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Mini Review

The Combined Approach in Cephalic Duodenopancreatectomy: A Surgical Strategy Adapted to Complex Forms

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Abstract

Cephalic duodenopancreatectomy (DPC) is the standard surgical procedure for the management of tumors of the pancreatic head, the ampulla of Vater, and the distal bile duct. It is a major, complex, and highly technical operation that requires great surgical precision. Despite continuous advances in surgical techniques and perioperative care, DPC remains associated with significant morbidity and mortality, even in high-volume specialized centers, several surgical approaches and strategies have been described for the management of tumors of the pancreatic head, aiming to optimize outcomes while minimizing postoperative morbidity, this article presents its principles, indications, technical steps, and the demonstrated benefits reported in recent literature.

Keywords: Cephalic Duodenopancreatectomy (CDP); Superior Mesenteric Artery (SMA)

Introduction

Cephalic duodenopancreatectomy (CDP) is the standard treatment for malignant tumors of the pancreatic head, the ampulla of Vater, and the duodenum. While the classical approach remains the initially taught technique, more recent strategies, such as the artery-first approach and mesopancreas-centered dissection, have emerged to address increasing technical and oncological challenges. The combined approach, by integrating these techniques in a personalized sequence, allows for optimized resection tailored to complex tumor profiles.

The superior mesenteric artery (SMA) first approach was proposed recently as a new modification of the standard pancreaticoduodenectomy associates better early perioperative results, and setup the scene for long-term oncological benefits.

Recent advances in surgical pathology and oncology indicate that, in pancreatic head carcinoma, the mesopancreatic resection margin is the primary site for R1 resection, and that epithelial-mesenchymal transition-related processes involved in tumor progression may impact on the prevalence of R1 resection or local recurrence rates after R0 surgery Resection.

The combined approach in pancreaticoduodenectomy (PD) is a hybrid surgical strategy that integrates multiple technical sequences derived from classical, arterial, and mesopancreatic approaches. Its goal is to maximize the chances of resect ability and

achieving R0 margins, while tailoring the operative strategy to the anatomical and oncological realities encountered intraoperatively. This technique is particularly indicated in locally advanced or borderline cases.

Discussion

Artery-first approach (with early control of major vessels)

The "artery-first approach" in duodenopancreatectomy (DPC), also known as the "artery-first pancreaticoduodenectomy" (AFPD) is a surgical strategy that involves early dissection and control of the superior mesenteric artery (SMA) before irreversible steps are taken (such as division of the pancreas or common bile duct). This approach allows for early assessment of tumor resect ability and vascular involvement, thereby improving patient selection and potentially reducing morbidity [1,2].

The artery-first approach can be divided into six types [3].

Approach Type	Description
1. Posterior Approach	Dissection from below the pancreas head toward the SMA root (from the infracolic region).
2. Medial Uncinate Approach	SMA is approached medially by dissecting the uncinate process.
3. Inferior Infracolic Approach	SMA exposed via a window below the transverse mesocolon.
4. Left Posterior Approach	SMA approached from the left, via ligament of Treitz and mesenteric root.
5. Inferior Supracolic Approach	Through the transverse mesocolon above the pancreas.
6. Superior Approach	SMA accessed above the pancreas, through hepatoduodenal ligament and celiac axis.

Table 1

Tumors involving the SMA are typically unresectable, artery first approach allows early exposure of the artery avoids unnecessary morbidity from non-curative resections and reduce blood loss by early ligation of arterial inflow to the pancreatic head [4], oncologic benefit by complete circumferential clearance (R0) around the SMA. improves lymphadenectomy and prevents futile surgery [5].

In this context, the 'artery-first' approach has emerged as a strategic surgical technique allowing early assessment of tumor resect ability, particularly with respect to the superior mesenteric arterial axis.

Comparative studies have shown that the "artery-first" approach, Increases the R0 resection rate (up to 84% vs 65%) [1,3,5], Reduces operative mortality (<5% in expert centers) [2,6] and does not significantly prolong operative time [7], Improves analysis of mesopancreatic lymph nodes, which is essential for accurate staging [8].

The "artery-first" approach is a major technical innovation in pancreatic surgery. By enabling early assessment of resect ability and providing better oncological control of the mesopancreatic plane, it is establishing itself as a standard in the management of borderline or locally advanced pancreatic adenocarcinomas.

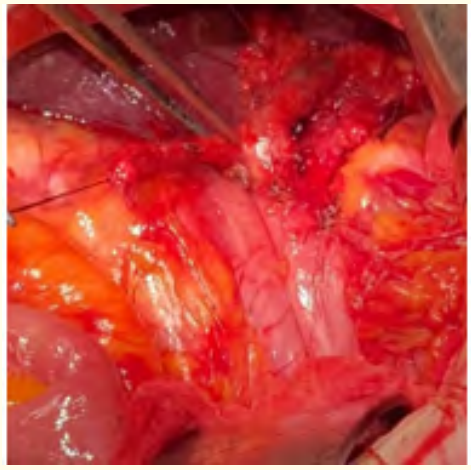

Figure 1: Per operative artery first.

Standard approach (sequential mobilization of structures)

The standard approach, also known as the classical Whipple procedure, involves a defined sequence of dissection and resection that is universally taught and practiced [9]. While newer techniques like the "artery-first" approach or mesopancreas-first dissections have emerged, the standard approach remains foundational, particularly in benign conditions or when vascular invasion is not suspected [10,13].

This technique involves anterograde resection, without early dissection of major arteries like the SMA (unlike artery-first strategies). It emphasizes exposure, stepwise devascularization, and conventional control of vascular and biliary structures.

Variants of the Standard Procedure [14].

Type	Description
Classic Whipple	Resection of distal stomach (antrectomy)
Pylorus-preserving PD	Preserves gastric emptying and duodenal integrity
Vein-resecting PD	En bloc resection of SMV/PV segment if involved
Robotic or Laparoscopic PD	Performed in high-volume, specialized centers

Table 2

Comparison with Artery-First Approach [15,16].

Parameter	Standard Approach	Artery-First/ Mesopancreas First
Early vascular control	No	Yes
Suitability for borderline tumors	Low	High
R0 resection rate	~60–70%	>80% (in expert hands)
Risk of futile surgery	Higher	Lower

Table 3

The standard pancreaticoduodenectomy remains the cornerstone of surgical treatment for periampullary and pancreatic head tumors. It is safe, reproducible, and effective in selected patients, especially when there is no major vessel invasion. However, for locally advanced or borderline resectable disease, artery-first and mesopancreatic approaches are increasingly favored due to their oncological superiority in margin clearance and early determination of unresectability mesopancreas-first or retrograde/artery-first approach (with early control of major vessels).

Figure 2: Standard approach

The mesopancreas is now recognized as the key site for achieving R0 resection in pancreatic head cancer. The concept emerged to address the high rate of R1 resections along the posterior and medial margins using the standard technique. The mesopancreatic approach aims for early dissection and control of the superior mesenteric artery (SMA) and associated neural/ lymphatic tissues, with the intent of improving margin status and avoiding futile resections.

The mesopancreas is not an anatomical mesentery like the mesorectum, but a fascial, neural, lymphovascular tissue plane extending from the posterior surface of the pancreatic head and uncinate process toward the SMA and celiac axis, adjacent to the aortocaval region, It includes: Lymphatics, Neural plexuses and Small vessels (first jejunal branches, arc of Bühler) [17].

Principles of the Mesopancreatic Approach are retrograde dissection of the uncinate and posterior pancreatic head, early identification of SMA, bloc resection of the mesopancreas with negative margins and assessment of arterial involvement before point of no return [18].

Mesopancreas-First Dissection start with Kocher maneuver extended to the aorta and SMA origin, Dissection of Treitz ligament for exposure of the first jejunal vein/artery, Full mobilization of duodenum and head of pancreas from retroperitoneum [19].

Advantages Over Standard PD [20].

Feature	Mesopancreatic Approach	Standard Approach
Early assessment of resectability	✅ (before pancreas divided)	❌
R0 resection rate	Higher (~80–90%)	Lower (~60–70%)
Artery-first dissection	Yes	No
Margin-negative along SMA	More reliable	Often involved
Oncologic radicality	Superior	Standard

Table 4

A study [4] demonstrated improved margin-negative resection and local control with mesopancreas-first PD compared to conventional PD.

The mesopancreatic approach represents a paradigm shift in pancreatic surgery, prioritizing oncologic clearance and vascular evaluation. It is especially valuable in the era of neoadjuvant therapy and borderline resectable tumors, aiming to maximize R0 resections and long-term survival

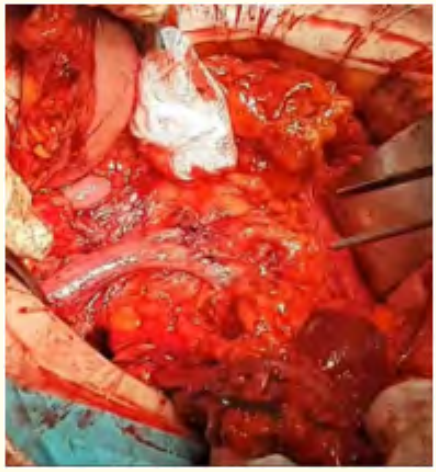

Figure 3: The mesopancreatic approach.

Vein-first approach in pancreaticoduodenectomy (PD)

The vein-first approach in pancreaticoduodenectomy is a surgical strategy that involves early dissection and control of the venous structures, particularly the superior mesenteric vein (SMV), portal vein (PV), and the spleno-mesenteric confluence, before proceeding to arterial dissection or mobilization of the pancreatic head. This technique has gained attention in the management of borderline resectable and locally advanced pancreatic cancers due to its potential to assess vascular involvement early in the procedure and guide intraoperative decision-making.

The primary objective of the vein-first approach is to evaluate the resectability of the tumor with respect to venous invasion. By identifying the extent of involvement of the SMV or PV at the beginning of the operation, the surgeon can decide whether vascular resection and reconstruction are feasible. This early assessment avoids unnecessary pancreatic resections in cases where venous infiltration is deemed unresectable, thereby preventing prolonged operative times and reducing intraoperative blood loss.

Technically, the procedure begins with the opening of the lesser sac and dissection along the root of the mesentery to expose the SMV. The posterior surface of the pancreas is mobilized to reveal the SMV-PV confluence. Careful dissection is performed to delineate the relationship between the tumor and the venous axis. If necessary, proximal and distal vascular control of the SMV is established in preparation for segmental resection or reconstruction.

This approach is particularly beneficial in cases of borderline resectable pancreatic tumors, where preoperative imaging suggests potential venous involvement. It is also useful in patients who have received neoadjuvant therapy, allowing the surgeon to assess the anatomical changes and treatment response. By prioritizing the venous assessment, the approach enables a more controlled and anatomically guided resection, especially when a vascular resection is anticipated.

However, the vein-first technique is not without limitations. It may be technically challenging in obese patients, those with post-radiation fibrosis, or in cases with large tumors obscuring the venous axis. There is also a risk of venous injury during early dissection if anatomical landmarks are not clearly visualized or if the approach is performed hastily.

Compared to the artery-first approach—which emphasizes early assessment of arterial involvement, especially of the superior mesenteric artery (SMA) and the celiac axis—the vein-first approach is tailored to cases where venous resectability is the critical determinant of operability. While both strategies aim to improve the oncologic outcome and reduce intraoperative complications, the selection of approach should be individualized based on preoperative imaging, tumor characteristics, and surgical expertise.

Several studies have supported the use of the vein-first approach. Nakao., *et al*. (1993) were among the first to describe early venous ligation as a strategic maneuver. More recently, Sahakyan., *et al*. (2018) and Kawai., *et al*. (2014) detailed the technical and anatomical considerations of this method, showing its safety and effectiveness in selected patients. Kamisawa., *et al*. (2016) highlighted its relevance in the management of borderline resectable disease, especially after neoadjuvant therapy.

In summary, the vein-first approach in pancreaticoduodenectomy provides a rational and oncologically sound technique for early evaluation of venous involvement in pancreatic cancer. When performed by experienced teams in appropriate patients, it facilitates vascular control, minimizes unnecessary resections, and contributes to better surgical planning and outcomes.

Combined approach in pancreaticoduodenectomy (PD)

"The best of all worlds" – Hybrid dissection for R0 resection.

Principle: Multiple angles of attack ensure safe radical resection and margin negativity, especially in borderline resectable tumors.

The combined approach in PD reflects the evolution of pancreatic surgery toward a multiplanar, oncologically-driven strategy. It unites the strengths of artery-first, retroperitoneal, and standard dissection techniques to ensure: better assessment of vascular involvement, early decision-making on resectability, optimized margin clearance Adaptation to tumor response post-chemotherapy.

It is increasingly becoming the preferred strategy in high-volume centers managing complex or borderline tumors.

The combined approach adapts to intraoperative findings: It starts inframesocolically (artery-first) to control the SMA, Then shifts retroperitoneally (posterior-first) to dissect the mesopancreas, Followed by anterograde (standard) steps: bile duct, stomach, duodenum, Can also incorporate vein-first dissection (if SMV-PV involvement suspected [21].

Step-by-Step Technique (Schematic Sequence) [19-22].

Phase	Region	Action
1	Inframesocolic (Artery-First)	Identify SMA from below mesocolon via the ligament of Treitz. Skeletonize right lateral SMA margin.
2	Posterior Dissection	Extend Kocher maneuver to the aorta. Mobilize pancreatic head from retroperitoneum. Dissect mesopancreas en bloc.
3	Vein-First	Isolate PV-SMV confluence. Assess for tumor invasion. Perform vein resection if needed.
4	Standard Foregut Dissection	Divide hepatic artery, GDA, bile duct, stomach/duodenum. Mobilize jejunum.
5	Pancreas Transection	Divide pancreatic neck after confirming resectability.
6	Uncinate Resection (Retrograde)	Detach from SMA and SMV from below upwards.
7	Lymphadenectomy	Standard D2 + mesopancreatic tissue (14, 16, 8, 13, 17 nodes).

Table 5

Conclusion

Pancreaticoduodenectomy is a complex and high-risk operation in which the surgical strategy significantly influences resect ability, margin status (R0 vs. R1), and oncologic outcomes. The choice of approach depends on tumor anatomy, preoperative imaging, neoadjuvant response, and the surgeon's expertise [22], each approach has its own specific indications.

However, the current trend in expert centers is shifting toward the combined approach, as it: Adapts to the most complex situations and provides improved oncological safety.

"The right approach is not unique, but tailored to the tumor and the surgeon".

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