IMMUNOLOGICAL PROFILE OF ACUTE MYELOID LEUKEMIA IN KURDISTAN IRAQ

BAYAR WASFY SALIM, MBCHB*

SANA DLAWAR JALAL, MBCHB, FIBMS, FRCPATH**

Submitted 13/2/2018; accepted 29/5/2018

ABSTRACT

Background: Immunophenotyping has become crucial in the diagnosis and classification of acute leukemias and identification of its aberrant phenotypes. This study aimed to evaluate the patterns in AML cases presented to the flowcytometry unit at the Sulaimani Public Health Laboratory, Kurdistan, Iraq,and to determine the frequency of aberrant expression of lymphoid associated antigen.

Subject and Methods: For the above purposes, 108 cases of acute myeloid leukemia (AML) were evaluated morphologically,and by flowcytometry with a panel of 22 antibodies. Furthermore, any aberrant expression of lymphoid associated antigens was reported.

Results: The morphological AML subtyping revealed that 29.6% of AML cases were M2, while M1 (36.1%) was the predominant subtype by immunophenotyping using WHO 2008 classification. CD117, CD45, CD13 and CD33 were the most frequently expressed markers (99.1%, 92.6%, 92.6% and 85.2% respectively). Forty-five patients (41.7%) expressed lymphoid associated antigens (nTdT, CD19, CD79a, CD10, CD4, CD56 and CD9) that was demonstrated in all AML subtypesexcept M6.CD56 was the most frequent(13%),followed by CD9 (12%), CD4 (8.3%), and CD19 (7.4%).CD79a, nTdT and CD10 were less frequent, present in <5% of cases each.

Conclusions: Immunophenotyping is an essential supplement to morphology in AML, whether for confirmation or accurate subtyping. Furthermore, more than 40% of cases show aberrant lymphoid antigen expression. The latter may serve as an important tool in future studies on minimal residual disease evaluation.

Duhok Med J 2018; 12 (1): 1-12

Keywords: Acute myeloid leukemia, Immunophenotyping, Flow cytometry, French-American- British.

Acute myeloid leukemia (AML) is a heterogeneous hematologic malignancy characterized by a clonal expansion of myeloid blasts in peripheral blood, bone marrow, and/or other tissues. It is the most common form of acute leukemia among adults where myeloid cell differentiation is arrested in an early stage of development[1]. The incidence of AML ranges from three to five cases per 100 000 population and it increases with age. Its peak incidence is in the seventh decade with slight male predominance[2,3].

The French-American-British (FAB) system had become the standard to classify AML into different sub-types, and AML is categorized on the stage of maturation of myeloid precursors and their malignant transformation characteristics at the time of initial diagnosis[4].

However, immunophenotyping using

* Senior house office, Department of Hematology, Duhok directorate of Health, Duhok, Kurdistan Region, Iraq.

** Assistant Professor, Department of Pathology, College of Medicine, University of Sulaimani, Kurdistan Region, Iraq.

Correspondence author to: *Sana Dlawar Jalal, dr.sanajalal612@gmail.com, Mobil +9647703649694*

multiparameter (at least 4-colors) flow cytometry (FCM) has recently been used to determine lineage involvement of a newly diagnosed acute leukemia and became an indispensable tool for quantitative and qualitative evaluation of antigen expression of hematopoietic cells[5]. The occurrence of aberrant phenotypes has been reported in acute leukemias with variable frequency although its prognostic significance remained debatable. Flow cytometry is very instrumental in this aspect where malignant blasts often have an antigenic profile that allows distinction from normal immature cells and even proved useful for disease monitoring[6,7]. Immunophynotypic patterns of AML in Iraqi Kurdistan have not been addressed before, and thusthis study was conducted to characterize these patterns in cases presenting to the flowcytometry unit at the Sulaimani Public Health Laboratory, Kurdistan, Iraq.

MATERIAL AND METHODS

A total of 108 acute myeloid leukemia (AML) cases immunophenotyped atthe Sulaimani Public Health Laboratory-molecular hematology and flowcytometry department, Kurdistan, Iraq using 4 colors flow cytometer during the period Jan 2012 till Dec 2016 were reviewed retrospectively. The selection of cases was based on the availability of records and slides. The analyzed samples were either peripheral blood (40) or bone marrow aspirate (68). Relapsed or recurrent cases of AML and cases with absent records were excluded. Morphological examinations of all peripheral blood and bone marrow smears involved reclassification according to the FAB morphological classification and the immunological criteria for diagnosis based on the World Health Organization (WHO) and European Group for the Immunological Characterization of Leukemia (EGIL) [3,5].

Flow cytometry immunophenotyping: All specimens freshly collected in K3 EDTA tubes were stained and lysed using a direct immunofluorescence method after proper processing according to the manufacturers' instructions. Samples were analyzed using two lasers, four colors, six parameter BD FACS Calibur flow cytometer (BD Biosciences, San Jose, CA, USA). Data acquisition and analyses were performed using CellQuest Pro software (BD Biosciences). Daily calibration was performed using BD Calibrite beads.A panel of monoclonal antibodies (MAb) was utilized that consisted of the myeloid markers: cMPO, CD117 ,CD13, CD33,CD15, CD14,CD64 and CD11c. B-cell markers : CD19,CD20,CD10 and CD79a,T-cell markers: cCD3,sCD3,CD4,CD5 and CD9 with the non-lineage markers:CD45, CD34, CD56, CD36,and nTdT. CD7, CD2 and HLA-DR were used in a limited number of cases. CD71 and CD235a (Gylycophorin A) were used to confirm the erythroid lineage and CD41 was used to confirm the megakaryocytic lineage. Isotype antibodies were used as a negative control in separate tubes. All MAb were purchased from BD Biosciences.

Blast cells were identified using side scatter (SSC) versus CD45 plot, then gating on CD34+ blasts using CD34 versus SSC plot, and further different plots followed to study the expression of other required markers. In samples where the

blasts were CD34 negative, the expression of the above mentioned markers was studied in the blast region identified by the SSC versus CD45. The consensus of EGIL of a threshold of 10% was used to define positive blasts for cytoplasmic markers and 20% for surface markers[5].

The study was approved by the scientific departmental and Kurdistan board ethics committees. Since the study is a retrospective study and patients were assessed anonymously, no informed consent was sought.

RESULTS

A total of 108 newly diagnosed AML cases were enrolled in this study, including 53 males and 55 females with (male to female ratio of 1.0:1.04). Their ages ranged from 7 days to 87 years with a median age of 38 years. Eighty eight patients (81.5%) were adults (> 15 years old).

***Blood Picture at presentation*:** The Hemoglobin (Hb) ranged from 4 to 15.2 g/dl, with a mean of (7.7±3.3 g/dl), the WBC ranged from 0.5 to 450 $\times 10^9$/L, with a mean of (47.1±71.7 x 10^9/L),while platelets count ranged from 5 to 700 x10^9/L with a mean of (84.1±118.6).

Morphological Classification: Bone marrow was infiltrated by blasts in all cases as per definition of AML (range 20-99%; Median 83.5% blast). FAB morphological AML subtyping revealed that the M2 (29.6%) subtype was the commonest subtype, while 23.1% of the cases were morphologically undifferentiated, and presumably diagnosed as M0.The least reported subtype was the M6 (0.93%). One of the patients (0.93%) did not fit into any of the FAB categories and therefore was labeled as unclassified (Table1).

Table1: Distribution of the Immunophenotypic and Morphological FAB Classifications

AML Subtype	Immunological Classification	FAB classification
M0	21(19.4%)	25(23.1%)
M1	39(36.1%)	22(20.4%)
M2	20(18.5%)	32(29.6%)
M3	7(6.5%)	7(6.5%)
M4	6(5.6%)	9(8.3%)
M5	13(12%)	11(10.2%)
M6	1(0.9%)	1(0.9%)
AML-MRC	1(0.9%)	1(0.9%)

Immunophenotypic classification: Using the panel of CD markers as detailed previously, AML-M1 (36.1%) was the predominant subtype followed by M0, M2, at 19.4% and 18.5 respectively; other subclasses were less common. The unclassified case by FAB showed to be AML with myelodysplasia related changes (AML-MRC) using flowcytometry according to the WHO 2008 classification (Table1)**.**

The CD markers and their uses in diagnosis: The results of immunophenotyping using the above mentioned MAb are summarized in Table [2]. CD45, CD117, CD13 and CD33 were the most frequently expressed markers (99.1%, 92.6%, 92.6% and 85.2% respectively). All the cases were positive for either CD13 or CD33 apart from AML M6. The MPO was detected in 73.2% of AML cases and 98.7% of AML –non-M0 cases (Table 2).

Table 2: Frequencies of antigen expression in 108 cases of acute myeloid leukemia enrolled

Classification based on flow	cMPO	CD117	CD34	CD13	CD33	CD15	CD36	CD14	CD64	CD11c	CD45
AML-M0 (21)	0	19 (90.5%)	20 (95.2%)	16 (76.2%)	14 (66.7%)	5 (23.8%)	0	0	0	1 (4.8%)	21 (100%)
AML-M1 (39)	39 (100%)	38 (97.4%)	35 (89.7%)	37 (94.9%)	35 (89.7%)	12 (30.8%)	3 (7.7%)	0	1 (2.6%)	5 (12.8%)	38 (97.4%)
AML-M2 (20)	20 (100%)	20 (100%)	16 (80%)	20 (100%)	20 (100%)	13 (65%)	1 (2%)	7 (35.0%)	10 (50.0%)	4 (20%)	20 (100%)
AML-M3 (7)	7 (100%)	6 (85.7%)	0	7 (100%)	7 (100%)	2 (28.6%)	0	1 (14.3%)	0	0	7 (100%)
AML- M4 (6)	5 (83.3%)	6 (100%)	6 (100%)	6 (100%)	6 (100%)	4 (66.7%)	3 (50%)	4 (66.7%)	4 (66.7%)	3 (50%)	6 (100%)
AML-M5 (13)	7 (53.9%)	10 (76.9%)	4 (30.8%)	13 (100%)	10 (76.9%)	10 (76.9%)	7 (53.8)	12 (92.3%)	13 (100%)	6 (46.2%)	13 (100%)
AML-M6 (1)	0	0	0	0	0	0	1 (100%)	0	0	0	1 (100%)
AML-MRC (1)	1 (100%)	1 (100%)	0	1 (100%)	0	0	0	0	1 (100%)	0	1 (100%)
Total	79 (73.2%)	100 (92.6%)	81 (75%)	100 (92.6%)	92 (85.2%)	46 (42.6%)	15 (13.9%)	24 (22.2%)	29 (26.9%)	19 (17.6%)	107 (99.1%)

Acute myeloid leukemia Subtypes Based on Immunophenotype:

Acute myeloid leukemia with minimal differentiation (AML-M0): twenty one cases (19.4%) were classified as minimal differentiated AML .The myeloid associated markers CD117 and/or CD33 were expressed in almost all the cases. In addition, all the cases expressed CD45 with CD34 (95.2%). CD33 (66.7%) were the next frequent markers expressed, unlike myeloperoxidase that was not expressed in any case.

Acute myeloid leukemia without maturation (AML-M1): thirty nine cases (36.1%) were classified as AML-M1.All the enrolled cases were positive for cMPO. CD45 (97.4%), CD117 (97.4%), and CD13 (94.9%), were the next most frequently expressed antigens.

Acute myeloid leukemia with maturation (AML-M2): Twenty cases (18.5%) were classified as AML-M2.Myeloperoxidase, CD45, CD117, CD13 and CD33 were detected in all cases .CD15 (65%) and CD64 (50%) were the next most frequent myeloid markers expressed.

Acute promyelocytic leukemia (AML-M3): Seven cases (6.5%) including four microgranular variants were included. All cases were positive for myeloperoxidase, CD45, CD13 and CD33, while CD117 was detected in (85.7% as weak and partial pattern of expression). HLA-DR and CD34 were not expressed in any of the seven cases.

Acute myelomonocytic leukemia (AML-M4): Six cases (5.6%) were classified as AML-M4.All the studied cases were positive for CD45, CD13, CD33, CD117, cMPO(83.3%), CD15 and CD14 (66.7% each) were the next most commonly expressed markers.CD4 was expressed in half of cases .

Acute monocytic leukemia (AML-M5): included 6 cases as acute monoblastic leukemia (M5a) and seven cases as monocytic leukemia (M5b). All the cases expressed CD45, CD13 and CD64. CD14 (92.3%), CD117 and CD33 (76.9% each), were the next most frequent antigens. The cases of M5a were negative for MPO,CD4 and about one third of the cases showed CD34 positivity, while (66.7%) expressed CD117.In contrast, all cases of M5b were myeloperoxidase positive, CD4, CD36 and CD14 positive and (71.4%) of the cases expressed CD117, yet on the minor population of blasts and/or promonocytes .

Acute erythroid leukemia (AML-M6): One case (0.93%) was classified as AML-M6. The case expressed CD45, CD36, CD71 and Glycophorin A in the absence of all other myeloid antigens and was classified as pure erythroid leukemia according the WHO 2008, with over (80%) blast cells being erythroid precursors.

Acute myeloid leukemia with myelodysplasia related changes (AML-MRC): One case (0.93%) of the AML cases showed an evident dysplasia involving the erythroid and myeloid lineage to a major extent. CD45, CD117, CD13 and MPO were expressed in this case. This case could not be classified according to FAB criteria.

Lymphoid –associated antigen expression: Forty-five patients (41.7%) expressed lymphoid associated antigens (nTdT, CD19, CD79a, CD10, CD4, CD56 and CD9) **Table 3**.Thirty three cases (30.6%) expressed a single lymphoid antigen, six (5.6%) expressed two lymphoid-associated antigens and two cases (1.8%) expressed three lymphoid–associated antigens without fulfilling criteria for biphenotypic acute leukemia (BAL). All AML subtypes demonstrated lymphoid‑associated antigens except M6. CD56 was the most frequently expressed lymphoid marker, it was present in 14 of 108 cases (13%). The expression was partial and dim. The next most frequently expressed lymphoid antigen is CD9, present in 13 cases (12%), followed by CD4 (8.3%), [in cases of AM-M4 and AML-M5, CD4 was not considered as lymphoid associated antigen], and CD19 (7.4%). CD79a, nTdT and CD10 were less frequent, present in less than 5% each.

Table 3: Frequency of lymphoid associated antigens expression

Markers	M0 (21)	M1 (39)	M2(20)	M3(7)	M4(6)	M5(13)	M6(1)	AML-MRC(1)	Total
CD4	2	2	3		0	0		1	8(3.7%)
CD9		4	1	5	1	1			12(11.1%)
NTdT	1								1(0.93%)
CD19		1	3						4(45.4%)
CD79a		1							1(0.93%)
CD79a+ nTdT		1							1(0.93%)
CD79a+CD19		0	1						1(0.93%)
CD4+ nTdT	1								1(0.93%)
CD10					1				1(0.93%)
CD9+CD79a	1								1(0.93%)
CD56	1	2	2			4			9(8.3%)
CD56+CD19			1		1				2(1.9%)
CD56+NTDT+CD19	1								1(0.93%)
CD56+CD10		1							1(0.93%)
CD56+CD79a+nTdT			1						1(0.93%)
Total	7(33.3%)	12(30.8%)	12(60%)	5(71.4%)	3(50%)	5(38.5%)	0	1	45

DISCUSSION

Acute myeloid leukemia (AML) is a heterogeneous group of disorders which often presentwith variable morphologic, immunophenotypic and cytogenetic patterns. The identification of these patterns can be useful for a better prognostic evaluation and an appropriate therapeutic approach[8].

The age and sex distribution of patients in this study are similar to a great extent to previous reports from Iraq[9, 10]. The distribution of morphological subtypes in this study according to FAB classification is highly consistent with a previous cytomorphological reports from Iraq [9], [10], where M2 (29.6%) is the most frequent subtype. While flowcytometry has shown that M1 is the predominant immunophenotypic subtype (36.1%) , which is contrast tothe findings of Al-Anizi et al -Iraq (2017) where M4 was

the predominant subtype (42.6%)[11] and also varied from other previous figures reported from Sudan, Egypt, and India, where they found that AML-M0, M4/M5 and M2 the most frequent subtypes respectively[12,13,14]. It should however be noted that the nature of this work which enrolled the referred cases to Sulaimani Public Health lab may have affected the actual frequencies of various subtypes, since cases with evident features of myeloid differentiation are less likely to be referred for flow cytometry leading of under-estimation of these subtypes.

Of the myeloid associated antigens used in this study: CD117, CD13 and CD33 were the most frequently expressed antigens.CD117 has a higher specificity for myeloid lineage than CD13 or CD33 and CD13 is more specific than CD33[15]. In this study, cMPO was expressed in 73.2% of AML cases, and the sensitivity of flow cytometry in the detection of MPO can be enhanced when considering the 3% cut-off instead of 10% (since the enzymatically inactive proenzyme can be also detected[16]. The frequency of the commonly expressed myeloid associated antigens in AML patients were within the ranges when compared to data from literatures for CD13(92.6% *versus* 60-90%),CD33 (85.2% *versus* 70-90%), MPO (73.2% *versus* 0-75%), while a bit higher for CD117 (92.6%*versus* 60-70%)[12, 16].

The use of a large panel for the immunophenotyping of AML could identify seemingly aberrant expression of lymphoid antigen in some cases. The frequency of aberrancy in AML has been found to be variable depending on the panel of markers studied, sample size and the criteria for aberrancy used, i.e. whether included asynchronous antigens expression in addition to lymphoid associated antigens expression in AML cases[17]. Our figure of lymphoid antigens expression in AML (41.7%) is consistent with a previous study from Iraq (42%)[11] and approaching previous figures of 34.2% from Brazilm[18], and 35% from India [19] ,but is lower than some other reported figures (47% - 67.5%)[20-22].

CD56 was the most frequent lymphoid associated antigens expressed in our AML cases (13%). CD56 is a neural cells adhesion molecule that together with CD3 defines natural killer cells, and not present on normal myeloid cells[6]. This observation is in accordance with Abdulatteef et al (2014) who also demonstrated that CD56 as the most frequent marker [21], although at a higher frequency (27.5%) and EL-Sissy et al (2006) and Chang et al (2007) at 21.7% and 15% respectively[20,22]. Other studies have shown CD7 as the most frequent lymphoid marker instead[4, 18, 23]. In the current study CD7 was only sparingly used and therefore it was not included in aberrancy assessment, which is a limitation of the current study. The CD56 positive cases were distributed among different FAB subtypes (M0, M1,M2,M4,M5) and it was expressed in 3 out of 20 M2 cases one of them co-expressed CD19 and the other co-expressed CD79a in accordance with other investigators reporting CD56 ,cCD79a and CD19 co-expression in AML-M2 particularly with t(8;21) [6,8,12,21]. These results demonstrate that CD79a expression is not restricted to B-ALL cases.

CD9 was detected in 12% of AML cases (from M0-M5) with (71.4%) of AML M3 expressing CD9 in agreement with EL-

Sissy et al 2006[20]. On the other hand, excluding the AML cases with monocytic differentiation (M4 and M5), CD4 was expressed in (8.3%) of AML cases approaching the figures reported by EL-Sissy et al (2006) and Saxena et al (1988) at 8.8% and 10% respectively[20, 24].

CD19, another B-Lymphoid marker was expressed in 7.4% of our patients, which is in accordance with several previous researchers reporting figures of 7.9-10% [11,17,18]. CD19 was reported in 8 cases, 5 of which were in AML-M2, including one in association with CD79a as observed by previous studies[6,17].

Some immunophenotypic patterns were associated with certain subtypes of AML in the current study. One such pattern was CD9 expression with the lack of expression of CD4, CD11c, CD36, CD34 and HLA-DR detected in all cases of AML-M3, but not other subtypes. Furthermore, the CD36 expression in the absence of CD34 and cMPO was found in more than half of AML-M5 cases. Likewise CD4 and CD117 expression helped substantially to differentiate AML-M5a /M5b in agreement with Khalidi *et al*[17]. Finally, it is important to note that although a correlation is clear between morphological and immunological classification of AML (Table 1), however, this correlation is not absolute and a combination of morphologic and immunological assessment is needed to determine the actual subtype[16,17,25]. Moreover, the more recent WHO classifications introduced cytogenetic and molecular studies as essential parts of the classification, which should be the subject of future research in newly diagnosed AML cases in our locality.

In conclusion immunophenotyping is an essential tool in the identification and subtyping of AML. The current study revealed that the most frequent AML subtype is AML M1, and the least AML-M6, with more than one third of cases showing aberrant lymphoid antigen expression. Further studies including cytogenetics and follow up to see impact of the latter observation on prognosis is needed.

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پوختە

شیوین بەرگریی ژ نەخوشیا پەنجەشیرا خینی ژ جوری مایلویدا دژوار ل کوردستانا –عیراقی

پێشەکی: رێکخستنا بەرگریێ یا بوویە بابەتەکێ ئێکلاکەر ددەستنیشانکرن وپولینکرنا لوکیمیا دژوار بتایبەتی ژبۆ دەستنیشانکرنا دروست بۆ کێمترین رێژەیا پەنجەشیرا خوینێ یا مەژی یا جیاواز. هێژ دیاردێن نەرێك دپەنجەشیرا خوینێ یا مەژی جهێ گەنگەشێ نە ژلایێ رویدانێ وچافەرێکرنێ.

ئارمانج: مەرەم ژڤێ ڤەکولینێ هەلسەنگاندنا جورێن حالەتێن پەنجەشیرا خوینێ یا مەژی یە ئەڤێن هاتیە پێشکێشکرن بۆ یەکەیا پیڤانا ڤەرێژێ ل تاقیگەها سلێمانیێ یا تەندروستیا گشتی ل کوردستانا عیراقێ ودەستنیشانکرنا رادەیا دەربرینا دیاردێن نەرێك ژکەرستێن لیمفاوی یێن پێڤە گرێدای.

رێکێن ڤەکولینێ : بۆ مەرەمێن دیارکری لسەری، (108) حالەتێن پەنجەشیرا خوینێ یا مەژی یا دژوار(AML) هاتنە هەلسەنگاندن وەك شێوە لدویڤ FAB، وپیڤانا ڤەرێژا شانەیا دگەل 22 کەرستێن دژەخور. وهەروەسا، هەر دیاردەکا نەرێك ژکەرستێن لیمفاوی یێن پێڤە گرێدای هاتیە راگەهاندن.

ئەنجام: ئەنجامێن FAB مورفولوجی یێن پەنجەشیرا خوینێ یا مەژی یا دژوار یا لاوەکی دیارکر 29.6٪ ژحالەتێن پەنجەشیرا خوینێ یا مەژی یا دژوار M2 بوون، بەلێ AML- M1 (36.1 ٪) ژجورێ لاوەکی یا بەربەلاڤ بوون برێکا ڤەرێژا بەرگریێ سایتومیتریك برێکا بکارئینانا پولینکرنا رێکخراوا تەندروستیا جیهانی 2008. CD45, CD13 CD117 وCD33 ژهەمیا بەربەلاڤتر بوون 99.1% ,92.6% ,92.6% و85.2%لدویڤئێك. 45 نەخوش (41.7%)دەربرینێ دکەن ژکەرستێن لیمفاوی یێن پێڤە گرێدای.(nTdT, CD19, CD79a, CD10, CD4, CD56 and CD9) هاتنە دیارکرن دهەمی جورێن پەنجەشیرا خوینێ یا مەژی یا دژوار ژبلی M6.CD56 کو ژهەمیا بەربەلاڤتربوون .(13%)، دویڤدا ,(8.3%) CD4 ,(12%) CD9, و CD19 (7.4%). nTdT ,CD79aوCDC10 ژهەمیا کێمتر بەلاڤبوون ویێن هەی د<5٪ژحالەتا بۆ هەرئێك ژوان.

دەرئەنجام:: ڤەکولینێن سیستەمێ بەرگریێ بمفانە بۆ دەستنیشانکرنا بنچینەیێن مەژی. بەلێ بتنێ بەس نینە، بۆ دەستنیشانکرنا جورێن لاوەکی FAB . وپێتڤیب پتر ڤەکولینا هەیە ژوان زانستێ جینێن شانەیی ودیڤچوونێ بۆ زانینا کارتێکرنا تێبینیا دوماهیێ لسەر چافەرێکرنێ.

الخلاصة

الانماط المناعية لمرضى ابيضاض الدم النقوي الحاد في كوردستان – العراق

الخلفية والأهداف دراسة النمط الظاهري المناعي "الاميونوفينوتايب" قد اصبح ضرورة في تشخيص وتصنيف إبيضاض الدم الحاد، ولا سيما من اجل التحديد الصحيح لأبيضاض الدم النقوي الحاد ذو التمايز الأرومي النقوي الأدنى AML (M0). إن الأنماط الشاذة للمعلمات السرطانية في أبيضاض الدم الحاد لا تزال مثار جدل من حيث نسب حدوثها و علاقاتهابإمكانية التنبؤ بمستقبل المرض. لذا كان الهدف من الدراسة هو لتقييم الانماط في حالات إبيضاض الدم النقوي الحاد التي قدمت الى وحدة الفلوسايتومتري في السليمانية/مختبر الصحة العامة/ كوردستان العراق، إضافة الى تحديد نسب حدوث الانماط الشاذة للمستضد اللمفاوي المرتبط

طرق البحث: للاغراض المذكورة اعلاه تم تقييم 108 من حالات إبيضاض الدم النقوي الحاد شكليا وفقا لتصنيف "FAB"وعن طريق تقنية الفلوسايتومتري مع مجموعةاجسام مضادة مكونة من 22 من جسم مضاد، مع الأخذ بنظر الإعتبار تحديد الانماط الشاذة للمستضد اللمفاوي المرتبط.

النتائج: كشفت الدراسة أن إبيضاض الدم الحاد ذو نمو أرومي مكتمل (AML-M) تشكل 29% من إبيضاض الدم الحاد إعتمادا على تصنيف فاب، بينما إبيضاض الدم النقوي ذو الأورمات أولية التمايز(AML-M2) كان السائد 36.1% طبقا للتصنيف المعتمد من قبل منظمة الصحة العالمية لأورام الدم لسنة ٢٠٠٨م والتي تمت بوساطة تحديد المعلمات السرطانية بتقنية الفلوسايتومتري. فكانت المعلمات السرطانية CD33 and CD13, CD45, CD117 الأكثرظهورا بنِسَب(99.1%, 92.6%, 92.6% and 85.2%) على التوالي.
اظهرت الدراسه وجود 45حالة تمتلك المعلمات السرطانية الشاذة للمستضد اللمفاوي المرتبط (41.7%) وقد وجدت في جميع الأنواع ماعدا إبيضاض الدم الحاد المتعلق بسلسلة كريات الدم الحمراء (AML –M6). CD56 كان الأكثر ترددا (13%)،ويليه CD9(12%) ثم CD4(8.3%)ويتبعه ,(7.4%) CD19. في حين بقيه المعلمات السرطانية الشاذة للمستضد اللمفاويأقل ترددا بينها وبنسب ٥٪ لكل واحدة.

الاستنتاجات: إن دراسة النمط الظاهري المناعي "الإميونوفينوتايب" ضروري لتحديد السلالة النقوية في إبيضاض الدم، ولكن لا يكفي وحده في تصنيف أنواع إبيضاض الدم النقوي الحاد طبقا لفاب. تتطلب دراسات اخرى تعتمد على الخصائص الوراثية الخلوية ومتابعة حالة المرضى سريريا لمعاينة أثر الأنواع المختلفة.