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Association of Body Mass Index with Reproductive and Metabolic Outcomes in Women with PCOS Undergoing Frozen-Thawed Blastocyst Transfer

Dondurulmuş-Çözülmüş Blastosist Transferi Yapılan PCOS'lu Kadınlarda Vücut Kitle İndeksinin Üreme ve Metabolik Sonuçlarla İlişkisi

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ABSTRACT

Objective: To evaluate whether body mass index (BMI) predicts in vitro fertilization (IVF) pregnancy and perinatal outcomes in women with polycystic ovary syndrome (PCOS) undergoing frozen-thawed blastocyst transfer within a standardized protocol.

Material and Methods: This retrospective cohort study included 69 frozen-thawed blastocyst transfer cycles from 53 women with PCOS at a single IVF center (June 2022-June 2025). All cycles followed a uniform progestin-primed ovarian stimulation protocol with a freeze-all strategy. Pregnancy outcomes were calculated per embryo transfer cycle; perinatal outcomes were assessed using a delivery-based approach. Univariable and multivariable regression analyses were performed with robust standard errors clustered by patient, with maternal age as a potential confounder.

Results: The mean maternal age was 29.5±4.1 years, and the mean BMI was 25.9±6.3 kg/m^2. The live birth rate per transfer was calculated as 33.3% (23/69). BMI was not significantly associated with biochemical pregnancy, clinical pregnancy, ongoing pregnancy, or live birth rates in either univariable or multivariable analyses. In univariable analysis, increasing BMI was associated with a higher risk of gestational diabetes mellitus; however, this association lost statistical significance following multivariable adjustment, though a trend in this direction could not be excluded (p=0.087). No significant association was identified between BMI and hypertensive complications of pregnancy or neonatal outcomes.

Conclusion: Based on our findings, BMI does not appear to be a strong predictor of IVF pregnancy success in women with PCOS undergoing frozen-thawed blastocyst transfer. BMI may be more relevant to perinatal metabolic risk than to reproductive outcomes.

Keywords: Polycystic ovary syndrome, body mass index, frozen embryo transfer, IVF outcomes, gestational diabetes

ÖZ

Amaç: Polikistik over sendromu (PKOS) tanılı kadınlarda, standardize bir protokol kapsamında donmuş–çözülmüş blastokist transferi sonrası vücut kitle indeksinin (VKİ) in vitro fertilizasyon (IVF) gebelik ve perinatal sonuçları öngörüp öngörmediğini değerlendirmektir.

Gereç ve Yöntemler: Bu retrospektif kohort çalışmaya, tek bir IVF merkezinde Haziran 2022-Haziran 2025 tarihleri arasında PKOS tanılı 53 kadına ait 69 donmuş-çözülmüş blastokist transfer siklusu dahil edildi. Tüm sikluslarda freeze-all stratejisiyle birlikte standart bir progestin-primed ovarian stimulation protokolü uygulandı. Gebelik sonuçları embriyo transfer siklusu başına, perinatal sonuçlar ise doğum bazlı paydalar kullanılarak hesaplandı. Anne yaşı potansiyel karıştırıcı değişken olarak modele alınarak, hasta bazında kümeleme yapılmış robust standart hatalar ile tek ve çok değişkenli regresyon analizleri gerçekleştirildi.

Bulgular: Ortalama anne yaşı 29,5±4,1 yıl, ortalama VKİ ise 25,9±6,3 kg/m^2 olarak saptandı. Transfer başına canlı doğum oranı %33,3 (23/69) olarak hesaplandı. VKİ; biyokimyasal gebelik, klinik gebelik, devam eden gebelik ve canlı doğum oranları ile tek ve çok değişkenli analizlerin hiçbirinde anlamlı düzeyde ilişkili bulunmadı. Tek değişkenli analizde artan VKİ, gestasyonel diyabet mellitus riskinde artış ile ilişkili bulunmuşken; çoklu analiz sonrası bu ilişkinin istatistiksel anlamlılığını yitirdiği ancak bu yönde bir trendi işaret edebileceği izlenmiştir (p=0,087). VKİ ile hipertansif gebelik komplikasyonları veya neonatal sonuçlar arasında anlamlı bir ilişki saptanmadı.

Sonuç: Çalışmamızın bulgularına göre VKİ, donmuş-çözülmüş blastokist transferi uygulanan PKOS'lu kadınlarda IVF gebelik başarısının güçlü bir öngörücüsü olarak görünmemektedir. VKİ, üreme sonuçlarından ziyade perinatal metabolik risk ile daha yakından ilişkili olabilir.

Anahtar Kelimeler: Polikistik over sendromu, vücut kitle indeksi, donmuş embriyo transferi, IVF sonuçları, gestasyonel diyabet

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INTRODUCTION

Polycystic ovary syndrome (PCOS), one of the most common endocrine disorders among women of reproductive age, is a leading indication for in vitro fertilization (IVF) treatment.[1] In addition to reproductive dysfunction, PCOS is frequently accompanied by metabolic disturbances, including insulin resistance (IR) and obesity, which may influence both pregnancy success and obstetric outcomes.[2-4] Consequently, identifying clinical factors that predict IVF and perinatal outcomes in women with PCOS remains of major clinical relevance.

Body mass index (BMI) has attracted substantial research attention as a potential modifier of IVF success. While obesity is generally associated with reduced spontaneous fertility and increased obstetric complications, its impact on IVF outcomes in women with PCOS remains controversial. Several studies reported reduced implantation and live birth rates with increasing BMI, whereas others reported no significant association between BMI and IVF success once treatment-related factors are controlled.[5,6] These inconsistencies may be partly explained by heterogeneity in study populations, stimulation protocols, embryo stage at transfer, and outcome definitions.

Maternal age represents another key determinant of IVF success and perinatal risk.[7] Failure to account for age as a potential confounder may lead to misinterpretation of conclusions regarding the independent effect of BMI. Moreover, variability in clinical practice, laboratory procedures, and embryo transfer (ET) strategies further complicates interpretation of existing data.

Given these considerations, evaluating the combined effects of BMI and maternal age on IVF and perinatal outcomes may provide clinically relevant insights.

The primary aim of this study was to evaluate, with a homogeneous study design, whether BMI predicts IVF pregnancy outcomes in women with PCOS undergoing freeze-all cycles with frozen-thawed blastocyst transfer following a uniform progestin-primed ovarian stimulation (PPOS) protocol. Secondary objectives were to evaluate the association between BMI and perinatal outcomes and to determine whether these associations persist after adjustment for maternal age.

MATERIAL AND METHODS

Study Design and Clinical Protocol

This retrospective cohort study included women aged 18-40 years with a diagnosis of PCOS who underwent blastocyst-stage frozen ET (FET) between June 2022 and June 2025 at Eurofertil IVF Center. anti-Müllerian hormone (AMH) levels were not considered for enrollment. The diagnosis of PCOS was solely based on the Rotterdam criteria.[8] Only cycles resulting in blastocyst transfers with the same endometrial preparation protocol (programmed hormone replacement therapy with oral estradiol) were included to maintain homogeneity. Cycles involving preimplantation genetic testing for aneuploidy and patients with a history of parental aneuploidy, recurrent implantation failure, or endometrial or uterine factors were excluded.

To minimize clinical and laboratory heterogeneity, all patients were managed using a uniform ovarian stimulation strategy. Controlled ovarian stimulation was performed with PPOS protocol in all cycles. Medroxyprogesterone acetate (Tarlusal® 5 mg, Deva İlaç) was given three times daily, starting together with gonadotropins on cycle day 2-3. When the leading follicles reached ≥17 mm, ovulation was triggered with gonadotropin-releasing hormone (GnRH) agonist (Gonapeptyl® 0.1 mg/mL, Ferring Pharmaceuticals). Oocyte retrieval was scheduled 35-36 hours post-trigger under transvaginal ultrasound guidance.

For endometrial preparation oral estradiol 2 mg three times daily (Estrafem® 2 mg, Novo Nordisk Tic. Ltd. Şti, İstanbul, Türkiye) was started on days 2-3 of the menstrual cycle, if initial ultrasound examination was normal. The first control visit was planned after 10 completed days of medication, and when the endometrial pattern was trilaminar and the endometrial thickness was >6 mm progesterone was started. GnRH agonist co-treatment for pituitary suppression was not employed in any cycle.

All clinical procedures were performed by a single gynecologist, and all embryological procedures were conducted by a single embryologist throughout the study period. This standardized approach was implemented to ensure consistency in stimulation management, embryo culture, vitrification, warming, and ET techniques.

Due to the retrospective nature of this study, an informed consent was not applicable. However, all patients were given written informed consent for routine clinical procedures at their admission. This study was approved by the Non-Interventional Clinical Research Ethics Committee of İstanbul Medipol University (date: 22 January 2026; decision no: 170).

Statistical Analysis

Each ET cycle was considered as a single analytical unit. Continuous variables were presented as mean ± standard deviation or median, and categorical variables as counts and percentages.

Pregnancy outcomes (biochemical pregnancy, clinical pregnancy, ongoing pregnancy, and live birth) were calculated per ET cycle. Perinatal outcomes were evaluated among pregnancies resulting in live birth, using a delivery-based approach for maternal outcomes and delivery-based parameters for neonatal outcomes.

Associations between BMI and study outcomes were first assessed using univariable regression analyses, with BMI entered as a continuous variable (kg/m^2). Multivariable regression models including both BMI and maternal age were then constructed to evaluate the independent effect of BMI, as maternal age is associated with both BMI and reproductive and perinatal outcomes and was therefore considered a potential confounder.

Binary outcomes were analyzed using logistic regression, and results are presented as odds ratios with 95% confidence intervals (CIs). Continuous perinatal outcomes were analyzed using linear regression. Because some patients contributed more than one cycle, robust standard errors clustered by patient identification number were used to account for within-patient correlation. Analyses were conducted using a complete-case approach, with sample size varying according to data availability. All tests were two-sided, and $p<0.05$ was considered statistically significant.

RESULTS

A total of 69 ET cycles from 53 unique patients with PCOS were included. While most patients (37/53) contributed a single cycle, others contributed two cycles. None of the patients contributed more than two cycles. Baseline demographic and hormonal characteristics of the study population are presented in Table 1. The mean maternal age was 29.5±4.1 years, and the mean BMI was 25.9±6.3 kg/m^2. Serum AMH levels showed a wide distribution, with a mean value of 4.94±4.15 ng/mL, reflecting the heterogeneity of ovarian reserve within the PCOS population. The distribution of BMI categories in the study population was as follows: 55.1% (38/69) of cycles were classified as normal weight (BMI: <25 kg/m^2), 10.1% (7/69) as overweight (BMI: 25-29.9 kg/m^2), and 34.8% (24/69) as obese (BMI: ≥30 kg/m^2), according to the World Health Organization classification.[9]

IVF cycle characteristics are presented in Table 2. As the population was composed of hyperresponders, a mean of 17.6±10.2 oocytes were retrieved per cycle. The mean number of metaphase II oocytes was 14.3±8.9, and the mean number of normally fertilized (2PN) embryos was 9.9±6.0. A median of 4 blastocysts per cycle was obtained, consistent with the expected response profile in PCOS patients undergoing controlled ovarian stimulation.

Pregnancy outcomes calculated per ET cycle are shown in Table 3. Biochemical pregnancy, defined as a positive serum beta-human chorionic gonadotropin test, was achieved in 46 of 69 cycles (66.7%). The clinical pregnancy rate was 52.2% (36/69), while ongoing pregnancy beyond 12 weeks occurred in 40.6% (28/69) of cycles. The live birth rate per ET was 33.3% (23/69). Biochemical pregnancy loss, representing the losses before sonographic confirmation, occurred in 10 cycles, representing

Table 1. Baseline demographic and hormonal characteristics of the study population (PCOS, ET cycles)

Variable	n	Mean ± SD	Median (IQR)	Min-max
Age (years)	69	29.5±4.1	30 (27-32)	20-40
Body mass index (kg/m^2)	66	25.9±6.3	23.6 (20.6-30.6)	17.3-44.7
Anti-Müllerian hormone (ng/mL)	68	4.94±4.15	4.09 (1.83-6.84)	0.10-21.0

Baseline characteristics are presented per embryo transfer cycle. Continuous variables are reported as mean ± standard deviation and median (interquartile range). Body mass index data were available in 66 cycles and anti-Müllerian hormone (AMH) data in 68 cycles. No patient selection was performed based on AMH levels, as AMH measurements were obtained from different laboratories using assay platforms with potential inter-assay variability

PCOS: Polycystic ovary syndrome, ET: Embryo transfer, SD: Standard deviation, IQR: Interquartile range, Min: Minimum, max: Maximum

Table 2. IVF cycle characteristics in PCOS patients undergoing embryo transfer

Variable	Mean ± SD	Median (IQR)	Min-max
Retrieved oocytes (n)	17.6±10.2	16.5 (9-24.5)	1-50
MII oocytes (n)	14.3±8.9	13 (7-19)	1-46
Normally fertilized oocytes (2PN, n)	9.9±6.0	9 (6-12)	1-34
Blastocysts obtained (n)	4.08±1.70	4 (4-5.75)	1*

*In one cycle, the transferred embryo reached blastocyst stage on day 4 of culture, and no additional blastocyst was observed on day 5. Since the "blastocysts obtained" variable reflects day-5 blastocyst counts, this cycle was recorded as 0, although a transferable day-4 blastocyst was in fact present and used for transfer

IVF cycle characteristics are presented per embryo transfer cycle. Continuous variables are reported as mean ± standard deviation and median (interquartile range). Data are shown for cycles with available information; the number of observations therefore varies across variables. The number of blastocysts refers to the total number of blastocysts obtained per cycle, irrespective of subsequent transfer or cryopreservation

IVF: In vitro fertilization, PCOS: Polycystic ovary syndrome, MII: Metaphase II, 2PN: Two pronuclei, SD: Standard deviation, IQR: Interquartile range, Min: Minimum, Max: Maximum

14.5% of all transfer cycles and 21.7% of biochemically positive pregnancies. Miscarriage before 12 weeks of gestation occurred in 8 cases (11.6%), representing pregnancy loss after sonographic confirmation but prior to the definition of ongoing pregnancy.

Perinatal outcomes were assessed among pregnancies resulting in live birth using a delivery-based approach. Gestational diabetes mellitus (GDM) was diagnosed in 33.3% (7/21) of deliveries, while preeclampsia or gestational hypertension occurred in 14.3% (3/21). Two live births lacked complete perinatal follow-up data and were therefore excluded from perinatal analyses.

Neonatal outcomes, evaluated using delivery-based data, showed that neonatal intensive care unit (NICU) admission was required in 38.1% (8/21) of deliveries, and congenital anomalies were documented in one case (4.8%). Among deliveries with available continuous data, the mean gestational age at delivery was 37.6±3.4 weeks, and the mean birth weight was 3189±650 g.

The association between BMI and both IVF and perinatal outcomes was first evaluated using univariable regression models, with BMI entered as a continuous variable. As shown in Table 4, BMI was not significantly associated with biochemical pregnancy, clinical pregnancy, ongoing pregnancy, or live birth rates per ET cycle.

In contrast, higher BMI was associated with an increased risk of GDM among pregnancies resulting in live birth. Each 1 kg/m^2 increase in BMI was associated with a nearly twofold increase in the odds of GDM. BMI was not significantly associated with preeclampsia/gestational hypertension or NICU admission.

Maternal age was included alongside BMI in multivariable models because it is a recognized determinant of reproductive and perinatal outcomes and is also associated with BMI, fulfilling criteria for a potential confounder. Results of the age-adjusted analyses are presented in Table 5.

After adjustment for maternal age, neither BMI nor maternal age was independently associated with IVF pregnancy outcomes, including clinical pregnancy, ongoing pregnancy, or live birth per ET.

In contrast, higher BMI was associated with an increased risk of GDM in univariable analyses. Although this association was attenuated and did not retain statistical significance after adjustment for maternal age, the direction and magnitude of the effect remained consistent. Neither

Table 3. IVF pregnancy outcomes per embryo transfer in women with PCOS

Outcome	n/N	%
Pregnancy (β-hCG positive)	46/69	66.7
Biochemical pregnancy loss	10/69	14.5
Clinical pregnancy	36/69	52.2
Ongoing pregnancy (≥12 weeks)	28/69	40.6
Live birth	23/69	33.3

Pregnancy outcomes were calculated per embryo transfer (ET) cycle, with the denominator defined as the total number of ET cycles performed (N=69)

IVF: *In vitro* fertilization, PCOS: Polycystic ovary syndrome, β-hCG: Beta-human chorionic gonadotropin, n: Number of events, N: Total number of embryo transfer cycles

Table 4. Association between body mass index and IVF and perinatal outcomes (BMI-only model)

A) IVF and pregnancy outcomes (per embryo transfer cycle)		
Outcome	BMI OR (95% CI)	p-value
Pregnancy (β-hCG positive)	1.01 (0.94-1.08)	0.78
Clinical pregnancy	1.05 (0.97-1.14)	0.23
Ongoing pregnancy (≥12 weeks)	1.02 (0.94-1.11)	0.64
Live birth	1.00 (0.92-1.09)	0.98
B) Perinatal outcomes (delivery-based)		
Outcome	**BMI OR (95% CI)**	**p-value**
Gestational diabetes mellitus	1.92 (1.08-3.42)	0.026
Preeclampsia/gestational hypertension	1.08 (0.94-1.25)	0.27
NICU admission (delivery-based proxy)	0.99 (0.89-1.10)	0.81

Univariable logistic regression analyses were performed to evaluate the association between body mass index (BMI) and pregnancy and perinatal outcomes. BMI was entered as a continuous variable (kg/m^2), and odds ratios represent the effect per 1 kg/m^2 increase in BMI. Pregnancy outcomes were calculated per embryo transfer cycle, while perinatal outcomes were analyzed using a delivery-based approach. Only cycles with available BMI data were included in the analyses

IVF: *In vitro* fertilization, NICU: Neonatal intensive care unit, β-hCG: Beta-human chorionic gonadotropin, OR: Odds ratio, CI: Confidence interval

Table 5. Multivariable analyses of BMI and maternal age as independent predictors of IVF and perinatal outcomes

A) IVF and pregnancy outcomes (per embryo transfer cycle)				
Outcome	**BMI OR (95% CI)**	**p**	**Age OR (95% CI)**	**p**
Pregnancy (β-hCG positive)	1.00 (0.93-1.08)	0.97	1.07 (0.92-1.24)	0.41
Clinical pregnancy	1.04 (0.96-1.13)	0.34	1.04 (0.92-1.18)	0.51
Ongoing pregnancy (≥12 weeks)	1.02 (0.94-1.10)	0.71	0.98 (0.87-1.10)	0.76
Live birth	1.00 (0.91-1.10)	0.99	0.98 (0.87-1.11)	0.76
B) Perinatal outcomes (delivery-based)				
Outcome	**BMI OR (95% CI)**	**p**	**Age OR (95% CI)**	**p**
Gestational diabetes mellitus	1.78 (0.92-3.45)	0.087	1.20 (0.59-2.43)	0.62
Preeclampsia/gestational hypertension	1.06 (0.92-1.22)	0.41	0.75 (0.47-1.20)	0.23
NICU admission (proxy)	0.98 (0.87-1.10)	0.72	0.87 (0.59-1.29)	0.49

Multivariable logistic regression models included body mass index (BMI) and maternal age simultaneously to evaluate their independent effects on outcomes. BMI and age were entered as continuous variables. Pregnancy outcomes were calculated per embryo transfer cycle, while perinatal outcomes were analyzed using a delivery-based approach. Robust standard errors clustered by patient identification number were applied to account for repeated cycles within the same woman. Due to missing BMI values, analyses were conducted in cycles with complete data

IVF: *In vitro* fertilization, β-hCG: Beta-human chorionic gonadotropin, OR: Odds ratio, CI: Confidence interval, NICU: Neonatal intensive care unit

BMI nor maternal age was independently associated with preeclampsia/gestational hypertension or NICU admission in adjusted analyses.

DISCUSSION

The main aim of our study was to provide a clinical perspective regarding BMI in the pre-cycle approach of PCOS patients considered for IVF.

The impact of BMI on IVF outcomes has been widely investigated, yet remains controversial. Large population-based studies and meta-analyses in unselected IVF populations have suggested a negative association between increasing BMI and live birth rates.[5,6,10] However, other studies have demonstrated that this association is attenuated or disappears after controlling for treatment-related factors such as embryo stage at transfer and cryopreservation strategy.[11,12]

In women with PCOS, heterogeneity in stimulation protocols and ET strategies further complicates interpretation. Our findings align with the latter view, suggesting that under standardized clinical and laboratory conditions, BMI alone does not appear to compromise IVF success in women with PCOS.

The absence of an association between BMI and IVF success in the present cohort may be partly explained by the use of frozen-thawed blastocyst transfer in all cycles. Accumulated evidence indicates that FET mitigates the adverse endometrial effects associated with obesity and supraphysiologic hormone exposure during fresh cycles.[13-15] By eliminating the hormonal milieu of controlled ovarian stimulation at the time of implantation, particularly in hyperresponders with higher expected steroid levels, freeze-all strategies may have reduced estrogen-related impairment of endometrial receptivity, thereby equalizing reproductive outcomes across BMI categories.

In contrast to reproductive outcomes, the observed association between BMI and GDM aligns with the literature. Obesity is a well-established risk factor for GDM, a risk that appears amplified in women with PCOS due to underlying IR.[16-18] In the present study, while increasing BMI seemed to be associated with a higher risk of GDM in univariable analyses, this association was attenuated in the multivariable model. However, the magnitude and direction of the effect may still point toward a trend between BMI and metabolic risk during pregnancy in women with PCOS.

Although higher BMI has also been linked to hypertensive disorders of pregnancy and adverse neonatal outcomes in the general obstetric population,[19,20] such associations were not observed in the present study. Our finding should be interpreted cautiously, given the limited number of deliveries and perinatal events, which may have reduced statistical power to detect more modest effects.

From a clinical standpoint, our findings may suggest some clinical implications during the IVF process for the management of women with PCOS. While weight optimization is often encouraged prior to assisted reproduction, the present results suggest that elevated BMI alone may not always be a strict determinant of IVF success for patients with PCOS in whom frozen-thawed blastocyst transfer is routinely performed. Instead, the clinical relevance of BMI in PCOS appears to lie predominantly in its impact on metabolic and obstetric outcomes, particularly GDM. Lifestyle modification and weight reduction may be encouraged for their general health benefits and potential

role in reducing perinatal complications; however, the decision to delay IVF based on BMI alone warrants careful consideration of patient age, ovarian reserve, and individual reproductive priorities.

Enhanced metabolic screening and closer obstetric surveillance may represent more pragmatic strategies for mitigating BMI-related risks once pregnancy is achieved in women with PCOS.

The strengths of this study include its homogeneous design, use of a uniform stimulation protocol and freeze-all strategy, and minimization of inter-operator variability by employing a single clinician and a single embryologist. Also, evaluating clinically important perinatal parameters could add value.

Study Limitations

This study has several limitations. First, its retrospective design and the relatively small number of perinatal events may have limited the statistical power of the regression analyses, increased the risk of type II error, and resulted in wider CIs. The low number of events per variable may also have affected model stability and increased the risk of overfitting. Therefore, the multivariable models were restricted to maternal age and BMI, which were considered the most clinically relevant covariates. Potentially relevant variables, including AMH levels, ovarian response parameters, and blastocyst-related characteristics, could not be included and residual confounding cannot be excluded. In addition, infant-level data and long-term offspring outcomes were unavailable. Accordingly, the absence of statistically significant associations for some outcomes should be interpreted with caution. Larger prospective studies are needed to further clarify the relationship between BMI, metabolic risk, and reproductive and perinatal outcomes in women with PCOS undergoing IVF.

CONCLUSION

Our findings suggest that BMI does not appear to be a strong predictor of IVF pregnancy success, including live birth. Regarding perinatal outcomes, higher BMI was associated with an increased risk of GDM in univariable analysis. Although this association did not reach statistical signaling after adjustment for maternal age, the direction and magnitude of the effect remained consistent, signalling a potentially clinically relevant relationship between BMI and metabolic risk during pregnancy in this population. Taken together, the findings of the present cohort may suggest that the clinical relevance of BMI in women with PCOS undergoing IVF may lie primarily in its association with perinatal metabolic risk rather than reproductive success, and elevated BMI solely may not be a rigid rationale for postponing IVF treatment in women with PCOS. Nevertheless, individualized metabolic counseling and structured multidisciplinary follow-up during pregnancy appear warranted in this population. These findings should be regarded as hypothesis-generating rather than conclusive, and replication in larger, prospective multicenter studies will be necessary before broader clinical recommendations can be made.

Ethics

Ethics Committee Approval: This study was approved by the Non-Interventional Clinical Research Ethics Committee of İstanbul Medipol University (date: 22 January 2026; decision no: 170).

Informed Consent: Due to the retrospective nature of this study, informed consent for participation was not applicable. However, all patients provided written informed consent for routine clinical procedures upon admission.

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Footnotes

Authorship Contributions

Surgical and Medical Practices: G.A., Concept: G.A., Design: G.A., Data Collection or Processing: G.A., A.U., Analysis or Interpretation: G.A., Literature Search: G.A., A.U., Writing: G.A., A.U.

Conflict of Interest: No conflict of interest was declared by the authors.

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