Original Article

Role of Heat Shock Protein 70 Expression in Identification of Death Due to Fatal Thermal Exposure

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ABSTRACT

Heat shock proteins (HSPs), are a group of proteins that function as intra-cellular chaperones for other proteins. They are expressed by cells in response to exposure to stress conditions. The aim of the present study was to evaluate the role of heat shock protein 70 (HSP70) expression as vitality marker in identification death due to fatal thermal exposure. This study was carried out on 21 cases of fire related fatalities (group I) and 21 cases of acute traumatic death without any evidence of antemortem thermal exposure (group II). All autopsy cases of group I were examined regarding the degree of burn, carbon soot aspiration and survival time. Carboxy hemoglobin (COHb) blood level was assessed. Immunohistochemical examination of sections from lungs, kidneys, heart and liver in all cases of both groups was done. Cases of group I showed significant strong positive HSP70 immunoreactivity (grade 3) in lung and kidney sections either with short or long survival time exposure when compared with cases of group II. Sections from heart and liver in both groups showed weak HSP70 immunoreactivity. There was no association between the degree of HSP70 expression and degree of burn, presence or absence of carbon soot and COHb blood concentration in group I. It was concluded that the immunohistochemical investigation of HSP70 expression in lungs and kidneys can support the proof of vitality in death due to fatal thermal exposure.

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Key words: Fatal thermal exposure, Vitality, Heat shock protein 70, Immunohistochemistry

I. INTRODUCTION:

It is mandatory to find out the cause as well as manner of death in cases of unnatural death (Madea and Argo, 2014). Fire related death is one of the most

challenging fatalities for examination by pathologists in legal death investigation especially for detection of vitality at time of occurrence and onset of heat stress (Saukko and Knight, 2015). Many methods have been used to determine whether a victim was alive o0r not during thermal exposure. The evaluation of antemortem burns is mainly based on examination of the signs of a cadaver and on-site examination (Tumer et al., 2012; DeHaan, 2012; Khushkadamov et al., 2012). Carbon soot found in the respiratory passages or stomach as well as elevated COHb level in blood are common signs of vitality. However, these signs may be absent in spite of antemortem heat exposure as in immediate death in case of explosion and sudden heat shock. Even, when the corpse is subjected to prolonged fire exposure with substantial carbonization such as in the case of house fires and vehicle fires, an external inspection of the corpse does not provide any assumptions regarding vitality at the time of fire outbreak. Moreover, the concentrations of carbon monoxide in blood may be within normal range in cases with fire fatalities in open air (Gerling et al 2001; Popovic et al 2009; Dettmeyer et al 2014).

The advancement of molecular biology has shown that biomarkers for nucleic acids and protein biomarkers in fire victims' lungs and bronchi have been affected by burns (Tsokos et al., 2000; Wang et al., 2011). Heat shock proteins (HSPs) are a set of proteins which belong to molecular chaperones. These chaperons function as regulatory molecules that keep proper folding process of the newly formed proteins and decrease their misfolding and improper aggregation. When cells are exposed to harmful influences such as heat, oxidative stress and ischemia the numbers of incorrectly folded, denatured and non-reversibly aggregated proteins are increased with subsequent loss of protein function (Walter and Buchner, 2002; Brinkmeie and Ohlendieck, 2014; Wang et al,. 2014). During such cellular stress, HSPs have a cytoprotective role where they direct the repair or degradation of proteins and signaling pathways within the cell. Thus HSPs are crucial to the organism's survival. The different types of HSPs are nominated basing on their molecular weight such as HSP27, HSP60 and HSP70 (Morimoto and Milarski, 1990). The present study was aimed to evaluate the role of HSP70 as vitality marker in identification death due to fire.

II. SUBJECTS AND METHODS

II.1 Subjects

This study was prospectively carried out at the mortuary of Banha medicolegal department, Ministry of justice on 42 cases of deaths presented to mortuary from May 2018 to December 2018. Inclusion criteria involved cases with known time of death with postmortem interval less than 24 hours. Exclusion criteria included cases of unknown time of death, putrefied cases and cases with pathological history that might lead to increase of HSP70 expression like cancer, skeletal muscle disease, rheumatoid arthritis and renal vascular disease. This study was approved by institutional review board of Faculty of Medicine, Zagazig University with reference number 4811/26-8-2018.

II. 2 Grouping

Group I consisted of 21 cases of fire fatalities. In all cases, autopsy confirmed that the cause of death was burn with degree of burn evaluated according to Tintinalli (2010). We selected cases that were alive during exposure to fire without any evidence of exposure to other trauma.

Group II consisted of 21 cases of acute traumatic death without any evidence of antemortem thermal exposure.

Each group was further subdivided into two groups according to survival time; a group of short survival time refers to sudden death at the scene. The other group of long survival time included cases died within hours at the hospital.

II.3 Methods

All cases were subjected to full history taking from police reports . Autopsy was performed in each case to detect the sex, the age, survival time and cause of death. The degree of burn, soot aspiration and COHb blood level was assessed in fire related fatalities. Tissue samples from lungs, kidneys, heart and liver were taken during forensic autopsies for immunohistochemical examination.

Immunohistochemical examination:

Samples of lungs, kidneys, heart and liver were fixed in 8–10% formalin. After fixation, they were embedded in paraffin wax, sliced (3–4 μm), and stained with HSP70 antibodies using the avidin-biotin peroxidase technique for localization of HSP70. A negative control was used in which the primary antibody was removed and replaced by phosphate buffered saline and positive controls (paraffin sections of tonsils) were run in parallel in order to standardize the immunohistochemical results (Happerfield et al., 1993).

Morphometric evaluation of immunostaining:

The evaluation of the immunohistochemical reaction in the sections of lungs, kidneys, heart and liver was performed according to (Preuss et al., 2008; Doberentz et al., 2014).

The immunohistochemical reaction of the tissue was graduated semiquantitatively in a four-degree scale as shown in (Table 1).

Table 1: Graduation of HSP70 expression (Doberentz et al., 2014)

Percentage of reddish stained structures in total	Graduation	Explanation
0	Grade 0	No reaction
>0 to 29.99	Grade 1	Weak reaction
30 to 59.99	Grade 2	Moderate staining
60 to 100	Grade 3	Intensive staining
	Grade 4	Analyzed structures were not existent in the section of the tissue sample

II.4 Statistical analysis

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) program version 22 for Windows (SPss Inc., 2011). Numerical data were found to follow normal distribution (tested by Shapiro- Wilk test for normality) and were summarized as mean ± standard deviation. Qualitative data were summarized as frequencies and percentages. Pearson's Chi square test, Fisher's exact test or Fisher-Freeman-Halton Exact test were used to examine association between two categorical variables.

III. RESULTS

Group I consisted of 15 males and 6 females with mean ages 39.5 ± 17.6 years old. Group II included 18 males and 3 females with mean ages 33.6 ± 15.2 years old (Table 2).

Table 2: Age and sex in the studied groups

Groups	Number	Sex Male/female	Age (years) mean ± SD
Group I	21	15/6	39.5 ± 17.6
Group II	21	18/3	33.6 ± 15.2

SD: standard deviation

Both groups of the study were divided according to survival time into two groups; short survival time group and long survival time group. Group I showed 16 cases with short survival time and 5 cases with long survival time. Group II showed 15 cases with short survival time and 6 cases with long survival time (Figure 1).

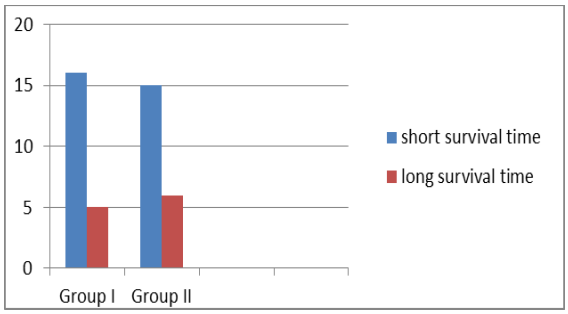

Figure 1: Chart representing survival time in both groups; number of subjects= 21 in each group

Causes of death in group I (fire fatality) revealed burning/ heat shock in 61.9% of cases, flue gas intoxication in 23.8% of cases and burning disease in 14.3% of cases due to complication of thermal injuries. In group II, the causes of death were shotgun wounds in 52.4% of cases, multiple stab wounds in 23.8%, and road traffic accidents in 23.8% of cases (Figure 2).

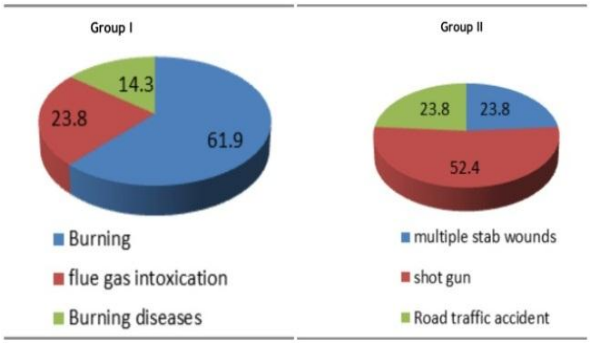

Figure 2: Pie chart representing causes of death in both groups of the study.

Regarding degree of burn; 52.4% of cases in group I (fire fatality) showed 4th degree, 23.8% showed 3rd degree, 14.3% were 2nd degree burn, and 9.5% of cases were mixed2nd& 3rd degrees (Figure 3). Visible soot was detected in 76.2% of cases and was absent in 23.8% of cases in group I (Figure 3).

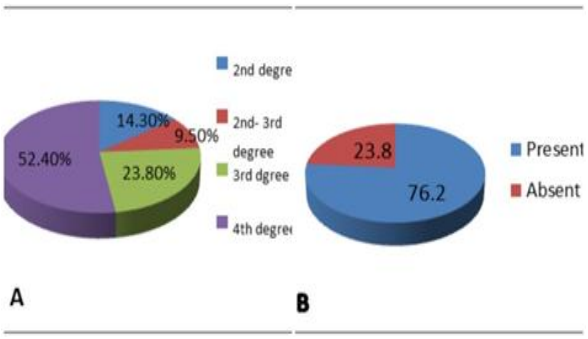

Figure 3: Pie charts representing (A): degree of burn; (B): visible soot in group I.

Immunohistochemical results

Regarding group I (fire fatality); lung sections showed strong positive HSP70 immunoreactivity in the central bronchial lining, blood vessels and alveoli where 95.2% of cases showed HSP70 immunoreactivity with grade 3 versus 19.1% of cases in group II p< 0.001 (Table 3; Figures 4, 5) . On association between survival time and HSP70 expression, sections from lungs in all cases (100 %) of group I with short survival times showed positive HSP70 immunoreactivity with grade 3 expressions versus 20 % of cases with short survival times in group II p < 0.001. Cases with long survival times showed positive HSP70 immunoreactivity with grade 3 expressions in 80 % of cases in group I versus 16.7 % in group II p< 0.001(Table 4, Figure 6).

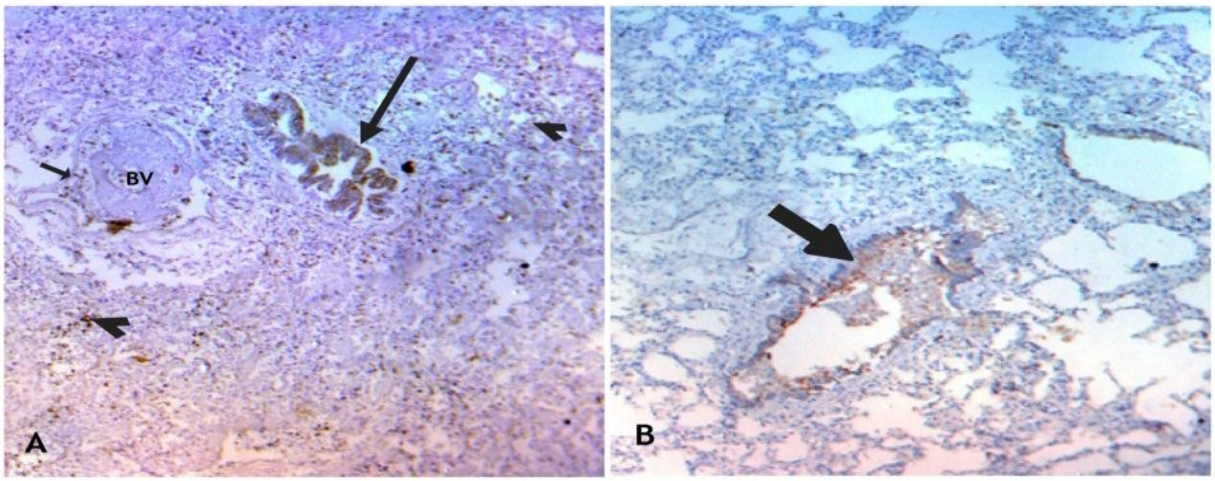

Figure 4: A photomicrograph of sections from lung tissue showing; (A): cases of group I showing HSP70 immunoreactivity with (grade 3) in the central bronchial lining (long arrow), blood vessels (short arrow) and alveoli (arrow head); (B): a case of group II showing HSP70 immunoreactivity with grade 2 in the central **bronchial** lining (arrow), (IHC x200).

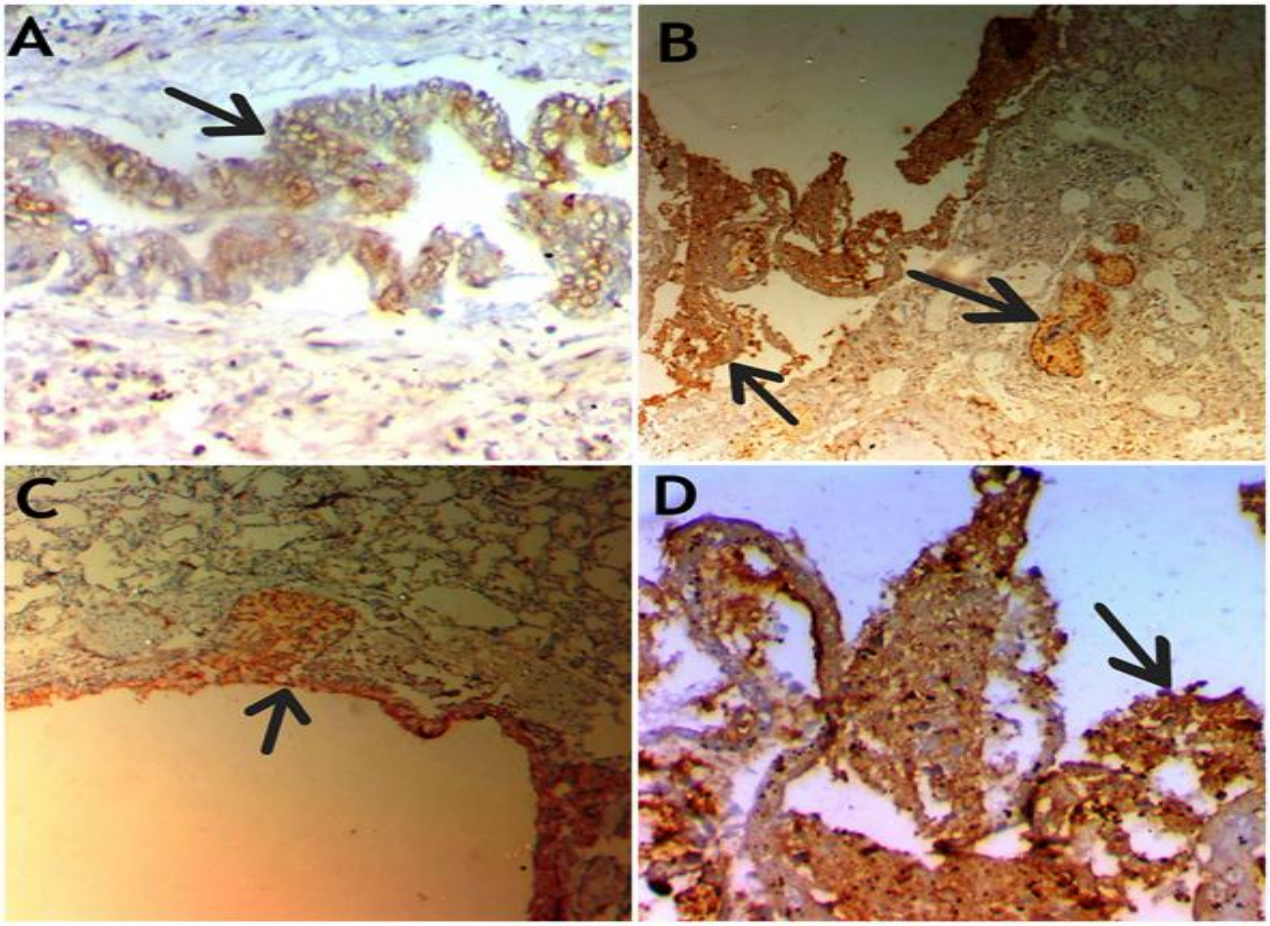

Figure 5: A photomicrograph of sections from lung tissue of group I showing; (A- D): strong positive HSP 70 immunoreactivity (arrow) with grade 3 (IHC x200).

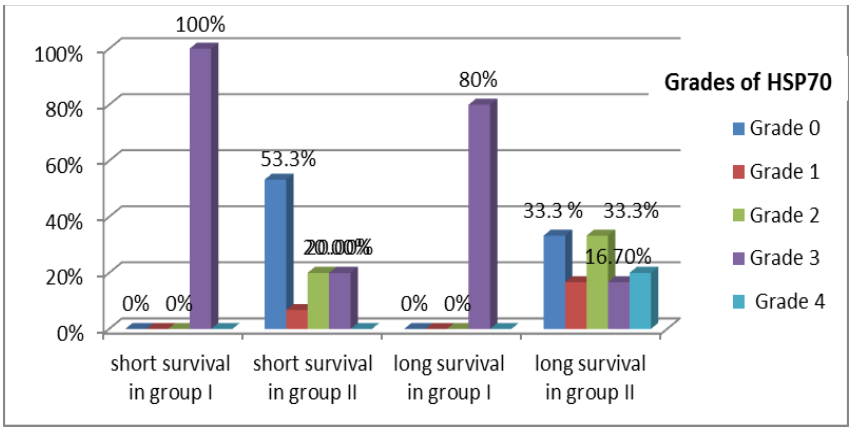

Figure 6:
Chart representing association between HSP70 expression in lung tissue and survival time in both groups of the study.

Kidney sections of group I showed strong HSP70 immunoreactivity in glomeruli, renal tubules and renal blood vessels where 76.2 % of cases showed HSP70 immunoreactivity with grade 3 versus 0.0% of cases in group II $p< 0.001$. On the other hand, 61.9% of cases in group II showed grade 0 HSP70 immunoreactivity (Table 3, Figures 7, 8). On association between survival time and HSP70 expression, 81.2% of cases in group I with short survival times showed grade 3 HSP70 immunoreactivity versus 0% in group II. As regard cases of long survival times, 60 % of cases in group I were significantly associated with grade 3 expression of HSP70 % versus 0% grade 3 expression in group II p <0.001 (Table 4, Figure 9).

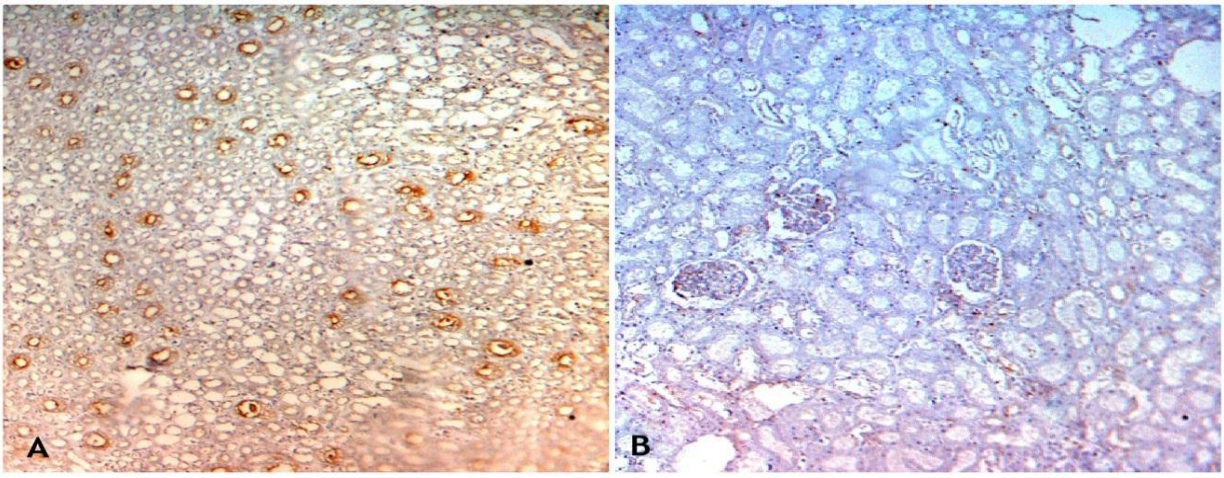

Figure 7: A photomicrograph of sections from renal tissue showing: A; group I with strong HSP70 immunoreactivity (grade 3); B: group II with weak HSP70 immunoreactivity (grade 1) (IHC x200).

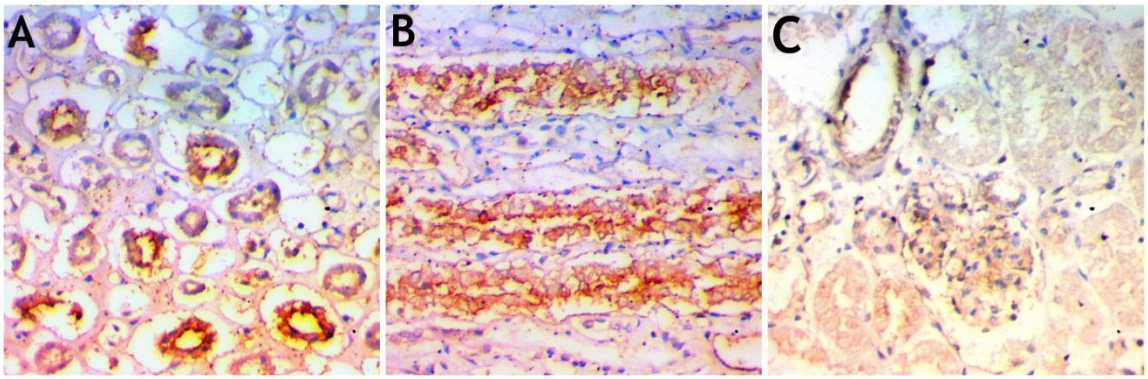

Figure 8: A photomicrograph of sections from the kidney of cases from group I showing strong HSP70 immunoreactivity (grade 3) in: (A): renal tubules and glomeruli; (B): renal tubules; C: blood vessels and glomeruli (IHC x200).

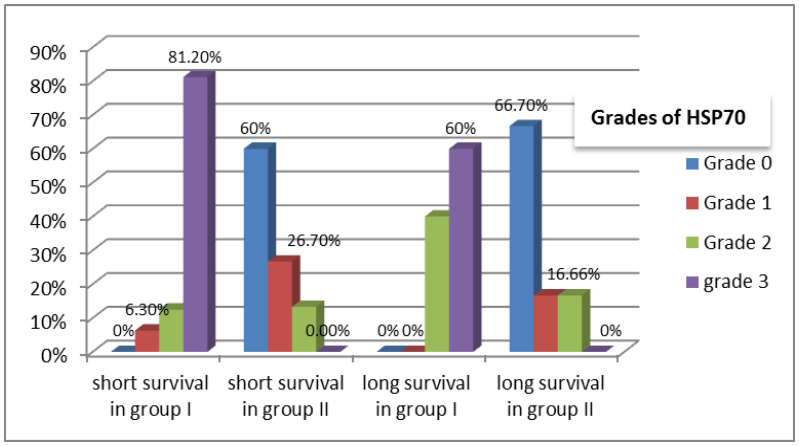

Figure 9: Chart representing association between HSP70 expression in renal tissue and survival time in both groups of the study.

Regarding myocardium, most cases of both groups showed negative expression of HSP70 (grade 0) where 61.9 % of cases from group I showed grade 0, 23.8% of cases showed grade 1 HSP70 immunoreactivity with non-significant difference from that of cases in group II as 76.2% of cases showed grade 0 and 19% of cases showed grade 1 HSP70 immunoreactivity p= 0.417 (Table 3, Figure 10). Cases with short survival time in group I showed grade 0 HSP70 immunoreactivity in 62.5% of cases versus 80% of cases in group II. Cases with long survival time showed grade 0 HSP70 immunoreactivity in 60% of cases in group I versus 66.7% of cases in group II p= 0.912 (Table 4, Figure 11).

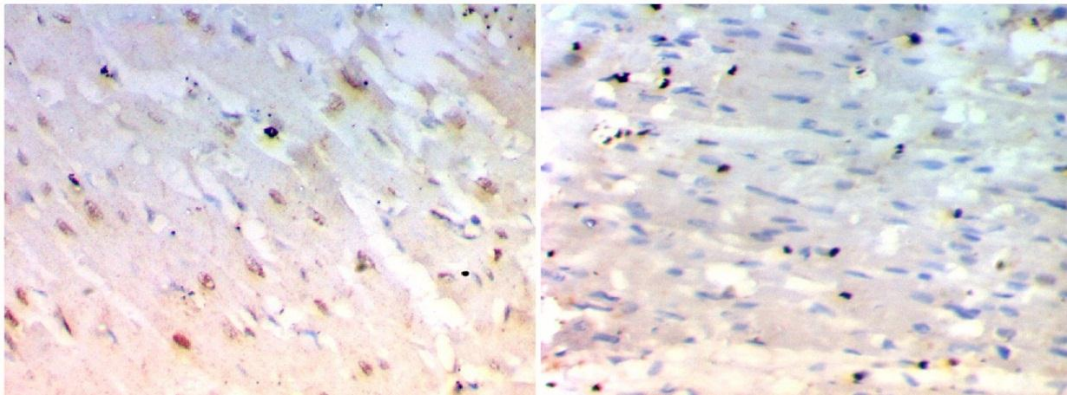

Figure 10: A photomicrograph of sections from heart tissue showing; (A): group I with grade 1 HSP70 immunoreactivity in myocytes; (B): group II with grade 0 HSP70 immunoreactivity (IHC x200).

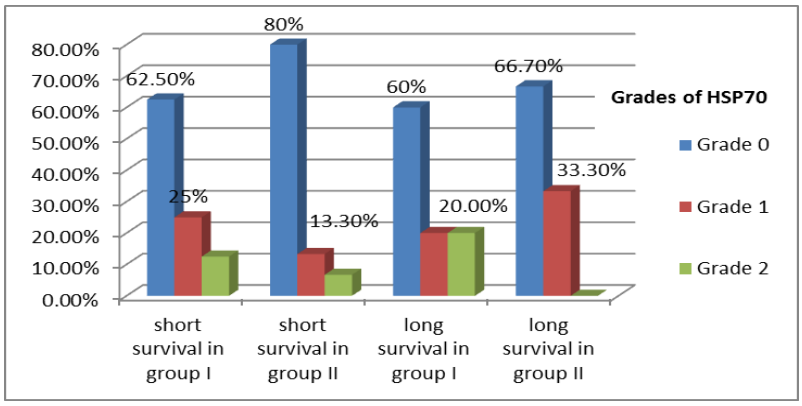

Figure 11: Chart representing association between HSP70 expression in heart tissue and survival time in both groups of the study.

Regarding liver sections, all cases of both groups showed weak expression of HSP70 with 71.4% of cases in group I showed grade I HSP70 immunoreactivity as compared to 9.5% of cases in group II (p <0.001) (Table 3, Figure 12) . In Group I, 62.5 % of short survival time cases showed grade 1 HSP70 immunoreactivity versus 13.3% of cases in group II. All cases with long survival time in group I showed grade 1 HSP70 immunoreactivity versus 0.0 % in group II (p <0.001) (Table 4, Figure 13).

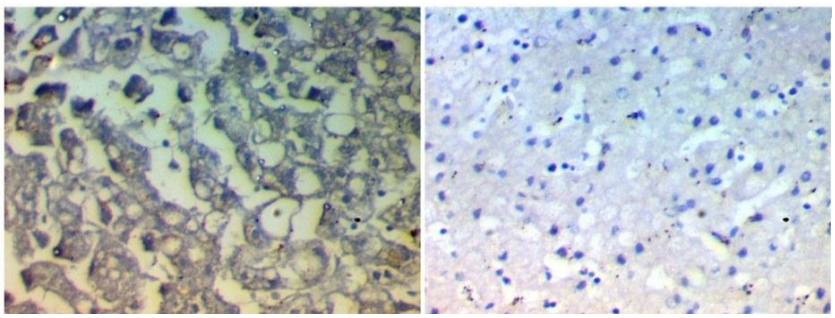

Figure 12: A photomicrograph of sections from liver showing; (A): group I with grade 1 HSP70 immunoreactivity (B); group II with grade 0 HSP70 immunoreactivity (IHC x400).

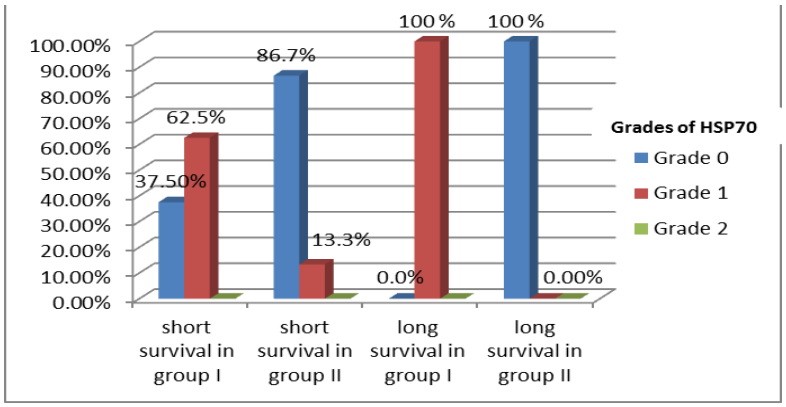

Figure 13: Chart representing association between grades of HSP70 in liver cells and survival time in both groups of the study.

Table (3): Comparison of grades of HSP70 expression in both groups of the study.

Organs	Grade of HSP70	Group I (n = 21)		Group II (n = 21)		Statistic test	*P*
Lungs	0	0	0.0%	7	33.3%	X^2_{FFH}=23.52	<0.001*
	1	0	0.0%	2	9.5%		
	2	0	0.0%	8	38.1%		
	3	20	95.2% a	4	19.1 %		
	4	1	4.8%	0	0.0%		
Renal tissue	0	1	4.8%	13	61.9%	X^2_{FFH}=31.06	<0.001*
	1	0	0.0%	5	23.8%		
	2	4	19.0%	3	14.3%		
	3	16	76.2% a	0	0.0%		
Heart	0	13	61.9%	16	76.2%	X^2_{FFH}=1.965	0.417 NS
	1	5	23.8%	4	19 %		
	2	3	14.3%	1	4.8%		
Hepatocytes	0	6	28.6%	19	90.5%	X^2ChS=16.701	<0.001*
	1	15	71.4%	2	9.5%		

N: number of subjects (42); X^2ChS: Pearson's Chi square test for independence; X^2FFH: Fisher-Freeman-Halton exact test; * significant at p <0.05; a: significant difference of HSP70 grade as compared to group II.

Table 4: Association between grade HSP70 expression and survival time in the studied groups

	Grade of HSP70	Group I (n = 21)				Group II (n = 21)				Organs	*P*
		Short survival n= 16		Long survival n= 5		Short survival n= 15		Long survival n= 6			
Lungs	0	0	0.0%	0	0.0%	8	53.3%	2	33.3%	X^2_{FFH}= 28.26	<0.001 *
	1	0	0.0%	0	0.0%	1	6.7%	1	16.7%		
	2	0	0.0%	0	0.0%	3	20 %	2	33.3%		
	3	16	100% a	4	80.0% b	3	20 %	1	16.7%		
	4	0	0.0%	1	20.0%	0	0.0%	0	0.0%		
Renal tissue	0	0	0.0%	0	0.0%	9	60.0%	4	66.7%	X^2_{FFH}= 30.638	<0.001 *
	1	1	6.2%a	0	0.0%	4	26.7%	1	16.66 %		
	2	2	12.5%	2	40.0%	2	13.3%	1	16.66 %		
	3	13	81.2% a	3	60% b	0	0.0%	0	0.0%		
Heart	0	10	62.5%	3	60.0%	12	80.0%	4	66.7%	X^2_{FFH}= 2.979	0.912 NS
	1	4	25.0%	1	20.0%	2	13.3%	2	33.3%		
	2	2	12.5%	1	20.0%	1	6.7%	0	0.0%		
Liver	0	6	37.5% a	0	0.0%	13	86.7%	6	100%	X^2_{FFH}= 18.854	<0.001 *
	1	10	62.5% a	5	100% b	2	13.3%	0	0.0%		

FE: Fisher' s exact test, n: number of cases, X^2, FFH: Fisher-Freeman- Halton exact test; a: significant as compared to short survival of group II; b: significant as compared to long survival of group II; NS: non-significant; *p*<0.001*: significant.

The association between the presence of visible soot in airways of deceased victims of group I and the grade of HSP70 expression in sections from lungs, kidneys, heart and liver was not found P> 0.05 (Table 5). Also, no association was found between the grade of HSP70 expression in the examined sections and degree of burn in cases of group I P> 0.05 (Table 6).

Table 5: Association between grade of HSP70 expression and soot visibility in group I (n = 21)

Organs	Grade of HSP70	Visible soot				Tests of significance	
		Absent (n = 5)		Present (n = 16)		Statistic Test	P
Lungs	0	0	0.	0	0.0%	X^2_{FFH}=4.122	0.512 NS
	1	0	0.0%	0	0.0%		
	2	0	0.0%	4	25%		
	3	4	80.0%	12	75%		
	4	1	20.0%	0	0.0%		
Renal tissue		0	0.0%	2	12.5%	X^2_{FFH}=3.822	0.553 NS
	1	0	0.0%	0	0.0%		
	2	0	0.0%	4	25.0%		
	3	5	100.0%	11	62.5%		
Heart	0	4	80.0%	9	56.3%	X^2_{FFH}= 4.854	0.789 NS
	1	1	20.0%	4	25.0%		
	2	0	0.0%	3	18.8%		
Liver	0	1	20.0%	5	31.3%	X^2FH=6.864	1.00 NS
	1	4	80.0%	11	68.8%		

n: number of cases; FE: Fisher's exact test; X^2_{FFH}: Fisher-Freeman-Halton exact test; NS: non-significant.

Table 6: Association between grade of HSP70 expression and degree of burn in group I.

Organs	Grade of HSP70	Degree of burn								Tests of significance	
		2 (n = 3)		2-3 (n = 2)		3 (n = 5)		4 (n = 11)		Statistic Test	P
Lungs	0	0	0.0%	0	0.0%	0	0.0%	0	0.0%	X^2_{FFH}=4.904	0.238 NS
	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
	2	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
	3	2	66.7%	2	100.0%	5	100.0%	11	100.0%		
	4	1	33.3%	0	0.0%	0	0.0%	0	0.0%		
Renal tissue	0	0	0.0%	0	0.0%	1	20.0%	1	9.1%	X^2_{FFH}=3.359	0.927 NS
	1	0	0.0%	0	0.0%	0	0.0%	0	0.0%		
	2	0	0.0%	0	0.0%	1	20.0%	3	27.3%		
	3	3	100.0%	2	100.0%	3	60.0%	7	63.6%		
Heart	0	2	66.7%	1	50.0%	4	80.0%	6	54.5%	X^2_{FFH}=3.864	0.881 NS
	1	0	0.0%	1	50.0%	1	20.0%	3	27.3%		
	2	1	33.3%	0	0.0%	0	0.0%	2	18.2%		
Liver	0	0	0.0%	0	0.0%	1	20.0%	5	45.5%	X^2_{FFH}=2.813	0.437 NS
	1	3	100.0%	2	100.0%	4	80.0%	6	54.5%		

n: number of cases; X^2FFH: Fisher-Freeman-Halton exact test; NS: non- significant.

Carboxy hemoglobin level showed concentration below 10% in 7 cases (33.3%), from 10 to 20% in 4 cases (19.1%) and above 20% in 10 cases (47.6%) of group I. There was no association between COHb% in cases of group I and the grade of HSP70 expression in the studied organs P> 0.05 (Table 7).

Table 7: Association between grade of HSP70 expression and COHb % in group I

Organs	Grade of HSP70	COHb%						Tests of significance	
		< 10% N=7 N/ %		10- 20% N= 4 N/%		>20 N= 10 N/ %		Statistic Test	P
Lungs	0	0	1.	0	0.0%	0	0.0%	FE	0.238 NS
	1	0	0.0%	0	0.0%	0	0.0%		
	2	0	0.0%	0	0.0%	1	10%		
	3	6	85.7 %	4	100.0%	9	90%		
	4	1	14.3 %	0	0.0%	0	0.0%		
Renal tissue	0	0	0.0%	1	25%	1	10%	X^2_{FFH}=1.622	0.473 NS
	1	0	0.0%	0	0.0%	0	0.0%		
	2	0	0.0%	1	25%	3	30%		
	3	7	100%	2	50%	6	60%		
Heart	0	5	80.0%	3	56.3%	5	50%	X^2_{FFH}= 2.421	0.952 NS
	1	1	20.0%	0	25.0%	4	40%		
	2	1	0.0%	1	18.8%	1	10%		
Liver	0	3	42.9%	1	25%	2	20%	X^2_{ChS}=2.301	0.72 NS
	1	4	57.1%	3	75%	8	80%		

N: number of cases; X2ChS: Pearson's Chi square test for independence, X2FFH: Fisher-Freeman-Halton exact test, NS: non- significant.

IV. DISCUSSION

Under ordinary biological conditions, HSPs are present in body cells at minimal concentrations, bound to the heat shock factor (HSf); a protein that regulate transcription of HSPs (Feder and Hofmann, 1999; Akerfelt et al., 2010; Brinkmeier and Ohlendieck, 2014). When body cells are exposed to variable stress stimuli, the number of denatured or misfolded proteins increases. HSPs dissociate from the HSf and bind to these misfolded proteins. The free HSf induces the expression and synthesis of new HSPs within minutes to protect the cells (Wu et al 1993; Beissinger and Buchner 1998). It was reported that hyperthermia-

induced necrotic cell death was associated with HSPs release (Tanaka et al., 2005). As HSPs are expressed in many conditions of cellular stress other than thermal injuries, the purpose of the present study was to evaluate whether HSP70 expression can be an indicative of death due to thermal injuries, and to investigate its expression in different organs.

The results of the present study showed strong positive HSP70 immunoreactivity (grade3) in the lung and kidney sections of cases in group I (fire fatality group) as compared to group II. This means that not only tissues in direct contact with the thermal effects showed strong positive immunoreactivity but also remote organs suggesting a vascular mediated response. This was in line with (Marschall,et al., 2006; Doberentz et al., 2014). On the same context, Fineschi et al. (2005) studied the tissue expression of HSP27, 70 and 90 in a case of heat stroke of an infant who died in an incubator and reported increased expression of these proteins in the epithelium of the trachea and in the skin of that case. Previous studies reported that the immunopositive HSP70 in the blood vessels present in different organs may indicate that hyperthermia occur immediately before death and before depletion of ATP as HSP70 is ATP dependent (Goto, 1993; Walter and Buchner, 2002; Kitamura, 2009; Doberentz et al., 2014). Another explanation may be that the expression of HSP70 may protect cells that form the vasculature, from cell death as a result of proinflammatory response (Kacimi and Yenari, 2015). Strong HSP70 expression could be also interpreted as an adaption that enhance repair and protect cells from damage (Kiyatkin and Sharma, 2011). Immunohistochemical examination of sections from heart and liver showed weak expression of HSP70 (grade 1& 0) respectively. Previous researches showed similar results and reported that the response of stress in heart revealed more reaction of the endothelial cells rather than heart tissue (Leger et al., 2000; Doberentz et al., 2014).

Moreover, other cases of acute traumatic death without premortem hyperthermal exposure (group II) in the present study showed weak positive HSP70 immunoreactivity. These finding were in agreement with (Doberentz et al., 2014). In a previous case report, two men who were shot and then burned showed that HSP27, 70 expressions in lungs, kidneys and heart were negative in these cases (Doberentz and Madea, 2019). Therefore, HSP70

immunostaining with grade 3 in lung and kidney can be a valuable marker of vitality in fire related deaths.

In the present study, we tried to assess whether HSP70 expression is associated with appearance of signs of vitality or not. There was no significant association between the degree of burn and the grade of HSP70 expression in all examined tissues of group I. This was in line with Doberentz et al. (2017) who found that all degrees of burn showed similar results regarding the grade of HSP70 expression without an identifiable tendency. The presence of visible soot in the airways or stomach of deceased victims and COHb % in blood showed no significant association with the grade of HSP70 expression in the lungs, renal tissues, heart and liver section of group I. This ensures the hypophysis that HSP70 can be a good prove of vitality even in absence of signs of vitality and when other antemortem influences like severe disease can be excluded (Doberentz et al., 2014).

In the present study, cases of group I with short survival periods showed positive HSP70 immunoreactivity with grade 3 in the lung and renal tissues when compared to that of group II. Also, all cases with short survival periods in the lung tissue of group I showed positive HSP70 immunoreactivity with grade 3 in 100% of cases while cases with long survival times showed positive HSP70 immunoreactivity with grade 3 in 80 % of cases. Regarding renal tissue in group I, 81.2% cases with short survival time showed positive HSP70 immunoreactivity with grade 3 versus 60% of cases with long survival time. This means that HSP70 was expressed rapidly after fire exposure. Regression of HSP70 immunoreactivity with time in lung sections may be due to depletion of ATP as HSP70 expression is ATP dependent chaperon (Walter and Buchner, 2002). previous study also revealed that HSP70 expression rapidly increased after cell damage and sublethal heat exposure of 44 °C in the brain and other mammalian cells (Chinese hamster O23 cells), but the expression decreased in the course of time (Currie et al., 2000)

V. CONCLUSIONS& RECOMMENDATION

In cases of death due to thermal injuries, HSP70 is expressed rapidly after exposure in high grade (grade 3) especially in pulmonary and renal tissues in contrast to other causes of traumatic death. A lack or low expression of HSP70 clearly demonstrates that the person was not alive when heat

stress started. Postmortem immunohistochemical examination of HSP 70 expression can be an evident support of the current methods that proof vitality in cases death due to thermal injuries.

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دور بروتين الصدمة الحرارية ٧٠ في تحديد الوفاة نتيجة التعرض الحراري القاتل

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المقدمة : بروتينات الصدمة الحرارية ، هي مجموعة من البروتينات التي تعمل كمرافقات داخل الخلايا للبروتينات الأخرى و يتم التعبير عنها استجابة للظروف المرهقة للخلايا. كان الهدف من هذه الدراسة هو تقييم دور تعبير بروتين الصدمة الحرارية ٧٠ كعلامة حيوية في تحديد الموت بسبب التعرض الحراري المميت.

الاشخاص و الطرق: أجريت الدراسة على ٤٢ حالة وفاة، منها ٢١ حالة، أسباب الوفاة فيها حروق شديدة (مجموعة ١) و ٢١ حالة اخرى اسباب الوفاة فيها الصدمات الحادة الغير مرتبطة بالحروق (مجموعة ٢). تم تشريح و فحص جميع جثث الحروق فيما يتعلق بدرجة الحرق و سناج الكربون و وقت البقاء حيا. تم تقييم مستوى اول اكسيد الكربون فى الدم. تم فحص جميع الحالات فيما يتعلق بتعبير بروتين الصدمة الحرارية ٧٠ في الرئتين والكلتين والقلب والكبد.

النتائج: أظهرت حالات الحروق (مجموعة ١) وجود إيجابي ذات دلالة إحصائية كبيرة للصبغ المناعى لبروتين الصدمة الحرارية ٧٠ من الدرجة الثالثة في عينات الرئتين والكليتين عند مقارنتها بحالات المجموعة ٢ . أظهرت عينات أنسجة القلب والكبد تعبيرًا ضعيفًا عن الصبغ المناعى لبروتين الصدمة الحرارية ٧٠ من الدرجة الاولى او الصفرية بينما أظهرت معظم حالات المجموعة الثانية تعبيرات سلبية من الدرجة الصفرية او الاولى عن الصبغ المناعى لبروتين الصدمة الحرارية ٧٠ فى عينات الرئتين والكليتين و القلب و الكبد. لم يكن هناك ارتباط بين درجة التعبير عن الصبغ المناعى لبروتينات الصدمة الحرارية ٧٠ و درجة الحروق ، وجود سناج الكربون ومستوى اول اكسيد الكربون.

الخلاصة و التوصيات: يمكن أن يدعم التعبير المناعي الكيميائي العالى لبروتين الصدمة الحرارية ٧٠ فى الرئتين و الكليتين إثبات الحيوية في حالات الوفاة المتعلقة بالحروق. و هكذا يمكن أن يكون الفحص الكيميائي المناعي بعد الوفاة لبروتين الصدمة الحرارية ٧٠ دعمًا واضحًا للطرق الحالية التي تثبت الحيوية في حالات الوفاة بسبب الإصابات الحرارية.