ARTERY FIRST TECHNIQUE FOR MANAGEMENT OF ABERRANT HEPATIC ARTERIAL ANATOMY DURING PANCREATICODUODENECTOMY-EXPERIENCE FROM A SPECIALIZED HEPATO-PANCREATO-BILIARY UNIT

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Abstract

Purpose: Aberrant hepatic arterial anatomy poses a challenge for surgeon during pancreaticoduodenectomy (PD). These anomalies are best picked up on preoperative imaging in order to avoid inadvertent injury to the aberrant vasculature resulting in liver ischemia or biliary-enteric anastomotic failure. We present our experience of dealing with aberrant hepatic vessels during PD.

Methods: Patients with aberrant hepatic vasculature who underwent PD between September 2014 and August 2015 were included. We used artery first technique for dissection in cases identified on preoperative imaging. Aberrations were classed according to Hiatt classification.

Results: 23 PD were performed with aberrant arterial anatomy in 10 (43%) cases. These vessels were recognized and preserved in 09 cases. In one patient, the replaced right hepatic artery (rRHA) arising from SMA was coursing through pancreatic parenchyma needing resection and reconstruction with uneventful postoperative recovery. We also identified one rRHA arising from SMA coursing lateral to CBD and entering liver parenchyma in gall bladder fossa.

Conclusion: Aberrant hepatic arterial anomalies are common and should ideally be picked up by preoperative imaging. It is possible to preserve these vessels in most cases with careful surgical dissection using artery first technique. Surgeons performing pancreaticoduodenectomy should be well versed with the aberrant vascular anatomy to minimize any inadvertent damage.

Key words: artery first technique, aberrant hepatic artery, pancreaticoduodenectomy

Introduction:

Pancreaticoduodenectomy offers the only chance of curative treatment of resectable pancreatic cancer. Although the mortality for this complex procedure has improved significantly over the last few decades, the morbidity still remains very high with post-pancreatectomy haemorrhage and anastomotic leakage being the most significant complications. Aberrant hepatic arterial anatomy is encountered in approximately 25% of patients. These anomalies are best picked up on preoperative imaging in order to avoid inadvertent injury to the aberrant vasculature. This may result in haemorrhage, inadequate perfusion to liver or bile duct with subsequent anastomotic failure.

Aberrant right hepatic artery is the commonest anomaly found in the hepatic vasculature. Michels described vascular anatomic variations in 1966 which were classified into 10 types which were later modified into 6 types by Hiatt et al (Table 1). According to Hiatt Classification, the replaced right hepatic artery arising from the SMA occurs in 10.6% of cases. This presents problem with possibility of haemorrhage, ischemia to the liver or bile duct, or
inadvertent damage to the adventitia of the vessel predisposing the patient to subsequent haemorrhagic complications.

An aberrant vessel, especially a replaced right hepatic vessel arising from SMA may course posterior to the pancreatic head or portal vein and thus may lie in the area of dissection. This situation places the aberrant vessel at risk of damage during resection. The aberrant vessel can be preserved in most of the circumstances by meticulous dissection; however it may require ligation in up to 20% of cases. We report our institutional experience of dealing with aberrant arterial anatomy encountered during pancreaticoduodenectomy.

**Methods:**

Patients undergoing pancreaticoduodenectomy at Shaukat Khanum Memorial Cancer Hospital and Research Centre Lahore, Pakistan between September 2014 and August 2015 were included in the study. Arterial anomalies were identified on preoperative cross-sectional imaging which included biphasic CT scan with pancreatic protocol in majority of the patients. Operative details were recorded regarding intraoperative identification management of aberrant vascular anatomy.

Artery first dissection was performed for aberrant vessels arising from SMA or for an aberrant vessel coursing caudal or lateral to the portal vein. Standard dissection for pancreaticoduodenectomy was performed for normal vascular anatomy or for other aberrant variations of hepatic vasculature.

### Results:

During the study period of one year, a total of 23 patients underwent pancreaticoduodenectomy. Normal vascular anatomy was observed in 13 (56.5%) of cases. Aberrant hepatic arterial anatomy was encountered in 10 (43.4%) cases. Details of aberrant vascular anatomy and the management are described in Table 2. The most common aberration was a replaced right hepatic artery arising from the SMA which was seen in 6 (26%) cases, followed by common hepatic artery arising from the superior mesenteric artery in 2 (8.7%) cases. In both these types of anomalies, artery first dissection was performed as the aberrant vessels were coursing through the area of proposed dissection. In one case, the replaced right hepatic artery was coursing through pancreatic parenchyma and had to be sacrificed for oncological reasons. This vessel was reconstructed by end-to-end anastomosis. Postoperative scans of this patient showed patency of the reconstructed vessel.

There were 13 (56.5%) patients with type 1 (normal) arterial anatomy according to Hiatt classification, one (4.4%) with type 2 and type 6 both. We did not encounter Hiatt type 4 vascular anomalies in our study population. All apart from one of these aberrant vessels were identified and preserved during dissection. In only one case resection and reconstruction of aberrant vessel was performed for oncological clearance. We also encountered rRHA arising from SMA coursing lateral to CBD and entering liver parenchyma in gall bladder fossa in one patient. This anomaly is not described in literature.

<table>
<thead>
<tr>
<th>Variation</th>
<th>Hiatt type</th>
<th>Incidence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Vascular Pattern</td>
<td>Type 1</td>
<td>75.7%</td>
</tr>
<tr>
<td>Aberrant Left Hepatic Artery from Left Gastric Artery</td>
<td>Type 2</td>
<td>9.7%</td>
</tr>
<tr>
<td>Aberrant Right Hepatic Artery from Superior Mesenteric Artery</td>
<td>Type 3</td>
<td>10.6%</td>
</tr>
<tr>
<td>Aberrant RHA and Aberrant LHA</td>
<td>Type 4</td>
<td>2.3%</td>
</tr>
<tr>
<td>Common Hepatic Artery from Superior Mesenteric artery</td>
<td>Type 5</td>
<td>1.5%</td>
</tr>
<tr>
<td>Common Hepatic Artery from Aorta</td>
<td>Type 6</td>
<td>0.2%</td>
</tr>
</tbody>
</table>
Table 2 - Hepatic artery aberrations according to Hiatt classification and their intraoperative management

<table>
<thead>
<tr>
<th>Variation</th>
<th>Hiatt type</th>
<th>No (%)</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Vascular Pattern</td>
<td>1</td>
<td>13 (56.5)</td>
<td>SD</td>
</tr>
<tr>
<td>Replaced RHA from SMA</td>
<td>3</td>
<td>06 (26)</td>
<td>AF</td>
</tr>
<tr>
<td>CHA from SMA</td>
<td>5</td>
<td>02 (8.7)</td>
<td>AF</td>
</tr>
<tr>
<td>Accessory LHA from LGA</td>
<td>2</td>
<td>01 (4.4)</td>
<td>SD</td>
</tr>
<tr>
<td>CHA from Aorta</td>
<td>6</td>
<td>01 (4.4)</td>
<td>SD</td>
</tr>
</tbody>
</table>

RHA-right hepatic artery; SMA-superior mesenteric artery; CHA-common hepatic artery; LHA-left hepatic artery; LGA-left gastric artery; SD-Standard dissection; AF-artery first dissection; aberrant artery slung followed by standard dissection.

Discussion:

We present our institutional experience of aberrant hepatic arterial anatomy encountered during pancreaticoduodenectomy. This is the first description of variant hepatic vascular anatomy from Pakistan and represents data from our population. We encountered anomalous vessels in 43% of cases undergoing pancreaticoduodenectomy. This proportion is significantly higher compared to previously described international literature. Aberrant vessels were seen in 24.3% patients in Hiatt’s landmark paper on hepatic arterial anatomy. Till date no local data is published on hepatic vascular anomaly. More recent literature looking at the pattern of aberrant hepatic vasculature also shows an incidence of aberrant hepatic vasculature in 16-19%2,5,8. We need larger sample to evaluate more accurate incidence of hepatic arterial anomaly in our patients as we lack local data.

The significance of identifying vascular pattern lies in planning dissection precluding inadvertent ligation of hepatic artery while performing pancreaticoduodenectomies as the anomalous artery may course through the proposed area of dissection. We performed artery first dissection by identifying the aberrant vessel before dissection and transection of the pancreas. The identified aberrant vessel was

and is at high risk of injury during cholecystectomy. One patient had type 3 anomaly (replaced right hepatic artery originating from SMA) but the course of artery was further abnormal as it courses lateral to CBD and entered in gall bladder fossa. This anomaly is not reported in literature and carries high risk of damage in cholecystectomies.

Figure 1. Reconstructed Image (A) showing the replaced right hepatic artery arising from superior mesenteric artery. (B) Axial sections showing the artery traversing the pancreatic parenchyma lateral to the portal vein and the common bile duct. rRHA- replaced Right hepatic artery, LHA-left hepatic artery, GDA-gastroduodenal artery, CA-celiac axis, SMA-superior mesenteric artery, CBD-common bile duct, PV-portal vein, SV-splenic vein, PP-pancreatic parenchyma.
slung in a vascular loop to ensure its preservation during the dissection. Artery first dissection was performed in all cases where the aberrant vessel was arising from the superior mesenteric artery since the vessel was coursing through the proposed area of dissection and would thus be at risk of damage during this dissection.

In cases where the aberrant vessel was not coursing through the area of proposed dissection (Hiatt type 2 or type 6 arterial anomaly), standard dissection technique was used as the vessel was not at a high risk of damage during dissection. In one patient, the aberrant vessel had to be sacrificed as it was coursing through the pancreatic parenchyma and required resection for oncological reasons. This vessel was resected and reconstruction by end to end anastomosis was performed. (Figure 1)

**Conclusion:**

This discrepancy in incidence of vascular anomalies in our population suggests the need for a more conscious effort to identify such variations on preoperative imaging. Failure to do so may result in inadvertent damage to these vessels with significant increase in the morbidity following this complex procedure. Majority of the aberrant vessels can be preserved by meticulous dissection and in our experience artery first technique is a suitable option to achieve this objective.

**References:**