

高频超声测量参数与早期类风湿关节炎抗风湿疗效的相关性及预测价值分析*

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摘要 目的:探究高频超声(HFUS)测量参数与早期类风湿关节炎(RA)抗风湿疗效的相关性及预测疗效的价值。**方法:**选取2022年3月至2023年3月安徽省桐城市人民医院收治的97例早期RA患者作为研究组,另选同期97例至少有一个关节炎表现的非RA患者作为对照组。比较两组HFUS测量参数(滑膜厚度、关节积液、血流信号、骨侵蚀评分)、类风湿因子(RF)、血沉(ESR)、C反应蛋白(CRP)水平,分析HFUS测量参数评分与ESR、RF、CRP水平的相关性,研究组均给予抗风湿治疗,比较不同疗效患者治疗前、治疗3个月后HFUS测量参数评分及变化值,分析治疗前后HFUS测量参数评分变化值与抗风湿疗效的相关性,并分析治疗前HFUS测量参数评分预测抗风湿疗效的价值。**结果:**研究组血流信号、滑膜厚度、骨侵蚀、关节积液评分、ESR及血清RF、CRP水平高于对照组($P<0.05$);研究组血流信号、滑膜厚度、骨侵蚀、关节积液评分与RF、ESR、CRP水平呈正相关关系($P<0.05$);疗效良好患者治疗前、治疗3个月后滑膜厚度、血流信号、关节积液、骨侵蚀评分低于疗效差患者,各参数评分变化值大于疗效差患者($P<0.05$);前滑膜厚度、血流信号、关节积液、骨侵蚀评分预测抗风湿疗效AUC分别为0.771、0.742、0.735、0.741,具有一定预测效能,各评分联合预测的AUC为0.921,大于单独预测的AUC($Z=2.316、2.220、2.887、2.414$, $P=0.021、0.026、0.004、0.016$)。**结论:**HFUS测量参数可用于早期RA诊断中,为临床早期评估RA活动度及抗风湿疗效提供参考,以针对性展开后续干预治疗,从而改善预后。

关键词 高频超声;类风湿关节炎;疾病活动度;诊断价值

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Correlation and predictive value of HFUS measurement parameters and anti-rheumatic efficacy of early rheumatoid arthritis

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Abstract Objective: To explore the correlation between high frequency ultrasound (HFUS) measurement parameters and the anti-rheumatic efficacy of early rheumatoid arthritis (RA), and the value of predicting the efficacy. **Methods:** A total of 97 cases of early RA patients admitted to Tongcheng People's Hospital of Anhui Province from March 2022 to March 2023 were selected as the study group, and another 97 cases of non-RA patients with at least one manifestation of arthritis in the same period were selected as the control group. The HFUS measurement parameters (synovial thickness, joint effusion, blood flow signal, bone erosion score), rheumatoid factor (RF), erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP) levels were compared between the two groups. The correlation between HFUS measurement parameter score and ESR, RF, and CRP levels was analyzed. The study group was given anti-rheumatic treatment. The HFUS measurement parameter scores and changes of patients with different curative effects before treatment and after 3 months of treatment were compared, the correlation between the changes of HFUS measurement parameter score before and after treatment and the anti-rheumatic efficacy was analyzed, and the value of HFUS measurement parameter score before treatment in predicting the anti-rheumatic efficacy was analyzed. **Results:** The blood flow signal, synovial thickness, bone erosion, joint effusion score, ESR and serum

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CRP levels were compared between the two groups. The correlation between HFUS measurement parameter score and ESR, RF, and CRP levels was analyzed. The study group was given anti-rheumatic treatment. The HFUS measurement parameter scores and changes of patients with different curative effects before treatment and after 3 months of treatment were compared, the correlation between the changes of HFUS measurement parameter score before and after treatment and the anti-rheumatic efficacy was analyzed, and the value of HFUS measurement parameter score before treatment in predicting the anti-rheumatic efficacy was analyzed. **Results:** The blood flow signal, synovial thickness, bone erosion, joint effusion score, ESR and serum

RF, CRP levels in the study group were higher than those in the control group ($P < 0.05$); in the study group, the blood flow signal, synovial thickness, bone erosion and joint effusion scores were positively correlated with RF, ESR and CRP levels ($P < 0.05$); the synovial thickness, blood flow signal, joint effusion and bone erosion scores of patients with good curative effect before treatment and 3 months after treatment were lower than those of patients with poor curative effect, and the changes of each parameter score were greater than those of patients with poor curative effect ($P < 0.05$); the AUC of anterior synovial thickness, blood flow signal, joint effusion and bone erosion score in predicting anti-rheumatic efficacy were 0.771, 0.742, 0.735 and 0.741, respectively, which had a certain predictive efficiency, and the AUC of combined prediction of each score was 0.921, which was greater than that of single prediction ($z=2.316, 2.220, 2.887, 2.414, P=0.021, 0.026, 0.004, 0.016$). **Conclusion:** HFUS measurement parameters can be used in the early diagnosis of RA and provide reference for early clinical evaluation of RA activity and anti-rheumatic efficacy, so as to carry out targeted follow-up intervention and improve prognosis.

Keywords high-frequency ultrasound; rheumatoid arthritis; disease activity; diagnostic value

类风湿关节炎(rheumatoid arthritis, RA)为一种全身免疫性疾病,临床症状多表现为对称性、慢性多关节炎,可引起关节增生、滑膜炎,侵犯韧带、关节软骨、肌腱等组织,最终导致关节囊破坏、关节功能丧失,具有较高致残率,对患者生活质量造成严重影响^[1-2]。报道显示,RA由于病情反复发作,易导致关节出现不可逆损伤,若未及时诊治可引起骨关节功能丧失甚至残疾^[3]。因此,尽早对RA进行明确诊断至关重要。以往临床对于RA多采用X线进行诊断,但对于RA早期骨损伤敏感度较低,易导致错失最佳治疗时间,从而影响预后^[4]。高频超声(high-frequency ultrasound, HFUS)目前已广泛应用于骨科疾病辅助诊断中,具有简便快捷、可重复性强等优势,可有效显示关节及滑膜病变情况,对于

RA早期诊断具有一定价值^[5-6]。但目前临床鲜有通过HFUS参数评估RA病情及治疗效果的相关研究,基于此,本研究试分析HFUS测量参数诊断早期RA的价值及与抗风湿疗效的相关性分析。

1 资料与方法

1.1 一般资料

选取2022年3月至2023年3月安徽省桐城市人民医院收治的97例早期RA患者作为研究组,另选同期97例至少有一个关节炎表现的非RA患者作为对照组;两组性别、年龄、体质量指数、病程、合并症(高血压、糖尿病)比较,差异均无统计学意义($P > 0.05$),见表1。

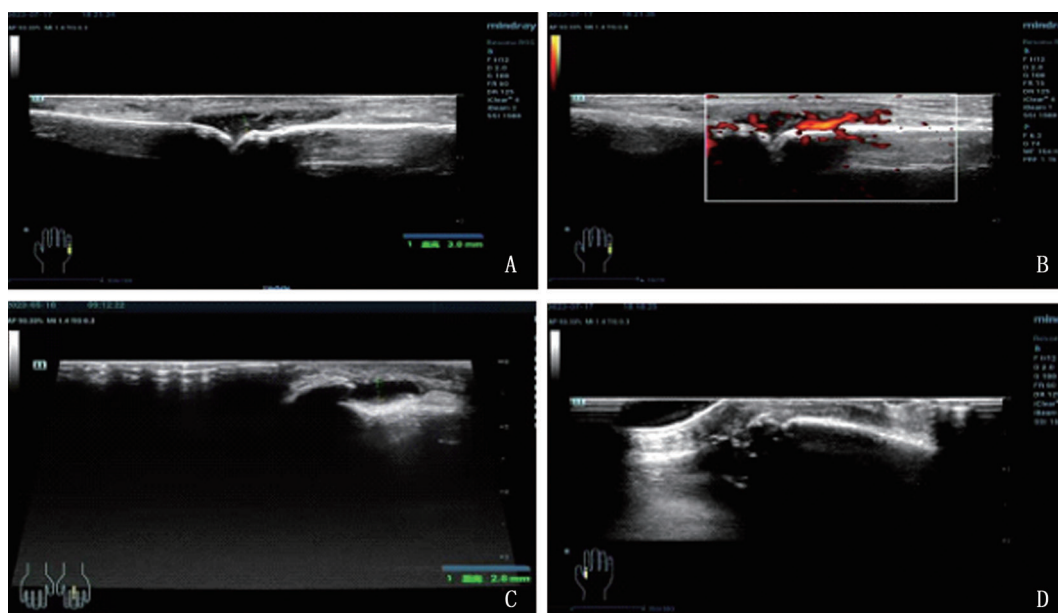
表1 两组一般资料比较

| 组别 | n | 性别 (男/女) | 年龄/岁, $\bar{x} \pm s$ | 体质量指数/ (kg/m^2), $\bar{x} \pm s$ | 病程/月, $\bar{x} \pm s$ | 合并症, n(%) | |
|------------|----|-------------|--------------------------|---|--------------------------|-----------|-----------|
| | | | | | | 高血压 | 糖尿病 |
| 研究组 | 97 | 52/45 | 59.52±6.32 | 23.32±1.03 | 18.84±4.85 | 36(37.11) | 12(12.37) |
| 对照组 | 97 | 54/43 | 60.28±6.52 | 23.53±0.98 | 19.23±5.12 | 40(41.24) | 10(10.31) |
| χ^2/t | | 0.083 | 0.824 | 1.455 | 0.545 | 0.346 | 0.205 |
| P | | 0.773 | 0.411 | 0.147 | 0.587 | 0.556 | 0.651 |

1.2 病例纳入及排除标准

1.2.1 纳入标准 均符合《2010年美国风湿病协会/欧洲抗风湿病联盟分类标准》^[7]中RA相关诊断标准;入组前1周内未使用相关抗风湿类药物治疗;可接受本研究治疗、检查方案;知晓本研究,并签订同意书。

1.2.2 排除标准 合并关节外伤或关节手术史者;合并全身性感染、自身免疫性疾病者;近两个月内服用激素类药物者;关节严重畸形难以评估疗效者;合并肝、肾等重大脏器功能障碍者;合并其他风湿性疾病者;合并精神异常或治疗、检查依从性较差者。



早期RA患者,女,年龄50岁,病程6个月;A:滑膜HFUS图像,显示滑膜增生(2分);B:血流信号HFUS图像,显示滑膜内血流信号(3分);C:关节积液HFUS图像,显示关节腔积液(2分);D:骨侵蚀HFUS图像,显示骨侵蚀(2分)。

图1 研究组典型掌指关节HFUS图像

2.2 HFUS测量参数评分与ESR、RF、CRP水平的相关性

相关性分析显示,研究组滑膜厚度、血流信号、关节积液、骨侵蚀评分与ESR、RF、CRP水平呈正相关关系($P < 0.05$),见表3。

2.3 不同疗效RA患者HFUS测量参数评分及变化值比较

研究组治疗3个月后疗效良好75例,疗效差22例。疗效良好患者治疗前、治疗3个月后滑膜厚度、血流信号、关节积液、骨侵蚀评分低于疗效差患者,各参数评分变化值大于疗效差患者($P < 0.05$),见表4。

表3 HFUS测量参数评分与ESR、RF、CRP水平的相关性

| 指标 | 滑膜厚度评分 | 血流信号评分 | 关节积液评分 | 骨侵蚀评分 |
|-----|----------|--------|--------|--------|
| ESR | <i>r</i> | 0.512 | 0.437 | 0.461 |
| | <i>P</i> | <0.001 | <0.001 | <0.001 |
| RF | <i>r</i> | 0.546 | 0.506 | 0.532 |
| | <i>P</i> | <0.001 | <0.001 | <0.001 |
| CRP | <i>r</i> | 0.491 | 0.392 | 0.418 |
| | <i>P</i> | <0.001 | 0.001 | <0.001 |

表4 不同疗效RA患者HFUS测量参数评分及变化值比较

| 组别 | <i>n</i> | 滑膜厚度评分 | | | 血流信号评分 | | |
|----------|----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | | 治疗前 | 治疗3个月后 | Δ | 治疗前 | 治疗3个月后 | Δ |
| 疗效良好 | 75 | 5.89±1.52 | 3.98±0.94 | 1.91±0.55 | 3.81±1.02 | 2.01±0.57 | 1.80±0.42 |
| 疗效差 | 22 | 6.95±1.14 | 6.53±1.02 | 0.42±0.13 | 4.62±1.05 | 4.16±0.93 | 0.36±0.11 |
| <i>t</i> | | 3.026 | 10.975 | 12.561 | 3.254 | 13.304 | 15.868 |
| <i>P</i> | | 0.003 | <0.001 | <0.001 | 0.002 | <0.001 | <0.001 |
| 组别 | <i>n</i> | 关节积液评分 | | | 骨侵蚀评分 | | |
| | | 治疗前 | 治疗3个月后 | Δ | 治疗前 | 治疗3个月后 | Δ |
| 疗效良好 | 75 | 1.98±0.53 | 0.94±0.27 | 1.04±0.32 | 1.69±0.47 | 0.46±0.09 | 1.23±0.33 |
| 疗效差 | 22 | 2.55±0.49 | 2.08±0.36 | 0.47±0.14 | 2.00±0.43 | 1.83±0.35 | 0.17±0.05 |
| <i>t</i> | | 4.508 | 16.086 | 8.107 | 2.771 | 30.923 | 14.962 |
| <i>P</i> | | <0.001 | <0.001 | <0.001 | 0.007 | <0.001 | <0.001 |

Δ :治疗前与治疗3个月后差值的绝对值。

2.4 治疗前 HFUS 测量参数评分预测抗风湿疗效的价值

以疗效差患者为阳性样本,疗效良好患者为阴性样本,绘制治疗前滑膜厚度、血流信号、关节积液、骨侵蚀评分预测抗风湿疗效差的 ROC 曲线,结

果显示,各评分预测的 AUC 分别为 0.771、0.742、0.735、0.741,均在 0.7 以上,具有一定预测效能,各评分联合预测的 AUC 为 0.921,大于单独预测的 AUC ($Z=2.316$ 、 2.220 、 2.887 、 2.414 , $P=0.021$ 、 0.026 、 0.004 、 0.016),见表 5、图 2。

表 5 治疗前 HFUS 测量参数评分预测抗风湿疗效的价值

| 指标 | AUC | 95%CI | 截断值 | 敏感度/% | 特异度/% | P |
|--------|-------|-------------|-------|-------|-------|--------|
| 滑膜厚度评分 | 0.771 | 0.674~0.850 | 6.42分 | 68.18 | 77.33 | <0.001 |
| 血流信号评分 | 0.742 | 0.643~0.825 | 3.83分 | 59.09 | 86.67 | <0.001 |
| 关节积液评分 | 0.735 | 0.635~0.819 | 2.19分 | 68.18 | 74.67 | <0.001 |
| 骨侵蚀评分 | 0.741 | 0.642~0.824 | 1.89分 | 63.64 | 81.33 | <0.001 |
| 联合预测 | 0.921 | 0.849~0.966 | — | 90.91 | 85.33 | <0.001 |

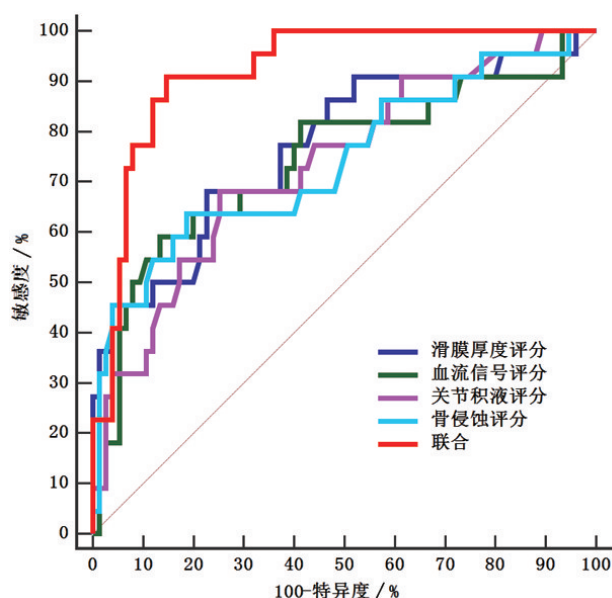


图 2 治疗前 HFUS 测量参数评分预测抗风湿疗效的 ROC 曲线

3 讨论

RA 为以关节炎症病变为主的疾病,可侵犯全身关节,引起关节结构损伤,对患者生命健康造成严重影响^[10]。报道显示^[11-12],RA 主要症状为关节肿痛、僵硬、功能障碍等,随病情进展可对呼吸系统、神经系统等造成损伤。因此,尽早明确诊断 RA 及其病情,针对性给予治疗措施具有重大意义。

影像学检查为目前临床早期诊断 RA 的主要方案,其中 X 线主要通过检查软组织肿胀、骨质疏松、关节面囊性变、关节间隙狭窄等进行诊断,但对于滑膜、肌腱等软组织病变敏感性较低,而 MRI 可通过

检查手关节、腕关节提示早期滑膜炎病变,但对患者具有一定辐射影响^[13-14]。随超声技术不断改善,HFUS 已实现小关节浅表结构高分辨率显像,具有简便快捷、可重复性强等优点,本研究经 HFUS 检查显示,研究组血流信号、滑膜厚度、关节积液、骨侵蚀评分明显高于对照组,提示临床可通过 HFUS 辅助评估诊断 RA。HFUS 检查成像快、分辨率高,随超声探头频率增加,分辨率随之升高,获得超声图像同时可清晰观察关节组织结构,通过延迟复合处理可提升超声成像的穿透深度,清晰反映膝关节病变情况,从而提高临床诊断率^[15]。报道显示,HFUS 与 X 线检查对于中晚期 RA 骨侵蚀检出率无明显差异,但对于早期 RA 骨侵蚀 HFUS 检出率为 X 线检查 8 倍左右,可有效弥补常规影像学检查对早期 RA 诊断灵敏度不足的缺点^[16-17]。

本研究相关性分析结果显示,研究组滑膜厚度、关节积液、血流信号、骨侵蚀评分与 RF、ESR、CRP 水平均呈正相关,进一步证实 HFUS 参数对 RA 的评估诊断价值。相关研究^[18-20]显示,血清 RF、CRP 及 ESR 为目前临床评估 RA 活动的血清学标志物,对于早期 RA 诊断具有较高灵敏度、特异度,其中 RF 多由外周淋巴结、关节滑膜、骨髓等产生,RA 患者中血清 RF 阳性率高达 80%左右,为临床诊断 RA 的重要血清标志物之一。CRP 为一种急性时相反应指标,机体受损或发生炎症时其水平可明显升高,当 RA 患者治疗后处于非活动期时其水平正常,停药后可出现升高,而 ESR 为临床评估 RA 活动度的主要指标。因此,HFUS 参数可用于评估 RA 及其病情进展

情况。本研究还发现,疗效良好患者治疗前、治疗3个月后血流信号、滑膜厚度、骨侵蚀、关节积液评分变化值大于疗效差患者,且变化值与早期RA抗风湿疗效呈正相关,说明HFUS对于RA患者临床疗效具有一定评估预测价值,提示临床可通过HFUS参数早期初步预测疗效,以针对性制定后续干预方案。当RA病变后血流发生改变,通过HFUS检查可获取全方位血流信号,提供血流方案,更为敏感地检测到血流流速变慢等异常现象,有效显示滑膜炎充血状况,因此可为临床评估预测疗效提供依据。

综上所述, HFUS测量参数对于早期RA具有较高诊断价值,临床可通过其早期评估活动度及疗效,以制定相应干预措施,改善预后。

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