

· 临床研究 ·

改良衰弱指数预测老年全髋关节置换术后并发症的临床应用

郝新宇¹, 欧阳春磊¹, 徐子尧¹, 米卫东², 刘靖^{2*}

(¹ 解放军医学院, 北京 100853; ² 中国人民解放军总医院第一医学中心麻醉科, 北京 100853)

【摘要】目的 探讨改良衰弱指数(mFI-5)预测老年全髋关节置换术后并发症的临床应用价值, 为患者围手术期综合干预提供参考依据。**方法** 回顾性分析2014年1月至2019年8月于中国人民解放军总医院第一医学中心骨科收治的年龄 ≥ 65 岁的老年全髋关节置换手术639例患者的临床资料。收集患者人口统计学资料、手术相关信息、mFI-5评分变量及术后并发症信息, 构建mFI-5。根据mFI-5评分分为衰弱组(mFI-5 ≥ 2 分)与非衰弱组(mFI-5 < 2 分)。术后并发症包括术后谵妄、脑卒中、肺炎、深静脉血栓及肺不张。比较2组患者术后并发症的发生情况。采用SPSS 26.0软件进行数据分析。根据数据类型, 组间比较分别采用 t 检验及 χ^2 检验。采用二分类多因素logistic回归分析探讨衰弱对全髋关节置换患者术后并发症的预测作用。**结果** 衰弱组190例(29.73%), 非衰弱组449例(70.27%)。2组患者性别、美国麻醉医师协会分级及麻醉方式比较, 差异均有统计学意义(均 $P < 0.05$)。衰弱组在慢性阻塞性肺疾病或慢性肺炎病史、非独立功能状态、2型糖尿病史、术前30d内充血性心力衰竭史以及需要药物治疗的高血压病史五个方面的发生情况均明显高于非衰弱组, 差异均有统计学意义[27例(14.21%)和9例(2.00%), 132例(69.47%)和43例(9.58%), 92例(48.42%)和23例(5.12%), 2例(1.05%)和0(0.00), 176例(92.63%)和177例(39.42%); 均 $P < 0.001$]。衰弱组患者总并发症发生率明显高于非衰弱组, 差异有统计学意义[94例(49.47%)和20例(4.45%); $P < 0.001$]。多因素logistic回归分析显示, 衰弱组患者出现术后并发症的风险是非衰弱组倍12.23倍($OR = 12.23, 95\%CI 6.51 \sim 23.98; P = 0.002$), 差异有统计学意义($P < 0.05$)。衰弱是术后谵妄($OR = 10.32, 95\%CI 5.63 \sim 23.79; P = 0.022$)、脑卒中($OR = 12.24, 95\%CI 5.09 \sim 69.01; P < 0.001$)、肺部感染($OR = 5.88, 95\%CI 2.31 \sim 23.91; P < 0.001$)和DVT($OR = 27.61, 95\%CI 3.02 \sim 78.24; P = 0.034$)的独立危险因素。**结论** mFI-5是预测老年全髋关节置换患者术后并发症的有效评估工具, mFI-5 ≥ 2 分可作为预测术后并发症的有效指标。

【关键词】 老年人; 改良衰弱指数; 全髋关节置换术; 术后并发症

【中图分类号】 R816.8

【文献标志码】 A

【DOI】 10.11915/j.issn.1671-5403.2022.07.104

Clinical application of modified frailty index in predicting complications after total hip arthroplasty in the elderly

HAO Xin-Yu¹, OUYANG Chun-Lei¹, XU Zi-Yao¹, MI Wei-Dong², LIU Jing^{2*}

(¹Medical School of Chinese PLA, Beijing 100853, China; ²Department of Anesthesiology, First Medical Center, Chinese PLA General Hospital, Beijing 100853, China)

【Abstract】Objective To explore the clinical value of the 5-factor modified frailty index (mFI-5) in predicting complications after total hip arthroplasty in the elderly with a view to providing a reference for patients with a comprehensive intervention during the perioperative period. **Methods** A retrospective analysis was made of the clinical data of 639 patients aged ≥ 65 years, who underwent total hip arthroplasty in the Department of Orthopedics of the First Medical Center of the Chinese People's Liberation Army General Hospital from January 2014 to August 2019. mFI-5 was calculated by collecting patient demographics, surgery-related information, mFI-5 scoring variables, and postoperative complications. According to the mFI-5 score, the patients were divided into a frail group (mFI-5 ≥ 2 points) and a non-frail group (mFI-5 < 2 points). Postoperative complications included postoperative delirium, stroke, pneumonia, deep vein thrombosis, and atelectasis. The two groups were compared in the incidence of postoperative complications. SPSS 26.0 was used for statistical analysis. Intergroup comparison was performed using t test or χ^2 test depending on data type. Multivariate logistic regression analysis was used to investigate the predictive effect of frailty on postoperative complications in patients with total hip arthroplasty. **Results** There were 190 cases (29.73%) in the frail group and 449 cases (70.27%) in the non-frail group. There

收稿日期: 2021-12-21; 接受日期: 2022-02-17

基金项目: 国家重点研发计划(2018YFC2001900)

通信作者: 刘靖, E-mail: liuj301@163.com

were significant differences in gender, American Society of Anesthesiologists classification and anesthesia method between the two groups (all $P < 0.05$). The frail group had significantly higher incidences in five aspects: history of chronic obstructive pulmonary disease or chronic pneumonia [27 (14.21%) vs 9 (2.00%)], dependent functional status [132 (69.47%) vs 43 (9.58%)], history of type 2 diabetes mellitus [92 (48.42%) vs 23 (5.12%)], history of congestive heart failure within 30 d before surgery [2 (1.05%) vs 0 (0.00%)], and history of hypertension requiring drug treatment [176 (92.63%) vs 177 (39.42%); all $P < 0.001$]. The incidence of total complications in the frail group was significantly higher than that in the non-frail group [94 (49.47%) vs 20 (4.45%); $P < 0.001$]. Multivariate logistic regression analysis showed that the risk of postoperative complications in the frail group was 12.23 times that of the non-frail group ($OR = 12.23$, 95% CI 6.51–23.98; $P = 0.002$), and the difference was statistically significant ($P < 0.05$). Frailty was independent risk factors of delirium ($OR = 10.32$, 95% CI 5.63–23.79; $P = 0.022$), stroke ($OR = 12.24$, 95% CI 5.09–69.01; $P < 0.001$), pulmonary infection ($OR = 5.88$, 95% CI 2.31–23.91; $P < 0.001$) and DVT ($OR = 27.61$, 95% CI 3.02–78.24; $P = 0.034$). **Conclusion** mFI-5 is an effective tool for predicting postoperative complications in the elderly patients with total hip arthroplasty, mFI-5 ≥ 2 being an important indicator to predict postoperative complications.

【Key words】 aged; modified frailty index; total hip arthroplasty; postoperative complications

This work was supported by the National Key Research and Development Program of China (2018YFC2001900).

Corresponding author: LIU Jing, E-mail: liuj301@163.com

随着老龄化进程加快以及髋关节诊疗技术的进步,因骨性关节炎、股骨头坏死等原因需要行全髋关节置换(total hip arthroplasty, THA)的患者迅速增加^[1]。衰弱是由于患者多器官生理储备功能急剧下降而增加的脆弱性状态,表现为面对手术等压力源的反应能力下降和残疾易感性增加^[2]。既往研究发现衰弱患者术后并发症发生率、死亡率以及住院费用均增加^[3]。接受THA的老年患者通常伴有慢性基础疾病,身体机能的衰退导致其对于手术创伤的修复能力下降,容易出现衰弱状态。改良衰弱指数(the 5-factor modified frailty index, mFI-5)根据患者5个临床共病发生情况进行计算,数值代表患者生理储备能力,分数越高代表患者越衰弱。mFI-5评分可量化老年患者的衰弱程度,不依赖患者病历资料的具体数值,而是通过简单的数学模型将复杂信息集成到单一指数中,从而简洁反映出个体健康状况。但mFI-5评分运用在老年THA的研究并不充分。本研究旨在探讨mFI-5预测老年全髋关节置换术后并发症的临床应用价值,为老年THA患者围手术期综合干预及评估预后提供参考依据。

1 对象与方法

1.1 研究对象

回顾性分析中国人民解放军总医院第一医学中心骨科于2014年1月至2019年8月收治的年龄 ≥ 65 岁的639例THA手术患者的病历资料。所有研究数据均提取于中国人民解放军总医院老年患者围术期数据库。纳入标准:病历资料完整;符合中华

人民共和国卫生部发布的《人工髋关节置换术》(WS/T335–2011)标准。排除标准:病历资料不全;严重痴呆及语言障碍等无法完成相关评估的患者。本研究获得中国人民解放军总医院医学伦理委员会批准(S2021–342–01)。

1.2 方法

根据患者病例信息、化验指标及检查结果计算mFI-5分数,并标定术后并发症。标定过程由3名经验丰富的临床医师进行,2名专业人员进行数据核对,保证数据准确性。

1.2.1 mFI-5评分使用方法 mFI-5评分用于患者术前综合评估。mFI-5评分由以下五项变量组成:2型糖尿病史,非独立功能状态,慢性阻塞性肺疾病(chronic obstructive pulmonary disease, COPD)或慢性肺炎病史,术前30 d内的充血性心力衰竭病史,需要药物治疗的高血压病史^[4]。非独立功能状态定义为术前30 d日常生活活动需要他人帮助,包括洗澡、进食、穿衣和行动^[5]。本次研究取五项变量的总分进行分析,即各变量出现阳性则赋值1分,阴性为0分,评分范围为0~5分,分数越高代表患者越衰弱。基于既往研究mFI-5 ≥ 2 分是预测老年患者术后并发症的重要指标^[6],并借鉴Weaver等^[7]和Traven等^[8]的分组方式,将患者分为2组:mFI-5 < 2分为非衰弱组,mFI-5 ≥ 2 分为衰弱组。术前运用mFI-5评分评价老年患者的衰弱程度,客观地反映个体健康状况。

1.2.2 一般情况及术后并发症的比较 (1)比较2组患者的年龄、性别、体质质量指数(body mass index, BMI)、吸烟史、饮酒史、美国麻醉医师协会

(American Society of Anesthesiologists, ASA)、麻醉方式及手术时间。(2)比较2组患者mFI-5评分变量。(3)比较2组患者术后并发症发生情况。术后并发症包括谵妄、脑卒中、肺部感染、深静脉血栓(deep vein thrombosis, DVT)及肺不张的发生情况。

1.3 统计学处理

采用SPSS 26.0统计软件进行数据分析。计量资料用均数±标准差($\bar{x} \pm s$)表示,采用*t*检验;计数资料用例数(百分率)表示,采用 χ^2 检验。运用二分类多因素logistic回归分析老年THA患者发生术后并发症的危险因素。*P*<0.05为差异有统计学意义。

2 结果

2.1 2组患者一般情况比较

共纳入年龄≥65岁THA患者639例,其中衰

弱组190例(29.73%),年龄(70.56±5.06)岁;非衰弱组449例(70.27%),年龄(70.11±4.63)岁。2组患者性别、ASA分级及麻醉方式比较,差异均有统计学意义(均*P*<0.05);年龄、BMI、吸烟史、饮酒史及手术持续时间方面比较,差异均无统计学意义(均*P*>0.05;表1)。

2.2 2组患者mFI-5变量的比较

衰弱组在COPD或慢性肺炎病史、非独立功能状态、2型糖尿病史、术前30d内充血性心力衰竭史以及需要药物治疗的高血压病史五个方面的发生率均明显高于非衰弱组,差异均有统计学意义(均*P*<0.05;表2)。

2.3 2组患者术后并发症发生情况比较

2.3.1 术后并发症的单因素分析 衰弱组患者各并发症及总并发症发生率均明显高于非衰弱组,差异均有统计学意义(均*P*<0.001;表3)。

表1 2组患者一般资料比较

Table 1 Comparison of baseline data between two group

Item	<i>n</i>	Female [<i>n</i> (%)]	BMI (kg/m ² , $\bar{x} \pm s$)	Smoking [<i>n</i> (%)]	Drinking [<i>n</i> (%)]	ASA[<i>n</i> (%)]		Anesthesia method[<i>n</i> (%)]			Duration of operation (min, $\bar{x} \pm s$)
						I+II	III+IV	General anesthesia	Nerve block	Epidural anesthesia	
Non-frail	449	257(57.24)	24.94±3.85	43(9.58)	436(97.10)	401(89.31)	48(10.69)	420(93.54)	27(6.01)	2(0.45)	107.31±45.87
Frail	190	132(69.47)	25.48±3.80	10(5.26)	183(96.32)	137(72.11)	53(27.89)	163(85.79)	20(10.53)	7(3.68)	113.16±45.22
<i>t</i> / χ^2		-0.426	-1.953	1.439	4.305	-6.252	4.426		5.231		-1.457
<i>P</i> value		0.269	0.004	0.102	0.071	0.601	<0.001		<0.001		0.139

BMI: body mass index; ASA: American Society of Anesthesiologists.

表2 比较2组患者mFI-5变量

Table 2 Comparison of mFI-5 variables between two groups

[*n*(%)]

Group	<i>n</i>	COPD or chronic pneumonia	Non-independent function state	Type 2 diabetes mellitus	Heart failure within 30 d before surgery	Hypertension requiring medication
Non-frail	449	9(2.00)	43(9.58)	23(5.12)	0(0.00)	177(39.42)
Frail	190	27(14.21)	132(69.47)	92(48.42)	2(1.05)	176(92.63)
χ^2		3.521	15.565	13.694	10.542	2.657
<i>P</i> value		<0.001	<0.001	<0.001	0.029	<0.001

mFI-5: the 5-factor modified frailty index; COPD: chronic obstructive pulmonary disease.

表3 2组患者术后并发症的单因素分析

Table 3 Univariate analysis of postoperative complications in two groups

[*n*(%)]

Group	<i>n</i>	Delirium	Stroke	Pneumonia	DVT	Atelectasis	Total
Non-frail	499	9(2.00)	3(0.67)	5(1.11)	1(0.22)	2(0.45)	20(4.45)
Frail	190	37(19.47)	20(10.53)	15(7.90)	14(7.37)	8(4.21)	94(49.47)
χ^2		4.116	-4.742	2.654	5.149	-1.765	3.238
<i>P</i> value		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

DVT: deep vein thrombosis.

2.3.2 术后并发症的多因素 logistic 回归分析 校正年龄、性别、ASA 分级、麻醉方式后,衰弱组患者出现术后并发症的风险是非衰弱组的 12.23 倍,差异有统计学意义($P<0.05$)。衰弱是术后谵妄、脑卒中、肺部感染和 DVT 的独立危险因素(表 4)。

表 4 校正年龄、性别、ASA 分级及麻醉方式术后并发症的多因素 logistic 回归分析

Outcome	<i>B</i>	<i>OR</i>	95% <i>CI</i>	<i>P</i> value
Total	3.39	12.23	6.51–23.98	0.002
Delirium	2.23	10.32	5.63–23.79	0.022
Stroke	2.78	12.24	5.09–69.01	<0.001
Pneumonia	3.21	5.88	2.31–23.91	<0.001
DVT	3.24	27.61	3.02–78.24	0.034
Atelectasis	1.88	2.74	0.679–5.58	0.627

ASA: American Society of Anesthesiologists; DVT: deep vein thrombosis.

3 讨论

在人口老龄化以及 THA 需求日益增长的背景之下,老年患者术前有效风险分层对术后结局和医疗保健资源利用有重要意义。mFI-5 运用于患者术前任何时段,可根据相应变量计算出分数,进而识别出衰弱患者。针对高风险衰弱患者,临床医师可进行策略性调整手术及护理计划以便于更好地个性化治疗,如可对衰弱患者早期随访以减少再入院率及减轻术后并发症。mFI-5 评分已应用于结直肠手术^[9]、根治性膀胱切除术^[10]、胰十二指肠切除术^[11]等手术的风险评估,但对老年患者 THA 的研究并不充分。本研究探讨 mFI-5 评分对 639 例老年 THA 患者术后并发症的预测作用,结果提示衰弱组患者发生术后并发症的风险是非衰弱组 12.23 倍($P=0.002$)。

本研究发现,衰弱是术后发生 DVT 的独立危险因素,衰弱组患者出现 DVT 的风险是非衰弱组 27.61 倍。既往研究将 DVT 与其他并发症合并分析^[12],本研究首次将 DVT 与术前衰弱状态单独研究。由于 THA 手术过程中下肢被动屈曲和内收时易造成血管挤压变形,从而导致血管壁受损,释放组织因子激活外源性凝血途径,且衰弱患者术后卧床时间相对延长、患肢制动等使血流淤滞,局部组织缺氧和代谢环境改变均可能增加术后 DVT 的发生^[13]。本研究结果还显示,衰弱组术后谵妄的风险

是非衰弱组的 10.32 倍,与既往研究结果一致^[14]。虽然谵妄的机制至今未阐明,但研究发现非独立功能状态是谵妄的危险因素,较多衰弱患者术前处于非独立功能状态,且 THA 手术过程中可能会引起中枢神经系统炎症、认知神经元网络之间的连接改变以及可能造成脑功能障碍的神经递质的释放,最终导致术后谵妄的产生。

此外,本研究显示衰弱组患者多伴有慢性基础疾病,48.42% (92/190) 患者伴有 2 型糖尿病,92.63% (176/190) 患者伴有需要药物治疗的高血压。2 型糖尿病患者所伴有的血管病变是导致脑卒中发病的危险因素,长期的高血糖状态导致脑血管动脉粥样硬化、微血管基底膜增厚,红细胞变形能力下降导致阻塞性脑血管病变的发生率明显增加^[15]。本研究结果表明,衰弱与非衰弱组术后脑卒中的发生存在明显差异(12.24 倍)。临床医师通过术前 mFI-5 评分识别出衰弱患者后可实施优化策略,如及早控制血糖、血压于稳定状态;补充蛋白质热量;接受更高水平的手术护理;雾化吸入,有效清除患者呼吸道分泌物;指导患者肺部功能锻炼,增强肺功能;合理使用抗菌药物,避免肺部感染的发生;调整手术及护理计划以便于更好地个性化治疗以及对衰弱患者额外实施早期随访以减少再入院率和减轻术后并发症发生率。

mFI-5 评分作为术前衰弱筛查工具,仅需术前信息能够方便快捷地运用于门诊、病房等医疗环境;以 ≥ 2 分分层研究发现,衰弱组与非衰弱组发生术后并发症的风险达 5~27 倍的明显差距。同时,评分具有客观性,不依赖于相对主观的评分如 ASA 等。本研究尚存以下局限性:(1) 研究属于单中心回顾性研究;(2) 未对其他可能影响老年 THA 术后并发症的因素进行分析,如脑血管意外病史及外周血管疾病病史等。

综上,mFI-5 是预测年龄 ≥ 65 岁老年 THA 患者术后并发症的有效评估工具。mFI-5 ≥ 2 分是预测术后并发症的有效指标,能够为此类患者围手术期综合干预提供参考依据。

【参考文献】

[1] Perry DC, Metcalfe D, Griffin XL, *et al.* Inequalities in use of total hip arthroplasty for hip fracture: population based study[J]. BMJ, 2016, 353: i2021. DOI: 10.1136/bmj.i2021.
[2] Seib CD, Rochefort H, Chomsky-Higgins K, *et al.* Association of

- patient frailty with increased morbidity after common ambulatory general surgery operations[J]. JAMA Surg, 2018, 153(2): 160-168. DOI: 10.1001/jamasurg. 2017. 4007.
- [3] Shen YJ, Hao QK, Wang YT, *et al.* The association between preoperative modified frailty index and postoperative complications in Chinese elderly patients with hip fractures[J]. BMC Geriatr, 2021, 21(1): 370. DOI: 10.1186/s12877-021-02330-7.
- [4] Sastry RA, Pertsch N, Tang O, *et al.* Frailty and outcomes after craniotomy or craniectomy for atraumatic chronic subdural hematoma[J]. World Neurosurg, 2021, 145: e242-e251. DOI: 10.1016/j.wneu. 2020. 10. 022.
- [5] Shin JI, Keswani A, Lovy AJ, *et al.* Simplified frailty index as a predictor of adverse outcomes in total hip and knee arthroplasty[J]. J Arthroplasty, 2016, 31(11): 2389-2394. DOI: 10.1016/j.arth. 2016. 04. 020.
- [6] 孙伟, 韩起鹏. 改良衰弱指数与腹腔镜肾根治性切除术后并发症相关关系[J]. 临床军医杂志, 2021, 49(7): 815-816, 819. DOI: 10.16680/j.1671-3826. 2021. 07. 39.
- Sun W, Han QP. The correlation between modified frailty index and complications after laparoscopic radical nephrectomy[J]. J Clin Med, 2021, 49(7): 815-816, 819. DOI: 10.16680/j.1671-3826. 2021. 07. 39.
- [7] Weaver DJ, Malik AT, Jain N, *et al.* The modified 5-item frailty index: a concise and useful tool for assessing the impact of frailty on postoperative morbidity following elective posterior lumbar fusions[J]. World Neurosurg, 2019, S1878-8750(19): 30038-30045. DOI: 10.1016/j.wneu. 2018. 12. 168.
- [8] Traven SA, McGurk KM, Reeves RA, *et al.* Modified frailty index predicts medical complications, length of stay, readmission, and mortality following total shoulder arthroplasty[J]. J Shoulder Elbow Surg, 2019, 28(10): 1854-1860. DOI: 10.1016/j.jse. 2019. 03. 009.
- [9] Simon HL, Keller DS. Author response to: comment on: frailty in older patients undergoing emergency colorectal surgery: USA National Surgical Quality Improvement Program analysis[J]. Br J Surg, 2020, 107(13): e663. DOI: 10.1002/bjs. 12034.
- [10] Voskamp MJ, Vermeer M, Molijn GJ, *et al.* The usefulness of the modified frailty index for muscle-invasive bladder cancer patients treated with radical cystectomy[J]. Curr Urol, 2021, 15(4): 253. DOI: 10.1159/000499263.
- [11] Nakano Y, Hirata Y, Shimogawara T, *et al.* Frailty is a useful predictive marker of postoperative complications after pancreaticoduodenectomy[J]. World J Surg Oncol, 2020, 18(1): 194. DOI: 10.1186/s12957-020-01969-7.
- [12] Sun WZ, Lu SB, Kong C, *et al.* Frailty and post-operative outcomes in the older patients undergoing elective posterior thoracolumbar fusion surgery[J]. Clin Interv Aging, 2020, 15: 1141-1150. DOI: 10.2147/CIA.S245419.
- [13] Chen Y, Qin JL. Modified frailty index independently predicts postoperative delirium and delayed neurocognitive recovery after elective total joint arthroplasty[J]. J Arthroplasty, 2021, 36(2): 449-453. DOI: 10.1016/j.arth. 2020. 07. 074.
- [14] Brown CH, Edwards C, Lin C, *et al.* Spinal anesthesia with targeted sedation based on bispectral index values compared with general anesthesia with masked bispectral index values to reduce delirium: the sharp randomized controlled trial[J]. Anesthesiology, 2021, 135(6): 992-1003. DOI: 10.1097/ALN. 0000000000004039.
- [15] Abraham WT, Lindenfeld JA, Ponikowski P, *et al.* Effect of empagliflozin on exercise ability and symptoms in heart failure patients with reduced and preserved ejection fraction, with and without type 2 diabetes[J]. Eur Heart J, 2021, 42(6): 700-710. DOI: 10.1093/eurheartj/ehaa943.

(编辑: 温玲玲)