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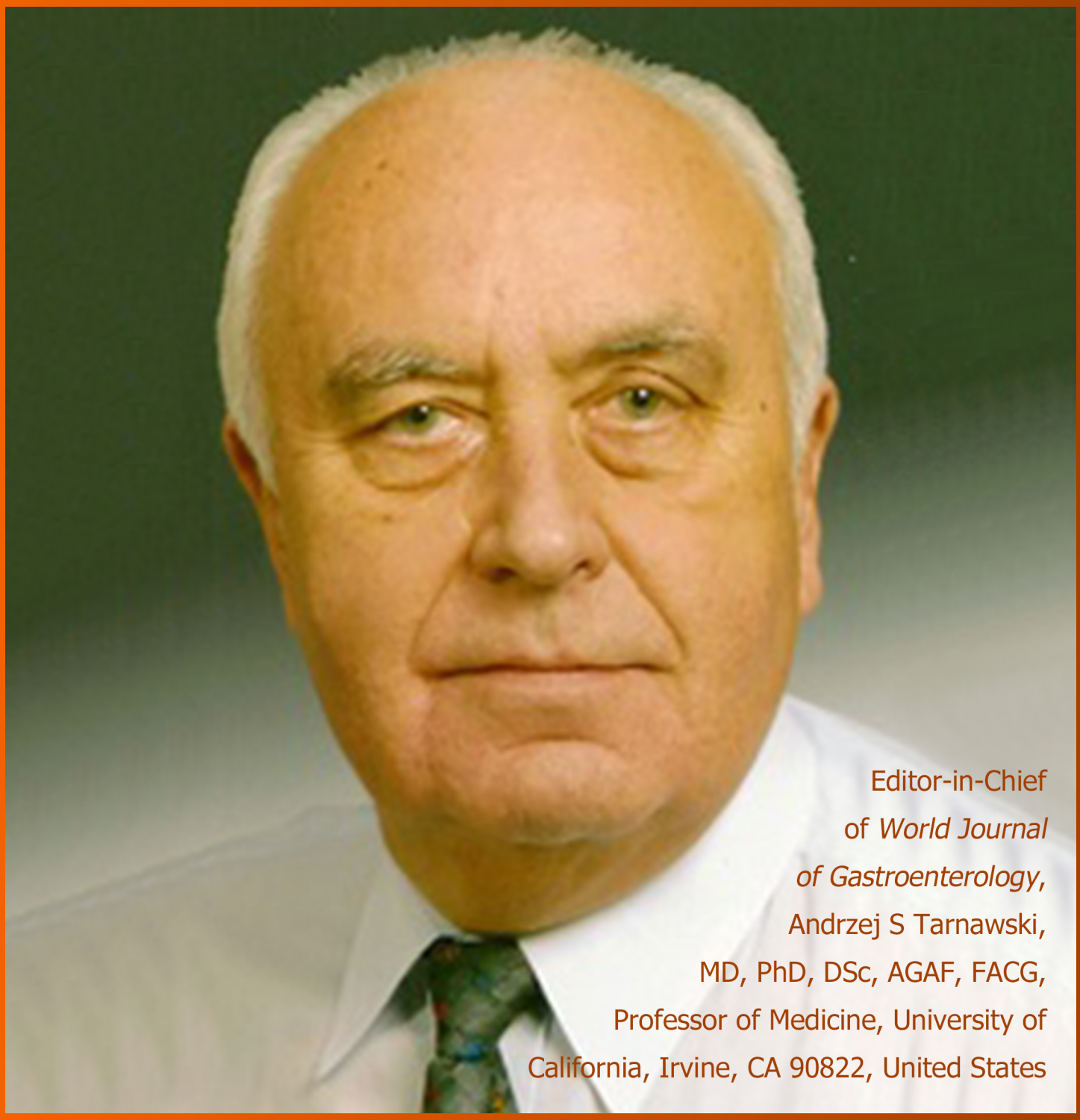

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ORIGINAL ARTICLE

Clinical Trials Study

Machine learning identifies the risk of complications after laparoscopic radical gastrectomy for gastric cancer

Qing-Qi Hong, Su Yan, Yong-Liang Zhao, Lin Fan, Li Yang, Wen-Bin Zhang, Hao Liu, He-Xin Lin, Jian Zhang, Zhi-Jian Ye, Xian Shen, Li-Sheng Cai, Guo-Wei Zhang, Jia-Ming Zhu, Gang Ji, Jin-Ping Chen, Wei Wang, Zheng-Rong Li, Jing-Tao Zhu, Guo-Xin Li, Jun You

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Abstract

BACKGROUND

Laparoscopic radical gastrectomy is widely used, and perioperative complications have become a highly concerned issue.

AIM

To develop a predictive model for complications in laparoscopic radical gastrectomy for gastric cancer to better predict the likelihood of complications in gastric cancer patients within 30 days after surgery, guide perioperative treatment strategies for gastric cancer patients, and prevent serious complications.

METHODS

In total, 998 patients who underwent laparoscopic radical gastrectomy for gastric cancer at 16 Chinese medical centers were included in the training group for the complication model, and 398 patients were included in the validation group. The clinicopathological data and 30-d postoperative complications of gastric cancer patients were collected. Three machine learning methods, lasso regression, random forest, and artificial neural networks, were used to construct postoperative complication prediction models for laparoscopic distal gastrectomy and laparoscopic total gastrectomy, and their prediction efficacy and accuracy were evaluated.

RESULTS

The constructed complication model, particularly the random forest model, could better predict serious complications in gastric cancer patients undergoing laparoscopic radical gastrectomy. It exhibited stable performance in external validation and is worthy of further promotion in more centers.

CONCLUSION

Using the risk factors identified in multicenter datasets, highly sensitive risk prediction models for complications following laparoscopic radical gastrectomy were established. We hope to facilitate the diagnosis and treatment of preoperative and postoperative decision-making by using these models.

Key Words: Gastric cancer; Laparoscopic radical gastrectomy; Postoperative complications; Laparoscopic total gastrectomy

Core Tip: This is a multicenter clinical study involving 17 Chinese medical centers, which uses machine learning methods to predict the risk of complications in laparoscopic gastric cancer surgery, contributing to the prevention and early warning of complications.

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INTRODUCTION

Laparoscopic radical gastrectomy is currently recommended for the treatment of early-stage gastric cancer[1,2]. The safety of laparoscopic distal gastrectomy (LDG) for gastric cancer has been confirmed in studies by CLASS01, KLASS01, and JCOG0912, whereas CLASS02 and KLASS03 confirmed the efficacy of laparoscopic total gastrectomy (LTG)[3-7]. Safety studies on laparoscopic proximal gastrectomy in gastric cancer are also being conducted in medical centers with extensive laparoscopic expertise. Meanwhile, an increasing number of prospective and retrospective studies have confirmed the safety and efficacy of laparoscopy in the treatment of progressive gastric cancer[3,8,9]. However, laparoscopic radical surgery for progressive gastric cancer is not universally accepted or widely used. Complication rates are closely monitored by surgeons as a criterion for assessing surgical safety. The identification of patients at high risk of complications might allow the selection of a risk-adapted procedure and intervening perioperative measures to reduce complications and increase the confidence of the surgeon. As a result, many scoring systems to evaluate the safety of surgery have been created, such as physiological capacity and surgical stress assessments and surgical mortality scores, to predict the risk of postoperative complications[10,11]. Although these algorithms can identify complications, they lack specificity for laparoscopic radical gastric cancer surgery. There are two models for predicting the complications of laparoscopic gastric cancer surgery. One is the complication score constructed by Professor Chang-Ming Huang's team at Fujian Medical University Union Hospital[12], and the other is a scoring system constructed by Ohkura *et al*'s team at Kyoto University Medical School Hospital in Japan[13]. Both models have excellent ability to predict complications. However, the data from previous studies were from a single center and had less external validation; thus, its applicability in different hospitals remains to be validated.

Early identification of patients with potentially high complication rates, elimination of risk factors for preoperative complications, guidance of intraoperative surgical decisions, and enhancement of early warning of postoperative complications are intended to improve the overall patient prognosis. Therefore, this study aimed to develop a multicenter model using three machine learning approaches to predict perioperative complication rates in patients undergoing LDG and LTG.

MATERIALS AND METHODS

Patient information

The training dataset included patients who underwent laparoscopic radical gastrectomy for gastric cancer from 2016 to 2020 at 16 medical centers in China, namely the First Affiliated Hospital of Army Medical University, the First Affiliated Hospital of Nanjing Medical University, the First Affiliated Hospital of Nanchang University, the First Affiliated Hospital of Xiamen University, the Affiliated Hospital of Qinghai University, the First Affiliated Hospital of Xinjiang Medical University, the First Affiliated Hospital of Xi'an Jiaotong University, Guangdong Provincial Hospital of Traditional Chinese Medicine, the Second Hospital of Jilin University, Xijing Hospital-the Air Force Military Medical University, the Second Hospital of Wenzhou Medical University, Zhongshan Hospital Xiamen University, Affiliated Hangzhou First People's Hospital with Zhejiang University School of Medicine, Zhangzhou Affiliated Hospital of Fujian Medical University, Quanzhou First Hospital affiliated to Fujian Medical University, and the second hospital affiliated to Xiamen Medical College. Validation datasets were obtained from gastric cancer patients undergoing laparoscopic radical gastrectomy at the Nanfang Hospital of Southern Medical University. Inclusion criteria: (1) Perioperative clinical stage ranging from T1a to T4a, N0 to N2, and M0; (2) Patients who underwent LTG or LDG combined with D2 Lymph node dissection and received a postoperative pathological diagnosis confirming R0 resection; (3) Postoperative pathological confirmation of gastric adenocarcinoma; and (4) The surgeons had extensive experience in laparoscopic gastric cancer, having completed at least 50 such cases. Exclusion criteria: (1) Intraoperative evidence of peritoneal dissemination, invasion of adjacent organs, or distant metastasis; (2) Combined multiorgan resection; (3) R1 or R2 resection; (4) Conversion to an open laparotomy; (5) Previous of malignancy; (6) History of abdominal surgery; and (7) Preoperative Neoadjuvant Therapy. The extent of lymph node dissection was based on the guidelines of the Japan Gastric Cancer Association. This study was approved by the Ethics Committee of the First Affiliated Hospital of Xiamen University.

Study variables

Study variables analyzed included age; sex; body mass index (BMI); American society of Aneshesiologists (ASA) score; Eastern Collaborative Oncology Group (ECOG) score; history of hypertension, diabetes, and severe cardiopulmonary disease; operative time; surgical bleeding volume; intraoperative blood transfusion; surgical approach; and method of gastrointestinal reconstruction. Complications were graded according to the Clavien–Dindo classification, where complications of grade 2 and above were defined as serious.

Model construction and evaluation

Normally distributed continuous variables are expressed as $\chi^2 \pm s$, and an independent samples *t*-test was used for comparisons between groups. Skewed distribution measurement data are expressed as mean (median), and non-parametric tests were used for comparisons between groups. The categorized variables are expressed as frequencies, and the χ^2 test and Fisher's exact probability method were used for comparisons between groups. The rank-sum test was used for hierarchical variables. Factors with a *P* value of < 0.05 for univariate analysis were further used for model construction of postoperative complications. The receiver operating characteristic curve and area under the curve (AUC) of the model validation results were used to evaluate predictive ability.

Lasso regression model construction

The "glmnet" R package was used to construct the Lasso regression model. The independent variables with *P* values < 0.05 in the logistic analysis were subjected to Lasso regression analysis, and the coefficients of the independent variables initially included in the model were gradually compressed as the penalty coefficient λ changed. Finally, the coefficients of some of the independent variables were compressed to zero to avoid overfitting the model. To find the best penalty coefficient λ for good model performance with the least impact, the value of λ + 1 with the least error in the ten-fold cross-validation method is chosen as the optimal value[14]. In the LTG and LDG models, the λ + 1 values were 0.0002534603 and 0.001445553, respectively (Supplementary Figure 1).

Random forest model construction

The "RandomForest" R package was used to construct a random forest model. Random forests involve multiple random data draws to generate many decision trees, and the results derived from these trees are combined to prevent model overfitting[15]. To build the final model, we used the minimum number of decision trees for which the error was stabilized. The model was constructed to rank the importance of variables in the random forest by using the improvement of the Gini index as an evaluation criterion for the importance of features (Supplementary Figure 2).

Artificial neural networks model construction

The "neuralnet" R package was used to construct a random forest model. The neural network mode transfers the rules hidden in the data to the network structure by processing the experimental data. An artificial neural network consists of three layers: Input, hidden, and output layers. The number of layers and neurons in the hidden layer are set according to actual requirements and experience[16]. To select the number of hidden layer neurons, the following empirical formula is used as a reference: Hh =Ns/[a × (Ni + No)], where Ni is the number of input layer neurons; No, number of output neurons; Ns, number of samples in the training set; and a, arbitrary value variable that can be taken by itself, typically ranging from 2 to 10.

RESULTS

Clinicopathological data of study subjects

A total of 998 and 398 patients were retrospectively included in the training and validation groups, respectively. The clinicopathological data of the patients are shown in Table 1. The research flow of this study is illustrated in Figure 1. There were 164 and 78 cases of serious complications in the modeling and validation groups, respectively (Table 2).

Univariable analyses of complications in laparoscopic radical gastrectomy

The variables included in the model were initially screened using univariate analysis. The results of the univariate analysis of LDG suggested significant differences in age, BMI, intraoperative bleeding, history of severe pulmonary disease, ECOG score, and ASA score between the group with severe complications and the group without severe complications (*P* < 0.05) (Table 3). In the univariate analysis of LTG, age, ECOG score, ASA score, length of surgery, whether complete laparoscopic surgery was performed, and history of severe lung disease were significantly different between the group with severe complications and the group without severe complications (*P* < 0.05) (Table 4).

Prediction model for complications of laparoscopic radical gastrectomy

We constructed three machine-learning-based models to predict the risk of complications associated with laparoscopic radical gastrectomy for gastric cancer.

In the LASSO regression model of LTG, six variables were selected: Age group, history of severe lung disease, operative time, surgical type, ECOG score, and ASA score. The AUC of the LASSO regression prediction model for LTG was 0.743 (*P* < 0.0001) in the training group and 0.667 (*P* < 0.0001) in the validation group. In the LASSO regression model of LDG, six variables were selected: Age, BMI, intraoperative bleeding volume, history of severe lung disease, ECOG score, and ASA score (Supplementary Figure 1). The AUC of the LASSO regression prediction model for LDG was 0.800 (*P* < 0.0001) in the training group and 0.688 (*P* < 0.0001) in the validation group.

In the LTG random forest model, the number of decision trees used to construct the final random forest model was 53. In the LDG random forest model, when the number of decision trees is greater than 99, the error within the model tends to stabilize (Supplementary Figure 2). The AUC of the random forest prediction model for LTG was 0.8969 (*P* < 0.0001) in the modeling group and 0.7515 (*P* < 0.0001) in the validation group. In the random forest prediction model of LDG, the AUC of the model was 0.8853 (*P* < 0.0001) in the training group and 0.9025 (*P* < 0.0001) in the validation group. The AUC

Table 1 Demographic and clinical characteristics of the training group and validation groups (mean ± SD)

Characteristic	Training group			Validation group		
	LGC (*n* = 998)	LTG (*n* = 572)	LDG (*n* = 426)	LGC (*n* = 398)	LTG (*n* = 165)	LDG (*n* = 233)
Age	59.8 (11.31)	60.0 (11.22)	59.6 (11.44)	57.8 (12.4)	59.2 (12.2)	57.0 (12.4)
Gender						
Female	307	156	151	173	45	82
male	691	416	275	342	120	151
BMI	22.6 (3.2)	22.9 (3.2)	22.3 (3.2)	22.6 (3.4)	22.7 (3.6)	22.5 (3.4)
ASA score						
2	964	556	408	365	148	217
3	34	16	18	33	17	16
ECOG score						
0	810	460	350	142	69	73
1	158	98	60	231	89	142
2	30	14	16	25	7	18
Severe heart disease	4	1	3	22	17	5
Severe lung disease	10	5	5	18	12	6
Hypertension	140	71	69	78	39	39
Diabetes	67	30	37	52	27	25
Operative time (min)	240 (63.0)	246.8 (73.1)	230.9 (44.6)	280.9 (76.4)	308.0 (86.1)	267.2 (68.9)
Bleeding volume (min)	130.5 (115.4)	147.8 (128.5)	107.3 (90.0)	54.3 (57.6)	78.7 (67.4)	57.9 (51.6)
Blood transfusion (mL)	25.5 (138.1)	34.3 (172.3)	13.62 (67.9)	19.0 (132.4)	11.0 (65.1)	22.0 (154.0)
Complication	139	64	75	78	51	27
ClavienDindo						
0	859	508	351	320	114	206
1	14	5	9	17	10	7
2	93	34	59	56	38	18
3	29	24	5	5	3	2
4	3	1	2	0	0	0

BMI: Body mass index; LDG: Laparoscopic distal gastrectomy; LTG: Laparoscopic total gastrectomy; LGC: Localized gastric cancer; ASA: Aneshesiologists; ECOG: Eastern Collaborative Oncology Group.

of the random forest prediction model for LTG was 0.9226 ($P < 0.0001$) in the training group and 0.7869 ($P < 0.0001$) in the validation group.

The input, hidden, and output layers in the LTG and LDG neural network models are shown in Supplementary Figure 3. The AUC of the neural network prediction model for LDG was 0.8451 ($P < 0.0001$) in the training group and 0.9142 ($P < 0.0001$) in the validation group. The AUC of the LTG prediction model was 0.8827 ($P < 0.0001$) in the training group and 0.747 ($P < 0.0001$) in the validation group.

DISCUSSION

Laparoscopic surgery is as safe and feasible as laparotomy in a variety of solid tumor radical procedures. The CLASS-01 study suggests that LDG is similar to open distal gastrectomy in terms of short-term outcomes, 3-year disease-free survival, and 5-year overall survival in gastric cancer patient[3,8]. The surgical indications for laparoscopic gastrectomy combined with D2 Lymph node dissection for gastric cancer remain controversial; however, the trend toward laparoscopic techniques seems irresistible. The accurate identification of postoperative complications could further improve the safety of laparoscopic techniques and expand their use in gastric cancer patients.

Table 2 Incidence of complications in the training group and validation groups

	Training group	Validation group
Complication	164	78
Anastomotic leakage	23	11
Anastomotic stricture	5	5
Anastomotic bleeding	6	0
Pancreatic fistula	3	0
Gastric and Intestinal stasis	10	0
Bleeding of peritoneal cavity	7	1
Surgical incision infection or fat liquefaction	18	3
Pulmonary infection	42	5
Abdominal infection	27	29
Sepsis	5	0
Urinary tract infection	1	13
Intestinal obstruction	14	7
Lymphorrhea	10	4
Deep vein thrombosis	1	1
Pulmonary embolism	1	1
Cardiac arrhythmia	0	0
Biliary leakage	1	0

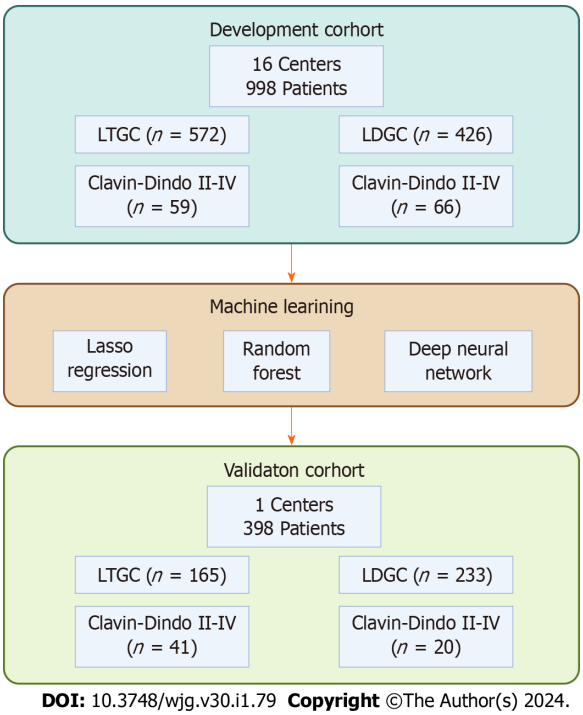

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Figure 1 Research flow diagram. LTGC: Laparoscopic total gastrectomy for gastric cancer; LDGC: Laparoscopic distal gastrectomy for gastric cancer.

This study was based on retrospective data from multiple medical centers in multiple provinces in China, where all surgeons were skilled and experienced in laparoscopic techniques, which could eliminate the impact of the surgical learning curve. There are currently some documented omissions in Clavien–Dindo grade 1 surgical complications; therefore, this study focused on serious complications (Clavien–Dindo grade 2-5). The results of the univariate analysis in this study showed that age, history of severe lung disease, ECOG score, and ASA score were common risk factors for

Table 3 Univariate analysis of severe complications after laparoscopic distal gastrectomy in gastric cancer patients

Variate	No-severe complication (%)	Severe complication (%)	t/χ^2	*P* value	OR	95%CI
Age group						
Age ≤ 65	239	38	1.905	0.168		
Age > 65	121	28			1.455	0.852-2.485
Gender						
Male	234	41	0.095	0.758		
Female	126	25			1.132	0.658-1.948
BMI group						
BMI ≤ 28	347	57	9.49	0.002		
BMI > 28	13	9			4.215	1.722-10.313
Hb	129.7 ± 26.6	126.8 ± 26.2	0.797	0.424	0.996	0.986-1.006
ALB	40.7 ± 4.85	40.3 ± 4.03	0.707	0.48	0.98	0.927-1.036
Tumor size	3.2 ± 1.8	3.5 ± 2.0	-1.346	0.179	1.101	0.967-1.266
Bleeding volume	103.3 ± 89.2	128.6 ± 91.9	-2.109	0.036	1.003	1.000-1.005
Operative time	230.7 ± 45.1	232.4 ± 42.2	-0.282	0.778	1.001	0.995-1.007
Blood transfusion	6.9 ± 49.86	50.00 ± 121.8	-27.381	< 0.001	1.006	1.003-1.010
Severe heart disease						
No	359	64	2.748	0.064		
Yes	1	2			11.219	1.002-125.553
Severe lung disease						
No	358	63	4.601	0.032		
Yes	2	3			8.524	1.396-52.039
Hypertension						
No	302	55	0.013	0.91		
Yes	58	11			1.041	0.541-2.109
Diabetes						
No	329	60	0.016	0.899		
Yes	31	6			1.061	0.424-2.654
Surgerical type						
Totally	82	20	1.734	0.188		
Assisted	278	46			0.678	0.380-1.212
Reconstruction						
Billroth I	90	12	6.133	0.105		
Billroth II	106	26			1.840	0.878-3.854
Roux-en-Y	113	24			1.593	0.755-3.360
Billroth II + Braun	51	4			0.588	0.180-19.19
ECOG score						
0	323	27	95.605	< 0.001		
1	34	26			9.148	4.804-17.421
2	3	13			51.840	13.913-193.157
ASA score						
2	353	55	29.802	< 0.001	10.086	3.750-27.124

BMI: Body mass index; ASA: Aneshesiologists; ECOG: Eastern Collaborative Oncology Group.

complications affecting laparoscopic gastric cancer surgery. ASA scores are used in an increasing number of centers for the pre- and postoperative management of surgical patients and are strongly associated with serious complications, morbidity, and mortality in surgical patients[17,18]. Similarly, this study found that patients with an ASA score of 3 had a much higher complication rate than those with an ASA score of 2. ECOG, a widely used measure of physical fitness recommended by the WHO, has been shown in several previous studies to be a risk factor for surgical complications after ovarian cancer reduction[19], laparoscopic hysterectomy[20], and radical nephrohysterectomy[21].

Several previous studies have suggested that patients with a high BMI have an increased risk of complications such as wound infection and intestinal obstruction owing to the accumulation of fat in the abdominal cavity, which affects lymph node dissection in gastric cancer and makes surgery more difficult[22,23]. However, in patients with a low BMI, esophagojejunostomy may be affected to some extent because of their smaller body size and narrow thorax; therefore, a high BMI in total gastrectomy did not show a significant risk. We also investigated the effect of the abdominal shape on the difficulty of surgery and the occurrence of complications in patients[24,25]. Therefore, subsequent studies incorporating factors related to body size are warranted.

Severe lung diseases considered in the study included obstructive emphysema, bronchial asthma, pneumonia, and pulmonary embolism. Laparoscopic surgery is likely to induce postoperative complications such as atelectasis, pulmonary infection, pulmonary edema, pulmonary embolism, and respiratory failure owing to continuous abdominal inflation, which is potentially more dangerous in the presence of an underlying lung disease. Therefore, in patients with a history of severe lung disease, the lung condition must be well-managed before performing laparoscopic surgery; otherwise, open surgery may be a more suitable option. Laparoscopic gastrectomy for gastric cancer is safe and reliable when the patient's general condition permits. For patients with severe underlying diseases, laparoscopic radical gastrectomy for gastric cancer should be performed with caution.

This study found that totally LTG was a risk factor for surgical complications, and whether this procedure can be safely conducted for gastric cancer patients remains uncertain. However, with the mastery of laparoscopic surgery, both the implantation of the anastomosis and suture anastomosis will no longer be difficult; rather, the totally laparoscopic technique can reduce the length of the abdominal incision and shorten the abdominal opening time. Future prospects are worth exploring in multicenter studies.

To guide clinical decision-making, sufficient preoperative preparation and perioperative monitoring should be performed for the high-risk population of gastric cancer postoperative complications, particularly cardiopulmonary function, identified in the construction model. If necessary, surgery should be postponed, and adequate monitoring of all aspects of the body and intervention in preoperative cardiopulmonary function should be performed in conjunction with consultations from various departments.

In this study, three machine learning methods were used to construct a complication prediction model for laparoscopic gastric cancer surgery, and all three methods showed good predictive performance both for laparoscopic distal gastric cancer radical surgery and for laparoscopic total gastric cancer radical surgery. The model prediction performance of random forest revealed certain advantages over the other two models; random forest model was more favorable for cases with discrete features, limited fetch values, and non-differentiability, among other reasons. The clinical data included in this study were primarily subtypes of variables, and the random forest model exhibited greater advantages in terms of predictive power when compared to all other models.

Compared to other laparoscopic gastrectomy complication models, this trial included medical institutions from different regions of China, and the validation set consisted of data from the main center of the CLASS-01, the Southern Hospital of Southern Medical University. The standardization of the validation dataset for surgery and the reliability of the data are guaranteed, which, to some extent, represents better applicability of the model for standardized laparoscopic gastric cancer surgery. This study also found that the prediction model was generally more effective in predicting complications of distal gastric radical surgery than of total gastric cancer radical surgery. This also indicates that laparoscopic distal gastric cancer surgery has become more consistent and standardized in most centers in China. In contrast, total gastric surgery has increased the confounding factors for complication prediction owing to the expansion and difficulty of the operation, which affects the predictive efficacy and indicates that the standardization of laparoscopic total gastric cancer radical surgery is still a work in progress. At present, the complications model of laparoscopic gastric cancer surgery based on artificial neural networks has been preliminarily applied in the main center for the early warning of preoperative patient complications. The specific benefits will be further reported through prospective research after expanding the sample size.

The present study had some limitations. Some patients were excluded from this study owing to the lack of a complication registry and clinicopathological data. Furthermore, this model is still in the exploratory stage, and its initial application is currently being launched at the main research center to extend the longitudinal depth of the data to be incorporated into the machine learning model. In the future, the model will be combined with an early warning system to assist in decision-making regarding clinical perioperative complications in gastric cancer patients.

CONCLUSION

The multicenter-based complication prediction scoring system constructed in this study can more accurately predict the

Table 4 Univariate analysis of severe complications after laparoscopic total gastrectomy in gastric cancer patients

Variate	No-severe complication (%)	Severe complication (%)	t/χ^2	*P* value	OR	95%CI
Age group						
Age < 65	332	30	4.381	0.036		
Age ≥ 65	181	29			1.733	1.032-3.047
Gender						
Male	372	44	0.113	0.736		
Female	141	15			0.899	0.485-1.667
BMI group						
BMI ≤ 28	481	53	1.319	0.251		
BMI > 28	32	6			1.702	0.680-4.257
Hb	129.1 ± 25.1	135.2 ± 25.7	-1.754	0.08	1.01	0.999-1.021
ALB	40.4 ± 3.1	39.7 ± 3.2	1.664	0.097	0.928	0.851-1.013
Tumor size	4.0 ± 2.2	3.8 ± 1.9	0.674	0.501	0.95	0.826-1.092
Bleeding volume	150.2 ± 133.5	130.2 ± 70.0	1.114	0.255	0.998	0.995-1.001
Operative time	248.9 ± 73.9	229.0 ± 62.5	1.983	0.048	0.996	0.991-1.000
Intraoperative blood transfusion	37.1 ± 180.8	10.17 ± 54.8	{0.099}	0.754	0.998	0.995-1.002
Severe heart disease						
No	512	59	0.115	0.734		
Yes	1	0				
Severe lung disease						
No	511	56	13.461	< 0.001		
Yes	2	3			13.687	2.239-83.665
Hypertension						
No	452	49	1.245	0.264		
Yes	61	10			1.512	0.728-3.140
Diabetes						
No	489	53	3.21	0.073		
Yes	24	6			2.307	0.902-5.896
Surgerical type						
totally	230	35	4.467	0.035		
assisted	283	24			0.557	0.322-0.964
ECOG						
0	426	34	22.379	< 0.001		
1	77	21			3.417	1.883-6.199
2	10	4			5.012	1.493-16.824
ASA						
2	505	51	28.024	< 0.001		
3	8	8			9.902	3.566-27.499

BMI: Body mass index; ASA: Aneshesiologists; ECOG: Eastern Collaborative Oncology Group.

occurrence of complications in patients. Such a prediction can help in the management of preoperative clinical risk factors and close monitoring of patients after surgery, which can improve the overall safety of surgery and lay the foundation for the widespread use of laparoscopic gastrectomy for gastric cancer.

ARTICLE HIGHLIGHTS

Research background

Laparoscopic radical gastrectomy is currently recommended for the treatment of early-stage gastric cancer. However, laparoscopic radical surgery for progressive gastric cancer is not universally accepted or widely used, potentially due to inadequate evaluation and prevention of surgical complications.

Research motivation

Preoperative general condition is an important factor affecting the complications of laparoscopic radical gastrectomy. Accurate prediction of complications can promote the application of laparoscopic radical gastrectomy for gastric cancer.

Research objectives

The aim of this study is to establish a complication prediction model, guide perioperative treatment strategies for gastric cancer patients, and prevent serious complications in laparoscopic radical gastrectomy.

Research methods

In total, laparoscopic radical gastrectomy for gastric cancer at 17 Chinese medical centers were included in complication model. Three machine learning methods, lasso regression, random forest, and artificial neural networks, were used to construct postoperative complication prediction models for laparoscopic distal gastrectomy and laparoscopic total gastrectomy, and their prediction efficacy and accuracy were evaluated.

Research results

The constructed complication model, particularly the random forest model, could better predict serious complications in gastric cancer patients undergoing laparoscopic radical gastrectomy.

Research conclusions

A highly sensitive risk prediction model for complications after laparoscopic radical gastrectomy has been established, and these models have been used to promote the diagnosis and treatment of preoperative and postoperative decisions.

Research perspectives

The complication warning function of this study has been integrated into the hospital internet warning system. In the future, the specific benefits of early warning systems will be further reported through prospective research after expanding the sample size.

FOOTNOTES

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