Success in assisted reproductive technology (ART) depends on obtaining high-quality oocytes (1). If we considered probability of success in patients with more retrieved oocytes, it can economize time and cost of ART treatments.

Follicle stimulating hormone (FSH) measurement at beginning of ART is a routine screening tool for predicting success (2). It is shown that women with an elevation of FSH on the day 3 have limitation in ovarian function (3) and reduction in ART success (4).

In our center we don’t know the best, reliable range of FSH to retrieve more oocytes and embryos that promote our ART success. Some reported that an elevated day 3 basal FSH level is associated with poor response as well as poor quality oocytes, which in turn can lead to a reduction in pregnancy rate and a rise in miscarriage rate (4, 5). Others reported different cut-off point for day-3 FSH to gain more oocytes. They used 17 IU/ml as a cut off to define moderately elevated and elevated basal FSH concentration (6, 7). Another cut off point for predicting ovarian reserve was suggested in 2004 by Onagawa and et al. that was 5.25 IU/ml (8).

In this study, different ranges of basal FSH were determined in order to suggest the success rate for gaining more oocytes and embryos. If we considered...
the probability of success in patients with more retrieved oocytes and embryos, it may economize our time and cost. Besides, the predictive ability of FSH ranges was evaluated, after controlling for confounders associate FSH levels, such as age, body mass index (BMI), type of ovary, type and dosage of Gonadotropins for stimulation, number of transferred embryos and stimulation duration.

**Materials and methods**

All 200 cycles in 200 patients, who underwent ART treatment from April 2007 to September 2008 in Fatemeh-Zahra Infertility and Reproductive Health Research Center of Babol were considered for this study.

Exclusion criteria were women with age less than 18 and more than 40 years, FSH level more than 15 IU/L and history of two poor response cycles.

This study was approved by ethical committee of Vice chancellor of Research and Technology of Babol Medical University and Informed consent was signed by all participating couples.

FSH level was measured at the second cycle day in two consequent cycles before beginning the treatment using Eliza test (Randox kite, German).

Patients were divided into three groups according to FSH levels; group A≤ 8, 8<group B ≤10 and group C > 10 and mean FSH ± SD was considered.

All patients underwent long protocol pituitary suppression with GnRH agonist and then controlled ovarian hyperstimulation (COH) was started as follow: 0.5mg Buserelin (Superfact injection; Aventis pharma Deutschland GmbH, Germany) injection was started subcutaneously from day 19 - 21 of pretreatment cycle and the dose was decreased to 25mg at the beginning of stimulation and was continued until the day of HCG injection.

Patients were divided to 3 groups at second day of stimulation; for group1: Gonal F (Serono S.A., Switzerland), For group2: HMG 75IU: Human Menopausal Gonadotropin (IBSA: Institute Biochimique SA–CH-Lugano) and for group 3: combination of both were administered daily and the treatment was continued according to patients response to ovarian stimulation.

When at least 3 oocytes reached the diameter of 16-18mm 5000IU HCG (Human Chorionic Gonadotropin Darou Paksh– mfg Co- Iran under technical cooperation with Organon) was administered and follicles were aspirated.

Sperm injection was done and embryos were transferred to uterus 48 to 72 hr after injection. For luteal phase support, Cyclogest suppository 400 mg (Activis, Banstaple, UK) twice per day was administered.

Pregnancy was defined when gestational sac was visualized by transvaginal ultrasonography on day 25 after oocytes retrieval.

The number of retrieved and fertilized oocytes and transferred embryos, and the rate of pregnancy per embryo transfer were compared among the three groups.

Fertilization was defined as presence of two pronucli with extrusion of second polar body and the number of transferred embryos was limited to a maximum of 5.

Data were analyzed by SPSS V.16 and independent t-test and χ² test were used for categorical groups. Statistical significant was considered at P< 0.05.

**Results**

In a total of 200 patients, the mean age in groups A, B, and C were 28.35±0.36, 27.63±1.40, and 30.32±1.32 respectively (Mean ±SD).

The mean of basal FSH levels in group A, B and C were 5.07±0.133 IU/ml, 9.00±0.000 IU/ ml and 12.15±0.631 IU/ ml respectively.

The main outcomes of ICSI cycles in three groups are summarized in Table 1.

<table>
<thead>
<tr>
<th>Table 1 Main outcomes of ICSI cycles</th>
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<tbody>
<tr>
<td><strong>Group A</strong></td>
</tr>
<tr>
<td>Number of retrieved oocytes (mean ± SD)</td>
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<tr>
<td>Number of fertilized oocytes (mean ± SD)</td>
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<tr>
<td>Number of transferred embryos (mean ± SD)</td>
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</table>

* Significant (P value< 0.05)
The number of retrieved and fertilized oocytes in group A (12.1±0.48 and 6.93±0.32 respectively) showed a significant difference in comparison to group B (7.88±1.20 and 4.36±0.46) and group C (7.45±1.42 and 4.63±0.92). The number of transferred embryos in group A also was significantly higher than groups B and C.

The characteristics of COH cycles are summarized in Table2. There was no significant difference regarding the age, BMI, type of gonadotropin, type of ovary and duration of stimulating in three groups.

Although, there was no significant difference among three groups regarding to the dosage of gonadotropins required for stimulation but an increasing trend was shown from group A to group C.

The pregnancy rate per embryo transfer was comparable in 3 groups with a peak in group B (33.3%) in comparison to group A (27.5%) and group C (22.7%) with no significant difference.

### Discussion

In the cases of elevated basal FSH levels a poor outcome for ART treatment is predicted because patients with high basal FSH level are generally thought to be poor responders to ovarian stimulation (9). Also Basal FSH in the early follicular phase, as reported previously, is a useful indicator of ovarian reserve (1, 2, 9, and 10).

In our study there was no significant difference regarding BMI and age among three groups. These results are similar to Kojama and et al study about age that has not been under influenced by FSH among his groups (11), but retrieved and fertilized oocytes are significantly higher in our study in the group with FSH ≤ 8 IU/ml. In Kojama study the number of retrieved oocytes, fertilized oocytes and transferred embryos in group with FSH ≤ 10IU/ml were higher than in group with FSH ≥15 IU/ml. Also in his study those in group with FSH between 10-15 IU/ml, showed a significant difference in comparison with group A in regards to the number of retrieved oocytes and with group C in regards to transferred embryos, though in Kojima study, group A were considered less than 10 IU/ml and in our study it is equal or less than 8 (≤8)and this maybe be a reason for this difference.

We found no significant difference in the number of gonadotropin ampoules needed in three groups but an increasing trend is shown from group A to C. Onagava and et al and Kojima and et al showed the same shift with no significance (8, 11). It would be interesting if we consider the difference of our classification with them.

The pregnancy rate was comparable in three groups with the peak in group B (33.3 %) in relation to group A (27.5%) and group C (22.7%) so that with increasing FSH, the number of ampoules increases. Onagava and et al and Kojima and et al showed the same shift with no significance (8, 11). It would be interesting if we consider the difference of our classification with them.

The pregnancy rate was comparable in three groups with a the pick in group B (33.3 %) in relation to group A (27.5%) and group C (22.7%). These results are in agreement with James P. that reported women younger than 38 years of age with FSH (10-15 or even 20 IU/ml) have acceptable pregnancy rates despite their limited oocytes (11). As Van Rooij and et al. reported high FSH levels should not necessarily lead to the exclusion of subfertile patients from treatment (12).

As well as Esposito in his study said “the use of FSH as a screening test is best employed to provide prognostic information for a patient undergoing IVF

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
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</thead>
<tbody>
<tr>
<td>Age (mean ±SD)</td>
<td>28.35±0.36</td>
<td>27.63±1.40</td>
<td>30.32±1.35</td>
</tr>
<tr>
<td>Number of required Gonadotropin Ampoules (mean ±SD)</td>
<td>30.54±0.93</td>
<td>31.00±2.53</td>
<td>34.00±4.43</td>
</tr>
<tr>
<td>Stimulation duration (mean ±SD)</td>
<td>15.66±0.15</td>
<td>15.83±0.45</td>
<td>15.05±0.54</td>
</tr>
<tr>
<td>Type of ovary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>normal</td>
<td>174(86.1%)</td>
<td>23(95.8%)</td>
<td>17(81%)</td>
</tr>
<tr>
<td>PCO</td>
<td>28 (13.9%)</td>
<td>1 (4.2%)</td>
<td>4 (19%)</td>
</tr>
<tr>
<td>Types of gonadotropin</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GonalF</td>
<td>102(50.7%)</td>
<td>13(54.2%)</td>
<td>14(63.6%)</td>
</tr>
<tr>
<td>HMG</td>
<td>87(43.3%)</td>
<td>9(37.5%)</td>
<td>5 (22.7%)</td>
</tr>
<tr>
<td>Mix of both</td>
<td>12(6%)</td>
<td>2(8.3%)</td>
<td>3 (13.6%)</td>
</tr>
<tr>
<td>Pregnancy rate</td>
<td>27.5 %</td>
<td>33.3 %</td>
<td>22.7 %</td>
</tr>
</tbody>
</table>
for the first time using a high cut-off concentration (>11.4 mIU)" (5) our study obviously has shown patients with basal FSH range, equals or under 8 IU/ml can expect most oocytes or embryos to donate or transfer. Maybe also we’ve become near to Onagava’s study that reported significant cut-off point for day-3 FSH to predict ovarian reserve is 5.25 IU/ml (8) and we have the range equal or less than 8 IU/ml is reliable too. Also we did not research about the quality of embryos that’s important for freezing embryos.

In this study, we had the most significant increase in retrieved and fertilized oocytes in the group with basal FSH level equals or under 8 IU/ml, so infertility experts can count them as good candidates to reserve more oocytes and embryos to freeze or donate.

Acknowledgment

Thanks to Dr. Soraya Khafri for her statistical advises.

References

12. van Rooij IA, de Jong E, Broekmans FJ, Looman CW, Habbema JD, te Velde ER. High follicle-stimulating hormone levels should not necessarily lead to the exclusion of subfertile patients from treatment. Fertil Steril 2004; 81:1478–85.