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Prognostic value of electrocardiogram in acute pulmonary embolism

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Abstract: Acute pulmonary embolism is a relatively common acute cardiovascular disease in clinical practice. It can lead to respiratory and circulatory failure, with a poor prognosis for patients, and is one of the common causes of death in cardiovascular diseases. Electrocardiography (ECG) is a simple, fast, and low-cost examination, making it one of the most commonly used imaging tests in clinical settings. In recent years, numerous studies have shown that ECG not only has diagnostic value for acute pulmonary embolism but also provides certain prognostic value for assessing patient outcomes. Abnormalities such as ST segment elevation in aVR lead, T wave inversion in leads V2-V4, right bundle branch block, sinus tachycardia, S1Q3T3 pattern, fragmented QRS complex dynamics, a lower depth of the S wave in lead V5, and atrial fibrillation on the ECG can predict mortality outcomes and length of hospital stay.

Keywords: Acute pulmonary embolism; Electrocardiogram; Right bundle branch block; T wave inversion; Prognosis
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Pulmonary embolism (PE) is a relatively common cardiovascular disease in clinical practice, with acute pulmonary embolism (APE) being the most prevalent form. APE can trigger various pathophysiological responses, including hypoxemia and right ventricular failure [1]. It is a potentially life-threatening medical emergency and a leading cause of cardiovascular mortality, posing a significant public health issue [2]. Due to the non-specific nature of most symptoms associated with PE, ranging from asymptomatic to hemodynamically unstable and fatal, its diagnosis can be challenging [3]. Although diagnostic methods have improved in recent years, enhancing the accuracy and timeliness of APE diagnosis, thus optimizing treatment, many patients still experience adverse outcomes, especially those with shock or hemodynamic instability [4]. Negative physiological consequences of APE can ultimately lead to right ventricular failure, which is the primary cause of death in APE patients [5]. Therefore, rapid and accurate assessment of disease severity and prognosis is crucial.

Electrocardiography (ECG) is one of the most common diagnostic tools used in clinical practice, typically serving as the primary examination for most cardiovascular diseases. As a fundamental test that reflects cardiac electrical activity, ECG can not only reveal disruptions in cardiac structure and function but also reflect systemic effects originating from non-cardiac sources, such as inflammation, ion imbalances, direct myocardial cytotoxicity, and hemodynamic changes caused by nervous system disorders [6]. Due to its widespread clinical use, the application of ECG in APE patients has also gained increasing attention. Some studies have shown a correlation between ECG abnormalities and hemodynamic instability, which can provide prognostic value for APE patients [7-8].

1 Grading of APE

Grading APE patients can help assess their prognosis to some extent, and therefore, timely risk assessment upon admission is essential [9]. Clinically, patients are generally classified into three categories — high-risk, intermediate-risk, and low-risk—based on hemodynamic status, right heart function, and myocardial injury markers. High-risk patients exhibit elevated myocardial injury markers, right heart dysfunction, shock, and hypotension; intermediate-risk patients have right heart dysfunction, with or without myocardial injury, but without shock or hypotension; low-risk patients have no signs of shock, right heart dysfunction, or myocardial injury. Right heart dysfunction is primarily indicated by gastrointestinal symptoms, such as abdominal distension, nausea, vomiting, and loss of appetite due to liver congestion, as well as exertional dyspnea. This occurs because, in right heart failure, impaired venous return leads to blood stasis, especially in the liver [10]. The Pulmonary Embolism Severity Index (PESI) is also commonly used to assess the severity of PE and evaluate patient prognosis [11-12]. The initial PESI score is based on factors like age, sex, comorbidities, and relevant clinical signs, while the simplified PESI includes selected variables (age, cancer history, chronic lung or heart disease history, pulse, systolic blood pressure, and oxygen saturation), with patients scoring 0 considered low risk, and all others considered high risk [13].

2 ECG findings in APE

Studies have demonstrated the diagnostic value of ECG for PE, as the occurrence of PE can lead to structural and functional changes in the heart, resulting in altered myocardial electrical activity [14-18]. While no single ECG abnormality is independently associated with PE, certain abnormalities have been shown to possess reasonable specificity [19-21]. ECG findings in APE include rhythm disturbances, changes in the QRS complex, and T-wave abnormalities, with the most common finding being sinus tachycardia [22]. Other findings include the $S_1Q_3T_3$ pattern, right bundle branch block (RBBB), and less common features such as right precordial T-wave inversions [23]. Recent studies have indicated that the presence of RBBB and $S_1Q_3T_3$ patterns in APE patients is valuable for assessing complications [24-25]. Additionally, ST-segment elevation may occur in APE, typically in the III, aVF, and V1-V4 leads, though the elevation is usually less than 0.1 mV and often lacks dynamic changes. For patients with acute chest pain, ECG should be performed immediately, and if ST elevation is observed, APE should be considered as a differential diagnosis, alongside acute myocardial infarction. Generally, the ST elevation in APE patients is mild and does not exceed 0.1 mV, and it typically does not show dynamic changes [26]. In APE stratification based on embolic size, ECG findings differ. In a retrospective study of 250 APE patients, those with massive or submassive PE demonstrated a significantly higher incidence of ECG abnormalities, such as right axis deviation, ST-segment changes, $S_1Q_3T_3$ pattern, and T-wave inversions in leads V1-V3 and V4-V6. T-wave inversions in V1-V3 and V4-V6 were independent predictors of massive or submassive PE. This study also found that T-wave inversions in V1-V3 had the highest overall diagnostic accuracy for distinguishing massive or submassive PE [27]. Moreover, ECG can reflect hemodynamic instability in APE, with myocardial ischemia and right ventricular strain patterns observable on 12-lead ECG [7].

3 Prognostic value of ECG in APE patients

Early diagnosis and treatment of APE are critical, and ECG, as a commonly used and convenient diagnostic tool, provides valuable insights in diagnosing APE and assessing its prognosis. Compared to other imaging studies, ECG is widely used in clinical practice due to its simplicity, ease of operation, and low cost, while also providing good reflection of cardiac activity, offering diagnostic value for acute cardiovascular conditions such as APE and acute myocardial infarction [6]. Furthermore, existing research suggests that ECG plays a role in predicting the prognosis of APE patients [28-31].

3.1 Prediction of adverse outcomes, including death

A meta-analysis showed that ECG findings indicating right ventricular strain caused by acute pulmonary hypertension (sinus tachycardia, $S_1Q_3T_3$ pattern, RBBB, T-wave inversions in V2-V3, ST elevation in aVR, and atrial fibrillation) were significantly associated with an increased likelihood of circulatory shock and PE-related death [32]. In a prospective study, patients were grouped based on early clinical deterioration (defined as respiratory failure, hypotension, arrhythmias, cardiac arrest, escalation of PE intervention, or death within 5 days). ECG findings, including sinus tachycardia, T-wave inversions (in V2-V4, II, III, and aVF leads), ST elevation (in aVR and V1), ST depression in V4-V6, and supraventricular tachycardia, were found to be associated with clinical deterioration. Supraventricular tachycardia was the only independent predictor of clinical deterioration. This study also examined the differences in ECG findings between patients with normal and abnormal right heart function assessed by echocardiography, showing significant differences in the presence of T-wave inversions, $S_1Q_3T_3$ pattern, RBBB, and ST changes in aVR [33]. The sudden obstruction of pulmonary arterial blood flow during APE increases right ventricular pressure, leading to right heart dysfunction, which can be reflected on ECG as right-axis deviation, repolarization abnormalities, myocardial injury patterns, conduction blocks, and rhythm disturbances [8].

High-risk APE patients exhibit right heart dysfunction, and the recovery of right heart function affects their prognosis. ECG can reflect the status of right heart function, thus providing prognostic value for critically ill APE patients. A large multicenter prospective study by Geibel *et al.* [34] analyzed the prognostic value of specific ECG parameters at admission in patients with severe APE. A total of 508 patients were included, and survival within 30 days of admission was used as the primary prognostic endpoint. Univariate analysis revealed that atrial arrhythmias (mainly atrial fibrillation or flutter), complete RBBB, peripheral low voltage, pseudo-infarction patterns in leads III and aVF (Q waves), and ST segment changes (elevation or depression) in left heart precordial leads were more common in patients with fatal outcomes, and were associated with poor clinical outcomes. Therefore, these ECG findings may provide prognostic value for 30-day survival in patients with severe APE. Another study from Italy evaluated the changes in ECG during hospitalization in APE patients and their prognostic impact on 30-day mortality. The results showed that the persistent presence of right ventricular strain on ECG after 3 days of admission was an independent predictor of 30-day mortality in high-risk APE patients. Right ventricular strain was defined as the presence of at least one of the following: RBBB, $S_1Q_3T_3$ pattern, and NTWs (T wave inversion). It was also found that the persistence of at least two of the following ECG abnormalities in high-risk APE patients was associated with higher risk: RBBB, T wave inversion in leads V1-V4, and qR pattern in lead V1. The risk of death was highest when all three abnormalities were present [35]. A study by Novicic *et al.* [36] indicated that the resolution of RBBB and the disappearance of the S wave in aVL were

associated with reduced all-cause 30-day mortality in medium- to high-risk patients, suggesting that RBBB may predict patient outcomes to some extent. In addition to the aforementioned ECG findings, which can assess the risk of adverse outcomes such as death, there are also studies showing that the dynamic changes of fragmented QRS (fQRS) complexes may help predict prognosis in APE patients. A retrospective study analyzing the significance of dynamic fQRS changes classified them into deep, shallow, and stable groups. The results indicated that shallow dynamic fQRS was a marker of a good prognosis, while deep dynamic fQRS indicated poor prognosis [37]. Other studies have also found that a high heart rate at admission increases the mortality risk in APE patients [38]. Furthermore, the presence of atrial fibrillation was associated with increased mortality and poorer clinical outcomes in hospitalized APE patients [39].

3.2 Prediction of hospitalization duration

For the prognosis of non-high-risk APE patients, better prediction of hospital stay duration allows low-risk patients to continue treatment in an outpatient setting after discharge, which can reduce both the psychological and financial burdens on patients to some extent [13]. A prospective study analyzed the predictive value of ECG for early discharge in non-high-risk APE patients. This study categorized patients into moderate-risk and low-risk APE groups. It was found that moderate-risk patients had larger right ventricular size and longer hospital stays than low-risk patients. Additionally, the ECG findings in the two groups differed: moderate-risk patients had more RBBB, $S_1Q_3T_3$, and V1-type Qr patterns compared to the low-risk group. The study also used early discharge (within 3 days of hospitalization) as a prognostic indicator and analyzed the prognostic significance of ECG for early discharge in both moderate- and low-risk patients. Univariate analysis showed that the S wave in lead V5 (S-V5) and the R wave in lead V1 + S-V5 were significant predictors for early discharge. After multivariate adjustment, S-V5 remained the only independent predictor for early discharge. A lower S-V5 (depth ≤0.15 mV) was associated with a better prognosis, indicating that a lower S-V5 (depth ≤0.15 mV) is related to early discharge in these patients [40]. For non-high-risk APE patients, ECG can provide important information to guide treatment and predict prognosis, helping identify those who may benefit from early discharge [41]. Many studies have analyzed the prognostic significance of ECG in APE patients, most of which focus on high-risk APE patients. However, the prognostic value of ECG in moderate- and low-risk APE patients is still less explored. In the case of moderate- and low-risk APE patients, it is crucial not only to categorize them as non-high-risk but also to identify factors that may influence their length of stay, thus potentially reducing hospitalization time, which can alleviate both the economic and psychological burdens on the patients.

4 Conclusion

APE is a clinically severe acute cardiovascular disease, and with ongoing medical advancements, the diagnostic rate for APE has improved, allowing patients to receive timely treatment. ECG, as a widely used and convenient diagnostic tool, not only serves as an initial clue in the diagnosis of APE but also provides significant prognostic value. Abnormalities such as ST elevation in aVR, T-wave inversions in V2-V4, RBBB, $S_1Q_3T_3$ pattern, sinus tachycardia, fQRS dynamics, lower S-V5 amplitude, and atrial fibrillation can predict adverse outcomes and hospitalization duration in APE patients. Therefore, ECG can serve as a valuable reference for the diagnosis and treatment of APE patients.

Conflict of interest None

Reference

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· 研究进展 ·

心电图在急性肺栓塞中的预后价值

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摘要：急性肺栓塞是临床较为常见的一种急性心血管疾病，其可引起呼吸、循环衰竭，患者预后较差，是心血管疾病中常见的死亡原因之一。心电图检查具有简便、快捷、费用低等特点，是临床上最常见的检查。近年来，许多研究显示心电图不仅对急性肺栓塞有诊断价值，同时在评估患者预后方面也有一定价值。患者心电图出现 aVR 导联 ST 段抬高、V2～V4 导联 T 波倒置、右束支传导阻滞、窦性心动过速、$S_1Q_3T_3$ 型、碎裂性 QRS 波群动态变化、较低的 V5 导联 S 波深度及心房颤动等异常可预测其死亡结局及住院时长。

关键词：急性肺栓塞；心电图；右束支传导阻滞；T 波倒置；预后

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Abstract: Acute pulmonary embolism is a common acute cardiovascular disease in clinical practice. It can lead to respiratory and circulatory failure, with a poor prognosis for patients, and is one of the common causes of death in cardiovascular diseases. Electrocardiography (ECG) is a simple, fast, and low-cost examination, making it one of the most commonly used test in clinical settings. In recent years, numerous studies have shown that ECG not only has diagnostic value for acute pulmonary embolism but also provides certain prognostic value for assessing patient outcomes. Abnormalities such as ST segment elevation in lead aVR, T wave inversion in leads V2-V4, right bundle branch block, sinus tachycardia, $S_1Q_3T_3$ pattern, fragmented QRS complex dynamics, a lower depth of the S wave in lead V5, and atrial fibrillation on the ECG can predict mortality outcomes and length of hospital stay.

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肺栓塞是临床中较为常见的一种心血管疾病，以急性肺栓塞(acute pulmonary embolism, APE)最为常见，APE 会引起多种病理生理反应，其中包括低氧血症和右心室衰竭[1]，是一种潜在的危及生命的医疗紧急情况，是心血管死亡的主要原因，是一个重大的公共卫生问题[2]。由于大多数肺栓塞相关症状是非特异性的，从无症状到血流动力学不稳定和死亡，因此，其诊断可能具有挑战性[3]。尽管近年来检查方式的多样性及准确性不断提高，能更早更准确的诊断 APE，争取了最佳治疗时间。但仍有不少患者出现死亡等不良结局，尤其是出现休克及血流动力学不稳定的患者[4]。APE 产生的负面生理后果，最终可导致右心室衰竭，这是 APE 患者主要死亡原因[5]。因此，更快更准确地评估病情严重程度、预测患者预后情况变得至关重要。

心电图是临床上最常见的检查手段，通常作为大部分心血管疾病的首要检查。心电图作为一项反映心脏电活动的基础检查，不仅能反映心脏结构和功能紊乱，同时也能反映部分非心脏来源的系统性影响，如炎症、离子电变化、直接心肌细胞毒性作用和神经系统紊乱引起的血流动力学变化[6]。由于心电图在临床的广泛应用，其在 APE 患者中的应用也逐渐被重视。有研究发现，心电图的异常与血流动力学不稳定存在

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一定关联[7]，对 APE 患者的预后有一定的预测价值[8]。

1 APE 的分级

APE 患者分级可在一定程度上评估患者的预后，因此，对于入院患者来说，及时进行风险评估尤为重要[9]。临床上通常根据 APE 患者的血流动力学、右心功能情况和心肌损伤标志物分为高危、中危和低危 3 级。高危患者有心肌损伤标志物升高、右心功能不全，同时伴有休克和低血压；中危患者存在右心功能不全，同时伴或不伴有心肌损伤，但无休克或低血压表现；低危患者既无休克表现也不存在右心功能不全或心肌损伤。上述右心功能不全主要表现为：出现因肝淤血而导致的腹胀、恶心、呕吐、食欲减退等胃肠道症状，以及劳累性呼吸困难，主要原因为右心功能不全时外周血回心受阻，导致血液淤积外周，尤其肝淤血明显[10]。肺栓塞严重指数（PESI）也是常用的肺栓塞严重程度分级工具，可用于评估患者的预后[11-12]。初始 PESI 主要根据年龄、性别、并发症、相关临床表现来进行评分；简化 PESI 评分包括原始评分的选定变量（年龄、癌症史、慢性心肺病史、脉搏、收缩压和血氧饱和度），0 分患者被认为是低风险，其他所有患者都被认为是高风险[13]。

2 APE 的心电图表现

研究发现心电图对肺栓塞的诊断具有一定价值，发生肺栓塞时可出现心脏结构及功能的改变，从而引起心肌细胞电活动改变[14-18]。虽然没有独立的异常心电图与肺栓塞明确相关，但某些异常心电图已被证明具有合理的特异性[19-21]。APE 的心电图表现包括节律和状态障碍以及 QRS 波、T 波的变化，最常见的为窦性心动过速[22]；此外还有 $S_1Q_3T_3$ 模式、右束支传导阻滞（RBBB）等，$S_1Q_3T_3$ 模式主要表现为Ⅰ导联为 S 波、Ⅲ导联为 Q 波、Ⅲ导联为倒 T 波，还有一些少见的表现，如右心前倒 T 波[23]。近年来，有许多研究表明 APE 患者的心电图表现为 RBBB 及 $S_1Q_3T_3$ 模式时对评估肺栓塞患者发生并发症也有一定价值[24-25]。在 APE 中，同时还存在 ST 段抬高，可出现Ⅲ、aVF 等肢体导联 ST 呈弓背向上图形，但抬高一般不超过 0.1 mV；也可有胸导联（V1～V4）ST 段抬高，呈弓背向上图形。因此，对于出现急性胸痛的患者，应第一时间行心电图检查，在有 ST 抬高的患者中，应在怀疑急性心肌梗死的同时，进一步排除是否为 APE。一般而言，APE 患者心电图 ST 抬高程度较轻，通常不超过 0.1 mV，且一般不出现动态改变[26]。在不同栓塞面积的 APE 分层中，心电图的表现也会有所不同，在一项纳入 250 例 APE 患者的回顾性研究中，将 APE 患者分为大面积性或亚大面积性肺栓塞组及节段性肺栓塞，研究结果显示，在大面积性或亚大面积性肺栓塞患者中，心电图异常发生率显著升高，包括电轴右偏、ST 段异常、$S_1Q_3T_3$ 模式、V1～V3 导联 T 波倒置、V4～V6 导联 T 波倒置和整体倒 T 波（V1～V6 导联）；其中 V1～V3 导联 T 波倒置、V4～V6 导联 T 波倒置是预测大面积性或亚大面积肺栓塞的独立预测因素。此研究还发现，与经典心电图表现相比，V1～V3 导联的倒 T 波，在鉴别大面积性或亚大面积性 APE 方面具有最高的总体诊断准确性[27]。此外，心电图可反映 APE 的血流动力学不稳定，Zhan 等[7]研究发现 APE 的血流动力学不稳定主要是通过心肌缺血体征和 12 导联心电图右心室应变模式反映出来。

3 心电图对 APE 患者的预后价值

很显然，APE 的早诊断、早治疗尤为重要，心电图作为临床常用且便捷的辅助检查可以在 APE 的诊断中提供有价值的参考信息，同时在 APE 患者的预后中也扮演重要的角色。心电图对比其他影像学检查，在临床上使用广泛，具有简便、易操作及费用低等优点，同时能很好地反映心脏活动，对 APE 及急性心肌梗死等急性心血管疾病有很好的诊断价值[6]。不仅如此，现有研究表明，心电图对 APE 患者的预后评估也有一定价值[28-31]。

3.1 *对死亡等不良结局的预测* 一项 Meta 分析显示心电图表现为急性肺动脉高压引起的右心室劳损（窦性心动过速、$S_1Q_3T_3$ 型、RBBB、V2～V3 导联 T 波倒置、aVR 导联 ST 段抬高和房颤）时与循环休克和肺栓塞死亡的概率显著增加有关[32]。在一项前瞻性研究中，根据 APE 患者是否出现早期临床恶化进行分组，将两组的心电图表现进行分析，研究将临床恶化定义为呼吸衰竭、低血压、心律失常、心脏骤停、肺栓塞干预升级或 5 d 内死亡，结果发现心电图表现中有窦性心动过速、T 波倒置（V2～V4、Ⅱ、Ⅲ和 aVF 导联）、ST 段抬高（aVR、V1 导联）、V4～V6 导联 ST 段压低、室上性心动过速表现的患者更容易出现临床恶化，且室上性心动过速是唯一独立预测临床恶化的心电图模式。此研究还将患者分为超声心动图右心室正常组及异常组，比较两组心电图表现，结果显示两组患者心电图表现为 T 波倒置（V2～V4、Ⅱ、Ⅲ和 aVF 导联）、$S_1Q_3T_3$ 型、RBBB、aVR 导联 ST 段抬高时有明显差异；aVR 导联 ST 段抬高、V2～V4 导联 T 波倒置、不完全性 RBBB、$S_1Q_3T_3$ 型和窦性心动过速是 APE 患者发生右心室异常的独立危险因素[33]。在发生 APE 时，因突然出现的肺动脉血流受阻可致右心室压力增加、扩张或心肌受损，从而引起右心室异常，心电图可反映右心室异常，常见的与 APE 中右心室异常相关的心电图异常包括向右轴移动、复极化异常、ST 段心肌损伤模式、传导阻滞和节律紊乱[8]。

高危 APE 患者存在右心功能不全，右心功能的恢复情况影响患者的预后，心电图可反映右心功能情况从而对危重 APE 患者有一定的预后价值。Geibel 等[34]一项大型多中心前瞻性研究分析了严重 APE 患者入院时特定心电图参数的预后价值。此研究共纳入 508 例患者，将入院后 30 d 内是否存活作为预后指标，单因素分析显示心房心律失常（主要是心房颤动或扑动）、完全性 RBBB、外周低电压、Ⅲ和 aVF 导联假梗死模式（Q 波）以及左心前导联 ST 段改变（抬高或降低）在死亡结局的患者中都更为常见，与不良临床结局相关。因此，上述心电图表现对于严重 APE 患者 30 d 内是否存活有一定的预后价值。另一项来自意大利的研究评估了 APE 患者住

院期间的心电图变化,以及这些心电图变化对 APE 患者 30 d 死亡率的预后作用。结果显示,入院 3 d 后右心室应变心电图表现的持续存在是高危 APE 患者 30 d 死亡率的独立预测因素。其中右心室应变定义为存在 RBBB、$S_1Q_3T_3$ 和 NTWs(T 波倒置)中的至少一种;同时发现 RBBB、V1～V4 导联 T 波倒置和 V1 导联 qR 3 种心电图异常中至少两种持续存在的高危 APE 住院患者风险更高,都存在则死亡风险最高[35]。Novicic 等[36]研究表明,RBBB 及 aVL 导联中 S 波的消退与中高危险患者的全因 30 d 死亡率降低有关,这说明 RBBB 可在一定程度上预测患者的死亡结局。除了上述心电图表现可评估患者发生死亡等不良结局的风险,也有研究发现碎裂性 QRS(fQRS)波群动态变化也可在一定程度上预测患者的预后情况。一项回顾性研究分析了 fQRS 波群动态变化对 APE 患者的意义,将 fQRS 波群动态变化分为较深组、较浅组和不变组,结果显示与动态较深 fQRS 波群相比,动态较浅 fQRS 波群是 APE 患者预后良好的指标,而动态较深 fQRS 波群则表明预后不良[37]。亦有研究发现入院时心率过快会增加 APE 患者的死亡率[38]。此外,合并心房颤动与 APE 住院患者的死亡率增加和临床结局较差相关[39]。

3.2　对住院时长的预测　对于一些非高危 APE 患者的预后来说,能更好地预测其住院时长,可以让低风险患者出院后门诊继续治疗,这在一定程度上减少患者的心理及经济负担[13]。一项前瞻性研究分析了心电图对非高危 APE 患者早期出院的预测价值,此研究将患者分为中危组及低危 APE 组,研究发现,中危患者的右心室大小及住院时长均高于低危组,同时两组患者的心电图表现有所不同,中危组心电图表现为 RBBB 型、$S_1Q_3T_3$ 型、V1 型 Qr 型较低危组多。该研究还将早期出院(患者入院后 3 d 内出院)作为预后指标,分析了心电图对于中、低危患者早期出院的预后意义,单因素分析显示,V5 导联 S 波(S-V5)和 V1 导联 R 波(R-V1)+S-V5 对早期出院具有预后意义;多因素调整后,S-V5 是早期出院唯一的独立预后因素,较低的 S-V5(深度≤0.15 mV)与较好的预后相关,这表明较低的 S-V5(深度≤0.15 mV)与这些患者的早期出院有关[40]。对于非高危 APE 患者来说,心电图在一定程度上可以为指导治疗和确定预后提供重要信息,识别早期出院的患者,使其受益[41]。许多研究分析了心电图在 APE 患者中的预后意义,其中大多数为高危 APE 患者的预后研究,而心电图在中、低危 APE 患者中的预后价值目前的研究仍较少,对于中、低危 APE 患者,在确定其为非高危风险的同时,也需要确定一些能影响其住院时长的风险,以便能减少患者的住院时长,这能在一定程度上减轻患者的经济负担及精神负担。

4　总　结

APE 是一种临床较为严重的急性心血管疾病,随着医学的不断发展,APE 的诊断率不断提高,这使患者可以尽快得到有效治疗,同时根据 APE 的临床特征判断患者的预后,给予相关干预措施尽可能的改善患者预后。心电图是临床上常用且便捷的检查,其能反映心脏电活动,既可作为 APE 诊断的初步线索,又对 APE 患者的预后有一定意义。患者心电图出现 aVR 导联 ST 段抬高、V2～V4 导联 T 波倒置、RBBB、$S_1Q_3T_3$ 型、窦性心动过速、fQRS 波群动态变化、较低的 S-V5 深度、心房颤动等异常可预测其死亡结局及住院时长。因此,临床充分利用心电图,可以对 APE 患者的诊治提供更好的参考价值。

利益冲突　无

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