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A Review on Amputation among Patients with Diabetic Foot.

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ABSTRACT

Diabetes is a metabolic disease that has high blood sugar levels. Polyuria, polydipsia, hunger and serious long-term complications such as cardiovascular diseases, stroke, chronic kidney failure, diabetic foot, and eye damage. The aim of this study was to investigate incidence of diabetic foot amputation. Articles that demonstrated the prevalence of limb amputation due to diabetic foot were included from various digital libraries. These keywords were used to search: diabetes, patient, complication, diabetic foot, and amputation. Studies that did not clearly point out to the issue were excluded from the study. The overall conclusion of all studies were that being involved with diabetes for long-term along with inappropriate treatment were related to the incidence of diabetic foot and infection and results in decreasing the quality of life.

Keywords: Diabetes, Diabetic Foot, Amputation

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INTRODUCTION

Diabetes mellitus (DM), which is usually recognized as diabetes in clinics, is a group of metabolic diseases that have high levels of blood sugar in a long-term period [1, 2].

Polyuria, polydipsia, and hunger are the main symptoms of diabetes. If not properly treated, it can leave many complications or such as diabetic ketoacidosis, non-ketotic hyperosmolar coma, cardiovascular diseases, stroke, acute renal failure, diabetic foot and damage to the eye [3].

Diabetes is due to insufficient insulin production in the pancreas, or inappropriate cell response to insulin [4]. There are three main types of diabetes:

1. Type one diabetes due to pancreas failure to produce insulin. This was previously referred to as Insulin Dependent Diabetes Mellitus or juvenile diabetes. Its etiology was unknown [5, 6].
2. Type two diabetes due to resistance to insulin. In this type, body cells do not respond appropriately to insulin. As the disease develops, insulin loss might also occur. This type was previously known as non-insulin dependent diabetes mellitus or adult diabetes. The main reason for this disease is inactivity and being overweight [7].
3. Gestational diabetes is another type of diabetes that occurs when pregnant women have high levels of blood sugar with no previous history of diabetes [8].

Preventing and controlling diabetes includes a healthy diet, exercise, not using Tabaco, and having normal body weight. Controlling blood sugar and appropriate foot care is also important for these patients [9].

Type one diabetes should be treated by insulin injection and type two diabetes might be treated with or without insulin. It must be kept in mind that insulin and other medications can decrease blood sugar levels. Weight reduction surgery is an effective action in treating type two diabetes. Gestations diabetes is also usually resolved after the birth of the child [10].

As previously estimates demonstrated, 387 million people are diagnosed with diabetes, worldwide. Almost 90 percent of all cases are type two [11]. This consists 8.3 percent of world's adult population. Diabetes led to 1.5 to 4.5 million annual deaths until 2014. Diabetes doubles mortality risk. It is expected that the number of patients increase to 592 million by the year 2035. The economic expense due to diabetes care is estimated to be 612 billion dollars in 2014. This number was 245 billion dollars in 2012 in the United States [12].

There is no recognized prevention for type one diabetes. Type two diabetes can be prevented with weight control, physical exercise, and a healthy diet. Recognized dietary changes can help preventing diabetes are as followed: a diet full of whole grains and fiber, high-density lipid such as unsaturated lipids in nuts and vegetable oils, and fish. Also, limiting sweetened drinks, eating red meat and other sources of saturated lipids can help preventing diabetes. Smoking also increases the risk for diabetes, thus smoke ceasing can be as a preventive activity [13, 14].

All types of diabetes increase long-term complications. These complications usually occur after ten to 20 years. However, they can be the first findings since diabetes might not be diagnosed before. Vascular damage can be an important long-term complication of diabetes. It increases the risk for cardiovascular diseases and about 75 percent of diabetes mortality is due to coronary artery complications. Macro-vascular complications such as stroke or peripheral vascular diseases are also complications of diabetes. Primary results of micro vascular complications include eye, kidney, and nervous damage. Eye complications are known as diabetic retinopathy that occurs due to retinal vascular damage. This can lead to gradual blindness. Kidney damage is known as diabetic nephropathy which is characterized by tissue damage, proteinuria, and chronic kidney disease. Patients might need dialysis or kidney transplant. Nerve damage is also referred to as diabetic neuropathy and is the most common complication of diabetes. Numbness, Paresthesia and pain are its symptoms that can lead to skin damage. Diabetic foot can also occur due to diabetic foot [15-17].

One of the most important debilitating complications of diabetes is diabetic foot [18]. Diabetic foot is diagnosed in 2.5 percent of patients with diabetes. This can lead to severe infections and amputation. This complication is important because it can prolong hospitalization and increase complications. Vascular damage and neuropathy are associated with diabetic wounds. Most patients with history of amputation have history of peripheral arterial diseases [19]. These patients need more medical and health care in order to decrease their complications.

METHODS

This study assessed the results of previous studies that were related to the frequency of limb amputations due to diabetic foot. Many articles were included from the beginning of the study. However, some of them were excluded afterwards due to unclear mention to the issue. Different digital libraries were used to collect data and diabetes, patient and complication, diabetic foot and limb amputation were the most important keywords used for search.

Literature review

Mofid et al conducted a five year study to investigate the prevalence of lower extremity amputation among patients hospitalized due to diabetic foot. They enrolled 105 male patients and 90 female patients who were involved with diabetic foot. Among all patients, 74 underwent surgery; 56 were male and 18 were female. Most patients were at 60 – 70 age group and patients aged between 20 and 30 were the smallest group. Nine patients were smokers. All smokers were male. Patients with a longer history of smoking was associated with surgical operation. The mean time past from diabetes diagnosis was 10.56 ± 8.32 and 70 of them had a history of diabetic foot. The mean blood sugar level of male patients was 365 and female patients was 278 [20].

Larijani et al conducted a study to evaluate the prevalence of limb amputation among patients with diabetic foot who referred to Imam Khomeini Hospital of Tehran in a 15 year period. This was a retrospective descriptive study. Medical documents of diabetic patients of Imam Khomeini and Shariati Hospital were assessed. Among 101 patients (56.4 percent male and 43.6 percent female) with a mean age of 97.11 ± 86.59 . The mean duration since diabetes onset was 8.54 ± 12.15 years. History of diabetic foot was 30.7 percent and 27.7 percent used to smoke. Also, 6.9 percent had digital deformity and two percent had charcot foot. The dorsal tibia pulse and dorsalis pedis pulse was not palpable among 15.8 percent and 16.8 percent of patients, respectively. Also, 49.5 percent of patients had gangrene on admission. Wound debridement, revascularization and amputation were seen in 22.8 percent, one percent and 34.7 percent, respectively. Amputation was associated with ulcer gangrene, and admission blood sugar above 140 [21].

Shahrad Bejestani et al conducted a study to investigate risk factors for diabetic foot and its outcomes. Patients with diabetic foot who referred to Hazrat RasoulAkram Hospital of Tehran in a five year period were included in this retrospective study. About 11.5 percent of patients wore tight shoes before last episode of hospitalization. In this case, this was the reason for foot ulcer. Also, 36.9 percent of patients had a previous history of diabetic foot or diabetic amputation. Regarding the outcomes of this situation, 41.5 percent experienced lower extremity amputation. On the other hand, 23.1 percent improved and no discharge, redness or edema has seen and patients were discharged and continued treatment outside the hospital. Also, 35.4 percent of patients improved completely. Seven patients died following limb amputation [22].

TalebiTaher et al conducted a study cross-sectional study among patients referred to hospitals in Tehran in a one year period. This study carried out retrospectively and samples were selected using conventional sampling and 52 patients were enrolled. All enrolled patients were in the third and fourth stage according to IDSA guidelines. They all had tissue culture and antimicrobial resistance pattern were evaluated. Among 52 patients, 36 (69.2 percent) were male and 16 (30.8 percent) were female. The mean age of participants was 60 ± 12.8 year (age range of 30 to 80). Among 52 patients, 29 (55.8 percent) had amputation that led to death, 20 (38.5 percent) were under treatment and three (5.8 percent) were discharged with full recovery status. All patients with fourth degree

infection and 12 with third degree infection underwent amputation due to severe bone involvement and defect in blood perfusion. Blood perfusion defect was diagnosed with angiography. Out of 29 amputated patients, 24 (86.2 percent) were diagnosed with diabetes for more than ten years. Eighteen out of 20 patients (90 percent) who underwent medical treatment also had a history of diabetes above ten years and two out of three cases of full recovery (66.6 percent) were diagnosed between one and five years. There was no association between amputation and duration of being involved with diabetes [23].

Mashayekhi et al conducted a study to investigate the prevalence of amputation among patients with diabetic foot in Shariati Hospital in a ten year period. This cross sectional study was conducted on all patients who referred to the hospital in a ten year period. All patients with diabetic foot who were hospitalized in Shariati Educational, research and management center were enrolled in this retrospective study. Out of 1070 hospitalized patients, 699 had the inclusion criteria. Among all participants, 436 (63 percent) had ischemic ulcers, 177 (26 percent) had neuropathic ulcers, 76 (11 percent) had both neuropathic and ischemic ulcers. Also, 373 patients (53.4 percent) had ulcer in right lower extremity while 271 (38.8 percent) had left lower extremity ulcers. Also, 54 (7.8 percent) had ulcers in both lower extremities. Regarding amputation, 338 (97 percent) underwent minor amputation and nine (three percent) patients experienced major amputation. According to Wegner criteria, patients with Wegner score above three had at higher risk for amputation. Prevalence of amputation was 61.7 percent among men and 45.2 percent among women. Statistically, men were at higher risk for amputation. Also, male gender, previous history of hospitalization of amputation, unemployment, ischemic ulcer and ulcers with Wegner degree above three were statistically associated with amputation [24].

Nikkhuy et al conducted a study to investigate the epidemiologic findings of diabetic foot infections that led to amputation. This retrospective study was conducted in Razi Hospital of Ahvaz during 2001 to 2003. Two groups of participants were included; control group (no amputation) and case (with amputation). In this study, 198 were diagnosed with diabetic foot, 72 underwent amputation. Also, 116 were male and 82 were female, 31.9 percent of those with extremity amputation aged between 60 and 69. The mean duration of having ulcer was 35 days among the amputation group and 22 days for the control group. The mean age of patients of amputation and control group were both 59.6 years. Among 82 women, 31 had diabetic foot that led to amputation and among 116 participants, 41 were amputated. There was no statistical association between amputation and age and gender. Also, the duration of being diagnosed with diabetes was associated with foot amputation. Leaving diabetes without treatment diabetes for more than 120 days was associated with foot amputation [3].

DISCUSSION

Diabetic foot is the result of any damage that is directly caused by diabetes or its long-term complications. The most important complications of diabetic foot are infection and neuropathic osteoarthropathy. Diabetic foot infection is often seen as cellulitis, chronic osteomyelitis and acute osteomyelitis, deep soft tissue and skin infections [25-29]. Diabetic ulcers are the most common reasons for lower extremity amputations. Its treatment needs specific expertise that includes routine and frequent evaluation and preventive care. Also, common risk factors that form diabetic neuropathy, change in foot structure or peripheral arterial obstruction must be carefully assessed.

Patient education regarding foot care, nail care and choosing appropriate shoes are important to reduce risk for damages that result in ulcers.

Previous studies concluded that the time past from diabetes onset is significantly related to limb amputation. In other terms, the duration between diabetes onset and treatment initiation is related to diabetic foots and limb amputation [30]. Most conducted studies were retrospective. Conducting a prospective study with patient follow up can show more important and efficient findings.

REFERENCES

- [1] Hellweg R, Hartung HD. *Journal of neuroscience research*. 1990;26(2):258-67.
- [2] Zhang J, Liu H, Yan H, Huang G, Wang B. *Gene*. 2013;518(2):405-11.
- [3] Association AD. *Diabetes care*. 2013;36(1):67-74.
- [4] Opie LH. *The Lancet*. 2011;378(9786):103-4.
- [5] Van Belle TL, Coppieters KT, Von Herrath MG. *Physiological reviews*. 2011;91(1):79-118.
- [6] Padgett LE, Broniowska KA, Hansen PA, Corbett JA, Tse HM. *Annals of the New York Academy of Sciences*. 2013;1281(1):16-35.
- [7] Knowler WC1, Barrett-Connor E, Fowler SE, Hamman RF, Lachin JM, Walker EA, Nathan DM. *The New England journal of medicine*. 2002;346(6):393-404.
- [8] Ryan E. *Diabetologia*. 2011;54(3):480-6.
- [9] Brunet S, Plotnikoff RC, Raine K, Courneya K. *Ethnicity & disease*. 2005;15(2):353-4.
- [10] Mann JF, Rossing P, Więcek A, Rosivall L, Mark P, Mayer G. *Nephrology Dialysis Transplantation*. 2015;30(4):1-5.
- [11] Vo QH, Nguyen PH, Zhao BT, Ali MY, Choi JS, Min BS, et al. *Fitoterapia*. 2015;103:113-21.
- [12] Rao G. *J Diabetes Metab*. 2015;6(489):2-5.
- [13] Saaristo T, Moilanen L, Korpi-Hyövälti E, Vanhala M, Saltevo J, Niskanen L, et al. *Diabetes care*. 2010;33(10):2146-51.
- [14] Chen L, Magliano DJ, Zimmet PZ. *Nature Reviews Endocrinology*. 2012;8(4):228-36.
- [15] Gabbay RA, Lendel I, Saleem TM, Shaeffer G, Adelman AM, Mauger DT, et al. *Diabetes research and clinical practice*. 2006;71(1):28-35.
- [16] Donaghue K, Fairchild J, Chan A, Hing S, Howard N, Silink M. *Journal of Pediatric Endocrinology and Metabolism*. 1999;12(2):185-92.
- [17] Pilon R, Bailey PH, Montgomery P, Bakker D. *Journal of Nursing and Healthcare of Chronic Illness*. 2011;3(3):234-44.
- [18] Madanchi N, Tabatabaei-Malazy O, Pajouhi M, Heshmat R, Larijani B, Mohajeri-Tehrani M-R. *J Diabetes Metab Disord*. 2013;12(1):36-41.
- [19] Boulton AJ, Vileikyte L, Ragnarson-Tennvall G, Apelqvist J. *The Lancet*. 2005;366(9498):1719-24.
- [20] Mofid A, Yazdani T, Dulabi H, Seyyed Alinaghi S A, Zandieh S. *Tehran University Medical Journal*. 2008;65(13):38-41.
- [21] Ramsey SD, Newton K, Blough D, McCulloch DK, Sandhu N, Reiber GE, et al. *Diabetes care*. 1999;22(3):382-7.
- [22] Shahrads Bejestani H, Motabar A. *Razi Journal of Medical Sciences*. 2004;11(39):77-83.
- [23] Talebi Taher M, Abasi M, Barati M. *Journal of Ardabil University of Medical Sciences*. 2010;10(3):232-40.
- [24] Mashayekhi M, Larijani B, Mohajeri MR, Rambod C. *Iranian Journal of Diabetes and Metabolism*. 2013;12(6):543-55.
- [25] Gardner SE, Frantz RA, Park H, Scherubel M. *Ostomy/wound management*. 2007;53(1):46-51.
- [26] Hofstaetter S, Trieb K. *Zeitschrift fur Orthopadie und Unfallchirurgie*. 2014;152(5):517-33.
- [27] Khan MJ. *US Pharmacist*. 2011;36(8):63-68.
- [28] Lipsky BA. *Diabetes care*. 2014;37(3):593-5.
- [29] Parvez N, Dutta P, Ray P, Shah VN, Prakash M, Khandelwal N, et al. *Diabetes technology & therapeutics*. 2012;14(8):669-74.
- [30] Nikkhooy A, Shabani Z, Ashrafizadeh S. *Scientific Medical Journal*. 2009;8(1):31-7.