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ANALYSIS OF THE HEPATIC DYSFUNCTION IN BURNS PATIENTS

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Abstract

Introduction: In this study we have made a prospective analysis of the hepatic dysfunction in burns patients bymeans of liver function tests. Our study aims to analyse the hepatic dysfunction in burns patients by means of liver function tests and to study the changes of liver function tests depending on the degree of burns, to test the correlation between severity of burns & changes in liver enzymes, and to assess prognosis of burns patients on the basis of liver function tests.

Material & Methods: A longitudinal study conducted on 100 patients at a tertiary care centre, Medical College, Thrissur in the Department of General Surgery from 2010 August - 2011 August. Patients above 12 years of age who are admitted with thermal injury and survived more than 48 hours were included in our study. Patients below 12 years of age, patients with pre-existing liver disorder or past history of jaundice, patients who survived less than 48 hours, patients with burns due to electricity or chemicals, associated with poisoning and patients who had taken discharge at request for favour of treatment in other hospitals were excluded. Prognostic burn index and burn index of the patients were calculated. Burn index was calculated as half the area of superficial burns plus the area of body with third degree burns. Prognostic burn index is the sum of age in years and burn index.

Results: In 100 thermal injury patient's liver function tests were done after 48 hours of burn injury. The results were analysed using statistical methods. The mean age of the patients was 32.41, the mean percentage of burns being 55.12. The male to female ratio was 9:91. All patients above 50% burns expired and those below 40% survived. In the 40-50% group half survived half expired. The expired patients showed mean survival of 11.92 days. 98% patients showed changes in liver function tests from normal standardized laboratory values. The changes in liver function tests with regard to percentage of burns, burn index and prognostic burn index were studied by regression analysis.

Conclusion: In this study it was revealed that thermal injury patients show liver function test changes after the first 48 hours of the insult. This may be due to the burns shock and the toxic products and inflammatory mediators producing hepatocellular damage immediately after the burns More sensitive and specific tests of liver function has to be undertaken to clearly delineate the amount and nature of hepatocellular damage occurring secondary to thermal injury.

Key words: Burn index, Thermal injury, Hepatic dysfunction, Liver enzymes, Prognosis

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INTRODUCTION

Thermal injury is one of the most severe forms of trauma that humans can sustain. Millions of people around the world are hospitalised for treatment of burns every year and thousands of these people die.[1]Recovery from the threat to life of major burn is only the first step in a lifetime of adjustment. After initial recovery burn patients often face compromised functional capacities and deformities that may prevent them from leading what we consider a normal life. [2] The personal tragedy is compounded by the economic loss of the burn

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victims' contributions to the community and society. Fifty percent of major burns occur during the formative and productive years. Their care is extensive and frequently lead to permanent disabilities. The management of burns needs well equipped burn centres and other facilities, which demand a lot of economic commitment. [3]In the developing countries like India burns still carries a high risk of mortality. Situation in Kerala is also not different through the overall health status in Kerala is better compared to the statistics in other parts of India. Lack of pre hospital management and proper resuscitation facilities in the peripheral health centres, meagre facilities for burn care even in the tertiary care set up and the poor socio- economic status of the majority of patients together produce poor results.[4] Setting up of a well- equipped Referral Burn Centre with a trained team with good economic support from the Government and non-governmental agencies and strengthening of peripheral health care facilities can produce promising results in burn management.[5]In the 1940s and 1950s inadequate fluid resuscitation during the immediate hours after a burn injury resulted in 20-40% of deaths among the patients.[6] With the advent of vigorous fluid resuscitation in the 1960s and 1970s irreversible burn shock has been replaced by sepsis as the leading cause of death in the burns population.[7] The development of topical and systemic antimicrobial agents, advances in nutritional support for the hyper metabolic response and the use of surgical techniques for earlyburn wound excision have now improved the rate of survival.[8]The natural history of burns was clearly described by Sir George Ballingal of Edinburgh as early as 1833. Writing about early death he stated, "He sinks from cause, which we cannot explain." The deaths that occurred at 10-12 days post burn he recognised as being febrile in nature and later deaths occurring 3 to 6 weeks after the burns as "sinking in a hectic state, exhausted by profuse discharge of matter from an extrinsic suppurating surface." The early deaths are mainly due to shock and inadequate resuscitation and late deaths due to sepsis, which may be wound sepsis or pulmonary sepsis. [9] Shock and sepsis ultimately lead to the multi organ dysfunction syndrome. Thenewresearches in the systemic inflammatory response and the multi organ dysfunction have given a new impetus to the research and management of burns injuries. [10]In this study we have made a prospective analysis of the hepatic dysfunction in burns patients by means of liver function tests. In burns patients, liver function is impaired as part of multi system failure. This occurs either in the initial shock phase or later due to infection or septicaemia. [11, 12] The involvement of liver as a part of septicaemia is well documented. The situation is not different in burn wound sepsis also. Here we focus on analysing the liver function changes in burns due to the shock phase. [13, 14] Our study aims to analyse the hepatic dysfunction in burns patients by means of liver function tests and to study the changes of liver function tests depending on the degree of burns, to test the correlation between severity of burns & changes in liver enzymes, and to assess prognosis of burns patients on the basis of liver function tests.

MATERIALS AND METHODS

A longitudinal study conducted on 100 patients at a tertiary care centre, Medical College, Thrissur in the Department of General Surgery from 2010 August - 2011 August. The cases were burns patients admitted in different surgical units in the Department of General surgery, Medical College, Thrissur. Patients above 12 years of age who are admitted with thermal injury and survived more than 48 hours were included in our study. Patients below 12 years of age, patients with pre-existing liver disorder or past history of jaundice, patients who survived less than 48 hours, patients with burns due to electricity or chemicals, associated with poisoning and patients who had taken discharge at request for favour of treatment in other hospitals were excluded.

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RESULTS

In 100 thermal injuriy patient's liver function tests were done after 48 hours of burn injury (Table 1).

Table 1: Distribution of study participants according to percentage of burns

Percentage of burns	Number	Male	Female
20-29	9	1	8
30-39	19	3	16
40-49	20	2	18
50-59	5	1	4
60-69	17	2	15
70-79	14	0	14
80-89	6	0	6
90-99	10	0	10

The results were analysed using statistical methods. The mean age of the patients was 32.41, the mean percentage of burns being 55.12 (Table 2).

Table 2: Distribution of study participants according to descriptive variable

Variable	Mean	Standard deviation	Minimum	Maximum
Age	32.41	13.54	13	75
Percentage of burns	55.12	20.95	20	98
Burn index	41.40	19.29	10	88
Prognostic burn index	73.81	23.53	29.5	150
Serum bilirubin	0.865	0.23	0.6	1.4
Serum total protein	4.76	0.73	3.8	6.6

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Serum albumin	2.58	0.52	1.8	4
SGOT	138.24	42.76	16	225
SGPT	59.9	23.11	24	122
Serum alkaline phosphatase	86.19	40.80	36	240
Days of survival	11.92	8.15	2	35

The male to female ratio was 9:91. All patients above 50% burns expired and those below 40% survived. In the 40-50% group half survived half expired. The expired patients showed mean survival of 11.92 days. 98% patients showed changes in liver function tests from normal standardized laboratory values (Table 3).The changes in liver function tests with regard to percentage of burns, burn index and prognostic burn index were studied by regression analysis.The changes in liver function tests with regard to percentage of burns, burn index and prognostic burn index were studied by regression analysis.Change of serum bilirubin with percentage of burns, burn index and prognostic burn index showed a linear relation on regression analysis with significant p values and positive correlation (Table 3).

Table 3: Distribution of study participants according to changes in liver function test by regression analysis

	r	r^2	Coefficient	F	Value
Bilirubin vs burns	0.580	0.337	0.0063	49.73	$2.51x10^{-10}$
Bilirubin vs burn index	0.533	0.284	0.0063	38.83	$1.16x10^{-6}$
Bilirubin vs PBI	0.390	0.151	0.0038	17.49	$6.29x10^{-5}$
Total protein vs burns	-0.629	0.397	-0.0256	64.44	$2.21x10^{-12}$
Total protein vs burn index	-0.568	0.323	-0.0250	46.75	$6.95x10^{-10}$
Total protein vs PBI	-0.524	0.275	-0.0190	37.16	$2.14x10^{-8}$
Albumin vs burns	-0.600	0.368	-0.0150	57.04	2.26x10-11
Albumin vs burn index	-0.580	0.330	-0.0156	48.71	3.54x10-10

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Albumin vs PBI	-0.480	0.230	-0.0100	29.35	$4.32x10^{-7}$
SGOT vs burns	0.560	0.314	1.1440	44.92	$1.31x10^{-9}$
SGOT vs burn index	0.499	0.249	1.1060	32.53	$1.24x10^{-7}$
SGOT vs PBI	0.409	0.167	0.7430	19.69	$2.39x10^{-5}$
SGPT vs burns	0.609	0.371	0.6720	57.80	$1.77x10^{-11}$
SGPT vs burn index	0.584	0.341	0.6990	50.74	$1.78x10^{-10}$
SGPT vs PBI	0.498	0.249	0.4900	32.44	$1.29x10^{-7}$
Alkaline phosphatase vs burns	0.489	0.239	0.9520	30.77	$2.47x10^{-7}$
Alkaline phosphatase vs burn index	0.475	0.226	1.0050	8.59	$8.85x10^{-7}$
Alkaline phosphatase vs PBI	0.452	0.205	0.7840	25.20	$231x10^{-6}$

The decrease of total protein level showed a linear relation with the percentage of burns on regression analysis with a 0.63 correlation. Similar changes were noted with burn index and prognostic burn index but correlation was weaker than with percentage of burns. Decrease in Serum albumin level showed a linear relation with total percentage of burns on regression analysis. It showed a 0.60 correlation. Burn index and prognostic burn index merited the same relation but the correlation was weaker than that with percentage of burns. Increase of SGOT showed a linear pattern with percentage of burns on regression analysis and the correlation was 0.56. Burn index and prognostic burn index showed weaker correlation. On regression analysis SGPT showed a linear pattern with total percentage of burns. Correlation was 0.60. Burn index and prognostic burn index also showed similar changes but with weaker correlation. On regression analysis serum alkaline phosphataseshowed a 0.489 correlation value with percentage of burns. The correlations were even weaker with burn index and prognostic burn index (Table 4).

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Table 4: Distribution of study participants according to days of survival by regression analysis

	r	r^2	Coefficient	F	Value
Days of survival vs total protein	0.313	0.098	5.2100	6.53	$1.30x10^{-2}$
Days of survival vs serum albumin	0.380	0.150	8.2930	10.42	$2.02x10^{-3}$
Days of survival vs SGOT	-0.320	0.101	-0.0725	6.77	$1.20x10^{-2}$
Days of survival vs SGPT	-0.400	0.160	-0.1610	11.50	$1.3x10^{-3}$
Days of survival vs alkaline phosphatase	-0.260	0.065	-0.0490	4.19	$4.5x10^{-2}$
Days of survival vs % of burns	-0.796	0.634	-0.4290	104.14	$9.86x10^{-15}$
Days of survival vs burn index	-0.828	0.685	-0.4130	130.77	$1.05x10^{-16}$
Days of survival vs PBI	-0.660	-0.438	-0.2583	46.74	$4.74x10^{-9}$

SURVIVAL AND PROGNOSIS

Of the 100 thermal injury patient only 38% survived. The mortality was more in females when compared to males. The mean percentage of burns in the survived group of patients is 33.84 and that of the expired group is 68.16. Since their variances showed high difference, Man whitney test was applied (Table 5). The percentage of burns was found to be a significantly higher in the expired patients. Burn index and prognostic burn index also showed significant relation with outcome. But the percentage of burns showed a stronger correlation. The means of total protein, serum albumin, SGOT, SGPT and Serum alkaline phosphatase were estimated for both the survived and expired groups. Their significance were tested using‘t’ test. Man Whitmey test was applied for Serum albumin and Serum alkaline phosphatase where the variance was heterogeneous. All of them showed significant p values. The mean value of SGOT, SGPT and alkaline phosphatase were significantly higher in the expired group when compared with the survived group. The serum total protein and serum albumin were significantly lower in the expired group when compared with the survived group. The H value was in the descending order of SGPT, SGOT serum total protein, serum albumin and serum alkaline phosphatase. For the patients who expired, regression analysis was done for the relation of the days of survival and each of the parameters. All of them showed a linear relation with significant correlation. As the liver enzyme value increase, the days of survival decreased. The days of survival decreased as the total protein and serum albumin levels decreased. The days of survival showedsignificantcorrelation with total percentage of burns, burnindex and prognostic burnindex. The relation was strongest with burnindex followed by total percentage of burns and prognostic burnindex in the decreasing order of strength of correlation.

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Table 5: Distribution of study participants according to analysis of outcome

		0	Means	Variance	Mann Whitney test		T test	
					H	P value	t value	P value
Mean burns vs outcome	Survived	38	33.84	46.623	6.7.974	0.000000		
	Expired	62	68.16	229.121				
Mean burn index vs outcome	Survived	38	23.70	37.805	62.648	0.000000		
	Expired	62	52.41	277.234				
Mean PBI vs outcome	Survived	38	56.57	269.975	35.983	0.000000	6.981	$1x10^{-6}$
	Expired	62	84.54	443.879				
Mean total protein vs outcome	Survived	38	5.32	0.528	36.913	0.000000	6.502	$2x10^{-6}$
	Expired	62	4.37	0.499				
Mean albumin vs outcome	Survived	38	2.95	0.271	28.776	0.000000		0.000000
	Expired	62	2.35	0.143				
Mean SGOT vs outcome	Survived	38	104.71	917.24	40.272	0.000000	7.761	0.000000
	Expired	62	158.79	1281.38				
Mean SGPT vs outcome	Survived	38	42.16	226.95	44.116	0.000000	7.505	
	Expired	62	70.77	412.60				
Mean alkaline phosphatese vs outcome	Survived	38	63.53	580.20	22.960	$2x10^{-8}$		
	Expired	62	100.08	1833.1				

DISCUSSION

Changes of liver function occur in thermal injury patients mainly on two situations of dry burn shock or during sepsis as a part of complications. In both these situations the patients can go into multi-organ dysfunction. Microscopic as well as functional changes of liver have been extensively studied in the thermally injured. All types of hepatic metabolism showed variations, which was manifested through alteration of the indices of liver function tests. Liver cell energetic studies in experimental animals also showed a reduction. Microscopic studies showed degeneration and necrosis of hepatic cells and proliferation of Kupffer cells. Mitochondrial changes which occur are cristolysis, intramitochondrial vacuolization, total vascular changes of mitochondria etc. [15, 16]

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Obvious increase in serum TNF activity and liver enzymes and a reduction in total proteins and albumin fraction were demonstrated in thermal injury patients. [17] The plasma protein profile of the thermal injury patients showed phasic variation. The autopsy studies of thermal injury patients also showed involvement of liver in 37.5% of cause.[18] Liver function assessment studies include tests for hepatocellular damage and tests for each of its functions like metabolism, synthesis, secretion and biliary secretion.[19,20] There is no single tests to study all the functions. Most of them are not specific or sensitive. A series of tests are employed for assessment of liver function. Biopsy of liver will reveal microscopic changes in the liver.

In this study I used serum bilirubin, SGOT, SGPT, serum alkaline phosphatase, serum total proteinand serum albumin levels in plasma to assess the liver function. SGOT & SGPT are not specific for liver, but SGPT occur in much higher concentration in the liver than elsewhere and consequently increased SGPT reflects hepatic damage more specifically. [20]

Alkaline phosphatase level rises when liver cells are damage. Serum total protein and serum albumin levels assess the synthetic function of liver.Dynamicsofliverfunctioncanbestudiedbyresidualnitrogen,Quick-Pyteltest,lipidprofile,sedimentation reaction, ATP content and tissue charge potential. [21, 22] Ultrastructure status of liver cells also help in assessing the liver cell changes. These tests can bring out even minor changes in the liver function and hepatocyte damage. [23]

In the study females were mostly affected by burns. The total survival of patients was 38%. All burns more than 50% died. In the 40-50% group there were 10 survivors and 10 mortalities. All below 40% survived. The liver function tests showed marked variations. Serum bilirubin was raised in 22%. SGOT was raised in 99% and SGPT raised in 77%. Serum alkaline phosphatase was raised in 12 % only. Serum total protein was decreased in 92% and serum albumin was decreased in 93% of cases. Any one of the enzyme changes was seen in 98% of patients.The enzyme changes have a linear increase with the percentage of burn, burn index and prognostic burn index, but the correlation was stronger with total percentage of burns. This rise in enzyme changes indicates hepatocellular damage secondary to thermal injury. [24] Part of this rise in enzyme level may be contributed by the effects of thermal injury on other organs and muscles. Total protein and albumin were decreased with increasing percentage of burns, burn index and prognostic burn index. Here also correlation was stronger with percentage of burns than with other indices. In this study the serum levels were estimated 48 hours after injury and so the reduction in total protein and serum albumin cannot be considered a good indicator of reduction in synthetic activity of the liver, since it manifests later. [25] But animal studies after 24 hours post burn with levels of mRNA extracts from liver have shown reduction in albumin is mainly contributed by the plasma loss and hyper catabolism secondary to the thermal injury. Serum bilirubin showed increase from normal limits in 22% of patients. There was 100% mortality in that group. The rise in serum bilirubin definitely indicates hepatocellular damage. [26]The liver function tests values were found to be very much related to the prognosis of the patient. Increased values of liver enzymes and decreased values of serum albumin and total protein were seen in the expired group when compared to the survived group. In the expired patients they showed a strong correlation with the number of days of survival. The mean of total percentage of burns, burnindex and prognostic burn index were also found to be higher in the expired group when compared with that of survivors, the significance was greater with percentage of burns. In the expired patients the number of days of survival also had strong correlation with burn index, percentage of burns and prognostic burn index in that order.

In this study it was revealed that thermal injury patients show liver function test changes after the first 48 hours of the insult. This may be due to the burns shock and the toxic products and inflammatory mediators producing hepatocellular damage immediately after the burns More sensitive and specific tests of liver function has to be undertaken to clearly delineate the amount and nature of hepatocellular damage

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occurring secondary to thermal injury. Ultra structural changes in the liver have to be studied to further analyse the pathophysiology of the changes occurring in liver secondary to the thermal injury.

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