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## REVIEW

# How to deal with hepatic artery injury during pancreaticoduodenectomy. A systematic review



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### KEYWORDS

Hepatic artery;  
Injury;  
Liver ischemia;  
Pancreaticoduodenectomy;  
Mortality

### Summary

**Background:** Operative injury to the hepatic artery is a serious complication of pancreaticoduodenectomy and guidelines to manage this complication are lacking.

**Methods:** A systematic search performed in PubMed database identified eleven studies overall including 20 patients having sustained injury to the hepatic artery during pancreaticoduodenectomy ( $n=18$ ) or total pancreatectomy ( $n=2$ ). One further unpublished personal observation following pancreaticoduodenectomy was also included.

**Results:** Sixteen of 21 patients (76%) experienced serious complications including liver necrosis/abscess ( $n=14$ ), acute liver failure ( $n=3$ ), and biliary anastomotic dehiscence ( $n=6$ ). Eleven patients (52%) were reoperated and 5 patients died (24%). Arterial injury was recognized and repaired immediately in five patients, four recovering uneventfully and one dying from acute liver failure (20%). In contrast delayed or conservative treatment in 16 patients was associated with serious early morbidity in 15 patients (94%), leading to death in 4 patients and late biliary complications in four others.

**Conclusions:** Accidental interruption of arterial flow to the liver during pancreaticoduodenectomy often results in serious short and long-term consequences. Immediate restoration of arterial flow is indicated whenever technically feasible and may prevent early life-threatening complications as well as late biliary stenosis.

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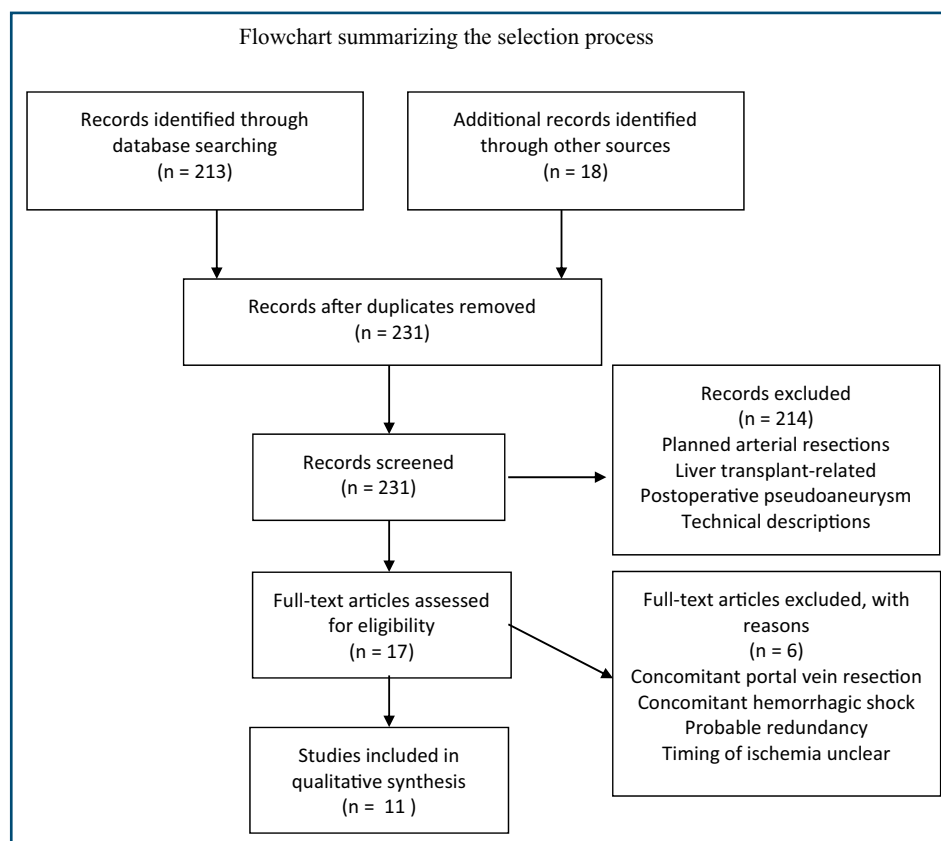
## Introduction

Pancreaticoduodenectomy (PD) is a complex surgical procedure that remains associated with significant morbidity

and mortality. Hepatic ischemic complications occur in 3–4% of patients and are among the most lethal [1]. These complications are explained by important vascular structures in close contact or embedded within the pancreas, and frequent peripancreatic inflammation or invasion by large tumors that may obliterate dissection planes and distort anatomy [1]. Also, an unanticipated aberrant arterial anatomy can be encountered, thus favouring accidental

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**Figure 1.** Prisma Flow diagram illustrating the selection process of the retained studies.

injury [2–4]. Operative injury to the hepatic artery has been sporadically reported with a variety of procedures including cholecystectomy, pancreatectomy, gastrectomy, hepatectomy and resection of the common bile duct [1–16]. Because of the scarcity of existing reports, little is known of the potential consequences of such an event during PD and clear guidelines to manage this complications are lacking including regarding the need for arterial reconstruction. The aim of this study was to analyse the existing literature reporting hepatic ischemic complications following PD and to propose guidelines for early diagnosis and therapeutic management of these complications.

## Patient and methods

A search of the literature limited to human subjects between 1990 and April 2016 was conducted in the PubMed database using the search terms “hepatic artery injury”, “hepatic artery reconstruction” and “pancreaticoduodenectomy”, “pancreatectomy” or “Whipple”. A manual cross-reference search of cited articles in the publications retrieved was performed and any relevant articles were examined. Only patients in whom interruption of arterial flow was diagnosed intraoperatively or was presumed to have occurred at the time of surgery were retained. Patients who underwent planned arterial resection for tumor involvement, patients in whom portal vein flow was also compromised following curative resection or injury to the portal vein and patients with liver ischemia due to celiac trunk stenosis were excluded. Also, perioperative hemodynamic instability constituted a criterion for exclusion.

Authors reviewed all studies to assess validity and any diverging opinions were discussed. The selection process is summarized in a flowchart (Fig. 1). Data from retained studies was transferred to standardized forms for analysis. The following data were recorded: author, patient age, underlying pathology, type of surgery, site of arterial injury, time to diagnosis, topography of liver necrosis, complications, management, treatment delay and outcome.

Eleven studies were identified reporting a total of 20 patients having sustained hepatic artery injury during PD ( $n=18$ ) or total pancreatectomy ( $n=2$ ) [1–11] (Tables 1 and 2). One unpublished personal observation of a patient who developed acute liver failure and liver necrosis following PD was also included in the present analysis, giving a total of 21 patients (Fig. 2). Only low-grade evidence studies including case reports, retrospective series and case control studies were available. Additional articles dealing with risk factors associated with liver desarterialization were also analysed to formulate recommendations.

## Results

Peripancreatic inflammation due to chronic pancreatitis ( $n=6$ ) or inflammatory neoplasms ( $n=2$ ) was present in 8 of 12 patients for whom the data was reported. Anatomic variants were present in 3 patients (14%) (a replaced proper hepatic artery in one patient and a replaced right hepatic artery originating from the superior mesenteric artery in two others). Interruption of flow concerned the common, proper and right hepatic arteries or was not mentioned in 1, 8, 5 and 7 patients respectively. Interruption of the common or proper hepatic arteries resulted in left lobe liver necrosis exclusively in 2 patients, bilobar necrosis in

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