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INDICATION AND CRITERIA OF PERIPHERAL BLOOD SMEAR

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Abstract:

A peripheral blood smear review is a standard test used to diagnose both hematologic and non-hematologic illnesses. An expert's evaluation of a peripheral smear allows for a broad examination of blood cell morphology and may identify metabolic, nutritional, genetic, and inflammatory problems, as well as hemolysis, blood-borne parasites, and neoplasia. Literature review among previous published studies up to November, 2021, carried out to reach the concept of indication for peripheral blood smear. In contrast, smears requested to evaluate anemia and thrombocytopenia, the most common reasons for peripheral smear review requests, had lower rates of potential clinical value, aside from confirming the absence of significant findings.

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INTRODUCTION:

A blood smear review (BSR) is described as a meticulous microscopic examination of a well-prepared and stained smear of peripheral blood with the goal of identifying morphological alterations important to patient diagnosis and monitoring [1]. It is also regarded as an internal quality control tool for evaluating the parameters offered by hematology analyzers. BSR is one of the most time-consuming processes in hematology laboratories, requiring great technical expertise to prevent errors inherent in the subjectivity of MBSR, such as manual differential leukocyte counts (MDLC) [2,3].

A complete blood count, often known as a CBC or, less frequently, a Hemogram, is the most common test performed in a clinical hematology laboratory. The differential leukocyte count, or DIFF, is the second most routinely done hematologic test. Both of these tests can be performed fairly reliably, efficiently, and cost-effectively using currently available automated hematology analyzers [4,5]. A qualified laboratory professional's microscopic evaluation of a correctly prepared and well-stained blood smear is, nevertheless, important and clinically valuable in a variety of contexts and for a variety of reasons [6,7]. Screening prepared blood films is time-consuming, tedious, and sensitive to inter- and intra-observer variance. This has consequences for both laboratory resources and diagnostic accuracy. As a result, many studies have addressed issues with microscopic image analysis of peripheral blood smears, and establishing image analysis methods for computer-assisted interpretations of peripheral blood smears is critical. (**Figure 1**) depicts the fundamental workflow processes in a peripheral blood smear image analysis system [8,9].

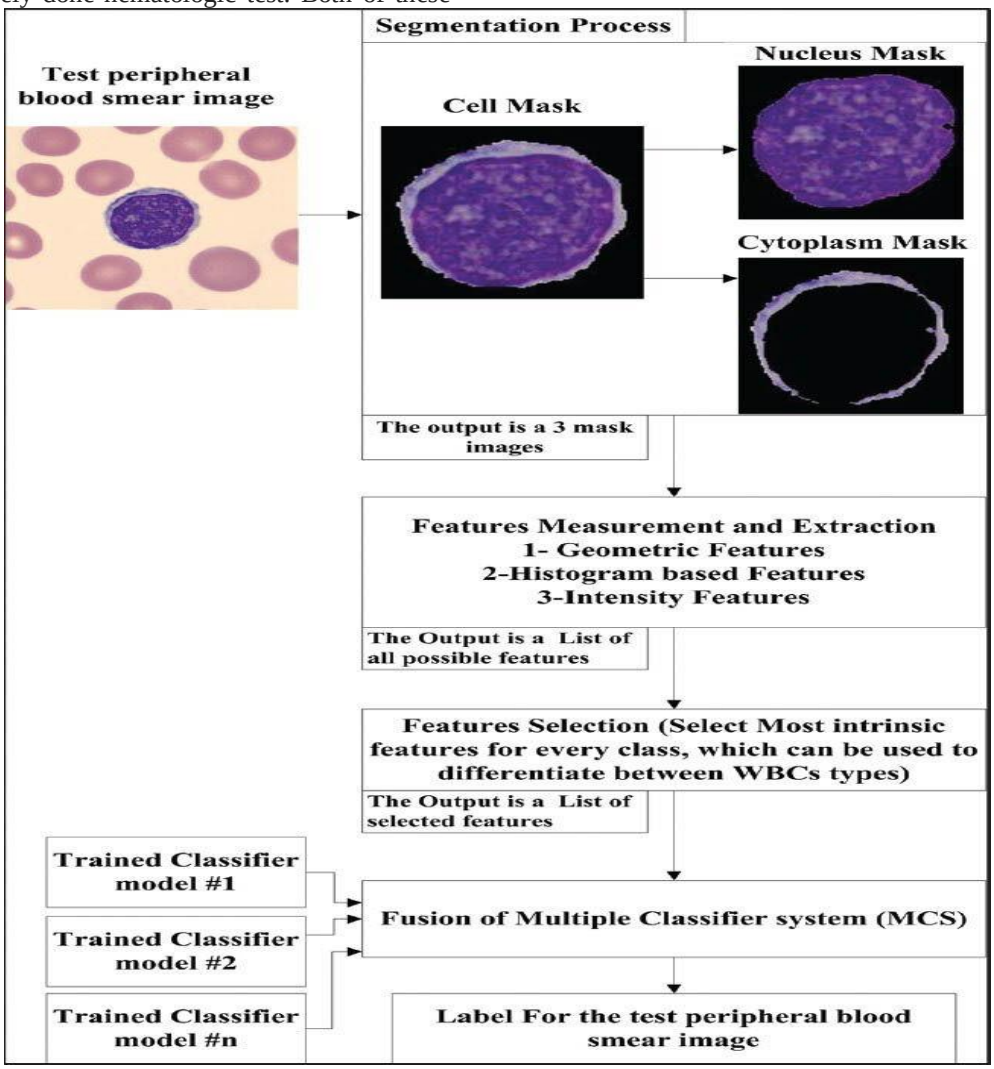

Figure 1: Workflow of peripheral blood smear image analysis, starting from image segmentation and features extraction

DISCUSSION:

A peripheral blood smear review is a standard test used to diagnose both hematologic and non-hematologic illnesses. An expert's evaluation of a peripheral smear allows for a broad examination of blood cell morphology, which may indicate metabolic, nutritional, genetic, and inflammatory problems, as well as hemolysis, blood borne parasites, and neoplasia [10]. Smear examination is frequently used as a reflex test to examine abnormalities detected by automated tests such as complete blood count with differential (CBC-D) [11]. Clinical concern for hemolysis, hematolymphoid neoplasms, and other disorders marked by abnormalities in blood cell morphology are also indications [12]. Despite the growth of automated laboratory tests in recent decades, smear review remains an agnostic test with the ability to reveal information beyond what automated testing alone can identify [11]. Furthermore, sample collection provides little risk to the patient, and the smear itself is simple and rapid to create.

Interestingly, in some situations, the reason for the smear was not directly related to the potentially significant discovery, implying that the discovery was unanticipated. These smear reviews were a subset of all studies with potential added clinical value; a list of smears with surprising findings is included in the report (**Table1**). The evaluation of peripheral blood smears is widely acknowledged as an important stage in the workup of many clinical conditions. However, the test predates the automated hematological and chemistry assays that are currently ubiquitous in resource-rich medical institutes. Modern hematology analyzers, for example, can detect platelet clumping as well as assess numerous RBC properties such as mean corpuscular volume, mean corpuscular hemoglobin concentration, and red cell dispersion width. These metrics analyze RBC morphology and may detect pseudo-thrombocytopenia, obviating the necessity for manual examination in some circumstances [12].

The list of criteria for smear review is usually developed by individual laboratories with input from pathologist(s), clinicians, and the hematology supervisory staff, and may be updated periodically as deemed appropriate. Although, clinical significance of the abnormal CBC and DIFF findings is the major determining factor in deciding which blood smears need review, several other factors may also influence such a decision. These factors may include patient population served, clinicians' concerns pertaining to specific patient populations, training and experience of blood smear examiners(s) and reviewer(s), workload of the laboratory and the reviewer(s), initial vs. follow-up smears, QC/quality assurance (QA) consideration, and teaching/educational considerations. Published criteria may be used by individual laboratories as a starting point in the process of developing their own set of criteria [13,14].

Table 1: Findings among individual smears requested for select indications

Indication	**Findings seen among individual smears requested for the specified indication**
Leukocytosis	• Atypical / variant lymphoid cells
	• Findings consistent with a hemoglobinopathy
	• Leukemia or blasts
	• Rouleaux
Anemia	• Atypical/variant lymphoid cells
	• Dysplasia
	• Findings consistent with a hemoglobinopathy
	• Hemolysis
	• Leukemia or blasts
	• Other
	• Platelet abnormality
	• Rouleaux
Leukopenia	• Atypical/variant lymphoid cells
	• Dysplasia
	• Findings consistent with a hemoglobinopathy
	• Hemolysis
	• Leukemia or blasts
	• Platelet abnormality

Thrombocytopenia	• Atypical/variant lymphoid cells
	• Dysplasia
	• Hemolysis
	• Leukemia or blasts
	• Platelet abnormality
	• Rouleaux
Hemolysis	• Dysplasia
	• Findings consistent with a hemoglobinopathy
	• Hemolysis
	• Leukemia or blasts
	• Other
	• Platelet abnormality
	• Rouleaux

Several of the reports describing the detection of yeast in blood smears suggested microscopic review as a method for early detection of yeast fungemia. The usefulness of blood smear review for this purpose ultimately depends on the frequency of very high yeast levels in clinical samples. Therefore, it is important to ascertain how frequently yeast levels of 10^5 and higher (the concentration we found was necessary to detect yeast in a blood smear) occur in clinical samples. In order to address this question, we reviewed the relevant literature. Several groups have used quantitative cultures to measure the concentration of yeast in blood samples from fungemic patients [15].
Recent investigations have applied molecular methods to the quantification of *Candida* in blood samples, and these methods are not subject to this limitation. For example, Maaroufi et al [16,17] described a polymerase chain reaction–based assay to quantify *C albicans* in blood samples from patients with clinically proven or suspected systemic *Candida* infections. They found a wide range of *C albicans* loads among 11 positive samples tested, extending from 5 to 100475 CFU/mL [17].

CONCLUSION:

The review of peripheral blood smears is a time-consuming, under-reimbursed investigation with uncertain therapeutic relevance. According to this multi-institutional study, smear review ordering processes vary, but result in a small number of smear reviews with potential clinical benefit beyond automated laboratory testing alone. The indications with the highest potential clinical value rates (WBC number, WBC morphology, and assessment for hematolymphoid malignancy). Smears requested to check anemia and thrombocytopenia, the two most prevalent causes for peripheral smear evaluation, had lower rates of possible clinical usefulness, aside from verifying the absence of noteworthy abnormalities.

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