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## D-二聚体、血小板计数、凝血酶原时间对重症肺炎患者预后的评估价值

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**[摘要]** 目的: 探究D-二聚体、血小板计数(platelet count, PLT)、凝血酶原时间(prothrombin time, PT)对重症肺炎患者预后的评估价值。方法: 选取2020年11月至2021年10月东方市人民医院收治的90例重症肺炎患者为研究对象, 收集所有患者一般资料及诊断24 h内的D-二聚体、PLT、PT, 根据28 d预后将其分为死亡组与存活组。相关指标与重症肺炎患者预后的关系采用单因素及logistic回归分析, D-二聚体、PLT、PT对重症肺炎患者预后的评估价值采用受试者工作特征曲线(receiver operating characteristic, ROC)分析。结果: 90例重症患者中28 d死亡38例(42.22%)、存活52例(57.78%)。与存活组相比, 死亡组急性生理与慢性健康状况评分系统II(Acute Physiology and Chronic Health Evaluation II, APACHE II)评分、PT及血清D-二聚体水平均明显更高, PLT水平则明显更低(均 $P<0.05$ )。Logistic回归分析显示: D-二聚体(OR=1.613)、PLT(OR=0.585)、PT(OR=1.317)均是重症肺炎患者死亡的独立影响因素(均 $P<0.05$ )。ROC曲线分析显示: D-二聚体、PLT、PT预测重症肺炎患者预后的曲线下面积(area under curve, AUC)分别为0.807、0.723、0.644, 三者联合的AUC为0.958, 敏感度为92.11%、特异度为84.62%。结论: D-二聚体、PLT、PT与重症肺炎患者预后密切相关, 诊断24 h内D-二聚体和PT较高、PLT较低提示患者死亡风险较大, 三者联合应用对评估重症肺炎患者预后具有重要价值。

**[关键词]** D-二聚体; 血小板计数; 凝血酶原时间; 重症肺炎; 预后

## Value of D-dimer, platelet count, and prothrombin time on prognosis of patients with severe pneumonia

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**Abstract** **Objective:** To explore the evaluation value of D-dimer, platelet count (PLT), and prothrombin time (PT) on the prognosis of patients with severe pneumonia. **Methods:** A total of 90 patients with severe pneumonia admitted to Dongfang People's Hospital from November 2020 to October 2021 were selected as the research subjects. The general data of all patients and D-dimer, PLT, and PT within 24 h of diagnosis were collected. According to the

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prognosis of 28 d, they were divided into a death group and a survival group. Univariate and logistic regression models were used to analyze the relationship between related indicators and the prognosis of patients with severe pneumonia, and receiver operating characteristic (ROC) was used to analyze the evaluation value of *D*-dimer, PLT, and PT on the prognosis of patients with severe pneumonia. **Results:** Among the 90 cases of severe patients, 38 patients (42.22%) died, and 52 patients (57.78%) survived within 28 d. Compared with the survival group, the Acute Physiology and Chronic Health Evaluation II (APACHE II) score, PT, and serum *D*-dimer levels in the death group were significantly higher, and the PLT level was significantly lower (all  $P < 0.05$ ). Logistic regression analysis showed that *D*-dimer (OR=1.613), PLT (OR=0.585), and PT (OR=1.317) were independent influencing factors of death in patients with severe pneumonia (all  $P < 0.05$ ). ROC curve analysis showed that the areas under the curve (AUC) of *D*-dimer, PLT, and PT in predicting the prognosis of patients with severe pneumonia were 0.807, 0.723, and 0.644, respectively. The diagnostic value of the combination of the three was the largest, with AUC of 0.958, sensitivity of 92.11% and specificity of 84.62%. **Conclusion:** *D*-dimer, PLT, and PT are closely related to the prognosis of patients with severe pneumonia. The higher *D*-dimer and PT within 24 h of diagnosis and the lower PLT suggest that patients have a greater risk of death. The combined application of the three has important value in evaluating the prognosis of patients with severe pneumonia.

**Keywords** *D*-dimer; platelet count; prothrombin time; severe pneumonia; prognosis

重症肺炎是临床常见的危重病症之一, 进展快、并发症多、病情重, 严重威胁患者生命, 其病死率为20%~70%<sup>[1]</sup>。尽早对重症肺炎患者预后进行准确、有效地评估以指导临床治疗, 对预后的改善具有重要意义。急性生理与慢性健康状况评分系统II(Acute Physiology and Chronic Health Evaluation II, APACHE II)可用于临床评估重症患者病情及预后, 其价值已被证实<sup>[2]</sup>, 但所需数据繁杂。既往研究<sup>[3-4]</sup>显示: 肺炎患者常存在凝血功能改变, 进展至重症后表现出明显的凝血异常, 且与预后有关。故抗凝也是临床重症肺炎治疗的重要环节之一<sup>[5]</sup>。*D*-二聚体水平作为机体高凝状态的反映, 在血栓性疾病、肺疾病的诊断、疗效评估等中具有重要意义<sup>[6]</sup>; 血小板计数(platelet count, PLT)也被发现与脓毒症、肺炎等多种疾病病情程度相关<sup>[7]</sup>; 凝血酶原时间(prothrombin time, PT)也是临床抗凝治疗的重要监测指标<sup>[8]</sup>。基于此, 本研究旨在研究*D*-二聚体、PLT、PT对重症肺炎患者预后的评估价值, 为临床研究提供一定参考。

## 1 对象与方法

### 1.1 对象

本研究为前瞻性研究, 经东方市人民医院医学伦理委员会审批。选取2020年11月至2021年10月东方市人民医院收治的90例重症肺炎患者为研究对象。纳入标准: 1)符合重症肺炎相关诊断标准<sup>[9]</sup>;

2)年龄>18岁; 3)住院治疗, 并在诊断24 h内完成相关检查; 4)患者及家属对本研究知情同意。排除标准: 1)合并血液系统疾病、凝血功能障碍、人类免疫缺陷病毒(human immunodeficiency virus, HIV)感染、肺结核、恶性肿瘤; 2)骨髓移植; 3)有免疫抑制剂、激素类药物长期应用史。

### 1.2 观察指标与检测方法

1)一般资料: 包括性别、年龄、基础疾病等。2)实验室资料: 于诊断24 h内检测外周血*D*-二聚体、白细胞计数(white blood cell count, WBC)、PLT、PT、活化部分凝血活酶时间(activated partial thromboplastin time, APTT); 并根据诊断24 h内临床指标的最差值计算APACHE II评分。其中*D*-二聚体采用免疫比浊法检测, WBC、PLT采用全自动血液分析仪(XN-1000型, Sysmex)检测, PT、APTT用全自动凝血仪(CS5100型, Sysmex)检测。3)28 d预后: 利用电话或微信等方式采集出院患者28 d时存活或死亡状态信息, 住院或院内死亡患者不需随访。根据28 d预后将患者分为死亡组与存活组。

### 1.3 统计学处理

使用SPSS 24.0统计学软件对研究数据进行分析。正态分布计量资料描述为均数±标准差( $\bar{x} \pm s$ ), 比较行两独立样本 $t$ 检验; 计数资料描述为例(%), 比较行 $\chi^2$ 检验或Fisher精确概率法; 采用Pearson相关系数法进行相关性分析; 重症肺炎患者预后的

独立影响因素采用logistic回归分析; *D*-二聚体、PLT、PT及其联合对重症肺炎患者预后的预测价值采用受试者工作特征曲线(receiver operating characteristic, ROC)分析。 $P < 0.05$ 为差异有统计学意义。

## 2 结果

### 2.1 一般情况

在90例重症患者中,男66例(73.33%),女24例(26.67%);年龄43~82( $68.30 \pm 11.42$ )岁;28 d死亡38例(42.22%),存活52例(57.78%)。

### 2.2 两组基线资料比较

与存活组相比,死亡组APACHE II评分、PT及血清*D*-二聚体水平均明显更高,PLT水平则明显更低,组间比较差异均有统计学意义(均 $P < 0.05$ )。两组性别、年龄、基础疾病等其他基线资料比较差异均无统计学意义(均 $P > 0.05$ ,表1)。

### 2.3 *D*-二聚体、PLT、PT与APACHE II的相关性

90例重症肺炎患者的*D*-二聚体、PT与APACHE II评分均呈正相关(分别 $r=0.379$ 、 $0.298$ , $P < 0.001$ 、 $0.004$ ),PLT与APACHE II评分呈负相关( $r=-0.352$ , $P < 0.001$ )。

### 2.4 重症肺炎患者预后影响因素的logistic回归分析

以重症肺炎患者是否死亡为因变量,以单因素分析中具有统计学意义的因素为自变量行logistic回归分析,结果显示:*D*-二聚体(OR=1.613)、PLT(OR=0.585)、PT(OR=1.317)均是重症肺炎患者死亡的独立影响因素(均 $P < 0.05$ ,表2)。

### 2.5 *D*-二聚体、PLT、PT对重症肺炎患者28 d死亡的预测效能

ROC曲线分析显示:*D*-二聚体、PLT、PT预测重症肺炎患者预后的曲线下面积(area under curve, AUC)分别为0.807、0.723、0.644,三者联合的AUC为0.958,敏感度为92.11%,特异度为84.62%(表3,图1)。

表1 两组基线资料比较

Table 1 Comparison of baseline data between the 2 groups

指标	死亡组( $n=38$ )	存活组( $n=52$ )	$t/\chi^2$	$P$
性别/[例(%)]			0.175	0.676
男	27 (71.05)	39 (75.00)		
女	11 (28.95)	13 (25.00)		
年龄/岁	$69.85 \pm 10.73$	$67.16 \pm 8.57$	1.322	0.190
基础疾病/[例(%)]				
糖尿病	8 (21.05)	6 (11.54)	1.513	0.219
高血压	15 (39.47)	21 (40.38)	0.008	0.931
冠心病	6 (15.79)	6 (11.54)	0.343	0.558
慢性肺病	5 (13.16)	3 (5.77)	—	0.275*
慢性肾病	1 (2.63)	1 (1.92)	—	1.000*
慢性肝病	1 (2.63)	0 (0.00)	—	0.422*
APACHE II评分	$24.43 \pm 7.85$	$17.54 \pm 4.76$	5.167	<0.001
<i>D</i> -二聚体/( $\text{mg}\cdot\text{L}^{-1}$ )	$3.48 \pm 1.18$	$2.32 \pm 0.74$	6.048	<0.001
WBC/( $\times 10^9\cdot\text{L}^{-1}$ )	$11.68 \pm 3.34$	$10.62 \pm 2.79$	1.637	0.105
PLT/( $\times 10^9\cdot\text{L}^{-1}$ )	$167.89 \pm 36.82$	$206.52 \pm 45.23$	4.320	<0.001
PT/s	$15.14 \pm 2.04$	$14.28 \pm 1.67$	2.196	0.031
ATPP/s	$39.47 \pm 3.19$	$38.38 \pm 3.02$	1.651	0.102

\*Fisher精确概率法。

\*Fisher exact probability method.

表2 重症肺炎患者预后影响因素的logistic回归分析

Table 2 Logistic regression analysis of prognostic factors in patients with severe pneumonia

项目	$\beta$	SE	Wald	P	OR	95%CI
D-二聚体	0.478	0.196	5.948	0.015	1.613	1.098~2.368
PLT	-0.536	0.177	9.170	0.003	0.585	0.414~0.828
PT	0.275	0.104	6.992	0.008	1.317	1.074~1.614

表3 D-二聚体、PLT、PT及三者联合对重症肺炎患者预后的预测价值

Table 3 Predictive value of D-二聚体, PLT, PT and their combination on prognosis of patients with severe pneumonia

项目	最佳截断值	AUC	P	95%CI	敏感度/%	特异度/%	阳性预测值/%	阴性预测值/%	阳性似然比	阴性似然比
D-二聚体	>3.22 mg/L	0.807	<0.001	0.710~0.882	63.16	92.31	85.71	77.42	8.21	0.40
PLT	$\leq 213.42 \times 10^9/L$	0.723	<0.001	0.619~0.812	92.11	51.92	58.33	90.00	1.92	0.15
PT	>16.01 s	0.644	0.017	0.537~0.743	36.84	90.38	73.68	66.20	3.83	0.70
三者联合		0.958	<0.001	0.893~0.989	92.11	84.62	81.40	93.62	6.00	0.09

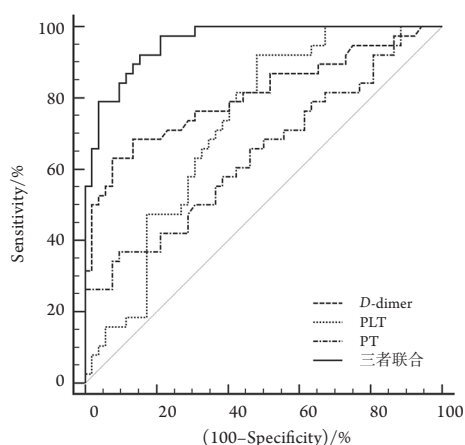


图1 D-二聚体、PLT、PT及三者联合预测重症肺炎患者预后的ROC曲线

Figure 1 ROC curves of D-dimer, PLT, PT and their combination in predicting the prognosis of patients with severe pneumonia

### 3 讨论

重症肺炎患者机体因感染而释放大量炎症介质,可累及多个器官、系统,发生呼吸/循环衰竭、多器官损伤等,是感染性疾病致死的首位病因<sup>[10]</sup>。“炎症-凝血交互”在重症肺炎凝血紊乱的发展中发挥了重要作用,病原体侵入机体将刺激机体释放多种细胞因子,损伤血管内皮,激活凝血系统及单核细胞等,而随着相关炎症介质

等细胞因子的高表达,凝血作用将进一步被放大,“关闭”纤溶,大量纤维蛋白沉积,最终形成微血管血栓,阻碍组织灌注,加重器官功能衰竭。Liu等<sup>[11]</sup>也认为:“炎症因子风暴”、凝血异常可能是部分重症肺炎患者病情加重或死亡的重要原因。

D-二聚体是机体纤溶亢进、高凝状态的标志物。Borovac等<sup>[12]</sup>研究发现:D-二聚体水平相比于常规炎症标志物,与社区获得性肺炎(communitary-acquired pneumonia, CAP)的病情程度及死亡风险预测的相关性更好。Querol-Ribelles等<sup>[13]</sup>发现:D-二聚体水平与APACHE II评分、肺炎严重程度评分(pneumonia severity index, PSI)均呈正相关。本研究结果显示:死亡组血清D-二聚体水平明显高于存活组,且与APACHE II评分呈正相关,进一步证实了D-二聚体与重症肺炎患者病情程度相关,有作为其预后预测因子的潜能,与邓银灿等<sup>[14]</sup>研究结果具有一致性。血小板不仅参与机体凝血-纤溶平衡的维持,也参与机体的主动免疫防御,提高抗微生物感染能力,因此PLT可用于感染性疾病的病情程度、预后的预测<sup>[15]</sup>。国外研究<sup>[16]</sup>显示:PLT的升高或下降均是CAP患者不良预后的提示,且有学者<sup>[17]</sup>指出脓毒症预后不良患者在病程早期常出现PLT下降。俞建峰等<sup>[18]</sup>也认为:早期PLT下降提示重症肺炎患者预后较差。本研究结果显示:死亡组PLT明显低于存活组,与APACHE II

评分呈负相关,提示PLT亦与重症肺炎病情程度相关,其水平降低可能与血小板被破坏、过度消耗及其生成被抑制有关<sup>[19]</sup>。PT是临床抗凝治疗的重要监测指标,PT延长可能与重症肺炎患者发生弥散性血管内凝血有关。重症肺炎患者因感染而释放大量炎症因子,激活凝血、抑制抗凝、“关闭”纤溶,使机体呈现高凝状态<sup>[20]</sup>,而患者普遍伴随的低血氧症也会提高血液黏稠度,另外,低氧也会经缺氧诱导因子(hypoxia inducible factor, HIF)途径加速血栓形成,最终导致PT延长<sup>[21]</sup>。本研究结果显示:PT在两组患者中表现出了明显差异,与APACHE II评分亦呈正相关,且logistic回归分析也证实:D-二聚体、PLT、PT均是重症肺炎患者死亡的独立影响因素,表明D-二聚体、PLT、PT均与重症肺炎患者的病情程度与预后密切相关。

本研究进一步用ROC曲线评价D-二聚体、PLT、PT及三者联合对重症肺炎患者预后的评估价值,结果显示:三者预测重症肺炎患者死亡的AUC分别为0.807、0.723、0.644,表明D-二聚体、PLT、PT对重症肺炎患者预后均具有较好的评估价值,李伟坚等<sup>[22]</sup>(D-二聚体 $>5.11$  mg/L)、冯开俊等<sup>[23]</sup>(PLT $\leq 340 \times 10^9$ /L)、陈焱颖等<sup>[24]</sup>(PT $>13.0$  s)的研究也得出了相似结论,且以三者联合的评估价值最大。

综上所述,D-二聚体、PLT、PT均与重症肺炎患者的预后关系密切,D-二聚体 $>3.22$  mg/L、PLT $\leq 213.42 \times 10^9$ /L、PT $>16.01$  s提示重症肺炎患者28 d死亡风险较高;且以三者联合应用对重症肺炎患者的预后的预测价值最高,可用于指导临床治疗。但本研究仍存在一定局限性:其一,纳入样本量较小,结果可能存在一定偏倚;其二,未对患者D-二聚体、PLT、PT等指标进行动态监测,仍需大样本、多中心的前瞻性研究进行进一步验证。

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