

CT angiographic patterns of Thai diabetic patients with critical limb ischemia

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Objectives To define the distribution pattern of peripheral arterial disease (PAD) in diabetic patients with critical limb ischemia (CLI) by using CT angiography.

Methods Ninety seven femoral run-off computed tomographic angiographies (CTAs) of diabetic patients with CLI were reviewed retrospectively from March 2010 to January 2013. Vascular obstructive lesions were classified as aortoiliac, femoropopliteal and below knee segments, with details of stenotic severity and lengths. Distribution patterns were analyzed by the Pearson Chi square test.

Results There were 478 lesions in 194 limbs. Aortoiliac and femoropopliteal diseases were found more frequently than below knee disease (133 vs. 68) in stenotic lesions less than 10 cm ($p = 0.0001$) long. However, below knee segment was involved more frequently than above knee disease (121 vs. 30, $p = 0.0001$) for occlusions equal in length or longer than 10 cm.

Conclusions Above knee arterial stenoses are seen frequently as significant in diabetic patients with CLI, and the findings of this study demonstrate both interest in and opportunities for inflow revascularization with endovascular therapy. **Chiang Mai Medical Journal 2013;52(3-4):51-55.**

Keywords: critical limb ischemia, diabetes, CT angiography

Introduction

Critical limb ischemia (CLI) is a limb threatening condition with a high mortality rate, as approximately 20-25% of the patients die within one year post diagnosis [1]. Diabetes is a well known major risk factor for causing up to four fold increased chance of CLI development, and a high amputation rate of up to 5 to 10 times that for non-diabetic patients [1,2]. Revasculariza-

tion, by either surgical bypass or endovascular therapy, is the main method for saving an affected limb, and the treatment plan is based on anatomical disease distribution, as mentioned in many major guidelines. Furthermore, infra-popliteal lesions are predominate in diabetic patients [2-4, 5].

Multidetector computed tomographic angiography (MDCTA) is a rapid and robust method for evaluating peripheral arterial disease. In the

authors' experience, they frequently found stenotic lesions in the above knee arterial segment, which raised the question of disease distribution pattern in the Thai population. Therefore, this retrospective study aimed to define the distribution pattern of peripheral arterial disease (PAD) in diabetic patients with critical limb ischemia (CLI).

Material and methods

This study was approved by the local ethical committee. From March 2010 to January 2013, it retrospectively researched patients who underwent multidetector computed tomographic angiography (MDCTA) of the abdominal aorta, with a femoral run-off. There were 765 cases from the institutional radiology database of this study. One hundred and twenty four diabetic cases were found among this group by using criteria of currently used antihypoglycemia agents or fasting blood sugar of more than 126 mg/dL. Critical limb ischemia, classified as Rutherford class 4 to 6, was found in 97 patients. Demographic data including age, sex, smoking history, hypertension, dyslipidemia, and presence of cerebrovascular and coronary arterial diseases also were recorded.

MDCTAs were performed by a 64-slice dual source MDCT (Seimens) scanner from the thoracoabdominal aorta down to both feet using the dual energy technique with tube A (140kV, 56 mAs reference) and tube B (80 kV, 234 mAs reference) with autoexposure control (Caredose 4D, Seimens). Arterial phase images were obtained by using contrast bolus tracking at the common femoral artery. Then, 100 ml of non-ionic contrast media (350 mgI/mL) were injected intravenously at 4 mL/s, followed by 45 cc of contrast media at a rate of 2.2 cc/s, and subsequent flushing with 20 cc of saline. A 64 x 0.6 mm collimator and pitch of 0.8 and 0.5 s rotation time were used for scanning, with retrospective reconstruction into a 1.5 mm image slice thickness with 1.2 mm interval. Image reconstruction in multiplanar reformation (MPR), maximum intensity projection (MIP), and the volume rendering technique (VRT) were carried out on a Syngo workstation.

All MDCTAs of 97 cases were reviewed on a PACS workstation (Panacea) by a radiologist (TS) with 7 years experience in vascular imaging. Obstructive lesion defined as any stenosis of more than 50% luminal diameter narrowing was classified as aortoiliac, femoropopliteal and below knee segments. Degree of stenosis was classified and reported into hemodynamically significant stenosis (50-99%) and occlusion (100%). Length of the lesions was recorded and classified into shorter than 10 cm and equal to 10 cm or more. In cases of more than one lesion in the same seg-

ment, the one with most severe luminal narrowing was the representative lesion. Occlusion and stenosis were recorded separately.

Distribution pattern of stenosis, occlusion in each segment, and length, were analyzed by using the Pearson Chi square test.

Results

Ninety seven MDCTA studies of diabetic patients presented with critical limb ischemia. The MDCTA of 194 limbs were reviewed and one case could not evaluate the below knee segment, due to heavily calcified arteries. Demographic data of the patients and severity of critical limb ischemia are summarized in Table 1.

All stenoses were defined by 478 obstructive lesions composed of 2000 occlusions and 278 stenoses, with more than 50% luminal diameter narrowing. They were distributed as aortoiliac, femoropopliteal and below knee segments with a value of 73 (15.27%), 145 (30.33%), and 260 (54.39%) lesions, respectively. Considering stenosis and occlusion with their length, the distribution pattern of the lesions is presented in Table 2.

In stenotic lesions less than 10 cm long (Table 2), predilection of above knee segments was noted significantly, i.e. 133 vs. 68 ($p < 0.001$). On the other hand, occlusions equal to 10 cm long or more statistically preferred the below knee segment rather than above knee segments, i.e. 121 vs. 30 ($p < 0.001$).

Table 1. Demographic data of patients

Age (year)	67.64 (38-90)
Sex (M : F)	51:46
Hypertension	57
Smoking	14
Dyslipidemia	25
Coronary arterial disease	9
Cerebrovascular disease	2
Rutherford's class	
4	15
5	51
6	31

Table 2. Distribution of obstructive lesions

Segment	Stenosis		Occlusion		Total
	< 10 cm	>= 10 cm	< 10 cm	>= 10 cm	
Aortoiliac	50	2	15	6	73
Femoropopliteal	83	17	21	24	145
Above knee	133*	19	36	30#	218
Below knee	68*	58	13	121#	260
Total	201	77	49	151	478

* $p < 0.001$, # $p < 0.001$,

Discussion

It has been known since 1964 that diabetic peripheral arterial disease mainly affect below knee arteries. This was described first by Strandness and confirmed later by many studies [6-10]. Graziani et al collected 417 diabetic patients with ischemic foot ulcers in a large series, and they classified lesions by using 10 cm as a cut point [8]. Graziani found that 74% of obstructive lesions were in below knee arteries [8]. This study found below knee lesions at 54.39% (260 from 478), which suggested that upper knee lesions in Thai patients may be higher than those in westerners. This finding may reveal a better chance of limb salvage in Thai patients.

This study also found that short segmental stenotic lesions of less than 10 cm long (66.16%, 133/201) had upper knee disease. Endovascular therapy is suitable for these kinds of lesions and it provides a greater opportunity for CLI patients to save their limbs; even though occlusions equal to or more than 10 cm long affect below knee arteries more than upper knee segments (121/151 vs. 30/151). The results of this study confirm the nature of infrapopliteal occlusive lesions in diabetic patients, as in prior studies [6-10].

Revascularization of below knee arteries is challenging and many new complex techniques have been developed for limb salvage that requires more specifically designed instruments. In contrast to upper knee disease, the revascularization technique, by either surgical or endovas-

cular therapy, has been well established and uses less sophisticated instruments [3]. In this study, the upper knee stenotic lesions and occlusions were 45.61% (218/478), therefore, the opportunity of either endovascular treatment or surgical bypass should be allowed in these segments.

The authors are aware that MDCTA is limited in evaluating calcified arteries. Although catheter-based angiography is the gold standard imaging technique, the 64-slice MDCT apparently provides high image quality, which leads to appropriate treatment decisions [12]. However, this study was unable to assess below knee arteries confidently in one patient.

In conclusion, significant above knee arterial stenoses are seen frequently in diabetic patients with CLI, and the findings in this study demonstrate interest in and opportunities for inflow revascularization with endovascular therapy in Thai diabetic patients.

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Conflicts of Interest: none

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รูปแบบของเอกซเรย์คอมพิวเตอร์หลอดเลือดขาของผู้ป่วยเบาหวานที่มีการขาดเลือดเรื้อรังชั้นวิกฤติ

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วัตถุประสงค์ เพื่อศึกษารูปแบบการกระจายของโรคหลอดเลือดแดงตีตันในผู้ป่วยเบาหวานที่มีอาการขาดเลือดเรื้อรังชั้นวิกฤติโดยใช้เอกซเรย์คอมพิวเตอร์

วิธีการศึกษา เป็นการศึกษาย้อนหลังในช่วงระหว่างมีนาคม 2554 ถึง มกราคม 2556 โดยสืบค้นเวชระเบียนและภาพเอกซเรย์คอมพิวเตอร์หลอดเลือดขาของผู้ป่วยที่ได้รับการวินิจฉัยว่าเป็นเบาหวาน และมีภาวะขาดเลือดชั้นวิกฤติจำนวน 97 ราย แบ่งรูปแบบการกระจายของรอยโรคออกเป็น aortoiliac, femoropopliteal และระดับต่ำกว่าเข่าลงไป และบันทึกระดับความรุนแรงและความยาวของรอยโรค ทำการวิเคราะห์ข้อมูลทางสถิติด้วย Pearson Chi square test

ผลการศึกษา พบรอยโรค 478 รอยโรคใน 194 ขา พบว่าภาวะหลอดเลือดตีตันที่สั้นกว่า 10 เซนติเมตรนั้น พบบ่อยในระดับเหนือเข่ามากกว่าในระดับต่ำกว่าเข่า (133 กับ 68) อย่างมีนัยสำคัญทางสถิติ ($p=0.0001$) แต่สำหรับรอยโรคชนิดหลอดเลือดอุดตันนั้นพบในระดับต่ำกว่าเข่ามากกว่าอย่างมีนัยสำคัญทางสถิติ (121 กับ 30, $p=0.0001$)

สรุป ในผู้ป่วยเบาหวานที่มีภาวะขาดเลือดเรื้อรังชั้นวิกฤติ มีหลอดเลือดตีตันในหลอดเลือดเหนือเข่าได้บ่อย ดังนั้นจึงควรตระหนักและเป็นโอกาสให้ผู้ป่วยได้รับการรักษาด้วยการเปิดขยายหลอดเลือดด้วยวิธีการรักษาผ่านหลอดเลือด **เชียงใหม่**
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