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The correlation between occupational stress and redox state among nurse population.

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Abstract

Background: This research is aimed to explore the influence of occupational stress on oxidation and oxidation resistance in nurse population.
Methods: 140 nurses were included in this research. The questionnaire was performed to collect the data of occupational stress. Moreover, the hydroxyl radical, antioxidant enzyme level was tested.
Results: Superoxide Dismutase (SOD) level in nurses younger than 30 y old was significantly higher than other groups while that was most lower in nurses older than 45 y old. The difference was significant (P<0.05). Compared with participants with lower academic degrees, nurses with higher degree had a significantly higher Glutathione Peroxidase (GSH-Px) level. The work prospect and work control was the main influence factors for SOD. Work risk was the negative factor while peace emotion was the positive factor of SOD (P<0.05).
Conclusion: The occupational stress, such as the work prospect and work control is associated with body's anti-oxidation ability.

Keywords: Occupational stress, Oxidation, Oxidation resistance, SOD, GSH-Px.

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Introduction

With the reform of health care system in China, the enhancement of legal concept, the increase of expectation for nurses by patients and society and increase of medical disputes, which make nurses more easily, have occupational stress in our country [1]. Several studies found that disorder of oxidation and antioxidant capacity caused by oxidative stress, which have relations with disease occurrence and development of cardiovascular system, nervous system, immune system, digestive system and endocrine system [2-4]. Occupational stress also can cause diseases in multiple system and multiple organs, such as Coronary Heart Disease (CHD), Ischemic Heart Disease (IHD), depression, neuro-endocrine disorders, cancer and gastric ulcer [5-9]. However, at present, the study about the relationship between occupational stress and redox state is limited. It is still need to discuss that whether occupational stress can cause oxidative stress, body injury, and diseases above or not. As a large occupational group, nurses are regarded as the investigation object in this study. Therefore, this research is to study the influences of occupational stress on hydrocarbon radical and anti-oxidative enzyme and explore whether occupational stress has relation with body oxidative stress or not among nurse population.

Materials and Methods

Objects

We conducted this study in county-level and township hospitals in Yangzhong city. A total of 152 nurses were selected in three county-level hospitals and six central hospitals (including township hospitals, health center, community health center). Stratified-cluster sampling was used to investigate nurses by internet-based questionnaire from one secondary unit and nine first-level units. Nurses over 20 y old and working years over one year were eligible for inclusion. Internet questionnaire with no answers had been excluded. Finally, 140 nurses were included in this research.

Questionnaire test

Four modules of occupational stress in occupational health information collection system on internet, includes investigation network, occupational health network establishment, occupational health assessment and occupational health consult. Occupational Stress Indicator (OSI) was referenced by Yu et al. [10]. This investigation selected OSI-R (occupational control scale, demand scale, risk scale, monotonicity scale, prospect scale, promotion and opportunity scale) and nervous reaction scale (occupational satisfaction scale, psychological health scale, daily nervous scale, body complaint scale). Occupational stress index scales of this study were given reliability analysis. Runbacks α of

coefficient of most scales were near to 0.7 or over 0.7. It showed that scale selected had relative good internal consistency.

Oxidative radical and antioxidant enzyme detection

The job code of nurses was serial number. Each effective questionnaire was given serial number corresponding to blood sampling. Achieving correspondence of biochemical test, such as blood drawing. The subjects should keep an empty stomach over 12 h, regular diet habit for two weeks, stop taking drugs which influenced glucose and blood lipid (such as lipid-lowering drug, glucose-lowering drug and some hypotensive drug). Blood in elbow vein was extracted in the sitting position after 5 min. Serum was separated within 3 h after blood extraction, then stored in -60°C refrigerator and detected within 3 d. Relative enzyme in serum was detected according to kits of hydrocarbon radical (OH. Colorimetry), glutathione peroxidases (GSH-Px, Colorimetry), superoxide disambiguation (AOD, hydrocarbon amine method), Peroxidase (POD, Colorimetry) and Catalase (CAT, ammonium molybdate) from Nanjing Jiancheng Bioengineering Institute. Whole course of detection followed operation steps, reaction time and reaction conditions strictly.

Quality control

(1) Quality control of internet-based questionnaire: filling mode and investigation objects were given introduction and training before investigation. Database management needed jurisdiction of staff, can read and investigate the completed progress of objects, assess content and quality. (2) Quality control of blood biochemical indicators: biochemical indicators were detected by CDC which had qualification authentication of biochemical detection and key laboratory in ministry of education. Professional doctors were responsible for comprehensive quality control. Collection, transportation and storage met laboratory requirements. Quality control graphs were drawn and the measurement result of index was controlled under $\bar{x} \pm 3$ s (control limit) for serum quality control. Number of questionnaire was in correspondence with accurate number of experimental samples. Each index experiment set standards, which were in contrast with blank. 10% samples were selected randomly and measured repeatedly.

Statistical analysis

Data were analysed by SPSS18.0. Continuous data were given statistical description by using mean and standard deviation. Mean comparison between multiple groups was given one-factor analysis of variance. Comparison between two groups was given LSD. Mean comparison between two groups were given t test. Control variables in hierarchical regression analysis were given entrance method. Independent variables were given step-by-step method. Increase of coefficient R^2, equation F value had statistical differences, which were standards of selecting independent variables. $P<0.05$, there were statistical differences.

Results

Nurses' serum hydrocarbon radical and oxidative enzyme comparison with different demographic characters

From Table 1, we can see, Superoxide Dismutase (SOD) activity of serum was the most high of nurses under 30 y old, lowest over 45 y old, there were statistical differences between groups ($P<0.05$). GSH-Px and SOD activity were highest among nurses under 5 working years; medium among nurses between 5 to 15 working y; and lowest in nurses over 25 working y. There were statistical differences between groups ($P<0.01$). Compared with the nurses with junior and high school education (vocational school), glutathione peroxidase (GSH-Px) activity of nurses with university education (junior college) was relatively high. The activity of serum SOD was low. There were statistical differences ($P<0.01$).

Table 1. Comparison of different characters with hydroxyl free radical and antioxidant enzyme activity.

Groups	N	OH	GSH-Px	SOD	POD	CAT
Age						
≤ 30	23	633.33 ± 39.45	627.59 ± 23.13	101.64 ± 22.76	10.67 ± 6.02	3.59 ± 1.99
>30	95	599.79 ± 77.42	613.82 ± 52.88	78.43 ± 23.88	10.12 ± 2.80	3.46 ± 2.78
≥ 45	13	626.26 ± 52.82	6.4.14 ± 44.29	57.61 ± 24.22	10.41 ± 8.87	2.52 ± 1.72
F		2.825	1.038	15.544	0.155	0.846
P		0.063	0.324	<0.01	0.857	0.431
Working (Y)						
≤ 5	11	622.67 ± 76.23	651.72 ± 35.24	61.96 ± 28.11	16.18 ± 5.27	2.93 ± 1.17
≥ 5	54	603. 57 ± 73.32	620.27 ± 50.39	64.54 ± 25.23	15.13 ± 4.89	3.18 ± 1.45
≥ 15	45	630.70 ± 59.28	595.27 ± 48.15	57.97 ± 21.95	10.83 ± 3.32	2.97 ± 1.03

≥ 25	21	617.19 ± 61.38	574.14 ± 27.89	62.17 ± 32.83	9.17 ± 4.71	2.46 ± 0.97
F		1.369	9.661	0.535	14.891	1.746
P		0.255	<0.01	0.659	<0.01	0.161
Academic						
Junior/senior middle School	30	622.56 ± 56.10	602.94 ± 39.74	67.78 ± 19.05	25.92 ± 12.19	3.31 ± 0.74
Undergraduate	101	603.06 ± 78.54	632.86 ± 54.52	60.40 ± 25.62	11.16 ± 9.51	2.73 ± 2.59
T		1.266	2.79	1.461	6.977	1.209
P		0.208	<0.01	0.147	<0.01	0.229

Multiple regression analysis of oxidative radical and antioxidant enzyme level by occupational stress factors

This study was to analyse the influences of occupational stress factors on oxidative radical and antioxidant enzyme level. Age, working years and education were regarded as control variables. Occupational stress factors as independent variables. Hydrocarbon radical and antioxidant enzyme as dependent variables were given hierarchial regression analysis. The results showed that the main influence factor on SOD was work prospect. The second was work control. All were contribution factors. The main influence factor on POD was work risk, which was negative influence factor. In the analysis of OH, GSH, Px and CAT, there was no variable entering into regression equation. The equation had no meaning, seen in Table 2.

Table 2. *The main influence factor of occupational factor on hydroxyl free radical and antioxidant enzyme activity.*

SOD	B	SE(B)	Beta	R	R^2	Adjusted R^2	SE
Work prospect	0.96	0.79	0.13	0.391	0.153	0.139	23.77
Work control	0.28	0.25	0.09				
POD							
Work risk	-0.68	0.43	-0.13	0.52	0.28	0.25	14.13

Step-by-step analysis of oxidative radical and antioxidant enzyme level by occupational stress factors

Stress reaction was regarded as independent variable and age, working years and education as control variables. Hydrocarbon radical and antioxidant enzyme as dependent variables were given hierarchical regression analysis, then to explore the influences of occupational stress reaction on hydrocarbon radical and antioxidant enzyme. The results showed, the main influence factor on OH was psychological satisfaction, negative influence factors. The main influence factor on GSH-Px was daily stress, negative influence factor. The second was psychological satisfaction and work satisfaction, all were contribution factors. The positive influence factor on SOD was emotion stable. Negative stress reaction was daily stress. In the regression analysis of POD and CAT, there was no variable entering into regression equation. The equation had no meaning, seen in Table 3.

Table 3. *The main influence response factor of occupational factor on hydroxyl free radical and antioxidant enzyme activity.*

OH	B	SE(B)	Beta	R	R^2	Adjusted R^2	SE
Emotion stable	-4.528	2.05	-0.35	0.38	0.14	0.07	59.38
GSH-Px							
Emotion stable	6.34	1.67	0.61	0.61	0.37	0.29	41.76
Daily stress	-10.76	3.51	-0.49				
Psychological satisfaction	0.79	0.26	0.28				
SOD							
Emotion stable	2.05	0.74	0.24	0.35	0.12	0.12	24.22
Daily stress	-2.17	0.99	-0.21				

Discussion

Free radical has strong oxidability. Its hazard is very wide, which can cause lipid per oxidation, injury normal tissue and cells of body. Present study thinks that cardiovascular diseases, inflammation, DNA variation and induction of cell apoptosis, which all have relations with free radical [11,12]. Oxygen radical of free radical *in vivo* is relatively high. Chemical property of OH is the most active [13]. OH can react with all substance (protein, DNA, sugar and phospholipids) in organism by extracting hydrogen, electron transfer and addition once forms in body.

Pathway of body antioxidant includes non-enzymatic and enzymatic pathway of vitamins E, C and selenium. Enzyme participating in radical scavenging includes GSH-Px, SOD, POD and CAT. GSH-Px participates in the process of clearing away hydrogen peroxide and lipid peroxide. SOD plays a key role in balancing oxidation and anti-oxidation of body, which can clear away lipid peroxide, reduce the formation of lipid peroxide, protect vascular endothelium from oxygen free radical, and prevent the formation of atherosclerosis. The studies show that, it can clear away specificity of oxygen free radical, protect vascular endothelial cell, reduce and regulate pressure of artery [14]. The main function of POD is to promote metabolism of hydrogen peroxide, which have relations with occurrence of AS, primary hypertension and myocarditis. Chen [15] has reported the activity of POD is low of patients with severe AS. CAT can catalyse hydrogen peroxide, which can be decomposed into oxygen and water and inhibit the production of OH.

Stress is the main reason of producing free radical *in vivo*. In normal physiological situation, a little free radical in body can be cleared away by antioxidant enzyme and antioxidant rapidly and not produce cytology effect of injuring body. Once body injury occurs, which will cause increase of free radical and decline of antioxidant activity. This balance state will be broke. Strong oxygen stress load has rapid effect and severe injury on body, which will cause the occurrence, development and severity diseases of multiple system and multiple organs directly and indirectly. At present, many studies show the oxygen stress load of patients with diabetes, asthma and viral infection increase. Ability of anti-oxidation decompensate, which cause unbalance of oxygen free radical clearing away barriers, finally cause body oxygen injury [16-18].

Occupation is a kind of social stress except physics, chemistry and biology nature, which is an unbalance state of long-term objective requirements and individual reaction under occupational environment. This study regards clinical nurses as target population to analyse the influences of occupational stress on balance state of free radical and peroxides, which will provide relevant pathological basis for cardiovascular, neural, endocrine diseases by occupational stress.

The results show that serum SOD activity decrease with the increase of age. The higher the working years, the lower serum GSH-Px and POD activity. Besides, the higher education, the higher serum GSH-Px, the lower serum POD activity. Because working years and education, which is influenced by age. Concentration of antioxidant enzyme tends to decreasing trend with the increase of age. This result meets change rule of normal biology.

Occupational stress factors, stress reaction and OH were given hierarchical regression analysis after controlling the influences of age, working years and education. The results show that the better the working prospect and the higher the work control degree, which can increase serum SOD activity. But the increase of work risk can reduce SOD activity. When the psychological satisfaction decreases, the concentration of OH will increase. Increase of daily stress, decrease of psychological satisfaction and work satisfaction, which will reduce activity of serum GSH-Px activity. The calmer the emotion and the lesser the daily stress, the higher the concentration of serum SOD. So we can see, the higher the occupational stress degree of nurses, the stronger the body oxidative ability and the weaker the antioxidant ability. This is an unbalance between oxidation and antioxidant ability, which will cause cardiovascular, neural, psychological, immune and digestive multiple physical and psychological diseases. This result is similar to the study results of Ge [19].

Above all, occupational stress is regarded as a social stress factor. Long-term and occupational stress may cause oxidative stress injury of body. The occupational stress, such as the work prospect and work control is associated with body's anti-oxidation ability.

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