Effects of chronic myeloid leukemia on some haematological parameters and indicators during chemotherapy period

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Abstract

This study include calculation of some haematological parameters & indicators of chronic myeloid leukemia(CML) after chemotherapy, involve collecting (40) blood samples from CML patients & (40) blood samples from normal individuals considered as control group with ages of (35-60) year; after making the haematological testes of these samples we noticed the presence of variable significant differences($p<0.05$) in the values, by which at the beginning of the treatment by chemotherapy there was obvious decreasing in all hemoglobin value (9.8±0.61)gm/100 ml ,the number of red blood cells (3.88±0.30) millions cells /mm3 & packed cell volume (40.7±2.57)% and decreasing of blood indices like MCV (80.4+2.13) fl, MCH (24.1±1.32) pg, MCHC (30.1±1.13)g/dl, and this decreasing continue throughout chemotherapy period, we also found obvious increasing in leukocytes and platelets numbers at the beginning of the treatment by chemotherapy (7765±665.1) cell/mm3 (396.6±41.2) cell/mm3 respectively, after that decreasing of these numbers throughout chemotherapy (7350 70)cell/mm3 of leukocytes. In addition to that we observe increasing in erythrocyte sedimentation rate(19.6±8.82)mm/1h ,and increasing in granular white blood cells like neutrophils cells (74.3±6.91)%, eosinophils cells(8.25±2.19)% and basophils cells (3.55±0.99)% of leukemia patients in comparison with control group.

تأثير مرض ابيضاض الدم النخاعي المزمن على بعض المعاييروالدلائل الدموية اثناء فترة العلاج الكيمياوي

سندس وليد خالد عثمان العبدالله

الخلاصـــة

تضمنت الدراسة الحالية حساب قيم بعض المعايير والدلائل الدموية لمرضى ابيضاض الدم النخاعي المزمن بعد اعطائهم العلاج الكيمياوي ، فقد شملت الدراسة جمع (40) عينة دم من مرضى ابيضاض الدم النخاعي المزمن و(40) عينة دم من اشخاص اصحاء اعتبرت كمجموع ة سيطرة وبأعمارمابين (35-60)سنة من مركزالاورام السرطانية في المنطقة الجنوبية، وبعد اجراء التحاليل الدموية لهذه العينات لوحظ وجود اختلافات معنوية مختلفة ($p<0.05$) في القيم فقد تبين في بداية علاجهم الكيمياوي وجود انخفاض واضح في كل من خضاب الدم (9.8±0.61)غرام /100 مل وعدد كريات الدم الحمر (3.88+0.30)مليون خلية /ملم³ وحجم الخلايا المتراصة (40.7±2.57)%. وانخفاض واضح في قيم الدلائل الدموية مثل MCV (80.4+2.13) fl و MCH(24.1±1.32) pg و MCHC (30.1±1.13) g/dl واستمر هذا الانخفاض اثناء فترة العلاج ، كذلك وجد زيادة واضحة في اعداد كريات الدم البيض في بداية العلاج (7765±665.1) خلية / ملم٣ وبعدها انخفضت هذه الاعداد اثناء فترة العلاج فأصبح عددها (7350±70)خلية/ ملم٣ وزيادة في اعداد الصفائح الدموية (396.6±41.2) خلية/ملم٣ انخفضت هذه الاعداد اثناء فترة العلاج كما لوحظ زيادة في معد ل ترسيب كريات الدم الحمر (19.6±8.82) ملم / ساعة ، ولوحظ زيادة في اعداد كريات الدم البيض الحبيبية كالخلايا العدلة (74.3±6.91) % والخلايا الحمضة (8.25±2.19) % والخلايا القعدة(3.55±0.99) % لدى مرضى اللوكيميا مقارنةً مع مجموعة السيطرة .

Introduction

Leukemia disease is group of malignant disorders of the productive tissues of blood components in red bone marrow characterized by increasing number of huge immature abnormal malignant white blood cells in red bone marrow that enter the peripheral blood circulation and then penetrate into other organs leading to functions failure of these organs[(1)(2)]. Leukemia word derived from Greek origin composed from leukos which mean white and Haima meaning blood , after that this word leukemia used to describe the disease and the European physicians in the nineteenth century call it white blood , leukemia disease defined as group of malignant disorders and abnormal growth of white blood cells characterized by accumulation of immature malignant white blood cells in the red bone marrow and blood then these cells remain immature and their growth stop at certain limit of their growth phase after that increasing of their number occur in blood circulation so called blood leukemia because of white blood cells abundance in blood over other components of blood [(3)(4)]). Causes of blood leukemia not known precisely but scientists and researchers suspect of multiple factors viral , genetic ,environmental , and immunological involved in this disease etiology [(5)].Leukemia classified according to the clinical pathway of the disease and the maturation degree of malignant white blood cells based on cells replication and development by which the disease classified into acute leukemia and here the cells unable to maturate but replicate rapidly while in chronic leukemia the cells can maturate but not normally without normal functioning, inspite of their replication the problem not in that but in the presence of these cells for longer period than of normal cells leading to presence of huge numbers of mature cells so this cause un ability of red bone marrow to produce normal cells and here developments occur slowly so chronic leukemia less danger than acute leukemia, and male more susceptible to the disease than female , also both types classified into secondary types (subtype) depending on the cells type lymphoid or myeloid in origin [(6)(7)], diagnosis of different types of this disease made depending on the morphological and biochemical characters of the cancer cells and also on the immunological , cytogenetic and molecular methods [(8)]. Acute myeloid leukemia (AML) characterized by rapid development by which abnormal blood cells replicate rapidly by which myeloblasts number increase in red bone marrow and blood lacking ability of differentian into different types of blood cells , and renewing of the cells spontaneously , and not undergo death that leading to increase of their numbers above the other types of blood cells , acute myeloid leukemia occur in individuals with age above 25 year, rarely children and aldoscents may have this with age [(9)(10)(11)]. While acute lymphoblastic leukemia (ALL) characterized by increasing of lymphoblasts numbers in red bone marrow and blood [(12)] occur in male more than female usually among children with age of 2-8 years and it's curing ratio may reach 90% (13).While chronic lymphocytic leukemia(CLL)characterized by accumulation of mature small lymphocytes in bone marrow , blood , lymph nodes and spleen , this occur due to disorder in apoptosis of the cells and not due to increasing of division ratio of the cells [(14)(15)], this type occur in the older patients usually with age of 60-80 year old and rarely happen in lower than 50 year old (16).Chronic myeloid leukemia (CML) which is one form of myeloid proliferation disorders due to malignant transformation of blood stem cells , this type occur in both ganders usually at age between 40-60 year old rarely happen in children and infants [(17)(18)].

Clinical pathway of the disease divided into three stages [(19)]:

- Chronic phase: Approximately 85% of CML patients diagnosed in this phase , which can continue for 2-7 years and in rare case 15-20 years .
- Accelerated phase: Intermediate stage by which 50% of CML cases developed in this phase gradually into blast phase which may continue months or years , this phase characterized by the 15-29% ratio of blast cells , and blast cells and promyelocytes more than 30% .
- Blast phase : In this phase 30% or more of blast cells can be diagnosed by blood and red bone marrow tests , this phase characterized by changing into acute myeloid leukemia or into acute lymphoid leukemia .

Procedure

Samples collection :

Blood collected (40 samples) from chronic myeloid leukemia patients referred to cancer center of southern region for 6 months period , and

(40 samples) of control group , blood putted in plastic tubes 5 ml volume supplied with anticoagulant substance EDTA for some specific blood tests including :- [2][21]

- Measurement of Hb concentration (g/100ml) using sahli method .[22]
- Measurement of packed cell volume PCV % using microheamatocrite method.[23]
- Total red blood cells count (cell/mm3) using haemocytometer.[22]
- Total white blood cells count (cell/mm3) using haemocytometer.[22]
- Differential white blood cells count using slide method .[22]
- Erythrocytes sedimentation rate (ESR).[22]

Using special formulae on the previous measurements we can get the following hematological indicators:[22]

- Mean corpuscular volume (MCV) according to the following following formula :

$$\text{Packed cell volume (PCV\%)} \times 10\ (fl) \over \text{RBCs count(million)}$$

- Mean corpuscular hemoglobin(MCH) According to the following formula :

$$\text{Hb concentration (gm/100ml)} \times 10\ (pg) \over \text{RBCs count(million)}$$

- Mean corpuscular hemoglobin concentration (MCHC)

$$\text{Hb concentration (gm/100ml)} \times 100\ (g/dl) \over \text{Packed cell volume (PCV\%)}$$

Results and Discussion

In this study we found significant differences ($P < 0.05$) in some haematological parameters by which there was decreasing in Hb concentration , RBCs number, haematological indicators values and packed cell volume PCV of chronic myeloid leukemia in comparison with control group as shown in figure (1), also this study shown significant increasing in Erythrocytes Sedimentation Rate (ESR), platelets number , and white blood cells count at the beginning of chemotherapy after that these cells began to decrease throughout chemotherapy as shown in figure (2-3). Also we observed significant differences in differential white blood cells count by which there was increasing in granular white blood cells (Neutrophils, Eosinophils and Basophils) as shown in figure (4). Total blood count considered as important test for diagnosis, evaluation, and treatment of blood diseases such as leukemia, this test provide a lot of information related to bone marrow health which represented by number; type and morphology of blood cells , the increasing and decreasing of results values in this

study due to the effect of this disease on red bone marrow and lymphatic system by which the presence of many abnormal cells lead to stop of bone marrow production of enough normal cells and increasing number of cancer cells and this affect negatively on the normal cells and their differentiation and functioning , these cells may accumulate in lymph nodes, bone marrow, and spleen causing swelling of these organs and repeated hemorrhage causing shortage in red blood cells number and hemoglobin concentration leading to anemia in those patients [25] , in addition to that cancer cells at their diffusion in red bone marrow sinuses secrete substances induce osteolysis and affect on the precursors of red blood cells causing destruction of them and of stem cells responsible for blood cells formation and differentiation processes leading to shortage in red blood cells formation [26][27]. Anemia also occurred due to disturbances happened in gastrointestinal tract as result of drugs side effect used in disease treatment affecting bone marrow leading to partial or total stop of blood components production [28]. Leukemia affect bone marrow leading to huge production of abnormal immature white blood cells leading to decreasing the function of leukocyte and lowering patient's immunity, increasing of the leukocyte numbers lead to splenic enlargement (splenomegally) which considered as storage organ of leukocytes and platelets so released from spleen and increase in number in blood circulation , also infection occurred and inflammatory processes due to decreasing patient's immunity and shortage of white blood cells during chemotherapy period because of treatment effects on bone marrow production of blood cells [1, 28, 29]. Increasing of granular leukocytes occur due to abnormal chromosomal change accompany the disease called Philadelphia chromosome (ph1) [30] which resulted from alternative translocation of long arms segments of chromosome 9 and chromosome 22 by which fusion of ABL gene part found on chromosome 9 with one of BCR gene sequences founded on chromosome 22 leading to production of emerged gene called BCR-ABL gene on chromosome 22 and this gene encoding abnormal new protein production called tyrosine kinase which affect on the proliferation and differentiation of blood cells leading to increase of granular leukocytes numbers and this genetic mutations occur in more than 95% of chronic myeloid leukemia cases [31-33].

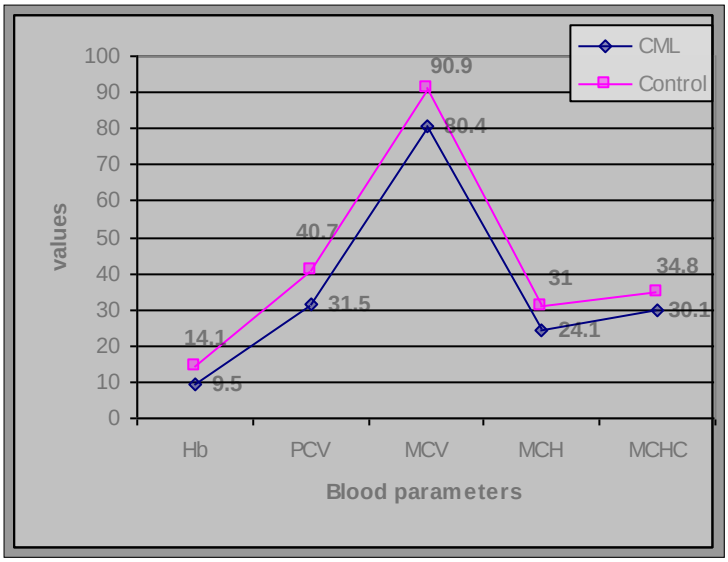

Figure (1):- Describe Hemoglobin concentration (gm/100ml), Packed cell volume (%) and hematological indicators in chronic myeloid leukemia and control group.

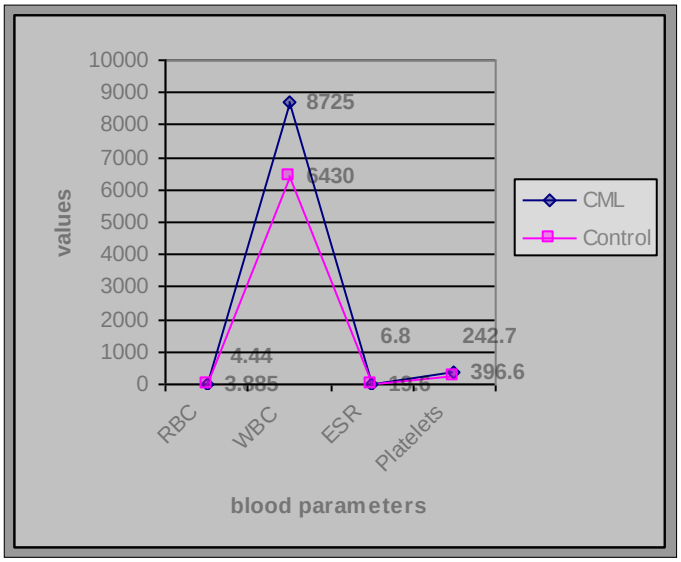

Figure (2) :- Describe Red blood cells count (cell/mm3), White blood cell count in chemotherapy beginning (cell/mm3),Pletalets count(cell/mm3)and Erythrocyte sedmintation rate (mm/1h)in chronic myeloid leukemia and control group.

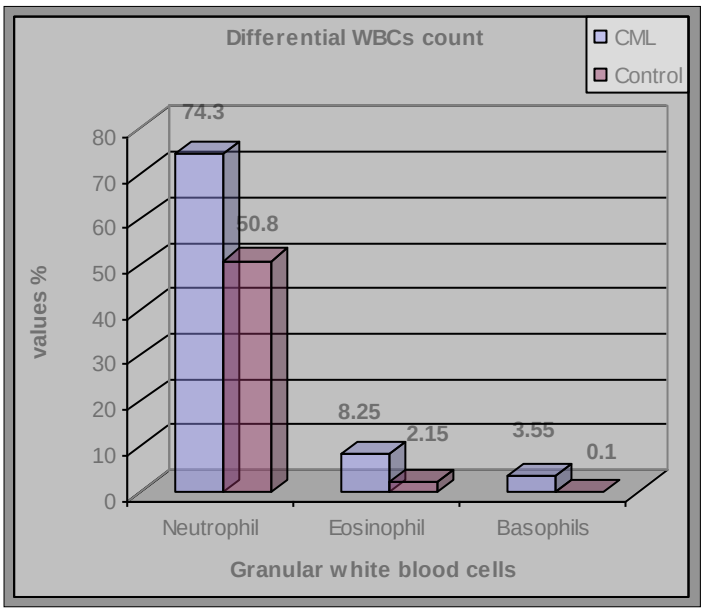

Figure (4):-Describe Granular white blood cells (Neutrophils , Basophils , Eosinophils)(%) in chroic myeloid leukemia and control group.

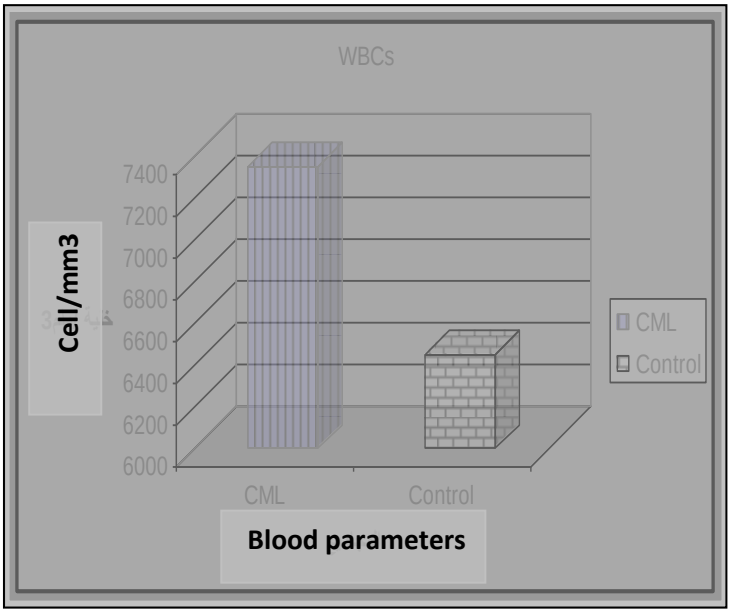

Figure (3):- Describe White blood cell count during chemotherapy period (cell/mm3)in chronic myeloid leukemia group and control group.

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