

A Study of Hematological Changes in Thermal Burn Patients at Tertiary Care Center in South Rajasthan

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Abstract: Burn injuries are among the most destructive of all injuries and a major global public health problem. The pathological changes produced in the circulatory and respiratory systems are complex, and failure to understand their progress and therapeutic management can cause the patient further problems. It is well known that a severely burned patient presents the greatest dysregulation of homeostasis of any injury. The study was conducted to study the haematological changes in thermal burn patients and the relation of haematological changes to the management strategy and outcome of treatment. A Cross-sectional study was conducted in 50 patients of thermal burn admitted in the Burn Ward of M.B. Govt. Hospital, R.N.T. Medical College, Udaipur during the year 2014-16. The patient's detailed clinical history and examination was done according to proforma. All the patients were examined and underwent routine and hematological investigations. Haemoglobin and haematocrit showed progressive decrease after the initial increase. The total leukocyte count increased initially after burn. Those patients corrected hematological disorder shows improvement in mobility and less mortality. Therefore it is emphasized that hematological disorder after thermal burn should be corrected to decrease morbidity and mortality.

Keywords: Burn injuries, Ward, Udaipur, hematological, Haemoglobin, haematocrit.

INTRODUCTION

Burns are usually associated with the application of heat energy such as hot liquids, metals, gases, flames, radiations, electricity or chemicals which cause tissue damage.

Burn wounds can be classified into 6 groups based on the mode of injury:

- Scalds: damage from contact with hot liquids.
- Contact burn: damage from contact with hot or cold solid material.
- Flame: damage from superheated oxidized air.
- Chemical: contact with noxious chemical.
- Electrical: Conduction of electrical current through tissues.
- Radiation: damage from radiation.

In MBGH mainly three type burn patients are admitted Flame, electrical & Scald. According to the depth burn are classified as

- First degree: Injury localized to the epidermis.
- Second degree :
- Superficial second degree: Injury to the epidermis & superficial dermis.

- Deep second degree: Injury through the epidermis & deep into the dermis.
- Third degree: Full thickness injury through the epidermis, dermis into subcutaneous fat.
- Fourth degree: Injury through the skin & subcutaneous fat into underlying muscle or bone.

Burn injuries are among the most destructive of all injuries and a major global public health problem. The pathological changes produced in the circulatory and respiratory systems are complex, and failure to understand their progress and therapeutic management can cause the patient further problems. It is well known that a severely burned patient presents the greatest dysregulation of homeostasis of any injury. Muir[1] has shown that a general relationship exists between the extent of deep burn and the amount of red cell destruction. Baxter[2] observed a shorter life span of red blood cells. Enremus[3] reported that 10% of the total red cell mass is injured during the burn process.

All these changes have been attributed to the presence of some type of detrimental plasma factor, because when the red cells are injected into a normal person they survive a normal length of time. Also, the serum of burn patients contains a substance that inhibits erythropoiesis.

Peripheral blood phagocytic cells (granulocytes and monocytes) may also be influenced, with serious consequences for infection resistance, which is known to deteriorate in burn injury.

Thrombocytopenia is almost universal in bacterial infections associated with bacteraemia and is usually the result of increased platelet consumption. The reduced platelet count may be an isolated finding or it may be associated with disseminated intravascular coagulopathy. Thrombocytopenia usually occurs early and can be an early indication of bacteraemia in burn patients.

MATERIALS AND METHODS

A Cross-sectional study was conducted in 50 patients of thermal burn admitted in the Burn Ward of M.B. Govt. Hospital, R.N.T. Medical College, Udaipur during the year 2014-16. The patient's detailed clinical history and examination was done according to proforma. All the patients were examined and underwent routine and hematological investigations. All patients who had thermal burn were included and burn other than thermal burn was excluded e.g. electric burn, chemical burn, etc.

All patients were evaluated, detailed clinical study including the mechanism of burn injury, age distribution, duration of hospitalization, treatment, surgical intervention and severity of injury, associated injuries and complications in relation to the patients' demographic characteristics was recorded. After hospitalization of each burn patient, resuscitation was performed using the Parkland formula and resuscitation was undertaken along with monitoring of vital parameters. Blood samples were taken from patient at the time of admission, 3rd day, 6th day, 9th day and 15th day for hemogram. If any surgical intervention required then it was done.

RESULTS

In this study this prospective study was conducted in 50 patients of thermal burn, admitted in burn unit of MBGH, Udaipur from the year of 2014 & onward.

A thorough clinical examination was done in all patients. In clinical examination the main emphasis was given All patients are evaluated by detailed clinical study including the mechanism of burn injury, age distribution, duration of hospitalization, treatment, prognosis, surgical intervention and severity of burn injury, associated injuries and complications in relation to the patient's demographic characteristics were recorded. After hospitalization of each burn patient, resuscitation was performed using the Parkland formula and this resuscitation was undertaken along with monitoring of vital parameters. Blood samples were taken from the patients at the time of admission, 3rd day, 6th day, 9th day and 15th day for hemogram.

Table-1: Age and gender wise distribution

S.No.	Age group (years)	Male	Female	Total	%
1.	≤ 5	1	2	3	6
2.	>5-10	2	1	3	6
3.	>10-20	3	7	10	20
4.	>20-30	11	8	19	38
5.	>30-40	6	3	9	18
6.	>40-50	1	2	3	6
7.	>50-60	3	0	3	6
	Total	27	23	50	100

In thermal burn patients out of 50 patients, 27 patients were male and 23 patients were female. Out of 50 patients, 12% patients were >5-10 years, 20%

patients were >10-20 years, 38% patients were >20-30 years, 18% patients were >30 years and 12% patients > 40 years.

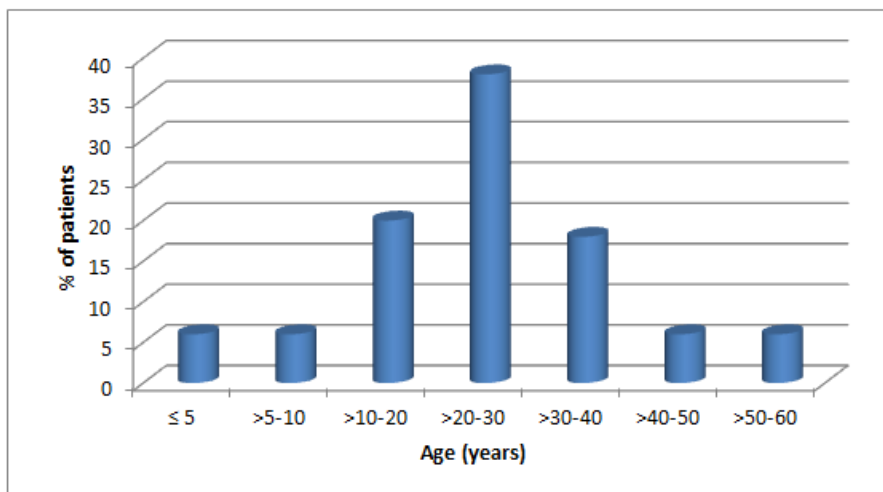


Table-2: Type of burn

S.No.	Type of burn	No.	%
1.	Thermal	48	96
2.	Scald burn	2	4
	Total	50	100

Out of 50 patients 96% patients showed thermal burn 4% patients showed scald burn.

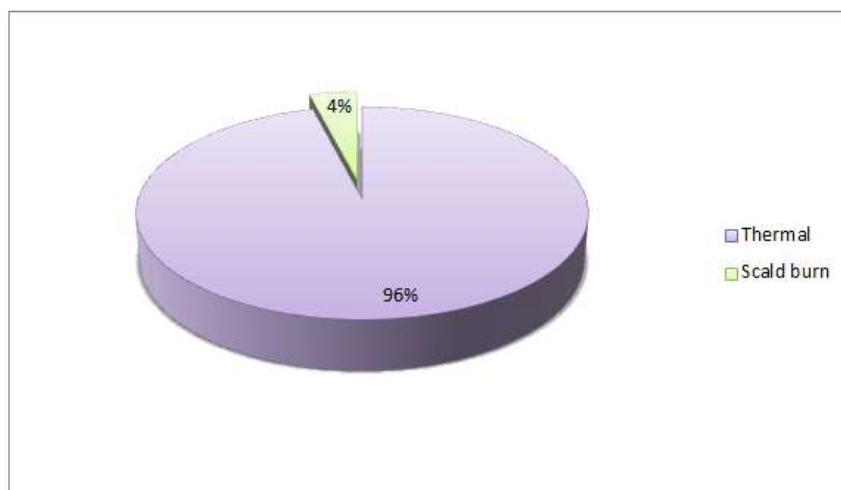


Table-3: Per cent burn

	0-10%	>10-20%	>20-30%	>30-40%	>40-50%	>50-60%	>60-70%	>70-80%	>80-90%	>90%
Male (n=27, 54%)	1 (3.70%)	5 (18.5%)	6 (22.2%)	2 (7.40%)	10 (37.04%)	2 (7.40%)	1 (3.70%)	0	0	0
Female (n=23, 46%)	3 (13.04%)	1 (4.35%)	4 (17.39%)	5 (21.74%)	2 (8.69%)	2 (8.69%)	0	3 (13.04%)	2 (8.69%)	1 (4.35%)
Total (n=50,100%)	4 (8%)	6 (12%)	10 (20%)	7 (14%)	12 (24%)	4 (8%)	1 (2%)	3 (6%)	2 (4%)	1 (2%)

In thermal burn patients it was observed that out of 27 male patients 37.04% patients had >40-50% burn and out of 23 female patients 21.74% patients had

>30-40% thermal burn. 6 females (26.08%) had more than >70% thermal burn however none of the male patients had >70% thermal burn.

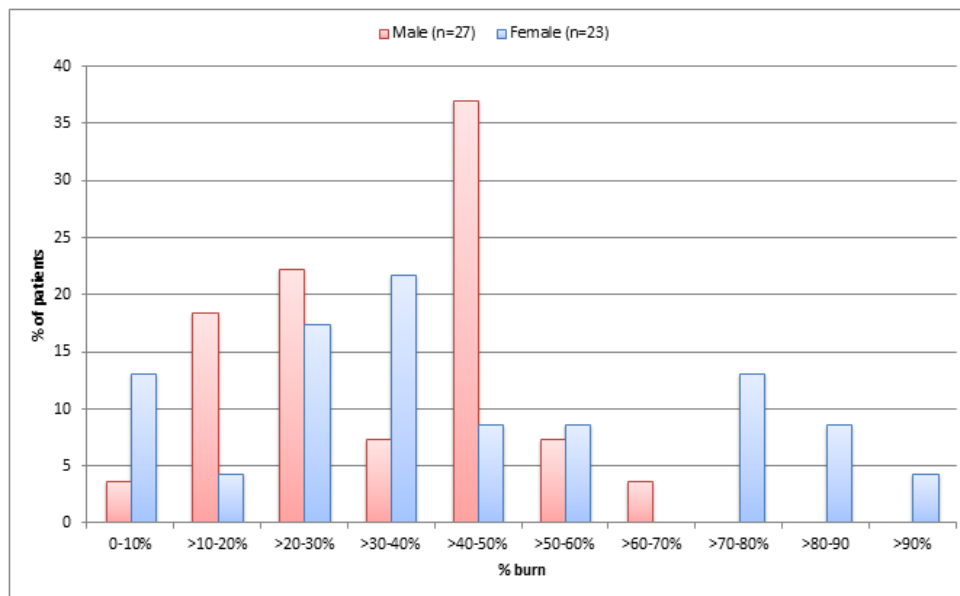


Table-4: Haemoglobin change in thermal burn patients

Hb (g/dl)(10-13)	On admission (n=50)		>3 days (n=33)		>6 days (n=13)		>9 days (n=6)		>15 days (n=4)	
	N	%	N	%	N	%	N	%	N	%
≤5	0	0	0	0	0	0	0	0	0	0
>5-7	0	0	0	0	1	7.69	1	1.67	1	25
>7-10	4	8	12	36.36	5	38.46	3	50	1	25
>10-13	14	28	16	48.48	6	46.15	2	33.33	2	50
>13-16	19	38	5	15.15	1	7.6	0	0	0	0
>16	13	26	0	0	0	0	0	0	0	0
Total	50		33		13		6		4	
Mean	14.312		11.07		10.12		9.083		9.325	

N= No. of patients

In thermal burn patients it was observed that 64% patients showed increase level of haemoglobin on day of admission and 15.15% patients showed increase level of haemoglobin on 3rd day. The mean

haemoglobin on admission and after 3rd day, 6th day, 9th day, 15th day of admission was 14.312, 11.07, 10.12, 9.083, 9.325 respectively.

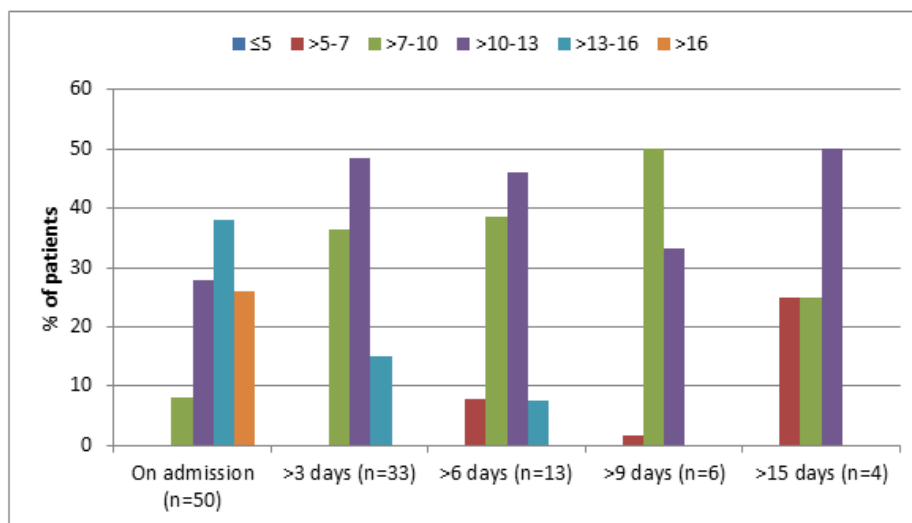


Table-5: Haematocrit change in thermal burn patients

Haematocrit (35-45%)	On admission (n=50)		>3 days (n=33)		>6 days (n=13)		>9 days (n=6)		>15 days (n=4)	
	N	%	N	%	N	%	N	%	N	%
<25	0	0	1	3.03	1	7.7	1	16.66	1	25
>25-34	3	6	14	42.42	8	61.54	4	66.67	3	75
>34-45	23	46	15	45.45	4	30.77	1	16.67	0	0
>45-55	16	32	2	6.06	0	0	0	0	0	0
>55	8	16	1	3.03	0	0	0	0	0	0
Total	50		33		13		6		4	
Mean	45.31		35.88		32.37		30.7		27.88	

In thermal burn patients it was observed that 48% patients had increase level of haematocrit on day of admission. On 3rd, 6th, 9th & 15th day of admission 42.42%, 61.54%, 66.67% & 75% patients showed

decrease level of haematocrit respectively. The mean hematocrite on day of admission and after 3rd day, 6th day, 9th day, 15th day was 45.31, 35.88, 32.37, 30.7, 27.88 respectively.

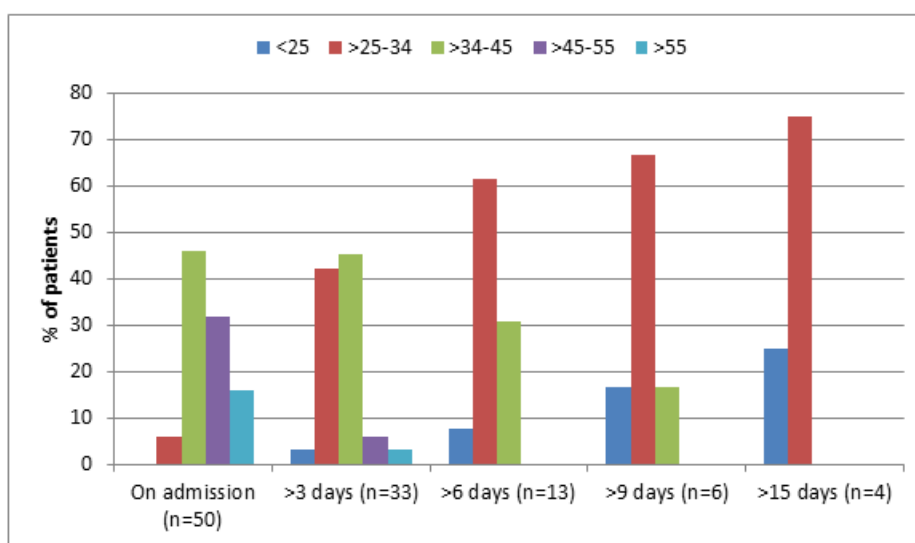


Table-6: TLC change in thermal burn patients

TLC (10 ³ /μL) (6-11 x 10 ³ /μL)	On admission (n=50)		>3 days (n=33)		>6 days (n=13)		>9 days (n=6)		>15 days (n=4)	
	N	%	N	%	N	%	N	%	N	%
1-2	1	2	2	6.06	1	7.69	0	0	0	0
>2-5	1	2	2	6.06	1	7.69	1	16.66	0	0
>5-10	11	22	18	54.54	8	61.53	3	50	4	100
>10-15	14	28	8	24.24	2	15.38	1	16.66	0	0
>15-25	16	32	2	6.06	1	7.69	1	16.66	0	0
>25	7	14	1	3.03	0	0	0	0	0	0
Total	50		33		13		6		4	
Mean	15.28		9.444		8.721		9.998		7.1	

In thermal burn patients it was observed that 74% patients showed >10000/dl TLC on day of admission. On 3rd, 6th, 9th, and 15th days of admission showed 33%, 23.07%, 33.32%, & 0% patients showed

>10000/dl TLC respectively. The mean total leucocyte count on day of admission, after 3rd day, 6th day, 9th day, 15th day of admission was 15.28, 9.444, 8.721, 9.998, 7.1 respectively.

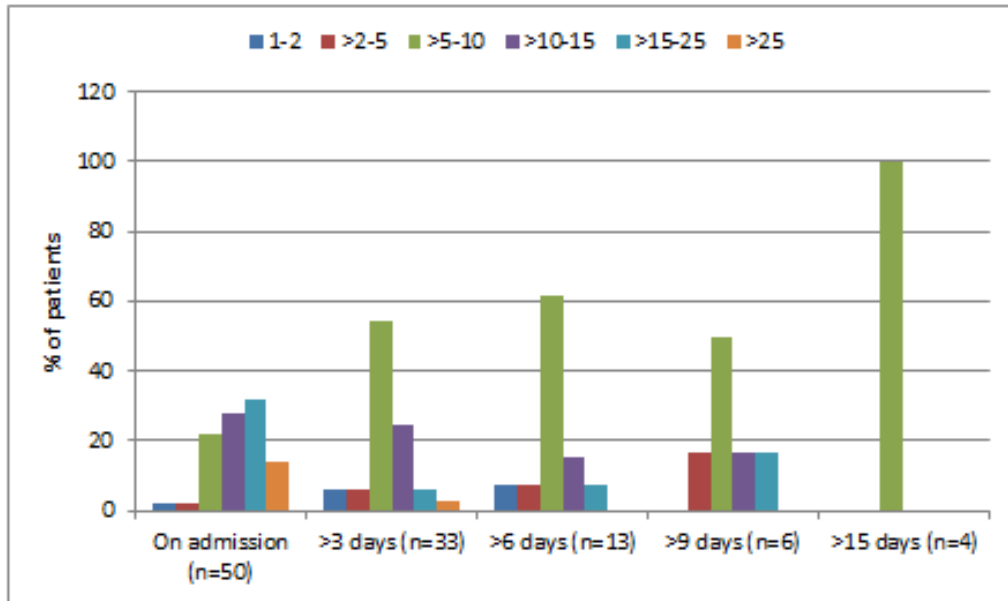
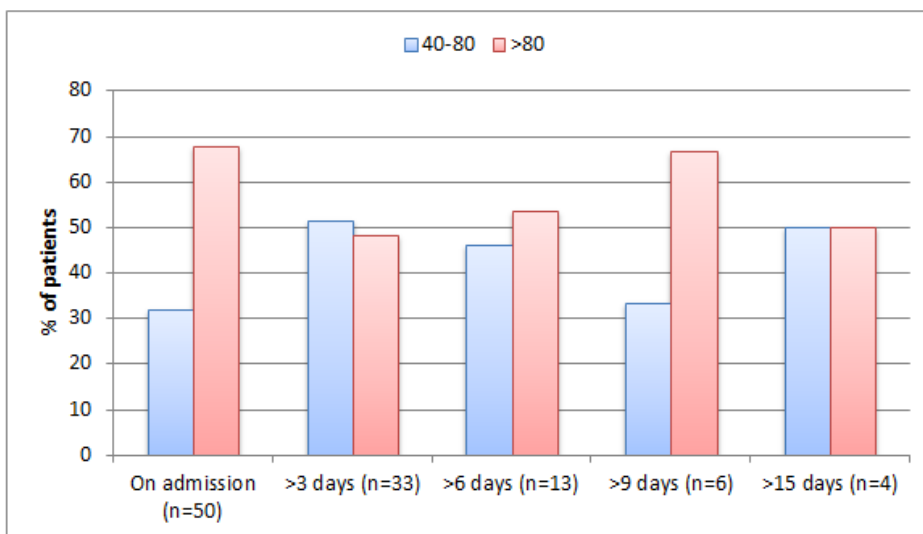


Table-7: Differential Leukocyte Count (granulocyte) In Thermal Burn Patients

DLC (40-80%)	On admission (n=50)		>3 days (n=33)		>6 days (n=13)		>9 days (n=6)		>15 days (n=4)	
	No. of patients	%	No. of patients	%	No. of patients	%	No. of patients	%	No. of patients	%
40-80	16	32	17	51.52	6	46.15	2	33.33	2	50
>80	34	68	16	48.48	7	53.85	4	66.67	2	50
total	50		33		13		6		4	
Mean	80.26		77.96		78.56		80.05		79.85	

In thermal burn patients it was observed that out of 50 patients on admission 16 patients (32%) showed normal granulocyte count, out of 33 patients 51.52% patients showed normal granulocyte count on 3rd day. 6th, 9th, 15th days 46.15%, 33.33%, 50% patients showed normal granulocyte count respectively. Out of

50 patients 68% patients showed raised granulocyte counts on days of admission. The mean differential leucocyte count on day of admission and after 3rd day, 6th day, 9th day and 15th day was 80.26, 77.96, 78.56, 80.05, 79.85 respectively.



In our study it was observed that 27 patients (54%) had septicaemia in which 13 male and 14 female patients. On day of admission the mean % burn, mean haemoglobin, mean hematocrit, mean total leucocyte count, was 54.92, 15.14, 47.94, 18.14, respectively. 12 patients (24%) had acute renal failure in which 5 male and 7 female patients. On day of admission the mean % burn, mean haemoglobin, mean hematocrit, mean total leucocyte count, was 53.1%, 16.2, 50.68, 19.67, respectively. 6 patients (12%) had mortality in which 1 male and 5 female patients. On day of admission the mean % burn, mean haemoglobin, mean hematocrit, mean total leucocyte count, was 60.5%, 15.11, 52, and 19.89, respectively. In our study it was observed that out of 50 patients the mortality was 6 in which 5 were female and 1 was male. In death patient's % burn was minimum 40 and maximum was 98. Most of the death patients showed high level of haemoglobin and haematocrite due to hemoconcentration. All patients showed high level of total leukocyte counts. Two (2, 4) patients showed high level of granulocyte count.

DISCUSSION

According to the study, thermal burn occurred more in male i.e. 54% as compared to 46% female. The finding of this study is contrary to finding of El-Sonbaty *et al.* [4] who observed that females outnumbered males i.e. 60% & 40% respectively.

In a study conducted by Belba *et al.* [5] on 162 patients of thermal burn in which male was 107(66%) and female was 55(34%).

Another study conducted by Sahib *et al.* [6] on 96 patients of thermal burn in which male was 45 (46.87%) and female was 51(53.13%).

In a study conducted by Fatin F Alkazaz *et al.* [8] on 27 patients of thermal burn in which male was 9 (33.3%) and female was 18 (66.6%).

In a study conducted by Vishnu Dutt Bohra *et al.* [10] on 105 burn patients who observed that males outnumbered females i.e. 58% & 42% respectively.

The incidence of thermal burn was maximum in >20-30 years (38%), followed by >10-20 years (20%) >30-40years (18%), <5years (6%),>5-10years (6%), >40-50years (6%), >50-60years (6%) age group.

In our study the minimum age of patient who suffered from thermal burn was 2year and maximum age was 60 year.

A study conducted by Sahib *et al.* [6] on 96 patients of age group of 18 to 45 years. Another study conducted by Adiga U *et al.* [7] on 30 patients of thermal burn of age group <18years.

In a study conducted by Fatin F Alkazaz *et al.* [8] on 27 patients of thermal burn. Their age group were 0-19 year (22.2%) , 20-39 year (48.1%), 40-59 year (25.9%) and >60 year (3.7%) .

In a study conducted by Muhammad Obaid Al-Muhammadi [9] on 125 patients the age of these patients were divided as follows: the first group (1- < 3years), the second group (3 - < 5 years), the third group (5-<10 years), the fourth group (10- <18 years),and the fifth group (18-58 years old).

Another study conducted by El-Sonbaty *et al.* [4] included 30 patients. Their ages varied between 17 and 47 years.

In a study conducted by Vishnu Dutt Bohra *et al.* (2015)¹⁰ on 105 burn patients. The age of these patients were divided as follows: the first group (< 20 years) 32%, (21-40 years) 55%, (41-60 years) 16%, (> 60 years) 2%.

In our study it was observed that 64% patients showed increase level of hemoglobin on day of admission & 15.15% patients showed increase level of hemoglobin on 3rd day of admission.7.6% patients showed increase level of hemoglobin after 6th days. None of patients had >13gm/dl hemoglobin after 9th days. After that there was progressive anemia after the initial haemoconcentration phase. The mean haemoglobin on admission and after 3rd day, 6th day, 9th day, 15th day of admission was 14.312, 11.07, 10.12, 9.083, 9.325 respectively.

The similar result was found in study conducted by El-Sonbaty M.A. *et al.* [4] on 30 patients that hemoglobin concentration showed high level immediately after the burn. This high level decreased gradually by day 4 post burn.

An another study conducted by Lawrence R. Schwartz *et al.* [11] showed that decrease level of hemoglobin after burn injury. A study conducted by Nakagawa T *et al.* [12] showed hypercoagulability in post burn patients.

A study conducted by Kim *et al.* [13] showed that hemoglobin began to increase immediately after burn injury and hemoglobin concentration dramatically changes within the first 72 hour after burn injury

In a study conducted by Muir [1] has shown that a general relationship exist between the extent of deep burn and the amount of red cell destruction. He observed that in deep burn of over 30% surface area this is often associated with early haemoglobinaemia.

Another study conducted by Enremus K [3] observed that 10% of total red cell mass is injured during the burn process. A study conducted by Wallner

et al. [14], showed that anemia is invariably seen in patients who have been severely burned.

In our study it was observed that 48% patients had increase level of hematocrit on day of admission. On 3rd, 6th, 9th and 15th days of admission 42.42%, 61.54%, 66.67%, 75% patients showed decrease level of hematocrite respectively. The mean hematocrite on day of admission and after 3rd day, 6th day, 9th day, 15th day was 45.31, 35.88, 32.37, 30.7, 27.88 respectively.

The similar result was found in study conducted by El-sonbaty M.A. [4] in 30 patients showed initial raised hematocrite on the day of admission and 4th post burn day followed by decrease in hematocrite value after that.

Another study conducted by Lawrence R. Schwartz [11] showed increase of packed cell volume in burn patients.

In a study conducted by Ahmed A *et al.* [15] in 118 burn patients showed initial increase of hematocrite and decrease in hematocrite after 7th post burn day. In our study it was observed that 74% patients showed >10000/dl TLC on day of admission. After 3rd, 6th, 9th and 15th days of admission showed 33%, 23.07%, 33.32% and 0% patients showed >10000/dl TLC respectively. The mean total leucocyte count on day of admission, after 3rd day, 6th day, 9th day, 15th day of admission was 15.28, 9.444, 8.721, 9.998, 7.1 respectively.

Similar results were found in a study conducted by Anandani [16] that showed increase level of TLC in post burn patients. Another study conducted by El-sonbaty *et al.* [4] showed highly significant leukocytosis in survivors.

Belba *et al.* [15] also stated that dramatically changes in leukocyte count during the clinical course of post burn patients.

Kim *et al.* [13] also showed that leukocyte count began to increase immediately after burn and stated that there was dramatic change in leukocyte count within 72 hours after burn injury.

In our study, it was observed that out of 50 patients on admission, 16 patients (32%) showed normal granulocyte counts, out of 33 patients, 51.52% patients showed normal granulocyte counts after 3rd day of admission. 6th, 9th, 15th days 46.15%, 33.33%, 50% patients showed normal granulocyte count respectively. Out of 50 patients 68% patients showed raised granulocyte counts on days of admission. The mean differential leucocyte count on day of admission and after 3rd day, 6th day, 9th day and 15th day was 80.26, 77.96, 78.56, 80.05, 79.85 respectively.

The Anandani[16] also stated that significant increase in differential leukocyte count (granulocyte count) in post burn patients. Another study conducted by D'Alesandro M.M. *et al.* [17] showed increase number of PMNs and decreased lymphocytes through 28 days.

CONCLUSION

Thermal burn occurred more in male sex. The incidence was maximum in 20-30 age group. Haemoglobin and haematocrit showed progressive decrease after the initial increase. The total leukocyte count increased initially after burn. When the TLC on higher side at the time of admission and percentage of burn more than 50%, there was more likelihood of developing septicaemia. At the time of admission, when the burn was more than 60%, increased TLC the mortality was found to be more.

REFERENCES

1. Muir LF. Red cell destruction in burns, with particular reference to the shock period, Br J Plast surg 14:273, 1966.
2. Baxter CR. Problems and complications of burn shock resuscitation. Surg. Clin. North Am., 58:1313-22, 1979.
3. Eurenus K. Hematologic changes in burns. Burns: a team approach. Saunders, Philadelphia. 1979;132.
4. El-Sonbaty MA, El-Otiefy MA. Haematological change in severely burned patients. Ann Burns Fire Disasters. 1996;9(4):206-15.
5. Belba M, Aleski A, Nezha I, Filaj V. Impact of severe burns in hematological parameters. AJ MHS 46(3):59-69, 2015.
6. Sahib AS. Dyslipidemia after thermal burn injury. Asian Journal of Pharmaceutical and Clinical Research. 4(4), 2011.17
7. Adiga U, Adiga S. Biochemical changes in thermal burn patient. International Journal of Research Studies in Biosciences. 3(7):88-91, 2015.
8. Fatin F Alkazaz, Sura A Abdulsattar, Farred MA Farred and Shahad J Mahmood. Risk factor of metabolism alteration in burn patients. 8(3):3057-3060, October 2014.
9. Muhammad Obaid Al-Muhammadi and Hayder Abdul Hussein Azeez. Some Physiological changes in burns patients. Medical Journal of Babylon. 8(3):303-17, 2011.
10. Vishnu Dutt Bohra, Deepti Gautam. Study of Metabolism Alteration in Burn Patients. 5(12), December 2015.
11. Lawrence R Schwartz, Chenicheri Balkrishnan. Thermal Burns; McGraw Hill Publishing Division, New York. 2004.
12. Nakagawa T, Saito H, Watanabe Y, Sato, Murakawa E. Coagulation and fibrinolysis parameters in disseminated intravascular

- coagulation (DIC). *Rinsho Byori.* 39(3):309-14, 1991.
13. Kim HS, Kwon HW, Yang HT, Chun W, Shin KS, Lee YK, Park JY, Cho HC, Lee KM. A Serial Study of Hematologic Change in Burned Patients. *Journal of Laboratory Medicine and Quality Assurance.* 2011 Jun 1;33(1):9-16.
 14. Wallner SE, Veturin RM, Seerk C, Robinson WA, Peterson JM. The anemia of thermal injury: Study of erythropoiesis *in vitro.* *J Trauma* 22:774-780, 1982.
 15. Ahmed A. Al-kaisy, S Sahib, Haedar A AL-Biati. Anemia After Thermal Injury: Role of oxidative stress. *J Med J* 46(1): 28-32, 2012.
 16. Anandani JH. Impact of thermal injury on hematological and biochemical parameters in burnt patients. *Biosci. Biotech. Res. Comm* 3(1):97-100, 2010.
 17. D'Alesandro MM, Gruber DF. Quantitative and functional alterations in peripheral blood neutrophils after 10% and 30% thermal injury. *J Burn Rehabil.* 11:295-300, 1990.