

# A Survey of the Presence of Lower Limb Arterial Insufficiency in Diabetic Patients Attending the Surgery Department of Golestan Hospital for Reasons other than Vascular Diseases

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## ABSTRACT

Diabetic ulcer is the commonest reason of lower limb amputation. When atherosclerosis progressed, lower limb ischemia occurred. We also know diabetes is one of the effective risk factors in atherosclerosis, for this reason lower limb ischemia is one of the commonest long term complications of diabetes. Chronic lower limb ischemia could be asymptomatic or occur with intermittent claudication with pain and cramp in legs muscles. Pain begins with activity and relieves with rest. First, ischemia associated with intermittent claudication and then painful ulcer with gangrene was observed. The other symptoms such as muscles atrophy, cutaneous atrophy, hair loss on dorsal surface of fingers, and increase in the thickness of toenails are associated to chronic ischemia. This study was conducted on diabetic patients admitted to the surgery department for reasons other than vascular diseases. We designed the Pro forma to record the patients' history including personal information, duration of suffering from diabetes. In addition, the symptoms of arterial insufficiency such as intermittent claudication, atrophic changes, cutaneous atrophy, muscles atrophy, hair loss on dorsal surface of fingers and increased thickness of toenails as well as pulse status other physical examinations were performed. The collected data were analyzed with SPSS package. Our study conducted on 120 diabetic patients that 52 (43.3%) patients were men. And 68 (56.7%) patients were women. Mean age in men and women had been  $60.8 \pm 10$ ,  $56.8 \pm 8.8$ . Based on our results 26 (21.7%) patients arterial pulse was not palpated and in 41 (34.2%) patients we found weak arterial pulses and in 53 patients (44.2%) arterial pulses were normal. Variance analysis test showed that the mean of the duration of suffering from diabetes had significant difference in these three groups ( $P= 0.018$ ). In other tests, pallor was observed in 49.2% of patients. Intermittent claudicating was found in 32.5% of patients and impaired capillary filling test were seen in 60% of patients. Results of the rubor of dependency test were positive in 43.5% of patients and venous filling time test in 60% of patients was abnormal. And in 65% of patients coldness of extremities was positive. Our findings showed that the performed clinical tests facilitate the diagnosis of ischemia and therefore it seems necessary to perform these tests for all diabetic patients especially when admitted for surgery operation.

**Key words:** Ischemia, Diabetes, Arterial Pulse, Lower Limb, Arterial Insufficiency.

## INTRODUCTION

Several studies have shown that there is a direct relationship between arterial disorders and foot ulcers. In fact, we can say that arterial diseases might be a risk factor for the impairment of wound healing and consequently amputation (1).

Peripheral arterial disease (PAD) is the chronic arterial occlusive disease in lower limbs due to atherosclerosis. Only half of the elderly patients with confirmed peripheral arterial disease are symptomatic. Patients with peripheral arterial disease might not be able to walk long distances or move fast enough due to comorbid conditions such

as lung disease or arthritis. Ulcers caused by chronic arterial insufficiency are formed commonly in the ankle, heel or leg. The case of fingers turned blue, dried away, and mummified or soft tissue lacking life covered with scabs is the gangrene caused by ischemic infarction. As time goes by, the lesion becomes purulent and dry gangrene turns into wet gangrene (1, 3,4, 2). PAD is very common in patients with diabetes and is considered one of the causes of diabetic foot ulcers especially in men. PAD causes impairment in wound healing followed by amputation. Arterial disorder is one of the most important risk factors of diabetic foot. The lower limb ischemia occurs as a result of the progression of arterial atherosclerosis and since diabetes is the most effective risk factor for atherosclerosis, therefore, it is one of the most common long-term complications of diabetic lower limb ischemia (5). Besides intermittent claudication other symptoms that can be seen in chronic ischemia include cutaneous atrophy, muscle atrophy, loss of hair on the dorsal surface of foot, and thickness of toenails(6, 7,5), which in the case of the change of foot form, this problem can cause unusual pressure to the leg (8). Among the symptoms of lower limb ischemia lack of arterial pulse, cold extremities, and color changes in foot along with position change could be mentioned (7,9). In mild to moderate ischemia the lack of pulse is the only clinical finding that is an indication of the presence of the disease in the examined position or proximal to it, which are expressed as three cases: it is not palpated at all (0), it is palpated decreased (1+) or normally (2+) (10,5,7). Conventional tests in vascular examinations include: 1) measuring the ABI (ankle-brachial index) index, 2) measuring the (blood?) pressure, 3) venous filling time test, and 4) capillary filling test, (9,1,6). The most important risk factors for PAD in diabetic patients that can be noted include old age, gender (in men the risk of the disease is higher), the duration of suffering from diabetes, high blood pressure, high HbA1c, high FPG (fasting plasma glucose), and higher BMI (14). In patients with diabetes PAD is diagnosed too late, which results in an increased incidence of complications and increased severity of infections and this leads to foot ulcers, gangrene, and amputation (2,9). The early diagnosis of PAD, in addition to changing and transforming risk factors and decreasing their dangerous complications, causes the improvement

of the quality of vascular reconstruction treatment methods (angioplasty and bypass) and enhances the effectiveness of the treatments (13,12). To diagnose the infection and its causes, culture, and antibiogram of the wound different methods are used including antibiogram from the wound, biopsy from the deep parts of the wound, X-ray of the foot, bone scan with labelled leukocytes, and MRI (14).

Diabetic patients are more vulnerable to various injuries than non-diabetic patients, thus, surgery is generally a risky operation for these patients, especially for the ones with ischemia. Therefore, this study was aimed at determining the prevalence of the symptoms of ischemia in diabetic patients that are candidate of a surgery.

## MATERIALS AND METHODS

This is a cross-sectional study conducted in 2010 in Golestan Hospital. The study population consisted of 120 diabetic patients not suffering vascular diseases, who were hospitalized in the above-mentioned hospital for various reasons. The patient's history including personal information, duration of suffering from diabetes and symptoms of arterial insufficiency including intermittent claudication, cold extremities, trophic changes including cutaneous atrophy, muscle atrophy, loss of hair on the dorsal surface of the fingers and toes and thickness of fingernails were taken from patients. Then, they were placed under examination and other tests. Examinations and tests included the examination of pulses for three modes: pulse does not palpate at all (0+), pulse has reduced (1+) and/or it is palpated normally (2+), rubor of dependency test, capillary filling test, venous filling time test, and occurrence of pallor test.

The pulses were examined for three conditions: pulse does not palpate at all (0+), pulse has reduced (1+), and/or pulse is palpated normally (2+). In the time method, the leg was elevated for 20 seconds, if the venous filling time takes less than 15 seconds after lowering the leg there is no problem (0), if it takes between 15-30 seconds it is (1+), if it takes between 30-40 seconds it is (2+), between 45-60 seconds it is (3+), and if it takes more than 60 seconds it is (4+). In the occurrence of pallor test, the leg was elevated for 60 seconds

and grading was done based on the pallor induction period. It was considered (0+) for absence of pallor, (1+) for occurrence after 60 seconds, (2+) for between 30-60 seconds, (3+) for less than 30 seconds, and (4+) when pallor occurs quickly.

After taking patient's history and performing abovementioned examinations and tests, the obtained results were recorded in a special checklist that was prepared for this purpose. The data were then entered into the computer and were analyzed by SPSS 18 software. Statistical tests used for data analysis included ANOVA test, student's t-test, chi-square test, and Fisher's exact test.

**RESULTS**

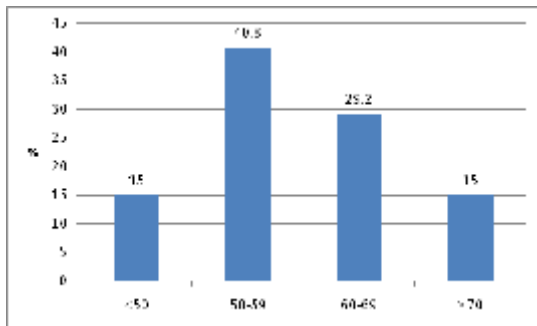
In this study, 120 patients, who had no history of vascular diseases and had been admitted to the surgery department of Golestan hospital for various reasons, were investigated. The mean age of these patients was  $58.6 \pm 9.5$ . The minimum and maximum observed ages were 38 and 80 respectively. 18 (15%) of these patients were under 50, 49 patients (40.8%) were in the age range of

59-59, 35 (29.2%) were in the age group of 69-60 , and 18 (15%) were in the age group of 60 years and older (Figure 1).

Fifty-three (44.3%) patients were female and 67 (55.8%) male (Fig. 2). The mean age of these men and women were  $60.8 \pm 10$  and  $56.8 \pm 8.8$  years respectively, and according to student's t-test the mean age of women and men had a significant difference ( $p = 0.02$ ) (Table 1).

The mean of the duration of suffering from diabetes in these patients were  $9.3 \pm 4.15$  years. The minimum and maximum duration of suffering from the disease were 6 and 25 years, respectively. In addition, 16 (13.3%) patients had been suffering from diabetes for less than 10 years. 16 (13.3%) had diabetes for 10-14 years, 74 patients (61.7%) for 15-19 years, and 14 (11.7%) 20 for years or more (Figure 3).

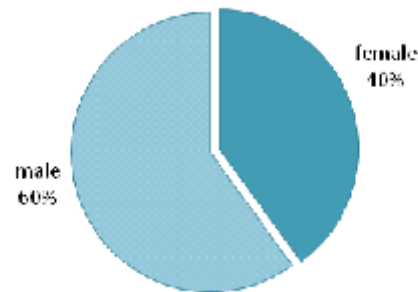
According to the examinations carried out, 26 patients (21.7%) had no arterial pulse, in 41



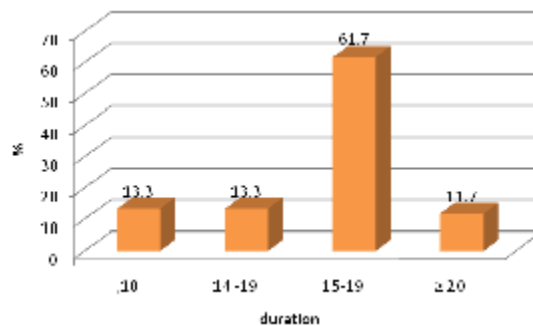
**Fig. 1: Percentage of the frequency of the age group in the patients under study**

**Table 1: Mean and variance of age versus gender**

Gender	Mean of age	Variance	P value
Female	60.8	10	0.02
Male	56.8	8.8	
Total	58.6	9.5	



**Fig. 2: Percentage of the frequency of gender in patients under study**



**Fig. 3: Percentage of the frequency of the duration of suffering from diabetes**

patients (34.2%) there was a reduction in pulse rate, and also in 53 patients (44.2%) the arterial pulse was normal (Figure 4). The analysis of variance (ANOVA) test showed that the mean of the duration of suffering from diabetes in these three age groups had significant difference ( $p = 0.018$ ) (Table 2).

According to the results of this study, 67 (55.8%) of the patients were male and 53 (44.2%) were female. Arterial insufficiency was observed in 24 females and 43 males (46.2% vs. 63.2%), but according to chi-square test, there was no significant difference between the frequency of arterial insufficiency and gender ( $p = 0.07$ ) (Table 3).



Fig. 4: Percentage of the frequency of the pulse condition in the patients

The mean age of patients with lower extremities arterial insufficiency was  $57.4 \pm 8.1$  and in patients without arterial insufficiency it was  $60 \pm 10.9$  years and according to student's t-test the mean age of the two abovementioned groups had no significant difference ( $p = 0.13$ ) (Table 4).

The mean of the duration of suffering from diabetes in patients with arterial insufficiency was  $16.3 \pm 3.8$  years and in patients without failure was  $14.2 \pm 3.8$  years and according to the student's t-test the mean disease duration in the two groups were significantly different ( $p = 0.005$ ) (Table 5).

Table 2: Mean and variance of the duration of diabetes suffering versus arterial pulse status

P value	Mean duration of diabetes	Variance	Pulse status
0.018	14.2	3.8	Normal
	16.1	3.4	Reduced
	16.5	4.4	No perceived Pulse
	16.4	3.9	Total

Table 3: Frequency distribution of arterial insufficiency of the lower limbs vs. gender (P-Value= 0.07)

Gender	Male		Female		Sum	
	frequency	Percentage	frequency	Percentage	frequency	Percentage
Present	24	46.2	43	63.2	67	55.8
Not-present	28	53.8	25	36.8	53	44.2
Total	52	100	68	100	120	100

Table 4: Mean and variance of age vs. presence of arterial insufficiency in lower limbs

Vascular insufficiency	Mean age	Variance	P value
Present	57.4	8.1	0.13
Non-present	69	10.9	
Total	58.6	9.5	

Table 5: Mean and variance of duration of suffering from diabetes vs. presence of lower limb vascular insufficiency

Vascular insufficiency	Duration of diabetes mean	Variance	P value
Present	16.3	3.8	0.005
Non-present	14.2	3.8	
Total	15.4	3.9	

Out of the 120 patients studied, 79 (65.8%) did not suffer from hypertension and hyperlipidemia diseases, 14 (11.7%) suffered from hyperlipidemia, and 27 (22.5%) had high blood pressure (figure 5).

Seventy-eight patients (65%) complained about cold extremities and 42 patients (35%) did not have such complaints (Figure 6).

The clinical examination of the patients showed that of 120 patients, 39 (32.5%) suffered from claudication (Fig. 7). Duration of suffering from diabetes in patients with claudication was  $17.1 \pm 3.4$  and in patients without claudication it was  $14.5 \pm 3.9$  years, and according to student's t-test the duration of suffering from diabetes in the two groups had significant difference ( $p = 0.001$ ) (Table 6).

According to the physical examination of the patients under study, 76 (63.3%) had cutaneous atrophy, 74 (61.7%) had muscle atrophy, 57 (47.5%)

had hair loss in foot area, and also 34 (28.3%) had reduced nail thickness (fig. 8).

According to the results of pallor test, in 22 (18.3%) patients pallor occurred immediately after lowering the leg (+4), in 14 (11.7%) patients it occurred in less than 30 seconds (+3), in 23 (19.2%) patients it occurred with a delay of 30-60 seconds (2+), in 52 (43.3%) patients pallor occurred after 60 seconds (1+), and in 9 patients (7.5%) pallor did not occur at all (Fig. 9).

The results of capillary refill test showed that 48 patients (40%) were normal, 37 patients (30.8%) had bleeding problem, and 35 patients (29.2%) were abnormal (Fig. 10).

The result of the above-mentioned test in 52 patients (43.3%) was positive and in 68 patients (56.7%) was negative (Figure 11). The duration of suffering from diabetes in patients who had a positive test result was  $16.7 \pm 4.2$  and in patients who had a negative test result was  $14.3 \pm 3.4$  years

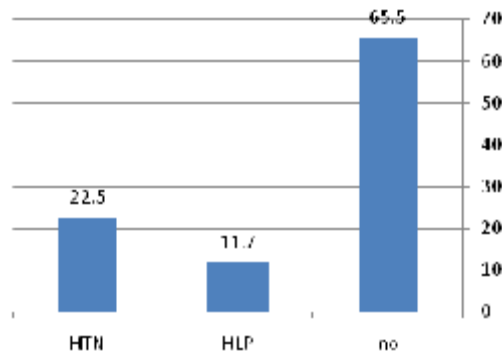


Fig. 5: Percentage of frequency of comorbidities in studied patients

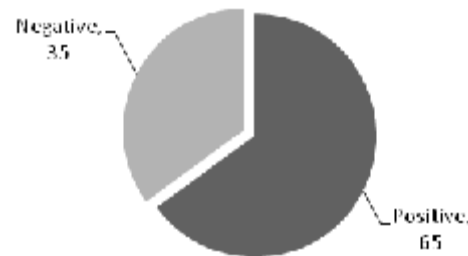


Fig. 6: Percentage of the frequency of the result of cold extremities test



Fig. 7: Percentage of the frequency of the presence of intermittent claudication in patients studied

Table 6: Mean and variance of duration of suffering from diabetes vs. presence of intermittent claudication

Intermittent claudication	Mean of diabetes suffering duration	Variance	P value
Present	17.1	3.4	0.001
Non-present	14.5	3.9	
Total	15.4	3.9	

and according to student's t-test the duration of suffering from diabetes in these two groups was statistically significant ( $p = 0.001$ ) (Table 7).

The result of the venous filling time test was normal in one patient (0.8%), (1+) in 47 patients (39.2%), (2+) in 39 patients (32.5%), (3+) in 13 patients (10.8%), and (4+) in 20 patients (16.7%) (Figure 12).

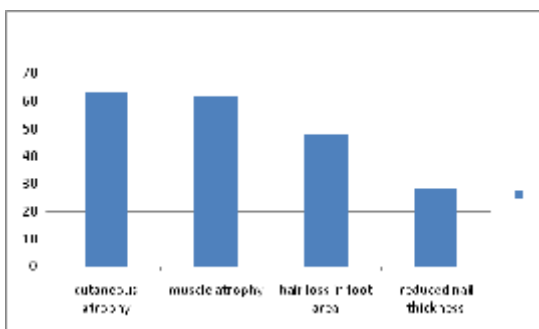


Fig. 8: Percentage of the frequency of the examination of the patients

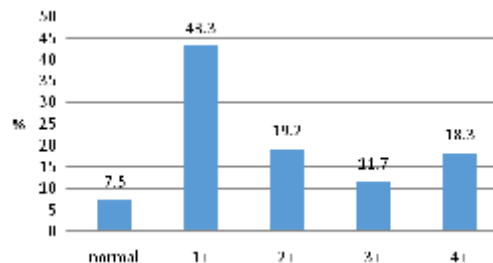


Fig. 9: Percentage of the frequency of the result of pallor test in patients studied

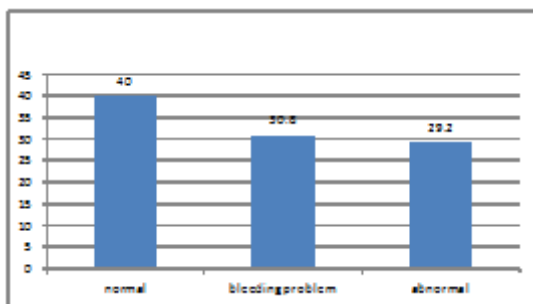


Fig. 10: Percentage of the frequency of the capillary filling test results

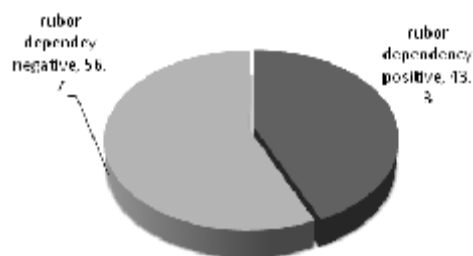


Fig. 11: Percentage of the frequency of the rubor of dependency test

Table 7: Mean and variance of the duration of suffering from diabetes vs. the rubor dependency test

Rubor dependency	Mean of diabetes duration	Variance	P value
Positive	16.7	4.2	0.001
Negative	14.3	3.4	
Total	15.4	3.9	

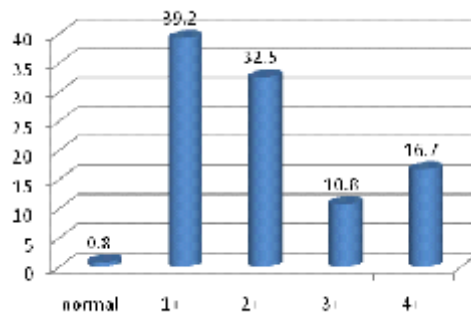


Fig. 12: Percentage of the frequency of the result of venous filling time test

## DISCUSSION AND CONCLUSION

The overall objective of this study was to study the presence of arterial insufficiency of the lower extremities in diabetic patients admitted to the surgery department of Golestan Hospital. In this study, those patients were investigated who suffered diabetes but did not suffer any kind of vascular diseases, and have been hospitalized in Golestan Hospital for various reasons such as

different surgeries. The minimum and maximum ages observed were 38 and 80. Therefore, in this study, a collection of diabetic patients who are in different age ranges have been examined and there will be no confounding effect of the age on the generalization of the results. Fifty two (43.3%) of the patients were female and 68 of them (56.7%) were male.

The mean age of the above-mentioned men and women were  $60.8 \pm 10$  and  $56.8 \pm 8.8$  years respectively, the mean age of men and women were significantly different. The results of various researches have showed that being male is an effective risk factor for lower extremities ischemia in diabetic patients (11).

The mean duration of suffering from diabetes in these patients was  $15.4 \pm 3.9$  years. Duration of suffering from diabetes is also one of the important risk factors in lower extremities ischemia (1,6, 9,5 and 11). So given that more than 80% of studied patients have been suffering diabetes for more than 10 years, the risk of ischemia and its complications in these patients is very high.

According to the examination performed, 26 patients (21.7%) were without arterial pulse and in 41 patients (34.2%) there was a reduction in pulse rate and in 53 patients (44.2%) arterial pulse was normal. The mean duration of suffering from diabetes in these three groups were significantly different, therefore, according to the results the pulse rate at extremities in more than 55% of patients was abnormal indicating a high percentage of them are probably suffering from ischemia.

Arterial insufficiency in 24 females and 43 males (46.2% vs. 63.2%) was observed. The frequency distributions of the arterial insufficiency had no significant difference with gender.

The arterial insufficiency in diabetic patients had no relationship with their age and gender in this study but it had a significant relationship with the duration of suffering from diabetes. Therefore, the duration of suffering from diabetes can be considered one of the effective

factors in the development of vascular lesions and ischemia in patients who have been suffering diabetes for a long time (usually more than 10 years).

Of 120 studied patients, 11.7% suffered hyperlipidemia and 22.5% had high blood pressure. In performing pallor test 49.2% of patients were normal, 32.5% had claudication, and in performing capillary refill test 60% were abnormal. The result of rubor of dependency test in 43.5% of cases was positive and the result of venous filling time test was abnormal in 60% of patients. Cold extremities test was also positive in 65% of patients. Findings of this study can be used to develop pharmaceutical and non-pharmaceutical treatments for different diabetes associated disorders such as wound, neuropathic pains (14-17).

Given the high prevalence of ischemia in diabetic patients undergoing various surgical procedures, the necessary measures should be taken when performing surgical procedures on these patients. On the other hand, given that chronic lower limb ischemia can be totally asymptomatic and/or be in the form of intermittent claudication, these symptoms may not be fully noticed by the patient or those around them. Therefore, it is necessary for diabetic patients undergoing various surgical procedures, to be considered and investigated regarding vascular problems and the possibility of the presence of ischemia prior to the surgery (5, 6). According to the results of this study, tests used in the examination of patients, have been positive in a significant portion of patients, which all of these tests are somewhat helpful in detecting ischemia. Therefore, taking the history of patients and applying these tests in the examining diabetic patients, especially those who are candidates for various surgeries, are very practical and should be performed.

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