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## CT 与 MRI 对肝硬化背景下小肝癌检出率的比较

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**摘要 目的:**分析比较 CT 与 MR 对肝硬化背景下小肝癌检出情况,探究 CT 与 MR 在肝硬化背景下小肝癌的诊断价值。**方法:**选择 2010 年 6 月~2015 年 6 月期间,我院收治确诊为肝硬化背景下小肝癌患者 91 例为研究对象,病理及临床相关方法确诊 102 个病灶,其中小肝癌 69 个和微小肝癌 33 个,患者均在不同时期或序列下行多排螺旋 CT 与 MRI 检查,分析比较两者对小肝癌和微小肝癌的检出率。**结果:**多排螺旋 CT 检查发现肝癌小病灶 91 个,其中 66 个小肝癌,25 个微小肝癌;MRI 检查发现 95 个病灶,小肝癌 67 个,微小肝癌 28 个;69 个小肝癌病灶,检出率最高的为 CT 动脉期(92.75%)与 LAVA 动脉期(92.75%),检出率最低的为 CT 平扫(76.81%);33 个微小肝癌病灶,检出率最高为 LAVA 动脉期(75.76%),检出率最低的为 LAVA 平衡期(36.36%);CT 平扫、门静脉期、动脉期、平衡期、MRI-IN-PHASE、LAVA 平衡期、LAVA 平扫对小肝癌的检出率显著高于对微小肝癌的检出率( $P<0.05$ );CT 对小肝癌的检出率显著高于微小肝癌的检出率( $P<0.05$ ),MRI 对小肝癌与微小肝癌的检出率无显著差异( $P>0.05$ );MRI 与 CT 对小肝癌的检出率不存在差异( $P>0.05$ ),但 MRI 对微小肝癌的检出率显著高于 CT( $P<0.05$ )。**结论:**MRI-LAVA 的动脉期序列对小肝癌病灶与微小肝癌病灶的检出率最高;CT 与 MRI 在对小肝癌的检出率不存在差异,但 MRI 对微小肝癌的检出具有更明显的优势。

**关键词:**CT;MRI;肝硬化;小肝癌;检测

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## Comparison of the Detection Rate of CT and MRI in Cirrhosis under the Background of Small Liver Cancer

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**ABSTRACT Objective:** To analyze and compare the detection rate of CT and MR in cirrhosis of the liver under the background of small liver cancer, and to explore their diagnosis value. **Methods:** 91 confirmed patients with cirrhosis in the context of small liver cancer from our hospital during June 2010 to June 2015 were selected as the objects, from which 102 lesions were diagnosed by pathology and clinical, including 69 cases of small liver cancer and 33 cases of micro hepatocellular carcinoma. All patients were examined at different times or sequence by spiral CT and MRI, and their detection rate of liver cancer were compared. **Results:** Using the row helical CT, 91 cases of lesions were found, including 66 cases of small liver cancer and 25 cases of micro liver cancer; And by MRI method, 95 lesions were examined, including 67 cases of small liver cancer and 28 cases of micro liver cancer. To the 69 lesions of small liver cancer, the highest detection rate were gotten at the arterial phase of CT(92.75%)and LAVA(92.75%), and the lowest one was by CT plain scanning (76.81%); To the 33 lesions of micro liver cancer, the highest detection rate was gotten at the arterial phase of LAVA (75.76%), and the lowest one was at the equilibrium phase of LAVA (36.36%). The detection rates to small liver cancer were significantly higher than that of the micro liver cancer by CT plain scanning, portal venous PHASE, arterial PHASE, equilibrium PHASE and MRI - IN - PHASE, LAVA balance period and LAVA plain scanning ( $P<0.05$ ); The detection rate of CT to small liver cancer was significantly higher than that to micro liver cancer ( $P<0.05$ ). There were no significant difference between the detection rates of magnetic resonance imaging (MRI) to small and micro liver cancer ( $P>0.05$ ). The detection rates of small liver cancer were not significantly different between by MRI and by CT ( $P>0.05$ ), but the rate of MRI to micro liver cancer was obviously higher than that of CT ( $P<0.05$ ). **Conclusion:** The detection rates to examine the small and micro liver cancer lesions were the highest at the sequence of MRI - LAVA arterial phase. There were no significant difference between CT and MRI to small liver cancer, but the detection rate of MRI had more obvious advantage.

**Key words:** CT; Magnetic resonance imaging (MRI); Cirrhosis; Small liver cancer; Detection

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### 前言

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肝癌是一种常见恶性肿瘤,在我国恶性肿瘤死因顺位中占第三位,早期患者无明显症状,随着疾病进展,患者肝区将出现疼痛、黄疸、消瘦、腹水、乏力等症状,步入疾病中晚期,治疗的难度及致死率大大增加,严重影响患者的生命安全<sup>[1,2]</sup>。研究报道<sup>[3]</sup>,肝癌患者的早期诊断与治疗是提高其生存率及治愈率的

重要途径。目前,病理组织诊断是诊断肝癌的"金标准",但由于其创伤性,给患者带来的痛苦较大,患者大多排斥<sup>[4]</sup>。而CT与MRI等影像学检查由于其具有检测方便、快速、无创等优点,目前已成为临床肝脏占位性病变诊断的主要方式<sup>[5,6]</sup>。有关肝硬化背景下小肝癌CT与MRI的检出研究大多针对两者在某期小肝癌检出比较,而对于CT各期及MRI各序列的检出报道较少<sup>[7]</sup>。因此,本研究通过分析比较CT与MR对肝硬化背景下小肝癌及微小肝癌检出情况进行比较,为临床早期诊断提供依据。

## 1 对象与方法

### 1.1 研究对象

选择2010年6月~2015年6月期间,我院收治确诊为小肝癌患者为研究对象。纳入排除标准:(1)均为肝硬化背景下小肝癌患者,小肝癌的诊断标准采用中国肝癌病理协作小组制定的标准<sup>[8]</sup>:单个癌结节直径 $\leq 3$  cm,多个癌结节数目 $\leq 2$ 个,各个结节最大径和 $\leq 3$  cm;癌结节直径 $\leq 1$  cm诊断为微小肝癌;(2)所有患者纳入研究前均未接受肝脏介入治疗及手术治疗;(3)所有患者纳入研究前半个月均行多排螺旋CT及MRI检查;(4)排除妊娠期妇女、合并其他恶性肿瘤患者;(5)所有患者及家属均知情同意,并签署《知情同意书》。经纳入排除标准共收集91例小肝癌患者,其中,男61例,女30例,年龄35~74岁,平均年龄 $(51.22 \pm 8.70)$ 岁。CT与MRI检查时间间隔0~15 d。91例患者共发现病灶102个,病灶直径在0.4~3.0 cm之间,其中33个病灶 $\leq 1.0$  cm,69个病灶为1.0~3.0 cm。其中,44例48个病灶通过手术切除确诊,3例3个病灶经原位肝移植全肝切除标本确诊,6例7个病灶经穿刺活检确诊,23例26个病灶经介入治疗染色与碘油沉积确诊,15例18个病灶通过实验室、临床、影像检查及短期随访确诊。

### 1.2 研究方法

CT检查:采用Aquilionone320排CT机对所有研究对象进行动态容积模式扫描,准直器的宽度为 $320 \times 0.5$  mm,转速为0.5 s/rot,管电压取100~120 kV,管电流取150~200 mA,FOV-L扫描;利用Mallinkroot型双筒高压注射器进行动态增强扫描,碘海醇(Iohexol,300 mgI/mL)肘静脉注射流速为4 mL/s,动脉期注射碘海醇30 s后进行全肝扫描,门静脉期注射碘海醇60 s后进行扫描,平衡期注射碘海醇120~180 s后进行扫描。门静脉期重建厚度取1.25 mm,根据肝脏大小,约10 s完成全肝扫描。MRI检查:采用联影1.5 T MR(型号:uMR560)扫描仪进行MRI检查,扫描序列与参数:横轴位呼吸触发T2脂肪抑制+自旋回波(Spin echo,FSE)T2WI,层间距1.5 mm,层厚6 mm,重复时间(Repeat time,TR)约2~3个呼吸周期,回波时间(Echo time,TE)为 $80 \pm 10$  ms,视野 $30 \text{ cm} \times 40 \text{ cm}$ ,矩阵 $224 \times 320$ ,激励次数(Number of incentives,NEX)为2;单次激发自旋回波与回波平像成像差值(SEE-PI)加权成像(Weighted imaging,DWI),弥散横轴位呼吸触发,T2屏气冠状位,TE为75.40 ms,TR为5000 ms,层间距为1.5 mm,层厚为6.0 mm,矩阵为 $128 \times 128$ ,视野(field of view,FOV)为 $40 \text{ cm} \times 40 \text{ cm}$ ,NEX为8;扰相快速稳态梯度回复采集序列(fast steady state phase gradient acquisition sequence,FSPGR)T1WI与反相位成

像相同,屏气、横轴位,TE 2.25 ms/4.5 ms,TR 120~250 ms,层间距为1.5 mm,层厚为6 mm,FOV为 $36 \text{ cm} \times 40 \text{ cm}$ ,矩阵 $170 \times 256$ ,NEX为1;以quick 3D技术行动态三维增强扫描,动脉期为18~22 s,门静脉期为60 s,平衡期为180 s,TR为5.14 ms,TE为2.30 ms,层厚为5 mm,层间距为2.5 mm,FOV $36 \text{ cm} \times 40 \text{ cm}$ ,矩阵 $192 \times 288$ ,依据肝脏的大小行单期全肝扫描约15~18 s完成。

### 1.3 图像分析

在PACS工作站所得图片均由两名经验丰富影像科医师在双盲条件下进行阅片,记录病灶数目,测量患者病灶大小及发生的肝段,在多排螺旋CT动脉期、门静脉期、平衡期及平扫的密度,在MRI各序列DWI、T2WI、梯度回波反相(OUT-PHASE gradient echo)、梯度回波同相(IN PHASE gradient echo,IN-PHASE)、动脉期、LAVA平扫、平衡期、门静脉期上的信号有无包膜、脂肪变性等。

### 1.4 统计学分析

采用SAS9.3统计软件进行统计分析,采用配对卡方检验对多排螺旋CT与MRI共12个序列或期患者小肝癌与微小肝癌的检出率进行比较,采用卡方检验对多排螺旋CT在小肝癌与微小肝癌的检出率进行比较、MRI在小肝癌与微小肝癌检出率进行比较,以 $P < 0.05$ 为差异有统计学意义。

## 2 结果

### 2.1 肝癌小病灶在CT各期的密度与MRI各序列上的信号情况

多排螺旋CT检查发现肝癌小病灶91个,其中66个小肝癌,25个微小肝癌;21个有包膜(完整与不完整),其中18个小肝癌,3个微小肝癌;MRI检查发现95个病灶,小肝癌67个,微小肝癌28个,54个有包膜,其中48个小肝癌,6个微小肝癌,见表1。

### 2.2 CT各期及MRI各序列对于小肝癌及微小肝癌的检出

69个小肝癌病灶,检出率最高的为CT动脉期(92.75%)、LAVA动脉期(92.75%),检出率最低的序列是CT平扫(76.81%);33个微小肝癌病灶,检出率最高为LAVA动脉期(75.76%),检出率最低的为LAVA平衡期(36.36%)。CT平扫、门静脉期、动脉期、平衡期、MRI-IN-PHASE、LAVA平衡期、LAVA平扫对小肝癌的检出率显著高于对微小肝癌的检出率( $P < 0.05$ ),MR-T2WI、MRI-OUT-PHASE、DWI、LAVA门静脉期、LAVA动脉期对小肝癌与微小肝癌的检出率无显著差异( $P > 0.05$ ),见表2。

### 2.3 CT和MRI对小肝癌及微小肝癌的检出

本研究显示,CT对小肝癌的检出率显著高于微小肝癌的检出率( $P < 0.05$ ),MRI对小肝癌与微小肝癌的检出率无显著差异( $P > 0.05$ );MRI与CT对小肝癌的检出率不存在差异( $P > 0.05$ ),但MRI对微小肝癌的检出率显著高于CT( $P < 0.05$ ),见表3。

## 3 讨论

近年来,随着医学影像学技术的发展及对比剂的应用,小肝癌的检出率明显上升,在肝癌的定位、定性、检出及分期中均起到重要的作用<sup>[9]</sup>。影像学在肝癌诊断的价值已远远超过血清学诊断<sup>[9,10]</sup>,能够为肝癌患者手术治疗方案制定及术后预测均提

供重要依据。目前,影像学检查以 CT 和 MRI 最为常见,其广泛应用于肝硬化背景小肝癌的筛查,但关于两种方式对小肝癌患者病灶的检出率国内外研究报道不尽相同<sup>[1]</sup>。CT 与 MRI 检查主要通过患者肝脏的形态、大小变化,肝脏正常组织与病变组织间信号差及密度差进行诊断。肝癌 CT 平扫的典型表现为密度低,DWI 与 T2WI 的信号相对较高,CT 与 MRI 增强动态扫

描动脉期呈现高信号或高密度,门静脉期呈现低信号或低密度,平衡期信号低或密度低,而小肝癌大部分呈"速升速降"强化方式,少部分肝癌患者由于分化程度、细胞成分死亡差异影像学检查表现不典型,增加早期检出的难度<sup>[2]</sup>。因此,本研究分析比较 CT 与 MR 对肝硬化背景下小肝癌检出情况,探究 CT 与 MR 在肝硬化背景下小肝癌的诊断价值。

表 1 肝癌小病灶在 CT 各期的密度与 MRI 各序列上的信号情况

Table 1 The density at each Phase of CT and the signal in each sequence of MRI in small lesions of liver cancer

| Examination sequences | Low density or signal |        | Medium density or signal |        | High density or signal |        |
|-----------------------|-----------------------|--------|--------------------------|--------|------------------------|--------|
|                       | 1~3 cm                | ≤ 1 cm | 1~3 cm                   | ≤ 1 cm | 1~3 cm                 | ≤ 1 cm |
| CT plain scanning     | 53                    | 17     | 13                       | 8      | 0                      | 0      |
| Arterial phase        | 13                    | 3      | 2                        | 3      | 51                     | 19     |
| Portal venous phase   | 43                    | 11     | 7                        | 5      | 16                     | 9      |
| Equilibrium phase     | 57                    | 19     | 9                        | 6      | 0                      | 0      |
| MR-T2 WI              | 0                     | 0      | 8                        | 5      | 59                     | 23     |
| DWI                   | 0                     | 0      | 10                       | 6      | 56                     | 23     |
| IN-PHASE              | 44                    | 14     | 7                        | 8      | 16                     | 6      |
| OUT-PHASE             | 47                    | 17     | 8                        | 7      | 12                     | 4      |
| LAVA plain scanning   | 45                    | 15     | 5                        | 9      | 17                     | 4      |
| Arterial phase        | 2                     | 1      | 3                        | 3      | 62                     | 24     |
| Portal venous phase   | 42                    | 10     | 7                        | 5      | 18                     | 13     |
| Equilibrium phase     | 52                    | 9      | 9                        | 16     | 6                      | 3      |

表 2 CT 各期及 MRI 各序列对于小肝癌及微小肝癌的检出

Table 2 Detection of small and micro liver cancer at each Phase of CT and in each sequence of MRI

| Examination sequences | 1~3 cm(n=69) |         | ≤ 1 cm(n=33) |         | x <sup>2</sup> | P     |
|-----------------------|--------------|---------|--------------|---------|----------------|-------|
|                       | Number       | Rate(%) | Number       | Rate(%) |                |       |
| CT plain scanning     | 53           | 76.81   | 17           | 51.52   | 5.313          | 0.022 |
| Arterial phase        | 64           | 92.75   | 22           | 66.67   | 8.311          | 0.003 |
| Portal venous phase   | 59           | 85.51   | 20           | 60.61   | 9.700          | 0.002 |
| Equilibrium phase     | 57           | 82.61   | 19           | 57.58   | 8.310          | 0.004 |
| MR T2WI               | 59           | 85.51   | 23           | 69.70   | 1.431          | 0.221 |
| DWI                   | 56           | 81.16   | 22           | 66.67   | 1.022          | 0.312 |
| IN-PHASE              | 60           | 86.96   | 20           | 60.61   | 4.911          | 0.025 |
| OUT-PHASE             | 59           | 85.51   | 21           | 63.64   | 2.651          | 0.112 |
| LAVA 平扫               | 62           | 89.86   | 19           | 57.58   | 7.356          | 0.007 |
| Arterial phase        | 64           | 92.75   | 25           | 75.76   | 1.334          | 0.245 |
| Portal venous phase   | 60           | 86.96   | 23           | 69.70   | 1.921          | 0.170 |
| Equilibrium phase     | 58           | 84.06   | 12           | 36.36   | 16.384         | 0.000 |

表 3 CT 和 MRI 对小肝癌及微小肝癌的检出

Table 3 Detection of small and micro liver cancer by CT and MRI

| Examination methods | 1~3cm(n=69) |         | ≤ 1 cm(n=33) |         | x <sup>2</sup> | P     |
|---------------------|-------------|---------|--------------|---------|----------------|-------|
|                     | Number      | Rate(%) | Number       | Rate(%) |                |       |
| CT                  | 66          | 95.65   | 25           | 75.76   | 10.332         | 0.001 |
| MRI                 | 67          | 97.10   | 28           | 84.85   | 3.411          | 0.068 |
| x <sup>2</sup>      | 0.251       |         | 1.997        |         |                |       |
| P                   | 0.723       |         | 0.044        |         |                |       |

研究报道<sup>[13]</sup>,MRI 检出肝癌的敏感性显著高于 CT, 其中 MRI 动脉早期检出的敏感性最高, 其次为 MRI 门静脉期,而 MRI 平扫、CT 平扫与门静脉期检查的敏感性较低。Kircher A 等<sup>[14]</sup>发现,MRI 动脉期对血供丰富小肝癌的检测率显著高于 CT, 且 MRI 延迟期对供血较少的小肝癌的检出率显著高于 CT。另有研究报道<sup>[15]</sup>,多排螺旋 CT 在小肝癌与微小肝癌的检出率显著高于 MRI 动态增强。本研究显示,CT 与 MRI 各期或序列在小肝癌与微小肝癌的检出率高低顺序存在差异,但研究发现 MRI-LAVA 动脉期(92.75%)与 CT 动脉期(92.75%)的检出率均相对较高,CT 平扫(76.81%)检出率相对较低。CT 动脉期与 MR 动脉期对小肝癌检出率较高原因可能与动脉期患者病灶和正常肝组织之间的信号或密度的差异最大有关,因为小肝癌大部分均供血丰富,且由肝动脉供血,而正常肝组织的血供来自于门静脉。本研究显示,MRI 与 CT 对小肝癌的检出率不存在差异( $P>0.05$ ),但 MRI 对微小肝癌的检出率显著高于 CT( $P<0.05$ ),可见,MRI 与 CT 在肝癌诊断的差别主要在于微小肝癌上,MRI 相对 CT 在检出微小病灶具有更明显的优势,究其原因可能存在以下几方面<sup>[16,17]</sup>:(1)动态 MRI 增强与 CT 增强存在差别,两者对比剂的用量、注射方式及增强后扫描时间上存在差异;(2)MRI 对组织的分辨率相对较高,且为多序列成像,DWI、T2WI、OUT-PHASE、IN-PHASE 及 LAVA 图像可相互补充,能够更明显的显示病灶特征,提高检出率,与既往研究报道一致<sup>[18-21]</sup>。本研究显示,69 个小肝癌病灶中 CT 未发现 3 个病灶,MRI 未检出 2 个病灶;33 个微小肝癌 CT 未检出病灶 8 个,MRI 未检出 5 个,且二者之间并不存在完全的重叠,因此,MRI 与 CT 在肝癌病灶的检出上均有一定互补作用。两者联合用于更有利于小肝癌及微小肝癌的诊断。

综上所述,MRI-LAVA 的动脉期序列对小肝癌病灶与微小肝癌病灶的检出率最高;CT 与 MRI 在对小肝癌的检出率不存在差异,但对于微小肝癌 MRI 相对于 CT 具有更明显的优势。

#### 参考文献(References)

- [1] Zeng J, Yin P, Tan Y, et al. Metabolomics study of hepatocellular carcinoma: discovery and validation of serum potential biomarkers by using capillary electrophoresis-mass spectrometry[J]. J Proteome Res, 2014, 13(7): 3420-3431
- [2] 潘改燕,潘艳,张鹏,等.益气活血解毒中药联合奥沙利铂对晚期肝癌 AFP、VEGF 的影响[J].现代生物医学进展,2016, 16(31): 6124-6127  
Pan Gai-yan, Pan Yan, Zhang Peng, et al. Effects of Yiqi Huoxue Jiedu Method and Oxaliplatin on Serum Levels of AFP and VEGF and Clinical Efficacy for Patients with Advanced Liver Cancer[J]. Progress in Modern Biomedicine, 2016, 16(31): 6124-6127
- [3] Wang YX, De Baere T, Idée JM, et al. Transcatheter embolization therapy in liver cancer: an update of clinical evidences[J]. Chin J Cancer Res, 2015, 27(2): 96-121
- [4] Jirun P, Zhang G, Kim HK, et al. Clinical utility of alpha fetoprotein and HCCR-1, alone or in combination, in patients with chronic hepatitis, liver cirrhosis and hepatocellular carcinoma [J]. Dis Markers, 2011, 30(6): 307-315
- [5] Stankovic Z. Four-dimensional flow magnetic resonance imaging in cirrhosis[J]. World J Gastroenterol, 2016, 22(1): 89-102
- [6] 戴谦,刘兆玉.64 层螺旋 CT 在原发性肝癌诊断中的应用价值研究[J].辽宁医学院学报,2015, 36(5): 19-21
- [7] Dai Qian, Liu Zhao-yu. Value Evaluation of 64-Slice Spiral CT for Diagnosis of Hepatic Carcinoma[J]. Journal of Liaoning Medical University, 2015, 36(5): 19-21
- [8] Kijima S, Sasaki T, Nagata K, et al. Preoperative evaluation of colorectal cancer using CT colonography, MRI, and PET/CT[J]. World J Gastroenterol, 2014, 20(45): 16964-16975
- [9] Tomba C, Elli L, Bardella MT, et al. Enteroscopy for the early detection of small bowel tumours in at-risk celiac patients [J]. Dig Liver Dis, 2014, 46(5): 400-404
- [10] Morani AC, Vicens RA, Wei W, et al. CAIPIRINHA-VIBE and GRAPPA-VIBE for liver MRI at 1.5 T: a comparative in vivo patient study[J]. J Comput Assist Tomogr, 2015, 39(2): 263-269
- [11] Korean Liver Cancer Study Group(KLCSG), National Cancer Center, Korea (NCC). 2014 Korean Liver Cancer Study Group-National Cancer Center Korea Practice Guideline for the Management of Hepatocellular Carcinoma[J]. Korean J Radiol, 2015, 16(3): 465-522
- [12] Xu Y, Lu X, Mao Y, et al. Clinical diagnosis and treatment of alpha-fetoprotein-negative small hepatic lesions[J]. Chin J Cancer Res, 2013, 25(4): 382-388
- [13] Liu J, Wang S, Linguraru MG, et al. Tumor sensitive matching flow: A variational method to detecting and segmenting perihepatic and perisplenic ovarian cancer metastases on contrast-enhanced abdominal CT[J]. Med Image Anal, 2014, 18(5): 725-739
- [14] Kircher A, Bongartz G, Merkle EM, et al. Rational imaging of hepatocellular carcinoma. The challenge of multimodal diagnostic criteria [J]. Radiologe, 2014, 54(7): 664-672
- [15] Zech CJ, Korpraphong P, Huppertz A, et al. Randomized multicentre trial of gadoteric acid-enhanced MRI versus conventional MRI or CT in the staging of colorectal cancer liver metastases[J]. Br J Surg, 2014, 101(6): 613-621
- [16] Cristea CG, Gheonea IA, Sandulescu LD, et al. Considerations regarding current diagnosis and prognosis of hepatocellular carcinoma [J]. J Med Life, 2015, 8(2): 120-128
- [17] Ricke J, Seidensticker M, Mohnike K. Noninvasive diagnosis of hepatocellular carcinoma in cirrhotic liver: current guidelines and future prospects for radiological imaging[J]. Liver Cancer, 2012, 1(1): 51-58
- [18] Zheng J, Li J, Cui X, et al. Comparison of diagnostic sensitivity of C-arm CT, DSA and CT in detecting small HCC [J]. Hepatogastroenterology, 2013, 60(126): 1509-1512
- [19] Choi JY, Lee JM, Sirlin CB. CT and MR Imaging Diagnosis and Staging of Hepatocellular Carcinoma: Part II.Extracellular Agents, Hepatobiliary Agents, and Ancillary Imaging Features [J]. Radiology, 2014, 273(1): 30-50
- [20] Corona-Villalobos CP, Halappa VG, Bonekamp S, et al. Functional Magnetic Resonance Imaging Response of Targeted Tumor Burden and Its Impact on Survival in Patients with Hepatocellular Carcinoma [J]. Invest Radiol, 2015, 50(4): 283-289
- [21] Lohrke J, Frenzel T, Endrikat J, et al. 25 Years of Contrast-Enhanced MRI: Developments, Current Challenges and Future Perspectives[J]. Adv Ther, 2016, 33(1): 1-28
- [22] Maniam S, Szklaruk J. Magnetic resonance imaging: Review of imaging techniques and overview of liver imaging[J]. World J Radiol, 2010, 2(8): 309-322