorta, atresia, and aneurysm of the renal artery. Adaptive changes have been less specifically categorized but are exemplified by the regulation of intracellular Na⁺ and Ca²⁺ by cell membrane pumps. Perhaps the abnormally high blood pressure of the giraffe could be considered an adaptation to the extraordinary length of the neck. The neural factor subtends a variety of complex nervous mechanisms ranging from the buffer nerve to those in specific regions of the brain such as the area postrema. Endocrine mechanisms are broadly understood, such as pheochromocytoma or primary aldosteronism. Of major importance are the varied humoral agents that constrict or dilate the blood vessels. Hemodynamic regulation comprises much of current study dealing with such factors as blood volume, viscosity, cardiac output, and intrarenal hemodynamics.

Clearly, this brief note is not meant to list all of the multiple mechanisms currently adumbrated as constituting the many facets of hypertension considered as a "disease of regulation." Rather, the mosaic concept is intended to provide a logical and orderly way of thinking about all forms of hypertension as a subject for research and as a means of analyzing the problem in patients. Certainly, it is not meant to be vague, as some less thoughtful critics have claimed, any more than the ring system was vague when introduced into organic chemistry.
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