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ORIGINAL RESEARCH ARTICLE

SURGICAL OUTCOME OF THE SUPERIOR MESENTERIC ARTERY FIRST TECHNIQUE COMBINING POSTERIOR AND UNCINATE PROCESS APPROACH TO PANCREATICODUODENECTOMY FOR THE PANCREATIC HEAD AND THE PERIAMPULLARY CANCER

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ABSTRACT

Background: Pancreaticoduodenectomy is the only curative treatment for periampullary and head of pancreas cancers. Various approaches have been described as the superior mesenteric artery (SMA) first technique. This study aimed to report the surgical outcome of the SMA first technique combining posterior and uncinate process approach to pancreaticoduodenectomy.

Methods: This retrospective study was done at the Department of Surgical Oncology at BP Koirala Memorial Cancer Hospital. The data was collected from January 2015 to September 2020. All the patients underwent pancreaticoduodenectomy for pancreatic head cancer and periampullary cancer with the technique combining posterior and uncinate process approaches.

Results: A total of 85 patients underwent pancreaticoduodenectomy with 42.4% male and 57.6% female. Fifty-nine (69.4%) cases were classified as resectable and 26 (30.6%) as borderline resectable. The median operative time was 300 minutes. The median intraoperative blood loss was 391ml. Intra-operative blood transfusion was done in 8.5%. The median total number of dissected lymph nodes was 13. The postoperative pancreatic fistula was seen in 8 patients while 4 patients had a post-pancreatectomy hemorrhage. Delayed gastric emptying was seen in 12 patients. There were overall 8 (9.4%) in-hospital mortality. R0 resection was achieved in 84 patients (98.82%).

Conclusions: The combined posterior and uncinate process approach SMA first technique for pancreaticoduodenectomy is a safe and standard technique. It decreases intraoperative blood loss, total operative time, and increases R0 resection compared to posterior or uncinate process approach only. It plays a key role in lowering the postoperative complication rate.

INTRODUCTION

Pancreaticoduodenectomy (PD) is the only effective treatment for cancers of the head of pancreas (HOP) and the periampullary region.[1] PD in the 21st century has become a well-established operation performed with varying frequency throughout the world.[3,4] Initial the reported morbidity and mortality rate was quite high. As the standardization of perioperative care, advances in surgical technique, and interventional radiology and intensive care support improved, the procedure became considerably safer.[5–9] Recently, several series with large numbers of Whipple procedures have reported low mortality.[10–13]

Since the introduction of PD, the surgical technique has been on the verge of rapid evolution with various modifications.[14] Previously, the involvement of the portal vein–superior mesenteric vein was given non-resectability status. Now as venous resection can be achieved safely and with greater awareness of the prognostic significance of the status of the posteromedial resection margin, non-resectability is now determined by involvement of the superior mesenteric artery (SMA). This led to the introduction of the SMA first technique. The basic concept of this technique is that artery is given a primary place in determining resectability. A trial dissection is directed towards the early determination of whether there is arterial involvement before committing an irreversible step in the operation. Various approaches have been described as SMA first technique.[14]

This study aimed to report the surgical outcomes of the SMA first technique combining posterior and uncinate process approach to PD at the Department of Surgical Oncology, BP Koirala Memorial Cancer Hospital (BPKMCH).

METHODS

This was a retrospective study done at the Department of Surgical Oncology at BPKMCH, Bharatpur, Nepal. The data was collected from January 2015 to September 2020. The complete enumeration sampling technique was used as all the patients who underwent PD for cancer of HOP and periampullary region with SMA first technique combining posterior and uncinate process approach were included in the study. All the surgeries

were done by the same unit of the Department of Surgical Oncology.

Patient data were obtained from a retrospective review of the database. The patient demographics (age, sex, chief complains), pre-operative data (hemoglobin, total bilirubin, weight loss, pre-operative interventions, oesophago-gastro-duodenoscopy (OGD) finding, co-morbidities, stage of resectability), intra-operative data (common bile duct (CBD) diameter, pancreatic duct diameter at the site of transection, pancreatic consistency, location and size of the tumor, arterial anomaly, operative time, blood loss), and post-operative outcome (total hospital stay, histological diagnosis, complications, in-hospital postoperative mortality, and morbidity) were analyzed. Postoperative pancreatectomy related complications were graded according to the International Study Group on Pancreatic Surgery (ISGPS).[15–17]

Operative Procedure:

The SMA first technique reported in this study is a combination of posterior with an uncinate process approach. At first generous kocherization is done for the good exposure of the SMA at its origin from the aorta. The tunnel anterior to the superior mesenteric vein (SMV) and portal vein (PV) is created. The gastro-colic trunk is divided. SMV and PV are retracted towards the left side by the finger of the assisting surgeon which exposes SMA. The operating surgeon continues dissecting the uncinate process away from the right side of SMA up to its origin which was already exposed by the posterior route. During this part of dissection, the inferior pancreaticoduodenal artery (IPDA) and branches of PV to uncinate process are ligated and the first jejunal vein and any aberrant right hepatic artery originating from SMA are well safeguarded. Following the ligament of Treitz, the duodenojejunal flexure is mobilized and the proximal jejunum is divided and delivered into the supra-colic compartment. This is followed by the right gastric artery and gastroduodenal artery ligation. Then, we take our attention to porta hepatis, the gallbladder is dissected from the cystic plate and CHD (common hepatic duct) is transected just above the cystic duct. Then distal gastrectomy is done. Lastly, we finish the resection steps by transecting the neck of the pancreas. The reconstruction is started with pancreaticojejunostomy in a duct to mucosa fashion followed by an end to side hepaticojejunostomy and side to side gastrojejunostomy.

All statistical analyses and graphics were performed with the SPSS version 16.0 statistical package for Windows. Normally distributed variables are reported as the mean and non-normally distributed variables are expressed as the median (range).

RESULTS

A total of 85 patients underwent PD for HOP cancer and periampullary cancer. The mean age of the patients was 55 years. There were 36 (42.4%) male and 49 (57.6%) female patients. The data of demographic and clinical characteristics are given in Table 1.

The OGD finding for 20 (23.5%) patients was normal. There was external compression of the first and second part of the duodenum in 24(28.2%) patients while 29 (34.1%) patients had growth in the second part of the duodenum or ampulla of Vater. The endoscope was not negotiable in the duodenum in 10 (11.8%) patients. The mean hemoglobin level was 11.2 gm/dl. The median preoperative total and direct bilirubin levels were 10.7 mg/dl and 7 mg/dl respectively. Twenty-eight (33%) patients had a preoperative total bilirubin level of ≥ 15 mg/dl. Among all borderline resectable (n=26) cases, 15 patients (58%) had preoperative total bilirubin level > 15 mg/ dl. Similarly, among all PV resection (n=9) cases, 7 (78%) had preoperative total bilirubin level > 15 mg/ dl.The CA 19-9 tumor marker was done in 23 (27%) patients with a mean level of 288.8 U/mL.

Table 1: Demographic and clinical characteristics

Characteristics	(n=85)
Age (mean), years	55
Gender, n (%)	
Male	36 (42.4)
Female	49 (57.6)
Chief complain, n (%)	
Abdominal pain	83 (97.6)
Jaundice	74 (87.1)
Vomiting	11 (12.9)
Co-morbidities, n (%)	
Hypertension	4 (4.7)
DM	4 (4.7)
COPD	2 (2.4)
Breast cancer	1 (1.2)
Hypothyroidism	1 (1.2)
Imaging and Endoscopic interventions, n (%)	
EUS	1(1.2)
OGD	85(100)
CECT scan of Abdomen and Pelvis	85(100)
MRCP	17(20)
ERCP with stenting	15(17.6)
Pre-operative PTBD	3(3.5)
Resectability based on CECT, n (%)	
Resectable	59 (69.4)
Borderline resectable	26 (30.4)
Significant weight loss, n (%)	26(30.58)

EUS= Endoscopic Ultrasound, OGD= oesophago-gastroduodenoscopy, CECT= Contrast-enhanced computed tomography, MRCP- Magnetic resonance cholangiopancreaticography, ERCP= Endoscopic Retrograde cholangiopancreaticography, PTBD= percutaneous transhepatic biliary drainage.

The data of intraoperative findings are given in Table 2. The mean diameter of the common bile duct and pancreatic duct at the transection of the neck was 24.2 mm and 3.7 mm respectively. Portal vein tangential resection with the primary

repair was done in 9(10.6%) patients. Intra-operative blood transfusion was done in 10 (8.5%) patients. The median size of the tumor was 3.8 cm and the uncinate process was involved in 25 (29.4%).

Table 2: Intraoperative findings

Intraoperative characteristics	(N=85)
Consistency of the pancreas, n (%)	
Soft	39(45.9)
Firm	35(41.2)
Hard	11(12.9)
Anomalies, n (%)	
Replaced RHA from SMA	12(14.1)
Accessory RHA from SMA	5(5.8)
Aberrant GDA	2(2.4)
CHA from SMA	3(3.5)
IPDA from 1st jejunal artery	1(1.2)
Intraoperative blood loss(median), ml(range)	391 (110-1000)
Total operative time (median), minutes	300
size of the tumor (median, range), cm	3.8(1-15)
Total node dissected (median), n	13

RHA= right hepatic artery, SMA= superior mesenteric artery, GDA= gastroduodenal artery, CHA= common hepatic artery, IPDA= inferior pancreatic duodenal artery

Table 3: Postoperative complications

Complication	(N=85)
Superficial SSI, n (%)	11(12.9)
Deep SSI, n (%)	5(5.9)
Pneumonia, n (%)	2(2.4)
Pancreatic fistula, n (%)	8(9.4)
Ascites , n (%)	12(14.1)
Hemorrhage, n (%)	4(4.7)
In-Hospital Mortality, n (%)	8(9.4)
Delayed gastric emptying, n (%)	16(18.8)
Biliary leak, n (%)	2(2.4)
Prolonged serous discharge, n (%)	1(1.2)

SSI=Surgical Site Infection

The incidences of different types of complications are given in Table 3. The incidence of major postoperative complications of pancreatic surgery defined according to the ISGPS is given in Table 4. There was significant difference in POPF with patients with soft consistency pancreas (8.2%) in comparison to firm/ hard consistency pancreas (1.2%) (p-value =.044, <0.05). Seven patients with POPF were conservatively managed and 1 patient was managed with ultrasound-guided pigtail drainage. Two patients with post-pancreatectomy hemorrhage (PPH) needed surgical exploration and one patient was radiologically embolized. All 16 (18.8%) patients with delayed gastric emptying (DGE) were managed conservatively with a nasogastric tube, nothing by mouth (NPO), and prokinetic drugs. The mortality among patients in resectable group was 3.38% and in borderline resectable group it was 23%. Out of 9 patients who had portal vein resection there was mortality in 4(44.4%) patients. Out of 28 patients who had preoperative bilirubin level was more than 15 mg/dl, mortality was seen in 6 (21.4%). A significant proportion of borderline resectable cases (58%) and PV resection cases (78%) had a preoperative total bilirubin level > 15 mg/ dl. This could have contributed to higher mortality rate, particularly in patients with higher bilirubin level.

Eighty-four patients underwent R0 resection and only 1 patient underwent R1 resection. The final biopsy showed that 84 patients were diagnosed with adenocarcinoma and only one patient with gastrointestinal stromal tumor (GIST). The location of the tumor was most common at the ampulla of Vater (36.5%) following by distal CBD (24.7%), head of the pancreas (33.1%), and duodenum (4.7%) respectively. In the histopathological examination report, 28 (33%), 34 (40%), and 21 (24.7%), 2 (2.4%) were staged as stage I, II, III, and IV respectively.

Table 4: Postoperative pancreatectomy related complications

Major PO complications	(N=85)
POPF, n (%)	
Biochemical leak	5(5.9)
Grade B	1(1.2)
Grade C	2(2.)
Total	8(9.4)
PPH, n (%)	
Grade A	1(1.2)
Grade B	-
Grade C	3(3.5)
Total	4(4.7)
DGE, n (%)	
Grade A	13(15.3)
Grade B	3(3.5)
Grade C	-
Total	13(18.8)

POPF= post-operative pancreatic fistula

PPH= post-pancreatectomy hemorrhage

DGE= delayed gastric emptying

DISCUSSION

The principle of the SMA first with posterior approach was initially described by Pessaux et al. in 2006.[18] The major advantages of this approach is 1) early determination of resectability status before taking irreversible step by checking the margin of SMA,[15,19] 2) reduces intraoperative bleeding as we can get early control of the blood flow in the pancreatic head by the division of the inferior pancreaticoduodenal artery (IPDA) in the early stage of PD, [4,20–22] 3) increase the R0 rate by complete dissection of the connective tissue around the SMA

and superior mesenteric vein (SMV) including lymph nodes,[22–25] 4) identify the accessory or anomalous RHA from the SMA, [4,21,26,27] 5) All these leads to the decrease in operative time.[18,19,22]

In our present study, we included the SMA first approach that consists of posterior along with uncinate process approach. In this technique, the HOP and uncinate process are dissected early during the operation. In the posterior approach, the posterior part of the pancreatic head is dissected off the vessels first without dividing the pancreatic neck. Its limitation is that this approach is difficult in patients with peripancreatic inflammation and adhesions around the head of the pancreas. [14] The principle of the uncinate process approach was first mentioned by Shukla et al. in 2007. Their modified version involved division of the ligament of Treitz and translocation of the proximal jejunum with its intact mesentery into the supra-colic compartment, by passing it to the right under the superior mesenteric vessels. This technique exposes the uncinate process completely and facilitates the separation from the SMA and the superior mesenteric vein (SMV).[28] In 2010, Hackert et al. described a medial or uncinate process first approach for the purpose of early dissection of the SMA. This approach included retrograde resection of the pancreatic head starting with the uncinate process after the division of the first jejunal loop and transection of the pancreas as the last operative step of the resection.[29] This technique overcame the limitation of the posterior approach in patients with peripancreatic inflammation with difficulty tunneling above PV especially with bulky tumor arising from the superior aspect of the pancreatic head. [14] Other advantages of this approach are early identification of SMA involvement at the uncinate process and early ligation of IPDA minimizes bleeding. The limitation of this technique is the late identification of replaced RHA. Our technique included the combination of both posterior and uncinate process approaches which gives us the advantage to overcome the limitation of each other.

Few reports have been reported with either only a posterior approach or only an uncinate process for PD. Dumitrascu et al reported that there were no significant differences between posterior approach PD group and standard PD group in early morbidity or mortality rates, hospital stay, and overall survival but there was a significant reduction in intraoperative blood loss and duration of operation with the posterior approach.[26] Their rate of POPF was higher than ours (23.80% vs 9.4%). Similarly, Figueras et al reported that the transfusion rate, the volume of blood products transfused, the overall complication rate, and postoperative hospital stay were lower in the initial SMA dissection group.[30]

Till now only one study has been reported which includes the posterior approach along with the uncinate process approach. Shrikhande et al compared 30 patients who underwent an SMA-first uncinate process approach with 14 patients who had standard PD with an uncinate process approach.[32] They found no significant difference in blood loss, duration of operation, complications, lymph node yield, and margin status compared to other approaches. Their median intra-operative blood loss was 800 ml while our median intra-operative blood loss was 391 ml. The median operative time was 457.5 min while we report our median of 300 minutes which was considerably less. Their postoperative complication rate was 40 % while ours was 32.9%. The median days of total hospital stay were almost similar (14 vs 14.2). Their median node resected was 8 while in our study it was 13. Their rate of POPF was slightly low. (6.7% vs 9.4%) Their mortality rate was 3.3% whereas ours was a bit higher with 9.4%. This may be due to the various factors like steep training curve, high mortality rate in patients in borderline resectable group (23%), co-morbidities (15.2%), poor nutritional status (30.5%), and high number of the soft pancreas (45.9%) which lead to POPF, and also high mortality rate in patients who underwent portal vein resection (44.4%). Besides this, one-third of patients (33%) patients had a total preoperative bilirubin level of ≥ 15 mg/ dl and among them the mortality rate was 21.4%. Hence, it may be advisable to decompress the biliary tree prior to surgery in patients with higher bilirubin levels. The mortality rate in BPKMCH is slowly in the decreasing trend as we keep on refining the technique and improving perioperative care.

There were a few drawbacks of our study. It was a single-center study. We need to study the long term prognosis with this combined approach in higher number of patients to further standardize this technique of PD.

CONCLUSION

The combined (posterior and uncinate process) approach of SMA first technique for PD is a safe and standard technique. It decreases intraoperative blood loss, total operative time, and increases R0 resection compared to posterior or uncinate process approach only. The early identification of replaced RHA and ligation of IPDA gives the surgeon a major advantage to prevent perioperative bleeding and shortens the total operative time. It plays a key role in lowering the postoperative complication rate.

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