Mechanosensing Biology
Mechanical stress is known to regulate body function, evidence of which can be seen in many tissues such as bone, muscle, heart, and vessels. Bedridden patients lose bone when they are immobilized for a long time. Astronauts also experience muscle and bone loss during space flight. The heart functions to pump blood, causing mechanical stress to itself and to vascular tissue. The effects of mechanical stress can be observed not only in adults but also in developmental periods of life. Even the earliest establishment of primordial tissues required microenvironmental stress that would later play a role in the maintenance of cell structure and the shape of organs.

The function of certain membrane channels is regulated by mechanical stress. In conjunction with local mechanical stimuli, systemic regulatory events such as endocrine and neurological controls work interactively. To respond to its environment, the body requires the signals of mechanical stress in the skeletal tissue cells. It has been suggested that multiple signaling pathways operate in diverse types of cells by responding in different ways to mechanical stress. In muscle cells, membrane proteins have been shown to maintain their localization and functions under loading conditions, whereas loss of mechanical stress can lead to rapid loss of membrane proteins such as dystrophin. Homeostasis is impaired upon loss of mechanical stress, leading to pathological conditions such as osteopenia, muscle atrophy, and vascular tissue dysfunction. It is important, therefore, to understand the mechanisms of such signaling induced by mechanical stress in the maintenance of homeostasis. These mechanical signaling events are believed to maintain the functioning of the body and must be considered in contemplating new approaches to treating dysfunction and disease.

In this monograph, mechanical stress is discussed by experts in the field with respect to the molecular, cellular, and tissue aspects in close connection with medicine. Taking these aspects together, the book provides the most up-to-date information on cutting-edge advancements in the field of mechanobiology. In elderly populations, such mechanical pathophysiology, as well as the mechanical activities of locomotor and cardiovascular systems, is important because skeletal and heart functions decline and cause various diseases in other organs. For this reason, concern about mechanical stress-related health problems of elderly patients has been rapidly increasing. This book provides a timely contribution to research into locomotor and circulatory diseases that are major problems in contemporary society.

Masaki Noda
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