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Edited by Kaviya Gopinath
E-mail: kaviyagopinath@gmail.com
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Intraoperative complications during caesarean delivery: A tertiary-care hospital study in North-East India

Jacob H. Phom[1], Salam Sushila[1,*], Khumanthem Pratima Devi[1] & Salam Hemabati Devi[2]

[1]Department of Obstetrics and Gynaecology, Regional Institute of Medical Sciences (RIMS), Imphal - 795004, Manipur, India; [2]Department of Transfusion Medicine, Shija Blood Centre & Transfusion Services, Imphal - 795004, Manipur, India; *Corresponding author

Affiliation URL:
https://rims.edu.in/
https://www.shijahospitals.com/

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Author contact:
Jacob H. Phom - E-mail: jacobhphomphom@gmail.com
Salam Sushila - E-mail: susiewang419@gmail.com
Khumanthem Pratima Devi - E-mail: pratimadutta09@gmail.com
Salam Hemabati Devi - E-mail: drhems21@gmail.com

Abstract:
Repeat caesarean section (CS) contributes substantially to rising CS rates worldwide and increases the risk of intraoperative difficulty and morbidity. This hospital-based cross-sectional study, conducted at the Regional Institute of Medical Sciences (RIMS), Imphal, from July 2024 to December 2025, assessed the incidence and spectrum of intraoperative complications in 200 consecutively enrolled women with gestational age >28 weeks undergoing CS, using a structured proforma and standardised intraoperative checklist, with analysis in SPSS version 26.0. The mean maternal age was 30.01 ± 5.45 years; 50.0% underwent primary CS, 23.0% had one previous CS, 27.0% had two previous CS and 58.5% were emergency procedures. Adhesions were the most frequent complication (17.5%), followed by extension of the uterine incision (15.0%), advanced bladder complications (11.0%), excessive blood loss/postpartum haemorrhage (9.0%) and scar dehiscence (7.5%); bladder injury and peripartum hysterectomy each occurred in 1.0%, no bowel injury was recorded and 15.0% required blood transfusion, 7.5% high-dependency unit admission and 2.5% intensive care unit admission. Complications were concentrated among women with previous caesarean delivery, highlighting the need for structured pre-operative risk counseling, surgical preparedness and strategies to reduce primary CS rates.

Keywords: Caesarean section (CS), intraoperative complications, adhesions, bladder injury, tertiary care, incidence

Background:
Caesarean section (CS) is among the most frequently performed surgical procedures worldwide, with global rates having risen substantially over recent decades and projected to continue increasing **[1, 2]**. In India, the national caesarean delivery rate was 21.5% in NFHS-5, with marked variation across states and healthcare sectors **[3]**. A major driver of this continuing rise is the increasing proportion of women delivered by repeat CS, reflecting the substantial burden of repeat caesarean delivery in India **[4]**. Each subsequent caesarean delivery is associated with a progressively higher risk of intraoperative and postoperative complications, including haemorrhage, adhesion formation, bladder and bowel injury, wound complications and the need for peripartum hysterectomy **[5]**. Adhesion formation is one of the most consistently reported sequelae of caesarean surgery and is associated with increasing surgical difficulty in repeat CS **[6]**. Bladder injury and difficult bladder dissection likewise occur more frequently in women with a history of multiple previous caesarean sections, owing to altered anatomy and adhesions **[7]**. Recent studies continue to report substantial adhesion-related surgical difficulty and intraoperative morbidity in repeat caesarean delivery, including evidence from Indian tertiary-care settings **[8]**. Much of the published literature on intraoperative complications of repeat CS originates from well-resourced healthcare systems and comparatively little contemporary data are available from tertiary referral centres in North-East India, a region with its own distinct obstetric case-mix and referral pattern. Given the substantial national burden of caesarean delivery in India **[9],** local incidence data are essential for patient counselling, surgical planning and resource allocation. Therefore, it is of interest to evaluate the incidence and spectrum of intraoperative complications among women undergoing caesarean section at a tertiary care teaching hospital serving the north-eastern region of India.

Materials and Methods:

Study design and setting:
This was a hospital-based cross-sectional study conducted in the Department of Obstetrics and Gynaecology, Regional Institute of Medical Sciences (RIMS), Imphal, Manipur- a tertiary care teaching hospital and major referral centre for the north-eastern region of India.

Study duration:
Data were collected over 18 months, from 1st July 2024 to 31st December 2025.

Study population and selection criteria:
All pregnant women with gestational age >28 weeks admitted for caesarean section, of any age, parity and CS type (elective or emergency), who provided informed consent, were enrolled consecutively. Women with a history of other major abdominal surgery (myomectomy, ovarian cystectomy, appendectomy, cholecystectomy, *etc*.), pre-existing medical comorbidities capable of independently causing surgical complications (bleeding disorders, severe cardiac, renal, or hepatic disease), or incomplete records were excluded.

Sample size:
Based on a reported national prevalence of repeat CS of 88.1% among Indian deliveries a minimum sample size of 162 was calculated ($Z=1.96$, $p=0.881$, $e=0.05$) and rounded up to 200 to allow for non-response and incomplete data.

Data collection:
A pre-designed structured proforma was used to record demographic, obstetric, intraoperative and postoperative data. Intraoperative findings and complications were documented in real time by the attending surgeon or a trained observer, using a standardised intraoperative checklist. Complications assessed

included adhesion formation (graded mild, moderate to severe, or dense), advanced bladder complications, extension of the uterine incision, scar dehiscence, excessive blood loss (>1000 mL), bladder or bowel injury, need for uterine artery or internal iliac artery ligation, peripartum hysterectomy and need for ICU/HDU admission or blood transfusion.

Ethical considerations:

The study protocol was approved by the Research Ethics Board, RIMS, Imphal (Reg. No. EC/NEW/INST/2020/1339, dated 1st June 2024). Written informed consent was obtained from all participants and confidentiality was maintained through de-identified, coded data collection forms.

Statistical analysis:

Data were entered into a password-protected database and analysed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation and compared using the independent t-test or ANOVA; categorical variables were expressed as frequencies and percentages and compared using the chi-square or Fisher's exact test, as appropriate. A p-value <0.05 was considered statistically significant.

Results:

A total of 200 women undergoing caesarean section were enrolled during the study period. The 26–30 year age group accounted for the largest proportion of subjects (37.0%), while advanced maternal age (>35 years) was noted in 18.5%. Term gestation (37–40 weeks) accounted for 82.0% of deliveries, with 10.0% preterm and 8.0% post-term. Emergency procedures outnumbered elective procedures, consistent with the referral case-mix typical of a tertiary care centre (**Table 1, Table 2**). Adhesions were the single most common intraoperative complication. Among the 35 women with adhesions, mild adhesions were most frequent (20, 10.0% of total), followed by moderate-to-severe (9, 4.5%) and severe dense adhesions (6, 3.0%); overall, 15 women (7.5%) had moderate to severe or dense adhesions, reflecting substantial surgical difficulty (**Table 3**). Blood transfusion was required in 15.0% of women, most commonly 2–3 units; the mean preoperative haemoglobin of 10.40 ± 1.56 g/dL reflects the prevalence of antenatal anaemia in this obstetric population. ICU admission was required in 2.5% and HDU admission in 7.5% of cases for closer haemodynamic monitoring (**Table 4**).

Table 1: Age and obstetric profile of the study population

Parameter	Value
Mean age ± SD (years)	30.01 ± 5.45
Age range (years)	19 – 45
Mean gestational age ± SD (weeks)	38.07 ± 1.64
Mean gravida ± SD (range)	2.69 ± 1.33 (1 – 7)
Mean parity ± SD (range)	1.25 ± 1.08 (0 – 5)

Table 2: Distribution by number of previous caesarean sections and type of current CS

Category	n	%
Primary CS (0 previous)	100	50
1 previous CS	46	23
2 previous CS	54	27
Emergency CS	117	58.5
Elective CS	83	41.5

Table 3: Overall incidence of intraoperative complications (n=200)

Complication	n	%
Adhesions	35	17.5
Extension of uterine incision	30	15
Advanced bladder complications	22	11
Excessive blood loss / PPH	18	9
Scar dehiscence	15	7.5
Uterine artery ligation required	9	4.5
Bladder injury	2	1
Peripartum hysterectomy	2	1
Bowel injury	0	0
Internal iliac artery ligation	0	0

Table 4: Postoperative outcomes (n=200)

Outcome	n	%
ICU admission	5	3
HDU admission	15	8
Blood transfusion required	30	15
– 1 unit	7	4
– 2 units	10	5
– 3 units	10	5
– 4 units	3	2
Mean preoperative haemoglobin ± SD	10.40 ± 1.56 g/dL	-
Mean duration of hospital stay ± SD	4.65 ± 0.90 days	-

Discussion:

The overall incidence of adhesions in the present study (17.5%) is broadly comparable to figures reported from recent repeat-CS cohorts, where adhesion formation remains a common operative finding and is associated with increasing surgical difficulty **[10].** The rate was; however, lower than that reported in recent Indian series from Chennai (31.7%) and Karnataka (40%) **[11, 12]** and considerably lower than some international cohorts **[13].** This difference is likely multifactorial. First, adhesion definitions and grading systems vary between studies. Systems such as the Tulandi–Lyell composite score capture even flimsy adhesions, whereas our checklist-based assessment may have recorded predominantly clinically relevant adhesions. Second, our cohort was restricted to women with one or two previous caesarean sections, while comparison studies included higher-order repeat procedures, in which adhesion frequency and density rise progressively **[13].** Differences in the proportion of emergency primary caesareans, postoperative infection and surgical technique at the index operation may also contribute **[3]**. The predominance of mild adhesions over dense adhesions in this cohort is likewise consistent with a population in which most women had undergone only one or two prior procedures, rather than higher-order repeat surgery **[14].** Advanced bladder complications (11.0%) and scar dehiscence (7.5%) in this series are within the spectrum of operative difficulties reported in contemporary repeat-CS literature **[15].** These findings are consistent with the mechanistic understanding that dense adhesions between the bladder and lower uterine segment increase the technical difficulty of bladder dissection and predispose to inadvertent injury **[16].** Excessive blood loss or PPH occurred in 9.0% of women. Contemporary evidence indicates that increasing surgical complexity in repeat CS may be accompanied by greater blood loss and transfusion requirements **[11, 14].** No bowel injury was recorded in this cohort. This may

again reflect the relatively low proportion of higher-order repeat CS in this population, a case-mix difference worth noting when comparing incidence figures across studies from different settings **[17, 18].** Contemporary data from India also indicate substantial variation in caesarean delivery patterns and repeat-CS burden across regions **[19],** which further limits direct comparison between centres. The requirement for blood transfusion in 15.0% of women, against background mean preoperative haemoglobin of 10.40 g or dL, underscores the importance of anticipating haemorrhage and ensuring appropriate perioperative preparedness in women undergoing caesarean delivery**.** Antenatal correction of anaemia is a modifiable factor that may reduce this burden. Strengths of this study include prospective, real-time intraoperative data collection using a standardised checklist, which minimises recall bias relative to retrospective record review **[11, 12].** Limitations include the single-centre, cross-sectional design, which limits generalisability. Adhesions were not graded using a validated scoring system, which may have led to under-recording of flimsy adhesions and limits direct comparison with studies that used such systems. Details of surgical technique at the previous caesarean were not consistently available. Finally, no woman in this cohort had more than two previous caesarean sections, so the incidence of complications specific to higher-order repeat CS (three or more prior procedures) could not be captured.

Conclusion:

In this tertiary care cohort, adhesions were the most frequent intraoperative complication of caesarean section, followed by extension of the uterine incision, advanced bladder complications, excessive blood loss and scar dehiscence. Complications requiring surgical escalation bladder injury and peripartum hysterectomy though uncommon occurred exclusively among women with previous caesarean delivery. These findings support routine preoperative risk stratification for women with prior CS, availability of experienced surgical teams and blood banking support at the time of repeat delivery and continued efforts to reduce the primary CS rate.

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References:

[1] Zaigham M *et al. PLOS Glob Public Health*. 2024 **4**:e0002877. [PMID: 38319901]
[2] https://www.who.int/news/item/13-05-2025-who-publishes-surgical-sub-group-membership-for-caesarean-section-recommendations
[3] Dutta R *et al. Lancet Reg Health Southeast Asia*. 2024 **32**:100512. [PMID: 39717057]
[4] Khadse RP *et al. Discov Public Health*. 2025 **22**:790. [DOI: 10.1186/s12982-025-01212-2]
[5] Kiruthika T & Jayanthy T. *Indian J Obstet Gynecol Res*. 2024 **11**:232. [DOI: 10.18231/j.ijogr.2024.046]
[6] Jain A *et al. Int J Reprod Contracept Obstet Gynecol*. 2025 **14**:1873. [DOI: 10.18203/2320-1770.ijrcog20251577]
[7] Weinstein J *et al. Eur J Obstet Gynecol Reprod Biol X*. 2024 **22**:100301. [PMID: 39011056]
[8] https://www.ijrcog.org/index.php/ijrcog/article/view/15447
[9] Fox KA *et al. Am J Obstet Gynecol*. 2026 **233**:S226. [PMID: 41485818]
[10] Aboshama RA *et al. Int J Gynaecol Obstet*. 2023 **161**:234. [PMID: 36200671]
[11] https://pubmed.ncbi.nlm.nih.gov/37390833/
[12] Mehanathan R *et al. Cureus*. 2025 **17**:e95708. [PMID: 41322761]
[13] Kizildemir YZ *et al. Clin Exp Obstet Gynecol*. 2025 **52**:40126. [DOI: 10.31083/CEOG40126]
[14] Doroldi S *et al. Arch Gynecol Obstet*. 2024 **310**:2829. [PMID: 39567413]
[15] Tanigaki S *et al. Int J Gynaecol Obstet*. 2025 **168**:436. [PMID: 39277817]
[16] Morang K *et al. Int J Reprod Contracept Obstet Gynecol*. 2021 **10**:4144. [DOI: 10.18203/2320-1770.ijrcog20214323]
[17] El Hajjar C *et al. Ann Med Surg (Lond)*. 2026 **88**:5554. [PMID: 42725180]
[18] Regmi DR *et al. JNMA J Nepal Med Assoc*. 2022 **60**:6. [PMID: 35199680]
[19] Neethi Mohan V *et al. BMC Pregnancy Childbirth*. 2023 **23**:622. [PMID: 37649006]

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