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Comparative Analysis of Obstetric Outcomes in Primiparous Versus Multiparous Women Undergoing Vacuum-assisted Delivery

Primipar ve Multipar Kadınlarda Vakum Destekli Doğumun Karşılaştırmalı Olarak Analizi

Melih Bestel, Elif Uçar

İstanbul Esenyurt University Faculty of Health Sciences, Department of Midwifery, İstanbul, Turkey

Abstract

Objective: To assess and compare maternal and neonatal outcomes of vacuum-assisted vaginal delivery in primigravid versus multigravid women.

Method: This retrospective study analyzed the obstetric outcomes of 65 women who underwent vacuum-assisted vaginal delivery and statistically compared maternal and neonatal outcomes between the primigravid and multigravid groups.

Results: Significant differences were observed between groups in labor duration, neonatal birth weight, and head circumference ($p<0.05$). Primigravid women had significantly longer labors, whereas multigravid women delivered neonates with higher birth weights and larger head circumferences. Episiotomy rates were notably higher in the primigravid group ($p<0.001$); however, no significant differences were found between groups for neonatal intensive care unit admissions, neonatal complications, or maternal complications ($p>0.05$).

Conclusion: This study demonstrated that parity influences outcomes of vacuum-assisted vaginal deliveries, with no significant differences in neonatal outcomes between groups. The use of vacuum assistance in vaginal deliveries appears to prevent, rather than cause, asphyxia by expediting labor. Vacuum-assisted vaginal delivery can serve as an effective intervention to reduce unnecessary cesarean sections.

Keywords: Apgar, asphyxia, complications, normal delivery, vacuum assisted delivery

Öz

Amaç: Vakum yardımlı vajinal doğum gerçekleştiren primigravid ve multigravid kadınlar arasında maternal ve neonatal sonuçlar karşılaştırılarak obstetrik sonuçların değerlendirilmesi amaçlanmıştır.

Yöntem: Çalışma retrospektif olarak 65 vakum yardımlı vajinal doğum yapan gebenin obstetrik sonuçları incelenmiş, primigravid ve multigravid gruplar arasında maternal ve neonatal sonuçlar istatistiksel olarak karşılaştırılmıştır.

Bulgular: Çalışmada travay süresi, yenidoğan doğum ağırlığı ve baş çevresi açısından gruplar arasında anlamlı fark tespit edilmiştir ($p<0,05$). Primigravid kadınlarda travay süresi belirgin şekilde daha uzunken, multigravid kadınlarda doğum ağırlığı ve baş çevresi daha büyük bulunmuştur. Epizyotomi oranları primigravid grubunda anlamlı derecede daha yüksekti ($p<0,001$). Bununla birlikte, yenidoğan yoğun bakım ünitesi kabulü, neonatal komplikasyonlar ve maternal komplikasyonlar açısından gruplar arasında anlamlı fark bulunmamıştır ($p>0,05$).

Sonuç: Bu çalışma, vakum yardımlı vajinal doğum sonuçları üzerinde paritenin etkisini ortaya koymuş; neonatal sonuçlar açısından gruplar arasında anlamlı fark olmadığını göstermiştir. Vakum yardımı, doğum sürecini hızlandırarak asfiksiye neden olmaktan ziyade asfiksiyi önleyici bir müdahale olarak değerlendirilebilir. Vakum yardımlı vajinal doğumlar, gereksiz sezaryen doğumların önlenmesinde etkili bir alternatif olarak kullanılabilir.

Anahtar kelimeler: Apgar, asfiksi, komplikasyonlar, normal doğum, vakum yardımlı doğum

Address for Correspondence: Elif Uçar, İstanbul Esenyurt University Faculty of Health Sciences, Department of Midwifery, İstanbul, Turkey
E-mail: eliflyy@hotmail.com **ORCID:** orcid.org/0000-0001-5302-4688
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Introduction

Vacuum-assisted vaginal delivery is an operative vaginal delivery method widely used to facilitate labour. This method is preferred, especially in cases of a prolonged second stage of labour, maternal fatigue, or fetal distress, and constitutes an important part of obstetric practice (1).

If normal spontaneous vaginal delivery is not possible or needs to be accelerated, or if labour has entered the second stage with cervical dilatation of 10 cm, there are two options for delivery: Provide assistance to the mother through instrumental vaginal delivery, or perform a caesarean section (2). However, a caesarean section can be considered only a last resort if instrumental vaginal delivery is unsafe or has failed. It carries maternal morbidity risks, such as greater blood loss and a greater need for postnatal care (3).

Vacuum extraction, performed by applying negative pressure to the fetal head with a vacuum device, carries advantages and risks for both mother and baby (4). The most important risks of vacuum-assisted delivery for the fetus include neonatal head trauma, intracranial haemorrhage, scalp abrasions, and neonatal hyperbilirubinaemia (5). A prospective cohort study from 2022 reported that approximately 13% of vacuum delivery attempts resulted in maternal trauma and 8% resulted in serious neonatal complications such as subgaleal hematoma (4).

For the mother, potential risks include tears in the birth canal, postpartum haemorrhage, need for episiotomy, and anal sphincter injuries. Anal sphincter injuries can lead to anal incontinence and a serious deterioration in quality of life (6,7). Maternal anal sphincter injuries and neonatal traumas are more common following operative vaginal delivery, especially after vacuum and forceps applications (4). Primiparity and instrumental delivery are the main risk factors for this condition (8). However, vacuum-assisted labour has been shown to be a safe and effective option when used for appropriate indications and performed by experienced obstetricians (9).

Benefits of vacuum extraction include shorter labour duration, shorter hospital stay compared with caesarean section, faster postpartum recovery, and lower rates of maternal complications (10). In addition, the use of vacuum-assisted delivery in appropriate cases may alleviate the burden on both individuals and the healthcare system by reducing cesarean delivery rates (11).

While the current literature contains numerous studies on the maternal and neonatal outcomes of vacuum-assisted deliveries, comparative studies of these outcomes across parity groups are limited. In particular, whether variables such as episiotomy rates, neonatal complications, and labor duration differ between primiparous and multiparous groups is important for clinical decision-making.

In this study, maternal and neonatal outcomes were compared between primigravid and multigravid women who underwent vacuum-assisted vaginal delivery. These findings are expected to provide important information to improve understanding of the effect of vacuum-assisted vaginal delivery on obstetric outcomes and to inform clinical practice.

Materials and Methods

This retrospective cross-sectional study included 65 pregnant women admitted to the obstetrics and gynaecology clinic of a rural district state hospital for vaginal delivery between March 2020 and July 2021. Patient data were retrieved from the hospital's digital records and through a review of physical patient files. Primiparous women at or above 34 weeks of gestation and women with previous vaginal deliveries, all with singleton, live, head-presenting fetuses, were included in the study. Exclusion criteria included a history of cesarean section, urinary or anal incontinence, or prior surgery for these conditions. Obstetric history, maternal outcomes, and neonatal outcomes were documented. This study was approved by the Ethics Committee of İstanbul Esenyurt University (approval number E-12483425-299-35347; meeting dated 07.09.2023; protocol number 2023/08-12).

Participants were divided into two groups. Group 1 (n=32) comprised primiparous pregnant women, and Group 2 (n=33) comprised multiparous pregnant women. Obstetric history and maternal and neonatal outcomes were recorded. Patient confidentiality was strictly maintained. All data were anonymized and stored in an encrypted system accessible only to the research team. No personally identifiable information was collected or used in the analysis.

Indications for vacuum extraction were based on the following clinical conditions, consistent with the literature: prolonged second stage of labor (n=28, 43.1%), reduced maternal effort or fatigue (n=19, 29.2%), non-reassuring fetal heart rate pattern (n=12, 18.5%), and other reasons (n=6, 9.2%). These indications were obtained retrospectively from birth records.

Each patient underwent vacuum-assisted delivery using a disposable device known as the "Kiwi Omnicup" (Figure 1), which consists of a silicone or plastic cup attached to a hand pump. Vacuum extraction procedures were performed by specialist physicians experienced in gynecology and actively involved in operative vaginal deliveries.

The cup was positioned on the fetal scalp, and negative pressure (500-600 mmHg) was applied. Delivery was facilitated by gentle traction synchronized with the uterine contractions. Following delivery, the vacuum was gradually released to detach the cup. An average of 2 traction strokes (range: 1-4) was applied during vacuum application, and cases requiring 3 or more traction strokes were carefully monitored. No cases requiring more than four traction strokes were encountered in the study (12). The vacuum head used in all cases was a conventional, disposable, soft-silicone cup. No hard-metal cup was used.

The diagnosis of neonatal asphyxia was made based on the American College of Obstetricians and Gynecologists criteria, and newborns with an Apgar score <7 at 5 minutes and/or an umbilical cord artery pH <7.0 were included in this category. However, because umbilical pH measurement was not available in all cases, the primary assessment was based on the 5-minute Apgar score (13).

Statistical Analysis

Statistical analyses were conducted using the IBM SPSS Statistics 27 software package. Frequency tables and descriptive statistics were utilized to interpret the results. Parametric tests were applied to measurements that were normally distributed. Accordingly, comparisons between two independent groups were performed using the independent-samples t-test (t-table value). For data that did not exhibit a normal distribution, non-parametric methods were employed. In this context, the Mann-Whitney U test (Z-value) was used to compare measurements between two independent groups. Additionally, Spearman's rank correlation coefficient was calculated to examine the relationship between two quantitative variables that were not normally distributed.

Power Analysis

Post-hoc power analysis was performed using G*Power (version 3.0.10) software. Given an effect size of 0.82, an alpha value of 0.05, and power (1-β) =0.90, the minimum sample size was calculated to be 60 participants.

Results

A statistically significant difference was found in age, trauma time (min), fetal weight, and head circumference among gravida classes ($p<0.05$). The duration of trauma (min) was significantly longer in patients with gravida 1 than in patients with gravida ≥2. In addition, weight, and head circumference were significantly higher in participants with Gravida ≥2 than in those with Gravida 1 (Table 1).

There was no statistically significant relationship between gravida groups and neonatal intensive care, complications

Figure 1. Kiwi® OmniCup® complete vacuum delivery system with PalmPump™

(including types of complications), blood TX, and maternal complications (p>0.05). It was determined that the groups were independent and homogeneous with respect to the characteristics mentioned.

A statistically significant correlation was found between gravida groups and episio (χ^2=53.607; p<0.001). It was determined that 31 patients (96.9%) with gravida 1 underwent episiotomy, whereas 31 patients (93.9%) with gravida ≥2 did not undergo episiotomy. It was determined that those with episiotomy were predominantly gravida 1, whereas those without episiotomy were predominantly gravida 62 (Table 2).

Table 1. Comparison of some parameters according to gravida groups

Variable	Gravida 1 (n=32)		Gravida ≥2 (n=33)		Statistical analysis* Probability
	$\bar{X}$ ± SD	Median [IQR]	$\bar{X}$ ± SD	Median [IQR]	
Age	24.09±3.77	24.0 [4.8]	29.88±6.11	30.0 [8.0]	t=-4.610 **p<0.001**
Duration of travay (min)	438.12±249.48	400.0 [258.8]	237.12±240.21	140.0 [315.0]	Z=-3.554 **p<0.001**
Fetal weight	3234.06±489.29	3300.0 [755.0]	3457.27±385.31	3430.0 [360.0]	t=-2.047 **p=0.045**
Fetal lenght	50.43±1.52	50.5 [1.0]	51.18±2.02	51.0 [2.0]	Z=-1.483 p=0.138
Head circumferences	34.78±1.45	35.0 [2.0]	35.67±1.02	36.0 [1.5]	Z=-2.600 **p=0.009**
1st minute Apgar	6.06±2.73	7.5 [5.0]	6.61±1.91	8.0 [2.5]	Z=-0.302 p=0.763
5th minute Apgar	7.96±1.65	8.5 [2.0]	8.06±1.39	9.0 [1.5]	Z=-0.055 p=0.956
pH	7.03±0.17	7.05 [0.2]	7.06±0.12	7.05 [0.1]	t=0.215 p=0.773

*: "Independent Sample's t-test" (t-table value) statistics were used to compare the measurement values of two independent groups for normally distributed data. The Mann-Whitney U test (Z-table value) was used to compare measurements between two independent groups for data that were not normally distributed. IQR: Interquartile range, SD: Standard deviation

Table 2. Examination of the relationships between gravida groups and qualitative characteristics

Gravida group / Variable	Gravida 1 (n=32)		Gravida ≥2 (n=33)		Statistical analysis* Probability
	n	%	n	%	
Episiotomy					
Yes	31	96.9	2	6.1	**p<0.001**
No	1	3.1	31	93.9	
Neonatal intensive care unit					
Yes	14	43.8	14	42.4	χ^2=0.012
No	18	56.2	19	57.6	p=0.914
Complication					
Yes	15	46.9	14	42.4	χ^2=0.130
No	17	53.1	19	57.6	p=0.718
Types of complication					
Asphyxia	8	57.1	8	53.3	p=1.000
Caput sucsadenenum	1	7.1	2	13.3	p=1.000
Cephal heamatoma	1	7.1	1	6.7	p=1.000
Respiratory distress	-	-	3	20.0	p=0.238
Temporary tachypnea	4	28.7	1	6.7	p=0.197
Blood transfusion					
Yes	3	9.4	3	9.1	p=1.000
No	29	90.6	30	90.9	
Maternal complication					
Yes	1	3.1	-	-	p=0.492
No	31	96.9	33	100.0	

*: Cross-tabulation tables and Pearson's χ^2 or Fisher's exact tests were used to examine the relationships between two qualitative variables

Discussion

In this study, maternal and neonatal outcomes of vacuum-assisted vaginal deliveries were compared between primiparous and multiparous women. The findings support the notion that obstetricians should not hesitate to utilize vacuum assistance when clinically indicated.

Since their introduction, disposable vacuum devices have been one of the important options among the limited choices available to clinicians in obstetrics when considering interventional vaginal delivery. Although their mechanism of action is similar to that of metal cup vacuum devices, disposable systems are widely preferred due to their ease of use and their capacity to reduce trauma to both the fetus and the mother (14). Nonetheless, the use of any assisted delivery technique carries potential risks for both maternal and neonatal health. Common maternal complications include anal sphincter injury, postpartum hemorrhage, wound dehiscence, and the need for episiotomy. Among neonates, cephalohematoma, subgaleal hemorrhage, and scalp abrasions are the most frequently reported adverse outcomes (5,6). There is no consensus regarding the relationship between episiotomy and anal sphincter injury across studies. Some studies have shown that vacuum-assisted deliveries increase the likelihood of perineal trauma and are associated with higher episiotomy rates (15,16).

One literature review suggested that routine episiotomy in non-instrumental vaginal deliveries may elevate the risk of sphincter injury (17), while other studies have indicated that, in the context of vacuum delivery, episiotomy may actually protect against anal sphincter damage in primiparous women (16,18-20). Furthermore, some evidence supports that episiotomy reduces the risk of sphincter injury compared to deliveries without episiotomy (18). Although this suggests that episiotomy may reduce serious injuries, no consensus on its necessity, benefits, or routine use has been reached (21). Guidelines recommend that episiotomy be considered in primiparous deliveries when vacuum extraction is used, but the decision should be individualized according to the clinical circumstances (22). The marked difference in episiotomy rates suggests that labor management varies significantly by parity. While the high rate of episiotomies, particularly among primiparous women, is intended to reduce the risk of anal sphincter injuries and advanced perineal tears, the routine applicability of this approach remains questionable. The current literature emphasizes that preventive episiotomy strategies should be considered within the framework of individualized decision-making.

In our study, routine episiotomy was not performed in multiparous women but was routinely performed in primiparous women. No maternal complications related to this approach were observed. Additionally, there was no significant difference in neonatal outcomes between the groups. Although the birth weight of neonates born to multiparous women was statistically higher than that of primiparous women, the need for episiotomy was lower in the multiparous group. These findings suggest that routine episiotomy may not be necessary in multiparous women undergoing vacuum-assisted delivery.

Studies have shown a significant association between vacuum-assisted labour and various neonatal complications. Severe cases of birth asphyxia have been reported in association with vacuum-assisted deliveries; rates of 4.8% for asphyxia and 3.8% for stillbirth suggest that these interventions may worsen fetal outcomes if not performed with caution (23). However, fetal distress is one of the most common indications for vacuum-assisted deliveries, and there is a strong association between the urgency of the intervention and adverse neonatal outcomes, such as labor asphyxia (24). In addition, it has been emphasised that neurological injuries, including intracranial haemorrhage, may occur because of factors such as improper vacuum placement on the fetal head or excessive traction during vacuum extraction (25).

Gupta and Bhagat (26) reported that neonatal complications, such as cephalohaematoma were less common with vacuum-assisted delivery than with forceps delivery, and that, even in cases of fetal distress, timely intervention with vacuum-assisted delivery significantly improved neonatal outcomes.

In this study, the most common neonatal complication reported was asphyxia rather than cephalohematoma. However, this should not be considered a direct result of vacuum application; rather, it should be considered a consequence of the fetal condition during labour that necessitates vacuum use. According to systematic reviews indicating that the incidence of severe neonatal morbidities—including asphyxia, a prolonged second stage, and fetal distress—increases complication rates, it has been stated that vacuum extraction, with appropriate indications may be effective in reducing such adverse outcomes (27). In our study, episiotomy was performed in two multiparous patients to accelerate labour. The neonates

of these two patients required neonatal intensive care and were diagnosed with asphyxia. However, fetal outcomes after vacuum-assisted vaginal delivery were compared between the two groups, and no statistically significant differences were found.

Study Limitations

The single-center design of this study and its limited sample size may reduce the generalizability of the findings. Future multicenter studies with larger samples are important to confirm these findings. In this study, neonatal outcomes, episiotomy rates and related complications could not be compared between patients who underwent non-vacuum-assisted vaginal delivery and those underwent cesarean section after labor.

However, our study shows that vacuum-assisted vaginal deliveries do not increase the incidence of asphyxia or maternal complications; on the contrary, they facilitate labour.

Conclusion

While vacuum-assisted vaginal delivery is an important alternative for the management of difficult labour, the practice of episiotomy should be approached with caution. Studies support the potential benefits of episiotomy in reducing serious lacerations, but potential risks remain controversial, particularly in certain populations, such as nulliparous women. Vacuum-assisted delivery may reduce the risk of developing fetal hypoxia by shortening the second stage of labor; however, prospective studies with larger samples are needed to support this effect. The results of this study suggest that obstetricians should not be reluctant to perform vacuum-assisted vaginal delivery when clinically indicated, because this approach can prevent unnecessary caesarean sections.

Ethics

Ethics Committee Approval: This study was approved by the Ethics Committee of İstanbul Esenyurt University (approval number E-12483425-299-35347; meeting dated 07.09.2023; protocol number 2023/08-12).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: M.B., E.U., Concept: M.B., E.U., Design: M.B., E.U., Data Collection or Processing: M.B., E.U., Analysis or Interpretation: M.B., E.U., Literature Search: M.B., E.U., Writing: M.B., E.U.

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