The Basic Elements of Bone

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Abstract

Bone is a dynamic tissue, and its metabolism is regulated by bone cells that respond to various environmental signals, including chemical, mechanical, electrical and magnetic stimuli. Three cell types are found in bone: osteoblasts, osteoclasts and osteocytes. In general, specific responses are governed by cellular receptors found in the membrane of the cells or within the cell itself. The cell membrane receptors bind the exogeneous signals and transfer the information across the cell's cytoplasm to the nucleus through a series of interactions that involve a complex set of transduction mechanisms. The periosteum lines the outer surface of bone. Periosteum covers the external surface of most bones to serve as a transitional region between the cortical bone and the overlying soft tissue or musculature. It is composed of two layers. The outer layer is in contact with muscle and other soft tissue elements and is populated by fibroblast-like cells. The inner layer is known as the cambium layer, and it is populated by fibroblast-appearing cells, many of which are committed progenitors of chondrocytes and osteoblasts. This layer contributes to appositional bone growth during bone development and is responsible for the expansion of the diameter of the long bones with aging. In this review of the basic elements of bone, bone cells, osteoclasts, osteoblasts and osteocytes and the periostium are discussed in detail in the light of the recent research. *Turk Jem 2008; 12: 10-1*

Key words: Osteocyt, Osteoblast, Osteoclast, Periosteum

Özet

Kemik dinamik bir doku olup, metabolizması manyetik, elektriksel, kimyasal, mekanik uyarılar dahil çeşitli çevresel sinyallere cevap veren kemik hücreleri tarafından düzenlenir. Kemikte üç tip hücre bulunur; osteositler, osteoklastlar ve osteoblastlar. Genelde özgün cevaplar, hücrelerin membranında veya hücre içinde bulunan reseptörler vasıtasıyla yönetilirler. Hücre membran reseptörleri dışardan gelen sinyalleri bağlayarak, bilgileri hücrenin sitoplazması boyunca hücre nükleusuna, birbirlerin etkileyen önemli bir dizi karmaşık iletim mekanizmalarıyla iletirler. Periost kemiğin dış yüzeyini kaplar. Periost birçok kemiğin dış yüzünü örter ve kortikal kemik ile yumuşak doku veya kas dokusu arasında bir geçiş alanı görevini üstlenir. İki tabakadan oluşur. Dış tabaka kas ve diğer yumuşak doku elemanları ile temastadır ve fibroblast benzeri hücrelerle doludur, iç tabaka katman doku tabakası olarak da bilinir ve çoğu kondrosit ve osteoblastların ön hücreleri olmaya programlanmış fibroblast görünümlü hücrelerle doludur. Bu tabaka kemik gelişimi sırasında, kemik ilavesiyle kemiğin büyümesine yardımcı olur ve yaşlanma ile uzun kemiklerin çaplarının genişlemesinden sorumludur. Bu, derlemede kemik hücreleri osteoklast, osteosit ve osteoblastlar ve periost, yakın geçmişin araştırmalarının ışığı altında tartışılmışdır. *Turk Jem 2008; 12: 10-1*

Anahtar kelimeler: Osteosit , Osteoblast, Osteoklast, Periostiyum

Introduction

Although the bone is a solid organ, it is not an unchanging mineralized hard tissue. It is a vital, dynamic organ with very important functions, such as mechanical integrity, locomotion and involvement in metabolic pathways associated with mineral homeostasis. The bone is also the primary site of homeostasis. It has been assumed by different researchers that bone architecture is influenced by mechanical stresses associated with its normal function.

As E. Seeman states in one of his artful articles "Bone is not an impermeable solid; it is a metropolis of highways and freeways, turpikes and under ground railways; a house of many rooms and corridors, with fluid-filled canal and canaliculi, wired with nerve fibres, fed with a vasculature no less complex than that of the hepatobiliary, pulmonary-alveolar or renal-glomerular systems". (Seeman E. The periosteum. Osteoporosis Int 18:123-128;, 2007).

The bone is surrounded by an envelope, which is called the periosteum. The cellular activity during growth adds bone to

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the periosteal surfaces, which increases the whole bone cross-sectional area thickening in the cortex of the bone. Most of the cortical thickness and mass is the product of periosteal apposition, which is a most important feature in the construction of the skeleton.

Under physiological conditions, the structural and functional relationship of bone helps maintain mineral homeostasis. To fulfill this structure/function relationship effectively, bone is constantly being broken down and rebuilt, which is a process called remodelling. This function is accomplished by various cells originate from different tissues, including osteoblasts (bone forming cells), osteocytes and osteoclasts (bone resorbing cells). The bone forming osteoblasts and their progenitors embryonically originate from the mesodermal germ cell layer. Osteoclasts are the principal, if not exclusive bone-resorbing cells, are members of the monocyte/macrophage family. Bone metabolism is regulated by these bone cells that respond to various environmental signals, including mechanical, electrical, chemical and magnetic stimuli. Generally specific responses are governed by cellular receptors found on the membrane of the cell or within the cell. Cell membrane receptors bind the exogenous signals and transfer the information across the cell's cytoplasm to the nucleus. Intracellular receptors (cytoplasmic or nuclear) bind the stimulus (usually a steroid hormone) and then translocate that effector to the nucleus where the steroid-receptor complex binds to a specific DNA promotor sequence on the gene.

In this article, the basic elements of bone, namely the periosteum, the bone cells and their functions are discussed in general and at the molecular level.