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入院时氧化应激指数与心脏骤停患者心肺复苏失败的关系研究

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【摘要】 目的 分析入院时氧化应激指数(OSI)与心脏骤停患者心肺复苏(CPR)失败的关系。方法 选取2017年2月—2018年2月在陆军总医院急诊科就诊的心脏骤停患者90例,根据CPR结果分为成功组46例和失败组44例;另选取同期体检健康者40例作为对照组。比较失败组和成功组患者临床特征及3组受试者入院时 OSI;绘制ROC曲线以评价入院时 OSI对心脏骤停患者 CPR失败的预测价值,入院时 OSI与心脏骤停患者 CPR失败的关系分析采用多因素 Logistic 回归分析。结果 (1)成功组和失败组患者年龄 ≥ 60 岁者所占比例、男性比例、高血压发生率、糖尿病发生率、冠心病发生率、慢性阻塞性肺疾病发生率、心电图电机械分离及无脉性室速检出率、pH值、血氧饱和度、血红蛋白、血小板计数及肌钙蛋白比较,差异无统计学意义($P>0.05$);失败组患者接受院外复苏者所占比例、心电图心脏停搏检出率、缺血修饰蛋白、血钠及血钾高于成功组,心脏骤停持续时间长于成功组($P<0.05$)。(2)成功组和失败组患者入院时 OSI高于对照组,失败组患者入院时 OSI高于成功组($P<0.05$)。(3)ROC曲线显示,入院时 OSI预测心脏骤停患者 CPR失败的曲线下面积为0.79[95%CI(0.68, 0.91)],最佳截断值为6.02,灵敏度为94.1%,特异度为64.0%。(4)多因素 Logistic 回归分析结果显示,入院时 OSI是心脏骤停患者 CPR失败的独立影响因素[OR=4.563, 95%CI(1.064, 19.576), $P<0.05$]。结论 心脏骤停患者处于氧化应激状态,且入院时 OSI >6.02 者 CPR失败风险较高,因此对入院时 OSI较高的心脏骤停患者行抗氧化应激治疗可能提高其 CPR成功率。

【关键词】 心脏骤停;心肺复苏术;氧化应激指数

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Relationship between Oxidative Stress Index at Admission and Cardiopulmonary Resuscitation Failure in Patients with Sudden Cardiac Arrest ZHENG Li-na¹, LIU Hai-liang^{2,3}

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【Abstract】 Objective To analyze the relationship between oxidative stress index (OSI) at admission and cardiopulmonary resuscitation failure in patients with sudden cardiac arrest. **Methods** From February 2017 to February 2018, a total of 90 patients with sudden cardiac arrest were selected in the Department of Emergency, General Hospital of Land Force of Chinese People's Liberation Army, and they were divided into A group (with successful cardiopulmonary resuscitation, $n=46$) and B group (with unsuccessful cardiopulmonary resuscitation, $n=44$) according to the cardiopulmonary resuscitation outcome; meanwhile a total of 40 healthy volunteers admitted to this hospital for physical examination were selected as control group. Clinical features were compared between A group and B group, and OSI at admission was compared in control group, A group and B group; ROC curve was drawn to evaluate the predictive value of OSI at admission on cardiopulmonary resuscitation failure in patients with sudden cardiac arrest, and multivariate Logistic regression analysis was used to analyze the relationship between OSI at admission and cardiopulmonary resuscitation failure. **Results** (1) No statistically significant differences of

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proportion of patients equal or over 60 years old, male proportion, incidence of hypertension, diabetes, coronary heart disease or chronic obstructive pulmonary disease, detection rate of electromechanical dissociation or pulseless ventricular tachycardia of ECG, pH value, oxyhemoglobin saturation, hemoglobin, blood platelet count or troponin was found between A group and B group ($P>0.05$); proportion of patients underwent cardiopulmonary resuscitation outside the hospital, detection rate of cardiac arrest of ECG, ischemia modified protein, serum sodium and serum kalium in B group were statistically significantly higher than those in A group, and duration of sudden cardiac arrest in B group was statistically significantly longer than that in A group ($P<0.05$). (2) OSI at admission in A group and B group was statistically significantly higher than that in control group, respectively, meanwhile OSI at admission in B group was statistically significantly higher than that in A group ($P<0.05$). (3) ROC curve showed that, AUC of OSI at admission in predicting cardiopulmonary resuscitation failure was 0.79 [95%CI (0.68, 0.91)] in patients with sudden cardiac arrest, the optimum truncation value was 6.02, the sensitivity was 94.1%, the specificity was 64.0%. (4) Multivariate Logistic regression analysis results showed that, OSI at admission was one of independent influencing factors of cardiopulmonary resuscitation failure in patients with sudden cardiac arrest [OR=4.563, 95%CI (1.064, 19.576), $P<0.05$]. **Conclusion** Oxidative stress exists in patients with sudden cardiac arrest, patients with OSI over 6.02 at admission have relatively high risk of cardiopulmonary resuscitation failure, thus anti-oxidative stress treatment may improve the success rate of cardiopulmonary resuscitation.

【Key words】 Cardiac arrest; Cardiopulmonary resuscitation; Oxidative stress index

心脏骤停是指心脏射血功能突然终止, 大动脉搏动及心音消失, 重要器官严重缺血、缺氧, 最终导致生命终止。心脏骤停是临床常见急危重症之一, 病死率极高^[1-2]。心肺复苏(CPR)是抢救心脏骤停的重要措施, 但仅30%~40%患者行CPR后可恢复自主循环^[3-4]。既往研究表明, 心脏骤停患者行CPR后早期病死率较高, 主要原因为心肌缺血/再灌注(I/R)损伤, 而氧化应激是加重心肌I/R损伤的主要原因之一^[5]。本研究旨在分析入院时OSI与心脏骤停患者CPR失败的关系, 现报道如下。

1 对象与方法

1.1 诊断、纳入与排除标准 (1)心脏骤停诊断标准: 患者意识丧失、无呼吸或不能正常呼吸(仅喘息)、大动脉搏动消失, 心电图检查显示心室颤动、无脉电活动、全心停搏^[6]。(2)纳入标准: ①病历资料完整; ②在院内发生心脏骤停或院外发生心脏骤停并直接由救护车送到医院者。(3)排除标准: ①合并恶性肿瘤者; ②在救护车上行CPR时间>10 min者。

1.2 研究对象 选取2017年2月—2018年2月在陆军总医院急诊科就诊的心脏骤停患者90例, 入院后均按照《2015年美国心脏协会心肺复苏指南及心血管急救指南》行CPR^[6], 根据CPR结果分为成功组46例和失败组44例; 另选取同期体检健康者40例作为对照组。本研究经陆军总医院伦理委员会审核批准, 所有患者知情并签署知情同意书。

1.3 观察指标 由1名医生基于急诊电子病历系统及救护员记录收集所有患者临床资料, 另1名医生核实数据, 内容包括年龄、性别、合并症〔包括高血压、糖尿病、冠心病及慢性阻塞性肺疾病(COPD)〕、有无接受院外复苏、心脏骤停持续时间、入院时心电图检查结果(包括心脏停搏、电机械分离、无脉性室速)及实验室检查指标(包括pH值、血氧饱和度、缺血修饰蛋白、血红蛋白、血小板计数、血钠、血钾、肌钙蛋白); 患者于入院后10 min内、健康体检者于体检当天抽取静脉血10 ml, 3 000 r/min离心10 min, 检测血清总氧化状态(TOS)和总抗氧化状态(TAS), 并计算OSI,

$OSI=TOS/TAS \times 100\%$ ^[7]。

1.4 CPR成功标准 以脉搏可触及, 心电图显示节律恢复(排除心室颤动和室性心动过速)定义为CPR成功。

1.5 统计学方法 采用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, 多组间比较采用单因素方差分析, 组间两两比较采用 q 检验, 两组间比较采用两独立样本 t 检验; 不符合正态分布的计量资料以 $M(QR)$ 表示, 组间比较采用Wilcoxon秩和检验; 计数资料分析采用 χ^2 检验; 绘制ROC曲线以评价入院时OSI对心脏骤停患者CPR失败的预测价值; 心脏骤停患者CPR失败的影响因素分析采用多因素Logistic回归分析。以 $P<0.05$ 为差异有统计学意义。

2 结果

2.1 成功组和失败组患者临床特征比较 成功组和失败组患者年龄 ≥ 60 岁者所占比例、男性比例、高血压发生率、糖尿病发生率、冠心病发生率、COPD发生率、心电图电机械分离及无脉性室速检出率、pH值、血氧饱和度、血红蛋白、血小板计数及肌钙蛋白比较, 差异无统计学意义($P>0.05$); 失败组患者接受院外复苏者所占比例、心电图心脏停搏检出率、缺血修饰蛋白、血钠及血钾高于成功组, 心脏骤停持续时间长于成功组, 差异有统计学意义($P<0.05$, 见表1)。

2.2 3组受试者入院时OSI比较 对照组受试者入院时OSI为(3.1 ± 4.1), 成功组为(5.2 ± 4.2), 失败组为(8.7 ± 3.8); 3组受试者入院时OSI比较, 差异有统计学意义($F=20.79$, $P<0.001$); 成功组和失败组患者入院时OSI高于对照组, 失败组患者入院时OSI高于成功组, 差异有统计学意义($P<0.05$)。

2.3 入院时OSI对心脏骤停患者CPR失败的预测价值 绘制ROC曲线显示, 入院时OSI预测心脏骤停患者CPR失败的曲线下面积为0.79 [95%CI (0.68, 0.91)], 最佳截断值为6.02, 灵敏度为94.1%, 特异度为64.0%, 见图1。

2.4 心脏骤停患者CPR失败影响因素分析 将表1中有统计学差异的指标及入院时OSI作为自变量, 将CPR失败作为因

表 1 两组患者临床特征比较

Table 1 Comparison of clinical features between the two groups

组别	例数	年龄≥60岁 [n(%)]	男性 [n(%)]	高血压 [n(%)]	糖尿病 [n(%)]	冠心病 [n(%)]	COPD [n(%)]	接受院外复苏 [n(%)]	心脏骤停持续时 间($\bar{x} \pm s$, min)	心脏停搏 [n(%)]
成功组	46	21 (45.7)	25 (54.3)	25 (54.3)	11 (23.9)	29 (63.0)	11 (23.9)	17 (37.0)	2.7 ± 4.1	11 (23.9)
失败组	44	27 (61.4)	29 (65.9)	26 (59.1)	10 (22.7)	28 (63.6)	6 (14)	29 (65.9)	8.7 ± 3.8	35 (79.5)
检验统计量值		2.23 ^a	1.25 ^a	0.21 ^a	0.02 ^a	0.00 ^a	1.55 ^a	7.54 ^a	7.19	27.85 ^a
P 值		0.14	0.47	0.65	0.89	0.95	0.21	<0.01	<0.01	<0.01

组别	电机械分离 [n(%)]	无脉性室速 [n(%)]	pH 值 ($\bar{x} \pm s$)	血氧饱和度 ($\bar{x} \pm s$, %)	缺血修饰蛋 白($\bar{x} \pm s$, mmol/L)	血红蛋白 ($\bar{x} \pm s$, g/L)	血小板计 数($\bar{x} \pm s$, 10 ⁹ /L)	血钠 ($\bar{x} \pm s$, mmol/L)	血钾 ($\bar{x} \pm s$, mmol/L)	肌钙蛋白 [M(QR), mg/L]
成功组	1 (2.1)	2 (4.3)	7.2 ± 0.2	79 ± 15	623 ± 155	128 ± 27	258 ± 129	135 ± 7	4.7 ± 1.0	46 (83)
失败组	0	0	7.1 ± 2.0	77 ± 13	717 ± 105	133 ± 23	236 ± 94	138 ± 5	5.4 ± 1.3	48 (73)
检验统计量值	0.97 ^a	1.96 ^a	0.34	0.67	3.35	0.94	0.92	2.33	2.87	0.04 ^b
P 值	1.00	0.50	0.06	0.59	<0.01	0.35	0.37	0.02	0.01	0.97

注：COPD=慢性阻塞性肺疾病；^a为 χ^2 值，^b为 *u* 值，余检验统计量值为 *t* 值

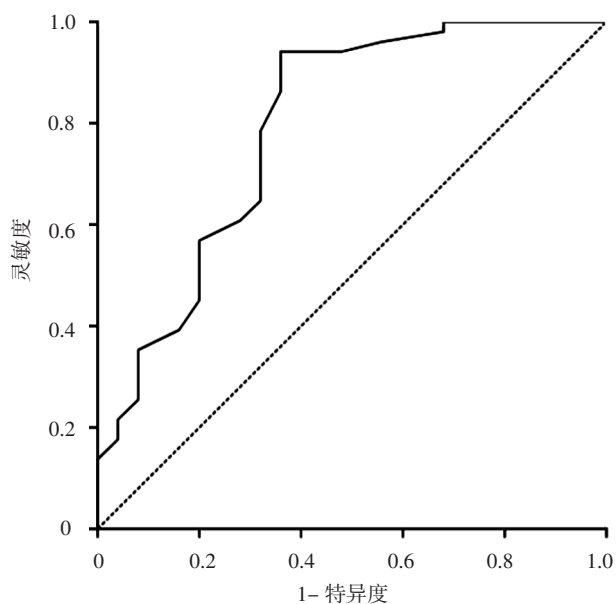


图 1 入院时 OSI 预测心脏骤停患者 CPR 失败的 ROC 曲线

Figure 1 ROC curve for OSI at admission in predicting CPR failure in patients with sudden cardiac arrest

变量（变量赋值见表 2）进行多因素 Logistic 回归分析，结果显示，心脏骤停持续时间和入院时 OSI 是心脏骤停患者 CPR 失败的独立影响因素（ $P < 0.05$ ，见表 3）。

3 讨论

心脏骤停可引起全身缺血、缺氧，机体重要脏器发生不同程度损伤。CPR 可使心脏骤停患者恢复自主循环，但缺血组织中氧自由基骤然增加并蓄积可进一步导致细胞结构损伤及代谢紊乱，即 I/R 损伤^[8-10]。既往研究表明，心肌 I/R 损伤是 CPR 成功率较低的重要原因之一，而氧化应激是加重心肌 I/R 损伤的主要机制^[11]。

氧化应激常发生于机体氧化和抗氧化状态失衡时，活性氧自由基（reactive oxygen species, ROS）是氧化应激的主要活性递质，其可引起线粒体氧化性损伤、组织蛋白变性、

表 2 变量赋值

Table 2 Variable assignment

变量	赋值
接受院外复苏	无 = 0, 有 = 1
心脏骤停持续时间	≤ 6.2 min = 0, > 6.2 min = 1
心脏停搏	无 = 0, 有 = 1
缺血修饰蛋白	≤ 683 mmol/L = 0, > 683 mmol/L = 1
血钠	≤ 135 mmol/L = 0, > 135 mmol/L = 1
血钾	≤ 5.3 mmol/L = 0, > 5.3 mmol/L = 1
入院时 OSI	≤ 6.02 = 0, > 6.02 = 1
CPR 失败	否 = 0, 是 = 1

注：CPR=心肺复苏，OSI=氧化应激指数

表 3 心脏骤停患者 CPR 失败影响因素的多因素 Logistic 回归分析
Table 3 Multivariate Logistic regression analysis on influencing factors of CPR failure in patients with sudden cardiac arrest

变量	β	SE	Wald χ^2 值	OR (95%CI)	P 值
常数项	0.236	0.955	0.061	-	0.805
接受院外复苏	0.192	0.688	0.078	1.212 (0.315, 4.665)	0.780
心脏骤停持续时间	1.826	0.732	6.219	6.209 (1.479, 26.068)	0.013
心脏停搏	0.871	0.689	2.278	2.389 (0.619, 9.219)	0.206
缺血修饰蛋白	-0.213	0.853	0.062	0.808 (0.152, 4.298)	0.803
血钠	-1.038	0.688	2.278	0.354 (0.092, 1.363)	0.131
血钾	1.147	0.704	2.653	3.150 (0.792, 12.527)	0.103
入院时 OSI	1.518	0.743	4.171	4.563 (1.064, 19.576)	0.041

注：“-”为无相关数据

DNA 损伤，进而引起机体代谢紊乱^[12-14]。既往研究表明，氧化应激与心血管疾病密切相关^[15]。OSI 是目前评估氧化应激状态的常见指标^[11, 16]。本研究结果显示，成功组和失败组患者入院时 OSI 高于对照组，失败组患者入院时 OSI 高于成功组，提示心脏骤停患者处于氧化应激状态；且入院时

OSI 是心脏骤停患者 CPR 失败的独立危险因素, 提示入院时 OSI>6.02 者 CPR 失败风险较高。缺血修饰蛋白是组织缺血损伤和氧化应激的重要指标, 且与心脏骤停患者预后有关^[17]。本研究结果显示, 失败组患者缺血修饰蛋白高于成功组, 提示氧化应激可能影响心脏骤停患者 CPR 结果。

综上所述, 心脏骤停患者处于氧化应激状态, 且入院时 OSI>6.02 者 CPR 失败风险较高, 因此对入院时 OSI 较高的心脏骤停患者行抗氧化应激治疗可能提高其 CPR 成功率。但本研究为单中心研究, 且样本量较小、观察指标较少, 故研究结果结论仍需扩大样本量、行多中心前瞻性研究进一步证实。

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