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The Disparate Course And Management Of Peripheral Arterial Disease In Diabetics And Non Diabetics – A Retrospective Study

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Abstract

Aim

The aim of this research was to compare the severity and results of peripheral arterial disease in the populations of diabetic and non-diabetic patients undergoing angiography.

Research Methods And Design

The Bollinger system was used to analyze lower-extremity angiograms that were randomly selected. In order to identify which patients had passed away and which ones had subsequently had an amputation or revascularization procedure, patient demographics, medical histories, and case notes were reviewed.

Out of 136 arteriograms obtained between 2020 and 2023, a total of 136 were analyzed. The patients' age (mean 6 SD) was 64+/- 10.8 years. Patients with diabetes (43%), non-diabetic patients (63.91 +/- 10.44 vs. 65.32 +/- 11.12 years, P =0.43), and ischemic heart disease (41.42 vs. 37.21%, P = 0.54) and hypercholesterolemia (24.45 vs. 30.81%, P =0.48) had comparable medical histories. Nonetheless, the diabetic group had a higher percentage of hypertensive patients (63.89% vs. 39.74%, P =0.006). All artery segments below the knee and the profunda femoris showed more severe arterial disease in diabetic patients (P =0.02).

The group with diabetes had a higher number of amputations: patients with diabetes had an amputation risk Yive times higher (41.46 vs. 11.51%, odds ratio [OR] 5.45, P=0.0001). The diabetic group had a higher mortality rate (51.75 vs. 25.64%, OR 3.12, P=0.002), and the diabetic patients who passed away had younger presentation ages (64.76 +/- 11.43 vs. 71.11 +/- 8.74 years, P =0.04) than the non-diabetic patients.

Results

Patients with diabetes have worse arterial disease and a worse prognosis than non- diabetic patients in patients with peripheral arterial disease.

Keywords: NIL

Introduction

Atherosclerosis-related peripheral arterial disease is typiYied by a progressive decrease in blood Ylow to one or more limbs. Peripheral arterial disease is relatively common in men and women under 50 years (approximately 2-6%), rising to >7% in those over 70[1]. The signiYicant risk factors for peripheral arterial disease include diabetes, smoking, hypertension, and hyperlipidemia.

Peripheral artery disease patients often have a poor prognosis and a shortened life expectancy due to the co-occurrence of cerebrovascular disease and/or coronary artery disease. About two-thirds of all deaths are caused by vascular disease, while half of all deaths are caused by coronary heart disease. It has also been shown that more than 40% of patients with peripheral arterial disease have renal artery stenosis[2]. In diabetic patients with chronic foot ulcers, peripheral arterial disease is a signiYicant risk factor for lower-extremity amputation as well.

There aren't many studies that compare peripheral arterial disease mortality and severity in patients with diabetes and those without the disease. While King et al. discovered that diabetic patients had increased profunda femoris involvement, Strandness et al. reported that diabetic patients had more infrapopliteal disease[3,4]. According to a recent study conducted in the United Kingdom, patients with diabetes had higher revascularization procedure costs than patients with peripheral arterial disease who were not diabetic.

The purpose of this research was to compare the severity and results of peripheral arterial disease in the populations of diabetic and nondiabetic patients undergoing angiography.

Methodology

The study comprised of 150 patients who were referred for peripheral angiography. The Yirst angiographic exam that was completed for each person between November 2020 and November 2023—that is, prior to any vascular or surgical intervention—was chosen for analysis. Table 1 provides demographic information as well as angiography indications. A radiologist who was blinded to the diabetic status and indication for angiography reviewed the angiograms.

Table 1—*Demographics, smoking history, follow-up duration, and indications for arteriography in diabetic and nondiabetic patients*

	Diabetic patients	Nondiabetic patients	*P* value
n	58	78	
Age (years)	63.83 ± 10.4	65.31 ± 11.11	0.43
Men (%)	34 (59.7)	47 (61.8)	0.42
Smokers* (%)	47 (81.0)	60 (76.9)	0.26
Duration of follow-up (years)	4.47 ± 1.25	4.52 ± 1.23	0.85
Indications for arteriography			
Intermittent claudication	50 (86.2)	64 (82.1)	0.25
Rest pain	2 (3.5)	9 (11.5)	0.04
Foot ulcer	24 (41.4)	7 (8.9)	<0.0001
Foot gangrene	7 (12.1)	2 (2.6)	0.01
Number of amputations	24 (41.4)	9 (11.5)	<0.0001
High level	18	9	
Low level	6	0	

Data are *n* (%) or means ± SD. *This includes current smokers and ex-smokers.

The degree of arterial disease was evaluated using the Bollinger scoring system (13). Each arterial segment in this system is given a number that corresponds to the severity of the disease. A segment with a minimum score of 0 indicates a normal segment, while a segment with a maximum score of 15 indicates total occlusion that lasts longer than half of the segment.

The case records were used to gather patient demographics, including age and sex, history of smoking, and conditions related to hypertension, ischemic heart disease, nephropathy, hypercholesterolemia, and peripheral vascular disease. A history of myocardial infarction or coronary revascularization, changes on electrocardiography, or clinical signs of angina were all used to diagnose ischemic heart disease.

The World Health Organization's previous criteria for hypertension—a systolic blood pressure of >160 mmHg and/or a diastolic blood pressure of >95 mmHg—or the patient's current antihypertensive medication were used to deYine hypertension. Patients with microalbuminuria (20–200 μg/min), macroalbuminuria (>200 μg/min), or a serum creatinine level >140 μmol/l were diagnosed with nephropathy.[5-7]

In order to determine which patients had undergone multiple revascularization procedures, lower-extremity amputations, or vascular reconstruction, as well as which patients had passed away in the years after their angiographic procedure (up until November 2023), case records were also reviewed[8,9]. If the amputation was high level, it was done close to the midfoot, and if it was low level, it was farther away.

Statistical Analysis

The two-sample t test was used to assess the variations in the mean values for age and cholesterol levels. The one-tailed test for proportions was used to either conYirm or deny any apparent differences in proportions (e.g., demographics, medical history, vascular risk factors, revascularization procedures and amputations, etc.) between patients with diabetes and those without it. The $\chi 2$ test and odds ratios (ORs) were used to investigate the relationships between diabetes and amputations, diabetes and mortality, amputation and revascularization.

The associations between total arterial occlusion (Bollinger score ≥13), ischemic heart disease, hypertension, amputation, and mortality were also assessed using this test. When necessary, Fisher's exact test was applied[10-12]. The relationship between the arterial occlusion score and the number of amputations was ascertained using the $\chi 2$ test for trend ($\chi 2$trend). The arterial disease scores of patients with and without diabetes were compared using the Mann-Whitney U test. When the P value was less than 0.05, statistical signiYicance was acknowledged and the 95% conYidence interval was computed appropriately.

Results

Out of the 150 patients who were chosen, this study included 136 whose case notes could be located. Their age was 64.74 ± 10.83 years (mean ± SD). Over a period of 13.0 ± 11.1 years, 58 patients (43%) had diabetes. Between patients with and without diabetes, there were no appreciable variations in the age and sex distribution, smoking history, incidence of intermittent claudication, or length of follow-up following angiography. Rest pain was less common in diabetic patients, despite the fact that they had a higher incidence of gangrene and foot ulcers than non-diabetic patients (Table 1).

Medical history and vascular risk factors:

The percentage of patients with a history of ischemic heart disease was similar in diabetic and non-diabetic patients (41.4 vs. 37.2%, P = 0.62). There was no difference in the percentage of patients with hypercholesterolemia (24.43 vs. 30.81%, P = 0.52) among 105 patients (41 of whom were diabetic) whose cholesterol levels had been recorded. Additionally, there was no distinction between patients with diabetes and those without diabetes in terms of mean total cholesterol levels (5.4 vs. 5.6 mmol/l, P = 0.5). Nonetheless, a higher percentage of patients with diabetes having hypertension (63.85 vs. 39.72%, P = 0.006).

Arteriographic Qindings:

The distribution and severity of disease in the aorta and lower limb arteries were evaluated using the Bollinger scoring system (Table 2). At least one totally occluded arterial segment (Bollinger score ≥13) was present in 108 patients (81%) in total. Complete occlusion of arterial segments did not correlate with the presence of symptoms (P = 0.2), ischemic heart disease history (P = 0.3), hypertension (P = 0.12), or mortality (P = 0.32). There was no difference in the severity of arterial disease between the aorta and the iliac and superYicial femoral arterial segments, but diabetic patients had more disease than non-diabetic patients in the profunda femoris, popliteal, anterior tibial, peroneal, and posterior tibial arterial segments.

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Table 2—*Differences in median arterial occlusion score between diabetic and nondiabetic patients*

	Median interquartile range additive occlusion score		
Arterial segment†	Diabetic patients	Nondiabetic patients	*P* value
Aorta	3 (3–4)	3 (3–3.5)	0.50
Common iliac	3 (2–3)	3 (2–3)	0.76
External iliac	2 (0–3)	3 (2–3)	0.15
Internal iliac	3 (0–6)	3 (0–4)	0.51
Profunda femoris	3 (0–5)	0 (0–2)	0.02
Superficial femoral	8 (4–13)	7 (2–9)	0.10
Popliteal	7 (3–10)	3 (0–4)	0.02
Anterior tibial	13 (4–15)	3 (0–13)	0.002
Peroneal	5 (0–15)	0 (0–6)	0.001
Posterior tibial	15 (0–15)	4 (0–14)	0.001

Data are *n* (interquartile range). *Because arterial segment disease was bilaterally similar, only one side (left) is used for analysis.

Table 3—*Levels of revascularization performed in diabetic and nondiabetic patients*

	Diabetic patients	Nondiabetic patients	*P* value
n	35 (60.3)	48 (61.5)	0.90
Iliofemoral region	8 (22.9)	11 (22.9)	0.98
Femoropopliteal region	27 (77.1)	34 (70.8)	0.52
Peroneal tibial region	0 (0)	3 (6.3)	0.07

Data are *n* (%).

Revascularisation procedures:

The number of patients who had revascularization procedures and the level at which they were completed are displayed in Table 3. There was no difference in the percentage of patients who underwent revascularization (60.31 vs. 61.53%, P = 0.9) between the diabetic and nondiabetic groups. Additionally, there was no difference in the two groups' levels of revascularization performed. Furthermore, there was no variation in the percentage of patients who had multiple revascularization procedures performed in the time frame after the angiographic procedure (20.74 vs. 21.83%, P = 0.9).

Amputation

A total of twenty-four diabetic patients—33 in all—had a lower limb amputated during the follow-up period. The number of amputations performed increased with arterial occlusion scores ($\chi 2$ trend 16.2, df = 1, P < 0.0001). Patients with diabetes had an amputation rate that was Yive times higher than that of non-diabetic patients (41.4 vs 11.5%, OR 5.4, 95% CI 2.3–12.9, P < 0.0001). The majority of amputations were high level, accounting for 75% of diabetic amputations and 100% of non diabetic amputations (Table 1).

Diabetes patients appeared to be more likely to undergo repeat amputations and foot-preserving amputations (distal to the midfoot). Twelve of the eighteen patients (or 55%) who underwent amputation had previously undergone revascularization. These do not necessarily indicate that revascularization was unsuccessful; in certain instances, the goal of revascularization was to reduce the degree of amputation and encourage wound healing following amputation. This series does not, however, provide conclusive evidence that revascularization lowers the risk of amputation.

Mortality:

Eight patients died during the course of a 2-year mean follow-up. These patients were slightly older (67.31 vs. 63.23 years, P = 0.03) and had a higher prevalence of ischemic heart disease at referral (50 vs. 33%, P < 0.05) than the patients who survived. The percentage of deaths in the diabetic group was signiYicantly higher (51.73 vs. 25.64%, OR 3.1, 95% CI 1.5–6.4, P = 0.002) when compared to the non-diabetic group.

Furthermore, the mortality rate of the diabetic patients was considerably lower than that of the non-diabetic group (64.73 ± 11.42 vs. 71.21 ± 8.72 years, P = 0.04). But between diabetic and non diabetic patients who had passed away, there was no difference in the percentage of revascularization procedures only (33.3 vs. 40%, P = 0.32), amputations only (30.0 vs. 15%, P = 0.11), or the percentage of patients who had both amputation and revascularization (23.3 vs. 20.0%, P = 0.39) (Table 4).

Table 4—*A comparison between diabetic and nondiabetic patients who died and diabetic and nondiabetic patients who survived*

	Diabetic patients			Nondiabetic patients		
	Survivors	Deceased	*P*	Survivors	Deceased	*P*
n	28	30		58	20	
Age (years)	62.9 ± 9.2	64.7 ± 11.4	0.51	63.3 ± 11.2	71.2 ± 8.7	0.005
Men	17 (59.7)	17 (61.8)	0.38	34 (58.6)	13 (65.0)	0.31
Smokers	23 (82.1)	24 (80.0)	0.41	44 (75.9)	16 (80.0)	0.35
Duration of diabetes (years)	10.4 ± 9.8	15.5 ± 11.8	0.08	—	—	—
Retinopathy	10 (35.7)	16 (53.3)	0.09	—	—	—
Neuropathy	12 (42.9)	16 (53.3)	0.21	—	—	—
Nephropathy	6 (21.4)	7 (23.3)	0.43	—	—	—
Hypertension	14 (50.0)	23 (76.7)	0.02	24 (41.4)	7 (35.0)	0.31
Ischemic heart disease	10 (35.7)	14 (46.7)	0.19	18 (31.0)	12 (60.0)	0.01
Total occlusion	13 (46.4)	24 (80.0)	0.004	28 (8.2)	15 (75.0)	0.02
Total amputations	8 (28.6)	16 (53.3)	0.03	2 (3.4)	7 (35.0)	0.001
Amputations only	3 (10.7)	9 (30.0)	0.04	0 (0)	3 (15.0)	0.001
Revascularization only	13 (46.4)	10 (33.3)	0.15	34 (58.6)	8 (40.0)	0.07
Both procedures*	5 (17.9)	7 (23.3)	0.30	2 (3.4)	4 (20.0)	0.01

Data are means ± SD or *n* (%). *Patients who had revascularization and amputation.

Compared to the patients who survived, a substantially higher proportion of patients with total arterial occlusions, a history of hypertension, and amputations were included in the diabetic deceased group. The group that did not have diabetes also showed this trend. In addition, a small trend toward higher rates of high-level amputations (81 vs. 63%, P = 0.16), a history of ischemic heart disease, and microvascular complications (retinopathy and neuropathy) was observed in the deceased diabetic patients in comparison to the survivors; however, these trends did not reach statistical signiYicance. Furthermore, patients who had undergone amputation alone experienced a higher death rate (75 vs. 43%, P = 0.04) than patients who had only undergone revascularization. However, there were no signiYicant differences between patients who had undergone both procedures and those who had only undergone amputation or revascularization (P = 0.2).

Conclusions

The results of this study have demonstrated that patients with diabetes have worse peripheral arterial disease below the knee and are more likely than patients without diabetes to require lower limb amputations. Peripheral artery disease in diabetic patients was associated with a higher death rate and younger age of death than in non diabetic patients. The profunda femoris artery was the only part of the vascular system above the knee in patients with

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diabetes that exhibited more advanced disease[13-15].

Prior epidemiological research has shown that patients with peripheral arterial disease have a lower survival rate when compared to the general population. Additionally, patients with diabetes have a higher incidence of peripheral arterial disease and a worse prognosis when compared to patients without diabetes. Prior research has also demonstrated worse profunda and infrapopliteal arterial disease in diabetic patients, which is consistent with our Yindings[16,17]. This study conYirms the positive trend that Faglia and colleagues noticed between the rate of amputations and the severity of arterial disease in diabetic patients.

There was no discernible variation in the intermittent claudication symptom between the two cohorts. This is comparable to a prior study that found no difference in the frequency of symptoms between subjects with peripheral vascular disease who were diabetic and those who were not. Nonetheless, the study relied on the existence or lack of pulses in the lower limb rather than radiological evaluation to support the diagnosis of vascular disease. Because the diabetic patients had worse disease, it is possible that the presence of diabetic neuropathy obscured the intermittent claudication pain, causing symptoms to not occur as frequently as expected. As a result, these patients might show up later than they would if their sensation was normal.

We did not Yind any differences in the rate of arterial revascularization procedures performed between patients with diabetes and those without diabetes, despite the fact that the diabetic patients in this study had more severe arterial disease. Numerous factors could be to blame for this[18-19]. First, the diabetic patients' more severe arterial disease below the knee may have prevented arterial reconstruction; second, even when technically possible, the high failure rate associated with extreme distal revascularization procedures may make them less common.

Summary

This study compares peripheral arterial disease patients with diabetes and those without the disease using angiographic Yindings. This study found that diabetic patients had worse angiographic Yindings, more amputations, and higher mortality than non diabetic patients in a group of patients referred for lower extremity angiography. Moreover, and consistent with earlier research, there is insufYicient proof to support the efYicacy of revascularization in preventing amputation. To Yind out if early diagnosis and intervention could stop amputation, more research is needed.

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