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The Hemogram without Differential may Negatively Impact Patient Care

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Abstract

The complete blood cell count (CBC) includes measuring the red blood cells (RBC), white blood cells (WBC), platelets (Plt), and automated differential white blood cell count. At 41.5 million tests, the CBC (CPT 85025) was the second most performed test in 2017 [1]. However, blood cell components can also be ordered separately (including CBC without WBC differential) and they are reimbursed at a lower rate than the CBC.

While this makes clinical and financial sense, modern CBC machines always measure every single cellular blood component but report out just what the clinician ordered. Since any test less than a complete blood count may miss important diagnoses (e.g. acute leukemia) ordering separate components endangers patients' lives and well-being.

Keywords: Complete blood count; Hemogram with differential; Hemogram without differential; Reimbursement; CPT 85025; Missed diagnosis; Acute leukemia

The Story (Part-1)

On a Monday morning in the early spring of 2019, a 67-year-old man walked into his primary care physician's office for his routine annual physical exam. He had no symptoms of any sort and the doctor did not find any abnormalities during the exam. A set of basic laboratory tests was also ordered as part of the annual exam.

The next day the primary care physician checked the lab results through the electronic medical records (EMR), and all results were within normal limits. The only slight abnormality was a borderline lymphocytosis on the patient's hemogram.

Since he had seen similar abnormalities before with no real clinical significance many times, the primary care physician did not make much of it and went on with his daily routine. A couple of hours later, however, he received a call from the pathologist working at the laboratory where the patient's specimens were sent. The pathologist informed the physician that what the automated blood count measured as lymphocytes were in fact blasts and, therefore, his patient had acute leukemia. The pathologist also informed the physician that additional tests should be performed in order to determine what type of leukemia it was. The physician agreed with the add-on tests while wondering how a man in seemingly perfect health could have such a diagnosis.

The Lab

To understand what happened from the moment the hemogram was ordered by the attending doctor until the moment he received the call from the pathologist we need to examine the process of blood count analysis.

Once the tube arrives in the lab, a technician runs it through an automated machine. Nowadays all blood counts are measured initially by these machines. They are equipped with computers connected directly to the EMRs and, if the results are normal or near-normal, the computer is programmed to transmit the results directly to the EMR without any human intervention, a process called auto verification. If the results fall outside certain set standards the machine's computer halts the process and flags the results. This is the point when a lab technician takes over. The lab tech makes a blood smear, examines it under the microscope, and compares the findings with the results reported by the machine. According to certain criteria, the lab tech will triage the case and then will decide whether the results could be allowed to be transmitted to the EMR or to be forwarded to a pathologist for further evaluation. The pathologist in turn has certain options depending on the findings.

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The pathologist may allow the results to be transmitted to the EMR without any other action or may halt the process and call the ordering clinician to inform him or her of an unexpected result and to suggest additional tests if necessary.

A few words about the automated blood cell counters. The Coulter counter was invented in the late 1940s by Wallace Coulter based on the Coulter principle which "states that particles pulled through an orifice, concurrent with an electric current, produce a change in impedance that is proportional to the volume of the particle traversing the orifice [2]". Nowadays the CBC machines are far more complex using simultaneously three distinct technologies for measuring and sorting out different cell populations.

Despite this significant technological advance, these machines are far from being perfect. Concerning measuring leukocyte subsets, for example, they can detect a maximum of only five types of cells (the so-called "five-part differential machines"): neutrophils, lymphocytes, monocytes, eosinophils, and basophils. Although the machines are not capable of recognizing other cell types (e.g. myelocytes, metamyelocytes, blasts, etc.) they are at least able to detect their presence in the blood sample. This is where the system of flagging abnormal results comes into place.

Being aware of this impediment and to avoid missing certain conditions, including, and especially, acute leukemias, The International Society of Laboratory Hematology established guidelines on the flags generated by CBC machines and what kind of actions these flags should trigger [3]. Here is a selection of criteria limited to leukocytes (Table 1):

ISLH Consensus Guidelines

Table 1: Suggested Criteria for Action Following Automated CBC and WBC Differential Analysis [3].

Rule#	Parameter	Primary	Action 1
5	WBC	<4.0 OR > 30.0	Slide Review
16	No diff or incomplete diff		Manual Diff and Slide Review
17	Neut#	<1.0 or > 20.0	Slide Review
18	Lymph#	>5.0 (adult) or >7.0 (<12 yrs old)	Slide Review
19	Mono#	>1.5 (Adult) or >3.0 (<12 yrs old)	Slide Review
20	Eos#	>2.0	Slide Review
21	Baso#	>0.5	Slide Review
25	Suspect flag	Flag+	Slide Review
37	Blast flag	Flag+	Slide Review

It must be mentioned that these new machines measure for every single blood sample all the parameters for all blood components regardless of the type of order.

For example, if a physician orders a simple hemogram which includes red blood cells with all indices, total white blood cells without differential and platelets, the machine, besides the parameters mentioned, also performs a leukocyte differential but suppresses the results, and reports strictly what the physician ordered. This way all the flags related to the leukocyte subsets and other abnormalities are disabled! In the table above one can see that a hemogram without differential has only one flag available and that one relates to the total number of WBCs (Rule# 5).

If the total number of leukocytes falls outside the minimal or maximal criterion the results will be flagged, but all other criteria (Rules 16 to 37) are disabled.

CMS

The Centers for Medicare and Medicaid Services (CMS) have implemented over the years a system of coding and reimbursement for both complete blood count (CBC) with differential and several tests representing partial automated or manual blood counts. Below is an extract of the 2020 Clinical Laboratory Fee Schedule (Table 2) [4].

Table 2: Extract of the 2020 Clinical Laboratory Fee Schedule.

Description	Code	National Fee Limit
CBC (with automated Hgb, Hct, RBC, WBC, platelet) plus automated diff	85025	$7.77
CBC as above without diff	85027	$6.47
Manual diff WBC (microscope)	85007	$3.80
Blood smear (microscope) without manual diff	85008	$3.43
WBC diff, automated	85004	$6.47
WBC, automated	85048	$2.54
Hemoglobin, automated	85018	$2.37
Hematocrit, automated	85014	$2.37
Platelet, automated	85049	$4.48

Most of the partial blood counts had been historically carried over the years without taking into account the changes in technology and how laboratories currently operate. As readily noticeable from the table above, the major advantage of having this multitude of partial hemograms is simply a financial one. When physicians order anything other than a "CBC plus automated differential," each patient saves just a small amount of money, but CMS overall, given its large number of members, saves millions of dollars. But is ordering partial blood count tests good medicine?

In addition to this relatively confusing array of related tests, CMS also restricts reimbursement as seen in the following "limitations:"

Limitations [5]

1. Testing of patients who are asymptomatic, or who do not have a condition that could be expected to result in a hematological abnormality, is screening and is not a covered service.

2. In some circumstances it may be appropriate to perform only hemoglobin or hematocrit to assess the oxygen-carrying capacity of the blood. When the ordering provider requests only hemoglobin or hematocrit, the remaining components of the CBC are not covered.

Both limitations encourage physicians to restrict the ordering of hemograms for asymptomatic patients or CBCs with a differential in other situations. However, as seen with the case in our story, the patient was asymptomatic and did "not have a condition that could be expected to result in a hematological abnormality." If the physician did not order a hemogram, this catastrophic diagnosis could have been missed.

As for the second "limitation", CMS does not understand that due to the current technology every single hemogram run by a laboratory goes through an identical process. The blood is run through a machine, the machine measures all parameters regardless of the order (whether a complete or partial hemogram) but only the requested values are reported. This means that the cost to run these partial hemograms is the same as for a CBC with differential, but the reimbursement is less.

The Story (Part-2)

Although the primary care physician was indeed surprised to find out that his "healthy" patient was suffering from acute leukemia, the doctor was happy that he ordered a CBC with differential instead of a simple hemogram without differential. Since the patient was asymptomatic, there was even a chance he might not have ordered a CBC altogether just to stay in compliance with the CMS reimbursement policy for such a situation!

The Solutions

Missing or delaying a life-threatening diagnosis is every doctor's nightmare and has the potential to catastrophically impact the patient's wellbeing and life. No matter how dedicated and knowledgeable a doctor may be, certain situations are out of their control. A physician may not even be aware of the circumstances that could lead to a missed diagnosis or a near-miss situation. In its desire to save money CMS may inadvertently contribute to situations like this. Maintaining antiquated criteria, out of touch with the current technological advancements, CMS is setting up the stage for systemic failure.

As illustrated by the case presented here, certain processes could be implemented to avoid the risk of missing important diagnoses. The laboratories have already taken measures to overcome the technical limitations of the automated blood counters.

However, if incentivized by the differential in CMS reimbursement or even lack of reimbursement in certain situations, physicians may fall in the trap of ordering tests that may bypass the system of checks implemented by laboratories. Keeping physicians informed about the dangers posed by ordering partial blood counts represents one major step in preventing systemic failures.

The EMR could be used as a second fail-safe mechanism. An algorithm can be implemented to compel physicians to order a CBC with differential every time they encounter a new patient.

For established patients, the algorithm could be implemented in such a way that if a patient is seen, after a certain period, the doctor would automatically order a CBC with differential.

Being aware that even with the most sophisticated measures, patients may still fall through the cracks, physicians and everyone involved, directly or indirectly, should always be aware of the different limitations of these measures and should always come up with creative solutions to perfect methods that avoid the risk of harming patients.

Conflict of Interest

None

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