·老年患者围术期管理专栏·

术前心电图检查对老年择期非心脏手术患者术后心血管并发症的预测价值

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【摘 要】 **目的** 探讨术前常规心电图(ECG)检查对老年择期非心脏手术患者术后心血管并发症的预测价值。**方法** 本研究为回顾性队列研究,选择 2012 年 11 月 15 日至 2013 年 01 月 15 日期间在北京大学第一医院接受择期非心脏手术的老年患者(年龄≥60 岁)为研究对象。记录术前 ECG 检查结果、患者围术期相关资料和术后住院期间的并发症。**结果** 本研究有 784 名患者进入统计分析。术前 ECG 异常的整体发生率为 35.1%。术后心血管并发症发生率在 ECG 正常组与 ECG 异常组之间无统计学差异(3.7% *vs* 3.6%, $P=0.946$)。术前 ECG 异常预测术后心血管并发症的 ROC 曲线下面积为 0.547(95% CI: 0.447 ~ 0.581, $P=0.351$)。多因素回归分析显示女性(OR = 3.164, 95% CI: 1.365 ~ 7.335, $P=0.007$)、年龄增加(OR = 1.131, 95% CI: 1.068 ~ 1.198, $P<0.001$)、美国麻醉医师协会(ASA)分级增高(OR = 3.067, 95% CI: 1.394 ~ 6.750, $P=0.005$)、手术时间延长(OR = 1.284, 95% CI = 1.045 ~ 1.489, $P=0.014$)是术后心血管并发症发生的独立危险因素。**结论** 术前ECG 检查对老年择期非心脏手术患者的术后心血管并发症预测价值有限。

【关键词】 心电图;老年人;非心脏手术;预测;术后并发症
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Predictive value of preoperative routine electrocardiography on postoperative cardiovascular complications in elderly undergoing schedualed non-cardiac surgery

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【**Abstract**】 **Objective** To determine the value of preoperative electrocardiogram (ECG) in the prediction of postoperative cardiovascular complications in elderly patients undergoing schedualed non-cardiac surgery. **Methods** A retrospective cohort study was carried out on the patients aged 60 years or older undergoing elective non-cardiac surgery in our department from November 15, 2012 to January 15, 2013. The results of preoperative ECG, perioperative data and postoperative complications during the hospital stay were recorded and analyzed. **Results** There were 784 patients included in the final analysis, and 275 of them (35.1%) were found having cardiac abnormality according to the results of ECG. There was no difference in the incidence of postoperative cardiovascular complications between those patients with and without normal ECG preoperatively (3.7% *vs* 3.6%, $P=0.946$). The area under ROC curve for postoperative cardiovascular complications predicted by abnormal preoperative ECG was 0.547 (95% CI: 0.447 – 0.581, $P=0.351$). Multivariate logistic regression analysis showed that female gender (OR = 3.164, 95% CI: 1.365 – 7.335, $P=0.007$), older age (OR = 1.131, 95% CI: 1.068 – 1.198, $P<0.001$), higher grade of American Society of Anesthesiologists Classification (OR = 3.067, 95% CI: 1.394 – 6.750, $P=0.005$) and prolonged duration of surgery (OR = 1.284, 95% CI: 1.045 – 1.489, $P=0.014$) were independent predictors of postoperative cardiovascular complications. **Conclusion** Preoperative ECG is of limited value in the prediction of postoperative cardiovascular complications in the elderly patients undergoing schedualed non-cardiac surgery.

【**Key words**】 electrocardiography; aged; non-cardiac surgery; prediction; postoperative complications

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心脏疾病会增加围术期并发症的发生率,包括心肌缺血性事件和死亡等[1,2]。有效的术前心脏风险评估可以降低患者的围术期风险,且有利于充分的术前准备。12导联心电图(electrocardiogram, ECG)

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作为一种无创监测方法,是围术期心血管评估的常规检查。有文献显示术前进行常规ECG检查对于预测患者预后的价值有限[3,4]。在一项前瞻性队列研究中,研究者观察了513例接受择期非心脏手术的老年患者(≥70岁),其中有75.2%的患者出现了≥1项ECG异常,但多因素回归分析显示ECG异常与术后心血管并发症之间的关系无统计学差异[5]。另一项回顾性研究显示,在接受中低危手术的患者中,ECG异常患者的术后并发症发生率与正常患者之间的组间比较无统计学差异[6]。鉴于已有的证据,国外相关指南建议术前ECG检查不宜作为常规检查,需要根据患者年龄、美国麻醉医师协会(American Society of Anesthesiologists, ASA)分级和手术的级别综合判断和个体化应用[4]。但国内尚缺乏符合我国国情的相应指导意见和临床证据,尤其是针对老年患者的相关研究。本研究旨在评估术前ECG检查对于老年择期非心脏手术患者术后心血管并发症的预测价值。

1 对象与方法

1.1 研究对象

选择2012年11月15日至2013年01月15日期间在北京大学第一医院接受择期非心脏手术的老年患者(≥60岁)作为研究对象。排除标准:(1)年龄<60岁;(2)急诊手术;(3)心脏手术;(4)在局部麻醉下接受手术的患者;(5)缺少术前ECG诊断结果。本研究为回顾性队列研究,获得北京大学第一医院临床伦理委员会的批准2014[734]。

1.2 方法

1.2.1 一般资料收集 本研究收集的资料包括患者的基本资料(年龄、身高、体质量、既往病史等)、术中资料(手术类型、手术时间、麻醉方法、麻醉时间、术中出入量等)和术后资料(术后并发症和死亡)。

1.2.2 术前ECG的诊断 患者术前ECG均由心内科医师进行分析,若有≥1项结果异常即被认为是检查结果异常。ECG异常判定标准参见文献[7]。

1.2.3 术后并发症的定义 术后并发症指术后住院期间发生的、对患者有不良影响且需要医学干预的情况。各种并发症的定义采用相关文献中公认的标准[8-11]。(1)急性冠脉综合征包括急性心肌梗死和不稳定型心绞痛。心肌梗死的诊断标准:有一项心肌酶(尤其是心肌肌钙蛋白I)高于心肌酶谱诊断敏感度99%时的数值;且伴有心肌缺血症状、ECG新发ST-T改变、完全性左束支传导阻滞、病理性Q波、影像学证实心肌运动异常或血管造影异常等症状之一。不稳定型心绞痛的诊断标准:缺血性症状加重,持续时间>10 min;心肌酶谱阴性;静息状态下ECG新发ST-T改变或加重,相邻两个导联J点上移0.1 mV,或相邻两个导联ST段压低≥0.05 mV,或T波倒置≥0.3 mV,或R/S>1。(2)符合下列条件之一即诊断为心功能不全:临床表现有呼吸困难、肺水肿或颈内静脉怒张;心房钠尿肽(brain natriuretic peptide, BNP)>500 pg/ml或N端B型钠尿肽原(N-terminal proBNP, NT-proBNP)>2000 pg/ml;肺毛细血管楔压≥18 mmHg、中心静脉压≥12 mmHg或心脏指数<2.2 L/(min·m^2)。(3)心律失常的诊断标准:术后新发心律失常且需要治疗。(4)肺部感染诊断标准:术后影像学新发或有进展的肺部阴影,伴有发热、浓痰、白细胞升高;病原学检测阳性。(5)肺栓塞的诊断标准:具有胸痛、呼吸骤停、晕厥和咯血的临床表现;超声或造影结果证实存在肺部血栓。(6)呼吸衰竭的诊断标准:动脉血二氧化碳分压>50 mmHg及(或)动脉血氧分压<60 mmHg。(7)脑卒中是指患者术后出现局灶性脑功能障碍且在24 h内没有恢复。(8)肺不张和肺部积液的诊断均需有影像学支持。

1.3 统计学处理

应用SPSS Statistics 20.0进行统计分析。计量资料以均数±标准差或中位数(四分位间距)表示,组间比较采用t检验或Mann-Whitney U检验进行统计分析。计数资料及等级资料以例数(百分率)表示,采用χ^2或Fisher's精确检验进行分析。等级资料统计分析采用趋势卡方检验。使用ROC曲线分析术前ECG异常对术后心血管并发症的预测曲线下面积。分两步筛选可能与术后心血管并发症相关的危险因素。首先使用单因素分析筛选与术后心血管并发症可能相关的危险因素,然后将单因素分析中有统计学意义的变量($P<0.10$)代入多因素logistic回归分析筛选术后心血管并发症的独立危险因素。$P<0.05$为差异有统计学意义。

2 结 果

2.1 两组患者基本资料比较

研究期间共筛选了2975例患者,最终有784例患者进入统计分析(图1),年龄(70±7)岁,体质量指数(body mass index, BMI)(24.5±3.6) kg/m^2。在入选的患者中,ECG正常组509例(64.9%),年龄(69±7)岁,BMI(24.4±3.5) kg/m^2;ECG异常组275例(35.1%),年龄(70±7)岁,BMI(24.7±3.6) kg/m^2。ECG异常组患者的年龄高于

ECG正常组患者($P<0.05$)。其他资料详见表1。比较两组的基本资料,结果发现ECG异常组术前合并缺血性心脏病、高血压和心律失常的发生率高于ECG正常组($P<0.05$)。

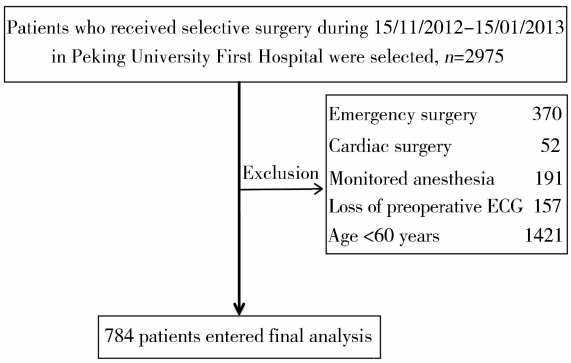


图1 入组流程图

Figure 1 Flow chart of this study

既往有缺血性心脏病病史的患者中有50.0%(61/122)的患者术前ECG出现异常,其发生率高于无缺血性心脏病病史患者的发生率(32.3%,214/662)($P<0.001$;表1)。既往有明确心律失常病史的患者中ECG异常的发生率高达91.5%(43/47),与无心律失常病史患者中的发生率(31.5%,232/737)比较,差异有统计学意义($P<0.001$;表1)。术前ECG异常中发生率较高的异常为ST-T改变、窦性心动过缓和完全性右束支传导阻滞(图2)。

2.2 两组患者围术期情况各指标的比较

两组患者手术时间、麻醉方式、麻醉时间、液体出入量方面无统计学差异,ECG异常组泌尿外科的手术比例高于ECG正常组(表2)。

术后心血管并发症的发生率为3.7%,在ECG正常组与ECG异常组之间无统计学差异(3.7% *vs*

表1 患者基本资料

Table 1 Basic characteristics of all patients [n(%)]

Item	Total(n=784)	Normal ECG group(n=509)	Abnormal ECG group(n=275)	P value
Age >70 years	329(42.0)	196(38.5)	133(48.4)	0.008
Female	355(45.3)	242(47.5)	113(41.1)	0.083
Preoperative history				
Ischemic cerebral disease	58(7.4)	38(7.5)	20(7.3)	0.922
Hemorrhagic stroke	7(0.9)	5(1.0)	2(0.7)	>0.999
Ischemic heart disease	122(15.6)	61(12.0)	61(22.2)	<0.001
Hypertension	398(50.8)	239(47.0)	159(57.8)	0.004
Arrhythmia	47(6.0)	4(0.8)	43(15.6)	<0.001
Sinus bradycardia	7(0.9)	1(0.2)	6(2.2)	0.009
Sinus tachycardia	3(0.5)	0(0.0)	3(1.1)	0.043
Sick sinus syndrome	1(0.1)	0(0.0)	1(0.4)	0.351
Atrial premature beat	8(1.0)	1(0.2)	7(2.6)	0.003
Atrial flutter	2(0.3)	0(0.0)	2(0.7)	0.123
Atrial fibrillation	9(1.2)	0(0.0)	9(3.3)	<0.001
Ventricular premature beat	10(1.3)	2(0.4)	8(2.9)	0.005
Ventricular tachycardia	2(0.3)	0(0.0)	2(0.7)	0.123
Atrioventricular block	10(1.3)	0(0.0)	10(3.6)	<0.001
Congenital heart disease	3(0.4)	0(0.0)	3(1.1)	0.043
Rheumatic heart disease	1(0.1)	1(0.2)	0(0.0)	>0.999
Diabetes	148(18.9)	90(17.7)	58(21.1)	0.244
Hyperlipidemia	18(2.3)	15(3.0)	3(1.1)	0.098
Asthma	3(0.4)	2(0.4)	1(0.4)	>0.999
Chronic bronchitis	13(1.7)	7(1.4)	6(2.2)	0.395
Emphysema	12(1.5)	7(1.4)	5(1.8)	0.762
Pneumonia infection	2(0.3)	2(0.4)	1(0.4)	0.544
Bronchiectasis	3(0.4)	1(0.2)	2(0.7)	0.283
Pulmonary interstitial fibrosis	4(0.5)	4(0.8)	0(0.0)	0.304
ASA				0.021
Ⅰ	36(4.6)	24(4.7)	12(4.4)	
Ⅱ	619(79.0)	415(81.5)	204(74.2)	
Ⅲ-Ⅳ	129(16.5)	70(13.8)	59(21.5)	

ECG: electrocardiogram; ASA: American Society of Anesthesiologists

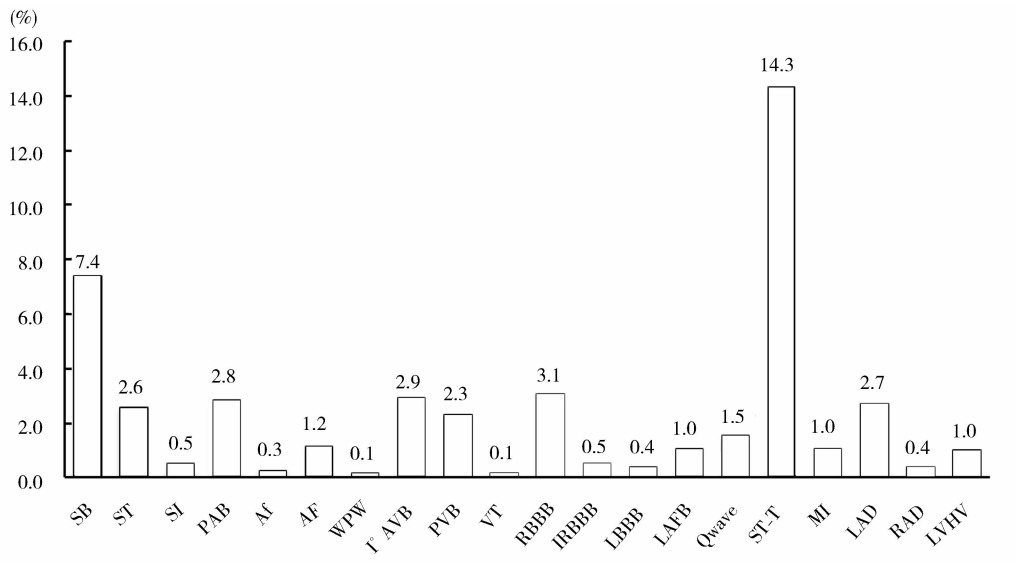


图 2 术前各项心电图异常的发生率

Figure 2 The prevalence of preoperative ECG abnormalities

Data are presented as %. SB: sinus bradycardia; ST: sinus tachycardia; SI: sinus irregularity; PAB: premature atrial beat; Af: atrial flutter; AF: atrial fibrillation; WPW: Wolff-Parkinson-White syndrome; AVB: atrioventricular block; PVB: premature ventricular beat; VT: ventricular tachycardia; RBBB: complete right bundle block; IRBBB: incomplete right bundle block; LBBB: complete left bundle block; LAFB: left anterior fascicular block; Q wave: Q wave abnormality; ST-T: ST-T abnormality; MI: myocardial infarction; LAD: left deviation of cardiac electric axis; RAD: right deviation of cardiac electric axis; LVHV: left ventricular high voltage

表 2 患者围术期资料

Table 2 Perioperative data of all patients

Item	Total (n = 784)	Normal ECG group (n = 509)	Abnormal ECG group (n = 275)	P value
Surgery time (h, $\bar{x} \pm s$)	2.3 ± 2.0	2.4 ± 2.1	2.2 ± 1.8	0.105
Surgery time ≥2 h [n(%)]	344(43.9)	228(44.8)	116(42.2)	0.482
Anesthesia time (h, $\bar{x} \pm s$)	3.5 ± 2.3	3.6 ± 2.4	3.4 ± 2.1	0.344
Surgery type [n(%)]				
Vascular	12(1.5)	11(2.2)	1(0.4)	0.066
Gynecologic	43(5.5)	26(5.1)	17(6.2)	0.529
General	186(23.7)	126(24.8)	60(21.8)	0.356
Urological	307(39.2)	176(34.6)	131(47.6)	<0.001
Thoracic	59(7.5)	44(8.6)	15(5.5)	0.106
Neurologic	7(0.9)	5(1.0)	2(0.7)	>0.999
Orthopedic	125(15.9)	89(17.5)	36(13.1)	0.109
Plastic	10(1.3)	9(1.8)	1(0.4)	0.178
Otolaryngological	35(4.5)	23(4.5)	12(4.4)	0.920
Anesthesia method [n(%)]				0.434
General	477(60.8)	315(61.9)	162(58.9)	
Regional	232(29.6)	143(28.1)	89(32.4)	
Combined	75(9.6)	51(10.0)	24(8.7)	
Crystal fluid [ml, M(Q_1, Q_3)]	1100(600, 1550)	1100(600, 1600)	1100(600, 1500)	0.967
Colloid fluid [ml, M(Q_1, Q_3)]	500(0, 500)	500(0, 500)	500(0, 500)	0.149
Intraoperative blood loss [ml, M(Q_1, Q_3)]	150(80, 400)	150(50, 400)	100(100, 350)	0.583
Intraoperative urine output [ml, M(Q_1, Q_3)]	400(200, 650)	450(200, 700)	400(200, 613)	0.389

ECG: electrocardiogram

3.6%, P = 0.946; 表 3)。ROC 分析显示术前 ECG 异常对术后心血管系统并发症的预测曲线下面积为 0.547(95% CI: 0.447 ~ 0.581, P = 0.351)。

术后心脏、脑部和肺部并发症的整体发生率为 6.1%, ECG 正常组及 ECG 异常组间无显著差异(6.1% *vs* 6.2%, P = 0.959; 表 3)。ROC 分析显示术前 ECG 异常对术后整体并发症预测的曲线下面积为 0.480 (95% CI: 0.379 ~ 0.581, P = 0.702)。

表3 术后并发症的发生率

Table 3 The prevalence of postoperative complications

[n(%)]

Item	Normal ECG group (n=509)	Abnormal ECG group (n=275)	P value
Total complication	31(6.1)	17(6.2)	0.959
Cardiac complication	19(3.7)	10(3.6)	0.946
ACS	5(1.0)	0(0.0)	0.168
Heart failure	1(0.2)	1(0.4)	>0.999
Arrhythmia	16(3.1)	10(3.6)	0.713
Ischemic stroke	2(0.4)	1(0.4)	>0.999
Pulmonary complication	12(2.4)	4(1.5)	0.393
Pneumonia infection	5(1.0)	4(1.5)	0.727
Atelectasis	3(0.6)	0(0.0)	0.556
Pleural effusion	4(0.8)	0(0.0)	0.304
Pulmonary embolism	3(0.6)	0(0.0)	0.556
Respiratory failure	2(0.4)	1(0.4)	>0.999
Death	1(0.2)	0(0.0)	>0.999

ECG: electrocardiogram; ACS: acute coronary syndrome

2.3 术前ECG异常和术后心血管并发症的独立危险因素

多因素回归分析显示,术前合并高血压、心律失常和缺血性心脏病是老年患者术前ECG异常的独立危险因素(表4);女性、年龄(每增加1岁)、ASA分级(每增加1级)和手术时间(每增加1 h)是术后心血管系统并发症的独立危险因素(表5)。

3 讨 论

在本研究中,ECG异常组患者的年龄高于ECG正常组患者。有研究显示,年龄每增加5岁ECG异常的发生风险就会增加30%[12]。我们的结果也发现>70岁患者的ECG异常发生率为40.4%(133/329),而≤70岁患者的发生率为31.2%(142/455,$P<0.05$)。这可能与随着年龄增加而心脏退行性病变加重有关[13]。

本研究中发现术前常规ECG检查对术后心血管并发症和术后整体并发症的预测价值有限,这一结论也得到了其他研究的支持。一项关于接受择期白内障手术患者的随机对照研究发现,常规进行术前检查(包括ECG检查)并不能降低术后整体并发症的发生率[14]。在另一项前瞻性队列研究中,研究者发现心血管系统术后并发症只与术前ASA分级和充血性心力衰竭病史有关,而ECG异常对心血管系统术后并发症的预测能力有限[5]。

表4 术前ECG异常的危险因素

Table 4 Risk factors of abnormalities on preoperative ECG

Risk factor	Univariate analysis P value	Multivariate logistic regression	
		OR (95% CI)	P value
Gender(male)	0.084	-	-
Age(per year increase)	0.024	-	-
History of hypertension	0.004	1.408(1.025-1.934)	0.035
History of ischemic heart disease	<0.001	1.871(1.234-2.838)	0.003
History of arrhythmia	<0.001	23.095(8.158-65.383)	<0.001
ASA(per grade increase)	0.021	-	-

All preoperative characteristics were firstly analyzed by univariate analysis. Factors with P value <0.10 entered multivariate logistic regression. ECG: electrocardiogram; ASA: American Society of Anesthesiologists

表5 术后心血管系统并发症的危险因素

Table 5 Risk factors of postoperative cardiovascular complications

Risk factor	Univariate analysis P value	Multivariate logistic regression	
		OR(95% CI)	P value
Gender(female)	0.012	3.164(1.365-7.335)	0.007
Age(per year increase)	<0.001	1.131(1.068-1.198)	<0.001
History of ischemic heart disease	0.006	-	-
History of pulmonary emphysema	0.033	-	-
History of pneumonia infection	0.021	-	-
ASA(per grade increase)	<0.001	3.067(1.394-6.750)	0.005
Surgery time(per hour increase)	0.069	1.248(1.045-1.489)	0.014
Preoperative ECG abnormality *	0.946	0.785(0.329-1.872)	0.585

All preoperative characteristics and perioperative data were firstly analyzed by univariate analysis. Factors with P value <0.10 entered multivariate logistic regression. * Preoperative ECG abnormality was forced to enter multivariate logistic regression. ASA: American Society of Anesthesiologists; ECG: electrocardiogram

但也有研究结果提示,术前 ECG 异常是围术期高风险患者术后心血管并发症的独立危险因素。Biteker 等[15]发现在围术期心血管并发症的高危人群中,ECG 异常组患者发生心血管并发症的风险高于普通患者约 5 倍。另一项关于 345 例接受主动脉手术和下肢搭桥手术患者的研究发现,术前 ECG 异常患者的术后心脏事件发生率高于 ECG 正常患者(21.6% *vs* 8.3%, $P<0.001$)[16]。但是研究者认为这些高危人群是因为合并很多内科疾病(如冠心病、心律失常等)才会出现 ECG 异常;与 ECG 相比较,患者合并疾病的病理生理状况对患者预后的影响更大,而且预测价值更高[6]。

我们的研究结果发现,合并冠心病、高血压和心律失常是术前 ECG 异常的高危因素。慢性高血压及冠心病会导致心肌和传导系统出现病变,导致 ECG 出现异常的风险显著增加[3,17]。在本研究中,高达 93.1% 的既往有心律失常病史患者出现术前 ECG 异常。2014 年美国心脏病学会及美国麻醉学会联合发布的《非心脏手术围手术期心血管评估与治疗指南建议》中指出,是否需要进行术前 ECG 检查应该结合患者病史及手术风险综合考虑,例如既往合并有冠心病、明显心律失常、外周动脉疾病、脑血管疾病或其他明显的结构性心脏病的患者,除低危手术外,围手术期应进行 ECG 检查;除低危手术外,怀疑冠心病的无症状患者可考虑行 ECG 检查;对接受低危手术的无症状患者,无须常规检查[18]。因此,建议术前 ECG 检查应个体化应用,对于异常情况也需充分结合患者既往病史、手术级别等综合考虑,以避免增加过多的检查和医疗费用,减少不必要的手术推迟、取消以及住院时间延长等情况[6]。

本研究发现女性、年龄增加、ASA 分级增加和手术时间长是术后心血管并发症的独立危险因素。男性和女性的生理差异使高龄女性缺血性心脏病的发病率更高,且容易发生与冠脉狭窄无关的心肌缺血[19]。女性心脏复极化阶段更长,增加了使用某些药物引发心律失常的可能[20]。心血管并发症的风险因素还包括焦虑或其他精神压力[21],术后老年女性更易出现上述危险因素[22]。多项研究还证实年龄增加是围术期并发症发生率增加的主要危险因素,与器官功能随着年龄增加而下降有关[23]。ASA 分级是对患者术前生理状况的综合判断,分级越高代表患者的生理状况越差,围术期的死亡率越高,是一项公认的用于预测患者预后的指标[24,25]。手术时间长意味着病情复杂、手术操作难度大和创伤较大,多项临床研究发现手术时间的延长与围术期并发症发生率和死亡率密切相关[26]。

本研究具有以下不足:第一,作为回顾性研究,部分患者的资料丢失可能导致统计分析的偏倚;第二,本研究为单中心研究,尚需要不同级别医疗机构的多中心研究;第三,本研究未进行远期随访,无法确定术前 ECG 异常是否会对远期预后产生影响。综上,本研究发现老年非心脏手术患者术前 ECG 检查异常的发生率较高,但其对术后心血管并发症和术后整体并发症的预测能力有限,还需要大样本、前瞻性研究进行进一步的探索。

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