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CT 定量分析在冠心病介入治疗前后血流灌注改变的评估价值 *

朱士砚[1,2] 胡春峰[1△] 李 强[3] 李江山[1] 荣玉涛[1] 宋 强[1]

(1 徐州医科大学附属医院放射科 江苏 徐州 221006;
2 江苏省淮安市洪泽区人民医院放射科 江苏 淮安 223100;3 宁波大学附属医院放射科 浙江 宁波 315040)

摘要 目的:探讨 CT 定量分析在冠心病介入治疗前后血流灌注改变的评估价值。**方法:**2018 年 2 月到 2020 年 11 月选择在本院诊治的冠心病患者 95 例作为研究对象,所有患者都给予经皮冠状动脉介入治疗,在介入前 1 d 与介入后 1 个月进行 CT 定量与超声检查,随访介入后 6 个月的冠状动脉再狭窄情况并进行相关性分析。**结果:**所有患者都顺利完成介入治疗,介入期无严重并发症发生。95 例患者介入后 1 个月的左室射血分数(ejectionfraction,EF)、左室短轴缩短率(fractionalshortening,FS)高于介入前 1 d (P<0.05),介入前后左室等容舒张时间(iso-volumicrelaxationtime,IVRT)对比差异无统计学意义(P>0.05)。95 例患者介入后 1 个月的心肌血流量 (Myocardialbloodflow,MBF)、心肌血容量 (Myocardialbloodvolume,MBV) 高于介入前 1d (P<0.05),达峰时间(Timetopeak,TTP)低于介入前 1 d(P<0.05)。介入后随访 6 个月,冠状动脉再狭窄 14 例,再狭窄率 14.7 %,其中中度狭窄 12 例,重度狭窄 2 例;Pearson 分析显示冠心病患者介入前 1 d 的 MBF、MBV、TTP 与 FS、EF 都存在相关性(P<0.05);Logistic 回归分析显示 MBF、MBV、TTP、FS、EF 为影响冠心病患者介入后随访再狭窄率的重要因素(P<0.05)。**结论:**CT 定量分析在冠心病介入前后的应用能有效反映血流灌注改变情况,且与患者的心功能存在相关性,也可有效预测患者介入随访冠状动脉再狭窄发生情况。

关键词: CT 定量分析;冠心病;经皮冠状动脉介入;血流灌注;心功能;冠状动脉再狭窄

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The Evaluation Value of CT Quantitative Analysis before and after Intervention of Cardiovascular Disease*

ZHU Shi-yan[1,2], HU Chun-feng[1△], LI Qiang[3], LI Jiang-shan[1], RONG Yu-tao[1], SONG Qiang[1]

*(1 Department of Radiology, Affiliated Hospital of Xuzhou Medical University, Xuzhou, Jiangsu, 221006, China;
2 Department of Radiology, Hongze District People's Hospital, Huaian City, Jiangsu Province, Huaian, Jiangsu, 223100, China;
3 Department of Radiology, Affiliated Hospital of Ningbo University, Ningbo, Zhejiang, 315040, China)*

ABSTRACT Objective: To explore the evaluation value of CT quantitative analysis of blood perfusion changes before and after intervention for cardiovascular disease. **Methods:** From February 2018 to November 2020, 95 cases of patients with coronary heart disease who were diagnosed and treated in our hospital were selected as the research objects. All patients were treated with percutaneous coronary intervention, and CT quantification were performed 1d before intervention and 1 month after the intervention with ultrasound examination, followed-up of coronary artery restenosis 6 months after intervention and conducted correlation analysis. **Results:** All patients were successfully completed the interventional treatment, and there were no serious complications occurred during the interventional period. The left ventricular ejection fraction (EF) and left ventricular short-axis shortening rate (FS) in the 95 patients 1 month after intervention were higher than those of 1 day before intervention (P<0.05), and the the difference in the left ventricular isovolumic relaxation time compared before and after intervention (iso-volumicrelaxationtime, IVRT) were not statistically significant (P>0.05). The myocardial blood flow (MBF) and myocardial blood volume (MBV) of 95 patients at 1 month after intervention were higher than 1 day before intervention (P<0.05), and time to peak (TTP) were lower than 1 day before intervention (P<0.05). Followed-up 6 months after intervention, 14 cases of coronary artery restenosis, restenosis rate 14.7 %, of which 12 cases were moderate stenosis, 2 cases were severe stenosis; Pearson analysis showed that MBF, MBV, TTP at 1 day before intervention of coronary heart disease patients were correlation to the FS and EF (P<0.05); Logistic regression analysis shows that MBF, MBV, TTP, FS, EF were important factors that affected the rate of restenosis in patients with coronary heart disease after intervention (P<0.05). **Conclusion:** The application of CT quantitative analysis before and after intervention of coronary heart disease can effectively reflect the changes of blood flow perfusion, and are related to the patient's cardiac function, and can also effectively predict the occurrence of coronary artery restenosis in patients

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作者简介:朱士砚(1983-),男,本科,主治医师,研究方向:心胸影像诊断,电话:18015155239,E-mail:apilo19830618@163.com

△ 通讯作者:胡春峰(1970-),男,博士,主任医师、教授,研究方向:心血管、胸部疾病的影像诊断,电话:13685161971,
E-mail:apilo19830618@163.com

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with interventional follow-up.

Key words: CT quantitative analysis; Coronary heart disease; Percutaneous coronary intervention; Blood perfusion; Heart function; coronary artery restenosis

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前言

冠心病的全称为冠状动脉粥样硬化性心脏病,为临床上最常见的心血管疾病类型之一,也是危害人类健康的最主要疾病之一[1,2]。该病患者若不得到及时诊治,容易出现心肌缺血、心力衰竭、心肌梗死等表现,严重影响下可导致患者死亡[3]。经皮冠状动脉介入治疗,特别是经皮冠状动脉成形结合冠状动脉支架置入术已成为目前治疗冠心病的主要方法之一[4,5]。但是冠状动脉病变部位介入治疗后的再狭窄是介入后的重要并发症,其发生率在 20 %左右,多发生于术后 6 个月左右,可影响患者的生存预后 [6]。冠状动脉计算机断层扫描(computedtomography,CT),血管成像(coronary CT angiography,CCTA)是当前评估冠状动脉病变程度的检查手段之一,但是其评估血管狭窄程度可能高估,阳性预测值较低,也很难识别心肌微循环障碍所导致的血流动力学变化[7,8]。而冠状动脉造影只能反映冠状动脉的形态学变化,不能提供病变冠状动脉所支配区域心肌的病理生理变化信息[9]。特别是当前很多介入后无症状再狭窄患者难以接受冠状动脉造影,并且冠状动脉造影检查属于有创性检查,在临床上的应用受到限制 [10,11]。CT 心肌灌注(computedtomography myocardialperfusion,CTP)为一种定量检查方法,可获取心肌灌注的定量参数,可用于评估冠状动脉狭窄情况,也可判断机体是否存在心肌灌注缺损[12,13]。本文具体探讨了 CT 定量分析在冠心病介入治疗前后血流灌注改变的评估价值,以促进 CT 定量分析的应用。现总结报道如下。

1 资料与方法

1.1 研究对象

2018 年 2 月到 2020 年 11 月选择在本院诊治的冠心病患者 95 例作为研究对象,纳入标准:经冠状动脉造影检查、病理检查等检查方式确诊为冠心病;年龄 30-80 岁,性别不限;具有 CT 定量分析的指征;患者知情同意本研究,生命体征稳定,意识清楚;本院伦理委员会批准了此次研究。排除标准:合并窦性心律过缓、房颤等疾病者;合并传染性疾病的患者;置入心脏起搏器者;合并肝肾功能不全或免疫功能低下者;先天性心脏疾病病例; 妊娠或哺乳期妇女; 对碘造影剂或三磷酸腺苷(adenosinetriphosphate,ATP)过敏的患者。

在 95 例患者中,男 52 例,女 43 例;平均年龄 58.25±4.22 岁;平均体重指数 24.91±1.47 kg/m^2;平均心率 82.12±0.24 次;平均收缩压 134.92±10.47 mmHg; 平均舒张压 75.99±2.11 mmHg;平均总胆固醇(totalcholesterol,TC) 4.52±0.22 mmol/L;平均低密度脂蛋白胆固醇(low-densitylipoprotein-cho-lesterol,LDL-C) 2.98±0.58 mmol/L;平均高密度脂蛋白胆固醇(high-densitylipoproteincholesterol,HDL-C) 1.18±0.22 mmol/L; 平均三酰甘油 (triacylglycerol,TG) 1.25±0.14mmol/L; 平均肌酐 68.28±6.33 μmol/L; 平均尿酸 351.58± 5.68 μmol/L; 平均载脂蛋白 A189.22±14.55 mg/L;平均血糖 5.31±0.18 mmol/L;平均尿素氮 5.62±0.32 mmol/L;吸烟 34 例,饮酒 45 例;平均白细胞 6.33±0.25× 10^9/L; 平均红细胞 4.56±0.33×10^{12} /L; 平均血红蛋白 123.14±8.27 g/L;平均 Gensini 积分 5.67±0.25 分;平均血小板 198.22±13.66×10^9/ L; 单支血管病变 60 例, 双支血管病变 25 例,三支血管病变 10 例。

1.2 CT 定量检查

所有患者都给予经皮冠状动脉介入治疗,在介入前 1 d 与介入后 1 个月进行 CT 定量分析。取患者仰卧位,应用西门子 64 层螺旋 CT 进行常规扫描, 自主动脉根部扫描至心脏膈面,采用心电门控扫描。CT 参数:管电压 500 mA、层厚 0.75 mm、管电压 120 kV,Z 轴覆盖范围 73 mm。灌注追踪自动技术引导下,于升主动脉确定感兴趣区,然后于 CT 值至 100 Hu 时于 6 s 后实施冠状动脉增强扫描, 以 140 μg/kg/min 的速率静脉注射三磷酸腺苷二钠注射液(2 mL,20 mg),3 min 后开始扫描,注射对比剂 50 mL,注射速率为 6.0 mL/s。灌注图像层厚 3 mm,扫描历时 30 s,间隔 2 mm。全程监测患者生命体征,当发现患者生命体征不平稳、心律失常、急性胸痛等任一症状立即终止检查。由具有丰富临床经验的影像学医师(工作年限≧5 年)对 CT 图像进行观察和分析, 定量心肌灌注数, 包括心肌血流量(Myocardialbloodflow,MBF)、达峰时间(Timetopeak,TTP)、心肌血容量(Myocardialbloodvolume,MBV)等。

1.3 超声检查

所有患者在介入前 1 d 与介入后 1 个月进行超声检查,使用 Agilentsonos 彩色多普勒超声心动图仪, 探头频率 2~3 MHz。患者平静呼吸,取左侧卧位,在双平面 Simpson 方法测定与计算左室射血分数 (ejectionfraction,EF)、左室短轴缩短率(fractionalshortening,FS)、左室等容舒张时间(iso-volumicrelaxationtime,IVRT)等指标。

1.4 随访调查

在介入后 6 个月进行冠状动脉造影,分为轻度狭窄(<50 %),中度狭窄(50 %-70 %),重度狭窄(>70 %),100 %为闭塞,血管狭窄程度≥ 50 %时判定为再狭窄。

1.5 统计方法

选择 SPSS19.00 软件进行数据分析,计数资料以例数(%)表示,两两对比为卡方 χ^2 检验。计量数据用均数±标准差表示,两两对比为 t 检验,用 Pearson 分析了解相关性,采用 Logistic 回归分析影响因素,检验水准为α=0.05。

2 结果

2.1 常规超声心功能变化对比

所有患者都顺利完成介入治疗, 介入期无严重并发症发生。95 例患者介入后 1 个月的 FS、EF 值高于介入前 1d(P<0.

05),介入前后 IVRT 值对比差异无统计学意义(P>0.05)。见表1。

表 1 冠心病患者介入前后常规超声心功能变化对比($\bar{x}\pm s$)

Table 1 Comparison of conventional echocardiographic changes before and after intervention in patients with coronary heart disease($\bar{x}\pm s$)

Time point	n	FS(%)	EF(%)	IVRT(s)
1 d before intervention	95	32.44±2.48	61.58±8.09	0.11±0.02
1 month after intervention	95	36.39±3.18*	69.28±6.66*	0.10±0.01

Note: Compared with 1 d before intervention, *P<0.05.

2.2 CT 定量指标变化对比

95 例患者介入后 1 个月的 MBF、MBV 值高于介入前 1 d(P<0.05),TTP 值低于介入前 1 d(P<0.05)。见表 2。

表 2 冠心病患者介入前后 CT 定量指标变化对比($\bar{x}\pm s$)

Table 2 Comparison of CT Quantitative Indicators before and after Intervention of Coronary Heart Disease($\bar{x}\pm s$)

Time point	n	MBF(mL/100 mL/min)	MBV(mL/100 mL)	TTP(%)
1 d before intervention	95	78.25±6.49	8.85±1.11	14.58±2.22
1 month after intervention	95	132.47±11.03*	13.58±2.16*	9.89±1.44*

Note: Compared with 1 d before intervention, *P<0.05.

2.3 随访冠状动脉狭窄情况

95 例患者介入后随访 6 个月，冠状动脉再狭窄 14 例,再狭窄率 14.7 %,其中中度狭窄 12 例,重度狭窄 2 例。

2.4 相关性分析

在 95 例患者中,Pearson 分析显示介入前 1 d 的 MBF、MBV、TTP 与 FS、EF 都存在相关性(P<0.05)。见表 3。

表 3 冠心病患者 CT 定量指标与超声心功能指标的相关性(n=95)

Table 3 Correlation between CT quantitative index and ultrasonic cardiac function index in patients with coronary heart disease (n=95)

Index		MBF	MBV	TTP
FS	r	0.633	0.562	-0.682
	P	0.000	0.002	0.000
EF	r	0.619	0.532	0.666
	P	0.000	0.004	0.000

2.5 影响因素分析

在 95 例患者中，以随访再狭窄作为因变量，以 MBF、MBV、TTP、FS、EF 作为自变量,Logistic 回归分析显示 MBF、MBV、TTP、FS、EF 为重要的影响因素(P<0.05)。见表 4。

表 4 影响冠心病患者随访再狭窄的多因素 Logistic 回归分析(n=95)

Table 4 Multivariate regression analysis Logistic restenosis in patients with coronary heart disease(n=95)

Index	β	SD	t	P	OR	95%CI
MBF	0.794	0.285	3.055	0.003	1.244	1.093-4.772
MBV	0.824	0.281	4.573	0.000	1.772	1.492-8.924
TTP	8.395	3.583	2.774	0.020	0.773	0.177-0.892
FS	0.456	0.068	5.111	0.000	1.256	1.114-3.298
EF	0.611	0.021	6.198	0.000	1.982	1.733-7.771

3 讨论

冠心病是由于冠状动脉粥样硬化或冠脉痉挛等导致的缺血性心肌损害,其病因尚未明确,糖尿病、高血压、多与吸烟、年龄等因素有关[14,15]。部分患者在临床上无明显症状,多数患者可表现为心血管堵塞、心悸、乏力等症状,若治疗不当容易引发心衰、心肌梗死征等并发症。经皮冠状动脉介入治疗为冠心病的主要治疗方法,能改善患者的预后,但是很多患者在介入后容易出现心肌代谢功能降低与心肌微循环灌注不良,导致介入后再狭窄率比较高[16]。同时冠心病患者的冠状动脉狭窄程度与心肌缺血程度之间并非呈直线关系,冠状动脉血管灌注变化情况分析对冠心病的诊断和预后判断具有重要价值[17,18]。

当前冠心病的诊断依赖于影像学检查,超声能同时观察冠状动脉管壁和管腔病变,在检查中比较快捷与方便[19]。本研究

显示所有患者都顺利完成介入治疗，介入期无严重并发症发生；95 例患者介入后 1 个月的 FS、EF 值高于介入前 1 d(P<0.05)，介入前后 IVRT 值对比差异无统计学意义(P>0.05)，结合相关研究[20]分析可知：传统超声判断冠状动脉左前降支病变的准确性较低，且重复性较差，而且常规超声不能很好解释介入后患者冠状动脉再狭窄的发生基础及其严重程度。

CT 定量分析是一种非侵入性的心脏功能成像，可观察冠脉形态并定量评估心肌灌注情况。并且其能够通过持续动态扫描的方式获取影像信息，有助于临床对心肌血流灌注情况做出早期判断[21-22]。特别是其获取心肌灌注的定量参数可评价冠状动脉血流分布的情况，从而判断是否存在心肌灌注缺损[23]。本研究显示 95 例患者介入后 1 个月的 MBF、MBV 值高于介入前 1 d(P<0.05)，TTP 值低于介入前 1 d(P<0.05)，结合 Orsini E 等研究可知：CT 定量分析具有较好的时间分辨率，低剂量扫描模式也具有很好的检查安全性，并可完整的评价心脏血流动力学过程，定量检测介入前后血流灌注情况[24]。另外，TTP 延长间接反映了心肌缺血区域血流灌注缓慢，MBF、MBV 可直观反映心肌血流灌注情况，上述 3 个个量化指标可作为冠心病评估的重要参考[25,26]。因此 CT 定量分析对冠心病介入治疗前后血流灌注改变情况具有较好的评估作用。

在冠心病患者中，给予长期阻塞的梗死血管进行介入治疗，有助于改善患者左心室功能，提高长期预后质量，有助于挽救心肌梗死后缺血心肌，加快梗死区心肌愈合，降低病死率，但是介入后再狭窄率一直比较高[27]。冠状动脉造影是临床诊断冠心病的主要方式，可明确判断冠状动脉是否狭窄与狭窄的程度，有助于正确评价心功能，但是为一种有创性检查[28,29]。常规 CT 具有较高的诊断敏感性，但是该检查方式存在严重钙化者评估受限、高估血管狭窄程度等不足。CT 定量分析也是一种非侵入性检查手段，可提供详细的心脏功能信息[30]。本研究 95 例患者介入治疗后随访 6 个月，冠状动脉再狭窄 14 例，再狭窄率 14.7 %，其中中度狭窄 12 例，重度狭窄 2 例；Pearson 分析显示冠心病患者介入前 1 d 的 MBF、MBV、TTP 与 FS、EF 都存在相关性 (P<0.05)；Logistic 回归分析显示 MBF、MBV、TTP、FS、EF 为影响冠心病患者介入后随访再狭窄率的重要因素(P<0.05)，当前也有研究显示心肌组织缺血状态下的 MBF、MBV、TTP 主要与心肌收缩状态和血流灌注状态有关，且 MBF、MBV 值的改变早于收缩功能的改变，本研究结果相符[31]。另外，不过本研究也存在一定的不足，没有设置健康组，介入前后观察的时间点也比较少，将在后续研究中进行探讨。

总之，CT 定量分析在冠心病介入前后的应用能有效反映血流灌注改变情况，且与患者的心功能存在相关性，也可有效预测患者介入随访冠状动脉再狭窄发生情况。

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