Outcome for Older Burn Patients

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Background: Physicians will be increasingly responsible for an aging society whose members demonstrate a notable striving for independence.

Hypothesis: With standard treatment of burns, older patients will have a survival rate of more than 70%, with at least 60% of patients becoming fully functional 6 months after hospital discharge.

Methods: A 7-year retrospective medical record review of burn unit patients was performed, and 221 (11%) of 1957 patients who were at least 59 years old were identified.

Results: Of 97 women (44%) and 124 men (56%), 64 (29%) had an associated smoke inhalation injury; 146 (66%), flame injury; and 44 (20%), scald injury. The bedroom and/or living room were the most common areas of injury (90 [41%]), followed by outdoors and the workplace (62 [28%]), the kitchen (40 [18%]), the bathroom (18 [8%]), and the garage or basement (11 [5%]) (P < .005). One hundred twenty-six injuries (57%) were associated with impaired judgment, mobility, or both. On hospital admission, 74 patients (36%) were intubated, 60 (30%) required intubation postoperatively, and 34 (18%) required both. The survival rate was 159 patients (72%) overall. Findings from an ethanol screening and a drug toxicology screening were positive in 22 and 32 patients (10% and 29%) on admission, respectively. Of the survivors, most were discharged to home with (87 [64%]) or without visiting nurse supervision, and at 6 months after discharge, 16 patients (30%) in transitional care facilities were able to return to an independent level of functioning. Of the 59- to 69-year-old age group, 83 (86%) survived compared with 59 (69%) in the 70- to 79-year-old age group and 18 (47%) in the 80 years and older age group.

Conclusions: In contrast to the usual male preponderance in patients with thermal injury, older women, many of whom are widowed, constituted almost half of the older patients admitted to the hospital. Modalities for injury prevention are necessary to provide optimal and safe household environments for a growing population of older persons.


As we approach the 21st century, US physicians are encountering increasingly older patients who demonstrate a considerable striving for independence. The advent of sophisticated technology has challenged traumatologists to tailor patient resuscitation according to individual needs. Therefore, special consideration of aggressive treatments relating to patient outcomes needs to be addressed since the number of older patients admitted to hospitals is a reflection of the population. Previous studies related to the outcomes of older patients with trauma have been reported in which small percentages of patients with burn injuries were included but often subsequently excluded owing to complex resuscitation issues.

Surgeons caring for older patients with burn injuries have a spectrum of treatment regimens ranging from conservative resuscitation and prolonged wound care to aggressive treatment with extensive hemodynamic monitoring in conjunction with early excision and skin grafting. In a recent overview, the poor outcome of older patients with burn injuries was among the burn issues to be addressed in the new millennium. The general belief is that older people with large burns do not do well even with the resuscitative measures and technologies currently available. This epidemiologic study was initiated to define the characteristics, mortality, and functional outcomes of older burn unit patients since our medical center has provided aggressive resuscitation and care for the older population.
SUBJECTS, MATERIALS, AND METHODS

STUDY POPULATION

A 7-year retrospective medical record review was conducted on all burn unit patients who were at least 59 years old at the time of admission to Loyola University Medical Center Burn Unit in Maywood, Ill (April 1, 1991–December 31, 1997). The study population consisted of 221 (11%) of 1957 patients who were admitted to the burn unit during that period.

BURN CARE

Burn unit patients were resuscitated according to the Parkland formula guidelines and treated with occlusive silver sulfadiazine–embedded gauze dressings initiated at the time of hospital admission and then twice daily until either the wounds healed or surgical intervention was begun. On hospital admission, levels for arterial blood gases and carbon monoxide hemoglobin were measured, chest x-ray films were obtained, and flexible fiberoptic bronchoscopy was performed in patients suspected of having smoke inhalation injury, which was diagnosed by carbon monoxide levels measuring higher than 15% and/or by positive findings from bronchoscopy. Within 48 hours of admission, patients received continuous enteral nutritional support or a supplemental hospital diet formulated on basal energy expenditure with incremental energy input determined by body weight and burn size. In the event of a clinical presentation of an infection or sepsis, empiric treatment with antibiotics was initiated until definitive culture findings and sensitivities were obtained. The diagnosis of infection was based on findings from blood and urine analysis or from cultures of wound or bronchoscopy specimens, and appropriate antibiotic therapy was commenced based on the final culture results. The patients who required wound debridement and skin grafting procedures were taken to the operating room when they were hemodynamically stable to minimize the time of burn-wound exposure and contamination. Patients did not receive glucocorticoids or heparin.

MECHANISM OF INJURY

One common theme among the general burn population was related to the mechanism of injury. Subject profiles suggested that many injuries occurred as a result of impaired judgment and/or mobility and were indeed preventable in nature given the environment in which the older patients resided. Impairment of judgment was defined on admission as clinical manifestations of Alzheimer disease, other dementia, or inebriation prior to injury. Impairment of mobility was determined if the patient had paralysis, limb amputations, wheelchair dependency, or mobility-limiting arthritis; these all affected the patients’ ability to evacuate the area in which the injury occurred. The bedroom and living room areas were combined because of the common mechanism of injury in these areas: smoking and falling asleep. In addition, one room served as both a bedroom and living room for many patients.

FUNCTIONAL OUTCOMES AT HOSPITAL DISCHARGE

Functional outcome at hospital discharge was defined as patient status at the time of release from the burn center. Patients were stratified into 1 of 4 functional outcome groups. Patients in group 1 had an independent level of function, sustained a small percent total burn surface area (% TBSA) injury, and were discharged to home to be cared for by relatives or friends, with a clinic visit scheduled within 1 or 2 weeks of discharge. Patients in group 2 were independent, needing temporary intervention from health care resources at home. These patients required short-term home intervention, such as a visiting nurse. Meals on Wheels, or physical or occupational therapy for 1 to 3 months until the patient was able to manage independently. Patients in group 3 were discharged to transitional care facilities, such as an assisted living center, an acute care rehabilitation center, a Veterans Affairs hospital, or a ventilator facility that provided structured care. These facilities provided special rehabilitative services for wound care that could not be performed at home until the patient demonstrated a manageable level of functioning conducive to the home environment. Patients in group 4 were not able to return home because they required extensive or total care and were released to a skilled care facility or nursing home.

STATISTICAL ANALYSIS

Data were analyzed using a computer program (Statistica; STATSOFT, Tulsa, Okla) for descriptive and basic statistics. The study population was analyzed as a whole and in groups by % TBSA (<19% TBSA, 20%-39% TBSA, and ≥40% TBSA), by age (59-69 years, 70-79 years, and ≥80 years), and by functional outcome (groups 1-4). The mean ± SDs, median, analysis of variance, 1-way analysis of variance, t test, and χ² 2 × 2 summary frequencies (Pearson product moment correlation and maximum likelihood χ²) were calculated. The data were distributed normally when categorized by decade or % TBSA in either a raw or log-linear analysis. P < .05 was considered significant.

RESULTS

GENERAL PATIENT CHARACTERISTICS

As a whole, the older burn population had a mean ± SD age of 71 ± 9 years (median, 71 years) with an 18% ± 19% TBSA (median, 10% TBSA). There were 97 women (44%) and 124 men (56%). One hundred forty-six injuries (66%) were caused by flame or flame explosion; 44 (20%), scalding; 5 (2%), chemicals; 13 (6%), electrical fires; and 13 (6%), other causes. In order of decreasing occurrence, 90 accidents (41%) took place in the bedroom and/or living room; 62 (28%), outdoors or the workplace; 40 (18%), the kitchen; 18 (8%), the bathroom; and 11 (5%), the garage or basement. Contributing factors to these accidents were impaired judgment (n = 47 [21%]); mobility restraints or constraints (n = 35 [16%]); and impairment of both judgment and mobility (n = 44 [20%]); however, 95 patients (43%) had no impairment. The head, upper torso, or upper extremities were involved in 110
burns (50%); the lower extremities or torso, 35 (16%); and both body regions, 76 (34%). One hundred seventy patients (77%) had 1 or more preexisting medical conditions, such as heart disease or diabetes, on hospital admission.

Older individuals have a higher incidence of poor prognosis with burns. The selection criteria for burn resuscitation in our study depended on the age of the patient, % TBSA, presence of smoke inhalation injury, findings from cardiac evaluation if found asystolic, and level of consciousness observed at the scene and at the hospital. For example, an 80-year-old patient with 80% TBSA, smoke inhalation injury, and asystole at the scene or hospital would not be resuscitated but provided with comfort measures. In unclear situations, the patients were resuscitated for 48 hours, during which time they were evaluated for further treatment. Patients who died within 1 to 3 days after admission were 71 ± 9 years old with 26% ± 32% TBSA, and 17 (28%) had smoke inhalation injury. The mean ± SD age for patients hospitalized for 4 to 7 days was 71 ± 9 years; mean % TBSA, 14% ± 16%; and 13% of patients had smoke inhalation injury. Patients who survived for longer than 8 days were 72 ± 8 years old with 16% ± 14% TBSA, and 36 (59%) had smoke inhalation injury.

Smoke inhalation injury was present in 64 patients (29%) who had ventilatory support lasting 13 ± 15 days (median, 5.5 days). Twenty patients (31%) who had smoke inhalation injury survived for 3 days or less; 12 (19%) died within 3 to 7 days. Of the patients with smoke inhalation injury in this study, 29 (45%) survived and were discharged. Seven patients (3%) had smoke inhalation injury without a burn injury, and only 3 survived. Seventy-four patients (36%) required intubation on admission for airway protection and oxygenation. Regarding smoke inhalation injury and/or perioperative airway management, 60 patients (30%) required postoperative intubation; of these, 26 (13%) had smoke inhalation injury. The others required postoperative intubation for situations such as residual anesthesia effects, generalized edema, intraoperative fluid load, airway patency, or transient support for optimal oxygenation. Thirty-four patients (18%) required preoperative and postoperative intubation. These patients usually had smoke inhalation injury, which was compounded by the effects of surgery and anesthesia, or lowered cardiac thresholds. There was a significant correlation between preoperative and postoperative intubation and smoke inhalation injury ($P<.001$). One hundred forty-one patients (77%) had 1 or more preexisting medical conditions, such as heart disease or diabetes, on hospital admission.

Findings from toxicology screenings were positive for serum ethanol (ETOH) in 22 patients (10%) of the study population. There was a significant correlation between ETOH presence and impairment of judgment and mobility ($P<.01$), as would be expected; this also reflected a significant association with % TBSA ($P<.001$). Mean ETOH serum levels were 27.6 ± 17.2 mmol/L. There was no significant correlation between ETOH presence and age by decades, sex, other drugs, infection, or mortality. Findings from toxicology screenings were positive for marijuana, cocaine, or benzodiazepines in 32 (29%) of 114 patients.

Sixty-nine patients (31%) of the study population had an infection in the hospital, of which 13 (19%) had 1 or 2 infections and 8 (12%) had 3 or more. Patients were at highest risk for urinary tract infections, which occurred secondary to catheterization prior to or at admission. The lengthier the hospitalization, the higher the risk of acquired infections such as urinary tract infection, pneumonia, sepsis, and wound infections. Ninety-five patients (37%) received mechanical ventilation did not develop an infection; 11 (18%) had 1 to 2 infections; 10 (16%), 3 to 4; and 5 (8%), 5. Multifactorial parameters such as infection, multiple-organ failure, and premorbid cardiopulmonary conditions contributed to mortality.

The mean ± SD number of grafting procedures was 1 ± 1 per hospital stay. Seventy-nine patients (46%) of the total study population did not require any surgery; of these, 50 (63%) survived. As soon as they were hemodynamically stable (frequently on the second or third day after admission) patients were taken to the operating room. If tolerated, as large an area of the TBSA as possible was debrided and/or excised. The purpose was to decrease hospital exposure and ensuing complications. Of the 92 patients (54%) who required surgery and who had second- and third-degree burns, 54 (32%) underwent 1 grafting procedure; 23 (14%), 2; 9 (5%), 3; and 4 (3%), 4 or 5. Eighteen (11%) of those who underwent grafting procedures did not survive; most patients in this group had either 1 or 2 surgeries. The overall length of hospitalization was 19 ± 22 days (median, 14 days), and the overall mortality rate was 28% (n = 62).

**PATIENT CHARACTERISTICS ANALYZED BY % TBSA**

**Table 1** gives the patient characteristics in relation to % TBSA. Most patients were in the <19% TBSA group, with an 18% frequency of smoke inhalation injury (n = 27) and an 86% survival rate (n = 130), which dropped off sharply with increased age. There was a statistically significant correlation between % TBSA and smoke inhalation injury ($P = .001$): 27 patients (18%) in the <19% TBSA group had smoke inhalation injury, whereas more than 15 patients (56%) of the ≥40% TBSA group had smoke inhalation injury. We explored whether there was any relationship between the extent of the burn and the patient’s living arrangement (alone or with others, married, single, or homeless); the patients were burned to varying degrees regardless of how many or how few people lived with them. Another way of searching for this relationship would be to survey patients on hospital admission as to whether others were present at the place of injury and had helped the victims put out the fire. There was no significant correlation between % TBSA and social status, living arrangements, number of comorbid medical conditions, impairment of judgment, and mobility.

**PATIENT CHARACTERISTICS ANALYZED BY AGE**

Analyzing the population from the perspective of age, **Table 2** demonstrates that most patients were aged 59
to 69 years, the median age was 64 ± 3 years, and the highest number of smoke inhalation injuries occurred in the 70- to 79-year-old age group.

If patient ages were analyzed by decade, a significant survival advantage was present in the younger patients compared with those who were aged 80 years or older ($P < .001$). Of 97 patients aged 59 to 69 years, 83 (86%) survived; of 86 patients aged 70 to 79 years, 59 (69%) survived; and of 38 patients aged 80 years or older, 18 (47%) survived. There was a statistically significant difference between sex and age by decade, with the 59- to 69-year-old age group comprising 66% men ($n = 64$), the 70- to 79-year-old age group having fairly equal sex distribution, and the 80 years or older age group comprising 63% women ($n = 24$) ($P < .01$). There was no significant correlation between the number of comorbid medical conditions, the number of infections, mortality, impairment of judgment and mobility, discharge status, age by decade, type or mechanism of injury, or smoke inhalation injury.

**PATIENT CHARACTERISTICS ANALYZED BY FUNCTIONAL OUTCOME**

Table 3 gives the discharge parameters for the burn unit patients. At discharge, 83 (42%) of all of the patients were in groups 1 and 2. These patients underwent no surgery ($n = 42$ [50%]) or 1 surgical procedure ($n = 33$ [40%]). Psychosocial findings indicated that 88 patients (44%) were married, 60 (30%) were widowed, and 52 (26%) were single or divorced. Of the married survivors discharged from the hospital, 63 (93%) returned to their spouse. Widowed patients stayed either alone ($n = 26$ [58%]) or with family ($n = 17$ [38%]). Of the widowed, 15 (47%) required a transitional or skilled care facility. Twenty-five (66%) of single or divorced patients stayed alone, 10 (26%) stayed with family, and 3 (2%) had either a friend or caretaker arrangement. Of the survivors, 47 (36%) were able to return home, 36 (27%) were independent but required minimal additional allied health services, 31 (23%) went to a transitional facility such as a ventilatory facility or a Veterans Affairs hospital, and only 17 (13%) required permanent skilled nursing care. In addition, most patients who went home independently or with minimal health service requirements had no impairment of judgment or mobility. When both impairment of judgment and mobility were present, worse outcomes correlated with more serious injury, and the patients were not as likely to return to their preinjury functional level. Of the 24% of all of the patients with no preexisting medical conditions, 30 (86%) went home not re-
Table 3. Patient Characteristics by Functional Outcome at Hospital Discharge

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group 1, Independent (n = 47)</th>
<th>Group 2, Independent With Temporary Health Care Intervention (n = 36)</th>
<th>Group 3, Transitional Care Facility (n = 31)</th>
<th>Group 4, Skilled Care Facility (n = 17)</th>
<th>Died (n = 69)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>67 ± 6 (66)</td>
<td>69 ± 7 (69)</td>
<td>73 ± 8 (73)</td>
<td>75 ± 8 (77)</td>
<td>75 ± 9 (74)</td>
</tr>
<tr>
<td>M/F, %</td>
<td>68/32</td>
<td>50/50</td>
<td>39/61</td>
<td>53/47</td>
<td>53/47</td>
</tr>
<tr>
<td>Positive findings from toxicology screening, %</td>
<td>22</td>
<td>22</td>
<td>29</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Smoke inhalation, %</td>
<td>16</td>
<td>3</td>
<td>19</td>
<td>7</td>
<td>55</td>
</tr>
<tr>
<td>Length of ventilation, d</td>
<td>4 ± 4 (2)</td>
<td>6 ± 8 (2)</td>
<td>23 ± 15 (23)</td>
<td>9 ± 9 (6)</td>
<td>13 ± 17 (4)</td>
</tr>
<tr>
<td>Total burn surface area, %</td>
<td>7 ± 6 (7)</td>
<td>11 ± 10 (7)</td>
<td>14 ± 11 (11)</td>
<td>20 ± 20 (14)</td>
<td>33 ± 26 (28)</td>
</tr>
<tr>
<td>Length of hospitalization, d</td>
<td>10 ± 9 (8)</td>
<td>20 ± 17 (8)</td>
<td>37 ± 25 (31)</td>
<td>26 ± 16 (23)</td>
<td>14 ± 16 (7)</td>
</tr>
<tr>
<td>Comorbidity, %</td>
<td>58</td>
<td>66</td>
<td>89</td>
<td>97</td>
<td>89</td>
</tr>
<tr>
<td>Infection, %</td>
<td>61</td>
<td>63</td>
<td>89</td>
<td>95</td>
<td>73</td>
</tr>
<tr>
<td>No. of surgeries (range, 0-5)</td>
<td>0.5 ± 0.7 (0)†</td>
<td>1.0 ± 1.0 (0)</td>
<td>1.5 ± 1.0 (1.0)</td>
<td>1.0 ± 1.0 (1.0)</td>
<td>1.0 ± 1.0 (0)</td>
</tr>
</tbody>
</table>

*Values are given as mean ± SD (median) except where indicated. Comorbidity indicates 1 to 5 preexisting medical conditions.
†The minimum and maximum range for surgeries was 0 to 2.

Table 4. Relation of Survival to Smoke Inhalation

<table>
<thead>
<tr>
<th>Survived (Smoke Inhalation)</th>
<th>No. (%)</th>
<th>Age, y</th>
<th>Total Burn Surface Area, %</th>
<th>Length of Hospitalization, d</th>
<th>Length of Ventilation, d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes (Yes)</td>
<td>29 (13)</td>
<td>71 ± 7</td>
<td>12 ± 14</td>
<td>26 ± 26</td>
<td>17 ± 13</td>
</tr>
<tr>
<td>No (Yes)</td>
<td>34 (15)</td>
<td>75 ± 9</td>
<td>37 ± 29</td>
<td>11 ± 12</td>
<td>10 ± 12</td>
</tr>
<tr>
<td>Yes (No)</td>
<td>131 (58)</td>
<td>70 ± 8</td>
<td>12 ± 12</td>
<td>21 ± 23</td>
<td>8 ± 10</td>
</tr>
<tr>
<td>No (No)</td>
<td>27 (15)</td>
<td>76 ± 8</td>
<td>28 ± 20</td>
<td>18 ± 20</td>
<td>17 ± 23</td>
</tr>
</tbody>
</table>

*Values given as mean ± SD except where indicated.

Table 4 demonstrates that most patients who survived (n = 131 [58%]) were younger, had no smoke inhalation injury, and the lowest % TBSA (11% ± 10%). Patients with smoke inhalation injury who survived (n = 29 [13%]) had a lower % TBSA compared with those who died, and the longest length of hospitalization (25 ± 26 days).

**COMMENT**

Since the early 1980s, demographics of older patients in the burn population have been delineated, and preventive measures have been published: “Don’t cook with sleeves;” “Don’t smoke in bed;” “Lower the temperature of the water heater.”12-14 To date, the only global recommendation publicized, but not always followed (especially in group homes or apartments), is to decrease the temperature of water heaters. Chairs, grab bars, and rubber mats have also been recommended for the shower and tub areas, as mobility issues become a fact of life with age.

Early surgical excision, wound debridement, and skin grafting have been recommended for patients with burns to decrease complications, infections, and hospital stay, although survival has not always been improved for these patients.15-18 Just as infants go through developmental phases in mastering locomotion and full use of all senses, older people develop a slow, subtle deterioration of their capacities, which may impede their ability to function but does not incapacitate them.19 Several reports20-22 have shown that at least 25% of patients who survive burn injury are able to maintain an independent lifestyle.

This study has demonstrated that aggressive burn care results in a 72% survival rate (n = 159) in the older population. Burn resuscitation and early surgical inter-
vention between days 2 and 5 were initiated as tolerated by the patient to limit the number of procedures and the length of hospitalization. This affected not only the chance of survival but also the quality of life for older patients with burn injuries as function was preserved and complications were minimized. As would be expected, the surviving patients were younger, had no smoke inhalation injury, a smaller % TBSA, shorter lengths of hospitalization, and were more likely to maintain independence on discharge. There was a subset of the surviving 70- to 79-year-old age group of approximately 15% who had 20% to 40% TBSA, smoke inhalation injury requiring mechanical ventilation, and increased length of hospitalization; they required transitional or skilled care on hospital discharge. The bedroom and/or living room were significant as these rooms were most frequently the location of injury occurrence in all age groups. Most younger patients were married and lived with a spouse compared with the older patients. Among the older survivors, a greater reliance on transitional and skilled care facilities resulted in a significantly less likely outcome of an independent lifestyle. This group of patients experienced the ongoing need for a high level of support for months after their injury. Approximately half of the older population were women, many of whom were widowed and living alone. In contrast, the older men were usually married and living with their spouse while some were single and/or divorced or homeless.

Because human longevity has been enhanced in recent years, patients should be given every opportunity to recover from a thermal injury with as few disabilities as possible. The health care, legal, and social aspects of the following paradigms should be studied further: older women living alone and impairment of mobility issues owing to preexisting medical conditions. Optimal and safe living environments for a growing older population are necessary for injury prevention.

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