International Surgery Journal
Alhaj SS et al. Int Surg J. 2025 Aug;12(8):1358-1363
http://www.ijsurgery.com

pISSN 2349-3305 | eISSN 2349-2902

DOI: https://dx.doi.org/10.18203/2349-2902.isj20252291

Case Report

Survival from an 87% total body surface area burn: a case report and literature review

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Received: 01 July 2025
Accepted: 19 July 2025

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ABSTRACT

The presented case examines the survival of a 22-year-old male with 87% total body surface area (TBSA) burns from a diesel tank explosion with rare and life-threatening injury with historically high mortality. We analyze critical interventions, complications and outcomes while reviewing literature on extensive burn management. A 20-year-old male presented with 87% TBSA superficial second and third degree burns from a diesel tank explosion. Initial assessment revealed hypertension (134/89 mmHg), respiratory rate of 47 bpm. Emergency management included intubation, fluid resuscitation (Ringer's lactate), escharotomies, and vasopressor support. ICU admission was complicated by disseminated intravascular coagulation (DIC), sepsis, and multi-organ dysfunction. The patient received resuscitation with 4 liters of crystalloids over 24 hours, guided by urine output to maintain levels above 0.6 mL/kg/hr. Patient was intubated. Surgical interventions included serial debridement, split-thickness skin grafting, and a tracheostomy performed on day 11. Infection control measures involved the use of colistin and a combination of meropenem and caspofungin, which were later adjusted in response to gram-negative sepsis. Supportive care consisted of mechanical ventilation, fresh frozen plasma transfusions, and careful management of electrolytes. The patient stabilized after 8 months, with gradual improvement in organ function. Discharge included specialist surgical (hand/plastic surgery clinics) follow-up. Survival in >87% TBSA burns remains rare but achievable with aggressive resuscitation, early excision, infection control, and multidisciplinary care. This case highlights evolving burn management strategies, though long-term disability and ethical considerations persist.

Keywords: Burns, Survival, Resuscitation, Sepsis, Skin grafting

INTRODUCTION

Burns are among the most devastating injuries, causing approximately 180,000 deaths annually-primarily in low- and middle-income countries WHO, 2023 stated. Non-fatal burns also carry a heavy toll: extended hospital stays, disfigurement, and lasting disability.[1] Historically, burns over 50% TBSA have mortality rates exceeding 80%; above 80% TBSA, survival is exceedingly rare.[2] The global burden is massive: India sees over 1 million moderate to severe burns yearly; Bangladesh, 173,000 pediatric cases.[1,3] In the U.S., 410,000 burn injuries were recorded in 2008, with 40,000 hospitalizations and average care costs per patient reaching $88,218-some exceeding $700,000.[1] Burn risk reflects entrenched structural vulnerabilities critically concentrated among young girls and children in LMICs-where open-flame cooking at floor level, gendered domestic roles, and unsafe housing converge with minimal regulation.[4-6] These risks are not incidental but embedded in poverty, gender norms, and cultural practices, such as postnatal hot-water bathing and convulsion treatment with fire. The home, often presumed a place of safety, is the site of 84% of pediatric burns, usually in kitchens where children are left unsupervised.[5] It shows systemic neglect and calls for the need for intersectional, culturally informed prevention strategies beyond standard safety messaging. We present a patient who survived 87% TBSA burns are a nearly unprecedented outcome. This patient's survival relied on aggressive fluid resuscitation, early debridement, and skin grafting as well as infection control targeting *Pseudomonas* and *Staphylococcus*, which is linked to 75% of burn sepsis deaths. Beyond survival, we question the ethical, clinical and economic implications in settings where 18% of survivors face disability and paraffin burns alone cost South Africa $26 million annually.[6]

CASE REPORT

A 20-year-old male sustained extensive burns involving approximately 87% of his TBSA following a diesel tank explosion. He was admitted in critical condition and underwent immediate fluid resuscitation using the Parkland formula, with an estimated 22,400 mL of Ringer's lactate administered over the first 24 hours-5,500 mL in the first 8 hours and another 5,500 mL over the next 12 hours-to prevent hypovolemic shock. Serial debridement procedures and a tracheostomy were performed as part of his acute burn care. A tracheostomy had been placed on August 18, 2023. Initially, he showed signs of stabilization and was stepped down from intensive surgical care. Figure 1 illustrate the extent of full-thickness burns upon initial presentation, demonstrating widespread injury involving approximately 87% of TBSA. Laboratory findings obtained 24 hours after admission are summarized in Table 1.

Figure 1 (A-D): The extent of full thickness burns upon initial presentation.

Table 1: Key laboratory investigations-day 1 post-admission.

Tests	Value	Normal range
Hematology		
Hemoglobin	9.3 g/dl (Low)	13.5-17.5 g/dl
White blood cell count	$14.7\times10^3/\mu l$ (High)	$4\text{-}11\times10^3/\mu l$
Platelet count	$63\times10^3/\mu l$ (Low)	$150\text{-}450\times10^3/\mu l$
Coagulation panel		
INR	1.59 (High)	0.8-1.1
Renal function and electrolytes		
Serum urea	11 mg/dl	6 to 24 mg/dl
Serum creatinine	0.78 mg/dl	0.7 to 1.3 mg/dl/l
Sodium (Na^+)	154 mEq/l (High)	135×145 mEq/L
Potassium (K^+)	4.2 mmol/l	3.6×5.2 mmol/l
Inflammatory markers		
C-reactive protein	161.7 mg/l (High)	Less than 0.3 mg/l
Procalcitonin	6.51 (High)→ 9.23 (High)→14.47 ng/ml (High)	Less than 0.05 ng/ml

On August 29, 2023, the most recent of several debridement procedures was performed. Figure 2 show the patient's wounds following serial debridement and skin grafting, indicating early stages of healing. Passive physiotherapy was initiated to maintain joint mobility and prevent contractures. Ongoing care focused on infection control, respiratory stabilization, wound management, and nutritional optimization.

Figure 2 (A and B): The patient's wounds following serial debridement and skin grafting.

In the following days, his condition began to deteriorate again. He became increasingly unwell, showing clinical signs of sepsis including greenish wound discharge and thick, yellow tracheal secretions. A respiratory panel confirmed *Pseudomonas aeruginosa* infection, and laboratory investigations revealed deranged liver function tests. The infectious disease team was consulted, and antimicrobial therapy was escalated to include colomycin (initiated on September 1, 2023), followed by meropenem and caspofungin (started on September 5, 2023). Despite these interventions, his respiratory function worsened, culminating in critically low oxygen saturations and failure to respond to manual ventilation. He required re-intubation, initiation of mechanical ventilation, and transfer back to the medical intensive care unit.

On reassessment, his Glasgow coma scale (GCS) score was 11: he was alert, with spontaneous eye opening and purposeful limb movements, but nonverbal. Pupils were equal and reactive. A general physical exam revealed widespread wound coverage and marked icterus. Hemodynamically, he remained stable without vasopressor or inotropic support, with a blood pressure of 134/89 mmHg and a pulse rate of 112 bpm. Despite being on high-flow oxygen, his SpO_2 dropped to 85%, suggesting progressing hypoxia. Bilateral reduced air entry at the lung base raised concern for ongoing infection or evolving acute respiratory distress syndrome (ARDS).

At ICU admission, he remained intubated and ventilator-dependent with a FiO_2 of 80%. He had a right subclavian central venous catheter (CVC) that had been in place for 15 days. Laboratory results showed elevated inflammatory markers, coagulopathy, and worsening liver enzymes, although renal function remained stable. He was clinically hypothermic with cold extremities but had equal air entry bilaterally. Ongoing management included broad-spectrum antibiotics, enteral nutrition, burn-protocol fluid management, and aseptic wound care. Despite persistent tachycardia, he remained afebrile and did not require vasopressor support.

In the days that followed, his respiratory condition remained fragile with minimal improvement. A repeat chest X-ray demonstrated bilateral infiltrates, suggesting worsening infection or ARDS. Lung-protective ventilation was maintained with FiO_2 adjusted to keep SpO_2 at or above 92%. Sedation was initiated to improve oxygenation and comfort. Given ongoing systemic inflammation, two additional sets of blood cultures were collected to evaluate for persistent or secondary infection. As part of sepsis protocol, plans were made to replace the existing CVC. Mean arterial pressure remained consistently above 65 mmHg without vasopressors, and nutritional support was continued enterally. Although the patient remained ventilator-dependent, there was cautious optimism for respiratory recovery and eventual weaning. His clinical course suggested a fragile but stable condition.

By the time of discharge, the patient was afebrile, clinically stable, and tolerating enteral feeds. His respiratory function had improved, although he remained under tracheostomy, with plans in place for gradual weaning. Wound healing was progressing with regular dressing changes, and his overall hemodynamic profile was preserved. He was transferred to a step-down rehabilitation facility for ongoing multidisciplinary care, including physical, nutritional, and psychological rehabilitation following his severe injury and complex ICU course.

DISCUSSION

Our patient in this case received 87% TBSA burns, a potentially fatal injury that required prompt, well-coordinated critical care. In the initial hours of care, it was essential to start lung-protective breathing, preserve the airway, and perform early fluid resuscitation using the Parkland formula. The patient experienced respiratory impairment, coagulopathy, and sepsis, which was confirmed by *Pseudomonas aeruginosa*, as is typical with burns this severe.

The patient needed continuous wound care, sedation, and nutritional support during the intensive care unit stay. He maintained his hemodynamic stability and maintained his renal function despite several obstacles. The requirement for ongoing infection control and ventilatory support was brought to light by the development of his chest imaging and inflammatory markers. This case exemplifies the complexities of managing severe burns, as well as the importance of early intervention, daily reassessment, and long-term rehabilitation and recovery planning.

The survival of patients with extensive burns exceeding 80% TBSA remains rare but increasingly documented for advances in intensive care, early surgery and use of antimicrobial strategies. This is illustrated in several reports as shown in Table 2.

Gomez et al have documented full recovery in a young adult with 92% TBSA burns following early debridement, skin grafting and aggressive nutrition and daily balneotherapy.[7] Absence of organ failure despite high fluid volumes and sustained caloric intake shows aggressive supportive care is needed in such cases. Nutritional targets near 7,000 kcal/day reflect a proactive metabolic response crucial to wound healing and immune support. Wang et al achieved survival in a pediatric patient with 93% TBSA burns complicated by sepsis and successful outcome followed staged debridement, mixed grafting using autologous and paternal allografts, and intensive ICU support.[8] Notably, the 54-day graft integration period points to prolonged vulnerability stressing the role of early, infection-targeted therapy and tailored graft strategies in pediatric burns.

Table 2: Summary of reported cases and studies on survival following extensive TBSA burns, (>80%).

Study (country, design)	Patient demographics	Burn profile	Resuscitation fluids	Surgical interventions	Ventilation/ ICU	Antibiotics/ antimicrobials	Major complications	Outcome (LOS)
Gomes 2000, Brazil, case report[7]	25 years ♂; no comorbidity	92% TBSA; 2-3° flame; inhalation	10 850 mL/24 h Ringer lactate + hypertonic saline	Tangential debridement; mesh autograft	No mechanical ventilation reported	Cefalotine, amikacin, imipenem, vancomycin, ceftazidime	Sepsis, hypo-proteinemia; no ARDS/DIC/ AKI	Survived; full recovery (72 d)
Wang 2023, China, case report[8]	5 years ♂; severe burn sepsis	93% TBSA; deep 2-3° flame; inhalation ✓ (tracheostomy)	Fluid supplementation; anti-shock protocol	Five operations; mixed auto-allografts	ICU; tracheostomy; artificial respiration	Culture-guided therapy	Sepsis, wound infection, malnutrition	Survived; rehab planned (54 d)
Guo 2009, China, retrospective comparative[9]	Mean 32 years; mostly ♂	80% TBSA; >50% full-thickness; flame; inhalation common	Higher volume in Group B (not stated)	Early excision + graft in 23/30	Tracheotomy; mechanical ventilation (Group B)	Not detailed	Burn shock, inhalation injury, sepsis	Mortality 96% (A) vs 63% (B)
AlAlwan 2022, Saudi Arabia, case report[10]	24 years ♂ (Somali); healthy	95% TBSA; superficial 2° gas-flame; no inhalation	Ringer's lactate, plasma, saline titrated by urine	Escharotomy all limbs; eyelid surgery; tracheostomy	Mechanical ventilation; inotropes; ICU stay	Ceftriaxone; later gram-negative coverage	DIC, sepsis, MOD, hyper-K, hypo-albuminemia	Survived; functional gain (86 d)
Ji 2023, China, retrospective cohort[11]	118 pts; 76% ♂; mean 46 years	Median 54% TBSA; confirmed inhalation	2 mL/kg/%; crystalloid: colloid 2:1-1:1	Annular escharotomy; tracheotomy 59%	All SOFA >2 ventilated; 21 ICU	Inhaled mucosolvan, budesonide; systemic N/S	ARDS, AKI, sepsis; mortality 29%	TBSA >80% survival 9%
Tan 2019, Malaysia, retrospective cohort[12]	393 pts; 74% ♂; mean 36 years	TBSA >20% key predictor; overall mortality 12%	Not stated	Not specified	Ventilation strongly predicts death (p<0.001)	Not discussed	SIRS, inhalation injury, respiratory failure	Higher mortality with TBSA >20%, early SIRS
Parashar 2025, India, autopsy study[13]	All ages; both sexes	30–>90% TBSA; flame; inhalation present	Not specified	Not documented	Not stated	Not detailed	Sepsis, hypovolemia, neurogenic shock, ATN	Low survival; LOS >10 d
El Danaf 1995, Egypt, cohort[14]	144 pts; incl. <6 years	30-85% TBSA full-thickness; delayed arrival	Not specified	Not mentioned	Not detailed	Not described	Delay + depth + TBSA ↑ mortality	Mortality 9.7%; rises with TBSA >30%
Li 2011, China, case report[15]	29 y ♂; healthy	99.5% TBSA; 71% 3°, 23% 4°; flame	Resuscitation started 30 h pre-referral	14 ops: escharectomy, amputation, microskin graft	Early mechanical ventilation	Anti-infection therapy on admission	Amputations, delayed granulation, PTSD, contractures	Survived; severe disability (2-y follow-up)
Özer, Turkey, case report[16]	Demographics N/R	87% TBSA; flame; inhalation ✓	Fluids started day 1	Autograft + auto-homograft	Ventilated day 3-87	Empirical → targeted (*A. baumannii, C. parapsilosis*)	Controlled infections; none long-term	Discharged day 157; full social function

Key: ♂=male; N/R=not reported; ARDS=acute respiratory distress syndrome; AKI=acute kidney injury; ATN=acute tubular necrosis; DIC=disseminated intravascular coagulation; MOD=multiple organ dysfunction; SIRS=systemic inflammatory response syndrome; SOFA=Sequential organ failure assessment; TBSA=total body surface area burned; LOS=length of stay.

Guo et al analyzed survival improvements over time in patients with >80% TBSA and >50% full-thickness burns.[9] Their comparison of cohorts before and after 1997 showed significantly reduced mortality, attributed to earlier excision and better respiratory management. All these findings confirm the survival benefit of early surgical intervention and mechanical ventilation in large burns with inhalation injury. Al Alwan et al reported survival in a 24-year-old with 95% superficial burns.[10] Key interventions include early escharotomy, targeted antibiotics and prolonged ICU support. Recovery despite disseminated intravascular coagulation and multiorgan dysfunction underscores the value of sustained resuscitation and physiotherapy even in complex systemic responses. Ji et al have also provided statistical validation of survival predictors.[11] Their work linked TBSA >80% and SOFA>2 to <10% survivals, with combined scoring offering strong predictive accuracy (AUROC 0.955). These data support the integration of dynamic scoring in clinical monitoring and triage decisions, especially in inhalation injuries. Tan et al extended this perspective in a large Malaysian cohort, where early SIRS, TBSA >20%, and mechanical ventilation were key mortality indicators.[12] The significant correlation between early SIRS and short survival emphasizes its role as a fast, practical triage tool for burn severity and prognosis.

Parashar et al examined autopsy data, showing sepsis as the leading cause of late mortality in burns ranging from 30-90% TBSA.[13] Despite some extended survival over 10 days, no full recoveries occurred. This underscores the need for early infection control and multidisciplinary intervention. However, the lack of management details limits insight into possible missed therapeutic opportunities. El Danaf confirmed burn size, depth, and delayed presentation as independent mortality predictors.[14] Pediatric patients had poorer outcomes, consistent with known vulnerability to fluid shifts, immune dysfunction, and delayed graft acceptance. Mortality sharply increased with TBSA >30% and delays beyond 2-5 hours' post-injury, stressing the value of early transport and burn center referral.

Li et al reported survival in a patient with 99.5% TBSA burns, managed with microskin and alloskin grafts.[15] Although functional outcomes were limited, survival was achieved through aggressive surgery, repeated grafting, and amputations. This case supports the feasibility of life-saving intervention even in near-total burns, though with significant morbidity. Özer et al presented a case closely resembling our own, with 87% TBSA flame and inhalation burns.[16] The patient required mechanical ventilation for 84 days, multiple surgeries using autografts and homografts, and infection-specific antibiotics. Full discharge with no complications after 157 days confirms the critical role of infection control, respiratory support, and staged wound closure.

Collectively, these reports point to four key pillars of survival in extensive burns: early excision and grafting, aggressive ICU support, sepsis control, and dynamic physiological monitoring. While outcomes remain uncertain, the potential for survival-even without long-term sequelae-continues to improve with systematic, evidence-based care.

CONCLUSION

We conclude that survival in >87% TBSA burns is rare but possible with prompt resuscitation, early excision, infection control, and intensive care. Our presented case shows that aggressive fluid management, staged grafting, and multidisciplinary support can overcome high mortality risks. Prolonged ICU stays, sepsis, and DIC remain major challenges. Advances in burn care such as biologic dressings and targeted antibiotics have improved outcomes, but ethical and economic dilemmas persist in resource-intensive cases. Survival is a milestone so long-term rehabilitation and quality of life must also be prioritized. We suggest evidence-based protocols should be established in extreme burn management.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Alhaj SS, Alkokhardi ZM, Al Sharji SA, Belhoul AM. Survival from an 87% total body surface area burn: a case report and literature review. Int Surg J 2025;12:1358-63.