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Haematology- from CBC to CPD

Abstract

Introduction: The cell population data or CPD are research population data, also known as "Investigation screen parameters" which can be of help in diagnosing and predicting variety of infections and malignancies. This review article aims to analyse the various studies that have been conducted till date utilizing the cell population data for diagnosing and predicting various diseases.

Conclusion: Recently, there has been a paradigm shift in reporting CBC parameters and in the usefulness of CPD and is gaining attention of researchers worldwide. As more and more studies are being conducted worldwide, the usefulness of CPD in detecting & predicting various hematologic & non hematologic conditions will be available and will revolutionize the branch of hematology.

Keywords: MNeV, MMoV, MLyV, leukocyte count, conductivity, cell biology, microscope

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Abbreviations: CBC, complete blood count; CPD, cell population data; VCS, volume, conductivity, scatter; SD, standard deviations

Introduction

It is widely believed that Dutch spectacle makers, Zacharias Jansen and his father, Hans were responsible for making the first compound microscope in the late sixteenth century, which magnified the images up to three times.[1] Later on Anton Van Leeuwenhoek, a Dutch tradesman and Father of Microbiology, made improvement in the microscope.[2] The invention of the microscope was a major breakthrough in the field of cell biology and since then pathologists have been diagnosing diseases through the microscope. Later on, the automated hematology analyzers made the work of pathologist simpler by providing CBC parameters and different flags and replaced microscopy to a certain extent. Till a few years back, the mainstay of hematology reports was the numerical complete blood count (CBC), in which total number of different types of leucocytes and their absolute numbers was reported also known as the differential leukocyte count. The semi automated and some of the fully automated hematology analyzers reported the differential data only and the slides had to be screened for cell morphology to gather any evidence of underlying disease condition. Recently, newer hematology analyzers like LH500, LH 750, DxH800 (Beckman Coulter), utilize the cell population data (CPD) generated through VCS technology to flag abnormal cells, which help in screening and detection of hematologic and non hematologic diseases.

VCS (volume, conductivity and scatter) technology measures nearly 8000 cells in their "near native state" using direct current impedance for measuring volume (V) of the cells. Conductivity (C)is measured by radiofrequency opacity to analyse the internal composition of the cells and light scatter (S) is measured by a laser beam to analyse the cytoplasmic granularity and structure of the nucleus.[3,4] The cell population data of normal leucocytes is generated by these instruments. The cell population data or CPD are research population data ,also known as "Investigation screen parameters" which can be of help in diagnosing and predicting variety of infections and malignancies like bacterial infections and sepsis, malaria, dengue, viral infections some types of anemia's like megaloblastic anemia's, myelodysplastic syndromes, lymph proliferative and myeloproliferative disorders and several plated related disorders.[5,6] These CPD consist of volumes of neutrophils, lymphocytes and monocytes (MMoV, MNeV, MLyV) and their standard deviations (SD). While the total WBC counts and their differential counts are given by automated hematology analyzers, a trained and experienced technologist has to go through the slides under the microscope .This can be subject to interobserver variation and variable amount of imprecision and sensitivity. Many studies have been conducted in the past few years utilizing these CPD for the benefit of the patients and without additional cost. This review article aims to analyse the various studies that have been conducted till date utilizing the cell population data for diagnosing and predicting various diseases.

Methods

Data was collected from internet regarding studies conducted on Beckman Coulter series of hematology analyzers using the cell population data for diagnosis of various hematologic and non hematologic diseases.

Results

Bacterial infection and sepsis

In 2005, Chaves Fernando et al conducted a study for the quantitative determination of neutrophils VCS parameters as indicators of acute bacterial infection.[6] They observed that the elevation of MNeV was associated with a higher WBC count and at a cut off value of 150 for the MNeV, there was 91% specificity and 70% sensitivity. Chaves Fernando et al in 2006 conducted a study on neutrophils volume distribution width in acute bacterial infection.[7] They observed a significant increase in NeVDW in bacteremic patients. With a cut off of 23 for NeVDW, they achieved 100% specificity and 69% sensitivity. Raimondi et al.,[8] Mardi et al.[9] and Park et al.[10] conducted similar studies with neutrophils volumes in pediatric patients, non systemic bacterial infections respectively.

Malaria

Briggs et al.[11] developed an automated malaria discrimination factor using VCS technology. Fourcade et al.[12] conducted a study to

detect malaria by means of hematology analyzer. This was probably the first study for malaria. Subsequently many studies have been conducted on the usefulness of CPD in detection of malaria.

Dengue

Simon[13] observed that monocytes anisocytosis was a new hematological marker for detection of dengue fever. Ranjana et al.[14] used lymph index as a marker of dengue infection and found that a lymph index cut off of >13.6 achieved a sensitivity & specificity of 71.17% and 78.05% respectively in predicting dengue infection as compared to controls.

Viral infections

Jung et al.[15] evaluated CPD of Unicel DxH800 Coulter system to screen for viral infection in children using a combination of CBC and CPD parameters. They achieved a sensitivity of 96.1% & specificity of 93.7% for detecting viral infection.[16] Zhu et al.[17] developed lymph index, a potential hematological parameter for viral infection.[10] They observed that the lymph index was significantly increased in viral infections & very minimal increase was observed in bacterial infections. Using a cut off of lymph index >12.92, they achieved a sensitivity of 91.7% and specificity of 97.2% for diagnosis viral infections.

CPD in other hematologic conditions

CPD has been used to diagnose a variety of other hematologic conditions, both malignant & non malignant, including megaloblastic anaemia, myelodysplastic syndrome lymph proliferative disease and in various platelet associated disorders.[17–21]

Discussion & conclusion

Manual differential count is now being replaced by automation because it is imprecise time consuming & labour intensive. Modern hematology analyzers are able to provide fast, precise, accurate & cost effective differential counts and are much more reliable. However, a microscopic examination of a well stained peripheral smear by an experienced pathologist is still the gold standard for diagnosis of various diseases and its role cannot be undermined. Recently, there has been a paradigm shift in reporting CBC parameters and in the usefulness of CPD and is gaining attention of researchers worldwide. As more and more studies are being conducted worldwide, the usefulness of CPD in detecting & predicting various hematologic & non hematologic conditions will be available and will revolutionize the branch of hematology. Majority of the studies have been conducted on The CPD parameters of Beckman Coulter series of hematology analyzers. More studies in different population groups and on other hematology analyzers are required to validate these studies and to incorporate them into the laboratory information system for the benefit of the clinicians and the patients alike. The studies in the coming years will definitely be game changers in the field of hematology.

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Conflict of interest

The author declares no conflict of interest.

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