



SHANGHAI JIAO TONG UNIVERSITY SCHOOL OF MEDICINE 学者介绍



赵 刚 博士

ZHAO Gang Ph.D, M.D

主任医师、硕士生导师



Chief Physician, Master's Supervisor

ORCID ID: 0000-0002-2405-3372



赵 刚（1974—），上海交通大学医学院附属仁济医院胃肠外科主任医师、行政副主任，胃肿瘤多学科团队首席专家。2008 年获得上海交通大学医学院外科学博士学位。现任中国医师协会外科医师分会胃肠道间质瘤诊疗专业委员会常委、秘书长、青年委员会主任委员，上海市医学会普外科青年委员会副主任委员。

从事胃肠外科领域的基础和临床工作 20 余年，擅长胃肿瘤的微创手术及术后综合治疗。在基础和临床研究方面，依托上海市肿瘤研究所癌基因及相关基因国家重点实验室和上海市免疫研究所，研究成果发表于 *Molecular Cancer*、*Journal of Translational Medicine*、*Ebiomedicine* 等杂志；且作为项目负责人及分中心负责人开展了多项临床研究，研究成果发表于 *BMC Cancer*、*Journal of Gastroenterology and Hepatology*、*Journal of Clinical Oncology* 等杂志。目前以第一作者或通信作者发表 SCI 收录论文 20 余篇，总计影响因子 70 余分。2017 年获得上海市卫生健康委员会优秀学科带头人（百人计划）。2019 年入选上海交通大学医学院研究型医师队伍。

该研究依托上海交通大学医学院“双一流”暨高水平地方高校建设“一流学科—临床医学—临床研究中心建设”项目。

ZHAO Gang, born in 1974, chief physician, deputy director of the Department of Gastrointestinal Surgery of Renji Hospital, Shanghai Jiao Tong University School of Medicine, and chief expert of multidisciplinary team of gastric cancer. He obtained his Ph.D from Shanghai Jiao Tong University School of Medicine in 2008. He is currently a member, secretary general and Youth Committee director of the Standing Committee of the Professional Committee for Diagnosis and Treatment of Gastrointestinal Stromal Tumor of the Surgeons Branch of the Chinese Medical Doctor Association, and deputy director of the Youth Committee of General Surgery of the Shanghai Medical Association.

Dr. ZHAO has been engaged in the basic and clinical work of gastrointestinal surgery for 20 years, and is good at minimally invasive surgery and comprehensive treatment of gastric cancer. In basic and clinical research, depending on the State Key Laboratory of Oncogenes and Related Genes of Shanghai Cancer Institute and Shanghai Institute of Immunology, the achievements of his were published in *Molecular Cancer*, *Journal of Translational Medicine* and *Ebiomedicine*. He has carried out a number of clinical studies, and the research results have been published in *BMC Cancer*, *Journal of Gastroenterology and Hepatology* and *Journal of Clinical Oncology*. To date, he has published more than 20 SCI-indexed papers with a total impact factor of over 70 points. In 2017, he was rewarded the excellent subject leader of the Shanghai Municipal Health Commission. In 2019, he was enrolled into Shanghai Municipal Education Commission—Gaofeng Clinical Medicine Grant Support.

The research relies on the Project of Clinical Research Center, Clinical Medicine, First-Class Discipline of “National Double First-Class” and “Shanghai Top-Level” high education initiative at Shanghai Jiao Tong University School of Medicine.



论著·临床研究

预测根治性胃癌切除术后并发症危险因素列线图模型的建立

吕恒宇, 黄 晨, 夏 翔, 赵 刚

上海交通大学医学院附属仁济医院胃肠外科, 上海 200127

[摘要] **目的**·探究根治性胃癌切除术+D2淋巴结清扫术后并发症发生的危险因素,以此建立列线图模型并进行验证。**方法**·收集2016年7月—2019年6月于上海交通大学医学院附属仁济医院胃肠外科胃癌专业组接受根治性胃癌切除术+D2淋巴结清扫术的1705例患者的临床资料。根据Clavien-Dindo分级系统对术后并发症进行分级,通过 χ^2 检验对 \geq Ⅱ级术后并发症的危险因素进行统计学分析;经多因素Logistic回归分析筛选 \geq Ⅱ级术后并发症的潜在危险因素,并建立列线图模型。将此样本作为训练组,并将2019年7月—12月在该专业组接受同样手术的612例患者作为验证组进行验证。**结果**·共计416例(24.4%)胃癌患者发生 \geq Ⅱ级术后并发症。多因素Logistic回归分析显示男性($OR=1.507$, $P=0.002$)、年龄 ≥ 60 岁($OR=1.962$, $P=0.001$)、肿瘤最大径 ≥ 5 cm($OR=1.456$, $P=0.002$)和全胃切除($OR=1.313$, $P=0.026$)是导致Ⅱ级术后并发症的独立危险因素。以此建立的列线图模型在训练组和验证组中均显示较好的区分度和预测一致性。**结论**·基于4个独立危险因素的列线图模型对根治性胃癌切除术后并发症有较好的预测性能,具备一定的临床推广和参考价值。

[关键词] 胃癌;术后并发症;危险因素;列线图;预测模型

[DOI] 10.3969/j.issn.1674-8115.2020.07.006 **[中图分类号]** R619.9 **[文献标志码]** A

Establishment of a nomogram model predicting risk factors of postoperative complications after radical gastrectomy for gastric cancer

LÜ Heng-yu, HUANG Chen, XIA Xiang, ZHAO Gang

Department of Gastrointestinal Surgery, Renji Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai 200127, China

[Abstract] **Objective**·To explore the risk factors of postoperative complications after radical gastrectomy + D2 lymphadenectomy and establish a predictive nomogram model. **Methods**·From July 2016 to June 2019, 1705 patients who received radical gastrectomy + D2 lymphadenectomy in the Department of Gastrointestinal Surgery, Renji Hospital, Shanghai Jiao Tong University School of Medicine were collected. According to Clavien-Dindo grading system, the postoperative complications were graded, and the risk factors of postoperative complications \geq grade II were analyzed by χ^2 test. Multivariate Logistic regression was used to analyze the independent risk factors of postoperative complications \geq grade II. According to the selected independent risk factors, the nomogram model was established. For verification, above patients were used as the training set, and 612 patients undergoing the same operation in this department from July to December 2019 were used as the validation set. **Results**·A total of 416 (24.4%) gastric cancer patients had postoperative complications. Multivariate Logistic regression analysis showed that male ($OR=1.507$, $P=0.002$), age ≥ 60 years old ($OR=1.962$, $P=0.001$), maximum diameter of tumor ≥ 5 cm ($OR=1.456$, $P=0.002$) and total gastrectomy ($OR=1.313$, $P=0.026$) were independent risk factors for postoperative complications \geq grade II. Based on these independent risk factors, the nomogram was established and presented good discrimination and predictive consistency in training set and validation set. **Conclusion**·The nomogram based on these four independent risk factors has a good predictive performance in predicting postoperative complications after radical gastrectomy for gastric cancer, and has a certain clinical application and reference value.

[Key words] gastric cancer; postoperative complication; risk factor; nomogram; predicting model

[基金项目] 国家自然科学基金(81802313);上海市教育委员会高峰高原学科建设计划(20191905)。

[作者简介] 吕恒宇(1999—),男,本科生;电子信箱:516710910010@shsmu.edu.cn。

[通信作者] 赵刚,电子信箱:zhaogangrj@163.com。

[Funding Information] National Natural Science Foundation of China(81802313); Shanghai Municipal Education Commission—Gaofeng Clinical Medicine Grant Support(20191905)。

[Corresponding Author] ZHAO Gang, E-mail: zhaogangrj@163.com。



胃癌是消化道最常见的恶性肿瘤之一,在全球所有恶性肿瘤中其发病率和死亡率分别排在第四位和第二位^[1]。在中国,每年新增胃癌患者约40万例,占全球新发病例的40%;年死亡病例约30万例,占全球死亡病例的近50%^[2]。不同于日本、韩国早期诊断率较高,中国胃癌早期诊断率低,近70%的患者就诊时肿瘤已处于局部进展期^[3]。对于局部进展期胃癌,根治性胃癌切除术+D2淋巴结清扫术是标准的手术治疗方式^[4]。但是,该术式也同时伴随出血、肺炎、吻合口漏、吻合口狭窄和术后感染等术后并发症的发生^[5]。

术后并发症不仅导致胃癌患者住院时间延长、住院费用增加、术后化学治疗(化疗)延期,还会对其长期生存造成不良影响^[6-9]。所以,如何在保证肿瘤根治的前提下降低术后并发症发生的风险、缩短住院时间、减少住院费用、降低术后死亡风险并同时提高术后化疗的及时性已得到越来越多临床医师的重视。故本研究拟采用国际上较为常用的Clavien-Dindo分级系统对胃癌术后并发症进行标准化的统计。通过单因素和多因素分析探究导致术后并发症的潜在危险因素,并以此建立根治性胃癌切除术+D2淋巴结清扫术后并发症的预测模型,旨在帮助胃肠外科医师准确评估术后并发症风险,对高风险患者采取必要的预防措施以减少术后并发症的发生率,最终达到缩短住院时间、延长生存期的目的。

1 资料与方法

1.1 研究对象

收集2016年7月—2019年6月在上海交通大学医学院附属仁济医院胃肠外科胃癌专业组接受手术治疗的胃癌患者,入组标准:①患者既往临床病史资料完整。②电子胃镜下组织病理检查诊断明确的胃腺癌。③患者接受根治性胃癌切除术+D2淋巴结清扫术。④术前影像学检查或术中探查未发现远处转移。排除标准:①急诊手术,包括胃癌并发症如出血、梗阻、穿孔导致的急诊手术。②术后病理提示Ⅳ期或R1、R2切除。③接受新辅助化疗的患者。研究得到上海交通大学医学院附属仁济医院伦理委员会批准(2018-105),在中国临床试验注册中心进行了注册(ChiCTR-PIC-17012358),获得所有患者的知情同意。

1.2 变量和定义

采用Clavien-Dindo分级系统对出现术后并发症的患者进行分组^[10]。Ⅰ级并发症包括任何偏离正常术后过程但无需药物治疗或外科治疗、内窥镜和放射学干预的情况;允

许使用止吐药、退热药、镇痛药、利尿剂和电解质以及理疗药物等治疗方案;还包括在床旁开放的伤口感染。Ⅱ级为需要其他药物治疗的并发症,还包括输血和全肠外营养。Ⅲ级为需要手术或介入治疗的并发症:Ⅲa级,不需要全身麻醉;Ⅲb级,需要全身麻醉。Ⅳ级为需要重症监护处理的并发症:Ⅳa级,单器官衰竭;Ⅳb级,多器官衰竭。Ⅴ级为术后死亡。

将发生≥Ⅱ级并发症的患者纳入并发症组,未发生并发症或发生Ⅰ级并发症的患者纳入无并发症组。如果单个患者发生多种并发症,则采用最高评分。相关并发症的定义如下:①肺炎:在胸部X线或者CT图像中出现炎性病灶,并且痰液培养呈阳性结果。②吻合口漏:术后出现发热、腹痛、腹胀及腹膜炎体征等;腹腔引流管量异常,发现肠液、胃液流出;口服造影剂后,指示剂从腹腔引流管引出;CT图像提示吻合口周脓肿或存在积液;消化道造影发现影像对比剂在片中从吻合口向外渗或流至引流管周围。③术后出血:包括胃内出血和腹腔出血;前者表现为胃肠减压吸出大量鲜红色血液,或出现呕血、黑粪等症状;后者表现为引流管引出鲜红血液,严重者可出现休克。④胰漏:淀粉酶水平大于上海交通大学医学院附属仁济医院临床研究中心的正常血清淀粉酶活性上限(110 U/L)3倍。⑤乳糜漏:术后3d或3d以后引流部位或伤口处引流出乳白色液体,检验发现三酰甘油水平≥110 mg/dL。⑥腹泻:每日3次或3次以上稀便或水样便。⑦胃排空障碍:在没有肠梗阻的情况下,在术后第10日不能耐受口服。⑧室上性心动过速:静息时心房率>100次/min。⑨尿路感染:清洁离心中段尿沉淀白细胞数≥10个/HP(高倍视野),或有尿路感染症状者。⑩切口裂开:术后患者突然用力后,切口破裂并伴随疼痛。⑪腹腔脓肿:患者术后感染形成腹腔局限性脓液聚积。⑫呼吸衰竭或者心功能衰竭:急性心力衰竭和急性肺水肿,或射血分数大幅度下降(>50%)或需要气管插管的辅助通气。病理分期依据国际抗癌联盟(Union for International Cancer Control, UICC)TNM(Tumor Node Metastasis)分类第8版^[11]标准进行。

1.3 列线图模型的构建

从患者的术前基本资料、术后病程以及术后病理报告中收集术后并发症的可能危险因素,包括性别、年龄、手术方式、切除范围、肿瘤最大径、病理分级、淋巴结清扫数目等。对各类指标用 χ^2 检验进行单因素分析,将其中有统计学意义($P<0.05$)的变量进一步进行多因素Logistic回归分析,筛选出独立危险因素。将筛选结果引入R软件

(版本 3.3.2), 运用 rms 软件包构建列线图模型。

1.4 列线图模型的验证

分别采用区分度和校准曲线评价列线图模型。绘制受试者工作特征曲线 (receiver operating characteristic curve, ROC 曲线), 计算曲线下面积 (area under the curve, AUC) 来评价模型的区分度。绘制列线图模型预测并发症概率与实际并发症概率的校准曲线, 验证列线图模型的一致性。

将本研究中的样本作为训练组, 以 bootstrap 法进行内部验证; 并选取 2019 年 7 月—12 月期间在上海交通大学医学院附属仁济医院胃肠外科胃癌专业组行根治性胃癌切除术 +D2 淋巴结清扫的 612 例胃癌患者作为验证组进行外部验证, 其纳入和排除标准同训练组。应用区分度和校准曲线进行评价, 并用 Hosmer-Lemeshow 检验分别判断训练组和验证组模型的拟合优度; 当 $P>0.05$ 时, 认为模型的拟合优度较高。

1.5 统计学分析

采用 SPSS 22.0 软件进行统计学分析。定性资料用 n (%) 表示, 使用 χ^2 检验。 $P<0.05$ 表示差异有统计学意义。

表 1 1 705 例胃癌患者术后并发症 (\geq II 级) 危险因素的单因素分析
Tab 1 Univariate analysis of risk factors of postoperative complications (\geq grade II) of 1 705 gastric cancer patients

Risk factor	Patients/ n (%)	Patients with complications (\geq grade II)		
		n (%)	χ^2 value	P value
Gender			15.023	0.001
Male	1 186 (69.6)	321 (77.2)		
Female	519 (30.4)	95 (22.8)		
Age			30.502	0.001
<60 year	1 184 (69.4)	334 (80.3)		
\geq 60 year	521 (30.6)	82 (19.7)		
Type of surgery			13.721	0.001
Open	1 359 (79.7)	358 (86.1)		
Laparoscope	346 (20.3)	58 (13.9)		
Range of resection			14.83	0.001
Partial	1 058 (62.1)	225 (54.1)		
Total	647 (37.9)	191 (45.9)		
Maximum diameter of tumor			15.068	0.001
\geq 5 cm	1 191 (69.9)	259 (62.3)		
<5 cm	514 (30.1)	157 (37.7)		
T stage			17.328	0.001
T ₁	418 (24.5)	80 (19.2)		
T ₂	198 (11.6)	35 (8.4)		

2 结果

2.1 术后并发症统计

根据入组标准纳入接受根治性胃癌切除术 +D2 淋巴结清扫的胃癌患者共计 1 705 例。根据 Clavien-Dindo 分级系统, 416 例 (24.4%) 患者发生了 \geq II 级术后并发症。其中, II 级为 376 例, 包括胃排空障碍 17 例、吻合口漏 48 例、胰漏 24 例、乳糜漏 6 例、术后出血 7 例、腹泻 12 例、室上性心动过速 39 例、尿路感染 25 例、肺炎 198 例; III a 级为 7 例, 包括切口裂开 3 例、腹腔脓肿 4 例; III b 级为 12 例, 包括吻合口漏 9 例、术后出血 3 例; IV a 级为 12 例, 均为心功能衰竭; IV b 级为 6 例, 均为心功能衰竭伴肺功能衰竭; V 级为 3 例。

2.2 影响术后并发症的危险因素

单因素分析显示, 男性、年龄 \geq 60 岁、T 分期、TNM 分期、肿瘤最大径 \geq 5 cm、全胃切除以及开放手术与术后并发症发生有关 ($P<0.05$) (表 1)。进一步多因素 Logistic 回归分析显示男性 ($OR=1.507$, $P=0.002$)、年龄 \geq 60 岁 ($OR=1.962$, $P=0.001$)、肿瘤最大径 \geq 5 cm ($OR=1.456$, $P=0.002$)、全胃切除 ($OR=1.313$, $P=0.026$) 是导致术后并发症发生的独立危险因素 (表 2)。

Continued Tab

Risk factor	Patients/ <i>n</i> (%)	Patients with complications (≥ grade II)		
		<i>n</i> (%)	χ^2 value	<i>P</i> value
T ₃	129 (7.6)	36 (8.7)		
T ₄	960 (56.3)	265 (63.7)		
N stage			3.594	0.309
N ₀	713 (41.8)	159 (38.2)		
N ₁	263 (15.4)	66 (15.9)		
N ₂	297 (17.4)	82 (19.7)		
N ₃	432 (25.3)	109 (26.2)		
TNM stage			10.915	0.004
I	520 (30.5)	102 (24.5)		
II	334 (19.6)	80 (19.2)		
III	851 (49.9)	234 (56.3)		
Resected lymph nodes			1.921	0.166
≤15	348 (20.4)	75 (18.0)		
>15	1 357 (79.6)	341 (82.0)		

表 2 1 705 例胃癌患者术后并发症 (≥ II 级) 危险因素的多因素分析
Tab 2 Multivariate analysis of risk factors of postoperative complications (≥ grade II) of 1 705 gastric cancer patients

Risk factor	Wald value	β value	OR (95%CI)	<i>P</i> value
Age ≥ 60 years	23.782	0.674	1.962 (1.496–2.572)	0.001
Male	9.444	0.410	1.507 (1.160–1.958)	0.002
Total resection	4.963	0.272	1.313 (1.033–1.668)	0.026
Max diameter of tumor ≥ 5 cm	9.600	0.376	1.456 (1.148–1.847)	0.002

2.3 列线图模型的建立及评价

根据多因素分析结果，运用 R 软件建立预测根治性胃癌切除术 +D2 淋巴清扫术后并发症的列线图模型（图 1）。通过绘制 ROC 曲线，对各项危险因素及该列线图模型在训练组中的预测能力进行评价，结果显示：男性、年龄 ≥ 60 岁、肿瘤最大径 ≥ 5 cm、全胃切除预测术后并发症的 AUC 分别为 0.550、0.572、0.560、0.553，而列线图模型的 AUC 为 0.625，说明列线图模型较其他单项危险因素具备更好的预测性能（图 2A）；在 612 例的胃癌验证组中，列线图模型（AUC=0.646）同样显示出较好的预测性能和一致性（图 2B）。校正曲线显示，该模型在训练组和验证组中均具备较好的一致性（图 2C、D）。用 Hosmer-Lemeshow 检验分别判断训练组和验证组模型的拟合优度，结果显示训练组的 *P* 值为 0.116，验证组的 *P* 值为 0.961，均 >0.05，表明本研究建立的列线图模型拟合优度较好。

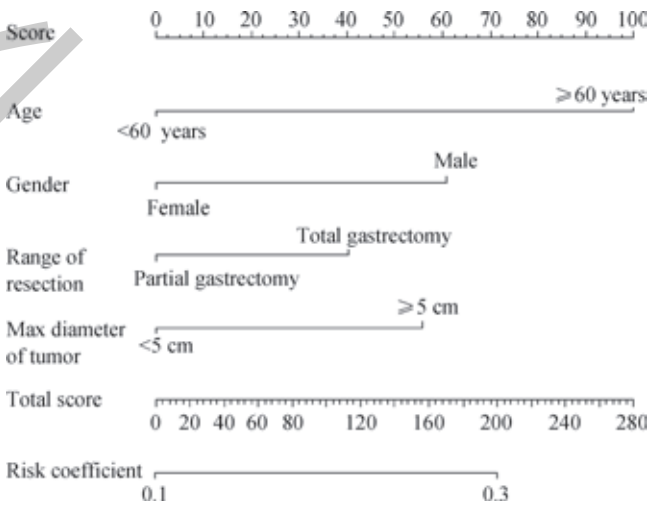
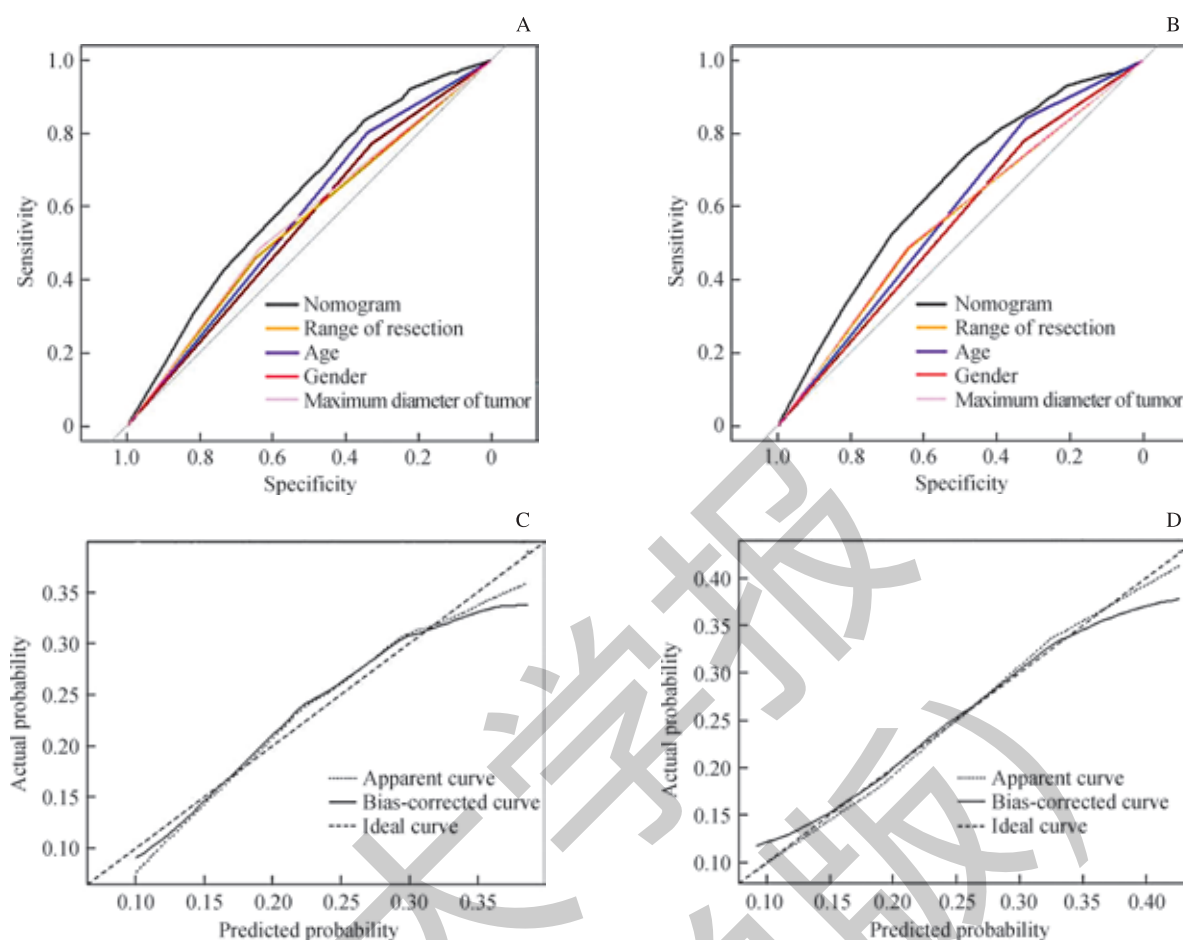


图 1 预测根治性胃癌切除术后并发症 (≥ II 级) 的列线图模型
Fig 1 Nomogram predicting postoperative complications (≥ grade II) after radical resection of gastric cancer



Note: A. ROC curve of nomogram in training set (nomogram, AUC=0.625; male, AUC=0.550; age ≥ 60 years, AUC=0.572; maximum diameter of tumor ≥ 5 cm, AUC=0.560; total gastrectomy, AUC=0.553). B. ROC curve of nomogram in validation set (nomogram, AUC=0.646; male, AUC=0.552; age ≥ 60 years, AUC=0.528; maximum diameter of tumor ≥ 5 cm, AUC=0.566; total gastrectomy, AUC=0.564). C. Calibration curve in training set. D. Calibration curve in validation set.

图 2 在训练组 ($n=1\,705$) 和验证组 ($n=612$) 中的 ROC 曲线和校正曲线

Fig 2 ROC curve and calibration curve for predicting postoperative complications after radical resection of gastric cancer in training set ($n=1\,705$) and validation set ($n=612$)

3 讨论

手术治疗是胃癌根治的基石。对于局部进展期胃癌,根治性胃癌切除+D2淋巴结清扫术已获得大量循证医学证据的支持和专家的认可^[12]。随着该术式在中国的推广普及,如何有效地提高手术安全性、降低术后并发症发生的风险、加快患者术后康复、减少住院时间、降低住院费用是目前胃癌外科领域的研究重点。特别是对于具有术后并发症高危因素的患者,应根据潜在的危险因素制定相对个体化术后并发症的防治策略,争取早发现、早诊断、早治疗,以促进患者快速恢复。

本研究中术后并发症的统计主要采用 Clavien-Dindo 分级系统^[10]。该分级系统最初由 Clavien 等^[13]在 1992 年提出,主要用于比较开放手术与腹腔镜胆囊切除术的治疗效果。2009 年,Clavien 团队^[10]发表了补充和更新版本的 Clavien-Dindo 分级系统和测评报告。该版本操作简易、评

价客观,已广泛用于评价外科手术的治疗效果,包括胰腺外科^[14]、胃肠外科^[15-17]、肝外科^[18]等。根据该分级系统,在本专业组接受手术治疗的 1 705 例胃癌患者中 \geq II 级术后并发症发生率为 24.4%,处于文献报道的术后并发症发生率范围 (21% ~ 50%)^[7, 19-21]。

多因素分析结果表明,年龄 ≥ 60 岁、男性、全胃切除、肿瘤最大径 ≥ 5 cm 是导致术后并发症发生的独立危险因素。年龄 ≥ 60 岁已经在很多文献中被证明是术后并发症的危险因素^[22-23]。然而对比年龄因素,高龄导致的合并症对术后并发症的影响可能更大。已有文献表明在高龄的老年患者中,美国麻醉协会分级 (American Society of Anesthesiologists, ASA) 3 级、4 级的比例更高^[9]。罹患心脏病或者肝病的胃癌患者术后发生并发症的风险也较高^[24]。因此,高龄、伴有合并症或存在系统性疾病胃癌患者术后发生并发症的风险较高,应引起胃肠外科医师的重视。除了高龄,全胃切除^[25-26]、男性^[27-28]、肿瘤最大径

$\geq 5\text{ cm}$ ^[29] 也被认为是导致胃癌术后并发症发生的危险因素, 这与本研究的结论相符。

列线图模型可以将多因素 Logistic 回归分析结果图形化、可视化, 以更加直观地衡量术后并发症的发生风险, 为临床使用提供支持。本研究依据多因素分析结果, 纳入年龄、性别、切除范围、肿瘤最大径 4 个临床指标制定预测术后并发症的列线图模型。相较于单项指标, 该模型无论在训练组还是验证组均显示出更高的区分度和准确度,

可为临床胃肠外科医师预防和诊断术后并发症提供参考。但该预测模型基于单中心研究得出, 仍需要多中心、前瞻性、大样本量的临床研究进一步证实。

综上所述, 年龄 ≥ 60 岁、男性、全胃切除、肿瘤最大径 $\geq 5\text{ cm}$ 是导致接受根治性胃癌切除术 + D2 淋巴结清扫术的胃癌患者术后并发症 ($\geq \text{II}$ 级) 发生的独立危险因素。基于这 4 个独立危险因素建立的列线图模型对术后并发症有较好的预测性能, 具有推广价值。

参 · 考 · 文 · 献

- [1] van Cutsem E, Sagaert X, Topal B, et al. Gastric cancer[J]. Lancet, 2016, 388(10060): 2654-2664.
- [2] Russo A, Li P, Strong VE. Differences in the multimodal treatment of gastric cancer: east versus west[J]. J Surg Oncol, 2017, 115(5): 603-614.
- [3] Yang L, Zheng RS, Wang N, et al. Incidence and mortality of stomach cancer in China, 2014[J]. Chin J Cancer Res, 2018, 30(3): 291-298.
- [4] 王宇宸, 吴舟桥, 石晋瑶, 等. 通过医嘱信息评估胃癌术后并发症登记情况的单中心可行性研究[J]. 中华胃肠外科杂志, 2019, 22(8): 729-735.
- [5] 张鹏, 兰天珩, 周一鸣, 等. 胃癌根治术围手术期并发症危险因素分析[J]. 中华胃肠外科杂志, 2019, 22(8): 736-741.
- [6] Wang SQ, Xu L, Wang Q, et al. Postoperative complications and prognosis after radical gastrectomy for gastric cancer: a systematic review and meta-analysis of observational studies[J]. World J Surg Oncol, 2019, 17(1): 52.
- [7] Kubota T, Hiki N, Sano T, et al. Prognostic significance of complications after curative surgery for gastric cancer[J]. Ann Surg Oncol, 2014, 21(3): 891-898.
- [8] Kim TH, Suh YS, Huh YJ, et al. The comprehensive complication index (CCI) is a more sensitive complication index than the conventional Clavien-Dindo classification in radical gastric cancer surgery[J]. Gastric Cancer, 2018, 21(1): 171-181.
- [9] Lee KG, Lee HJ, Yang JY, et al. Risk factors associated with complication following gastrectomy for gastric cancer: retrospective analysis of prospectively collected data based on the Clavien-Dindo system[J]. J Gastrointest Surg, 2014, 18(7): 1269-1277.
- [10] Clavien PA, Barkun J, de Oliveira ML, et al. The Clavien-Dindo classification of surgical complications: five-year experience[J]. Ann Surg, 2009, 250(2): 187-196.
- [11] Amin MB, Greene FL, Edge SB, et al. The eighth edition AJCC Cancer Staging Manual: continuing to build a bridge from a population-based to a more "personalized" approach to cancer staging[J]. CA Cancer J Clin, 2017, 67(2): 93-99.
- [12] 季加孚, 季鑫, 步召德. 从规范化到精准化: 胃癌手术治疗的发展[J]. 中华外科杂志, 2016, 54(3): 164-168.
- [13] Clavien PA, Sanabria JR, Strasberg SM. Proposed classification of complications of surgery with examples of utility in cholecystectomy[J]. Surgery, 1992, 111(5): 518-526.
- [14] DeOliveira ML, Winter JM, Schafer M, et al. Assessment of complications after pancreatic surgery: a novel grading system applied to 633 patients undergoing pancreaticoduodenectomy[J]. Ann Surg, 2006, 244(6): 931-937.
- [15] Xia X, Xu J, Zhu CC, et al. Objective evaluation of clinical outcomes of laparoscopy-assisted pylorus-preserving gastrectomy for middle-third early gastric cancer[J]. BMC Cancer, 2019, 19(1): 481.
- [16] Powell A, Coxon AH, Patel N, et al. Prognostic significance of post-operative morbidity severity score after potentially curative D2 gastrectomy for carcinoma[J]. J Gastrointest Surg, 2018, 22(9): 1516-1527.
- [17] Bosma E, Pullens MJ, de Vries J, et al. The impact of complications on quality of life following colorectal surgery: a prospective cohort study to evaluate the Clavien-Dindo classification system[J]. Colorectal Dis, 2016, 18(6): 594-602.
- [18] Levi Sandri GB, Colasanti M, Santoro R, et al. Laparoscopic right hepatectomy for hepatocellular carcinoma in cirrhotic patient[J]. Hepatobiliary Surg Nutr, 2015, 4(6): 436-438.
- [19] Li ZY, Bai B, Zhao Y, et al. Severity of complications and long-term survival after laparoscopic total gastrectomy with D2 lymph node dissection for advanced gastric cancer: a propensity score-matched, case-control study[J]. Int J Surg, 2018, 54(Pt A): 62-69.
- [20] Eto K, Hiki N, Kumagai K, et al. Prophylactic effect of neoadjuvant chemotherapy in gastric cancer patients with postoperative complications[J]. Gastric Cancer, 2018, 21(4): 703-709.
- [21] Watanabe M, Kinoshita T, Tokunaga M, et al. Complications and their correlation with prognosis in patients undergoing total gastrectomy with splenectomy for treatment of proximal advanced gastric cancer[J]. Eur J Surg Oncol, 2018, 44(8): 1181-1185.
- [22] Park DJ, Lee HJ, Kim HH, et al. Predictors of operative morbidity and mortality in gastric cancer surgery[J]. Br J Surg, 2005, 92(9): 1099-1102.
- [23] Persiani R, Antonacci V, Biondi A, et al. Determinants of surgical morbidity in gastric cancer treatment[J]. J Am Coll Surg, 2008, 207(1): 13-19.
- [24] Jeong SH, Ahn HS, Yoo MW, et al. Increased morbidity rates in patients with heart disease or chronic liver disease following radical gastric surgery[J]. J Surg Oncol, 2010, 101: 200-204.
- [25] Bozzetti F, Marubini E, Bonfanti G, et al. Total versus subtotal gastrectomy: surgical morbidity and mortality rates in a multicenter Italian randomized trial. The Italian Gastrointestinal Tumor Study Group[J]. Ann Surg, 1997, 226(5): 613-620.
- [26] Degiuli M, Sasako M, Ponti A, et al. Morbidity and mortality after D2 gastrectomy for gastric cancer: results of the Italian Gastric Cancer Study Group prospective multicenter surgical study[J]. J Clin Oncol, 1998, 16(4): 1490-1493.
- [27] Kim SM, Youn HG, An JY, et al. Comparison of open and laparoscopic gastrectomy in elderly patients[J]. J Gastrointest Surg, 2018, 22(5): 785-791.
- [28] Li SS, Costantino CL, Mullen JT. Morbidity and mortality of total gastrectomy: a comprehensive analysis of 90-day outcomes[J]. J Gastrointest Surg, 2019, 23(7): 1340-1348.
- [29] Jiang N, Deng JY, Ding XW, et al. Effect of complication grade on survival following curative gastrectomy for carcinoma[J]. World J Gastroenterol, 2014, 20(25): 8244-8252.

[收稿日期] 2020-03-23

[本文编辑] 崔黎明

