Preventable Wheelchair-related Thermal Injury

William Bull, MD¹; Michael Priebe, MD²; Gina Dillig, MD³; Diane Dado, MD^{2,4}

¹Plastic and Reconstructive Surgery, Loyola University Medical Center, Chicago, Illinois; ²Hines Veterans Administration Hospital, Hines, Illinois; ³Cook County Hospital, Chicago, Illinois; ⁴Loyola University Medical Center, Division of Plastic and Reconstructive Surgery, Loyola University Medical Center, Chicago, Illinois

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Abstract

Background/Objective: Wheelchair-related injuries are common, and with proper reporting of injuries, advanced technologic support may offer new ways to prevent those injuries.

Method: Case Report and Findings: A man with tetraplegia who retains only minimal use of his right hand experienced a right-sided armrest malfunction of his wheelchair resulting in his wheelchair controls being out of reach. This left him stranded in the sun for almost 2 hours in 86°F weather. During that time, he developed full thickness sunburns of his left forearm and deep partial thickness burns of the left fingertips where they were in contact with the left armrest.

Conclusion: This patient's full thickness burns could have been prevented if his motorized wheelchair had back-up communication in the event of a malfunction. Technology developers must realize the need for such systems. Health care professionals must advocate for a higher standard of safety and report injuries related to wheelchair malfunction.

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INTRODUCTION

The Food, Drug, and Cosmetic Act is administered by the US Food and Drug Administration (FDA). In 1976, a Medical Device Amendment was created to provide comprehensive federal safety regulations for medical devices such as wheelchairs (1). Clinicians are not required to report injury, but a voluntary reporting system called MedWatch is available (1). An estimated 36,000 wheelchair-related injuries requiring evaluation in the emergency department occurred annually in the United States from 1986 through 1992. However, the rates are on the rise each year, with 55,514 serious accidents/injuries necessitating emergency care in 1992 (2). In a study analyzing fatal wheelchair accidents in the United States, the cause and body system involved were noted. We found that 6.6% of deaths involved thermal injuries, and 8.8% of deaths were caused by injuries of the integumentary system (3).

Despite efforts to regulate safety and report faulty equipment contributing to serious injuries, persons with spinal cord injury and others with severe mobility

impairment are still sustaining morbidity related to technology failures. This case presentation satisfies two goals: to raise awareness of the need for technically advanced communication for persons with spinal cord injury and to warn others of the possible harm inflicted when wheelchair controls are out of reach.

CASE REPORT

The subject of this report is a man, 44 years of age, with right C5, left C4 spinal cord injury from assault and battery more than 20 years ago. He retained some function of his right arm and thumb but has complete paralysis of his lower extremities and left arm. He requires a chest restraint for upright sitting posture in his wheelchair. He is a nonsmoker and a nondrinker. For the previous 3.5 years, the patient had used a Storm Series wheelchair base and a La Bac (La Bac Systems, Highland Ranch, CO) tilt-in-space seating system. The wheelchair is entirely black (Figure 1).

During the first few days of summer, the patient decided to spend time outside exploring his neighborhood. On one outing, when he was a short distance from his apartment, the right armrest and the mounted joystick controls disconnected from the body of the wheelchair, leaving him without access to the wheelchair

Please address correspondence to William Bull, MD, 2160 S. 1st Avenue, Maywood, IL 60153; phone: 708.327.2365; fax: 708.327.2810 (e-mail: jb@dupageplastics.com).

Figure 1. The patient's wheelchair with joystick controls and chest restraint.

controls. The armrests on this seating system are held in place by a single bolt (Figure 2). Because of the limited movement of his right arm, he could not reach the controls and was stranded in the sun in 86°F weather. Without other means of communication, he continually called for help, which arrived 2 hours later.

He was initially seen in an emergency department where he was instructed to perform wet to dry dressing changes twice daily. This treatment continued at home for 1 month. When it became apparent that the wounds had not healed, he was evaluated for plastic surgery.

The patient presented to the outpatient plastic surgery clinic 1 month after the injury with 2 full thickness burns to his left dorsal volar forearm and deep partial thickness burns to his left fingertips. The volar proximal forearm burn measured 6×3.5 cm. The distal volar forearm burn measured 6×4 cm. The third, fourth, and fifth fingertips each had a 1- to 1.5-cm dry, black eschar. The burns occurred where the fingers had direct contact with the black armrest.

Both proximal and distal left forearm burns were debrided and grafted with a split thickness skin graft from the left thigh; the fingertips were allowed to heal by secondary intention. Figure 3 shows the extent of wound healing at 2 weeks after injury. At his 1-month post-operative visit, the graft had taken at both forearm sites, and the left fingertips were healing well (Figures 4 and 5).

DISCUSSION

In a study analyzing fatal wheelchair accidents in the United States, the cause and body system involved were noted. The authors found that 6.6% of deaths involved thermal injuries, and 8.8% of deaths were caused by the injuries of the integumentary system (3). Because of the black color of the armrests, the surface temperature was increased. In addition, the patient also had darkly pigmented tattoos on both arms, which may have

Figure 2. The patient's wheelchair armrest held on the chair with a single bolt. This armrest disconnected from the chair and left the patient without access to the controls.

increased the depth of the sunburn, but no literature validates this hypothesis. The tattoo on the immobile left arm measured 14×4 cm. Figure 6 shows the tattoo remaining on the right arm; the left tattoo was destroyed by the burn.

This patient was treated successfully with no long-term sequelae, but this injury was preventable. Before incurring the burns, this patient had experienced problems with his right armrest disconnecting. He had sought adjustments of his wheelchair through his occupational therapist. Each time, the clinicians could not find a specific problem with the chair that was causing the failure of the armrest. This particular armrest has been known to disconnect when improperly or incompletely connected to the chair, according to his therapists.

Figure 3. Full thickness burns on patient's left dorsal volar forearm from unprotected sun exposure.

Figure 4. Grafted forearm burns healing well at 1-month postoperative visit.

Intervention to educate the caregiver and warn those involved that this can happen was provided. Further intervention, including reporting the problem voluntarily to the MedWatch program (1), may have been appropriate. Reporting safety problems raises governmental awareness and is the first step in developing a solution. A recent trial suggests that routine maintenance of wheelchairs using a standardized checklist reduces accidents (4).

Because technology is not error-proof, back-ups should be available to patients who depend on it daily. Voice-operated communication would be an ideal solution. Wheelchairs with hands-free communication would allow patients to call for help when a problem arises. A modified hands-free cellular phone could also be

Figure 5. Fingertips initially burned where they had direct contact with black armrest were healing well at 1-month postoperative visit.

Figure 6. Tattoo on patient's right arm. The tattoo on the left immobile arm was destroyed by the burn.

a solution. A monitoring system might be instituted to alert caregivers when a patient needed help. This case report underscores the need for technology providers to consider the use of voice-activated communication systems, such as the MedAlert system, for their patients in wheelchairs. As patient care providers, one of our goals is to prevent and treat injuries. As technology applications increase, safety considerations must receive greater attention.

CONCLUSION

This case of thermal injury in a wheelchair user with tetraplegia could have been prevented with the addition of a hands-free communication system to alert his caregiver of his situation. Wheelchair-related injuries are on the rise according to the FDA, and the numbers reported most likely underrepresent the total injuries incurred (2). Reporting patient injuries related to wheelchairs is imperative because it stimulates awareness of necessary safety features and improved regulation.

REFERENCES

1. Kirby RL, Ackroyd-Stolarz SA. Wheelchair safety-adverse reports to the United States Food and Drug Administration. *Am J Phys Med Rehabil.* 1995;74:308-312.

2. Ummat S, Kirby RL. Nonfatal wheelchair-related accidents reported to the national Electronic Injury Surveillance System. *Am J Phys Med Rehabil.* 1994;73:163–167.
3. Calder CJ, Kirby RL. Fatal wheelchair-related accidents in the United States. *Am J Phys Med Rehabil.* 1990;69:184–189.
4. Hansen R, Tresse S. Fewer accidents and better maintenance with active wheelchair check-ups: a randomized controlled clinical trial. *Clin Rehabil.* 2004;18:631–639.
5. Belcher M, Frank A. Survey of the use of transport by recipients of a regional electric indoor/outdoor powered wheelchair service. *Disabil Rehabil.* 2004;26:563–575.
6. Corfman T, Cooper RA, Fitzgerald SG, Cooper R. Tips and falls during electric-powered wheelchair driving: effects of seatbelt use, leg rests, and driving speed. *Arch Phys Med Rehabil.* 2003;84:1797–1802.
7. Cooper R, Rentschler A. Wheelchair armrest strength testing. *Assist Technol.* 2000;12:106–115.
8. Kirby RL, Smith C. Fall during a wheelchair transfer a case of mismatched brakes. *Am J Phys Med Rehabil.* 2001;80:302–304.
9. Kirby RL, Lugar JA, Breckenridge C. New wheelie aid for wheelchairs: controlled trial of safety and efficacy. *Arch Phys Med Rehabil.* 2001;82:380–390.
10. Van Roosmalen L, Bertoci GE, Hobson DA, Karg P. Preliminary evaluation of wheelchair occupant restraint system usage in motor vehicles. *J Rehabil Res Dev.* 2002;39: 83–93.