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Re-amputation after minor foot amputation in diabetic patients: Risk factors leading to limb loss

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Abstract

Burn injury in diabetic patients has been a recent topic of interest in published studies. Previous studies have shown increased complications in diabetic patients compared with nondiabetic controls who have sustained these injuries. A paucity of research has been devoted to foot-specific diabetic burn injury. We present a case series evaluating the mechanisms and complications of diabetic foot burns.

Keywords

diabetes; injury; neuropathy; trauma; wound

Introduction

The diabetic population has unique complications, including microvascular disease, peripheral neuropathy, and delayed wound healing. Because of these complications, there has been recent interest in burn injuries occurring in these patients. Recent studies have shown worse outcomes for diabetic patients compared with nondiabetic patients. These have included an increased rate of infection, skin graft failure, prolonged wound healing, and longer hospital stay (1–3). Kimball et al (2) focused solely on lower extremity burns in diabetic patients and found increased hospital admissions, increased admission to the intensive care unit, longer hospital stays, and an increased incidence of renal failure compared with nondiabetic controls. These studies have included the entire body or the entire lower extremity. The study by Kimball et al (2) did not report on the specific location of the lower extremity burns. A recent prospective study by Schwartz et al (3) reported on a total of 10 foot burns within their data (2). Studies of isolated diabetic foot burns have been limited to small case series with 6 patients or fewer (4–8). One case series has focused solely

on isolated foot burns, including 33 patients, but none were diabetic (9). Our goal in the present study was to evaluate the specific characteristics of diabetic foot burns to aid in the future management of these injuries. We sought to determine the (1) common mechanism of injury in patients with neuropathic and non-neuropathic diabetes; (2) delay in seeking medical care, if any; (3) length of hospital stay; (4) rate of surgical intervention; and (5) rate of complications, especially of infection and amputation.

Materials and Methods

We identified 189 diabetic patients who had sustained a lower extremity burn at our institution from January 1, 2003 through January 1, 2011. The patients were identified by “International Classification of Diseases,” version 9 codes for a lower extremity burn (codes 945.00 to 945.39) and diabetes mellitus (codes 250.00 to 250.99). The medical records were reviewed, and only patients with isolated foot burns were included in the present study. Any patient with a burn proximal to the level of the ankle was excluded. This left 33 patients, with 156 excluded. The medical records were reviewed to document the gender, age, race, comorbidities, smoking status, presence and level of peripheral neuropathy, presence and severity of peripheral arterial disease (PAD), mechanism of injury, burn depth, interval to presentation for medical care, length of hospital stay, surgical intervention, and complications. The burn mechanism was classified as fire (flash or flame), scald (liquid, grease, or steam), contact, chemical, electrical, or radiation. Liquid scald burns were then separated into spill or immersion. Documentation of inhalation injury was included. The burn depth was documented as full thickness, deep partial thickness, superficial partial thickness, and superficial. Peripheral neuropathy was diagnosed on physical examination by the loss of protective sensation using a 5.07 monofilament. The presence of PAD was diagnosed on the basis of diminished or absent pulses and the findings from noninvasive arterial studies. The complications included wound infection requiring oral or intravenous antibiotics, osteomyelitis, skin graft failure, amputation, pneumonia, urinary tract infection, acute renal failure, or line infection.

Results

Our study population included 20 males and 13 females. Of the 33 patients, 22 were white, 10 were black, and 1 was Hispanic. Also, 6 patients had type 1 and 27 type 2 diabetes mellitus. Only 8 of the 33 patients (24.2%) were considered to have controlled diabetes. Six patients were currently receiving dialysis, 4 patients had undergone previous toe amputations of either foot, and 4 were current smokers. Most patients (27 of 33, 81.8%) had peripheral neuropathy. The neuropathy was limited to the level of the forefoot in 7 patients and the level of the ankle in 20 patients. Seven patients had PAD (Table).

Mechanism of Injury and Burn Severity

The mechanism of burn injury varied; however, the most prevalent mechanism was scald burn (4 grease, 12 immersion, and 5 spill; total of 21 patients, 63.6%). The mechanism of injury was flame burns for 3, contact burns for 9; 17 burns were bilateral. No patient had chemical, electrical, or radiation burns. No patients had associated inhalation injuries, and none required intubation. No patients required fluid resuscitation, because all burns were

less than 1% the total body surface area. The burn depth was superficial in 2, superficial partial thickness in 12, deep partial thickness in 5, and full thickness in 14.

Interval to Presentation and Hospital Stay

The mean period to presentation for medical care was 3.6 (0 to 32) days, with 11 patients presenting the same day. The mean length of hospital stay was 5.03 (0 to 22) days.

Surgical Intervention

All patients but 1 with a full-thickness or deep partial thickness burn (18 patients) required surgery. Of the 18 patients requiring surgery, the average number of surgeries was 1.94. Five patients required 2, one required 3, two required 4, and one required 5 surgeries. Of the 18 patients, 12 (66.7%) required split-thickness skin grafting and 1 required a rotational flap. All patients treated conservatively were treated with silver sulfadiazine 1% cream (Silvadene, Pfizer, Bristol, TN) and local wound care.

Complications

The complications included soft tissue infection, osteomyelitis, amputation, acute renal failure, and pneumonia. Of the 33 patients, 15 (45.5%) developed a wound infection. Of the 15 patients, 12 (80%) required intravenous antibiotics, 4 (26.7%) developed osteomyelitis, and 5 (33.3%) required amputation. Only 1 (3%) patient requiring amputation had PAD, and this was mild. Only 1 (3%) patient developed acute renal failure, and 1 (3%) developed hospital-acquired pneumonia. No line infections developed.

Discussion

Our results have demonstrated that the most common mechanism of injury was immersion (12 of 33, 36.4%), followed by contact burns (9, 27.3%), both of which went unnoticed because of peripheral neuropathy. All immersion injuries were caused by diabetic patients soaking their feet. The contact burns were caused from an unshod foot touching various hot surfaces, including a hot radiator, a heating pad, a hot popcorn bag, an engine block from a riding mower, an exhaust pipe from a motorcycle, and walking on hot asphalt. All these patients had neuropathy. These injuries could have been prevented or reduced in severity with previous education and patient compliance. All patients without neuropathy had experienced burns from grease or liquid spills onto the dorsum of 1 or both feet. Our results are similar to those of previous studies (1–8). Shalom et al (10) evaluated diabetic burns on the entire body and noted an increase in scald burns; however, the mechanism was not further classified. Schwartz et al (3) found that diabetics were more likely to incur a scald injury from the tub or shower and not hot fluid spills. The case series of 6 patients by Dijkstra et al (5) reported 4 immersion burns from footbaths and 2 unspecified contact burns. Kimball et al (2) found scalding to be the most common etiology of burns in those with and without diabetes; however, the entire lower extremity was evaluated. We believe our results provide more input on the mechanism and the simplicity of prevention.

The incidence of infection was 45.5%, with 80% of these patients requiring intravenous antibiotics. Memmel et al (11) compared 68 total body diabetic burns and 995 nondiabetic

burns and found a 27% wound infection rate in those with diabetes compared with 11% for those without diabetes. McCampbell et al (1) also showed an increase in the burn wound infection rate, with 35.1% in those with diabetes versus 28.0% for those without diabetes. Kimball et al (2) showed a very low infection rate of 4.7%, which was only slightly greater than that for patients without diabetes. Our rate of infection was significantly greater. This might have resulted from the anatomic location. All these cited studies had evaluated burns from the entire body or entire lower extremity and did not directly compare foot burns for the rate of infection. Our rate of osteomyelitis was 12.1% (4 patients), with 2 patients requiring amputation, 1 of which was below the knee. The other 2 patients with osteomyelitis were lost to follow-up and might have required amputation. Four of our 5 patients had required toe amputations, either partial or with disarticulation at the metatarsophalangeal joint. One patient eventually required a below-the-knee amputation after multiple surgeries. In the case series of 6 patients reported by Dijkstra et al (5), 5 required toe amputations with 1 eventually requiring a below-the-knee amputation because of necrotizing fasciitis.

We have also demonstrated additional complications of these isolated injuries, including a delay in medical treatment of 3.06 days, a mean length of hospital stay of 5.06 days, and more than one half of the patient population requiring a mean of 1.94 surgeries. Previous studies have shown delayed presentation, increased hospital stay, and increased surgical intervention compared with controls (1–3).

Our study was limited, because it was a retrospective case series with no control group and no statistical analysis performed. Also, our study population was gathered using diagnostic codes, and our follow-up data were limited. Despite these limitations, we have presented the largest case series of isolated diabetic foot burns to our knowledge.

In conclusion, we have demonstrated that most burn injuries in patients with diabetes are likely preventable with proper patient education and compliance. We have also demonstrated the severity of these isolated injuries. Within our population, we found a 45% infection rate, 15% amputation rate, delay in medical treatment of 3.06 days, and a mean length of hospital stay of 5.06 days. Also, more than one half of the patient population required a mean of 1.94 surgeries. It is of vital importance for the foot and ankle specialist to educate patients with diabetes and to acknowledge the severity of these seemingly minor foot injuries.

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Table

Mechanisms, severity, and outcomes of isolated diabetic foot burns

Variable	Value
Burn mechanism	
Grease	4 (12.12)
Immersion	12 (36.36)
Spill	5 (15.15)
Contact	9 (27.27)
Flame	3 (9.09)
Burn depth	
Superficial	2 (6.06)
Superficial partial thickness	12 (36.36)
Deep partial thickness	5 (15.15)
Full thickness	14 (42.42)
Interval to hospital presentation (d)	3.6 (0–32)
Length of hospital stay (d)	5.03 (0–22)
Surgical intervention	
Simple debridement	9 (27.27)
STSG	13 (39.39)
Flap	1 (3.03)
Amputation	5 (15.15)
Amputation rate	
Minor	3 (9.09)
Major	1 (3.03)
Wound infection	
Requiring oral antibiotics	3 (9.09)
Requiring intravenous antibiotics	12 (36.36)
OM	4 (12.12)
ARF	1 (3.03)
Pneumonia	1 (3.03)
Line infection	0
UTI	1

Abbreviations: ARF, acute renal failure; OM, osteomyelitis; STSG, split-thickness skin graft; UTI, urinary tract infection