*Effecieny of Antioxidant defenses System in Burned Patients of Both Sexes with Second and Third Degrees of Burn

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Abstract

Thermal burns are one of the most problem worldwide. Patients with burns are characterized by hypermetabolic state, increased vascular permeability, protein degradation, immune abnormalities, and oxidative stress. The present study was conducted to evaluate abnormalities occurring in antioxidants activities of burned patients of both sexes (males and females). One hundred fourteen subjects were recruited in this study of both sexes. Of those, 100 subjects (50 males and 50 females) were burned with thermal injuries. Burned males were subdivided according to severity of burn in to two groups; 25 burned males affected with second degree of burn and 25 burned males affected with third degree of burn. Similarly, the same classification was also applied with burned females. Fourteen healthy subjects (20 males and 20 females) were used as control group. All ages of the subjects were ranged between 20-40 years old.

Results obtained from this present study indicated that levels of catalase activity in all burned patients groups were significantly lower ($p<0.05$) than of healthy groups. Continuously, results of glutathione peroxidase activity were also significantly decreased ($p<0.05$) in all burned groups. Concentrations of reduced glutathione (GSH) showed a significant and insignificant fall in most burned patients (males and females).For measurement of lipid peroxidation, malondialdehyde (MDA) used in this study and served as indicator of lipid peroxidation and its values showed a progressive increase ($p<0.05$) in burned males and females when compared with healthy control group. The possible explanation of changes mentioned above may be attributed to progressive increase oxidative stress and release of inflammatory mediators which in-turn aggravate and worse physiological disturbances in burned patients.

Key Words : Burns , Oxidants , Anti-oxidants.

Biology Classification QP 501 801

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Introduction

Severe thermal injury, is followed by excessive hyper-metabolic state which sustain for up to one to two years post-burn. The response is manifested by increasing metabolic rates, multi-organ abnormalities, muscle protein degradation, growth inhibition, impaired glucose tolerance, elevated hazard for infection, and increase vascular permeability [1]. Reactive oxygen species (ROS) is a accomulative term used for definition of oxidant groups, which are either free radicals or molecular species have ability to generate free radicals. Intracellular generation of ROS particularly generate by superoxide ($O_2^{\cdot -}$) radicals and nitric oxide ($NO^{\cdot}$) radicals. Under normal physiologic circumstances, approximately 2% of the oxygen used by the body is changed into $O_2^{\cdot -}$ through mitochondrial respiratory chain, phagocytosis process, etc. ROS ratio up-regulates during infections course, exercise, exposure to utraviolet light, ionizing radiation,[2]. When they found at minimal concentration, ROS play essential intracellular functions, as second intracellular messenger, gene regulators and mediators for many cellular activator such as kinases and transcription factors. They also exert a necessary role in our body′s defense mechanism against variety of infectious organisms. If they present in high concentration $O_2^{\cdot -}$,$NO^{\cdot}$ causes formation of peroxynitrites that alter mitochondrial membrane damage, which is key way to the stimulation pathways causing to cellular apoptosis [3]. The aims of this study to estimation of oxidant-antioxidants status including levels of catalase and glutathione peroxidase activities, and of reduced glutathione (GSH) levels. Also, the level of lipid peroxidation was determined by measuring malondialdehyde (MDA).

Materials and Methods

Subjects of study

The present study was performed during the period ranged from December 2013 to August 2014. All blood samples were collected from burned patients admitted to burn unit in Hilla teaching hospital.

A total number of subjects was 140:burned patients and healthy subjects of both sexes. Number of burned patient was 100 (50 males and 50 females) affected with thermal injury and sub-classified into four groups according to severity of burn(second degree and third degree of burns) . Burned males subdivided in to two subgroups: 25 males affected with second degree of burn and other 25 males affected with third degree of burn. Similarly, the same classification was applied with group of burned females. All patients were

diagnosed by consultant physicians specialized in that hospital. The fourteen healthy subjects (20 males and 20 females) were selected to be used as control group. All ages of subjects ranged between 20-40 years old.

Assay of Catalase activity

catalase (EC.1.1 1 .1.6) catalyses the decomposition of hydrogen peroxide to give water and molecular oxygen. Catalase activity was determined according to a previously reported method [4].The decomposition of H202 can be followed directly by the decrease in absorbance at 240 nm. The difference in absorbance per unit time is a measure of catalase activity.

Determination of serum reduced glutathione (GSH) level

5.5-dithiobis (2-nitrobenzoic acid ( )DTNB) is a disulfide chromogen that is readily reduced by sulfahydryl group of GSH to an intensely yellow compound. The absorbance of the reduced chromogen is measured at 412 nm, directly proportional to the GSH concentration [5].

Determination of malondialdehyde (MDA) concentration

The level of malondialdehyde was determined by modified procedure described by Guide and Shah [6].The test is based on the reaction of MDA with thiobarbituric acid (TBA); forming MDA-TBA_2 product that absorbs strongly at 532 nm .

Determination of serum glutathione peroxidase (GPx)

GPx was assayed according to the procedure of Pagliag and Valetin [7] with some modification.

Statistical analysis

All values were expressed as means ± stander deviation (SD). The data were analyzed by using of computer SPSS program. Student's t-test was used to examine the differences among different groups and $p<0.05$ was used as lowest significant limit [8].

Results

Level of Catalase Activity (CAT)

Data of catalase activity were presented in table (1) and showed a significant drop ($p<0.05$) in burned males affected with second and third degree of burn, when compared with healthy males group . Also , the results which are presented in table (2) explained a significant lowering ($p<0.05$) of CAT activity in burned females undergo from second and third degree of burns in a comparison with healthy females .

Concentration of Reduced Glutathione Activity (GSH)

Level of GSH in table (1) were insignificantly decreased ($p>0.05$) in

burned males with second degree of burn , while , males affected with third degree showed a significant fall ($p<0.05$) of GSH level , when compared with healthy males . Concentration of GSH (table 2) of burned females were significantly decreased ($p<0.05$) in second degree of burn , whereas, females affected with third degree of burn showed insignificant decrease ($p>0.05$) of GSH concentration , in comparison with healthy females group .

Concentrations of Malondialdehyde (MDA)

Concentrations of MDA (table 1) have explained a significant elevation ($p<0.05$) in burned males affected with second and third degree of burns , when compard with healthy control males . Also , the results which are illustrated in table (2) pointed out a significant increase ($p<0.05$) of MDA in burned females with second and third degree of burns in a comparison with healthy females group .

Glutathione Peroxidase Activity (Gpx)

-Glutathione Peroxidase Activity at 30 second

The data that are showed in table (1) explained a significant lowering ($p<0.05$) of Gpx at 30 second in burned males with second and third degree of burns , when compared with healthy males . On the other hand , in table (2), there is insignificant drop ($p>0.05$) of Gpx activity at 30 second in females burned patients affected with second and third degree of burns in a comparison with healthy females group .

-Glutathione Peroxidase Activity at 60 second

Results which are presented in table (1) were significantly decreased ($p<0.05$) of Gpx activity at 60 second in burned males with second and third degree of burns in a comparison with healthy males . In addition , data summarized in table (2) showed a significant drop ($p<0.05$) of Gpx actinity at 60 second in burned females with second and third degree of burns , when compared with healthy control females group .

Table(1): Means of levels of catalase activity (CAT K/mL), reduced glutathione concentration (GSH mmol/mL), concentration of malondialdehyde (MDA mmol/mL), and glutathione peroxidase activity (Gpx at 30 second and 60 second U/L) of healthy and burned males complained with second and third degree of burns.

Groups / parameters	Healthy (control) group	(First group) Second burn degree	(Second group) Third burn degree
CAT (K/mL)	3.670±1.665	0.041*±0.044	0.293*±0.597
GSH (µmol/mL)	103.14±37.344	96.29±20.621	32.04*±26.475
MDA(µmol/mL)	17.67±5.870	28.97*±9.272	39.63*±10.229
Gpx (30) (U/L)	232.26±11.040	154.98*±29.261	161.8*±30.385
Gpx (60) (U/L)	231.27±15.588	213.00*±10.088	192.89*±14.576

-Values are means ±SD

-Means with asterisk * are significantly different at $p<0.05$

Table(2) Means of levels of catalase activity (CAT) K/mL, glutathione reductase activity (GSH) mmol/mL , concentrations of malondialdehyde (MDA) mmol/mL and glutatione peroxidase activity (Gpx at 30 second and 60 second) U/L of healthy and burned females suffering from second and third degree of burns.

Groups / parameters	Healthy (Control) group	(First group) Second burn degree	(Second group) Third burn degree
CAT (K/mL)	6.738±4.898	0.336*±0.481	0.149*±0.116
GSH(µmol/mL)	115.83±23.965	83.84*±20.980	105.34±15.519
MDA(µmol/mL)	16.97±3.900	35.80*±9.301	36.65*±7.758
Gpx (30) (U/L)	264.71±.189.098	189.50±15.335	154.57±24.267
Gpx (60) (U/L)	223.42±19.535	206.00*±15.011	199.78*±16.225

-Values are means ±SD

-Means with asterisk * are significantly different at $p<0.05$

Discussion

Catalase (CAT)

Data obtained for catalase activity showed a significant lowering ($p<0.05$) in both sexes of burned patients undergoing from second and third degree of burns. Our results were consistent with other researchers who indicated depletion of catalase activity in burn injuries [9,10].These results were not agreed with study Nagane *et al,*[11], that showed the mean level of catalase activity in burned patients were significantly increased when compared to the control. Increase catalase activity appear to have some association with neuroendocrine stimulation that is shown in sepsis and trauma. Experimental studies reported that rats subjected to thermal skin injury have increased serum H_2O_2 scavenging activity, and this activity was deactivated by addition of sodium azide, a catalase inhibitor [12]. Our observation were supported by Horton and White [13], who confirmed that in normal body state there is a regulation between free radical production and antioxidant activities, but during traumatic injuries, the regulating mechanism become disturbed lead to increase ROS and decrease antioxidants.

Reduced glutathione (GSH)

Values of our study have been explained a significant fall ($p<0.05$) of GSH activity in different groups (males and females) when compared with healthy control group. Values of present study were agreed with study of Sahib *et al,* [14], that recorded serum level of GSH in burned patients were significantly reduced at zero time and continued significantly lower than control group until healing occurrence. These results were inconsistent with the study of Mühl *et al,* [15], which explained that serum GSH were significantly increased in burn trauma patients. Excessive production of free radicals is continued by depletion of antioxidant such as catalase, glutathione, and superoxide dismutase [9,10]. Sener *et al,*[16], noted that thermal burn act to elevate MDA level correlated by lowering in the GSH concentration. Depletion of GSH level in this study may be implied that reduced glutathione exhausted against oxidative stress and re-establishment of sulfhydryl group.

Malondialdehyde (MDA)

The present study showed significantly heightened ($p<0.05$) of malondialdehyde (MDA) concentration in both sexes of burned patients affected with second and third degree of burn. This study was agreed with the previous study of Atik *et al,* [17] that found serum MDA levels were significantly higher in all degrees of burns when compared to controls. Biochemical evidence indicates that MDA is one of these lipid oxidation products, and it is used as a marker of oxidative stress in tissue and cells [18]. In fact, malondialdehyde (MDA) is the product of the peroxidation of membrane phospholipids. MDA is a prominant biological marker by which to assess the intensity of oxidative stress. After burning, the degree of lipid peroxidation products like MDA rises [19]. Previous experimental studies have shown that thermal skin damaged is associated by significant increases in MDA levels [20]. Severe thermal burns result increases in MDA levels correlated by

decrease in the GSH levels [16]. Szpringer *et al,*[21], noted an increase in lipid peroxidation level within 48 hours after burn. Hongming *et al,*[22] noted that higher lipid peroxidation rate at the first 3 days. Obovious increases in plasma MDA levels were showed in burned patients associated with the extent of damage and these values decreasing progressively while remaining above the normal 30 days [23].

Other reports showed an increased level of lipid peroxidation products in the plasma and of lung and liver within the 4 days after burn [24]. Also, it has been found that there is an increase in conjugated dienes, lipid peroxides and MDA contents in plasma and lung tissue was showed in animals after burn injury [21].Clinical observation in burnt patients, expressing an increased in lipid peroxidation products concentration as early as within the 8 hour, the 1 and 2 day after burn injury [22].

Glutathione peroxidase (Gpx)

The results of glutathione peroxidase (Gpx) activity at 30 second showed a significant decreased ($p<0.05$) in males burned patients suffering from second and third degrees of burns. In females burned explained insignificant fall ($p>0.05$) of patients affected with second and third degrees of burns. Whereas the activity of this enzyme at 60 second demonstrated a significant depletion ($p<0.05$) in both sexes suffering from second and third degrees of burns.

Horton,[25] noted that there is an up-regulation of xanthine oxidase stimulated by histamine leads to the formation of oxygen free radicals resulting in severe cell injury. This is accelerated by impairment in natural antioxidant mechanisms and additional amount of free-radical production by neutrophils.

Previous observation indicated that thermal injury is followed by a progressive increase in liberation of ROS in the body. Within the early stage of the disease. ROS generation happens in hypoxia and damaged capillaries in the injured area. Such as state causes the xanthine dehydrogenase to change into xanthine oxidase using molecular oxygen as an electron acceptor after reperfusion. Its results is production of superoxide radical anion [26].While a major source of ROS in burn injury is exogenous, adherent and activated neutrophils induce a burst of free radicals [13]. Also, while burn damage increase free radicals production, this type of traumatic injury also antagonize antioxidant protective mechanisms rendering burn patients become more susceptible to ROS-mediated injury. Furthermore, it has been showed that ROS take part to burn-mediated immune suppression and that the adminstration of antioxidants has a positive effect on immune function, which may lowering the incidence of wound infection and other related complication [27].

Many previous researches demonstrated that free radicals and antioxidants level are progressive production after thermal injury but levels of free radicals proceed level of antioxidants and participate in the pathogenesis of organ injury and have been associated in the pathogenesis of inflammation, systemic

inflammatory response, immunosuppression, infection and sepsis, tissue damage, and multiple organ failure [28,29]. Progressive free radical production is paralleled by impaired antioxidant activities: as indicates by burn-related depletion in superoxide dismutase, catalase, glutathione, tocopherols, and ascorbic acid [9,10]. The source of free radicals after burn injury are multiple and include the mitochondria, NADPH oxidase, xanthine oxidase, and others [30,31].

Berger *et al.*[32], explained that in the initial phase of illness oxidative stress was proportional to the severity of the patient´s states and that this particularly marked in burn patients. Patients with major burn injury suffered acute early trace element depletion caused by the extensive exudative trace element losses because of vascular permeability, which persisted until wound healing. Oxidative stress was worsened and aggravated by these trace element deficiencies, especially of zinc, and this was linked to impaired immune response.

Conclusion

The values of antioxidants explained a significant decrease of their activities such as GSH, Gpx, and CAT having associated with the degree of burn. Lipid peroxidation process were progressed through a high level of MDA product and its concentration proportionate directly with severity of burn and gender factors

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*كفاءة نظام الدفاع المضادة للاكسدة لدى الاشخاص المصابين بالحروق من الدرجة الثانية و الثالثة من كلا الجنسين

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الخلاصة

تعد الحروق الحرارية من اهم المشاكل و الاخطار على مستوى العالم. تتميز الاضطرابات البدنية الحاصلة مع الحروق من خلال ارتفاع معدل العمليات الايضية و ارتفاع نضوحية الاوعية الدموية و تحطم البروتينات للأشخاص المصابين بالحروق واضطراب العمليات التأكسدية والاستجابات المناعية والالتهابية. تضمنت الدراسة الحالية تحديد مستوى المنظومات المضادة للأكسدة . شمل العدد الكلي للدراسة 140 شخصا مصابين بالحروق واصحاء ومن كلا الجنسين (ذكور واناث). كان 100 شخصا مصابا بالحروق الحرارية من كلا الجنسين (50 ذكرا و50 انثى). قسم الذكور و الاناث المصابين بالحروق الى مجموعتين ثانويتين طبقا لدرجة الحروق، اذ شملت المجموعة الاولى 25 ذكرا و25 انثى مصابين بالحروق من الدرجة الثانية في حين شملت المجموعة الثانية 25 ذكرا و25 انثى مصابين بالحروق من الدرجة الثالثة. اما بالنسبة للاشخاص الاصحاء (40 شخصا) فقد تم اختيار 20 ذكرا و 20 انثى اصحاء وقد استخدموا كمجموعة سيطرة. تراوحت جميع اعمار اشخاص الدراسة بين 20-40 سنة.

اذ بينت النتائج ان قيم انزيم Catalase اضهرت انخفاضا معنويا ($p<0.05$) في كل المجاميع المدروسة عند مقارنتها مع مجموعة الاشخاص الاصحاء وكذلك قد انخفضت قيم فعالية انزيم (Glutathione peroxidase) ايضا بصورة معنوية ($p<0.05$) لدى جميع الاشخاص المصابين بالحروق من كلا الجنسين عند مقارنتهم مع نظرائهم من مجموعة الاشخاص الاصحاء. كما تبين حصول انخفاض معنوي وغير معنوي في قيم الكلوتاثيون المختزل Reduced (glutathione) في اغلب المجاميع المدروسة عند مقارنتها مع مجموعة السيطرة. ولأجل تقييم مستوى تأكسد الدهون (Lipid peroxidation) فقد تضمنت الدراسة الحالية تقدير مستوى تركيز مركب Malondialehyed (MDA) اذ لوحظ حصول ارتفاع معنوي ($p<0.05$) في قيم MDA لدى جميع الاشخاص المصابين بالحروق بالدرجة الثانية و الثالثة عند مقارنتهم مع الاشخاص الاصحاء.

يمكن الاستنتاج من النتائج المذكورة في اعلاه ، ان التغيرات الحاصلة لدى الاشخاص المصابين بالحروق قد تعود بالاساس الى ارتفاع الاجهاد التأكسدي وارتفاع انتاج الوسائط الالتهابية والتي بدورها تؤدي الى اختلافات في اغلب الوظائف الفلسجية للجسم.

الكلمات المفتاحية:- الحروق، المؤكسدات، مضادات الاكسدة

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*البحث مستل من رسالة الماجستير للباحث الثاني