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АНАЛИЗ ИЗМЕНЕНИЙ ЭЛЕКТРОЛИТНЫХ ПОКАЗАТЕЛЕЙ У ЖЕНЩИН ПРИ ЭКСТРАКОРПОРАЛЬНОМ ОПЛОДОТВОРЕНИИ

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ANALYSIS OF CHANGES IN ELECTROLYTE PARAMETERS IN WOMEN DURING IN VITRO FERTILIZATION PROGRAM

Цель исследования: определить концентрацию основных электролитов плазмы у женщин на основании определения клинико-патогенетической роли нарушений нейроэндокринной регуляции водно-солевого обмена путем индивидуализации медикаментозной коррекции в программе экстракорпорального оплодотворения, а также изучить данные о современных методах профилактики и коррекции электролитных нарушений.

Материалы и методы исследования: Было обследовано 110 пациенток в программе экстракорпорального оплодотворения.

Выводы: Таким образом, при применении стандартных протоколов индукции овуляции в программе экстракорпорального оплодотворения у пациенток наблюдаются изменения электролитных показателей калия и натрия крови.

Синдром гиперстимуляции яичников по данным статистического анализа выявлено только у пациенток основной группы со стандартными протоколами индукции овуляции. Данный синдром не наблюдался у пациенток получавших комбинированную терапию.

Исследовательские материалы. 110 пациенток в программе экстракорпорального оплодотворения были обследованы.

Conclusions. Thus, when using standard protocols for ovulation stimulation in in vitro fertilization program patients are more prone to have potassium and sodium imbalance.

Ovarian hyperstimulation syndrome was detected only in patients of the main group with the standard ovulation induction protocols. This syndrome was not observed in patients receiving the combination therapy.

Key words: reproductive health, water-salt metabolism, sodium, potassium, in vitro fertilization, ovarian hyperstimulation syndrome.

Introduction

Water-salt metabolism is a part of mineral metabolism and a combination of water and salts entering the body, their distribution in the internal environment and excretion from the human body [1, 2, 3]. Water-salt metabolism ensures the blood volume, osmotic pressure and acid-base balance stability [4, 5, 6].

The number of women with disorders have been increasing recently. That is primarily connected with hypothalamic-pituitary dysfunction, autoimmune diseases, emergence of puberty and adolescence somatic diseases, which are common at the adulthood [7]. The use of supporting reproductive technologies in this category of patients is not always effective. It occurs due to the difficulty of selecting an adequate ovarian stimulation protocol with a high probability of developing water-salt metabolism disorders [8, 9, 10].

There are some predictors that are considered quite uninformative and lead to ovarian hyperstimulation syndrome due to the lack of risk factors in case of abnormal water-salt metabolism [11]. They include young age, polycystic ovary syndrome, elevated antimullerian hormone levels, stimulation of ovarian superovulation with gonadotropin-releasing hormone agonists and a large number of follicles during the ovarian stimulation [8, 12, 13, 14].

Ovarian hyperstimulation syndrome is an iatrogenic condition that occurs in response to the controlled ovarian stimulation. The etiological and pathogenetic mechanisms of this syndrome have not still been ascertained [7, 15, 16].

The risk of developing ovarian hyperstimulation syndrome is constantly increasing when applying supporting reproductive technologies in this category of patients using the modern protocols of the controlled ovarian stimulation [17, 18].

The objective of this study was to determine the concentration of basic plasma electrolytes in women at the in vitro fertilization program who received more individualized medication correction based on the determination of the clinical and pathogenetic role of...
the neuroendocrine regulation of water-salt metabolism disorders, as well as to explore the modern methods of electrolyte disorder prevention and correction.

**Research materials and methods** included 110 in vitro fertilization program patients examined at ME (Municipal Enterprise) Regional Medical Center for Human Reproduction, Zaporizhzhia City Council, Zaporizhzhia. The main group was divided into two subgroups: 1\textsuperscript{st} subgroup included 60 patients who were induced the ovulation at the in vitro fertilization program in accordance with generally accepted recommendations; 2\textsuperscript{nd} subgroup included 30 patients who received the combination therapy (diuretics, nootropics and vasoactive drugs) as a supplement to standard ovulation stimulation schemes. Its aim was to prevent and correct the disorders of neuroendocrine water-salt metabolism regulation in women. The control group included 20 patients with a lack of somatic and hormonal disorders of the reproductive system who were inseminated with male sperm in the physiological cycle.

Both main and control group patients were induced the anthropometry with the determination of the body mass index and the establishment of the woman morphological type. The sodium and potassium concentration in the serum was identified.

As a result of the statistical analysis, it was determined that the risk of developing ovarian hyperstimulation was observed only in the 1\textsuperscript{st} subgroup whereas the syndrome of ovarian hyperstimulation was occurred only in the 1\textsuperscript{st} subgroup patients. (Table 3).

<table>
<thead>
<tr>
<th>Indicator</th>
<th>1\textsuperscript{st} subgroup n=60</th>
<th>2\textsuperscript{nd} subgroup n=30</th>
<th>control group n=20</th>
<th>p - values by one-factor variance analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium, mmol/l</td>
<td>4,60±0,04</td>
<td>4,51±0,07</td>
<td>4,39±0,08</td>
<td>0,074</td>
</tr>
<tr>
<td>Sodium, mmol/l</td>
<td>143,97±0,36</td>
<td>142,88±0,65</td>
<td>143,69±0,61</td>
<td>0,219</td>
</tr>
</tbody>
</table>

Table 1. Disorders of electrolyte metabolism in patients on the 2\textsuperscript{nd} – 3\textsuperscript{rd} day of the menstrual cycle

<table>
<thead>
<tr>
<th>Indicator</th>
<th>1\textsuperscript{st} subgroup n=60</th>
<th>2\textsuperscript{nd} subgroup n=30</th>
<th>control group n=20</th>
<th>p - values by one-factor variance analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium, mmol/l</td>
<td>4,68±0,06</td>
<td>4,45±0,06</td>
<td>4,57±0,07</td>
<td>0,049</td>
</tr>
<tr>
<td>Sodium, mmol/l</td>
<td>142,60±0,34</td>
<td>141,43±0,59</td>
<td>142,72±0,53</td>
<td>0,132</td>
</tr>
</tbody>
</table>

Table 1. Disorders of electrolyte metabolism in patients after ovulation trigger

As a result of the statistical analysis, it was determined that the risk of developing ovarian hyperstimulation syndrome was observed in patients of the 1\textsuperscript{st} and 2\textsuperscript{nd} subgroups whereas the syndrome of ovarian hyperstimulation was occurred only in the 1\textsuperscript{st} subgroup patients. (Table 3).
Table 3. The concentration of major blood electrolytes in patients at the risk of developing ovarian hyperstimulation syndrome and with ovarian hyperstimulation syndrome, M±SD

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Patients with ovarian hyperstimulation syndrome</th>
<th>Patients at the risk of developing ovarian hyperstimulation syndrome</th>
<th>control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium, mmol/l</td>
<td>4,72±0,17</td>
<td>4,58±0,08</td>
<td>4,57±0,07</td>
</tr>
<tr>
<td>Sodium, mmol/l</td>
<td>142,42±0,82</td>
<td>141,90±0,67</td>
<td>142,72±0,53</td>
</tr>
</tbody>
</table>

Note : * - statistically significant difference from the comparison group by t-test (p <0,05)

Among the 1st subgroup patients with ovarian hyperstimulation syndrome, the potassium level was increased somewhat the next day after the ovulation trigger introduction (potassium - 4,72±0,41 mmol/l), although the sodium level was decreased (sodium - 142,42±9,46 mmol/l) compared to the patients of the same group on the second and third menstrual cycle day (potassium - 4,68±0,15 mmol/l, sodium - 144,34±10,3 mmol/l). Ovarian hyperstimulation syndrome was not observed in the patients of the 2nd subgroup (Fig. 1).

Fig. 1. The results of the electrolytes study in patients with ovarian hyperstimulation syndrome

Conclusions.
1. Consequently, when using the standard protocols of the controlled ovarian stimulation at the in vitro fertilization, the patients developed an electrolyte imbalance. It involved increasing potassium and sodium level in patients with the standard protocols of the controlled ovarian stimulation and decreasing potassium level in patients who received the combination therapy.
2. The sodium increase in patients of the control group and the sodium decrease in patients who received the combination therapy were observed.
3. The risk of developing ovarian hyperstimulation syndrome was determined in patients of the main group.
4. Some significant differences were noticed in patients receiving the combination therapy. Their potassium and sodium levels the next day after the ovulation trigger introduction were lower than those ones of the same group on the second and third menstrual cycle day.
5. In accordance with the analysis, the ovarian hyperstimulation syndrome was detected only in patients of the main group with the standard ovulation induction protocols. This syndrome was not observed in patients receiving the combination therapy.

References:
Gozhenko A. Preventive mechanisms of water-salt metabolism regulation through the prism of the


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