Difference Between B cell receptor and T cell receptor

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Key Difference - B cell receptor vs T cell receptor

The defense system of the body is mainly developed with the presence of leukocytes which act against invading pathogens such as viruses and bacteria. Different types of leukocytes with different functions are present in the human body. B cells and T cells are the major leukocytes which involve in initiating specific immune responses. B cells function in the production of specific antibodies which involve in humoral adaptive immunity. T cells involve in cell mediated adaptive responses. Different responses are initiated by both cells. The receptors found in B cells and T cells are known as B cell receptors and T cell receptors respectively. The detection process of antigens differs according to the type of leukocyte as, either B cell or T cell. **The B cell receptors bind to soluble antigens that are present freely whilst T cell receptors only recognize antigens when displayed on Major Histocompatibility Complex (MHC)**. This is the **key difference** between B cell receptor and T cell receptor.

What is B cell receptor?

The B cell receptor (BCR) is a transmembrane receptor protein located on the outer surface of B cells. B cells are produced as well as mature in the bone marrow. The B cell development is initiated by the production of a functional pre-B cell receptor (pre-BCR). The pre-BCR consists of two immunoglobulin heavy chains and two surrogate light chains. These chains cooperate with IgA and IgB which are signaling molecules. The BCRs which is also known as integral membrane proteins reside in many identical copies at the surface of the B cells.

The B cell receptor complex is composed of an antigen binding subunit (MIg) which is made of two immunoglobulin heavy chains and two immunoglobulin light chains and a disulphide- linked heterodimer of Ig-alpha and Ig–beta proteins together, that make up a signaling subunit. The heavy chains of BCRs consist of gene segments like 51 VH, 25 DH, 6 JH and 9 CH. 51 VH segments that encode the N terminal of the antibody. This N terminal of the antibody includes the first two hyper-variable regions. 25 DH segment is a diversity gene segment which encodes the third part of the hyper-variable region. 6 JH is the joining gene segment which encodes the V region, and the 9 CH segment encodes the C region of the BCR.

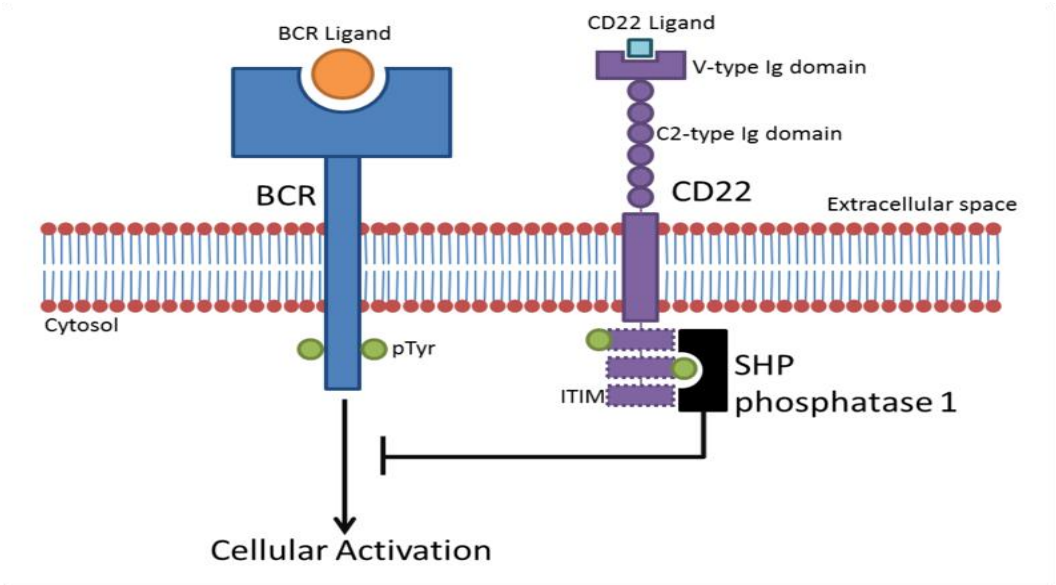

Figure 01: B cell receptor

BCRs have a specific binding site, and this site binds to a region of the antigen called the antigenic determinant. The binding is aided by non-covalent forces, the complementarity of the receptor surface and the surface of the antigenic determinant. If the BCR is present on the surface of B lymphocytes, it transmits intracellular signals which help in the regulation of cell growth and differentiation while also binding to specific antigens to generate an immune response. Memory cells that move through the circulation to produce immune responses are also produced by the activation of BCRs. The antigens which are bound to this, occur with the engulfment by the B cells due to receptor-mediated endocytosis. Then the antigens are being digested into small fragments and are later displayed at the surface of the cells inside the class II histocompatibility molecule.

What is T cell receptor?

T cell receptor (TCR) is found on the surface of T lymphocytes. TCRs function is to recognize foreign particles known as antigens to initiate an immunological response. During normal conditions, the body develops and produces many T cells, and each of the cells possesses a unique TCR on its surface. The development of TCR occurs due to the recombination of genes which encode TCRs prior to the encounter of antigens. In the surface of a T cell, identical TCRs occur in larger quantities. The antigens which bind with the TCRs are small peptide particles which are epitopes that occur through the phagocytosis of the foreign pathogen. These epitopes are displayed by Major Histocompatibility Complex (MHC) molecules.

T cells are of two types. Cytotoxic T cells (Tc) and Helper T cells (Th). The TCRs present on Tc cells recognize foreign epitopes which are presented by MHC Class I molecules. They possess the ability to differentiate nonself (foreign) antigens from self-antigens. Therefore, it prevents the occurrence of immune responses against the body's own cells. Th cells recognize antigens displayed on MHC Class II molecules. A surface glycoprotein CD8 in Tc cells and CD4 in Th involve during the binding process of the foreign epitope to both types of T cells. CD4 and CD8 co-receptors

recognize antigens presented on MHC Class II and MHC Class I molecules respectively.

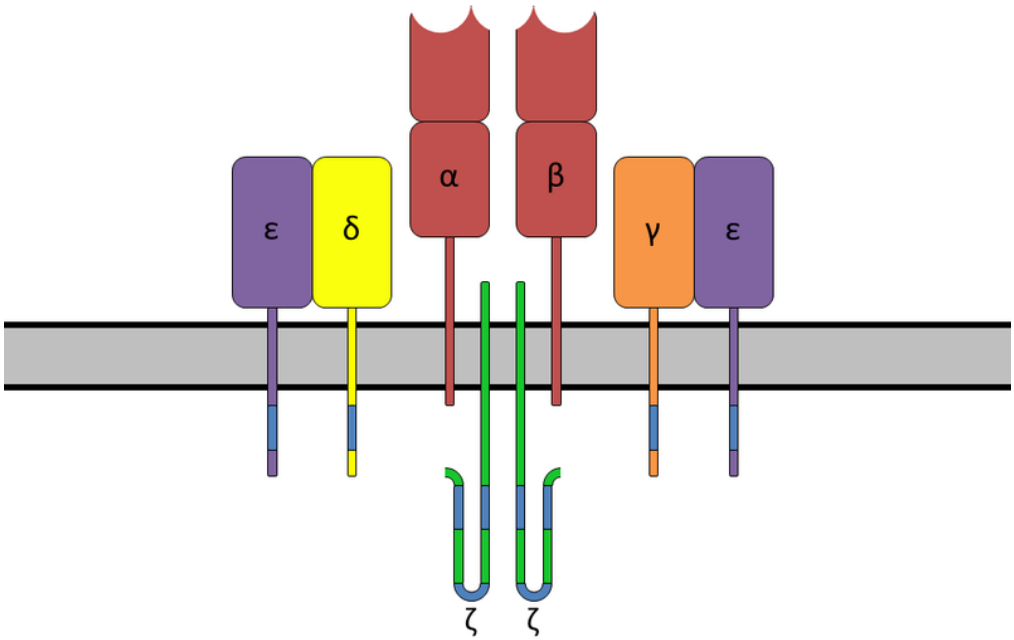

Figure 02: T cell receptor

The TCR is a transmembrane heterodimer which is composed of two chains. Thy typical structure of TCR is not sufficient in transducing a signal. This occurs due to the short cytoplasmic chains they possess. To overcome these situations, TCRs associate CD3 transmembrane proteins. The CDS complex consists of different subunits which include CDe, CDg, CDd and Z (CDz). This develops the TCR complex which is able to transduce a signal.

Due to the chance of binding a self-antigen by TCR, once an antigen gets bound to TCR, it does not initiate an immune response immediately. This is referred to as T cell tolerance. To initiate an immune response, the T cell (TCR) requires a second signal in the form of a co-stimulatory molecule derived from an antigen presenting cell.

What are the Similarities Between B cell receptor and T cell receptor?

- Both receptors are integral membrane proteins.
- Present on the cell surface as many identical copies.
- Both types possess unique binding sites.
- Both types of receptors are encoded by genes that are assembled through recombination of segments of DNA.
- Both receptors bind to the antigenic determinant portion of the antigen, and the binding occurs through noncovalent forces.

What is the Difference Between B cell receptor and T cell receptor?

B cell receptor vs T cell receptor	
B cell receptor is a transmembrane receptor protein located on the outer surface of B cells.	T cell receptor is an antigen recognizing molecule present on the surface of T lymphocytes.
Recognition of epitope-antigens	
B cell receptor recognizes soluble antigens.	T cell receptor recognizes antigens displayed on MHC Class I and MHC Class II molecules.

Summary - B cell receptor vs T cell receptor

B cells and T cells are important components of the immunity system. Both cells possess cell surface receptors known as BCR and TCR respectively. Both receptors are integral membrane proteins and present on the cell surface as many identical copies. Both BCR and TCR possess unique binding sites. They differ in the process of the recognition of antigens. The BCRs detect and bind to soluble antigens that are present freely whilst TCR only recognize antigens when displayed on Major Histocompatibility Complex (MHC). This is the difference between B cell receptor and T cell receptor.

Reference:

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Image Courtesy:

1.'Schematic representation of the CD22 and B-cell receptor signalling process' By Minimuns - Drawn using Powerpoint (CC BY-SA 3.0) via Commons Wikimedia
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