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## 多发伤合并腹部脏器损伤血清凝血功能指标、CK及PCT水平及其对预后的影响

刘明双<sup>1</sup>, 徐勇<sup>2</sup>, 丰文学<sup>1</sup>, 蒋林祝<sup>1</sup>, 胥艳<sup>1</sup>

(成都三六三医院急诊科, 成都 610041; 2. 西南医科大学附属医院内分泌科, 四川 泸州 646000)

**[摘要]** 目的: 观察多发伤合并腹部脏器损伤患者血清凝血指标、肌酸激酶(creatinase, CK)、降钙素原(procalcitonin, PCT)水平, 并分析多发伤合并腹部脏器损伤预后的影响因素。方法: 收集2014年1月至2019年8月收治的124例多发伤患者。按是否合并腹部脏器损伤分为合并组( $n=71$ )与非合并组( $n=53$ ), 比较两组血清凝血酶原时间(prothrombin time, PT)、活化部分凝血活酶时间(activated partial thromboplastin time, APTT)、血小板计数(platelet count, PLT)、纤维蛋白原(fibrinogen, FIB)、CK及PCT水平的差异。合并组按照入院30 d预后分为生存组与死亡组, 比较两组上述指标的差异, 并进行单因素及多因素logistic回归分析筛选影响多发伤合并腹部脏器损伤预后的因素。结果: 合并组PT, APTT, FIB, CK, PCT及创伤严重程度评分(Injury Severity Score, ISS)高于未合并组( $P<0.05$ ), PLT低于未合并组( $P<0.05$ ); 合并组患者院内30 d死亡36例(50.70%), 死亡组血压 $<60$  mmHg、创伤至入院时间 $\geq 6$  h、ISS $>25$ 、GCS $<10$ 所占比例及PT, APTT, FIB, CK, PCT, ISS高于存活组, PLT低于存活组( $P<0.05$ ); 创伤至入院时间, ISS, GCS评分, PT, APTT, FIB, PLT, CK, PCT均为影响多发伤合并腹部脏器损伤患者预后危险因素( $P<0.05$ ), 收缩压和PLT为保护因素。结论: 多发伤合并腹部脏器损伤伴明显凝血功能紊乱, CK和PLT水平上升, 且上述因子均为影响患者预后的因素。

**[关键词]** 多发伤; 脏器损伤; 凝血功能; 肌酸激酶; 降钙素原; 预后

## Serum coagulation function indexes, CK and PCT levels in patients with multiple trauma complicated with abdominal visceral injury and the effect on prognosis

LIU Mingshuang<sup>1</sup>, XU Yong<sup>2</sup>, FENG Wenxue<sup>1</sup>, JIANG Linzhu<sup>1</sup>, XU Yan<sup>1</sup>

(1. Department of Emergency, Chengdu 363 Hospital, Chengdu 610041; 2. Department of Endocrinology, Affiliated Hospital of Southwest Medical University, Luzhou Sichuan 646000, China)

**Abstract** **Objective:** To analyze features of serum coagulation indexes, creatine kinase (CK) and procalcitonin (PCT) of patients with multiple trauma complicated with abdominal visceral injury, and summarize influencing factors of prognosis. **Methods:** A total of 124 patients with multiple trauma admitted between January 2014 and August

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通信作者 (Corresponding author): 刘明双, Email: lw\_0190928@163.com

2019 were selected. They were divided into a complication group ( $n=71$ ) and a non-complication group ( $n=53$ ) according to whether they had abdominal visceral injury. The levels of serum prothrombin time (PT), activated partial thromboplastin time (APTT), platelet count (PLT), fibrinogen (FIB), CK and PCT were compared between the two groups. Patients in the complication groups were divided into the survival group and the death group according to the 30-day prognosis, and above indicators were compared between the two groups. Univariate and multivariate Logistic regression analysis were applied to screen influencing factors of prognosis in multiple trauma complicated with abdominal visceral injury. **Results:** PT, APTT, FIB, CK, PCT and Injury Severity Score (ISS) in the complication group were higher than those in non-complication group ( $P<0.05$ ), while PLT was lower than that in non-complication group ( $P<0.05$ ). There were 36 patients in complication group died in the hospital within 30 days, and the mortality rate was 50.70%. The proportions of blood pressure  $<60$  mmHg, time from trauma to admission  $\geq 6$  h, ISS  $>25$  points and GCS score  $<10$  points, PT, APTT, FIB, CK, PCT and ISS in the death group were higher than those in the survival group, while PLT was lower than the survival group ( $P<0.05$ ). The time from trauma to admission, ISS, GCS score, PT, APTT, FIB, PLT, CK and PCT were prognostic risk factors for patients with multiple trauma and abdominal visceral injury ( $P<0.05$ ). Systolic blood pressure and PLT were protective factors. **Conclusion:** There is obvious coagulopathy in patients with multiple trauma complicated with abdominal visceral injury. The concentrations of CK and PLT increase, and these factors are related factors affecting the prognosis of patients.

**Keywords** multiple trauma; visceral injury; coagulation; creatine kinase; procalcitonin; prognosis

多发伤系指单一致伤因素引起两个或以上解剖部位受损的伤病类型<sup>[1]</sup>。急性腹部多发伤在急诊外科相对常见,常累及多器官及系统,或伴严重感染,有部分同时合并多脏器功能障碍,是导致患者死亡的关键原因<sup>[2]</sup>。统计<sup>[3]</sup>显示:严重多发伤伴多脏器损伤病死率超过50%。近期有报道<sup>[4]</sup>指出:严重多发伤病情进展与机体炎症瀑布效应、凝血功能紊乱存在紧密联系。多发伤入院时常伴严重生理功能紊乱,凝血、抗凝、纤溶平衡破坏,受缺氧、应激因素进一步刺激引起创伤性血管内凝血或大出血,造成患者院内死亡<sup>[5-6]</sup>。本研究拟对多发伤合并腹部脏器损伤患者血清凝血指标、炎症参数等进行观察,并与未合并腹部脏器损伤的多发伤患者进行对比,分析合并腹部脏器损伤患者以上参数特征,并总结其近期预后影响因素,以期改善多发伤预后提供参考。

## 1 对象与方法

### 1.1 对象

124例多发伤患者均来自2014年1月至2019年8月成都三六三医院急诊科收治病例。入选标准:年龄 $\geq 18$ 岁;多发创伤至急诊收治入院时间 $\leq 12$  h;伤前身体健康,无重大外伤史或输血史;创伤部位 $\geq 2$ 个;创伤严重程度评分(Injury

Severity Score, ISS) $>16$ ;有明确血清凝血、炎症因子筛查结果;临床资料完善。排除标准:合并各类心肌病变;神经肌肉病变;缺氧缺血性脑病;原发病心肝肾肺脏器官功能障碍;全身恶性肿瘤;先天性凝血功能障碍;6个月内有抗凝药物使用史;长期应用阿司匹林;自身免疫性疾病;临床资料不全。按是否合并腹部脏器损伤分为合并组( $n=71$ )与非合并组( $n=53$ )。非合并组男34例,女19例;年龄21~75( $47.9\pm 12.3$ )岁;意外事故伤31例、挤压伤2例、高处坠落伤16例、其他伤4例。合并组男46例,女25例;年龄20~77( $48.3\pm 11.2$ )岁;意外事故伤42例、挤压伤5例、高处坠落伤21例、其他伤3例;合并脾损伤22例,肝损伤15例,腹膜后器官损伤11例,肠系膜损伤10例,肠道损伤13例。

### 1.2 方法

多发伤患者入院即刻采集外周血10 mL,枸橼酸钠抗凝,2 000 r/min离心10 min,分离血清,待测。纤维蛋白原(fibrinogen, FIB)、凝血酶原时间(prothrombin time, PT)、活化部分凝血活酶时间(activated partial thromboplastin time, APTT)应用日本希森美康株式会社CA-1500型全自动凝血分析仪及配套试剂盒测定。PT, APTT检测时试剂预温至37 °C, PT孵育1 min, APTT孵育3 min; FIB含量采用磁珠法测定;血小板计数(platelet count,

PLT)的检测在美国Beckman-coulter全自动血液分析机上完成;肌酸激酶(creatine kinase, CK)检测应用日本OLYMPUS AU 400全自动生化分析,试剂盒购自德国DisSys公司;双夹心免疫发光法测定降钙素原(procalcitonin, PCT)水平,试剂盒购自德国B.R.A.H.M.S公司,按照试剂使用说明操作。所有病例同时进行ISS评分<sup>[7]</sup>,将人体分为6个区域,选取身体3个最严重损伤区最高简明损伤评分(Abbreviated Injury Scale, AIS)值平方和,分值1~75,轻伤ISS≤16分;重伤>16分;严重伤>25分,当ISS超过20分时病死风险增加,超过50分存活率较低。

### 1.3 预后分组

多发伤合并腹部脏器损伤病例皆按照住院30 d内预后情况(即死亡与否)分为死亡组及存活组,比较住院30 d不同预后患者各基线资料(人口学情况、收缩压、血糖、致伤原因、创伤至入院时间、基础疾病、腹部脏器官受损部位)及凝血各参数、CK、PCT差异,筛选预后影响因素。

### 1.4 统计学处理

采用SPSS 19.0软件进行数据分析。计数资料采用%描述,组间比较行 $\chi^2$ 或Fisher检验;计量资料经检验均符合正态分布,应用均数±标准差( $\bar{x}\pm s$ )描述,行组间独立样本 $t$ 检验,采用单因素分析筛选影响预后因子进入多因素logistic回归分析。 $P<0.05$ 为差异有统计学意义。

## 2 结果

**2.1 各组凝血指标, CK, PCT水平及ISS评分对比**  
合并组PT, APTT, FIB, CK, PCT及ISS评分高于未合并组( $P<0.05$ ), PLT低于未合并组( $P<0.05$ , 表1)。

### 2.2 合并组不同预后患者基线情况比较

合并组院内30 d死亡36例(50.70%),按入院30 d内死亡情况分为存活组( $n=35$ )与死亡组( $n=36$ )。存活组与死亡组在性别、年龄、血糖、致伤原因、基础疾病、腹部受损脏器等方面的比较差异无统计学意义( $P>0.05$ ),死亡组血压<60 mmHg(1 mmHg=0.133 kPa)、创伤至入院时间 $\geq 6$  h, ISS>25, GCS<10所占比例高于存活组( $P<0.05$ , 表2)。

### 2.3 合并组不同预后患者凝血指标, CK, PCT水平

合并组中死亡患者PT, APTT, FIB, CK, PCT, ISS评分高于存活组, PLT低于存活组( $P<0.05$ , 表3)。

### 2.4 影响多发伤合并腹部脏器损伤预后多因素分析

多因素分析显示:创伤至入院时间, ISS, GCS, PT, APTT, FIB, PLT, CK及PCT均为影响多发伤合并腹部脏器损伤患者预后危险因素( $P<0.05$ ),而收缩压和PLT为保护因素( $P<0.05$ ),即正常范围内高收缩压、高PLT水平多发伤合并腹部脏器损伤患者死亡风险较低(表4)。

表1 2组凝血指标, CK, PCT水平及ISS对比( $\bar{x}\pm s$ )

Table 1 Comparison of coagulation indicators, CK, PCT levels and ISS between the 2 groups ( $\bar{x}\pm s$ )

组别	<i>n</i>	PT/s	APTT/s	FIB/(g·L <sup>-1</sup> )	PLT/( $\times 10^9\cdot L^{-1}$ )	CK/(U·L <sup>-1</sup> )	PCT/(ng·mL <sup>-1</sup> )	ISS评分
合并组	71	15.79 ± 1.23	46.72 ± 4.93	6.21 ± 0.59	78.63 ± 4.95	1038.97 ± 298.98	5.45 ± 1.52	25.71 ± 7.13
未合并组	53	14.12 ± 0.43	39.53 ± 5.11	4.14 ± 0.36	98.53 ± 9.23	419.76 ± 56.71	1.76 ± 0.35	17.26 ± 3.74
<i>t</i>		9.454	7.909	22.583	15.446	14.864	17.317	7.853
<i>P</i>		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

表2 合并组不同预后患者基线情况比较

Table 2 Comparison of baseline conditions of patients with different prognosis in the combined group

组别	<i>n</i>	性别/[例(%)]		年龄/[例(%)]		收缩压/[例(%)]		血糖/[例(%)]	
		男	女	<55岁	$\geq 55$ 岁	$\geq 60$ mmHg	<60 mmHg	<10 mmol/L	$\geq 10$ mmol/L
死亡组	36	25 (69.44)	11 (30.56)	27 (75.00)	9 (25.00)	7 (19.44)	29 (80.56)	24 (66.67)	12 (33.33)
存活组	35	21 (60.00)	14 (40.00)	24 (68.57)	11 (31.43)	20 (57.14)	15 (42.86)	31 (88.57)	4 (11.43)
<i>t</i>			0.694		0.362		10.701		3.704
<i>P</i>			0.404		0.547		0.001		0.054

续表2

组别	致伤原因/[例(%)]				创伤至入院时间/[例(%)]		基础疾病/[例(%)]		
	意外事故伤	坠落伤	挤压伤	其他	<6 h	≥6 h	高血压	糖尿病	其他
死亡组	24 (66.67)	9 (25.00)	2 (5.56)	1 (2.78)	21 (58.33)	15 (41.67)	12 (33.33)	13 (36.11)	4 (11.11)
存活组	18 (51.43)	12 (34.29)	3 (8.57)	2 (5.71)	32 (91.43)	3 (8.57)	6 (17.14)	7 (20.00)	3 (8.57)
<i>t</i>		1.805				8.596			0.204
<i>P</i>		0.613				0.003			0.902

  

组别	腹部受损脏器/[例(%)]				ISS/[例(%)]		GCS/[例(%)]		
	肝	脾	腹膜后器官	肠系膜	肠道	>25	16~25	<10	≥10
死亡组	9 (60.00)	12 (33.33)	7 (19.44)	5 (13.89)	3 (8.33)	30 (83.33)	6 (16.67)	28 (77.78)	8 (22.22)
存活组	6 (17.14)	10 (28.57)	4 (11.43)	5 (14.29)	10 (28.57)	15 (42.86)	20 (57.14)	16 (45.71)	19 (54.29)
<i>t</i>			1.683				12.526		7.741
<i>P</i>			0.094				<0.001		0.005

表3 合并组不同预后患者凝血指标、CK、PCT水平( $\bar{x} \pm s$ )Table 3 Coagulation indicators, CK, PCT levels in patients with different prognosis in the combined group ( $\bar{x} \pm s$ )

组别	<i>n</i>	PT/s	APTT/s	FIB/(g·L <sup>-1</sup> )	PLT/(×10 <sup>9</sup> ·L <sup>-1</sup> )	CK/(U·L <sup>-1</sup> )	PCT/(ng·mL <sup>-1</sup> )	ISS
死亡组	36	17.37 ± 3.67	50.59 ± 4.53	7.01 ± 0.76	70.45 ± 6.77	1 309.79 ± 301.96	6.36 ± 1.78	26.39 ± 3.07
存活组	35	15.27 ± 1.23	47.69 ± 3.21	5.98 ± 0.88	80.75 ± 5.96	997.96 ± 129.34	5.42 ± 0.57	24.27 ± 3.92
<i>t</i>		3.214	3.104	5.283	6.797	5.627	2.978	2.541
<i>P</i>		0.002	0.003	<0.001	<0.001	<0.001	0.004	0.013

表4 影响多发伤合并腹部脏器损伤预后多因素分析( $\bar{x} \pm s$ )Table 4 Multivariate analysis affecting the prognosis of multiple injuries combined with abdominal organ injury ( $\bar{x} \pm s$ )

因素	$\beta$	SE	wald $\chi^2$	<i>P</i>	OR	95%CI
收缩压	-0.763	0.325	5.512	0.019	0.466	0.247~0.882
创伤至入院时间	0.771	0.341	5.112	0.024	2.162	1.108~4.218
ISS	0.935	0.172	29.551	<0.001	2.547	1.818~3.568
GCS	0.827	0.168	24.232	<0.001	2.286	1.645~3.178
PT	0.625	0.112	31.140	<0.001	1.868	1.500~2.327
APTT	0.525	0.123	18.218	<0.001	1.690	1.328~2.151
FIB	0.573	0.198	8.375	0.004	1.774	1.203~2.615
PLT	-0.475	0.118	16.204	<0.001	0.622	0.493~0.784
CK	0.365	0.103	12.558	<0.001	1.441	1.177~1.763
PCT	0.679	0.174	15.228	<0.001	1.972	1.402~2.773

### 3 讨论

多发伤多由交通事故或高处坠落等高能暴力损伤引起,病情危重,易并发腹部脏器功能受损,危及患者生命安全<sup>[8]</sup>。本研究共调查124例多发伤患者,发生其中合并腹部脏器损伤占57.26%,略高于

赵菊红等<sup>[9]</sup>的统计结果。本研究样本数量偏少,可能出现统计学偏倚,造成数据与既往统计结论存在一定的差异,有待后续增加入组病例数量进一步验证结论。其次,本研究入选病例大部分致伤原因为交通伤、坠落伤,伤情重,腹部脏器损伤风险高。对多发伤短期内病情进展的确切原因及机制尚未

能完全阐明。前期文献[10-11]报道: 全身炎症反应、补体激活、缺血/再灌注损伤及氧化应激损伤等均参与多发伤病情进展过程。近年来有学者<sup>[12]</sup>提出: 凝血机制紊乱、凝血系统激活同样为多发伤进展的关键机制。多发伤诱因主要为高能暴力损伤, 诸如意外事故、打击、坠落伤等, 高能应激刺激可引起个体外源性凝血系统活化, 活化凝血酶, 促使大量纤维蛋白生成, 破坏抗凝血酶II及蛋白C系统, 导致纤溶系统功能遭到抑制, 造成凝血-纤溶系统失去平衡, 可能诱导弥散性血管内凝血及大出血, 且随凝血失衡的加重及病情的进展, 可能进一步诱导多脏器功能衰竭, 威胁患者生命安全<sup>[13]</sup>。本研究发现: 多发伤合并腹部脏器损伤患者凝血参数PT, APTT, FIB低于未合并腹部脏器损伤者, PLT较未合并组低, 证实多发伤合并腹部脏器损伤患者凝血紊乱更为明显, 与梅程清等<sup>[14]</sup>的研究结论相同, 符合多发伤凝血紊乱学说。分析可能原因为: 多发伤并腹部脏器受损病例常伴低血容量及循环系统障碍, 创伤后机体凝血活化, 大量凝血因子、血小板被消耗, 诱导血管内微栓子生成, 继发纤溶系统亢进, 造成凝血功能紊乱<sup>[15]</sup>; 且创伤后大量失血导致促凝血素生成减少, 血小板功能异常, 造成凝血功能紊乱; 此外, 多发性创伤后大部分患者处于低血压、缺氧及脑缺血状态, 对下丘脑体温正常调节产生影响, 抑制产热, 导致体温降低, 造成血液浓缩, 血球比上升, 血液黏度异常上升, 致使凝血功能恶化, 直接抑制创伤后凝血瀑布反应中酶反应速率, 降低循环系统血小板数量, 形成恶性循环, 最终导致病情呈不可逆进展<sup>[16]</sup>。故必须重视多发伤患者凝血功能的纠正, 防止致命性腹部脏器损伤发生。

也有学者<sup>[17]</sup>指出: 多发伤病情进展中凝血与炎症相互作用, 共同促成病情进展。本研究结果显示: 多发伤合并腹部脏器受损病例血清PCT, CK水平皆较未合并组高。其中PCT系机体严重创伤、全身炎症反应或感染等病理产物<sup>[18]</sup>, 属降钙素前体蛋白, 在内毒素及炎症细胞因子介导下, 蛋白质溶解抑制, PCT释放进入循环。正常人体内血循环PCT含量极低, 而多发伤, 尤其腹部多发伤常伴急性感染, 机体应激程度高, 炎症介质异常释放, 引起全身炎症瀑布效应, 促进PCT释放, 导致外周血循环PCT浓度上升<sup>[19]</sup>。CK则为分布于脑组织、骨骼肌及心肌胞质及线粒体内酶类, 在肌肉损伤早期CK浓度明显上升, 是骨骼肌及心肌损伤的灵敏度较高的指标, 危重症诱导心脏继发性损害后CK浓度常呈异常上升<sup>[20]</sup>。本研究

结果证实, 合并腹部脏器受损患者CK浓度高于未合并受损者, 表明CK可能预估多发伤患者脏器受损。此外, 本研究还发现多发伤合并腹部脏器受损病死率高达50.70%, 与秦燕明等<sup>[21]</sup>统计的50.0%相近, 表明合并腹部脏器损伤多发伤患者有较高的死亡风险。而死亡组患者PT, APTT, FIB, PCT, CK高于存活组, PLT低于存活组。进一步分析预后影响因素, 结果显示: PT, APTT, FIB, PCT, CK, PLT等因子及ISS和GCS、创伤至入院时间及血压均与患者预后有关, 提示随凝血功能紊乱程度及全身炎症反应程度的加重, 多发伤患者病情加重, 可能预示更差的短期预后, 表明凝血功能及炎症因子检测可能作为多发伤患者病情进展及预后评估的重要依据, 进一步证实炎症及凝血共同促进多发伤病情进展。在该过程中, 炎症因子发挥激活外源性凝血途径的作用, 同时对抗凝、纤溶系统激活产生抑制; 而凝血酶活化可促进巨噬细胞、单核细胞分泌大量炎症因子, 促进白细胞趋化于炎症部位, 加重机体炎症反应, 导致病情进展。

因此, 在多发伤诊治过程中必须密切关注凝血因子及炎症因子的改变, 用以指导病情及预后评估, 作为确立临床治疗方式的参考, 以减少腹部脏器损伤发生风险, 改善患者预后。

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