

# 磁共振成像

月刊  
总第160期  
2010年1月创刊

2025年第16卷第10期  
2025年10月20日出版

刊名题写：时任第十一届全国人大常委会副委员长韩启德

主管单位 中华人民共和国国家卫生  
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学科编辑 王星皓 胡 磊  
出版单位 《磁共振成像》  
杂志社有限公司

发行范围 公开  
发行单位 本刊发行部

国内发行 中国邮政集团有限公司  
北京市报刊发行局  
邮发代号 2-855  
国外总发行 中国国际图书贸易集团有限公司  
国外发行代号 M 8958  
印刷单位 北京科信印刷有限公司

电 话 010-67113815  
E-mail editor@cjmri.cn  
网 址 www.chinesemri.com  
定 价 每册30元

国内统一连续出版物号  
CN 11-5902/R

国际标准连续出版物号  
ISSN 1674-8034

广告发布登记证号 京西市监广登字20170242号  
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结直肠癌的全球发病率位居第三, 死亡率则居第二。在中国, 直肠癌约占全部结直肠癌的50%~60%。直肠癌患者的区域淋巴结状态是制订治疗策略和评估预后的重要依据。无淋巴结转移患者的5年生存率可达70%~80%, 而存在淋巴结转移的患者5年生存率下降至30%~60%。目前, 直肠癌治疗前的淋巴结状态评估主要依赖于影像学检查。影像学评估通常依据淋巴结的大小(短轴直径)及其形态特征(如形状、边缘及内部信号强度)进行判断。传统影像学方法在诊断准确性方面仍存在不足, 主要受限于良恶性淋巴结在影像特征上的重叠性以及评估过程中的主观因素影响。因此, 提高直肠癌淋巴结转移诊断的准确性, 对于推动个体化治疗和改善患者临床预后具有重要意义。

影像组学能通过自动化、高通量方法从影像数据中提取大量定量特征, 进而对疾病进行诊断、疗效评估及预后分析等。目前多数直肠癌相关影像组学研究依赖人工或半自动方法分割肿瘤区域, 而这些分割方法耗时且需要操作者具备丰富的解剖知识。因此, 在处理复杂成像场景的图像时, 往往会导致肿瘤分割效果不佳、影像组学特征提取的可重复性降低。近年来, 深度学习推动了医学图像自动分割领域的快速发展, 该技术具备高效、便捷和减少观察者间差异的优势, 并已在脑部、前列腺和肺部肿瘤等病灶分割中表现出色。然而, 现有研究尚未充分探索深度学习自动分割与影像组学在直肠癌淋巴结转移预测中的协同效应。

本研究比较了三种深度学习自动分割网络(3D U-Net、3D V-Net、nnU-Net v2)在直肠癌患者术前MRI图像中的肿瘤分割精度, 发现nnU-Net v2具有最佳的分割准确性; 并基于自动分割肿瘤区域的影像组学(T2WI和DWI)特征构建直肠癌区域淋巴结预测模型, 结果显示模型具有良好的预测效能。这一研究结果有望提高直肠癌区域淋巴结预测的效率及准确度。详见内文第60页。

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磁共振成像

办精品期刊 促学科发展 惠百姓健康

官方网站 在线投稿 知乎平台 官方微博 搜狐平台 网易平台 哔哩哔哩 企鹅号 微信平台

CHINESE JOURNAL OF MAGNETIC RESONANCE IMAGING

磁共振成像 杂志社

www.chinesemri.com

# CHINESE JOURNAL OF MAGNETIC RESONANCE IMAGING

ISSN 1674-8034, CN 11-5902/R, CODEN CCIHBW, Established in 2010 Monthly Vol. 16, No. 10, Oct 20, 2025

**Responsible Institution**

National Health Commission of the  
People's Republic of China

**Sponsor**

Chinese Hospital Association  
Beijing Tiantan Hospital of Capital  
Medical University

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of Magnetic Resonance Imaging

**General Distributor**

Domestic: Beijing Newspaper and  
Periodical Distribution Bureau of China  
Post Group Co., Ltd.  
Postal Code: 2-855  
Overseas: China International Book  
Trade Group Co., Ltd., P.O. Box 399,  
Beijing, China  
Code No.: M 8958

**Mail Order**

Third Floor, Building 4, No. 358,  
Yudaihe East Street, Tongzhou District,  
Beijing 101100, China

**Tel & Fax** 8610-67113815

**E-mail** editor@cjmri.cn

**Website** www.chinesemri.com

**Price:** USD 30.00

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## About the cover

Colorectal cancer is the third most common cancer in terms of global incidence and the second leading cause of cancer related mortality. In China, rectal cancer (RC) accounts for approximately 50% to 60% of all colorectal cancer cases. The status of regional lymph nodes is an important factor in determining treatment strategy and prognosis in patients with rectal cancer (RC). The 5-year survival rate of patients without metastatic lymph nodes is 70% to 80%, while metastatic lymph nodes indicate a declined survival rate of 30% to 60%. Currently, assessment of lymph node status is mainly provided by imaging modalities in RC before treatment. The dimensions (short axis diameter) and characteristics (shape, margin, and internal signal) of the lymph nodes are commonly employed imaging criteria for evaluating the lymph node status of RC. The unsatisfactory diagnostic accuracy of lymph node status should be attributed to overlap in traditional imaging criteria between benign and malignant lymph nodes and subjective influences from observers. Therefore, it is imperative to enhance the diagnostic accuracy of lymph node metastasis (LNM) in order to facilitate personalized treatment and improve clinical outcomes in RC.

Radiomics enables the extraction of a large number of quantitative features from medical imaging data via automated, high-throughput techniques, facilitating disease diagnosis, therapeutic response assessment, and prognosis prediction. Manual or semi-automatic segmentation is commonly employed for feature extraction in the majority of radiomics studies with RC, while these approaches necessitate a substantial amount of time and laborious work, as well as operators with proficient anatomical knowledge. Therefore, handling images with intricate imaging scenarios often leads to unsatisfactory tumor segmentation and inferior reproducibility of radiomics features extraction. Deep learning (DL) has significantly advanced the field of automatic medical image segmentation in recent years. This technology offers notable advantages, including high efficiency, convenient, and reduced inter-observer variability, and outstanding performance across various medical segmentation tasks, such as with brain lesions, prostate tumors, and lung tumors. However, current research has not yet comprehensively investigated the synergistic potential of DL-based automatic segmentation and radiomics for predicting LNM in rectal cancer.

This study compared the tumor segmentation accuracy of three DL-based automatic segmentation networks (3D U-Net, 3D V-Net, and nnU-Net v2) using preoperative MRI images from patients with RC. The results demonstrated that nnU-Net v2 achieved the highest segmentation performance. Furthermore, a predictive model for regional LNM in RC was constructed based on radiomics features extracted from the automatically segmented tumor regions of T2WI and DWI. The results demonstrate that the model exhibits robust predictive performance, and these findings are anticipated to enhance the efficiency and accuracy of regional lymph node prediction in RC. Please see text page 60.

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