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Variations in Hepatic Artery Anatomy and its Implications in Laparoscopic Whipple Surgery

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1. Introduction

Pancreato-Duodenectomy (PD) is a complex procedure with significant postoperative morbidity. Oncological outcome depends on marginal and nodal clearance around critical abdominal vasculature. The presence of aberrant vessels necessitates prompt identification and meticulous dissection around it [1]. Although preoperative imaging helps in appreciating proper vascular anatomy, surgeon has got a pivotal role in delineating and preserving it without compromising oncological principles. Laparoscopic Whipples' procedure is done only in few experienced centers. The role of laparoscopy has been evaluated very less so far in literature when such vascular aberrations are present. We did a prospective study to assess the impact presence of these variations on the laparoscopic PD [2].

2. Materials and Methods

All patients undergoing laparoscopic PD for periampullary tumors in our institution from January 2018 to December 2020 were included in the study. Arterial anatomy was documented with Contrast Enhanced Computed Tomogram (CECT) - pancreatic protocol. Patients with Locally advanced / unresectable tumors or with involvement of replaced hepatic artery were excluded from the study. The hepatic artery anomalies were classified based on Hiatt's classification1. Intraoperatively, the anomalies and its relation with tumor were confirmed by examining porta visually and with intra operative ultrasound as and when required. Proper lymphadenectomy was done around the common hepatic artery, portal vein and aberrant vessel. Patient database was maintained including demography, radiologic examinations, operative reports, pathology reports and postoperative course. The postoperative course was monitored and imaging was repeated in patients with suspicion of liver dysfunction.

3. Results

A total of 40 patients have undergone laparoscopic PD during our study period. Of this 9(22.5%) patients had variations in hepatic artery anatomy and the remaining 31 (77.5%) patients had classical hepatic arterial anatomy. In this classical anatomy, common hepatic artery was arising from the celiac trunk, which in turn gave rise to Gastroduodenal Artery (GDA) and proper hepatic artery and the latter dividing into right and left hepatic arteries. Of the 9 patients with arterial anomalies, 3 (33%) patients had replaced Right Hepatic Artery (rRHA) arising from Superior Mesenteric Artery (SMA) Hiatt's type 3 and 3(33%) patients had accessory Left Hepatic Artery (aLHA) arising from Left Gastric Artery (LGA) Hiatt's type 2. One patient had rRHA arising from Gastroduodenal Artery (GDA). Interestingly, one patient had rRHA arising from Celiac Trunk (CT) directly with GDA arising from LHA. One patient had normal hepatic artery origin, but RHA was coursing anterior to the CBD.

The average operative time was 440 minutes. None required perioperative blood transfusion with mean blood loss of 100 ml. During the postoperative period there was no incidence of postoperative pancreatic hemorrhage (PPH). Four patients had grade-A

postoperative pancreatic fistula (POPF), one patient had grade B POPF, and another patient had grade C POPF, which required intervention. The average hospital stay was 10.7 days.

Histopathology showed five patients had periampullary carcinoma; one each had D3 duodenal adenocarcinoma, pancreatic head adenocarcinoma and distal cholangiocarcinoma. The average lymph nodes yield is around 17.7. All the patients had R0 resections (Table 1 and 2).

Table 1:

Type of anomaly	Hiatt's classification	Michels' classification[2]	percentage
rRHA from SMA	Type 3	Type 3	3(33%)
aLHA from LGA	Type 2	Type 5	3(33%)
rRHA from celiac trunk	NA	NA	1(11%)
rRHA from GDA	NA	NA	1(11%)
Normal RHA anterior to CBD	NA	NA	1(11%)

Table 2:

Parameter	Average ± SD
Age	65.7 ± 12.4
M:F	7:02
Operative time	439.4 ± 65.3
Length of hospital stay	10.7 ± 2.0
Blood loss	331.2 ± 150
POPF No POPF Grade A Grade B Grade C	3 4 1 1
Tumor type Periampullary Ca HOP Distal cholangiocarcinoma Duodenal adenocarcinoma	 5 1 1 2
Average lymph node yield	20 ± 7.6

4. Discussion

Aberrant hepatic arterial anatomy is not uncommon. In this study, 22.5% of patients had arterial aberration. Hiatt et al reported 24% of their patients had anomalous arteries and Koop et al had this variation at an incidence of 21% [3]. Interestingly 6 types of variations were noticed in the current study. One patient had direct origin of rRHA from celiac trunk, which was described earlier by Koop. Gruttadauria S et al noted rRHA arising from GDA in their study of 701 cases. This anomaly was observed in a patient of this study [4].

It has to be emphasized that the presence of variations must be identified pre-operatively using proper CECT- pancreatic protocol. This helps us to identify the anatomy, its relationship to the tumor and its course till liver [5, 6]. Properly done and interpreted CT avoids intraoperative surprises and make surgeon prepared. All anomalies were road mapped pre-operatively in this study with cross sectional imaging.

In Spite of these anomalies, intraoperative blood loss was comparable to other studies with normal arterial anatomy. In contrary, Jha et al showed there existed a mild risk of intra operative blood loss and chance of injury to the aberrant vessel during open PD [7]. The advantage of laparoscopy can be due to better vision and subsequent appreciation of dissecting planes. CR-POPF was very low in this study and had no correlation with difficult arterial anatomy. There was no incidence of liver dysfunction post operatively.

In terms of oncological outcome, all cases had R0 resection and the average lymph node yield was comparable to studies done by Kim JH et al [8]. Earlier studies have claimed the presence of aberrant hepatic arteries as a factor to compromise the extent of pancreatic resection in open Whipple procedure. Recent studies show comparable radicality in open PD with or without arterial anomalies.

Our study is one of few studies to observe comparable oncological outcome without increased perioperative morbidity following laparoscopic PD in presence of aberrant hepatic arteries. Large number of patients have to be studied before categorical conclusions.

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