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ORIGINAL ARTICLE

A New Classifier Based on Laboratory Indicators for Early Diagnosis and Prognosis Prediction of Ewing's Sarcoma

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SUMMARY

Background: **Ewing's sarcoma (ES) is a prevalent bone malignancy. It is critical to explore new diagnostic and prognostic indicators because of the rapid progression of ES and the low survival rate of metastatic ES patients. However, few parameters of clinical significance have been found. The aim of this study was to establish a new classifier with clinical laboratory data to help ES detection and prognosis prediction.**

Methods: **A total of 135 ES patients, 150 healthy individuals, and 228 patients with primary benign bone lesions were included. Logistic regression on clinical laboratory indicators was conducted to establish the classifier, and then the classifier was assessed by drawing the receiver operating characteristic (ROC) curves. Patient survival was evaluated using the Kaplan-Meier method.**

Results: **We established the diagnostic classifier, called C_{es}, with clinical laboratory indicators to distinguish ES from healthy individuals. C_{es} showed great diagnostic performance in the test cohort (area under the receiver operating characteristic curve (AUC) 0.95) and could identify early-stage (AUC 0.93) and small-size (AUC 0.95) ES effectively. In addition, the classifier had good ability to differentiate ES from primary benign bone lesions (AUC 0.77 for C_{es}, AUC 0.83 for C_{es} + age). Furthermore, C_{es} was associated with tumor metastasis and event-free survival (EFS) of ES patients and showed better performance than lactate dehydrogenase (LDH) in prognosis prediction.**

Conclusions: **Our study indicates that C_{es} has the potential to be a non-invasive biomarker for ES diagnosis and prognosis.**

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Supplementary Tables

Table S1. The included hematological and biochemical parameters and their abbreviations.

Full name	Abbreviation	Full name	Abbreviation
White blood cell count	WBC	Lactate dehydrogenase	LDH
Percentage of lymphocytes	LY%	Alpha-hydroxybutyrate dehydrogenase	HBD
Monocyte percentage	MO%	Creatine kinase	CK
Neutral cell percentage	NE%	Total protein	TP
Percentage of eosinophils	EO%	Albumin	ALB
Basophil percentage	BA%	Urea	Urea
Absolute number of lymphocytes	LY#	Creatinine	CRE
Absolute number of monocytes	MO#	Uric acid	UA
Absolute number of neutrophils	NE#	Glucose	Glu
Absolute number of eosinophils	EO#	Triglyceride	TG
Absolute number of basophils	BA#	High density lipoprotein cholesterol	HDL-C
Red blood cell count	RBC	Low density lipoprotein cholesterol	LDL-C
Hemoglobin content	HGB	Total bilirubin	TBIL
Hematocrit	HCT	Direct bilirubin	DBIL
Mean erythrocyte hemoglobin	MCH	Calcium	Ca
Red blood cell volume distribution width	RDW	Inorganic phosphate	IP
Mean erythrocyte hemoglobin concentration	MCHC	Albumin/globulin	A/G
Platelet count	PLT	Aspartate aminotransferase /Alanine aminotransferase	AST/ALT
Mean platelet volume	MPV	Direct bilirubin/Total bilirubin	DBIL/TBIL
Alanine aminotransferase	ALT	Absolute number of lymphocytes/ Absolute number of monocytes	LMR
Aspartate aminotransferase	AST	Absolute number of neutrophils/ Absolute number of lymphocytes	NLR
Gamma-glutamyl transpeptidase	GGT	Platelet count/Absolute number of lymphocytes	PLR
Alkaline phosphatase	ALP		

Table S2. Age and gender comparison between ES patients and random selected HCs.

		Training cohort			Test cohort		
		ES	HC	p	ES	HC	p
Gender	Male	46	54	0.74	29	32	0.95
	Female	34	36		26	28	
Age (Mean ± SD)		17.41 ± 7.96	16.37 ± 7.56	0.35	16.62 ± 6.70	15.45 ± 7.38	0.21

ES - Ewing's sarcoma, HC - healthy control, SD - standard deviation.

Table S3. Basic demographics of 228 patients with primary benign bone lesions at diagnosis.

	Gender		Age (Mean ± SD)
	Male	Female	
Simple bone cyst	6	4	25.20 ± 15.96
Aneurysmal bone cyst	3	2	26.60 ± 12.62
Osteoma	23	19	25.81 ± 10.88
Osteoid osteoma	8	2	16.60 ± 9.55
Giant cell tumor	63	37	27.40 ± 8.70
Hemangioma	12	7	21.00 ± 13.74
Osteochondroma	23	6	20.24 ± 6.65
Enchondroma	7	6	25.92 ± 7.48

Table S4. Age and gender comparison between ES patients and those with primary benign bone lesions.

		Test cohort		
		ES	Benign bone lesions	p
Gender	Male	29	144	0.154
	Female	26	84	
Age (Mean ± SD)		16.62 ± 6.70	24.99 ± 10.19	< 0.05

ES - Ewing's sarcoma, SD - standard deviation.