

# 衰弱评估在急诊手术患者中的应用进展

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## 摘要

急诊手术患者常伴有多病共存、生理储备下降而呈现较高衰弱发生率, 导致围术期麻醉风险增加。术前衰弱评估对识别高危患者与风险分层、优化围术期管理策略尤为重要。本综述系统梳理了适用于急诊手术场景的衰弱评估工具, 并分析其应用特点与预测效能。尽管这些工具在急诊环境中具有重要应用价值, 仍普遍存在操作复杂、依赖完整临床信息及人群适应性有限等局限。未来可重点发展融合机器学习技术的整合型评估工具, 以提升早期识别与精准管理能力, 从而改善患者预后。

## 关键词

衰弱, 急诊外科手术, 老年人, 术前评估, 风险因素

# Advances in Frailty Assessment for Emergency Surgery Patients

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## Abstract

Frailty is highly prevalent among emergency surgery patients, often associated with multiple comorbidities and decreased physiological reserve, leading to increased perioperative anesthetic risks. Pre-operative frailty assessment is crucial for identifying high-risk patients, stratifying risk, and optimizing perioperative management strategies. This review systematically examines frailty assessment tools applicable to emergency surgical settings and analyzes their practical characteristics and predictive performance. Although these tools hold significant clinical value in emergency environments,

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they generally face limitations such as assessment complexity, reliance on complete clinical information, and limited population adaptability. Future efforts should prioritize the development of integrated assessment tools that incorporate machine learning technology to enhance early detection and precision management, thereby improving patient outcomes.

## Keywords

Frailty, Emergency Surgical Procedures, Aged, Preoperative Care, Risk Factors

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## 1. 引言

急诊手术患者的术前评估常面临时间紧迫、信息完整性受限等挑战,麻醉风险显著升高[1]。衰弱已被证实是较年龄更为精准地预测术后不良结局的独立危险因素[2],世界急诊外科学会(World Society of Emergency Surgery, WSES)亦明确推荐将衰弱评估纳入急诊外科诊疗流程[3]。本综述旨在系统阐述衰弱评估在急诊手术患者中的应用进展,以期改善围术期管理策略提供循证依据。

## 2. 急诊手术患者衰弱发生率

流行病学研究显示,急诊手术患者中衰弱检出率呈上升趋势[4]。成年人总体衰弱发生率约 10.6%~13.2% [5] [6], ≥55 岁人群升至 14.6% [7],老年群体中可达 20%~41% [8]-[10]。瑞典多中心研究报告为 57.3% [11], 中国为 44.6% [12]。按手术风险分层,高风险急诊普外科手术患者的衰弱发生率(15.06%~31.0%)显著高于低风险患者(9.89%~21.6%) [13] [14]。值得注意的是,衰弱为一动态过程,早期识别与干预对延缓其进展、改善患者预后及优化临床资源配置至关重要[15]。

## 3. 衰弱对急诊手术患者预后的影响

衰弱是急诊手术患者不良结局的独立预测因素,与死亡率和并发症升高、住院时间和术后重症监护病房(Intensive Care Unit, ICU)停留时间延长、以及生活质量下降显著相关。

### 3.1. 死亡率

随着衰弱程度增加,患者死亡风险明显上升,且对短期死亡率的影响尤为显著。新西兰一项针对年龄 ≥ 55 岁接受急诊手术患者的多中心前瞻性研究显示,临床衰弱量表(Clinical Frailty Scale, CFS) ≥ 5 分的衰弱患者术后 30 天和 1 年死亡率分别为非衰弱患者的 2.6 倍和 2.0 倍[7];另一项纳入年龄 ≥ 65 岁接受急诊普外科手术患者的荟萃分析发现, CFS ≥ 5 分或 11 项改良衰弱指数(11-item Modified Frailty Index, mFI-11) ≥ 3 分的衰弱患者术后 30 天死亡风险比为 2.91 [8]。此外, Alkadri 等[9]报道,在年龄 ≥ 66 岁急诊普外科手术患者中,术前衰弱指数(preoperative Frailty Index, pFI) ≥ 0.21 的衰弱患者术后居家存活天数明显少于非衰弱患者,其 30 天和 1 年居家存活天数分别减少 32%和 28%,且半数衰弱患者术后 1 年内居家存活天数为 0。

### 3.2. 并发症

Kenawy 等[16]采用 5 项改良衰弱指数(5-item Modified Frailty Index, mFI-5)对老年急诊普外科手术患

者的研究表明, 轻、中、重度衰弱患者的并发症风险依次增加 46%、148%和 401%。衰弱患者术后更易发生肺炎、脓毒症和再次手术[7][17], 严重并发症风险增至 50%~287% [7][8][17][18]且抢救失败率也较非衰弱患者增加 50%~130% [14]。

### 3.3. 住院时间和 ICU 停留时间

研究[19]证实, 急诊手术老年患者的衰弱程度与住院时间呈正相关, 即衰弱程度越重, 住院时间越长。Parmar 等[20]的前瞻性多中心研究进一步显示, 衰弱患者术后 ICU 占用率显著上升, 且 ICU 停留时间延长的风险随 CFS 评分增加而递增, 其中中重度衰弱患者的相关风险可达非衰弱患者的 4 倍以上。

### 3.4. 生活质量

超过 30%的老年急诊腹部手术患者出院后无法返家[3], 8.8%需依赖他人完成基本日常生活活动能力), 30.1%丧失工具性日常生活能力。衰弱使无法返家风险增加 1 倍[7], 超过 1/3 的衰弱患者需更高级别护理[21], 且功能独立性进行性丧失, 严重影响生存质量[7]。

约 1/3 的急诊衰弱患者术后需康复干预, 是非衰弱患者的 2 倍[7]。因此, 建议针对衰弱患者早期规划康复资源, 并将此类风险纳入术前沟通内容。

## 4. 用于急诊手术患者的衰弱评估工具

尽管 WSES 2023 共识强烈推荐对急诊手术患者常规开展衰弱评估[3], 但麻醉医师对其认知与应用仍存在明显不足。近一半高年资麻醉医师不熟悉衰弱评估, 仅 9%曾接受相关培训[22]。当前常用评估工具如衰弱表型模型, 累积缺陷模型(Rockwood 指数)等不仅操作耗时, 且不同工具识别出的衰弱人群重合度较低, 反映出衰弱本身具有高度异质性和多维复杂特征[2]。在急诊环境中, 评估时间需短于 5 分钟才具备临床可行性[23], 常用于急诊手术患者衰弱评估的量表主要有以下几种。

### 4.1. 临床衰弱量表

CFS 是由 Rockwood 团队开发, 当前的 9 级版本能精细区分衰弱程度, 尤其适用于老年患者。WSES 2023 共识将  $CFS \geq 5$  分作为衰弱诊断标准, 推荐所有  $\geq 65$  岁的急诊手术患者常规进行 CFS 筛查, 评定为衰弱者应在 72 小时内接受老年综合评估(Comprehensive Geriatric Assessment, CGA) [3]。尽管多数研究认为 CFS 在不同评估者间具有优良的一致性[24]-[26], 但新近 Ellis 等[19]的研究指出有 15.4%的评分变异源于评估者差异, 同时急性疾病严重程度也可能干扰评估可靠性。目前关于 CFS 对手术结局影响的外部验证多基于死亡率、住院时间等客观终点, 而对患者主观感受及生活质量影响的研究仍较少[27]。

### 4.2. 改良衰弱指数(Modified Frailty Index, mFI)

由 Velanovich 等创建的 mFI-11 可有效预测急诊手术患者的不良预后[7], 而更便捷的 mFI-5 在长期死亡率预测方面的价值与其相当。尽管 mFI-5 在预测术后早期结局和心血管事件风险方面不如 mFI-11 全面, 但因其变量少、效率高, 更适用于急诊场景[28]。需要注意的是, 两者均基于合并症计数模型, 仅依赖术前信息, 可能无法有效识别功能性衰弱, 且在病史不全的急诊患者中适用性有限[29][30]。

### 4.3. 创伤特异性衰弱指数(Trauma-Specific Frailty Index, TSFI)与急诊普外科手术衰弱指数(Emergency General Surgery Frailty Index, EGSFI)

由 Joseph 团队开发的 TSFI 是首个专为老年急诊创伤患者设计, 基于入院前状态的快速床旁多维评估工具。该工具包含 15 个条目, 涵盖共病、认知、日常生活能力、心理及营养 5 个维度, 以  $\geq 0.27$  为界

值。内部验证显示其对出院后不良结局具有良好的预测能力, 其受试者工作特征(Receiver Operating Characteristic, ROC)曲线的曲线下面积(Area Under the Curve, AUC)达 0.829 [31]。随后该团队推出专为老年急诊普外科手术患者优化的 EGSFI, 包含共病、日常生活能力、心理及营养 4 个维度共 15 项多维变量, 以  $\geq 0.325$  为界值, 可预测术后并发症(AUC = 0.712)和抢救失败(AUC = 0.746)风险, 但尚未经外部多中心研究验证[32][33]。后续 Weiss 等[34]将 EGSFI 进一步简化至 6 项指标以提升临床实用性, 虽内部验证效能较高(AUC = 0.871), 但外部验证的 AUC 降至 0.700, 且存在低估功能丧失的风险, 故目前仅建议其用于资源有限时的快速筛查。

#### 4.4. 基于病史数据的评估工具

术前衰弱指数(Preoperative Frailty Index, pFI)是基于健康管理数据的老年手术多维评估工具, 涵盖合并症、认知、功能、情绪、营养及社会经济等 30 个变量, 每个变量按 0、0.5 或 1 分三级赋分。累计总分除以 30,  $\geq 0.21$  判定为衰弱。该工具有效预测急诊手术患者的长期死亡风险(AUC = 0.700)。其优势包括对不良结局预测较准确, 及在数据缺失低于 15% 时评估稳定性较好(Kappa = 0.97), 但评估内容未涵盖认知功能与肌少症等核心维度[35]。

医院衰弱风险评分(Hospital Frailty Risk Score, HFRS)为通过衰弱相关诊断编码筛查的自动化工具, 原用于预测老年住院患者的不良结局[36]。Grudzinski 等[2]的大样本回顾性研究中显示: HFRS  $\geq 15$  分可较准确预测老年急诊普外科手术患者的住院时间和医疗费用, 但其效能受病历质量限制。

#### 4.5. 快速筛查工具

在繁忙的急诊科环境中, 简易且高灵敏度的衰弱筛查工具有助于快速识别高危患者。急诊简化版风险分析指数(Risk Analysis Index, RAI)包含认知、决策、生活、行动、精神及沟通能力评估共 6 个条目, 每项评分 0~6 分, 总分  $\geq 3$  分即判定为衰弱。研究表明, 该工具筛查衰弱的灵敏度较高[37], 但与其他评估工具的一致性较低[2]。

佛兰德精简版老年急诊风险筛查量表(Flemish version of the Triage Risk Screening Tool, fTRST)则对认知功能下降、独居或缺乏照护、近期跌倒或活动受限、近 3 个月住院史及多重用药共 5 项指标进行评分, 总分  $\geq 2$  分提示存在衰弱。该工具是当前最简短的术前衰弱筛查工具之一, 外部验证显示其对死亡率的预测敏感度达 96.0%~100%, 但特异性较低(42.7%~43.5%) [38], 准确性有限[39]。该工具依赖病史及家属代述, 主观性较强, 仅适用于快速初步筛查。

此外, Nissen 等[40]开发的 FaP-ED (Frailty adjusted Prognosis in Emergency Department)融合生命体征与衰弱评估, 操作简便, 在老年急诊患者中预测短期死亡风险的 AUC 达 0.860, 准确性优于单独使用英国国家早期预警评分(National Early Warning Score, NEWS; AUC = 0.800)或 CFS (AUC = 0.820), 适合急诊快速评估。

Liu 等[12]基于 Fried 表型构建了 5 项自评衰弱筛查问卷(Frailty Screening Questionnaire, FSQ), 证实其在中国急诊老年患者中具有可行性, 并与短期死亡及多项不良结局显著相关, 适用于快速筛查。

#### 4.6. 基于功能与储备的评估方案

Katz 指数(Katz Index)通过量化功能独立性, 可有效评估患者入院时功能状态, 弥补多维工具时效性不足的缺陷[41]。Cihoric 等[42]探索的美国东部肿瘤协作组体能状态评分(Eastern Cooperative Oncology Group performance status, ECOG)不依赖于病历, 能快速反映术前生理储备, 可作为衰弱替代指标。动态银发代码(Dynamic Silver Code, DSC)与行走功能丧失显著相关(OR = 7.45), 同样适用于急诊老年患者的

辅助评估[43]。

## 4.7. 术前多维辅助评估指标

### 4.7.1. 影像学参数

基于影像学的肌少症(Sarcopenia)评估可作为传统衰弱工具的有效补充, 尤其适用于病史不全或无法配合功能测试的患者[3]。腰大肌面积(psoas area, PA)常被标准化为腰肌指数(muscle index, PMI)或腰大肌体表面积比(Psoas muscle to Body Surface Area ratio, PBSA), 操作简便但仅反映肌肉数量而非质量[5][44]; 相比之下, 腰大肌密度在预测老年急诊手术患者术后死亡率方面价值更高, 且更适用于急诊场景, 但其评估需专用软件, 并可能存在人群差异性[44][45]。Simpson 等[46]的多中心研究显示, 低腰大肌与第三腰椎体横截面积比值(psoas major-to-L3 cross-sectional area, PML3)者死亡率增加 9-10 倍, 联合朴茨茅斯修正生理与手术严重度评分(Portsmouth-Physiological and Operative Severity Score for the enUmeration of Mortality and morbidity, P-POSSUM)可显著提升预测准确性。然而, 目前仍缺乏高质量研究以确立可靠的风险分层标准。

### 4.7.2. 生物标志物

Rattray 等[47]证实生育三烯酚类和肉碱类的 12 种特异性生物标志物可用于区分衰弱表型。George [48]与 Berry [49]等团队则提出可通过常规检验指标识别“炎性衰老”表型, 如红细胞沉降率持续升高( $\geq 16$  mm/h)、淋巴细胞计数增多( $\geq 4.1 \times 10^9/L$ )及红细胞体积分布宽度动态上升, 该类表型与术后远期死亡率和 ICU 停留时间延长相关, 但目前尚缺乏其预测结局的有力证据。

## 5. 小结与展望

### 5.1. 局限性与目前困境

本综述作为叙述性综述, 在证据整合上存在主观性。其次, 所纳入研究多基于国际临床数据, 国际衰弱评估工具在我国急诊应用中面临病史不全、方言与文化差异、缺乏本土常模及急诊资源紧张等现实挑战。衰弱是老年急诊手术患者预后不佳的独立危险因素, 现有评估工具虽有一定预测价值, 但仍存在操作耗时、依赖完整数据及人群异质性等局限。Razjouyan 等[50]尝试基于机器学习方法构建的简约衰弱指数虽实现快速识别心衰患者死亡风险, 但 AUC 仅 0.640~0.650, 预测准确性有限。Belmin 等[51]将人工智能预警嵌入社区照护, 使急诊就诊率下降, 却面临假阳性偏高问题。

### 5.2. 展望

未来应重点开发自动化、多维度融合的评估系统, 结合机器学习提升预测精度, 并验证适用于中国人群的快速筛查工具, 构建“社区-急诊”协同模式。整合老年与社区衰弱性指标, 建立双重衰弱性风险分层模型并嵌入区域医疗信息系统。对于高风险患者触发前瞻性干预以降低不必要的就诊, 同时, 患者就诊时, 系统自动生成高危预警, 即时启动院内多学科加速康复路径。再通过出院计划移交与主动社区随访机制, 实现院内外管理的无缝衔接, 从而系统优化高龄衰弱患者的围手术期结局与远期预后。

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