HYPERBARIC OXYGENATION AND ENDOMETRIAL RECEPTIVITY
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Background
One of the most dynamic tissues of woman’s body in generative period is the endometrium. It is susceptible to daily hormone-dependent changes. Over months, it goes through the phase of proliferation, which is followed by and continued with secretory phase and finally, the phase of degenerative changes of endometrium in cycles without pregnancy. The most recognized hormone responsible for prevention of degenerative changes of endometrium is chorionic gonadotropin secreted by embryo and stimulated by corpus luteum to enhance the secretion of ovarian steroids. One of the most important factors for implantation of fertilized egg cell is definitely the receptivity of endometrium. Other than optimal hormonal milieu, vascularization and oxygenation of endometrium have a special significance. Reproductive physiology requires a lot of research with a view to improve endometrial receptivity and percentage of implantation. It is well known that the implantation will be achieved only if endometrium is adequately developed (1). Transvaginal ultrasound examination has a crucial role in non-invasive evaluation of endometrial receptivity. There have been attempts to ascertain whether there are specific endometrial sonographic features that can be used to predict the incidence of pregnancy in natural and stimulated cycles. Two most common features that are currently assessed are the endometrial thickness and reflectivity (texture or quality).

Objective
To investigate the role of HBO therapy in endometrial thickness and reflectivity; to analyze the effects of hyperbaric oxygenation on uterine arterial blood flow and subendometrial vascularization.

Method
In three-year study conducted at the University Clinic of Gynecology and Obstetrics “Narodni front” and Center for Hyperbaric Medicine (CHM), 32 female patients aged from 27 to 34 years were followed up and selected due to infertility of unknown etiology. All earlier regular tests and diagnostic procedures failed to clarify the impossibility of conception. The patients agreed to hyperbaric oxygen therapy on voluntary basis. The treatment was carried out in Haux multiplace chamber on 2.3 ATA for 70 min. Seven sessions were performed every day from day 5 to 11 of menstrual cycle in each patient. Transvaginal ultrasonography was used to monitor the endometrial changes from day 9 of menstrual cycle to the time of ovulation. The subjects were scanned at the same period of menstrual cycle and in the same way, one month before HBO therapy. The criteria we have adopted for grading the endometrial quality are London Gynecology and Fertility Center Criteria (Grade C, Grade B, Grade A).
Grade A: a multilayer endometrial pattern with bulla of the endometrium showing echogenicity that is slightly more than that of myometrium. This is the most desirable endometrial grading to have at the time of ovulation.
Grade B: A multilayer endometrial; pattern with the bulk of the endometrium exhibiting an exhibiting an echogenicity that is similar to or less than that of the myometrium.
Grade C: An entirely homogenous hyperechoic endometrium. This may be noted in the first days of the menstrual period before the endometrium is shed completely.
Results and discussion

<table>
<thead>
<tr>
<th>Days of menstrual cycles</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade C (%)</td>
<td>96.5</td>
<td>97.3</td>
<td>92.4</td>
<td>93.1</td>
<td>90.4</td>
<td>91.2</td>
<td>91.2</td>
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<tr>
<td>Grade B (%)</td>
<td>3.5</td>
<td>2.7</td>
<td>7.6</td>
<td>6.9</td>
<td>7.2</td>
<td>7.3</td>
<td>8.8</td>
</tr>
<tr>
<td>Grade A (%)</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>2.4</td>
<td>1.5</td>
<td>0</td>
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</tbody>
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Table I. Endometrial quality before HBO therapy

As seen from Table 1, desirable ultrasonogram of endometrium during folliculometry and ovulation was not satisfactory in the majority of patients, i.e. only 1.5% of patients met desirable criterion indicating the adequate ultrasound prediction of good endometrial receptivity. An average thickness of endometrium at the time of ovulation in these patients ranged from 7.7 ± 1.6 mm, with good endometrial receptivity.

<table>
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<tr>
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<th>14</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade C (%)</td>
<td>52.8</td>
<td>55.9</td>
<td>47.1</td>
<td>22.2</td>
<td>25.9</td>
<td>17.1</td>
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<td>Grade B (%)</td>
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<td>42.2</td>
<td>60.3</td>
<td>62.4</td>
<td>47.8</td>
<td>36.5</td>
<td>38.5</td>
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<tr>
<td>Grade A (%)</td>
<td>0</td>
<td>1.9</td>
<td>2.6</td>
<td>15.4</td>
<td>26.3</td>
<td>46.4</td>
<td>45.3</td>
</tr>
</tbody>
</table>

Table II. Endometrial quality during the HBO therapy

The obtained results clearly revealed that desirable quality of endometrium was good and significantly better in the cycle when HBO therapy had been applied (p < 0.001), when compared to the cycle before the therapy. It was noted that ultrasound characteristics of quality achieved better values which maintained during the ovulation and beginning of secretory phase, what all contributed to considerably higher and better prognosis of implantation. According to ultrasound characteristics, HBO therapy had significant effect to improvement of endometrial receptivity (2, 3, 4, 5). In patients undergoing HBO oxygenation, an average thickness of endometrium at the time of ovulation was 10.5 ± 2.8 mm. The analysis of Doppler parameters for evaluation of uterine artery perfusion and subendometrial vascularization found no significant changes of resistance (Ri – resistance index and Pi – pulse index). It corroborated the fact that the effect of HBO therapy to endometrial quality was not achieved by increased blood supply of uterus, that is, endometrium, but better oxygenation by volume of dissolved oxygen directly resulted in the improved endometrial receptivity (6, 7). Therefore, HBO therapy has significant advancement over medicamentous treatment, such as viagra or nifedipine which have been intended to produce better quality of endometrium by vasodilatory effects and higher blood inflow. Accordingly, if endometrial receptivity is also conditioned by the volume of delivered oxygen, then hyperbaric oxygen is the drug of choice.

Conclusion

Good oxygenation of endometrium causes its better receptivity. HBO therapy increases tissue oxygenation, better than any other known medicaments so far. The effects of HBO therapy are prolonged and maintain even upon the completion of therapy for some time, i.e., considerably longer that the effects of medicaments, what is especially important for the effects to secretory endometrium which should enable implantation and eventually provides for desired pregnancy.
References