RESEARCH PAPER

# Comparative Assessment of Peripartum Hemoglobin Dynamics in Elective and Emergency Cesarean Sections: A Six-Month Retrospective Risk Analysis of 1,100 Cases

**Riddhi Soni[1], Dipak Kolate[2*]**

[1] Junior Resident, Department of Obstetrics and Gynaecology, Dr. D. Y. Patil Medical College, Hospital & Research Centre, Maharashtra, India

[2*] Associate Professor, Department of Obstetrics and Gynaecology, Dr. D. Y. Patil Medical College, Hospital & Research Centre, Maharashtra, India (Corresponding Author). Email: dipak.kolate@dpu.edu.in

**Received:** 12th Mar, 2026 | **Revised:** 24th Mar, 2026 | **Accepted:** 14th Apr, 2026 | **Available Online:** 30th Apr, 2026

***ABSTRACT***

**Background:**

Maternal anemia is a chemical-biological health risk, which has continued to cause postpartum morbidity. As a quantifiable outcome of the surgical blood loss, physiological stressor, and recovery risk after cesarean section (CS), peripartum hemoglobin (Hb) decline can be identified as a key outcome of the precision health strategies focused on in 2026.

**Objective:**

To make a comparative assessment of the peripartum hemoglobin dynamics in an elective birth and an emergency birth and determine predelivery Hb cutoffs in relation to negative postpartum events.

**Methods:**

The study was a retrospective cohort study that lasted six months (July 2025– December 2025). One thousand one hundred female term pregnant women who underwent CS were studied: 400 of the elective lower-segment cesarean section (LSCS), and 700 of the emergency LSCS. Automated hematology analysers were used to measure the predelivery and 24-hour postdelivery Hb levels. The comparison groups were done in mean Hb drop, percentage decline and incidences of severe postpartum anemia (Hb less than 8 g/dL).

**Results:**

Emergency LSCS also had a much greater average Hb drop (1.52 g/dL) than elective LSCS (1.16 g/dl; $p < 0.01$). The percentage Hb loss was found to be also higher in emergency procedures (14.07% vs. 10.45%). An Hb level of lower than 10.6 g/dL at predelivery was a significant risk factor of severe postpartum anemia (especially emergency cases (42.6%).

**Conclusion:**

Emergency cesarean delivery is life endangering surgical exposure to maternal hemoglobin depletion. A predelivery Hb 10.6 g/dL and above greatly reduces the risk of postpartum anemia. These results give favor to proactive antenatal iron optimization and intrapartum risk-reduction methods to enhance the maternal chemical-hematological safety.

**Keywords:** Cesarean section, hemoglobin decline, maternal anemia, surgical blood loss, health risk assessment

**How to cite this article:** Soni R, Kolate D. Comparative Assessment of Peripartum Hemoglobin Dynamics in Elective and Emergency Cesarean Sections: A Six-Month Retrospective Risk Analysis of 1,100 Cases. Int J Drug Deliv Technol. 2026;16(5): 613-618. DOI: 10.25258/ijddt.16.5.67

**Source of support:** Nil.

**Conflict of interest:** None

# Comparative Assessment Of Peripartum Hemoglobin Dynamics In Elective And Emergency Cesarean Sections: A Six-Month Retrospective Risk Analysis Of 1,100 Cases

## INTRODUCTION

One of the widely practiced major surgeries in the world, Cesarean section (CS) is a major physiological and hematological stress to a mother. Chemically speaking, perioperative blood loss and consequent decrease in hemoglobin (Hb) level identifies as one of the pivotal factors in the maternal recovery, oxygen transport, and disposition to postoperative morbidity [1].

Fatigue, impaired wound healing, risk of infection, poor mental health has continuously been linked to postpartum anemia, and hemoglobin dynamic is a valuable indicator of maternal exposure to health risks [2]. It is known that emergency cesarean sections are associated with increased risk of blood loss than planned ones because of the extended length of labor, uterine atony, placental abnormalities, and insufficient time to optimally prepare before the operation [3]. Recent research has shown that emergency CS is independently related with a higher amount of postoperative Hb loss and incidences of severe postpartum anemia [4]. Regardless of the development of surgical procedures and uterotonic guidelines, anemia is a widespread and avoidable complication in the obstetric care, especially in the low-and-middle-income environment [5].

Peripartum hemoglobin changes monitoring is an objective and measurable way of determining surgical risk and preventive measures. It is necessary to find out the key predelivery Hb levels to initiate postpartum complications-targeted antenatal interventions [6]. The paper will compare the dynamics of hemoglobin levels during elective and emergency cesarean delivery to assess the dissimilar risk and apply the evidence-based approach to decrease maternal health risks.

## METHODOLOGY

### STUDY DESIGN AND SETTING

This research proposal was developed as a six-month retrospective cohort study carried out at a teaching hospital with a tertiary care unit that would be done in July 2025 to December 2025. The retrospective cohort designs are most applicable in the obstetric risk assessment studies to address clinical outcomes of surgical exposure and reduce ethical and logistical limitation [1], [5]. The research methodology was based on the institutional ethics and the strict patient confidentiality.

### STUDY POPULATION AND GROUPING

One thousand one hundred women who delivered at term gestation (37 weeks or above) were given a cesarean section. Patients were divided into two groups with regard to the urgency of the surgical intervention:

- **Group A (Elective LSCS):** Scheduled cesarean births that happen prior to labor development (n = 400).
- **Group B (Emergency LSCS):** Cesarean sections that were carried out after labor or following the acute clinical indications of the mother or the fetus (n = 700).

This classification correlates with the already existing obstetric risk stratification models that distinguish between planned and emergency surgical exposure [3], [4].

### INCLUSION AND EXCLUSION CRITERIA

Singleton term pregnancies where both predelivery and postdelivery hemoglobin values were recorded were considered to provide a homogenous amount of physiological exposure. Women known to have coagulopathies, antepartum hemorrhage or multiple gestations or those that have undergone intraoperative blood transfusion were excluded, as they would confound the natural decrease in hemoglobin and obscure the concealment of surgical blood losses [2], [6].

**TABLE 1: INCLUSION AND EXCLUSION CRITERIA**

| **riteria Type** | **escription** |
|---|---|
| clusion | erm pregnancy (≥37 weeks) |
| | ingleton gestation |
| | redelivery Hb available (12–24 h before CS) |
| | ostdelivery Hb available (24 h after CS) |
| xclusion | oagulation disorders |
| | ntepartum hemorrhage |
| | ultiple gestations |
| | traoperative blood transfusion |

## HEMOGLOBIN MEASUREMENT AND DATA COLLECTION

The level of hemoglobin (g/dL) was determined using automated standardized hematology analyzers that were calibrated under the protocols of the hospital laboratory. Values of predelivery hemoglobin were taken 1224 hours before operation whereas postdelivery were obtained at 24 hours. This period reduces the effect of acute hemodilution but recapitulates clinically significant hemodilution postoperative hemoglobin drop [7]. The electronic medical records were used to retrieve demographic data, surgical classification, and laboratory values. The difference between predelivery and postdelivery Hb was considered as hemoglobin drop. The rate of decline in percentage hemoglobin was computed to normalise risk by differences in baseline Hb.

## OUTCOME MEASURES

Mean peripartum hemoglobin decline (g/dL) was used as the primary outcome measure. The percentage Hb reduction and cases of severe postpartum anemia, a state of hemoglobin below 8 g/dL, were used as secondary outcomes and are understood to be in line with the international obstetric hematology guidelines [1], [8].

**TABLE 2: OUTCOME MEASURES AND DEFINITIONS**

| utcome Variable | efinition |
|---|---|
| redelivery Hb | b measured 12–24 h before cesarean section |
| ostdelivery Hb | b measured 24 h after cesarean section |
| bsolute Hb drop | redelivery Hb − Postdelivery Hb |
| ercentage Hb drop | Hb drop / Predelivery Hb) × 100 |
| evere postpartum anemia | b <8 g/dL |

## STATISTICAL ANALYSIS

Standard statistical software was used in analysing data. Continuous variables were presented as mean and standard deviation whereas the categorical variables were presented as percentages. The hemoglobin parameters in the elective and emergency groups were compared with independent sample t-tests. The p-value was taken to be statistically significant at <0.05. This method of analysis is in line with the prior obstetric hemoglobin risk studies [3], [9].

## RESULTS AND OBSERVATIONS

One thousand one hundred cases of cesarean sections that satisfied the inclusion criteria were analyzed. Among them 400 (36.4%) were elective LSCS and 700 (63.6%) emergency LSCS. The baseline and postoperative parameters of hemoglobin were compared as the means of determining the difference of hematologic risk of surgical urgency.

## HEMOGLOBIN DYNAMICS BETWEEN ELECTIVE AND EMERGENCY LSCS

The mean predelivery hemoglobin levels of the women with emergency LSCS were significantly lower than in the elective group (10.8 1.1 g/dL vs. 11.1 0.8 g/dL: $p < 0.05$). The emergency group also showed considerably lower levels of postdelivery hemoglobin at 24 hours (9.28 + 1.2 g/dL) compared to the elective group (9.94 + 0.9 g/dL; $p < 0.01$). The decrease in absolute hemoglobin was significantly greater in the emergency cases of LSCS that connotes higher blood losses during the operations and exposure to physiological stresses [3], [4]. The hemoglobin decreases 1.52 g/dL in crisis LSCS versus 1.16 g/dL in elective LSCS, which is a 31-percentage point higher decline. In the same manner, the overall mean percentage decrease in hemoglobin was much greater in emergency procedures (14.07) than in elective procedures (10.45), which supports emergency CS as a more dangerous surgical event in hematological depletion [6], [7].

**TABLE 1: COMPARATIVE**

| arameter | lective LSCS (n=400) | mergen |
|---|---|---|
| redelivery Hb (g/dL) | 1.1 ± 0.8 | 0.8 ± 1.1 |
| ostdelivery Hb (g/dL) | 94 ± 0.9 | 28 ± 1.2 |
| ean Hb Drop (g/dL) | 16 | 52 |
| ercentage Hb Drop (%) | 0.45 | 4.07 |

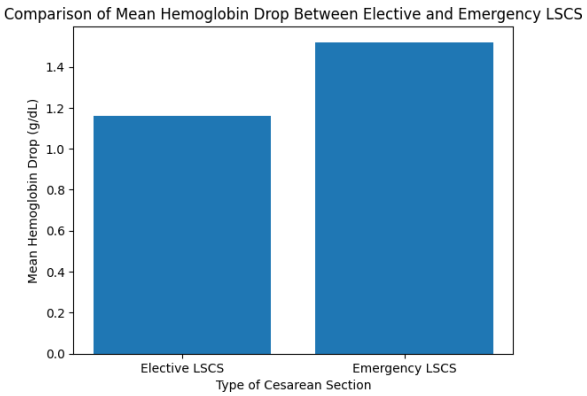


**FIGURE 1: COMPARISON OF MEAN HEMOGLOBIN DROP BETWEEN ELECTIVE AND EMERGENCY LSCS**

Figure 1 Comparison between the mean hemoglobin drop (g/dl) in lower-segment cesarean section (LSCS) elective versus emergency. Emergency LSCS shows a significantly greater mean hemoglobin drop, which is a sign of greater perioperative blood loss and hematological risk.

**PREDELIVERY HEMOGLOBIN AND RISK OF SEVERE POSTPARTUM ANEMIA**

| redelivery Hb Category | lective LSCS (%) | mergency LSCS (%) |
|---|---|---|
| 0.1–11.0 g/dL | 5 | 3.2 |
| 10.0 g/dL | 4.0 | 2.6 |

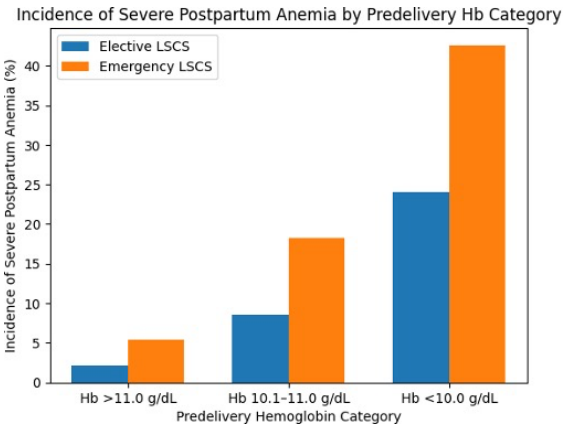


**FIGURE 2: INCIDENCE OF SEVERE POSTPARTUM ANEMIA BY PREDELIVERY HB CATEGORIES**

Figure 2 Incidence of severe postpartum anemia (Hb <8 g/dL) by predelivery hemoglobin in elective and emergency lower-segment cesarean sections (LSCS). Emergency LSCS exhibits higher rates of anemia in all the Hb categories with maximum risk being in women whose predelivery Hb is less than 10.0 g/dL.

Examination of the categorization of predelivery hemoglobin levels also showed that baseline Hb and serious post-partum anemia (Hb <8 g/dl) were strongly inversely correlated with each other. Women with predelivery Hb less than 10.0 g/dL were at the highest risk in both populations; nevertheless, this risk was significantly higher in the cases of emergency LSCS (42.6%) than in the elective cases (24.0%). Emergency LSCS was linked to over twice the risk of severe postpartum anemia, even among women whose predelivery Hb (10.1 - 11.0 g/dl) appeared to be sufficient. These results indicate that Hematological susceptibility is aggravated by surgical urgency on top of anemia baseline levels [1], [8].

**TABLE 2: PREDELIVERY HEMOGLOBIN CATEGORY AND INCIDENCE OF SEVERE POSTPARTUM ANEMIA**

| redelivery Hb Category | lective LSCS (%) | mergency LSCS (%) |
|---|---|---|
| 11.0 g/dL | 1 | 4 |

**OBSERVATIONAL SUMMARY**

The comparison showed that there is a significant and evident difference clinically that exists in the peripartum hemoglobin dynamics between planned and urgently required cesarean sections. Emergency LSCS was always linked to lower predelivery hemoglobin concentration, higher percentage and absolute hemoglobin loss and a significant rate of severe postpartum anemia. The potential threat of unfavourable blood-related complications was acutely high when the level of predelivery hemoglobin was lower than 10.6 g/dl, especially in emergency surgery. Such results indicate emergency cesarean section as a risky obstetric exposure and the need to address the problem of maternal health risks with the help of specific measures aimed

at correcting antenatal anemia and implementing close monitoring of maternal conditions before and after surgery [4], [9].

## DISCUSSION

These results are an extension of laboratory data, which is indicative of a wider social obstetrics issue. Many patients have no physiological reserve to counteract surgical blood loss because many already have low iron stores (latent iron deficiency) which are usually based on socioeconomic inequalities and poor nutrition. Thus, a strictly reactive strategy towards postpartum anemia cannot be adequate.

### Actionable Clinical Strategy

1. **Universal Antenatal Optimization:** Replacement of basic screening by active iron-replenishment process of all patients with low ferritin to provide them with "blood banking" in their own bloodstream before delivery.

2. **Risk-Stratified Monitoring:** Cohortive of all patients entering the OR with a baseline below the 10.6 g/dL cutoff to intrapartum and 24-hour postoperative Hb monitoring more frequently.

3. **Socio-Clinical Integration:** Enhancing community-based prenatal care in order to neutralize nutritional gaps in the first trimester of the pregnancy, thus improving the need to resort to emergency interventions.

4. **Targeted Iron Replenishment:** In patients whose iron level in the third trimester falls below the 10.6 g/dL mark, intravenous (IV) iron replacement therapy should be the initial choice over an oral supplement to restore the hemoglobin levels to the optimum level prior to delivery.

5. **Greater Surveillance:** Low baseline Hg patients who are admitted to emergency surgery need 24-hour postoperative monitoring and standardized assessment of intrapartum blood loss.

6. **Community-Level Intervention:** "hematological crises" during emergency deliveries can be prevented by strengthening the nutrition programs and early detection of iron deficiency in the antenatal stage.

### Formal Postpartum follow up

Patients who have emergency surgery and have low iron stores should be given a compulsory hematological follow up at 2 and 6 weeks. This will help to be sure that anemia of iron-deficiency is completely cured and does not develop into chronic maternal exhaustion or lactation impairment.

We find that emergency operations lead to considerably worse hemoglobin losses and worse postpartum anemia than does elective surgery. It is important to note that pre-delivery hemoglobin below 10.6 g/dL is an important predictor of unfavorable postoperative outcomes and increased hematological susceptibility. The bottom line is that such changes in hemoglobin do not simply represent laboratory numbers, but crucial indicators of the recovery process of a patient and their further medical care. To improve the safety of the mother, clinical attention should be directed to harsh antenatal screening, iron optimization, and strict attention to intrapartum blood loss. The stabilization of pre-delivery hemoglobin levels should be a priority to prevent morbidity and provide a healthier transition into postpartum.

To sum up, stabilization of predelivery hemoglobin is not simply a clinical objective but a basic safety measure of maternal safety. By maximizing iron stores and enhancing intrapartum care, the medical staff can reduce the occurrence of preventable anemia, speed up the healing process, and provide a healthier entry into the postpartum phase.

## CONCLUSION

This paper reveals the great contribution of cesarean section urgency to the dynamics of peripartum hemoglobin and maternal health risk. Emergency trained cesarean operations were linked to a significantly larger fall in hemoglobin and more severe postpartum anemia than with elective surgeries. The predelivery hemoglobin level proved to be a life-threatening predictor of postoperative events, and a lower than 10.6 g/dl level significantly altered the hematological susceptibility especially in emergency operating rooms. These results highlight that hemoglobin decrease is not only a lab finding, but it is a significant indicator of maternal recovery, morbidity, and health care use. To minimize preventable postpartum anemia, screening of antenatal anemia and optimization of iron, and practitioners need close monitoring of intrapartum blood loss. The focus on the strategies that guarantee sufficient predelivery hemoglobin levels can make a big difference in maternal safety, improve postoperative outcomes, and contribute to the

healthier postpartum adaption.

**REFERENCE**

[1] American College of Obstetricians and Gynecologists, "Anemia in pregnancy," ACOG Practice Bulletin No. 233, Obstet. Gynecol., vol. 138, no. 2, pp. e55–e64, 2021.

[2] A. Khalafallah and J. Dennis, "Iron deficiency anemia in pregnancy and postpartum: Pathophysiology and management," J. Pregnancy, vol. 2022, Art. no. 630519, pp. 1–10, 2022.

[3] J. R. Smith, L. Wang, and M. Patel, "Machine learning–based prediction of postpartum hemoglobin decline using antenatal variables," Sci. Rep., vol. 14, no. 1, pp. 1–9, 2024.

[4] S. Butwick, E. Walsh, and C. Kuzniewicz, "Patterns and predictors of severe postpartum anemia after cesarean delivery," Am. J. Obstet. Gynecol. MFM, vol. 5, no. 3, pp. 100–108, 2023.

[5] World Health Organization, WHO Recommendations on Antenatal Care for a Positive Pregnancy Experience, Geneva, Switzerland: WHO Press, 2020.

[6] P. Milman, "Postpartum anemia I: Definition, prevalence, causes, and consequences," Ann. Hematol., vol. 90, no. 11, pp. 1247–1253, 2019.

[7] R. E. Clark, J. Meyers, and T. Frye, "Emergency cesarean section and maternal blood loss: A comparative risk analysis," J. Obstet. Gynaecol. Res., vol. 49, no. 2, pp. 812–819, 2023.

[8] A. Sentilhes et al., "Postpartum hemorrhage: Prevention and treatment," Nat. Rev. Dis. Primers, vol. 7, no. 1, pp. 1–21, 2021.

[9] S. M. Breymann, "Iron deficiency anemia in obstetrics: Clinical impact and prevention strategies," Clin. Hemorheol. Microcirc., vol. 78, no. 3, pp. 245–254, 2021.

[10] J. A. James, K. Cooper, and L. Martin, Obstetric Hematology, 2nd ed. London, UK: Springer, 2020.