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Original Article

Comparative study of maternal and neonatal outcome of 1st stage and 2nd stage caesarean sections in a tertiary centre.

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Abstract

Introduction

Caesarean delivery during the second stage of labour is technically more difficult because of deep fetal head engagement and prolonged labour, potentially increasing maternal and neonatal morbidity.

Materials and Methods

This hospital-based retrospective observational study included 120 women undergoing intrapartum caesarean section at a tertiary care centre, with 60 first-stage and 60 second-stage procedures. Demographic, obstetric, operative, maternal, and neonatal outcomes were extracted from hospital records. Group comparisons used independent-samples t-tests for continuous variables and chi-square tests for categorical variables, with $p<0.05$ considered significant.

Results

Maternal age was comparable between first-stage and second-stage groups (25.87 ± 3.42 vs. 26.43 ± 3.71 years; p=0.387). Second-stage caesarean sections were associated with longer labour (10.64 ± 2.87 vs. 7.82 ± 2.31 hours; p<0.001) and longer second-stage duration (89.27 ± 31.54 vs. 36.42 ± 18.61 minutes; p<0.001). Uterine incision extension (21.7% vs. 5.0%; p=0.008), difficult fetal head delivery (30.0% vs. 3.3%; p<0.001), and atonic postpartum haemorrhage (18.3% vs. 6.7%; p=0.044) were more frequent in the second-stage group. Operative duration (61.82 ± 14.71 vs. 48.63 ± 10.24 minutes; p<0.001) and estimated blood loss (781.83 ± 211.46 vs. 612.50 ± 143.72 mL; p<0.001) were also greater. Mean 1-minute and 5-minute Apgar scores were lower (6.93 ± 1.12 vs. 7.52 ± 0.86; p=0.002 and 8.19 ± 0.91 vs. 8.71 ± 0.62; p<0.001), while neonatal resuscitation (25.0% vs. 8.3%; p=0.013) and NICU admission (26.7% vs. 10.0%; p=0.017) were higher after second-stage caesarean section.

Conclusion

Second-stage caesarean section was associated with greater maternal operative morbidity and less favourable early neonatal outcomes than first-stage caesarean section.

Recommendations

Timely intrapartum decision-making and preparedness for difficult fetal extraction, haemorrhage, and neonatal resuscitation are essential when second-stage caesarean delivery is anticipated.

Keywords: *caesarean section; first stage of labour; second stage of labour; maternal outcome; neonatal outcome.*
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Introduction

Caesarean section is one of the most frequently performed operative procedures in obstetric practice and is an essential intervention when vaginal delivery poses a risk to the mother or fetus [1]. Although caesarean delivery can substantially reduce maternal and perinatal morbidity in appropriately selected cases, the timing of the procedure during labour may influence both maternal and neonatal outcomes [2]. Caesarean section performed during the first stage of labour, before complete cervical dilatation, generally allows relatively easier access to the fetal head and may be associated with fewer technical difficulties [3]. In contrast, caesarean section performed during the second stage, after complete cervical dilatation and descent of the fetal head, can be technically challenging and may be associated with increased maternal and neonatal complications [4].

Second-stage caesarean section is frequently performed for persistent fetal malposition, arrest of descent, failed instrumental delivery, or non-reassuring fetal status [5]. At this stage, the deeply engaged fetal head may be impacted within the maternal pelvis, making delivery through the uterine incision more difficult [3]. This may increase the likelihood of difficult fetal head extraction, extension of the uterine incision, increased blood loss, bladder or uterine injury, and postpartum haemorrhage. Prolonged labour and repeated attempts at operative vaginal delivery before caesarean section may further contribute to maternal morbidity. Consequently, second-stage caesarean section is often regarded as a technically demanding procedure requiring appropriate operative expertise and preparedness for potential complications [6,7].

The timing of caesarean delivery may also influence neonatal outcomes. Prolonged labour, fetal head impaction, and the underlying indication for caesarean section may increase the risk of neonatal compromise [8]. Neonates delivered following second-stage caesarean section may have lower Apgar scores, greater requirements for resuscitation, and increased rates of admission to neonatal intensive care units [9]. However, maternal and neonatal outcomes are influenced by multiple factors, including gestational age, parity, fetal presentation, indication for caesarean section, duration of labour, and fetal condition at the time of surgery. Therefore, comparison of outcomes between caesarean sections performed during different stages of labour can provide clinically relevant information regarding the risks associated with delayed operative delivery [10].

Despite the increasing frequency of caesarean delivery, data comparing maternal and neonatal outcomes according to the stage of labour at which caesarean section is performed remain important, particularly in tertiary-care settings where second-stage caesarean sections are commonly undertaken. Identification of differences in operative complications, blood loss, postpartum morbidity, neonatal condition, and NICU requirement may help improve intrapartum decision-making and preparedness for difficult caesarean delivery. Therefore, the present study aimed to compare the maternal and neonatal outcomes of first-stage and second-stage caesarean sections in a tertiary care centre.

Materials and methods

Study design and setting

A hospital-based retrospective observational study was conducted in the Department of Obstetrics and Gynaecology at ESIC Medical College, PGIMSR and Model Hospital, Rajajinagar, Bengaluru, Karnataka, India. The institution is a tertiary teaching and referral centre located in Rajajinagar, Bengaluru, with a 500-bed hospital and a sanctioned capacity of 750 beds. It provides 24-hour emergency care, labour-room and operative services, intensive care and neonatal intensive care, blood-bank and diagnostic facilities, and a broad range of medical and surgical specialty services. The centre primarily serves Employees' State Insurance beneficiaries in Bengaluru and also receives referred patients from surrounding areas. Women were categorised into first-stage or second-stage caesarean-section groups according to the documented stage of labour at operative delivery.

Study duration

The retrospective record-review period extended from **01/01/2025 to 31/12/2025**.

Study population

The study population comprised pregnant women who underwent caesarean section during labour at the study centre. A total of 120 eligible women were included in the study, with 60 women undergoing caesarean section during the first stage of labour and 60 during the second stage of labour. Data pertaining to maternal characteristics, obstetric history, gestational age, indication for caesarean section, duration of labour, intraoperative findings, maternal complications, and neonatal outcomes were recorded.

Inclusion criteria

Pregnant women who underwent caesarean section during labour at the study centre during the study period were included. Women with documented information regarding the stage of labour at the time of caesarean section and relevant maternal and neonatal outcomes were considered eligible for analysis.

Exclusion criteria

Women with incomplete or unavailable medical records, those who did not undergo caesarean delivery at the study centre, and women with major pre-existing medical conditions that could independently influence maternal or neonatal outcomes were excluded from the analysis. Women undergoing elective caesarean section without labour were also excluded.

Sampling technique

All eligible cases fulfilling the predefined inclusion and exclusion criteria during the study period were identified from the hospital records. A total of 120 women meeting the eligibility criteria were included in the final analysis. The participants were divided equally into first-stage caesarean section and second-stage caesarean section groups, with 60 women in each group.

Data collection

Data were collected retrospectively from patient case records, antenatal records, labour room records, operative notes, postpartum records, and neonatal records. Information regarding maternal age, parity, gestational age at delivery, duration of labour, duration of the second stage, fetal presentation, membrane status, meconium-stained liquor, indication for caesarean section, operative duration, estimated blood loss, intraoperative complications, postpartum haemorrhage, blood transfusion, postoperative complications, duration of hospital stay, and maternal intensive care admission was recorded using a predesigned data collection proforma. Neonatal information including birth weight, Apgar scores at 1 and 5 minutes, requirement for resuscitation,

NICU admission, respiratory distress, birth trauma, neonatal sepsis, and neonatal mortality was also recorded.

Classification of caesarean section according to stage of labour

Caesarean sections were classified according to the stage of labour at the time of decision and delivery. First-stage caesarean section included procedures performed during the first stage of labour, before complete cervical dilatation. Second-stage caesarean section included procedures performed after complete cervical dilatation, during the second stage of labour. The stage of labour was determined from the documented cervical dilatation and labour records.

Assessment of indications for caesarean section

The documented indication for caesarean delivery was recorded from the labour room and operative records. Indications were categorised as non-progress of labour, fetal distress or non-reassuring fetal status, failed induction of labour, cephalopelvic disproportion, malposition or malpresentation, and other relevant indications as documented in the medical records.

Assessment of maternal intraoperative outcome

Maternal intraoperative outcomes were assessed from operative records. Operative duration and estimated blood loss were recorded. Intraoperative complications including extension of the uterine incision, difficult delivery of the fetal head, uterine or uterine artery injury, bladder injury, atonic postpartum haemorrhage, requirement for blood transfusion, and other operative complications were documented.

Assessment of postoperative maternal outcome

Postoperative maternal outcomes were assessed from the records until discharge from the hospital. The occurrence of postpartum haemorrhage, postoperative fever, wound infection, requirement for additional antibiotics, blood transfusion, intensive care admission, duration of hospital stay, and maternal mortality was recorded. The overall occurrence of maternal complications was compared between the first-stage and second-stage caesarean section groups.

Assessment of neonatal outcome

Neonatal outcomes were assessed using delivery room, neonatal, and NICU records. Birth weight and Apgar scores at 1 and 5 minutes were recorded. Neonatal morbidity was assessed based on the requirement for resuscitation, NICU admission, respiratory distress, meconium aspiration, neonatal sepsis, birth trauma, and neonatal mortality. An Apgar score below 7 was considered an adverse neonatal outcome for comparative analysis.

Data management: The collected data were entered into a Microsoft Excel spreadsheet and subsequently checked for completeness and consistency. Each participant was assigned a unique study identification number, and personally identifiable information was excluded from the analytical dataset.

Quantitative variables

Quantitative variables included maternal age, gestational age, total labour duration, second-stage duration, operative duration, estimated blood loss, postoperative haemoglobin, length of hospital stay, neonatal birth weight, and Apgar scores. These variables were retained in their continuous form for primary between-group comparisons and were summarised as mean ± standard deviation. Maternal age categories (18–24, 25–29, and ≥30 years) were retained as descriptive reproductive-age strata from the study dataset. Gestational age was grouped as <37 weeks, 37–39 weeks, and ≥40 weeks to distinguish preterm, term, and births occurring at 40 weeks or later. Birth weight <2500 g represented low birth weight; 2500–3499 g and ≥3500 g were retained as prespecified descriptive strata. Inferential comparisons of age, gestational age, and birth weight also used the continuous measurements to avoid loss of numerical information.

Statistical analysis

Data were analysed using IBM SPSS Statistics software. Categorical variables were expressed as frequencies and percentages, and quantitative variables were expressed as mean ± standard deviation. Independent-samples t-tests were used for continuous between-group comparisons, including maternal age, gestational age, labour duration, second-stage duration, operative duration, estimated blood loss, postoperative haemoglobin, hospital stay, birth weight, and Apgar scores. Pearson's chi-square test was used for categorical comparisons when expected cell counts were adequate. Two-sided Fisher's exact test was used for sparse 2 × 2 comparisons in which an expected cell count was <5; these rows are identified in the relevant table notes. Categorised gestational age was presented descriptively because of sparse numbers in the preterm category, while the continuous gestational-age comparison used the independent-samples t-test. No Mann–Whitney U-test results were used in the final analysis. A two-sided p-value <0.05 was considered statistically significant.

Ethical considerations

Ethical approval was obtained from the Institutional Ethics Committee, ESIC Medical College, PGIMSR and Model Hospital, Rajajinagar, Bengaluru, before commencement of the study. As this was a retrospective analysis of existing medical records, confidentiality and privacy were maintained throughout. Data were anonymised before analysis and used exclusively for research purposes.

Results

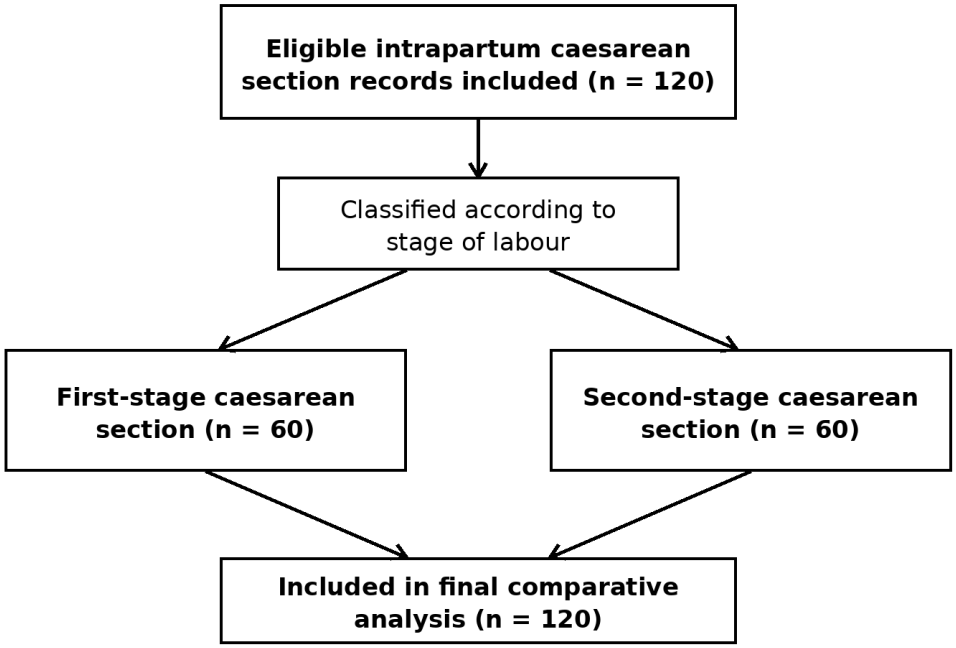

Figure 1. Participant flow through the study

The mean maternal age was comparable between the first-stage and second-stage caesarean section groups (25.87 ± 3.42 vs. 26.43 ± 3.71 years). Most women in both groups were aged 25–29 years and were primigravida. Rural women constituted 61.7% of the first-stage group and 68.3% of the second-stage group. No significant differences were observed between the groups regarding age, age category, parity, or residence. (Table 1)

Table 1: *Comparison of Maternal Demographic Characteristics Between the Study Groups*

Variable	First-stage CS (n=60)	Second-stage CS (n=60)	Test value	p-value
Age (years), mean ± SD	25.87 ± 3.42	26.43 ± 3.71	t = 0.87	0.387
Age group (years)			χ^2 = 0.77	0.680
18–24	24 (40.0%)	21 (35.0%)		
25–29	27 (45.0%)	29 (48.3%)		
≥30	9 (15.0%)	10 (16.7%)		
Parity			χ^2 = 1.32	0.517
Primigravida	36 (60.0%)	40 (66.7%)		
Gravida 2	17 (28.3%)	15 (25.0%)		
Gravida ≥3	7 (11.7%)	5 (8.3%)		
Residence			χ^2 = 0.60	0.439
Rural	37 (61.7%)	41 (68.3%)		
Urban	23 (38.3%)	19 (31.7%)		

Note. Data are presented as mean ± SD or n (%). Maternal age was compared with the independent-samples t-test; age group, parity, and residence were compared with Pearson's chi-square test.

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The mean gestational age was similar between the first-stage and second-stage groups (38.71 ± 1.02 vs. 39.02 ± 0.91 weeks). However, women undergoing second-stage caesarean section had a significantly longer duration of labour (10.64 ± 2.87 vs. 7.82 ± 2.31 hours) and second stage of labour (89.27 ± 31.54 vs. 36.42 ± 18.61 minutes). Meconium-stained liquor was also more frequent in the second-stage group (28.3% vs. 13.3%). (Table 2)

Table 2: *Comparison of Gestational Age and Obstetric Characteristics*

Variable	First-stage CS (n=60)	Second-stage CS (n=60)	Test value	p-value
Gestational age (weeks), mean ± SD	38.71 ± 1.02	39.02 ± 0.91	t = 1.73	0.086
Gestational age			Descriptive	—
<37 weeks	3 (5.0%)	2 (3.3%)		
37–39 weeks	36 (60.0%)	33 (55.0%)		
≥40 weeks	21 (35.0%)	25 (41.7%)		
Duration of labour (hours), mean ± SD	7.82 ± 2.31	10.64 ± 2.87	t = 5.93	<0.001
Duration of second stage (minutes), mean ± SD	36.42 ± 18.61	89.27 ± 31.54	t = 11.17	<0.001
Membranes ruptured >18 h	6 (10.0%)	12 (20.0%)	$\chi^2 = 2.31$	0.128
Meconium-stained liquor	8 (13.3%)	17 (28.3%)	$\chi^2 = 4.20$	0.040

Note. Data are presented as mean ± SD or n (%). Gestational age, labour duration, and second-stage duration were compared using independent-samples t-tests. Membrane status and meconium-stained liquor were compared using Pearson's chi-square test. Gestational-age categories are descriptive because the preterm category contained sparse observations.

Non-progress of labour was the most common indication for first-stage caesarean section (30.0%), followed by fetal distress (26.7%) and failed induction (21.7%). In the second-stage group, fetal distress was the commonest indication (23.3%), followed by malposition/malpresentation (23.3%) and cephalopelvic disproportion (20.0%). Non-progress of labour and failed induction were significantly more frequent in the first-stage group, whereas malposition/malpresentation was significantly more common in the second-stage group. (Table 3)

Table 3: *Indications for Caesarean Section*

Indication	First-stage CS (n=60)	Second-stage CS (n=60)	χ^2 value	p-value
Non-progress of labour	18 (30.0%)	7 (11.7%)	7.06	0.008
Fetal distress / non-reassuring fetal status	16 (26.7%)	14 (23.3%)	0.18	0.672
Failed induction	13 (21.7%)	4 (6.7%)	6.87	0.009
Cephalopelvic disproportion	7 (11.7%)	12 (20.0%)	1.53	0.216
Malposition / malpresentation	3 (5.0%)	14 (23.3%)	8.41	0.004
Other indications	3 (5.0%)	9 (15.0%)	3.16	0.075

Note. Data are n (%). Each indication was compared between groups using Pearson's chi-square test.

Intraoperative maternal complications were considerably more frequent among women undergoing second-stage caesarean section. Extension of the uterine incision occurred in 21.7% of second-stage procedures compared with 5.0% of first-stage procedures, while difficult fetal head delivery occurred in 30.0% and 3.3%, respectively. Atonic postpartum haemorrhage was also more frequent in the second-stage group (18.3% vs. 6.7%). Overall, intraoperative complications occurred in 41.7% of second-stage compared with 13.3% of first-stage caesarean sections. (Table 4)

Table 4: *Comparison of Intraoperative Maternal Complications*

Maternal outcome	First-stage CS (n=60)	Second-stage CS (n=60)	χ^2 value	p-value
Extension of uterine incision	3 (5.0%)	13 (21.7%)	7.07	0.008
Difficult fetal head delivery	2 (3.3%)	18 (30.0%)	15.65	<0.001
Atonic postpartum haemorrhage	4 (6.7%)	11 (18.3%)	4.07	0.044
Intraoperative blood transfusion	2 (3.3%)	7 (11.7%)	Fisher's exact	0.163
Bladder injury	0 (0.0%)	3 (5.0%)	Fisher's exact	0.244
Uterine artery injury	1 (1.7%)	4 (6.7%)	Fisher's exact	0.364

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Maternal outcome	First-stage CS (n=60)	Second-stage CS (n=60)	χ^2 value	p-value
Conversion to hysterectomy	0 (0.0%)	1 (1.7%)	Fisher's exact	1.000
Any intraoperative complication	8 (13.3%)	25 (41.7%)	12.03	<0.001

Note. Data are n (%). Pearson's chi-square test was used when expected cell counts were adequate; two-sided Fisher's exact test was used for intraoperative blood transfusion, bladder injury, uterine artery injury, and conversion to hysterectomy because of sparse expected cell counts.

The mean operative duration was significantly longer in the second-stage group than in the first-stage group (61.82 ± 14.71 vs. 48.63 ± 10.24 minutes). Estimated blood loss was also significantly higher following second-stage caesarean section (781.83 ± 211.46 vs. 612.50 ± 143.72 mL), with correspondingly lower postoperative haemoglobin levels. The mean hospital stay was longer in the second-stage group (5.12 ± 1.17 vs. 4.23 ± 0.81 days), while postoperative fever, wound infection, and ICU admission were numerically more frequent. (Table 5)

Table 5: *Comparison of Operative and Postoperative Maternal Outcomes*

Outcome	First-stage CS (n=60)	Second-stage CS (n=60)	Test value	p-value
Operative duration (minutes), mean ± SD	48.63 ± 10.24	61.82 ± 14.71	t = 5.71	<0.001
Estimated blood loss (mL), mean ± SD	612.50 ± 143.72	781.83 ± 211.46	t = 5.18	<0.001
Postoperative haemoglobin (g/dL), mean ± SD	10.34 ± 1.18	9.71 ± 1.26	t = 2.84	0.005
Postoperative fever	4 (6.7%)	9 (15.0%)	χ^2 = 1.97	0.160
Wound infection	2 (3.3%)	6 (10.0%)	Fisher's exact	0.272
Need for additional antibiotics	7 (11.7%)	15 (25.0%)	χ^2 = 3.39	0.066
Length of hospital stay (days), mean ± SD	4.23 ± 0.81	5.12 ± 1.17	t = 4.89	<0.001
Maternal ICU admission	1 (1.7%)	3 (5.0%)	Fisher's exact	0.619
Maternal mortality	0 (0.0%)	0 (0.0%)	—	—

Note. Data are presented as mean ± SD or n (%). Continuous outcomes were compared using independent-samples t-tests. Categorical outcomes used Pearson's chi-square test, except wound infection and maternal ICU admission, for which Fisher's exact test was used because of sparse expected cell counts.

Mean neonatal birth weight was comparable between the first-stage and second-stage groups (2938.50 ± 421.36 vs. 2871.17 ± 438.72 g). However, neonates delivered by second-stage caesarean section had significantly lower mean Apgar scores at 1 minute (6.93 ± 1.12 vs. 7.52 ± 0.86) and 5 minutes (8.19 ± 0.91 vs. 8.71 ± 0.62). An Apgar score below 7 at 1 minute was observed in 28.3% of neonates in the second-stage group compared with 11.7% in the first-stage group. (Table 6)

Table 6: *Comparison of Neonatal Birth Weight and Apgar Scores*

Neonatal outcome	First-stage CS (n=60)	Second-stage CS (n=60)	Test value	p-value
Birth weight (g), mean ± SD	2938.50 ± 421.36	2871.17 ± 438.72	t = 0.87	0.386
Birth weight			χ^2 = 0.91	0.635
<2500 g	7 (11.7%)	9 (15.0%)		
2500–3499 g	43 (71.7%)	42 (70.0%)		
≥3500 g	10 (16.7%)	9 (15.0%)		
Apgar score at 1 min, mean ± SD	7.52 ± 0.86	6.93 ± 1.12	t = 3.24	0.002
Apgar score at 5 min, mean ± SD	8.71 ± 0.62	8.19 ± 0.91	t = 3.60	<0.001
Apgar <7 at 1 min	7 (11.7%)	17 (28.3%)	χ^2 = 5.05	0.025
Apgar <7 at 5 min	2 (3.3%)	7 (11.7%)	Fisher's exact	0.163

Note. Data are presented as mean ± SD or n (%). Continuous outcomes were compared using independent-samples t-tests; birth-weight categories and Apgar <7 at 1 minute used Pearson's chi-square test. Fisher's exact test was used for Apgar <7 at 5 minutes because of sparse expected cell counts.

Neonatal morbidity was higher following second-stage caesarean section. The need for neonatal resuscitation

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was significantly greater in the second-stage group (25.0% vs. 8.3%), as was NICU admission (26.7% vs. 10.0%). Respiratory distress, meconium aspiration, neonatal sepsis, and birth trauma were also more frequent in the second-stage group, although these differences did not reach statistical significance. Neonatal mortality was observed in one case (1.7%) in the second-stage group and none in the first-stage group. (Table 7)

Table 7: *Comparison of Neonatal Morbidity and NICU Admission*

Neonatal outcome	First-stage CS (n=60)	Second-stage CS (n=60)	χ^2 value	p-value
Need for neonatal resuscitation	5 (8.3%)	15 (25.0%)	6.14	0.013
NICU admission	6 (10.0%)	16 (26.7%)	5.69	0.017
Respiratory distress	4 (6.7%)	10 (16.7%)	2.99	0.084
Meconium aspiration	1 (1.7%)	5 (8.3%)	Fisher's exact	0.207
Neonatal sepsis	1 (1.7%)	3 (5.0%)	Fisher's exact	0.619
Birth trauma	1 (1.7%)	5 (8.3%)	Fisher's exact	0.207
Neonatal mortality	0 (0.0%)	1 (1.7%)	Fisher's exact	1.000

Note. Data are n (%). Pearson's chi-square test was used for neonatal resuscitation, NICU admission, and respiratory distress. Fisher's exact test was used for meconium aspiration, neonatal sepsis, birth trauma, and neonatal mortality because of sparse expected cell counts.

Overall, adverse maternal and neonatal outcomes were more frequent among women undergoing second-stage caesarean section. Maternal complications occurred in 41.7% of second-stage compared with 13.3% of first-stage procedures, while postoperative complications occurred in 28.3% and 13.3%, respectively. Neonatal resuscitation, NICU admission, low 1-minute Apgar score, and composite adverse neonatal outcome were also significantly more common in the second-stage group. (Table 8)

Table 8: *Overall Comparison of Maternal and Neonatal Adverse Outcomes*

Outcome	First-stage CS (n=60)	Second-stage CS (n=60)	χ^2 value	p-value
Maternal complication	8 (13.3%)	25 (41.7%)	12.03	<0.001
Significant intraoperative haemorrhage	5 (8.3%)	13 (21.7%)	4.09	0.043
Blood transfusion	2 (3.3%)	7 (11.7%)	Fisher's exact	0.163
Postoperative complication	8 (13.3%)	17 (28.3%)	4.12	0.042
Neonatal resuscitation	5 (8.3%)	15 (25.0%)	6.14	0.013
NICU admission	6 (10.0%)	16 (26.7%)	5.69	0.017
Low Apgar at 1 minute	7 (11.7%)	17 (28.3%)	5.05	0.025
Composite adverse neonatal outcome	8 (13.3%)	19 (31.7%)	5.88	0.015

Note. Data are n (%). Pearson's chi-square test was used except for blood transfusion, for which Fisher's exact test was used because of sparse expected cell counts.

Discussion

Maternal demographic characteristics were similar between the groups; mean maternal age did not differ significantly (25.87 ± 3.42 vs. 26.43 ± 3.71 years; p=0.387). In contrast, women undergoing second-stage caesarean section had a markedly longer total duration of labour (10.64 ± 2.87 vs. 7.82 ± 2.31 hours; p<0.001) and second-stage duration (89.27 ± 31.54 vs. 36.42 ± 18.61 minutes; p<0.001). Meconium-stained liquor was also more frequent in the second-stage group (28.3% vs. 13.3%; p=0.040). These findings indicate that second-stage caesarean delivery occurred after substantially greater exposure to labour and was accompanied by more signs of intrapartum fetal stress. Selo-Ojeme et al. similarly reported greater exposure to prolonged and augmented labour among women delivered by caesarean section at full cervical dilatation [11], and Pearson and MacKenzie described the clinical burden associated with second-stage caesarean delivery [12]. A plausible explanation is that labour dystocia, persistent malposition, arrest of descent, or evolving fetal compromise can prolong intrapartum management before the decision for operative delivery is made, thereby increasing both maternal tissue oedema and fetal stress.

The clearest maternal difference was the increase in intraoperative morbidity during second-stage caesarean section. Uterine incision extension occurred in 21.7% versus 5.0% (p=0.008), difficult fetal head delivery in 30.0% versus 3.3% (p<0.001), and atonic postpartum

haemorrhage in 18.3% versus 6.7% (p=0.044) in second-stage and first-stage groups, respectively. Any intraoperative complication was recorded in 41.7% of second-stage procedures compared with 13.3% of first-stage procedures (p<0.001). These findings are consistent with Asıcıoglu et al., who reported more intraoperative complications and uterine incision extensions with second-stage caesarean delivery [13], and with Vitner et al., who reported incision extension in 17.1% of second-stage versus 4.6% of first-stage procedures [14]. Lurie et al. also documented greater blood loss, uterine atony, and incision extension during second-stage caesarean delivery [15]. The likely mechanism is mechanical: at full dilatation the fetal head is often deeply engaged or impacted, the lower uterine segment is stretched and oedematous, and access for controlled extraction is restricted. These conditions can increase traction on the uterine incision and predispose to extension, vascular injury, uterine atony, and haemorrhage [16].

Operative and early postoperative findings further support the greater procedural burden of second-stage caesarean section. Mean operative duration was 61.82 ± 14.71 minutes in the second-stage group versus 48.63 ± 10.24 minutes in the first-stage group (p<0.001), while estimated blood loss was 781.83 ± 211.46 versus 612.50 ± 143.72 mL (p<0.001). Postoperative haemoglobin was lower after second-stage surgery (9.71 ± 1.26 vs. 10.34 ± 1.18 g/dL; p=0.005), and hospital stay was longer (5.12 ± 1.17 vs. 4.23 ± 0.81 days; p<0.001). Overall postoperative complications were also more frequent (28.3% vs. 13.3%; p=0.042). Similar patterns of longer surgery, greater blood loss, transfusion, and prolonged hospitalisation have been described by Asıcıoglu et al. [13] and Lurie et al. [15]. Wilkof-Segev et al. further showed that unintended uterine incision extension is associated with longer operative time, increased blood loss, haemoglobin reduction, and prolonged hospital stay [17]. In the present cohort, the increased need for manoeuvres to disengage the fetal head, repair extensions, secure haemostasis, and manage uterine atony offers a coherent explanation for the longer procedures, higher blood loss, postoperative haemoglobin reduction, and delayed discharge.

Neonatal outcomes were also less favourable following second-stage caesarean section despite comparable mean birth weight (2871.17 ± 438.72 vs. 2938.50 ± 421.36 g; p=0.386). Mean Apgar scores were lower at 1 minute (6.93 ± 1.12 vs. 7.52 ± 0.86; p=0.002) and 5 minutes (8.19 ± 0.91 vs. 8.71 ± 0.62; p<0.001). Neonatal resuscitation was required in 25.0% versus 8.3% (p=0.013), NICU admission occurred in 26.7% versus 10.0% (p=0.017), and the composite adverse neonatal outcome occurred in 31.7% versus 13.3% (p=0.015). Pearson and MacKenzie reported lower Apgar scores in association with second-stage caesarean delivery [12], while Asıcıoglu et al. found higher frequencies of low Apgar scores, NICU admission, neonatal sepsis, fetal injury, and neonatal death [13]. A meta-analysis by Pergialiotis et al. also linked prolonged second-stage labour with increased neonatal and maternal morbidity [18]. The absence of a significant birth-weight difference suggests that the poorer early neonatal condition in this study was not primarily explained by fetal size. More likely contributors include longer labour, evolving fetal compromise, meconium exposure, head impaction, and the additional manipulation sometimes required during difficult extraction.

Generalizability

The findings of the present study should be interpreted in the context of its retrospective, hospital-based design and the characteristics of women undergoing caesarean section at a single tertiary care centre. Although the study provides useful information regarding differences in maternal and neonatal outcomes according to the stage of labour at which caesarean section was performed, the findings may not be directly generalizable to other geographical regions, healthcare settings, or populations with different obstetric characteristics. Nevertheless, the study provides relevant insights into the increased maternal and neonatal morbidity associated with caesarean section performed during the second stage of labour. These findings may assist clinicians in intrapartum decision-making, counselling, operative preparedness, and appropriate management of women requiring caesarean delivery during advanced labour.

Conclusion

The present study demonstrates that second-stage caesarean section is associated with higher maternal and neonatal morbidity compared with first-stage caesarean section. Women undergoing second-stage caesarean section had significantly greater blood loss, longer operative duration and hospital stay, and higher frequencies of uterine incision extension, difficult fetal head delivery, and atonic postpartum haemorrhage. Neonates delivered during the second stage had lower Apgar scores and significantly higher requirements for neonatal resuscitation and NICU admission. These findings emphasize the importance of timely intrapartum assessment, appropriate decision-making regarding mode and timing of delivery, anticipation of difficult fetal head extraction, and adequate preparedness for maternal and neonatal complications during second-stage caesarean section.

Limitations

The study was conducted at a single tertiary care centre and included a relatively limited sample size of 120 women, which may restrict the generalizability of the findings to other populations and healthcare settings. The retrospective design depended on the accuracy and completeness of existing medical records, and some potentially relevant clinical variables may not have been

consistently documented. The study did not include a comparison group of women undergoing vaginal delivery or women without labour, and therefore the findings specifically reflect differences between first-stage and second-stage caesarean sections. In addition, potential confounding factors such as maternal age, parity, previous caesarean delivery, indication for caesarean section, duration of labour, fetal position, and fetal status may have influenced the observed outcomes. Long-term maternal and neonatal outcomes following hospital discharge were also not assessed.

Recommendations

Women requiring caesarean section during labour should undergo careful and timely assessment of maternal and fetal condition, with particular attention to the progress of labour, fetal station and position, and the indication for operative delivery. When caesarean section is anticipated during the second stage of labour, clinicians should be prepared for difficult fetal head extraction and potential complications such as uterine incision extension, increased blood loss, uterine atony, and postpartum haemorrhage. Adequate availability of experienced obstetric and anaesthetic teams, appropriate surgical instruments, blood products when clinically indicated, and neonatal resuscitation facilities should be ensured. Appropriate intrapartum monitoring and timely decision-making may help reduce preventable maternal and neonatal morbidity. Larger prospective multicentre studies with adequate sample sizes and adjustment for potential confounding factors are recommended to further clarify the differences in outcomes between first-stage and second-stage caesarean sections.

Abbreviations

CS, caesarean section; **NICU**, neonatal intensive care unit; **PPH**, postpartum haemorrhage; **SD**, standard deviation; **SPSS**, Statistical Package for the Social Sciences; **USG**, ultrasonography.

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Conflict of interest

The authors declare no conflict of interest.

Author contributions

All authors contributed to the conception and design of the study, review of the literature, interpretation of results, preparation and revision of the manuscript. Statistical analysis and interpretation of the data were performed by the designated authors.

Data availability

Data are available upon reasonable request from the corresponding author.

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