ACCURACY OF CLINICAL EVALUATION IN DIAGNOSING ARTERIAL OCCLUSIVE DISEASE OF THE LOWER EXTREMITY

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SYNOPSIS

The resting ankle/arm systolic pressure ratio and the post/preexercise ankle pressure ratio are used to diagnose arterial occlusive disease of the lower extremity because of their high correlation with arterial stenosis documented angiographically. We compared the accuracy in diagnosing arterial occlusive disease by traditional clinical evaluation (history and/or physical findings) with that by the non-invasive tests mentioned above in 254 diabetic patients. In the 219 patients with no claudication pain, 83 had arterial occlusive disease by the non-invasive tests, i.e. there were 38% false negatives. In the 35 patients with claudication pain, 13 had no arterial occlusive disease, i.e. there were 37% false positives. In the 12 patients with abnormal history and phsyical findings, all had arterial occlusive disease. We propose that the simple technique of measuring ankle systolic pressure at rest and after exercise complements clinical evaluation and increases the accuracy of diagnosing arterial occlusive disease of the lower extremity.

INTRODUCTION

During the past two decades noninvasive vascular studies contributed to the diagnosis, definition of severity and management of arterial occlusive disease in the lower extremity (1,2,3,4,5,6). Several techniques have been used. A commonly used one is the measurement of ankle systolic blood pressure using Doppler ultrasonic flow detectors and relating this to the brachial systolic pressure. Excellent correlation between the ankle/arm systolic pressure ratio and arterial stenosis documented angiographically have been established (1,2,3,4,5,6). The combined use of the resting and post-exercise ankle systolic pressures had been shown to be a sensitive index of mild arterial occlusive disease (6,7,8,9). Because the method is simple, repeatable and causes no discomfort to the patient, it has become a valuable tool in the assessment of the patient with arterial occlusive disease in the lower extremity (4,5).

Clinical evaluation of these patients usually involves taking a good history and performing a careful physical examination. However, these methods of assessment can be subjective. The purpose of this study is to compare the information obtained by traditional clinical evaluation with that obtained by noninvasive vascular testing.

SUBJECTS AND METHODS

Two groups of subjects were studied. The group of normal subjects consisted of 22 healthy young Chinese volunteers who had no clinical evidence of arterial occlusive disease in the lower extremity. There were 12 males and 8 females. Their ages ranged from 20 to 39 years, with the mean age of 24.5 years. The diabetic group consisted of 254 patients from the University Departments of Medicine (219) and Orthopaedics (35), Singapore General Hospital. There were 141 males and 113 females. Their ages ranged from 15 to 81 years, with the mean age of 53.7 years. There were 198 Chinese, 37 Indians, 15 Malays and 4 Eurasians.

The following methods were used to assess the presence of arterial occlusive disease in the lower extremity; patient history, physical examination and determination of ankle systolic pressure (at rest and after exercise). All procedures were done by one physician.

Patient history: Each subject was asked a series of questions relating to leg pain to determine the presence of intermittent claudication:

1. Do you get pain in either leg when walking on level/uphill?
2. In what part of your leg do you feel it?
3. What do you do if you get it while you are walking?
4. Does the pain ever disappear when you continue to walk?
5. What happens to the pain if you stand still?
6. How soon before the pain is relieved?
7. Does the pain ever occur when you are at rest?

The history was considered positive if the subject had leg pain caused by exertion, relieved by rest and did not start when the subject was at rest.

Physical examination: This consisted of (a) palpation of the femoral, popliteal, dorsalis pedis and posterior tibialis pulses, and (b) auscultation of the iliac and femoral arteries. The examination was considered positive if a dorsalis pedis/posterior tibialis pulse was absent or a bruit was audible over the femoral artery.

Ankle systolic pressure determinations: These tests were performed with the subjects at rest in the supine position and their limbs at the level of the chest. The inflatable portion of the cuff used was 30 x 14 cm. Brachial systolic pressure was determined by auscultation. (Preliminary studies showed that the systolic pressures recorded by auscultation and by Doppler ultrasound detector were similar). The ankle systolic pressure was determined with a 5 MHz Doppler probe (Parks Laboratory Ltd., Beaverton, Oregon, U.S.A., Model 841) over the dorsalis pedis or posterior tibialis artery. The blood pressure cuff was applied around the ankle above the malleolus and the systolic pressure was recorded as the return of flow signals during gradual deflation of the cuff. Duplicate readings were obtained.

The ankle systolic pressure after exercise was then determined as described by Carter[7]. The exercise consisted of up to 2.5 minutes of dorsilfexion and extension of the ankle at the rate of about 1 per second. During the first 30 seconds the hand of the examiner provided resistance to the movement of increase the work load. if claudication developed during the 2.5 minutes period, the exercise was stopped. Two systolic pressure determinations were made during the first minute after the exercise.

The quality of the sound of the pulse was noted to be diphasic or monophasic.

For each subject the ankle/arm systolic pressure ratio at rest and the post-exercise/pre-exercise ankle systolic pressure ratio were calculated. In the normal group the ankle/arm ratio was 1.05 ± 0.05 (Mean $\pm$ S.D.). Any subject with a ratio of ≤ 0.86 was considered to have an abnormal reading, implying the presence of mild, but hemodynamically significant arterial occlusive disease even though their ankle/arm pressure ratio at rest was normal.

RESULTS

In this study an abnormal test by the non-invasive Doppler technique implied the presence of arterial occlusive disease. In the first comparison of clinical evaluation with the non-invasive test (Table 1), the ankle/arm pressure ratio (< 0.94) was used to diagnose arterial occlusive disease. Mild cases with normal resting ankle/arm pressure ratio, but abnormal post/pre-exercise ankle pressure ratio were ex-

TABLE 1. CLINICAL EVALUATION VS NONINVASIVE TESTING — I

NONINVASIVE TESTS		NORMAL	ABNORMAL*
1. **HISTORY**			
Normal	219	159	60 (27%)
Abnormal	35	16 (46%)	19
2. **PHYSICAL FINDINGS**			
Normal	184	150	34 (19%)
Abnormal	70	25 (36%)	45
3. **HISTORY AND PHYSICAL FINDINGS**			
Normal	161	134	27 (17%)
Abnormal†	93	41 (44%)	52
Abnormal††	12	0	12

*Criterion for abnormality = resting ankle/arm pressure ratio ≤ 0.94.

†Either history and/or physical findings are abnormal.

††Both history and physical findings are abnormal.

cluded when this criterion was used. Of the 219 patients with no claudication pain, 60 had arterial occlusive disease by the non-invasive tests, i.e. there were 27% false negatives. Of the 35 patients with claudication pain, 16 had no arterial occlusive disease, i.e. there were 46% false positives. According to physical findings 184 patients were normal, but 19% were false negatives. Seventy patients had abnormal physical findings, but 36% were false positives. Of the 161 patients with both normal history and physical findings, there were 17% false negatives. Of the 93 patients with abnormal history and/or physical findings, there were 44% false positives.

In the second comparison of clinical evaluation with non-invasive tests (Table 2), the ankle/arm pressure ratio at est ($\leq$ 0.94) and the post/pre-exercise ankle pressure ratio were used to denote the presence of arterial occlusive disease. Mild cases of arterial occlusive disease with functional impairment of flow were included in this comparison. By history there were 38% false negatives and 37% false positives. By physical findings there were 28% false negatives and 24% false positives. Of the 161 patients with normal history and physical findings, there were 26% false negatives. Of the 93 patients with abnormal history and/or physical findings, there were 32% false positives. Twelve patients had claudication and abnormal physical findings. They all had arterial occlusive disease by the non-invasive tests.

Table 3 shows the sound quality of the pulse in all patients. Approximately 10% of subjects with no disease had monophasic sounds whereas 39% of subjects with disease had diphasic sounds.

DISCUSSION

In this study we did not do arteriography, but used the resting and post-exercise ankle systolic pressures to denote the presence of significant arterial occlusive disease in the lower extremity. Experimental evidence support the use of these criteria. Systolic blood pressure measured by the Doppler method are comparable to direct intraarterial pressure measurements (10). Previous studies involving large series of patients showed a highly significant correlation between the clinical as well as angiographic severity of the arterial occlusive disease and the magnitude of ankle systolic pressure reduction (1, 2, 3, 4, 5, 6). Other studies demonstrated the combined use of the resting and post-exercise ankle systolic pressure to be a sensitive index of early cases

TABLE 2. CLINICAL EVALUATION VS NONINVASIVE TESTING — II

NONINVASIVE TESTS		NORMAL	ABNORMAL*
1. **HISTORY**			
Normal	219	136	83 (38%)
Abnormal	35	13 (37%)	22
2. **PHYSICAL FINDINGS**			
Normal	184	132	52 (28%)
Abnormal	70	17 (24%)	53
3. **HISTORY AND PHYSICAL FINDINGS**			
Normal	161	120	41 (26%)
Abnormal†	93	29 (32%)	64
Abnormal††	12	0	12

*Criteria for abnormality = ankle/arm pressure ratio $\leq$0.94 and post-exercise/pre-exercise ankle pressure ratio $\leq$0.86

†Either history and/or physical findings are abnormal

††Both history and physical findings are abnormal

TABLE 3. QUALITY OF PULSE SOUND VS NONINVASIVE TESTING

		QUALITY OF SOUND	
		MONOPHASIC	DIPHASIC
NONINVASIVE TESTS			
Normal	149	15 (10%)	134
Abnormal*	105	64	41 (39%)
TOTAL	254	79	175

*Criteria for abnormality = resting ankle/arm pressure ratio $\leq$ 0.94 and post-exercise/pre-exercise ankle pressure ratio $\leq$ 0.86.

of arterial occlusive disease (6, 7, 8, 9). Daily ankle blood pressure over 10-15 days are consistent[5] and the ankle/arm systolic pressure ratio has a day-to-day coefficient of variation of 6.4% (11). When two other conditions (emboli/acute thrombosis and aortoiliac disease) are ruled out, a marked reduction in ankle systolic pressure usually denotes the presence of arterial occlusive disease in the lower extremity. On the other hand, the physician should also recognize the possible error of a falsely high ankle systolic pressure in the patient with non-compressible calcified vessels.

A good history and a carefully performed physical examination are generally considered adequate to diagnose arterial occlusive disease in the lower extremity. In this study there are 38% false negatives in the 219 patients who gave a negative history. This group of patients probably include (a) those with mild disease, (b) those who have occulsion of certain arterial segments (tibial/peroneal) that produce no symptoms, (c) those in whom neuropathy may have modified the pain pattern, and (d) those with pseudoclaudication. Although the history of typical intermittent claudication pain appears clear, there was 37% false positives in the 35 patients who gave a positive history. As with the history, this study shows a 28% false negative among the 184 patients with normal physical findings and a 24% false positive among the 70 patients with abnormal physical findings. Several factors may account for this: (a) observer variability in recording pedal pulses (12, 13), (b) Congenital absence of pedal pulses (14), and (c) difficulty in palpating pedal pulses in swollen extremities.

Our findings, in general, corroborate those reported by Marinelli et al (15). But in history, the false negatives (38% vs 31%) and false positives (37% vs 26%) are slightly higher in our study. In physical findings the false negatives (28% vs 21%) are slightly higher in our study and the false positives (24% vs 44%) lower. The discrepancies between the two studies may be due to population differences and experimental design. Our subjects were Oriental and theirs were Caucasian. Their interviews were conducted by several research technologists whereas ours were conducted by one physician.

The quality of the pulse sound had been suggested to be helpful in deciding the presence of arterial occlusive disease (16, 17). A normal pulse is high pitched and diphasic whereas an abnormal pulse is low pitched and monophasic. Our study shows that there are 39% false positives and 10% false negatives when sound is used as the criteria, suggesting that objective pressure readings are more helpful.

When both the history and physical examination are abnormal, the chances of having arterial occlusive disease are high, 100 per cent in our study. However, when both the history and physical examination are normal, there is a 26% false negative. When only the history or physical examination is abnormal there is a 32% false positive. We feel that history taking and physical examination are useful, important and integral in the assessment for arterial occlusive disease in the lower extremity. But, it can be complemented by the measurement of ankle systolic pressure, at rest and after exercise. This technique is simple, repeatable and causes no discomfort to the patient.

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