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INCIDENCE AND PATTERNS OF MULTIORGAN DYSFUNCTION SYNDROME AMONG PATIENTS WITH MAJOR BURNS ADMITTED AT KENYATTA NATIONAL HOSPITAL

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ABSTRACT

Background: Major burn injuries are frequently complicated by multiorgan dysfunction syndrome (MODS), which remains a leading cause of morbidity and mortality worldwide. While outcomes have improved in high-income countries in recent years, there is no local data on MODS among burn patients.

Objective: To determine the incidence, pattern of organ involvement, and prognosis of multiorgan failure among major burns patients admitted at Kenyatta National Hospital

Design: This was a prospective observational study.

Study Setting: The Kenyatta National Hospital burns unit and plastic surgery wards (4D).

Subjects/Participants: We enrolled 78 patients with major burns, defined as $\geq 20\%$ TBSA in adults and $\geq 15\%$ TBSA in children, with or without inhalation injury. Patients were followed up over the course of admission and reviewed on a daily basis for features of organ dysfunction. Organ dysfunction was assessed using the Sequential Organ Failure Assessment (SOFA) score for adults, and a paediatric version (pSOFA) for paediatric participants.

Results: The study enrolled seventy-eight patients, most of whom were male 60.3% (n=47). The age distribution of the participants was skewed; it ranged from 4 months to 59 years, with a median of 14 years, and an interquartile range of 22.5 years. The cumulative incidence of MODS was 38.5%, with an overall mortality risk of 20%. The lungs and the liver were the most commonly affected organ systems at 51.3%, and 48.7% respectively.

Conclusion: There was a high incidence of MODS among major burns patients admitted to Kenyatta National Hospital, with over one-third developing MODS. All patients admitted with major burns should be closely monitored for the development of MODS.

Keywords: Major burns, Multiorgan Dysfunction Syndrome (MODS), SOFA score

INTRODUCTION

Major burn injuries represent one of the most severe forms of trauma and are associated with profound physiological derangements affecting nearly all organ systems (1). Globally, burns account for approximately 180,000 deaths annually, with the majority occurring in low- and middle-income countries, particularly in Africa and Southeast Asia. Despite advances in burn care, mortality remains high, largely due to complications such as sepsis and multiorgan dysfunction syndrome (MODS) (2).

MODS is defined by a progressive and potentially reversible dysfunction of two or more organ systems following an acute insult. The pathogenesis of MODS in thermal injury starts with extensive release of inflammatory cytokines such as interleukins-6 & 8 that cause multiple blood vessels to dilate, and increase capillary permeability. The changes on the blood vessels cause third spacing, resulting in tissue swelling, and reduced intravascular volume (3). Over days and weeks following injury, however, the body enters a state of compensatory immunomodulation resulting in immunosuppression. Immunosuppression

increases susceptibility to infections, and septic shock, factors that lead to MODS. Secondly, the reduction in intravascular volume, and subsequent decline in cardiac output compromises organ perfusion. Additionally, hypermetabolism induced by the extensive tissue injury compounds stress on all body organs (4,5).

While the global incidence of MODS among burn patients is undetermined, studies in single centres have reported a decline in incidence over the past decades. The reduction in the incidence of MODS and improved clinical outcomes has been attributed to improvements in burn care, such as comprehensive resuscitation protocols, and appropriate use of antimicrobials (6). Based on single centre studies, large burn surface area, inhalational injury, presence of infection or sepsis, increasing age (>40 years), and male gender were the main risk factors for developing MODS (6–8).

In our African context, studies on the incidence and predictors of MODS among burn patients are unavailable. Studies have been conducted to assess the prognosis and predictors of outcomes among burn patients. A study by Nthumba and Oliech at Kenyatta National Hospital highlighted inhalational injury, total burn surface area, and depth of burns as the strongest prognostic factors (9). A similar study on prognosis indicators at the Kenyatta Hospital burns unit highlighted a state of acidosis characterized by high serum lactic acid levels and lower base deficit were significantly associated with increased risk of mortality in the first seven days post-injury (9). However, studies specific to multiorgan dysfunction syndrome (MODS) are lacking.

Understanding MODS, its incidence, risk factors, and pattern of organ involvement, in our local context is essential for improving care and guiding resource allocation. This study was conducted among major burns patients admitted to Kenyatta National Hospital to fill this evidence gap.

MATERIALS AND METHODS

Study Design: This was a prospective observational study conducted over a three-month period.

Study setting: The study was carried out at Kenyatta National Hospital, a 2,000-bed tertiary referral and teaching hospital located in Nairobi, Kenya. The hospital admits an average of 55 burn patients per month and provides specialized burn and reconstructive services.

Study Population: All patients admitted with major burns, defined as $\geq 20\%$ TBSA in adults and $\geq 15\%$ TBSA in children, with or without inhalation injury, were eligible for inclusion.

Inclusion Criteria: Adults with burns $\geq 20\%$ TBSA, Children with burns $\geq 15\%$ TBSA, Major burns patients with inhalation injury

Exclusion Criteria: Patients with significant comorbidities (diabetes mellitus, hypertension, immunosuppression, including HIV or malignancy) Patients who declined consent or for whom consent could not be obtained

Sample Size and Sampling: A sample size of 78 patients was determined using standard prevalence-based calculations and corrected for the finite population. Consecutive sampling was employed until the desired sample size was achieved.

Data Collection: Demographic data, burn characteristics, and clinical parameters were recorded using a structured questionnaire. The questionnaire included the Sequential Organ Failure Assessment (SOFA) score, a validated tool used to assess organ dysfunction. A pediatric version of the SOFA score (pSOFA) was used to evaluate pediatric patients. The pediatric version of the SOFA score differs from the adult version, by making age-dependent adjustments in setting the cut-off points for the variables measured in the different body systems.

All participants were reviewed daily during routine hospital rounds. Any decline in organ function identified during daily rounds prompted a detailed assessment using the SOFA score tool. Notably, all study participants, including those who had no registered signs of organ dysfunction during daily reviews, were comprehensively assessed with the SOFA score on days 1, 3, 5, 7, and 21 of admission.

The study defined multiorgan dysfunction syndrome (MODS) as dysfunction in two or more organ systems.

Data Analysis: Data were cleaned and analysed using the Statistical Package for Social Sciences (SPSS) IBM® version 26. Descriptive statistics were used to summarize the data; measures of dispersion, and measure of central tendency were given for quantitative data, while frequencies and percentages were derived for qualitative data. The data was further summarized in tables and figures.

Ethical considerations: Ethical approval for the study was obtained from the Kenyatta National Hospital–University of Nairobi (KNH-UON) Ethics and Research Committee (approval number P846/11/2022). Research permit and clearance was also obtained from the National Commission for Science, Technology and Innovation (NACOSTI). Informed consent was obtained from the study participants, and consent forms were availed in multiple language. The participants were informed about the purpose of the study, and their right to withdraw from it. The data gathered was handled with confidentiality, and personal identifying data was omitted.

RESULTS

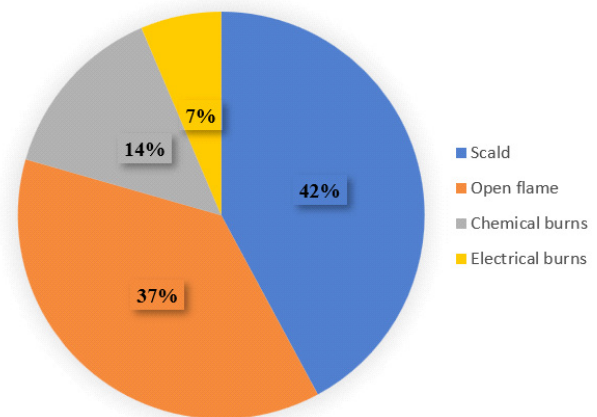
Demographic Data: Seventy-eight patients were enrolled, of whom 47 (60.3%) were male, and 31 (39.7%) were female. The age distribution of the study participants was skewed; the minimum age was 4 months, and the maximum was 59 years, with a median of 14 years. Grouping the ages if the participants in quartiles, the interquartile range was 22.5 years.

Table 1: The Age Distribution of the Study Participants

Age		
Median		14.0
Minimum		0.4
Maximum		59.0
Range		58.6
Percentiles	25	3.8
	50	14.0
	75	26.3
Interquartile Range		22.5

Burn Characteristics: The 78 patients enrolled into the study had major burns, defined as TBSA $\geq 20\%$ in adults, and TBSA $\geq 15\%$ in children, and all patients with inhalational burns. The mean TBSA was 31.9% (± 14.3). Scald injuries were the main mechanism of injury as noted in 42% of cases, followed by open flame burns (37.2%), chemical burns (14.1%) and electrical burns (6.4%) as shown in Figure 1.

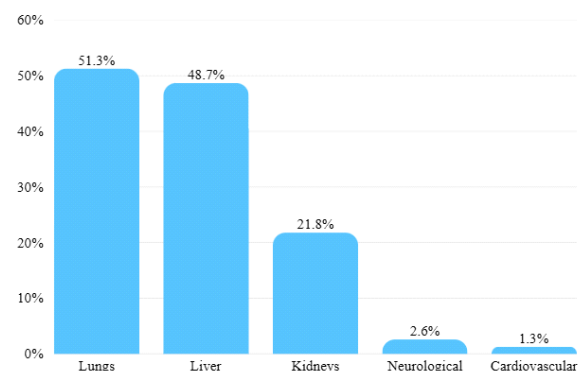
Figure 1: Mechanisms of Injury



Incidence of Multiorgan Failure: All 78 individuals enrolled in the study had severe burns and were at risk of developing MODS. Over the course of admission, 30 individuals developed MODS, representing a cumulative incidence of 38.5%.

Pattern of Organ Involvement: Among individuals who developed MODS, the lungs were the most commonly affected accounting for 51.3% of cases. The liver was the second most common affected organ system at 48.7%, followed by the kidneys at 21.8%. Cardiovascular and neurological systems were less affected accounting for 1.3% and 2.6% of cases respectively as shown in Figure 2.

Figure 2: Pattern of Organ Involvement in MODS



Prognosis: Out of 30 patients who developed MODS in the course of admission, 6 succumbed to their injuries representing a mortality rate of 20%.

DISCUSSION

This study demonstrates a high incidence of multiorgan failure among major burns patients admitted to KNH, with over one-third developing MODS. The incidence of 38.5% is comparable to reports from other low- and middle-income countries, where rates range between 30% and 40% (6,10).

On pattern of organ involvement, respiratory dysfunction was the most common, while the cardiovascular system was least affected. The predominant respiratory dysfunction mirrors the findings of a study by Nguyen & Nguyen reported a similar pattern in their study, reported in 44.44% of cases. In contrast however, the cardiovascular system was the second most affected system accounting for 41.88% of cases (6). Similarly, a study Cumming *et al* reported a pattern where the respiratory system was most affected (49.4%), while the hepatic system was least affected (3.6%) (7). Lung dysfunction in major burns is secondary to exaggerated inflammatory response to injury, with resultant increased capillary permeability. Additionally, direct damage to lung tissue for patients with inhalational injury contribute to the lung dysfunction (11).

Hepatic and renal dysfunction were the second and third most commonly affected organ systems. Hepatic dysfunction in burn patients is often multifactorial, resulting from hypoperfusion, sepsis, drug toxicity, and the hypermetabolic response. Renal failure, similarly, reflects a combination of hypovolemia, myoglobinuria, sepsis, and nephrotoxic exposures (12,13).

MODS often heralds a poor prognosis for major burns patients; it is recognized as one of the main causes of death in major burns. Indeed, a study in Vietnam reported a high mortality of 86.79% for major burns patient who had MODS (14). In contrast, Cuning *et al* reported favourable prognoses. In their study, 71% of burn patients who developed MODS survived. The favourable prognosis was attributed to longer periods on mechanical ventilation, and extended admission to intensive care (7). Similarly, Chen *et al* reported low mortality rate of 2.3% among patients with MODS. The favourable outcomes were in part attributed to early surgical intervention (14). In our study, we observed a mortality rate of 20%.

STRENGTHS AND LIMITATIONS

This study is a first of many steps needed in understanding MODS among thermal injury patients in our set up. Epidemiological studies have established a heavy burden of burns in low- and middle-income countries (LMICs). However, literature on burns care and its complications such as

MODS in LMICs is limited, a factor that limits overall care. Therefore, local evidence on the manifestation of MODS in thermal injury patients is essential in improving burn care our setup.

This study had a limited scope; it focused on the incidence of MODS and patterns of organ involvement in severe burn patients. However, additional details about MODS, such a time of onset, clinical outcomes and the factors influencing them, are worth studying. While they have been missed in this study, we recommend further comprehensive studies. Furthermore, consecutive sampling was our sampling method of choice in our set-up. We acknowledge the method presents a bias in the selection of the study participants, and may limit generalizability of this study's findings.

The time limit of three months within which the study was conducted presents a potential bias in burn injury patterns. Therefore, longer durations should be considered in future studies for a comprehensive picture. Furthermore, the study excluded individuals with comorbid conditions such as HIV, conditions that increase the risk of developing MODS. It will be relevant for future studies to observe the patterns of MODS among individuals with comorbidities.

CONCLUSION & RECOMMENDATIONS

Multiorgan dysfunction syndrome (MODS) is common among patients with major burns admitted at Kenyatta National Hospital with an incidence of cumulative incidence of 38.5%, with a mortality rate of 20. The lungs and the liver are the most commonly affected organ systems. The mortality risk for major burn patients who develop MODS is 20%.

This study demonstrates that MODS is common among patients with major burns. All patients admitted with major burns should be monitored for MODS. The SOFA score is a validated clinical tool that should be used to guide monitoring. Additionally, the recommended burn care practices such as fluid resuscitation, and infection control should be observed among patients with major burns to prevent progression into MODS.

We further recommend additional local studies on MODS among thermal injury patients, and around burn care in general. It will be especially relevant to study outcomes among burn patients who develop MODS, and the factors influencing them.

REFERENCES

1. Feng JY, Chien JY, Kao KC, *et al*. Predictors of Early Onset Multiple Organ Dysfunction in Major Burn Patients with Ventilator Support: Experience

- from A Mass Casualty Explosion. *Sci Rep*. 2018 Jul 19;8(1):10939. doi:10.1038/s41598-018-29158-3
2. Bordeanu-Diaconescu EM. Comprehensive Review and Update on Multiple Organ Dysfunction Syndrome in Burn Patients: Pathophysiology, Risk Factors, and Management Strategies. *Romanian J Mil Med*. 2024 Nov 1;127(6):480–90. doi:10.55453/rjmm.2024.127.6.8
3. ŻwierzeŃ W, Piorun K, Skórka-Majewicz M, *et al*. Burns: Classification, Pathophysiology, and Treatment: A Review. *Int J Mol Sci*. 2023 Feb 13;24(4):3749. doi:10.3390/ijms24043749
4. Pape HC, Moore EE, McKinley T, *et al*. Pathophysiology in patients with polytrauma. *Injury*. 2022 Jul;53(7):2400–12. doi:10.1016/j.injury.2022.04.009
5. Szymanski KD, Tannan SC. Thermal Burns. *Stat Pearls*. 2026.
6. Nguyen LN, Nguyen TG. Characteristics and outcomes of multiple organ dysfunction syndrome among severe-burn patients. *Burns*. 2009 Nov;35(7):937–41. doi:10.1016/j.burns.2009.04.015
7. Cumming J, Purdue GF, Hunt JL, O'Keefe GE. Objective Estimates of the Incidence and Consequences of Multiple Organ Dysfunction and Sepsis after Burn Trauma: *J Trauma Inj Infect Crit Care*. 2001 Mar;50(3):510–5. doi:10.1097/00005373-200103000-00016
8. Fitzwater J, Purdue GF, Hunt JL, O'Keefe GE. The Risk Factors and Time Course of Sepsis and Organ Dysfunction after Burn Trauma: *J Trauma Inj Infect Crit Care*. 2003 May;54(5):959–66. doi:10.1097/01.TA.0000029382.26295.AB
9. Nthumba PM, Oliech JS. Outcome of moderate and severe thermal injuries at Kenyatta National Hospital. Vol. 10. 2005;10(2).
10. Asim M, Amin F, El-Menyar A. Multiple organ dysfunction syndrome: Contemporary insights on the clinicopathological spectrum. *Qatar Med J*. 2020;2020(2):22. doi:10.5339/qmj.2020.22
11. Steinvall I, Bak Z, Sjöberg F. Acute respiratory distress syndrome is as important as inhalation injury for the development of respiratory dysfunction in major burns. *Burns*. 2008 Jun;34(4):441–51. doi:10.1016/j.burns.2007.10.007
12. Kraft R, Herndon DN, Finnerty CC, *et al*. Occurrence of Multiorgan Dysfunction in Pediatric Burn Patients: Incidence and Clinical Outcome. *Ann Surg*. 2014 Feb;259(2):381–7. doi:10.1097/SLA.0b013e31828c4d04
13. Sheng Z. Prevention of multiple organ dysfunction syndrome in patients with extensive deep burns. Vol. 5. 2002 Aug;5(4):195–9.
14. Yan H, Zhang J, Yuan Z, *et al*. Characteristics of burn deaths from 2003 to 2009 in a burn center: A retrospective study. *Burns Trauma*. 2013;1(2):80. doi:10.4103/2321-3868.118933