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· COVID-19 专栏 ·

## 凝血指标、炎症指标与 COVID-19 的关系研究

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**【摘要】** 背景 COVID-19 病情严重程度与凝血指标、炎症指标异常等存在一定关系。目的 探讨凝血指标、炎症指标与 COVID-19 的关系。方法 回顾性选取武汉大学人民医院 2020 年 1—5 月收治的 COVID-19 患者 280 例作为观察组, 根据预后将其分为存活亚组 ( $n=231$ ) 和死亡亚组 ( $n=49$ )。另选取 2020 年 3—9 月本院健康体检者 120 例作为对照组。分别比较观察组与对照组、存活亚组与死亡亚组一般资料、凝血指标 [包括凝血酶原时间 (PT)、活化部分凝血活酶时间 (APTT)、纤维蛋白原 (FIB)、D-二聚体 (D-D)]、炎症指标 [包括 C 反应蛋白 (CRP)、降钙素原 (PCT)]。采用多因素 Cox 比例风险回归分析探讨 COVID-19 患者预后的影响因素, 绘制受试者工作特征曲线 (ROC 曲线) 分析凝血指标、炎症指标对 COVID-19 的诊断价值及其预后的预测价值。结果 观察组 PT 长于对照组, 血浆 FIB、D-D 水平及血清 CRP、PCT 水平高于对照组 ( $P < 0.05$ )。存活亚组年龄小于死亡亚组, 冠心病发生率和血浆 FIB、D-D 及血清 CRP、PCT 水平低于死亡亚组, PT 短于死亡亚组 ( $P < 0.05$ ); 多因素 Cox 比例风险回归分析结果显示: 年龄 [ $HR=2.869$ ,  $95\%CI(1.497, 5.500)$ ]、冠心病 [ $HR=3.796$ ,  $95\%CI(1.680, 8.579)$ ]、PT [ $HR=2.596$ ,  $95\%CI(1.703, 3.957)$ ]、血浆 D-D 水平 [ $HR=2.289$ ,  $95\%CI(1.473, 3.557)$ ] 及血清 CRP [ $HR=2.542$ ,  $95\%CI(1.607, 4.021)$ ]、PCT [ $HR=2.596$ ,  $95\%CI(1.724, 3.910)$ ] 水平是 COVID-19 患者预后的影响因素 ( $P < 0.05$ )。ROC 曲线分析结果显示, PT、血浆 FIB 水平、血浆 D-D 水平、血清 CRP 水平、血清 PCT 水平诊断 COVID-19 的 ROC 曲线下面积 (AUC) 分别为  $0.592$  [ $95\%CI(0.542, 0.641)$ ]、 $0.665$  [ $95\%CI(0.616, 0.711)$ ]、 $0.680$  [ $95\%CI(0.631, 0.725)$ ]、 $0.690$  [ $95\%CI(0.642, 0.735)$ ]、 $0.632$  [ $95\%CI(0.583, 0.680)$ ]; PT、血浆 D-D 水平、血清 CRP 水平、血清 PCT 水平预测 COVID-19 患者预后的 AUC 分别为  $0.536$  [ $95\%CI(0.479, 0.596)$ ]、 $0.593$  [ $95\%CI(0.533, 0.651)$ ]、 $0.603$  [ $95\%CI(0.543, 0.660)$ ]、 $0.637$  [ $95\%CI(0.577, 0.693)$ ]。结论 年龄、冠心病、PT、血浆 D-D 水平及血清 CRP、PCT 水平是 COVID-19 患者预后的影响因素, 而凝血指标、炎症指标对 COVID-19 诊断及预后预测并无较大价值。

**【关键词】** 新型冠状病毒肺炎; 凝血指标; 炎症指标; 诊断; 预后评估

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**Relationship of Coagulation Indexes, Inflammation Indexes and COVID-19** CAI Xin, CAI Zhongxiang, CHAI Hui, SONG Yujuan, LENG Huijun, LI Qianyu

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**【Abstract】** **Background** The severity of COVID-19 is related to the abnormal coagulation indicators and inflammatory indicators of patients. **Objective** To discuss of relationship of coagulation indexes, inflammation indexes and COVID-19. **Methods** A total of 280 cases of patients with COVID-19 admitted to Renmin Hospital of Wuhan University from January to May 2020 were retrospectively selected as the observation group, and they were divided into the survival subgroup ( $n=231$ ) and the death subgroup ( $n=49$ ) according to the prognosis. Another 120 cases who underwent physical examination in our hospital from March to September 2020 were selected as the control group. General information, coagulation indexes [including prothrombin time (PT), activated partial thrombin time (APTT), fibrinogen (FIB), D-dimer (D-D)], inflammatory indexes [including C-reactive protein (CRP), procalcitonin (PCT)] were compared between the observation group and the control group, the survival subgroup and the death subgroup, respectively. Multivariate Cox proportional hazards

regression analysis was used to discuss the influencing factors of prognosis of COVID-19. Receiver operating characteristics (ROC) curve was drawn to analyze the value of coagulation indexes and inflammatory indexes in the diagnosis and prognosis prediction of COVID-19. **Results** PT of the observation group was longer than that of the control group, and levels of plasma FIB, D-D and serum CRP, PCT were higher than those of the control group ( $P < 0.05$ ). Age of the survival subgroup was smaller than that of the death subgroup, incidence of coronary heart disease, levels of plasma FIB, D-D and levels of serum CRP, PCT were lower than those of the death subgroup, PT was shorter than that of the death subgroup ( $P < 0.05$ ); the results of multivariate Cox proportional hazards regression analysis showed that, age [ $HR=2.869$ ,  $95\%CI(1.497, 5.500)$ ], coronary heart disease [ $HR=3.796$ ,  $95\%CI(1.680, 8.579)$ ], PT [ $HR=2.596$ ,  $95\%CI(1.703, 3.957)$ ], plasma D-D level [ $HR=2.289$ ,  $95\%CI(1.473, 3.557)$ ], serum CRP level [ $HR=2.542$ ,  $95\%CI(1.607, 4.021)$ ], serum PCT level [ $HR=2.596$ ,  $95\%CI(1.724, 3.910)$ ] were influencing factors of prognosis of COVID-19 patients ( $P < 0.05$ ). ROC curve showed that, area under curve (AUC) of PT, plasma FIB level, plasma D-D level, serum CRP level, serum PCT level in the diagnosis of COVID-19 was  $0.592$  [ $95\%CI(0.542, 0.641)$ ],  $0.665$  [ $95\%CI(0.616, 0.711)$ ],  $0.680$  [ $95\%CI(0.631, 0.725)$ ],  $0.690$  [ $95\%CI(0.642, 0.735)$ ],  $0.632$  [ $95\%CI(0.583, 0.680)$ ], respectively; AUC of PT, plasma D-D level, serum CRP level, serum PCT level in predicting the prognosis of COVID-19 patients was  $0.536$  [ $95\%CI(0.479, 0.596)$ ],  $0.593$  [ $95\%CI(0.533, 0.651)$ ],  $0.603$  [ $95\%CI(0.543, 0.660)$ ],  $0.637$  [ $95\%CI(0.577, 0.693)$ ], respectively. **Conclusion** Age, coronary heart disease, PT and levels of plasma D-D, serum CRP, PCT are influencing factors of prognosis of COVID-19 patients, and coagulation indexes and inflammatory indexes have no great value in the diagnosis and prognosis prediction of COVID-19.

**【Key words】** COVID-19; Coagulation index; Inflammation index; Diagnosis; Prognosis evaluation

COVID-19 是一种急性感染性肺部疾病, 其病原体是  $\beta$  冠状病毒 (是一种单链 RNA 病毒), 具有临床症状不典型、潜伏期传染性强、传播速度快、无症状感染者也可成为感染源等特点<sup>[1-2]</sup>, 患者主要临床症状有发热、咳嗽、胸闷、乏力、呼吸困难、腹泻、呕吐等, 存在个体差异。多项流行病学调查结果显示, 严重急性呼吸综合征冠状病毒 2 (severe acute respiratory syndrome coronavirus 2, SARS-CoV-2) 潜伏期为 1~14 d, 少数潜伏期 > 14 d, 其传播途径不仅限于呼吸道飞沫, 还可通过接触病毒污染物进行传播, 因而人群普遍易感, 而人体在接种 COVID-19 灭活疫苗后虽有一定免疫力, 但疫苗作用持续时间尚不明确<sup>[3-4]</sup>。有研究表明, COVID-19 患者疾病严重程度与病毒类型、自身免疫力密切相关<sup>[5-6]</sup>。目前临床尚未有可治愈 COVID-19 的治疗方法, 主要治疗方案仍是隔离治疗、对症支持治疗。根据现阶段收治的多数 COVID-19 患者预后良好, 但死亡率仍较高, 且高龄、合并慢性病患者预后相对较差, 儿童病例症状较轻<sup>[7]</sup>。目前国内针对 COVID-19 的病原学、发病机制、治疗方案等研究逐渐增多。近期有研究表明, 凝血功能与 COVID-19 患者疾病严重程度有关, 且炎症指标亦随患者疾病严重程度而改变<sup>[8-10]</sup>。为更客观地评价 COVID-19 患者病情、获得更多辅助决策及预后判断指标, 本研旨在探讨凝血指标、炎症指标与 COVID-19 的关系, 现报道如下。

## 1 对象与方法

**1.1 研究对象** 回顾性选取武汉大学人民医院 2020 年 1—5 月收治的 COVID-19 患者 280 例 (普通型 195 例, 重型 85 例) 作为观察组。纳入标准: (1) 患者咽拭子标本实时荧光定量反转录-聚合酶链式反应 (real time fluorescent quantitative reverse transcription-polymerase chain reaction, rRT-PCR) 阳性; (2) 符合《新型冠状病毒肺炎诊疗方案 (试行第六版)》<sup>[11]</sup>

制定的 COVID-19 诊断标准; (3) 近 2 周内未服用影响凝血功能的药物; (4) 临床资料完整。排除标准: (1) 急性心脑血管疾病者; (2) 恶性肿瘤终末期者; (3) 长期服用免疫抑制剂者; (4) 合并血液系统疾病者。根据预后将观察组患者分为存活亚组 ( $n=231$ ) 和死亡亚组 ( $n=49$ )。另选取 2020 年 3—9 月本院健康体检者 120 例作为对照组。纳入标准: (1) 与观察组患者性别、年龄相似; (2) 对本研究内容知情、同意, 自愿参与并配合提供研究相关数据。排除标准: (1) 恶性肿瘤、血液系统疾病者; (2) 精神疾病、语言障碍者。本研究经武汉大学人民医院伦理委员会审核批准。

**1.2 方法** (1) 收集研究对象一般资料, 包括性别、年龄、基础疾病 (包括高血压、糖尿病、冠心病、呼吸系统疾病)。(2) 采集观察组患者入院 24 h 内、对照组受试者体检当日空腹外周静脉血 3~5 ml, 应用全自动凝血分析仪 (CS5100 型, 日本 Sysmex 公司生产) 检测凝血酶原时间 (prothrombin time, PT)、活化部分凝血活酶时间 (activated partial thromboplastin time, APTT) 及血浆纤维蛋白原 (fibrinogen, FIB)、D-二聚体 (D-dimer, D-D) 水平; 采用酶联免疫吸附试验 (enzyme-linked immunosorbent assay, ELISA) 检测血清 C 反应蛋白 (C-reactive protein, CRP)、降钙素原 (procalcitonin, PCT) 水平, 具体操作严格按照试剂盒说明书进行。

**1.3 统计学方法** 应用 SPSS 17.0 统计学软件进行数据处理。符合正态分布的计量资料以 ( $\bar{x} \pm s$ ) 表示, 组间比较采用两独立样本  $t$  检验; 计数资料以相对数表示, 组间比较采用  $\chi^2$  检验; COVID-19 患者预后的影响因素分析采用多因素 Cox 比例风险回归分析; 绘制受试者工作特征曲线 (receiver operating characteristic curves, ROC 曲线) 分析凝血指标、炎症指标对 COVID-19 的诊断价值及其预后的预测价值。以  $P < 0.05$  为差异有统计学意义。

2 结果

2.1 观察组和对照组临床资料比较 观察组 PT 长于对照组, 血浆 FIB、D-D 水平及血清 CRP、PCT 水平高于对照组, 差异有统计学意义 ( $P < 0.05$ ); 两组性别、年龄、高血压发生率、糖尿病发生率、冠心病发生率、呼吸系统疾病发生率、APTT 比较, 差异无统计学意义 ( $P > 0.05$ ), 见表 1。

2.2 COVID-19 患者预后的影响因素分析

2.2.1 存活亚组、死亡亚组临床资料比较 存活亚组年龄小于死亡亚组, 冠心病发生率和血浆 FIB、D-D 水平及血清 CRP、PCT 水平低于死亡亚组, PT 短于死亡亚组, 差异有统计学意义 ( $P < 0.05$ ); 两组性别、高血压发生率、糖尿病发生率、呼吸系统疾病发生率、APTT 比较, 差异无统计学意义 ( $P > 0.05$ ), 见表 2。

2.2.2 COVID-19 患者预后影响因素的多因素 Cox 比例风险回归分析 将表 2 中有统计学差异的指标作为自变量, COVID-19 患者预后作为因变量 (赋值: 死亡=0, 存活=1), 进行多因素 Cox 比例风险回归分析, 结果显示: 年龄、冠心病、PT、血浆 D-D 水平及血清 CRP、PCT 水平是 COVID-19 患者预后的影响因素 ( $P < 0.05$ ), 见表 3。

2.3 凝血指标、炎症指标对 COVID-19 的诊断价值及其预后的预测价值

2.3.1 凝血指标、炎症指标对 COVID-19 的诊断价值 ROC 曲线分析结果显示, PT、血浆 FIB 水平、血浆 D-D 水平、血清 CRP 水平、血清 PCT 水平诊断 COVID-19 的曲线下面积 (AUC) 分别为 0.592 [95%CI (0.542, 0.641)]、0.665 [95%CI (0.616, 0.711)]、0.680 [95%CI (0.631, 0.725)]、0.690 [95%CI (0.642, 0.735)]、0.632 [95%CI (0.583, 0.680)], 见表 4、图 1。

积 (AUC) 分别为 0.592 [95%CI (0.542, 0.641)]、0.665 [95%CI (0.616, 0.711)]、0.680 [95%CI (0.631, 0.725)]、0.690 [95%CI (0.642, 0.735)]、0.632 [95%CI (0.583, 0.680)], 见表 4、图 1。

表 3 COVID-19 患者预后影响因素的多因素 Cox 比例风险回归分析  
Table 3 Multivariate Cox proportional hazard regression analysis of influencing factors on prognosis in patients with COVID-19

变量	赋值	$\beta$	SE	Wald $\chi^2$ 值	P 值	HR (95%CI)
年龄	实测值	1.054	0.332	10.279	0.002	2.869 (1.497, 5.500)
冠心病	有=0, 无=1	1.334	0.416	10.283	0.001	3.796 (1.680, 8.579)
PT	实测值	0.954	0.215	19.689	< 0.001	2.596 (1.703, 3.957)
FIB	实测值	0.744	0.387	3.696	0.055	2.104 (0.986, 4.493)
D-D	实测值	0.828	0.225	13.542	< 0.001	2.289 (1.473, 3.557)
CRP	实测值	0.933	0.234	15.898	< 0.001	2.542 (1.607, 4.021)
PCT	实测值	0.954	0.209	20.836	< 0.001	2.596 (1.724, 3.910)

2.3.2 凝血指标、炎症指标对 COVID-19 患者预后的预测价值 ROC 曲线分析结果显示, PT、血浆 D-D 水平、血清 CRP 水平、血清 PCT 水平预测 COVID-19 患者预后的 AUC 分别为 0.536 [95%CI (0.479, 0.596)]、0.593 [95%CI (0.533, 0.651)]、0.603 [95%CI (0.543, 0.660)]、0.637 [95%CI (0.577, 0.693)], 见表 5、图 2。

表 1 对照组和观察组临床资料比较

Table 1 Comparison of clinical data between the control group and the observation group

组别	例数	性别 (男/女)	年龄 ( $\bar{x} \pm s$ , 岁)	基础疾病 [n (%)]			
				高血压	糖尿病	冠心病	呼吸系统疾病
对照组	120	58/62	51.9 $\pm$ 10.7	58 (48.33)	22 (18.33)	15 (12.50)	16 (13.33)
观察组	280	125/155	51.8 $\pm$ 12.3	146 (52.14)	42 (15.00)	44 (15.71)	48 (17.14)
$t(\chi^2)$ 值		0.461 <sup>a</sup>	0.093	0.488 <sup>a</sup>	0.694 <sup>a</sup>	0.690 <sup>a</sup>	0.907 <sup>a</sup>
P 值		0.497	0.926	0.485	0.405	0.406	0.341

组别	PT ( $\bar{x} \pm s$ , s)	APTT ( $\bar{x} \pm s$ , s)	FIB ( $\bar{x} \pm s$ , g/L)	D-D ( $\bar{x} \pm s$ , mg/L)	CRP ( $\bar{x} \pm s$ , mg/L)	PCT ( $\bar{x} \pm s$ , ng/L)
对照组	13.1 $\pm$ 2.3	27.8 $\pm$ 4.3	2.62 $\pm$ 0.82	0.45 $\pm$ 0.23	5.84 $\pm$ 2.33	0.09 $\pm$ 0.05
观察组	14.0 $\pm$ 3.1	28.8 $\pm$ 6.2	3.19 $\pm$ 1.15	2.36 $\pm$ 2.05	42.04 $\pm$ 30.56	0.35 $\pm$ 0.33
$t(\chi^2)$ 值	2.705	0.097	4.919	10.172	12.951	8.588
P 值	0.007	0.923	< 0.001	< 0.001	< 0.001	< 0.001

注: <sup>a</sup> 为  $\chi^2$  值; PT= 凝血酶原时间, APTT= 活化部分凝血活酶时间, FIB= 纤维蛋白原, D-D=D-二聚体, CRP=C 反应蛋白, PCT= 降钙素原

表 2 存活亚组、死亡亚组临床资料比较

Table 2 Comparison of clinical data between the survival subgroup and the death subgroup

组别	例数	性别 (男/女)	年龄 ( $\bar{x} \pm s$ , 岁)	高血压 [n (%)]	糖尿病 [n (%)]	冠心病 [n (%)]	呼吸系统疾 病 [n (%)]	PT ( $\bar{x} \pm s$ , s)	APTT ( $\bar{x} \pm s$ , s)	FIB ( $\bar{x} \pm s$ , g/L)	D-D ( $\bar{x} \pm s$ , mg/L)	CRP ( $\bar{x} \pm s$ , mg/L)	PCT ( $\bar{x} \pm s$ , ng/L)
死亡亚组	49	28/21	59.8 $\pm$ 10.8	29 (59.2)	10 (20.4)	15 (30.6)	12 (24.5)	16.9 $\pm$ 3.6	29.8 $\pm$ 6.6	3.25 $\pm$ 0.67	7.05 $\pm$ 6.33	115.06 $\pm$ 82.32	1.55 $\pm$ 1.32
存活亚组	231	126/105	50.1 $\pm$ 9.3	117 (50.6)	32 (13.9)	29 (12.6)	36 (15.6)	13.4 $\pm$ 1.6	28.6 $\pm$ 4.7	2.90 $\pm$ 1.34	1.36 $\pm$ 1.12	26.55 $\pm$ 17.02	0.09 $\pm$ 0.07
$t(\chi^2)$ 值		0.110 <sup>a</sup>	6.441	1.180 <sup>a</sup>	1.362 <sup>a</sup>	9.953 <sup>a</sup>	2.257 <sup>a</sup>	10.496	1.551	2.645	12.376	14.486	16.147
P 值		0.740	< 0.001	0.277	0.243	0.002	0.133	< 0.001	0.126	0.011	< 0.001	< 0.001	< 0.001

注: <sup>a</sup> 为  $\chi^2$  值

表4 凝血指标、炎症指标对 COVID-19 的诊断价值

Table 4 Diagnostic value of coagulation indexes and inflammation indexes in COVID-19

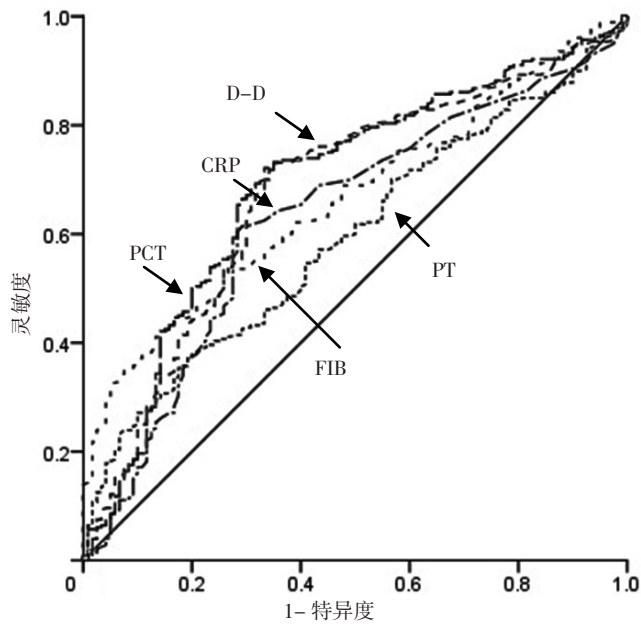
指标	AUC (95%CI)	最佳截断值	灵敏度 (%)	特异度 (%)
PT	0.592 (0.542, 0.641)	14.1 s	80.83	37.14
FIB	0.665 (0.616, 0.711)	29.11 g/L	85.83	42.14
D-D	0.680 (0.631, 0.725)	3.15 mg/L	66.67	72.14
CRP	0.690 (0.642, 0.735)	9.57 mg/L	65.00	73.21
PCT	0.632 (0.583, 0.680)	0.19 ng/L	70.83	61.43

注: AUC= 曲线下面积

表5 凝血指标、炎症指标对 COVID-19 患者预后的预测价值

Table 5 Predictive value of coagulation indexes and inflammation indexes on prognosis of patients with COVID-19

指标	AUC (95%CI)	最佳截断值	灵敏度 (%)	特异度 (%)
PT	0.536 (0.479, 0.596)	16.0 s	87.45	26.53
D-D	0.593 (0.533, 0.651)	3.29 mg/L	88.31	34.69
CRP	0.603 (0.543, 0.660)	25.54 mg/L	44.59	75.51
PCT	0.637 (0.577, 0.693)	0.24 ng/L	86.15	38.78



注: PT= 凝血酶原时间, FIB= 纤维蛋白原, D-D=D-二聚体, CRP=C 反应蛋白, PCT= 降钙素原

图1 凝血指标、炎症指标诊断 COVID-19 的 ROC 曲线

Figure 1 ROC curve of coagulation indexes and inflammation indexes in the diagnosis of COVID-19

### 3 讨论

我国将 COVID-19 规定为乙类传染病, 按甲类传染病进行管理<sup>[12-13]</sup>。随着临床对 COVID-19 患者临床表现、病理改变的认识不断加深, 及医护人员诊疗经验的不断积累, 我国 COVID-19 疫情得到有效缓解。新型冠状病毒是目前为止发现的第 7 种可感染人类的 SARS-CoV-2, 其可导致肺功能损伤,

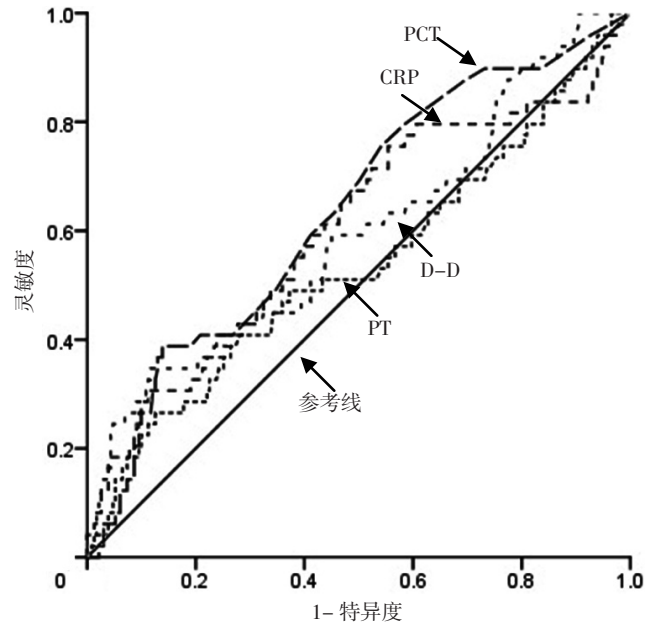


图2 凝血指标、炎症指标预测 COVID-19 患者预后的 ROC 曲线

Figure 2 ROC curve of coagulation indexes and inflammation indexes in predicting prognosis of patients with COVID-19

进而累及神经、消化、泌尿、血液等多个系统, 且感染者发病初期临床症状不明显, 导致临床误诊率较高<sup>[14-15]</sup>。相关研究发现, COVID-19 传播途径广且传染力强, 存在人群普遍易感性, 根据疾病严重程度可分为轻型、普通型、重型及危重型<sup>[16-18]</sup>。调查显示, COVID-19 就诊患者多表现为发热、咳嗽、呼吸困难等症状, 部分症状不典型患者无发热, 其首发症状为恶心、呕吐、腹泻等, 目前临床轻型、普通型就诊患者居多, 但少数危重型患者病情进展迅速, 就诊时即已出现呼吸窘迫、凝血功能障碍、难以纠正的代谢性酸中毒、多器官功能衰竭等严重并发症<sup>[19-23]</sup>。因此, 临床对于 COVID-19 患者的早期诊断及预后判断尤为重要。

现阶段临床主要通过呼吸道症状、影像学表现等辅助诊断 COVID-19 及其分型, 已有多项研究证实 COVID-19 普通型与重型患者凝血指标和炎症指标存在差异<sup>[24-27]</sup>。SARS-CoV-2 与 SARS 样冠状病毒具有高度同源性, 患者主要表现为肺组织发生变性、缺氧、坏死, 可继发高纤维蛋白血症, 进而导致血液出现高凝状态, 形成血栓<sup>[28]</sup>。多项研究表明, 重型 COVID-19 患者体内普遍存在高凝状态, 需使用血管活性药物来改善微循环<sup>[28-33]</sup>。

PT 作为外源性凝血途径指标, 凝血酶、内毒素、炎性因子等可诱导机体血管内皮细胞、单核巨噬细胞等表达, 故 PT 可反映感染诱发凝血功能异常等疾病。FIB 作为血浆中含量最高的凝血因子, 其水平在机体受到严重创伤及感染时升高<sup>[34]</sup>。D-D 作为纤维蛋白降解产物, 其水平变化可反映机体高凝及继发性纤溶亢进表现, 还可反映机体感染状态及炎症反应程度<sup>[35]</sup>, 且有研究表明, D-D 与社区获得性肺炎有关, 推测其有望成为重症肺炎患者预后的预测指标之一<sup>[36-37]</sup>。本研究结果显示, 观察组 PT 长于对照组, 血浆 FIB、D-D 水平高于

对照组,分析原因为:COVID-19患者主要病理变化为肺泡隔血管水肿、充血,且有透明血栓形成,还可导致炎性递质及促炎因子释放,进而加剧血液高凝状态,诱发凝血功能异常,故导致PT延长,血浆FIB、D-D水平升高;本研究结果还显示,存活亚组PT短于死亡亚组,血浆FIB、D-D水平低于死亡亚组,与张兵华等<sup>[38]</sup>研究结果一致。

细胞因子炎症风暴作为全身炎症反应,主要指免疫效应细胞释放大量趋化因子、促炎细胞因子,进而导致全身炎症反应。研究表明,全身炎症反应是COVID-19患者病情恶化的重要原因之一,因此临床可通过检测炎症指标对患者病情进行评估<sup>[39-41]</sup>。CRP作为临床常用的炎症指标之一,可准确且快速地反映机体感染状态;PCT作为降钙素前肽,正常人群血清PCT水平极低,当处于细菌感染状态时其特异性升高<sup>[42]</sup>。本研究结果显示,观察组血清CRP、PCT水平高于对照组,存活亚组血清CRP、PCT水平低于死亡亚组,与宋伟南等<sup>[43]</sup>研究结果一致,表明COVID-19患者机体存在炎症反应,且存活者炎症指标水平降低。《新型冠状病毒肺炎诊疗方案(试行第七版)》中指出,CRP水平进行性升高是重型及危重型COVID-19患者临床预警指标之一<sup>[44-47]</sup>。

本研究多因素Cox比例风险回归分析结果显示,年龄、冠心病、PT、血浆D-D水平及血清CRP、PCT水平是COVID-19患者预后的影响因素,ROC曲线分析结果显示,PT、血浆FIB水平、血浆D-D水平、血清CRP水平、血清PCT水平预测COVID-19的AUC分别为0.592、0.665、0.680、0.690、0.632,而PT、血浆D-D水平、血清CRP水平、血清PCT水平预测COVID-19患者预后的AUC分别为0.536、0.593、0.603、0.637,可见PT、血浆FIB水平、血浆D-D水平、血清CRP水平、血清PCT水平对COVID-19患者的诊断价值并不大,且PT、血浆D-D水平、血清CRP水平、血清PCT水平对COVID-19患者预后的预测价值亦不大,但仍需警惕患者凝血指标、炎症指标变化情况,尤其对于各指标明显异常者应密切关注其病情变化情况,防止病情恶化。

综上所述,年龄、冠心病、PT、血浆D-D水平及血清CRP、PCT水平是COVID-19患者预后的影响因素,而凝血指标、炎症指标对COVID-19诊断及预后预测并无较大价值。但本研究为单中心的回顾性研究,纳入样本量有限、观察指标较少,故结果可能存在一定偏倚,后续需通过调整研究时间、扩大样本量等进一步证实本研究结论。

作者贡献:蔡馨进行文章的构思与设计,撰写论文,进行论文的修订,并对文章整体负责、监督管理;蔡馨、蔡忠香、李茜雨进行研究的实施与可行性分析;柴慧、宋宇娟进行数据收集、整理、分析;蔡馨、冷慧君进行结果分析与解释;蔡馨、李茜雨负责文章的质量控制及审核。

本文无利益冲突。

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