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ABOUT COVER

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The primary aim of *World Journal of Gastrointestinal Surgery* (*WJGS*, *World J Gastrointest Surg*) is to provide scholars and readers from various fields of gastrointestinal surgery with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

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ORIGINAL ARTICLE

Case Control Study

Factors associated with hypertension remission after gastrectomy for gastric cancer patients

Bing Kang, Xiao-Yu Liu, Yu-Xi Cheng, Wei Tao, Dong Peng

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Abstract

BACKGROUND

Previous studies reported hypertension remission after gastrectomy for gastric cancer patients, and the remission rate was 11.1%-93.8%. We have reported the factors of hypertension remission previously, however, the follow-up time was six months. It is necessary to identify risk factors for hypertension for a relatively longer follow-up time.

AIM

To analyze the predictive factors for hypertension remission one year after gastrectomy of gastric cancer patients and to construct a risk model for hypertension remission.

METHODS

We retrospectively collected the medical information of patients with concurrent gastric cancer and hypertension in a single clinical center from January 2013 to December 2020. Univariate and multivariate logistic regression of hypertension remission were conducted, and a nomogram model was established.

RESULTS

A total of 209 patients with concurrent gastric cancer and hypertension were included in the current study. There were 108 patients in the remission group and 101 patients in the non-remission group. The hypertension remission rate was 51.7% one year after gastrectomy. The remission group had younger aged patients (P = 0.001), larger weight loss (P = 0.001), lower portion of coronary heart disease (P = 0.017), higher portion of II-degree hypertension (P = 0.033) and higher portion of total gastrectomy (P = 0.008) than the non-remission group. Younger age (P =

0.011, odds ratio = 0.955, 95%CI: 0.922-0.990), higher weight loss (P = 0.019, odds ratio = 0.937, 95%CI: 0.887-0.989) and total gastrectomy (P = 0.039, odds ratio = 2.091, 95%CI: 1.037-4.216) were independent predictors for hypertension remission. The concordance index of the model was 0.769 and the calibration curve suggested great agreement. Furthermore, decision curve analysis showed that the model was clinically useful.

CONCLUSION

Younger age, higher weight loss and total gastrectomy were independent predictors for hypertension remission after gastrectomy for gastric cancer patients. The nomogram could visually display these results.

Key Words: Gastric cancer; Hypertension; Gastrectomy; Remission; Nomogram

Core Tip: The purpose of the current study is to analyze the predictive factors for hypertension remission one year after gastrectomy of gastric cancer patients and to construct a risk model for hypertension remission. We found that younger age, higher weight loss and total gastrectomy were independent predictors for hypertension remission after gastrectomy for gastric cancer patients. The nomogram could visually display these results.

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INTRODUCTION

Gastric cancer is the fifth most common cancer and the third most common cause of cancer-related death[1,2]. In China, gastric cancer patients account for about approximately 50% of the world's population[3]. Despite improvements in treatment strategies, radical gastrectomy remains the cornerstone of gastric cancer treatment[4-6].

Hypertension is a major risk factor for cardiovascular disease and an important cause of morbidity and mortality[7,8]. It is estimated that, in 2025, hypertensive patients will account for nearly one-third of adults worldwide[9,10]. In China, the prevalence of hypertension has increased significantly because of urbanization, economic growth, and the aging population[11]. A total of 26.6%-33.6% of the general population is diagnosed with hypertension, resulting in an estimated 23 million deaths per year[12].

Obese patients could experience hypertension remission after bariatric surgery[13,14]. Previous studies reported hypertension remission after gastrectomy for gastric cancer patients, and the remission rate was 11.1%-93.8%[15-20]. We have reported the factors of hypertension remission previously, however, the follow-up time was six months[15].

It is necessary to identify risk factors for hypertension for a relatively longer follow-up time. Therefore, the purpose of the current study was to analyze the predictive factors for hypertension remission one year after gastrectomy in gastric cancer patients; moreover, we constructed a nomogram to visually display these associated factors.

MATERIALS AND METHODS

Patients

We retrospectively collected the medical information of patients with concurrent gastric cancer and hypertension in a single clinical center from January 2013 to December 2020. This study was carried out in accordance with the World Medical Association Declaration of Helsinki. Ethical approval was obtained from the Institutional Ethics Committee of the local hospital (2022-133-2), and informed consent was obtained from all patients.

Inclusion and exclusion criteria

The analysis of this study was restricted to patients who: (1) Had concurrent gastric cancer and hypertension who underwent radical gastrectomy; and (2) had a pathology confirming R0 resection. On

the other hand, those excluded had: (1) Incomplete medical records (n = 32); (2) Irregular follow-up or death within the first year after gastrectomy (n = 37); (3) Irregular hypertension monitoring (n = 77); (4) Irregular antihypertensive medications use (n = 21); (5) Secondary hypertension (n = 4); and (6) had no cardiologist when changing antihypertensive medications (n = 44). Finally, a total of 209 patients with concurrent gastric cancer and hypertension were included in this study, and the flow chart of patient selection is shown in Figure 1.

Definition

Hypertension (HTN) was defined as follows: the average systolic blood pressure (SBP) ≥ 140 mmHg or diastolic blood pressure (DBP) ≥ 90 mmHg at least three times on different days. Hypertension was classified into I, II and III degrees. Degree I HTN was an average SBP was between 140 and159 mmHg or an average DBP between 90 and 99 mmHg; the degree II-HTN was as follows: the average SBP was between 160 and 179 mmHg or the average DBP was between 100 and 109 mmHg; and the degree III was as follows: the average SBP ≥ 180 mmHg or the average DBP ≥ 110 mmHg.

Hypertension remission was divided into two groups: the remission group and the non-remission group. The remission group was defined as follows: (1) SBP and/or DBP decreased with the same antihypertensive medications; (2) The antihypertensive medications were reduced or ceased. The non-remission group was defined as the antihypertensive medications that remained the same or increased. Weight loss was defined as: weight (one year after gastrectomy) minus preoperative weight.

Surgery management and follow-up

Subtotal gastrectomy or total gastrectomy plus D2 Lymph node dissection was conducted according to the guidelines of the 2010 Japanese gastric cancer treatment guidelines (ver. 3)[21]. The gastrectomy type was based on the location and size of the tumor and the reconstruction methods included the Billroth I, Billroth II or Roux-en-Y methods. Patients were regularly followed up every three months for the first three years and every six months for the following two years.

Data collection

Patients' information was collected through the inpatient system, outpatient system and telephone interview. The collected information was as follows: age, sex, preoperative body mass index, preoperative weight, preoperative albumin, pre-operative hemoglobin, one-year postoperative weight, weight loss, smoking, drinking, type 2 diabetes mellitus (T2DM), coronary heart disease (CHD), hypertension classification, neoadjuvant chemotherapy, surgical techniques (subtotal gastrectomy or total gastrectomy), reconstruction methods, tumor stage, tumor size, hypertension duration and hypertension remission.

Statistical analysis

The continuous data are shown as the mean ± SD and the categorical data are shown as n (%). Chi-square tests, Fisher's exact test or independent samples t tests were used to compare the difference between the remission group and the non-remission group.

Parameters were analyzed by univariate regression analysis for potential predictors of hypertension remission. Multivariate regression analysis was used to identify independent risk factors for hypertension remission. Then, a nomogram was generated. Bootstraps with 300 resamples were performed for internal validation. The predictive performance was assessed by Harrell's concordance index (C-index). A calibration curve was plotted to evaluate the calibration of the nomogram. Decision curve analysis (DCA) was performed to evaluate the clinical usefulness of the nomogram.

Data were analyzed using SPSS (version 22.0) statistical software and R software (version 3.6.1). A bilateral P value of < 0.05 was considered statistically significant.

RESULTS

Patients

A total of 209 patients with concurrent gastric cancer and hypertension were included in the current study according to the inclusion and exclusion criteria (Figure 1). There were 108 patients in the remission group and 101 patients in the non-remission group. The hypertension remission rate was 51.7%.

Characteristics of the remission group and the non-remission group

We compared the baseline information and surgical information of the two groups. The remission group had younger patients (63.6 ± 8.7 years *vs* 67.4 ± 8.0 years, P = 0.001), larger weight loss (-8.2 ± 6.7 kg *vs* -5.6 ± 4.6 kg, P = 0.001), lower portion of CHD (8.3% *vs* 19.8%, P = 0.017), higher portion of II-degree hypertension (47.2% *vs* 31.7%, P = 0.033) and higher portion of total gastrectomy (31.5% *vs* 15.8%, P = 0.008) than the non-remission group. There was no significant difference in terms of other

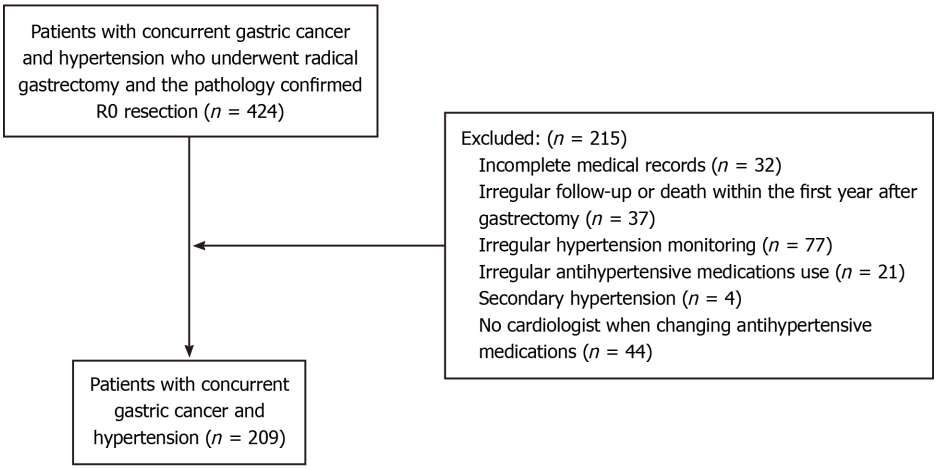

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Figure 1 Inclusion criteria and exclusion criteria of patients with concurrent gastric cancer and hypertension.

information ($P > 0.05$) (Table 1).

Univariate and multivariate logistic regression of hypertension remission

Univariate analyses were conducted to identify potential risk factors for hypertension remission. In univariate logistic regression, younger age ($P = 0.002$, odds ratio = 0.947, 95%CI: 0.916-0.980) and higher weight loss ($P = 0.002$, odds ratio = 0.922, 95%CI: 0.875-0.971), CHD ($P = 0.020$, odds ratio = 0.368, 95%CI: 0.159-0.853) and total gastrectomy ($P = 0.009$, odds ratio = 2.441, 95%CI: 1.248-4.775) were statistically significant (Table 2).

Multivariate logistic regression was conducted to identify independent risk factors. In multivariate logistic regression, younger age ($P = 0.011$, odds ratio = 0.955, 95%CI: 0.922-0.990) and higher weight loss ($P = 0.019$, odds ratio = 0.937, 95%CI: 0.887-0.989) and total gastrectomy ($P = 0.039$, odds ratio = 2.091, 95%CI: 1.037-4.216) were independent predictors (Table 2).

Nomogram, validation and clinical usefulness

The nomogram was built as shown in Figure 2A. The score of each variable could be calculated by drawing vertical line upward to the point scale. The risk factors for hypertension remission could be calculated by summing the total points.

The C-index value of the nomogram was 0.769. The calibration curve of the nomogram suggested great agreement (Figure 2B).

The DCA for the nomogram is shown in Figure 2C, which indicated that when the threshold probability was larger than 0.33, the nomogram might add more benefit than the treat-all or treat-none strategies.

DISCUSSION

A total of 209 patients with concurrent gastric cancer and hypertension were included in the current study and the hypertension remission rate was 51.7% one year after gastrectomy. Younger age, higher weight loss and total gastrectomy were independent predictors for hypertension remission. The C-index of the model was 0.769 and the calibration curve suggested great agreement. Furthermore, decision curve analysis showed that the model was clinically useful.

Previous studies reported that patients with concurrent colorectal cancer and hypertension and/or T2DM could experience hypertension or T2DM remission[22,23]. In gastric cancer patients, remission of T2DM and hypertension was also observed after gastrectomy[20,24-28]. Onco-metabolic surgery was proposed because of the observation of hypertension and/or T2DM remission after gastrectomy for gastric cancer patients. Based on the current findings of hypertension and/or T2DM remission after gastric cancer and colorectal cancer surgery, we thought the onco-metabolic surgery might expand to gastrointestinal cancer surgery.

In terms of patients with concurrent gastric cancer and hypertension, the remission rate was 11.1%-93.8%[15-20]. We summarized these findings in Table 3. We previously reported that age and the surgical techniques used can predict the remission of hypertension six months after gastrectomy[15], however, the follow-up time was only 6 mo. Kim *et al*[16] reported that in early gastric cancer survivors with hypertension, gastrectomy resulted in better blood pressure control, which might be due to the gastrectomy itself, beyond weight loss. Therefore, it was necessary to identify exact risk factors for

Table 1 Baseline characteristics of the remission group and the non-remission group

Characteristics	Remission (*n* = 108)	Non-remission (*n* = 101)	*P* value
Age (yr)	63.6 ± 8.7	67.4 ± 8.0	0.001[b]
Sex			0.420
Male	70 (64.8)	60 (59.4)	
Female	38 (35.2)	41 (40.6)	
Pre-operative BMI (kg/m^2)	23.4 ± 3.0	23.3 ± 32.9	0.770
Pre-operative weight (kg)	63.1 ± 10.0	61.9 ± 10.1	0.366
Pre-operative albumin (g/L)	39.5 ± 5.9	39.4 ± 5.3	0.902
Pre-operative hemoglobin (g/L)	117.9 ± 28.5	118.3 ± 24.4	0.922
Weight loss (kg)	-8.2 ± 6.7	-5.6 ± 4.6	0.001[b]
Smoking	39 (36.1)	41 (40.6)	0.923
Drinking	44 (40.7)	31 (30.7)	0.130
T2DM	21 (19.4)	19 (18.8)	0.908
CHD	9 (8.3)	20 (19.8)	0.017[a]
Hypertension classification			0.033[a]
I	27 (25.0)	25 (24.8)	
II	51 (47.2)	32 (31.7)	
III	30 (27.8)	44 (43.6)	
Neoadjuvant chemotherapy	7 (6.5)	7 (6.9)	0.897
Surgical techniques			0.008[b]
Subtotal gastrectomy	74 (68.5)	85 (84.2)	
Total gastrectomy	34 (31.5)	16 (15.8)	
Reconstruction methods			0.771
B-I	37 (34.3)	36 (35.6)	
B-II	15 (13.9)	17 (16.8)	
R-Y	56 (51.8)	48 (47.6)	
Tumor stage			0.174
I	37 (34.3)	36 (35.6)	
II	15 (13.9)	17 (16.8)	
III	56 (51.8)	48 (47.6)	
Tumor size			0.556
< 5 cm	92 (85.2)	83 (82.2)	
≥ 5 cm	16 (14.8)	18 (17.8)	
Hypertension duration			0.346
≤ 5 yr	53 (49.1)	43 (42.6)	
> 5 yr	55 (50.9)	58 (57.4)	

[a]$P < 0.05$.
[b]$P < 0.01$.
Variables are expressed as the mean ± SD, *n* (%). T2DM: Type 2 diabetes mellitus; BMI: Body mass index; CHD: Coronary heart disease; B-I: Billroth I reconstruction; B-II: Billroth II reconstruction; R-Y: Roux-en-Y reconstruction.

hypertension remission.

Table 2 Univariate and multivariate logistic regression of hypertension remission

Risk factors	Univariate analysis		Multivariate analysis	
	OR (95%CI)	*P* value	OR (95%CI)	*P* value
Age (yr)	0.947 (0.916-0.980)	0.002[b]	0.955 (0.922-0.990)	0.011[a]
Sex (male/female)	0.794 (0.454-1.391)	0.421		
Pre-operative BMI (kg/m^2)	1.014 (0.925-1.112)	0.769		
Pre-operative weight (kg)	1.013 (0.986-1.040)	0.365		
Pre-operative albumin (g/L)	1.003 (0.956-1.053)	0.902		
Pre-operative hemoglobin (g/L)	0.999 (0.989-1.010)	0.922		
Weight loss (kg)	0.922 (0.875-0.971)	0.002[b]	0.937 (0.887-0.989)	0.019[a]
Smoking (yes/no)	0.973 (0.557-1.700)	0.923		
Drinking (yes/no)	1.552 (0.877-2.748)	0.131		
T2DM (yes/no)	1.042 (0.523-2.077)	0.908		
CHD (yes/no)	0.368 (0.159-0.853)	0.020[a]	0.517 (0.212-1.265)	0.148
Hypertension classification (III/II/I)	0.761 (0.533-1.087)	0.133		
Neoadjuvant chemotherapy (yes/no)	0.931 (0.315-2.753)	0.897		
Surgical techniques (Total gastrectomy/subtotal gastrectomy)	2.441 (1.248-4.775)	0.009[b]	2.091 (1.037-4.216)	0.039[a]
Reconstruction methods (R-Y/B-II/B-I)	1.318 (0.968-1.794)	0.080		
Tumor stage (III/II/I)	1.072 (0.795-1.445)	0.650		
Tumor size (≥ 5 cm/< 5 cm)	0.802 (0.384-1.674)	0.557		
Hypertension duration (> 5 yr/≤ 5 yr)	0.769 (0.446-1.328)	0.346		

[a]$P < 0.05$.
[b]$P < 0.01$.
OR: Odds ratio; CI: Confidence interval; T2DM: Type 2 diabetes mellitus; BMI: Body mass index; CHD: Coronary heart disease; B-I: Billroth I reconstruction; B-II: Billroth II reconstruction; R-Y: Roux-en-Y reconstruction.

Table 3 Previous studies reporting the remission of hypertension after gastrectomy for gastric cancer patients

Ref.	Year	Country	Sample size	Remission rate	Summary
Peng *et al* [15]	2020	China	143	55.3%	Age and the surgical techniques used can predict the remission of hypertension 6 mo after gastrectomy. However, the follow-up time was only 6 mo
Kim *et al* [16]	2019	South Korea	66	57.6%	In early gastric cancer survivors with hypertension, gastrectomy resulted in better blood pressure control, which may be due to the gastrectomy itself, beyond weight loss
Lee *et al* [17]	2015	South Korea	351	11.1%	The results came from a nationwide cohort study with limited baseline information, no further information could be found in terms of risk factors for hypertension remission
Park *et al* [18]	2020	South Korea	33	42.4%	The study focused on the comparison between the long-limb R-Y reconstruction between conventional R-Y reconstruction, the information for hypertension remission was limited
Wang *et al*[19]	2020	China	16	93.8%	Elaborate parameters of endocrine hormone change, however, the sample size was too small

The molecular mechanism of hypertension remission after gastrectomy for gastric cancer patients is unclear, but it might be related to bariatric surgery for obese patients[29,30]. There were many possible molecular mechanisms of hypertension remission for obese patients after bariatric surgery: elevated activation of the renin–angiotensin–aldosterone system in obese patients might normalize after surgery [31] and the improvement of gastrointestinal gut hormone levels and insulin resistance after surgery [32], a possible effect of these gut hormones on the sympathetic nervous system[33], adipokines and other inflammatory cytokines would lead to hypertension recovery[34]. Thus, similar to bariatric surgery, multiple factors might work together for hypertension remission after gastric cancer surgery

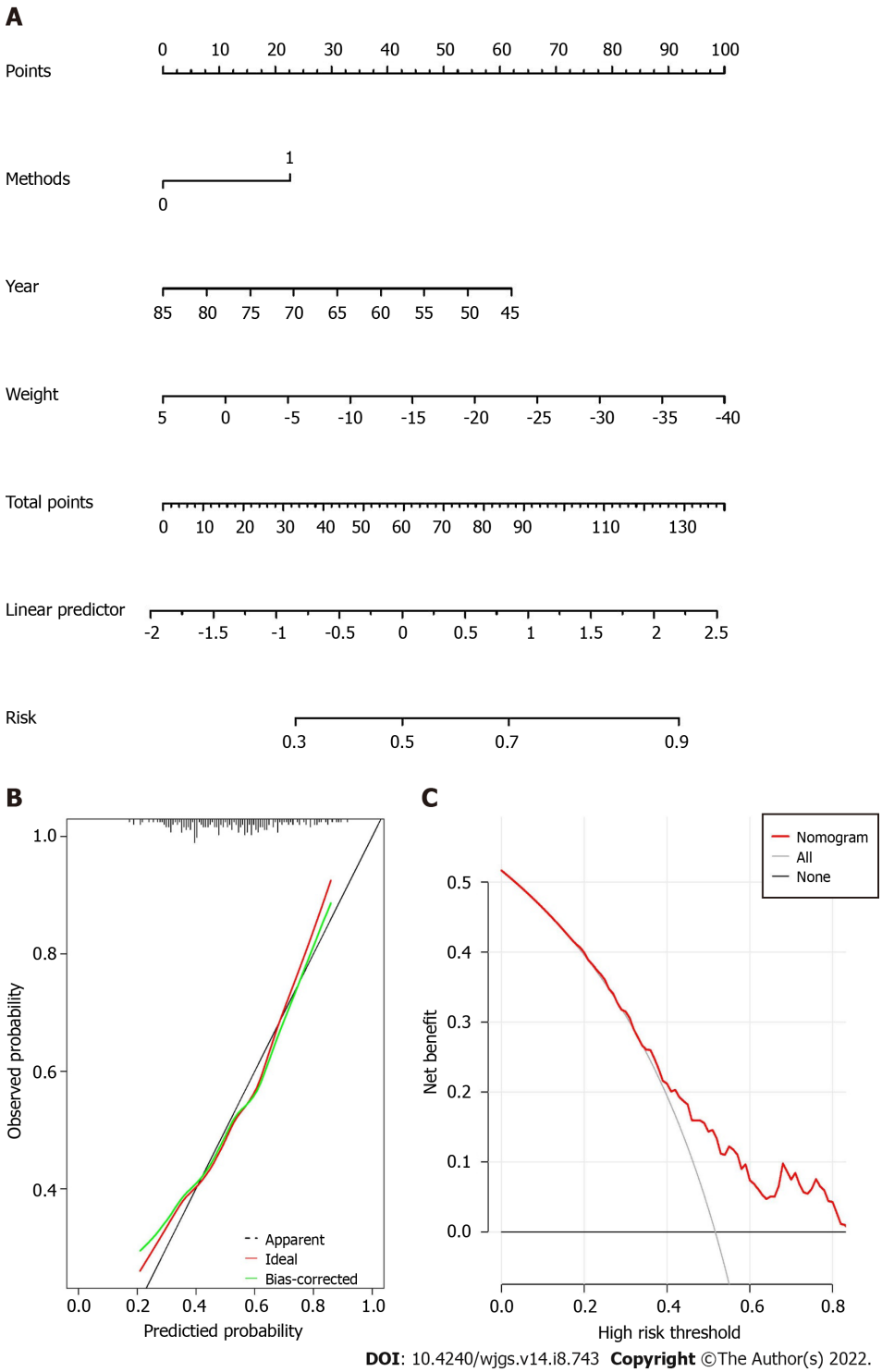

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Figure 2 Predictive model for hypertension remission. A: Nomogram for hypertension remission; B: Calibration curve of the nomogram; C: Decision curve analysis for predicting hypertension remission. TG: Total gastrectomy; SG: Subtotal gastrectomy.

[35-37]. Furthermore, it was reported that early hypertension remission might be related to endocrine hormones and late hypertension remission might be related to neurohumoral regulation[36,37].

For younger patients, vascular elasticity might contribute to the higher rate of hypertension remission [15]. Total gastrectomy had a wider extent than subtotal gastrectomy, and a larger volume of residual stomach in subtotal gastrectomy allowed more food than total gastrectomy, thus total gastrectomy might be associated with higher remission of hypertension[16]. The purpose of this study was different from previous studies reporting the remission of hypertension after gastrectomy for gastric cancer patients. Lee *et al*[17] found no risk factors for hypertension remission. Park *et al*[18] focused on the comparison between long-limb R-Y reconstruction and conventional R-Y reconstruction. The information for hypertension remission was limited. Another study from China focused on the elaborate parameters of endocrine hormone change, however, the sample size was too small[19]. In this study, we

identified three independent predictive factors including younger age, total gastrectomy and higher weight loss, which led to hypertension remission after gastrectomy. Weight loss was an important factor for hypertension control, which was related to lifestyle changes that promoted hypertension remission [38-40].

Some limitations existed in this study. First, this was a retrospective single center study, which might cause selection bias and some detailed data were lost; Second, the follow-up time was relatively short; Third, we only established internal validation, and external validation is needed in the future; Fourth, some blood parameters including leptin, adiponectin, renin, angiotensin II and aldosterone are needed in the following experiments. Therefore, multi-center, large-sample studies with more parameters are needed in future studies to elaborately analyze the factors of hypertension remission.

CONCLUSION

In conclusion, younger age, higher weight loss and total gastrectomy were independent predictors for hypertension remission after gastrectomy for gastric cancer patients one year after surgery. The nomogram could visually display these results. Our study predicted that younger hypertension patients who underwent gastrectomy for gastric cancer might decrease anti-hypertensive medication and relieve hypertension-related comorbidities.

ARTICLE HIGHLIGHTS

Research background

Previous studies reported hypertension remission after gastrectomy for gastric cancer patients, and the remission rate was 11.1%-93.8%. We have reported the factors of hypertension remission previously, however, the follow-up time was six months. It is necessary to identify risk factors for hypertension for a relatively longer follow-up time.

Research motivation

The purpose of the current study was to analyze the predictive factors for hypertension remission one year after gastrectomy in gastric cancer patients.

Research objectives

The purpose of the current study is to analyze the predictive factors for hypertension remission one year after gastrectomy of gastric cancer patients and to construct a risk model for hypertension remission.

Research methods

Univariate and multivariate logistic regression of hypertension remission were conducted, and a nomogram model was established.

Research results

A total of 209 patients with concurrent gastric cancer and hypertension were included in the current study and the hypertension remission rate was 51.7% one year after gastrectomy. Younger age, higher weight loss and total gastrectomy were independent predictors for hypertension remission. The C-index of the model was 0.769 and the calibration curve suggested great agreement. Furthermore, decision curve analysis showed that the model was clinically useful.

Research conclusions

Younger age, higher weight loss and total gastrectomy were independent predictors for hypertension remission after gastrectomy for gastric cancer patients. The nomogram could visually display these results.

Research perspectives

Our study predicted that younger hypertension patients who underwent gastrectomy for gastric cancer might decrease anti-hypertensive medication and relieve hypertension-related comorbidities.

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FOOTNOTES

Author contributions: Kang B and Liu XY contributed equally to this work; Tao W and Peng D contributed to conception and design of the study; all authors contributed to data collection; Cheng YX and Peng D contributed to the data analysis; Peng D led the quality assessments; Kang B and Liu XY write the origin draft; all the authors have agreed on the manuscript which will be submitted, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

Institutional review board statement: This study was conducted in accordance with the World Medical Association Declaration of Helsinki and was approved by the Medical Ethics Committee of the First Affiliated Hospital of Chongqing Medical University (2022-133-2).

Informed consent statement: This study is a retrospective study, and the patients is come from a teaching hospital of the First Affiliated Hospital of Chongqing Medical University. When we deliver the ethics application, we have also delivered application for exemption of informed consent, and This study was approved by the Medical Ethics Committee of the First Affiliated Hospital of Chongqing Medical University (2022-133-2).

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REFERENCES

1 **Sung H**, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, Bray F. Global Cancer Statistics 2020: GLOBOCAN Estimates of Incidence and Mortality Worldwide for 36 Cancers in 185 Countries. *CA Cancer J Clin* 2021; **71**: 209-249 [PMID: 33538338 DOI: 10.3322/caac.21660]
2 **Gao K**, Wu J. National trend of gastric cancer mortality in China (2003-2015): a population-based study. *Cancer Commun (Lond)* 2019; **39**: 24 [PMID: 31046840 DOI: 10.1186/s40880-019-0372-x]
3 **GBD 2017 Stomach Cancer Collaborators**. The global, regional, and national burden of stomach cancer in 195 countries, 1990-2017: a systematic analysis for the Global Burden of Disease study 2017. *Lancet Gastroenterol Hepatol* 2020; **5**: 42-54 [PMID: 31648970 DOI: 10.1016/S2468-1253(19)30328-0]
4 **Matsui R**, Inaki N, Tsuji T. Impact of diabetes mellitus on long-term prognosis after gastrectomy for advanced gastric cancer: a propensity score matching analysis. *Surg Today* 2022; Online ahead of print [PMID: 35226172 DOI: 10.1007/s00595-022-02482-y]
5 **Youn SI**, Son SY, Lee K, Won Y, Min S, Park YS, Ahn SH, Kim HH. Quality of life after laparoscopic sentinel node navigation surgery in early gastric cancer: a single-center cohort study. *Gastric Cancer* 2021; **24**: 744-751 [PMID: 33389274 DOI: 10.1007/s10120-020-01145-6]
6 **Wang FH**, Zhang XT, Li YF, Tang L, Qu XJ, Ying JE, Zhang J, Sun LY, Lin RB, Qiu H, Wang C, Qiu MZ, Cai MY, Wu Q, Liu H, Guan WL, Zhou AP, Zhang YJ, Liu TS, Bi F, Yuan XL, Rao SX, Xin Y, Sheng WQ, Xu HM, Li GX, Ji JF, Zhou ZW, Liang H, Zhang YQ, Jin J, Shen L, Li J, Xu RH. The Chinese Society of Clinical Oncology (CSCO): Clinical guidelines for the diagnosis and treatment of gastric cancer, 2021. *Cancer Commun (Lond)* 2021; **41**: 747-795 [PMID: 34197702 DOI: 10.1002/cac2.12193]
7 **Carey RM**, Whelton PK. New findings bearing on the prevention, detection and management of high blood pressure. *Curr Opin Cardiol* 2021; **36**: 429-435 [PMID: 34059611 DOI: 10.1097/HCO.0000000000000864]
8 **Filippini T**, Malavolti M, Whelton PK, Vinceti M. Sodium Intake and Risk of Hypertension: A Systematic Review and Dose-Response Meta-analysis of Observational Cohort Studies. *Curr Hypertens Rep* 2022; **24**: 133-144 [PMID: 35246796 DOI: 10.1007/s11906-022-01182-9]
9 **Kearney PM**, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of

worldwide data. *Lancet* 2005; **365**: 217-223 [PMID: 15652604 DOI: 10.1016/S0140-6736(05)17741-1]
10 **Mills KT**, Bundy JD, Kelly TN, Reed JE, Kearney PM, Reynolds K, Chen J, He J. Global Disparities of Hypertension Prevalence and Control: A Systematic Analysis of Population-Based Studies From 90 Countries. *Circulation* 2016; **134**: 441-450 [PMID: 27502908 DOI: 10.1161/CIRCULATIONAHA.115.018912]
11 **Wang J**, Zhang L, Wang F, Liu L, Wang H; China National Survey of Chronic Kidney Disease Working Group. Prevalence, awareness, treatment, and control of hypertension in China: results from a national survey. *Am J Hypertens* 2014; **27**: 1355-1361 [PMID: 24698853 DOI: 10.1093/ajh/hpu053]
12 **Forouzanfar MH**, Liu P, Roth GA, Ng M, Biryukov S, Marczak L, Alexander L, Estep K, Hassen Abate K, Akinyemiju TF, Ali R, Alvis-Guzman N, Azzopardi P, Banerjee A, Bärnighausen T, Basu A, Bekele T, Bennett DA, Biadgilign S, Catalá-López F, Feigin VL, Fernandes JC, Fischer F, Gebru AA, Gona P, Gupta R, Hankey GJ, Jonas JB, Judd SE, Khang YH, Khosravi A, Kim YJ, Kimokoti RW, Kokubo Y, Kolte D, Lopez A, Lotufo PA, Malekzadeh R, Melaku YA, Mensah GA, Misganaw A, Mokdad AH, Moran AE, Nawaz H, Neal B, Ngalesoni FN, Ohkubo T, Pourmalek F, Rafay A, Rai RK, Rojas-Rueda D, Sampson UK, Santos IS, Sawhney M, Schutte AE, Sepanlou SG, Shifa GT, Shiue I, Tedla BA, Thrift AG, Tonelli M, Truelsen T, Tsilimparis N, Ukwaja KN, Uthman OA, Vasankari T, Venketasubramanian N, Vlassov VV, Vos T, Westerman R, Yan LL, Yano Y, Yonemoto N, Zaki ME, Murray CJ. Global Burden of Hypertension and Systolic Blood Pressure of at Least 110 to 115 mmHg, 1990-2015. *JAMA* 2017; **317**: 165-182 [PMID: 28097354 DOI: 10.1001/jama.2016.19043]
13 **Nudotor RD**, Canner JK, Haut ER, Prokopowicz GP, Steele KE. Comparing remission and recurrence of hypertension after bariatric surgery: vertical sleeve gastrectomy versus Roux-en-Y gastric bypass. *Surg Obes Relat Dis* 2021; **17**: 308-318 [PMID: 33189600 DOI: 10.1016/j.soard.2020.09.035]
14 **Neff KJ**, Baud G, Raverdy V, Caiazzo R, Verkindt H, Noel C, le Roux CW, Pattou F. Renal Function and Remission of Hypertension After Bariatric Surgery: a 5-Year Prospective Cohort Study. *Obes Surg* 2017; **27**: 613-619 [PMID: 27628054 DOI: 10.1007/s11695-016-2333-7]
15 **Peng D**, Cheng YX, Tao W, Zou YY, Qian K, Zhang W. Onco-Metabolic Surgery: A Combined Approach to Gastric Cancer and Hypertension. *Cancer Manag Res* 2020; **12**: 7867-7873 [PMID: 32922085 DOI: 10.2147/CMAR.S260147]
16 **Kim HJ**, Cho EJ, Kwak MH, Eom BW, Yoon HM, Cho SJ, Lee JY, Kim CG, Ryu KW, Kim YW, Choi IJ. Effect of gastrectomy on blood pressure in early gastric cancer survivors with hypertension. *Support Care Cancer* 2019; **27**: 2237-2245 [PMID: 30317431 DOI: 10.1007/s00520-018-4491-8]
17 **Lee EK**, Kim SY, Lee YJ, Kwak MH, Kim HJ, Choi IJ, Cho SJ, Kim YW, Lee JY, Kim CG, Yoon HM, Eom BW, Kong SY, Yoo MK, Park JH, Ryu KW. Improvement of diabetes and hypertension after gastrectomy: a nationwide cohort study. *World J Gastroenterol* 2015; **21**: 1173-1181 [PMID: 25632190 DOI: 10.3748/wjg.v21.i4.1173]
18 **Park YS**, Park DJ, Kim KH, Lee Y, Park KB, Min SH, Ahn SH, Kim HH. Nutritional safety of oncometabolic surgery for early gastric cancer patients: a prospective single-arm pilot study using a historical control group for comparison. *Surg Endosc* 2020; **34**: 275-283 [PMID: 30927123 DOI: 10.1007/s00464-019-06763-5]
19 **Wang Y**, Yang W, Zhu Y, Jin N, Wu W, Zheng F. Decreased hypertension in non-obese non-diabetic gastric cancer patients after gastrectomy. *Asian J Surg* 2020; **43**: 926-929 [PMID: 32593493 DOI: 10.1016/j.asjsur.2020.04.009]
20 **Cheng YX**, Peng D, Tao W, Zhang W. Effect of oncometabolic surgery on gastric cancer: The remission of hypertension, type 2 diabetes mellitus, and beyond. *World J Gastrointest Oncol* 2021; **13**: 1157-1163 [PMID: 34616520 DOI: 10.4251/wjgo.v13.i9.1157]
21 **Japanese Gastric Cancer Association**. Japanese gastric cancer treatment guidelines 2010 (ver. 3). *Gastric Cancer* 2011; **14**: 113-123 [PMID: 21573742 DOI: 10.1007/s10120-011-0042-4]
22 **Peng D**, Liu XY, Cheng YX, Tao W, Cheng Y. Improvement of Diabetes Mellitus After Colorectal Cancer Surgery: A Retrospective Study of Predictive Factors For Type 2 Diabetes Mellitus Remission and Overall Survival. *Front Oncol* 2021; **11**: 694997 [PMID: 34295822 DOI: 10.3389/fonc.2021.694997]
23 **Cheng YX**, Tao W, Liu XY, Yuan C, Zhang B, Wei ZQ, Peng D. Hypertension Remission after Colorectal Cancer Surgery: A Single-Center Retrospective Study. *Nutr Cancer* 2022; 1-7 [PMID: 34994247 DOI: 10.1080/01635581.2021.2025256]
24 **Kim JW**, Cheong JH, Hyung WJ, Choi SH, Noh SH. Outcome after gastrectomy in gastric cancer patients with type 2 diabetes. *World J Gastroenterol* 2012; **18**: 49-54 [PMID: 22228970 DOI: 10.3748/wjg.v18.i1.49]
25 **An JY**, Kim YM, Yun MA, Jeon BH, Noh SH. Improvement of type 2 diabetes mellitus after gastric cancer surgery: short-term outcome analysis after gastrectomy. *World J Gastroenterol* 2013; **19**: 9410-9417 [PMID: 24409070 DOI: 10.3748/wjg.v19.i48.9410]
26 **Wang KC**, Huang KH, Lan YT, Fang WL, Lo SS, Li AF, Wu CW. Outcome after curative surgery for gastric cancer patients with type 2 diabetes. *World J Surg* 2014; **38**: 431-438 [PMID: 24132827 DOI: 10.1007/s00268-013-2291-3]
27 **Kim JH**, Huh YJ, Park S, Park YS, Park DJ, Kwon JW, Lee JH, Heo YS, Choi SH. Multicenter results of long-limb bypass reconstruction after gastrectomy in patients with gastric cancer and type II diabetes. *Asian J Surg* 2020; **43**: 297-303 [PMID: 31060769 DOI: 10.1016/j.asjsur.2019.03.018]
28 **Shin YL**, Park SH, Kwon Y, Lee CM, Park S. Restoration for the foregut surgery: bridging gaps between foregut surgery practice and academia. *J Minim Invasive Surg* 2021; **24**: 175-179 [PMID: 35602858 DOI: 10.7602/jmis.2021.24.4.175]
29 **Arias A**, Rodríguez-Álvarez C, González-Dávila E, Acosta-Torrecilla A, Novo-Muñoz MM, Rodríguez-Novo N. Arterial Hypertension in Morbid Obesity after Bariatric Surgery: Five Years of Follow-Up, a Before-And-After Study. *Int J Environ Res Public Health* 2022; **19** [PMID: 35162597 DOI: 10.3390/ijerph19031575]
30 **Climent E**, Oliveras A, Pedro-Botet J, Goday A, Benaiges D. Bariatric Surgery and Hypertension. *J Clin Med* 2021; **10** [PMID: 34575161 DOI: 10.3390/jcm10184049]
31 **Landsberg L**, Aronne LJ, Beilin LJ, Burke V, Igel LI, Lloyd-Jones D, Sowers J. Obesity-related hypertension: pathogenesis, cardiovascular risk, and treatment: a position paper of The Obesity Society and the American Society of Hypertension. *J Clin Hypertens (Greenwich)* 2013; **15**: 14-33 [PMID: 23282121 DOI: 10.1111/jch.12049]
32 **le Roux CW**, Welbourn R, Werling M, Osborne A, Kokkinos A, Laurenius A, Lönroth H, Fändriks L, Ghatei MA, Bloom SR, Olbers T. Gut hormones as mediators of appetite and weight loss after Roux-en-Y gastric bypass. *Ann Surg* 2007; **246**: 780-785 [PMID: 17968169 DOI: 10.1097/SLA.0b013e3180caa3e3]

33 **Yamamoto H**, Kishi T, Lee CE, Choi BJ, Fang H, Hollenberg AN, Drucker DJ, Elmquist JK. Glucagon-like peptide-1-responsive catecholamine neurons in the area postrema link peripheral glucagon-like peptide-1 with central autonomic control sites. *J Neurosci* 2003; **23**: 2939-2946 [PMID: 12684481]

34 **Woelnerhanssen B**, Peterli R, Steinert RE, Peters T, Borbély Y, Beglinger C. Effects of postbariatric surgery weight loss on adipokines and metabolic parameters: comparison of laparoscopic Roux-en-Y gastric bypass and laparoscopic sleeve gastrectomy--a prospective randomized trial. *Surg Obes Relat Dis* 2011; **7**: 561-568 [PMID: 21429816 DOI: 10.1016/j.soard.2011.01.044]

35 **Schiavon CA**, Drager LF, Bortolotto LA, Amodeo C, Ikeoka D, Berwanger O, Cohen RV. The Role of Metabolic Surgery on Blood Pressure Control. *Curr Atheroscler Rep* 2016; **18**: 50 [PMID: 27324638 DOI: 10.1007/s11883-016-0598-x]

36 **Ahmed AR**, Rickards G, Coniglio D, Xia Y, Johnson J, Boss T, O'Malley W. Laparoscopic Roux-en-Y gastric bypass and its early effect on blood pressure. *Obes Surg* 2009; **19**: 845-849 [PMID: 18758869 DOI: 10.1007/s11695-008-9671-z]

37 **Drucker DJ**. The role of gut hormones in glucose homeostasis. *J Clin Invest* 2007; **117**: 24-32 [PMID: 17200703 DOI: 10.1172/JCI30076]

38 **Hall ME**, Cohen JB, Ard JD, Egan BM, Hall JE, Lavie CJ, Ma J, Ndumele CE, Schauer PR, Shimbo D; American Heart Association Council on Hypertension; Council on Arteriosclerosis, Thrombosis and Vascular Biology; Council on Lifestyle and Cardiometabolic Health; and Stroke Council. Weight-Loss Strategies for Prevention and Treatment of Hypertension: A Scientific Statement From the American Heart Association. *Hypertension* 2021; **78**: e38-e50 [PMID: 34538096 DOI: 10.1161/HYP.0000000000000202]

39 **Kwee LC**, Ilkayeva O, Muehlbauer MJ, Bihlmeyer N, Wolfe B, Purnell JQ, Xavier Pi-Sunyer F, Chen H, Bahnson J, Newgard CB, Shah SH, Laferrère B. Metabolites and diabetes remission after weight loss. *Nutr Diabetes* 2021; **11**: 10 [PMID: 33627633 DOI: 10.1038/s41387-021-00151-6]

40 **Ortiz-Gomez C**, Romero-Funes D, Gutierrez-Blanco D, Frieder JS, Fonseca-Mora M, Lo Menzo E, Szomstein S, Rosenthal RJ. Impact of rapid weight loss after bariatric surgery on the prevalence of arterial hypertension in severely obese patients with chronic kidney disease. *Surg Endosc* 2020; **34**: 3197-3203 [PMID: 31492989 DOI: 10.1007/s00464-019-07094-1]

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