弥散加权磁共振成像技术在恶性肿瘤早期疗效评价及N分期的应用

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摘要 近10年来,功能磁共振成像被广泛应用于研究恶性肿瘤治疗疗效早期评价以及良恶性淋巴结的鉴别。弥散加权磁共振成像(diffusion weighted imaging,DWI)技术是功能磁共振成像的一种,是目前唯一应用于临床的可测量人体内水分子扩散运动的方法。它通过测量活体组织内的水分子弥散运动,从而为早期评价患者对治疗的反应、良恶性淋巴结的鉴别提供重要信息。本文综述了功能磁共振尤其是弥散加权磁共振成像在恶性肿瘤早期疗效评价及淋巴结良恶性鉴别的研究进展,认为弥散加权磁共振成像技术作为一种无创性的功能成像检查方法,通过其高分辨率以及功能成像的特点在以上两方面已经显示出较PET/CT更大的优势,具有相当大的发展前景。

关键词 放疗;热疗;弥散加权磁共振成像;早期疗效;淋巴结

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Application of Diffusion Weighted Magnetic Resonance Imaging in Early Therapeutic Evaluation of Malignant Tumor Treatment and Accurate Lymph Node Staging

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Abstract Over the past decade, functional magnetic resonance imaging (fMRI) has been widely used to study the early therapeutic evaluation of malignant tumor treatment and identification of benign and malignant lymph nodes. Diffusion weighted magnetic resonance imaging (DWI) technology is one of the fMRI technologies, which issensitive to the microscopic motion of water molecules and allows for noninvasive characterization of biological tissues based on their water diffusion properties. The degree of restriction of water diffusion in biological tissues is related to tissue cellularities and the integrity of cell membranes. Thus, DWI may demonstrate early changes in cancers at the cellular level, such as the breakdown of cancer cells or the distortion of the microenvironment. This paper reviews published articles concerning both the early therapeutice valuation and identification of benign and malignant lymph nodes. As a noninvasive screening method with its high resolution and functional imaging features, DWI has shown superiority compared with PET/CT, bearing considerable development prospects.

Keywords radiotherapy; hyperthermia; diffusion weighted magnetic resonance imaging; response; lymph nodes

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RECIST1.1[1]

2~3

intensity modulated radiotherapy IMRT

，

[2]

diffusion weighted imaging DWI

1 弥散加权磁共振成像

1.1 弥散加权磁共振成像简介和原理

[3] apparent diffusion coefficient ADC DWI

ADC

ADC

ADC

ADC

ADC

1.2 弥散加权磁共振图像的主要影响因素

b

b

ADC

b

ADC

b

b ADC

[3]

DWI ADC

ADC b

regions of interest ROI

Lambregts [4] 46

3

ROI

ADC 3

ADC

2 弥散加权磁共振在疗效评价中的研究

2.1 弥散加权磁共振在放化疗疗效评价中的研究

ADC

ADC

[5]

DWI ADC

DWI

DWI Park [6]

8 1

3 1 DWI

PSA serum prostate-specific antigen 4 ADC 0.86×10^{-3} 1.03×10^{-3} 1.15×10^{-3} 1.26×10^{-3} mm^2/s PSA

9.05 9.18 9.25 4.11 ng/mL PSA 3

ADC 1 ADC

PSA ADC

-0.04×10^{-3} -0.017×10^{-3} mm^2/s

DWI

Imanishi [7] 27 T_4

20 40 Gy DWI 20 Gy

ADC 1.13×10^{-3} 0.93×10^{-3} mm^2/s P=0.005 ADC 1.00×10^{-3} mm^2/s

ADC

79% 73% 74% 20 Gy

ADC 35.4% 1.5% P=0.0007

20 Gy ADC 15%

71% 100%

85% [8]

Makino [9] 25

ΔADC r

0.435 P<0.05 ADC 0.43± 0.23 $\times10^{-3}$ mm^2/s 0.25±0.15 $\times10^{-3}$ mm^2/s P<0.05

Cai[10] 2
ADC De Paepe[11] Chen[12]
2 ADC
Wu[13]
1
ADC Ohno
[14] PR 18 SD 40 PD 6 3
ADC 2.05±0.40 $\times 10^{-3}$ 2.68±0.60 $\times$
10^{-3} 3.00±0.33 $\times 10^{-3}$ mm^2/s ADC
Zheng[15]
ADC Barbaro[16] Musio
[17]
ADC

ADC

ADC

5
ADC
ADC ADC

2.2 弥散加权磁共振在热疗疗效评价方面的研究

DWI

41℃
[18] DWI

ADC[19] [20] VX2
[21] ADC ADC
ADC
ADC

ADC

ADC

ADC ADC

10 d ADC
ADC

3 弥散加权磁共振在准确淋巴结分期中的应用

1 cm 1 cm
2 5

10% 20%
5
20%[22]

[23]
DWI
CT CT DWI
69 [

DWI PET/
CT CT DWI
PET/CT Weber [27]
ADC PET
Hagtvedt [28] 27 PET/CT
DWI 1
70% PET/CT
DWI
19 d
2 d DWI
[29 30]

5 展望

DWI
b
b
b
b
ADC
DWI
DWI
N

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·学术动态·

中国科学技术协会

中国科协第280次青年科学家论坛聚焦“雾霾成因与$PM_{2.5}$污染治理”

2014年9月4—6日，由中国科协主办、中国颗粒学会承办，主题为“雾霾成因与$PM_{2.5}$污染治理”的中国科协第280次“青年科学家论坛”在西安召开。

本次论坛由中国科学院地球环境研究所研究员曹军骥、北京大学研究员要茂盛、清华大学教授张强、复旦大学教授成天涛担任执行主席，来自中国科学院有关院所、环境保护部有关研究院所和监测站、中国气象科学院、北京大学、清华大学、复旦大学、西安交通大学、中山大学、南开大学等约80个单位的260余位青年科学家、研究生参与研讨，针对雾霾特征及形成机制、细粒子物理化学特征、$PM_{2.5}$来源、排放及区域污染、颗粒物控制技术及政策等议题的最新进展展开交流。

本次论坛对目前中国雾霾成因与$PM_{2.5}$污染治理等问题达成以下共识：灰霾的形成原因复杂，是内外因共同作用的结果，$PM_{2.5}$污染治理势在必行，建议国家应着力建设一个仪器数据等科研资源可轻松优化共享的平台和机制，为青年科学家建立良好的合作氛围，整合各部门、各团队的优势力量，对大范围灰霾进行综合性质的全面研究，在此基础之上，进行合理的来源解析；针对灰霾的形成原因和来源特征，才能采取合理、经济和有效的控制措施，力争在最短的时间内摸清灰霾成因，控制$PM_{2.5}$污染，还需要加强极端天气的预警预报和应急预案工作，减少灰霾的危害和暴露水平。

详见中国科协网http://www.cast.org.cn/n35081/n35533/n38560/15946166.html。