

Original article

The results analysis of complete blood count during the first half of 2015 at the Central Child Teaching Hospital in Baghdad.

Rasha Tariq Jawad¹, Ebtehal Ali Hussien²

¹MD. M.B.Ch.B. F.I.C.M.S/Hematopathology ,Senior Specialized Hematopathologist, Manager of the Hematology Unit, Laboratory Department / Central Child Teaching Hospital ,Baghdad ,Iraq.

² BMLT, Laboratory technician / Hematology Unit, Laboratory Department / Central Child Teaching Hospital ,Baghdad ,Iraq.

Received 5/1/2016

accepted 15/2/2016

Abstract:

Background: Complete blood count (CBC) is the most commonly requested test by physicians. The central child teaching hospital is the second largest pediatric hospital in IRAQ. We review the CBC for the first half of 2015 at that hospital.

Objectives: this study was arranged to explore the prevalence of anemia, leucocytosis, leucopenia, thrombocytosis, thrombocytopenia, using automated CBC counter Emerald & Ruby Abbott for outpatient and inpatients respectively.

Patients and methods: A retrospective study included a total of 19341 patient attended central child teaching hospital (from the 1st of January -1st of July 2015). All of them did complete blood picture test using ruby Abbott and emerald Abbott hematology autoanalyzer, 14418 of them were inpatients and 4723 patients attended to the outpatient clinic.

Results: the results were analyzed as anemia, leucocytosis, leucopenia, thrombocytosis, thrombocytopenia for the whole patients and for each month to the inpatients so that to analyze the result according to season. Anemia was seen more commonly in the inpatients (30.79%) than the outpatient (20.8%). Leucopenia was seen more in outpatients (17.15%) than in inpatients (8.1%), while leukocytosis shown to be (10.8%) of inpatients and 2% of outpatients. Thrombocytopenia was (8.3%) of inpatient and (3.1%) of outpatients. Regarding the monthly incidence we found that the highest percentage of anemia in outpatients seen at May (42%), while the lowest was seen at January (19.76%).Leucocytosis and thrombocytosis both showed the highest percentage at January (19.76%), (15.29%) respectively.

Conclusion: anemia, leucocytosis, and thrombocytosis seen in inpatients more than outpatients ,leucopenia seen in outpatients more than inpatients ,thrombocytosis showed near results for in and out patients but a little higher for inpatients.

Keywords: analysis, CBC, children

Introduction:

Complete blood picture is the most commonly requested test by physician as it is easy and highly informative for patient's health. It requires minimum amount of anti-coagulated whole blood and done on automated blood count machine lasting few minutes to get the results.

The primary field of interest is whether the patient have anemia, whether the WBC count have evidence of infection and whether the platelets count affect hemostasis.⁽¹⁾ Pediatric anemia refers to a hemoglobin or hematocrit level lower than the age-adjusted reference range for healthy children. Physiologically, anemia is a condition in which reduced hematocrit or hemoglobin levels lead to diminished oxygen-carrying capacity that does not optimally meet the metabolic demands of the body. Anemia is not a specific disease entity but is a condition caused by various underlying pathologic processes.⁽²⁾ In addition, conditions are emphasized in which anemia is the only hematologic abnormality. The combination of anemia with leucopenia, neutropenia, or thrombocytopenia may suggest a

more global failure of hematopoiesis, caused by conditions such as aplastic anemia, Fanconi anemia, myelofibrosis, or leukemia, or may suggest a rapid destruction or trapping of all blood elements, such as hypersplenism, localized coagulopathy in a large hemangioma or hemophagocytic lymphohistiocytosis (HLH) or macrophage activation syndrome (MAS)⁽²⁾. The WHO show that the prevalence of anemia is (47.4%) among preschool aged children⁽³⁾ prevalence of anemia in Iraq in children under 5 from 1995-2011 is 36%⁽⁴⁾. Inpatients prevalence of anemia seen more than general population ,a study in India show that anemia in inpatient in one tertiary pediatric hospital was(72.79%)⁽⁵⁾ , another study in Brazil showed the prevalence of anemia in pediatric hospital to be (56.6%) 10⁽⁶⁾.while it is 59%,and 24% respectively in the general population of these countries⁽⁴⁾. Leukocytosis is a common laboratory finding encountered in hospital practice, in the emergency department or a medical or surgical setting. Generally, the vast majority of cases of

The results analysis of complete blood count

.Rasha Tariq Jawad , Ebtehal Ali Hussien

leukocytosis are reactive and benign—resulting from liberation of various cytokines that stimulate the development of leukocyte precursors and release of mature cells from the marrow, endothelium, and spleen. Most reactive episodes of leukocytosis are neutrophilic in nature (“neutrophilia”) and result from a myriad of stressors. ⁽⁷⁾ Occasionally, the total leukocyte count will exceed 25,000 cells/mm³, with the majority of cells being polymorphonuclear leukocytes. This scenario is referred to as a leukemoid reaction, and may be difficult to differentiate from a leukemic picture, hence the name “leukemoid.” As such, in patients with leukemoid reactions, the main differential diagnostic concerns include chronic myelogenous leukemia, acute myelogenous leukemia, or other myeloproliferative disorders. A typical leukemoid reaction, however, occurs in the presence of an acutely stressful or inflammatory/infectious event, such as hemorrhage, hemolysis, febrile episodes, sepsis, trauma, pancreatitis, or *Clostridium difficile* infection. *Clostridium difficile* has the unique propensity of causing leukemoid reactions in cases of severe colitis, and likely results from liberation of cytotoxins ⁽⁷⁾. Leukopenia

is a less commonly encountered problem in routine practice than is leukocytosis. In general, leukopenia may result from decreased marrow production of leukocyte precursors, by peripheral destruction or sequestration of circulating leukocytes, or by autoimmune cellular damage or destruction. The most common etiology of leukopenia is decreased marrow production due to a variety of disorders that damage the developing leukocyte mass in the bone marrow ⁽⁷⁾.

A low platelet count (thrombocytopenia) may also be detected in the complete blood count. Thrombocytopenia which is defined as platelet less than 150×10^3 per μL . It is often discovered incidentally on complete blood picture test. A patient with platelet count greater than 50×10^3 per μL rarely have symptoms. Platelet count from 30 to 50×10^3 per μL rarely manifest as purpura. A count from 10 to 30×10^3 per μL may cause bleeding with minimal trauma. A platelets count less than 5×10^3 per μL may cause spontaneous bleeding. This may be due to bone marrow problems, some medications or, immunologic or genetic problems, advanced liver disease, or cancers such as leukemia ⁽⁸⁾. Thrombocytosis is often associated with

The results analysis of complete blood count

.Rasha Tariq Jawad , Ebtehal Ali Hussien

infection or an inflammation such as osteomyelitis or rheumatoid arthritis ,hematological causes include chronic blood loss red cell destruction ,splenectomy and rebound following recovery from bone marrow suppression. Moderately increased platelet count does not usually have pathological implication⁽⁹⁾.

The complete blood count values are usually reported based on the number of cells in a specific volume of blood. Fully automated multichannel instrument usually measure from 8 to 20 component .automated instruments have high level of precision ,if instrument are carefully calibrated and their correct operation is ensured by quality control procedure they produce test that are generally accurate ⁽⁹⁾.A complete blood count may be done as part of a regular physical examination. Normal values for the complete blood count (CBC) tests depend on age, sex, how high above sea level you live, and the type of blood sample .each ethnic group has its normal range and many literatures establish their own normal range for specific hospitals in these towns ^(10,11) . Table (1) shows the normal value of infant and children which clarify the difference with age.

What Affects the Test⁽⁹⁾

- Factitiously low WBC occasionally occurs as consequence of WBC agglutination ,prolonged sample storage ,abnormally fragile cells(leukemia)
- A very high WBC count is more common and usually result from failure of RBC lysis .this occurs with RBC of neonates or uremia or the presence of abnormal hemoglobin such as S or C Hb.
- Low platelets count may be due to giant platelets. Identified as red cells or of EDTA-induced platelets. Clumping
- High platelet count may be due to marked microcytosis or fragmented red cells or fragmented WBC or due to bacteria or fungi.
- The automated MCV& Hct are prone to certain errors. those resulting from microclots or partial clotting ,extreme microcytosis and the presence of cryoglobulin or cold agglutinins the latter cause factitious elevation of MCV as the agglutinated cells counted as single cell.

Patients and Methods:

A total of 19141 patients attended and did complete blood count (CBC) at the

The results analysis of complete blood count

.Rasha Tariq Jawad , Ebtehal Ali Hussien

Central Child Teaching Hospital in Baghdad Iraq for the period from the 1st of January to the 1st of July 2015. We retrospectively analyzed CBC results of those patients. 14418 was hospitalized (inpatients), 4723 was outpatients. 2 ml of venous blood was collected in k3 EDTA tubes from the patients, and the CBC for inpatients made on Rupa Abbott autoanalyzer working on principle of electrical impedance. the outpatient CBC done on Emerald Abbott Autoanalyzer. The test done at the hematological units of the outpatients laboratory and the central laboratory. the result was compared with the schedule of hematological normal values for normal infants and normal children that is published on Dacie and Lewis practical hematology eleventh edition⁽⁹⁾ The results of the first half of 2015 is analyzed according to the incidence of anemia ,leucocytosis , leucopenia, thrombocytosis , thrombocytopenia. The automated counters measure the hemoglobin concentration by modification of the manual HiCN method with cyanide reagent ,RBC and other blood cells counted by aperture impedance , blood is highly diluted in a buffered electrolyte solution under controlled condition the diluted blood passed through the aperture scattering

light or change the potential between two electrodes (depending on the technology used) which last as long as the cell take to pass ,the number of pulses indicate the count ,the height of the pulse indicate the volume of the cell passing through (MCV) .WBC is determined in whole blood in which red cells have been lysed .Platelets are counted in whole blood using the same technique with an upper threshold is needed to separate platelets from red cells and a lower threshold to separate platelets from debris and electronic noise. Three part differential count assigns cells to categories usually designated: granulocytes (large cells), lymphocytes (small cells), and monocytes (mononuclear or middle cells) .three part differential counts from a single channel instrument^(1,9,12)

The normal values may differ slightly based on the reference range and the machine used in the laboratory and, therefore, the results may be slightly different from one laboratory to the next^(10,11). The normal reference range is typically provided and printed with the results of the complete blood count for accurate interpretation. Different laboratories may report slightly different reference ranges⁽¹³⁾

Table (1); hematological values for normal infants and normal children (Dacie and Lewis 11th edition) ⁽⁹⁾

Parameter	birth	Day 3	Day 7	Day 14	1 month	2 month	3-6 months	1 year	2-6 years	6-12 years
RBC×10 ¹² / _L	5-7	4-6.6	4.9-6.3	3.6-6.2	3-5.4	3.1-4.3	4.1-5.3	3.9-5.1	4-5.2	
Hb g/dl	14-22	15-21	13.5–21.5	12.5–20.5	11.5-16.5	9.4-14	11.1-14.1		11-14	11.5-15.5
Pcv(range)	45-75	45-67	42-66	31-71	33-53	28-42	30-40	30-38	34-40	35-45
MCV	100-120	92-118	88-126	86-124	92-116	87-103	68-84	72-84	75-78	75-95
MCH	31-37				30-36		24-30	25-29	24-30	25-33
retics×10 ⁹ /L	120-400	50-350	50-100		20-60	30-50	40-100	30-100		
WBC×10 ⁹ /L	10-26	7-23	6-22		5-21	5-15	6-18	6-16	5-15	5-13
N×10 ⁹	4-14	3-5	3-6	3-7	3-9	1-5	1-6	1-7	1.5-8	2-8
L×10 ⁹ /L	3-8	2-8	3-9		3-16	4-10	4-12	3.5–11	6-9	1-5
M×10 ⁹ /L	0.5-2	0.5-1	0.1-1.7		0.3-1	0.4–1.2	0.2-1.2	0.2 -1.0		
E×10 ⁹ /L	0.1-1	0.1-2	0.1–0.8	0.1–0.9	0.2-1	0.2 - 1.0				
Platelets	100–450	210–500	160–500	170–500	200-500	210-650	200-550		200-490	170-410

The reported values are either directly measured or calculated by the machine.

The measured values are:

- WBC number
- RBC number
- Mean Corpuscular Volume (MCV)
- Hemoglobin (Hg)
- Platelet count
- Mean platelet volume(MPV)

The calculated values are:

- Hematocrit (HCT)
- Mean Corpuscular Hemoglobin (MCV)
- Mean Corpuscular Hemoglobin Concentration (MCHC)
- Mean Corpuscular Hemoglobin (MCH)
- Red Cell Distribution Width (RDW)

Results

A total of 19141 patients included in this study with age range from (1day-14 years old). About third of the inpatients (30.79 %) and only 20.8% of the outpatients were with low hemoglobin concentration (table 2).leucopenia seen in 8.1% of inpatient and 17.15% of the outpatients while leucocytosis seen in 10.8%. of the inpatients and 2% of the outpatients . Thrombocytopenia seen in 8.3% of the inpatients and 3.11% of the outpatients while thrombocytosis seen in 6.8% of the inpatients and 5.14% of the out patients (Table 2).

Table (3) showed that the highest percentage of anemia was at May (42,9%) and the lowest was seen at January (19.76%). The highest percentage of leucocytosis was seen at January (19.76%) for inpatients, the lowest percentage seen at June (4.1%). Leucopenia was seen comparable for the whole five months and a lower percentage in June (5.1%) (Table 4).

Patients with thrombocytosis were higher in January (15.9%) and the lowest percentage was seen in June (2.35%), while thrombocytopenia showed the highest percentage in April (12.72%) and the lowest in January (2.68%) (Table 5).

Table (2): percentage of high Hb, WBC, platelet, and low Hb, WBC, platelet for inpatient and outpatient.

Test	IP(N=14419)	%	OP(N=4723)	%
Low Hb.	4438	30.79%	984	20.8
Low WBC	1166	8.1%	810	17.15%
High WBC	1562	10.8%	96	2%
Low plt.	1194	8.3%	147	3.11%
High plt.	981	6.8%	243	5.14%

Table (3): the percentage of anemic patients in the inpatients for each month and the total of the 1st half of 2015.

Month	No. of patient	Patients with low Hb.	Percentage
January	2419	478	19.76%
February	2560	873	34.1%
March	2227	767	34.49%
April	2367	569	24.03%
May	2383	1023	42.93%
June	2462	728	29.56%
Total	14418	4438	30.79%

Table (4) the percentage of leucopenia& leucocytosis for each month and the total of the 1st half of 2015.

Month	No. of patients	Patients with low WBC	Percentage	Patients with high WBC	Percentage
January	2419	212	8.76%	478	19.76%
February	2560	203	7.92%	218	8.51%
March	2227	183	8.21%	306	13.74%
April	2367	231	9.75%	269	11.36%
May	2383	212	8.9%	191	8.01%
June	2462	125	5.1%	100	4.1%
Total	14418	1166	8.1%	1562	10.8%

Table (5): the percentage of thrombocytopenia and thrombocytosis for each month and the total of the 1st half of 2015.

Month	Pat. No.	Low plt.	Percentage	High plt.	Percentage
January	2419	65	2.68%	370	15.29%
February	2560	137	5.35%	87	3.39%
March	2227	192	8.62%	261	11.71%
April	2367	301	12.72%	78	3.29%
May	2383	249	10.45%	127	5.32%
June	2462	250	10.15%	58	2.35%
Total	14418	1194	8.3%	981	6.8%

Discussion

The result of our study showed that anemia seen in 30% of the hospitalized patient and 20% of the outpatient was anemic. prevalence of anemia seen differ from one country to another 10% of hospitalized adult patients seen to be anemic in one study⁽¹⁴⁾ while another study in Brazil show that 56% of hospitalized children under the age of 5 are anemic⁽⁶⁾.in a study in India which chose the same age as ours they show that anemia seen in 72% of the hospitalized patients ⁽⁵⁾ . The studies show that anemia worldwide seen in 43%undre 5 years⁽¹⁴⁾ , even in the developed world 21-26%

become anemic at some point during their childhood and adolescence⁽⁵⁾ .

Leucopenia in this study seen in (8.1%) of the inpatient and (17.15%) of the outpatient . as we depend on the table of Dacie and Lewis for CBC count ,a WBC below $5 \times 10^9 /L$ considered leucopenia that why we as middle eastern people should establish our own normal range ^(10,12) ,even in the west black people have a lower normal leukocytes than white and the books ask the physician not to do unneeded test for those patients and to put this in mind ⁽⁷⁾

The results analysis of complete blood count

.Rasha Tariq Jawad , Ebtehal Ali Hussien

Leucocytosis seen in 10.8% of hospitalized patient and 2% of outpatients. That is seems logical as usually hospitalized patients are more ill than outpatients.

Thrombocytosis seen in 6.8 % of the inpatients and 5.14% of the outpatients .thrombocytosis in children is common but usually without symptoms the cause mostly infection ,trauma, surgery ,renal disease and chronic inflammation .in a study in Taiwan thrombocytosis seen in 7.6% of hospitalized patient in (KMCH) hospital which is very near to our result ⁽⁸⁾.

Thrombocytopenia which is defined as platelet less than 150×10^3 per μL . It is often discovered incidentally on complete blood picture test patient with platelet count greater than 50×10^3 per μL rarely have symptoms. Platelets count from 30 to 50×10^3 per μL rarely manifest as purpura. A count from 10 to 30 may cause bleeding with minimal trauma .A platelets count less than 5 may cause spontaneous bleeding in the current study 8% of hospitalized patients seen to be thrombocytopenic .this include all thrombocytopenia below 150×10^3 which have so many reasons. all the literatures consider ITP as the main

cause in children the incidence 100 cases per million person annually 50% occur in children . Psuedothrombocytopenia from EDTA dependent agglutinin should be put in mined ⁽¹⁵⁾.

Conclusion :

anemia, leucocytosis, and thrombocytosis seen in inpatients more than outpatients ,leucopenia seen in outpatients more than inpatients ,thrombocytosis show near results for in and out patients but a little higher for inpatients.

References

1. Fischbach FT, Dunning MB. Manual of Laboratory and Diagnostic Tests, 8th ed. Philadelphia: Lippincott Williams and Wilkins.2009
2. Susumu I , Robert J Arceci. Pediatric Acute Anemia. <http://emedicine.medscape.com/article/954506-overview>
3. WHO. Worldwide Prevalence of Anemia 1993-2005: Global Database ON Anemia. Geneva :WHO;2008.
4. Stevens GA, Finucane MM, DeRegil LM, et al. Global, regional, and national trends in hemoglobin concentration and prevalence of total and severe anemia in children and pregnant and non-pregnant women for 1995-2011: a systematic analysis of population-representative data. The Lancet Global Health 2013; 1(1): e16-e25.
5. Firdose S, Siddaraju P. Anemia among hospitalized children at a multispecialty hospital, Bangalore. India. Journal of family medicine and primary care .2014 Jan-Mar;3(1):48-53
6. Eliane S. , Campos G, Emídio C. de Albuquerque, Ilma K, Grande de Arruda, Prevalence of anemia in under five-year-old children in a children's hospital in Recife, Brazil Rosemary Ferreira dos Santos,. Rev Bras Hematol2011; 33(2): 100–104.
7. Mark A, Marinella MD. Infectious disease. Leukocytosis and leucopenia. [http://www. antimicrobe.org /new/e19.asp](http://www.antimicrobe.org/new/e19.asp)
8. Chen HL, Chioou SS, Sheen JM. Thrombocytosis in children at one medical center of southern Taiwan. Acta Paediatrca Tiawinaca1999 , 40(5):309-313.
9. Carol Briggs ,Barbara J.Bain. Daicie and Lewis .Practical Hematology .Basic Hematological Techniques Eleventh Edition .2012
10. Buseri FI, Siaminabo IJ, Jeremiah ZA, Reference values of hematological indices of infants, children, and adolescents in Port Harcourt, Nigeria, July 2010 Volume 2010:2 Pages 65—70.
11. Alexander H, Judith K, Benjamin M, Peter GK, Bertrand L, Haematological and biochemical reference intervals for infants and children in Gabon. Tropical Medicine and International Health, 2011. March ;volume 16 (3) pp 343–348

The results analysis of complete blood count

.Rasha Tariq Jawad , Ebtehal Ali Hussien

12. Chris Higgins. Understanding laboratory investigations: a guide for nurses, midwives and healthcare professionals' .third edition. Part three Hematology tests.2013.Wiley-Blackwell publication

13. Rachoin JS, Cerceo E, Milcarek B, Hunter K, Gerber DR Prevalence and impact of anemia in hospitalized patients. South Med J. 2013 Mar;106(3):202-6.

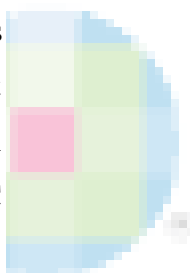
14. Rehemah. Simbauranga, Erasmus kamugisha. Prvalence and factors associated with severe anemia amongst under 5 children at bugando medical center ,mwanza, tanzania. BMC Hematology.2015.

15. Ropert guaer. Omack WA.. Thrompocytopenia. American Family Physicion. Medical Center Family Medicine Residency ,Fort Bragg, north carolina. 2012 march15; 85(6): 612-622

Correspondence to:

Dr.Rasha Tariq Jawad

Manager of the Hematology Unit,
Laboratory Department / Central Child
Teaching Hospital, Baghdad, Iraq.



تحليل نتائج تعداد الدم الكامل خلال النصف الأول من عام 2015 في مستشفى الطفل المركزي التعليمي في بغداد

رشا طارق جواد 1 ، ابتهال علي حسين 2

F.I.C.M.S /M.B.Ch.B / MD1 / اختصاص أمراض الدم المختبري ، مدير وحدة أمراض الدم، قسم

المختبرات / مستشفى الطفل المركزي التعليمي في بغداد، العراق.

BMLT 2، فني مختبري / وحدة أمراض الدم، قسم المختبر / المستشفى الطفل المركزي التعليمي في بغداد، العراق.

الملخص:

الخلفية: تعداد الدم الكامل (CBC) هو الأكثر طلباً عادة كتحليل دم من قبل الأطباء. المستشفى التعليمي الطفل المركزي هو ثاني أكبر مستشفى للأطفال في العراق. نستعرض نتائج CBC للنصف الأول من عام 2015 في هذه

الأهداف: تم ترتيب هذه الدراسة لاستكشاف مدى انتشار فقر الدم، فرط الكريات البيض، نقص الكريات البيض، كثرة الصفيحات، نقص الصفيحات الدموية، وذلك باستخدام المحلل الآلي CBC لمرضى العيادة الاستشارية والمرضى الداخليين للمستشفى على التوالي.

المرضى والطرق: دراسة استيعابية، كان ما مجموعه 19341 مريضاً حاضراً المستشفى التعليمي المركزي (من 1 يناير من 1 يوليو) لكل واحد منهم تم إجراء اختبار صورة الدم باستخدام روبي ابوت المحلل التلقائي. 14418 من المرضى كانوا داخلون للرداهات وحضر 4723 المرضى إلى العيادة الخارجية.

النتائج: تم تحليل النتائج على النحو التالي: فقر الدم، فرط الكريات البيض، نقص الكريات البيض، كثرة الصفيحات، نقص الصفيحات الدموية للمرضى كلهم وعن كل شهر للمرضى الراقدين بحيث تكون تحليل النتيجة وفقاً للموسم. فقر الدم كان أكثر شيوعاً في المرضى المنومين (30، 79٪) من العيادات الخارجية (20، 8٪).

واعتبر نقص الكريات البيض أكثر في العيادات الخارجية (17، 15٪) من المرضى المنومين في (1، 8٪)، في حين أن زيادة عدد الكريات البيضاء أظهرت أن (10.8٪) من المرضى المنومين و (2٪) من العيادات الخارجية. كان نقص الصفيحات (8.3٪) من المرضى الداخليين و (3.1٪) من مرضى العيادات الخارجية. وفيما يتعلق

الإصابة الشهرية وجدنا أن أعلى نسبة فقر الدم لدى مرضى العيادات الخارجية شهدت في مايو (42٪)، في حين كان ينظر إلى أدنى مستوى في كانون الثاني (19.76٪). فرط الكريات البيض والصفيحات سواء أظهر أعلى نسبة في كانون الثاني (19.76٪)، (15.29٪) على التوالي.

الخلاصة: فقر الدم، فرط الكريات البيض، وكثرة الصفيحات شوهدت أكثر في المرضى المنومين من العيادات الخارجية، نقص الكريات البيض شوهدت أكثر في العيادات الخارجية من المرضى المنومين، كثرة الصفيحات كانت متقاربة النتائج للمجموعتين مع زيادة طفيفة للداخليين .

كلمات البحث: تحليل، CBC، الأطفال