

• 消化专栏 •

磁共振电影相位对比对肝硬化门静脉高压食管胃底静脉曲张破裂出血介入术预后不良风险的预测价值

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[摘要] 目的 探讨磁共振相位对比电影成像(cine phase-contrast magnetic resonance imaging, Cine PC MRI)相关参数预测肝硬化门静脉高压食管胃底静脉曲张破裂出血(cirrhotic portal hypertension-esophagogastric variceal bleeding, CPH-EVB)介入术预后不良风险的价值。方法 选取2021年1月—2024年1月河北省保定市第二中心医院收治的CPH-EVB患者102例作为研究对象进行前瞻性研究,均于介入术治疗前行Cine PC MRI检查,并于术后随访12个月,失访1例,依据患者预后分为预后良好组70例、预后不良组31例,比较2组临床资料及Cine PC MRI定量参数[门静脉内径(portal vein diameter, Dpv)、门静脉横截面积(portal vein cross-sectional area, Apv)、门静脉血流速度(portal vein blood flow velocity, Vpv)、门静脉血流量(portal vein blood flow volume, Qpv)],采用点二列相关性分析各指标与病情指标的相关性,Logistic回归分析确定CPH-EVB介入术预后的影响因素,分析Cine PC MRI定量参数(Dpv、Apv、Vpv、Qpv)与CPH-EVB介入术预后的关系,绘制受试者工作特征(receiver operating characteristic, ROC)曲线,计算曲线下面积(area under curve, AUC)分析各指标对CPH-EVB介入术预后的预测价值。结果 预后不良组Child-Pugh分级C级占比(70.97%)、出血量 ≥ 500 mL占比(67.74%)高于预后良好组(45.71%、40.00%), Dpv[(1.58 $\pm$ 0.13)cm]、Apv[(2.17 $\pm$ 0.15)cm²]高于预后良好组[(1.47 $\pm$ 0.10)cm、(2.05 $\pm$ 0.11)cm²], Vpv[(6.87 $\pm$ 1.14)cm/s]、Qpv[(15.19 $\pm$ 3.61)cm²/s]低于预后良好组[(8.53 $\pm$ 1.59)cm/s、(18.76 $\pm$ 4.08)cm²/s],差异有统计学意义($P < 0.05$)。相关性分析结果显示, Dpv、Apv与Child-Pugh分级($r = 0.669, 0.681$)、出血量($r = 0.674, 0.686$)呈正相关(均 $P < 0.001$), Vpv、Qpv与Child-Pugh分级($r = -0.702, -0.710$)、出血量($r = -0.715, -0.721$)呈负相关(均 $P < 0.001$)。Logistic回归分析结果显示, Dpv(OR=1.897, 95%CI: 1.335~2.697)、Apv(OR=2.002, 95%CI: 1.418~2.826)、Vpv(OR=0.695, 95%CI: 0.507~0.953)、Qpv(OR=0.756, 95%CI: 0.589~0.971)是CPH-EVB介入术预后不良风险的独立影响因素($P < 0.05$);绘制ROC曲线分析结果显示, Dpv、Apv、Vpv、Qpv联合预测CPH-EVB介入术预后不良风险的AUC为0.924,高于各参数单独预测(0.758、0.730、0.765、0.783,均 $P < 0.05$)。结论 Cine PC MRI定量参数(Dpv、Apv、Vpv、Qpv)与CPH-EVB患者介入术后预后及病情指标(Child-Pugh分级、出血量)有关,各指标联合可为临床预测CPH-EVB介入术后预后提供一定参考。

[关键词] 肝硬化;食管和胃静脉曲张;电影相位对比磁共振 doi:10.3969/j.issn.1007-3205.2026.01.004
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Predictive value of cine phase-contrast magnetic resonance imaging in assessing the risk of poor prognosis in interventional therapy for patients with cirrhotic portal hypertension-esophagogastric variceal bleeding

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[Abstract] Objective To investigate the value of cine phase-contrast magnetic resonance imaging (Cine PC MRI)-related parameters in predicting the risk of poor prognosis in interventional therapy for patients with cirrhotic portal hypertension-esophagogastric variceal bleeding (CPH-EVB). **Methods** A total of 102 patients with CPH-EVB admitted to the the Second Central Hospital of Baoding City from January 2021 to January 2024 were selected as the research subjects for a prospective study. All patients underwent Cine PC MRI before interventional therapy, and were followed up for 12 months after operation, and one case was lost to follow-up. According to the prognosis of the patients, they were divided into good prognosis group ($n=70$) and poor prognosis group ($n=31$). The clinical data and Cine PC MRI quantitative parameters [portal vein diameter (Dpv), portal vein cross-sectional area (Apv), portal vein blood flow velocity (Vpv), portal vein blood flow volume (Qpv)] were compared between the two groups. The correlation between each index and disease index was analyzed by point-biserial correlation. Logistic regression analysis was used to determine the influencing factors of prognosis of CPH-EVB intervention. The relationship between Cine PC MRI quantitative parameters (Dpv, Apv, Vpv, Qpv) and prognosis of CPH-EVB intervention was analyzed, and the receiver operating characteristic (ROC) curve was drawn. The area under the ROC curve (AUC) was calculated to analyze the predictive value of each index for the prognosis of CPH-EVB intervention. **Results** The proportion of Child-Pugh classification C (70.97%) and the proportion of bleeding volume ≥ 500 mL (67.74%) in the poor prognosis group were higher than those in the good prognosis group (45.71%, 40.00%); Dpv [(1.58 ± 0.13) cm] and Apv [(2.17 ± 0.15) cm²] were higher than those in the good prognosis group [(1.47 ± 0.10) cm, (2.05 ± 0.11) cm²], while Vpv [(6.87 ± 1.14) cm/s] and Qpv [(15.19 ± 3.61) cm³/s] were lower than those in the good prognosis group [(8.53 ± 1.59) cm/s, (18.76 ± 4.08) cm³/s], showing significant differences ($P < 0.05$). Correlation analysis showed that Dpv and Apv were positively correlated with Child-Pugh classification ($r=0.669, 0.681$, both $P < 0.05$) and bleeding volume ($r=0.674, 0.686$, both $P < 0.05$), while Vpv and Qpv were negatively correlated with Child-Pugh classification ($r=-0.702, -0.710$, both $P < 0.05$) and bleeding volume ($r=-0.715, -0.721$, both $P < 0.01$). Logistic regression analysis showed that Dpv (OR=1.897, 95%CI: 1.335–2.697), Apv (OR=2.002, 95%CI: 1.418–2.826), Vpv (OR=0.695, 95%CI: 0.507–0.953) and Qpv (OR=0.756, 95%CI: 0.589–0.971) were independent influencing factors for poor prognosis of CPH-EVB intervention ($P < 0.05$). The ROC curve showed that the AUC of Dpv, Apv, Vpv and Qpv combined to predict the risk factors for poor prognosis of CPH-EVB intervention was 0.924, which was higher than that of each parameter alone (0.758, 0.730, 0.765, 0.783, all $P < 0.05$). **Conclusion** The quantitative parameters of Cine PC MRI (Dpv, Apv, Vpv, Qpv) are related to the prognosis and disease indicators (Child-Pugh classification, bleeding volume) of CPH-EVB patients after interventional therapy. The combination of each index can provide a certain reference for clinical prediction of the prognosis of CPH-EVB after interventional therapy.

[Key words] liver cirrhosis; esophageal and gastric varices; cine phase-contrast magnetic resonance imaging

肝硬化诱发的门静脉高压的发生可诱导上消化道出血, 其中肝硬化门静脉高压食管胃底静脉曲张破裂出血 (cirrhotic portal hypertension-esophagogastric variceal bleeding, CPH-EVB) 病情较凶险, 患者病死率较高^[1-2]。临床有效评估 CPH-EVB 血流动力学情况, 可在一定程度上指导治疗方案的制定, 并改善患者预后。但多普勒超声成像影响因素较多, CT 门静脉血管造影无法定量评价门静脉的血流速度, 而 Cine PC MRI 可定量研究全身血流情况, 且安全无创, 重复性、准确性较高^[3-4]。磁共振相位对比电影成像 (cine phase-contrast magnetic resonance imaging, Cine PC MRI) 是一种无创测量血流的方法, 其后处理

技术较强大, 可清晰显示门体侧支循环情况, 在临床定量研究门静脉血流动力学中有一定应用价值^[5-6]。门静脉血流情况对 CPH-EVB 患者病情评估及后续治疗方案的制定有重要意义, 目前临床研究门静脉血流常采用多普勒超声成像或 CT 门静脉血管造影^[7-8]。但目前分析其与 CPH-EVB 患者介入术后预后关系的相关研究较少, 基于此, 本研究通过比较不同预后患者 Cine PC MRI 定量参数 [门静脉内径 (portal vein diameter, Dpv)、门静脉横截面积 (portal vein cross-sectional area, Apv)、门静脉血流速度 (portal vein blood flow velocity, Vpv)、门静脉血流量 (portal vein blood flow volume, Qpv)] 的情况, 旨在为临床预测 CPH-

EVB患者介入术后预后提供参考。现报告如下。

1 资料与方法

1.1 一般资料 前瞻性选取2021年1月—2024年1月河北省保定市第二中心医院收治的CPH-EVB患者102例为研究对象。纳入标准：①经临床诊断符合《肝硬化诊治指南》^[9]中肝硬化相关的诊断标准；②因急性上消化道出血入院，并于入院后24~72 h内完成急诊胃镜检查，证实为食管胃底静脉曲张破裂出血，镜下可见活动性喷血、渗血或曲张静脉上附着新鲜血栓头等近期出血征象；③无高血压、糖尿病等慢性疾病；④无其他影响门静脉血流动力学的疾病。排除标准：①腹部手术史；②合并恶性肿瘤；③存在血液系统疾病。

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1.2 方法

1.2.1 资料收集 由医护人员收集患者临床资料，包括性别、年龄、体重指数，评估检测患者肝硬化类型（乙型肝炎肝硬化、酒精性肝硬化、丙型肝炎肝硬化）、静脉曲张程度、Child-Pugh分级、出血量，收集患者接受的介入术方式（内镜下治疗术、逆行静脉栓塞术、经颈静脉肝内门体分流术）。其中肝硬化类型依据《肝硬化诊治指南》^[8]相关标准进行分类。静脉曲张程度依据形态及出血情况进行分级^[10]，轻度：无红斑、红色条纹、血泡样（红色征），但静脉曲张呈直线形或略有迂曲；中度：静脉曲张呈直线形或略有迂曲且存在红色征，或呈蛇形迂曲隆起但无红色征；重度：静脉曲张呈蛇形迂曲隆起且存在红色征，或呈串珠状、结节状或瘤状。Child-Pugh分级^[11]依据总胆红素、血清白蛋白、凝血酶原时间延长、腹腔积液、肝性脑病情况，将患者分为A级、B级、C级，其中A级为代偿期肝硬化，B级为失代偿早期，C级为失代偿晚期。本研究仅纳入B级、C级患者。出血量评估需结合患者及家属对呕血与黑便频率、容量的描述，以及入院时血红蛋白下降程度，血流动力学状态，并由2位高年资主治医师共同估算出血总量，并将患者分为<500 mL和≥500 mL。

1.2.2 Cine PC MR检测 于患者入院时，采用西门子公司MAGNETOM Lumina 3.0 T机进行Cine PC MR检测。患者禁食4~6 h，训练呼吸（如呼气末屏气或均匀呼吸），连接心电/脉搏以同步扫描，需取仰卧位，头先进，采用体部线

圈测量，①HASTE序列：重复时间（repetition time, TR）=5.1 ms，回波时间（echo time, TE）=3.1 ms，层厚8.0 mm，层数1层，视野范围（field of view, FOV）=320 mm，矩阵192×256，激励次数（number of signals averaged, NSA）=1，获取横断位、冠状位、矢状位定位像；②Phase Contrast序列：轴位TR=3.1 ms，TE=1.6 ms，层厚5.0 mm，层数24层，FOV=350 mm，矩阵252×256，NSA=1，定位门静脉血管。基于第一肝门层面冠状定位门静脉，平行于门静脉长轴行斜矢状门静脉扫描，最后采用冠状面、斜矢状面双定位垂直肝外门静脉中点，检测、记录门静脉的横截面积，血流速度。后处理采用Syngo Via后处理工作站，勾画门静脉主干范围，测量Dpv、Apv、Vpv、Qpv。

1.2.3 预后评估 依据患者实际情况及《肝硬化诊治指南》^[9]相关标准制定治疗方案，并采取常规治疗及内镜下治疗术、逆行静脉栓塞术或经颈静脉肝内门体分流术等。术后随访12个月，失访1例，根据随访结果将患者分为预后良好组70例和预后不良组31例（其中死亡6例）。预后良好组：随访期间存活且未发生食管胃底静脉曲张再出血。预后不良组：符合以下任一情况均视为预后不良，①随访期间发生食管胃底静脉曲张再出血；②随访期间因任何原因死亡。

1.3 观察指标 ①比较2组临床资料，包括性别、年龄、体重指数、肝硬化类型（乙型肝炎肝硬化、酒精性肝硬化、丙型肝炎肝硬化）、静脉曲张程度、Child-Pugh分级、出血量、介入术方式（内镜下治疗术、逆行静脉栓塞术、经颈静脉肝内门体分流术）情况。②比较2组Cine PC MRI定量参数（Dpv、Apv、Vpv、Qpv）。③分析Cine PC MRI定量参数（Dpv、Apv、Vpv、Qpv）与患者Child-Pugh分级、出血量的相关性。④分析CPH-EVB介入术预后的影响因素。⑤平滑曲线拟合分析Cine PC MRI定量参数（Dpv、Apv、Vpv、Qpv）与CPH-EVB介入术预后的关系。⑥分析Cine PC MRI定量参数（Dpv、Apv、Vpv、Qpv）对CPH-EVB介入术预后的预测价值。

1.4 统计学方法 应用SPSS22.0统计软件分析数据。计量资料比较采用 t 检验，计数资料比较采用 χ^2 检验；采用点二列相关性分析各指标与Child-Pugh分级、出血量的相关性；患者CPH-EVB介入术预后的影响因素采用Logistic回归分析，并采用方差膨胀因子（variance inflation factor, VIF）

对多重共线性进行诊断, $VIF > 10$ 提示存在多重共线性, 此时需依照理论依据删除引起共线性的因素之一; 采用平滑曲线拟合分析各指标与 CPH-EVB 介入术预后不良风险的相关性; 绘制受试者工作特征 (receiver operating characteristic, ROC) 曲线, 计算曲线下面积 (area under curve, AUC) 评估各指标单独及联合检测对 CPH-EVB 介入术预后不良风险的预测效能。 $P < 0.05$ 为差异有统计学意义。

2 结 果

2.1 2组临床资料比较 与预后良好组比较, 预后不良组 Child-Pugh 分级 C 级、出血量 ≥ 500 mL 占比较高, 差异有统计学意义 ($P < 0.05$); 2组性别、年龄、体重指数、肝硬化类型、静脉曲张程度、介入术方式比较, 差异无统计学意义 ($P > 0.05$)。见表 1。

表 1 2组临床资料比较

Table 1 Comparison of clinical data between the two groups

组别	例数	性别(例数,%)		年龄 ($\bar{x}\pm s$,岁)	体重指数 ($\bar{x}\pm s$)	肝硬化类型(例数,%)		
		男性	女性			乙型肝炎 肝硬化	酒精性 肝硬化	丙型肝炎 肝硬化
预后不良组	31	20(64.52)	11(35.48)	56.81±5.12	22.50±1.63	21(67.74)	8(25.81)	2(6.45)
预后良好组	70	43(61.43)	27(38.57)	57.14±5.36	22.27±1.48	49(70.00)	18(25.71)	3(4.29)
χ^2/t 值		0.087		0.289	0.698	0.220		
P 值		0.768		0.773	0.487	0.896		

组别	例数	静脉曲张程度(例数,%)			Child-Pugh 分级(例数,%)		出血量(例数,%)	
		轻度	中度	重度	B 级	C 级	<500 mL	≥500 mL
预后不良组	31	1(3.23)	5(16.13)	25(80.65)	9(29.03)	22(70.97)	10(32.26)	21(67.74)
预后良好组	70	3(4.29)	13(18.57)	54(77.14)	38(54.29)	32(45.71)	42(60.00)	28(40.00)
χ^2/t 值		0.167			5.507		6.620	
P 值		0.920			<0.001		<0.001	

组别	例数	介入术方式(例数,%)		
		内镜下治疗术	逆行静脉栓塞术	经颈静脉肝内门体分流术
预后不良组	31	15(48.39)	14(45.16)	2(6.45)
预后良好组	70	36(51.43)	30(42.86)	4(5.71)
χ^2/t 值		0.085		
P 值		0.958		

2.2 2组 Cine PC MRI 定量参数比较 与预后良好组比较, 预后不良组 Dpv、Apv 较高, Vpv、Qpv 较低, 差异有统计学意义 ($P < 0.05$)。见表 2。

表 2 2组 Cine PC MRI 定量参数比较

Table 2 Comparison of quantitative parameters of Cine PC MRI between the two groups

组别	例数	Dpv(cm)	Apv(cm ²)	Vpv(cm/s)	Qpv(cm ² /s)
预后不良组	31	1.58 $\pm$ 0.13	2.17 $\pm$ 0.15	6.87 $\pm$ 1.14	15.19 $\pm$ 3.61
预后良好组	70	1.47 $\pm$ 0.10	2.05 $\pm$ 0.11	8.53 $\pm$ 1.59	18.76 $\pm$ 4.08
t值		4.637	4.504	5.240	4.196
P值		< 0.001	< 0.001	< 0.001	< 0.001

2.3 Cine PC MRI 定量参数与病情指标的相关性 点二列相关性分析, Dpv、Apv 与 Child-Pugh 分级、出血量呈正相关, Vpv、Qpv 与 Child-Pugh 分级、出血量呈负相关 ($P < 0.05$), 见表 3。

2.4 Cine PC MRI 定量参数与 CPH-EVB 介入术预后不良风险的 Logistic 回归分析 因 Child-Pugh 分级、出血量与 Dpv、Apv、Vpv、Qpv 同时纳入

Logistic 回归分析时存在多重共线性 ($VIF > 10$), 故将 Child-Pugh 分级、出血量剔除。以 CPH-EVB 介入术预后情况 (预后不良 = 0, 预后良好 = 1) 作为因变量, Dpv、Apv、Vpv、Qpv (均为连续变量) 作为自变量, 结果显示, Dpv、Apv、Vpv、Qpv 是 CPH-EVB 介入术预后不良风险的独立影响因素 ($P < 0.05$), 见表 4。

表3 Cine PC MRI定量参数与病情指标的相关性

Table 3 Correlation between Cine PC MRI quantitative parameters and disease indicators

指标	Child-Pugh分级		出血量	
	r值	P值	r值	P值
Dpv	0.669	<0.001	0.674	<0.001
Apv	0.681	<0.001	0.686	<0.001
Vpv	-0.702	<0.001	-0.715	<0.001
Qpv	-0.710	<0.001	-0.721	<0.001

2.5 Cine PC MRI定量参数与CPH-EVB介入术

表4 Cine PC MRI定量参数与CPH-EVB介入术预后不良风险的Logistic回归分析

Table 4 Logistic regression analysis of quantitative parameters of Cine PC MRI and the risk of poor prognosis in CPH-EVB intervention surgery

变量	回归系数	标准误	Wald χ^2 值	P值	OR值	95%CI
Dpv	0.641	0.175	13.397	<0.001	1.897	1.335~2.697
Apv	0.694	0.182	14.543	<0.001	2.002	1.418~2.826
Vpv	-0.364	0.103	12.468	<0.001	0.695	0.507~0.953
Qpv	-0.279	0.074	14.254	<0.001	0.756	0.589~0.971
常量	-0.338	0.095	12.517	<0.001	—	—

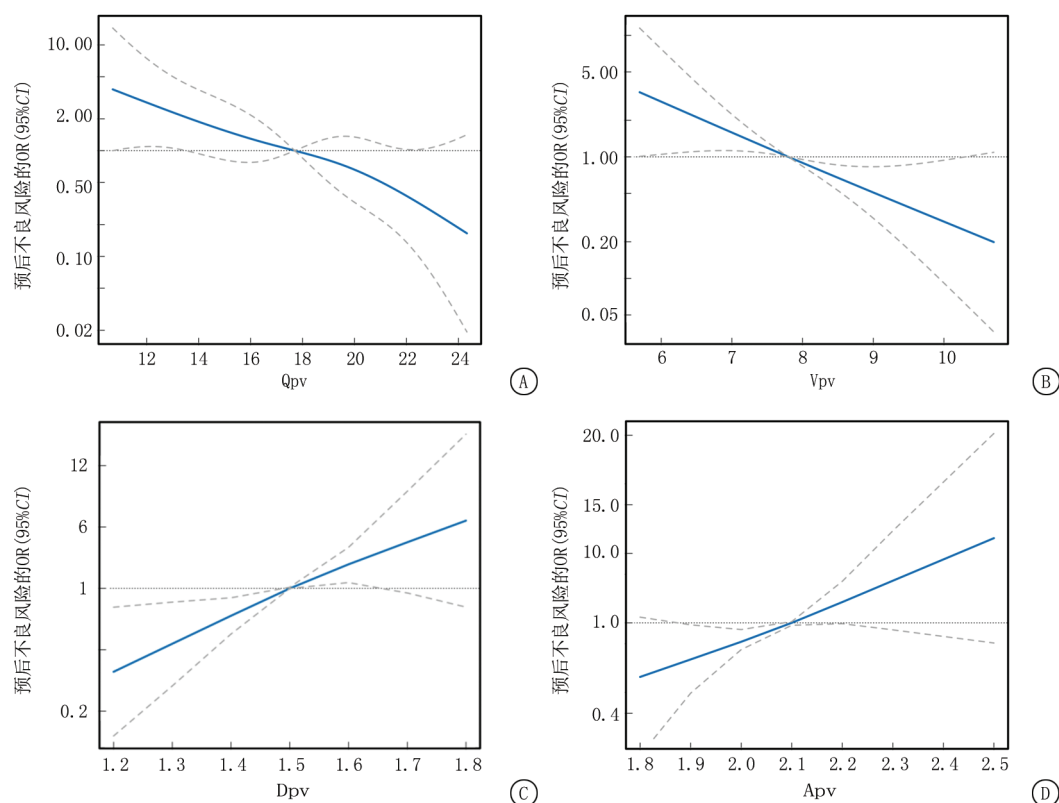


图1 Cine PC MRI定量参数与CPH-EVB介入术预后不良风险的平滑曲线拟合

A. Qpv与预后不良风险的平滑曲线拟合；B. Vpv与预后不良风险的平滑曲线拟合；C. Dpv与预后不良风险的平滑曲线拟合；D. Apv与预后不良风险的平滑曲线拟合

Figure 1 Smooth curve fitting of Cine PC MRI quantitative parameters and the risk of poor prognosis in CPH-EVB intervention

2.6 Cine PC MRI定量参数对CPH-EVB介入术预后不良风险的预测价值 以预后不良组为阳性

预后不良风险的平滑曲线拟合分析 校正其他因素后，平滑曲线拟合分析显示，Dpv、Apv与CPH-EVB介入术预后不良风险呈近似“/”的正相关线性关系，随着Dpv、Apv升高CPH-EVB介入术预后不良风险呈逐渐增加趋势（ $P<0.05$ ）；Vpv、Qpv与CPH-EVB介入术预后不良风险呈近似“\”的负相关线性关系，随着Dpv、Apv升高CPH-EVB介入术预后不良风险呈逐渐降低趋势（ $P<0.05$ ），见图1。

数据，以预后良好组为阴性数据，绘制ROC曲线进行分析，结果显示，Dpv、Apv、Vpv、Qpv预

测 CPH-EVB 介入术预后不良风险的 AUC 为 0.758、0.730、0.765、0.783，敏感度为 64.52%、67.74%、74.19%、77.42%，特异度为 78.57%、71.43%、75.71%、72.86%；Dpv、Apv、Vpv、Qpv 联合预测 CPH-EVB 介入术预后不良风险的 AUC 为 0.924，敏感度为 83.87%，特异度为 87.14%，预测价值显著高于各参数单一预测价值 ($Z=2.797、3.549、2.708、2.382$, $P=0.005、0.001、0.007、0.017$)，见图 2。

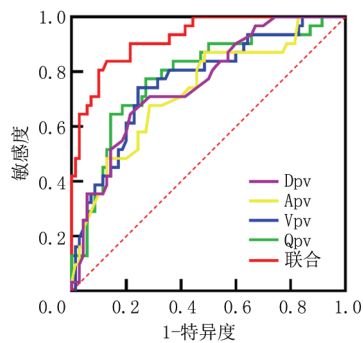


图2 Cine PC MRI定量参数对CPH-EVB介入术预后不良风险的预测价值

Figure 2 The predictive value of Cine PC MRI quantitative parameters for the risk of poor prognosis in CPH-EVB intervention surgery

3 讨 论

肝硬化门静脉高压是临床常见慢性疾病，临床主要表现为门静脉系统血流动力学改变^[12-14]。食管胃底静脉曲张破裂出血是肝硬化门静脉高压并发症之一，临床发病急，随着病情程度加剧，患者极易出现失血性休克，临床病死率较高^[15-16]。目前临床常采用介入术治疗CPH-EVB患者，治疗效果较好，患者临床病死率显著下降^[17-18]。但仍有部分患者有病情较重等原因，导致介入术后病情未缓解甚至死亡，影响患者预后^[19-20]。因此，有效预测CPH-EVB患者介入术后预后情况，可以为临床治疗提供指导，进而改善患者预后。

肝硬化早期门静脉血流可保持相对稳定状态，随着肝硬化程度加剧，Vpv降低，肝脏功能发生障碍甚至发生肝功能衰竭^[21-22]。Cine PC MRI对门静脉血流的测定是一项非创伤性技术，通过定量参数评价门静脉高压程度，并客观反映肝硬化门静脉高压病情进展^[23-24]。Dpv、Apv是反映门静脉血管情况的参数，Vpv、Qpv则为门静脉血流相关参数，而肝硬化患者肝小叶塌陷，并形成弥漫

性纤维间隔及肝实质结节增生，导致门静脉血管扭曲、减少，门静脉血流阻力增加，导致门静脉高压形成，Cine PC MRI定量参数Dpv、Apv值升高，Vpv、Qpv值降低^[25-26]。肝硬化失代偿期且存在门静脉高压的患者随着病情发展，可能出现食管胃底静脉曲张破裂出血的情况^[27-28]。Bhurwal等^[29]研究指出，食管胃底静脉曲张破裂出血治疗过程中凝血酶的使用可有效改善患者预后，表明凝血作用可能是CPH-EVB患者临床治疗和预后改善的重点之一。而临床对CPH-EVB患者行介入术治疗的主要目的是止血和预防再出血^[30-31]，但Dpv、Apv值异常升高，Vpv、Qpv值异常降低提示血管直径较长且血流流速较低，血流阻力仍较大，此时患者肝功能损伤极重，经介入术治疗后，门静脉压力未降低至一定标准，可能导致CPH-EVB患者食管胃底静脉曲张破裂出血情况未缓解甚至加剧，影响预后^[32]。本研究结果显示，与预后良好组比较，预后不良组Dpv、Apv值较高，Vpv、Qpv值较低，Cine PC MRI定量参数（Dpv、Apv、Vpv、Qpv）与患者病情指标Child-Pugh分级、出血量呈现明显相关性，提示各指标可能是通过反映CPH-EVB患者病情以影响预后情况，在此基础上本研究进一步分析发现，在剔除干扰因素后，Cine PC MRI定量参数（Dpv、Apv、Vpv、Qpv）是患者预后的影响因素，表明各指标与患者预后有关。临床可通过对CPH-EVB患者进行Cine PC MRI定量参数检测，以评估患者病情、预测患者预后，并在此基础上制定针对性干预方案，尽可能降低不良预后的发生风险。

平滑曲线拟合具有更贴合真实数据分布，并在此基础上有效防止过拟合等优势，基于此，本研究创新性的采用平滑曲线拟合进一步分析各指标与患者预后的关系，结果显示，Dpv、Apv与Child-Pugh分级、出血量呈正相关，Vpv、Qpv与Child-Pugh分级、出血量呈负相关，进一步表明Cine PC MRI定量参数与CPH-EVB患者介入术后预后有关。采用ROC曲线进一步分析结果显示，Dpv、Apv、Vpv、Qpv联合预测患者预后不良风险的AUC显著高于各指标单独预测，提示Cine PC MRI定量参数对患者预后有一定预测价值，可为临床预测患者预后提供参考。本研究通过采用多种统计学方法，分析Cine PC MRI定量参数与

CPH-EVB患者介入术预后的相关性及对患者预后的预测价值,可为临床预测CPH-EVB患者预后提供更具科学性的参考依据,但本研究未能对Cine PC MRI工作机制及CPH-EVB发病原理进行深入研究,且研究随访时间较短,可能导致研究结果不全面,无法验证Cine PC MRI定量参数与患者介入术后长期预后的关系,希望未来能够针对以上不足进行深入研究,为临床提供更有价值的参考。

综上所述,Cine PC MRI定量参数(Dpv、Apv、Vpv、Qpv)与CPH-EVB患者介入术后预后有关,且对患者预后有一定预测价值,对CPH-EVB临床治疗方案的制定提供一定参考价值。

[参考文献]

- [1] Liu R, Sun Y, Xu K, et al. A histogram model to predict the risk of bleeding from oesophageal and gastric variceal rupture in cirrhosis [J]. J Coll Physicians Surg Pak, 2022, 32(5): 586-590.
- [2] Wang YL, Han J, Ma XM, et al. Effects of primary preventive treatment under endoscope for esophageal and gastric varices on bleeding rate and its relevant factors [J]. Zhonghua Gan Zang Bing Za Zhi, 2022, 30(4): 407-412.
- [3] Hafiz R, Kocaoglu M, Trout AT. Comparison of phase contrast magnetic resonance imaging and scintigraphy for determination of split pulmonary blood flow in children and young adults with congenital heart disease [J]. Pediatr Radiol, 2023, 53(10): 2040-2047.
- [4] Komi S, Inoue Y, Hata H, et al. Clinical evaluation of left ventricular diastolic function using phase-contrast cine cardiovascular magnetic resonance imaging: A comparison with steady-state free precession cine cardiovascular magnetic resonance imaging and echocardiography [J]. J Comput Assist Tomogr, 2022, 46(1): 56-63.
- [5] Takase K, Saito K, Tajima Y, et al. Comparison of T1 mapping on gadoteric acid-enhanced magnetic resonance imaging with conventional functional liver reserve indices and technetium-99m galactosyl serum albumin scintigraphy [J]. Cureus, 2024, 16(10): e70952.
- [6] Arai AE, Schulz-Menger J, Shah DJ, et al. Stress perfusion cardiac magnetic resonance vs spect imaging for detection of coronary artery disease [J]. J Am Coll Cardiol, 2023, 82(19): 1828-1838.
- [7] Tezcan S, Ulu Ozturk F, Ayvazoglu Soy E, et al. Portal venous flow alterations in hepatic artery thrombosis following liver transplant [J]. Exp Clin Transplant, 2022, 20(4): 395-401.
- [8] Oechtering TH, Roberts GS, Panagiotopoulos N, et al. Clinical applications of 4D flow MRI in the portal venous system [J]. Magn Reson Med Sci, 2022, 21(2): 340-353.
- [9] 中华医学会肝病学会. 肝硬化诊治指南 [J]. 临床肝胆病杂志, 2019, 35(11): 2408-2425.
- [10] Singh A, Gattani R. A narrative review of advancements in understanding and treating varicose veins [J]. Cureus, 2023, 15(11): e48093.
- [11] Xie E, Yeo YH, Scheiner B, et al. Immune checkpoint inhibitors for Child-Pugh class B advanced hepatocellular carcinoma: A systematic review and meta-analysis [J]. JAMA Oncol, 2023, 9(10): 1423-1431.
- [12] Karnib M, Haraf R, Tashtish N, et al. MELD score is predictive of 90-day mortality after veno-arterial extracorporeal membrane oxygenation support [J]. Int J Artif Organs, 2022, 45(4): 404-411.
- [13] 贺世超, 王瑜, 朱斌. 急性病毒性肝炎患者心电图异常相关因素及其对预后的预测价值 [J]. 临床误诊误治, 2024, 37(4): 24-28, 41.
- [14] Shukla A, Rockey DC, Kamath PS, et al. Non-cirrhotic portal fibrosis/idiopathic portal hypertension: APASL recommendations for diagnosis and management [J]. Hepatol Int, 2024, 18(6): 1684-1711.
- [15] Singh S, Chandan S, Vinayek R, et al. Comprehensive approach to esophageal variceal bleeding: From prevention to treatment [J]. World J Gastroenterol, 2024, 30(43): 4602-4608.
- [16] Chinese Society of Spleen and Portal Hypertension Surgery, Chinese Society of Surgery, Chinese Medical Association. Expert consensus on the diagnosis and treatment of esophageal and gastric variceal rupture bleeding in cirrhotic portal hypertension (2024 edition) [J]. Zhonghua Wai Ke Za Zhi, 2025, 63(3): 177-186.
- [17] Daðadóttir SM, Ingason AB, Hreinsson JP, et al. Comparison of gastrointestinal bleeding in patients with and without liver cirrhosis [J]. Scand J Gastroenterol, 2024, 59(9): 1081-1086.
- [18] Liu X, Wang Y, Zheng L, et al. Risk factors analysis of endoscopy and TIPS in the treatment of secondary esophagogastric varicose bleeding with cirrhosis [J]. Afr Health Sci, 2023, 23(3): 655-663.
- [19] Burghart L, Ferenci P, Petrenko O, et al. Portal hypertension and its prognostic implications in patients with Wilson's disease [J]. Aliment Pharmacol Ther, 2024, 60(2): 257-266.
- [20] Patel RK, Chandel K, Tripathy T, et al. Role of interventional radiology (IR) in vascular emergencies among cirrhotic patients [J]. Emerg Radiol, 2024, 31(1): 83-96.
- [21] Small BG, Hatley O, Jamei M, et al. Incorporation and performance verification of hepatic portal blood flow shunting in minimal and full PBPK models of liver cirrhosis [J]. Clin Pharmacol Ther, 2023, 114(6): 1264-1273.

- [22] Brown RS Jr, Brown KA, Flamm S, et al. Screening and management of portal hypertension and varices in cirrhosis: Expert perspectives[J]. *Hepatol Commun*, 2025, 9(4):e682.
- [23] Bane O, Stocker D, Kennedy P, et al. 4D flow MRI in abdominal vessels: Prospective comparison of k-t accelerated free breathing acquisition to standard respiratory navigator gated acquisition[J]. *Sci Rep*, 2022, 12(1):19886.
- [24] Shimada R, Sofue K, Wang T, et al. Development of respiratory motion-resolved hepatobiliary phase cine-magnetic resonance imaging for stereotactic body radiotherapy in liver tumor[J]. *Sci Rep*, 2024, 14(1):31347.
- [25] Anton A, Campreciós G, Pérez-Campuzano V, et al. The pathophysiology of portal vein thrombosis in cirrhosis: Getting deeper into Virchow's triad[J]. *J Clin Med*, 2022, 11(3):800.
- [26] Guo Y, Dong S, Li M, et al. A new model of portal vein thrombosis in rats with cirrhosis induced by partial portal vein ligation plus carbon tetrachloride and intervened with rivaroxaban[J]. *BMC Gastroenterol*, 2024, 24(1):161.
- [27] Castater CA, Meyer C, Phillips S, et al. Complete heart block after low dose octreotide infusion for esophageal variceal bleeding[J]. *Am Surg*, 2023, 89(9):3867-3869.
- [28] Turco L, Reiberger T, Vitale G, et al. Carvedilol as the new non-selective beta-blocker of choice in patients with cirrhosis and portal hypertension[J]. *Liver Int*, 2023, 43(6):1183-1194.
- [29] Bhurwal A, Makar M, Patel A, et al. Safety and efficacy of thrombin for bleeding gastric varices: A systematic review and meta-analysis[J]. *Dig Dis Sci*, 2022, 67(3):953-963.
- [30] Zeng Z, Wang Z, Jin J, et al. Comparison of endoscopic ultrasound-guided cyanoacrylate injection and transjugular intrahepatic portosystemic shunt in the prevention of gastric varices rebleeding[J]. *Surg Laparosc Endosc Percutan Tech*, 2024, 34(5):518-523.
- [31] Patel RK, Tripathy T, Chandel K, et al. Left-sided portal hypertension: What an interventional radiologist can offer?[J]. *Eur Radiol*, 2025, 35(5):2530-2542.
- [32] Zheng Y, Hu Q, Zhou J, et al. Evaluation of the presence and severity of spontaneous splenorenal or gastrosplenic shunts via four-dimensional flow magnetic resonance imaging: A preliminary study [J]. *Quant Imaging Med Surg*, 2024, 14(10):7625-7639.

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