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The Evaluation of Hemodynamic and Endocrine Response and Nesfatin-1 in Patients Undergoing Inhalation and Total Intravenous Anesthesia

İnhalasyon ve Total İntravenöz Anestezi Uygulanan Hastalarda Hemodinamik, Endokrin Yanıt ve Nesfatin-1'in Değerlendirilmesi

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ÖZ

Amaç: Çalışmanın amacı, farklı anestezi tekniklerinin cerrahi stres yanıtı ve nesfatin-1 düzeyleri üzerindeki etkilerini araştırmaktır.
Araçlar ve Yöntem: Bu çalışma, Mart-Haziran 2015 tarihleri arasında prospektif, randomize ve kontrollü olarak gerçekleştirildi. Septoplasti operasyonu geçiren 90 hasta, Desfluran + N_2O (Grup 1), Desfluran + Remifentanil (Grup 2) ve Propofol + Remifentanil (Grup 3) olmak üzere üç gruba randomize edildi. Kan örnekleri indüksiyondan hemen önce, postoperatif derlenme odasında 30. dakikada ve postoperatif 24. saatte alındı. Serum insülin, glukoz, adrenalin, noradrenalin, kortizol ve nesfatin-1 düzeyleri ölçüldü.
Bulgular: Gruplar arasında glukoz, adrenalin, noradrenalin ve nesfatin-1 düzeyleri açısından herhangi bir zaman noktasında anlamlı fark gözlenmedi ($p > 0,05$). Ancak, postoperatif 24. saatte insülin düzeyleri Grup 1'de Grup 3'e kıyasla anlamlı derecede yüksekti (sırasıyla 18,24 miu/ml ve 5,52 miu/ml; $p < 0,05$). Postoperatif 30. dakikada Grup 3'te ölçülen kortizol seviyeleri diğer gruplara göre anlamlı bir artış gösterdi (10,82 µg/dl; $p < 0,05$).
Sonuç: Septoplasti geçiren hastalarda farklı anestezi teknikleri, hemodinamik ve endokrin yanıtlar ile nesfatin-1 düzeyleri üzerinde benzer etkiler göstermiştir.

Anahtar Kelimeler: cerrahi stres yanıt; inhalasyon anestezisi; Nesfatin-1; TİVA

ABSTRACT

Purpose: The aim of this study was to investigate the effects of different anesthesia techniques on the surgical stress response and nesfatin-1 levels.
Materials and Methods: This prospective, randomized, controlled study was conducted between March and June 2015. Ninety patients undergoing septoplasty were randomized into three groups: Desflurane + N_2O (Group 1), Desflurane + Remifentanil (Group 2), and Propofol + Remifentanil (Group 3). Blood samples were collected immediately before induction, at the 30th minute in the postoperative recovery room, and at the 24th postoperative hour. Serum insulin, glucose, adrenaline, noradrenaline, cortisol, and nesfatin-1 levels were measured.
Results: There were no significant differences between groups in glucose, adrenaline, noradrenaline, and nesfatin-1 levels at any time point ($p > 0.05$). However, insulin levels at the 24th postoperative hour were significantly higher in Group 1 compared to Group 3 (18.24 miu/ml vs. 5.52 miu/ml; $p < 0.05$). Cortisol levels measured at the 30th postoperative minute in Group 3 showed a significant increase compared to the other groups (10.82 µg/dl; $p < 0.05$).
Conclusion: Different anesthesia techniques produced similar effects on hemodynamic and endocrine responses as well as nesfatin-1 levels in patients undergoing septoplasty.

Keywords: surgical stress response; inhalation anesthesia; Nesfatin-1; TIVA

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INTRODUCTION

Endocrine, autonomic, metabolic, and immunological responses to harmful stimuli to maintain body homeostasis are called stress. These responses can occur in traumas, sepsis, and starvation. Fear of surgery, hunger, surgery, and anesthesia methods applied to the patient are important sources of stress for the patient. The endocrine response or stress reaction is a series of autonomic, neuroendocrine, and metabolic responses initiated by various harmful stimuli and aimed at maintaining the body's homeostasis and thus sustaining life. Harmful stimuli are fear, pain, trauma, infection, burns, hunger, systemic inflammatory response syndrome (SIRS), or sepsis.[1,2]

With the effect of hormones released during stress, the functioning of systems and organs can change. Thus, some cardiovascular complications such as accelerated heartbeat, tension, elevated blood pressure, suppression of immune systems, thromboembolisms, stress ulcers, heart failure as a result of increased oxygen (O_2) demand and load of the heart, pulmonary infarction, and failure may occur.[1]

Surgery and anesthesia cause metabolic and hormonal changes. The body's reaction to surgical stress includes activation of the sympathetic nervous system and an increased secretion of hormones from the pituitary gland that promotes catabolism and immune suppression.[3] This response is directly related to the degree of damage, the size and duration of the surgical procedure, the amount of fluid and blood lost during the surgical procedure, and the degree of pain felt after surgery.[4]

The relationship between endocrine and metabolic responses to stress is bidirectional. While anesthesia and accompanying surgery may cause endocrine and metabolic changes by creating stress themselves, anesthesia in particular may reduce or even prevent this response. In a person undergoing surgery under anesthesia, stress responses provide no benefit and may be harmful by increasing energy consumption and myocardial workload. Therefore, controlling the stress response may reduce postoperative morbidity and mortality. [1]

Studies investigating the effects of different anesthesia techniques on recovery and stress response have shown that combining inhalation anesthetics with remifentanil not only shortens recovery time but also suppresses the endocrine and metabolic stress responses at least as effectively as TIVA.[5-7]

Nesfatin-1 is a molecule called the satiety molecule in the hypothalamus and has an increased role in multiple endocrine functions.[8,9] Studies show that individuals with higher anxiety exhibit increased plasma nesfatin-1 levels compared to those with lower anxiety. Furthermore, plasma nesfatin-1 levels have been linked with total stress and depression scores.[10]

This study aimed to investigate the effect of different anesthesia techniques on hemodynamic and endocrine responses and nesfatin-1 levels, a new peptide hormone.

MATERIALS and METHODS

Study Design

The study was designed as a single-center, randomized, prospective trial.

Study Site

This study was performed on 90 patients who underwent septorhinoplasty between March and June 2015 in the operating rooms of Firat University Hospital.

Ethical Approval and Informed Consent

This study was approved by Firat University Non-Interventional Research Ethics Committee (dated 17.06.2014 and numbered 12-05).

This prospective randomized study was designed in compliance with the Declaration of Helsinki. All participants who met the inclusion criteria were informed about the study, and informed consent was obtained from each individual.

Inclusion and Exclusion Criteria

The study included 90 patients aged 18 to 60 years, classified as ASA I-II risk group, who received no premedication and underwent septorhinoplasty surgery lasting at least two hours

Patients with an ASA risk group ≥ 3, those who received premedication, had surgeries lasting less than 2 hours, or had psychiatric, cardiovascular, or metabolic disorders were excluded from the study.

A detailed medical history was taken, and systemic examinations were performed at the Firat University Anesthesiology and Reanimation Polyclinic.

Procedure

Patients brought to the operating table were monitored using electrocardiography (ECG), heart rate (HR), noninvasive arterial blood pressure (NIBP), and peripheral oxygen saturation (SpO_2). A 0.9% NaCl infusion was started intravenously through a 20 G IV cannula.

G*Power (version 3.1.9.2, University of Kiel, Germany) was used for the power analysis of the study. It was calculated that a total of 84 patients, 28 patients in each group, would be needed to reach 87% specificity in power analysis. Considering the possibility of data loss, the groups were formed with 30 patients.

The 90 patients included in the study were randomly divided into three groups using the closed-envelope method:

Group I (n=30): The group of patients to receive desflurane, N_2O and O_2,

Group II (n=30): The group of patients to receive desflurane, remifentanil, O_2, and dry air,

Group III (n=30): The patient group to receive propofol, remifentanil, O_2, and dry air.

In group I patients (n=30), 2 mg/kg propofol (Propofol®, Fresenius Kabi, Germany) was administered intravenously after preoxygenation. After the loss of eyelash reflex was observed, 0.1 mg/kg vecuronium (Blok-L®, Mustafa Nevzat İlaç, Turkey) was administered. Endotracheal intubation was performed approximately 2-3 minutes after vecuronium administration. Anesthesia maintenance was maintained with 50% O_2+ 50% N_2O+ desflurane (Suprane®, Baxter, USA) at a concentration of 6%. When skin suturing was completed at the end of the operation, desflurane inhalation was discontinued and patients were ventilated with 100% oxygen. In patients exhibiting spontaneous respiratory effort, neuromuscular block was reversed using a combination of 0.5 mg atropine and 2 mg neostigmine. Patients with adequate spontaneous respiration were extubated.

In group II patients (n=30), 0.5 mcg/kg remifentanil was initially administered as an intravenous bolus after preoxygenation with 100% O_2 for 3 minutes before induction. Then 2 mg/kg propofol was administered intravenously. After the loss of eyelash reflex was observed, 0.1 mg/kg vecuronium was administered. Endotracheal intubation was performed approximately 2-3 minutes after vecuronium administration. Anaesthesia was maintained with 50% O_2 + 50% dry air + desflurane at a concentration of 6%. Remifentanil infusion was continued at a dose of 0.3 µg/kg/min. When skin suturing was completed at the end of the operation, desflurane inhalation was discontinued and patients were ventilated with 100% oxygen. In patients exhibiting spontaneous respiratory effort, neuromuscular block was reversed using a combination of 0.5 mg atropine and 2 mg neostigmine. Patients with adequate spontaneous respiration were extubated.

In group III patients (n=30), 0.5 mcg/kg of remifentanil was administered as an intravenous bolus at the beginning of induction. Propofol 20 mg/kg/hour and remifentanil 0.3 mcg/kg/min infusion was started with 8 lt/min O_2. After eyelash reflex and loss of consciousness, 0.1 mg/kg vecuronium was administered intravenously. The patient was intubated 2-3 minutes after vecuronium administration. Infusion of propofol 3 mg/kg/hour and remifentanil 0.3 µg/kg/min was continued with 50% dry air and 50% oxygen. Propofol infusion was stopped five minutes before the end of the operation and remifentanil infusion was stopped after the last skin suture and patients were ventilated with 100% oxygen. Neuromuscular block was reversed with 0.5 mg atropine +2 mg neostigmine in patients with spontaneous respiratory effort. Patients with adequate spontaneous respiration were extubated.

Data Collection Procedure

5 ml venous blood samples were taken from the patients in all groups at three times: just before induction, at 30 minutes in the postoperative recovery room, and at 24 hours

postoperatively. Blood samples were centrifuged at 4000 rpm for 5 minutes and serum was collected and stored at -80 °C until the study day. Serum Nesfatin-1 levels (Human NES1 (Nesfatin 1) ELISA Kit, E-EL-H2373-Elabscience Biotechnology Co., Ltd. China) were measured by ELISA (Biotek Elx-50) method in the laboratory of the Department of Biochemistry, Faculty of Medicine, Firat University. Serum catecholamine (Eureka lab division, Z25010, Italy) levels were analyzed by High-Performance Liquid Chromatography (Shimadz 4 prominence c, LC-2010HT, US) in the Central Laboratory of Firat University Faculty of Medicine. Cortisol and insulin levels were measured by chemiluminescent method (ADVIA Centaur XP, Siemens, Germany) and glucose levels were measured spectrometrically.

Data Analysis and Management

The primary outcomes of this study were the evaluation of glucose, insulin, cortisol, adrenaline, noradrenaline, adrenaline, and nesfatin-1 levels in blood samples taken in 3 different periods in both three groups between and within groups.

The secondary outcomes of this study were the intra- and inter-group evaluation of HR, SBP, and DBP values in three groups starting in the preoperative period and continuing throughout the postoperative period.

Statistical Analyses

Statistical analysis was conducted using SPSS 21.0 (The Statistical Package for the Social Sciences, Chicago, USA). Data were recorded as mean ± standard deviation (SD). Analysis of variance (ANOVA) was used to assess parametric tests, and the Tukey HSD test was applied for post-hoc comparisons when significant differences were identified between groups. For intragroup comparisons of repeated measurements, paired t-tests were utilized. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Demographic data showed no statistically meaningful differences in both intra- and inter-group analyses. (p>0.05) (Table 1).

Table 1. Demographic data of the patients (mean±sd).

Variables	Group 1 (n=30)	Group 2 (n=30)	Group 3 (n=30)
Gender(M/F)	12/18	10/20	14/16
Age (year)	27.36±7.11	23.13±5.73	25.93±7.06
Weight (kg)	68.40±10.21	62.70±10.13	64.96±10.17

Group 1:Desflurane + N_2O; Group 2: Desflurane + Remifentanil; Group 3:Propofol + Remifentanil.

In the DKB evaluation, the value measured in Group 2 in the 1st period was found to be statistically significantly higher than Group 1 (p<0.05). In the 2nd and 3rd periods, the values measured in Group 2 were statistically significantly higher than the values measured in Group 3 (p<0.05). In the intragroup evaluation, the values in the 2nd and 3rd periods were found to be statistically significantly lower than those in the 1st period across all groups (p<0.05). In addition, the value in the 3rd period was statistically significantly lower than the value in the 2nd period in all groups (p<0.05)(Figure 1).

Systolic blood pressure (SBP) and heart rate (HR) results showed no statistically significant variation between the groups. (p>0.05). However, in intragroup evaluation, SBP and HR values in the 2nd and 3rd periods were observed to be statistically significantly lower compared to the values recorded in the 1st period across all groups (p=0.001). In all groups, the measurements taken during the 3rd period were statistically significantly lower than those recorded in the 2nd period (p=0.001) (Figures 2 and 3).

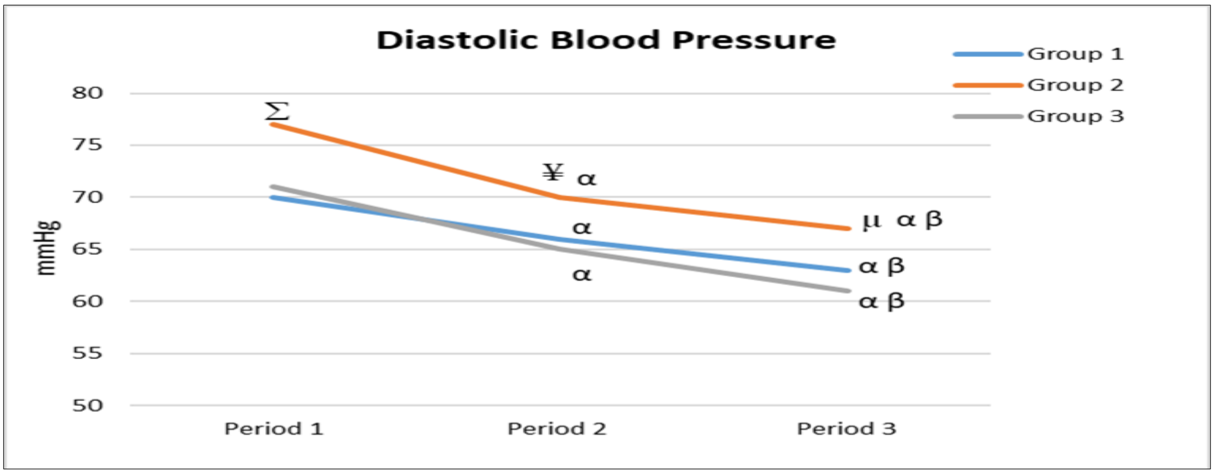

Figure 1. Intergroup and intragroup diastolic blood pressure results.
Between groups: ∑→compared to Grup 1, ¥→ compared to Grup 3; ∞→ compared to Grup 3
Within group: α →compared with Period 1, β→ compared with Period 2
Group 1:Desflurane + N_2O; Group 2: Desflurane + Remifentanil; Group 3:Propofol + Remifentanil; Period 1: Immediately before induction; Period 2: 30th minute in the recovery room; Period 3: 24th hour postoperatively.

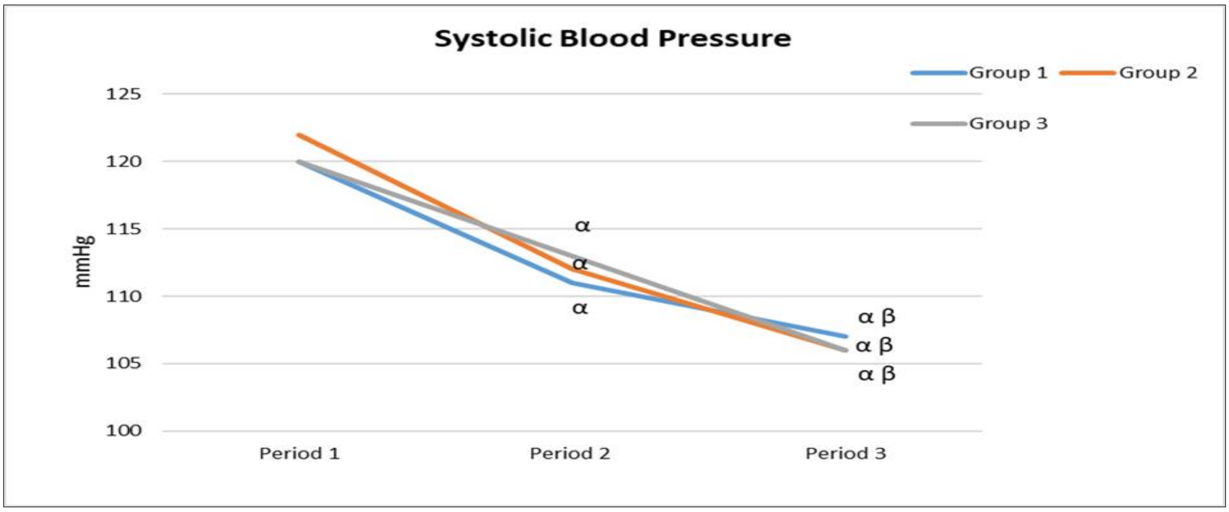

Figure 2. Intra-group systolic blood pressure results.
In-group: α→ compared with α Period 1, β → compared with Period 2
Group 1:Desflurane + N_2O; Group 2: Desflurane + Remifentanil; Group 3:Propofol + Remifentanil; Period 1: Immediately before induction; Period 2: 30th minute in the recovery room; Period 3: 24th hour postoperatively.

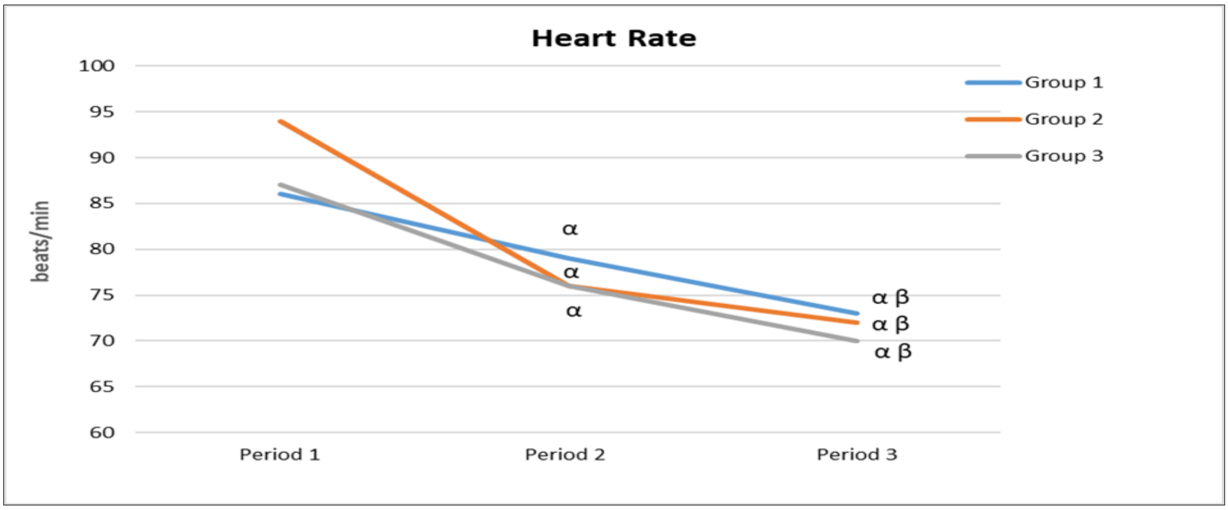

Figure 3. Intragroup heart rate results.
In-group: α →compared with α Period 1, β→ compared with Period 2
Group 1:Desflurane + N_2O; Group 2: Desflurane + Remifentanil; Group 3:Propofol + Remifentanil; Period 1: Immediately before induction; Period 2: 30th minute in the recovery room; Period 3: 24th hour postoperatively.

The hemodynamic parameters including systolic blood pressure, diastolic blood pressure, and heart rate changes of the patients according to the results of statistical analyses between all groups are summarised in Table 2.

Table 2. Hemodynamic changes in patients (mean±sd).

	Period	Group 1 (n=30)	Group 2 (n=30)	Group 3 (n=30)
Heart Rate (beats/min)	1	$86.73 \pm 20.42^{*\beta}$	$94.00 \pm 20.41^{*\beta}$	$87.46 \pm 18.81^{*\beta}$
	2	$79.56 \pm 12.68^{\alpha}$	$76.96 \pm 10.25^{\alpha}$	$76.53 \pm 13.05^{\alpha}$
	3	73.86±9.74	72.50±8.52	70.23±9.97
Systolic Blood Pressure (mmHg)	1	$120.00 \pm 11.62^{*\beta}$	$122.97 \pm 12.03^{*\beta}$	$120.57 \pm 13.83^{*\beta}$
	2	$111.80 \pm 7.29^{\alpha}$	$112.00 \pm 11.75^{\alpha}$	$113.23 \pm 9.58^{\alpha}$
	3	107.73±6.27	106.30±8.57	106.13±7.13
Diastolic Blood Pressure (mmHg)	1	$70.23 \pm 10.30^{*\beta}$	$77.16 \pm 9.55^{*\beta\gamma}$	$71.76 \pm 11.28^{*\beta}$
	2	$66.26 \pm 6.95^{\alpha}$	$70.73 \pm 8.58^{\alpha\infty}$	$65.43 \pm 6.90^{\alpha}$
	3	63.93±5.99	$67.86 \pm 7.54^{\infty}$	61.86±5.67

Immediately before induction; Period 2: 30th minute in the recovery room; Period 3; 24th hour postoperatively.
γ $p < 0.05$ Between Group 2 and Group 1. ∞ $p < 0.05$ Between Group 2 and Group 3. * $p < 0.05$ Between Period 1 and Period 2. β $p < 0.05$ Between Period 1 and Period 3. α $p < 0.05$ Between Period 2 and Period 3.

Serum glucose levels showed no statistically significant variation between the groups($p>0.05$) In intragroup evaluation, the values in the 3rd period in group 1 and group 2 were statistically significantly higher than the values in the 1st period ($p<0.05$) (Figure 4).

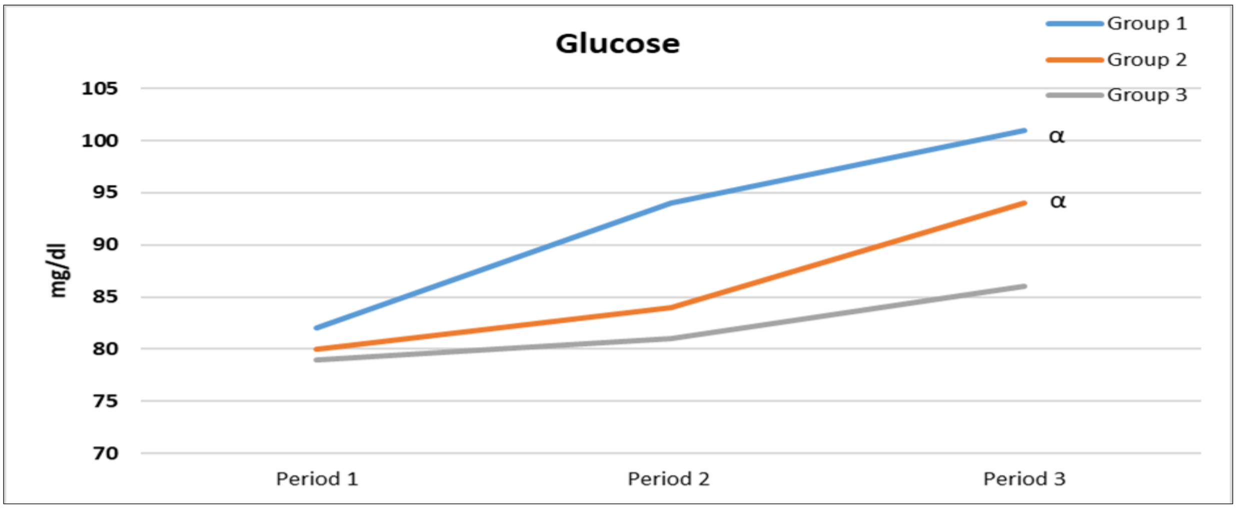

Figure 4. Glucose results within the group.
In-group: α →compared with α Period 1
Group 1:Desflurane + N_2O; Group 2: Desflurane + Remifentanil; Group 3:Propofol + Remifentanil; Period 1: Immediately before induction; Period 2: 30th minute in the recovery room; Period 3: 24th hour postoperatively.

In the intergroup evaluation, the insulin level measured in the 3rd period was statistically significantly higher in Group 1 than in Group 3 ($p<0.05$). In the intra-group evaluation, the insulin value measured in the 3rd period in group 1 was statistically significantly higher than the 1st period, and the insulin value measured in the 3rd period in group 2 was statistically significantly higher than the 1st and 2nd-period values ($p<0.05$) (Figure 5).

In the intergroup evaluation, the cortisol value measured in the 2nd period was found to be statistically significantly higher in group 3 compared to the other groups ($p<0.05$). In intragroup evaluation, the cortisol value measured in the 3rd period in group 1 was found to be statistically significantly higher than the 2nd period ($p<0.05$). The 2nd and 3rd-period values in group 2 were statistically significantly lower than the 1st-period values ($p<0.05$) (Figure 6). Serum adrenaline and serum noradrenaline levels showed no statistically significant variation between the groups ($p>0.05$) (Figure 7,8).

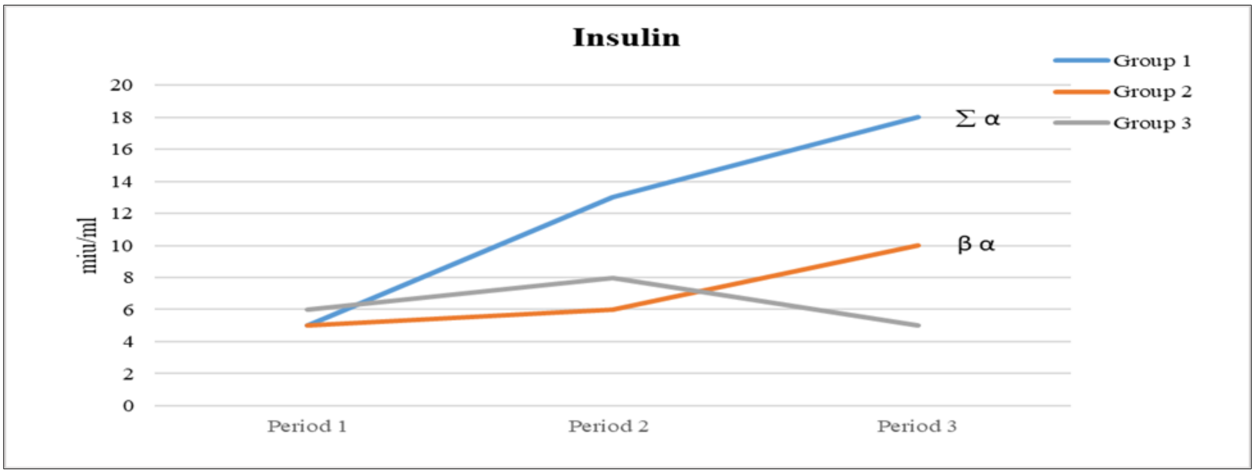

Figure 5. Insulin results between and within groups.
Between groups: ∑ →compared to Grup 3
In-group: α →compared with α Period 1, β→ compared with Period 2
Group 1:Desflurane + N_2O; Group 2: Desflurane + Remifentanil; Group 3:Propofol + Remifentanil;
Period 1: Immediately before induction; Period 2: 30th minute in the recovery room; Period 3: 24th hour postoperatively.

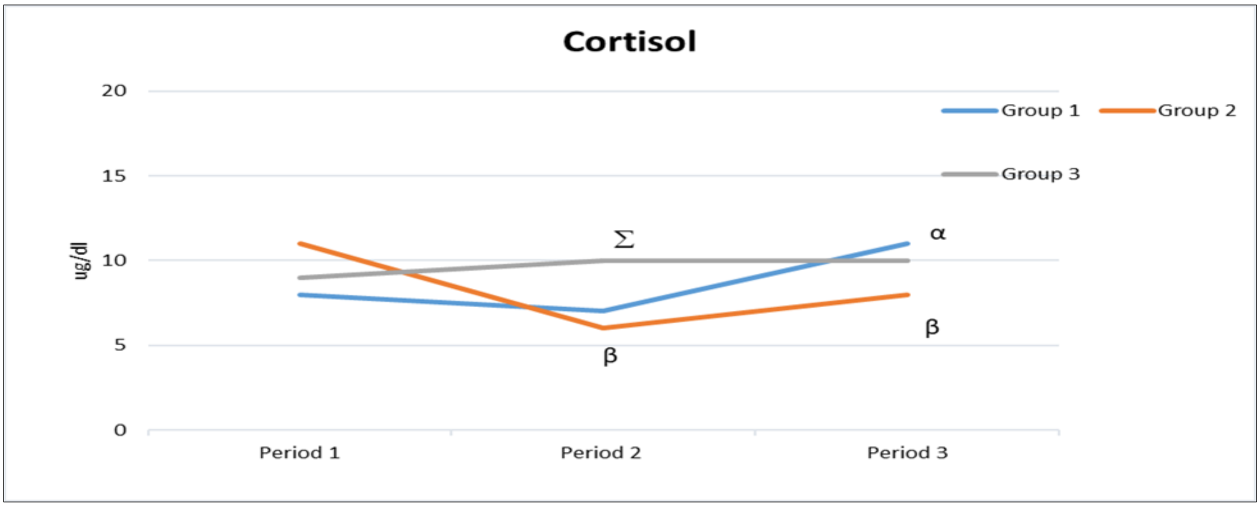

Figure 6. Intergroup and intragroup cortisol results.
Between groups: ∑→ Compared with Group 1 and Group 2
In-group: α → compared with α Period 2, β→ compared with Period 1
Group 1:Desflurane + N_2O; Group 2: Desflurane + Remifentanil; Group 3:Propofol + Remifentanil; Period 1: Immediately before induction; Period 2: 30th minute in the recovery room; Period 3: 24th hour postoperatively.

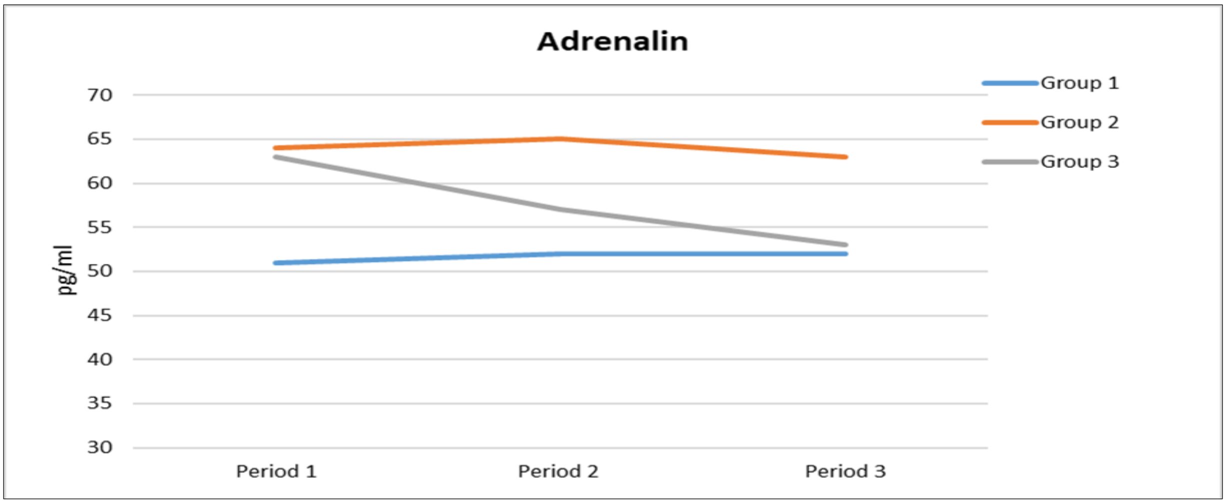

Figure 7. Adrenaline results between and within groups.
Group 1:Desflurane + N_2O; Group 2: Desflurane + Remifentanil; Group 3:Propofol + Remifentanil; Period 1: Immediately before induction; Period 2: 30th minute in the recovery room; Period 3: 24th hour postoperatively.

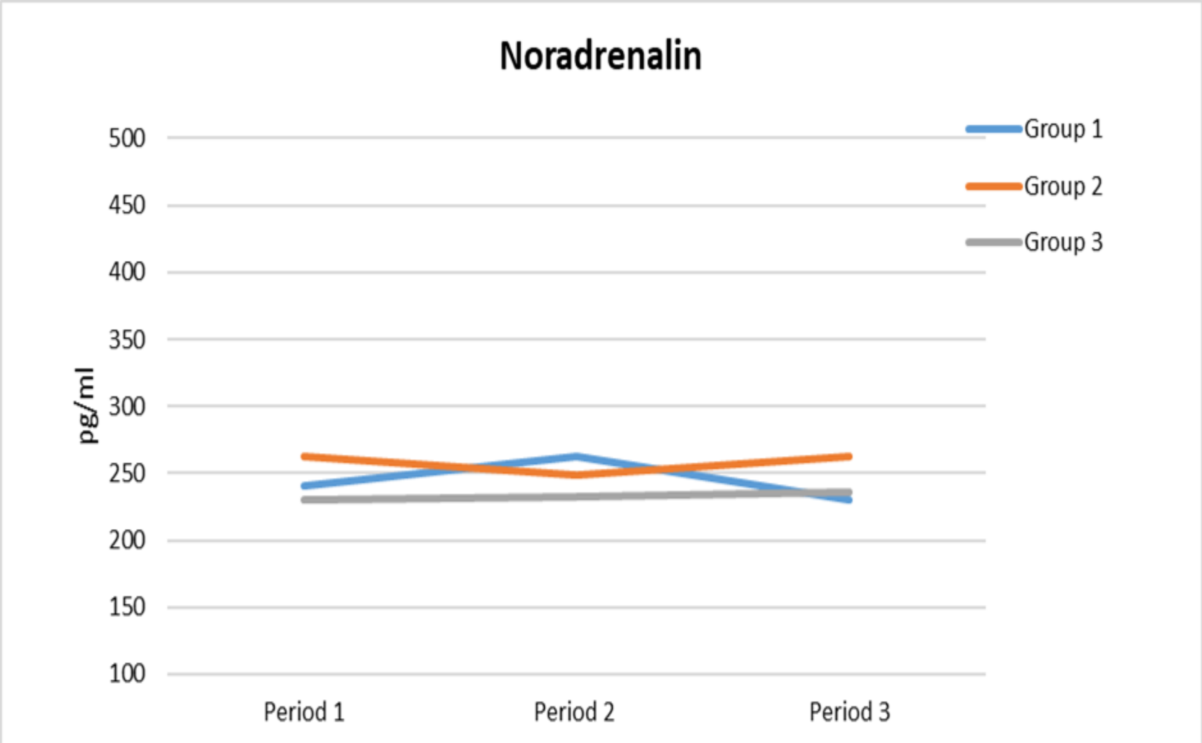

Figure 8. Noradrenaline results between and within groups.
Group 1:Desflurane + N_2O; Group 2: Desflurane + Remifentanil; Group 3:Propofol + Remifentanil; Period 1: Immediately before induction; Period 2: 30th minute in the recovery room; Period 3: 24th hour postoperatively.

Serum nesfatin-1 levels showed no statistically significant variation between the groups($p>0.05$) (Figure 9). The changes in the biochemical parameters of the patients according to the results of statistical analyses between all groups are summarised in Table 3.

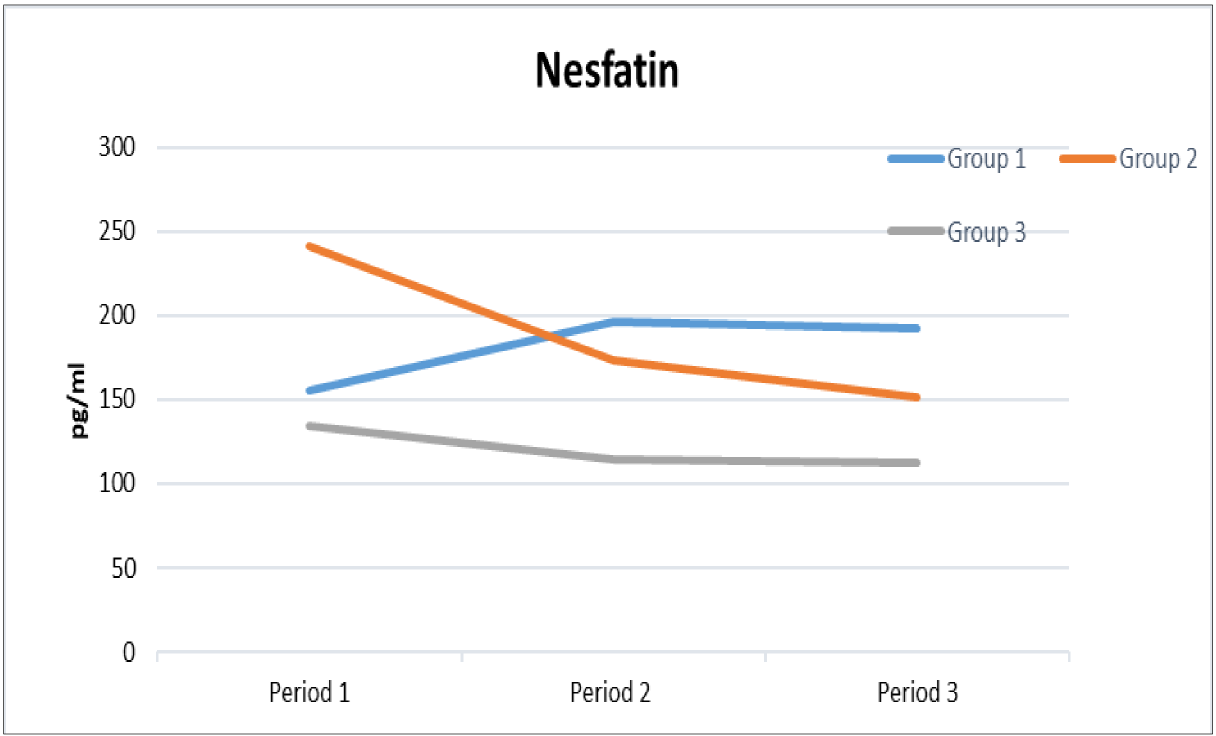

Figure 9. Inter-group and intra-group Nesfatin-1 results
Group 1:Desflurane + N_2O; Group 2: Desflurane + Remifentanil; Group 3:Propofol + Remifentanil; Period 1: Immediately before induction; Period 2: 30th minute in the recovery room; Period 3: 24th hour postoperatively.

Table 3. Biochemical changes in patients (mean±sd).

Variables	Period	Group 1 (n=30)	Group 2 (n=30)	Group 3 (n=30)
Glucose (mg/dl)	**1**	82.27±18.43 *	80.60±13.07 *	79.23±13.23
	2	94.30±31.20	84.97±13.05	81.77±14.42
	3	101,83±31.49	94.27±19.05	86.43±28.36
Cortisol (ug/dl)	**1**	8.70±6.00	11.71±5.58*β	9.98±3.63
	2	7.22±5.17 ε α	6.45±3.90∞	10.82±5.98
	3	11.60±6.98	8.17±5.96	10.49±5.02
Insulin (miu/ml)	**1**	5.88±8.04*	5.90±4.49*	6.58±8.05
	2	13.30±32.18	6.64±5.44α	8.29±9.98
	3	18.24±22.28ε	10.36±7.45	5.52±6.40
Noradrenalin (pg/ml)	**1**	241.45±57.13	263.10±67.00	230.60±80.14
	2	263.10±67.00	249.37±64.90	233.53±83.17
	3	230.60±80.13	263.23±82.70	236.37±74.09
Adrenalin (pg/ml)	**1**	51.00±26.46	64.71±16.09	63.74±42.35
	2	52.34±29.53	65.60±17.98	57.16±19.43
	3	52.86±26.68	63.57±18.68	53.87±15.97
Nesfatin (pg/ml)	**1**	155.13±133.29	241.70±301.52	134.23±105.26
	2	196.38±271.43	173.83±244.40	114.03±87.04
	3	192.47±241.86	151.61±108.38	112.13±58.76

Group 1:Desflurane + N_2O; Group 2: Desflurane + Remifentanil; Group 3:Propofol + Remifentanil; Period 1: Immediately before induction; Period 2: 30th minute in the recovery room; Period 3: 24th hour postoperatively.
ε p<0.05 between Group 1 and Group 3. ∞ p<0.05 between Group 2 and Group 3. β p<0.05 between Period 1 and Period 2. *: p<0.05 between Period 1 and Period 3. α p<0.05 between Period 2 and Period 3.

DISCUSSION

The body responds to stimuli that may harm itself to maintain homeostasis. These responses, which serve as a protective function that ensures the continuation of life, maybe endocrine, autonomic, metabolic, or immunological.[1,11]

Different anesthesia methods may have different effects on the hormonal autonomic response and different plasma concentrations of anesthetics may cause differences in the endocrine response. Therefore, interpretation of the hormonal response induced by anesthesia and surgery and comparison with other studies is difficult.

Patients classified as minor surgery candidates, expected to experience minimal bleeding and mild postoperative pain, and belonging to the ASA I-II risk group who underwent septorhinoplasty were included in our study.

General anesthesia is the anesthetic technique used in septorhinoplasty. While volatile anesthetics alone can control plasma cortisol and other stress hormone levels in the absence of surgical stress, they are known to be insufficient in managing stress once surgical stimulation begins. It is well established that combining volatile anesthetics with intravenous opioids effectively controls surgical stress during the intraoperative period, preventing increases in plasma glucose concentration.[12,13]

Studies investigating the effects of different anesthesia techniques on recovery and stress response have shown that inhalation anesthesia combined with remifentanil shortens recovery time and suppresses endocrine and metabolic stress responses at least as effectively as TIVA.[5-7] Desflurane decreases mean arterial pressure, systemic vascular resistance, cardiac output, and myocardial contractility in a dose-dependent manner.[14] To prevent these undesirable effects of desflurane, it is recommended to use fentanyl, alfentanil, esmolol, esmolol, clonidine, or opioid and/or N2O during premedication.[14-16] In a study comparing the effects of TIVA and inhalation anesthesia on endocrine stress response and hemodynamics, Adams et al.[17] showed that no difference was observed between the two groups in terms of hemodynamics during surgical intervention, whereas there was a significant decrease in HR in the TIVA group compared with the inhalation group. Tavlan et al.[18] concluded that hemodynamic responses were similar between the groups in their study in which they followed the depth of anesthesia based on hemodynamic data in propofol-remifentanil and desflurane-remifentanil anesthesia in intracranial mass surgery.

In our study, we aimed to reduce the surgical stress response by adding remifentanil to the inhalation anesthetic. However, when the groups receiving propofol and desflurane were compared in terms of hemodynamic parameters—measured immediately before induction, at 30 minutes in the postoperative recovery unit, and at 24 hours postoperatively—no statistically significant differences were found between the groups. In both groups, systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR) were significantly lower in the postoperative period compared to the preoperative values. This was attributed to the absence of premedication, the preoperative fasting period, and the associated fluid deficit, which led to elevated pre-induction values. The postoperative decreases were thought to result from correction of the fluid deficit during surgery, adequate analgesia, and the achievement of the desired depth of anesthesia.

The increase in catecholamines after surgical incision increases blood glucose concentration through glycogenolysis and gluconeogenesis. In addition to regular fluid and IV insulin administration during surgery, the anesthetic technique and inhalation agent selected are also reported to be important in glucose control.[19,20] In our study, glucose values measured in the 3rd period in all groups were found to be higher than the values in the 1st period. However, we think that the statistically insignificant increase in glucose in Group 2 compared to Group 1 may be due to the better suppression of the stress response by TIVA.

It is known that both physical and psychological stresses increase ACTH and thus cortisol to a great extent.[21] Cortisol is the most selected parameter in the evaluation of endocrine response to anesthesia and surgery. It has been reported that the location and magnitude of surgery, rather than anesthesia, significantly change the cortisol response, and cortisol, known as an indicator of the pituitary response, increases more in upper abdominal and thoracic surgery.[22,23] In our study, although there was a statistically significant difference between the groups in terms of cortisol values, cortisol values measured in all groups were within normal limits. We think that this may be because the surgical stress related to septorhinoplasty operation, which is in the minor surgery category, is lower than major surgeries, the severity of tissue injury is low and anesthesia suppresses this response to a certain extent.

Su et al.[8] reported that nesfatin-1 has antihyperglycemic properties and that peripheral nesfatin-1 plays an active role in glucose homeostasis. Nesfatin-1 increases intracellular Ca levels with the increase in postprandial plasma glucose levels, and as a result, insulin secretion increases in pancreatic beta islet cells stimulated by glucose.[24] In our study, no statistically significant differences were observed in nesfatin levels both within and between groups. Additionally, no correlation was found between nesfatin-1 levels and glucose or insulin levels in the evaluations.

Limitations

This study has certain limitations. The patients included in the study were only in the ASA I-II group according to the ASA physical status classification. This may exclude the stress responses of individuals with moderate and severe diseases. In addition, the fact that the surgical procedure within the scope of the study was a rhinoplasty operation in the low-risk category according to the surgical risk classification may limit the evaluation of stress responses that may occur in surgical procedures in the medium and high-risk categories. In addition, the fact that the operation hours were not planned considering stress hormones with circadian rhythm may also be regarded as a deficiency.

In conclusion, this study demonstrated that surgery itself acted as a stressor. Systolic and diastolic blood pressure, as well as heart rate, significantly decreased at the 24th postoperative hour (defined as the third period). Although different anesthetic techniques led to significant differences in serum cortisol levels between groups, cortisol values remained within normal limits. This was attributed to the classification of septorhinoplasty as a minor surgical procedure, the low severity of tissue injury, and the effectiveness of the anesthetic techniques in suppressing the stress response. While no correlation was observed between nesfatin-1 and surgical stress parameters, it was concluded that further large-scale studies are necessary to evaluate the potential of nesfatin-1 as a marker for surgical stress response.

Conflict of Interest

The authors declare that there is not any conflict of interest regarding the publication of this manuscript.

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Ethics Committee Permission

This study was approved by Firat University Non-Interventional Research Ethics Committee (dated 17.06.2014 and numbered 12-05).

Authors' Contributions

Concept/Design: İD, AA. Data Collection and/or Processing: AA. Data analysis and interpretation: İD, AA. Literature Search: AA. Drafting manuscript: AA. Critical revision of manuscript: İD. Supervisor: İD.

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