12.1E: Vitamin D Receptor

Vitamin D, along with vitamin A, are unique among the vitamins because they have nuclear receptors. Many steroid hormones have nuclear receptors. The following figure illustrates the action of a nuclear hormone receptor.

In the figure above of the hormone (in this case thyroid hormone), the receptor’s ligand (something that binds to the receptor), enters the nucleus and binds to the thyroid hormone receptor (TR). The TR has paired (formed a dimer) with the retinoid X receptor (RXR) on the hormone response element (HRE) in the promoter of target genes. The HRE for thyroid hormone is the thyroid hormone response element. Target genes are those whose transcription is altered by the hormone binding to its receptor on the response element. The mRNA produced then leaves the nucleus where it is translated into protein.

Vitamin A and D have nuclear receptors that act in the same fashion as nuclear hormone receptors. The video below very clearly explains the action of a nuclear hormone receptor. A thorough explanation of the nuclear Vitamin D receptor...
follows.

Video: Steroid Hormones

1,25(OH)\(_2\)D is considered to be the active form of vitamin D because it is the form that binds to the vitamin D receptor (VDR). Like the thyroid hormone example above, there is a vitamin D response element (VDRE) in the promoter of specific vitamin D target genes. In the figure below, 25(OH)D, the major circulating form of vitamin D, is usually transported through the blood to the kidney by vitamin D binding protein (DBP). Again, the kidney converts 25(OH)D to 1,25(OH)\(_2\)D by use of the enzyme 1alpha-hydroxylase. 1,25(OH)\(_2\)D moves from the kidney, or the tissue itself, into the nucleus. It then binds to the vitamin D receptor (VDR), that is dimerized to the RXR on the vitamin D response element of the target gene. Consequently, this then increases transcription of mRNA. The mRNA then moves into the cytoplasm to synthesize specific proteins. This process is shown in the figure below.
It's through this action that 1,25(OH)₂D is able to increase calcium absorption. In this case, the target gene is the calcium-binding protein calbindin. Thus, increased 1,25(OH)₂D leads to increased calbindin mRNA. This then leads to increased calbindin protein levels. Calbindin will be discussed in more detail in the calcium section.

References & Links


Video

- Steroid Hormone Receptor - [http://www.youtube.com/watch?v=Dxyq8GAWbpo](http://www.youtube.com/watch?v=Dxyq8GAWbpo)