Pattern and Causes of Amputation in Diabetic Patients – A Multicentric Study from India

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Abstract

Objective: One of the most significant complications of diabetes is foot disease, which often leads to amputations. India being the diabetic capital of the world, this study has been planned to assess the pattern and causes of amputations in diabetic patients across various parts of India.

Subjects and Methods: A total of 1985 (M:F 1249:736) type 2 diabetic subjects were selected from 31 centres across India. Out of 1985 subjects, a total of 1295 (850:445) patients who had undergone amputations both major and minor were included in this analysis. An amputation is preceded by foot ulcers. The development of a foot ulcer is considered to result from a combination of peripheral vascular disease, neuropathy, infection and poor foot care. Peripheral vascular disease was assessed by using Doppler studies. Presence of neuropathy was assessed by using 10g monofilament and 125 Hz tuning fork. Presence of gross infection was assessed by using 10g monofilament and 125 Hz tuning fork.

Results: The major cause for the occurrence of amputations among the patients was found to be infection. Almost 90% of the major amputations were of toes and rays. Infection was found to be the major cause of amputation in India. Below knee, toes and rays amputations were the most common type of amputations. diabetic patients should be educated on foot care and importance of proper foot wear.

Introduction

Diabetes mellitus, one of the major risk factors for premature mortality and morbidity due to its complications14,15. India being the diabetic capital of the world has more than 35 million people affected by diabetes currently, with future estimation of around 80 million people in 20301. One of the most significant complications of diabetes is foot disease, which often lead to amputations. The burden by means of hospital stay and treatment and loss of employment.

Hind complications are a major cause of hospital admission for people with diabetes. In developing countries, it has been estimated that foot problems may account for about 40% of the health care resources available15,16.

Foot complications not only affect the physical functional status but also affect their psychosocial status and increase the financial burden by means of hospital stay and treatment and loss of employment.

This study has been planned to assess the pattern and causes of amputations in diabetic patients across various parts of India.

Subjects and Methods

A total of 1985 (M:F 1249:736) type 2 diabetic patients were selected from 31 centres across India. The majority of the centres are from the southern part of the country. The number of centres from each region were as follows; North (n=3) East (n=4), West (n=3) and South (n=21). The details of the centres from each region are plotted on a map (figure 1). The above centres were invited to participate in this study. All the centres had facilities to assess neuropathy and peripheral vascular disease. The study was conducted at Diabetes Research Centre, Chennai, India, a tertiary care centre for diabetes. Records of every third type 2 diabetic subjects were examined at different centres for a period of one year to identify patients who underwent amputations. The sources from where the cases were identified...
Table 1: General characteristics of the study regions and study subjects

<table>
<thead>
<tr>
<th>Region</th>
<th>No. of Centres</th>
<th>No. of diabetic patients</th>
<th>No. of subjects with Amputations</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>3</td>
<td>199</td>
<td>127</td>
</tr>
<tr>
<td>East</td>
<td>4</td>
<td>304</td>
<td>215</td>
</tr>
<tr>
<td>West</td>
<td>3</td>
<td>182</td>
<td>113</td>
</tr>
<tr>
<td>South</td>
<td>21</td>
<td>1300</td>
<td>840</td>
</tr>
<tr>
<td>Total</td>
<td>31</td>
<td>1985</td>
<td>1295</td>
</tr>
</tbody>
</table>

Table 2: Demographic and clinical details of the study subjects

<table>
<thead>
<tr>
<th></th>
<th>Without amputations (n=690)</th>
<th>With amputations (n=1295)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male/Female</td>
<td>399/291</td>
<td>850/445</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Age (in Years)</td>
<td>52.8±11.6</td>
<td>56.5±10.3</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Duration of DM (in years)</td>
<td>7.7±5.9</td>
<td>11.9±6.4</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>HbA1c %</td>
<td>8.1±0.8</td>
<td>9.0±2.1</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

are operating theatre records, hospital discharge data or limb fitting centres. The study was approved by the ethics committee of the institution.

Out of 1985 subjects, a total of 1295 (850:445) type 2 diabetic subjects who had undergone amputations both major and minor were included in this analysis. A proforma which contains personal details, demographic data, surgical history, level of amputation, diabetes history, deformity details, causes of amputations and a history of other associated diabetic complications was used to collect the data. More details on the presence of foot deformity, infections and exact level of amputation were recorded. Peripheral vascular disease was assessed by using Doppler studies. Presence of neuropathy was assessed by using 10g monofilament and 125 Hz tuning fork.

Foot deformity was defined as any contracture or abnormal prominence that cannot be manually reduced. Foot infection was defined as the presence of purulent drainage or two or more signs of inflammation which includes warmth, tenderness, swelling and redness. The amputation was considered as a major amputation if it was done at the level of hind quarter, hip, above knee, through knee, below knee or through ankle or tarsus. Minor amputations were done through tarsometatarsal joints, through metatarsal bones, toes or rays.

Toe amputation was done in patients with toe ulceration, gangrene limited to toe and osteomyelitis of the distal or middle phalanx or a septic inter phalangeal joint. Ray amputation was done in patients where the necrotic process involved the base of the toe. Transmetatarsal amputation was performed when the infection involved multiple toes or the metatarsophalangeal joint.

The proforma was filled by a trained Researcher / Patient educator or a nurse. Mean ± standard deviation and proportions are reported for the variables. Group comparison was done by Student’s ‘t’ test. A p value of <0.05 was considered statistically significant. SPSS package (version 10.0) was used for statistical analysis.

Results

A total of 1985 (M:F 1249:736) type 2 diabetic subjects were selected from 31 centres across India. Of the total subjects, 1295 (M:F 850:445) patients had undergone amputations. Table 1 and Table 2 shows the characteristics of the study patients. The mean age of the amputees was 56.5 ± 10.3 years and the mean duration of diabetes was 11.9 ± 6.4 years. The patients who had undergone amputations were older, had longer duration of diabetes and the mean HbA1c levels were higher among them when compared with the patients without amputations. (p<0.0001).

Table 3 shows the causes for the occurrence of amputations among the study patients. The major cause was found to be infection. Almost 90% of the patients had infection. Trauma was reported in 4.5% of the subjects and frost bite in 0.9% of the subjects.

Table 4 shows the details on the level of amputations among the study subjects. Patients had different types of amputations:

Table 3: Various causes for the occurrence of amputation among study subjects

<table>
<thead>
<tr>
<th>Reasons for Amputation</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infection</td>
<td>1169 (90.3)</td>
</tr>
<tr>
<td>Trauma</td>
<td>59(4.5)</td>
</tr>
<tr>
<td>Frost Bite</td>
<td>12(0.9)</td>
</tr>
</tbody>
</table>

Values are n (%)

Table 4: Details on the level of amputation among the study subjects

<table>
<thead>
<tr>
<th>Level of Amputation</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hind quarter</td>
<td>26(2)</td>
</tr>
<tr>
<td>Hip</td>
<td>8(0.6)</td>
</tr>
<tr>
<td>Above Knee</td>
<td>45(3.5)</td>
</tr>
<tr>
<td>Through Knee</td>
<td>25(1.9)</td>
</tr>
<tr>
<td>Below Knee</td>
<td>222(17.1)</td>
</tr>
<tr>
<td>Through ankle or Tarus</td>
<td>51(3.9)</td>
</tr>
<tr>
<td>Through Tarsometatarsal joints</td>
<td>95(7.3)</td>
</tr>
<tr>
<td>Through Metatarsal Bones</td>
<td>108(8.3)</td>
</tr>
<tr>
<td>Great toe (+/- other toes) or first ray</td>
<td>333(25.7)</td>
</tr>
<tr>
<td>Other toe(s) or ray(s) (including great toe)</td>
<td>382(29.5)</td>
</tr>
</tbody>
</table>

Values are n (%)
major amputations accounting for 29.1% (n=377) and minor amputations in 70.9% (n= 918) of subjects. Among the subjects who underwent major amputations, more than 50% accounts for below knee amputations and 11.9% above knee amputations. Out of total amputations, over half of the incident amputations were of toes and rays.

Table 5 shows the details of the deformities in study patients. Presence of claw toes was seen in 64% of patients. Osteoarthropathy was present in 32.4%, nerve thickening in 0.9%, per planus in 0.5% and per cavus in 0.5%.

Figure 2 shows the prevalence of associated diabetic complications among the study subjects. As expected, prevalence of neuropathy (82%) was high in the patients. About 35% had the presence of retinopathy and peripheral vascular disease. Nephropathy was present in 21.4%, cardiovascular disease in 24.2% cerebrovascular accidents occurred in 4.2% and arterial embolism was seen in 3.2% of the patients.

Discussion

Foot complications among people with diabetes are common. Most of the foot problems associated with diabetes in India are neuropathic and infective rather than vascular in origin as in developed countries17. This study was aimed to describe the causes of amputations and pattern of amputations in type 2 diabetic patients across India. The study evaluated the profile of amputations to some extent at a national level. More prevalent cause of amputation was found to be infection (90%). About 29.1% of subjects had undergone major amputations and 70.9% underwent minor amputations. Among the patients who had undergone major amputations, below knee amputation was found to be very common. Of the total amputations, half were of toes and rays.

In a recent study conducted at a Kenyan rural hospital18, more prevalent cause of amputation was reported as trauma (35.7%) whereas it was only 4.5% in our study. Foot infection was the main cause of amputation in our study. The development of a foot ulcer is mainly associated with the presence of peripheral neuropathy, peripheral vascular disease, foot deformity and infection. Approximately 85% of our study subjects had the presence of neuropathy, 35% had PVD and presence of claw toes was seen in 64% of subjects. Another study from turkey reported the change in the profile of amputations in diabetic foot19. The overall amputation rate in the above study was 39.4%. Ray amputation (35%) and below knee amputation (30%) were the two most commonly applied procedures, the results are consistent with the findings of our study.

A review of the epidemiology of diabetic foot problems in Africa20 highlighted the risk factors and other conditions associated with diabetic foot complications. In Africa also it constitute an increasing public health problem and it is a leading cause of admission, amputation and mortality in diabetic patients13,20. In a multinational study, Chaturvedi et al showed that vascular complications and their risk factors are associated with the occurrence of amputations in both type 1 and type 2 diabetes21. In a recent study from Sudan, it was reported that significant factors associated with major lower extreme amputations were ischaemia, neuropathy, depth of wound and grade of infection22. These differences seen in the risk factors and causes of amputations show the ethnic variations between countries.

Significant reductions in amputations can be achieved by well organized diabetic foot care teams with podiatric specialists, good glyemic control and by educating patients on foot care6,11,13,23. Prevention of foot ulceration is possible by simple interventions which can reduce amputations upto 80%,24. Globally, in many countries including Sweden, Netherlands and the United Kingdom, multidisciplinary foot care centres have been shown to be very effective in the reduction of foot amputations25.

In India, by implementing preventive strategies such as intensive management and foot care education were helpful in preventing newer problems and surgery in diabetic foot disease26. In a recent report, it was shown that recurrence of healed ulcers occurred in only one sixth of patients and amputations in just 1% of subjects. The study concluded that it is possible to reduce the burden of foot problems by educating patients on foot care and by providing appropriate foot wear27. Amputations rate in some island populations, such as Fiji and Nauru, were once extremely common but showed a reduction by institution of a national foot care and health education and prevention28. Hence it is possible to reduce the burden of foot problems in developing countries by implementing simple interventions.

In conclusion, this multicentric study showed the profile of amputations in India. Infection was found to be the major cause of amputation. Below knee amputation, toes and rays amputation were the most common types of amputations. All the high risk patients should be educated on foot care and importance of proper foot wear.

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Conflict of Interest: None declared.

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