

## RENAL CHANGES IN BURN-RELATED FATALITIES: AN AUTOPSY-BASED ANALYSIS

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Received : 19/11/2023  
Received in revised form : 02/01/2024  
Accepted : 17/01/2024

**Keywords:**

Renal Pathology, Burn Injuries, Autopsy, Histopathology, Thermal Burns, Septicemic Shock, Tubular Necrosis.

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DOI: 10.47009/jamp.2024.6.1.72

Source of Support: Nil,  
Conflict of Interest: None declared

*Int J Acad Med Pharm*  
2024; 6 (1); 374-378



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### Abstract

**Background:** Burn injuries are a significant public health issue, often leading to fatal outcomes and complex medical conditions, including renal pathology. This study aims to elucidate the renal changes observed in fatalities due to burns. **Material & Methods:** A descriptive study was conducted at Andhra Medical College/King George Hospital, Visakhapatnam, over a one-year period from November 2021 to October 2022. Fifty cases from autopsied individuals who succumbed to thermal burns were selected. Data were collated from hospital records, autopsy, and histopathology reports. Exclusion criteria included highly decomposed and charred bodies, burns from electrical and chemical sources, known renal diseases, and COVID-19 positive cases. A detailed post-mortem examination with a focus on renal analysis was performed, and tissue processing steps were rigorously followed. **Results:** Of 1,917 autopsied cases, 89 (4.64%) were burn-related fatalities, with 50 cases undergoing detailed renal analysis. The majority of cases were female (56%), with the highest incidence in the >60 age group (40%). Most deaths occurred within 2-5 days post-burn, primarily due to septicemic shock (68%). Microscopic renal changes included blood vessel congestion in all cases, with various forms of tubular necrosis being prevalent. Renal changes correlated with the survival period and percentage of burns over the total body surface area. **Conclusion:** The study provides significant insights into the renal pathologies associated with burn-related deaths. Understanding these changes can help in better clinical management and potentially improve outcomes in burn victims.

## INTRODUCTION

Burn injuries rank among the most devastating of all traumas, presenting a unique set of challenges in both acute management and long-term care. Globally, burns lead to a significant number of deaths and complications, impacting individuals of all ages and backgrounds.<sup>[1,2]</sup> The multifaceted nature of burn injuries often results in a spectrum of systemic complications, one of the most critical being renal pathology.<sup>[3]</sup>

In the realm of forensic medicine, autopsies of burn victims offer invaluable insights into the systemic impacts of severe burns, particularly concerning renal changes. Renal pathology in the context of burn injuries has been a subject of ongoing research,

as the kidneys play a pivotal role in the body's response to trauma and recovery.<sup>[4,5]</sup> The relationship between the extent of burns, the survival period post-injury, and the resultant renal changes remains a complex interplay that requires thorough investigation.<sup>[6,7]</sup>

This study, conducted at Andhra Medical College/King George Hospital (KGH) in Visakhapatnam, aims to fill gaps in the current understanding of renal changes in burn-related fatalities. By examining cases of thermal burn victims through autopsy and histopathological analysis, the study seeks to delineate the renal alterations that occur in these patients, thereby contributing to a more comprehensive understanding of burn pathology. Such knowledge is crucial not

only for forensic purposes but also for advancing clinical approaches in managing burn victims, potentially leading to improved outcomes and survival rates.

## MATERIALS AND METHODS

### Study Design and Duration

This descriptive study was carried out at Andhra Medical College/King George Hospital (KGH), Visakhapatnam. The duration of the study spanned one year, commencing in November 2021 and concluding in October 2022.

### Sample Size

From the extensive pool of autopsies conducted at the institution during this period, 50 cases were meticulously selected for the study.

### Inclusion Criteria

- The criteria for inclusion in the study were:
- Autopsied cases specifically of thermal burns.
- Cases encompassing a diverse range of age groups and including both genders.

### Exclusion Criteria

- The study excluded cases based on the following criteria:
- Highly decomposed bodies.
- Charred bodies, rendering examination challenging.
- Burns resulting from electrical sources and chemical agents.
- Cases with a prior history of known renal diseases.
- Cases confirmed positive for COVID infection.

### Data Collection

Data for this study were meticulously collected from various sources at Andhra Medical College/King George Hospital (KGH), Visakhapatnam. This included detailed hospital records, autopsy reports, and histopathology reports. Additional information such as age, sex, residence, occupation, and time of incidence was compiled from an array of documents like police inquest reports, FIRs, complaints, hospital records, narratives from relatives, and post-mortem reports.

### Post-mortem Examination

A comprehensive post-mortem examination with a special focus on renal analysis was conducted for each case. This involved the collection of samples from both kidneys of each subject, which were then preserved in 10% formalin for subsequent histopathological examination.

### Tissue Processing

The tissue processing procedure encompassed several steps, including fixation in 10% formalin, tissue processing, section cutting, deparaffinization, and finally, mounting. These procedures were conducted as per standard histopathological techniques.

### Statistical Analysis

For the analysis and interpretation of collected data, SPSS Version 23 statistical software was employed.

The findings were presented in the form of graphs and charts, providing a visual representation of the results and facilitating easier comprehension of the data patterns and trends.

## RESULTS

### General Findings

The study analyzed a total of 1,917 autopsy cases from November 2021 to October 2022. Among these, 89 cases (4.64% of total cases) were identified as deaths due to burns. A detailed bilateral kidney analysis was conducted on 50 of these cases (2.61% of total cases).

### Demographics

The gender distribution among the 50 cases showed 22 males (44%) and 28 females (56%). Age-wise, the highest incidence was observed in the >60 years group (40%), followed by equal distribution (14% each) in the 21-30 and 31-40 years groups. The marital status revealed 72% were married and 28% unmarried. Regarding occupation, dependants formed the largest group (36%), followed by pensioners (14%), and both students and housewives (12% each).

### Clinical Findings

The analysis of burns percentage showed most cases involved 51-70% of body surface area (42%). The majority of deaths occurred between 2 to 5 days (42%). The primary cause of death was determined as septicemic shock (68%), followed by hypovolemic shock (26%), and neurogenic shock (6%).

### Manner of Death

The manner of death was predominantly accidental (76%) while 24% were suicides. No homicides were reported.

### Microscopic Renal Changes

The study observed various renal changes. Blood vessel congestion was present in all cases (100%). Other notable changes included diffuse tubular necrosis of the DCT (30 cases), focal tubular necrosis with protein casts (22 cases), and focal tubular necrosis of the PCT (18 cases).

### Renal Changes in Relation to Survival Period

Renal changes varied with survival periods. For instance, within the first day, focal tubular necrosis of both the PCT and DCT was noted. By the second day, additional changes like hydropic degeneration, sclerosed glomeruli, and interstitial oedema were observed. These changes evolved over the survival period, with different types and degrees of tubular necrosis and degeneration noted.

### Renal Changes in Relation to Percentage of Burns over Total Body Surface Area

Renal changes were also correlated with the extent of burns. In cases with less than 30% burns, focal tubular necrosis with protein casts in the PCT and diffuse tubular necrosis of the DCT were observed. As the burn percentage increased, additional changes like vacuolar degeneration and interstitial

oedema were noted, especially in cases with burns covering 31-50% of the body. Higher burn

percentages corresponded with more severe renal changes.

**Table 1: General Findings**

Description	Number of Cases	Percentage
Total Autopsied Cases (Nov 2021 - Oct 2022)	1917	-
Deaths due to Burns	89	4.64% of total cases
Cases Undergoing Detailed Bilateral Kidney Analysis	50	2.61% of total cases

**Table 2: Demographics - Gender Distribution**

Gender	Number of Cases	Percentage
Male	22	44%
Female	28	56%
Total	50	100%

**Table 3: Demographics - Age Distribution**

Age Group	Number of Cases	Percentage
1-10 yrs	4	8%
11-20 yrs	4	8%
21-30 yrs	7	14%
31-40 yrs	7	14%
41-50 yrs	3	6%
51-60 yrs	5	10%
>60 yrs	20	40%
Total	50	100%

**Table 4: Demographics - Marital Status**

Marital Status	Number of Cases	Percentage
Married	36	72%
Unmarried	14	28%
Total	50	100%

**Table 5: Distribution of Study Population Based on Occupation**

S. No.	Occupation	Number of Cases	Percentage
1	Daily Laborer	5	10%
2	Dependents	18	36%
3	Pensioners	7	14%
4	Fisherman	3	6%
5	Teachers	2	4%
6	Students	6	12%
7	Mason	3	6%
8	House Wives	6	12%
Total		50	100%

**Table 6: Percentage of Burns Involved Over the Total Body Surface Area**

Percentage of Burns	Number of Cases (n=50)	Percentage
<30%	1	2%
31-50%	8	16%
51-70%	21	42%
71-90%	15	30%
>90%	5	10%
Total	50	100%

**Table 7: Survival Period Distribution**

Survival Period	Number of Cases (n=50)	Percentage
<1 day	7	14%
2-5 days	21	42%
6-10 days	15	30%
11-20 days	4	8%
21-30 days	3	6%
Total	50	100%

**Table 8: Clinical Findings - Cause of Death**

Cause of Death	Number of Cases	Percentage
Neurogenic Shock	3	6%
Hypovolemic Shock	13	26%
Septicemic Shock	34	68%

Total	50	100%
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**Table 9: Distribution of Manner of Death**

Manner of Death	Number of Cases	Percentage
Suicide	12	24%
Accident	38	76%
Homicide	0	0%
Total	50	100%

**Table 10: Distribution of Microscopic Renal Changes**

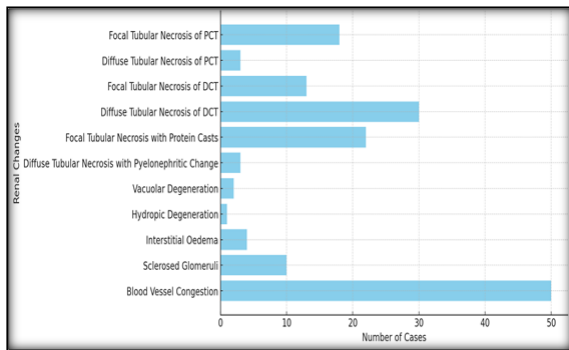
S. No.	Renal Change	Number of Cases
1	Focal Tubular Necrosis of Proximal Convoluted Tubule (PCT)	18
2	Diffuse Tubular Necrosis of PCT	3
3	Focal Tubular Necrosis of Distal Convoluted Tubule (DCT)	13
4	Diffuse Tubular Necrosis of DCT	30
5	Focal Tubular Necrosis with Protein Casts	22
6	Diffuse Tubular Necrosis with Pyelonephritic Change	3
7	Vacuolar Degeneration	2
8	Hydropic Degeneration	1
9	Interstitial Oedema	4
10	Sclerosed Glomeruli	10
11	Blood Vessel Congestion	50

**Table 11: Renal Changes in Relation to Survival Period**

S. No.	Survival Period	Renal Changes
1	<1 day	Focal Tubular Necrosis of Proximal Convoluted Tubule (PCT) and Distal Convoluted Tubule (DCT)
2	2nd Day	Focal Tubular Necrosis of PCT and DCT, Hydropic Degeneration, Sclerosed Glomeruli, Interstitial Oedema
3	3rd Day	Focal Tubular Necrosis of PCT, Diffuse Tubular Necrosis of DCT, Protein Casts
4	5th Day	Focal Tubular Necrosis with Protein Casts, Vacuolar Degeneration
5	6-10 days	Focal Tubular Necrosis of PCT with Protein Casts, occasional Vacuolar Degeneration, Diffuse Tubular Necrosis of DCT with occasional Focal Tubular Necrosis, Interstitial Oedema
6	11-20 days	Focal Tubular Necrosis of PCT, Diffuse Tubular Necrosis of DCT
7	21-30 days	Sclerosed Glomeruli, Focal Tubular Necrosis of PCT with Pyelonephritic changes, Diffuse Tubular Necrosis of DCT, Interstitial Oedema

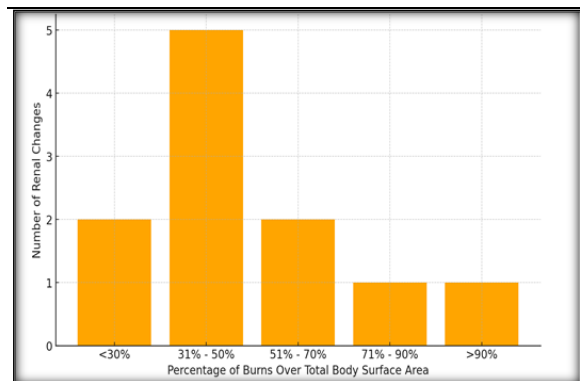
**Table 12: Renal Changes in Relation to Percentage of Burns over Total Body Surface Area**

S. no.	% of Burns Over Total Body Surface Area	Renal Change
1	<30%	Focal Tubular Necrosis with Protein Casts in Proximal Convoluted Tubule (PCT), Diffuse Tubular Necrosis of Distal Convoluted Tubule (DCT)

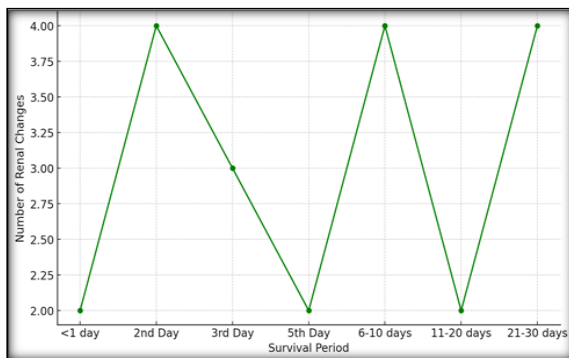


**Figure 1: Distribution of Microscopic Renal Changes**

**Figure 2: Renal Changes in Relation to Survival Period**



**Figure 3: Renal Changes in Relation to Percentage of Burns Over Total Body Surface Area**



## DISCUSSION

The findings of this study at Andhra Medical College/King George Hospital (KGH) underscore the complex interplay between burn injuries and renal pathology, a critical aspect often overshadowed in the acute management of burn

patients. Our analysis of 50 autopsy cases reveals several key insights and trends.

Firstly, the predominance of renal changes in burn-related fatalities, particularly tubular necrosis and blood vessel congestion, highlights the kidneys' vulnerability to systemic disruptions caused by severe burns. The high incidence of diffuse tubular necrosis in the distal convoluted tubule aligns with previous studies that have linked this pathology to acute kidney injury (AKI) in burn patients<sup>8,9</sup>. This suggests that the mechanisms of renal injury in burns may involve ischemia, inflammation, and direct thermal damage.<sup>[10]</sup>

The gender and age distribution, with a higher incidence in females and in the >60 age group, may reflect social and behavioral factors, such as the involvement of women in domestic cooking in certain cultures, making them more susceptible to burns.<sup>[11,12]</sup> This demographic trend warrants further investigation into preventive measures and targeted education on burn safety.<sup>[13]</sup>

The study also found that the majority of fatalities occurred within 2-5 days post-burn, predominantly due to septicemic shock.<sup>[14]</sup> This finding is consistent with literature indicating that sepsis is a leading cause of death in burn patients, often compounded by the compromised immune response and extensive skin damage.<sup>[15]</sup>

Interestingly, the correlation between the extent of burns and renal pathology suggests a dose-response relationship. Patients with more extensive burns showed more severe renal pathology, indicating a potential threshold for renal injury in burn patients.<sup>[16]</sup> This observation could guide clinical thresholds for intensive renal monitoring and intervention in burn patients.

#### Limitations

The sample size, though adequate for a preliminary investigation, is relatively small for generalizing the findings. Additionally, the study's retrospective nature and reliance on autopsy data limit the ability to explore causative relationships comprehensively.

## CONCLUSION

Our findings highlight the importance of renal evaluation in burn patients and suggest that early intervention in burn management could mitigate renal complications. Future research with larger sample sizes and prospective designs would be valuable to further understand the renal implications of burn injuries and to improve patient outcomes.

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