

## 磁共振成像在子宫内膜癌术前评估中的临床应用

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**摘要:** **目的** 探讨磁共振成像在子宫内膜癌术前评估中的临床应用价值。**方法** 回顾性收集 94 例经手术病理证实的子宫内膜癌患者, 将术前磁共振成像检查结果与手术病理结果对照, 评价 T2 加权像 (T2WI) 结合增强扫描或弥散加权成像 (DWI) 判断子宫内膜癌肌层浸润深度及淋巴结转移的价值。**结果** 94 例子宫内膜癌中, 无或浅肌层浸润的子宫内膜癌 62 例、深肌层浸润的子宫内膜癌 32 例; 24 组转移性淋巴结、164 组非转移性淋巴结。T2WI 结合增强扫描或 DWI 鉴别无/浅肌层浸润和深肌层浸润的准确率、特异性、敏感性、阴性及阳性预测值分别为 88.3%、90.3%、84.4%、91.8%、81.8% 和 81.9%、87.1%、71.9%、85.7%、74.2%。T2WI 结合增强扫描、DWI 判断淋巴结转移的准确率、特异性、敏感性、阴性及阳性预测值分别为 89.4%、96.8%、54.5%、90.9%、78.3% 和 91.5%、95.5%、72.7%、94.3%、77.4%。**结论** 磁共振成像 T2WI 结合增强扫描判断子宫内膜癌肌层浸润深度的能力优于 T2WI 结合 DWI, DWI 鉴别淋巴结转移较 T2WI 结合增强扫描更敏感。

**关键词:** 子宫内膜癌; 磁共振成像; 弥散加权成像

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## Clinical Application of Magnetic Resonance Imaging in Preoperative Evaluation of Endometrial Cancer

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**ABSTRACT: Objective** To investigate the value of magnetic resonance imaging (MRI) in the preoperative assessment of endometrial cancer. **Methods** Ninety-four patients with histopathologically confirmed endometrial carcinoma were retrospectively enrolled in this study. MRI findings were compared with the pathologic findings in all cases. The depth of myometrial invasion and lymph node metastasis were evaluated by T2 weighted imaging (T2WI) combined with contrast enhancement or diffusion weighted imaging (DWI). **Results** Among these 94 patients, 62 had no or superficial myometrial involvement and 32 cases had deep myometrial involvement. Meanwhile, 24 groups of metastatic lymph nodes and 164 groups of non-metastatic lymph nodes were detected. The accuracy, specificity, sensitivity, negative predictive value, and positive predictive value of T2WI combined with contrast enhancement in discriminating no/superficial myometrial involvement from deep myometrial involvement were 88.3%, 90.3%, 84.4%, 91.8%, and 81.8%, whereas those of T2WI combined with DWI were 81.9%, 87.1%, 71.9%, 85.7%, and 74.2%, respectively. The accuracy, specificity, sensitivity, negative predictive value, and positive predictive value of T2WI combined with contrast en-

hancement in identifying metastatic lymph nodes were 89.4% , 96.8% , 54.5% , 90.9% , and 78.3% , whereas those of T2WI combined with DWI were 91.5% , 95.5% , 72.7% , 94.3% , and 77.4% , respectively. **Conclusions** T2WI combined with contrast enhancement is superior to T2WI combined with DWI in evaluation of the depth of myometrial invasion. However, DWI is more sensitive in identifying lymph node metastasis than T2WI combined with contrast enhancement.

**Key words:** endometrial cancer; magnetic resonance imaging; diffusion weighted imaging

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子宫内膜癌是常见的妇科肿瘤之一。其预后影响因素主要包括病理类型及分级、确诊时的分期、淋巴结转移及淋巴血管间隙浸润情况<sup>[1]</sup>。有报道肌层浸润深度达到或超过肌层厚度50%的子宫内膜癌患者,盆腔和腹主动脉旁淋巴结转移的发生率是无肌层浸润或浸润深度<50%者的6~7倍<sup>[2]</sup>。子宫内膜癌术前分期及肌层浸润深度,与手术方法的选择密切相关。磁共振成像(magnetic resonance imaging, MRI)增强扫描对肌层浸润深度及宫颈受累的判断,优于超声、CT及MRI平扫<sup>[3-4]</sup>。有研究表明动态增强扫描可提高子宫内膜癌术前分期的准确率<sup>[5-6]</sup>,但也有作者认为动态增强扫描提高时间分辨率的同时降低了空间分辨率,会对子宫深肌层浸润做出假阴性判断<sup>[7]</sup>。有研究报道子宫内膜癌与正常肌层对比最强的时间点为50~150s<sup>[8]</sup>,是否可以在对比最强的时间点进行增强扫描,替代动态对比增强,判断子宫内膜癌肌层浸润,是目前争论的热点问题<sup>[7]</sup>。弥散加权成像(diffusion weighted imaging, DWI)判断子宫内膜癌肌层浸润的准确率为62%~90%<sup>[8]</sup>。有报道子宫内膜癌转移性淋巴结的表观弥散系数(apparent diffusion coefficient, ADC)值显著低于炎性淋巴结, Nakai等<sup>[9]</sup>认为DWI仅有助于淋巴结的检出,ADC值不能鉴别淋巴结的性质。因此,本研究旨在进一步明确MRI增强扫描及DWI在子宫内膜癌术前TN分期评估中的作用。

## 对象和方法

**对象** 回顾性收集2007年1月至2012年3月我院手术治疗经病理证实的子宫内膜癌患者94例,年龄39~70岁,平均(54.2±15.9)岁。所有患者均在术前2周内行MRI平扫加增强加DWI检查,所有患者MRI检查后及术前未经任何抗肿瘤治疗。

**MRI检查方法** 应用GE Signa EXCITE Twin Speed HD 1.5T磁共振扫描仪,8通道体部线控相圈。盆腔磁

共振扫描平扫序列包括横轴位自旋回波T1加权像,重复时间400~600ms,回波时间10~20ms;横轴位、矢状位、冠状位快速自旋回波T2加权像(T2 weighted imaging, T2WI),重复时间2500~4000ms,回波时间60~100ms,视野30cm×30cm,矩阵256×256,激发次数2,层厚4mm,间隔1mm。横轴位DWI,重复时间4500ms,回波时间62.4ms,反转时间160ms,激发次数4,矩阵128×128,视野38cm×38cm,层厚4mm,间隔1mm, b=0, 800s/mm<sup>2</sup>。增强扫描通过上肢静脉经注射器手推注入对比剂钆喷替酸葡甲胺,剂量为0.1mmol/kg体重,其后延迟60s进行图像采集。

**图像分析及标准** 由2名放射科医师在不知道手术病理结果的前提下,共同分析所有患者的MRI图像,并达成共识。肌层浸润深度MRI判断标准:(1)结合带完整,增强后内膜下强化带清晰光滑,视为无肌层浸润;(2)结合带部分破坏,内膜下强化带不规则,肿瘤信号不超过肌层厚度的1/2,视为浅肌层浸润;(3)结合带部分或完全破坏,内膜下强化带不规则,肿瘤信号达到或超过肌层厚度的1/2,视为深肌层浸润。符合以下标准之一则视为淋巴结转移:(1)短径>10mm或淋巴结坏死,增强后环形强化;(2)淋巴结ADC值不高于该患者子宫内膜癌的平均ADC值。按照解剖部位将盆腔淋巴结划分为左/右侧髂总、髂内、髂外、闭孔、骶前组,采用刀切法(病理结果中某组淋巴结中有1个淋巴结转移,则该组淋巴结为转移性淋巴结)评价MRI诊断淋巴结转移的能力。

**ADC值测量** 应用AW 4.2工作站Functool软件重建出ADC图。由2名放射科医师共同确定椭圆形感兴趣区,并达成共识。每个感兴趣区至少≥20个体素,应包括显示肿瘤的所有层面或DWI显示的所有淋巴结,参照同层面横轴位T2WI尽可能大的绘制感兴趣区,同时避免出血、坏死及囊变区,测量子宫内膜癌及淋巴结的平均ADC值。

**统计学处理** 手术病理结果做为金标准, 采用四格表法, 计算 T2WI 结合增强扫描、DWI 判断肌层浸润深度及淋巴结转移的准确率、特异性、敏感性、阴性预测值、阳性预测值。

## 结 果

**MRI 术前评估结果** 所有患者术前 2 周内行 MRI 平扫加增强加 DWI 检查, 根据 2009 年国际妇产科联盟分期标准, T2WI 结合增强扫描诊断无或浅肌层浸润的子宫内层癌 61 例 (图 1), 深肌层浸润 33 例; T2WI 结合 DWI 诊断无或浅肌层浸润的子宫内层癌 63 例, 深肌层浸润 31 例。T2WI 结合增强扫描诊断淋巴结转移 23 组, 无淋巴结转移 165 组; DWI 诊断淋巴结转移 31 组, 无淋巴结转移 157 组。

**手术及病理结果** 所有患者均经腹行全子宫加双侧附件切除加盆腔淋巴结清扫, 伴或不伴腹主动脉旁淋巴结清扫, 并常规行腹腔冲洗液瘤细胞检查。根据 2009 年国际妇产科联盟分期标准, 无或浅肌层浸润的子宫内层癌 62 例; 深肌层浸润的子宫内层癌 32 例。手术共切除 1572 枚淋巴结, 24 组转移性淋巴结 (192 枚); 164 组非转移性淋巴结 (1380 枚)。

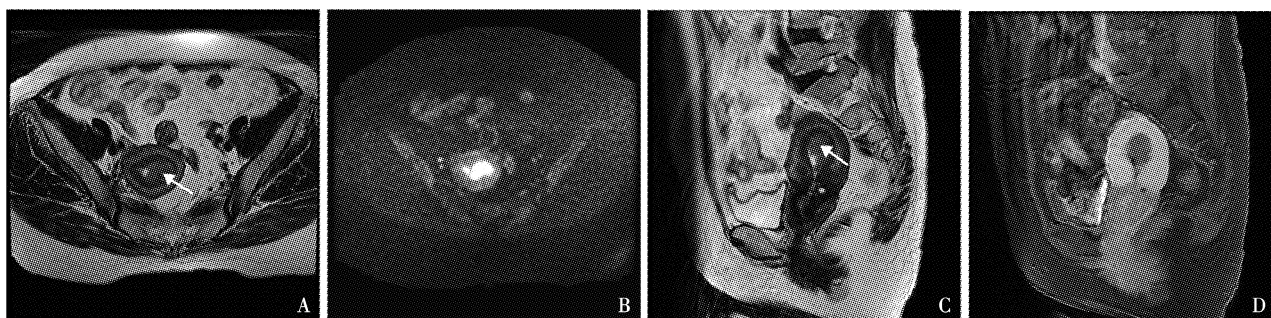
**MRI 与手术病理对照结果** 94 例子宫内层癌患

者中, MRI 平扫结合增强扫描正确判断肌层浸润深度的共 83 例, 误诊 11 例; MRI 平扫结合 DWI 诊断正确 77 例, 误诊 17 例。188 组手术清扫的盆腔淋巴结中, MRI 平扫结合增强扫描正确判断淋巴结性质的共 168 组, 误诊 20 组; DWI 诊断正确 172 组, 误诊 16 组。MRI 平扫结合增强扫描或 DWI 判断肌层浸润深度、淋巴结转移的准确率、特异性、敏感性、阴性预测值、阳性预测值见表 1、2。

## 讨 论

子宫肌层浸润深度是子宫内层癌重要的形态学预后因素, 与淋巴结转移的发生率、患者的生存期密切相关<sup>[10-11]</sup>。术前判断子宫内层癌肌层浸润深度对治疗方法的选择具有重要意义, 渴望保留生育能力而无肌层浸润的子宫内层癌患者可选择激素治疗。7% ~ 10% 系统性淋巴结切除可形成淋巴管囊肿<sup>[12-13]</sup>, 大多数学者认为无或浅肌层浸润的子宫内层癌无需淋巴结清扫<sup>[1,7]</sup>。MRI 具有良好的软组织分辨率及多方位成像的优点, 是子宫内层癌术前评估重要的影像学方法之一。

常规 MRI 平扫通过 T2WI 判断肌层浸润深度, 大多数子宫内层癌 T2 信号强度略高于子宫肌层, 但



A. 横轴位 T2 加权像示宫腔扩张, 其内见 T2 略高信号影 (箭头), 结合带变薄, 结合带外侧缘信号均匀, 无深肌层浸润; B. 与图 A 同层面的横轴位弥散加权像 ( $b = 800 \text{ s/mm}^2$ ) 示宫内膜癌病变呈明显高信号; C. 矢状位 T2 加权像示宫腔扩张, 其内见 T2 略高信号影 (箭头), 结合带变薄, 结合带外侧缘信号均匀, 无深肌层浸润; D. 矢状位 T1 对比增强示强化较弱的宫内膜癌与明显强化的子宫肌层交界面不规则, 提示浅肌层浸润

A. axial T2 weighted imaging of the uterus demonstrates that the endometrial cavity is occupied by slightly hyperintense tumor (arrow) with thinning of the junctional zone and the external margin of junctional zone have heterogeneous signal intensity without evidence of deep endometrial invasion; B. axial diffusion weighted image with a b value of  $800 \text{ s/mm}^2$  at same level as figure A showed the tumor with a remarkably high signal intensity on the dark background; C. sagittal T2 weighted imaging of the uterus demonstrates that the endometrial cavity is occupied by slightly hyperintense tumor (arrow) with thinning of the junctional zone, and the external margin of junctional zone is heterogeneous signal intensity without evidence of deep endometrial invasion; D. T1 contrast-enhanced image confirms an irregular interface between the less enhancing endometrial cancer and the strongly enhancing normal myometrium, suggesting superficial myometrial invasion

图 1 57 岁高分化子宫内层癌女性的盆腔磁共振图像

Fig 1 Magnetic resonance images of the pelvis in a 57-year-old woman with well differentiated endometrial cancer

表 1 磁共振成像诊断肌层浸润深度的能力 (%)

Table 1 Diagnostic ability of magnetic resonance imaging in determining the depth of myometrial invasion (%)

序列 Sequence	准确率 Accuracy	特异性 Specificity	敏感性 Sensitivity	阴性预测值 Negative predictive value	阳性预测值 Positive predictive value
T2 加权像 + 增强扫描 T2 weighted imaging + enhancement	88.3 (83/94)	90.3 (56/62)	84.4 (27/32)	91.8 (56/61)	81.8 (27/33)
T2 加权像 + 弥散加权成像 T2 weighted imaging + diffusion weighted imaging	81.9 (77/94)	87.1 (54/62)	71.9 (23/32)	85.7 (54/63)	74.2 (23/31)

表 2 磁共振成像诊断淋巴结转移的能力 (%)

Table 2 Diagnostic ability of magnetic resonance imaging in identifying the metastatic lymph nodes (%)

序列 Sequence	准确率 Accuracy	特异性 Specificity	敏感性 Sensitivity	阴性预测值 Negative predictive value	阳性预测值 Positive predictive value
T2 加权像 + 增强扫描 T2 weighted imaging + enhancement	89.4 (168/188)	96.8 (150/155)	54.5 (18/33)	90.9 (150/165)	78.3 (18/23)
弥散加权成像 Diffusion weighted imaging	91.5 (172/188)	95.5 (148/155)	72.7 (24/33)	94.3 (148/157)	77.4 (24/31)

约 14% 的子宫内膜癌信号强度等或低于子宫肌层<sup>[4]</sup>，此外，绝经后妇女结合带变薄，常显示不清，影响常规 MRI 对肌层浸润深度的判断。目前，多采用 MRI 平扫结合增强（包括动态增强）扫描或 DWI 判断子宫内膜癌肌层浸润深度。造影剂注射后 50 ~ 120 s，子宫内膜癌与明显强化的正常肌层对比最强，是判断肌层浸润深度的最重要时相<sup>[8]</sup>。文献报道 MRI 平扫结合增强扫描判断肌层浸润深度的准确率为 59% ~ 100%，敏感性为 33% ~ 100%，特异性为 72% ~ 100%<sup>[14]</sup>。本研究 MRI T2WI 结合增强扫描判断有无深肌层浸润的准确率、特异性、敏感性、阴性预测值、阳性预测值分别为 88.3%、90.3%、84.4%、91.8%、81.8%。判断错误的 11 例中，6 例手术病理证实的浅肌层浸润 MRI 过度判断为深肌层浸润，其中 2 例为充满整个宫腔的息肉样子宫内膜癌造成子宫肌层明显变薄，1 例为合并宫腔积液、积血的子宫内膜癌造成子宫肌层明显变薄，2 例为绝经后子宫，子宫肌层明显变薄，1 例由于增强扫描图像采集时间过早，子宫肌层与肿瘤信号对比不明显；5 例手术病理证实的深肌层浸润 MRI 低估为浅肌层浸润，其中 1 例为充满整个宫腔的息肉样子宫内膜癌，2 例为子宫内膜癌合并多发肌瘤，1 例为子宫内膜癌合并子宫腺肌症，1 例为双角子宫一侧宫角的子宫内膜癌。本研究的误诊原因与文献报道的一致，即各种原因如肿瘤体积较大、合并子宫肌瘤或腺肌症等引起子宫肌层厚度发生变化，造成 MRI 错误判断肌层浸润深度<sup>[8,15-16]</sup>。

DWI 是目前唯一能够活体观察水分子微观运动

的成像方法，在女性盆腔肿瘤中的应用主要集中于病变的检出、定位、分期、随访等。子宫内膜癌 DWI 信号强度明显高于子宫肌层，可借此判断肌层浸润深度。本研究 MRI 平扫结合 DWI 判断有无深肌层浸润的准确率、特异性、敏感性、阴性预测值、阳性预测值分别为 81.9%、85.7%、71.9%、87.1%、74.2%，均低于本研究 MRI T2WI 结合增强扫描，与大多数文献报道的结果不一致<sup>[17-19]</sup>。Rechichi 等<sup>[18]</sup>利用 1.5T 磁共振，b 值采用 0 和 500 s/mm<sup>2</sup> 的 DWI 判断子宫内膜癌有无深肌层浸润的敏感性、特异性、阳性及阴性预测值分别为 84.6%、70.6%、52.4%、92.3%，均高于 T1 动态对比增强。Lin 等<sup>[19]</sup>利用 3.0T 磁共振，b 值采用 0 和 1000/mm<sup>2</sup> 的 DWI 与 T2WI 融合图像判断子宫内膜癌有无肌层浸润、有无深肌层浸润的受试者工作特征曲线下面积分别为 0.945、0.990，动态对比增强的曲线下面积分别为 0.833、0.979。本研究 DWI 结合 T2WI 判断有无深肌层浸润的准确率较低，主要与弥散加权像上正常子宫肌层信噪比较低，难以准确判断肌层厚度有关。通过提高磁场强度、降低 b 值或将 DWI 与 T2WI 图像融合有助于提高 DWI 判断子宫内膜癌肌层浸润深度的准确率。

目前，临床上应用的各种影像学检查方法判断术前子宫内膜癌淋巴结转移的能力较低<sup>[20]</sup>。以短径 10 mm 做为 MRI 判断淋巴结转移的标准，敏感性为 17% ~ 80%，大多数研究的敏感性较低<sup>[14]</sup>。无论转移或炎性淋巴结，DWI 均表现为高信号，但有文献报道子宫内膜癌与宫颈癌转移性淋巴结的 ADC 值显

著低于非转移性淋巴结，以相对 ADC 值结合大小原则判断淋巴结转移的敏感性可达 83%<sup>[21]</sup>。本研究 DWI 判断淋巴结转移的敏感性高于 MRI 平扫结合增强扫描。虽然利用 ADC 值评价淋巴结转移缺乏统一的诊断标准，转移与炎性淋巴结的 ADC 值存在一定程度的重叠，但以患者自身子宫内层的平均 ADC 值或炎性淋巴结如腹股沟淋巴结的 ADC 值做为参照标准，有助于判断淋巴结的性质，进而可能提高常规 MRI 判断淋巴结转移的能力。

本研究的局限性包括：（1）子宫内膜癌肌层浸润深度与淋巴结转移的发生率相关，因此肌层浸润深度影响 2 名医师对淋巴结性质的判断；（2）测量 ADC 值时，感兴趣的绘制具有随机性；（3）转移性淋巴结占所有切除淋巴结的比例较低，造成样本的选择偏倚，进而影响研究结果。

综上，本研究结果表明 1.5T MRI T2WI 结合增强扫描判断子宫内膜癌肌层浸润深度的能力优于 T2WI 结合 DWI，DWI 鉴别淋巴结转移较 T2WI 结合增强扫描更敏感。

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