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Review Article

Role of Haematology and Immunology in COVID 19

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Abstract

From an evolutionary point of view, the primary function of the immune system was to safeguard the host from pathogens. The immune system's discriminatory functions have been shaped by selective pressures, which constantly balance the killing of pathogens with protecting host tissues. The immune system plays a crucial role in antitumor immunity as well as protecting against microbial pathogens. A wide range of hematologic disorders are characterized by immune dysfunction, which can be under- or overactive. In this section, we go over the fundamental aspects of the immune system as well as the key ideas that are necessary for comprehending how immune dysfunction affects hematologic disorders.

Medical and scientific efforts to comprehend the biological basis of COVID-19 pathophysiological mechanisms have been prompted by the ongoing pandemic of Corona Virus Disease 2019 (COVID-19), which was brought on by the Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV-2). As a result, evaluating the risks associated with COVID-19 infection and the efficacy of its management may benefit from an examination of a variety of immunological and haematological parameters.

A 70-year-old man, who was previously in good health, presents with six weeks of stifling night sweats and fatigue. Lymphadenopathy in the inguinal, axillary, and cervical regions stands out during the physical exam. For mild anemia and an elevated lactate dehydrogenase level, laboratory studies are important. A lymph node biopsy reveals CD20+CD10+Bcl6+ large B cells, indicating a germinal center subtype of diffuse large B-cell lymphoma. He goes into complete remission after undergoing immunochemotherapy with rituximab, cyclophosphamide, doxorubicin hydrochloride, vincristine sulfate, and prednisone, also known as R-CHOP, for six cycles. However, despite salvage immunochemotherapy, his lymphoma recurs within six months and progresses. He then discusses with his hematologist the pros and cons of a Bispecific T-Cell Engager (BiTE) clinical trial versus Chimeric Antigen Receptor T Cell (CAR-T) therapy.

Keywords: Haematology, Immunology, COVID-19, Pathogen

INTRODUCTION

The innate and adaptive arms of the immune system are traditionally divided into two primary arms. The innate immune system's most important characteristic is its rapid, nonspecific response to a wide range of pathogens and tissue damage. Germ line-encoded Pattern Recognition Receptors (PRRs), which are able to recognize conserved features of pathogens or damaged cells, which are referred to as damage-associated molecular patterns or pathogen-associated molecular patterns, mediate this response. Granulocytes, monocytes/macrophages, Dendritic Cells (DCs), and Natural Killer (NK) cells are all members of the innate immune system. Innate immune cells recognize broadly conserved structures like bacterial lipopolysaccharide, which is a component of gram-negative bacteria, or pathogen-associated nucleic acids like double-

stranded RNA through PRRs. There are four primary types of PRRs: C-type lectin receptors, NOD-like receptors, RIG-I-like receptors, and toll-like receptors (Anderson B, 2015).

The median age was 65 years old, with an interval of -57 to 71 years. P values that were extremely significant were obtained when white blood cell and lymphocyte counts were compared. Ferritin and D-dimer levels had P values that were extremely significant, while LDH and CRP levels were both statistically significant. In mild-to-moderately infected patients, the correlation of lymphocytic subsets had a significant impact on total lymphocyte counts, while in mild-to-moderately infected cases, both CD4+ and CD8+ counts had a statistically significant impact. Additionally, levels of D-dimer, CRP, and LDH were found to be statistically significant (Barnes J, 2013).

Immune System Response

Antigen specificity and the development of immunological memory, the capacity of lymphocytes to respond to a previously encountered antigen more rapidly and effectively upon exposure, are the central characteristics of the adaptive immune response, which stands in contrast to the innate immune response. The adaptive immune system's primary cells are B and T lymphocytes. B-Cell Receptor (BCR) and T-Cell Receptor (TCR) antigen receptors are expressed by both lineages and undergo somatic rearrangement to enable B and T cells to recognize and respond to specific antigens. The primary mediators of the humeral (i.e., antibody-mediated) immune response, which serves to shield the host from microbes from outside the cell and stop the spread of pathogens inside the cell, are B cells. T cells are the primary effector cells that kill virally infected or transformed host cells and support the humeral immunity. They also mediate the cellular immune response (Choquet A, 2018).

DISCUSSION

Antigen specificity and the development of immune memory that lasts a long time are shared characteristics among lymphocytes in the adaptive immune system. By somatically rearrangement of several sets of gene segments encoding the BCR, which is also a membrane-bound form of antibodies or Immunoglobulins (Ig), and TCRs to generate receptor diversity, specificity is achieved by each lymphocyte bearing an antigen receptor that recognizes a single epitope. Through DNA recombination mediated by the Recombination-Activating Genes (RAG1/2), the Variable (V), Diversity (D), and Joining (J) gene segments are somatically rearranged during B- and T-cell development in a manner that is comparable to that which takes place at the light and heavy chains of the immunoglobin loci or the and chains of the TCR locus (Clayton S, 2016).

Until the TCR's recognition of peptide-MHC complexes triggers an intracellular biochemical signalling cascade that initiates a program of clonal proliferation and differentiation (with additional input from stimulatory molecules and cytokines), naive T cells circulate in the periphery and become effector T cells. In the adaptive immune response to pathogens, CD4+ and CD8+ T cells play distinct functional roles but undergo similar differentiation processes over several days to reach functional maturity. TCR signal strength, stimulatory ligands, and the local cytokine milieu all have an impact on the differentiation of naive cells of both lineages, which are activated by their TCRs. The expression of important transcription factors and effector molecules, which give the activated T cell its unique function, is driven by the integration of these signals. After activation, activated CD8+ T cells cause host cells to die, whereas activated CD4+ T cells primarily activate other immune cells through cytokine production or direct cell-to-cell contact. Naive CD4+ T cells have the potential to become one of several principal effector (or "helper") subsets, such as TH1, TH2, TH17, or T Follicular Helper (TFH) cells, depending on the signals they receive during differentiation. Peripheral T-cell lymphomas have been described as distinct subsets that are most likely the result of these subsets. In the right setting, naive CD4+ T cells can also be induced to become Tregs and perform immunosuppressive functions, in addition to the typically derived Tregs. After being stimulated by an antigen, CD8+ T cells develop into effector cells with terminal differentiation or memory cells with a long lifespan (Dunn G, 2017).

Effective Immune Response

A successful immune response prevents damage to the host while clearing the pathogen and establishing immunologic memory. Diverse cell types, cytokines, and anatomical localization all need to be carefully orchestrated in a multistep process. There are three main phases to a typical immune response: acute inflammatory response of the innate immune system to the pathogen that is invading, presentation of the antigen, and adaptive immune response involving B lymphocytes and CD4+ and CD8+ T cells. Initial response to acute inflammation: The epithelial and mucosal surfaces of the respiratory, gastrointestinal, and urogenital tracts are typical examples of barrier surfaces that aim to stop pathogens from entering the host. The majority of pathogens cause a local infection in the tissues after passing through these barriers. Through their germ line-encoded PRRs, innate immune cells initiate an intracellular signalling cascade that activates their unique effector functions by recognizing pathogen- and damage-associated molecular patterns. The production of cytokines and chemokines encourages local inflammation by attracting innate effector cells like monocytes and neutrophils to the circulation. The presentation of pathogen-derived antigens by APCs elicits the adaptive immune response in local lymphoid tissues in the event that the initial innate immune response is unable to contain the infection (Eigenbrode SD, 2007).

Biomarkers for immune effectiveness can be found in a variety of global longitudinal studies on immune system responses, which may aid in the fight against this global

infectious disease. Additionally, research on immune responsiveness has made it possible to develop a disease-specific treatment (Fiksel J, 2014).

The investigation of a number of laboratory parameters that were linked to the severity and mortality of COVID-19 infection was the novel scope of this study. These parameters include the number of white blood cells, or WBCs; throughout the course of this pandemic, patients were tested for lymphocytes, platelet count, D-dimer, and ferritin. The severity of the disease was estimated using other inflammatory biomarkers like CRP (Glika DC, 2007).

CONCLUSION

In many hematologic disorders, immunotherapeutic approaches to overcoming or bypassing immune dysfunction have been clinically successful. The allogeneic HSC transplant, which was first performed on a human being in 1957, is the most well-known example of immunotherapy used to treat hematologic malignancies. Discoveries resulting from decades of research have revealed that the reconstituted donor-derived immune system, particularly donor lymphocytes, mediates a graft-versus-leukaemia/ lymphoma effect and also leads to graft-versus-host disease, in which activated donor T cells recognize the host (Hoover E, 2015).

COVID-19 is a disease that spreads beyond the borders of its source country; However, it has quickly spread throughout the entire world. Because of this, new research from all over the world is providing a lot of information and a lot of clinical data about patients who have the COVID-19 virus. This could help in the early detection of different patient groups and in defining the complications that come with it, especially when it comes to other chronic diseases. However, there are insufficient data to characterize the numerous alterations in immunological and haematological parameters that occur in COVID-19-infected patients. Additional findings from this study can be used to develop treatment plans for COVID-19-infected patients at various stages (Maxwell K, 2014).

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CONFLICT OF INTEREST

None

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