

· 心肌梗死专题研究 ·

ST 段抬高型心肌梗死患者经皮冠状动脉介入治疗后 Q 波形成发生风险的列线图模型构建



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【摘要】 目的 分析ST段抬高型心肌梗死(STEMI)患者经皮冠状动脉介入治疗(PCI)后发生Q波形成的影响因素,并构建其列线图模型。**方法** 选取2017年3月至2021年3月河池市第一人民医院收治的533例行PCI的STEMI患者作为研究对象,根据PCI后有无Q波形成将其分为Q波形成组($n=164$)和无Q波形成组($n=369$)。收集患者的基线资料及PCI前心功能指标[左心室射血分数(LVEF)、左心室舒张末期内径(LVEDD)、左心室收缩末期内径(LVESD)]、心肌损伤标志物[天冬氨酸氨基转移酶(AST)、乳酸脱氢酶(LDH)、肌酸激酶、肌酸激酶同工酶、心肌肌钙蛋白I(cTnI)]、血红蛋白。STEMI患者PCI后发生Q波形成的影响因素分析采用多因素Logistic回归分析。采用R软件的“rms”程序包构建STEMI患者PCI后Q波形成发生风险的列线图模型;采用Bootstrap法重复抽样1 000次进行验证,计算一致性指数(CI),绘制校正曲线以分析该列线图模型的预测结果与实际结果的一致性;采用“rmda”软件包绘制决策曲线,分析该列线图模型预测STEMI患者PCI后发生Q波形成的净获益率。**结果** 本组533例STEMI患者PCI后发生Q波形成164例,Q波形成发生率为30.77%。Q波形成组年龄大于无Q波形成组,男性占比和吸烟、合并糖尿病、TIMI血流分级为0~2级者占比及脑钠肽高于无Q波形成组,STB时间长于无Q波形成组,血红蛋白低于无Q波形成组($P<0.05$)。多因素Logistic回归分析结果显示,年龄、吸烟、STB时间、脑钠肽、血红蛋白是STEMI患者PCI后发生Q波形成的独立影响因素($P<0.05$)。基于上述影响因素构建STEMI患者PCI后Q波形成发生风险的列线图模型,结果显示,CI为0.976,该列线图模型预测STEMI患者PCI后发生Q波形成的校正曲线趋近于理想曲线;ROC曲线分析结果显示,该列线图模型预测STEMI患者PCI后发生Q波形成的AUC为0.976,最佳截断值为0.402,灵敏度为0.915,特异度为0.935。决策曲线分析结果显示,阈值为0~1.0范围内,该列线图模型预测STEMI患者PCI后发生Q波形成的净获益率 >0 ,最大净获益率为0.308。**结论** 年龄、吸烟、STB时间、脑钠肽、血红蛋白是STEMI患者PCI后发生Q波形成的独立影响因素,基于上述影响因素构建的列线图模型具有较高的预测效能,且具有可行性。

【关键词】 心肌梗死; ST段抬高型心肌梗死; 冠状动脉介入治疗; Q波; 列线图模型

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Construction of Nomogram Model of Occurrence Risk of Q Wave Formation after Percutaneous Coronary Intervention in Patients with ST-Segment Elevation Myocardial Infarction LAN Bigao, LIN Lutao

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【Abstract】 Objective To analyze the influencing factors of Q wave formation in patients with ST-segment elevation myocardial infarction (STEMI) after percutaneous coronary intervention (PCI), and construct its risk prediction nomogram model. **Methods** A total of 533 STEMI patients undergoing PCI from March 2017 to March 2021 in Hechi First People's Hospital were selected as the research subjects. According to whether Q wave formed after PCI, they were divided into Q wave formation group ($n=164$) and non Q wave formation group ($n=369$). The baseline data, cardiac function indexes [left ventricular ejection fraction (LVEF), left ventricular end diastolic diameter (LVEDD), left ventricular end systolic diameter (LVESD)], myocardial injury markers [aspartate aminotransferase (AST), lactate dehydrogenase (LDH), creatine kinase, creatine kinase isoenzyme, cardiac troponin I (cTnI)] and hemoglobin of patients before PCI were collected. The influencing factors of Q wave formation in STEMI

patients after PCI were analyzed by multivariate Logistic regression analysis, and the nomogram model of occurrence risk of Q wave formation in STEMI patients after PCI was constructed by using the "rms" package of R software; the consistency index (CI) was calculated by repeated sampling 1 000 times by Bootstrap method. The calibration curve was drawn to analyze the consistency between the predicted results of the nomogram model and the actual results; the decision curve was drawn by "rmda" software package to predict the net benefit rate of the nomogram model of occurrence risk of Q wave formation in STEMI patients after PCI.

Results There were 164 cases of Q wave formation after PCI in 533 patients with STEMI. The incidence of Q wave formation was 30.77%. The age of the Q wave formation group was larger than that of the non Q wave formation group, the proportion of patients with male, smoking, diabetes mellitus, grade 0–2 of TIMI blood flow were higher than those of the non Q wave formation, STB time was longer than that of the non Q wave formation, hemoglobin was lower than that of the non Q wave formation group ($P < 0.05$). Multivariate Logistic regression analysis results showed that age, smoking, STB time, brain natriuretic peptide and hemoglobin were independent influencing factors of Q wave formation in patients with STEMI after PCI ($P < 0.05$). Based on the above influencing factors, a nomogram model of occurrence risk of Q wave formation in STEMI patients after PCI was constructed. The results showed that the CI was 0.976, and the correction curve of the nomogram model for predicting the risk of Q wave formation was closed to the ideal curve; ROC curve analysis results showed that the AUC of Q wave formation in STEMI patients after PCI predicted by the nomogram model was 0.976, the best cut-off value was 0.402, the sensitivity was 0.915 and the specificity was 0.935. The results of decision curve analysis showed that within the threshold range of 0–1.0, the net benefit rate of the nomogram model for predicting the Q wave formation in STEMI patients after PCI was > 0 , and the maximum net benefit rate was 0.308.

Conclusion Age, smoking, STB time, brain natriuretic peptide and hemoglobin are independent influencing factors of Q wave formation in patients with STEMI after PCI, and nomogram model of occurrence risk of Q wave formation in STEMI patients after PCI constructed based on the above influencing factors has good prediction efficiency, and can obtain a high net benefit rate.

【Key words】 Myocardial infarction; ST-segment elevation myocardial infarction; Percutaneous coronary intervention; Q wave; Nomogram model

ST段抬高型心肌梗死 (ST-segment elevation myocardial infarction, STEMI) 患者经冠状动脉介入治疗 (percutaneous coronary intervention, PCI) 后罪犯血管开通, 梗死心肌获得再灌注^[1], 但部分患者仍会发生心血管事件, 进而影响其预后^[2]。因此, 早期识别伴有高风险心血管事件的 STEMI 患者具有重要的现实意义。Q波是诊断 STEMI 的心电图表现, Q波的出现意味着广泛心肌缺血、心肌纤维化和心肌瘢痕^[3]。STEMI 患者 PCI 后发生 Q 波形成提示其存在梗死区域间的阻滞, 心功能继续恶化、心律失常发生风险升高, 需加强治疗^[4]。既往研究表明, Q 波形成与 PCI 后心肌灌注不足有关, 可增加不良心血管事件发生风险, 与预后密切相关^[5]。因此, 本研究拟构建 STEMI 患者 PCI 后 Q 波形成发生风险的列线图模型, 旨在早期预测 STEMI 患者 Q 波形成发生风险并及时采取预防措施, 以改善患者预后。

1 对象与方法

1.1 研究对象 选取2017年3月至2021年3月河池市第一人民医院收治的533例行PCI的STEMI患者作为研究对象, 其中男369例, 女164例; 年龄36~68岁, 平均(53.9 ± 5.1)岁; Killip 分级^[6]: II级338例, III级195例。根据患者PCI后有无Q波形成将其分为Q波形成组($n=164$)和无Q波形成组($n=369$)。本研究经河池市第一人民医院医学伦理委员会审核批准 (HCDY20170134)。

1.2 纳入与排除标准 纳入标准: (1) 符合《急性ST段抬高型心肌梗死诊断和治疗指南》^[7]中的STEMI诊断标准, 并经心电图检查证实; (2) 首发STEMI; (3) 单支冠状动脉病变; (4) 首次接受PCI。排除标准: (1) 合并先天性心脏

病、心肌病等其他类型心脏病者; (2) 陈旧性心肌梗死者; (3) PCI前已发生Q波形成者; (4) 合并心包积液者; (5) 有无法解释的心电图表现者; (6) 安装心脏起搏器者。

1.3 观察指标

1.3.1 基线资料 收集患者的基线资料, 包括年龄、性别、体质指数、吸烟情况、饮酒情况、合并糖尿病、合并高血压、TIMI血流分级^[8]、Killip分级、梗死部位及发病至球囊扩张 (symptom onset to balloon, STB) 时间。

1.3.2 心功能指标 收集患者PCI前心功能指标, 包括左心室射血分数 (left ventricular ejection fraction, LVEF)、左心室舒张末期内径 (left ventricular end diastolic diameter, LVEDD)、左心室收缩末期内径 (left ventricular end systolic diameter, LVESD), 所用仪器为彩色多普勒超声仪 (日本东芝, SSA-370/E3型)。

1.3.3 心肌损伤标志物 PCI前, 采集患者空腹静脉血5 ml, 3 500 r/min离心5 min (离心半径10 cm), 取上层血清, 采用全自动生化分析仪 (日本日立, 7170A型) 检测血清天冬氨酸氨基转移酶 (aspartate aminotransferase, AST)、乳酸脱氢酶 (lactate dehydrogenase, LDH)、肌酸激酶、肌酸激酶同工酶、心肌肌钙蛋白I (cardiac troponin I, cTnI) 水平, 采用放射免疫法检测脑钠肽水平。

1.3.4 血红蛋白 PCI前, 采集患者空腹静脉血1 ml, 加入乙二胺四乙酸二钾进行抗凝处理, 应用血细胞分析仪 (贝克曼, dxh600型) 检测血红蛋白水平。

1.3.5 Q波形成情况 PCI后, 患者胸痛或心力衰竭症状复发, 经心电图检查发现Q波定义为Q波形成。

1.4 统计学方法 采用SPSS 25.0统计学软件进行数据处理。计数资料以相对数表示, 组间比较采用 χ^2 检验; 计量资料进行Shapiro-Wilk正态性检验, 均符合正态分布, 以 $(\bar{x} \pm s)$ 表示, 组间比较采用两独立样本 t 检验; STEMI患者PCI后发生Q波形成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。采用R软件的“rms”程序包构建STEMI患者PCI后Q波形成发生风险的列线图模型; 采用“caret”程序包, 经Bootstrap法重复抽样1 000次进行验证, 计算一致性指数(C-index, CI), 绘制校正曲线以分析列线图模型的预测结果与实际结果的一致性; 采用“rmda”软件包绘制决策曲线, 分析列线图模型预测STEMI患者PCI后发生Q波形成的净获益率。

2 结果

2.1 Q波形成情况 本组533例STEMI患者PCI后发生Q波形成164例, Q波形成发生率为30.77%。

2.2 两组患者基线资料、心功能指标、心肌损伤标志物及血红蛋白比较 Q波形成组患者年龄大于无Q波形成组, 男性占比和吸烟、合并糖尿病、TIMI血流分级为0~2级者占比及脑钠肽高于无Q波形成组, STB时间长于无Q波形成组, 血红蛋白低于无Q波形成组, 差异有统计学意义($P < 0.05$); 两组患者体质指数、饮酒者占比、合并高血压者占比、Killip分级、梗死部位、LVEF、LVEDD、LVESD、AST、LDH、肌酸激酶、肌酸激酶同工酶及cTnI比较, 差异无统计学意义($P > 0.05$), 见表1。

2.3 多因素Logistics回归分析 将表1中差异有统计学意义的指标作为自变量, 将STEMI患者PCI后有无发生Q波形成(赋值: 未发生=0, 发生=1)作为因变量, 进行多因素Logistic回归分析, 结果显示, 年龄、吸烟、STB时间、脑钠肽、血红蛋白是STEMI患者PCI后发生Q波形成的独立影响因素($P < 0.05$), 见表2。

2.4 列线图模型构建及验证 将STEMI患者PCI后发生Q波形成的影响因素作为指标构建列线图模型, 见图1。采用Bootstrap法重复抽样1 000次, 结果显示, CI为0.976; 校正曲线分析结果显示, 该列线图模型预测STEMI患者PCI后Q波形成发生风险的校正曲线趋近于理想曲线, 见图2; ROC曲线分析结果显示, 该列线图模型预测STEMI患者PCI后发生Q波形成的AUC为0.976 [95%CI (0.964, 0.987)], 最佳截断值为0.402, 灵敏度为0.915, 特异度为0.935, 见图3。

2.5 决策曲线 决策曲线分析结果显示, 阈值为0~1.0范围内, 该列线图模型预测STEMI患者PCI后发生Q波形成的净获益率 >0 , 最大净获益率为0.308, 见图4。

3 讨论

研究表明, 下壁心肌梗死时梗死部位出现广泛的心肌坏死, 不能除极, 但其他部位心肌正常除极, 坏死心肌表面的心电图电极记录到的除极向量背离电极, 形成Q波^[9]。Q波通常提示陈旧性心肌梗死, 研究表明, STEMI患者就诊时存在病理性Q波的比例较低, 但患者PCI后发生Q波形成的风险较高^[10]。Q波形成与广泛的心肌损伤有关^[11]。因此, 有必要对STEMI患者PCI后Q波形成发生风险进行预测, 以优化治疗

表1 Q波形成组和无Q波形成组患者基线资料、心功能指标、心肌损伤标志物及血红蛋白比较

Table 1 Comparison of baseline data, cardiac function indicators, myocardial injury markers, and hemoglobin between the Q wave formation group and the non Q wave formation group

变量	Q波形成组 (n=164)	无Q波形成组 (n=369)	$t(\chi^2)$ 值	P值
年龄 ($\bar{x} \pm s$, 岁)	55.4 $\pm$ 5.0	53.3 $\pm$ 5.0	4.638	<0.001
性别 [n (%)]			8.647 ^a	0.003
男	128 (78.05)	241 (65.31)		
女	36 (21.95)	128 (34.69)		
体质指数 ($\bar{x} \pm s$, kg/m ²)	24.6 $\pm$ 0.8	24.6 $\pm$ 0.6	0.719	0.472
吸烟 [n (%)]	88 (53.66)	121 (32.79)	20.741 ^a	<0.001
饮酒 [n (%)]	111 (67.68)	230 (62.33)	1.411 ^a	0.235
糖尿病 [n (%)]	35 (21.34)	37 (10.03)	12.440 ^a	<0.001
高血压 [n (%)]	83 (50.61)	174 (47.15)	0.543 ^a	0.461
TIMI血流分级 [n (%)]			2.485 ^a	0.013
0~2级	115 (70.12)	217 (58.81)		
3级	49 (29.88)	152 (41.19)		
Killip分级 [n (%)]			0.389 ^a	0.697
Ⅱ级	102 (62.20)	236 (63.96)		
Ⅲ级	62 (37.80)	133 (36.04)		
梗死部位 [n (%)]			0.357 ^a	0.836
前壁	124 (75.61)	272 (73.71)		
后壁	31 (18.90)	78 (21.14)		
下壁	9 (5.49)	19 (5.15)		
STB时间 ($\bar{x} \pm s$, min)	231.7 $\pm$ 22.8	196.6 $\pm$ 20.0	17.895	<0.001
LVEF ($\bar{x} \pm s$, %)	49.7 $\pm$ 5.0	50.3 $\pm$ 5.5	1.173	0.241
LVEDD ($\bar{x} \pm s$, mm)	56.6 $\pm$ 5.5	56.0 $\pm$ 5.8	1.169	0.243
LVESD ($\bar{x} \pm s$, mm)	45.1 $\pm$ 4.5	44.7 $\pm$ 4.5	1.055	0.292
AST ($\bar{x} \pm s$, U/L)	60 $\pm$ 6	59 $\pm$ 6	1.516	0.130
LDH ($\bar{x} \pm s$, U/L)	404 $\pm$ 41	399 $\pm$ 43	1.479	0.140
肌酸激酶 ($\bar{x} \pm s$, U/L)	253 $\pm$ 25	249 $\pm$ 25	1.561	0.119
肌酸激酶同工酶 ($\bar{x} \pm s$, U/L)	40 $\pm$ 4.0	39 $\pm$ 4	1.908	0.057
cTnI ($\bar{x} \pm s$, μ g/L)	0.27 $\pm$ 0.04	0.26 $\pm$ 0.03	0.611	0.542
脑钠肽 ($\bar{x} \pm s$, ng/L)	167 $\pm$ 16	137 $\pm$ 14	22.044	<0.001
血红蛋白 ($\bar{x} \pm s$, g/L)	101.4 $\pm$ 10.0	113.2 $\pm$ 11.9	11.108	<0.001

注: STB=发病至球囊扩张, LVEF=左心室射血分数, LVEDD=左心室舒张末期内径, LVESD=左心室收缩末期内径, AST=天冬氨酸氨基转移酶, LDH=乳酸脱氢酶, cTnI=心肌肌钙蛋白I; ^a表示 χ^2 值

表2 STEMI患者PCI后发生Q波形成影响因素的多因素Logistic回归分析
Table 2 Multivariate Logistic regression analysis of the influencing factors of Q wave formation after PCI in STEMI patients

变量	赋值	β	SE	Wald χ^2 值	P值	OR值	95%CI
常量	-	-29.606	4.456	44.139	<0.001	<0.001	-
年龄	实测值	0.085	0.040	4.471	0.034	1.089	(1.006, 1.178)
性别	女=0, 男=1	0.588	0.692	0.722	0.396	1.800	(0.464, 6.981)
吸烟	无=0, 有=1	1.577	0.575	7.532	0.006	4.843	(1.570, 14.940)
糖尿病	无=0, 有=1	-0.287	0.612	0.219	0.640	0.751	(0.226, 2.492)
TIMI血流分级	3级=0, 0~2级=1	-1.226	0.741	2.738	0.098	0.293	(0.069, 1.254)
STB时间	实测值	0.073	0.010	49.726	<0.001	1.076	(1.054, 1.098)
脑钠肽	实测值	0.128	0.017	60.188	<0.001	1.137	(1.101, 1.174)
血红蛋白	实测值	-0.104	0.020	26.416	<0.001	0.901	(0.866, 0.938)

注: -表示无相关数据

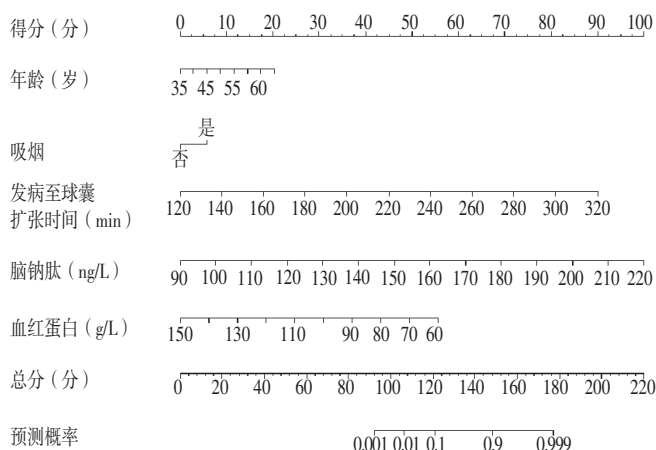


图1 STEMI患者PCI后Q波形成发生风险的列线图模型

Figure 1 Nomogram model of occurrence risk of Q wave formation after PCI in STEMI patients

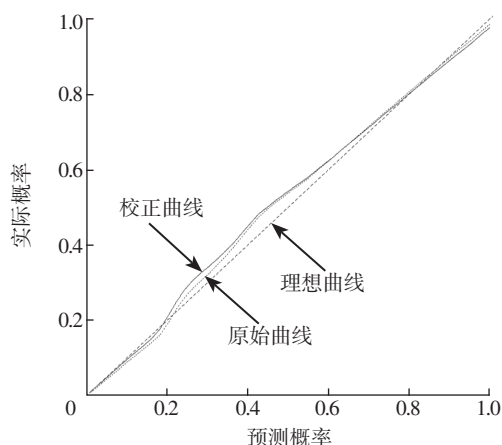


图2 STEMI患者PCI后Q波形成发生风险的列线图模型的校正曲线

Figure 2 Calibration curve of nomogram model of occurrence risk of Q wave formation after PCI in STEMI patients

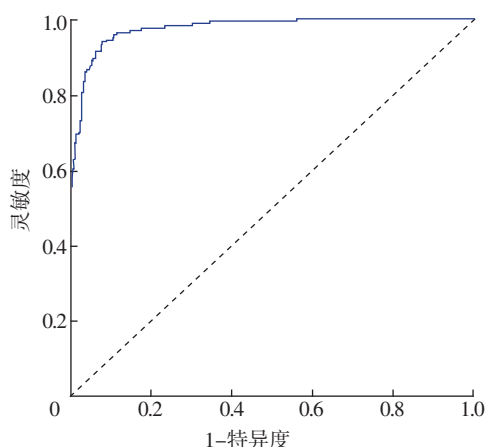


图3 列线图模型预测STEMI患者PCI后发生Q波形成的ROC曲线

Figure 3 ROC curve of the nomogram model for predicting the Q wave formation after PCI in STEMI patients

方案、减少Q波形成,改善患者预后。

本研究结果显示,年龄、吸烟、STB时间、脑钠肽、血

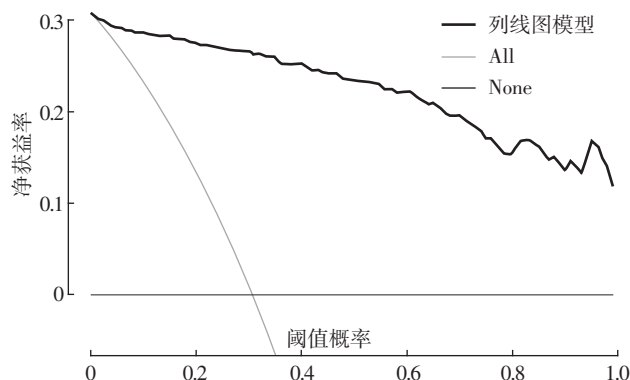


图4 列线图模型预测STEMI患者PCI后发生Q波形成的决策曲线

Figure 4 Decision curve of the nomogram model for predicting the Q wave formation after PCI in STEMI patients

红蛋白是STEMI患者PCI后发生Q波形成的独立影响因素,分析原因可能如下:年龄高的STEMI患者血管病变相对复杂,可能存在多支病变,冠状动脉微循环障碍严重^[12-13];年龄越大,STEMI患者内皮功能相对更差,心肌梗死扩大速度更快,PCI后Q波形成发生风险更高^[14]。吸烟是引起冠状动脉粥样硬化的重要原因,吸烟的STEMI患者冠状动脉病变相对严重,PCI后可能由于粥样硬化斑块脱落而造成冠状动脉闭塞,心肌损伤广泛,导致Q波形成^[15-16]。因此,针对吸烟的STEMI患者应普及吸烟危害,告诫患者戒烟。STB时间延长意味着STEMI患者梗死血管未及时开通,冠状动脉微循环状态不佳,再灌注不足,可能造成更大范围的心肌损伤,导致Q波形成^[17-18]。因此,未来应将救治由院内前移至院前、院外,避免STB时间延长。脑钠肽是一种肽类激素,主要由心肌细胞分泌^[19-20]。STEMI发生后心肌缺血呈动态改变,脑钠肽水平快速变化,可反映心肌坏死程度、心室功能损伤程度及心室重构情况等^[21]。由此推测,脑钠肽可能与STEMI患者PCI后发生Q波形成有关,但目前尚无研究证实其具体机制。既往研究证实,急诊PCI后早期应用脑钠肽对急性心肌梗死患者心功能、血管内皮功能具有积极作用^[22-23]。因此,针对行PCI的STEMI患者应监测其脑钠肽水平并予以针对性处理。血红蛋白水平低的患者易合并贫血,而STEMI患者存在心肌缺血,贫血不仅不利于心肌缺血恢复,还可能引起反复心肌缺血、心肌细胞凋亡及坏死,扩大心肌损伤范围,促进STEMI患者疾病进展,导致Q波形成^[24-25]。研究表明,血红蛋白与PCI后心肌损伤有关^[26]。因此,行PCI的STEMI患者应及时检测血红蛋白,如血红蛋白降低则应进行营养支持、输血等,以避免发生贫血而影响患者预后。

本研究基于STEMI患者PCI后发生Q波形成的影响因素构建了列线图模型,采用Bootstrap法重复抽样1 000次,结果显示,CI为0.976;校正曲线分析结果显示,该列线图模型预测STEMI患者PCI后发生Q波形成的校正曲线趋近于理想曲线;ROC曲线分析结果显示,该列线图模型预测STEMI患者PCI后发生Q波形成的AUC为0.976,提示该列线图模型的区分度良好;决策曲线分析结果显示,阈值为0~1.0范围内,该列线图

模型预测STEMI患者PCI后发生Q波形成的净获益率 >0 ,最大净获益率为0.308,表明该列线图模型具有可行性。

综上所述,年龄、吸烟、STB时间、脑钠肽、血红蛋白是STEMI患者PCI后发生Q波形成的独立影响因素,基于上述影响因素构建的列线图模型具有较高的预测效能,且具有可行性。但本研究为单中心研究,且未进行外部验证,构建的列线图模型在其他中心的预测效能及可行性尚有待进一步验证。

作者贡献:蓝壁高进行文章的构思与设计,负责撰写、修订论文,负责文章的质量控制及审校,并对文章整体负责、监督管理;蓝壁高、林陆韬进行研究的实施与可行性分析,结果分析与解释;林陆韬进行数据收集、整理、分析。

本文无利益冲突。

参考文献

- [1] BULLUCK H, CHAN M H H, PARADIES V, et al. Incidence and predictors of left ventricular thrombus by cardiovascular magnetic resonance in acute ST-segment elevation myocardial infarction treated by primary percutaneous coronary intervention: a meta-analysis [J]. *J Cardiovasc Magn Reso*, 2018, 20 (1): 72. DOI: 10.1186/s12968-018-0494-3.
- [2] THIELE H, DESCH S, DE WAHA S. Acute myocardial infarction in patients with ST-segment elevation myocardial infarction: ESC guidelines 2017 [J]. *Herz*, 2017, 42 (8): 728-738. DOI: 10.1007/s00059-017-4641-7.
- [3] 刘敏,贾凯侠.病理性Q波在心肌梗死患者冠状动脉改变诊断方面的效果[J].*检验医学与临床*, 2018, 15 (22): 3418-3421. DOI: 10.3969/j.issn.1672-9455.2018.22.027.
- [4] ZHENG Y G, BAINEY K R, TYRRELL B D, et al. Relationships between baseline Q waves, time from symptom onset, and clinical outcomes in ST-segment-elevation myocardial infarction patients: insights from the vital heart response registry [J]. *Circ Cardiovasc Interv*, 2017, 10 (11): e005399. DOI: 10.1161/CIRCINTERVENTIONS.117.005399.
- [5] TOPAL D G, LØNBORG J, AHTAROVSKI K A, et al. Early Q-wave morphology in prediction of reperfusion success in patients with ST-segment elevation myocardial infarction treated with primary percutaneous coronary intervention—a cardiac magnetic resonance imaging study [J]. *J Electrocardiol*, 2020, 58: 135-142. DOI: 10.1016/j.jelectrocard.2019.12.011.
- [6] HASHMI K A, ADNAN F, AHMED O, et al. Risk assessment of patients after ST-segment elevation myocardial infarction by killip classification: an institutional experience [J]. *Cureus*, 2020, 12 (12): e12209. DOI: 10.7759/cureus.12209.
- [7] 中华医学会心血管病学分会, 中华心血管病杂志编辑委员会. 急性ST段抬高型心肌梗死诊断和治疗指南 [J]. *中华心血管病杂志*, 2015, 43 (5): 380-393.
- [8] YILDIZ M, HENRY T D. Preprocedure thrombolysis in myocardial infarction (TIMI) flow grade: has its time come and gone? [J]. *Catheter Cardiovasc Interv*, 2020, 95 (3): 501-502. DOI: 10.1002/ccd.28770.
- [9] 仇杰, 谢勇, 李雨涵, 等. 入院时胸导联Q波总振幅与R波总振幅比值对急性ST段抬高型前壁心肌梗死患者急诊经皮冠状动脉介入治疗后短期预后的预测价值研究 [J]. *实用心脑血管病杂志*, 2020, 28 (1): 17-22. DOI: 10.3969/j.issn.1008-5971.2020.01.y03.
- [10] KOSMIDOU I, REDFORS B, CROWLEY A, et al. Prognostic implications of Q waves at presentation in patients with ST-segment elevation myocardial infarction undergoing primary percutaneous coronary intervention: an analysis of the HORIZONS-AMI study [J]. *Clin Cardiol*, 2017, 40 (11): 982-987. DOI: 10.1002/clc.22751.
- [11] 覃远文. ST段抬高型心肌梗死患者PCI术后早期Q波形态等参数对再灌注成功的影响 [J]. *宁夏医科大学学报*, 2020, 42 (3): 289-293. DOI: 10.16050/j.cnki.issn1674-6309.2020.03.014.
- [12] 蒋兴林, 蔡琳, 成联超, 等. 不同年龄段ST段抬高型心肌梗死患者行急诊PCI治疗时救治延误的差异及分析 [J]. *临床心血管病杂志*, 2019, 35 (11): 1002-1005. DOI: 10.13201/j.issn.1001-1439.2019.11.007.
- [13] 高行娟, 张赛, 陈雪瑾, 等. 不同年龄段男性急性ST段抬高型心肌梗死患者临床特征的对比分析 [J]. *实用心脑血管病杂志*, 2019, 27 (5): 57-62, 67. DOI: 10.3969/j.issn.1008-5971.2019.05.012.
- [14] NAVARESE E P, RAO S V, KRUCOFF M W. Age, STEMI, and cardiogenic shock: never too old for PCI? [J]. *J Am Coll Cardiol*, 2019, 73 (15): 1901-1904. DOI: 10.1016/j.jacc.2018.12.088.
- [15] 王娟, 许浩博, 乔树宾, 等. 吸烟的冠心病患者冠状动脉病变特点及经皮冠状动脉介入治疗后长期预后评价 [J]. *中国循环杂志*, 2018, 33 (11): 1053-1058. DOI: 10.3969/j.issn.1000-3614.2018.11.004.
- [16] REDFORS B, FURER A, SELKER H P, et al. Effect of smoking on outcomes of primary PCI in patients with STEMI [J]. *J Am Coll Cardiol*, 2020, 75 (15): 1743-1754. DOI: 10.1016/j.jacc.2020.02.045.
- [17] 宋莉, 邓士兵, 管常东, 等. ST段抬高型心肌梗死患者早期和晚期延迟PCI并置入药物洗脱支架的远期预后比较 [J]. *中华心血管病杂志*, 2020, 48 (2): 118-122. DOI: 10.3760/cma.j.issn.0253-3758.2020.02.006.
- [18] CHANDRASEKHAR J, MARLEY P, ALLADA C, et al. Symptom-to-balloon time is a strong predictor of adverse events following primary percutaneous coronary intervention: results from the Australian capital territory PCI registry [J]. *Heart Lung Circ*, 2017, 26 (1): 41-48. DOI: 10.1016/j.hlc.2016.05.114.
- [19] 吴忠璟, 夏可辉, 钟书刚. 血清Copeptin、BNP及cTnI在老年急性ST段抬高型心肌梗死诊断中的价值 [J]. *中华全科医学*, 2019, 17 (8): 1368-1371. DOI: 10.16766/j.cnki.issn.1674-4152.000946.

(下转第39页)

- prognosis of ST-elevation acute myocardial infarction [J]. *Ann Clin Lab Sci*, 2020, 50 (6): 775-780.
- [16] FERRANTE G, BARBIERI L, SPONZILLI C, et al. Predictors of mortality and long-term outcome in patients with anterior STEMI: results from a single center study [J]. *J Clin Med*, 2021, 10 (23): 5634. DOI: 10.3390/jcm10235634.
- [17] 陈鑫森, 邵萌, 张天, 等. 血液学参数预测急性ST段抬高型心肌梗死患者经皮冠状动脉介入治疗术后发生主要不良心血管事件的价值研究 [J]. *中国全科医学*, 2020, 23 (27): 3389-3395. DOI: 10.12114/j.issn.1007-9572.2020.00.245.
- [18] 仇杰, 谢勇, 李雨涵, 等. 入院时胸导联Q波总振幅与R波总振幅比值对急性ST段抬高型前壁心肌梗死患者急诊经皮冠状动脉介入治疗后短期预后的预测价值研究 [J]. *实用心脑血管病杂志*, 2020, 28 (1): 17-22. DOI: 10.3969/j.issn.1008-5971.2020.01.y03.
- [19] LÖFGREN J, BEARD J, ASHLEY T. Groin hernia surgery in low-resource settings — a problem still unsolved [J]. *N Engl J Med*, 2018, 378 (14): 1357-1358. DOI: 10.1056/NEJMc1800621.
- [20] MCKENZIE A, ZHOU C, SVENDSEN C, et al. Ability of a novel shock index that incorporates invasive hemodynamics to predict mortality in patients with ST-elevation myocardial infarction [J]. *Catheter Cardiovasc Interv*, 2021, 98 (1): 87-94. DOI: 10.1002/ccd.29460.
- [21] 王国余, 刘玲, 王叶宝, 等. MSI对行急诊介入治疗的老年ST段抬高型STEMI患者预后的预测价值 [J]. *中国老年学杂志*, 2020, 40 (14): 2924-2926. DOI: 10.3969/j.issn.1005-9202.2020.14.004.
- [22] WANG G Y, WANG R Z, LIU L, et al. Comparison of shock index-based risk indices for predicting in-hospital outcomes in patients with ST-segment elevation myocardial infarction undergoing percutaneous coronary intervention [J]. *J Int Med Res*, 2021, 49 (3): 3000605211000506. DOI: 10.1177/03000605211000506.
- [23] SHANGGUAN Q, XU J S, SU H, et al. Modified shock index is a predictor for 7-day outcomes in patients with STEMI [J]. *Am J Emerg Med*, 2015, 33 (8): 1072-1075. DOI: 10.1016/j.ajem.2015.04.066.
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(上接第34页)

- [20] 吴铮, 吕昀, 王平, 等. 急性非ST段抬高型心肌梗死患者血清hs-CRP、CK-MB、cTnI、NT-proBNP的表达及临床意义 [J]. *疑难病杂志*, 2018, 17 (12): 1297-1300, 1305. DOI: 10.3969/j.issn.1671-6450.2018.12.001.
- [21] HE W F, JIANG L, CHEN Y Y, et al. The association of baseline N-terminal pro-B-type natriuretic peptide with short and long-term prognosis following percutaneous coronary intervention in non-ST segment elevation acute coronary syndrome with multivessel coronary artery disease: a retrospective cohort study [J]. *BMC Cardiovasc Disord*, 2021, 21 (1): 202. DOI: 10.1186/s12872-021-02010-9.
- [22] 张莹洁, 任岩春, 赵永峰, 等. 急诊PCI术后早期应用脑钠肽对急性心肌梗死患者神经内分泌激素、血管内皮功能及心功能的影响 [J]. *疑难病杂志*, 2020, 19 (5): 447-451. DOI: 10.3969/j.issn.1671-6450.2020.05.004.
- [23] 陈强, 李楠, 王卓. 重组人脑钠肽对急性心肌梗死患者经皮冠状动脉介入治疗后心肌损伤及心肌重构的影响研究 [J]. *实用心脑血管病杂志*, 2021, 29 (1): 71-75. DOI: 10.12114/j.issn.1008-5971.2021.01.014.
- [24] ZEREN G, AVCİ İ İ, ŞİMŞEK B, et al. Post percutaneous coronary intervention hemoglobin levels predict in-hospital mortality in patients with STEMI treated with primary percutaneous coronary intervention [J]. *Anatol J Cardiol*, 2021, 25 (9): 623-629. DOI: 10.5152/AnatolJCardiol.2021.07282.
- [25] 刘琛, 李凤德, 杨红红. 老年急性心肌梗死再发的现状调查及影响因素分析 [J]. *心肺血管病杂志*, 2020, 39 (10): 1188-1192. DOI: 10.3969/j.issn.1007-5062.2020.10.007.
- [26] TANG C C, LUO E F, WANG D, et al. Usefulness of haemoglobin level combined with CAMI-STEMI score for predicting MACCE in patients with acute ST-elevation myocardial infarction after PCI [J]. *Biomed Res Int*, 2019, 2019: 8534752. DOI: 10.1155/2019/8534752.
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