Postoperative Morbidity and Mortality Following D2 Gastrectomy-an Audit of 456 Cases

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Abstract

Background D2 gastrectomy is routinely performed in Japanese centres for carcinoma stomach with low morbidity and mortality. There were concerns in Western centres with regard to D2 gastrectomy in view of high morbidity and mortality rates. This study was aimed to study the postoperative morbidity and mortality following D2 gastrectomy for carcinoma stomach in a high volume centre in India.

Methods It was a retrospective analysis of all the patients who underwent D2 gastrectomy from 1991 to 2010.

Results D2 gastrectomy was performed in 456 patients during this period. Respiratory events were the most common cause of morbidity in the study group (2.4 %). Male gender ($p = 0.007$), presence of gastric outlet obstruction ($p = 0.01$) and pathological T4 ($p = 0.05$) independently predicted increased post operative morbidity in multivariate analysis. The morbidity and mortality rates declined with increase in hospital volume and experience of the surgeon.

Conclusion D2 gastrectomy for carcinoma stomach can be performed safely in specialized centres with low morbidity and mortality rates.

Keywords D2 gastrectomy · Morbidity · Mortality · Carcinoma stomach

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Introduction

Japanese centres have shown that D2 gastrectomy for gastric carcinomas can be safely performed with low morbidity and mortality [1, 2]. The surgery is unpopular among Western centres after two randomized controlled trials showed significantly high complication rates [3, 4]. The aim of the study was to analyze the postoperative morbidity and mortality following D2 gastrectomy for carcinoma stomach and to identify the factors which are associated with an increased risk of postoperative complications.

Methods

The study was a retrospective analysis of all the patients who underwent D2 gastrectomy in our institution from 1991 to 2010. Postoperative period was defined as upto 60 days from the date of surgery. Morbidity was classified as minor (wound infection without dehiscence, urinary tract infection, paralytic ileus, fever of unknown cause, minor pulmonary atelectasis, etc.) or major (hemorrhage, anastomotic leak, duodenal leak, intra abdominal abscess, intestinal obstruction, major cardiorespiratory events requiring ICU care, drain output >100 ml for more than a week or any complication prolonging hospital stay more than a month or leading to mortality). Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 10. AJCC 6th edition was used for staging the disease. Statistical significance was considered when p value was <0.05.

Results

D2 gastrectomy was performed in 456 patients from 1991 to 2010, which included 325 males and 131 females. The mean age at presentation was 53 years (Range 18 to 76 years). The stage-wise distribution is as follows: Stage IA (4.6 %), Stage IB (8.6 %), Stage II (21.3 %), Stage IIIA (30 %), Stage IIIB (20.2 %) and Stage IV (15.1 %). The treatment details are enumerated in Table 1. The incidences of major and minor morbidity as well as mortality are listed in Table 2.

The most common major postoperative morbidity was respiratory problems (2.4 %), followed by intestinal obstruction (1.8 %), cardiac events (0.6 %), intra-abdominal abscess (0.6 %), duodenal blow-out (0.6 %) and anastomotic leak (0.3 %). The median hospital stay in patients who had morbidity was higher when compared to those who did not (16 versus 12 days). Univariate analysis was performed using variables to predict for increased risk of morbidity after radical gastrectomy using T-test and logistic regression method. Multivariate analysis of significant variables was done by logistic regression method. The mean duration of hospital stay was significantly higher for patients who had morbidity in the post operative period (18.8 days versus 12.4 days, $p < 0.05$). Weight, blood loss, duration of surgery, gender, gastric outlet obstruction, type of surgery and the pathological T status were found to be statistically significant on univariate analysis (Table 3 and 4). Multivariate analysis showed male gender, presence of gastric outlet obstruction and pathological T4 were independently found to be associated with increased post operative morbidity (Table 5).

The post operative morbidity and its relationship to hospital volume and experience of operating surgeon were also studied. Two time periods from 1990 to 2000 and 2001–2010 were analyzed (Table 6). Table 7 shows morbidity and mortality trends over four time periods. With increase in hospital load

Table 2 Postoperative complications

	Morbidity			Mortality
	Minor	Major	Overall	
All cases	10.7 %	5.9 %	16.7 %	1.8 %
Type of surgery				
Distal	9.5 %	5.4 %	14.9 %	1.1 %
Total	13.9 %	7.1 %	20.2 %	3.6 %
Proximal			25 %	25 %
Anastomosis				
Billroth I			14.6 %	1.5 %
Billroth II			15.2 %	0.9 %
Multiorgan resection				
None			15.9 %	1.4 %
Spleen/pancreas			23.4 %	3.3 %
Others			30 %	10 %

and experience of the surgeon over the years, the morbidity and mortality showed a downward trend (Fig. 1).

Discussion

Although D2 gastrectomy is performed with a low morbidity and mortality in Japan [1], it is not very popular in Western countries, especially after two randomized controlled trials [3, 4] reported significantly higher complication rates for D2 compared to D1. Table 8 compares our audit with centers across the globe; the figures suggest standards on par with best of the centers.

The incidence of anastomotic leak ranges from 1.3 % to 24.2 % [20, 21, 22, 14, 17]. With increasing surgical experience and use of staplers for anastomosis, the incidence of leak has come down in high volume centers. The reported incidence of postoperative anastomotic hemorrhage is 0.43 %

Table 1 Treatment details

Type of surgery	Distal gastrectomy 368 (80.7 %)	Total gastrectomy 84 (18.4 %) + 4(Proximal)	All cases 456
Multiorgan resection			
Spleen/Pancreas	4	23 + 3(Proximal)	30 (6.6 %)
Other organs	6	4	10 (2.2 %)
Anastomosis			
Billroth I	137		137
Billroth II	230	1	231
Mean blood loss	490.49 ± 259.3 ml	610.11 ± 302.6 ml	513.6 ± 271.9 ml
Median duration of surgery	4 h	5 h	4 h
Mean number of nodes dissected	27.2	30.7	27.9
Median hospital stay (range)	12 days (4 to 44)	13 days (3 to 64)	12 days (3 to 64)

Table 3 T-test for comparison of means (Univariate analysis)

	<i>n</i> = 380 (No morbidity)		<i>n</i> = 76 (Morbidity present)		<i>p</i> value
	Mean	Standard deviation	Mean	Standard deviation	
Hospital stay(days)	12.42	2.2	18.8	9.9	<0.05
Age(years)	52.97	10.77	52.13	11.77	0.54
Hemoglobin(mg/dl)	10.9	2.5	10.9	2.5	0.87
Weight(kg)	50.9	9.4	53.8	9.4	0.01
Blood loss(ml)	489.8	256.2	632.2	316.1	<0.05
Duration of surgery(hrs)	4.5	1.0	5.1	1.2	<0.05
Tumor size(cm)	5.3	2.5	5.5	2.3	0.49

Table 4 Univariate analysis

Variables		<i>n</i> = 380 (No morbidity)	<i>n</i> = 76 (Morbidity present)	Odds ratio	95 % confidence interval	<i>p</i> value
Gender	Male	261	64	1.00*		
	Female	119	12	0.41	0.21–0.79	<0.05
Gastric outlet obstruction	Absent	222	58	1.00*		
	Present	158	18	0.44	0.25–0.77	0.004
Serum Albumin	<3 g%	32	7	1.00*		
	≥3 g%	348	69	0.91	0.38–2.14	0.82
Type of surgery	Distal gastrectomy	313	55	1.00*		
	Total and Proximal gastrectomy	67	21	1.78	1.01–3.15	<0.05
Multiorgan resection	Nil	350	66	1.00*		
	Spleen	23	7	1.61	0.66–3.91	0.29
	Others	7	3	2.27	0.57–9.01	0.24
Anastomosis	Billroth I	117	20	1.00*		
	Billroth II	196	35	1.04	0.58–1.89	0.89
	Others	67	21	1.83	0.93–3.63	0.08
Histology	Adenocarcinoma	277	57	1.00*		
	Mucin secreting carcinoma	56	9	0.78	0.36–1.67	0.52
	Signet ring cell carcinoma	38	9	1.15	0.53–2.51	0.72
	Others	9	1	0.54	0.06–4.35	0.56
T status	T1	25	5	1.00*		
	T2	62	14	1.13	0.37–3.47	0.83
	T3	287	52	0.92	0.33–2.47	0.85
	T4	5	5	5.00	1.04–23.98	0.04
N status	N1	148	30	1.00*		
	N2	83	17	1.01	0.53–1.94	0.97
	N3	57	7	0.61	0.25–1.46	0.26
	N0	92	22	1.18	0.64–2.17	0.59
Stage	I	49	11	1.00*		
	II	80	17	0.95	0.41–2.19	0.9
	III	191	38	0.89	0.42–1.86	0.75
	IV	59	10	0.75	0.30–1.93	0.56

Table 5 Multivariate analysis

Variable		Odds ratio	95 % confidence interval	p value
Gender	Male	1.00*		
	Female	0.40	0.2–0.78	0.007
Gastric outlet obstruction	Absent	1.00*		
	Present	0.46	0.25–0.85	0.01
Type of surgery	Distal gastrectomy	1.00*		
	Total and Proximal gastrectomy	1.35	0.73–2.50	0.34
T status	T1	1.00*		
	T2	1.25	0.40–3.91	0.7
	T3	1.12	0.39–3.20	0.83
	T4	5.32	1.03–27.41	0.05

[23]. The incidence of intra abdominal infection and abscess ranged from 1.5 % to 12 % [24, 25, 13, 14]. Age, prolonged operation time, and combined organ resection were the precipitating factors, and was associated with and without anastomotic leak [25]. The incidence of reported duodenal blow out was low both in our series and in literature [5]. Respiratory complications were the most common complications in our series. It ranged from 3.4 % to 13 % in various series [5, 26, 15, 13]. The incidence of pleural effusion was 4.28 % postoperatively in a series reported by Kostić Z et al. [15]. Aggressive chest physiotherapy, incentive spirometry, early mobilization and use of prophylactic antibiotics have reduced the incidence of respiratory complications. Prophylactic antibiotics and sterile precautions have reduced the incidence of wound infections [24, 27, 28, 29]. The duration of the operation was the only significant risk factor for surgical site infections after open gastrectomy [29] and that wound infection rate did not decrease with longer duration of antimicrobial prophylaxis [27]. The rates of reoperation in the immediate postoperative period was low in some series [10, 30], but as high as upto 18 % in others [4]. Intra abdominal hemorrhage, anastomotic dehiscence, adhesive obstruction and intra abdominal abscesses were the common reasons for redo laparotomy. Mortality rate was found to be high after redo laparotomy [10]. Pancreatic fistula

Table 6 Hospital volumes and complications (Two time periods)

	1991–2000	2001–2010
Number	137	319
Morbidity (%)	21.9	14.4
Mortality (%)	4.4	0.6

Table 7 Hospital case load and complications (Four time periods)

Year-group	Number	Morbidity (%)	Mortality (%)
1991–1995	65	26.2	3.1
1996–2000	72	18.1	5.6
2001–2005	151	17.2	0.7
2006–2010	168	11.9	0.6

has been reported in some series after radical gastrectomy [2, 15]. A randomized controlled trial by Imamura H et al. showed there was no significant increase in morbidity or mortality with additional bursectomy, though there was a significant increase in blood loss with additional bursectomy [31]. In our center, we routinely do bursectomy at radical gastrectomy, and this has not translated to increased morbidity or mortality.

Various factors influence post operative morbidity and mortality. Splenectomy and distal pancreatectomy was found to increase post operative complications in various series [4, 15, 22, 32, 33]. Fatouros M et al. found no significant increase in morbidity and mortality with resection of spleen [34]. We do not routinely perform splenectomy as part of radical gastrectomy. Male gender independently predicted increased morbidity in our series and in Jeong O et al. [33]. It is possibility due to associated smoking which can predispose to respiratory and wound complications. Tumor size more than 5 cm [15] and pathological T4 in our series predicted increased morbidity. Gastric outlet obstruction was not reported to be associated with increased incidence of high grade postoperative complications [35]. Large tumors and presence of gastric outlet obstruction can be associated with cancer cachexia and nutritional problems which account for significant morbidity. Poor performance status also predicted for increased morbidity [22].

The complication rates reflect the surgical load and experience in that center. With increasing experience and hospital volume, post operative adverse events decrease. Table 9

Fig. 1

Table 8 Postoperative complications in different centers

	Present study [1]	JCOG [4]	Dutch [4]	MRC [3]	Italy IGCSG [5]	Italy IGCSG [6]	MSKCC [7]	Peru [8]	Innamura H et al. [9]	Sah BK et al. [10]	Luna A et al. [11]	Gong DJ et al. [12]	Gil-Rendo A et al. [13]	Diaz de Liano A et al. [14]	Kostić Z et al. [15]	Biffi R et al. [16]	Kan YF et al. [17]	Osenigo E et al. [18]	Shrikhande SV et al. [19]
Number of patients	456	263	331	200	86	624	655	243	210	1639	106	125	434	126	70	250	1142	1118	159
Mean blood loss (ml)	514	430	NA	NA	NA	NA	NA	NA	475	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Mean duration (min)	276	237	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Morbidity	16.7 %	21 %	43 %	46 %	16 %	13 %	31.3 %	22.7 %	14.3 %	31 %	50.5 %	20.8 %	38.4 %	29 %	27.14 %	18 %	11.2 %	52 %	8.8 %
Mortality	1.8 %	0.8 %	10 %	13 %	0 %	1.8 %	3.3 %	2.8 %	0.95 %	11.1 %	7.8 %	3.2 %	2.7 %	1.6 %	5.71 %	1.2 %	3.6 %	6 %	1.25 %
Mean hospital stay (days)	15.6	21	25	23	13	12	NA	13	NA	NA	NA	NA	NA	NA	NA	14.8	NA	NA	13

Table 9 Hospital volume and complications

	Present study	JCOG [1]	Dutch [4]	MRC [3]	Italy IGCSG [5]	Yonemura Y et al. [2]
Number of patients	456	263	331	200	86	128
Average number of patients/hospital/year	23	>50	1	1.5	8	50
Morbidity	16.7 %	21 %	43 %	46 %	16 %	26 %
Mortality	1.8 %	0.8 %	10 %	13 %	0 %	0.7 %

compares the surgical load and complication rates at various centers. Many specialized centers in the west [5, 6, 7, 8] are now reporting low post operative complications comparable to that in Japan. In this large series from our centre which is a high volume center, we have shown the morbidity and mortality rates to be comparable to the best figures worldwide.

Conclusion

D2 gastrectomy for carcinoma stomach can be performed in dedicated units with low morbidity and mortality rates that are comparable to the best figures worldwide. Increasing hospital volume and surgeon experience, along with a coordinated effort by anesthetists, nursing staff, physiotherapists and surgeons can reduce the post operative complications to a minimum. Male gender, presence of gastric outlet obstruction and pathological T4 are the factors independently predicting a significantly higher risk of post operative complications after D2 dissection.

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Conflicts of Interest The authors declare that there is no conflict of interest.

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