行政院國家科學委員會專題研究計畫　成果報告

磁振造影對心肌存活之評估：與多保他命超音波心圖及鉈-201 斷層造影之比較

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執行單位：國立臺灣大學醫學院內科

計畫主持人：黃博昭

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計畫名稱：

磁振造影對心肌存活之評估：與多保他命超音波心圖與鉈－201 斷層造影之比較

Assessment of myocardial viability by magnetic resonance imaging: comparison with dobutamine echocardiography and thallium-201 SPECT

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執行機構及單位名稱：國立台灣大學醫學院內科、核子醫學部、影像醫學部

一、中英文摘要

中文摘要

慢性冠心病為心臟衰竭及死亡的重要原因，正確的評估心肌存活，對病人之治療及預後非常重要。新近研發之磁振造影儀具極佳的解析力，可評估心肌存活。本研究之目的，乃利用新型磁振造影測定心肌存活，並與多保他命超音波心圖與鉈－201 斷層造影所得比較之。

研究對象包括 14 位慢性冠心病者，經心導管證實其冠狀動脈有≥ 70%的狹窄，並有左心室功能異常。所有病人均於一個月內接受心肌磁振造影、多保他命超音波心圖與鉈－201 斷層造影等檢查。

心肌磁振造影乃利用顯影劑（gadolinium-DTPA）注射後心肌出現延遲性顯影可測定心肌存活與否，以 0 至 4 分定量之（≥ 2 分為壞死心肌）。鉈－201 之顯現≤ 50%則該節段心肌為壞死；多保他命超音波心圖則以多保他命注射前後的心室壁無運動被認定為壞死。每個人左心室均以 17 個節段分析之。

結果顯示，磁振造影的延遲性顯影和鉈－201 顯像及多保他命心肌存活之相關性相當強。磁振造影和鉈－201 斷層造影於評估心肌存活之一致性為 74.4%。三種檢查的一致性為 65.5%.。結論：以磁振造影測定心肌存活和鉈－201 顯像、多保他命超音波的相關性不錯，但以何種檢查最能判斷存活心肌（預測接受血管再造術後心室壁之復原），則需進一步的研究。

Abstract

Chronic coronary artery disease (CAD) is the leading cause of congestive heart failure and cardiac mortality. Functional recovery depends on accurate identification of reversible, viable myocardium. We evaluated the value of contrast-enhanced magnetic resonance imaging (MRI) in the assessment of myocardial viability.

The study population consisted of 14 patients with angiographically significant CAD (≧70% diameter stenosis) and left ventricular (LV) dysfunction. Each patient underwent simultaneous dobutamine stress echocardiography (DSE), thallium-201 (^{201}Tl) SPECT, contrast-enhanced MRI and coronary angiography within one month. MRI and ^{201}Tl images were semiquantitatively interpreted using a 17-segment model. For ^{201}Tl SPECT, segment with a severe (≦50% of peak uptake), fixed perfusion defect was considered as scar. In gadolinium-enhanced MRI, hyperenhacement score ≧ 2 was defined as nonviability. The amount of viable tissue in MRI correlated positively with ^{201}Tl uptake and DSE (p＜0.0001, each). The concordance rate of MRI and ^{201}Tl SPECT in detecting myocardial viability was 74.4%. Complete agreement of the 3 tests was 65.5%. In conclusion, there is a good correlation between the amount of viable tissue on MRI and ^{201}Tl uptake and also between these and contractile reserve detected by DSE. However, further study of a larger number of patients with revascularization is needed to explore which modality is superior in predicting functional recovery after intervention.

二、緣由與目的

In patients with chronic CAD and LV dysfunction, the extent of viable myocardium closely relates to the prognosis [1-4]. Many techniques have been applied for the assessment of myocardial viability, including positron emission tomography (PET), single photon emission computed tomography (SPECT), and DSE. At present, metabolic and perfusion PET has emerged as gold standard for assessing myocardial viability. However, the high cost and the requirement of an onsite cyclotron for production of short-life PET perfusion tracer limit its clinical utility. On the other hand, although scintigraphic techniques appear more sensitive for detection of viability, their specificity to predict functional recovery is general lower, ranging from 48-82% [5-7].

Contrast-enhanced MRI is able to detect myocardial scar with high spatial resolution [8-11]. However, it remains unclear which of the following techniques, i.e. MRI, DSE or ^{201}Tl SPECT, is most relevant to functional recovery after successful revascularization. Accordingly, we evaluated patients with chronic stable CAD and LV dysfunction, to compare the accuracy of MRI with DSE and ^{201}Tl SPECT in predicting viable myocardium.

三、方法

Fourteen patients (13 men, 1 women, aged 69.9 ± 10.7 years) with angiographically significant CAD (≧70% diameter stenosis) and wall motion abnormalities who were referred to our cardiology laboratory for assessment of

myocardial viability were studied. Each patient underwent resting echocardiography, MRI and coronary angiography within one month. Of the 14 patients, simultaneous DSE and ^{201}Tl SPECT were performed in 11, dipyridamole in 2 and treadmill stress ^{201}Tl SPECT in one patient. The stress-reinjection ^{201}Tl SPECT procedures have been described previously in our laboratory [12,13].

ECG-gated cine MR images were acquired using a 1.5-T scanner (Siemens Sonata, Germany) in multiple short-axis views and two orthogonal long-axis views, during repeated breath-holds for approximately 15 seconds. Gadolinium-DTPA (0.2mmol/kg) was injected intravenously and contrast-enhanced images were acquired 15 minutes later using an inversion-recovery segmented gradient echo sequence. Inversion times were adjusted to null normal myocardium.

All MRI and ^{201}Tl SPECT images were interpreted using a 17-segment model [14]. ^{201}Tl activity in each segment was scored in 0－4 scores (0＝normal, 1＝mildly reduced, 2＝moderately reduced, 3＝severe, and 4＝absent of photon activity). A segment with a severe (≦50% of peak ^{201}Tl uptake), fixed perfusion defect was considered nonviable. For MRI, the average segmental transmural extent of enhancement in each segment was assessed visually using the following scale (gadolinium score): 0＝none, 1＝1% to 25%, 2＝26% to 50%, 3＝51% to 75%, and 4＝76% to 100% enhancement. A score ≧ 2 indicated nonviable myocardium.

The DSE images were independently interpreted using a 16-segment model proposed by the American Society of Echocardiography [15]. Wall motion in each segment was visually assessed as 1＝normal, 2＝mild hypokinesia, 3＝moderate or severe hypokinesia, 4＝akinesia, and 5＝dyskinesia. Dysfunctional segments exhibiting a biphasic response, worsening or sustained improvement were considered viable, whereas those with unchanged wall motion were considered as scar [16].

All continuous variables are expressed as mean ± SD. Student's *t* test and chi-square or Fisher's exact test were used when appropriate. A 2 tailed probability value＜0.05 was considered statistically significant.

四、結果

Of the 14 patients studied, good quality for contrast-enhanced MR images was obtained in 12 patients. In 204 segments obtained from these 12 patients, the amount of viable tissue on MRI and ^{201}Tl uptake correlated positively (^{201}Tl uptake activity＝0.86 gadolinium score＋0.16, r＝0.60, p＜0.0001). For images of DSE and MRI, similar positive correlation was also seen (r＝0.57, p＜0.0001). The concordance of MRI and ^{201}Tl SPECT in detecting myocardial viability was 74.4%, and the concordance between MRI and DSE was 78.8%. Among 160 segments from MRI, DSE and ^{201}Tl SPECT, complete agreement of viability based on these three tests was

obtained in 65.6%.

Figure 1 shows the relation between ^{201}Tl uptake and hyperencement of contrast-enhanced MRI. Nonviability was detected in 68 segments with stress ^{201}Tl SPECT, and 19 segments (27.9%) were found viable in MRI; while 28 (36.4%) of 77 segments as scar on MRI were found viable on stress ^{201}Tl SPECT.

五、討論

This study demonstrates a good correlation among the amount of viable tissue on MRI, ^{201}Tl uptake and DSE. The concordance rate of MRI and ^{201}Tl SPECT in detecting myocardial viability was 74.4%. So far, no data are available regarding the comparison among contrast-enhanced MRI, ^{201}Tl SPECT and DSE. Similarly to our findings, Patrick et al. [17] recently noted a good correlation between ^{18}F-FDG PET and MRI. Combined assessment of DSE, ^{201}Tl SPECT and MRI might reflect various classes of tissue composition or hibernating stages in dysfunctional myocardium which might have great impact in predicting functional recovery after successful revascularization.

六、結論及成果自評

This study demonstrates a modest agreement between ^{201}Tl SPECT and contrast-enhanced MRI for the detection of myocardial viability in patients with chronic CAD and LV dysfunction and establishes the value of contrast-enhanced MRI for assessing myocardial viability. The limitation of the present study is the lack of an independent measurement of viability, that is, functional outcome after revascularization. Recovery of regional dysfunction and improvement of clinical symptoms in this study was available in only one patient who underwent revascularization. Further study with a larger number of patients with revascularization is needed to explore this issue.

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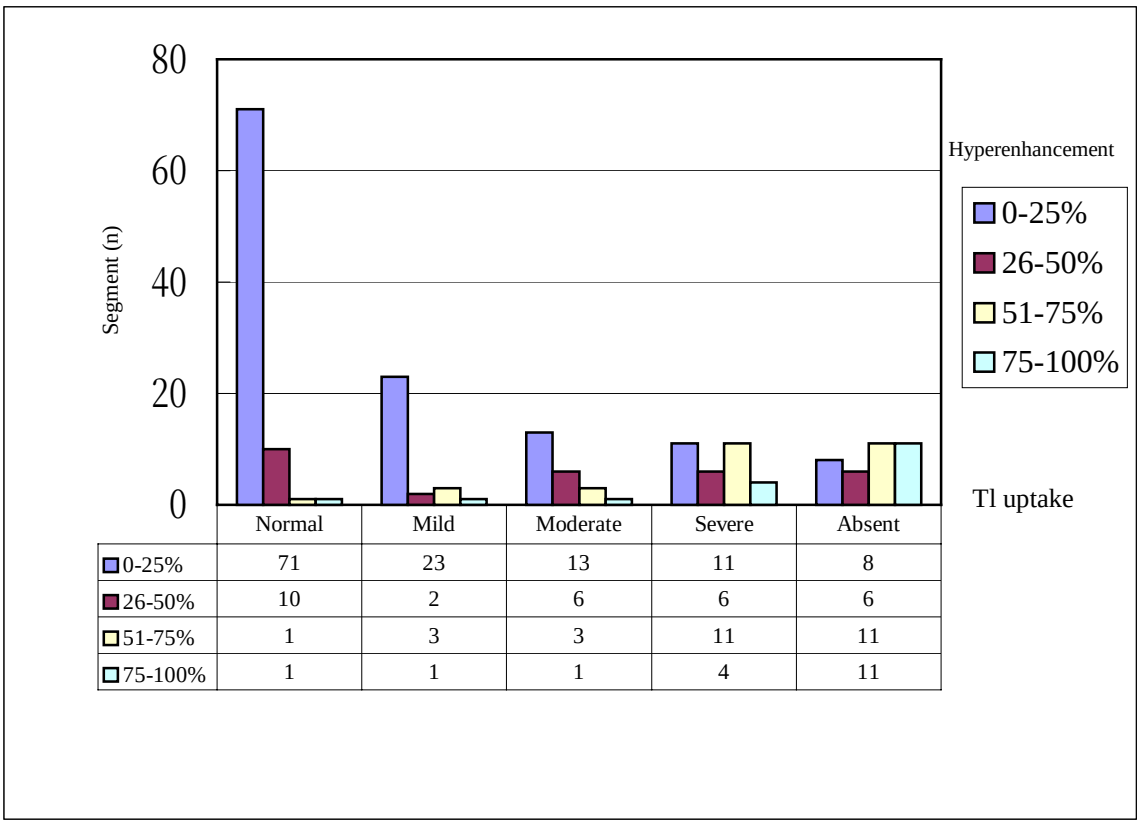
Figure 1. Relationship between thallium uptake and hyperenhancement in contrast-enhanced MRI



	Normal	Mild	Moderate	Severe	Absent
0-25%	71	23	13	11	8
26-50%	10	2	6	6	6
51-75%	1	3	3	11	11
75-100%	1	1	1	4	11