Original Article

Hepatic Artery Anomalies and Its Impact in Patients Undergoing Pancreaticoduodenectmy. A Comparative Study from Kashmir Valley

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Abstract

Background: Pancreaticoduodenectomy provides the only opportunity to cure resectable and borderline pancreatic ductal adenocarcinoma. This is linked to a high rate of morbidity and mortality, especially when combined with hepatic artery anomalies. The goal of this study was to analyse the spectrum and impact of hepatic artery anomalies on intraoperative and postoperative variables, and oncologic outcomes in patients undergoing pancreaticoduodenectomy. **Materials and Methods:** All patients with resectable periampullary or pancreatic head tumours who underwent pancreaticoduodenectmy (PD) were included. Patients were divided into two groups using computer-generated random numbers; Group A included patients who had pancreaticoduodenectmy (PD) with normal hepatic artery anatomy and Group B included patients with aberrant hepatic artery anatomy. The data was collected and analysed using SPSS 22. **Results:** Among the 238 patients who met the inclusion criteria, 177(74.36%) participants were included in Group A (Normal hepatic artery anatomy) and 61 (25.36%) in Group B (Aberrant hepatic artery anatomy). The mean age of patients in Group A was 51.3 ± 8.63 years while it was 50.6 ± 8.09 years in Group B. The difference in gender, BMI, pre-operative haemoglobin, bilirubin and albumin between two groups was statistically insignificant (P value >0.05). The difference in mean operative time of Group A 230.9(168–390) minutes and Group B 319.6(200–620) minutes was statistically significant (p-value <0.001). The mean blood loss in Group A (511.5 120.18 ml) was significantly lower than in Group B (623.6 127.06 ml) ($P \leq 0.001$). There were no significant differences between the two groups in terms of post-operative pancreatic fistula, delayed gastric emptying, wound infection, atelectasis, hospital stay, peri-operative mortality, positive resection margins, and mean lymph node yield. **Conclusion:** Patients with hepatic artery anomalies who undergo pancreaticoduodenectomy have significantly more operative blood loss. This could be due to the procedure's complexity and lengthy operative time. There were no differences between the two groups in terms of postoperative morbidity, oncological outcome, or mortality.

Keywords: Pancreatoduodenectomy, aberrant right hepatic artery, surgical complication, postoperative pancreatic fistulas, oncological outcome

Introduction

Pancreatic cancers constitute 2–3% of all the cancers including 85% of ductal adenocarcinomas and other pathological variants arising primarily in the head of the gland.[1] Other tumours that present as a mass in the head of the pancreas include those that arise from the ampulla or the distal common bile duct, which account for roughly one-third of all tumours in that area.[1] Pancreaticoduodenectomy offers the only, although small, chance of cure in case of resectable and borderline pancreatic ductal adenocarcinoma.[2] The standard resection involves removing the duodenum and pancreatic head, including the distal part of the bile duct, while leaving

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the gastric antrum and pylorus intact, which is thought to have a better physiological outcome. Because of their close proximity to the common bile duct (CBD) and portal vein (PV), hepatic artery branches serve as important anatomical landmarks in the surgical resection of such tumours. Furthermore, due to the inherent variations in hepatic arterial branches found in 20–50% of subjects, a thorough understanding of anatomy, techniques to anticipate, prevent, and safely navigate intraoperative complications, and postoperative outcomes are essential components of every Hepato-Pancreatico-Biliary (HPB) surgeon's armamentarium.[3,4] The goal of this study was to analyse the spectrum and impact of hepatic artery anomalies on intraoperative variables, postoperative outcomes, and oncologic outcomes in patients undergoing pancreaticoduodenectomy at our tertiary care centre.

Materials and Methods

The comparative observational study was conducted in the Department of Surgical Gastroenterology, Sheri—Kashmir Institute of Medical Sciences, Srinagar, a tertiary care hospital in Kashmir valley from May 2005 to April 2020.The department is the only referral unit in state of JandK where Pancreaticoduodenectomy (PD) is performed on a regular basis. The study protocol underwent an ethical evaluation and was approved by the Institutional Ethical Committee under the reference number IEC/SKIMS/144/2018. A total of 238 subjects who underwent PD for resectable periampullary or pancreatic head neoplasm were included after receiving proper ethical clearance and written informed consent. Patients with borderline, locally advanced, or metastatic carcinomas, as well as patients with poor performance and those receiving neo-adjuvant therapy, were excluded. The clinical history, physical examination, radiological imaging, and tumour markers were used to make the diagnosis of pancreatic head neoplasms and periampullary carcinoma (CA 19-9, CEA). Following a detailed history and a thorough general physical and systemic examination, all patients underwent a baseline investigation that included a complete blood count, kidney and liver function tests, serum electrolytes, a chest radiograph, and abdominal and pelvic ultrasonography. The tumour site, size, local extent, hepatic artery anomalies, vascular involvement, loco-regional lymphadenopathy, and presence of associated hepatic, peritoneal metastasis were all assessed using a 64-row Multidetector CT (MDCT) machine.

Prior to surgery, the patients were optimised, which included correction of electrolyte imbalance and coagulopathy. The two groups were compared in terms of intraoperative variables such as operative approach, findings, operative time, operative blood loss, and blood units transfused.

Operative blood loss was estimated according to suction reservoir volume and gauzes weight.

Operative blood loss= suction reservoir volume + (wet gauze weight - dry gauze weight) x 2 in ml.

During the post-operative period, patients were closely monitored for complications such as pancreatic fistulas, delayed gastric emptying, post-pancreatectomy haemorrhage, wound infection, and other systemic complications (wound infection, atelectasis), as well as mortality. Positive margins and lymph node yield were recorded as oncological outcomes. The patients were followed weekly until the 30th post-operative day, after which they were attached to the Out Patient Department for a monthly check-up.

Statistical analysis

The statistical analysis was performed using SPSS software (SPSS version 22, IBM, Armonk, NY, USA). The distribution of continuous variables was evaluated according to the Shapiro-Wilk normality test. If the distribution was normal, Student-t test was used for statistical analysis; if the distribution was not normal, Mann-Whitney U test was used. The categorical variables were analyzed by Fisher-exact test (two-tailed) or chi-square. The P value was estimated and value <0.05 was considered significant. The mean and frequency were calculated using Microsoft Excel 2016.

Ethical consideration

The study was conducted in accordance with the ethical principles that have their origin in the Declaration of Helsinki. It was carried out with patients verbal and analytical approval before sample was taken. The study protocol and the subject information and consent form were reviewed and approved by a local ethics committee according to the document number IEC/SKIMS/144/2018 dated 18/09/2018 to get this approval.

Results

In total, 238 subjects who underwent PD were included in the final analysis. 177(74.36%) participants were included in Group A with Normal hepatic artery anatomy, and 61(25.36%) were included in Group B with Aberrant hepatic artery anatomy. The youngest patient was a 35-year-old female and oldest was a 75-year-old male. There were no significant differences in age, gender, Body Mass Index (BMI), pre-operative haemoglobin, serum bilirubin, and albumin levels, or indications for pancreaticoduodenectomy [Tables 1 and 2]. Mean operative time in the group A and the group B patients was 230.9(168–390) minutes and 319.6(200–620) minutes respectively and statistically significant (p-value <0.001). The difference in intra-operative blood loss between the two groups was statistically significant with p value of less than 0.001.

There was slightly higher rate of postoperative complications in patients with hepatic artery anomalies, but it was statistically insignificant. Pancreatic adenocarcinoma was the most common reason for surgery, accounting

Table 1: Patient demography and other characteristics

Patient Characteristics	Group A [Normal anatomy]	Group B [Aberrant hepatic artery anatomy]	P-Value
Age(Mean in Years)	51.3 ± 8.63	50.6 ± 8.09	0.584(Non significant)
Gender(Male:Female Ratio)	112: 65	41: 20	0.581(Non significant)
BMI	21.85 ± 1.32	21.90 ± 1.36	0.806 (Non significant)
Mean preoperative Haemoglobin (gm/dl)	11.25 ± 1.49	11.51 ± 1.69	0.262 (Non significant)
Serum Bilirubin (mg/dl)	8.40 ± 3.92	8.31 ± 4.30	0.889 (Non significant)
Serum Albumin(gm/dl)	3.80 ± 0.45	3.75 ± 0.47	0.470 (Non significant)

Table 2: Indication of Surgery in two groups

Diagnosis	Group A (No.) [Normal anatomy]	Group B (No.) [Aberrant hepatic artery anatomy]	P value
Pancreatic Carcinoma	124	39	0.569
Ampullary Carcinoma	31	10	
Distal cholangio Carcinoma	19	10	
Duodenal Carcinoma	3	2	
Total	177	61	

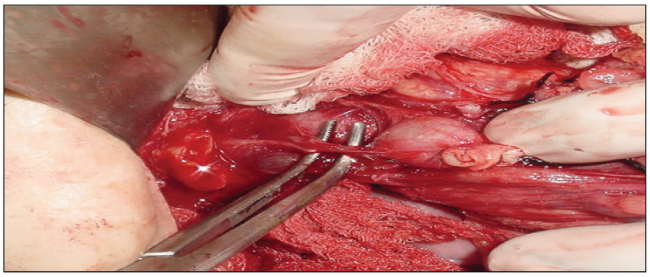

Figure 1: Accessory right hepatic artery

for 163 (68.48%), followed by ampullary carcinoma 41 (17.23%). Michels Type III was the most common anomaly in our patients (14.7%), followed by Type VI (7.6%), Type II (1.7%), and Type IV (1.3%) [Figure 1]. We were able to preserve anomalous Right hepatic artery (ARHA) except in three cases where ARHA traverse through the tumour and were sacrified to achieve oncological outcome.

The most common complication was wound site infection, which occurred in 24 (10.08 percent) of our patients. There were no other significant differences in overall rates of post-operative pancreatic fistula, delayed gastric emptying, wound infection, atelectasis, hospital-stay, peri-operative mortality, positive resection margins, and mean lymph node yield [Table 3].

Discussion

Pancreaticoduodenectomy is a complex procedure used to treat benign and malignant lesions involving the duodenum, distal bile duct, and pancreatic head.[5] The procedure is complex and technically demanding, with a high risk of intra and post-operative complications. When associated with inherent anatomical vascular variations, it becomes more difficult and challenging to perform surgery. The most common vascular anomaly is an aberrant right hepatic artery (aRHA), which, if injured, causes bile duct or liver ischemia, resulting in bilioenteric anastomotic leak.[6] The study aimed to compare and analyse the clinical and surgical implications of hepatic artery anomalies in pancreaticoduodenectomy patients (PD).

Age, gender, BMI, haemoglobin, bilirubin, and albumin levels were well matched between the two groups. In 74.4 percent of cases, the hepatic artery anatomy was normal. Michels Type III was the most common anomaly in our patients (14.7%), followed by Type VI (7.6%), Type II (1.7%), and Type IV (1.3%). Azhar Perwaiz, Adarsh Chaudhary, and colleagues[7] discovered normal arterial anatomy in 73.5 percent of cases in their study. In their research, they discovered a similar spectrum of anomalies. Except in three cases where ARHA traversed the tumour and was sacrificed to achieve an oncological outcome, we were able to preserve anomalous RHA in all cases. In their series, Ashwin Rammohan *et al*.[8] dissected and preserved the aberrant artery in 79 percent of cases, ligated it in 18.6 percent, and performed dissection and primary anastomosis in 2.3 percent of cases.

There was a significant trend toward increased blood loss and operative time in the aRHA group in our study. The difference in blood loss between the two groups was significant, which could be attributed to the complexity of the procedure (anatomical and technical difficulties) and the longer operative time in group B. However, Asif Jah *et al*[9] found a trend toward increased blood loss and operative time in their study, but the difference was not statistically significant.

The most common complications after the pancreaticodudnectomy are delayed gastric emptying, pancreatic fistula, and wound infections. Pancreatic

Table 3: Intra-operative and post-operative comparison in group A and Group B

Parameters	Group A [Normal anatomy]	Group B [Aberrant hepatic artery anatomy]	P- Value
Mean Operative Time	230.9(168-390)	319.6(200-620)	<0.001
Intra-operative Blood Loss(ml)	511.5 ± 120.18	623.6 ± 127.06	<0.001
Peri-operative blood transfusion requirement(Percentage)	32.8%	39.3%	0.351
Postoperative pancreatic fistula	7.3%	8.2%	0.828
Delayed Gastric Emptying	6.8%	8.2%	0.711
Wound infection	9.6%	11.5%	0.676
Atelectasis	7.3%	8.2%	0.828
Hospital stay(Days)	9.9 ± 1.93	10.7 ± 3.67	0.122
Peri-operative mortality	3.4%	3.3%	0.967
Positive resection margins	4.5%	4.9%	0.898
Mean lymph node yield	11.73	11.84	0.619

fistula is associated with delayed gastric emptying, abdominal abscesses, incision site infection, sepsis, and bleeding after pancreaticodudnectomy.[3,4,7,10] Wound infection occurred in 10.08 percent of patients in our study (including both groups), followed by pancreatic fistula in 7.56 percent, basal atelectasis in 7.56 percent, delayed gastric emptying in 7.14 percent, and mortality in 3.36 percent. The mean hospital stay in our study was 9.9 ± 1.93 days in the normal anatomy group and 10.7 ± 3.67 days in the anomalous hepatic artery group, with no statistically significant difference between the two groups. Azhar Perwaiz *et al*.[7] found pancreatic fistula in 8.5 percent of cases, delayed gastric emptying in 7% of cases, and wound infection in 4.5 percent of cases in their study. In their study, the mean hospital stay in patients with and without hepatic artery anomaly was 10 ± 6 and 9.9 ± 5.1 days, respectively, with no statistically significant difference between the two groups. They discovered a significant difference in blood loss and operating time. In our study, the mean lymph node yield was 11.73 and 11.84, respectively; positive margin status was seen in 4.5 percent and 4.9 percent of cases, respectively, in patients without and with hepatic artery anomaly, with no statistically significant difference. In their study, Asif Jah *et al*[9] found similar results.

Conclusion

Patients with hepatic artery anomalies undergoing pancreaticoduodenectomy experience significantly more operative blood loss. This may be due to complexity of the procedure and prolonged operative time. Peri-operative blood transfusion requirement was also more in patients with hepatic arterial anomalies. Though the operative time and blood loss was significant more in arterial anomaly group, postoperative morbidity, oncological outcome and mortality were not significantly affected.

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Author contributions

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