Lower Extremity Burns Related to Sensory Loss in Diabetes Mellitus

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A chart review of 37 hospitalized patients with diabetes mellitus who received burn therapy showed that ten (27 percent) had preventable lower-extremity burns related to sensory loss. Most of these ten burns occurred from heat applied for self-care of diabetes, namely, from hot tap water, a hot moist compress, or a heating pad. These ten patients, compared with the other 27 diabetic burn patients, were more likely to be men younger than 45 years old, to have insulin-dependent diabetes, and to have been burned during self-treatment. These findings underscore the importance of injury-prevention educational efforts by physicians in cautioning their diabetic patients, especially those with lower-extremity sensory losses, about potential burns from heat applied to the lower extremities for self-care.

Diminished sensation from peripheral neuropathy and a resultant reduced sensitivity to heat would seem to predispose diabetic patients to a risk for thermal injury. Frequent exposure of the lower extremities to heat during diabetic self-care may provide additional risk for burns. Several textbooks on diabetes mellitus routinely caution about the risk of lower-extremity burns[1,2] but professional journals have not reported clinical reviews that document the occurrence of such burn injuries.

A chart review was conducted of all hospitalized diabetic patients receiving burn care during a 15-year-period in one Midwestern city to determine whether any burns were associated with peripheral neuropathy. Reported here are the findings of this review, including a summary of characteristics of diabetic patients who experienced these burns.

METHODS

The charts were reviewed of all hospitalized diabetic patients receiving burn wound care at four hospitals in Madison, Wisconsin, from May 1, 1970, through April 30, 1985. Three were community hospitals—St. Marys, Madison General, and Methodist Hospital—and the fourth was a tertiary care referral center, the University of Wisconsin Hospital and Clinics. Only the first admission for each burn was counted as a case, although all admissions were reviewed. Each patient's age, sex, race, the agent of burn, injury scenario with any environmental or host risk factors (including diabetic complications), location of injury on the body, percentage of burn surface area, length of hospitalization, and outcome were recorded.

Significance levels were calculated for two-by-two tables using the Fisher exact probability test and for continuous variables using the two-tailed Student's t test.[3]

RESULTS

There were 37 hospitalizations of individuals with diabetes mellitus who received burn treatment. Burn injury summary data and demographic characteristics are reported in Table 1. Twenty-seven diabetic patients (73 percent of the total cases) had burn injuries not associated with sensory loss. These 27 nonspecific burns resulted primarily from flame (15) and scalds from contact with hot substances (8). The burns were caused, for example, by house fires, outdoor trash fires, and scald burns from coffee and were typical of such injuries occurring in the general population. The diabetes may have prolonged the healing process, thereby lengthening the hospitalization.

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TABLE 1. HOSPITALIZED BURN PATIENTS WITH DIABETES MELLITUS

Patient Characteristics	Total	Lower-Extremity Sensory-Loss Burns	Nonspecific Burns	Significance (Fisher Exact) P
Male (%)	23(62.2)	9(90.0)	14(51.8)	<.03
Number ≤45 years old (%)	9(24.3)	6(60.0)	3(11.1)	<.01
Mean age ±SD, years	58.3 ± 18.0	44.3 ± 19.0	63.5 ± 14.9	<.01*
Insulin-dependent diabetes (%)	13(35.1)	8(80.0)	5(18.5)	<.01
Diabetic neuropathy (%)	12(32.4)	10(100.0)	2(7.4)	<.01
Length of hospitalization, days (range)	35.8(1–189)	19.8(3–46)**	36.4(3–146)***	NS*
Mean burn surface area, % (range)	14.5(1–90)	3.0(1–7)	18.8(1–90)	<.05*
Skin grafting required (%)	13(35.1)	1(10.0)	12(44.4)	NS
Burned from self-treatment (%)	8(21.6)	7(70.0)	1(3.7)	<.01
Total (%)	37(100.0)	10(27.0)	27(73.0)	

* Student's *t* test (2-tailed)
** n = 8 (see text)
*** n = 18

The remaining ten patients (27 percent of the total cases) had lower-extremity burns directly related to the diminished sensation associated with symmetrical diabetic neuropathy. Seven were burned by heat applied for diabetic self-care. Specifically, five burns were caused by hot tap water used in foot care (two of these cases were presented previously[4]), and two additional burns were caused by a hot moist compress or heating pad used to treat sores or cellulitis in the lower leg. The three remaining burns occurred from walking barefoot on a sandy beach or blacktop driveway or from warming feet near a campfire. Although their burn surface areas were relatively small (the mean was 3 percent, with a range of 1 to 7 percent), all ten patients required hospitalization, with a mean length of 19.8 days for eight of the ten cases. (The two remaining patients had truncated hospitalizations, with one committing suicide on day 15 after a renal transplant following initial burn treatment, and a second leaving the hospital against medical advice on the first day after refusing the recommended amputations involving both feet.) All cases were second-degree burns with blister formation, while three also had some third-degree burn area.

This subset of lower-extremity, sensory-loss burn patients differed in several ways from the diabetic patients with nonspecific burns. Almost all ten sensory-loss patients were male and relatively young. Most had insulin-dependent diabetes mellitus (IDDM), and most were burned from self-treatment. Their mean burn surface area was small.

CASE REPORTS

Patient 1. A 28-year-old man with IDDM of many years' duration had decreased sensory function in his feet because of distal diabetic neuropathy. In an effort at self-care he soaked his feet in hot water. Exposure time plus water temperature resulted in a second-degree scald burn to his left foot. During his ensuing 22-day hospitalization for burn treatment, he underwent amputation of the first and second toes on his left foot, with delayed primary flap closure.

Patient 2. A 32-year-old-man with IDDM had undergone a below-knee amputation of the right leg at age 29 years. His left leg now had decreased sensation distally. The patient used a hot moist compress to treat sores on his left foot, inadvertently causing a second-degree burn. Blisters developed on his foot over the first metatarsal-phalangeal joint and lateral malleolus. Slow wound healing necessitated a hospitalization of 46 days.

Patient 3. A 50-year-old man with poorly controlled IDDM of 18 years' duration and sensory loss associated with diabetic neuropathy walked on a blacktop driveway for ten minutes at midafternoon on a very hot day. He experienced no pain. His burns, discovered by his wife, consisted of both white and erythematous bullous lesions on his toes and the plantar surface of both feet. He was hospitalized for three days with these acute second- and third-degree burns. His discharge summary stated that long-term outpatient burn treatment would be required.

DISCUSSION

Burn injuries in diabetic persons have severe consequences. Once even a relatively small burn has occurred, the diabetic patient is likely to require much more medical attention than would a nondiabetic patient with a com-

parable burn. Burn infections are common. Microvascular disease often associated with diabetes results in poor healing responses and the development of ulcers.[5] Gangrene may occur, necessitating amputations. Even without the necessity for amputation, burns in diabetic patients may require long hospitalization, whereas a second-degree burn of 3 percent surface area in an otherwise healthy person would normally result in no hospitalization. While not typically a cause of mortality, diabetic neuropathy is often responsible for a great deal of morbidity and reduced quality of life.[6]

The burns associated with lower-extremity sensory loss, representing more than one fourth of the burns reviewed here, were probably preventable injuries. As most of the burns occurred from the prolonged application of heat during self-care, frequently from soaking in warm or hot water, educating diabetic patients about the danger of hot tap water and the inverse relationship between exposure time and water temperature may help prevent the type of burn injuries reported here.[4]

A diabetic individual with sensory loss in the lower extremity should check the water temperature before placing feet in bath water. Water temperatures of 60 to 65.6 °C (140 to 150 °F), commonly found in households,[7] cause full-thickness epidermal burns within 2 to 5 seconds.[8] Lowering the water temperature to 48.9 °C (120 °F) lengthens the time for causing full-thickness burns in normal adult skin to 10 minutes of exposure and thus has been recommended as providing passive protection against rapid scalds.[4,7] This temperature, however, may not be sufficiently low to provide burn protection to persons with diabetes or sensory loss from other causes,[9] especially to those who frequently use hot water soaking as a method of self-care. Since soaking, by definition, is lengthy submersion in water, the only way to lower the risk of a soaking burn is to lower the water temperature. A safe temperature for soaking is considered to be approximately 38 °C (100 °F). Some physicians strongly recommend against soaking the diabetic foot in any warm water.[1]

Individuals with diabetes also frequently use heating pads and other hot compresses either to diminish the cold-foot feeling that arises from the impairment of microvascular circulation or to treat ulcers or infections of the lower extremities, which are common in this disease. As a result, physicians should also warn their diabetic patients about these home-treatment methods as potential sources of significant burns.[2] Other risky practices, such as walking barefoot outside or warming cold feet by a fire, may likewise result in burns in persons with little or no peripheral sensation. Cautions about burns should be added when diabetic individuals are warned that walking barefoot may cause cuts.

The finding that the subpopulation of lower-extremity sensory-loss burn patients was almost exclusively a younger, insulin-dependent male group was unexpected. Distal symmetrical neuropathy also occurs in women, in the relatively old, and in diabetic patients without IDDM.[10] It is uncertain why, in this review, fewer diabetic patients in these categories were found to experience burn injuries associated with sensory loss. Perhaps younger male patients with IDDM, especially those with diabetic neuropathy and distal sensory loss, might benefit from increased counseling about the necessity for caution in their self-care efforts when the joint regulation of insulin, exercise, and diet is discussed.

In summary, preventable burns in diabetic individuals do occur. In much the same way that traditional diabetes education programs have contributed to lower hospital admissions for disorders of diabetic control,[11] perhaps a more focused injury-prevention educational effort might also lessen the use of health services by diabetic patients. Special educational efforts should be directed toward individuals with lower-extremity sensory loss. Specific topics to stress include the relationship between exposure time and temperature in burns, the danger of such common everyday substances as hot tap water, and the need for increased attention to foot problems and their safe treatment.

References

1. Rowbotham JL, Gibbons GW, Kozak GP: The diabetic foot. In Kozak GP (ed): Clinical Diabetes Mellitus. Philadelphia, WB Saunders, 1982, pp 215–228
2. Levin ME: Medical evaluation and treatment. In Levin ME, O'Neal LU (eds): The Diabetic Foot, ed 3. St. Louis, CV Mosby, 1983, pp 1–60
3. Colton T: Statistics in Medicine. Boston, Little, Brown, 1974
4. Katcher ML: Scald burns from hot tap water. JAMA 1981; 246: 1219–1222
5. Foster DW: Diabetes mellitus. In Petersdorf RG, Adams RD, Braunwald E, et al (eds): Harrison's Principles of Internal Medicine, ed 10. New York, McGraw-Hill, 1983, pp 661–679
6. Olefsky JM: Diabetes mellitus. In Wyngaarden JB, Smith LH Jr (eds): Cecil Textbook of Medicine, ed 17. Philadelphia, WB Saunders, 1985, pp 1320–1341
7. Feldman KW, Schaller RT, Feldman JA, et al: Tap water scald burns in children. Pediatrics 1978; 62:1–7
8. Moritz AR, Henriques FC Jr.: Studies of thermal injury: II. The relative importance of time and surface temperature in the causation of cutaneous burns. Am J Pathol 1947; 23:695–720
9. Feldman KW, Clarren SK, McLaughlin JF: Tap water burns in handicapped children. Pediatrics 1981; 67:560–562
10. Pincus JH: Neurologic complications of diabetes mellitus. In Schnatz JD (ed): Diabetes Mellitus: Problems in Management. Menlo Park, Calif, Addison-Wesley, 1982, pp 401–413
11. Scott RS, Brown LJ, Clifford P: Use of health services by diabetic persons. II. Hospital admissions. Diabetes Care 1985; 8:43–44