



中华临床医师杂志 (电子版)

Chinese Journal of Clinicians (Electronic Edition)

登

期刊导读

8卷8期 2014年4月 [最新]

期刊存档

期刊存档 ▼

[查看目录](#)

期刊订阅

在线订阅

邮件订阅

RSS

作者中心

资质及晋升信息

作者查稿

写作技巧

投稿方式

作者指南

编委会

期刊服务

建议我们

会员服务

广告合作

继续教育

您的位置: [首页](#)>> 文章摘要[中文](#)[English](#)

磁共振引导高强度聚焦超声治疗子宫肌瘤临床研究

陈军臣, 许永华, 王智彪, 陈文直

400016 重庆医科大学生物医学工程学院(陈军臣、许永华、王智彪、陈文直); 中国科学院上海临床中心 上海(许永华)

许永华, Email: yhxu@scrc.ac.cn

科技部“十二五”支撑计划课题(2011BAI14B1)

摘要:磁共振引导高强度聚焦超声(MRgHIFU)利用MRI准确解剖定位引导及实时温度监测功能和高体外将超声能量聚集于治疗靶区使其温度瞬间升高,选择性灭活体内某特定区域病灶,而对病灶结构无损害或损害很少。本文对MRgHIFU治疗子宫肌瘤的作用机制、温度监控技术、临床治疗适应效和并发症及其优势和不足进行综述。

关键词:磁共振成像; 平滑肌瘤; 聚焦超声

[评论](#) [收藏](#) 全

文献标引:陈军臣, 许永华, 王智彪, 陈文直. 磁共振引导高强度聚焦超声治疗子宫肌瘤临床研究[J/CD]. 中版, 2014, 8(8):1512-1520. 复制

参考文献:

- [1] Al-Bataineh O, Jenne J, Huber P. Clinical and future applications of high intensity focused ultrasound in cancer[J]. Cancer Treat Rev, 2012, 38(5): 346-353.
- [2] Illing RO, Kennedy JE, Wu F, et al. The safety and feasibility of extracorporeal focused ultrasound (HIFU) for the treatment of liver and kidney tumours in a Western population[J]. Eur Urol, 2005, 48(8): 890-895.
- [3] Chapman A, ter Haar G. Thermal ablation of uterine fibroids using MR-guided truly non-invasive treatment modality[J]. Eur Radiol, 2007, 17(10): 2505-2511.
- [4] Lénárd ZM, McDannold NJ, Fennessy FM, et al. Uterine leiomyomas: MR imaging-ultrasound surgery--imaging predictors of success[J]. Radiology, 2008, 249(1): 187-193.
- [5] Lynn JG, Zwemer RL, Chick AJ, et al. A new method for the generation and use of ultrasound in experimental biology[J]. J Gen Physiol, 1942, 26(2): 179-193.
- [6] Fry WJ, Barnard JW, Fry FJ, et al. Ultrasonically produced localized selective thermal ablation of the central nervous system[J]. Am J Phys Med, 1955, 34(3): 413-423.

- [7] Fry WJ, Mosberg WH Jr, Barnard JW, et al. Production of focal destructive lesions in the nervous system with ultrasound[J]. J Neurosurg, 1954, 11(5): 471–478.
- [8] Wang ZB, Wu F, Wang ZL, et al. Targeted damage effects of high intensity focused ultrasound (HIFU) on liver tissues of Guizhou Province miniswine[J]. Ultrason Sonochem, 1997, 4(2): 111–115.
- [9] 冯若. 高强度聚焦超声无创性外科的兴起[J]. 临床超声医学杂志, 1999(2): 65–67.
- [10] Wang Z, Bai J, Li F, et al. Study of a "biological focal region" of high-intensity focused ultrasound[J]. Ultrasound Med Biol, 2003, 29(5): 749–754.
- [11] Zhang L, Wang ZB. High-intensity focused ultrasound tumor ablation: review of clinical experience[J]. Front Med China, 2010, 4(3): 294–302.
- [12] Jolesz FA, Hynynen K. Magnetic resonance image-guided focused ultrasound surgery[J]. Radiology, 2002, 245(2): S100–S112.
- [13] Catane R, Beck A, Inbar Y, et al. MR-guided focused ultrasound surgery (MRgFUS) for palliation of pain in patients with bone metastases--preliminary clinical experience[J]. J Bone Min Res, 2007, 18(1): 163–167.
- [14] Yu T, Luo J. Adverse events of extracorporeal ultrasound-guided high intensity focused ultrasound therapy[J]. PLoS One, 2011, 6(12): e26110.
- [15] Rabinovici J, Inbar Y, Revel A, et al. Clinical improvement and shrinkage of uterine fibroids after thermal ablation by magnetic resonance-guided focused ultrasound surgery[J]. Ultrasound Gynecol, 2007, 30(5): 771–777.
- [16] Whitake L. Body & mind: Giving fibroids the heat[N]. Time, 2006-07-07.
- [17] Grossman L, Brock-Abraham C, Carbone N, et al. The 50 best inventions[N]. TIME, 2007-07-07.
- [18] Walker CL, Stewart EA. Uterine fibroids: the elephant in the room[J]. Sciencemag.org, 2007, 317(5840): 1589–1592.
- [19] Ananthakrishnan G, Murray L, Ritchie M, et al. Randomized comparison of uterine artery embolization (UAE) with surgical treatment in patients with symptomatic uterine fibroids: subanalysis of 5-year MRI findings[J]. Cardiovasc Intervent Radiol, 2013, 36(3): 676–683.
- [20] Hanafi M. Predictors of leiomyoma recurrence after myomectomy[J]. Obstet Gynecol, 2007, 110(4): 877–881.
- [21] Yoo EH, Lee PI, Huh CY, et al. Predictors of leiomyoma recurrence after laparoscopic hysterectomy[J]. J Minim Invasive Gynecol, 2007, 14(6): 690–697.
- [22] Taran FA, Tempany CM, Regan L, et al. Magnetic resonance-guided focused ultrasound compared with abdominal hysterectomy for treatment of uterine leiomyomas[J]. Ultrasound Obstet Gynecol, 2009, 34(5): 572–578.
- [23] Cline HE, Schenck JF, Hynynen K, et al. MR-guided focused ultrasound surgery using a transrectal probe[J]. J Assist Tomogr, 1992, 16(6): 956–965.

[24] Cline HE, Hynynen K, Watkins RD, et al. Focused US system for MR imaging-guided focused ultrasound ablation of uterine leiomyomas[J]. Radiology, 1995, 194(3): 731-737.

[25] Tempany CM, Stewart EA, McDannold N, et al. MR imaging-guided focused ultrasound ablation of uterine leiomyomas: a feasibility study[J]. Radiology, 2003, 226(3): 897-905.

[26] Zhang L, Chen WZ, Liu YJ, et al. Feasibility of magnetic resonance imaging-guided high-intensity focused ultrasound therapy for ablating uterine fibroids in patients with leiomyomas of the uterus[J]. Eur J Radiol, 2010, 73(2): 396-403.

[27] 许永华, 符忠祥, 杨利霞, 等. MRI导航和温度监控下高强度聚焦超声治疗子宫肌瘤[J]. 中华妇产科杂志, 2010(11): 869-874.

[28] Gizzo S, Saccardi C, Patrelli TS, et al. Magnetic Resonance-Guided Focused Ultrasound Myomectomy: Safety, Efficacy, Subsequent Fertility and Quality-of-Life Improvements[J]. Reprod Sci, 2014, 21(4): 465-476.

[29] ter Haar G. Therapeutic ultrasound[J]. Eur J Ultrasound, 1999, 9(1): 3-9.

[30] Simon CJ, Dupuy DE, Mayo-Smith WW. Microwave ablation: principles and applications[J]. Radiographics, 2005, 25 Suppl 1: S69-83.

[31] Tempany CM. From the RSNA refresher courses: Image-guided thermal therapy of gynecologic tumors[J]. Radiographics, 2007, 27(6): 1819-1826.

[32] Chen L, ter Haar G, Hill CR. Influence of ablated tissue on the formation of high-intensity focused ultrasound lesions[J]. Ultrasound Med Biol, 1997, 23(6): 921-931.

[33] 马芳, 李发琪, 王智彪. 超声空化效应的研究进展[J]. 临床超声医学杂志, 2003, 5(1): 1-4.

[34] Khokhlova VA, Bailey MR, Reed JA, et al. Effects of nonlinear propagation, cavitation, and boiling in lesion formation by high intensity focused ultrasound in a gel phantom[J]. J Acoust Soc Am, 2006, 119(3): 1834-1848.

[35] Chen L, Rivens I, ter Haar G, et al. Histological changes in rat liver tumor after treatment with high-intensity focused ultrasound[J]. Ultrasound Med Biol, 1993, 19(1): 67-74.

[36] 丁炎, 吴鹏西. MRI 无创测温技术在高强度聚焦超声治疗肿瘤中的应用[J]. 现代中西医结合, 2004, 13(33): 4316-4318.

[37] Bloembergen N, Purcell EM, Pound RV. Relaxation effects in nuclear magnetic absorption[J]. Physical Review, 1948, 73(7): 679.

[38] Cline HE, Hynynen K, Hardy CJ, et al. MR temperature mapping of focused ultrasound ablation of uterine leiomyomas[J]. Magn Reson Med, 1994, 31(6): 628-636.

[39] Heisterkamp J, Matheijsen NA, van Hillegersberg R, et al. Accuracy of MR probe-based temperature monitoring during interstitial laser coagulation (ILC) in the liver at respiration[J]. Magn Reson Med, 1999, 41(5): 919-925.

[40] Delannoy J, Chen CN, Turner R, et al. Noninvasive temperature imaging using MR temperature mapping[J]. Magn Reson Med, 1991, 19(2): 333-339.

- [41] Damianou C, Ioannides K, Hadjisavvas V, et al. MRI monitoring of lesions created below the boiling point and of lesions created above the boiling point using high intensity focused ultrasound[J]. Journal of Biomedical Science and Engineering, 2010, 3(8): 763–775.
- [42] MacFall J, Prescott DM, Fullar E, et al. Temperature dependence of canine bone diffusion coefficient measured in vivo with magnetic resonance echo-planar imaging[J]. Hyperthermia, 1995, 11(1): 73–86.
- [43] Denis de Senneville B, Quesson B, Moonen CT. Magnetic resonance temperature measurement during hyperthermia[J]. Hyperthermia, 2005, 21(6): 515–531.
- [44] McDannold N, Tempany CM, Fennessy FM, et al. Uterine leiomyomas: MR imaging and thermal dosimetry during focused ultrasound thermal ablation[J]. Radiology, 2006, 239(1): 160–167.
- [45] http://www.accessdata.fda.gov/cdrh_docs/pdf4/P040003b.pdf[OL]. 2013-1-22.
- [46] Stewart EA, Gostout B, Rabinovici J, et al. Sustained relief of leiomyoma symptoms after focused ultrasound surgery[J]. Obstet Gynecol, 2007, 110(2 Pt 1): 279–287.
- [47] Coakley FV, Foster BR, Farsad K, et al. Pelvic applications of MR-guided high-intensity focused ultrasound[J]. Abdom Imaging, 2013, 38(5): 1120–1129.
- [48] Stewart EA, Rabinovici J, Tempany CM, et al. Clinical outcomes of focused ultrasound for the treatment of uterine fibroids[J]. Fertil Steril, 2006, 85(1): 22–29.
- [49] Fjeld T, Sorrentino V, Cline H, et al. Design and experimental verification of focused ultrasound lenses for the coagulation of large tissue volumes[J]. Phys Med Biol, 1997, 42(12): 1871–1883.
- [50] Sokka SD, King R, Hynynen K. MRI-guided gas bubble enhanced ultrasound heating of rabbit thigh[J]. Phys Med Biol, 2003, 48(2): 223–241.
- [51] Salomir R, Palussière J, Vimeux FC, et al. Local hyperthermia with MR-guided focused ultrasound: spiral trajectory of the focal point optimized for temperature uniformity in a large region[J]. J Magn Reson Imaging, 2000, 12(4): 571–583.
- [52] Kehler MO, Mougenot C, Quesson B, et al. Volumetric HIFU ablation under 3D MRI thermometry[J]. Med Phys, 2009, 36(8): 3521–3535.
- [53] Voogt MJ, van Stralen M, Ikink ME, et al. Targeted vessel ablation for more efficient resonance-guided high-intensity focused ultrasound ablation of uterine fibroids[J]. Radiol, 2012, 35(5): 1205–1210.
- [54] 梁志刚, 肖雁冰, 杨誉佳, 等. 碘海醇联合 HIFU 治疗子宫肌瘤的临床研究[J]. 中国实用妇产科杂志, 2012, 27(10): 946–949.
- [55] 肖雁冰, 梁志刚, 孙丽君, 等. 碘化油增强 HIFU 损伤离体子宫肌瘤效果的实验研究[J]. 中国实用妇产科杂志, 2009, 23(8): 735–737.
- [56] Takegami K, Kaneko Y, Watanabe T, et al. Erythrocytes, as well as microbubbles, are important factors in improving thermal and therapeutic effects of high-intensity focused ultrasound[J]. Ultrasound Med Biol, 2005, 31(3): 385–390.

[57] Peng S, Xiong Y, Li K, et al. Clinical utility of a microbubble–enhancing agent in treatment of uterine fibroids with high intensity focused ultrasound: a retrospective study. *Eur Radiol*, 2012, 81(12): 3832–3838.

[58] Wang Z, Li F, Bai J. A study of acoustic environment in tissue of high intensity focused ultrasound[C]. 3rd International Symposium on therapeutic ultrasound. Lyon, France, 2012: 413–417.

[59] Voogt MJ, Trillaud H, Kim YS, et al. Volumetric feedback ablation of uterine fibroids using magnetic resonance-guided high intensity focused ultrasound therapy[J]. *Eur Radiol*, 2012, 22(3): 416–417.

[60] Venkatesan AM, Partanen A, Pulanic TK, et al. Magnetic resonance imaging-guided volumetric feedback ablation of symptomatic leiomyomata: correlation of imaging with histology[J]. *J Vasc Interv Radiol*, 2012, 23(6): 786–794.e4.

[61] Smart OC, Hindley JT, Regan L, et al. Gonadotrophin-releasing hormone and magnetic resonance-guided ultrasound surgery for uterine leiomyomata[J]. *Obstet Gynecol*, 2006, 108(1): 161–167.

[62] Smart OC, Hindley JT, Regan L, et al. Magnetic resonance guided focused ultrasound for uterine fibroids—the tissue effects of GnRH agonist pre-treatment[J]. *Eur J Radiol*, 2006, 68(2): 162–167.

[63] Funaki K, Fukunishi H, Sawada K. Clinical outcomes of magnetic resonance-guided ultrasound surgery for uterine myomas: 24-month follow-up[J]. *Ultrasound Obstet Gynecol*, 2007, 29(5): 584–589.

[64] Harding G, Coyne KS, Thompson CL, et al. The responsiveness of the uterine fibroid evaluation questionnaire to changes in health-related quality of life questionnaire (UFS-QOL)[J]. *Health Qual Life Outcomes*, 2007, 5(1): 103.

[65] Hindley J, Gedroyc WM, Regan L, et al. MRI guidance of focused ultrasound treatment of uterine fibroids: early results[J]. *AJR Am J Roentgenol*, 2004, 183(6): 1713–1719.

[66] Okada A1, Morita Y, Fukunishi H, et al. Non-invasive magnetic resonance-guided ultrasound treatment of uterine fibroids in a large Japanese population: impact of treatment on patient outcome[J]. *Ultrasound Obstet Gynecol*, 2009, 34(5): 579–583.

[67] Yoon SW, Seong SJ, Jung SG, et al. Mitigation of abdominal scars during MR-guided focused ultrasound treatment of uterine leiomyomas with the use of an energy-blocking scar probe[J]. *Eur Radiol*, 2011, 22(12): 1747–1750.

[68] Zhao WP, Chen JY, Zhang L, et al. Feasibility of ultrasound-guided high intensity focused ultrasound ablating uterine fibroids with hyperintense on T2-weighted MR imaging[J]. *Eur Radiol*, 2011, 21(1): e43–e49.

[69] Fennessy FM, Tempany CM, McDannold NJ, et al. Uterine leiomyomas: MR imaging and ultrasound findings after MR-guided focused ultrasound surgery—results of different treatment protocols[J]. *Radiology*, 2007, 245(1): 160–167.

[70] Park MJ, Kim YS, Keserci B, et al. Volumetric MR-guided high-intensity focused ultrasound ablation of uterine fibroids: treatment speed and factors influencing speed[J]. *Eur Radiol*, 2012, 22(5): 943–950.

[71] Trumm CG, Stahl R, Clevert DA, et al. Magnetic resonance imaging-guided focused ultrasound ablation of uterine fibroids: treatment speed and factors influencing speed[J]. *Eur Radiol*, 2012, 22(5): 943–950.

treatment of symptomatic uterine fibroids: impact of technology advancement on ablative patients[J]. Invest Radiol, 2013, 48(6): 359–365.

[72] de Melo FC, Diacoyannis L, Moll A, et al. Reduction by 98% in uterine myoma size with significant symptom relief after peripheral treatment with magnetic resonance image focused ultrasound surgery[J]. J Minim Invasive Gynecol, 2009, 16(4): 501–503.

[73] Desai SB, Patil AA, Nikam R, et al. Magnetic Resonance-guided Focused Ultrasound for Uterine Fibroids: First Study in Indian Women[J]. J Clin Imaging Sci, 2012, 2: 74.

[74] Napoli A, Anzidei M, Ciolina F, et al. MR-guided high-intensity focused ultrasound: current status of an emerging technology[J]. Cardiovasc Intervent Radiol, 2013, 36(5): 1190–1196.

[75] Rabinovici J, David M, Fukunishi H, et al. Pregnancy outcome after magnetic resonance focused ultrasound surgery (MRgFUS) for conservative treatment of uterine fibroids[J]. Fertil Steril, 2010, 93(1): 199–209.

[76] Froeling V, Meckelburg K, Schreiter NF, et al. Outcome of uterine artery embolization and MR-guided high-intensity focused ultrasound treatment for uterine fibroids: long-term results[J]. Invest Radiol, 2013, 48(12): 2265–2269.

[77] Leon-Villapalos J, Kaniorou-Larai M, Dziewulski P. Full thickness abdominal wall magnetic resonance guided focused ultrasound therapy[J]. Burns, 2005, 31(8): 1054–1059.

[78] Gorny KR, Woodrum DA, Brown DL, et al. Magnetic resonance- guided focused ultrasound for uterine leiomyomas: review of a 12-month outcome of 130 clinical patients[J]. J Vasc Interv Radiol, 2007, 18(8): 857–864.

[79] Machtlinger R, Inbar Y, Cohen-Eylon S, et al. MR-guided focus ultrasound (MRgFUS) for symptomatic uterine fibroids: predictors of treatment success[J]. Hum Reprod, 2012, 27(10): 2130–2136.

[80] Morita Y, Ito N, Hikida H, et al. Non-invasive magnetic resonance imaging-guided focused ultrasound treatment for uterine fibroids – early experience[J]. Eur J Obstet Gynecol Reprod Biol, 2008, 139(2): 199–203.

[81] Pron G, Mocarski E, Bennett J, et al. Tolerance, hospital stay, and recovery after uterine artery embolization for fibroids: the Ontario Uterine Fibroid Embolization Trial[J]. Invest Radiol, 2003, 14(10): 1243–1250.

[82] Huang Y, Curiel L, Kukic A, et al. MR acoustic radiation force imaging: in vivo validation of MRgFUS using MR acoustic radiation force imaging and ultrasound motion tracking[J]. Med Phys, 2009, 36(6): 2016–2020.

综 述

核受体NR4A1功能及调控的研究进展

谷亚龙，张新东，金保方. 中华临床医师杂志：电子版
2014;8(8):1507-1511.

[摘要](#) [FullText](#) [PDF](#) [评论](#) [收藏](#)

磁共振引导高强度聚焦超声治疗子宫肌瘤临床研究

陈军臣，许永华，王智彪，陈文直. 中华临床医师杂志：电子版

2014;8(8):1512-1520.

[摘要](#) [FullText](#) [PDF](#) [评论](#) [收藏](#)

妇科腹腔镜手术麻醉对眼内压影响的研究进展

牛金柱,赵君. .中华临床医师杂志:电子版

2014;8(8):1521-1524.

[摘要](#) [FullText](#) [PDF](#) [评论](#) [收藏](#)

氯胺酮导致下尿路症状的研究进展

王晓龙,刘同族. .中华临床医师杂志:电子版

2014;8(8):1525-1528.

[摘要](#) [FullText](#) [PDF](#) [评论](#) [收藏](#)

组胺预测心肌缺血研究进展

雷芾华,张玲,侯月梅. .中华临床医师杂志:电子版

2014;8(8):1529-1533.

[摘要](#) [FullText](#) [PDF](#) [评论](#) [收藏](#)

变异型心绞痛发病机制及其认识

曲茹虹,李璇,林宛如. .中华临床医师杂志:电子版

2014;8(8):1534-1537.

[摘要](#) [FullText](#) [PDF](#) [评论](#) [收藏](#)

多发性硬化记忆性T细胞亚群的免疫学研究进展

向雅娟,何洋,刘广志. .中华临床医师杂志:电子版

2014;8(8):1538-1542.

[摘要](#) [FullText](#) [PDF](#) [评论](#) [收藏](#)

人脑胶质瘤相关基因的研究进展

谢欣,易伟,于燕妮,张著学,陈祎. .中华临床医师杂志:电子版

2014;8(8):1543-1548.

[摘要](#) [FullText](#) [PDF](#) [评论](#) [收藏](#)

RGS5在肿瘤抗血管生成的研究进展

谭叶,丁晓,陆海军. .中华临床医师杂志:电子版

2014;8(8):1549-1552.

[摘要](#) [FullText](#) [PDF](#) [评论](#) [收藏](#)

血小板源性生长因子及其受体与胃癌的靶向治疗

刘军才,孙燕来,张毅. .中华临床医师杂志:电子版

2014;8(8):1553-1556.

[摘要](#) [FullText](#) [PDF](#) [评论](#) [收藏](#)

浆细胞样树突状细胞在肝脏疾病中的作用

张新宁,刘荣. .中华临床医师杂志:电子版

2014;8(8):1557-1560.

[摘要](#) [FullText](#) [PDF](#) [评论](#) [收藏](#)

肠道菌群与炎症性肠病

陈玉霞,詹学. .中华临床医师杂志:电子版

2014;8(8):1561-1566.

[摘要](#) [FullText](#) [PDF](#) [评论](#) [收藏](#)

全瓷贴面在前牙美学区的应用前景及潜在风险

刘艳玲,李方兵,赵曦. .中华临床医师杂志:电子版

2014;8(8):1567-1569.

[摘要](#) [FullText](#) [PDF](#) [评论](#) [收藏](#)

