

Risk Factors Leading to Lower Extremity Amputation in Diabetic Patients: An Observational Study

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Abstract

Introduction: Diabetes mellitus is the most common endocrine disorder, currently considered as pandemic, affecting both developed and developing countries. Our study aims to find the association between major lower extremity amputation with age, gender, HbA1c, duration of diabetes mellitus, triglycerides, smoking, neuropathy, nephropathy, vasculopathy, osteomyelitis, socio economic status and sepsis in diabetic patients.

Material and Methods: Observational cross section study conducted at department of General Surgery, Saveetha Medical College Hospital, Chennai from March 2016 to September 2017. Around 100 diabetic patients who were going for lower extremity amputation were included. All diabetic patients with foot/toe ulceration (Grade 3,4,5 – Wagner classification of diabetic foot) requiring amputation, infection (severe sepsis) of the lower limb requiring amputation gangrene of the lower limb requiring amputation and underlying osteomyelitis of the lower limb requiring amputation were included in our study. Diabetic patient undergoing amputation following road traffic accident crush injury and diabetic patient undergoing amputation following lower limb tumours were excluded from this study. Permission as taken from Institutional Ethics Committee of Saveetha Medical College prior to the initiation of the study.

Results: Based on the observation and statistical analysis of this study, there is no association between increasing age, gender and duration of diabetes mellitus with major lower extremity amputation. Based on the observation and statistical analysis of this study, there is significant association between increasing HBA1C, triglycerides, neuropathy, nephropathy, vasculopathy, osteomyelitis and sepsis with major lower extremity amputation (P=0.001).

Conclusion: Based on the our study observations we conclude that the risk factors elevated HbA1C which indicated uncontrolled diabetes mellitus. Elevated triglycerides, diabetic neuropathy, diabetic nephropathy, osteomyelitis, and sepsis have significant association with major amputation and avoiding these risk factors has profound influence in the prevention of major lower extremity amputations.

Keywords: Diabetes Mellitus, Amputation, HBA1C, Diabetic Neuropathy, Diabetic Nephropathy, Sepsis.

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Introduction

Diabetes mellitus is the most common endocrine disorder, currently considered as pandemic, affecting both developed and developing countries. Diabetes give rise to micro vascular complications like retinopathy, nephropathy, neuropathy, and macro vascular complications like ischemic heart disease, stroke and peripheral vascular disease. Diabetes mellitus is a common disease all over the world and its frequency is increasing steadily in India. [1-3] Though the treatment options for people with diabetes have improved, many continue to suffer from various complications of the disease. Diabetic foot related problems occur frequently and it has serious consequences like amputations of extremities. [4-6]

The lifetime risk for developing foot ulcers in diabetic patients is the range of 20 to 30 %. Many studies have shown that around 80% of amputations in lower limb are preceded by foot ulcers. As age & duration of diabetes increases, the risk of foot ulceration & amputations also increases by 3 to 4 folds. [2,7] The total number of people with diabetes is expected to rise from 171 million in 2000 to 366 million by 2030. [3,8,9] As the population with diabetes increases, more and more amputations of lower extremity can be expected in future. [10] Diabetic foot ulcer is one of the major complications of diabetes mellitus, may cause significant morbidity and lower extremity amputation⁴. Our study aims to find the association between major lower extremity amputation with age, gender, HbA1c, duration of diabetes mellitus, triglycerides, smoking, neuropathy, nephropathy, vasculopathy, osteomyelitis, socio economic status and sepsis in diabetic patients.

Material and Methods

Observational cross section study conducted at department of General

Surgery, Saveetha Medical College Hospital, Chennai from March 2016 to September 2017. Around 100 diabetic patients who were going for lower extremity amputation were included. All diabetic patients with foot/toe ulceration (Grade 3,4,5 – Wagner classification of diabetic foot) requiring amputation, infection (severe sepsis) of the lower limb requiring amputation gangrene of the lower limb requiring amputation and underlying osteomyelitis of the lower limb requiring amputation were included in our study. Diabetic patient undergoing amputation following road traffic accident crush injury and diabetic patient undergoing amputation following lower limb tumours were excluded from this study. Permission as taken from institutional Ethics Committee of Saveetha Medical College prior to the initiation of the study.

After eliciting the detailed history of the patient including age, sex, socio economic status, duration of diabetes mellitus, history of smoking, history of ulcer - mode of onset, progression, infection were noted. Clinical examination of the lower limb was done along with the examination of vascular system (peripheral pulses), neural system (position joint, pressure sensations, tendon reflex, pin prick test) and Blood investigations – Complete blood count, Random blood sugar, Urea, Creatinin, HbA1c, Triglycerides, Serology were taken. Radiological investigation – x-ray foot / leg (osteomyelitis), Doppler study of lower limb (vasculopathy), Ultrasonogram of abdomen (to r/o contracted kidney in CKD) were done.

These data collected from clinical history (age, sex duration of diabetes mellitus, smoking), clinical examination (vasculopathy, neuropathy), blood parameters HbA1c, triglycerides, urea creatinin (CKD), complete blood count (sepsis). Doppler study of lower limb

(vasculopathy), ultrasonogram of kidney (CKD) and the proposed and executed the level of amputation were tabulated and analysed statistically and the results were provided.

Results

Based on the observation and statistical analysis of this study, there is no association between increasing age and major lower extremity amputation

($P=0.130$); there is no association between increasing duration of diabetes mellitus and major lower extremity amputation ($P=0.307$); there is no association between gender and major lower extremity amputation ($P=0.852$); there is no association between smoking and major lower extremity amputation ($P=1.000$) and there is no association between socio economic status and major lower extremity amputation ($P=0.588$) (Table 1).

Table 1: Association between major lower extremity amputation and socio-demographic variables (N=100)

S. No.	Variable	Minor amputation	Major amputation	T test/ X ²	P value
1	Age	56.55±1.46	61.15±2.94	-1.527	0.130
2	Gender				
	Male	44	16	0.035	0.852
	Female	30	10		
3	Duration of diabetes mellitus				
	< 5 Years	6	0	2.361	0.001
	5 – 10 Years	18	6		
	>10 Years	50	20		
4	Smoking				
	Absent	27	10	0.032	1.000
	Present	47	16		
5	Socioeconomic status				
	II	23	11	1.924	0.588
	III	32	10		
	IV	16	5		
	V	3	0		

Based on the observation and statistical analysis of this study, there is significant association between increasing HBA1C and major lower extremity amputation ($P=0.001$); there is significant association between triglycerides and major lower extremity amputation ($P=0.005$); there is significant association between neuropathy and major lower extremity amputation ($P=0.0001$); there is significant association

between nephropathy and major lower extremity amputation ($P=0.048$); there is no association between vasculopathy and major lower extremity amputation ($P=0.141$); there is significant association between osteomyelitis and major lower extremity amputation ($P=0.029$) and there is significant association between sepsis and major lower extremity amputation ($P=0.0001$) (Table 2).

Table 2: Association between major lower extremity amputation and clinical parameters (N=100)

S. No.	Variable	Minor amputation	Major amputation	T test/ X ²	P value
1	HBA1C	9.29±1.28	11.15±1.25	-6.900	0.0001
2	Triglycerides				
	Normal	54	11	7.953	0.005
	Elevated	20	15		
3	Neuropathy				
	Absent	36	3	11.138	0.001
	Present	38	23		
4	Nephropathy				
	Absent	62	17	3.926	0.048
	Present	12	9		
5	Vasculopathy				
	Absent	38	9	2.163	0.141
	Present	36	17		
6	Osteomyelitis				
	Absent	32	5	4.759	0.029
	Present	42	21		
7	Sepsis				
	Absent	66	2	58.726	0.0001
	Present	8	24		

Discussion

In the study by Maria Teresa Verrone Quilici et al [11] the age of the patients (n=100;Men=68;Women=32) ranged from 31.9 to 89.7 years, with 55% of patients older than 60 years. In this study the age of the patients (n=100; Men=60;Women=40) ranged from 29 to 86 years, with 44% patients older than 60 years.

In the study by Maria Teresa Verrone Quilici et al [11], 22% had been diabetic for less than 5 years, 24% from 5-10 years and 54% for more than 10 years whereas in this study of the total 100 patients 6% had been diabetic for less than 5 years. 24% from 5-10 years and 70% for more than 10 years. Based on the observation and analysis of my study, there is no association between increasing duration of diabetes mellitus and major lower extremity amputation (p value – 0.307).

In this study the mean HbA1c level for minor amputations was 9.29 and for major amputations was 11.15. Based on the observation and analysis of my study, there

is a significant association between increasing HbA1c and major lower extremity amputation (p value – 0.0001)

In the study by Maria Teresa Verrone Quilici et al [11] 41% had dyslipidemia whereas in this study 35% had dyslipidemia of which 20% underwent minor amputations and 15% underwent major amputations. Based on the observation and analysis of my study, there is a significant association between elevated triglycerides and major lower extremity amputation (p value – 0.005).

In this study 63% were smokers of which 16% underwent major amputations and 47% underwent minor amputations. Based on the observation and analysis of my study, there is no association between smoking and major lower extremity amputation (p value – 1.000).

In this study 61% of patients were found to have peripheral neuropathy. 38% underwent minor amputations and 23% had major amputations. Based on the observation and analysis of my study, there is a significant

association between neuropathy and major lower extremity amputation (p value – 0.001). In the Seattle VA case control study the significance of this condition in terms of population attributable risk% was high due to the higher prevalence of hypoaesthesia among the cases (78%) than among the controls (18%).

According to Abolfazl Shojaiefard et al [12] those who required amputation had a significantly higher (p value <0.05) incidence of nephropathy. In this study 21% were found to have nephropathy out of which 9% had major amputations and 12% had minor amputations. Based on the observation and analysis of my study, there is an association between nephropathy and major lower extremity amputation (p value – 0.0048). [13]

In the study by Maria Teresa Verrone Quilici et al [11] 63% had peripheral vascular disease. In this study 53% were identified with peripheral vascular disease 36% with peripheral vascular disease underwent minor amputations and 17% underwent major amputations. Based on the observation and analysis of my study, there is no association between vasculopathy and major lower extremity amputation (p value – 0.141).

In the study by Maria Teresa Verrone Quilici et al [11] 2016), 52% patients had osteomyelitis. Amputations were more frequent in patients who had osteomyelitis than those lacking this condition (p<0.001). In this study osteomyelitis was present in 63% of patients of which 21% underwent major amputation and 42% underwent minor amputations. Based on the observation and analysis of my study, there is a significant association between osteomyelitis and major lower extremity amputation (p value – 0.029).

In this study 8% of patients who underwent minor amputations and 24% of patients who underwent major amputations presented with sepsis. Based on the observation and analysis of my study, there

is a significant association between sepsis and major lower extremity amputation.

Knowledge of these factors and their influence on amputation outcomes is critical to allow multidisciplinary teams to develop management and treatment protocols for patients with diabetes planning for lower limb extremity amputation.

Conclusion

Based on the our study observations we conclude that the risk factors elevated HbA1C which indicated uncontrolled diabetes mellitus. Elevated triglycerides, diabetic neuropathy, diabetic nephropathy, osteomyelitis, and sepsis have significant association with major amputation and avoiding these risk factors has profound influence in the prevention of major lower extremity amputations.

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