Boffin Access
FOSTERING KNOWLEDGE

Open Access Journal | Volume: 4.1

Journal of Cancer Research and Oncobiology

ISSN 2517-7370

Relationship between pretreatment serum LDH and clinical characteristics, laboratory findings and histological type in Hodgkin lymphoma patients: A Single Center Experience in Syria

Firas Hussein M. D*

Associate Professor in clinical Hematology, Head of Internal Medicine Department, Head of Clinical Hematology Department, Tishreen University Hospital, Lattakia, Syria.

Abstract

Background: Many studies suggested that lactate dehydrogenase (LDH) is elevated in most neoplasms, including Hodgkin's lymphoma. LDH is not specific to diagnose the type of cancer, it may provide important information toHodgkin's lymphoma patients including: clinical and biological characteristics, risk stratification according IPS, response to treatment, disease relapse, disease progression and predicting outcome.

Aim of study: Studying the correlation between pre – treatment serum LDH and the clinical, laboratory, and histological characteristics of Hodgkin lymphoma patients in our center in Syria

Patients and Methods: This was retrospective study conducted from a Single Institution at University Tishreen hospital in Lattakia city, Syria, over a period of five years from January 2011 to December 2015. 208 patients (85 female, 123 male) were enrolled in the study. Inclusion criteria were newly diagnosed patients of Hodgkin lymphoma aged more than 14 years, who were admitted to our center of chemotherapy. We analyzed recorded data from patient's files. Patients or their guardians provided written informed consent to participate in the study. The sample is divided into two groups according to pre-treatment Serum LDH: LDH > 480 (65 pts.) and LDH ≤ 480 (143 pts.). Then we have assessed the correlation between pre – treatment serum LDH and the clinical, laboratory, and histological characteristics of Hodgkin lymphoma patients.

Results: The study sample included 208 cases of newly diagnosed Hodgkin lymphoma. According to the criteria for entering the study (123 males, 59. 10% and 85 females, 40. 90%). The ages of the study sample patients ranged from 14 to 79 years, with the average age of the study sample 31. 5 years. The sample was distributed according to the histological type: Nodular sclerosis 65. 4%, Mixed cellularity 31. 3%, Lymphocyte-Rich 2. 4%, Lymphocytic depletion 1%. The sample was distributed according to staging: Stage I (5. 8%), Stage II (44. 2%), Stage III (33. 2%), and Stage IV (16. 8%). Advance stage (86. 5%) and Limited (13, 5%). General symptoms B were seen in 82. 7% of patients. The Mediastinal mass was found in 46. 7% of the research sample and Bulky was greater than 10 cm in 10. 6% of the study patients. Our study revealed that there are no statistically significant differences according to sex and age between the two groups of Hodgkin's lymphoma patients, as well as the histological type. The group LDH > 480 was associated with a higher elevation in WBC, AMC, and more lower in HGB and ALB. There are statistically significant differences between the two groups of Hodgkin's lymphoma patients according to the presence of B symptoms, Mediastinal mass and its size, staging and spread disease.

Conclusion: Pre- treatment serum LDH more than 480 u/ml is an important indicator of the severity and prognosis of Hodgkin lymphoma. It is highly clinically associated with advanced stage, presence of B symptoms, bulky mediational mass.

Key words: Hodgkin lymphoma, Pre - treatment serum LDH, patient's characteristics.

Abbreviations

LDH: Lactate dehydrogenase

HL: Hodgkin's lymphoma

NHL: Non -Hodgkin's lymphoma

Article Information

DOI:	10.31021/JCRO.20214132
Type:	Research
Journal Type:	Open Access
Volume:	4 **Issue: 1**
Manuscript ID:	JCRO-4-132
Publisher:	Boffin Access Limited
Received Date:	03 March 2021
Accepted Date:	13 March 2021
Published Date:	17 March 2021

*Corresponding author:

Firas Hussein

Department of Clinical Hematology
Tishreen University hospital, Lattakia
Syria.
Tel: +963 935017659
Email: drfirashussein@yahoo. com

Citation: Firas Hussein M. D. Relationship between pretreatment serum LDH and clinical characteristics, laboratory findings and histological type in Hodgkin lymphoma patients: A Single Center Experience in Syria. J Cancer Res oncobiol. 2021 Mar; (4)1:132.

WHO: World Health Organization

NLPHL: Nodular lymphocytic predominant Hodgkin's lymphoma

NSHL: Nodular sclerosing Hodgkin's lymphoma

LRHL: Lymphocyte-rich HL Hodgkin's lymphoma

MCHL: Mixed cellularity Hodgkin's lymphoma

LDHL: Lymphocyte depletion Hodgkin's lymphoma

IPS: International prognostic factors

ESR: Erythrocyte sedimentation rate

WBC: White blood cells count

ANC: Absolute neutrophils count

ALC: Absolute lymphocytes count

AMC: Absolute monocytes count

LMR: Lymphocytes monocytes ratio

HGB: Blood Hemoglobin concentration

PLT: Platelets count

ALB: Serum Albumin

Introduction

Hodgkin's lymphoma (HL) is a neoplastic B cell lymphoma begin in lymphoid tissue and spreads to another lymphoid structures and may attack non-lymphoid tissues, it comprises 1% of all cancer patients and 14% of all lymphoma cases. Hodgkin's lymphoma differ of non -Hodgkin's lymphoma (NHL) by the presence of Reed-Sternberg cells [1-2]. It is a curable disease, Cure rates approach 80-90% of patients, and HL have the best outcome among hematological malignancies and neoplastic diseases [3]. According to World Health Organization(WHO), Hodgkin's lymphoma is classified into two distinct entities: nodular lymphocytic predominant HL(NLPHL), and classical HL. Classical HL comprises 95% of all HL patients, and can be histologicment classified into four different subtypes; nodular sclerosing HL (NSHL), which is the most common histological subtype, lymphocyte-rich HL (LRHL), mixed cellularity HL (MCHL) and lymphocyte depletion HL (LDHL) [4-5]. The "International Prognostic Factors Project on Advanced Hodgkin's Disease" suggested seven parameters had prognostic significance in Hodgkin lymphoma patients. These were age, sex, stage IV disease, low albumin level (< 4. 0 g/dL), anemia (< 10. 5 g/dL), leukocytosis (> 15000/mm3) and lymphopenia (< 600/mm3). The risk stratification of HL depend on a number of prognostic factors for determining early- and advanced-stage HL, theses prognostic were bulky disease, erythrocyte sedimentation rate (ESR), LDH, hemoglobin, serum albumin levels, presence of "B" symptoms, age and extra lymphatic involvement [6]. Lactate dehydrogenase (LDH) is a cytoplasmic enzyme, which is widely expressed in many tissues such as heart, muscle, and various tumors, and it is detectable in serum. It catalyzes the reduction of pyruvate to form lactate, which is the last step of glycolysis. In malignancies, cancer cells metabolism is shifted to aerobic glycolysis and pyruvate transformation to lactate is unregulated. Lactate dehydrogenase (LDH) is often raised in aggressive cancer and hematological malignancies. The tumor microenvironment acidification can leading to tumor progression and metastasis. High serum lactate dehydrogenase levels have been reported as a poor prognostic indicator in many solid tumors such as non- small cell lung cancer, malignant lymphoma, pancreatic carcinoma, and colorectal cancer. It is also correlates with staging, poor outcome and metastasis in many solid tumors [**7**]. Many studies suggested that lactate dehydrogenase (LDH) is in most neoplasms, including Hodgkin lymphoma. LDH is not specific to diagnose the type of cancer, it may provide important information to risk stratification according IPS, response to treatment, disease relapse, disease progression and predicting outcome [8]. Many previous studies show significant correlation between serum LDH levels and staging of lymphoma. Really, increased serum LDH is a common finding in patients with cancer and is highly correlated to tumor aggressiveness or a high tumor burden [9-10]. Some studies suggest that Lactate Dehydrogenase (LDH) levels reflect the total amount of tumor cells. it represent a valuable biochemical parameter in patients with lymphomas and its serum level has been considered as very important in the evaluation of disease spread in both Hodgkin and non -Hodgkin lymphomas. It might be used as indicator to determine Hodgkin's disease severity and prognosis in addition to other prognostic factors [11-16]. Other studies suggest that high levels of LDH were significantly higher among patients with B symptoms, bulky disease, extra nodal involvement, low hemoglobin concentration and low serum albumin levels among Hodgkin lymphoma patients [17] which prompted us to study the correlation between pre – treatment serum LDH and the clinical, laboratory, and histological characteristics of Hodgkin lymphoma patients in our center?

Patients and Methods: This was retrospective study conducted from a Single Institution at University Tishreen hospital in Lattakia city, Syria, over a period of five years from 1 January 2011 to 31 December 2015. 208 patients (85 female, 123 male) were enrolled in the study. Inclusion criteria were newly diagnosed patients of Hodgkin lymphoma aged more than 14 years, who were admitted to our center of chemotherapy. We analyzed recorded data from patient's files: medical history, full physical examination complete blood count, AMC, ALC, LMR, erythrocyte sedimentation rate, liver function tests, serum LDH, serum Albumin. , histological type, radiological investigations, bone marrow biopsy, staging, spread of disease, Mediastinal bulky mass and international prognostic factors IPS. Patients or their guardians provided written informed consent to participate in the study. The sample is divided into two groups according to pre-treatment Serum LDH: LDH > 480 (65 pts.) and LDH ≤ 480 (143 pts.). Then we have assessed the correlation between pre – treatment serum LDH and the clinical, laboratory, and histological characteristics of Hodgkin lymphoma patients. We used frequencies and percentages for qualitative variables, and measures of central tendency for quantitative variables. The initial variables were tested using the log-rank test, and groups were compared by using the log-rank test. Results were statistically significant when p-value <0. 05. The program (IBM SPSS statistics) version19 was adopted to calculate statistical transactions and analyze results.

Results: The study sample included 208 cases of newly diagnosed Hodgkin lymphoma. According to the criteria for entering the study Criteria at the Radiation Chemotherapy Center at Tishreen University Hospital during the period between 1-1-2011 until 31 December 2015, (123 males, 59. 10% and 85 females, 40. 90%) of patients with Hodgkin's lymphoma. The ages of the study sample patients ranged from 14 to 79 years, with the average age of the study sample 31. 5 years. The sample was distributed according to the histological type: Nodular sclerosis 65. 4%, Mixed cellularity 31. 3%, Lymphocyte-Rich 2. 4%, Lymphocytic depletion 1%. The sample was distributed according to staging: Stage I (5. 8%), Stage II (44. 2%), Stage III (33. 2%), Stage IV (16. 8%). Advance stage (86. 5%) and Limited (13, 5%). General symptoms B were seen in 82. 7% of patients. The Mediastinal mass was found in 46. 7% of the research sample and Bulky was greater than 10 cm in 10. 6% of the study patients. We note that the combined chemotherapy with radiotherapy represented 43. 7% of the research sample studied against 56. 3% for chemotherapy alone. The sample was distributed according to pre-treatment serum LDH as fowling: LDH > 480 in 31, 25% (65/208pts), LDH ≤ 480 in 68, 75% (143/208pts). The Distribution of sample of patients with Hodgkin lymphoma according to risk factors for IPS is shown in [Table 1].

We have studied the correlation between pre-treatment Serum LDH and demographic variables, histological type in Hodgkin lymphoma patients. Our study revealed that there are no statistically significant differences according to sex and age between the two groups of Hodgkin's lymphoma patients, as well as the histological type, *(p > 0, 05*) as shown in [Table 2].

We have also studied the influence of pre-treatment Serum LDH on Laboratory findings as white blood cells count (WBC), absolute neutrophils count (ANC), absolute lymphocytes count (ALC), absolute monocytes count (AMC), lymphocytes monocytes ratio (LMR), blood Hemoglobin concentration (HGB), Platelets count (PLT) and serum Albumin (ALB). Our study conducted that there are statistically significant differences between the two groups of Hodgkin's lymphoma patientsfor all laboratory parameters, except for platelet counts (PLT), ANC and ALC. The group LDH > 480 was associated with a higher elevation in WBC (12910. 7±5969. 5 /ml versus 10894. 4±5162. 8 /ml, P-value 0, 01) , AMC (537. 1±406. 8/ml versus 419. 7±366. 5/ml, P-value 0, 04), and more lower in HGB (10. 7±1. 7g/dl versus 11. 3±1. 9g/dl, P-value 0, 02), LMR (5. 5±5. 7 versus 8. 5±10. 4, P-value0, 02) and ALB (3. 5±0. 7g/versus 3. 7±0. 7g/dl, P-value 0, 04) as shown in [Table 3].

Finally, we have studied the correlation ship between baseline Serum LDH and clinical characteristics {the presence of B symptoms, the presence of Mediastinal mass, bulky disease, staging and disease spread) in Hodgkin's lymphoma patients. We found that there are statistically significant differences between the two groups of Hodgkin's lymphoma patients according to the presence of B symptoms, Mediastinal mass and its size, staging and spread disease. B symptoms were observed in (93. 8%) of the LDH group > 480 versus (77. 6%) of LDH group ≤ 480, (p < 0. 004). the Mediastinal mass and its size was observed in(61. 5%) of the LDH group > 480 versus (39. 9%)of LDH group ≤ 480, (p < 0. 006). may, the important significant difference between the two groups of Hodgkin's lymphoma patients was the staging of disease and its spread, stage (III. IV) was observed in (73. 9%) of the LDH group > 480 versus (39. 2%) of LDH group ≤ 480, (p < 0. 0001), advance disease was observed in (96. 9% of the LDH group > 480 versus (81. 8%) of LDH group ≤ 480, (p < 0. 003) as shown in [Table 4].

Discussion: The study sample included 208 cases(123 males, 59. 10% and 85 females, 40. 90%), average age of the study sample 31. 5 years, the sample was distributed according to the histological type: Nodular sclerosis 65. 4%, Mixed cellularity 31. 3%, Lymphocyte-Rich 2. 4%, Lymphocytic depletion 1%. The sample was distributed according to staging: Stage I (5. 8%), Stage II (44. 2%), Stage III (33. 2%), Stage IV (16. 8%). Advance stage (86. 5%) and Limited (13, 5%). General symptoms B were seen in 82. 7% of patients. The Mediastinal mass was found in 46. 7% of the research sample and Bulky was greater than 10 cm in 10. 6% of the study patients. The sample was distributed according to pretreatment serum LDH as fowling: LDH > 480 in 31, 25% (65/208pts), LDH ≤ 480 in 68, 75% (143/208pts).

IPS(risk factors)	Number pts	Percent
Sex (male)	**123**	**59.1%**
Age (years) >45 ≤45	 56 152	 26.9% 73.1%
(160 pts.) SerumAlbumin 4g/dl≤ <4g/dl	 61 99	 38.1% 61.9%
HB >10.5g/dl 10.5g/dl≥	 131 77	 63% 37%
WBC >15000/mL ≤15000/mL	 55 153	 26.4% 73.6%
ALC 600/mL≤ <600/mL	 205 3	 98.6% 1.4%
Stage IV	35	16.8%

Table 1: Distribution according to risk factors for IPS in a sample of patients with Hodgkin lymphoma

Demographic variables	LDH>480(65) pts.	LDH≤480 (143) pts.	P-value
sex male Female	 42(64.6%) 23(35.4%)	 81(56.6%) 62(43.4%)	0.2
age	30[14 - 79]	32[14 - 72]	0.7
Histological type	**LDH>480(65) pts.**	**LDH≤480 (143) pts.**	**P-value**
N.S M.C L.R L.D	20(30.8%) 44(67.7%) 0(0%) 1(1.5%)	45(31.5%) 92(64.3%) 5(3.5%) 1(0.7%)	0.4

Table 2: Differences in the distribution between the two groups of Hodgkin's lymphoma patients according to demographic variables and histological type

Laboratory findings	LDH>480(65)	LDH≤480(143)	P-value
WBC	12910.7±5969.5	10894.4±5162.8	0.01
ANC	10451.4±5656.1	8903.2±8757.6	0.1
ALC	1782.1±851.8	2011.9±1148.8	0.1
AMC	537.1±406.8	419.7±366.5	0.04
LMR	5.5±5.7	8.5±10.4	0.02
HGB	10.7±1.7	11.3±1.9	0.02
PLT	338.3±117.4	316.1±135.5	0.2
ALB	3.5±0.7	3.7±0.7	0.04

Table 3: The differences in the distribution according to laboratory findings between the two groups of patients with Hodgkin's lymphoma.

Our finding revealed that there are no statistically significant differences according to histological type between the two groups of Hodgkin's lymphoma patients, *(p > 0, 05*). we reported also the important significant difference between the two groups of Hodgkin's lymphoma patients was the staging of disease and its spread, stage (III. IV) was observed in (73. 9%) of the LDH group > 480 versus (39. 2%) of LDH group ≤ 480, (p < 0. 0001), advance disease was observed in (96. 9% of the LDH group > 480 versus (81. 8%) of LDH group ≤ 480, (p < 0. 003). This agrees with results of *Rawand P et al.* [18] who had studied the relationship between Serum Lactate dehydrogenase (LDH) and Presentation, Stage and Histologic type of 13 patients with Hodgkin's lymphoma (HL) and 37 patients with non-Hodgkin's lymphoma (NHL) from April to October 2009. They reported that There was no relationship between mean LDH level and histological subtype among HL patients, While in NHL, the mean LDH level among high-grade NHL patients was somewhat higher than that of patients with intermediate grade NHL without statistical significant level (P = 0. 082). They revealed a correlation between the extent of disease represented by stage of

clinical characteristics	LDH≤480(143)	LDH>480(65)	P-value
B symptoms A B	32(22.4%) 111(77.6%)	4(6.2%) 61(93.8%)	0.004
Mediastinal mass Absent Found Bulky≥10 <10	25(38.5%) 40(61.5%) 10(15.4%) 30(46.1%)	86(60.1%) 57(39.9%) 12(8.4%) 45(31.5%)	0.006 0.04
Stage I Stage II Stage III Stage IV	1(1.5%) 16(24.6%) 33(50.8%) 15(23.1%)	11(7.7%) 76(53.1%) 36(25.2%) 20(14%)	0.0001
Disease spread Advance Limited	63(96.9%) 2(3.1%)	117(81.8%) 26(18.2%)	0.003

Table 4: The distribution differences according to clinical characteristics (the presence of general symptoms, a presence of Mediastinal mass, staging, bulky disease and disease spread) between the two groups of Hodgkin's lymphoma patients.

lymphoma and Serum Lactate dehydrogenase [18]. *Tahannejad Z et al.* [19] observed a similar findings in their study from 30 patients who suffered from Hodgkin's Lymphoma, they revealed that Stages III and IV (advanced stages) were observed in 61. 4% of sample. serum Lactate dehydrogenase was statistically higher in patients in comparison with controls (P < 0. 01). they revealed also elevated levels of Lactate dehydrogenase (LDH) among patients in advanced stages (stages III, IV in comparison patients in early stage initial (stages I, II). (P < 0. 001)(19). In contract, *Lucia Nogova et al.* [20] suggested that increased serum LDH is most commonly in classical Hodgkin lymphoma, they found an elevated lactate dehydrogenase level in 84% of classical Hodgkin lymphoma patients versus 68% in lymphocyte predominance Hodgkin lymphoma patients (LPHL) [20]**.** Our study revealed that there was an important correlation between the presence of bulky Mediastinal mass and pre-treatment serum LDH, it was observed in(61. 5%)of the LDH group > 480 versus (39. 9%)of LDH group ≤ 480, (p < 0. 006), this is explained by *Straus DJ et al.* [21], they reported that elevated serum LDH reflect the total amount of tumor cells in the mediastinum representing as Bulky Mediastinal mass in Hodgkin lymphoma patients [21]. Our study suggested that there are statistically significant differences between the two groups of Hodgkin's lymphoma patients according to the presence of B symptoms, Mediastinal mass and its size, staging and spread disease. B symptoms were observed in (93. 8%) of the LDH group > 480 versus (77. 6%) of LDH group ≤ 480, (p < 0. 004). There were statistically significant differences between the two groups of Hodgkin's lymphoma patients for laboratory parameters as hemoglobin concentration and serum albumin, The group LDH > 480 was associated with a more lower levels in HGB (10. 7±1. 7g/dl versus 11. 3±1. 9g/dl, P-value 0, 02), and ALB (3. 5±0. 7g/versus 3. 7±0. 7g/dl, P-value 0, 04). this agrees with *Saadettin Kılıckap et al.* [17]. They analyzed data of 391 HL patients (61% male, 39% female; mean age 35. 7±15. 1 years). The most common classical HL histological subtype was nodular sclerosing HL (NSHL) (42. 7%). The most common stage was II 50. 4%. Pretreatment serum LDH were higher among patients with "B" symptoms, bulky disease extra nodal involvement, low hemoglobin concentration and low serum albumin [17]. Our finding agrees also with *E. Bien et al.* [8] They studied prospectively the utility of serum Lactate dehydrogenase (LDH) and other markers in diagnosis, prognosis and monitoring of response to therapy in 30 Childs presenting Hodgkin's lymphoma(HL). They revealed that increased pretreatment serum LDH is correlated with bulky disease and with advanced HL stages. Pretreatment serum LDH was found elevated in 90% of patients with bulky disease and elevated in 71% of children with advanced stages Pretreatment Serum LDH may act as markers for diagnosis and used in monitoring of therapy efficacy in childhood HL [8]. B-symptoms are caused by the production of pro-inflammatory cytokines by the Hodgkin tumor cells and associated with other laboratory abnormalities such as elevated serum LDH. Anemia is characterized by alterations in iron metabolism. Elevated production of hepcidin, which inhibits the absorption of iron from the intestine, and iron, stores in the reticuloendothelial system especially the liver, that result in hyperferritinemia. Elevated serum ferritin have been recognized in HL and have been suggested to be a prognostic marker ago. Low levels of serum albumin are associated with a bad prognosis in many neoplasias, including HL. The IPS score defines albumin levels of 4. 0 g/dl as cut-point. Serum albumin is reduced by increased production of inflammatory cytokines such as Interleukin -6, witch inhibit its hepaticsyntheses [4]. Common findings in WBC counts in HD patients include leukocytosis with neutrophilia, lymphocytopenia, and monocytosis. In the IPS, the prognostic cut point for white blood cell count is 15000/microL, for lymphocytopenia it is 600/microL [22-23]. Recently, the monocyte count, monocyte count /the lymphocyte count ratio (LMR) has been reported to be an important prognostic factor in HL. Since its publication in 2016, The prognostic value of LMR is controversial, lower LMR at diagnosis was associated with poor OS and PFS in HL, and LMR cut-off values ranged from 1. 1 to 2. 8 [24-25]. The optimal cut-off of LMR for the elderly patients HD was 2. 2. In the non-elderly patients (< 60 years), patients with LMR < 2. 8 had significantly lower OS compared with those with LMR ≥2. 8 (p < 0. 001, both) [26]**.** This present study approved that there are statistically significant differences between the two groups of Hodgkin's lymphoma patients for all white blood cells (WBC) parameters, except for ANC and ALC. The group LDH > 480 was associated with a higher elevation in WBC (12910. 7±5969. 5 /ml versus 10894. 4±5162. 8 /ml, (P-value 0, 01) , higher AMC (537. 1±406. 8/ml versus 419. 7±366. 5/ml, (P-value 0, 04), and lower in LMR (5. 5±5. 7 versus 8. 5±10. 4, (P-value0, 02). This study agrees with *Theodoros P eft al.* [27]. They revealed that lower LMR was strongly associated with many prognostic factors reflecting tumor burden and biological aggressiveness of the disease, including B-symptoms, advanced stage, number of involved sites, anemia, leukocytosis, lymphocytopenia, thrombocytosis, elevated ESR (≥50 mm/hour), albumin < 4 g/dL, elevated lactate dehydrogenase (LDH), and high IPS (≥3) [27].

Conclusion

Pre- treatment serum LDH more than 480 u/ml is an important indicator of the severity of Hodgkin lymphoma. It is highly clinically associated with advanced stage, presence of B symptoms, bulky mediational mass. It is also associated with a higher elevation in WBC, AMC, and more lower in HGB, LMR and serum ALB. Our study revealed an important correlation between high levels of pre - treatment serum LDH and bad international prognostic factors (IPS) of Hodgkin lymphoma. Therefore, Further and future studies are suggested for more evaluation its actual role in predicting the outcome of Hodgkin lymphoma patients.

Declarations

Ethics approval and consent to participate

Written consent was obtained for the patients to participate in the study, written informed consent was obtained from a parent for participants under 18 years old. Our institutional

ethics committee in the faculty of medicine- Tishreen University approved our study.

Consent for publication: written consent to publish this information was obtained from study participants. **Availability of data and materials:** All data generated or analyzed during this study are included in this published article [and its supplementary information files].

Competing interests:

No conflict of interest.

Funding:

Funding was received.

Authors' Contributions:

Corresponding author analyzed and interpreted the patient data.

Acknowledgement:

Not applicable

References

1. Ferlay J, Bray F, Pisani P, et al (Eds). GLOBOCAN 2002: Cancer Incidence, Mortality and Prevalence Worldwide. Lyon: IARC Press; 2004.
2. Pahwa P, Karunanayake CP, Spinelli JJ, Dosman JA, McDuffie HH. Ethnicity and incidence of Hodgkin's lymphoma in Canadian population. BMC Cancer 2009; 9:141- 9 [CrossRef].
3. Casasnovas RO, Mounier N, Brice P, Divine M, Morschhauser F, Gabarre J, et al. Adult Lymphoma Study Group. Plasma cytokine and soluble receptor signature predicts outcome of patients with classical Hodgkin's lymphoma: a study from the Grouped'Etude des Lymphomes de l'Adulte. J ClinOncol. 2007; 25:1732-40.
4. Yung L, Linch D. Hodgkin's lymphoma. Lancet 2003; 361:943-51. [CrossRef].
5. MacLennan KA, Bennett MH, Tu A, Hudson BV, Easterling MJ, Hudson GV, et al. Relationship of histopathologic features to survival and relapse in nodular sclerosing Hodgkin's disease. A study of 1659 patients. Cancer 1989; 64:1686-93. [CrossRef].
6. Hasenclever D, Diehl V. A prognostic score for advanced Hodgkin's disease. International Prognostic Factors Project on Advanced Hodgkin's disease. N Engl J Med 1998; 339:1506-14. CrossRef].
7. Galleze A et al. Increased Level of Lactate Dehydrogenase Correlates with Disease Growth in Algerian Children with Lymphoma. JOURNAL OF HEMATOLOGY AND ONCOLOGY RESEARCH. 2017, Vol-2 Issue 4 Pg. no. 7- 15.
8. E. Bien, A. Balcerska. Serum Soluble Interleukin-2 Receptor, Beta2-Microglobulin, Lactate Dehydrogenase and Erythrocyte Sedimentation Rate in Children with Hodgkin's Lymphoma. 2009, Journal of Immunology 70, 490–500.
9. Lei Y, Xiaohong X, Chunlei P, Jinzhi W, Zhuchen S, Zhirong C. Prognostic values of serum LDH and β2-MG in patients with non-Hodgkin's lymphoma. Chinese-German Journal of Clinical Oncology. 2009; 8(6):353–355.
10. Suzuki K, Terui Y, Nishimura N, Mishima Y, Sakajiri S, Yokoyama M, Takahashi S, Tsuyama N, Takeuchi K, Hatake K. Prognostic value of C-reactive protein, lactase dehydrogenase and anemia in recurrent or refractory aggressive lymphoma. Jpn J ClinOncol. 2013; 43(1):37-44.
11. Gocheva L, Koleva I. KlinOnkol. Long-term outcome of treatment for Hodgkin's disease: the University Hospital Sofia experience. 2010; 23(1):34-42.
12. Fu XH, Wang SS, Huang Y, Wang B, Huang HQ, Zhang L, et al. Feasibility study of application of international prognostic score on prediction of prognosis for advanced Hodgkin's lymphoma. Ai Zheng. 2006; 25(8): 1013-8.
13. Itoh K, Kinoshita T, Watanabe T, Yoshimura K, Okamoto R, Chou T, etal. Prognostic analysis and a new risk model for Hodgkin lymphoma in Japan. Int J Hematol. 2010; 91(3):446-55.
14. Osterman B, Jonsson H, Tavelin B, Lenner P. Non-Hodgkin's lymphoma in northern Sweden. Prognostic factors and response to treatment. ActaOncol 1993; 32: 507–515.
15. Aisenberg A. Coherent view of non-Hodgkin's lymphoma. J ClinOncol1995; 13:2656–75.
16. Garcia R, Hernandez JM, Caballero MD, González M, Galende J, del Cañizo MC, et al. Serum lactate dehydrogenase level as a prognostic factor in Hodgkin's disease. Br J Cancer 1993; 68:1227–71.
17. Saadettin Kılıckap et al. Clinical Features and Prognostic Factors of Hodgkin's Lymphoma: A Single Center Experience. Balkan Med J 2013; 30: 178-85.
18. Rawand P. Shamoon, Ranan K. Polus. Serum Lactic Dehydrogenase (LDH) Activity in Lymphomas: Prognostic Significance and Relationship to Presentation, Stage and Histologic Type. Zanco J. Med. Sci. , Vol. 14, (Special issue 1), 2010. p85-89.
19. Tahannejad Z etal. The levels of Serum Alkaline Phosphatase and Lactate Dehydrogenase in Hodgkin Lymphoma. IJBC 2012; 3: 125-128.
20. Lucia Nogova et al. Lymphocyte-Predominant and Classical Hodgkin's Lymphoma: A Comprehensive Analysis From the German Hodgkin Study Group. JCO, VOLUME 26 -NUMBER 3 - JANUARY 20 2008, p434-439.
21. Straus DJ, Gaynor JJ, Myers J et al. Prognostic factors among 185 adults with newly diagnosed advanced Hodgkin's disease treated with alternating potentially non cross-resistant chemotherapy and intermediate-dose radiation therapy. J ClinOncol 1990; 8: 1173–1186.
22. Hasenclever D, Diehl V. A prognostic score for advanced Hodgkin's disease. International Prognostic Factors Project on Advanced Hodgkin's disease. N Engl J Med. 1998; 339:1506-14.
23. Porrata LF, Ristow K, Colgan JP, Habermann TM, Witzig TE, et al. Peripheral blood lymphocyte/monocyte ratio at diagnosis and survival in classical Hodgkin's lymphoma. Haematologica. 2012; 97:262-9.
24. Shing Fung Lee et al. Prognostic value of lymphocyte-monocyte ratio at diagnosis in Hodgkin lymphoma: a meta-analysis. BMC Cancer. 2019; 19: 338.
25. Liangyou Gu et al. Prognostic role of lymphocyte to monocyte ratio for patients with cancer: evidence from a systematic review and meta-analysis. Advance Publications 2016.
26. Young WhaKoh et al. The absolute lymphocyte to monocyte ratio is associated with poor prognosis in classical Hodgkin lymphoma patients younger than 60 years of age. hematological oncology. Volume33, Issue3, September 2015, Pages 133-140.
27. Theodoros P et al. Prognostic Implication of the Absolute Lymphocyte to Absolute Monocyte Count Ratio in Patients With Classical Hodgkin Lymphoma Treated With Doxorubicin, Bleomycin, Vinblastine, and dacarbazine or Equivalent Regimens. Oncologist. 2016 Mar; 21(3): 343–353.