·综　　述·

# 胰肠吻合及其改良对于术后胰瘘影响的研究现状

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［摘要］ 胰十二指肠切除术被认为是治疗十二指肠、远端胆管和胰头良恶性病变最有效的方式。术后胰瘘会对病人的生存率、预后造成重大影响。胰肠吻合作为术后胰瘘的危险因素之一，学者们从吻合方式、辅助材料等多方面进行改进，试图最大程度地降低术后胰瘘的发生。此文就胰肠吻合及其改良对于术后胰瘘的影响做一综述，为进一步降低术后胰瘘发生率提供相关理论借鉴。

［关键词］ 胰十二指肠切除术；胰管空肠吻合术；胰瘘；文献综述
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**Research advances of effects of pancreaticojejunostomy and its modifications on postoperative pancreatic fistula**

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［**Abstract**］ Pancreaticoduodenectomy has been a golden standard for treating benign and malignant lesions of duodenum, distal bile duct and pancreatic head. Postoperative pancreatic fistula may significantly affect the survival and prognosis of patients. Pancreaticojejunostomy is one of the risk factors of postoperative pancreatic fistula. Researchers have modified anastomotic modes and auxiliary materials for minimizing the occurrence of postoperative pancreatic fistula. It may guide clinical decision-making for individualization to provide theoretical rationales for further lowering the incidence of postoperative pancreatic fistula.

［**Key words**］ Pancreaticoduodenectomy; Pancreaticojejunostomy; Pancreatic fistula; Review

胰十二指肠切除术（pancreaticoduodenectomy，PD）是治疗十二指肠、远端胆管和胰头良恶性病变最有效的方式[1-2]。该手术操作复杂、手术时间长、切除范围广，被认为是外科最具挑战的手术之一，同时也伴随着多种术后并发症的发生。术后相关胰瘘是PD最常见、最具威胁性的并发症，可能导致假性动脉瘤、腹腔出血，甚至危及病人生命[3]，发生率约5%～26%，对于病人的预后有着重大影响[4-5]。胰腺质地、胰管直径、病理类型等是术后胰瘘的独立危险因素[6-8]，但这些因素与病人自身情况有着直接关联。胰肠吻合作为外科医生可控制的危险因素，学者们对其吻合方式、细节做出改进和创新，旨在减少术后胰瘘的发生率，提高病人生存率和预后。本文就PD中胰肠吻合及其改良对于术后胰瘘的影响做一综述，以期为进一步降低术后胰瘘发生率提供相关理论借鉴。

## 一、胰肠吻合发展简史

1898年，Halsted在十二指肠壶腹肿瘤切除术中行胰十二指肠端端吻合，被认为是胰肠吻合的雏形[9]。此后，Kausch、Hirschel、Tenani等在PD中也进行胰十二指肠端端吻合[10]。1935年，Whipple等[11]尝试不进行消化道重建，而是将主胰管和胰腺残端直接闭合，但由于出现多种并发症而被淘汰。学者们研究发现，十二指肠不是生存所必须器官，反

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而仅切除部分十二指肠会造成残端缺血，引起多种并发症[11]。1936年，Roscher将十二指肠全部切除，进行首例胰腺空肠吻合[10]。1944～1945年，Child和Whipple[12-13]先后提出了两种不同的消化道重建方式，Child行胰肠端端吻合、胆肠和胃肠端侧吻合，Whipple行胆肠端端、胰肠和胃肠端侧吻合。最终通过实践，Child法可降低因胰液提前被胆汁激活而造成吻合口漏的风险，成为目前最主流的吻合顺序。

二、胰肠吻合

胰肠吻合的方式有多种，根据位置分类，有端端吻合、端侧吻合；根据胰腺是否嵌入肠腔，可分为套入式吻合和导管-黏膜吻合。目前，端侧套入式吻合和导管-黏膜吻合应用较为广泛。可根据胰管大小、胰肠口匹配度、胰腺质地等情况采用合适的吻合方式。对于术后胰瘘，端侧导管-黏膜吻合和套入式吻合的随机对照研究较多（表1）。Berger等[14]进行的双中心大样本量研究表明，端侧套入式吻合术后胰瘘发生率明显低于导管-黏膜吻合。而Bai等[15]的研究显示两种方法术后胰瘘总发生率相似，但导管-黏膜吻合的临床相关术后胰瘘发生率更低。Senda等[16]则认为两者的术后胰瘘发生率差异无统计学意义，但在软质地胰腺中，端侧套入式吻合的术后胰瘘发生率更低。同样，EI Nakeeb等[17]的随机对照研究结果也表明两者差异无统计学意义。端端套入式吻合应用较少，国内，彭淑牖等[18]自创的捆绑式端端吻合具有显著优势，与传统的端端吻合进行大样本量随机对照研究，捆绑式端端吻合术后未发生胰瘘，但该方法仍受限于胰肠口匹配问题，未得到广泛使用。大多数研究结果表明，目前仍无研究能够充分证明何种胰肠吻合对于降低术后胰瘘发生率具有显著优势，但由于导管-黏膜吻合维持了胰管与空肠的连续性与通畅性，且不必考虑胰腺质地、胰肠口匹配与否的问题，同时能够保留胰腺的生理功能，成为当前国际上主要推荐的胰肠吻合方式。

**表1**　导管-黏膜吻合与套入式端侧吻合的随机对照研究文献汇总

| 作者 | 年份 | 吻合方式 | 例数 | 术后胰瘘（例） | *P*值[a] |
|---|---|---|---|---|---|
| Bassi等[19] | 2003 | 导管-黏膜吻合 | 72 | 9 | ＞0.05 |
| | | 套入式端侧吻合 | 72 | 11 | |
| Berger等[14] | 2009 | 导管-黏膜吻合 | 97 | 23 | ＜0.01 |
| | | 套入式端侧吻合 | 100 | 12 | |
| EI Nakeeb等[17] | 2015 | 导管-黏膜吻合 | 53 | 11 | 0.460 |
| | | 套入式端侧吻合 | 54 | 8 | |
| Bai等[15] | 2016 | 导管-黏膜吻合 | 64 | 18 | 0.729 |
| | | 套入式端侧吻合 | 68 | 21 | |
| Senda等[16] | 2018 | 导管-黏膜吻合 | 61 | 14 | 0.077 |
| | | 套入式端侧吻合 | 59 | 6 | |

注：[a]两种吻合方式术后胰瘘发生率的比较。

三、胰胃吻合

1946年Waught等[20]首次报道，将胰腺残端缝合到胃的浆膜层，胰管被全层缝合到胃壁。胰胃吻合术后胰瘘发生率是否优于胰肠吻合至今仍无定论。在代表性随机对照研究中（表2），Takano等[21]和Figueras等[22]对胰胃吻合和导管-黏膜吻合进行对比，证明胰胃吻合的术后胰瘘发生率更低，而Topal等[23]的大样本量研究结果也与之相似，但胰肠吻合采用的是套入式端侧吻合。在代表性的荟萃分析中，Menahem等[24]和Ratnayake等[25]的结果也表明胰胃吻合的术后胰瘘发生率更低。在胰胃吻合改良方面，国内彭淑牖等[26]对105例病人实施创新式捆绑胰胃吻合，术后病人均未发生胰瘘。但也有大量研究结果表明两者的术后胰瘘发生率差异无统计学意义。Yeo等[27]和Andrianello等[28]对胰肠端端吻合和胰胃吻合进行对比，结果表明两者的术后胰瘘发生率相似。而后Bassi等[29]、Duffas等[30]、Wellner等[31]、Keck等[32]将胰胃吻合与导管-黏膜吻合进行对比，结果差异也无统计学意义。众多研究表明胰胃吻合不劣于胰肠吻合，但该技术在国内并未得到推广，考虑原因可能与术后出血风险高、正常生理结构被改变、胃酸易腐蚀胰腺残端，最终导致吻合口瘘等原因有关。

**表2**　胰胃吻合与胰肠吻合的随机对照研究文献汇总

| 作者 | 年份 | 吻合方式 | 例数 | 术后胰瘘（例） | *P*值[a] |
|---|---|---|---|---|---|
| Yeo等[27] | 1995 | 胰胃吻合 | 73 | 9 | ＞0.05 |
| | | 胰肠端端吻合 | 72 | 8 | |
| Takano等[21] | 2000 | 胰胃吻合 | 73 | 0 | 0.014 |
| | | 导管-黏膜吻合 | 69 | 9 | |
| Wellner等[31] | 2003 | 胰胃吻合 | 59 | 6 | 0.775 |
| | | 导管-黏膜吻合 | 57 | 7 | |
| Bassi等[29] | 2005 | 胰胃吻合 | 69 | 9 | ＞0.05 |
| | | 导管-黏膜吻合 | 82 | 13 | |
| Duffas等[30] | 2005 | 胰胃吻合 | 81 | 13 | ＞0.05 |
| | | 胰肠吻合 | 68 | 14 | |
| Figueras等[22] | 2013 | 胰胃吻合 | 65 | 10 | 0.014 |
| | | 导管-黏膜吻合 | 58 | 20 | |
| Topal等[23] | 2013 | 胰胃吻合 | 162 | 13 | 0.002 |
| | | 套入式端侧吻合 | 167 | 33 | |
| Menahem等[24] | 2015 | 胰胃吻合 | 562 | 63 | ＜0.001 |
| | | 胰肠吻合 | 559 | 84 | |
| Keck等[32] | 2016 | 胰胃吻合 | 171 | 34 | 0.617 |
| | | 胰肠吻合 | 149 | 33 | |

注：[a]两种吻合方式术后胰瘘发生率的比较。

四、改良吻合方式

学者们在吻合方式上不断创新，试图创建一种不会发生胰瘘的吻合方式，发展至今已有上百种吻合方式。国内，陈孝平[33]创建“贯穿胰腺纵向U形缝合”，解决了过去“横向”缝合打结力度难以掌握的问题，降低因打结力度过大导致组织缺血坏死，甚至大出血、胰瘘等情况的发生率，并进行回顾性分析，B/C级胰瘘仅1例。陈勇军等[34]对“纵向”缝合进行多中心大样本量回顾性分析，结果表明B/C级胰瘘总发生率为6.04%，且在细胰管时存在明显优势。洪德飞等[35]认为胰肠吻合过于复杂的操作会降低吻合质量，增加手术时间和胰瘘发生率。通过减少缝合次数而简化吻合，创造“洪氏一针法”。“一针法”的关键在于找到主胰管后，将引流管通过一针

缝合固定在内，再进行逐步缝合胰腺断面和空肠浆肌层，对412例病人进行分析，术后B级、C级胰瘘的发生率分别为6.1%、1.0%，且吻合时间明显缩短，证明该方法易行、安全，尤其是在胰管直径＜3 mm、胰腺质地柔软的情况下优势更加明显。但付裕等[36]在2022年进行的回顾性分析表明，“洪氏一针法”吻合时间和术后胰瘘发生率与传统吻合相比虽有改善，但差异均无统计学意义。此外，具有代表性的创新吻合还有捆绑式吻合、301式吻合、“两点法”吻合[37-39]，均是以减少操作步骤的方式进行改进，但均缺乏大样本量对照研究来证明其优势。对于导管-黏膜吻合的改良，具有代表性的改良术式有Kakita法、Blumgart法[40-41]等。Kakita法应用于65例病人未出现胰瘘，但该方法是将胰液进行外引流，此方法在日本应用较为广泛，其他国家少见。Blumgart法是1996年创建的一种新型导管-黏膜吻合，系双层缝合，内层将胰管与空肠开口进行缝合，外层用“U”形合法将空肠浆肌层缝合包裹胰腺残端，发展至今成为国际上最受欢迎的胰肠吻合之一，2020年，Li等[42]进行的荟萃分析，共纳入2 412例病人，结果显示，与非Blumgart法相比，Blumgart法能够显著降低B/C级胰瘘发生率。学者们也对其做出了较多改进，例如减少缝合次数、加用引流管等方法，改良Blumgart法对于降低术后胰瘘也取得了可观的结果[43-45]。

五、生物愈合及其他辅助技术

除吻合方式外，其他因素也会影响术后胰瘘的发生。在胰肠吻合最初的探索时期，学者们试图通过多层、紧密的缝合来防止术后胰瘘的发生[10]，但术后往往出现较多的并发症，针头距离太近会导致胰腺残端缺血，缝合过多会导致针孔漏，缝合过紧会导致胰腺水肿、坏死等[46]，术后结果适得其反。学者们随后提出“生物愈合”的概念，逐渐强调组织学方面的重要性[47-48]。胰肠吻合的目的是永久性的生物愈合，而机械连接则是生物愈合的过渡手段[47]。针对以生物愈合为目的的胰肠吻合，Gai等[49]认为吻合应遵循“宽、松、疏”的原则，考虑残端组织的血液供应、吻合口张力等多方面因素。

除此之外，辅助材料对术后胰瘘的作用也有大量研究，学者们通过处理吻合面来降低术后胰瘘发生率。1987年，Tashiro等[50]报道了一项新技术，在吻合面使用纤维蛋白封闭剂，并认为这有助于预防胰瘘。Lai等[51]在荟萃分析中，共纳入5项胰肠吻合术后使用纤维蛋白封闭剂的研究，认为纤维蛋白封闭剂对于降低术后胰瘘发生率的效果不确定；类似的方法还有使用聚乙二醇止血贴片来降低术后胰瘘发生率[52]；另外，有研究证明利用肝圆韧带包裹创面也可降低术后胰瘘的发生[53-54]。置入支架是否能降低术后胰瘘的发生率仍是一个值得讨论的问题。Cai等[55]的随机对照研究结果认为在胰管内不放置支架对术后胰瘘的发生率无影响。而Satoi等[56]认为在改良Blumgart法中不植入内支架可降低术后胰瘘发生率。2022年，一项荟萃分析纳入7项随机对照研究共847例病人，结果显示胰管内支架与术后胰瘘发生率无关，但外部支架可降低术后胰瘘发生率[57]。此外，吻合使用的手术缝线也是关键因素之一[58-59]。Andrianello等[60]的研究对比聚酯线组和聚二氧环己酮线组的胰肠吻合，结果显示聚酯线组的术后胰瘘发生率更低。国内众多专家推荐导管-黏膜吻合内层使用PDS® Ⅱ，外层使用Prolene缝线进行缝合可降低术后胰瘘发生[61-63]。除了辅助材料，机器人的三维成像、运动缩放、震颤过滤等优点[64]，在进行精细且复杂的手术时体现其重要意义。在PD术中，McMillan等[65]认为机器人PD术后胰瘘的发生率不劣于开放性手术。多项机器人与开放性PD相比，术后胰瘘发生率相似[66-69]，与腹腔镜手术比较差异也无统计学意义[70-71]。但关于机器人的研究大多是比较PD术后的结局指标，暂缺少针对胰肠吻合相关的机器人随机对照研究。

六、总结及展望

由于术后胰瘘受病人自身和外部多种因素的影响，导致各中心的随机对照研究结果存在差异，目前最佳的胰肠吻合方式仍未达成共识。各种胰肠吻合方式均存在优缺点，导管-黏膜吻合应用最为广泛，但该吻合操作难度大，在胰管较小时寻找困难，同时胰腺残端暴露于腹腔，胰腺残端与肠壁可能存有腔隙，导致胰液积聚，这些原因也可能导致术后胰瘘的发生。端端吻合不必刻意寻找胰管，可使胰液完全排入肠腔，但需要考虑胰肠口匹配问题，同时肠液可能会腐蚀胰腺残端，导致出血、胰管狭窄等风险。除此之外，手术工具、手术耗材视各中心的具体情况来定。

综上所述，目前暂未研究出一种能完全消除胰瘘的解决方案，故提倡各中心根据手术经验和技术水平来选择吻合方案，将术后胰瘘发生率控制在可接受范围内，最大程度地提高病人的术后生存率和预后。

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(上接第 366 页)

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