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### Key Words

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## Results of Surgical Treatment for Peripheral Arterial Occlusive Disease in Women

**Background.** The incidence and prevalence of peripheral arterial occlusive disease (PAOD) in women is more prevalent than generally appreciated, and the results of surgical treatment are not certain. The purpose of this study was to investigate the result of surgical treatment of PAOD in female patients in our service.

**Methods.** Medical records of female patients undergoing surgical treatment for PAOD in Taipei Veteran General Hospital from January 1, 1997 to July 31, 1998 were reviewed retrospectively. The clinical variables were evaluated, including age, smoking, diabetes mellitus, hypertension, renal function, coexistent coronary disease, history of stroke, Fontaine stages, surgical procedures and results.

**Results.** There were 20 female patients undergoing surgical treatment for PAOD during the study period, aged from 57 to 91 years, with an average of  $73.7 \pm 2.2$ . Four patients presented with rest pain. Twelve patients presented with gangrene of lower limbs. Ten patients underwent bypass surgery. Three patients received embolectomy. One patient underwent below knee amputation after femoro-popliteal bypass. One patient underwent below knee amputation after embolectomy. Five patients underwent above knee amputation without bypass surgery or embolectomy. Four patients (20%) died after surgery.

**Conclusions.** The female patients of PAOD presented with severe symptoms and advanced Fontaine stages. The delay in diagnosis and referral resulted in an unsatisfying outcome of surgical treatment. An aggressive approach in diagnosis and referral is necessary for better results.

Peripheral arterial occlusive disease (PAOD) occurs in about 1 to 4 percent of the elder population.<sup>1</sup> The symptoms and signs include pain during walking or exercise (intermittent claudication), ischemic pain at rest, ulcers and gangrene.<sup>1,2</sup> The disease is more prevalent than generally appreciated in women,<sup>3</sup> and its risk increases sharply with age.<sup>4</sup> Besides, PAOD itself is a strong risk factor of other cardiovascular events and mortality.<sup>5</sup> There is a 3- to 4-fold increase in the relative risk for all-cause mortality associated with PAOD.<sup>5,6</sup> The relative risk of cardiovascular death is between 4 and 6.<sup>5,7</sup>

The results of surgical treatment for PAOD in women are not certain. The purpose of the retrospective study was to investigate the results of surgical treatment for PAOD in female patients in our service.

### METHODS

The medical records of female patients treated surgically for PAOD in Taipei Veterans General Hospital from January 1, 1997 to July 31, 1998 were reviewed retrospectively. The major diagnostic criteria of PAOD include: (1) intermittent claudication, (2) ankle/brachial blood pressure Index (ABI) < 0.9, (3) flow velocity deficits measured by Doppler, and (4) absent posterior tibial or dorsalis pedis pulses. The severity of symptoms and signs of PAOD are classified by Fontaine stage: no symptom is classified as Fontaine stage 1, intermittent claudication is classified as Fontaine stage 2, resting pain is classified as Fontaine stage 3, and ulcer and gangrene is classified as Fontaine stage 4.<sup>8</sup>

Risk factors of PAOD secondary to atherosclerosis,

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such as tobacco consumption, diabetes mellitus and hypertension, were analyzed. Smoking 1 pack or more per day up to the date of surgery was considered a positive factor. Hypertension was considered a condition requiring therapy with anti-hypertension medication. Clinically diabetes mellitus (DM) was considered a condition requiring therapy with insulin or oral hypoglycemic agents.<sup>9</sup> In the Framingham study, age-specific incidence accelerated rapidly in women.<sup>10</sup> We also classified our patients by the age of 70 years. Patients who had blood creatinine level above 2.0 mg/dL were considered renal insufficient. Coronary artery disease was documented if a definite diagnosis was made by symptoms, EKG or coronary arteriography.

The surgical procedure was decided on the basis of clinical presentation and angiography findings. Embolectomy was done for patients who presented themselves with symptoms of acute occlusion and were confirmed to have acute embolism by arteriography. A bypass procedure was done for patients who presented with symptoms of chronic stenosis and whose arteriography revealed adequate distal run-off of distal arteries.

Amputation or disarticulation was done for patient who presented with irreversible gangrene in the lower extremities.

## RESULTS

From January 1, 1997 to July 31, 1998, 20 female patients with PAOD received surgical treatment. They were aged from 51 to 91, with an average of  $73.7 \pm 2.2$ . Thirteen patients (65%) were older than 70. Three patients (15%) consumed cigarettes. Thirteen patients (65%) were diabetic. Twelve patients (60%) had hypertension. Three (15%) patients had renal insufficiency. Two patients (10%) had stroke history. Six patients (30%) had coexisting coronary artery disease. Four patients (20%) suffered from intermittent claudication (Fontaine stage 2), 4 patients (20%) had rest pain (Fontaine stage 3), and 12 patients (60%) presented with tissue gangrene of lower limb (Fontaine stage 4).

The operative variables and outcome are shown in Table 1. In the 12 patients presenting with tissue gan-

**Table 1. Operative variables and outcome**

Patient	Fontaine stages	Operative Procedures	Site	Compl.	Mortality
#1	2	F-P bypass	Left	no	no
#2	4	AK amputation	Left	no	yes
#3	2	Aorto-femoral bypass	Left	no	no
#4	4	AK amputation	Right	no	no
#5	3	F-P Bypass	Right	no	no
#6	4	AK amputation	Bil.	no	no
#7	4	AK amputation	Right	no	yes
#8	3	Embolectomy, BK Amputation	Right	no	no
#9	3	Embolectomy	Right	Bradycardia	yes
#10	2	F-P Bypass	Right	no	no
#11	4	F-P Bypass	Left	no	no
#12	4	F-P Bypass	Left	no	no
#13	4	Toe disarticulation	Right	no	no
#14	2	Aorto-bifemoral, F-P bypass	Bil.	no	no
#15	4	F-P Bypass, BK Amputation	Right	no	no
#16	4	Toe disarticulation	Right	no	no
#17	4	AK amputation	Bil.	Resp. Fail.	yes
#18	4	Left F-P Bypass, Right BK Amputation	Bil.	no	no
#19	3	Embolectomy	Left	no	no
#20	4	F-P Bypass	Right	no	no

AK = above knee; Bil. = bilateral; BK = below knee; Compl. = complications; F-P bypass = femoro-popliteal bypass; Resp. Fail. = respiratory failure.

grene, 5 underwent above-knee amputation directly with bypass surgery because of the profound gangrene of the lower leg (patients #2, #4, #6, #7, and #17). Two patients (patients #13 and #16) received toe disarticulation. Femoro-popliteal bypass procedures were done for another 4 patients of Fontaine stage 4 (patients #11, #12, #15, and #20). One patient (patient #15) received below-knee amputation after femoro-popliteal bypass. One patient received femoro-popliteal bypass in the lower limb and below-knee amputation in the right lower limb (patient #18).

Embolectomy was done for 3 patients presenting with rest pain (Fontaine stage 3) (patients #8, #9, and #19). Below-knee amputation was done for 1 patient (patient #8) after embolectomy. Another patient of Fontaine stage 3 received femoro-popliteal bypass (patient #5).

Femoro-popliteal bypass was done for 4 patients presenting with intermittent claudication (Fontaine stage 2). All the patients at Fontaine stage 2 recovered well after surgery without complication or mortality.

Two patient (10%) developed complications and 4 patients (20%) died in our study. One patient of Fontaine stage 3 suffered from bradycardia after embolectomy (patient #9). She had coexisting coronary artery disease. One patient of Fontaine stage 4 developed respiratory failure after above-knee amputation (patient #17). Both patients died after complications. Another 2 patients of Fontaine stage 4 died of sepsis after above-knee amputation (patients #2 and #7).

## DISCUSSION

The incidence of PAOD in women lagged 10 years behind that in men, but the gap decreased with age.<sup>10</sup> The incidence of PAOD increases sharply with age whatever criteria are applied. In our experience, elder female patients have higher morbidity of PAOD.

The coronary arteries are smaller in female than in male.<sup>11</sup> In the retrospective study of Magnet *et al.*<sup>12</sup>, the patency of bypass and survival rate were both worse in female patients of PAOD than in their male counterparts. The women who required infrainguinal bypass were older and had smaller infrainguinal arteries in comparison with men. Aged female patient with PAOD

often complicated with associated atherosclerotic disease such as coronary artery disease, stroke and congestive heart failure.

Pre-menopausal women are at a lower risk of coronary artery disease than man of similar age. Ovarian estrogen is believed to decrease the risk of coronary artery disease. It remains unproven whether the risk of coronary artery disease in women is influenced by endogenous estrogen.<sup>13</sup> But it is believed that estrogen may inhibit growth of atherosclerotic plaque and decrease the prevalence of myocardial ischemia and myocardial infarction by modulating vasospasm.<sup>14</sup>

Three patients (15%) consumed cigarettes in our study. Smoking is the most consistently associated risk factor of PAOD in women.<sup>15</sup> In the cohort study of Cronenwett *et al.*, 93% of 75 women requiring surgery were cigarette smokers.<sup>16</sup> The study of Holmes *et al.* also presents that all women under 46 years of age presenting with symptoms were cigarette smokers.<sup>17</sup> Smoking increases the risk of claudication more dramatically in women than in men.<sup>15</sup> Lowe *et al.* found a direct correlation of smoking with fibrinogen levels and abnormal ABIs.<sup>18</sup> Smoking influences the progression of intermittent claudication to resting pain. Prognosis of PAOD in women improved after cessation or reduction of smoking.

There were 13 diabetic patients (65%) in our study. Impaired glucose tolerance increased the risk of intermittent claudication 4-fold in women versus 2.4-fold in men.<sup>10</sup> In case with glycosuria, the risk of intermittent claudication increased 8.6-fold in women and 3.5-fold in men.<sup>10</sup> Gangrene is 17 times and amputation is at least 5 times more likely in diabetic patients with PAOD.<sup>10</sup> Survival among women was substantially influenced by DM, which was present in more than half of the women requiring bypass surgery.<sup>10</sup> DM was identified as the most pernicious risk factor in women for every cardiovascular endpoint examined in the Framingham study. Elevated diastolic pressure (85 mmHg in women and 90 mmHg in men) also increases the risk of intermittent claudication.<sup>10</sup>

Conservative therapy is the mainstay of therapy for women with stable intermittent claudication. Smoking cessation, exercise training, antiplatelet therapy, lipid-lowering therapy and estrogen replacement therapy are beneficial for myocardial infarction and stroke in post-

menopausal women.<sup>19</sup> Invasive interventions, including percutaneous transluminal angioplasty and surgery, are required in patients with rest pain, ulcers, gangrene, and disabling claudication.

In conclusion, female patients with PAOD presented themselves with severe symptoms and advanced disease. The results of surgical treatment were not satisfying. A more aggressive attitude in diagnosis and referral might improve the outcome of this group of patients.

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