

· 临床研究 ·

老年心力衰竭患者心电图校正 QT 间期改变及相关因素分析

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【摘要】目的 探讨老年心力衰竭患者心电图校正的 QT 间期 (QTc) 变化及其延长的相关因素。**方法** 选取 2018 年 1 月至 2021 年 1 月于无锡市惠山区第二人民医院收治的左心功能不全, 但窦性心律、无明确的束支传导阻滞 532 例患者的临床资料。所有患者治疗前均完成心功能评估及心电图和心脏超声检查。按 QTc \geq 440 ms 和 QTc $<$ 440 ms 分组, 按纽约心脏病学会 (NYHA) 心功能分级, 年龄, 左室射血分数 (LVEF), 左室舒张末内径 (LVEDd), 脂蛋白磷脂酶 A₂ (Lp-PLA₂), 氨基末端脑钠肽前体 (NT-proBNP), 合并高血压、糖尿病、冠心病、其他心脏相关性疾病等两种及以上疾病分类统计, 分析老年心力衰竭患者 QTc 变化及其延长的相关危险因素。采用 SPSS 21.0 软件进行数据分析。根据数据类型, 组间比较分别采用 *t* 检验、 χ^2 检验及方差分析, 二分类多因素 logistic 回归分析 QTc 延长的相关危险因素。**结果** NYHA 心功能 I ~ IV 级老年患者分别为 71、130、245、86 例, QTc 依次为: (415.34 \pm 22.80)、(423.72 \pm 38.95)、(433.45 \pm 37.33) 和 (465.74 \pm 37.69) ms, 组间差异均有统计学意义 (均 $P < 0.05$)。所有患者 QTc 均值 (433.69 \pm 39.35) ms, 其中, QTc \geq 440 ms 组患者 207 例, QTc (472.63 \pm 31.40) ms; QTc $<$ 440 ms 组患者 325 例, QTc (408.89 \pm 18.02) ms。QTc \geq 440 ms 组和 QTc $<$ 440 ms 组相关因素比较, 年龄 [(78.32 \pm 7.55) 和 (75.03 \pm 8.07) 岁], LVEDd [(51.89 \pm 9.77) 和 (48.95 \pm 8.69) mm], LVEF [(48.01 \pm 9.98)% 和 (56.75 \pm 8.50)%], Lg(NT-proBNP) [(3.33 \pm 0.74) 和 (3.03 \pm 0.68)], 差异均有统计学意义 (均 $P < 0.05$); Ln (Lp-PLA₂) [(4.87 \pm 0.65) 和 (4.79 \pm 0.84)], 差异无统计学意义 ($P > 0.05$)。二分类多因素 logistic 回归分析显示, LVEDd、LVEF、NT-proBNP 及合并两种及以上疾病为 QTc 延长的危险因素。**结论** 老年心力衰竭患者 QTc 延长与心功能不全的严重程度相关, 心脏相关性疾病及心脏结构改变是其延长的危险因素。

【关键词】 老年人; 心力衰竭; 心电图描记术; QT 间期**【中图分类号】** R541.6**【文献标志码】** A**【DOI】** 10.11915/j.issn.1671-5403.2022.01.006

Change of corrected QT interval in electrocardiogram and associated risk factors for its prolongation in elderly patients with heart failure

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【Abstract】Objective To investigate the change of corrected QT interval (QTc) of electrocardiogram (ECG) and associated risk factors of its prolongation in the elderly patients with heart failure. **Methods** A total of 532 old patients with left cardiac insufficiency, who had a sinus rhythm and no clear bundle branch block, were enrolled in the study in Wuxi Huishan District No. 2 People's Hospital from January 2018 to January 2021. All patients had received cardiac function assessment, ECG, and cardiac ultrasound examination before the treatment. They were divided into QTc \geq 440 ms group and QTc $<$ 440 ms group. Analyses were made of the changes of QTc and the risk factors of its prolongation in elderly patients with heart failure in relation to classification of New York Heart Association (NYHA), age, left ventricular ejection fraction (LVEF), left ventricular end-diastolic diameter (LVEDd), lipoprotein phospholipase A₂ (Lp-PLA₂), amino-terminal brain natriuretic peptide (NT-proBNP), comorbidities of two or more diseases such as hypertension, diabetes mellitus, coronary heart disease and other heart-related diseases. SPSS statistics 21.0 was used for statistical analysis. Depending on data type, comparison between two groups was performed using *t*-test, χ^2 test or Fisher exact test. Logistic regression analysis was used to determine the risk factors of the prolonged ECG QTc. **Results** The patients fell into NYHA Class I-IV were 71, 130, 245, and 86, and the means of QTc in the four class groups was (415.34 \pm 22.80), (423.72 \pm 38.95), (433.45 \pm 37.33) and (465.74 \pm 37.69) ms respectively ($P < 0.05$). The mean QTc was (433.69 \pm 39.35) ms, with 207 patients in the QTc \geq 440 ms group [mean = (472.63 \pm 31.40) ms] and 325 in the QTc $<$ 440 ms group [mean = (408.89 \pm 18.02) ms]. The difference between the two groups was significant in age [(78.32 \pm 7.55) vs (75.03 \pm 8.07) years], LVEDd [(51.89 \pm 9.77) vs (48.95 \pm 8.69) mm], LVEF

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[(48.01±9.98)% vs (56.75±8.50)%], Lg(NT-proBNP) [(3.33±0.74) vs (3.03±0.68)], but not significant in ln(Lp-PLA₂) [(4.87±0.65) vs (4.79±0.84)], $P>0.05$]. Logistic regression analysis showed that the LVEDD, LVEF, NT-proBNP and comorbidities of two or more heart-related diseases were the risk factors for QTc prolongation. **Conclusion** The prolonged ECG QTc in elderly patients with heart failure is correlated with cardiac insufficiency, and heart-related diseases and cardiac structural change are the risk factors.

【Key words】 aged; heart failure; electrocardiogram; QT interval

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QT间期定义为心电图QRS波群的起点至T波终点,代表心室除极开始到复极完成所需要时间。它的长短与心率的快慢密切相关:心率越快,QT间期越短,反之则越长,当心率在60~100次/min,其正常范围是320~440ms。因此,在一定的心率条件下,常用校正的QT间期(corrected QT interval, QTc)反应心脏除复极时间^[1]。QTc是反应心脏整体的除复极时间,但在心脏异质性增大时,心肌整体动作电位时程延长,QT离散增加,体表心电图QTc延长,直接表现为心肌除复极的非同步,易形成折返,为恶性心律失常的发生提供了可能^[2]。随着我国老年人口的增加,冠心病、高血压及糖尿病等慢性病增多,医疗水平的提高使心脏病患者生存期延长,致心力衰竭患病率呈持续升高趋势^[3]。老年患者有更多的心力衰竭危险因素,共病较多,并且更有可能因心功能急性失代偿而入院,因此,对老年心力衰竭患者的防治尤为重要^[4]。心电图QTc改变与心肌电活动密切相关,也是心肌电重构的重要表现形式。于老年患者而言,心肌电重构多建立在结构重构基础上,心脏结构重构为心力衰竭形成提供了条件^[5]。本研究结合心电图QTc特征,探讨心电图QTc在老年心力衰竭患者中变化的意义及相关影响因素。

1 对象与方法

1.1 研究对象

选取2018年1月至2021年1月于无锡市惠山区第二人民医院收治的左心功能不全,且窦性心律、无明确的束支传导阻滞的老年患者532例。其中男性207例,女性325例;年龄60~95岁,平均(76.31±7.99)岁;高血压276例、冠心病237例、糖尿病113例、风湿性心脏病25例、扩张性心肌病19例及高血压性心脏病8例,合并两种疾病148例,合并两种以上疾病69例。本研究经医院伦理委员会批准,患者均知情同意。

1.2 方法

1.2.1 纳入标准 年龄≥60岁;心力衰竭定义为各种心脏疾病导致的以肺循环淤血为特征的临床表现;多次就诊仅以首次入选。排除标准:急性心肌梗

死、明确的肺部疾患、血清K⁺<3.0mmol/L、恶性肿瘤、束支传导阻滞及近1周内服用胺碘酮等延长心脏QT间期药物患者。

1.2.2 资料收集 患者就诊即刻按病史、症状及体征完成纽约心脏病协会(New York Heart Association, NYHA)心功能评估。治疗前完成心电图和心脏超声检查,采用日本光电心电图机ECG-1350P,自带Bazett's公式校正QT间期,QTc以心电图机自行记录为主并人工审核,选择II或V₁导联,要求基线平稳,以毫秒(ms)为计量单位。

按NYHA心功能分级,分别统计I~IV级相应患者并获取心电图QTc数据,分析不同分级心功能对心电图QTc的影响。按QTc≥440ms和QTc<440ms分组,以合并高血压、糖尿病、冠心病、其他心脏相关性疾病等两种及以上疾病,年龄,左室射血分数(left ventricular ejection fraction, LVEF),左室舒张末内径(left ventricular end-diastolic diameter, LVEDd),脂蛋白磷脂酶A₂(lipoprotein phospholipase A₂, Lp-PLA₂),氨基末端脑钠肽前体(amino-terminal brain natriuretic peptide, NT-proBNP)分类统计,分析老年心力衰竭患者心电图QTc变化及其延长的相关危险因素。

1.3 统计学处理

采用SPSS 21.0软件进行数据分析。计量资料以均数±标准差($\bar{x}\pm s$)表示,多组间比较采用单因素方差分析,组间两两比较采用SNK检验;Lp-PLA₂和NT-proBNP呈偏态分布,分别取自然对数和取对数后符合正态分布,采用 t 检验;计数资料用例数(百分率)表示,采用 χ^2 检验;二分类多因素logistic回归分析QTc延长的相关危险因素。 $P<0.05$ 为差异有统计学意义。

2 结果

2.1 心功能不同的老年患者QTc变化

532例老年心力衰竭患者按NYHA心功能分级,I~IV级分别为71、130、245、86例,相应QTc均值依次为(415.34±22.80)、(423.72±38.95)、(433.45±37.33)和(465.74±37.69)ms,组间比较,差异均有统计学意义(均 $P<0.05$)。

2.2 QTc<440 ms 与 QTc≥440 ms 组间相关因素比较

532例老年患者QTc均值(433.69±39.35)ms,其中,QTc≥440ms患者207例,QTc(472.63±31.40)ms;QTc<440ms患者325例,QTc(408.89±18.02)ms。2组间相关因素比较,除Lp-PLA₂外,余相关因素差异均有统计学意义(P<0.05;表1)。

2.3 二分类多因素 logistic 回归分析 QTc 延长的相关危险因素

采用二分类多因素 logistic 回归分析,以QTc为因变量,年龄、LVEDd、LVEF、NT-proBNP、两种及以上疾病为自变量。QTc<440ms赋值为“0”,QTc≥440ms赋值为“1”;LVEDd<55mm赋值为“0”,LVEDd≥55mm赋值为“1”;LVEF≥50%赋值为“0”,LVEF<50%赋值为“1”;NT-proBNP<1800ng/L赋值为“0”,NT-proBNP≥1800ng/L赋值为“1”;合并两种及以上疾病赋值为“1”,反之为“0”。结果显示,除年龄干扰因素较大外,余均为QTc延长的危险因素(P>0.05;表2)。

3 讨论

心力衰竭是一种典型的心血管综合征,多与年龄相关,因心脏结构和功能改变所致^[6]。老年心力衰竭患者心血管代偿储备功能下降,心脏前后负荷相对或绝对增大,共病及神经内分泌紊乱累及心肌细胞及心肌电传导,因损伤的不均一性,增大心肌细胞对刺激反应的差异性。心力衰竭越重,心肌损伤越明显,QTc越长,故通过心电图QTc变化的研究对判断心脏功能

及预后具有重要意义^[7]。本研究提示,老年心力衰竭患者QTc延长与心力衰竭的严重程度相关。

心电图QTc在一定的范围内利于心肌电稳定,过短或过长均易发生心律失常^[8]。原发性长QT综合征一般为遗传性离子通道病,易致心律失常甚至猝死^[9];获得性长QT综合征在住院患者中较多,其致死性心律失常和猝死的风险较大^[10]。老年患者随年龄增大,基础疾病增多、心肌电储备功能下降和不稳定性增加,易致心功能不全、心律失常及心血管事件风险增大^[11]。本研究提示,QTc<440ms与QTc≥440ms老年患者间年龄差异明显,即年龄越大,QTc延长越明显。由于医学进步,心肌病及心脏瓣膜性疾病患者预后大为改观,生存期限明显延长,使得相应心血管疾病虽发病相对年轻,但延续至老年患病人数逐渐增多。该类患者年龄跨度大,心脏异质性均明显增大,可能是本研究中年龄与QTc相关性并不明显的原因所在。心脏形态改变的基础是结构重构,而结构重构是心肌电重构持续存在的基础,本研究中,LVEDd在QTc延长组较正常组明显增大,差异有统计学意义。尽管LVEF不能反应心脏收缩的敏捷性和时效性,但其灵敏度低、特异度高,仍是心功能不全患者重要评估指标^[12]。NT-proBNP是心力衰竭标志物,主要反应患者急性心功能,NT-proBNP升高并结合NYHA分级可识别高风险患者^[13]。心脏相关性疾病QTc延长,其心血管事件风险明显增大,合并疾病越多,心功能不全危险因素越多,心脏损害越明显,QTc也越长^[14]。Lp-PLA₂是血管特

表1 QTc<440 ms 与 QTc≥440 ms 组间因素比较

Table 1 Comparison of indices between QTc<440 ms and QTc≥440 ms groups

Group	n	Age (years, $\bar{x}\pm s$)	LVEF (%, $\bar{x}\pm s$)	LVEDd (mm, $\bar{x}\pm s$)	Ln(Lp-PLA ₂) ($\bar{x}\pm s$)	Lg(NT-proBNP) ($\bar{x}\pm s$)	Two or more diseases [n(%)]
QTc<440 ms	325	75.03±8.07	56.75±8.50	48.95±8.69	4.79±0.84	3.03±0.68	83(25.54)
QTc≥440 ms	207	78.32±7.55	48.01±9.98	51.89±9.77	4.87±0.65	3.33±0.74	134(64.74)
t/χ ²		4.714	5.574	6.871	1.079	4.753	81.322
P value		0.001	<0.001	<0.001	0.281	<0.001	<0.001

QTc: corrected QT interval; LVEF: left ventricular ejection fraction; LVEDd: left ventricular end-diastolic diameter; Lp-PLA₂: lipoprotein phospholipase A₂; NT-proBNP: amino-terminal brain natriuretic peptide.

表2 多因素 logistic 回归分析 QTc 延长的危险因素

Table 2 Multivariate logistic regression analysis of risk factors of QTc prolongation

Item	B	SE	Wald	P value	OR(95%CI)
Age	-0.018	0.005	10.812	0.001	0.982(0.972-0.993)
LVEDd	0.544	0.259	4.410	0.036	1.7222(1.037-2.861)
LVEF	1.315	0.241	29.699	0.000	3.7242(2.321-5.975)
NT-proBNP	0.655	0.250	6.887	0.009	1.9252(1.180-3.141)
Two or more diseases	0.738	0.254	8.411	0.004	2.0922(1.270-3.444)

QTc: corrected QT interval; LVEDd: left ventricular end-diastolic diameter; LVEF: left ventricular ejection fraction; NT-proBNP: amino-terminal brain natriuretic peptide.

异性的炎症标志物,与冠心病的严重程度呈正相关^[15]。因此,Lp-PLA₂ 理应成为 QTc 延长的危险因素,但在本研究中,QTc<440 ms 与 QTc≥440 ms 组间并无统计学差异,可能与本研究纳入不限于冠心病患者且冠心病患者相对较少相关。

随医学发展,心力衰竭研究日益细化,对不同类型老年心力衰竭患者 QTc 延长的研究比较能更好地揭示其相应类型的危险因素。本研究因纳入患者人数相对较少,未行进一步分类比较,也是不足之处;同时,严重低钾血症及部分药物致心肌 QTc 延长,这在心力衰竭患者中更为明显并增加心律失常风险^[16];而急性心肌梗死、明确的肺部疾患、恶性肿瘤及束支传导阻滞因对 QTc 影响存在较大不确定性或干扰心功能判断,故均未纳入研究。再者,由于患者心功能短期内变化较大,而心功能评估主要依据患者临床症状,缺乏客观的评判标准,且影响 QTc 的因素较多,本研究只纳入和排除临床常见因素,均为不足之处。另外,尽管 Bazett's 公式应用最为广泛,其不足之处也显而易见,特别是在慢心率(<50 次/min)或快心率(>120 次/min)条件下。因此,QTc 只是心律失常的一种风险提示,具体需结合临床^[17]。

综上,老年患者心脏功能差,QTc 延长不仅提示心功能不全,且与心血管事件风险及死亡率相关。而 QTc 主要反应的是心室肌心肌电传导,并非心功能评判的直接指标。在慢性疾病防治中,相应检查化验资料的获取越全面,对疾病风险评估越真实。心电图检查费用低廉,QTc 的获取和管理,对医务人员,特别是基层医院医务人员评估患者心脏疾病风险有重要价值^[18]。

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