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Maternal and Neonatal Outcomes of Vacuum-Assisted Deliveries: A Hospital-Based Cross-Sectional Observational Study

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ABSTRACT

Background: Vacuum-assisted vaginal delivery (VAVD) is a critical obstetric intervention that offers a safe alternative to cesarean section when appropriately applied. While widely practiced, outcome variability persists based on institutional practices and operator proficiency, necessitating localized data to inform clinical decision-making.

Objectives: To evaluate maternal and neonatal outcomes of vacuum-assisted vaginal deliveries and to identify common clinical indications necessitating its use during the second stage of labor.

Methods: This hospital-based cross-sectional observational study was conducted over 12 months at the Department of Obstetrics and Gynecology, Saveetha Medical College. A total of 196 term singleton pregnancies undergoing VAVD were included. Maternal outcomes (perineal trauma, postpartum hemorrhage, retained placenta) and neonatal outcomes (Apgar scores, NICU admission, perinatal complications) were assessed using standardized clinical criteria. Data were analyzed descriptively.

Results: Most participants were aged below 26 years (70.4%), and 74.4% were primigravidas. The predominant indication for VAVD was prolonged second stage of labor (54.4%), followed by poor maternal efforts (20.2%) and fetal distress (18.3%). Maternal complications were infrequent, with vaginal wall tears in 3.8% and postpartum hemorrhage in 1.4% of cases. Neonatal outcomes were favorable, with only 1.4% of newborns scoring <4 on the Apgar scale at 1 minute and 0.9% at 5 minutes. NICU admission was required in 17.3% of cases. Perinatal complications such as birth asphyxia (4.3%) and neonatal depression (3.8%) were observed at low rates.

Conclusion: Vacuum-assisted vaginal delivery, when performed by trained providers under appropriate clinical indications, is associated with low maternal and neonatal morbidity. These findings support the continued use of VAVD in tertiary care centers as a safe and effective alternative to cesarean section, particularly for primigravidas with prolonged second-stage labor. Strengthening operator training and antenatal education can further enhance outcomes.

Keywords: *Vacuum-assisted vaginal delivery, instrumental delivery, maternal outcomes, neonatal outcomes, Apgar score, perinatal complications, prolonged second stage, NICU admission, obstetric interventions, primigravida*

1. INTRODUCTION

Operative vaginal delivery using vacuum extractors remains a crucial technique in modern obstetrics, particularly when prompt delivery is necessary during the second stage of labor. Compared to forceps delivery, vacuum extraction is associated with less maternal soft tissue trauma and is often preferred due to easier learning curves and less anesthetic requirement (1,2).

Prolonged second stage of labor poses significant risks including postpartum hemorrhage, perineal trauma, and uterine rupture in the mother, and hypoxic-ischemic encephalopathy or birth asphyxia in the neonate (3,4). The World Health Organization recommends operative intervention in selected cases to improve perinatal outcomes, especially in resource-limited settings (5).

Vacuum-assisted vaginal delivery (VAVD) is considered a safe and effective alternative to cesarean section in appropriate cases. Recent meta-analyses and population-based studies affirm its utility when performed by trained personnel under strict indications (6,7). However, reported complication rates vary widely based on provider experience, technique, and institutional protocol, underscoring the need for localized outcome studies (8).

In India, few large-scale retrospective analyses have specifically evaluated maternal and neonatal outcomes following vacuum use. Understanding institution-specific data is critical to promoting evidence-based obstetric practices and reducing unnecessary cesarean deliveries (9).

Objectives

The primary objective of this study was to evaluate maternal and neonatal outcomes associated with vacuum-assisted vaginal deliveries in a tertiary care hospital. In addition to this, the study aimed to identify the most common clinical indications necessitating vacuum use during the second stage of labor. It also sought to determine the incidence and nature of maternal complications such as perineal tears and postpartum hemorrhage. Furthermore, the study assessed key neonatal outcomes including Apgar scores at 1 and 5 minutes, the requirement for NICU admission, and the occurrence of perinatal complications such as birth asphyxia, neonatal depression, and other adverse events. The prespecified hypotheses were that vacuum-assisted vaginal deliveries, when conducted by trained professionals under appropriate clinical circumstances, would result in low rates of maternal and neonatal complications, and that prolonged second stage of labor would emerge as the predominant indication for vacuum application.

2. MATERIALS AND METHODS

Study Design and Setting

This was a hospital-based cross-sectional observational study conducted in the Department of Obstetrics and Gynecology at Saveetha Medical College and Hospital, Tamil Nadu, India. The study period spanned 12 months, from January 2024 to January 2025. Data were collected prospectively during participants' hospitalization for delivery.

Participants

All women who underwent vacuum-assisted vaginal delivery (VAVD) during the study period were considered for inclusion. The eligibility criteria included:

- Singleton pregnancies
- Term gestation (≥37 completed weeks)
- Cephalic presentation
- Vacuum-assisted vaginal delivery conducted in the second stage of labor

Exclusion criteria were:

- Multiple gestations
- Preterm labor (<37 weeks)
- Fetal anomalies (congenital or chromosomal)
- Deliveries by cesarean section or forceps

Participants were enrolled consecutively from institutional labor room records to reduce selection bias.

Variables and Data Collection

The primary objective was to assess maternal and neonatal outcomes following VAVD. Data were recorded using a standardized and pre-tested proforma by trained research staff. Maternal variables included age, gravida status, clinical indication for vacuum use, and maternal complications such as:

- Vaginal, perineal, and cervical tears
- Postpartum hemorrhage (PPH)
- Retained placenta

Neonatal variables included:

- Apgar scores at 1 and 5 minutes
- NICU admission status
- Perinatal complications: birth asphyxia, neonatal depression, hyperbilirubinemia, Erb's palsy, meconium aspiration syndrome (MAS), convulsions, transient tachypnea of the newborn (TTNB), and combined complications

All measurements and diagnoses were made by attending clinicians using consistent clinical definitions based on institutional protocols and WHO recommendations.

Bias Control and Data Integrity

To minimize measurement bias, uniform criteria and definitions were applied for all outcomes. Consecutive sampling reduced selection bias, and prospective data collection minimized recall errors. Missing data were negligible and excluded on a per-variable basis.

Study Size

The sample size of 196 participants was determined by the total number of eligible VAVD cases recorded during the 12-month study period. No a priori sample size calculation was performed as this was a census of all eligible cases during the study timeframe.

Statistical Methods

Data were analyzed descriptively using Microsoft Excel. Categorical variables were presented as frequencies and percentages. Quantitative variables such as maternal age and gestational age were grouped into clinically meaningful categories. No inferential statistics, subgroup analyses, or multivariable models were applied, as the primary intent was to describe population characteristics and outcome frequencies.

Results

Out of the 196 participants, the highest proportion belonged to the 21–25 years age group (81, 41.3%), followed by 18–20 years (57, 29.1%) and 26–30 years (49, 25%). Only 9 participants (4.6%) were between 31–35 years of age. Regarding parity, a majority were primigravida (146, 74.4%), while 50 participants (25.6%) were multigravida.

The distribution of age and gravida status is presented in Table 1. A visual representation of age group distribution is shown in Figure 1, which highlights that more than 70% of the participants were under 26 years of age.

Table 1. Distribution of Study Participants by Age Group and Gravida Status

Age group (years)	Percentage (%)	Frequency (n=196)
18-20	29.1	57
21-25	41.3	81
26-30	25	49
31-35	4.6	9

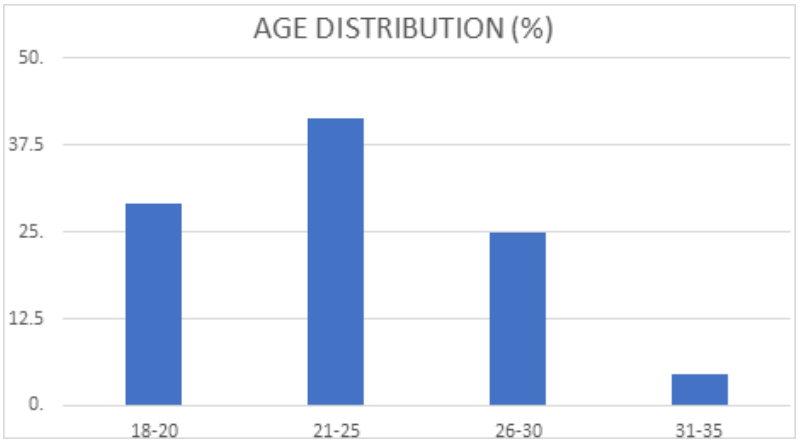

Figure 1. Age Distribution of Participants in the Study

Indications for Instrumental Delivery

The most common indication for instrumental vaginal delivery was prolonged second stage of labor, noted in 107 cases (54.4%). This was followed by poor maternal efforts (40 cases, 20.2%), fetal distress (36 cases, 18.3%), and cut short second stage (14 cases, 7.2%).

These clinical indications are summarized in Table 2. The distribution is further illustrated in Figure 2, a pie chart clearly showing that more than half of the procedures were necessitated by prolonged labor.

Table 2. Clinical Indications for Instrumental Vaginal Delivery

Indication	Percentage (%)	Frequency (n=196)
Poor maternal efforts	**20.2**	**40**
Cut short 2nd stage	**7.2**	**14**
Fetal distress	**18.3**	**36**
Prolonged 2nd stage	**54.4**	**107**

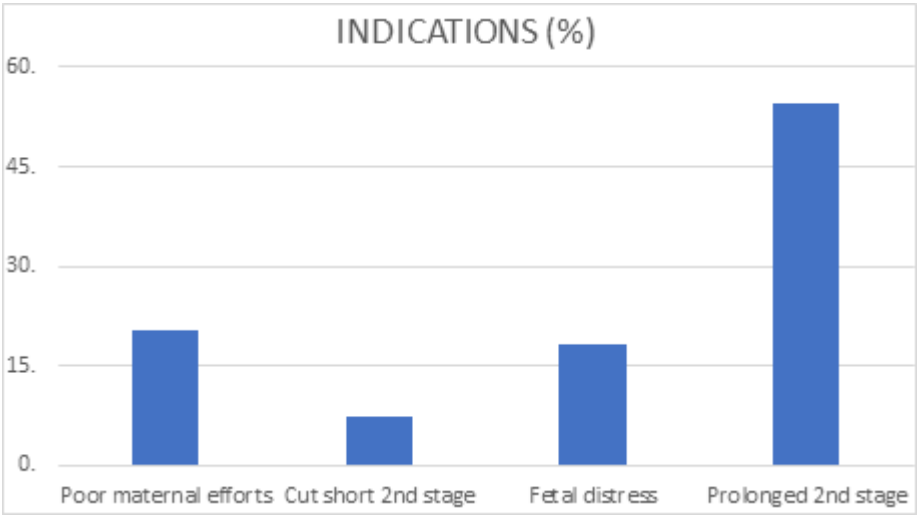

Figure 2. Distribution of Indications for Instrumental Vaginal Delivery

Maternal Complications

Among maternal complications, the most frequent was vaginal wall tear, reported in 7 patients (3.8%). Perineal tears and postpartum hemorrhage (PPH) were each reported in 3 cases (1.4%). Less common complications included cervical tears (2 cases, 0.96%) and retained placenta (1 case, 0.5%).

A detailed account of all maternal complications is presented in Table 3. Figure 3 provides a bar graph that visually compares the relative frequencies of these complications.

Table 3. Maternal Complications Following Instrumental Vaginal Delivery

Complication	Percentage (%)	Frequency (n=196)
PPH	1.4	3
Vaginal wall tear	3.8	7
Perineal tear	1.4	3
Retained placenta	0.5	1
Cervical tear	0.96	2

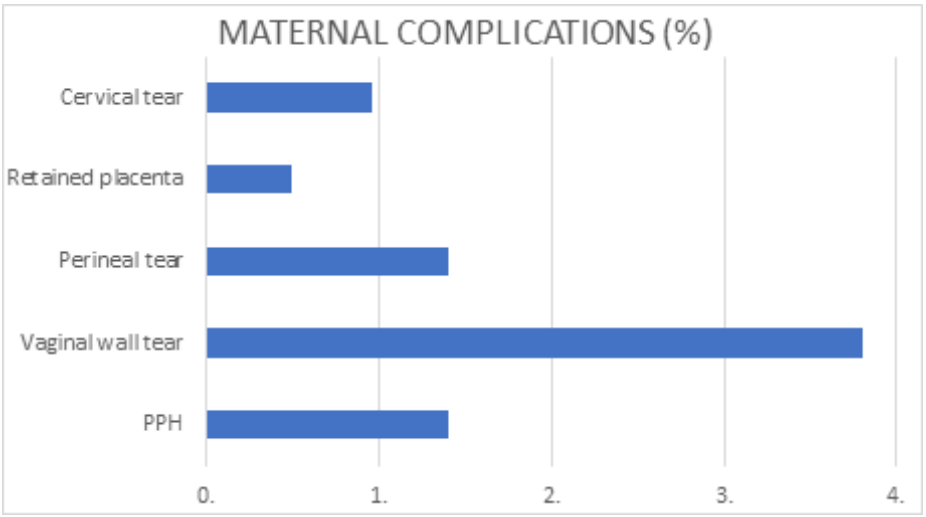

Figure 3. Frequency of Maternal Complications Observed Post-Delivery

Neonatal Outcomes

Apgar Scores

At 1 minute post-delivery, 16 neonates (8.1%) had Apgar scores between 4–6, and 3 (1.4%) scored between 0–3. By 5 minutes, only 8 neonates (4.3%) remained in the 4–6 range, while 2 (0.9%) were in the 0–3 range, suggesting overall improvement with resuscitation efforts.

NICU Admission

A total of 34 neonates (17.3%) required NICU admission, while 162 (82.6%) did not.

These outcomes are summarized in Table 4.

Table 4. Neonatal Apgar Scores at 1 and 5 Minutes Post-Delivery

Apgar Score (1 min)	**Percentage (%)**	**Frequency (n=196)**
0-3	1.4	3
4-6	8.1	16
Apgar Score (5 min)	**Percentage (%)**	**Frequency (n=196)**
0-3	0.9	2
4-6	4.3	8

Perinatal Complications

The most frequently observed perinatal complications were perinatal asphyxia (8 cases, 4.3%) and neonatal depression (7 cases, 3.8%). Other complications included hyperbilirubinemia (2.4%), hypernatremia (0.9%), and rare events like ERBS palsy, convulsions, TTNP, meconium aspiration syndrome (MAS), and one case with combined asphyxia and ERBS.

These are detailed in Table 5, while Figure 4 provides a column chart that illustrates the range and distribution of perinatal complications among the neonates studied.

Table 5. Perinatal and Neonatal Complications Observed Post-Delivery

Perinatal Complication	**Percentage (%)**	**Frequency (n=196)**
Perinatal asphyxia	4.3	8
Neonatal depression	3.8	7

ERBS palsy	0.4	1
Hyperbilirubinemia	2.4	5
Convulsions	0.4	1
Hypernatrimia	0.9	2
TTNP	0.4	1
MAS	1.4	3
Asphyxia + ERBS	0.4	1

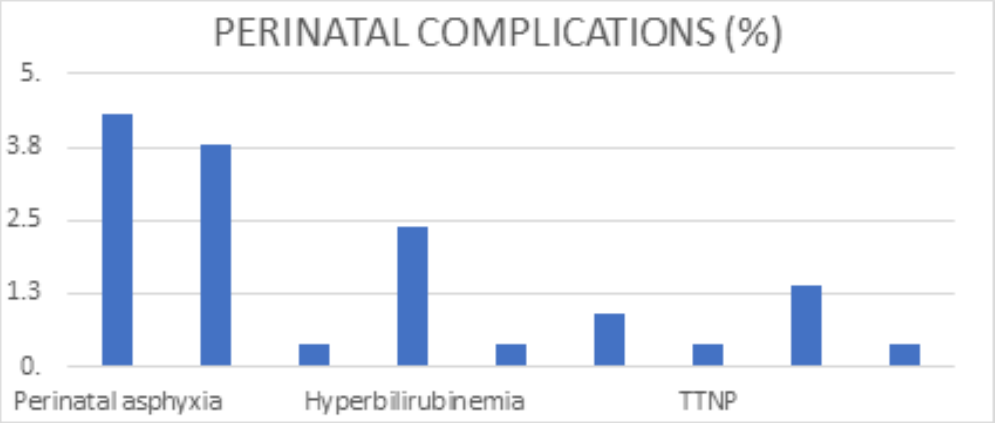

Figure 4 Types and Frequencies of Perinatal Complications Among Neonates

3. DISCUSSION

This cross-sectional observational study assessed maternal and neonatal outcomes associated with instrumental vaginal deliveries in a tertiary care setting. The findings highlight both the effectiveness and safety of this mode of delivery when used under appropriate clinical indications and operator expertise.

Key Results and Interpretation

The predominance of primigravida women (74.4%) aligns with global obstetric trends, where unproven pelvic anatomy and reduced expulsive efficiency in first-time mothers are known contributors to prolonged labor (10,11). Furthermore, a significant proportion of participants were under the age of 26 years, a demographic consistently linked with higher rates of assisted vaginal delivery due to physiological factors such as reduced pelvic compliance and inefficient uterine contractions (10,12).

Prolonged second stage of labor emerged as the most common indication for instrumental intervention (54.4%), consistent with reported rates ranging from 32% to 69% in comparable low-resource or high-volume settings (13). Other key indications included poor maternal efforts (20.2%) and fetal distress (18.3%), which mirror the distribution observed in multicenter analyses where acute intrapartum compromise frequently necessitates operative delivery (10,14). These findings underscore the critical role of timely recognition and management of second-stage labor complications, supported by continuous fetal surveillance (15,16).

Maternal complication rates were notably low, with vaginal wall tears (3.8%) and postpartum hemorrhage (1.4%) being the most frequent. This reflects the benefits of skilled operator technique and adherence to institutional protocols, in contrast to higher complication rates in settings without standardized delivery guidelines (17,18). Cervical tears (0.96%) and retained placenta (0.5%) were infrequent, aligning with data from tertiary centers that follow strict selection criteria and controlled application of forceps or vacuum (19,20).

Neonatal outcomes demonstrated favorable recovery patterns. Apgar scores below 4 at one minute were observed in only 1.4% of neonates, decreasing to 0.9% at five minutes, indicating effective resuscitation and intrapartum care. This is consistent with prior studies where transient neonatal depression is reversible with prompt postnatal intervention (21). NICU admission was required in 17.3% of cases, a figure within expected ranges and primarily attributable to intrapartum fetal distress rather than procedural trauma (22).

Perinatal complications were observed in a small subset of cases, with perinatal asphyxia (4.3%) and neonatal depression

(3.8%) being the most prevalent. These rates compare favorably with studies reporting 5–12% incidence in similar populations, suggesting appropriate case selection and management protocols (21). Severe complications such as seizures (0.4%) and Erb's palsy (0.4%) were rare, consistent with outcomes seen in low station applications of instruments under experienced supervision (23).

Clinical Implications

The findings affirm the role of instrumental vaginal delivery as a safe and effective alternative to cesarean section, particularly in primigravida patients with prolonged second-stage labor. When performed by trained personnel using strict eligibility and safety protocols, it offers a lower-risk option for both mothers and neonates. These results support the continued use of operative vaginal delivery in tertiary care settings as part of comprehensive intrapartum care. Moreover, the high representation of primigravida mothers underscores the importance of antenatal education focusing on labor preparedness and pushing techniques.

Limitations

This study is not without limitations. The absence of long-term neonatal follow-up restricts conclusions regarding neurodevelopmental sequelae, an area requiring future prospective studies. Additionally, the lack of a control group (e.g., spontaneous vaginal or cesarean deliveries) limits comparative interpretation. These limitations are inherent to retrospective observational studies in resource-constrained environments but do not diminish the internal validity of the findings.

Generalisability

While the single-center design may limit external validity, the patient profile and clinical practices reflect those of similar tertiary institutions in South Asia. Thus, the findings can reasonably be generalized to comparable settings, especially where instrumental deliveries are commonly practiced in primigravidas under monitored labor conditions.

4. CONCLUSION

Instrumental vaginal delivery, when conducted under appropriate clinical indications and by skilled personnel, remains a safe and effective alternative to cesarean section in managing selected obstetric cases, particularly among primigravida women experiencing prolonged second-stage labor. This study demonstrated low rates of maternal and neonatal complications, with favorable Apgar score recovery and minimal severe perinatal morbidity.

The findings support the continued integration of operative vaginal delivery into obstetric practice, provided institutional protocols, operator training, and fetal surveillance systems are robust. Given the high proportion of primigravidas and younger mothers requiring assistance, strengthening antenatal education and intrapartum monitoring is essential. Further studies with long-term neonatal follow-up and comparison groups are warranted to comprehensively evaluate the impact of instrumental delivery on maternal and child health outcomes.

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