

ANALYTICAL STUDY TO COMPARE THE DOPPLER WAVEFORMS AT ANKLE AND TOES TO ASSESS DISTAL PERFUSION OF DIABETIC FOOT ULCER PATIENTS

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Abstract

Background: To compare the Doppler waveforms at ankle and toes to assess distal perfusion of diabetic foot ulcer patients. **Material & Methods:** This cross sectional, analytical study was done on 70 diabetic foot ulcer patients with >2-week duration of ulcer and above 18 years of age in the general surgery department, SMVMCH from December 2020 to May 2022 with the approval of IEC. Patients with gangrene of 1st and 2nd toes, extensive ulcer where Doppler can't be done and active cellulitis where assessment of vascular status is difficult were excluded. Arterial Doppler waveform was recorded at ankle (ATA/PTA) and toe digital vessels. **Results:** The mean age of the study participants was 56.01± 9.38. 68.6% of the participants were males and 31.4% were females. Hypertension was present in 28.6% of the participants and addiction factors like smoking (22.9%) and alcohol intake (38.6%) were also present. Out of 18 patients who had triphasic flow at involved ankle (ATA), only 3 patients (16.7%) had triphasic flow at involved toe. Also, out of 17 patients who had triphasic flow at involved ankle (PTA), only 4 patients (23.5%) had triphasic flow at involved toe. Among 36 patients who had monophasic flow at involved toe, 11 patients (30.6%) also had monophasic flow at uninvolved toe. Similarly, among 27 patients who had monophasic flow at involved ankle (ATA), 4 patients (14.8%) also had monophasic flow at uninvolved ankle (ATA). Also, among 26 patients who had monophasic flow at involved ankle (PTA), 5 patients (19.2%) also had monophasic flow at uninvolved ankle (PTA). Only 18 patients (26.9%) had triphasic flow at involved ankle (ATA) while 16 patients (23.9%) had triphasic flow at involved ankle (PTA) and only 7 patients (10.4%) had triphasic flow at involved toe. Out of 65 patients with SpO₂ >95% at involved hallus/2nd toe, only 15 patients (23.1%) had triphasic flow at involved ankle (ATA and PTA) while only 7 patients (10.8%) had triphasic flow at involved toe. **Conclusion:** Phasicity at the level of toe seems to be a more reliable predictor of distal perfusion in patients with Diabetic ulcer. Vascular assessment has to be done in the bilateral lower limbs to prevent the morbidity by early management strategies.

INTRODUCTION

Aim

To compare the Doppler waveforms at ankle and toes to assess distal perfusion of diabetic foot ulcer patients.

Study Duration

The study was conducted for period of 18 months with the approval of Institutional Ethics Committee (IEC). The present study was conducted in the Department of General surgery, Sri Manakula

MATERIALS AND METHODS

Inclusion Criteria

Patients with diabetic foot ulcers of >2-week duration undergoing arterial Doppler who are asymptomatic for peripheral vascular disease.

Patients above 18 years of age.

Patients who are vocal and willing to participate in the study.

Exclusion Criteria

Patients with extensive ulcer where Doppler can't be done.

Patients with gangrene of 1st and 2nd toes.

Patients with active cellulitis where assessment of vascular status is difficult.^[1]

RESULTS

Among 27 patients who had monophasic flow at involved ankle (ATA), 24 (88.9%) had monophasic flow at involved toe and the remaining 3 (11.1%) had biphasic flow at involved toe. Of 28 patients who had biphasic flow at involved ankle, 10 (35.7%) had monophasic flow at involved toe, 13 (46.4%) had biphasic flow and 5 (17.9%) had triphasic flow at involved toe. Out of 18 patients with triphasic flow at involved ankle, 3 (16.7%) had monophasic flow, 28 (38.4%) had biphasic flow and 8 (11%) had triphasic flow at involved toe. There was a statistically significant association between phasicity at involved ankle (ATA) and phasicity at involved toe ($p=0.000$) [Table 1].

Among 26 patients who had monophasic flow at involved ankle (PTA), 22 (84.6%) had monophasic flow at involved toe and 3 (11.5%) had biphasic flow at involved toe. Of 30 patients who had biphasic flow at involved ankle, 13 (43.3%) had monophasic flow

at involved toe, 14 (46.7%) had biphasic flow and 3 (10.0%) had triphasic flow at involved toe. Out of 17 patients with triphasic flow at involved ankle, 2 (11.8%) had monophasic flow, 28 (38.4%) had biphasic flow and 8 (11%) had triphasic flow at involved toe. There was a statistically significant association between phasicity at involved ankle (PTA) and phasicity at involved toe ($p=0.000$) [Table 2].

Among 27 patients who had monophasic flow at involved ankle (ATA), 4 (14.8%) had monophasic flow at uninvolved ankle, 14 (51.9%) had biphasic flow at uninvolved ankle and 9 (33.3%) had triphasic flow at uninvolved ankle. Of 25 patients who had biphasic flow at involved ankle, 2 (8.0%) had monophasic flow, 9 (36.0%) had biphasic flow and remaining 14 (56.0%) had triphasic flow at uninvolved ankle. Out of 15 patients with triphasic flow at involved ankle, 6 (40.0%) had biphasic flow and remaining 9 (60.0%) had triphasic flow at uninvolved ankle. There was no statistically significant association between phasicity at involved ankle (ATA) and phasicity at uninvolved ankle (ATA) ($p=0.267$) [Table 3].

Among 26 patients who had monophasic flow at involved ankle (PTA), 5 (19.2%) had monophasic flow, 16 (61.5%) had biphasic flow and remaining 5 (19.2%) had triphasic flow at uninvolved ankle. Out of 27 patients who had biphasic flow at involved ankle, 1 (3.7%) had monophasic flow, 15 (55.6%) had biphasic flow and remaining 11 (40.7%) had triphasic flow at uninvolved ankle. Out of 14 patients with triphasic flow at involved ankle, 1 (7.1%) had monophasic flow, 5 (35.7%) had biphasic flow and remaining 8 (57.1%) had triphasic flow at uninvolved ankle. There was no statistically significant association between phasicity at involved ankle (PTA) with phasicity at uninvolved ankle (PTA) ($p=0.079$) [Table 4].

Table 1: Association between Phasicity at involved ankle (ATA) with phasicity at involved toe (n=73)

Phasicity at involved ankle (ATA)		Phasicity at involved toe			Total	p-value
		Monophasic	Biphasic	Triphasic		
Monophasic	Count	24	3	0	27	0.000
	% within phasicity at involved ankle (ATA)	88.9%	11.1%	0.0%	100.0%	
Biphasic	Count	10	13	5	28	
	% within phasicity at involved ankle (ATA)	35.7%	46.4%	17.9%	100.0%	
Triphasic	Count	3	12	3	18	
	% within phasicity at involved ankle (ATA)	16.7%	66.7%	16.7%	100.0%	
Total	Count	37	28	8	73	
	% within phasicity at involved ankle (ATA)	50.7%	38.4%	11.0%	100.0%	

*n is 73 as the 3 bilateral cases were considered as 6 involved limbs.

Table 2: Association between Phasicity at involved ankle (PTA) with phasicity at involved toe (n=73)

Phasicity at involved ankle (PTA)		Phasicity at involved toe			Total	p-value
		Monophasic	Biphasic	Triphasic		
	Count	22	3	1	26	

Monophasic	% within phasicity at involved ankle (PTA)	84.6%	11.5%	3.8%	100.0%	0.000
Biphasic	Count	13	14	3	30	
	% within phasicity at involved ankle (PTA)	43.3%	46.7%	10.0%	100.0%	
Triphasic	Count	2	11	4	17	
	% within phasicity at involved ankle (PTA)	11.8%	64.7%	23.5%	100.0%	
Total	Count	37	28	8	73	
	% within phasicity at involved ankle (PTA)	50.7%	38.4%	11.0%	100.0%	

*n is 73 as the 3 bilateral cases were considered as 6 involved limbs.

Table 3: Association between Phasicity at involved ankle (ATA) with phasicity at uninvolved ankle (ATA) (n=67)

Phasicity at involved ankle (ATA)		Phasicity at uninvolved ankle (ATA)			Total	p-value
		Monophasic	Biphasic	Triphasic		
Monophasic	Count	4	14	9	27	0.267
	% within phasicity at involved ankle (ATA)	14.8%	51.9%	33.3%	100.0%	
Biphasic	Count	2	9	14	25	
	% within phasicity at involved ankle (ATA)	8.0%	36.0%	56.0%	100.0%	
Triphasic	Count	0	6	9	15	
	% within phasicity at involved ankle (ATA)	0.0%	40.0%	60.0%	100.0%	
Total	Count	6	29	32	67	
	% within phasicity at involved ankle (ATA)	9.0%	43.3%	47.8%	100.0%	

*n is 67 as the 3 bilateral cases were excluded.

Table 4: Association between Phasicity at involved ankle (PTA) with phasicity at uninvolved ankle (PTA) (n=67)

Phasicity at involved ankle (PTA)		Phasicity at uninvolved ankle (PTA)			Total	p-value
		Monophasic	Biphasic	Triphasic		
Monophasic	Count	5	16	5	26	0.079
	% within phasicity at involved ankle (PTA)	19.2%	61.5%	19.2%	100.0%	
Biphasic	Count	1	15	11	27	
	% within phasicity at involved ankle (PTA)	3.7%	55.6%	40.7%	100.0%	
Triphasic	Count	1	5	8	14	
	% within phasicity at involved ankle (PTA)	7.1%	35.7%	57.1%	100.0%	
Total	Count	7	36	24	67	
	% within phasicity at involved ankle (PTA)	10.4%	53.7%	35.8%	100.0%	

*n is 67 as the 3 bilateral cases were excluded.

CONCLUSION

In the present study, it was found that only a small proportion of patients with triphasic flow at involved ankle have triphasic flow at involved toe. Some of the patients with monophasic flow at involved ankle or toe also have monophasic flow at uninvolved ankle or toe. Hence without any delay vascular assessment has to be done in the bilateral lower limbs, preferably at the level of toes, so that early detection of deficient vascular perfusion in lower limbs is feasible to prevent the morbidity by early management strategies.

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