Abstract

Aim
To evaluate if there is an association between IVF patients’ ABO blood group system, ovarian reserve markers and ART outcomes.

Methods
This retrospective observational study enrolled 509 patients who treated with in vitro fertilization (IVF) cycle. Study population divided four groups in terms of blood type. Risk factors evaluated were: follicle stimulating hormone (FSH), estradiol (E2), thyroid stimulating hormone (TSH), peak E2 levels, duration of infertility, antral follicle count (AFC), number of mature oocytes retrieved, number of grade of embryos, clinical pregnancy rates (CPR) per women, total gonadotropin dose.

Results
The mean (± SD) age and BMI of the study cohort was 30.1 (±4.67) years, 27.4 (±2.91) kg/m², respectively. The distribution of ABO blood types in the cohort was as follows: 40.6 % (A), 6.09 % (AB), 20.4 % (B), and 32.8 % (O). There was no statistical difference in the mean age, BMI, basal FSH level, basal E2 level, peak E2 levels and total gonadotropin administered, peak endometrial stripe, or total number of oocytes retrieved and embryo quality. The pregnancy rate was similar between the groups (p>0.05).

Conclusion
There was no significant association between blood type and ovarian reserve or response during IVF treatment in our population.

Key words: IVF; Blood Type; Ovarian Reserve

Introduction
The quantity and quality of oocytes within the ovaries is determined as ovarian reserve (OR) and it showed reproductive capacity of ovaries. To investigate the success of assisted reproductive techniques (ART) for improving the safety of ovarian stimulation procedures, it is important to evaluate the ovarian reserve [1, 2]. The safety of ovarian stimulation based on to evaluate proper ovarian reserve in order to reduce the risk of developing ovarian hyper stimulation syndrome in ART cycles. Although it is difficult to determine the OR, it was showed that age, FSH (follicle-stimulating hormone) concentrations, inhibin B serum levels, anti-Müllerian hormone (AMH) levels; antral follicle count (AFC) by transvaginal ultrasound should predict the OR. Nevertheless, since OR is believed an important factor for the prognosis of IVF success, getting a good appraisal for the optimal dose of ovarian stimulation should be useful. Recent studies have showed that blood type antigens have an association between distinct diseases [3]. Furthermore, some studies have suggested an association between blood group ABO and diminished ovarian reserve [4, 5]. The aim of this study was to evaluate whether there is an association between IVF patients’ ABO blood group system, ovarian reserve markers and ART outcomes.

Method

Ethics Statement
This study was approved by the Ethics Committee of Ankara Zekai Tahir Burak Women's Health Research and Education Hospital. Informed consent was obtained from each participant before enrolling in the study.

Study Population and Design
This retrospective observational study enrolled 509 patients seen between January 1, 2014 and December 31, 2015 at the outpatient ART department of infertility clinic of Ankara Zekai Tahir Burak Women's Health Research and Education Hospital, a tertiary referral hospital. Study group divided four group according to blood types. Risk factors evaluated were; follicle stimulating hormone (FSH),...
estradiol (E2), thyroid stimulating hormone (TSH), peak E2 levels, duration of infertility, antral follicle count (AFC), number of mature oocytes retrieved, number of grade of embryos, clinical pregnancy rates (CPR) per women, total gonadotropin dose. Groups were compared in terms of risk factors.

Statistical Analysis
Statistical analyses were performed using SPSS 15.0 for Windows (SPSS, Chicago, IL, USA). The mean and standard deviation (SD) were calculated for continuous variables. The normality of the variables was analyzed using the Kolmogorov–Smirnov test. An independent samples t-test was used to evaluate associations between continuous variables. All variables were included in the backward stepwise procedure. The Pearson correlation coefficient was used to test associations between clinical parameters. Receiver operator characteristic (ROC) curve analysis was used to establish the cut-off value for the cystatin levels. Two-sided p-values were considered statistically significant at $p < 0.05$.

Results
There were a total of 509 patients in the study group. The mean (± SD) age and BMI of the study cohort was 30.1 (±4.67) years, 27.4 (±2.91) kg/m², respectively. The distribution of ABO blood types in the cohort was as follows: 40.6 % (A), 6.09 % (AB), 20.4 % (B), and 32.8 % (O). Table 1 summarizes the demographic, clinical, and laboratory characteristics of the IVF patients. There was no statistical difference in the mean age, BMI, basal FSH level, basal E2 level, peak E2 levels and Antral follicle count. Furthermore, there was no difference in the total gonadotropins administered, peak endometrial stripe, or total number of oocytes retrieved and embryo quality. The pregnancy rate was similar between the groups ($p>0.05$).

### Table 1: Demographic and clinical parameters of patients

<table>
<thead>
<tr>
<th>values</th>
<th>Blood types</th>
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<tbody>
<tr>
<td></td>
<td>O (n=167)</td>
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<tr>
<td>Age (years)</td>
<td>30.17±5.07</td>
</tr>
<tr>
<td>BMI (kg/m2)</td>
<td>26.12±4.11</td>
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<tr>
<td>Baseline FSH (IU/L)</td>
<td>6.19±2.28</td>
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<tr>
<td>Baseline E2 (pg/mL)</td>
<td>48.35 ± 21.75</td>
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<tr>
<td>Antral follicle count</td>
<td>10.13 ± 5.39</td>
</tr>
<tr>
<td>Total gonadotropin dose (IU)</td>
<td>2255 ± 1390</td>
</tr>
<tr>
<td>Endometrial thickness (mm)</td>
<td>10.34 ± 1.99</td>
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<tr>
<td>Peak E2 (pg/mL)</td>
<td>2327 ± 2731</td>
</tr>
<tr>
<td>Number of retrieved oocytes</td>
<td>10.29 ± 6.03</td>
</tr>
<tr>
<td>Number of M II oocytes</td>
<td>6.595.11</td>
</tr>
<tr>
<td>Embryo quality (grade I embryo) (%)</td>
<td>42.5</td>
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<tr>
<td>Clinical pregnancy rate (%)</td>
<td>32.3</td>
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</tbody>
</table>

Discussion
Our findings suggest no association between ABO blood type and ovarian stimulation response in ovarian reserve and assisted reproductive technique outcomes. Base line FSH and E2 levels were similar between ABO blood types. Antral follicle count had an increase in AB blood type group but this data was not statically significant between groups. The mean pregnancy rate was 37.52±25.51 and it had an increase in AB blood type group. The ART outcomes were similar between groups.

Ovarian reserve (OR) tests as a screening tool to assess the chance of individual patients achieving a pregnancy or a live birth with IVF treatment. Hormonal status is an indirect determination of OR but it has several drawbacks. On cycle day 3 estrogen levels expected to be low. Estrogen suppresses the synthesis of FSH as a negative feedback mechanism. The FSH level is only significant if estrogen levels are low. Therefore, it is imperative to detect both hormone levels at the same time. Generally, FSH levels < 10 mIU/mL is considered an indicator of sufficient ovarian reserve [6]. Elevated day 3 FSH levels in a previous cycle are associated with a reduction in the overall live birth rate if compared to women with normal basal FSH levels [7].

The association between ABO blood type and ovarian reserve were studied in recent studies. The first study was published by Nejat et al. [8]. They found that patients with blood type O were significantly more likely to show diminished ovarian reserve than those with blood types A or AB (OR 2.14, 95% CI 1.22–3.80). While analyzing the subgroup of patients with FSH >12 mIU/mL (OR 2.44, 95% CI 1.22–5.04), this association was stronger. They speculated that the antigen provide protection against diminished ovarian reserve because of significantly higher representation of blood type A and AB in the group with normal ovarian reserve. Lin
et al. studied on 35,479 Chinese women and found an association between ABO blood type and DOR occurrence. Further, the authors demonstrate that women with blood type O were statistically significantly less likely to have DOR, whereas those with B antigen (blood type B or AB) were statistically significantly more likely to have DOR. In our study, we found no association between ABO blood type and ovarian reserve. The FSH, estradiol levels and AFC were similar between groups and in AB blood type group showed increased estradiol levels and AFC, but it was not significant different between groups.

The relation between different ABO blood types and gynecologic conditions has been demonstrated in previous studies. Binder et al [9] reported the first study which showed a possible relation between blood type A and OHSS. Pereira et al [10]. studied 2575 patients who underwent controlled ovarian stimulation (COS) for in vitro fertilization (IVF) and found no association between ABO blood type and ovarian stimulation response in patients with DOR. They speculated that the predictive value of ABO blood type in determining ovarian stimulation response in such patients is currently limited.

In patients treated COS for IVF, ovarian response to gonadotropins and oocyte output ultimately reflects ovarian reserve. Spitzer et al [11]. demonstrated the relation between ABO blood type and ovarian reserve through measurements of cumulus oocyte complexes (COCs) and metaphase II (MII) oocytes collected after ovarian stimulation in 1889 IVF cycles. The authors found similar number of COCs and MII oocytes across all blood types and ages. Another study, Awartani et al [12]. Studied 424 patients who underwent 566 IVF cycles and concluded that there was no significant association between blood type and ovarian reserve or response during IVF treatment in our population Our results are uniform with the results from these studies, revealed no association between ABO blood type and DOR and IVF outcomes. Although grade I embryo rate and Clinical pregnancy rate have an increase in AB blood type group, there were no statistically significant different between groups.

**Conclusion**

Our findings demonstrated that there was no significant association between blood type and ovarian reserve or response during IVF treatment in our population.

**References**