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Original Research Article

Histo-pathological changes in kidneys in autopsies of flame burns at a tertiary care center in North Western India: an autopsy based study at SMS medical college Jaipur (2015-2016)

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ABSTRACT

Background: Burn injury is associated with an intricate patho-physiological response with rapid involvement of various organ systems and which in turn impact the patient with multisystem disruption. These damages can be attributed to the alteration occurring at the tissue and cellular level leading to the histological changes in the renal tissue.
Methods: The main aim of this study was to document the histo-pathological changes in kidneys of fatal cases of flame burns. This study was hospital based observational descriptive study carried out at mortuary of SMS medical college and attached hospitals, Jaipur, Rajasthan, India to study and document the histo-pathological changes in the fatal cases due to flame burns.
Results: In this study, most common histo-pathological finding in kidneys was cloudy degeneration followed by congestion. Acute tubular necrosis of proximal convoluted necrosis was most commonly observed during 3 to 7 days of mortality (18 cases) followed by mortality during 0 to 48 hours. Acute tubular necrosis of distal convoluted tubules was most commonly observed during 3 to 7 days followed by mortality during 0 to 48 hours.
Conclusions: This study revealed that cloudy degeneration and acute tubular necrosis were the hallmark changes in burn patients which were most prominent at 3-7 days after sustaining burn injuries. This reflects the role of immediate management provided to the patient during this period with timely and effective fluid restoration and it possibly will change the prognosis of patients.

Keywords: Acute tubular necrosis, Burns, Renal tissue, Renal failure

INTRODUCTION

Burns are the second leading cause of accidental death, following vehicle crashes.[1] It remains one of the leading problems for the treating doctors of modern times because of its tiring clinical course, high mortality rates and sometimes, unacceptable results of treatment and is one the leading cause of death and disability. An estimated 2,65,000 deaths every year are caused by burns-the clear majority occur in low- and middle-income countries.[2] In a developing and middle-income country like India burn injuries are quite prevalent due to high population density, domestic accidents, poverty, illiteracy, lack of appropriate safety measures, and negligence in certain working environments and unsafe use of materials associated with fireworks used during festivals and worship. Burn injury causes severe medical complications; it not only destroys the cutaneous barrier protecting the patient from a hostile environment, but it also causes a cascade of patho-physiological changes in

every organ system and the extent and duration of organ function alterations are directly related to the extent of thermal injury. These identical changes occur to some degree in all injured patients.

Burn injury is associated with an intricate patho-physiological response with rapid involvement of various organ systems and which in turn impact the patient with multisystem disruption. The major cause of death in the burn patients includes multiple organ failure and infection. These damages can be attributed to the changes occurring at the tissue and cellular level involving the alteration of the cellular architecture of the organs. It is suggested that they can be understood better with a pathological study of the victim's organs.[3]

Kidney is invariably involved in burn patients leading to acute renal failure and other complications. Acute renal failure (ARF) is a frequent and important phenomenon but not the only one that can induce death.[4] It usually occurs immediately after burns and is mostly due to reduced cardiac output, which is mainly caused by fluid loss. This is usually caused by delayed or inadequate fluid resuscitation but may also result from substantial muscle breakdown or haemolysis and it is usually reversible.[5] Very few researchers have reported various Histo-pathological changes in renal tissue following an episode of flame burn.[6-12] Renal failure is associated with high mortality rate hence understanding its patho-physiology at cellular level is essential to anticipate and prevent such complications.

The studies documenting these changes at cellular changes are scarce hence this study was undertaken to study the histo-pathological changes of kidneys due to flame burns.

METHODS

This study was a hospital based observational descriptive study carried out at mortuary of SMS medical college and attached hospitals, Jaipur, Rajasthan, India after obtaining due clearance from research and review board of SMS medical college and hospital with assistance of department of pathology, Sawai Man Singh medical college, Jaipur, rajsthan, India for preparation and analysis of samples during March 2015 to August 2016. During this period, a total of 6,112 medico-legal autopsies were conducted among which there were 117 cases of fatalities due to flame burns. Out of these, 80 cases of deaths due to flame burns were selected for study including based on inclusion and exclusion criteria. Special emphasis was given for examination of both kidneys for any gross pathological changes during autopsy.

Appropriate samples of bilateral renal tissues were subjected for histo-pathological examination after proper preservation and fixation in 10% formaline solution and processed for routine method of paraffin sectioning and stained with hematoxyline and eosin staining procedure.

RESULTS

Females were predominant study population in the present study (55%). Female to male ratio was 1.22:1. Majority of the burn victims were between 20 to 40 years in both males and females with 58.75% each. Next common age group was surprisingly between 10-20 years (16.25%) followed by 40-50 years (13.75%). Least affected age group was 60-70 years (02.50%). The proportion of age wise distribution was almost similar in both sexes.

In the present study, majority of cases of burn deaths had suffered more than 50% burns with majority of cases having more than 85% burn surface area (22.50%) (FIGURE 1).

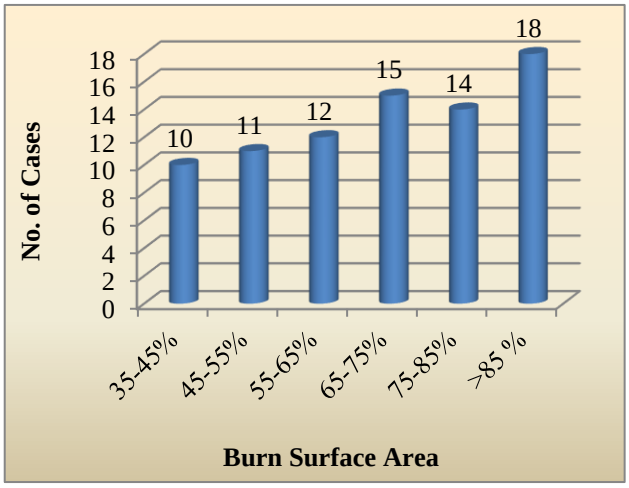

Figure 1: Distribution of fatal burn cases according to total burn surface area.

Most patients succumbed to burn injuries between 4 to 7 (33.75%) days followed by followed by 7 to 14 days (18.75%) (Figure 2).

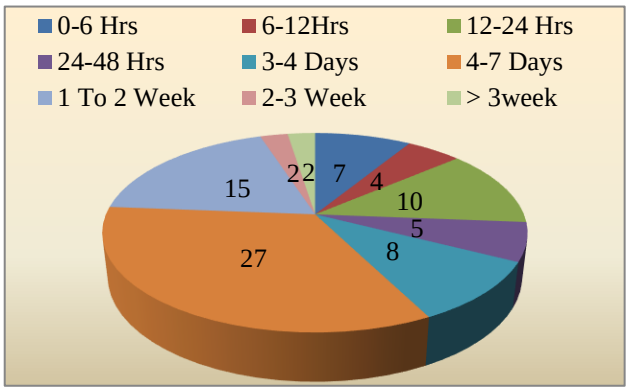

Figure 2: Distribution of fatal burn cases according to duration of survival.

Burn shock as a cause of death was most commonly seen in >85% burns (54.16%) whereas toxemia and septicemia were seen in all categories of extent of burn ranging from mild to severe burns. However, toxemia was slightly higher in moderately burnt patients in 55-85% burn area (69.23%).

Arrays of histo-pathological changes were seen in renal tissue in cases of burn deaths. The most common histo-pathological alteration in kidneys in the present study was cloudy degeneration of tubules seen in 60 out of 80 cases (75.00%) (Figure 3).

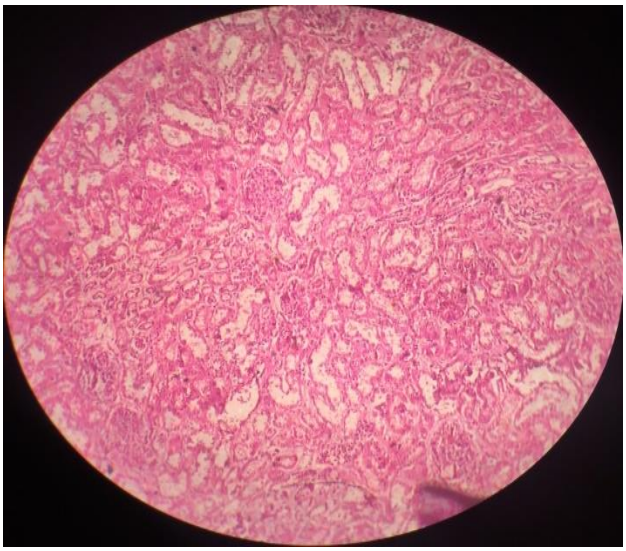

Figure 3: Cloudy degeneration of kidney.

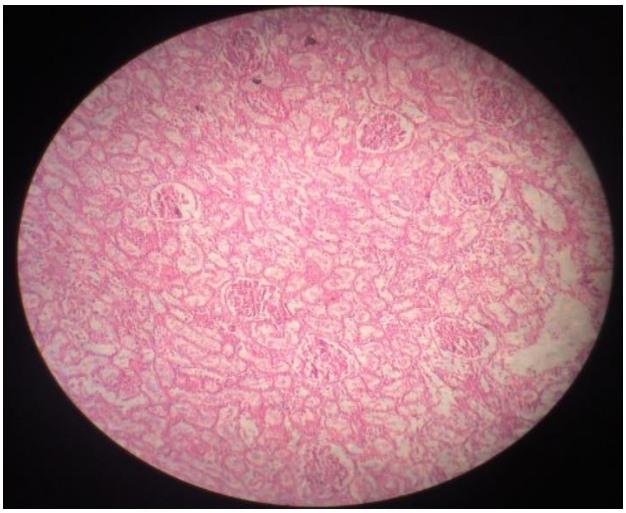

Figure 4: Acute tubular necrosis of proximal convoluted tubules. (10 X view).

Acute tubular necrosis (ATN) of proximal convoluted tubules was the next common pathology seen in 42 cases (Figure 4 and 5) followed by acute tubular necrosis (ATN) of distal convoluted tubules in 41 cases (Figure 6 and 7). Epithelial regeneration and glomerulonephritis were the least common pathologies seen in 4 cases each (Table 1).

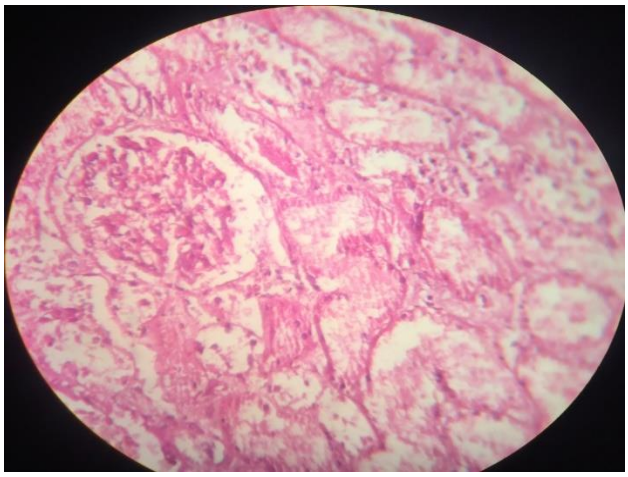

Figure 5: Acute tubular necrosis of proximal convoluted tubules. (40 X view).

In this study, cloudy degeneration in kidneys was most common finding and maximum cases were those whose burn surface area was above 85% (18 cases). Tubular casts were a frequent finding in cases with burn surface area between 65 to 75% cases with 4 cases. Congestion was seen in kidneys with burn surface areas above 85% in 12 cases. Epithelial regeneration was seen more in cases with above 85% burn surface area (3 cases).

Table 1: Histopathological changes in kidneys in fatal burn cases.

Histopathological changes	Number
Cloudy degeneration	60 (75.00%)
Tubular casts	14 (17.50%)
Pyelonephritis	05 (06.25%)
Congestion	53 (66.25%)
Epithelial regeneration	04 (05.00%)
Glomerulonephritis	04 (05.00%)
Interstitial lymphocytic infiltration	29 (36.25%)
ATN (PCT)	42 (52.50%)
ATN (DCT)	41 (51.25%)

Acute tubular necrosis of proximal tubules was seen most commonly seen in patients with burn surface area above 85% with 8 cases. ATN was a frequent finding in cases with burn surface area 45 to 55%, 55% to 65%, 75% to 85% with 7 cases each. Interstitial lymphocytic infiltration was seen in 6 cases with burn surface area above 85% (Table 2).

Majority of histo-pathological changes were more frequent in 3-7 days after burn. In the present study, cloudy degeneration of kidney was the most consistent finding in patients who survived for 4-7 days (20 cases) and least common finding in patient who survived for less than 12 hours and above 3 weeks (10 cases).

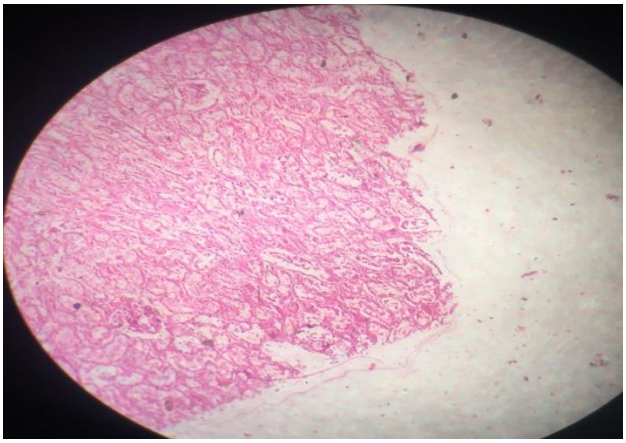

Figure 6: Acute tubular necrosis of distal convoluted tubules. (10 X view).

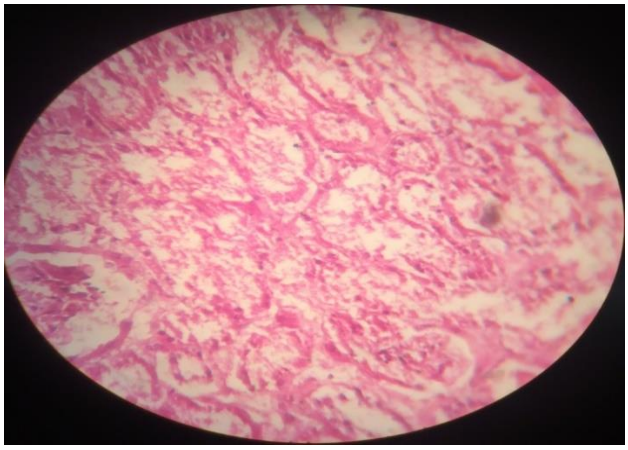

Figure 7: Acute tubular necrosis of distal convoluted tubules. (40 X view).

Table 2: Distribution of fatal burn cases according to histo-pathological changes in kidneys and total burnt surface area.

Histo-pathological change in kidneys	Total burn surface area						
	35-45%	45-55%	55-65%	65-75%	75-85%	≥85%	Total (%)
Cloudy degeneration	06	08	11	09	14	12	60 (75.00%)
Tubular casts	02	02	02	04	02	02	14 (17.50%)
Pyelonephritis	00	01	00	01	02	01	05 (06.25%)
Congestion	07	05	09	10	10	12	53 (66.25%)
Epithelial regeneration	00	00	01	00	00	03	04 (5.00%)
Glomerulonephritis	02	01	00	00	01	00	04 (5.00%)
Interstitial lymphocytic infiltration	05	04	04	05	05	06	29 (36.25%)
ATN (PCT)	06	07	07	06	07	08	41 (51.25%)
ATN (DCT)	04	03	09	07	10	08	41 (51.25%)

(n=80).

Table 3: Distribution of fatal burn cases according to duration of survival and histo-pathological changes in kidney.

Histo-pathological changes in kidney	Duration of survival									
	0-6 hours	6-12 hours	12-24 hours	24-48 hours	3-4 days	4-7 days	1- 2 week	2-3 weeks	> 3 weeks	Total
Cloudy degeneration	06	04	04	05	05	21	12	01	02	60 (75.00%)
Tubular casts	01	00	01	01	04	03	03	00	01	14 (17.50%)
Pyelonephritis	00	00	00	00	02	02	00	01	00	05 (6.25%)
Congestion	04	02	07	04	03	19	13	00	01	53 (66.25%)
Epithelial regeneration	00	00	03	00	01	00	00	01	01	06 (7.50%)
Glomerulonephritis	00	00	00	00	00	02	01	00	01	04 (5.00%)
Interstitial lymphocytic infiltration	05	01	04	02	04	07	05	00	01	29 (36.25%)
ATN (PCT)	05	01	07	01	04	14	07	02	00	41 (51.25%)
ATN (DCT)	03	01	06	02	04	16	08	01	00	41 (51.25%)

Tubular casts were seen mostly in patient who survived for about 3 to 7 days with 7 cases. Pyelonephritis was seen in patients who survived for 3 to 4 days with 4 cases. Congestion was most frequent finding in 19 cases who survived for 4 to 7 days. Acute tubular necrosis of proximal convoluted tubules and distal convoluted tubules was seen mostly in patients who survived for 4 to 7 days with 14 cases and16 cases each. Patients

succumbing to death in 4-7 days of burn injury witnessed maximum histo-pathological changes in kidney (Table 3). In this study ATN of PCT and DCT was the most consistent finding in all cases irrespective of their cause of death. Congestion was most common in septicemia with 24 cases (Table 4).

Table 4: Distribution of cases according to cause of death and histo-pathological changes in kidney.

Histo-pathological change in kidney	Septicemia	Shock	Toxaemia	Total
Cloudy degeneration	17	20	23	60
Tubular casts	5	02	07	14
Pyelonephritis	3	00	02	05
Congestion	24	15	14	53
Epithelial regeneration	02	03	01	06
Glomerulonephritis	03	00	01	04
Interstitial lymphocytic infiltration	10	12	07	29
ATN(PCT)	14	14	13	41
ATN(DCT)	16	11	14	41

DISCUSSION

In this study ATN was the most consistent finding in all causes of death with 17.50%, 17.50%, and 16.25% each for septicemia, shock toxaemia respectively. Congestion was most common in septicemia with 24 cases congestion in 66.25%, 63.75% had tubular necrosis, 36.25% had lymphocytic infiltration, tubular casts in 17.5% cases, pyelonephritis in 06.25% and glomerulonephritis and epithelial regeneration in 5% cases each. Study results are quite like Shinde AB and Keoliya AN for all changes except cloudy degeneration which was proportionately much higher in this study.[9] The results of the present study were slightly variable to those of Sevitt S (tubular necrosis in 59.30% and cloudy swelling in 37.21%), and Bhetariya BV et al (tubular necrosis in 81.25% cases and cloudy swelling in 18.75% cases).[10,11] The results of the present study are much variable in relation to cloudy swelling which was found in much higher proportions in the present study. Agramaso RV observed changes of cloudy swelling in 10% case whereas, 33.33% cases had degenerative changes in the renal tubules.[12] There were no significant changes in rest of the cases.

The present study was not consistent with the other studies as cloudy degeneration was found in a much higher proportion in the present study. These differences were due to the differences in the total burnt surface area of the study population and the post burn duration of survival. Also as the center is a tertiary care referral center and caters population from all over Rajasthan mostly from rural and remote areas which like any other rural and remote areas of our country still lack the initial basic treatment amenities.

There were 51.25% cases of proximal and distal tubular necrosis, 50% cases of diffuse tubular necrosis. Study results are quite variable to those of Bhetariya BV et al, who reported 65.63% cases had predominant proximal tubular necrosis and 15.62% cases with predominant distal tubular necrosis either focal in 9.37%. The results of the present study are quite similar as regards to some aspects of tubular necrotic changes in renal tissue to those of Sevitt S who found proximal tubular necrosis in 19.77% cases and distal tubular necrosis in 39.53% cases (18.60% with focal and 20.93% with diffuse type).[10,11] Sevitt S reported that 37.21% cases had no tubular necrosis which is quite similar to the present study.[10] Thus the present study was consistent with the study of Sevitt S in respect of acute tubular necrotic changes of kidney.

In the present study, maximum cases showing cloudy degeneration were of 4-7 days survival .50% cases with tubular casts and 80% cases with pyelonephritis were of survival duration of 3-7 days. Epithelial regeneration and interstitial lymphocytic infiltration was more commonly observed in cases who succumbed to death within 24 hours after sustaining burn injury. Maximum cases showing acute tubular necrosis did not survive more than a week. The observed histo-pathological features in the present study correlated well with the duration of survival and it was found that majority of the histo-pathological changes were prevalent in cases with 4-7 days of post burn survival. Bhetariya BV et al found that all cases showing changes of cloudy swelling had minimum duration of survival of 0-12 hours whereas, cases showing changes of acute tubular necrosis were distributed in correlation with duration of survival ranging from 36 hours to over a week.[11]

In the present study, too minimum duration of survival in cases with cloudy degeneration and tubular necrosis in 0-12 hours and were more prevalent upto 1-2-weeks survival period. Agramaso RV observed changes of cloudy swelling in victims who died quickly of

suffocation whereas cases showing degenerative changes in the renal tubules survived between 4 and 26 days.[12] Thus, the results of the present study were consistent with those of Bhetariya BV et al and Agramaso RV in respect of the observed histopathological features with the post burn survival duration.[11,12] The results of the present study are not consistent with those of Shinde AB and Keoliya AN who reported that cloudy degeneration was most common in cases with less than 96 hours survival period; epithelial regeneration and acute pyelonephritis in 3-4 days.[9]

CONCLUSION

Histo-pathological examination of kidneys revealed that cloudy degeneration and acute tubular necrosis were the hallmark changes seen in renal architecture in burn patients which are most prominent at 3-7 days after sustaining burn injuries. This reflects the role of immediate management provided to the patient where timely and effective fluid restoration may change the course of prognosis of different patients. Extent of burn was found to affect the duration of survival as also evident from earlier studies and both contribute independently to histo-pathologic alterations of kidney.

Hence it is correct to say that if kidneys are prevented from any damage by appropriate measures especially in the initial period after burn injury the likelihood of the patient survival is increased remarkably. Nephrotoxic drugs in burn patients should never be used. In routine medico-legal autopsies of burn deaths histo-pathological examination of the kidneys should be encouraged to establish the cause of death. Further studies to establish clinical correlation with histo-pathological examination of kidneys should be carried out to determine the clinical alteration in relation to renal deterioration to formulate guidelines for effective management and reduction of mortality in burn patients.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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