Preventing Delayed Gastric Emptying After Whipple's Procedure—Isolated Roux Loop Reconstruction With Pancreaticogastrostomy

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Abstract Although delayed gastric emptying (DGE) after Whipple's pancreaticoduodenectomy is not life-threatening and can be treated conservatively, it results in discomfort and significant prolongation of the hospital stay and adds on to the hospital costs. To overcome this problem, we started using the isolated loop technique of reconstruction along with pancreaticogastrostomy and we present our series using this technique. All consecutive patients undergoing Whipple's pancreaticoduodenectomy in a single surgical unit from January 2009 until December 2012 were included. In the absence of hepatic and peritoneal metastasis, resection (Whipple's procedure) with curative intent was done using isolated loop technique with pancreaticogastrostomy. Delayed gastric emptying was assessed clinically and on oral gastrograffin study. Bile reflux was also assessed on clinical parameters and evidence of beefy friable gastric mucosa on upper GI endoscopy and presence of reflux on hepatobiliary scintigraphy. A total of 52 patients were operated using this technique from January 2009 to October 2012. The mean operative time was 260.8 ± 50.3 , and the mean operative blood loss was $1,068.0 \pm 606.1$ ml. Mean gastric emptying time 106.0 ± 6.1 min (89–258 min). Three out of the 52 (5.7 %) patients had persistent vomiting in the post-operative period requiring reinsertion of NG tube. A HIDA scan done on POD7 for all patients did not show any evidence of bile reflux in any of the patients. Pancreatogastrostomy with isolated

loop in pancreaticoduodenal resection markedly reduces the post-operative incidence of alkaline reflux gastritis and DGE.

Keywords Whipple's procedure · Delayed gastric emptying · Isolated loop · Bile reflux

Introduction

Since its first description in 1930s, Whipple's pancreaticoduodenectomy [1] has become increasingly accepted as a safe and appropriate surgery for patients with benign and malignant disease of the pancreas and periampullary region. The mortality rate after pancreaticoduodenectomy is declining and is currently reported to be 5 % in specialized centres [2–6]. Post-operative morbidity is still high after this procedure, up to 60 % [2–6]. The most serious and potentially lethal complications are pancreatic leakage, gastrointestinal or intraabdominal haemorrhage and intraabdominal abscess. A less serious complication is delayed gastric emptying (DGE), which is reported to occur in 25–70 % of patients after pancreaticoduodenectomy [7–12]. DGE is not always associated with pancreatic anastomotic leak and is a frustrating complication for which the mechanism has not been fully understood. Although DGE is not life-threatening and can be treated conservatively, it results in discomfort and significant prolongation of the hospital stay and adds on to the hospital costs. Alkaline reflux gastritis is also a significant cause of post-operative emesis as well as a contributing factor to delayed gastric emptying. Incidence of DGE has not been shown to depend on the technique of pancreaticoduodenectomy (PD) and the type of reconstruction

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for the pancreatic stump. However, an antecolic gastrodeudonostomy with a pylorus-preserving pancreaticoduodenectomy (PPPD) has been shown to have a significantly less DGE when compared to a retrocolic gastrodeudonostomy.

Use of an isolated loop of jejunum for pancreaticojejunostomy (PJ) was introduced with the purpose of making a PJ leak clinically less significant. We have been doing a pancreaticogastrostomy for the pancreatic remnant at our institute for the last 25 years. Initially, we were performing the reconstruction using a single loop of jejunum as per the standard pancreaticoduodenectomy (PD). However, there was a high incidence of post-operative delayed gastric emptying and bile reflux, which meant that patients had to be kept on prolonged enteral feeding through feeding jejunostomy. To overcome this problem, we started using the isolated loop technique of reconstruction, and we present our series using this technique.

Materials and Method

All consecutive patients undergoing Whipple's pancreaticoduodenectomy in a single surgical unit from January 2009 until December 2012 were included. All patients underwent evaluation and preparation for the surgery according to the defined protocol. The demographic details including BMI were noted. A detailed history and clinical examination was done and findings recorded. The preoperative investigations including haemogram, serum albumin, level of bilirubin, coagulation profile and liver enzymes were done. Any associated co-morbidities like hypertension (HTN), DM, coronary artery disease (CAD), chronic obstructive pulmonary disease (COPD), and tuberculosis (TB) were also recorded. All patients underwent a complete cardiac and pulmonary evaluation, including a chest X-ray, electrocardiogram, echocardiography, and pulmonary function tests. Preoperative nutritional supplementation if given was noted.

Patients with clinical signs and symptoms of periampullary carcinoma were included. All patients underwent an ultrasound of the abdomen followed by a triple phase CECT and an MRCP. Patients with doubtful lesions underwent an endoscopic ultrasound.

Patients who did not have any radiological evidence of a metastatic disease were taken up for surgery under general anaesthesia (GA). Staging laparoscopy was carried out, and in the absence of hepatic and peritoneal metastasis, resection (Whipple's procedure) with curative intent was done.

Technique of Isolated Loop

Standard resection of Whipple's procedure is done. The pancreatic stump is managed with a two-layered

pancreaticogastrostomy (Fig. 1). An isolated jejunal limb is then created by dividing jejunum 15 cm from the proximal end and preserving the vascular arcade. This isolated limb of jejunum is anastomosed with the jejunum 40 cm from the divided end in a side to side jejunojejunostomy. The long limb is then taken retrocolic and anastomosed with the common hepatic duct in an end-to-side single-layered duct to mucosa hepaticojejunostomy. The other end of the isolated limb is then anastomosed with the distal stomach. A covering Witzel's feeding jejunostomy is then created 15 cm distal to the jejunojejunostomy.

A note was made of intraoperative variable including operative time, amount of blood loss and post-operative parameters like requirement of ventilator, need for blood transfusion and other blood products, use of somatostatin analogues, drain output and character, amylase of the drain fluid, feeding whether enteral or parenteral, any reexplorations and wound-related problems were also noted. An oral gastrograffin study was done on POD5 and a hepatobiliary scintigraphy was done on POD7 and findings recorded.

Measurement of DGE and Bile Reflux

Delayed gastric emptying was defined as

1. Reinsertion of NG after its removal
2. Requirement of prolonged TPN or FJ feeds (>7 days)
3. Hold up of oral contrast in the stomach for more than 4 h after an oral gastrograffin study. Bile reflux was assessed on clinical parameters in the form of epigastric pain, bilious emesis and evidence of beefy friable gastric mucosa on upper GI endoscopy and presence of reflux on hepatobiliary scintigraphy.

Fig. 1 Diagrammatic representation of technique of isolated loop reconstruction after Whipple's procedure

Results

A total of 52 patients were operated using this technique from January 2009 to October 2012. The median age of the patients was 51 years with a range of 22–70 years. There were 27 (52.9 %) male and 25 (47.1 %) female patients in the study population with a male to female ratio of (1.3:1). The detailed demographic and clinical profile is given in Table 1.

The most common symptoms were obstructive jaundice, pain abdomen, cholangitis, weight loss and pruritus. Among these, the predominant symptoms were obstructive jaundice and weight loss, which was seen in 47 (84 %) out of 52 patients.

Based on the history and clinical examination, a diagnosis of surgical obstructive jaundice due to periampullary carcinoma was made in all patients. On radiological examination, ampullary growth was seen in 21 (41 %) patients, pancreatic head tumour was seen in 18 (35 %) patients and lower-end CBD growth was seen in 12 (24 %) patients. Preoperative histological diagnosis of ampullary carcinoma was made in 21 (41 %) and a diagnosis of cholangiocarcinoma was made in 4 (8 %) patients.

Tumour was located in the head of the pancreas in 18 (35 %), ampulla of Vater in 20 (42 %) and lower end of common bile duct in 11 (21 %) patients. Enlarged lymph nodes were found in 41 (78 %) patients. Minimal ascites was also present in 13 (25 %) patients.

The mean operative time was 260.8 ± 50.3 min, ranging from 180–390 min, and the mean operative blood loss was $1,068.0 \pm 606.1$ ml ranging from 400–2,600 ml. Prior to this technique, the average operating time was 240.4 min, and average blood loss was similar (950 ml). Thus, there was an additional time of only 20 min added to the overall procedure without increase in average blood loss.

Intraoperatively, 32 (61 %) patients were given blood transfusion; 8 (15 %) patients were given blood transfusion in the immediate post-operative period, and all 50 (96 %) patients were given transfusion in the post-operative period. The average number of red blood cells transfused to these patients was two packed cells (1–4 packed cells) intraoperatively and four packed cells (2–8 packed cells) post-operatively. One patient with carcinoma on the head of the pancreas had involvement of the portal vein. Tumour was resected along with a cuff for portal vein, and portal vein was repaired.

Table 1 Demographic profile of patients

Number	52
Females/males	1.3:1
Age	51 (22–70) years
Jaundice	47 (84 %)

Nasogastric tube was removed in all patients on post-operative day 2, as the drainage was minimal and feeding was commenced from the FJ from post-operative day 3, after the return of bowel sounds. An oral gastrograffin study was done on post-operative day 5, and all patients were subsequently allowed orally. Three out of the 52 (5.7 %) patients had persistent vomiting in the post-operative period, requiring reinsertion of NG tube on POD5. Mean gastric emptying time was 106.0 ± 6.1 min (89–258 min). The three patients requiring reinsertion of NG tube also showed a prolonged hold up of contrast on the gastrograffin study (gastric emptying time of 242, 256 and 258 min, respectively).

None of the patients experienced any symptoms of bile reflux. Twenty-three of the 52 patients underwent an UGIE for unrelated cause, and none of them showed features compatible with bile reflux gastritis. A HIDA scan done on POD7 for all patients did not show any evidence of bile reflux in any of the patients.

Discussion

Whipple's procedure in the past was associated with a very high mortality rate ranging from 45–55 %, but with increased experience and better patient management strategies, the mortality rate has come down to <5 % in major centres from around the world [2–6]. However, the morbidity associated with this procedure has not come down, and more than 50 % of the patients experience complications in the post-operative period [2–6]. As the mortality rate has fallen with the modern experience of high-volume centres, the most common post-operative complications for pancreatic head resection remain pancreatic fistula, infection and DGE. DGE is the leading cause of morbidity after pancreaticoduodenectomy, occurring in approximately one third of all patients [7–12]. The incidence of DGE was initially thought to be increased after pylorus preservation but is now recognized to be equal after classic or pylorus-preserving pancreaticoduodenectomy. The occurrence of DGE often requires the prolonged use of nasogastric intubation, the initiation of parenteral or enteral nutritional support and ultimately delays hospital discharge. Some authors have suggested that a solution to the problem of DGE after pancreaticoduodenectomy is the routine use of tube gastrostomy or combined tube gastrostomy and feeding jejunostomy, as a means of eliminating the need for prolonged nasogastric drainage and allowing enteral nutritional support.

The pathogenesis of DGE after pancreaticoduodenectomy has been speculated to involve several factors such as gastric dysrhythmias, gastric atony, ischemic injury to the antropyloric muscle mechanism and presence of biliary reflux gastritis [13–15].

In the recent years, although various definitions for DGE exist, the most widely acceptable definitions are (1) According

to the first definition, DGE occurs when the nasogastric tube is left in place for ≥ 10 days plus one of the following: emesis after removal of the nasogastric tube, reinsertion of a nasogastric tube, post-operative use of prokinetic agents after the tenth post-operative day or failure to progress with diet. (2) According to the second definition, DGE occurs when nasogastric intubation is required ≥ 10 days following the operation or is reinserted due to vomiting. (3) According to the third definition, DGE occurs when nasogastric intubation is required ≥ 10 days following the procedure or when a solid diet cannot be tolerated on or before the 14th post-operative day [16–18]. Independent of the correct definition, DGE not only leads to repeated episodes of nausea and vomiting but also has an impact on post-operative weight gain, duration of hospitalization and related morbidity, while it may also lead to fatal aspiration and pneumonia. It is therefore a dangerous and potentially life-threatening complication.

Most early studies showed that PD is superior to PPPD regarding incidence rates of DGE [11, 12]. However, only one study has demonstrated statistical significance in this outcome [11]. Another study showed that the difference in the occurrence rates of DGE after the two procedures is not significant because DGE when present resolves spontaneously within 6 weeks [12]. Later performed studies seem to support that the incidence rates of DGE following either PD or PPPD are comparable, although supporters of PD over PPPD regarding DGE rates also exist. Some recent trials have even provided significantly lower rates of DGE following PPPD than following PD [15].

Few techniques have been described to decrease the incidence of DGE after classical PD and PPPD. A recently reported modification in the classical PD and PPPD procedures is the performance of duodenojejunostomy/gastrojejunostomy antecolically instead of retrocolically [19]. The theoretical background for this technique is that decreased blood circulation (especially venous drainage) of the jejunal limb following biliary-pancreato-enteric reconstructions can lead to decreased motility and profound oedema of the jejunal limb itself and eventually oedema of the duodenojejunal anastomosis. Compromised venous drainage of the jejunal limb, which is the peristalsis starting point of the newly constructed intestinal pathway, might lead to delayed recovery of jejunal peristalsis at the site of duodenojejunostomy, which will then cause DGE. From a theoretical point of view, antecolic duodenojejunostomy avoids mechanical problems because the descending jejunal loop is more mobile than after retrocolic reconstruction.

The use of an isolated limb for PJ after PD has been described as a method to make pancreatic leak less significant. These patients were also found to have significantly lesser incidence of DGE as compared to the standard single-loop reconstruction, the possible explanation being the reduction in clinically significant pancreatic fistula rates. Isolated loop has also been described to overcome gastric stasis following pylorus-preserving pancreaticoduodenectomy.

Delayed gastric emptying has not been studied extensively following pancreaticogastrostomy. A review of 160 patients by Fabre et al. [17] showed an incidence of 22.5 % after PG reconstruction. A randomized study comparing pancreaticogastrostomy (PG) (69 patients) vs end-to-side pancreaticojejunostomy (PJ) (82 patients) showed that PG is superior regarding DGE rates (2 vs 10 patients or 3 vs 12 %, respectively, $P=0.03$) [20]. By using the PG reconstructive technique instead of PJ, the authors found that significantly less complications occur (25 vs 68 %, respectively, $P=0.002$). More specifically, the lower rates of biliary fistulae (0 vs 8.5 %, respectively, $P=0.01$) and intraabdominal fluid collections (10 vs 27 %, respectively, $P=0.01$) following PG compared with PJ are the main culprits for the decreased rates of DGE.

Post-operative complications have also been reported to correlate significantly with the occurrence of DGE in other trials as well. Horstmann and associates [15] showed that the incidence of DGE increases from 1 %, when no post-operative complications occur, to 28 and 43 %, respectively, when moderate (wound infection, temporary cardiopulmonary complications, transient occurrence of amylase/lipase-rich drainage fluid without signs of sepsis) and severe (anastomotic leakage, bleeding, septic complications, reoperation) complications occur ($P<0.0001$). The results of several other studies lend support to this theory.

Before we cooperated in the isolated loop technique, the incidence of DGE in our patients was about 21.6%. However, after the use of isolated loop technique, this incidence has come down significantly to 5.2 % without a significant increase in mean operative time and blood loss.

We have been routinely using pancreaticogastrostomy for reconstruction. There are no reports in literature regarding use of isolated loop with PG. Therefore, even though such an operative manoeuvre adds to the operative time and an additional small bowel anastomosis, this is a small price to pay for the tremendous advantage it bestows on the outcome.

Conclusion

Technique of reconstruction with pancreatogastrostomy isolated loop and hepaticojejunostomy in pancreaticoduodenal resection markedly reduces the post-operative incidence of alkaline reflux gastritis and delayed gastric emptying

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