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Mapping of Myeloid Neoplasm for Sudanese patients Attended Radio and Isotope nuclear center- Khartoum from 2016 to 2020

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Abstract

Myeloid neoplasms are predominant among population in general ethnic origins in spite the fact that some of them usually restricted to some population. I Sudan mussing trusted data is unfortunate fact researchers face at all levels, sometimes due to lack of professional staff, who well-qualified to ensure valid data and right entry protocols can be followed. Khartoum radioactive and Isotope therapy hospital is one of the facilities with huge responsibilities to take care of neoplasms diagnostic patients at every step of treatment course, all steps of patients are dependent on statistic section in the hospital, which is missing or characterized by diminished balance between patients and staff, the thing makes patients or their guardians act according to that, leading to missing of data, which depends on patients files, set for diagnosis, treatment program and then follow up. Myeloid neoplasm distribution observed with un defined concepts, the reason this study was implemented to find a concept of myeloid neoplasm distribution, mapping them. The study was approved via MLS of Alzaeim Alazhary university, ministry of health, hospital administration as well.

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Background

Hematopoietic stem or progenitor cell clonal diseases are known as myeloid malignancies. They are caused by changes in the genome and the epigenome that interfere with important functions like differentiation, self-renewal, and proliferation. They include acute stages like acute myeloid leukemia (AML) and chronic stages like myeloproliferative neoplasms (MPN), myelodysplastic syndromes (MDS), and chronic myelomonocytic leukemia (CMML) (2). Pre-leukemic features are present in MDS and MPN, which often progress to AML. Leukemogenesis requires multiple mutations, just like solid tumors do. Ten years ago, these gene changes were separated into two groups: class I mutations, which promote cell proliferation or prevent apoptosis, and class II mutations, which interfere with hematopoietic cell differentiation. Certain class II mutations, like Runx1 mutations, cause MDS, while some class I mutations, like the Bcr-Abl fusion kinase, cause MPN on their own. In several mouse models, AML is caused by a combination of class I and class II mutations. It was therefore hypothesized that leukemia would arise from hematopoietic cells whose differentiation is inhibited by class II mutations. Novel mutations in a range of molecules, including signaling molecules, cohesin complex proteins, splicing factors, and epigenetic factors, can now be efficiently identified thanks to recent advancements in high-speed sequencing. The majority of these mutations fall outside of the class I or class II categories. These mutations' functional effects are currently the subject of in-depth research (3).

Risk factors of leukemia

Leukemia is a clonal, malignant, and heterogeneous disease. The disease may be mostly caused by mutations in progenitor or hematopoietic stem cells. Uncontrolled infiltration and growth of other hematopoietic tissues, abnormal blood cells, and bone marrow are its main clinical manifestations. These abnormalities inhibit normal hematopoietic tissues and result in corresponding clinical manifestations. Clinical investigations have revealed that acute myeloid leukemia (AML) accounts for approximately 34% of newly diagnosed leukemia patients, chronic lymphocytic leukemia (CLL), chronic myeloid leukemia (CML), and acute lymphocytic leukemia (ALL) for 28% of cases (4).

Types of myeloid neoplasms

AML

One of the primary forms of leukemia is AML. According to clinical research, ALL is the second most common cause of death for patients under the age of fifteen and primarily affects children between the ages of two and ten (5). On the other hand, the median age of onset for AML is 60 years old, and its incidence rises steadily with age (4). The hallmark of AML is the clonal proliferation of myeloid progenitors, or blasts, in the peripheral blood and bone marrow. AML was once thought to be incurable, but today it can be cured in about 35–40% of patients under the age of 60. The prognosis for those over 60 is getting better but is still bad. According to recent research, the disorder is caused by a sequence of recurrent genetic changes in hematopoietic stem cells that accumulate with aging. A

phenomenon known as clonal evolution has been identified with both founding clones and novel sub clones using deep sequencing techniques on primary and relapsed tumors, influencing the therapeutic approach. Even with our growing knowledge of the biology of AML, our attempts to date to modify treatment approach have been unsatisfactory (5).

Changes in the blast thresholds and new genetic entities to define AML were introduced by the International Consensus Classification of AML, which revised (as shown in figure 1-1) the previous revised fourth edition World Health Organization (WHO) classification of AML. This further expanded the spectrum of classification identified by cytogenetic and mutational profiles. Genetic aberrations are prioritized in the classification of AML disease due to their predominant influence on disease phenotype and outcome. Therapy-related predisposing features, prior myelodysplastic syndrome (MDS) or MDS/myeloproliferative neoplasm (MPN), and germline predisposition are appended as qualifiers of the primary diagnosis (6).

The cause of leukemia is a topic of debate. As of right now, leukemia is thought to be caused by three things: alkylating agents, benzene, and ionizing radiation. However, only a small percentage of patients' pathogenesis can be explained by the risk factors that are currently known, and the pathophysiology of the majority of these diseases is still unknown. Leukemia risk factors include theories about smoking, electromagnetic fields, hair dye, organic solvents, and viral infections. According to some scientists, exposure to the electromagnetic field environment created by the high-voltage power line system can result in neurological disorders, Alzheimer's disease, and reproductive problems in addition to several cancers, including melanoma, breast cancer, and leukemia (4).

CML

The Philadelphia chromosome's fused oncogene, known as BCR-ABL1, is indicative of the myeloproliferative disease known as chronic myeloid leukemia (CML), which develops from a reciprocal t(9;22) chromosomal translocation (q34;q11.2) that produces a constitutively active tyrosine kinase. In 2018, the incidence rate of CML was nearly one case per 100,000 people worldwide, and it represents 15% of newly diagnosed adult leukemia cases. The clinical course of CML is triphasic, consisting of three phases: an accelerated phase, a blast phase, and an initial chronic phase. Typically, CML is diagnosed during its chronic phase, which can progress to a blast crisis (7) in the absence of appropriate medical intervention. Oftentimes, routine blood tests inadvertently reveal CML. Many times, a patient with leukocytosis does not exhibit any symptoms of the illness. More often than not, though, a thorough medical history reveals a decline in overall health, decreased ability to tolerate physical activity, appetite loss, abdominal fullness, weight loss, and increased perspiration. Significant leukocytosis patients much less frequently experience priapism, visual disturbances, tinnitus, and altered consciousness, which are signs of excessive blood viscosity. In rare instances, the diagnosis may be preceded by pain in the left subcostal region, which could be attributed to splenic rupture, infarction, or spleen capsule inflammation. On physical examination, splenomegaly is

typically evident. Laboratory test results quickly give rise to the suspicion of CML. Typically, leukocytosis exhibits the characteristics of microscopic granulocytes at all developmental stages, including myelocytes, promyelocytes, metamyelocytes, and occasionally myeloblasts. Thrombocythemia, basophilia, and/or eosinophilia accompany this. The characteristic of CML is low granulocytic activity of phagocytosis (FAG), which sets it apart from other chronic myeloproliferative disorders (8).

The next diagnostic step is a bone marrow biopsy. Material is gathered for molecular, cytogenetic, and cytological analyses during this procedure. Immunophenotyping of myeloid cells (to determine the quantity and features of blasts) and optional bone marrow histopathological analysis can also be helpful at times. A rich-cell bone marrow with a higher proportion of granulopoietic cells at all developmental stages is typically seen on the myelogram. In order to establish a diagnosis, the Ph chromosome must be shown to be present through karyotype analysis or BCR-ABL transcript analysis using polymerase chain reaction (PCR) (or optionally fluorescence in situ hybridization). Determining the disease's phase is the next step in the diagnostic process. At the time of diagnosis, the majority of patients are in the chronic phase (CP). On the other hand, some patients are identified as being in either the blast phase (BP) or the acceleration phase (AP). Because the right treatment must be chosen, it is crucial to determine the disease's stage (8).

The uncommon and diverse group of hematological disorders known as myeloproliferative neoplasms (MPNs) share a common biology in which defects in hematopoietic stem cells alter myeloid progenitor cells, causing an excess of mature and immature cells in one or more myeloid lineage cell types. Polycythemia vera (PV), essential thrombocythemia (ET), and primary (idiopathic) myelofibrosis (PMF) are the three classic MPN entities. Though they vary, the signs and symptoms include headaches, excessive sweating, fatigue, bruising, and bleeding. The most frequent complications that lead to a considerable increase in morbidity and mortality are hemorrhagic and thrombotic events. Furthermore, patients with MPN may develop myelodysplastic syndrome (MDS) or acute myeloid leukemia (AML), commonly referred to as blast phase myelofibrosis (BF-MF), which has a far worse prognosis. To date, risk factors related to health, family history, and environment have been proposed; however, little is known about the etiologic mechanisms of these disease entities (9).

Myeloproliferative neoplasms, in contrast to myeloid neoplasms, typically have a natural history measured in decades rather than years, with supportive care being the only course of treatment. But behind a façade of benign myeloproliferation lies a clone of transformed hematopoietic stem cells that, though it happens more or less frequently in each of these conditions, is capable of growing and changing into an aggressive form of acute leukemia or bone marrow failure. Each type of myeloproliferative neoplasm has the ability to evolve into a different type in addition to sharing phenotypic similarities, which complicates diagnosis, risk assessment, and treatment decisions. Additionally, despite being studied for over a century, the pathophysiology of myeloproliferative neoplasms remains unclear, and treatment options are generally supportive. However, driver mutations have recently been

found in over 90% of myeloproliferative neoplasm patients, offering important new information about the pathophysiology of these tumors. Integrating this new information with the decades' worth of clinical experience is currently the difficult task in order to enhance therapy, risk assessment, and diagnosis (10).

JAK2 V617F

Typical chronic myeloproliferative diseases (MPD) like polycythemia vera (PV), essential thrombocythemia (ET), and myelofibrosis with myeloid metaplasia (MMF) have been linked to the somatic mutation JAK2 V617F. JAK2 V617F mutation is uncommon (2–5%) in typical forms of myelodysplastic syndromes (MDS); however, it has been found to be more common in patients with MDS/MPD-U (platelet count >600×109/L and ringed sideroblasts more than 15%). and in a subset of MDS patients who have a proliferative bone marrow and an isolated 5q deletion (11).

Mapping cancers

Africa's population health is improving significantly, as evidenced by falling infant mortality rates, falling HIV/AIDS fatality rates, and rising life expectancy. These benefits can be linked to increased vaccination rates, antiretroviral therapy for HIV, bed nets as a malaria intervention, and a decrease in HIV transmission from mother to child. Alongside these advancements, Africa's disease landscape is changing significantly, with a decline in the burden of communicable diseases and an increase in morbidity and death from non-infectious diseases like cancer, cardiovascular disease, and type 2 diabetes. Given that cancer is currently Africa's fifth most common cause of death, more research on the disease's prevalence in the continent is necessary. Prior research on the epidemiology of cancer in Africa concentrated on sub-Saharan Africa, specific cancer groups like childhood cancer and cervical cancer in addition to other types, and the role of infections in the pathogenesis of cancer (12).

Expecting out comes

-Finding real frequencies among every population, will lead to real mapping myeloid neoplasms, so it may be a key for distinguish real risk factors and solving plan can be set.

-Enhancing methods of diagnose.

Materials and methods

This study was conducted as retrospective descriptive. A total number of cancer patients in addition to myeloid neoplasms diagnosed patients were included in this study in 5 years (2016 to 2020) attended Khartoum hospital of nuclear and isotope therapy. Patients diagnose with acute myeloid leukemia, chronic myeloid leukemia and myeloid dysplastic syndrome were included in this study.

2-7 Data collection

Data obtained from files of patients over 5 years via statistical section of Khartoum hospital of nuclear and isotope therapy, data used included age, gender, duration of diagnosis, locations (West, north, central and Khartoum sectors) beside roots (ascending tribes). Complete blood count results, tools of diagnosis or protocol used (bone marrow aspiration, flow cytometry, Philadelphia chromosome detection and Jack2 mutation).

Data collected from files of patients diagnosed with myeloid neoplasm disorders were sorted to 3 categories, AML, CML and MDS. Observing diagnosis tools, patients' genders and origins or residential areas and parameters assessed during path of disease or at the time of follow up.

I/ Diagnosis tools

a/ complete blood count (CBC)

It is the first line of observing odd readings of total white blood cell (TWBC) count, hemoglobin concentration beside platelet count. Generally, TWBC increased among AML and CML but sometimes low count accompanied the AML with low Hb and platelet, which may increase in some cases of CML and highly increased in some MDS as in essential thrombocythemia (ET). In MF most of parameters may be depressed and CBC can reflect such thing.

CBC parameter obtain from 88 individuals all patient was under treatment

b/ Bone marrow aspiration

Bone marrow aspiration is the key of diagnosis. As frequencies of cellular components and deviations from normality navigating toward the right diagnosis, either normal, hypo cellular or hyper cellular.

c/ Flow cytometer

Cluster differentiations are logs giving cellular proliferation solid diagnosis orientation. Such as CD 45 or CD33, HLA-DR in case of myeloid proliferation.

d/ Philadelphia chromosome

It reflects translocation of (9-22) arms bringing aging of myeloid cells and preventing of apoptosis, which in case of CML, but there are some cases of CML it brought negative results.

e/ Jack2 V617F

A somatic mutation in JAK2 V617F in hematopoietic stem cells has been reported to cause increased sensitivity to erythropoietin and independent growth to growth factor. The mutation is commonly found in a majority of patients with myeloproliferative neoplasm (MPN) characterized by proliferation of one or more of the myeloid cell lineages in the

bone marrow and circulating immature cells in the peripheral blood. The mutation occurs in 95% of patients with polycythemia vera and 50% of patients with essential thrombocythemia and primary myelofibrosis and in other diseases included in this category, except chronic myelogenous leukemia (18).

II/ Mapping myeloid neoplasm

Depending of resident locations or ascending tribes, which files of patients mentioned. In order to categorize area for each disease more the prominent in each where.

III/ Comparing measured parameters among cases selected to be representatives for disorders targeted in this study. 88 patients under prognosis were selected according to full information their files contained, to give clues about parameters and outcome of comparing with healthy subjects set as control group.

Result

This descriptive cross sectional study was conducted in Khartoum state in radiation and isotope Center-Khartoum, different types of cancers' patients attend, in addition to myeloid neoplasms in the 5 years were included. This study tracked myeloid neoplasm in 5 years in Sudan and the result was found to be (4.9%). They were Acute myeloid leukemia (AML=), chronic myeloid leukemia (CML=3.20%), myelodysplastic or proliferative disorders (MDS or MPD=0.13%), which included polycythemia, essential thrombocythemia and myelofibrosis.

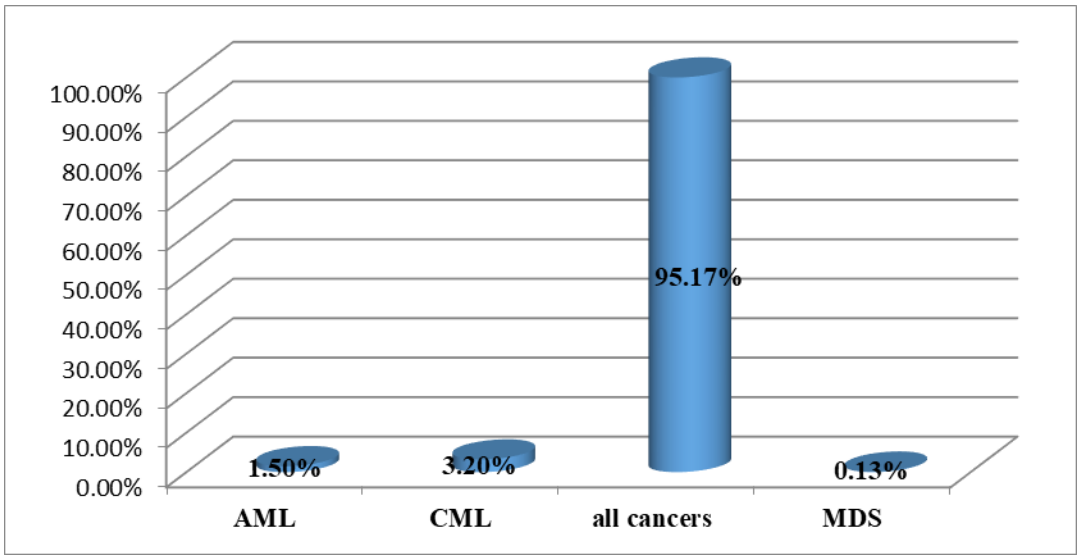

Figure 3-1: Myeloid neoplasm comparing to other cancers from 2016 to 2020

Diagnosis tools: Diagnosis of myeloid neoplasm depended on appearance of parameters of complete blood count on the first place, as most of them usually have been discovered accidentally. Increase WBC count is the main observation for leukemia, beside hemoglobin

and its related parameter, which reflect the degree of navigation of BM myeloid toward myeloid proliferation or not. Peripheral blood picture as it part of CBC also reveals the presence of myeloid series blast or mature cells to distinguish the phase of leukemia. BM aspiration is set for diagnosis protocol and it 100% conducted for differentiation type of neoplasm suspected to be. Cluster differentiation is also conducted by 100%, even of some patients lack the financial recommended, but the hospital provides almost free charges to make diagnosis performed in the ideal way, as well as Philadelphia chromosome and Jack mutation for CML and MDS respectively, which are routinely performed. So right diagnosis assured for patients with myeloid neoplasms.

Comparing frequency of myeloid neoplasm over the 5 year, AML were 604 cases, CML were 1240 cases and MDS were 52 cases, there were significant differences as P value for each disease was low than 0.05 as in table 3-1.

Table 3-1: Frequencies of Myeloid neoplasm from 2016 to 2020

	2016		**2017**		**2018**		**2019**		**2020**		**P. value**
Total of cancers	7426		8317		8670		8196		6351		
	No	%	No	%	No	%	No	%	No	%	
AML 604	124	1.66	152	1.83	123	1.4	112	1.36	93	1.46	0.004*
CML 1240	247	3.33	263	3.2	276	3.2	248	3.03	206	3.2	0.025*
MDS 52	3	0.04	11	0.13	0	0.0	6	0.073	32	0.50	0.000*

Significant difference p value <0.0

Comparing occurrence of myeloid neoplasm among genders, distribution has no fixed rate, in AML males were more frequent in 2016, 2017, no significant difference obtained for each year as p value for each was >0.05, for 2018 and 2019 females were more affected than males but with no significant different as well. While 2020 males were more frequent than females than there was significant different obtained as p value was <0.05 as in table 3-2.

Table 3-2: Comparing Gender distribution among Myeloid neoplasms from 2016 to 2020

	2016		2017		2018		2019		2020	
	M	F	M	F	M	F	M	F	M	F
AML	124		152		123		112		93	
N	63	61	77	75	60	63	48	64	59	34
%	(50.8)	(49.2)	(50.6)	(49.4)	(48.8)	(51.2)	(42.9)	(57.1)	(63.4)	(36.6)
P. value	0.857		0.871		0.787		0.131		0.010*	
CML	247		263		276		248		206	
N	130	117	147	116	131	145	116	135	114	92
%	(52.6)	(47.4)	(44.1)	(55.9)	(47.5)	(52.5)	(45.6)	(54.4)	(55.3)	(44.7)
P. value	0.408		0.056		0.399		0.230		0.125	
MPD	3		11		0		6		32	
N	2	1	4	7	0	0	3	3	17	15
%	(66.7)	(33.3)	(100)	0	0	0	(50)	(50)	(53.1)	(46.9)
P. value	0.564		0.096		-		-		0.577	

Geographic distributions of cancers in Sudan showed that Khartoum state and western sector were more prominent than other sectors in 2019 and 2020, comparing with frequencies of both sectors in half year of 2022, revealed that increased cancer occurrence and significant differences obtained. Central sector, which includes Gezira, Blue Nile, While Nile and areas around them has low cancer rate in 2020 than 2019 but in half year of 20200 was increased rate of cancers and significant difference obtained when compared with. Northern and Eastern sectors were increased rate of cancer in 2019 than 2020 and the half years of 2022, bringing significant difference as well. Foreigners were more affected in 2019 than 2020 and half of 2022 with significant difference as p value was 0.000 as in table 3-3.

Table 3-3: Geographic distribution of cancer in Sudan

Sector	Year						P. value
	2019		2020		2022 (1-6) months		
	N	%	N	%	N	%	
Khartoum	2341	28.6	2431	38.3	4053	55.4	0.000*
Western	2468	30.1	1585	25	1014	13.9	0.000*
Central	1718	21	1218	19	1127	1.7	0.000*
North	916	11.7	563	9	543	7.4	0.000*
Eastern	525	6.4	394	8.9	394	5.4	0.000*
Foreigners	228	2.8	190	3	190	2.6	0.000*
Total	8196		6351		7321		

According to cases taken as representatives for myeloid neoplasm, their geographical distribution as in table 3-5, showed that AML case were came from western sector more frequent than other parts, central sector followed then north, east and Khartoum area and figure 3-2. CML showed equal distribution in north, center and west as in figure 3-3. MDS was increased in west, then north more than other parts as in figure 3-4.

Table 3-4: Geographic distribution of myeloid neoplasm in Sudan

	North	East	west	Center
AML%	11.8	8.8	52	38.1
CML%	32.0	4.0	32.0	32.0
MDS%	26	4	39	32

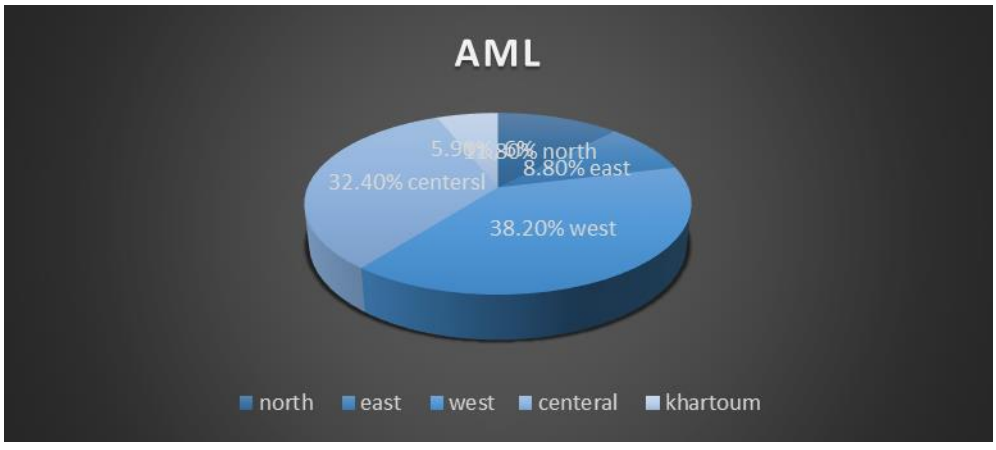

figure 3-2: AML geographical distributions

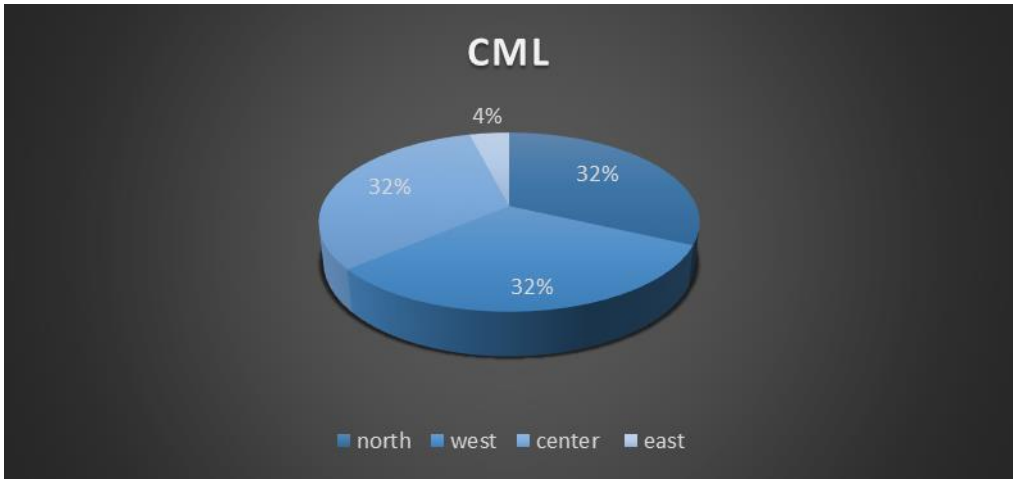

Figure 3-3: CML geographical distributions

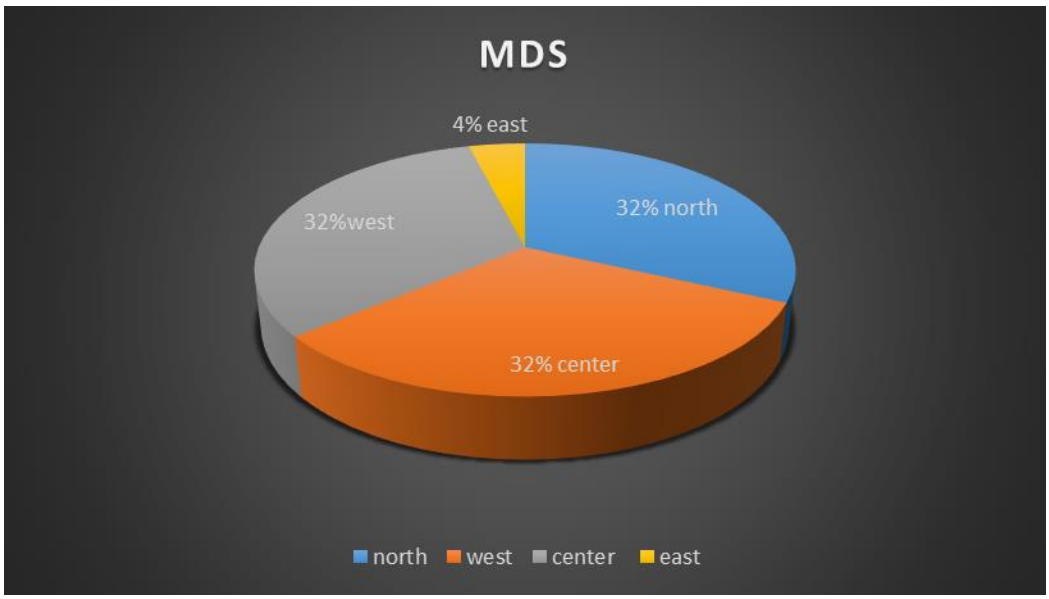

figure 3-4: MDS geographical distributions

Ethnic distributions of selected patients of myeloid neoplasm revealed that central sector of Sudan filled with relocated residents, the thing changing frequencies when come to tribe ascending from. CML patients in central sector has more than 50% came from western regions of Sudan. (To assess treatment follow up), 88 myeloid disorders patients were selected patients as representatives for myeloid neoplasm, to observe their measured parameters and compare with 88 healthy subjects (control group). There were significant differences p values <0.05 in Hb (it was low level among patients, but clinically patients were stable) and TWBC was increased among patients with myeloid neoplasm than control, neutrophil and platelets had no significant difference when compared between case and control reflecting good prognosis through treatment path as in table 3-6.

Table 3-6: Comparison of CBC between case and control

Parameter	Case	Control	P. value
Hb	9.5 ± 2.7	12.6 ± 2.0	0.000*
TWBC	102.2 ± 93.6	6.8 ± 2.1	0.000*
Neutrophils	68.3 ± 22.1	58.3 ± 12.7	0.083
Platelets	392.3 ± 336.4	271.2 ± 103.3	0.079

Considering gender in myeloid neoplasm patients, Hb, TWBC and platelets had no significant difference when compared, slight increase of Hb, TWBC and platelets and decreased Blast percentage among males than females (p value >0.05), but neutrophil percentage was increased among male group to limit of significant difference obtained as p value <0.05 as in table 3-7, blast didn't give significant difference as variation in mean or increased standard deviation when it increased block the significance may occur).

Table 3-7: Comparison of CBC according to gender

Parameter	Male	Female	P. value
Hb	9.9 ± 2.8	9.1 ± 2.6	0.429
TWBC	100.2 ± 89.4	103.8 ± 100.5	0.926
Neutrophils	79.2 ± 9.5	57.4 ± 26.0	0.031
Blast	48.0 ± 42.0	49.3 ± 35.8	0.976
Platelets	388.8 ± 346.7	395.5 ± 339.6	0.960

Regarding to the diagnosis of myeloid neoplasm (CML, MDS and AML), CBC parameters were compared, Hb was decreased among AML more than other sorts, significant different obtained as p value was 0.001. TWBC was more increased CML patients, then AML and MDS and significant difference obtained as well (p value 0.008). Blast, even its noticeable high level in AML, no significant difference obtained when compared with others' sorted groups (MDS and CML), Platelet levels also had no significant difference among myeloid neoplasm types as in table 3-8.

Table 3-8: Comparison of CBC according to diagnosis

Parameter	Diagnosis	Mean±SD	P. value
Hb	CML	10.6±1.9	0.001*
	MDS	7.7±0.5	
	AML	6.4±2.9	
TWBC	CML	137.9±90.1	0.008*
	MDS	8.1±5.1	
	AML	29.7±36.4	
Neutrophils	CML	70.7±14.6	0.679

	MPD	69.3±33.2	
	AML	58.0±40.9	
Blast	CML	6.0±0.0	0.088
	MPD	10.0±0.0	
	AML	76.0±16.4	
Platelets	CML	454.8±324.9	0.183
	MPD	412.3±239.8	
	AML	142.4±68.3	

Duration diagnosis was sorted to ≤5 years and >5 years, CBC parameters when compared according to that, no significant differences obtained as in table 3-9.

Table 3-9: Comparison of CBC according to duration of diagnosis

Parameter	Duration	Mean ± SD	P value
Hb	≤ 5	8.0 ± 1.8	0.088
	> 5	10.0 ± 2.8	
TWBC	≤ 5	60.8 ± 37.1	0.177
	> 5	117.4 ± 89.7	
Neutrophils	≤ 5	71.5 ± 27.5	0.755
	> 5	67.4 ± 21.4	
Blast	≤ 5	41.0 ± 20.2	0.451
	> 5	80.0	
Platelets	≤ 5	299.7 ± 281.5	0.408
	> 5	424.7 ± 354.4	

Patients of myeloid neoplasm age's sorted to <40, 40-60 and >60 years, comparing parameters between the 3 age's ranges revealed that TWBC only had significant difference, while other parameters showed no difference as in table 3-10.

Table 3-10: Comparison of CBC according to age

Parameter	Age	Mean+SD	P. value
Hb	< 40	10.5+2.4	0.232
	40 - 60	10.1+2.8	
	> 60	8.4+25.7	
TWBC	< 40	63.6+104.7	0.021*
	40 - 60	162.3+104.2	
	> 60	60.0+52.8	
Neutrophils	< 40	82.6+8.6	0.208
	40 - 60	64.0+15.0	

	> 60	70.3+21.9	
Blast	< 40	.	0.421
	40 - 60	6.0±0.0	
	> 60	52.7±40.3	
Platelets	< 40	437.6±231.7	0.964
	40 - 60	395.0±100.7	
	> 60	397.8±154.5	

Discussion

Cancer ranks as a leading cause of death and an important barrier to increasing life expectancy in every country of the world. According to estimates from the World Health Organization (WHO) in 2019, cancer is the first or second leading cause of death before the age of 70 years in 112 of 183 countries and ranks third or fourth in a further 23 countries. Cancer's rising prominence as a leading cause of death partly reflects marked declines in mortality rates of stroke and coronary heart disease, relative to cancer, in many countries (19).

This descriptive study was conducted in Khartoum hospital for nuclear radio and isotopes therapy, different types of cancers' patients attend in order to diagnosis or follow up, such as breast cancer, thyroid neoplasm, Kaposi sarcoma, lymphoma, brain tumors and others. This study tracked myeloid neoplasm in 5 years in order to map them in Sudan. They were Acute myeloid leukemia (AML), chronic myeloid leukemia (CML), myeloid leukemia and myelodysplastic or proliferative disorders (MDS or MPD), which included polycythemia, essential thrombocythemia and myelofibrosis. out of 2016 to 2020 attended cancers' patients, MDS were lower frequencies over these years (0.13%), CML had increased steady rate of existence (3.2%) then AML with 1.5% occurrence. Comparing frequency of myeloid neoplasm over the 5 year, AML were 604 cases, CML were 1240 cases and MDS were 52 cases, there were significant differences as P value for each disease was low than 0.05.Comparing occurrence of myeloid neoplasm among genders, distribution has no fixed rate, AML males were more frequent in 2016, 2017, no significant difference obtained for each year as p value for each was >0.05, for 2018 and 2019 females were more affected than males but with no significant different as well, while 2020 males were more frequent than females than there was significant different obtained as p value was <0.05.Geographic distributions of cancers in Sudan showed that Khartoum state and western sector were more prominent than other sectors in 2019 and 2020, comparing with frequencies of both sectors in half year of 2022, revealed that increased myeloid cancers' occurrence and significant differences obtained. Central sector, which includes Gezira, Blue Nile, While Nile and areas around them has low cancer rate in 2020 than 2019 but in half year of 20200 was increased rate of cancers and significant difference obtained when compared with. Northern and Eastern sectors were increased rate of cancer in 2019 than 2020 and the half years of 2022, bringing significant difference as well. Foreigners were more affected in 2019 than 2020 and half of 2022 with significant difference as p value was 0.000.

According to cases taken as representatives for myeloid neoplasm, their geographical distribution showed that AML case were came from western sector more frequent than other parts, central sector followed then north, east and Khartoum area. CML showed equal distribution in north, center and west. MDS was increased in west, then north more than other parts. Ethnic distributions of selected patients of myeloid neoplasm revealed that central sector of Sudan filled with relocated residents, the thing changing frequencies when come to tribe ascending from. CML patients in central sector has more than 50% came from western regions of Sudan.

To assess treatment, follow up), 88 myeloid disorders patients were selected patients as representatives for myeloid neoplasm, to observe their measured parameters and compare with 88 healthy subjects (control group). There were significant differences p values <0.05 in Hb (it was low level among patients, but clinically patients were stable) and TWBC was increased among patients with myeloid neoplasm than control, neutrophil and platelets had no significant difference when compared between case and control, reflecting good prognosis through treatment path. Considering gender in myeloid neoplasm patients, Hb, TWBC and platelets had no significant difference when compared, slight increase of Hb, TWBC and platelets and decreased Blast percentage among males than females (p value >0.05), but neutrophil percentage was increased among male group to limit of significant difference obtained as p value <0.05.Regarding to the diagnosis of myeloid neoplasm (CML, MDS and AML), CBC parameters were compared, Hb was decreased among AML more than other sorts, significant different obtained as p value was 0.001. TWBC was more increased CML patients, then AML and MDS and significant difference obtained as well (p value 0.008). Blast, even its noticeable high level in AML, no significant difference obtained when compared with others' sorted groups (MDS and CML), Platelet levels also had no significant difference among myeloid neoplasm types. Duration of diagnosis was sorted to $\leq$5 years and >5 years, CBC parameters when compared according to that, no significant differences obtained. Patients of myeloid neoplasm age's sorted to <40, 40-60 and >60 years, comparing parameters between the 3 age's ranges revealed that TWBC only had significant difference, while other parameters showed no difference.

A partial agreement with a Tanzanian study conducted as cross-sectional analysis of all hematological malignancies at Cancer Care Centre from December 2016 to May 2019 was performed and a narrative report provides information about diagnostic means, treatment and the use of synergies. A total of 209 cases have been 63% of CML cases were seen in patients under the age of 45. Sexes were almost equally balanced in all NHL groups while clear male predominance was found in HL and CML (13). An agreement with a Morocco study of patients diagnosed with hematological malignancies (HM) between January 2008 and December 2012 in three Centre's in Eastern Morocco providing cancer diagnosis, treatment or palliative care services. In the study, a total of 660 cases of HM were registered between January 2008 and December 2012. Overall, 6075 cases of cancers all sites combined were registered during this study period, indicating that HM account for around 10.9 % (660/6075) of all cancers recorded. Among the 660 registered cases of HM,

53 % were males and 47 % were females, with a male to female ratio of 1.1. Thus, overall, men are slightly more affected with HM than women. By contrast, a female predominance was observed myeloproliferative neoplasms (MPN), acute myeloid leukemia (AML) and the myelodysplastic syndrome (MDS) (15).

A partial agreement with a French study conducted to estimate the incidence of various types of hematologic malignant neoplasm in breast cancer survivors, both in absolute terms and in association with the general population. This nationwide cohort study conducted in France used data from the French National Health Data System, a database that contains all of French residents' health-related expenses. Among women diagnosed with cancers in between July 2006 to December 2016 were included (n = 439 704). Overall, 3046 cases of hematologic malignant neoplasm occurred: 509 cases (16.7%) of AML, 832 cases (27.3%) of MDS and 267 cases (8.8%) of MPN (20).

Comparison with international burden of AML, here in Sudan AML is low, as globally observed that the incidence case of AML was increased gradually in the past 28 years (from 63.84 × 103 in 1990 to 119.57 × 103 cases in 2017, increasing by 87.3%),

while CML has steady rate over the 5 years in this study and like it's occurrence globally, as from 1990 to 2017, the number of annual incident cases of CML was stable, and there were 31,752 (29,590–34,066) cases in 1990 and 34,179 (, 31,516–36,714) cases in 2017. MDS has low incidence than AML and CML here in Sudan, in USA, it estimated that 3.6 cases/100x103 every year.

Conclusion

- This study concluded that; Fluctuation on the frequency of myeloid neoplasm was obtained; CML remain constant until 2020 but AML presented with low rate and there was increased in MDS, so reasons should be traced and followed.
- Regarding gender distribution of myeloid cancer; there was equal distribution in all years except in 2020, were male were more affected by the disease than female.
- Geographic distributions of myeloid neoplasms in Sudan showed that the western sector has high rate of AML, then central region. CML was dominated in North, west and center at the same level, but the east were lower levels of distribution in all types of myeloid neoplasm.
- Age risk factor (40-60) was noticed to have the highest WBCs count among patients with myeloid neoplasm although they were under treatment.

Recommendation

- For this reasons should be justified and traced through sophisticated data analysis inside the hospitals or more focus researches in orders to improve disease and patient's outcome.
- Further study should be done in genetics and environmental risk factors that may associate with a certain sectors in Sudan could be assessed and investigated to lower or prevent the incidence of disease.

- Data entry should be applied through organized and international way by professional staff, in order to discover the possible risk factors early through epidemiological and scientific researches.

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