Billroth II with Braun Enteroenterostomy vs. Roux en Y Reconstruction Post Distal Gastrectomy

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Abstract

Background: Roux-en-Y reconstruction is superior to Billroth-II; it is an important factor that improves quality of life. Is modification (Braun enteroenterostomy) in Billroth-II has similar or superior effect**??**

Materials and methods: This study includes 34 operable patients who subjected to radical distal gastrectomy with D1 and D2 lymphadenectomy between May 2014 and Jan. 2017 at surgical oncology department, South Egypt Cancer Institute. Billroth-II with Braun enteroenterostomy versus Roux-en-Y reconstruction where done (post gastrectomy).

Results: Mean operative time was 167 min (SD ±60) in Billroth-II-Braun vs. 192 min (SD ±64) in Roux-en-Y, mean blood loss was 490(SD±200) ml in Billroth-II-Braun vs. in Roux-en-Y 413(SD±232) ml, Hospital stay was 14(±5) days in Billroth-II-Braun vs. 16(±7) days in Roux-en-Y, all of them with **p value > 0.05**. Anastomotic leak occurred in 1 in Billroth-II-Braun vs. 2 in Roux-en-Y while surgical site infection occurred in 8 cases in Billroth-II-Braun and 3 in Roux-en-Y, pneumonia 1 case in Billroth-II-Braun and 2 in Roux-en-Y, DVT and PE 2 cases in Billroth-II-Braun **p value > 0.05**. The majority of dumping (early and late) occur in 7 cases in Roux-en-Y group and biliary reflux occurs in 12% of cases (1 in Billroth-II-Braun and 3 in Roux-en-Y) with **p value = 0.043**. Thirty-day mortality occurs in 2 cases in Billroth-II-Braun and 2 in Roux-en-Y with **p value > 0.05.** Anastomotic recurrence occurs in 4 cases in Billroth-II-Braun while 4 in Roux-en-Y, one case develop anastomotic. Regional lymph nodes metastasis in 1 in Billroth-II-Braun), and distant metastasis in 7 in Billroth-II-Braun and 3 in Roux-en-Y, local and distant metastasis in 2 in Billroth-II-Braun and 1 in Roux-en-Y, the mortality was 9 cases of Billroth-II-Braun, 3 in Roux-en-Y during follow up, **p value > 0.05**. Median of overall and disease free survival in both groups 16 months and 11 months respectively with **p value > 0.05**.

Conclusions: Billroth-II with Braun enteroenterostomy is superior to Roux-en-Y reconstruction and improves the motility disorders

Keywords: Gastric cancer, distal gastric cancer, distal gastrectomy, Billroth II, Braun Enteroenterostomy and Roux-en-Y.

Introduction

Gastric cancer is one of the most common cancers, the estimated new cases for both sexes is 11.1 incidence and 8.2 deaths per 100.000 worldwide and form the fourth leading cause of cancer-related deaths Figure 1[1]. The estimated new cases for both sexes in Egypt is 2.8 incidence and 2.3 deaths per 100.000 [2].

Although the incidence of gastric cancer at the upper third of stomach has gradually increased over the years, distal gastric cancers as well as distal gastrectomy are still the mainstream [3]. Surgical treatment (include resection with proper perigastric lymphadenectomy) remains the cornerstone of radical resection of potentially curable gastric cancer [4].

Since about hundred years, first subtotal

gastrectomy 1881 and total gastrectomy 1897 had been successfully, the best surgical procedure for distal gastric cancer still remains controversial [5].

However, there is still controversy regarding which is the best reconstruction method after distal gastrectomy DG [6]. Billroth I (B-I), Billroth II (B-II), and Roux-en-Y (REY) (which are acceptable options) are used to maintain bowel continuity [7]. B-I and REY reconstruction have been widely applied. All of them have their advantages and disadvantages, B-I characterized by its technical simplicity and preservation the physiological passage of the food but patients may suffer from gastritis or cancer in remnant stomach. In contrast REY reconstruction is a choice if the remnant stomach or duodenum becomes short due to extensive resection to ensure the safety margin and prevent bile reflux, and what so-called stasis syndrome [8-10]. B-II reconstruction is as an alternative to REY reconstruction and the incidence of reflux symptoms is low in Roux-en Y in comparison with Billroth II after distal gastrectomy [9, 10].

Many drugs used to treatment of bile reflux; none are consistently effective. , Cholestyramine and Pro motility agents (e.g., metoclopramide) may have a role if gastroparesis is suspected [11].

The procedures that used to prevent bile reflex were; Roux-en Y gastrojejunostomy (the most familiar) Braun entero-enterostomy and the Henley procedure (anti peristaltic jejunal interposition) [11].

For this reason, Braun enteroenterostomy anastomosis was designed to decrease this bile inflow to the stomach. Braun anastomosis will be a good substitute for REY [9].

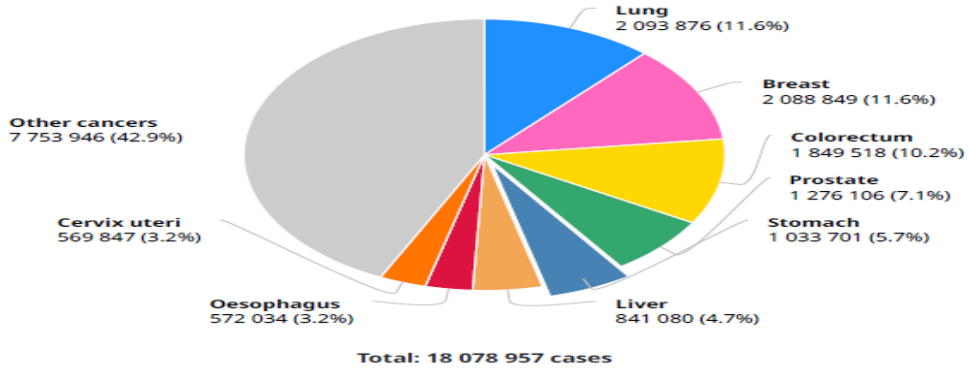

Figure 1 Estimated number of new cases in 2018, worldwide, all cancer, both sexes, all ages

Patients and methods

Patients

Thirty four patient diagnosed as distal gastric cancer was operated with radical subtotal distal gastrectomy with D1 and D2 lymphadenectomy between May 2014 and Jan. 2017 at surgical oncology department in South Egypt Cancer Institute (SECI) Assiut University Egypt. Blood investigations were done for all patients, upper endoscopy done for localization of the lesion with tissue diagnosis. CT pelvi-abdomen and chest is mandatory to evaluate tumor extension, lymph node and distant metastasis (Staging), and assessing the operability.

Eligibility criteria

Inclusion

All patients with histopathologic diagnosis of proximal gastric cancer

Exclusion

Patient above 70 years, stage IV gastric carcinoma with sever comorbid disease (As cirrhotic in liver failure, and recent myocardial infarction within the previous 6 months.) ASA >3 PS

Staging

All cases were diagnosed with pelvi-abdominal and chest CT proved by tissue diagnosis through esophago-gastro-duodenoscopy. Staging was done in accordance with the seventh edition of the AJCC for having a standard understanding

Surgical approach

Distal gastric cancer was operated with curative radical subtotal distal gastrectomy with D1 and D2 lymphadenectomy, a gross safety margin was achieved. All cases are operated by abdominal approach, open or laparoscopy assisted.

Methodology

In this study all patient were divided in to two groups according to reconstruction method in to group 1 Billroth II gastro-jejunostomy with Braun enteroenterostomy **(B II Braun)** and group 2 with Roux en Y gastro-jejunostomy **(REY)**, each group followed by endoscopy and pelvi-abdomen computed tomography (**CT**) scan after six months then annually for early complications, intra-operative, post-operative morbidity and mortality, late complications motility disorders, treatment failure and two

years disease free survival (DFS) and overall survival (OS).

Aim of the study

Comparative study between Billroth II gastro-jejunostomy with Braun enteroenterostomy and Roux en Y gastro-jejunostomy reconstruction post subtotal distal gastrectomy for gastric cancer in the form of intra-operative complications, intra- operative blood lose, operative time, 30 days post-operative complications, safety, hospital stay, motility disorders, treatment failure and two years DFS and OS.

Statistical analysis

Statistical data were analyzed using SPSS version 24.0 (SPSS Inc., Chicago, IL, USA). The independent sample t-test was used to compare the means of the two groups. The statistical analyses were performed using the chi-squared test or the paired Student's t-test as appropriate. Survival was evaluated using the Kaplan - Meier method, including the log-rank test for the model. $P < 0.05$ was considered statistically significant.

Results

Table 1.

Table 1 Clinical characteristics

Clinical characteristics (Table 1)

Thirty four patients underwent subtotal distal gastrectomy (**SDG**) for distal gastric cancer with D1 and D2 lymphadenectomy. Reconstruction after SDG where done with gastro-jejunostomy; 19 patients with B II Braun and 15 patients with REY. The mean age is 56.15 SD ± 12. In this study, there was male predominance 67and most patients with B II Braun were above 60 yrs.

Fifteen patients have previous history of gastritis in both groups without significant statistical difference (P value = 0.667) and only one case had history of previous gastric surgery. Previous morbidity found in 36% of in form of DM, HTN or IHD.

Abdominopelvic CT scan revealed that 68% of the tumors located at pylorus, 15% greater curvature, 12% leaser curvature and 6% body without significant statistical differences. Tumor size range 1-8 cm and mean of 4.13 cm standard deviation (SD ±2.2). Only 12% patient received neoadjuvant therapies without significant statistical differences see

		B II Braun n=19 (%)	Roux en Y n=15 (%)	P
Age (year) mean (SD)		56(±14)	53(±10)	0.4347
Age Group				0.162
	20-29Ys	0(00%)	1(7%)	
	30-39Ys (16%)	0(00%)	1(7%)	
	40-49Ys (16%)	3(16%)	6(40%)	
	50-59Ys (34%)	7(31%)	2(13%)	
	>=60 (34%)	9(47%)	5(33%)	
Sex				0.154
	Male (67%)	8(42%)	10(67%)	
	Female (33%)	11(58%)	5(33%)	
Comorbidity				0.503
	Diabetes (15%)	2(11%)	5(33%)	
	Hypertension (12%)	2(11%)	2(13%)	

	Ischemic Heart Disease (9%)	2(11%)	1(7%)	
Previous Gastric surgery (3%)		1(5%)	0(00%)	0.367
Tumor Location				0.210
	Pyloric (68%)	11(58%)	12(80%)	
	Body (6%)	1(5%)	1(7%)	
	Lesser Curvature (12%)	4(21%)	0(00%)	
	Greater Curvature (15%)	3(16%)	2(13%)	
Tumor size in CT cm mean (SD)		5(±2)	4(±2)	0.241
Neoadjuvant Chemotherapy (12%)		3(16%)	1(7%)	0.206

Surgical Procedure and Operative Finding (Table 2)

Twenty nine percent of cases (5 in B II Braun and 5 in REY) operated laparoscopically, while the others with open surgery (14 in B II Braun and 10 in REY). Regarding surgical factors, R0 resection in 91% of cases (16 in B II Braun and 15 in RYGJ), and R1 (positive margin) in 9% of cases (3 in B II Braun) without significant differences. Lymphadenectomy D2 was done in 62% of cases (13 in B II Braun and 8 in REY) and D1 in 38% of cases (6 in B II Braun and 7 in REY) without statistical significant differences. Extended resection due to infiltration of adjacent structure (spleen or transvers colon and distal pancreas) done in 12% of cases (3 in B II Braun and 1 in REY) with p value = 0.045. Mean operative time was 180 min SD ±62.7 (167 min (SD ±60) in B II Braun and 192 min (SD ±64) in REY), and mean blood loss was 400 ml SD ±216.29 ml in min (490(±200) ml in B II Braun and 413(±232) ml in REY) without significant statistical differences. No differences found in hospital stay in both groups (14(±5) days in B II Braun and 16(±7) days in REY) see Table 2.

Table 2 Surgical Procedure and Operative Finding

		B II Braun n=19 (%)	Roux en Y n=15 (%)	P
Surgical approach				
	Open (71%)	14(26%)	10(33%)	0.655
	Laparoscopic-assisted (29%)	5(74%)	5(67%)	
Blood loss in ml mean (SD)		413(±232)	490(±200)	0.772
Operative time in min. mean (SD)		167(±60)	192(±64)	0.257
R status				0.107
	R0 (91%)	16(81%)	15(100%)	
	R1 (9%)	3(16%)	0(00%)	
Lymphadenectomy				0.369
	D1 (38%)	6(32%)	7(47%)	
	D2 (62%)	13(68%)	8(53%)	
Extended Resection				
	Transvers colectomy (9%)	3(16%)	0(00%)	0.045
	Splenectomy & Distal Pancreatectomy (3%)	0(00%)	1(7%)	
Harvested nodes mean (SD)		15 (±5)	14(±8)	0.776
Positive nodes mean (SD)		4(±3)	4(±3)	0.328
Hospital stay Days mean (SD)		14(±5)	16(±7)	0.228

Pathological characteristics (Table 3)
Postoperative pathology revealed 50% of cases were adenocarcinoma (7 in B II Braun and 10 in REY), 41% Signet ring (9 in B II Braun and 5 in RYGJ), and 9% mucoid-adenocarcinoma (3 in B II Braun). In regard to Lauran classification; Diffuse type represent 68% of all cases (12 in B II Braun and 11 in REY) while intestinal type 32% (7 in B II Braun and 4 in REY). High grade tumor 62% (10 in B II Braun and 11 in REY), moderate grade 29% (7 in B II Braun and 3 in REY), Low grade 9% (2 in B II Braun and 1 in REY).
As regard to depth invasion of tumor; 86% pT3 (14 in B II Braun and 8 in REY), 12% pT2 (4 in B II Braun and 4 in REY), and 9% pT4 (1 in B II Braun and 2 in REY). Lymph node metastasis documented in pN1 35% (8 in B II Braun and 4 in REY), pN2 29% (7 in B II Braun and 3 in REY), pN0 24% (2 in B II Braun and 6 in REY) and pN3 12% (2 in B II Braun and 2 in REY). Lymphovascular invasion (LVI) found in 41% cases (9 in B II Braun and 5 in REY). Number of retrieved lymph nodes ranged between (1-31) and meanof 14nodes (15(±5) in B II Braun and 14(±8) in REY), of them positive LNs ranged between (1-16) nodes and mean of 3.65 (4(±3) in B II Braun and 4(±3) in REY) without significant statistical differences. Majority of cases are Stage II and Stage III 44% (8 in B II Braun and 7 in REY) and (9 in B II Braun and 6 in REY), while Stage I 12% (2 in B II Braun and 2 in REY), without significant statistical differences, see Table 3and Figure 2.

Table 3 Pathological characteristics

		B II Braun n=19 (%)	Roux en Y n=15 (%)	P
Type of pathology				0.118
	Mucoid-Adenocarcinoma (9%)	3(16%)	0(00%)	
	Adenocarcinoma (50%)	7(37%)	10(67%)	
	Signet ring (41%)	9(47%)	5(33%)	
Lauran Classification				0.528
	Intestinal (32%)	7(37%)	4(27%)	
	Diffuse (68%)	12(63%)	11(73%)	
Grade				0.464
	Low (9%)	2(10%)	1(7%)	
	Moderate (29%)	7(37%)	3(20%)	
	High 62%)	10(53%)	11(73%)	
Depth of tumor invasion				0.469
	pT1 (3%)	0(00%)	1(7%)	
	pT2 (12%)	4(21%)	4(27%)	
	pT3 (86%)	14(74%)	8(53%)	
	pT4 (9%)	1(5%)	2(13%)	
Lymph node metastasis				0.210
	pN0 (24%)	2(10%)	6(23%)	
	pN1 (35%)	8(42%)	4(36%)	
	pN2 (29%)	7(37%)	3(32%)	
	pN3 (12%)	2(10%)	2(9%)	
Distant metastasis				
	M1	0	0	
AJCC – Stage				0.905
	Stage I (12%)	2(11%)	2(13%)	
	Stage II (44%)	8(42%)	7(47%)	
	Stage III (44%)	9(47%)	6(40%)	

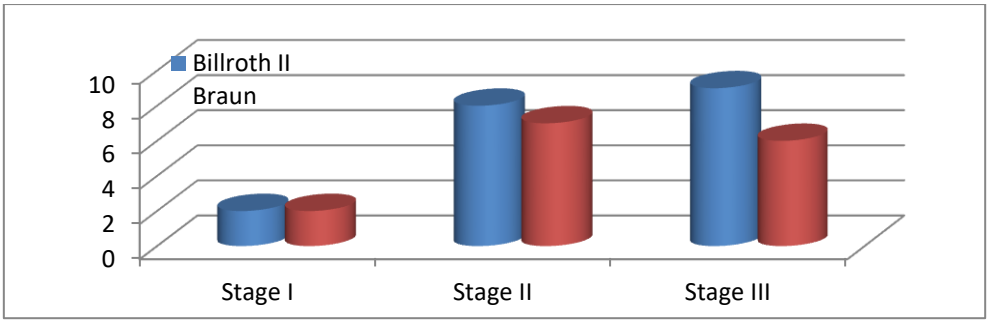

Figure 2 Case distribution per stage (post treatment or pathological staging)

Morbidity and mortality (Table 4)

Postoperative complications were observed in (50%) of patient (10 in B II Braun and 7 in REY), ranged from surgical site infection up to pulmonary embolism. Anastomotic leak occurred in 12% of cases (1 in B II Braun and 2 in REY and surgical site infections (SSI) occur in 32% of cases (8 in B II Braun and 3 in REY). Non-surgical complications in the form of pneumonia registered in 12% of cases (1 in B II Braun and 2 in REY), DVT and PE 56% of cases found in B II Braun without significant statistical difference. Motility disorders found in 44% of cases There were significant difference in the motility disorders between both groups p value = 0.043, where the majority of dumping (early and late) 21% occur in REY group (5 and 2 respectively) and biliary reflux occurs in 12% of cases (1 in B II Braun and 3 in REY). Thirty-day mortality occurred in 12% of cases (2 in B II Braun and 2 in REY), MODS post pneumonia 9% (1 in B II Braun and 2 in REY) without significant statistical difference see Table 4.

Table 4 Postoperative complications in the proximal and total gastrectomy groups

		B II Braun n=19 (%)	Roux en Y n=15 (%)	P
Early morbidity (50%)		10(53%)	7(47%)	0.169
Early Specific Complication				0.324
	Surgical site infections (32%)	8(42%)	3(20%)	
	Anastomotic leak (12%)	1(5%)	2(13%)	
	Gastric Obstruction (3%)	0(00%)	1(7%)	
Early Non Specific Complication				0.324
	DVT (3%)	1(5%)	0(00%)	
	Pneumonia (12%)	1(5%)	2(13%)	
	PE (3%)	1(5%)	0(00%)	
Motility Disorders				0.043
	Early Dumping (15%)	0(00%)	5(26%)	
	Late Dumping (6%)	0(00%)	2(14%)	
	Biliary Reflux (12%)	1(5%)	3(20%)	
Perioperative morality (12%)		2(11%)	2(13%)	0.800
	PE (3%)	1(5%)	0(00%)	
	MODS post Pneumonia (9%)	1(5%)	2(13%)	

Recurrence and Final outcome (Table 5 and 6)

The median follow up for patient with gastrectomy was 16 months with range (1 in B II Braun and 3 in REY). Sixty fife percent of cases received adjuvant therapy, (10 in B II Braun and 5 in REY) received chemotherapy and (2 in B II Braun and 5 in REY) received chemoradiation

Table 5.

During follow up, endoscopy and CT pelvi-abdomen was done in most cases and recurrence found in 16 cases, see Table 6. Eight cases develop anastomotic recurrence (4 in B II Braun and 4 in REY), 1 cases develop anastomotic and regional lymph nodes metastasis (1 in B II Braun), and 10 develop distant metastasis (7 in B II Braun and 3 in REY). Three cases develop both local and distant metastasis (2 in B II Braun and 1 in REY). During the whole period of follow up

12 patients were died (9 in B II Braun and 3 in REY) Table 6.

Table 5 Adjuvant Therapy

		B II Braun n=19 (%)	Roux en Y n=15 (%)	P
Adjuvant Therapy				0.095
	Chemotherapy (44%)	10(52%)	5(33%)	
	Chemo-radiotherapy (21%)	2(11%)	5(33%)	

Table 6 Recurrence Pattern according to each procedure

	B II Braun n=19 (%)	Roux en Y n=15 (%)	P
No Recurrence (53%)	10(53%)	8(53%)	0.967
Anastomotic Recurrence (24%)	4(21%)	4(26%)	0.702
Anastomotic + Regional Recurrence (3%)	1(5%)	0(00%)	0.429
Distant Recurrence (29%)	7(37%)	3(20%)	0.285
Lung metastasis (12%)	3(16%)	1(7%)	0.192
Liver metastasis (15%)	4(21%)	2(13%)	
Local + Distant Recurrence (9%)	2(10%)	1(7%)	0.694

Survival (Table 7)

Two years survival ranged between (6-24) with a median of 16 months and two years disease free survival ranged between (3-24) with a median of 11 months see Table 7 and Figure 3.

Table 7 Two years Overall Survival and Disease Free Survival

	B II Braun	Roux en Y	P
Overall Survival mon. (median)	24	24	0.163
Disease Free Survival mon. (median)	17	14	0.644

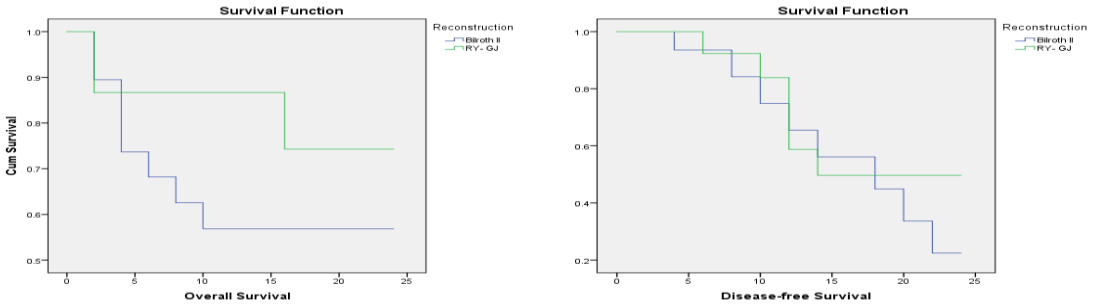

Figure 3 Kaplan Meier for cumulative two years overall survival and disease free survival curves of patients reconstructive methods

Discussion

The different procedures of reconstruction after distal gastrectomy were done to improve quality of life with low side effect.

Here in this study the operative time in B II Braun is longer than REY p = 0.257 which is comparable with data published by Cui et al. 2017and In Choi, C., et al. 2016 where REY is longer with operative time of 152± 33 and 292±58 respectively with p < 0.010. And the blood loss during surgery in B II Braun group is more that in RYGJ group 490(±2)ml vs. 413(±2)ml respectively with no statistical differences p = 0.772. This is not seen in study published by In Choi, C., et al. 2016, where DG done for 66 patients where blood loss in REY group is more than B II Braun group 245±207 ml and 161±146 ml respectively. This can be explained by most case in our series were done by open maneuver versus that done

in previous studies [9, 12].

The post-operative complication in our study were reported in 50% of cases (10 in B II Braun group vs. 7 in REY group) in which surgical site infection 32% of all cases was higher in B II Braun group (8 in B II Braun

group vs. 3 in REY group)and anastomotic leakage 12% of all cases was high in REY group (1 in B II Braun group vs. 2 in REY group) without statistical differences p = 0.324 this is not seen by In Choi, C., et al. 2016 where postoperative morbidity account for (3(12%) in B II Braun group vs. 1(2.5%) in REY group) and Cui et al. revealed postoperative morbidity account (4(15%) in B II Braun group vs. 6(20 %) where surgical site infection 1(3.8%) seen in B II Braun group and anastomotic leakage reported in 1(3.3%) in REY group [9, 12].

Regarding to biliary reflux, in our study it was low. It was reported in 4 (12%) cases (1(5%) in B II Braun group vs. 3(20%) in REY group) with significant statistical difference p = 0.045, which is different to data published where its high in B II Braun group. Cui et al. revealed biliary reflux in 12(22.5%) (7(28%) in B II Braun group vs. 5(17%) in REY group) with p value = 0.343 and In Choi, C., et al. 2016 registered biliary reflux in 34 (51%) cases (22(84%) in B II Braun group vs. 12(30%) in REY group) with p < 0.001, also Lee, M.-S., et al. 2012 report biliary reflux in 68(56%) (39(75%) in B II Braun group vs. 2(3.7%) in REY group) with p value < 0.0001, this can be explained by; some bile still flows into the stomach because the pressure from the afferent loop to the remnant gastric cavity is lower than that to the efferent loop [9, 12, 13]. Early dumping observed in (15%) of cases all of them in RYGJ group which was statistically significant this also opposite what reported by motility disorders in the form of early dumping seen in (26%) in B II Braun group

Thirty-day mortality not reported in data published by Lee et al., In Choi, C., et al. 2016 and Cui, L.-H., et al. 2017, while it was occurs in 12% of cases (2 in B II Braun group and 2 in REY group), the majority due to multi organ dysfunction syndrome MODS post pneumonia 9% (1 in B II Braun group and 2 in RYGJ group) without significant statistical difference, this can be explained by; those patient are old patient and their ASA PS ≈ 3 and heavy smokers [9, 12, 13].

The two years overall treatment failure in this study was seen in 47% of cases (23% in both groups B II Braun group and REY group). Median time of local treatment failure was 10 months while 11 months in distant treatment failure. Regarding the main patterns of treatment failure, there was no difference in local failure between the groups 23% (REY vs. B II Braun), whereas distant failure was dominant in B II Braun after DG (31.5% B II Braun vs. 20% REY) (P = 0. 376),

In this study the 2-year overall survival rate in the B II Braun after DG was 52.6% while 80%in REY after DG. There was no difference in median overall survival of both groups (REY vs. B II Braun) it about 24 months. Stage-specific survival analysis between the groupsin our study revealed, that the 2-year overall survival rate in stage I-II was 66% in REY after DG vs. 60% in B II Braun after DG, while stage III was 100% in REY after DG vs. 52.6% in B II Braun after DG (P = 0.498),

Conclusions

Billroth-II with Braun enteroenterostomy is superior to Roux-en-Y reconstruction and

improves the motility disorders

Abbreviations

ASA	American Society of Anesthesiologists
B II	Billroth II
B II Braun	Billroth II with Braun enteroenterostomy
CTR	Chemotherapy
DFS	Disease Free Survival
MODS	Multi Organ Dysfunction Syndrome
OS	Overall Survival
PS	Physical status
QoL	Quality of life
REY	Roux En Y
SDG	Subtotal Distal Gastrectomy
SECI	South Egypt Cancer Institute
SSI	Surgical Site Infection

Conflict of interest: The authors declare that they have no conflict of interest.

Ethical approval: All procedures performed in the study were in accordance with the ethical standards of the institution.

Informed consent: Informed consent was obtained from all individual participants included in the study

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Figures

Tables