·临床研究·

6 min步行试验联合血清细胞因子对慢性心力衰竭患者预后的评估价值

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【摘 要】 目的 探讨6 min步行试验(6MWT)联合血清细胞因子对慢性心力衰竭患者(CHF)预后的评估价值。**方法** 选取2020年1月至2021年1月琼海市人民医院收治的82例CHF患者为研究对象。收集患者临床资料及左心室射血分数(LVEF)、纽约心脏病协会(NYHA)心功能分级及血清氨基末端脑钠肽前体(NT-proBNP)水平等心功能指标。患者入院后行6MWT试验,检测白细胞介素-22(IL-22)、肿瘤坏死因子-α(TNF-α)及核因子-κB(NF-κB)等血清细胞因子水平。采用SPSS 19.0统计软件进行数据处理。采用Pearson或Spearman相关法分析6MWT及血清细胞因子水平与心功能指标之间的相关性。采用受试者工作特征(ROC)曲线评估各指标对CHF患者预后的预测价值。采用Cox风险比例回归模型分析影响CHF患者预后的独立危险因素。**结果** 随访1年,失访患者2例,根据不良终点事件发生情况分为事件组(n=36)与非事件组(n=44)。事件组6MWT显著低于非事件组[(301.25±36.78)和(413.51±42.36)m],血清IL-22[(643.51±53.69)和(511.07±60.11)pg/ml]、TNF-α[(412.15±56.69)和(284.55±35.79)ng/L]及NF-κB[(96.67±13.69)和(70.05±12.57)pg/ml]水平均显著高于非事件组,差异均有统计学意义(均P<0.05)。NYHAⅡ级患者6MWT显著高于NYHAⅢ级患者[(390.52±45.87)m和(346.47±43.15)m],血清IL-22[(540.09±60.33)和(589.01±58.77)pg/ml]、TNF-α[(325.21±53.69)和(352.02±54.77)ng/L]及NF-κB[(78.07±10.85)和(84.04±11.33)pg/ml]水平均显著低于NYHA Ⅲ级,差异均有统计学意义(均P<0.05)。相关性分析提示,CHF患者6MWT与LVEF呈正相关(r=0.511,P<0.001),与NYHA心功能分级(r=-0.405,P=0.012)及血清NT-proBNP水平均呈负相关(r=-0.456,P<0.001);血清IL-22水平与LVEF呈负相关(r=-0.383,P=0.016),与NT-proBNP水平呈正相关(r=0.296,P=0.037);血清TNF-α水平与LVEF均呈负相关(r=-0.425,P=0.008),与NYHA心功能分级(r=0.305,P=0.030)及血清NT-proBNP水平(r=0.377,P=0.017)均呈正相关;血清NF-κB水平与LVEF(r=-0.317,P=0.028)呈负相关,与NYHA心功能分级(r=0.304,P=0.031)及血清NT-proBNP水平(r=0.246,P=0.043)均呈正相关。CHF患者TNF-α水平与6MWT呈负相关(r=-0.369,P=0.018),与血清IL-22(r=0.413,P=0.010)及NF-κB(r=0.356,P=0.021)水平均呈正相关。ROC曲线分析发现,6MWT、血清TNF-α及NF-κB水平联合预测CHF患者不良预后的ROC曲线下面积为0.991(95%*CI* 0.939~1.000),灵敏度为0.972,特异度为0.977,优于单一指标检测。Cox风险比例回归分析显示,6MWT及血清TNF-α水平是影响CHF患者出院后1年发生不良终点事件的独立危险因素。**结论** 6MWT、TNF-α、IL-22及NF-κB联合应用对CHF患者预后有良好的预测价值。

【关键词】 慢性心力衰竭;6min步行试验;白细胞介素-22;肿瘤坏死因子-α;核因子-κB;预后
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Evaluation value of 6-minute walk test combined with serum cytokines for prognosis of chronic heart failure

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【Abstract】 Objective To explore the value of 6-minute walk test (6MWT) combined with serum cytokines in evaluating the prognosis of chronic heart failure (CHF). **Methods** A total of 82 CHF patients admitted to our hospital from January 2020 to January 2021 were selected as the study subjects. Their clinical data and cardiac function indicators such as left ventricular ejection fraction (LVEF), New York Heart Association (NYHA) class, and serum N-terminal pro-brain natriuretic peptide(NT-proBNP) levels were collected. 6MWT test was conducted on all of them after admission. The serum levels of cytokines, including interleukin-22 (IL-22),

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tumor necrosis factor-α (TNF-α) and nuclear factor-kappa B (NF-κB) were detected and recorded. SPSS statistics 19.0 was used for data processing. Pearson or Spearman correlation analyses were employed to analyze the correlation of 6MWT results and serum cytokine levels with cardiac function indicators. Receiver operating characteristic (ROC) curve was plotted to assess the predictive values of various indicators for the prognosis of CHF patients. Cox risk proportional regression model was applied to analyze independent risk factors affecting the prognosis. **Results** During 1-year follow-up, 2 patients were lost. The other patients were divided into event group (n=36) and non-event group (n=44) according to the occurrence of adverse end points. The patients in the event group had significantly shorter 6MWT distance [(301.25±36.78) *vs* (413.51±42.36) m], and obviously higher serum levels of IL-22 [(643.51±53.69) *vs* (511.07±60.11) pg/ml], TNF-α [(412.15±56.69) *vs* (284.55±35.79) ng/L] and NF-κB [(96.67±13.69) *vs* (70.05±12.57) pg/ml] when compared with those in the non-event group (all P<0.05). Opposite results [6MWT distance: (390.52±45.87) *vs* (346.47±43.15) m; IL-22: (540.09±60.33) *vs* (589.01±58.77) pg/ml; TNF-α: (325.21±53.69) *vs* (352.02±54.77) ng/L; NF-κB: (78.07±10.85) *vs* (84.04±11.33) pg/ml] were observed in the patients of NYHA class Ⅱ than those of NYHA class Ⅲ (all P<0.05). Correlation analysis showed that 6MWT result was positively correlated with LVEF in the CHF patients (r=0.511, P<0.001), and negatively with NYHA class (r=−0.405, P=0.012) and serum NT-proBNP level (r=−0.456, P<0.001); serum IL-22 level was negatively correlated with LVEF (r=−0.383, P=0.016) and positively with NT-proBNP level (r=0.296, P=0.037); serum TNF-α level was negatively correlated with LVEF (r=−0.425, P=0.008), and positively with NYHA class (r=0.305, P=0.030) and serum NT-proBNP level (r=0.377, P=0.017); Serum NF-κB level was negatively correlated with LVEF (r=−0.317, P=0.028), and positively with NYHA class (r=0.304, P=0.031) and serum NT-proBNP level (r=0.246, P=0.043). The TNF-α level was negatively correlated with 6MWT result (r=−0.369, P=0.018), and positively with serum IL-22 (r=0.413, P=0.010) and NF-κB levels (r=0.356, P=0.021). ROC curve analysis found that the area under the curve of combined 6MWT result and serum TNF-α and NF-κB for predicting poor prognosis in CHF patients was 0.991 (95%*CI* 0.939−1.000), with a sensitivity of 0.972, and a specificity of 0.977, and all these values were superior to those of a single indicator. Cox risk proportional regression analysis indicated that 6MWT result and serum TNF-α level were independent risk factor for adverse end points in CHF patients within 1 year after discharge. **Conclusion** 6MWT result combined with TNF-α, IL-22 and NF-κB levels shows good predictive value for the prognosis of CHF patients.

【Key words】 chronic heart failure; 6-minute walk test; interleukin-22; tumor necrosis factor-α; nuclear factor-κB; prognosis

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慢性心力衰竭(chronic heart failure, CHF)是多种心血管疾病的终末阶段,在老年人群中较为多发,且整体预后较差。目前,传统指标如心功能分级、超声心脏参数以及血清氨基末端脑钠肽前体(N-terminal pro-brain natriuretic peptide, NT-proBNP)等在评估CHF预后中均存在一定的局限性,寻找新的、可靠的指标是当前研究的热点[1]。有研究发现,6 min步行试验(six-minute walk test, 6MWT)是一项便于操作、安全易行的亚剂量运动试验,可较好地反映CHF患者心功能及日常生活活动量[2]。肿瘤坏死因子-α(tumor necrosis factor-α, TNF-α)能直接损伤心肌纤维,其血清浓度异常升高将造成心肌水肿、降低患者心肌收缩功能,是反映CHF病情及预后的常见炎症因子[3]。而血清白细胞介素-22(interleukin-22, IL-22)是一种可参与免疫炎症反应的新型细胞因子,韦颖等[4]研究表明,IL-22可能参与CHF的致病机制。核因子-κB(nuclear factor-kappa B, NF-κB)存在于血管内皮细胞及心肌细胞内,有研究提示,NF-κB参与多种心血管疾病的发生及发展[5]。本研究拟探讨6MWT联合TNF-α、IL-22及NF-κB等血清细胞因子对CHF预后的评估价值,旨在提高临床对CHF不良预后预判的准确性。

1 对象与方法

1.1 研究对象

选取2020年1月至2021年1月琼海市人民医院收治的82例CHF患者为研究对象。纳入标准:年龄60~80岁;符合欧洲心脏病学会中CHF的诊断标准[6];纽约心脏病协会(New York Heart Association, NYHA)心功能分级Ⅱ~Ⅲ级。排除标准:合并心肌炎、肺栓塞或恶性肿瘤;合并精神障碍;随访丢失。本研究经琼海市人民医院伦理委员会批准(伦理审批号:2020-H13),所有患者均知情且签署同意书。

1.2 方法

1.2.1 一般资料 收集患者包括年龄、性别、体质量指数、入院时血压、病因及病史等数据。

1.2.2 心功能指标 收集患者包括入院时左心室射血分数(left ventricular ejection fraction, LVEF)、NYHA心功能分级、血清NT-proBNP及左心室舒张末期内径等数据。

1.2.3 6MWT 所有患者均在入院后24 h内进行

6MWT。实验地点为病房走廊,走廊长约 50 m,平直无障碍。首先向患者讲解实验过程,进行 1 次适应性 6MWT。在适应性试验之后再进行 2 次 6MWT,每次实验间隔 15 min,保障足够休息时间。测量患者 6 min 内步行的绝对距离,取第 2 次及第 3 次测量结果的平均值作为最终结果。

1.2.4 血清细胞因子水平检测 患者入院后 24 h 内采集外周静脉血 6 ml。采用酶联免疫吸附法检测血清 IL-22、NF-κB 及 TNF-α 水平。试剂盒均购自美国 Uscn Life Science & Technology 公司,严格按照试剂盒相关步骤进行操作。

1.2.5 随访及不良终点事件 患者经标准抗心力衰竭治疗后出院,出院时医师根据《中国心力衰竭诊断及治疗指南 2018》[7] 为患者制定院外服药方案。采取门诊、电话相结合的方式随访 1 年,记录患者不良终点事件发生情况。不良终点事件包括主要不良心血管事件、心力衰竭再次入院、心源性死亡、恶性心力衰竭及全因死亡等[8]。

1.3 统计学处理

采用 SPSS 19.0 统计软件处理数据。计量资料以均数±标准差($\bar{x}\pm s$)表示,组间比较采用独立样本 t 检验;计数资料以例数(百分率)表示,组间比较采用 χ^2 检验。相关性分析采用 Pearson 或 Spearman 相关分析法。绘制受试者工作特征(receiver operating characteristic, ROC)曲线评价单指标以及多指标联合预测 CHF 不良终点事件的价值。采用 Cox 风险比例回归模型分析影响 CHF 患者预后不良的相关因素。$P<0.05$ 为差异有统计学意义。

2 结 果

2.1 随访结果

出院后随访 1 年,失访患者 2 例(2.44%),其余 80 例患者均完成随访。将患者按是否发生不良终点事件分为事件组($n=36$)及非事件组($n=44$)。

2.2 2 组患者临床资料比较

2 组患者年龄、NYHA 心功能分级、LVEF 及 NT-proBNP 水平比较,差异均有统计学意义(均 $P<0.05$;表 1)。

2.2 2 组患者 6MWT 及血清细胞因子水平比较

2 组患者入院时 6MWT、血清 IL-22、TNF-α 及 NF-κB 水平比较,差异均有统计学意义(均 $P<0.05$;表 2)。

2.3 不同 NYHA 心功能分级 CHF 患者 6MWT 及血清细胞因子水平比较

NYHA Ⅲ级患者血清 IL-22、TNF-α 及 NF-κB 水平均显著高于 NYHA Ⅱ级患者,6WMT 低于 NYHAⅡ级患者,差异均有统计学意义(均 $P<0.05$;表 3)。

表 1 2 组患者临床资料比较

Table 1 Comparison of clinical data between two groups

Item	Event group($n=36$)	Non-event group($n=44$)	t/χ^2	P value
Gender(male/female, n)	20/16	24/20	0.008	0.928
Age(years, $\bar{x}\pm s$)	75.15±10.02	70.43±8.97	2.221	0.029
BMI(kg/m^2, $\bar{x}\pm s$)	22.74±2.46	23.11±3.04	0.589	0.558
NYHA class(Ⅱ/Ⅲ, n)	8/28	22/22	6.519	0.011
Etiology[n(%)]			0.224	0.974
Dilated cardiomyopathy	2(5.56)	16(36.36)		
Heumatic cardiomyopathy	8(22.22)	8(18.18)		
Hypertensive heart disease	7(19.44)	9(20.45)		
Ischemic cardiomyopathy	9(25.00)	11(25.00)		
LVEF(%, $\bar{x}\pm s$)	48.59±7.41	57.52±8.43	4.974	<0.001
LVEDD(mm, $\bar{x}\pm s$)	55.64±6.63	54.83±7.04	0.525	0.601
NT-proBNP(pg/ml, $\bar{x}\pm s$)	4 615.47±633.69	3 266.84±545.18	10.231	<0.001
Urea(mmol/L, $\bar{x}\pm s$)	8.36±1.86	7.96±1.75	0.989	0.326
SCr(mmol/L, $\bar{x}\pm s$)	86.69±16.57	90.14±15.37	0.964	0.338
UA(mmol/L, $\bar{x}\pm s$)	343.56±29.85	336.52±33.17	0.987	0.327
SBP(mmHg, $\bar{x}\pm s$)	132.15±12.36	135.07±10.56	1.139	0.258
DBP(mmHg, $\bar{x}\pm s$)	76.85±8.45	77.08±7.99	0.125	0.901

BMI: body mass index; NYHA: New York Heart Association; LVEF: left ventricular ejection fraction; LVEDD: left ventricular end-diastolic diameter; NT-proBNP: N-terminal pro-brain natriuretic peptide; SCr: serum creatinine; UA: uric acid; SBP: systolic blood pressure; DBP: diastolic blood pressure. 1 mmHg=0.133 kPa.

表2 2组患者6MWT及血清细胞因子水平比较

Table 2 Comparison of 6MWT and serum cytokine levels between two groups ($\bar{x}\pm s$)

Item	Event group (n=36)	Non-event group (n=44)	t	P value
6MWT(m)	301.25±36.78	413.51±42.36	12.503	<0.001
IL-22(pg/ml)	643.51±53.69	511.07±60.11	10.282	<0.001
TNF-α(ng/L)	412.15±56.69	284.55±35.79	12.250	<0.001
NF-κB(pg/ml)	96.67±13.69	70.05±12.57	9.053	<0.001

6MWT: six-minute walk test; IL-22: interleukin-22; TNF-α: tumor necrosis factor-α; NF-κB: nuclear factor-kappa B.

表3 不同NYHA心功能分级CHF患者6MWT及血清细胞因子水平比较

Table 3 Comparison of 6MWT and serum cytokine levels in CHF patients with different NYHA cardiac function grades ($\bar{x}\pm s$)

Item	NYHAⅡ patients (n=30)	NYHAⅢ patients (n=50)	t	P value
6MWT(m)	390.52±45.87	346.47±43.15	4.317	<0.001
IL-22(pg/ml)	540.09±60.33	589.01±58.77	3.569	<0.001
TNF-α(ng/L)	325.21±53.69	352.02±54.77	2.135	0.036
NF-κB(pg/ml)	78.07±10.85	84.04±11.33	2.318	0.023

NYHA: New York Heart Association; CHF: chronic heart failure; 6MWT: six-minute walk test; IL-22: interleukin-22; TNF-α: tumor necrosis factor-α; NF-κB: nuclear factor-kappa B.

2.4 6MWT及血清细胞因子与CHF患者心功能指标的相关性

相关性分析显示,CHF患者6MWT与LVEF水平呈正相关,与NYHA心功能分级及血清NT-proBNP水平呈负相关(均P<0.05)。血清IL-22水平与LVEF呈负相关,与血清NT-proBNP水平呈正相关(均P<0.05)。血清TNF-α及NF-κB水平与LVEF水平均呈负相关,与NYHA心功能分级及血清NT-proBNP水平均呈正相关(均P<0.05)。CHF患者TNF-α水平与6MWT距离呈负相关,与血清IL-22及NF-κB水平均呈正相关(均P<0.05;表4)。

2.5 6MWT及血清细胞因子预测CHF患者不良终点事件的价值

ROC曲线分析结果发现,6MWT、TNF-α、IL-22及NF-κB单指标在预测CHF患者不良终点事件中均具有一定的效能。4个指标联合预测CHF患者不良终点事件的曲线下面积为0.991(95%*CI* 0.939~1.000),灵敏度为0.972,特异度为0.977,可有效提高预测效能。详见表5、图1。

2.6 影响CHF患者预后的Cox风险比例回归分析

Cox风险比例回归分析提示,入院时NT-proBNP、6MWT及血清TNF-α水平是影响CHF患者出院后1年发生不良终点事件的独立危险因素(P<0.05;表6)。

表4 6MWT及血清细胞因子与CHF患者心功能指标之间的相关性分析

Table 4 Correlation of 6 MWT and serum cytokines with cardiac function indicators in patients with CHF

Item	6MWT		IL-22		TNF-α		NF-κB	
	r	P value	r	P value	r	P value	r	P value
6MWT	-	-	-0.213	0.066	-0.369	0.018	-0.139	0.284
IL-22	-0.213	0.066	-	-	0.413	0.010	0.145	0.273
TNF-α	-0.369	0.018	0.413	0.010	-	-	0.356	0.021
NF-κB	-0.139	0.284	0.145	0.273	0.356	0.021	-	-
LVEF	0.511	<0.001	-0.383	0.016	-0.425	0.008	-0.317	0.028
NYHA	-0.405	0.012	0.211	0.075	0.305	0.030	0.304	0.031
NT-proBNP	-0.456	<0.001	0.296	0.037	0.377	0.017	0.246	0.043

6MWT: six-minute walk test; CHF: chronic heart failure; IL-22: interleukin-22; TNF-α: tumor necrosis factor-α; NF-κB: nuclear factor-kappa B; LVEF: left ventricular ejection fraction; NYHA: New York Heart Association; NT-proBNP: N-terminal pro-brain natriuretic peptide. -: no datum.

表5 6MWT及血清细胞因子预测CHF患者不良终点事件的价值

Table 5 Value of 6MWT and serum cytokines in predicting adverse endpoint events in patients with CHF

Item	Cut-off	AUC	*SE*	95%*CI*	P value	Sensitivity	Specificity
6MWT	351.50	0.914	0.035	0.830-0.965	<0.001	0.778	0.955
IL-22	560.26	0.751*	0.056	0.642-0.841	<0.001	0.583	0.841
TNF-α	333.71	0.874$^{\#}$	0.039	0.781-0.938	<0.001	0.694	0.932
NF-κB	81.08	0.769$^{*\triangle}$	0.055	0.661-0.856	<0.001	0.694	0.795
Joint predictor	-	0.991$^{*\#\triangle\blacktriangle}$	0.009	0.939-1.000	<0.001	0.972	0.977

6MWT: six-minute walk test; CHF: chronic heart failure; IL-22: interleukin-22; TNF-α: tumor necrosis factor-α; NF-κB: nuclear factor-kappa B. -: no datum. Compared with 6MTW, $^{*}P$<0.05; compared with IL-22, $^{\#}P$<0.05; compared with TNF-α, $^{\triangle}P$<0.05; compared with NF-κB, $^{\blacktriangle}P$<0.05.

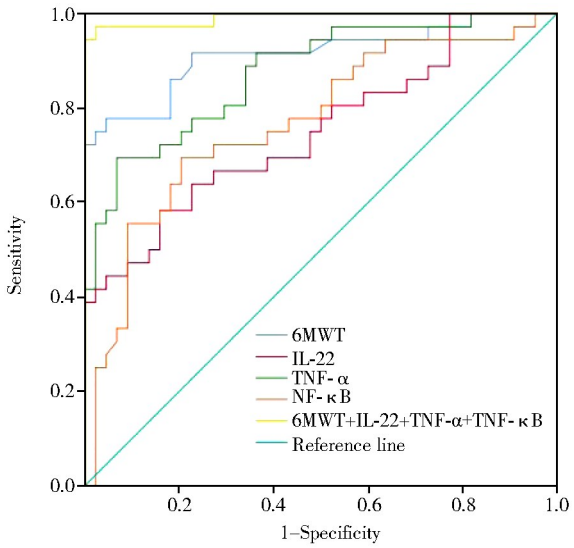

图 1 6MWT 及血清细胞因子预测 CHF 患者不良终点事件的 ROC 曲线

Figure 1 ROC curve of 6MWT and serum cytokines in predicting adverse endpoint events in patients with CHF

6MWT: six-minute walk test; CHF: chronic heart failure; ROC: receiver operating characteristic; IL-22: interleukin-22; TNF-α: tumor necrosis factor-α; NF-κB: nuclear factor-kappa B.

3 讨 论

2014 年中国心血管临床研究中心发现，CHF 是造成我国心血管疾病患者死亡的首要原因[9]。CHF 病死率及再住院率极高，筛选可靠的预后预测指标，对患者进行有效的预后评估及危险分层显得格外重要。

6MWT 是检测患者功能性运动能力的试验，多个心血管协会均建议将其列为评价 CHF 患者心功能及预后的一线诊断试验[10]。本研究发现，事件组入院时 6MWT 显著低于非事件组，且 NYHA Ⅲ级者 6WMT 水平显著低于 NYHA Ⅱ级患者，提示 6WMT 在 CHF 病情分层及预后判断中具有一定的应用潜能。汪玉龙等[11]研究发现，6MWT 水平能有效反映 CHF 患者病情严重程度，可用于判断患者预后，与本研究结论相似。

CHF 的发病机制一直是临床研究的重点与难点，从 CHF 发病机制出发，筛选可预测 CHF 预后的指标，是临床研究方向之一。本研究发现，事件组及 NYHA Ⅲ级患者血清细胞因子 TNF-α、IL-22 及 NF-κB 水平均显著高于非事件组及 NYHA Ⅱ级患者（均 $P<0.05$）。TNF-α 是一种炎症细胞因子，可通过降低心肌收缩力与平均主动脉压，促使心功能不全。此外，TNF-α 还可直接损伤心肌纤维，造成心肌水肿，降低患者心肌收缩功能，从而促进 CHF 病情进展[12]。IL-22 是近年来新发现的炎症细胞因子，广泛参与机体的免疫炎症反应。有学者发现，血清 IL-22 与其他炎症因子水平密切相关，共同启动炎症瀑布反应，参与 CHF 患者的免疫调节紊乱过程[13]。NF-κB 是一种重要的转录调控因子，有研究表明，NF-κB 是 CHF 病理发展过程中介导多种炎症细胞因子持续产生并释放的重要通路[14]。NF-κB 还可介导炎症介质所引起的心肌与内皮细胞凋亡[15]，损害心肌功能，引起 CHF 的发生及发展。

相关性分析发现，CHF 患者 6MWT、血清 TNF-α、IL-22 及 NF-κB 水平与其心功能指标 LVEF、NYHA 心功能分级以及 NT-proBNP 水平之间均存在一定相关性，进一步说明 6MWT 及血清 TNF-α、IL-22 及 NF-κB 在反映 CHF 患者心功能水平中具有潜在价值。此外，本研究还发现 CHF 患者血清 TNF-α 与 IL-22 水平呈正相关。Weber 等[16]研究发现，阻断 IL-22 作用后，脾肾等外周器官中的 TNF-α、IL-6 等炎症因子表达水平均降低，提示 IL-22 可能通过调节促炎症因子的表达，参与 CHF 的病理生理过程。同时，本研究中患者 TNF-α 表达水平与 NF-κB 水平也呈正相关，进一步证实 NF-κB 可通过调节炎性介质的产生，参与 CHF 病理过程。

表 6 影响 CHF 患者预后因素的 Cox 风险比例回归分析

Table 6 Cox hazard proportional regression analysis of affecting factors for prognosis of patients with CHF

Factor	*B*	*SE*	*Wald* χ^2	*HR*	*P* value	95%*CI*
Age	1.152	0.887	1.687	3.153	0.195	0.552-18.012
NYHA	1.332	0.741	3.231	3.774	0.073	0.883-16.184
LVEF	-0.556	0.331	2.822	0.571	0.094	0.305-1.099
NT-proBNP	0.458	0.115	15.861	1.546	<0.001	1.259-1.977
6MWT	0.769	0.255	9.094	2.158	0.003	1.302-3.561
IL-22	0.466	0.336	1.924	1.591	0.166	0.821-3.083
TNF-α	0.845	0.313	7.288	2.328	0.007	1.272-4.312
NF-κB	0.636	0.339	3.520	1.882	0.061	0.969-3.653

CHF: chronic heart failure; NYHA: New York Heart Association; LVEF: left ventricular ejection fraction; NT-proBNP: N-terminal pro-brain natriuretic peptide; 6MWT: six-minute walk test; IL-22: interleukin-22; TNF-α: tumor necrosis factor-α; NF-κB: nuclear factor-kappa B.

ROC曲线分析发现,6MWT、TNF-α、IL-22及NF-κB联合应用对CHF患者预后有良好的预测价值,优于单独应用。此外,Cox风险比例回归分析提示,6MWT及血清TNF-α水平是影响CHF患者预后的独立危险因素。

综上,6MWT、TNF-α、IL-22及NF-κB联合应用在预测CHF患者不良终点事件中具有良好的潜能。但本研究为单中心研究且样本量有限,为增强研究结论的可靠性,下一步将开展大样本量的研究对结果进行验证。

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