



胰腺癌转化治疗后手术治疗的进展*

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【摘要】 胰腺癌具有起病隐匿、侵袭性强和治疗反应差等特点,根治性切除仍是目前唯一可能治愈的方式,但约80%的患者初诊时已处于局部进展期或转移阶段,失去根治性手术机会。近年来,随着新型药物的研发和化疗方案的不断更新,转化治疗的效果取得显著进展。转化治疗旨在通过系统性治疗(包括化疗、靶向治疗、免疫治疗等)联合局部治疗(放疗、介入治疗等),通过缩小肿瘤体积、消除微转移灶,将局部进展期或转移性胰腺癌等初始不可切除的肿瘤转化为可切除的状态,从而提高手术切除率,使患者生存获益。胰腺癌转化治疗后手术治疗目前仍存在诸多争议,本文介绍了转化治疗方案和治疗周期,转化治疗后疗效评估手段,转化治疗后手术的切除率、治疗效果,重点总结了转化治疗后手术的技术要点(包括R0切除、静脉处理、动脉切除处理、动脉鞘剥离处理要点),动脉切除重建的学习曲线,并指出微创技术(如腹腔镜/机器人)的应用潜力,生物标志物、影像学与人工智能的整合前景有望优化个体化决策,多学科协作、手术团队的综合实力、手术技巧的掌握和提升也是影响转化治疗后的可切除性和疗效的关键因素。

【关键词】 胰腺癌 转化治疗 转化手术 动脉切除 动脉鞘剥离 综述

Advances in Surgical Treatment Following Conversion Therapy for Pancreatic Cancer

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[Abstract] Pancreatic cancer is characterized by an insidious onset, high invasiveness, and poor response to treatment. Radical resection remains the only potentially curative approach currently available. However, approximately 80% of patients are already in the locally advanced or metastatic stage at initial diagnosis and have missed the opportunity for radical surgery. In recent years, with the development of novel drugs and updates to chemotherapy regimens, significant progress has been made in improving the efficacy of conversion therapy. Conversion therapy aims to transform initially unresectable tumors, such as locally advanced or metastatic pancreatic cancer, into a resectable state through systemic therapies (including chemotherapy, targeted therapy, immunotherapy, etc.) combined with localized treatments (such as radiotherapy, interventional therapy, etc.). This approach reduces tumor volume and eliminates micrometastases, thereby improving surgical resection rates and patient survival outcomes. However, considerable controversy remains regarding surgical treatment after conversion therapy for pancreatic cancer. This article provides an overview of conversion therapy regimens and treatment cycles, methods for evaluating therapeutic efficacy post-conversion therapy, the resection rates, and treatment outcomes of surgery following conversion therapy. The key technical points of post-conversion therapy surgery, including R0 resection, venous management, arterial resection and reconstruction, and the management of periaarterial divestment, are highlighted. The learning curve for arterial resection and reconstruction is also discussed. Additionally, the potential applications of minimally invasive techniques (such as laparoscopy and robotics) are highlighted. The integration of biomarkers, imaging, and artificial intelligence holds promise for optimizing individualized decision-making. Multidisciplinary collaboration, the comprehensive competence of the surgical team, and the mastery and refinement of surgical skills are also critical factors that influence resectability and therapeutic outcomes after conversion therapy.

[Key words] Pancreatic cancer Conversion therapy Conversion surgery Arterial resection Periaarterial divestment Review

胰腺癌恶性程度极高、预后极差,居消化道恶性肿瘤榜首,总体5年生存率仅13%左右^[1-2]。我国国家癌症中心

发布的最新数据显示,2024年我国胰腺癌发病人数和死亡人数分别为76 030和68 222,其年新发率和年死亡率基本等同^[3]。目前为止,外科手术切除仍是胰腺癌患者获得长期生存的最可靠方式。由于缺乏特异性症状和可靠的早期筛查工具,大多数患者在诊断时已处于局部进展期

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(locally advanced pancreatic cancer, LAPC)(30%~35%)或转移性阶段(50%~55%)^[4]。LAPC常因主要血管受侵而丧失手术机会^[5]。对于局部进展期或转移性胰腺癌等初始不可切除的胰腺癌患者,转化治疗成为一种重要的治疗策略,目的在于将不可切除的肿瘤转化为可切除状态,从而提高手术切除率和患者生存率^[6]。因此转化治疗后手术切除是此类患者重要的治疗方案,然而转化治疗后肿瘤局部纤维结缔组织发生炎症改变,组织间隙缺乏,增加了手术难度。因此充分的术前评估、平稳的度过学习曲线以及掌握足够的手术技巧,是转化治疗后安全实施手术的前提。本文系统总结了近年来胰腺癌转化治疗及其后续手术治疗的相关研究进展并进行综述。

1 转化治疗方案和治疗周期

转化治疗主要针对局部进展期胰腺癌和转移性胰腺癌,局部进展期胰腺癌的定义参考美国国立综合癌症网络(National Comprehensive Cancer Network, NCCN)指南2021年V2版^[7],即肿瘤位于胰头/钩突实体瘤与肠系膜上动脉(superior mesenteric artery, SMA)或腹腔干(celiac axis, CA)接触大于180°,胰体/胰尾实体瘤与SMA或CA接触大于180°,或实体瘤接触CA和主动脉受累,或肿瘤受累或闭塞(可能是由于肿瘤或无症状血栓)导致肠系膜上静脉(superior mesenteric vein, SMV)或门静脉(portal vein, PV)无法重建。

目前转化治疗仍无标准方案,主要沿用晚期胰腺癌一线治疗方案或新辅助治疗方案,即吉西他滨+白蛋白结合型紫杉醇(AG方案)和奥沙利铂+伊立替康+氟尿嘧啶+亚叶酸钙四药在内的FOLFIRINOX或改良方案(mFOLFIRINOX)^[7-8]。JCOG1407研究发现,mFOLFIRINOX方案和AG方案的转化治疗效果相当^[9],在治疗中中位总生存期和无疾病进展期效果相当,而AG方案较mFOLFIRINOX方案似乎有更好的疾病控制率(96.5% vs. 87.3%)。另外的研究分析却显示,与AG方案相比,FOLFIRINOX的总生存期更长,且差异有统计学意义^[10-11]。新近的NAPOLI-3研究显示^[12],伊立替康脂质体+氟尿嘧啶+亚叶酸钙+奥沙利铂(即NALIRIFOX方案)在老年患者中疗效与AG方案相当,且剂量调整不影响疗效,为体能状态较差患者提供了新选择。综上,针对不同身体状况的患者,选择制定合适的个体化的方案,从而保证完成足够剂量的化疗药物的输送仍是目前最主要的考虑因素^[13]。

目前针对初始不可切除胰腺癌患者转化治疗的时间仍无定论,根据NCCN指南2021年V2版,建议至少4个月

的诱导治疗^[7],也有研究结果显示,大于6个月的术前治疗与较长的总生存期相关^[14],是良好预后的独立相关因素^[15]。因此,基于目前的证据,转化治疗的时长应不低于4个月,并根据患者的治疗反应来评估和决定继续转化治疗或进行手术。

2 转化治疗的疗效评估

目前转化治疗后疗效评估手段仍较局限,目前主要基于实体肿瘤临床疗效评价标准(response evaluation criteria in solid tumor, RECIST),该标准主要基于影像学评估,增强计算机断层扫描(computed tomography, CT)仍作为目前最主要的转化治疗后的评估标准^[16],有研究证明了转化治疗期间的骨骼肌质量减少是影响胰腺癌患者生存的独立危险因素^[17]。多年来解剖分期被认为是选择手术患者的关键参数,然而,传统增强CT成像无法区分肿瘤和纤维化,导致转化治疗后血管受累程度往往被高估。有研究表明CT在胰外神经侵犯中也会被高估^[18],综上,单纯CT不能足够准确地评估肿瘤反应以预测R0切除率,且影像学通常低估了转化治疗后的肿瘤可切除性。有研究显示,磁共振成像(magnetic resonance imaging, MRI)提供了高对比度分辨率,同时提高了CT等衰减肿瘤的可见度,从而有助于评估转化治疗后肿瘤大小的变化,且弥散加权成像(diffusion weighted imaging, DWI)在评估转化治疗反应方面的性能也有帮助,因此,对术前增强CT未发现肝转移的患者补充使用肝脏MRI,可提高对隐匿性肝转移的检出率,从而预防无效手术^[19]。但由于原发性肿瘤的强烈促纤维增生反应,常规形态学成像在区分治疗后纤维化和肿瘤活性方面存在很大局限性。2021年,《美国放射学杂志》专家小组建议,当CT或MRI评估不足时,18氟脱氧葡萄糖示踪剂的正电子发射断层扫描CT(18FDG-PET/CT)可能有助于转化治疗后的反应评估,对于那些不产生CA19-9的人来说也是如此^[20],因此18FDG-PET/CT作为一种功能成像工具,对转化治疗后出现的显著的代谢和组织学反应变化有很强的预测能力,应该作为一种辅助和推荐的选择方式^[21-22]。

血清CA19-9是胰腺癌诊疗中最广泛应用的生物标志物,被用于评估全身疾病负荷、转化治疗后的肿瘤反应和预测术后复发,也是国内外指南推荐临床最常使用的生物标志物^[7-8]。对于LAPC患者,有研究发现CA19-9小于100 U/mL可能预后良好的因素^[23],一项包括来自17项研究的2242名LAPC患者,对转化治疗后CA19-9反应的系统回顾表明,CA19-9相对转化治疗前下降50%以上或恢复正常与更好的总生存率相关^[24],另一项研究也发现转化

治疗后CA19-9恢复正常比变化幅度更能预测总体生存率^[25]。然而,血清CA19-9存在固有的局限性:高胆红素血症时血清CA19-9反应性增加和5%~10%的患者不产生血清CA19-9。在不产生CA19-9的患者中,其他肿瘤标志物,如癌胚抗原(CEA)^[26]和杜克胰腺单克隆抗原2型(DUPAN2)^[27],可能有一定的替代指示意义,其中CEA在30%~60%的胰腺癌患者中升高,在治疗后的改变可能意义更大^[28]。综上目前转化治疗后手术探查的指征主要参考胰腺癌新辅助治疗的推荐:即对于转化治疗后无病情进展的患者,根据外科医师的专业知识和手术技术水平,如果切除和血管重建可行,即使影像学检查未发现肿瘤明显降期,也应进行手术探查^[8,29]。

3 转化治疗后手术切除率和治疗效果

LAPC转化治疗后手术切除率在不同中心之间的差异较大^[30-32]。在2021年的一项系统评价中,包括来自21项研究653名接受FOLFIRINOX诱导治疗的LAPC患者,无论是否接受放疗,切除率为26%(95%CI: 20%~32%),R0切除率为88%(95%CI: 78%~95%)^[33]。另一项关于术前AG方案治疗临界可切除胰腺癌和LAPC系统综述显示,在LAPC患者中,AG方案与16%的手术切除率和77%的R0切除率相关^[34]。NORPACT-2研究发现,对于LAPC患者接受转化治疗后,手术切除率为13%(12/92),经调整永久时间偏差后,接受切除和仅接受化疗的患者的中位总生存期为28.4个月和12.6个月($P=0.001$),该研究认为在高容量中心接受转化治疗的LAPC患者的切除率和生存期效果良好^[35]。一项纳入125项研究包含11713名患者的荟萃分析发现,其中的LPAC经转化治疗后,22.2%行手术切除,且手术切除的生存期明显提高(32.2个月 vs. 13.9个月, $P<0.001$)^[36],STOOP等^[37]研究显示,接受FOLFIRINOX转化治疗后成功手术切除的患者中位OS为35个月,而未手术的患者中位OS仅为16个月。LEE等^[32]的研究表明,转化治疗后手术切除组的总生存期显著高于未切除组(56个月 vs. 21个月, $P<0.001$),且在多变量分析中,治疗性手术($P<0.001$)是最重要的因素。RANGELOVA等^[38]的研究表明,无论转化治疗的方案和是否减量,切除患者的生存率均高于未切除患者(中位生存期 22.4个月 vs. 12.7个月, $P<0.0001$),手术切除对提高生存期有积极影响。我中心自2018年10月开始行LAPC转化治疗,截止2025年6月,共完成手术切除28例,确诊后和术后中位生存期分别为31个月和25个月,与目前文献报道的结果相似。综上,所有在转化治疗期间没有进展的LAPC患者,都应考虑进行手术切除^[39],且转化治疗后行手术切除较

未切除的总生存期明显延长。

对于转移性胰腺癌,转化治疗后手术切除也可带来显著生存获益,研究表明,切除组中位总生存期(overall survival, OS)显著优于非切除组(25.5个月 vs. 8.1个月, $P<0.001$),且转移灶病理完全缓解组优于残留转移灶组^[40]。YAMADA等^[41]的一项针对胰腺癌伴腹膜转移的患者的研究中,79名患者在接受转化治疗后进行了手术治疗,中位OS达到32.5个月。IDE等^[42]的研究发现,在LAPC和转移性胰腺癌病例中,分别有13.3%和2.1%的患者实现了手术治疗,且转化手术组总体生存期显著升高(32.9个月 vs. 11.3个月, $P<0.01$)。我中心行转化治疗的合并肝转移的胰腺癌患者,4例完成了手术切除,除1例因术后出血围术期死亡外,其余3例从确诊至2025年6月分别存活了9个月、17个月和22个月,其中1例生存9个月的患者仍存活并继续随访中。由此可见转化手术可显著改善预后,即使在转移性胰腺癌中也是如此。因此,对于转化治疗有效的转移性胰腺癌,如果评估可实现转移灶和原发灶的同步切除,手术切除也能生存获益。

4 转化治疗后手术切除的技术要点

目前的指南关于LAPC的推荐,在各个中心的认同度差异仍较大,来自韩国的一项调查问卷也证实临床中该问题的客观存在^[43],因此对转化治疗后手术技术进行系统的总结是有必要的,并为胰腺专科医师提供参考,来进行合理的适合中心实际情况的临床决策。切除率的差异除了与肿瘤生物学相关,似乎更多地与技术问题有关,不是所有的胰腺切除手术质量都是同质的,其技术差异区间波动较大^[44]。另外需要留意的是,由于化疗后间质纤维化、局部炎症粘连等问题,术前基于RECIST的影像学评估并不准确,需要术者根据术者的技术并结合术中实际探查情况谨慎选择合适的手术方式^[45]。

4.1 R0切除要点

转化手术的R0切除是延长LAPC患者总生存期的重要治疗方法,2017年德国海德堡大学医胰腺中心提出“海德堡三角”概念^[46],即清扫门静脉-肠系膜上静脉、腹腔干-肝总动脉、SMA构成的三角形区域内所有血管、淋巴结和神经组织,HACKERT等^[46]将海德堡三角手术(TRIANGLE手术)应用于15例经转化治疗的LAPC患者,发现转化治疗可进一步降低切缘阳性率,延长了无进展生存期。与其他癌种不同,胰腺癌具有嗜神经性,易通过侵犯神经复发并沿着神经进行转移,因此对于海德堡三角的神经丛清扫至关重要^[47]。一项纳入330名胰十二指肠切除术患者的研究结果显示,海德堡三角清扫降低了

R1 切除率(海德堡三角手术组: 31.4%, 传统手术组: 42.9%)^[48], 我国蒋奎荣、苗毅教授团队的研究也证实了该结论, LAPC 转化治疗后行联合海德堡三角清扫胰腺癌切除术的 R0 切除率较高, 围手术期病死率及术后主要并发症发生率未见明显升高, 且可能改善患者的远期生存^[49]。TRIANGLE 手术应作为一项关键技术应用到胰腺癌手术过程中, 因其有可能增加清扫的淋巴结数量, 降低并发症发生率, 且增加 LAPC 患者转化治疗后根治性切除的效果^[50]。一项 Meta 分析显示, 动脉优先入路的并发症发生率、术中出血量明显降低, 且可显著提高 R0 切除率, 降低局部复发率, 延长生存时间^[51]。

4.2 静脉处理要点

对于有静脉受累的胰腺癌, 新发布的法国指南建议, 如果局限于侧壁环周受累、没有静脉闭塞以及没有肿瘤与腹腔干或肠系膜上动脉接触的情况下, 则应进行静脉切除^[52]。现有的大宗数据的 Meta 分析也表明了静脉切除^[53]的安全性和有效性, 其合理性也得到了证实, 根据国际胰腺外科研究小组(International Study Group of Pancreatic Surgery, ISGPS) 相关研究将静脉切除重建分为以下 4 种类型^[54]: 1 型, 静脉部分切除, 原位侧壁缝合; 2 型, 静脉部分切除, 补片修补; 3 型, 节段切除, 端端吻合; 4 型, 静脉节段切除, 血管移植(人工血管或者自体血管)。我们中心的联合静脉切除重建的相关经验和手术技巧也在前面发表的文章中进行了详细介绍^[55]。

4.3 动脉切除处理要点

因动脉切除重建手术难度大, 围手术期并发症和死亡率难以控制, 风险高, 所以是否行动脉切除重建存在很大争议, 但随着转化治疗越来越多的应用, 对于侵犯重要血管的肿瘤, 动脉切除术(如腹腔干或肠系膜上动脉切除)可能在特定情况下是合理的, 但需权衡手术风险与获益。其中联合腹腔干切除的胰体尾癌切除术(distal pancreatectomy with en bloc celiac axis resection, DP-CAR) 显示出可接受的并发症发生率和生存获益^[56], DP-CAR 又称改良 Appleby 手术, 对选定患者的动脉切除包括肝动脉或腹腔干切除, 一般建议在多学科团队会议上进行讨论, 同时考虑到肿瘤位置和动脉受累类型^[52], 这也符合目前荟萃分析的结论^[57-58]。有研究显示: 对于局部晚期胰腺体癌患者, 转化治疗后的 DP-CAR 和单纯胰体尾切除的患者的 5 年生存率分别为 41.1% 和 50.6%^[59]。另外, 联合 TRIANGLE 手术和根治性逆行模块化胰脾切除术(radical antegrade modular pancreatectomy, RAMPS) 组成的手术技术有助于提高局部进展期胰腺癌 R0 切除率, 并为病变动脉切除提供了一种替代手术方法^[60], 研究报道的胰十二指肠联

合 SMA 切除重建手术的研究多为回顾性, 死亡率波动在 2% ~ 13% 左右^[61-64], 但动脉切除在胰腺癌手术中仍有重要意义, 特别是对于行转化治疗后的患者^[65], MIHALJEVIC 等^[66] 报告胰十二指肠联合 SMA 切除术后并发症发生率为 59%, 术后 90 d 病死率为 10%。LIANG 等^[64] 研究发现, 对 36 个连续的病例采用了根治性切除联合肠自体移植, 其中 24 名接受了胰十二指肠手术, 11 名接受了全胰切除术, 1 名接受了远端胰腺切除术。术后病理显示 R0 切除率为 94.4%, 2 名(5.6%) 患者在手术后 30 d 内死于多器官衰竭。36 名患者中有 12 名出现严重的术后不良事件(≥ 3 级), 腹泻、胃轻瘫和腹部感染是最常见的不良事件, 诊断后和手术后患者的中位总生存期分别为 21.4 个月和 14.5 个月。该术式显示出可接受的并发症发生率和死亡率, 同时将 SMA 离体切除和肠移植技术结合, 为 SMA 受侵的胰腺癌患者提供了新的选择。

4.4 动脉鞘剥离处理要点

现有的研究证据意见更倾向于, 即使在有动脉包裹的癌症患者中, 转化治疗后的手术也可以安全地进行, 并提供长期生存, 其中动脉周围和血管外膜下剥离, 即动脉鞘剥除术^[60, 67-70], 一般对于肿瘤侵及 SMA 外膜而未累及外弹力层的病人, 可行动脉鞘剥除术。CAI 等^[67] 比较了 72 例联合动脉鞘剥除的胰腺癌根治术与 235 名标准胰腺癌手术患者数据, 发现两组术后并发症发生率分别为 40% 和 37%, 术后 90 d 死亡率分别为 8% 和 3%, 差异无统计学意义, 证明了该术式的安全性, KUMAR 等^[60] 的研究也证实该论点。HABIB 等^[69] 探索了胰腺癌动脉侵犯的不同影像学征象, 发现显示“晕征”的患者, 即包裹的 SMA 保持完全通畅且无动脉侵犯, 手术涉及手术剥离 SMA 上浸润的神经淋巴组织, 留下裸露的“骨骼化动脉”, 而涉及 SMA 的“线状征”更可能导致动脉侵犯, 无法成功实现肿瘤的完整切除, 该研究描述并展示了在治疗显示“晕征”的 SMA 包裹大于 180° 的局部进展期胰腺癌患者时常规使用的动脉鞘剥离术, 这种做法将胰腺切除术作为一种治疗选择扩展到五分之四的 LAPC 患者中。ISHIDA 等^[68] 的研究纳入 61 名接受手术的动脉包裹患者, 其中 20 名(33%) 诊断为 SMA, 14 名(23%) 诊断为肝动脉, 4 名(6.6%) 诊断为腹腔干, 1 名(1.6%) 诊断为替代肝动脉, 22 名(36%) 诊断为两条或多条动脉。14 名患者(23%) 接受了动脉切除术, 47 名患者(77%) 进行了动脉剥离术, 主要并发症发生率(Clavien-Dindo ≥ 3 级) 为 21.3%, 90 d 死亡率为 4.9%, R0 切除率为 70.5%, 术后中位 OS 为 21.2 个月, 5 年生存率为 22.1%。LOOS 等^[71] 比较研究了 195 名联合动脉切除与 190 名动脉鞘剥除的胰腺癌根治术患者, 结果显示动脉鞘

剥除术与动脉切除的R0切除率(32.2% vs. 23.8%, $P=0.143$)以及中位OS(21.5个月 vs. 17.7个月),虽差异无统计学意义,但动脉鞘剥除术有更优的趋势。综上,动脉鞘剥除术可替代部分转化治疗后LAPC患者的联合动脉切除,但胰腺癌手术中动脉鞘剥除与动脉切除的可行性、提高的安全性和肿瘤等效性必须通过临床试验进行评估^[70]。

5 动脉切除重建的学习曲线

通过上述研究可以看出联合动脉切除重建仍维持较高的严重并发症发生率和死亡率,LOOS等^[71]关于动脉切除安全性的研究显示,195名联合动脉切除的胰腺切除患者中的95名(48.7%)和190名联合动脉鞘剥除的患者(100%)接受了转化化疗,整个患者队列的住院死亡率为8.8%($n=385$)。但进一步分析发现,随着病例量的增加和专业知识的增加,2013年后住院死亡率显著降低至4.8%($n=186$)($P=0.005$)。该研究发现对于经验丰富的胰腺外科医生对联合动脉切除的胰腺切除术度过学习曲线需要15名,在此截点预测的住院死亡率可以降低到世界各地主要手术中心和研究中心报告的平均住院死亡率以下,在度过学习曲线后,联合动脉切除的手术在LAPC患者中是有效的,具有良好的长期生存前景。另一项研究纳入111名接受了合并动脉切除的胰腺切除术的患者,其中55%进行了动脉重建。90 d内主要并发症发生率(Clavien-Dindo ≥ 3 级)和死亡率分别为54%和13%。但在2010年后死亡率显著降低(9% vs. 29%, $P=0.02$),表明现代转化治疗后联合动脉切除的胰腺切除术在度过学习曲线后,在选定病例中的存在潜在肿瘤学益处^[72]。

转化治疗后计划手术切除患者,腹腔镜的探查被认为是有效的^[73],随着腹腔镜和机器人辅助手术技术的发展,微创手术在胰腺癌转化治疗中的应用呈逐渐增多趋势^[74]。理论上这些技术不仅减少了手术创伤,还提高了手术的精准性和安全性,但由于局部进展期胰腺癌手术的复杂性和转化治疗手术难度增加,腹腔镜等微创技术的应用仍很局限,其安全性和有效性仍需大样本随机对照研究证实。在胰腺微创手术中,一般需要额外的学习曲线来安全地进行血管切除。修改后的德尔菲共识研究建议经过培训后,每年至少进行20次胰腺微创手术,且只有在进行50~100次手术后才能进行血管和多脏器切除术^[75],总之,胰腺微创手术在高容量中心的经验丰富的外科医生中的可行性和安全性得到了普遍认可。然而,微创血管手术仍处于早期发展阶段,特别是对于节段性血管切除和重建。由于缺乏关于长期结果的文献,大规模

使用胰腺微创手术进行胰腺癌手术目前仍存争议^[76-77]。

6 未来展望

综上所述,随着转化治疗在局部进展期胰腺癌和转移性胰腺癌患者身上的广泛应用,在经验丰富的高容量胰腺专科中心,越来越多的此类患者预后有所改善,但局部进展期胰腺癌和转移性胰腺癌的综合治疗涉及的过程繁多,因此,转化治疗的规范化发展需进一步明确适应证并建立统一的疗效评估体系,以优化患者筛选和治疗策略。腹腔镜/机器人辅助手术等微创技术与转化治疗的结合有望在降低创伤的同时提升肿瘤切除率,但其可行性及长期疗效仍需更多循证医学证据支持。此外,生物标志物、影像学技术与人工智能的整合应用,可能为肿瘤生物学行为评估和切除可行性预测提供更精准的量化依据,从而推动个体化治疗决策的进步。如何在各个环节做出正确的评估和合适的选择成为关键,多学科团队的合作和综合实力也是患者选择的重要因素,转化治疗后胰腺癌的可切除性,除了和治疗效果相关,也和手术团队的综合实力等密切相关。因此,手术技巧的掌握和提升也是提高局部进展期胰腺癌和转移性胰腺癌患者治疗效果的关键因素。

* * *

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