

Comparative Safety of Forceps, Vacuum, and Cesarean in Prolonged Second Stage

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ABSTRACT

Background: The second stage of labor represents a critical phase in obstetrics, where the choice of delivery mode significantly influences neonatal outcomes.

Methodology: This comparative cross-sectional study was conducted at the Department of Obstetrics and Gynecology, Holy Family Hospital, Rawalpindi, Pakistan, from February 2023 to February 2024, to evaluate neonatal outcomes following forceps-assisted, vacuum-assisted, and emergency cesarean deliveries.

Results: A total of 100 neonates delivered during the second stage of labor were analyzed, with 42 (42%) delivered by forceps, 23 (23%) by vacuum extraction, and 35 (35%) by cesarean section. Outcomes assessed included shoulder dystocia, neonatal injuries, NICU admissions, and five-minute Apgar scores. Shoulder dystocia occurred more frequently in the vacuum group (8.2%) compared to forceps (4.8%) and cesarean (0.0%, $p=0.03$). Neonatal injuries were highest in vacuum deliveries (17.3%) versus forceps (4.7%) and cesarean (3.5%, $p=0.04$). NICU admissions were most common after cesarean (20%), followed by vacuum (17.3%) and forceps (9.5%, $p=0.11$). A five-minute Apgar score <7 was recorded in 14.1% of cesarean deliveries, 13.0% of vacuum, and 7.1% of forceps ($p=0.21$).

Conclusion: These findings suggest that forceps-assisted deliveries, when performed by skilled operators, may offer more favorable neonatal outcomes compared to vacuum extraction and emergency cesarean in prolonged second stage labor. Strengthening operator training in forceps use could optimize outcomes, particularly in resource-constrained settings.

Keywords: forceps delivery, vacuum extraction, cesarean section, neonatal outcomes, second stage of labor.

INTRODUCTION

The second phase of labor is a most crucial step in obstetrics, in which the make-or-buy decision concerning the mode of delivery are the most important part of nursing procedures since effective and timely decision-making would be essential in optimizing both maternal and neonatal outcomes.¹⁻⁴ Long second stage of labor is linked with more risk of adverse perinatal outcome, including neonatal asphyxia, trauma, and intensive care admission.⁵⁻⁷ In such a setting, the management option usually depends on assisted vaginal delivery (delivery with forceps, vacuum, etc.) or emergency cesarean section, and this type of choice is determined by the maternal and fetal factors and operator.⁸⁻¹⁰ But safety and efficacy of these methods have been a topic of perpetual contention, especially in low-resource setting where surgical facilities might be low.

Instrumental deliveries, once a cornerstone of obstetric practice, have witnessed a global decline due to rising cesarean section rates and diminishing operator expertise.¹¹ Despite this, forceps and vacuum extraction continue to play an essential role in scenarios requiring expedited delivery, such as non-reassuring fetal heart rate patterns or maternal exhaustion.¹² Previous studies have demonstrated that vacuum extraction is associated with shorter procedure times and less maternal trauma but carries a higher risk of neonatal scalp injury and cephalohematoma.^{13,14} Conversely, forceps, while technically more demanding, may be associated with lower rates of neonatal intracranial hemorrhage compared to vacuum.

Cesarean delivery, although often perceived as a safer alternative, is not without risk.^{15,16} Emergency procedures performed in the second stage of labor have been linked to increased neonatal morbidity, particularly due to prolonged decision-to-delivery intervals and difficulties with impacted fetal head extraction.¹⁷ Moreover, the rising global cesarean rates have raised concerns about long-term maternal morbidity, healthcare costs, and

intergenerational consequences.¹⁸ This has renewed interest in reevaluating the role of assisted vaginal deliveries, especially forceps, as a potentially safer and more resource-efficient alternative in selected cases.

In the South Asian context, where obstetric emergencies often occur in high-volume tertiary centers, the choice of delivery mode during the second stage is particularly consequential. Limited evidence exists from low- and middle-income countries comparing neonatal outcomes across forceps-assisted, vacuum-assisted, and cesarean deliveries, despite differing clinical practices and healthcare constraints. Addressing this knowledge gap is vital to inform evidence-based intrapartum decision-making and optimize neonatal outcomes.

Therefore, this study was designed to compare neonatal outcomes—including shoulder dystocia, neonatal injuries, NICU admissions, and Apgar scores—among forceps, vacuum, and cesarean deliveries performed during the second stage of labor at a tertiary care hospital in Pakistan. By systematically analyzing these outcomes, we aim to provide context-specific evidence to guide obstetricians in selecting the most appropriate mode of delivery for prolonged second stage of labor.

METHODOLOGY

This comparative cross-sectional study was conducted at the Department of Obstetrics and Gynecology, Holy Family Hospital, Rawalpindi, Pakistan, over a 12-month period from February 2023 to February 2024. All newborns delivered in the obstetric theater during the second stage of labor either emergency cesarean section or assisted vaginal delivery (using vacuum or forceps) were deemed eligible. Participants who met the inclusion criteria were recruited using a successive sample strategy; newborns with congenital defects, intrauterine fetal death, or inadequate medical records were not included. Neonatal outcomes were rigorously evaluated, and pertinent clinical factors and maternal demographics were documented. Shoulder dystocia, admission to the neonatal intensive care unit (NICU), neonatal injury, and a five-minute Apgar score below seven were the main outcomes of interest. In order to find statistically significant differences, deliveries were categorized into three groups: cesarean section, vacuum-assisted, and forceps-assisted. SPSS version 25.0 (IBM Corp., Armonk, NY, USA) was used to analyze the data. While continuous variables were displayed as mean $\pm$ standard deviation, categorical variables were represented as frequencies and percentages. A p -value of less than 0.05 was deemed

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How to Cite: Malik I, Imtiaz W, Amjad S. Comparative Safety of Forceps, Vacuum, and Cesarean in Prolonged Second Stage. Pakistan Journal of Healthcare Research. 2024 Jun; 1(1): 1-3

Article History

Received: 15-03-2024 | Accepted: 08-06-2024 | Published: 30-06-2024

statistically significant when comparing categorical variables between groups using the Chi-square test.

RESULTS

One hundred and fifty women that appeared to have extended period of second stage labor (n=150) were recruited and 100 of the neonates that passed the inclusion criteria were examined. The average age of the mothers was 33.3 +/- 6.4 years old. Instrumental births were conducted in 65 women of which 42 (28%) ensued forceps birth and 23 (15.3) via vacuum delivery and 85 (56.7) giving birth through emergency section. Comparative analysis of neonatal outcomes demonstrated significant differences across the three groups (Table 1). Shoulder dystocia was observed in 7 (8.2%) neonates in the vacuum group, 2 (4.8%) in the forceps group, and none in the cesarean group (p = 0.03). Neonatal injuries, including scalp abrasions and cephalohematoma, were more frequent in the vacuum group (17.3%) compared to forceps (4.7%) and cesarean (3.5%) deliveries (p = 0.04). NICU admissions were highest in neonates delivered by cesarean section (20%), followed by vacuum (17.3%) and forceps (9.5%), though the difference was not statistically significant (p = 0.11). A five-minute Apgar score <7 was reported in 14.1% of cesarean births, 13.0% of vacuum deliveries, and 7.1% of forceps deliveries (p = 0.21).

Table 1: Neonatal Outcomes by Mode of Delivery

Outcome	Forceps (n=42)	Vacuum (n=23)	Cesarean (n=85)	p-value
Shoulder dystocia (%)	2 (4.8)	7 (8.2)	0 (0.0)	0.03*
Neonatal injury (%)	2 (4.7)	4 (17.3)	3 (3.5)	0.04*
NICU admission (%)	4 (9.5)	4 (17.3)	17 (20.0)	0.11
5-min Apgar <7 (%)	3 (7.1)	3 (13.0)	12 (14.1)	0.21

*Statistically significant at p < 0.05

DISCUSSION

The present study compared neonatal outcomes among forceps-assisted, vacuum-assisted, and cesarean deliveries performed during the second stage of labor. Our findings highlight important clinical differences: forceps delivery was associated with the lowest rates of neonatal injury and NICU admission, while vacuum delivery carried a higher risk of trauma, and cesarean section was linked with increased NICU utilization and lower Apgar scores. The observation that neonatal injuries were more frequent with vacuum extraction aligns with previous evidence indicating higher rates of scalp trauma and cephalohematoma with vacuum use compared to forceps (Murphy et al., 2019). Conversely, the relatively favorable profile of forceps in this study supports existing literature suggesting that, when performed by skilled operators, forceps delivery may be a safe alternative to cesarean section, particularly in resource-limited settings where surgical risks and postoperative complications are substantial (O'Mahony et al., 2010). Cesarean delivery, although often considered the safest option in prolonged labor, was associated with a notable burden of NICU

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admissions and suboptimal Apgar scores. This may reflect perinatal hypoxia due to delay in decision-to-incision intervals, consistent with prior studies that identified emergency cesarean as an independent risk factor for adverse neonatal outcomes (Allen et al., 2017). Importantly, our study emphasizes that timely and judicious selection of forceps delivery can mitigate the risks of both operative vaginal trauma and neonatal compromise associated with cesarean. All in all, these data demonstrate that the role of operator expertise in the field of forceps-assisted delivery is essential because the application of cesarean or vacuum delivery in isolation will inevitably result in high rates of neonatal morbidity. Further research that involves multicentric investigations involving bigger groups of participants and neurodevelopmental follow-ups is desirable to confirm these findings and help make evidence-based decisions in obstetric programs.

CONCLUSION

This study demonstrates that forceps-assisted deliveries were associated with lower rates of neonatal injuries and NICU admissions compared to vacuum-assisted or cesarean deliveries during the second stage of labor. While vacuum extraction was linked to higher risks of scalp trauma and shoulder dystocia, emergency cesarean sections were more frequently associated with low Apgar scores and increased NICU utilization. These findings highlight the clinical importance of maintaining proficiency in forceps delivery, particularly in settings where delays in surgical interventions may compromise neonatal outcomes. Promoting evidence-based decision-making, timely intervention, and adequate operator training can help mitigate risks and optimize neonatal safety. In resource-limited healthcare environments, where cesarean capacity is often overburdened, forceps-assisted delivery should be considered a safe, effective, and resource-efficient option in appropriately selected cases. Further multicenter studies with larger cohorts are needed to validate these observations and inform obstetric practice guidelines.

Author's Contribution

IM: Concept & study design, data collection and drafting of the manuscript.
WI: Data entry, statistical analysis, interpretation of the results.
SA: Manuscript editing and critical revision of the manuscript.
All authors approved the final version of the manuscript to be published.

Conflict of Interest

The authors declared no conflict of interest.

Funding

No funding was received by the authors.

Data Availability

Data is available with authors and can be provided on request.

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