

Impact of bilateral subcostal rooftop incision combined double lifting retractor on recent surgical outcomes of obese patients with advanced gastric cancer

L.-M. QIAN, J.-M. HUANG

Gastrointestinal Surgery of the People's Hospital of Jiangyin, Jiangyin, China

Both authors equally contributed for this work

Abstract. – OBJECTIVE: To investigate the impact of bilateral subcostal rooftop incision under bilateral costal margins combined double lifting retractors on the recent surgical outcome of obese patients with advanced gastric cancer.

PATIENTS AND METHODS: We retrospectively analyzed the clinical data of 138 obese patients with gastric cancer under radical gastrectomy. The patients were divided into two groups, the MI group (n=68) and RI group (n=70). Patients in MI group were treated by midline incision via upper abdomen combined single double lifting retractor technology while the patients in RI group were treated by roof incision under bilateral costal margins under combined double lifting technology. The abdomen entering and closing time, the operation time, bleeding volume, blood transfusion rate, postoperative drainage volume, postoperative hospitalization time, postoperative detected number of perigastric lymph node, postoperative pain score, postoperative complications and short-term survival between the two groups were compared and analyzed.

RESULTS: The average abdominal entering and closing time of RI group were slightly longer than MI group, but the average total operation time of RI group was shorter than MI group. The average bleeding volume was 98.4 ± 46.8 ml, the postoperative intraperitoneal drainage was 24 h (123.8 ± 69.0 ml), 48 h (101.9 ± 36.7 ml), 72 h (45.1 ± 24.6 ml), and the postoperative hospitalization time was 12.9 ± 2.5 d, and the incidence of postoperative complications was 17.1%, all of which were less than MI group. The difference on the average total detected number of perigastric lymph node between the two groups was not statistically significant. 129 cases (93.5%) were followed up for 12 to 36 months, and the difference on survival curve between the two groups was not statistically significant ($p > 0.05$).

CONCLUSIONS: Bilateral subcostal rooftop incision was favorable for exposing the stomach, adjacent organs and large vessels, convenient for operation and would not affect the postoperative recovery, so it was a good choice for obese patients with gastric cancer.

Key Words

Obesity, Advanced gastric cancer, Radical gastrectomy, Bilateral subcostal rooftop incision.

Introduction

At present, gastric carcinoma is the most common malignant tumor of the digestive system, and D2 radical gastrectomy is the standard operation for gastric cancer in our country. With the change of eating habits and the improvement of living standards, the number of patients with obesity gastric cancer is increasing rapidly. Currently, WHO has adopted the body mass index (BMI) as the standard for diagnosis of obesity and BMI >30 is defined as obesity¹. Different from the systemic obesity of westerners, obesity in China is mainly abdominal obesity (waist circumference, male >85 cm; female >80 cm). The CT volume scanning method can directly make a quantitative measurement on the body fat and has become a major measurement method in evaluating the content and distribution of fat tissues of human body. Males in China are dominated by visceral fat and women are dominated by body surface fat. Studies have indicated that obesity could increase the prevalence of postoperative complications and mortality in patients undergoing major abdominal surgery^{3,4}, especially the patients dominated by visceral fat². Subcostal incision is generally used in operations of organs in upper and right upper abdomen, such as cystectomy, kidney or adrenal gland surgery or splenectomy while bilateral subcostal rooftop incision is originated from the herringbone incision (also called as Mercedes-Benz incision) of hepatic disease surgeries (such as liver resection and liver transplantation), but free from median upward extension. At present, the application of the incision in obese patients un-

der gastric cancer surgery has been rarely reported. Although the effect of laparoscopic technology for early obese gastric cancer has been widely recognized, its clinical efficacy in the treatment of advanced gastric cancer is still controversial. For advanced gastric cancer, laparotomy is still the major surgery. This study was focused on investigating the impacts of bilateral subcostal rooftop incision combined double lifting retractor technology on the recent surgical outcomes of advanced obese gastric cancer patients, such as the operation condition, the total number of lymph node dissection, postoperative pain score, postoperative hospitalization time, postoperative complications and survival curves.

Patients and Methods

Patients

Retrospectively, a total of 138 patients were identified, who were diagnosed with obese gastric cancer under radical gastrectomy with D2 lymph node dissection in the gastrointestinal surgery of the People's Hospital of Jiangyin, among which 109 were males and 29 were females, with the median age of 62 (29-75) years. All of the patients underwent preoperative obesity assessment through BMI, waist circumference and multi-slice spiral CT scanning method. CT scan measurement indexes included (Table I, Figure 1). The obese patients were randomly divided into two groups:

the MI group (n=68) and RI group (n=70). Patients in MI group were treated by midline incision via upper abdomen combined single double lifting retractor technology (Figure 3) while the patients in RI group were treated by roof incision under bilateral costal margins under combined double lifting technology (Figure 2). Differences on age, gender, BMI, waist circumference, CT scan measurement, gastric cancer stage, and surgical method between the two groups were not statistically significant (Table I).

Observation Indicators

Operations of all patients were conducted by the same one senior chief physician and the lymph nodes in all gastric cancer specimen were immediately removed to test for pathology. The abdomen entering and closing time, the operation time, postoperative drainage volume, postoperative hospitalization time, detected number of postoperative perigastric lymph nodes, postoperative pain score, postoperative complications and of the two groups were recorded. After operation, telephone or clinical follow-up was planned and the patients' living conditions were observed, including the occurrence of an incisional hernia (after the stitches on the incision were taken out, the surface healed well, reducible mass gradually appeared, which could disappear in supine position and could touch deep defect). Abdomen entering time was starting from cutting open the skin to the end of peritoneum opening. Abdomen closing time was starting

Table I. Comparison of general clinical data and obesity related indexes of patients in the two groups.

No.	Age (year)	Gender (cases) male/female	Stage of the disease (cases)				Method of gastric resection (cases) Subtotal		BMI (kg/m ²)	Waistline (cm)
			II	IIIA	IIIB	IIIC	gastrectomy/total gastrectomy			
RI group	70	59.9±7.2	56/14	17	12	30	11	45/25	32.1±1.2	84.2±4.3
MI group	68	60.3±8.6	53/15	15	16	28	9	51/17	31.7±1.3	85.4±3.0
<i>p</i> value		0.777	0.767			0.817		0.171	0.120	0.057

No.	CT scan (mm)			
	SCF ¹	APD ²	TD ³	
RI group	70	26.7±2.2	208.3±17.8	318.9±12.3
MI group	68	26.3±2.6	211.2±19.2	322.4±11.6
<i>p</i> value		0.263	0.351	0.087

¹SCF (subcutaneous fat), referring to the maximal value from the dermis to rectus abdominis anterior sheath, and the average number of the left and right SCF was the measured value; ²APD (abdominal anterior-posterior diameter), referring to the measured distance from navel to spinous process's connection to abdominal section and lumbar section; ³TD (abdominal transverse diameter), referring to the measured distance of the horizontal line of anterior lumbar vertebra.

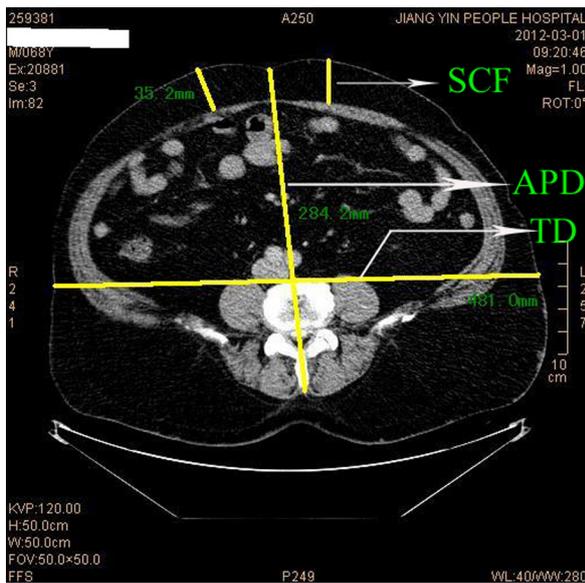


Figure 1. CT scan measurement indexes: SCF (subcutaneous fat), that is the thickness of subcutaneous fat, which is the maximum value from dermis down to rectus abdominis anterior sheath; APD (abdominal anterior-posterior diameter), that is abdominal anterior-posterior diameter, which is the measuring distance between the line from umbilicus to spinous process and abdominal wall section and lumbar section; TD (abdominal transverse diameter), that is abdominal transverse diameter, which is the measuring distance of front horizontal line of lumbar vertebra.

from suturing peritoneum to the end of skin closure. Operation time was starting from cutting open the skin to the end of skin closure. Intraop-

erative blood loss was the calculated result based on the volume in the suction bottle and the use of gauze. The incision pain score by the visual analog scales (VAS) was applied. A horizontal line or vertical line of 10 cm, with both ends marking with 0 (no pain) and 10 (severe pain), marked the score that best represented the pains; 0-3 points represented mild pains, 4-6 points represented moderate pains, 7-10 points represented severe pains. Early post-operative complications include disease or clinical symptoms associated with surgery within 2 weeks after surgery. Incision fat liquefaction referred to that incision continued to have oily liquid overflow, delayed healing referred to the incision infection of wound due to a purulent secretion, and delayed healing after the normal days for stitch removal, had passed. Incision split generally referred to that the patients, after severe coughing, suddenly felt pains in the incision and the dressing in incision had bloody fluid and sometimes had small intestine exposure; abdominal hemorrhage referred to that bloody fluid were drained from peritoneal drainage tube or that were confirmed by CT and other imaging examinations; chylous leakage referred to that peritoneal drainage fluid were in white and could be confirmed if the chylemia was positive. Generally, the case that the triglyceride content in drainage fluid was more than 1.13 mmol/L or the content of chylomicron was over 4% could be confirmed as chylous leakage. Gastrointestinal leakage referred to that digestive tract content were drained from abdominal cavity or were confirmed by CT or diges-

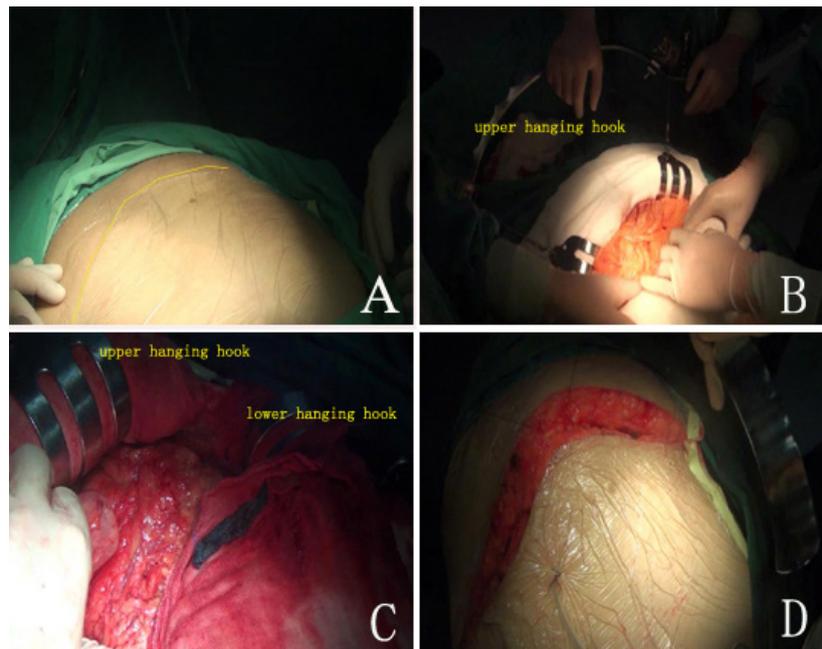


Figure 2. Rooftop incision and dual suspension wire retractor. **A**, Skin incision; **B**, Installing upper suspension wire retractor; **C**, Upper and lower suspension wire retractor; **D**, Abdominal closure.



Figure 3. From the center of upper abdomen to the left and around navel incision and single suspension wire retractor. **A**, Skin incision; **B**, Laparotomy; **C**, Single suspension wire retractor.

tive tract radiography and other radiological examinations; gastroplegia referred to those symptoms such as abdominal distention, nausea, vomiting and intractable hiccup occurred after stopping gastrointestinal decompression, liquid diet or changing liquid diet into semi-liquid diet after distal gastrectomy, vomited a large amount of gastric content after eating, with or without bile, symptoms were temporarily relieved after vomit, gastrointestinal decompression extracted a large amount of liquid, 1000-3000 ml per day, and digestive tract iodine oil radiography indicated delayed gastric emptying; pulmonary infection referred to fever and purulent sputum or confirmed by chest X-ray examination; deep venous thrombosis referred to unilateral or bilateral lower limb swelling and vascular ultrasound examination confirmed deep venous thrombosis and blood circulation was <50%; pulmonary embolism referred to sudden dyspnea, chest pain, decreased oxygen saturation, which failed to rise after oxygen uptake, confirmed hypoxia under blood gas analysis, elevated D-2-dimer and could be confirmed by pulmonary artery CTA, manifesting in luminal filling defect, artery truncation or “pruning syndrome”.

Statistical Analysis

SPSS17.0 software (SPSS Inc., Chicago, IL, USA) was adopted for statistical analysis and *t*-test was applied for measurement data such as abdomen entering and closing time, operative bleeding volume, operation time, postoperative drainage volume of the abdominal cavity, postoperative hospitalization time and postoperative detected number of routine pathological perigastric lymph nodes. χ^2 was used to test the level of incision pain and the incidence of the complication after the operation; Kaplan-Meier was applied for testing recent survival rate after the operation. $p < 0.05$ means the difference is of statistical significance.

Results

Incision Method and Operation Condition

The average abdomen entering time (14.8 ± 4.7 min) and closing time (19.5 ± 2.9 min) of patients in RI group were slightly longer than those in MI group (9.9 ± 2.3 min and 15.4 ± 2.9 min), but the difference was of no statistical significance. The total average operation time (197.8 ± 23.1 min) in RI group was shortened by 40 min when compared with MI group ($p < 0.05$); the bleeding volume in RI group was reduced in comparison to MI group (Table II).

Incision Method and Postoperative Recovery

The postoperative drainage volume of the abdominal cavity in RI group was less compared with MI group. The level of pain after operation in RI group was significantly lower when compared with MI group. The average hospitalization time in RI group was shortened by 2 days when compared with MI group, the difference of the detected number of pathological lymph nodes in the two groups was of no statistical significance (Table II).

Incision Method and Postoperative Complication

There were 12 cases in RI group and 29 cases in MI group with complications after the operation. The type of complication could be seen in Table III, the incidence rate of the two groups were 17.1% and 42.6%, respectively, and the differences of the two groups were of statistical significance.

Incision Method and Survival Curve

In 138 cases, there was no surgical death, 129 cases (93.5%) were followed up for 12 to 36 months, the median survival time in RI group was 24 months, while in MI group was 27 months. The difference of the recent survival curve in the two groups was of no statistical significance (Figure 4).

Table II. Comparison of operative and postoperative conditions of patients in the two groups

No.	Abdomen entering time (min)	Abdomen closing time (min)	Operation time (min)	Operative bleeding volume (ml)	Postoperative drainage volume (ml)			Level of postoperative pain (VAS)			Post-operative hospital stay (d)	Dissection number of lymph nodes	
					24 h	48 h	72 h	Low	Moderate	High			
RI group	70	14.8±4.7	19.5±2.9	197.8±23.1	98.4±46.8	123.8±69.0	101.9±36.7	45.1±24.6	10	50	10	12.9±2.5	22.9±4.7
MI group	68	9.9±2.3	15.4±2.9	237.1±21.8	169.1±74.9	236.3±72.1	146.9±56.0	78.5±48.3	5	33	30	14.8±3.6	21.7±3.4
<i>p</i> value		0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.001		0.000	0.078

Discussion

In addition to closely relating to cardiovascular, diabetes mellitus and other diseases, obesity also increases the risks of at least nine kinds of cancers including colon cancer, breast cancer, uterine cancer, kidney cancer, esophageal cancer, pancreatic cancer, gallbladder cancer, liver cancer and gastric cancer, causing serious harms to human health. The obese population in China is mainly abdominal obesity. Some scholars^{5,6} hold that abdominal form is one of the key factors that would affect the operation. Obesity is due to their hypertrophic abdominal wall, large anterior and posterior enterocelia diameter, and relatively more omentum majus and adipose tissues in the abdominal cavity, not only hinder the exposure of the surgical field, but also lead to narrow operation space. Moreover, the patients usually have more adipose tissues in peripheral blood vessels and the blood vessels are brittle, so their tissues and blood vessels are more vulnerable to damage when the tissues are stretched repeatedly during operation, thus resulting in increased blood loss⁶⁻⁹. Therefore, the median incision laparotomy on obese gastric cancer patients would become quite difficult to perform due to the incomplete exposure caused by dividing the peritoneum outside duodenum, dealing with the left and right gastroepiploic vessels, short gastric vessels and posterior gastric vessels in the depth, stripping the pancreatic capsule and clearing the No. 7, 8, 9, 10,

Table III. Specific conditions for the incidence of postoperative complications in two groups.

Complication	RI group	MI group	<i>p</i> -value
Fat colligation	6	11	
Incision infection	2	6	
Incision split	0	2	
Incisional hernia	0	3	
Intra-abdominal hemorrhage	1	4	
Chylous fistula	4	4	
Anastomotic leakage or stump fistula	0	3	
Gastroparesis	1	4	
Pulmonary infection	3	7	
Deep vein thrombosis	1	3	
Pulmonary embolism	0	1	
Incidence number	12	29	0.001

*Multiple complications may occur in the same patient.

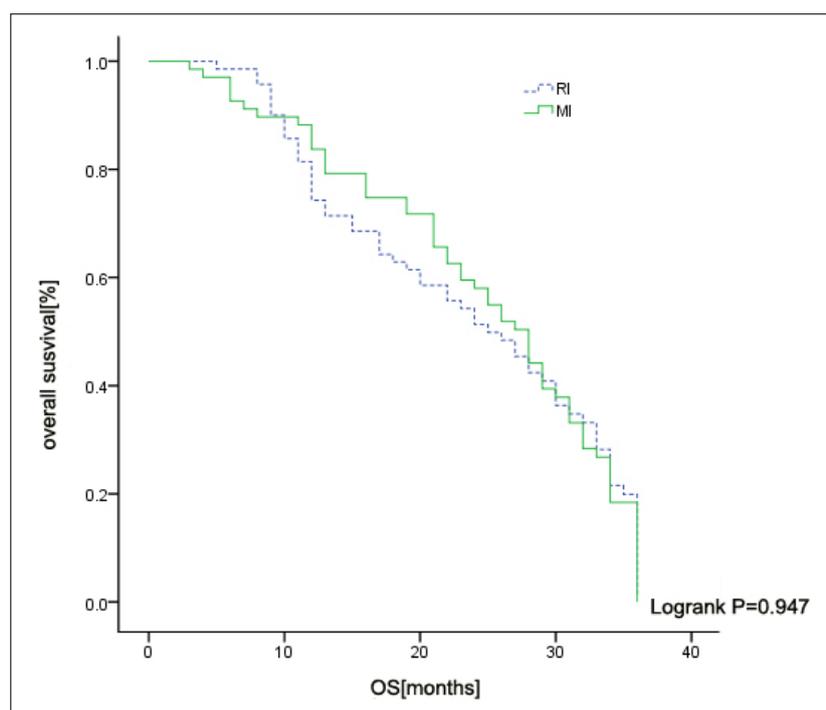


Figure 4. Two recent survival curve graphs.

11, 13 lymph nodes beside the great deep vessels, thus resulting in blood loss and pancreatic parenchyma injuries^{10,11}. Besides, due to the poor subphrenic exposure, total gastrectomy would affect the esophageal jejunum anastomosis, which leads to more difficulty of the median incision operation, longer operation and more complications.

However, the unique visual angle of bilateral subcostal rooftop incision could support a wider visual field and the double lifting retractor technology could further expand the visual field, thus being more favorable for the operations. The results of our study have shown that the total operation time of RI group was less than the MI group, mainly manifesting in that the time for dealing with spleen fossa, stripping pancreatic capsule, and clearing lymph nodes in truncus coeliacus and beside the main branches were greatly shortened. Moreover, bilateral subcostal rooftop incision was more favorable for identifying the space between the deep pancreatic parenchyma and the peripancreatic fat, reducing the trauma of pancreatic parenchyma, lowering the occurrence of traumatic focal pancreatitis, reducing the occurrence of abdominal hemorrhage and anastomotic fistula, reducing surgical trauma, shortening the anesthesia time, decreasing the occurrence of the post-operative complications, thus being more beneficial for the patients and their recovery. The postoperative pains of RI group were significant-

ly lighter than the control group, which might be related with the intercostal nerve transection. The result of our follow-up showed that it does not increase the occurrence of recent incisional hernia. The obese patients, due to their incrassated chest wall, elevated diaphragm and limited compliance of thorax, would suffer from decreased vital capacity and would be dominated by abdominal respiration. For these patients, bilateral subcostal rooftop incision was more favorable and it would not interfere their abdominal respiration and the post-operative complications (such as pulmonary atelectasis or pulmonary infection), which were much less. The detected number of pathological lymph nodes after operation of RI group was equivalent to the MI group, and the 1-year and 3-year survival rates between the two groups were not statistically significant, indicating that the change of incision method would not affect the final curative effects of gastric cancer treatment.

Conclusions

Bilateral subcostal rooftop incision was favorable for the radical gastrectomy on obese patients with advanced gastric cancer, its surgical trauma was slight and would not affect the recent outcome of patients, so it was a good choice for obese patients with gastric cancer.

Conflict of Interests

The Authors declare that they have no conflict of interests.

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