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高血压(hypertension, HTN)与2型糖尿病(type 2 diabetes mellitus, T2DM)是全球最常见的心血管代谢性疾病,二者常合并存在。同时患有HTN和T2DM者,其全因死亡及心血管事件风险均显著升高。HTN与T2DM通过胰岛素抵抗、肾素-血管紧张素-醛固酮系统过度激活、慢性炎症及氧化应激等机制相互促进,形成恶性循环,加速心肌重构和心功能损害。然而,常规心功能指标如左心室射血分数对亚临床期心功能障碍不敏感,难以早期评估共病患者的心脏损害。

心脏磁共振特征追踪(cardiac magnetic resonance feature-tracking, CMR-FT)技术基于常规电影序列,通过追踪心肌像素运动,能够无创、精准地量化整体及节段心肌应变。与超声相比,该技术无声窗依赖,可实现高分辨率的心脏整体评估,在检测HTN与T2DM共病所致的亚临床心功能障碍方面具有独特优势。

本研究采用CMR-FT技术获取HTN患者双心室的常规心功能参数及整体与节段心肌应变参数。通过多变量线性回归校正混杂因素,并采用Benjamini-Hochberg法控制多重比较的假发现率,筛选出HTN合并T2DM组与单纯HTN组间存在显著差异的心功能及应变指标。采用Spearman相关系数分析左、右心室应变参数的相关性。利用弹性网络正则化回归、10折交叉验证及Bootstrap重抽样进行变量筛选,经共线性诊断后纳入多因素logistic回归分析,确定HTN患者合并T2DM的独立相关因素,并建立临床-影像联合预测模型。结果显示,联合模型具有良好的鉴别效能,能有效检出HTN患者合并T2DM相关的早期心室功能损害。校准曲线与决策曲线分析证实模型校准度良好且具有临床实用性,为临床早期风险分层与个体化干预提供了影像学依据。详见内文第70页。

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#### About the cover

Hypertension (HTN) and type 2 diabetes mellitus (T2DM) are the most common cardiovascular and metabolic diseases worldwide, and they frequently coexist. Individuals with both HTN and T2DM have significantly increased risks of all-cause mortality and cardiovascular events. HTN and T2DM promote each other through shared mechanisms including insulin resistance, overactivation of the renin-angiotensin-aldosterone system, chronic inflammation, and oxidative stress, forming a vicious cycle that accelerates myocardial remodeling and cardiac dysfunction. However, conventional cardiac function parameters such as left ventricular ejection fraction are insensitive to subclinical myocardial dysfunction, making it difficult to detect early cardiac impairment in patients with these comorbidities.










Cardiac magnetic resonance feature-tracking (CMR-FT) technology, based on routine cine sequences, can non-invasively and accurately quantify global and segmental myocardial strain by tracking myocardial pixel motion. Compared with echocardiography, this technique is not dependent on ultrasound acoustic windows, enabling high-resolution whole-heart assessment, and offers unique advantages in detecting subclinical myocardial dysfunction induced by the coexistence of HTN and T2DM.

In this study, CMR-FT was used to obtain conventional biventricular functional parameters as well as global and segmental myocardial strain parameters in HTN patients. Multivariable linear regression was performed to adjust for confounding factors, and the Benjamini-Hochberg method was applied to control the false discovery rate in multiple comparisons, identifying significant differences in cardiac function and strain parameters between the HTN+T2DM group and the HTN-only group. Spearman correlation coefficients were used to analyze correlations between left and right ventricular strain parameters. Elastic net regularized regression combined with 10-fold cross-validation and Bootstrap resampling was employed for variable selection; after collinearity diagnostics, the selected variables were entered into multivariable logistic regression to identify independent factors associated with the presence of T2DM in HTN patients and to develop a combined clinical-imaging predictive model. The results showed that the combined model had good discriminative performance and could effectively detect early ventricular functional impairment related to T2DM in HTN patients. Calibration curves and decision curve analysis confirmed good calibration and clinical utility of the model, providing an imaging basis for early risk stratification and individualized intervention. Please see text page 70.

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