

Technical Limitations of the Artery-First Approach in Pancreaticoduodenectomy

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1. Abstract

The artery-first approach in pancreaticoduodenectomy (PD) was developed to optimize early assessment of tumor resectability, particularly in locally advanced pancreatic adenocarcinoma [1–3]. This technique is based on the initial dissection of the superior mesenteric artery (SMA).

Despite its advantages in terms of patient selection and improved R0 resection rates, this approach presents significant limitations related to technical complexity, anatomical variations, local operative conditions, and its still-debated oncological benefit [4–7].

The aim of this article is to critically analyze the technical, anatomical, and oncological limitations of this approach.

1.2. Introduction

Pancreaticoduodenectomy remains the standard treatment for resectable tumors of the pancreatic head [8]. However, the high rate of R1 resections reported in some series has led to the development of techniques aimed at improving margin clearance, particularly at the level of the mesopancreas [9,10].

In this context, the artery-first approach was introduced to allow early assessment of superior mesenteric artery (SMA) involvement, a key determinant of resectability [1,2,11]. Several technical variations have been described (medial, posterior, infracolic approaches), each with specific advantages and constraints [3,12].

Despite its theoretical benefits, this approach presents important limitations that hinder its widespread adoption, especially in light of major advances in diagnostic imaging, which now allow accurate patient selection prior to surgery

2. Discussion

2.1. Anatomical and Tumoral Limitations

Arterial tumor invasion represents the main limitation of the artery-first approach. Tumor contact exceeding 180° with the SMA is generally considered a contraindication to resection [13,14]. In such cases, early SMA dissection becomes not only difficult but also associated with a high risk of major complications.

Furthermore, arterial anatomical variations are frequent (up to 30%) [15]. The presence of an aberrant right hepatic artery arising from the SMA significantly complicates dissection and increases the risk of iatrogenic vascular injury [16].

2.2. Technical Complexity and Learning Curve

The artery-first approach is a demanding technique requiring advanced expertise in pancreatic surgery [3,5]. Early SMA dissection requires precise knowledge of retro-pancreatic anatomy and vascular relationships.

Several studies have shown an initial increase in operative time [6], as well as higher intraoperative morbidity in low-volume centers [17]. This dependence on surgical experience limits its reproducibility on a large scale.

2.3. Exposure Difficulties and Local Conditions

Exposure of the SMA may be compromised by several factors, including visceral obesity, chronic pancreatitis, and prolonged jaundice [18].

Moreover, neoadjuvant therapies can induce perivascular fibrosis, making dissection more challenging and sometimes misleading in assessing true tumor invasion [19,20]

2.4. Hemorrhagic Risk

Dissection in close proximity to the SMA and SMV exposes patients to an increased risk of hemorrhagic complications [21]. High-risk situations include injuries to the superior mesenteric vein, gastroduodenal trunk lesions, and difficult dissections in inflammatory conditions. These complications may compromise the continuation of resection [22].

2.5. Limitations in Venous Involvement

Although the artery-first approach is effective for arterial assessment, it remains limited in evaluating venous involvement [23]. Portal vein or SMV invasion may be underestimated preoperatively and difficult to assess at the beginning of surgery.

This may lead to complex and unanticipated venous reconstructions [24].

2.6. Oncological Limitations

One of the main objectives of the artery-first approach is to improve R0 resection rates [4,25]. However, its impact on overall survival remains controversial.

Some meta-analyses report improved R0 rates and a reduction in unnecessary laparotomies, but without consistent significant benefit in long-term survival [26,27].

2.7. Organizational Limitations

This approach is mainly performed in high-volume centers [28]. It requires advanced surgical expertise, high-quality preoperative imaging, and multidisciplinary management.

Its use therefore remains limited in low-resource settings [29].

3. Conclusion

The artery-first approach represents an important technical advancement in pancreatic surgery, allowing better assessment of arterial resectability and optimization of surgical strategy [1,3].

However, its technical and oncological limitations are significant, including high operative complexity, dependence on surgical expertise, difficulties in cases of fibrosis or anatomical variations, and an unclear survival benefit.

Thus, this approach should be integrated into an individualized strategy within specialized centers.

Current advances in diagnostic radiology now allow differentiation and classification of tumors according to NCCN criteria prior to surgery, thereby reducing the relevance of the artery-first approach [30].

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