

3.0T 高分辨MRI 诊断直肠癌直肠系膜淋巴结转移的应用价值

陈琰 杨心悦 卢宝兰 肖晓娟 庄晓翌 余深平

【摘要】 目的 探讨 3.0T 高分辨 MRI 对直肠癌直肠系膜淋巴结转移的诊断价值。方法 采用描述性病例系列研究方法,回顾性收集中山大学附属第一医院 2015 年 11 月至 2016 年 11 月期间经病理证实为原发直肠癌且术前行 3.0T 直肠 2D 高分辨 MRI 检查患者的影像学 and 术后病理资料,纳入患者的手术时间需距术前 MRI 检查不超过 2 周,排除术前接受放疗、化疗或同期放化疗者以及 MRI 检查后未行手术者。MRI 扫描序列包括高分辨矢状位、冠状位、正交轴位 T2 加权像(T2WI),重复时间为 3000~4000 ms,回波时间为 77~87 ms,层厚均为 3 mm,无间隔扫描,视野为 18~22 cm。两名腹部 MRI 诊断医师分别测量淋巴结最短径(各测量 3 次取平均值),观察淋巴结形态、边缘及信号特征。高分辨 MRI T2WI 评价淋巴结转移标准为形态不规则、边缘模糊和(或)信号混杂。将术前 MRI 诊断淋巴结有无转移的结果与术后病理结果进行对照,计算高分辨 MRI 评价直肠系膜淋巴结及不同短径淋巴结转移的灵敏度、特异度、准确性、阳性预测值(PPV)、阴性预测值(NPV),并采用 Kappa 检验评价高分辨 MRI 与病理结果的一致性。Kappa 值为 0~0.20 为一致性极低,0.21~0.40 为一致性一般,0.41~0.60 为一致性中等,0.61~0.80 为高度一致性,0.81~1.00 为几乎完全一致。结果 共 81 例患者纳入本研究,其中男 50 例、女 31 例,年龄为(59.3±11.1)岁。病理诊断为高分化腺癌 1 例、中分化腺癌 63 例、中-低分化腺癌 9 例、低分化腺癌 2 例、黏液腺癌 3 例、绒毛管状腺癌 3 例;T₁ 期 2 例、T₂ 期 20 例、T₃ 期 45 例、T₄ 期 14 例;N₀ 期 34 例、N₁ 期 40 例、N₂ 期 7 例;M₀ 期 76 例、M₁ 期 5 例。MRI 与病理相匹配淋巴结共 377 枚,168 枚(44.6%)为转移淋巴结,58.0%(47/81)的患者淋巴结转移阳性。转移淋巴结短径的中位数为 5.4(2.4~18.6) mm,长于未转移淋巴结的短径[中位数 3.8(2.0~8.7) mm, Z=10.586, P=0.000]。高分辨 MRI 评价淋巴结是否转移的灵敏度为 74.4%(125/168)、特异度为 94.7%(198/209)、准确性为 85.7%(323/377)、PPV 为 91.9%(125/136)、NPV 为 82.2%(198/241)。术前高分辨 MRI 评价淋巴结是否转移和患者是否有转移淋巴结的结果与术后病理结果一致性的 Kappa 值分别为 0.71 和 0.70,为高度一致。短径>10 mm 的 14 枚淋巴结均有转移,高分辨 MRI 诊断的灵敏度、准确性及 PPV 均为 100.0%,与病理结果完全一致。124 枚短径 5~10 mm 的淋巴结中,95 枚(76.6%)有转移,高分辨 MRI 诊断的灵敏度为 78.9%(75/95)、特异度为 86.2%(25/29)、准确性为 80.6%(100/124)、PPV 为 94.9%(75/79)、NPV 为 55.6%(25/45),与病理结果的一致性中等(Kappa 值为 0.55)。239 枚短径≤5mm 淋巴结,59 枚(24.7%)有转移,高分辨 MRI 诊断的灵敏度为 61.0%(36/59)、特异度为 96.1%(173/180)、准确性为 87.4%(209/239)、PPV 为 83.7%(36/43)、NPV 为 88.3%(173/196),与病理结果高度一致(Kappa 值为 0.63)。结论 直肠高分辨 MRI 能清楚观察直肠系膜淋巴结形态、边缘及信号特征,对直肠系膜淋巴结转移有较高的诊断价值。

【关键词】 直肠肿瘤; 直肠系膜淋巴结; 磁共振成像; 高分辨

基金项目:广东省科技计划(2014A020212126);海南省社会发展科技专项(SF201405)

Diagnostic accuracy of 3.0T high-resolution MRI for assessment mesorectal lymph node metastases in patients with rectal cancer Chen Yan, Yang Xinyue, Lu Baolan, Xiao Xiaojuan, Zhuang Xiaozhao, Yu Shenping

DOI: 10.3760/cma.j.issn.1671-0274.2018.07.013

作者单位: 510080 广州,中山大学附属第一医院放射科(陈琰、杨心悦、卢宝兰、余深平); 518036 北京大学深圳医院放射科(肖晓娟); 570311 海口,海南省人民医院放射科(庄晓翌)

通信作者:余深平, Email: ethan_yu@sina.com

作者简介:陈琰,女,1992 年 2 月出生,在读医学硕士, Email: chenyan_me@163.com; 余深平,男,1967 年 7 月出生,医学博士,主任医师,副教授,硕士生导师

Department of Radiology, The First Affiliated Hospital, Sun Yat-sen University, Guangzhou 510080, China (Chen Y, Yang XY, Lu BL, Yu SP); Department of Radiology, Peking University Shenzhen Hospital, Shenzhen 518036, China (Xiao XJ); Department of Radiology, Hainan General Hospital, Haikou 570311, China (Zhuang XZ)

Corresponding author: Yu Shenping, Email: ethan_yu@sina.com

【Abstract】 Objective To evaluate the diagnostic value of 3.0T high-resolution MRI in mesorectal lymph node metastasis of rectal cancer. **Methods** The images and postoperative pathological data of patients with pathologically diagnosed rectal cancer who underwent prospective 3.0T two dimensional high-resolution MRI rectal examinations and surgery within two weeks after MRI examination at the First Affiliated Hospital, Sun Yat-sen University from November 2015 to November 2016 were retrospectively collected. Patients who received preoperative neoadjuvant therapy and those who did not undergo operation after MRI examination were excluded. The MRI sequences included high-resolution sagittal, coronal and oblique axial T2 weighted image (T2WI) (repetition time/echo time, 3000-4000 ms/77-87 ms; slice thickness/gap, 3 mm/0 mm; field of view, 18-22 cm). Two abdominal MRI radiologists independently assessed the morphology, margin, signal of all visible mesorectal nodes, measured their minor axes (three times for each radiologist) and gave estimation of the malignancy. The criteria of metastatic nodes on high-resolution MRI T2WI were nodes with irregular shape, ill-defined border and/or heterogeneous signal. The results of MRI diagnosis were compared with postoperative pathology. The sensitivity, specificity, accuracy, positive predictive value (PPV) and negative predictive value (NPV) of mesorectal nodes and nodes with different short-axis diameter ranges were calculated to evaluate the diagnostic efficiency of high-resolution MRI. Kappa statistics was used to evaluate the agreement for per node and for per patient between high-resolution MRI and pathological results. A Kappa value of 0-0.20 indicated poor agreement; 0.21-0.40 fair agreement; 0.41-0.60 moderate agreement; 0.61-0.80 good agreement; and 0.81-1.00 excellent agreement. **Results** A total of 81 patients were enrolled in the retrospective cohort study, including 50 males and 31 females with age of (59.3 ± 11.1) years. Histopathology showed 1 case of well differentiated adenocarcinoma, 63 of moderately differentiated adenocarcinoma, 9 of moderately to poorly differentiated adenocarcinoma, 2 of poorly differentiated adenocarcinoma, 3 of mucinous adenocarcinoma and 3 of tubulovillous adenocarcinoma. Histopathological staging showed 2 cases in T1 stage, 20 in T2 stage, 45 in T3 stage and 14 in T4 stage; 34 in N0 stage, 40 in N1 stage and 7 in N2 stage; 76 in M0 stage and 5 in M1 stage. A total of 377 nodes were included in the node-by-node evaluation, of which 168 (44.6%) nodes were metastatic from 58.0% (47/81) patients. The median short-axis diameter was 5.4 (2.4-18.6) mm in metastatic nodes, which was significantly larger than 3.8 (2.0-8.7) mm in non-metastatic nodes [$Z=10.586$, $P=0.000$]. The sensitivity, specificity, accuracy, PPV and NPV were 74.4% (125/168), 94.7% (198/209), 85.7% (323/377), 91.9% (125/136) and 82.2% (198/241), respectively. The Kappa values between high-resolution MRI and histopathological diagnosis for node-by-node and patient-by-patient were 0.71 and 0.70 respectively, indicating good agreements. Fourteen nodes >10 mm were all metastatic. The results of high-resolution MRI for nodal status were consistent with the results of histopathological diagnosis, and the sensitivity, accuracy and PPV were all 100.0%. Among 124 nodes with short-axis diameter of 5-10 mm, 95 (76.6%) were metastatic, and the sensitivity, specificity, accuracy, PPV and NPV were 78.9% (75/95), 86.2% (25/29), 80.6% (100/124), 94.9% (75/79) and 55.6% (25/45), respectively. The agreement was fair (Kappa value 0.55) between high-resolution MRI and histopathological diagnosis. Among 239 nodes with short-axis diameter ≤ 5 mm, 59 (24.7%) were metastatic, and the sensitivity, specificity, accuracy, PPV and NPV were 61.0% (36/59), 96.1% (173/180), 87.4% (209/239), 83.7% (36/43) and 88.3% (173/196), respectively. The agreement was good (Kappa value 0.63) between high-resolution MRI and histopathological diagnosis. **Conclusion** Rectal high-resolution MRI has good diagnostic value for estimating metastatic mesorectal nodes by evaluating the morphology, margin and signal of nodes.

【Key words】 Rectal neoplasms; Mesorectal lymph nodes; Magnetic resonance imaging; High-resolution

Fund program: Science and Technology Planning Project of Guangdong Province (2014A020212126); Social Development Science and Technology Special Fund of Hainan Province (SF201405)

直肠癌患者淋巴结转移的风险为 29%~52%，淋巴结转移对术后局部复发和远处转移有预测价值，术前准确评价直肠癌区域淋巴结转移情况，对临床合理制定治疗方案有重要意义^[1-5]。但目前各种影像检查方法诊断直肠癌淋巴结转移的准确性均不高。高场强磁共振成像(magnetic resonance imaging, MRI)目前已在临床广泛应用，其图像空间分辨率和信噪比高，并能获得多方位高分辨 T2 加权像(T2 weighted image, T2WI)，已成为直肠癌最重要的术前分期评价手段，提高了直肠癌 T 分期诊断效能^[6]。同时高分辨 MRI 能更清楚地显示淋巴结，但关于高分辨 MRI 诊断直肠癌淋巴结转移效能(与病理匹配)的相关研究仍较少。本研究通过与病理对照，旨在探讨 3.0T 高分辨 MRI 术前评价直肠癌直肠系膜淋巴结的应用价值。

资料与方法

一、研究对象

研究对象的纳入标准：(1)术后病理证实为原发直肠癌；(2)术前行 3.0T 直肠 2D 高分辨 MRI 检查；(3)MRI 扫描参数相同；(4)手术距 MRI 检查不超过 2 周；(5)患者检查前签署知情同意书。排除标准：(1)MRI 检查禁忌证；(2)术前接受放疗、化疗或同期放化疗；(3)MRI 检查后未行手术。

根据以上标准，回顾性纳入中山大学附属第一医院 2015 年 11 月至 2016 年 11 月期间经病理证实为直肠癌的 81 例患者的影像学和术后病理资料，进行描述性病例系列研究。其中男 50 例、女 31 例，年龄为(59.3±11.1)岁。41.1%(30/73)患者血清癌胚抗原(carcino embryonic antigen, CEA)水平超过正常值上限。病理诊断为高分化腺癌 1 例、中分化腺癌 63 例、中-低分化腺癌 9 例、低分化腺癌 2 例、黏液腺癌 3 例、绒毛管状腺癌 3 例；T₁ 期 2 例、T₂ 期 20 例、T₃ 期 45 例、T₄ 期 14 例；N₀ 期 34 例、N₁ 期 40 例、N₂ 期 7 例；M₀ 期 76 例、M₁ 期 5 例。本研究符合 2013 版《赫尔辛基宣言》要求。

二、MRI 检查方法

采用 3.0T MRI 仪(德国 SIEMENS 公司,型号: MAGNETOM Verio),6 通道相控阵体部表面线圈。本研究扫描序列包括常规横断位 T1 加权像(T1 weighted image, T1WI) 和 T2WI, 2D 高分辨矢状位、冠状位、正交轴位(定位线垂直于病灶基底部所在肠壁)T2WI(具体参数见表 1)。根据肠镜所示肿瘤位置注入适量(40~80 ml)医用超声耦合剂(病灶较大及位置较低者不予注入)。检查前 10 min 肌注山莨菪碱 20 mg 以减少肠道运动伪影。因 T1WI 不是诊断直肠癌的常规推荐序列,故本研究未分析 T1WI^[7]。

三、图像分析

患者直肠高分辨矢状位、冠状位、正交轴位 T2WI 均由两名有经验的腹部 MRI 诊断医师在图像工作站评价直肠系膜淋巴结状态,若有分歧,经协商取得一致意见。两名诊断医师分别测量淋巴结最短径(各测量 3 次取平均值),观察淋巴结形态、边缘及信号特征。高分辨 MRI T2WI 评价淋巴结转移标准:形态不规则、边缘模糊和(或)信号混杂。

四、病理检查及与 MRI 对照

MRI 检查后 1~13(中位数 4) d 行直肠癌根治术,其中 1 例行直肠癌扩大根治术。手术标准方法为全直肠系膜切除(total mesorectal excision, TME),切除范围包括直肠、直肠系膜及完整的直肠系膜筋膜^[8]。根据术前 MRI 定位淋巴结,术中按分区定位并记录淋巴结位置,术后分离淋巴结并送检。按光学显微镜下发现淋巴结内有无肿瘤细胞诊断为转移或非转移淋巴结。将相应分区内的淋巴结与 MRI 上淋巴结进行匹配和对照,剔除 MRI 与病理不能匹配的淋巴结。患者是否存在远处转移根据术后病理标本、术前胸腹部计算机断层扫描(computed tomography, CT)、腹部 MRI 或正电子发射计算机断层显像(positron emission tomography, PET)诊断。直肠癌的病理分期参照美国癌症联合委员会(American Joint Committee on Cancer, AJCC)/国际抗癌联盟(Union for International Cancer Control, UICC)结直肠癌 TNM 分期系统^[9]。

表 1 3.0T 直肠 2D 高分辨磁共振 T2 加权像参数

方位	重复时间/回波时间(ms)	层厚/层间距(mm)	层数	回波链长度	矩阵	视野(cm)	体素(mm)	成像时间(s)
矢状位	3000/87	3/0	19	12	320×256	18	0.7×0.6×3.0	150
冠状位	4000/77	3/0	25	21	384×308	22	0.7×0.6×3.0	172
正交轴位	3000/84	3/0	24	16	320×320	18	0.6×0.6×3.0	198

五、统计学方法

应用 SPSS 20.0 软件进行统计分析。与术后病理结果对照,计算直肠高分辨 MRI 评价直肠系膜淋巴结及不同短径淋巴结转移的灵敏度、特异度、准确性、阳性预测值(positive predictive value, PPV)、阴性预测值(negative predictive value, NPV)。采用 Kappa 检验评价高分辨 MRI 与病理结果的一致性(Kappa 值为 0~0.20 为一致性极低,0.21~0.40 为一致性一般,0.41~0.60 为一致性中等,0.61~0.80 为高度一致性,0.81~1.00 为几乎完全一致)^[10]。非正态分布资料的比较采用 Mann-Whitney U 检验, $P < 0.05$ 为差异有统计学意义(显著性水平为双侧)。

结 果

一、直肠高分辨 MRI 评价转移淋巴结的效能

MRI 与病理相匹配淋巴结共 377 枚,每例患者 3~8 (中位数 5) 枚,168 枚(44.6%)淋巴结转移阳性,58.0% (47/81) 患者淋巴结转移阳性(病理诊断 4 例 T₂ 期、36 例 T₃ 期、7 例 T₄ 期),典型病例淋巴结转移 MRI 图像见图 1、图 2 和图 3。转移淋巴结短径的中位数为 5.4 (2.4~18.6) mm,长于未转移淋巴结的短径[中位数 3.8 (2.0~8.7) mm, $Z=10.586, P=0.000$]。高分辨 MRI 评价淋巴结是

否转移的灵敏度为 74.4% (125/168)、特异度为 94.7% (198/209)、准确性为 85.7% (323/377)、PPV 为 91.9% (125/136)、NPV 为 82.2% (198/241),假阳性率为 5.3% (11/209),假阴性率为 25.6% (43/168)。术前高分辨 MRI 评价淋巴结是否转移和患者是否有转移淋巴结的结果与术后病理结果一致性的 Kappa 值分别为 0.71 和 0.70,为高度一致,见表 2 和表 3。

表 2 术前直肠高分辨磁共振成像评价 377 枚淋巴结与术后病理对照结果(枚)

术前磁共振结果	术后病理结果		总计
	淋巴结转移阳性	淋巴结转移阴性	
淋巴结转移阳性	125	11	136
淋巴结转移阴性	43	198	241
总计	168	209	377

表 3 直肠高分辨磁共振成像对直肠系膜淋巴结转移的诊断价值

诊断价值	淋巴结是否转移[% (枚)]	患者是否有转移淋巴结
	(377 枚)	[% (例)] (81 例)
灵敏度	74.4 (125/168)	87.2 (41/47)
特异度	94.7 (198/209)	82.4 (28/34)
准确性	85.7 (323/377)	85.2 (69/81)
阳性预测值	91.9 (125/136)	87.2 (41/47)
阴性预测值	82.2 (198/241)	82.4 (28/34)

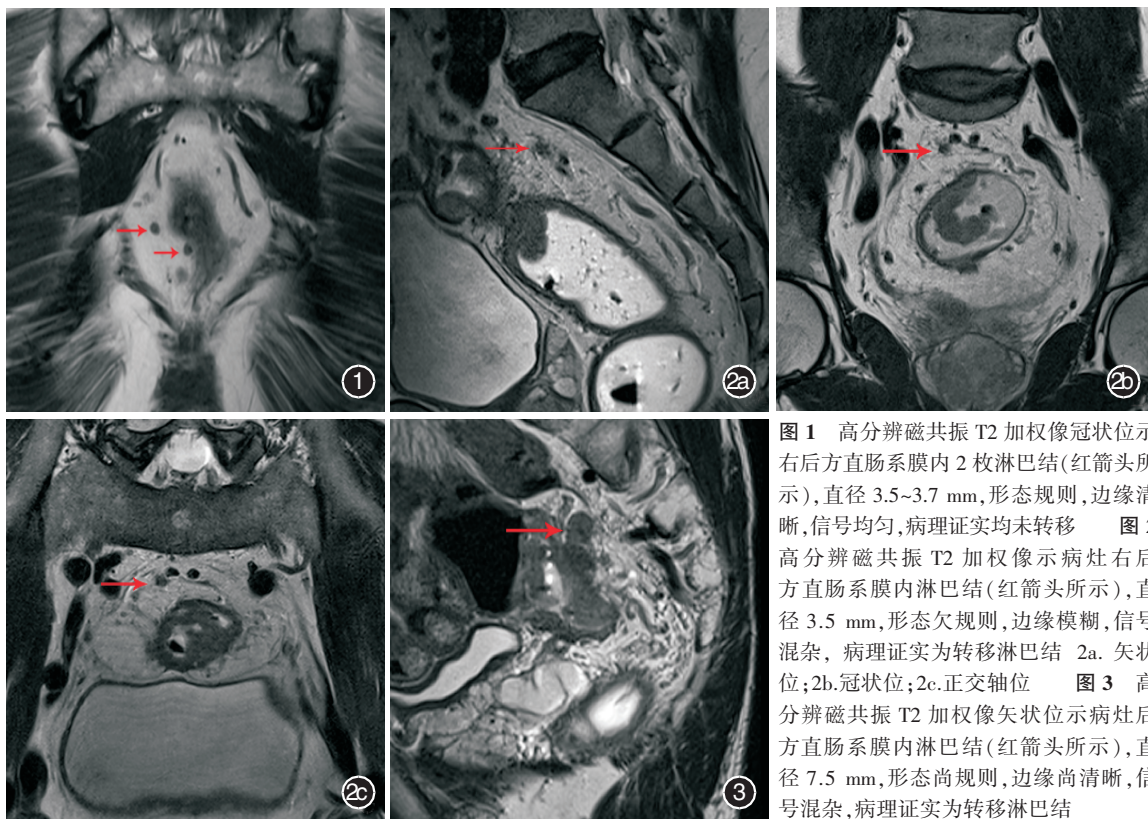


图 1 高分辨磁共振 T2 加权像冠状位示右后方直肠系膜内 2 枚淋巴结(红箭头所示),直径 3.5~3.7 mm,形态规则,边缘清晰,信号均匀,病理证实均未转移 图 2 高分辨磁共振 T2 加权像示病灶右后方直肠系膜内淋巴结(红箭头所示),直径 3.5 mm,形态欠规则,边缘模糊,信号混杂,病理证实为转移淋巴结 2a. 矢状位;2b. 冠状位;2c. 正交轴位 图 3 高分辨磁共振 T2 加权像矢状位示病灶右后方直肠系膜内淋巴结(红箭头所示),直径 7.5 mm,形态尚规则,边缘尚清晰,信号混杂,病理证实为转移淋巴结

- chemoradiotherapy for locally advanced rectal cancer: treatment outcomes and analysis of prognostic factors [J]. *Cancer Res Treat*, 2012, 44(2):104-112. DOI:10.4143/crt.2012.44.2.104.
- [13] van de Velde CJ, Boelens PG, Borras JM, et al. EURECCA colorectal: Multidisciplinary management: European consensus conference colon & rectum [J]. *Eur J Cancer*, 2014, 50(1):1.e1-e34. DOI:10.1016/j.ejca.2013.06.048.
- [14] 庄晓墨,余深平,崔冀,等. 3.0T 磁共振背景抑制弥散加权成像对直肠癌淋巴结转移的诊断价值 [J]. *中华胃肠外科杂志*, 2011, 14(11):842-845. DOI:10.3760/cma.j.issn.1671-0274.2011.11.007.
- [15] Dieguez A. Rectal cancer staging: focus on the prognostic significance of the findings described by high-resolution magnetic resonance imaging[J]. *Cancer Imaging*, 2013, 13(2): 277-297. DOI:10.1102/1470-7330.2013.0028.
- [16] Bipat S, Glas AS, Slors FJM, et al. Rectal Cancer: Local Staging and Assessment of Lymph Node Involvement with Endoluminal US, CT, and MR Imaging-A Meta-Analysis [J]. *Radiology*, 2004, 232(3):773-783. DOI:10.1148/radiol.2323031368.
- [17] Beets-Tan RG. Pretreatment MRI of lymph nodes in rectal cancer: an opinion-based review[J]. *Colorectal Dis*, 2013, 15(7): 781-784. DOI:10.1111/codi.12300.
- [18] Doyon F, Attenberger UI, Dinter DJ, et al. Clinical relevance of morphologic MRI criteria for the assessment of lymph nodes in patients with rectal cancer [J]. *Int J Colorectal Dis*, 2015, 30(11):1541-1546. DOI:10.1007/s00384-015-2339-y.
- [19] Akasu T, Iinuma G, Takawa M, et al. Accuracy of high-resolution magnetic resonance imaging in preoperative staging of rectal cancer[J]. *Ann Surg Oncol*, 2009, 16(10):2787-2794. DOI: 10.1245/s10434-009-0613-3.
- [20] Zhang H, Zhang C, Zheng Z, et al. Chemical shift effect predicting lymph node status in rectal cancer using high-resolution MR imaging with node-for-node matched histopathological validation[J]. *Eur Radiol*, 2017, 27(9):3845-3855. DOI:10.1007/s00330-017-4738-7.
- [21] Dworak O. Morphology of lymph nodes in the resected rectum of patients with rectal carcinoma [J]. *Pathol Res Pract*, 1991, 187(8):1020-1024. DOI:10.1016/S0344-0338(11)81075-7.
- [22] Koh D, Chau I, Tait D, et al. Evaluating mesorectal lymph nodes in rectal cancer before and after neoadjuvant chemoradiation using thin-section T2-weighted magnetic resonance imaging [J]. *Int J Radiat Oncol Biol Phys*, 2008, 71(2):456-461. DOI: 10.1016/j.ijrobp.2007.10.016.
- [23] Park JS, Jang YJ, Choi GS, et al. Accuracy of preoperative MRI in predicting pathology stage in rectal cancers: node-for-node matched histopathology validation of MRI features[J]. *Dis Colon Rectum*, 2014, 57(1):32-38. DOI:10.1097/DCR.00000000000004.
- [24] Nougaret S, Reinhold C, Mikhael HW, et al. The use of MR imaging in treatment planning for patients with rectal carcinoma: have you checked the "DISTANCE"? [J]. *Radiology*, 2013, 268(2):330-344. DOI:10.1148/radiol.13121361.
- [25] Nicastrì DG, Doucette JT, Godfrey TE, et al. Is occult lymph node disease in colorectal cancer patients clinically significant? A review of the relevant literature [J]. *J Mol Diagn*, 2007, 9(5): 563-571. DOI:10.2353/jmoldx.2007.070032.
- [26] 王屹. 直肠癌转移性淋巴结影像诊断及临床应用[J]. *中华胃肠外科杂志*, 2016, 19(6):630-633. DOI:10.3760/cma.j.issn.1671-0274.2016.06.007.

(收稿日期:2017-06-27)

(本文编辑:王静)

· 名词解析 ·

吻合口漏与吻合口瘘

目前,国内“吻合口漏”和“吻合口瘘”两个名词存在混用现象。为规范这两个名词在论文中的使用,本编辑部征求相关的各位专家意见,现达成以下共识。

吻合口漏 对应英文词汇为“anastomotic leakage”或“anastomotic leak”,指吻合口不完整而导致的消化道内容物外漏。“漏”是一种对于病理过程的动态描述,强调物质通过病理状态下形成的异常交通流向其本不该出现的区域,引起或不引起病理改变。从时间上讲,一般吻合口术后早期发生的破裂应称为“漏”。

吻合口瘘 瘘的对应英文词汇为“fistula”,为器官管道与体表皮肤之间、器官管道与器官管道之间的慢性感染性通道,病灶里的分泌物由此流出,一般由瘘口(内口、外口)和瘘管构成。“瘘”是一种对于病理状态的形态的静态描述,强调形态学可见的异常交通,及其导致的病理结局。从时间上讲,吻合口瘘多指消化道漏并发症发生以后的继发事件。

综上,对于消化道内容物通过破裂的吻合口外溢,推荐使用“吻合口漏”。

(本刊编辑部)