Effect of vitamin C treatment on some central nervous system functions in young rats whose mothers treated with hydrogen peroxide during the lactation period

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Abstract

This study was designed to evaluate the effect of vitamin on young rats whose mothers exposed to 1% hydrogen peroxide in drinking water during the lactation period on the function of the nervous system. The study consisted of three groups, Control group, hydrogen peroxide group, vitamin C with hydrogen peroxide group, showed that treatment with hydrogen peroxide for mothers led to significant decrease in the weights of young-rats-age21 days and significant increase in the righting reflex test, cliff avoidance and the olfactory discrimination test in young rats at age of week and also in the onset movement test and at the time of negative geotaxis test in-young-rats age21days. Treatment of mothers with hydrogen peroxide caused significant decrease in open-field activity and number of times standing on backlists during 3minutes and in the approach response, touch and sound of young rats at age 21 days. While, hydrogen peroxide treated group resulted in significant increase in time of negative geotaxis test and hydrogen peroxide had no effect on response of tail pinch as compared to other groups. When treating mothers with vitamin C significant increase in weights of youngsters age 21 days, as well as in onset of movement test and in number of squares cutoff within 3minutes in open-field activity and number of times standing on backlists during 3minutes in young-rats age 21 days. Also there was significant decrease in starting reflex test, olfactory distinction and negative geotaxis test compared to hydrogen peroxide treated group. It was concluded from the study that vitamin C plays an important role as an antioxidant by improving the nervous system function in young rats their mothers exposed to with hydrogen peroxide in drinking water.

Keywords: Hydrogen peroxide, Nervous system, Oxidative stress, Rats, Vitamin C

Introduction

Oxygen is one of the necessary elements for life, and most of it is naturally reduced to water through breathing processes in mitochondria. As for the remainder of oxygen 1-2%, it is exposed to incomplete reductive reactions through which radicals of the Superoxide anion radical, which is one of the most varieties of free radicals are toxic, other types of free oxygen roots that include hydrogen peroxide, hydroxyl radical, and singlet oxygen (1-3). Many studies confirm the role of oxidative stress in causing many pathological conditions by generating free radicals and effective oxygen classes (4), and free radicals are defined as molecules that have one or more than ten electrons in an unconfigured way in the outer envelope (5), and for these free radicals Toxic effects on the phospholipids present in the cell membrane, as they act to oxidize and form malondialdehyde (MDA) in a process called lipid peroxidation.
peroxidation, and this leads to an increase in the
membranous exudation of the membrane with impaired cell
function (6). Several studies also confirmed that free
radicals lead to a nervous system affliction with many
diseases (7) and that young animals are most vulnerable to
toxic effects as the main source of exposure to these
toxic substances is milk and that the lactating period is very
important in the life of young people because it is
characterized by rapid growth and development of nervous
system, as the motor mechanisms of these toxic substances in
young people differ from adults, which makes the young at
great risk (8), and that the period of brain tissue formation
occurs at the last stage of pregnancy and lasts for 18 months
after birth in humans and is called sudden growth Brain
growing spurt, and in rats, the period of sudden brain
development begins immediately after birth and reaches its
climax on the tenth day of life, and this period is
characterized by the formation of network communication
and the creation of the two medulla (9). Vitamin C is one of
the water soluble vitamins, this vitamin is stable in acidic
solutions but it is very sensitive to oxidation, which is
accelerated by the presence of copper salts and at high
temperatures and exposure to air and light (10). Vitamin C
is involved in accelerating the absorption of iron in the gut
and contributes to making use of the iron stored in the body
(11). Vitamin C is considered one of the most powerful
natural antioxidants (12), as it is found in a large
concentration in many tissues, and works as a sweeper for
effective oxygen classes, especially radicals of negative
superoxide, hydrogen peroxide, hydroxyl radical and
singlet oxygen (13). Vitamin C is considered an important
factor in preventing the effects of oxidative stress in poultry
despite the manufacture of this vitamin in their bodies (14),
and also vitamin C is an important factor in eliminating the
neurological signs resulting from poisoning with sodium
nitrate and causing the production of free radicals (15).

Many recent studies have confirmed the strength of this
vitamin in reducing the severity of stress. The oxidative
process that results in the generation of the reactive oxygen
species responsible for destroying the cells components
(16-18). For this reason, this study aimed to use vitamin C
and evaluate its effect on the efficiency of the nervous
system in young rats his mothers exposed to hydrogen
peroxide during the lactation period in drinking water.

Materials and methods

Female albino rats were used in this study at the age
100-120 day that weight ranged between 200-220 g. The
rats were reared under special laboratory conditions
represented by a natural light cycle (10 hours of light and
14 hours of darkness) in special plastic cages prepared for
this purpose and at a temperature of 18 ± 2°C, water and
food were submitted ad libitum. Females were placed with
adult males for fertilization at a ratio of 3: 1, and then the
mothers were isolated at the first day after birth with their
offsprings, each in their cage, and the treatments were
performed. The experiment included 3 groups. Mothers of
the first group (G1) were given water and a regular diet
during the 21 days of lactation. The second group (G2), the
mothers were given 1% hydrogen peroxide (Al-Hayat
Laboratory, Iraq) with drinking water, and the third group
(G3) mothers were given vitamin C 500 mg/kg body weight
(BDH, England) (19) using the intragastric gavage needle
and the hydrogen peroxide 1% With drinking water, tests
were conducted on the nervous system of young rats at the
age of 21 days, including righting reflex test, cliff
avoidance test and olfactory discrimination test as
neurological behavioral tests, and onset of movement test,
open-field activity negative geotaxis test as indicator for
central nervous system activity. As well as, approach
response, ouch response, click response and tail pinch
response were measurement. Furthermore, weights of
young rats, at one day and after 21 days old was recorded
(20,21).

The data were statistically analyzed using the Tukey’s
test and the difference was considered significant at the
probability level P<0.05 (22). Data for sensory and motor
stimulatory responses in young rats at the age of 21 days
were analyzed using Mann-Whitney-U test for data that
was in the form of numerical scores.

Results

The results showed in table 1 a significant decrease in
the body weight of young rats their mothers treated with
hydrogen peroxide for 21 days compared with the control
group. While giving vitamin C to mothers for 21 days led to
a significant increase in the weights of young rats compared
to the weights of young rats their mothers treated with
hydrogen peroxide.

Table 2 revealed a significant increase in Righting
reflex test, Cliff avoidance and olfactory discrimination in
young rats their mothers treated with hydrogen peroxide
during a week of lactation compared with the control group.
When giving vitamin C and hydrogen peroxide to mothers,
a significant decrease was observed in a Righting reflex test
and olfactory discrimination in young rats compared to the
young rats their mothers treated with hydrogen peroxide for
a week and values return to normal values of the control
group, and no significant difference was recorded in the
Cliff avoidance in young rats their mothers Treatment with
hydrogen peroxide and vitamin C compared with young
rats their mothers exposed to hydroxide peroxide at the age
of a week, with a significant increase in the Cliff avoidance
in young rats their mothers treated with hydrogen peroxide
and vitamin C compared to control group in the first week
of age.

The results of table 3 showed that the treatment of
mothers with hydrogen peroxide led to a significant
increase in the onset of movement test and negative geotaxis test in young rats at the age of 21 days compared to the young rats in control group, while a significant decrease was observed in the number of square moving during 3 minutes and the number of times standing on the hind legs during 3 minutes for young rats at the age of 21 days and the rate their mothers treatment with hydrogen peroxide during the lactation period compared with the control group. When treating mothers with hydrogen peroxide and vitamin C, a significant increase was observed in the number of square blocks during 3 minutes and the number of times standing on the hind legs during 3 minutes in young rats at the age of 21 days and returning to the control group. Treatment with hydrogen peroxide and vitamin C did not cause a significant change in the young rats when compared with the young rats treated with hydrogen peroxide at the age of 21 days, and then return to the control group. Treatment with hydrogen peroxide and vitamin C did not cause a significant change in the approach response, touch response and click response in young rats at the age of 21 days when compared to the young rats group whose mothers treated with hydrogen peroxide at the age of 21 days, while a significant decrease was observed in the negative geotaxis test in the young rats, whose mothers treated with hydrogen peroxide and vitamin C at the age of 21 days and then return to the control group. Table 4 showed that giving hydrogen peroxide to mothers resulted in a significant decrease in the approach response, touch, click and tail pinch to the normal values of control.

Table 1: Effect of vitamin C on body weight of young rats

| Groups | means ±SE / n=10 animals |
|--------|-------------------------|
|        | One day old (gm) | 21 day old (gm) |
| G1     | 4.4±0.05a         | 27.55±0.71b     |
| G2     | 4.85±0.07a        | 16.85±0.3a      |
| G3     | 4.8±0.05a         | 28.25±0.52b     |

Different letters in each column refer to significance P≤0.05.

Table 2: The effect of vitamin C on neurological behavior measurements in young rats at the age of one week

| Groups | Righting Reflex | Cliff Avoidance | Olfactory Discrimination |
|--------|-----------------|-----------------|-------------------------|
| G1     | 2.7±0.2a        | 10.6±0.3a       | 15.4±0.8a               |
| G2     | 6.95±0.7b       | 12.85±0.7b      | 30±1.3b                 |
| G3     | 2.9±0.4a        | 13.05±0.9b      | 16.9±2.1a               |

Different letters in each column refer to significance P≤0.05.

Table 3: The effect of vitamin C on neurological behavior measurements in young rats at the age of 21days

| Groups | means ±SE / n=10 animals |
|--------|-------------------------|
|        | Onset of Movement | Open-Field activity | No. of standing on the back legs | Negative Geotaxis |
| G1     | 2.55±0.42a           | 56.3±2.4b          | 7.9±0.5b                      | 4.4±0.2a          |
| G2     | 5.9±0.31b            | 20.7±1.5a          | 4.05±0.42a                    | 12.65±0.9b        |
| G3     | 5.1±0.4b             | 55.5±2.1b          | 7.4±0.3b                      | 5.05±0.4a         |

Different letters in each column refer to significance P≤0.05.

Table 4: The effect of vitamin C treatment on sensory and motor stimulatory response in young rats at the age of 21days

| Groups | means ±SE / n=10 animals |
|--------|-------------------------|
|        | Approach Response | Touch Response | Click Response | Tail Pinch Response |
| G1     | 3±0.0                  | 2±0.2          | 4±0.0          | 3±0.0               |
| G2     | 1.5±0.0*               | 0.8±0.0*       | 2.8±0.3*       | 2.9±0.5             |
| G3     | 3±0.0                  | 2.3±0.0        | 3.8±0.3        | 3.1±0.0             |

* Means a significant difference compared with control group.

Discussion

This study is concerned with observing the effect of antioxidants represented by vitamin C on some nervous system functions of young rats whose mothers are exposed to oxidative stress-induced with hydrogen peroxide with drinking water. The results of the study showed a significant decrease in the weights of young rats his mothers treated with hydrogen peroxide at the age of 21 days, which is due to the decrease in the amount of feed consumed by the young, and this is consistent with the findings of Aziz (23), which is due to the increase in the active oxygen varieties that deplete glutathione and catalase as antioxidants (24). Meanwhile, the results revealed that
giving vitamin C for 21 days led to a significant increase in the body weights of the young rats and this is in line with what Al-Taie reached (19) as vitamin C is the first line of defense against oxidative stress and thus works to improve the animal's ability for food intakes (25). The study also showed a significant increase in reflex tests to correct the posture of the body and avoid high edge and olfactory discrimination in young rats at the age of a week when treating their mothers with hydrogen peroxide during lactation and this is due to changes in the metabolism of neurotransmitters in the central nervous system and the occurrence of neuropathy in the brain, spinal cord and peripheral nerves (26). Where the neurotransmitters play an important role in the function of the central nervous system and they interact with each other in a complex way, acetylcholine plays an important role in learning and memory (27). The administration of hydrogen peroxide also resulted in a significant increase in the onset of movement test and the negative geotaxis test, a decrease in the number of square blocks and the number of times standing on the back legs within 3 minutes, the reason for this is that hydrogen peroxide generates free radicals that lead to neuropathy in the brain and spinal cord an surrounding nerves, which affect the neurotransmitters, the chemical and serotonergic system, which lead to the breaking down of the cell membrane, the release of proteins and the destruction of the DNA of the neurons in young rats his mothers treated with hydrogen peroxide (27), This is in agreement with the findings of Mustafa and Al-Baggou (28) that administration of chlorpyrifos and deltamethrin in mice led to a significant decrease in the open field and a significant increase in the time of completion of negative geotaxis test, Qasim (15) also found that the administration of sodium nitrate led to a significant decrease in motor activity within the open field, and this is consistent with the findings of the current study, while the current study did not agree with Qasim’s findings in the negative geotaxis test (15), this is consistent with the findings of Qasim (15), where the study proved that vitamin C has antioxidant effects on the functions of the nervous system, Hassan (12) also, found that vitamin C reduced the effects of heat stress in broilers.

The current study showed a significant decrease in the catalytic response to the approach, touch and click in young rats at the age of 21 days when their mothers treated with hydrogen peroxide and perhaps the reason for that is due to neuropathy, which is one of the diseases of the nervous system due to the generation of reactive oxygen species that have a major role in sabotaging the brain cells, spinal cord and nerves Surrounding it which leads to a change in the metabolism of the neurotransmitters in the nervous system (29).

Giving vitamin C with hydrogen peroxide for mothers has significantly increased the stimulatory response to approaching, touching, sound or crackling in young rats at the age of 21 days. This is due to the role of vitamin C in protecting against oxidation, as well as having an important role in the synthesis of peptides in the peptide amidation and myelin formation and protection neural synapses from free radicals as well as protecting neurons from glutamate toxicity caused by free radicals (29).

Conclusions

It was concluded from this study that the use of vitamin C has an important role in ameliorating the dysfunction of nervous system in young rats their mothers treated with hydrogen peroxide during the lactation period.

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Conflict of interest

There is no conflict of interest.

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تأثير المعاملة بفيتامين ه في بعض وظائف الجهاز العصبي المركزي في صغار الجرذان المعاملة أممها بيروكسيد الهيدروجين أثناء فترة الرضاعة

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الخلاصة

صممت هذه الدراسة للتعرف على تأثير فيتامين ه (50 ملغ / كجم من وزن الجسم) في صغار الجرذان المعاملة أممها بيروكسيد الهيدروجين (100 ملغ/ Thiếtسل) على بعض التغيرات التي تحدث في وظيفة الجهاز العصبي. وقد اوضحت الدراسة التي تمثلت ثلاثة مجاميع، مجموعة السيطرة ومجموعة بيروكسيد الهيدروجين و مجموعة فيتامين H مع بيروكسيد الهيدروجين. تم وضع المعاملة بيروكسيد الهيدروجين للأمهات إثر إحداث انخفاضاً معيّنًا في أوزان صغار الجرذان بعمر 21 يومًا، وحدوث زيادة معيّنة في اختبار معكوس تؤدي إلى وضع الجسم وتثبت الحملة واختبار

التمييز الشمي في صغار الجرذان بعمر أسبوع، أيضاً في اختبار البدء بالحركة في زمن الاتزان الأرضي السالب في صغار الجرذان بعمر 21 يومًا. ووضعت المعاملة بيروكسيد الهيدروجين انخفاضاً معيّنًا في التنقل الحركي داخل الميدان المفتوح والمسموح في المربعات المقطعة خلال ثلاثة دقائق، وعدد مرات الوقوف على القوائم الحلقية خلال ثلاثة دقائق، وفي الاتزان الحركي الفعلي للالتراب وللمصوصة أو الطلقة في 21 يومًا. كذلك لوحظ أن بيروكسيد الهيدروجين médico تأثير على الاتزان الحركي لفرص النمل في صغار الجرذان بعمر 21 يومًا، ولاحظ أنه عند وجود بعض المعاملات، من فيتامين H ونحظر حدوت زيادة معنوية في أوزان الصغار بعمر 21 يومًا وكذلك في اختبار البدء بالحركة في زمن الاتزان الأرضي السالب في صغار الجرذان بعمر 21 يومًا، ون كن نتائج المعالمة، بعد مراحل الإعداد. ونستنتج من الدراسة أن بيروكسيد الهيدروجين يمكنه أن يركز في بعض وظائف الجهاز العصبي في صغار الجرذان المعاملة أممها بيروكسيد الهيدروجين.