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| **Name:** |
| Ryan Nemeh |
| **Group:** |
| 9B-1 |
| **Basic Science Question:** |
| What is Osteoclasts and Osteoblasts? |
| **Report:** |
| Skeletal growth, renewal, bone remodeling resorption of bones, and bone cell biology are common terms used when referring to osteoblasts and osteoclasts. Both are vital in the process of bone production as well as bone resorption.  There are a few factors that connect the relationship between osteoclasts osteoblasts. They each play an important role in basic bone cell biology and the process in which bone is produced in the body. Bone resorption is a key element in the osteoclast process, which is primarily involved in breaking down the tissue in bones, followed by a releasing of minerals, which then follows a transfer of bone tissue and calcium to the blood. Osteoblasts assist in new bone formation. Osteoclasts are responsible for bone resorption whereas osteoblasts are  involved in the bone remodeling processes and are bone-forming cells that originate from mesenchymal osteoprognitor cells. Another significant term to know is osteocytes which are mature permanent bone cells.  It is important to understand these terms entirely and understand the process by which osteoclasts and osteoblasts occur in bone. Osteoclasts resorb old osteocytes; also during the process in which osteoblasts assist in creating new bone, osteoblasts then mature into new osteocytes.  In “Osteoblast-Osteoclast Interactions” the article at-hand focuses on bone homeostasis and how studies have shown that there is a significant relationship between osteoclasts and osteoblasts and most importantly that they “can communicate with each other through direct cell-cell contact, cytokines and extracellular matrix interactions.” It also explains that "more and more studies have proven that osteoclasts can also affect osteoblast activity." This article effectively and comprehensibly explains the significance of the role of osteoblasts in osteoclast formation (cell-cell contact etc) as well as the role of osteoclasts in bone formation and all the contributing factors to each. Osteoclasts are described as "an "orchestrator" implicated in "concerted regulation of bone turnover." (Chen X;Wang Z;Duan N;Zhu G;Schwarz EM;Xie C;, *Osteoblast-osteoclast interactions*). Osteoclasts are also defined in this article as being "important regulators of osteoblast activity and angiogenesis, both by releasing factors stored in bone matrix, and secreting clastokines that regulate the activity of neighboring cells." (Chen X;Wang Z;Duan N;Zhu G;Schwarz EM;Xie C;, *Osteoblast-osteoclast interactions*). Again, an example of the relationship between osteoclasts and osteoblasts.  It is important to understand both osteoclasts and osteoblasts are critical cells present in the formation and consistency of bone. For example, a result of osteoporosis occurs when the relationship between osteoclasts and osteoblasts cannot effectively work due to underlying trauma occurring in the bone. This is also an explanation as to why these cells are necessary in order for each the cells to function properly, whether it be osteoclast or osteoblast. Another example of trauma to the bone would be a fractured bone. For example, a fractured radius, how does a bone repair itself? Through this process of bone remodeling in which osteoblasts assist in repairing the bone by creating new bone. This doesn’t necessarily suggest it will create new bone identical to the form of the individual’s original anatomy, but it will begin reparations to help heal and repair as best as possible. Bone resorption initially would occur, followed by osteoblasts creating new bone at the site of trauma. This is a simplified explanation of how and when processes of osteoblasts and osteoclasts occur in the body, but important to recognize.  In the article, “Osteoblast Precursors, but Not Mature Osteoblasts, Move into Developing Fractured Bones along with invading Blood Vessels” it provides a thorough, in-depth explanation on the role osteoblasts provide during a time in which a fracture of bone occurs. A rough summary of data found in this article is, “Pulse-chase studies showed the osterix expressing osteoblast precursors, labeled in the perichondrium prior to vascular invasion of cartilage, give rise to trabecular osteoblasts, osteocytes, and stromal cells inside the developing bone. Throughout translocation, some precursors were found to intimately associate with invading blood vessels… A similar coinvasion occurs during enochondral healing of bone fractures. In contrast, perichondria mature osteoblasts did not exhibit perivascular localization and remained in the outer cortex of developing bones. These findings reveal the specific involvement of immature osteoblast precursors in the coupled vascular osteogenic transformation essential to endochondral bone development and repair.” (Maes C;Kobayashi T;Selig MK;Torrekens S;Roth SI;Mackem S;Carmeliet G;Kronenberg HM;, *Osteoblast precursors, but not mature osteoblasts, move into developing and fractured bones along with invading blood vessels*). The article also contains multiple detailed diagrams providing information regarding precursor osteoblasts and mature osteoblasts. Another important detail of this particular article is where it explains the presence of only immature osteoblasts precursors that invade fetal bone from the perichondrium. It then continues to explain how “a fraction of these cells wrap around blood vessels in percyte-like fashion… Osteoblastic/vascular migrations in bone repair resemble the developmental pattern.” (Maes C;Kobayashi T;Selig MK;Torrekens S;Roth SI;Mackem S;Carmeliet G;Kronenberg HM;, *Osteoblast precursors, but not mature osteoblasts, move into developing and fractured bones along with invading blood vessels*).  A summary of the role that osteoblasts and osteoclasts play in the formation of bone is more complicated than a simple definition, their involvement in mammal anatomy and bone make-up is not a simple execution. The best way of simplifying the explanation of their roles would be by explaining what osteoblasts and osteoclasts are by definition. Osteoblasts are involved in the formation and mineralization of bones whereas osteoclasts are involved in the bone breakdown and bone resorption. Osteoblast are cells smaller in size and uninucleated, whereas osteoclasts are rather large cells that are multi-nucleated cells. Both are developed from different cells, for example, osteoclasts from monocytes or macrophages, and osteoblasts solely originate from osteogenic cells. One promotes breakdown of bone, osteoclasts, whereas the other, promotes the formation of bone. It is important to note that osteoclasts do not possess receptors for parathyroid hormone, however osteoblasts do possess these receptors. Defining osteoclasts and osteoblasts is a complicated task because the role each cell plays in bone formation cannot be simplified, the sources reviewed provide a brief in-depth explanation of what these cells tasks entail. An accurate conclusion would be that osteoclasts and osteoblasts are more intricate than a simple definition can provide and their role in human anatomy and bone formation is a vital part of bone composition. |
| **References:** |
| Maes C;Kobayashi T;Selig MK;Torrekens S;Roth SI;Mackem S;Carmeliet G;Kronenberg HM;. (n.d.). Osteoblast precursors, but not mature osteoblasts, move into developing and fractured bones along with invading blood vessels. Retrieved October 22, 2020, from https://pubmed.ncbi.nlm.nih.gov/20708594/  Chen X;Wang Z;Duan N;Zhu G;Schwarz EM;Xie C;. (n.d.). Osteoblast-osteoclast interactions. Retrieved October 22, 2020, from https://pubmed.ncbi.nlm.nih.gov/28324674/  A;, C. (n.d.). The Great Beauty of the osteoclast. Retrieved October 22, 2020, from https://pubmed.ncbi.nlm.nih.gov/24976175/ |