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胰腺增强 CT 实质期与门静脉期联合评估对急性坏死性胰腺炎的早期诊断价值

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[摘　要]　**目的：**探讨胰腺增强CT实质期与门静脉期联合评估对急性坏死性胰腺炎(acute necrotizing pancreatitis，ANP)的早期诊断价值。**方法：**收集2016年1月至2017年12月收治的92例急性胰腺炎(acute pancreatitis，AP)患者的临床和影像学资料，对比有无发生胰腺坏死患者早期胰腺增强CT扫描实质期(单期)和胰腺实质期+门静脉期(双期)的CT严重指数(computed tomography severity index，CTSI)评分，通过受试者工作特征(receiver operating characteristic，ROC)曲线分析单期和双期CTSI评分对AP合并胰腺坏死的诊断效能。**结果：**本组25例发生胰腺坏死，67例未发生胰腺坏死。胰腺坏死患者单期和双期CTSI评分均显著高于未发生胰腺坏死患者(P<0.05)。胰腺坏死患者中，单期与双期CTSI评分差异无统计学意义(P>0.05)。未发生胰腺坏死患者中，单期CTSI评分显著高于双期(P<0.05)。ROC曲线分析发现：单期和双期CTSI评分对AP胰腺坏死均有一定诊断价值(P<0.05)。CTSI评分早期诊断胰腺坏死的敏感性、特异性和曲线下面积(AUC)，单期分别为0.960，0.478和0.666，双期分别为0.960，0.582和0.774，单期评估的AUC显著小于双期(P<0.05)。**结论：**单纯胰腺实质期增强CT扫描早期诊断AP胰腺坏死可能被高估、特异性较低，胰腺实质期和门静脉期联合评估有助于提高AP胰腺坏死的早期诊断效能。

[关键词]　多排计算机断层扫描；胰腺炎；急性坏死；放射成像增强

Early diagnostic value of enhanced CT combined with pancreas parenchyma phase and portal venous phase for acute necrotizing pancreatitis

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Abstract　**Objective:** To explore the early diagnostic value of enhanced CT combined with pancreatic parenchyma phase and portal venous phase for acute necrotizing pancreatitis (ANP). **Methods:** The clinical and

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imaging data of 92 patients with acute pancreatitis (AP) from January 2016 to December 2017 were collected. The computed tomography severity index (CTSI) scores of pancreatic parenchymal phase and pancreatic parenchymal phase combined portal vein phase were compared in patients with or without pancreatic necrosis. The diagnostic efficacy of the CTSI in the pancreatic parenchymal phase and the pancreatic parenchymal phase combined portal vein phase on pancreatic necrosis were analyzed by the receiver operating characteristic (ROC) curve. **Results:** In this series, 25 had pancreatic necrosis and 67 had no pancreatic necrosis. Regardless of the CTSI score of the pancreatic parenchymal phase or the pancreatic parenchymal phase combined portal vein phase for patients with pancreatic necrosis were significantly higher than those without pancreatic necrosis (P<0.05). In patients with pancreatic necrosis, there was no significant difference between the CTSI score of pancreatic parenchymal phase and pancreatic parenchyma phase combined portal venous phase. However, in patients without pancreatic necrosis, CTSI score of the pancreatic parenchymal phase was significantly higher than that of pancreatic parenchymal phase combined portal vein phase (P<0.05). ROC curve analysis showed that CTSI score of pancreatic parenchymal phase CTSI score and pancreatic parenchymal phase combined portal vein phase were of certain diagnostic value for pancreatic necrosis (P<0.05). The sensitivity, specificity and area under curve (AUC) for pancreatic parenchymal phase in diagnosing pancreatic necrosis were 0.960, 0.478 and 0.666 respectively, and 0.960, 0.582 and 0.774 respectively for the pancreatic parenchymal phase combined portal vein phase. The AUC of pancreatic parenchymal phase was significantly less than that of pancreatic parenchymal phase combined portal vein phase (P<0.05). **Conclusion:** Enhanced CT scan alone of pancreatic parenchymal phase imaging for early diagnosis of AP pancreatic necrosis may be overestimated and lower specificity. Combined pancreatic parenchymal phase and portal venous phase assessment can help to improve the early diagnostic efficacy of AP pancreatic necrosis.

Keywords multidetector computed tomography; pancreatitis; acute necrotizing; radiographic image enhancement

CT是诊断急性胰腺炎(acute pancreatitis，AP)及其并发症的重要手段之一[1]。基于增强CT图像分析的CT严重指数(computed tomography severity index，CTSI)评分在临床上可以早期预测AP的严重程度和预后[2]。但是，目前对增强CT评估胰腺坏死到底是只需通过单独的胰腺实质期图像判读即可还是必须联合门静脉期图像共同分析，尚存争议[3-4]。部分学者[3]认为胰腺坏死在增强CT扫描胰腺实质期呈无强化或强化减弱的影像特征，这已足够判断AP是否并发胰腺坏死，并具有减少辐射剂量、降低潜在辐射风险的优势；另有学者[4]则认为胰腺实质期无强化或强化减弱不仅提示胰腺坏死的可能，也可能是胰腺缺血或水肿的表现，仅凭胰腺实质期图像可能导致对胰腺坏死的高估和误判，因此推荐胰腺实质期和门静脉期联合评估。本研究回顾性分析了增强CT扫描单独胰腺实质期和胰腺实质期联合门静脉期早期诊断AP胰腺坏死的价值，为临床上准确评估胰腺坏死以及客观作出CTSI评分提供资料依据。

1 对象与方法

1.1 对象

回顾性分析2016年1月至2017年12月解放军福州总医院收治的92例AP患者的临床与影像学资料，其中男50例、女42例，年龄23~74(48.2±12.1)岁，BMI (23.6±4.5) kg/m^2，其中胆源性胰腺炎55例、酒精性胰腺炎18例、高脂血症胰腺炎15例、暴饮暴食4例。纳入标准：1)符合AP诊断标准[5]；2)发病1周(±1 d)曾行腹部CT平扫+多期增强扫描检查，包括平扫、动脉期、胰腺实质期、门静脉期图像。排除标准：1)不符合AP诊断标准；2)未行腹部CT平扫+多期增强检查者；3)只有发病1周前或1周后腹部CT检查资料者；4)发病4周后未行腹部CT平扫+多期增强检查，判断是否存在胰腺包裹性坏死者；5)不明原因的AP；6)本研究所需临床资料缺失者。收集下列指标：1)人口学特征，包括性别、年龄、AP病因学类型、BMI；2)临床指标，包括住院时间、器官功能衰竭、死亡情况；3)根据发病4周后CT检查发现包裹性坏死(walled-off

necrosis，WON)并结合临床作为胰腺坏死的诊断标准。

1.2 CT 扫描与评分

Philips iCT 256或Philips Brilliance 64排螺旋CT机，扫描参数：管电压120 kV，管电流100 mAs，螺距1.172:1，重建层厚5 mm，层间距5 mm。平扫后以非离子型碘造影剂静脉注射，行动脉期、胰腺实质期和门静脉期多期增强扫描，延迟时间分别为10，20和60 s。每次扫描均为一次屏气中完成。由2名处于盲态的CT放射诊断学高级职称医师分别独立阅片，第1次阅片仅给出平扫、动脉期和胰腺实质期图像，2周后进行第2次阅片给出平扫、动脉期、胰腺实质期和门静脉期图像。每次阅片随机发放每位患者的图像，两位放射诊断学医师均独立阅片，并独立进行CTSI评分，最后将结果公布，有争议时经过讨论分析得出一致结果。

1.3 统计学处理

应用SPSS 21.0统计软件进行分析。符合正态分布的计量资料以均数±标准差($\bar{x}\pm s$)表示，两组间比较采用独立样本t检验；非正态分布的计量资料以中位数(M)±四分位数间距(Q)表示，同组比较采用非参数Wilcoxon符号秩和检验，两组间比较采用非参数Mann-Whitney U检验。计数资料以例数和百分率表示，组间比较采用卡方检验。CT评分系统对胰腺坏死的诊断价值采用受试者工作特征(ROC)曲线分析，曲线下面积(AUC)表示预测的准确性，AUC越接近1表示诊断效能越高。P<0.05为差异有统计学意义。

2 结果

2.1 一般情况

本组92例AP患者中，发生胰腺坏死25例、未发生胰腺坏死67例。有无发生胰腺坏死的AP患者在性别、年龄、BMI和病因学类型方面差异无统计学意义(P>0.05)，但是发生胰腺坏死的AP患者器官功能衰竭发生率、住院时间、病死率显著提高(P<0.05，表1)。

表1 有无胰腺坏死的AP患者一般资料和临床指标比较(n=92)

Table 1 Comparison of general data and clinical indicators of AP patients with or without pancreatic necrosis (n=92)

指标	胰腺坏死(n=25)	无胰腺坏死(n=67)	$t/\chi^2/Z$	P
性别			0.442	0.506
男	15	35		
女	10	32		
年龄/岁	47.5 ± 11.7	48.5 ± 11.4	0.372	0.711
BMI/(kg·m^{-2})	23.1 ± 3.8	23.8 ± 4.3	0.716	0.476
病因学类型			0.505	0.918
胆源性	16	39		
酒精性	5	13		
高脂血症	3	12		
暴饮暴食	1	3		
器官功能衰竭			21.627	<0.001
有	16	10		
无	9	57		
住院时间*/d	45.0 ± 29.5	21.5 ± 17.0	4.759	<0.001
死亡	3	1	4.833	0.028

*住院时间为非正态分布的计量资料，采用M+Q表示。

*The hospitalization time is a non-normal distribution measurement data, which is shown as M + Q.

2.2 有无胰腺坏死 AP 患者单独胰腺实质期和联合门静脉期 CTSI 评分比较

不管是早期增强CT扫描胰腺实质期CTSI评分还是胰腺实质期+门静脉期CTSI评分，胰腺坏死患者均显著高于未发生胰腺坏死患者(P<0.05)。胰腺坏死患者中，早期增强CT扫描胰腺实质期CTSI评分与胰腺实质期+门静脉期CTSI评分差异无统计学意义(P>0.05)。但是，未发生胰腺坏死患者中，早期增强CT扫描胰腺实质期CTSI评分显著高于胰腺实质期+门静脉期CTSI评分(P<0.05，表2)。

表2 有无胰腺坏死AP患者胰腺期与胰腺期+门静脉期状态下的CTSI评分比较(M ± Q)

Table 2 Comparison of CTSI scores between pancreatic parenchymal phase and pancreatic parenchymal phase plus portal venous phase in AP patients with or without pancreatic necrosis (M ± Q)

类别	n	胰腺期CTSI评分	胰腺期+门静脉期CTSI评分	Z	P
胰腺坏死	25	5.0 ± 6.0	5.0 ± 5.5	–0.392	0.695
无胰腺坏死	67	3.0 ± 6.0	1.0 ± 4.0	–2.319	0.020
Z		–2.481	–4.093		
P		0.013	<0.001		

2.3 单独胰腺实质期和联合门静脉期 CTSI 评分对胰腺坏死的诊断效能

ROC曲线分析发现：早期增强CT扫描胰腺实质期CTSI评分和胰腺实质期+门静脉期CTSI评分对AP胰腺坏死均有一定的诊断价值(P<0.05)。胰腺实质期CTSI评分早期诊断胰腺坏死的最佳截断值为2分，其敏感性、特异性和AUC分别为0.960，0.478和0.666(95%CI 0.556~0.777)。胰腺实质期联合门静脉期CTSI评分早期诊断胰腺坏死的的最佳截断值为2分，其敏感性、特异性和AUC分别为0.960，0.582和0.774(95%CI 0.679~0.869)，胰腺实质期联合门静脉期评估胰腺坏死的AUC显著大于胰腺实质期(P<0.05，图1)。

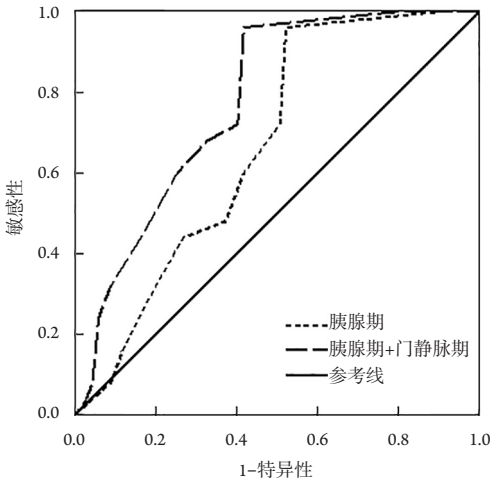

图1 单独胰腺实质期和联合门静脉期CTSI评分诊断胰腺坏死的ROC曲线

Figure 1 ROC curve of CTSI of pancreatic parenchymal phase and pancreatic parenchymal phase plus portal venous phase in diagnosis of pancreatic necrosis

3 讨论

ANP是指胰腺实质和/或胰周组织坏死，通常较间质水肿性胰腺炎病情严重，可继发感染，是导致全身炎症反应综合征和器官功能衰竭并显著增加AP中晚期病死率的一个重要因素[6-8]。CT是临床上评估胰腺坏死的主要手段之一，AP发病1周后进行增强CT检查是鉴别间质水肿性胰腺炎和ANP更有价值，一般间质水肿性胰腺炎的增强CT表现为胰腺实质均匀强化，只有胰周脂肪间隙模糊或积液，而ANP的增强CT表现为胰腺实质的无增强区域，发病1周内坏死区域主要表现为斑片状不均质强化，1周后由于坏死液化呈现均质强化减弱或无强化，增强CT还可对胰腺坏死范围进行评估[9-11]。

然而，目前国内外对于AP增强CT扫描检查是否应该包括动脉期、胰腺实质期和门静脉期尚存争议，我国最新AP指南中只提及发病1周后增强CT检查对评断胰腺坏死价值更大，但未详细给出增强CT的具体方案[12-13]。有学者从最低限度辐射剂量的角度考量，指出不应包括门静脉期增强扫描，并认为通过平扫、动脉期和

胰腺实质期CT图像评判胰腺坏死及其范围已足够[3]。一般情况下，正常胰腺实质在胰腺实质期和门静脉期强化的CT值分别为100~150 HU和100~110 HU。前期有学者[14]指出：只要胰腺实质任何区域的胰腺实质期CT值低于30 HU即可作出胰腺坏死的影像学诊断。然而，胰腺实质在胰腺实质期强化减弱除可能为胰腺坏死外，还可能是由于胰腺低灌注、缺血和水肿引起，因此仅凭胰腺实质期强化减弱来诊断胰腺坏死可能存在高估。本研究通过以胰腺实质期、胰腺实质期联合门静脉期CT增强图像分别对92例AP患者进行CTSI评分，发现尽管在发生胰腺坏死的AP患者中胰腺实质期CTSI评分与胰腺实质期联合门静脉期CTSI评分差异无统计学意义，但是在未发生胰腺坏死的AP患者中胰腺实质期CTSI评分显著高于胰腺实质期联合门静脉期CTSI评分，提示仅依靠胰腺实质期图像分析判定胰腺坏死和AP严重程度存在高估的情况。CTSI评分是预测AP严重程度和预后的有效手段之一，本研究中ROC曲线分析发现CTSI评分为2是诊断胰腺坏死的最佳截断值，这与既往研究[15]结果一致，CTSI评分<2时，AP患者并发症和死亡风险极低，CTSI评分=2时发生并发症的风险增加，而>2时则并发症和病死率显著升高。进一步通过ROC曲线分析发现：尽管胰腺实质期CTSI评分和胰腺实质期联合门静脉期CTSI评分对AP胰腺坏死均有一定的诊断价值，但是胰腺实质期CTSI评分早期诊断胰腺坏死的敏感性、特异性和AUC均显著低于胰腺实质期联合门静脉期CTSI评分，则进一步证实胰腺实质期联合门静脉期图像分析的必要性和重要性。笔者认为：胰腺实质期和门静脉期正常强化可排除胰腺坏死的可能，而胰腺实质期明显强化减弱时要根据门静脉期强化的不同情况来具体分析，如果门静脉期也表现为明显强化减弱则提示胰腺坏死的可能，但是如果门静脉期表现为正常强化则不支持胰腺坏死的诊断，可能与胰腺缺血、水肿因素有关。

综上所述，本研究结果表明增强CT扫描单纯胰腺实质期早期诊断AP胰腺坏死可能被高估、特异性较低，胰腺实质期和门静脉期联合评估有助于提高AP胰腺坏死的早期诊断效能。

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