

INCIDENCE OF PULMONARY COMPLICATIONS FOLLOWING LSCS – A PROSPECTIVE STUDY

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ABSTRACT

Background: Lower Segment Caesarean Section (LSCS) is one of the most commonly performed obstetric surgeries. While often life-saving, it is associated with potential postoperative complications, among which pulmonary complications are under recognized but clinically significant. **Aim and Objectives:** This study aimed to determine the incidence, types, and risk factors of pulmonary complications following LSCS in a tertiary care hospital. **Materials and Methods:** A hospital-based prospective observational study was conducted over 10 months (July 2024 to April 2025) at Government Medical College Hospital, Tamil Nadu. A total of 200 post-caesarean women were enrolled. Patients with pre-existing pulmonary diseases were excluded. Data were collected using a structured proforma and included demographic, obstetric, surgical, and respiratory parameters. Pulmonary complications assessed included desaturation, aspiration pneumonia, ARDS, pleural effusion, and oxygen requirement. Statistical analysis was performed using SPSS, with significance set at $p < 0.05$. **Results:** Pulmonary complications were observed in 10 patients (5%). Desaturation occurred in 16% of cases, and 17% required postoperative oxygen therapy. Aspiration pneumonia and ARDS were noted in 0.5% each, while pleural effusion was seen in 1.5%. Non-aspiration pneumonia occurred in 2.5% of patients. Most complications were associated with emergency LSCS and general anaesthesia. CT findings included reactive effusion (23.5%), ground-glass opacities (10.5%), and basal atelectasis (8.5%). No maternal deaths were reported. **Discussion and Conclusion:** Though infrequent, pulmonary complications post-LSCS contribute to increased morbidity, prolonged hospitalization, and oxygen dependency. Emergency surgeries and use of general anaesthesia were key risk factors. Structured perioperative monitoring, early mobilization, and respiratory physiotherapy can help mitigate risks. Incorporating pulmonary surveillance into routine post-LSCS care is essential, especially in high-risk groups.

INTRODUCTION

Caesarean section (CS) refers to the surgical delivery of a foetus through incisions in the abdominal wall (laparotomy) and uterus (hysterotomy) [Source: Williams Obstetrics]. When the incision is made in the lower uterine segment, it is termed Lower Segment Caesarean Section (LSCS), which is the most commonly performed surgical procedure in modern obstetrics. LSCS is a vital component of emergency obstetric care and has significantly contributed to reducing maternal and perinatal mortality and morbidity when appropriately indicated.^[Ref.No-1] Globally, caesarean section rates have increased sharply over the last few decades. According to the World Health Organization (WHO), the ideal

population-based caesarean section rate should be between 10% and 15%.^[Ref.No-2,3] Caesarean section rates above this range do not cause further reductions in maternal or neonatal mortality. Despite this, the caesarean section rates have tripled in some regions from 6.7% in 1990 to 19.1% in 2014 and there is an increasing trend even more.^[Ref.No-4,5,6] This trend is more pronounced in middle- and high-income countries globally. In India too, the rate of caesarean section has shown a consistent upward trend exceeding recommended limits. In India, the NFHS-5 (2019–2021) revealed that caesarean delivery rates have doubled in the last decade, with states like Telangana, Andhra Pradesh, and Tamil Nadu showing rates of over 40%.^[Ref.No-7,8,9] More than 85% of caesarean deliveries are performed for four major indications: prior caesarean section,

labor dystocia or arrest, fetal distress (jeopardy), and abnormal fetal presentation. Of these, the latter three are common causes for primary cesarean delivery.^[Ref.No10]

Several factors contribute to the increased rates of caesarean sections, including advanced maternal age at first child birth, enhanced access to elective caesarean delivery, rising maternal obesity, increased electronic foetal monitoring, the perceived safety of caesarean section over vaginal delivery, and growing patient demand for convenience [Mahadik K et al]. Advances in the field of anesthesia and neonatal care have also contributed to a greater acceptance of surgical birth.

While Caesarean sections are lifesaving, is not without risks. Caesarean section being a major abdominal surgery, it carries short- and long-term complications for the mother. Immediate maternal complications include hemorrhage, infection, surgical trauma, anesthetic-related events, and thrombo embolic disorders. Long-term consequences span beyond subsequent pregnancies, encompassing increased risks of placenta previa, placenta accreta spectrum, uterine rupture, and subfertility. It is to be noted that a highly significant is the spectrum of pulmonary complications that can arise post-LSCS is underexplored in previous studies.

Pulmonary complications are among the most critical and potentially life- threatening adverse outcomes of cesarean delivery. These include atelectasis, pulmonary embolism (PE), pneumonia, aspiration pneumonitis, pleural effusion, and in severe cases, acute respiratory distress syndrome (ARDS). Such complications are often under reported and under diagnosed in obstetric practice. This is usually attributed to the overlapping physiological changes of pregnancy and lack of structured respiratory assessment postoperatively. But pulmonary complications significantly contribute to maternal morbidity and mortality. Studies report that postoperative pulmonary complications (PPCs) occur in 2–5% of women undergoing cesarean delivery, though the incidence may be higher in high-risk populations. Among these, PE is particularly concerning and is considered one of the leading causes of maternal mortality in developed countries. It has an estimated incidence of 2.6 per 1,000 LSCS deliveries, with a higher rate observed in obese women and those undergoing emergency cesarean. Atelectasis, although often self- limited, may occur in up to 50% of women receiving spinal anesthesia and is more prevalent among those with poor pain control or delayed ambulation. Postoperative pneumonia, although less frequent than in other surgeries, poses a serious threat due to rapid deterioration in oxygenation and maternal respiratory reserve postpartum.

Multiple risk factors predispose women to pulmonary complications following LSCS. These include patient-related factors such as advanced

maternal age, anaemia, high body mass index (BMI), chronic respiratory illness, and smoking history; surgery- related factors such as duration of procedure, type of anesthesia, blood transfusion, and emergency status; and perioperative care aspects such as in adequate analgesia, prolonged immobilization, or missed prophylaxis for thrombo embolism. General anesthesia, though rarely used for cesarean sections in modern practice, significantly increases the risk of aspiration, hypoventilation, and impaired mucociliary clearance. Spinal and epidural anesthesia, while safer overall, can also contribute to hypoxia and basal lung collapse due to altered diaphragmatic function. Additional contributors include postpartum fluid shifts, hormonal changes affecting pulmonary vascular tone, and increased intra-abdominal pressure from gravid uterus or postoperative ileus, all of which can impair lung mechanics.

The American College of Obstetricians and Gynaecologists (ACOG) advises scheduling elective caesarean sections after 39 weeks of gestation, preferably after labor onset and confirmed lung maturity, to reduce neonatal respiratory risks. Studies have consistently shown higher rates of respiratory complications—such as transient tachypnea of the newborn (TTN) and respiratory distress syndrome (RDS)—in babies born via C-section, particularly before 39 weeks. This is largely due to the absence of labor-induced lung fluid clearance. Elective C-sections between 35 and 38 weeks significantly increase respiratory morbidity in new borns, with risks ranging from 2.8% to 27.1%. Antenatal corticosteroids have been suggested to reduce these risks, though more evidence is needed to support routine use.

The importance of recognizing and managing pulmonary complications in the post-cesarean period cannot be overstated. Pulmonary issues not only prolong hospital stays and increase healthcare costs, but they also impact maternal-infant bonding and breastfeeding initiation. In resource-limited settings, lack of prompt diagnosis and respiratory support can lead to fatal outcomes. Despite this, pulmonary complications are not routinely studied or addressed in most postpartum care protocols. Given that cesarean section rates continue to rise and that women undergoing LSCS often have coexisting risk factors such as anemia, preeclampsia, or obesity, a better understanding of pulmonary complications is critical for reducing maternal morbidity. Few clinical guidelines comprehensively address pulmonary surveillance post-LSCS. In developing countries, lack of awareness, limited availability of diagnostic imaging, and poor follow-up care further compound the problem.

In this context, the present study aims to explore the incidence, types, risk factors, and clinical outcomes of pulmonary complications following LSCS. Understanding the patterns and predictors of respiratory morbidity in this specific surgical

population is vital for designing preventive strategies, tailoring perioperative management, and improving overall maternal health outcomes. By focusing on this neglected yet crucial aspect of cesarean-related morbidity, the study seeks to inform both clinicians and policymakers about the need for structured postoperative respiratory monitoring and intervention. As cesarean delivery continues to rise globally and in India, identifying the determinants of avoidable complications becomes imperative—not only for safe guarding maternal health but also for optimizing resource utilization and quality of obstetric care.

Aim and Objectives

Aim

To assess the incidence of pulmonary complications following caesarean section.

MATERIALS AND METHODS

This hospital-based prospective observational analytical study was conducted to assess the incidence of pulmonary complications following caesarean section. The methodology adopted for participant selection, data collection, and analysis is described below.

Inclusion Criteria

- All women who underwent caesarean section(LSCS),whether elective or emergency.
- Single to nor multiple pregnancies.
- Willing to provide informed consent for participation.

Exclusion Criteria

- Women with respiratory symptoms during the antepartum period.
- Known history of pre-existing pulmonary diseases such as:
- Pulmonary tuberculosis
- Bronchial asthma
- Chronic obstructive pulmonary disease (COPD)
- Interstitial lung disease
- Any other chronic lung condition

RESULTS

1. AGE WISE DISTRIBUTION OF STUDY POPULATION

In the present study involving 200 participants, the majority were in the 26–30 years age group, accounting for 81 cases (40.5%), followed by 65 cases (32.5%) in the 21–25 years group. 28 participants (14%) were aged 31–35 years, while 23 (11.5%) were below 20 years of age. Only 3 participants (1.5%) belonged to the 36–40 years age group. [Table-1, Chart-1]

Table1: Age Wise Distribution of Study Population

Age	Number	Percentage
<20	23	11.50
21 -25	65	32.50
26 -30	81	40.50
31 -35	28	14.00
36 -40	3	1.50
Total	200	100.00

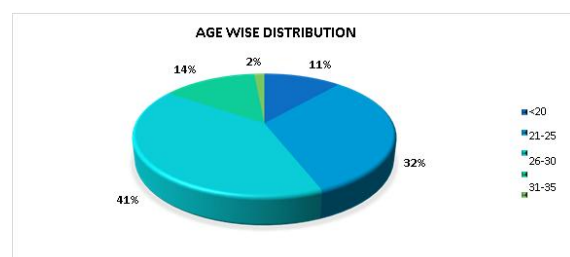


Chart 1: Age Wise Distribution of Study Population

2. DISTRIBUTION OF STUDY PARTICIPANTS ACCORDING TO GRAVIDA

In the present study comprising 200 women who underwent Lower Segment Caesarean Section (LSCS), 61 participants (30.50%) were primi gravid (first pregnancy), while the remaining 139 women (69.50%) were multi gravida (having had two or more pregnancies). [Table-2, Chart-3]

Table 2: Distribution of Patients based on Gravida

Gravida	Number	Percentage
Primi	61	30.50
Multi	139	69.50
Total	200	100.00

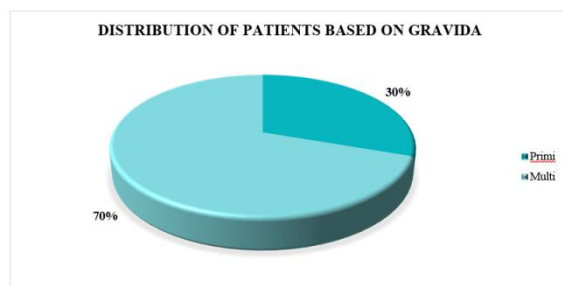


Chart 2: Distribution of Patients based on Gravida

3. BODY MASS INDEX WISE DISTRIBUTION OF PARTICIPANTS:

In the current study on pulmonary complications following LSCS, majority of participants (141 women, 70.5%) had a normal BMI (18.50–24.99). 33 cases (16.5%), were classified as overweight (BMI 25.00–29.99), while 17 women (8.50%) fell in to the obese category (BMI 30.00 – 34.99). Only 9 participants (4.5%) were under weight (BMI <18.5). . [Table-3, Chart-3]

Table 3: Body Mass Index Wise Distribution of Participants

BMI	Number	Percentage
<18.5(Underweight)	9	4.50
18.50 to 24.99 (Normal)	141	70.50
25.00to29.99(Over Weight)	33	16.50
30.00 to 34.99 (Obese)	17	8.50
Total	200	100.00

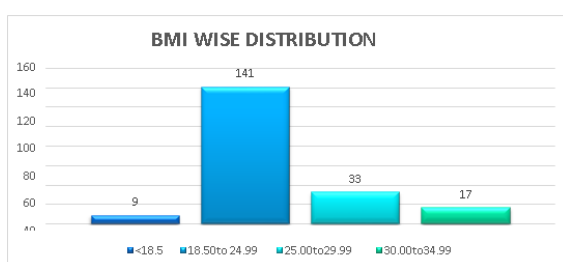


Chart 3: Body Mass Index Wise Distribution of Participants

4. DISTRIBUTION OF STUDY PARTICIPANTS BASED ON TYPE OF LSCS

Out of the total 200 cesarean deliveries analyzed in the study, 233 cases (77.67%) were performed as emergency LSCS, while only 67 cases (22.33%) were elective LSCS. [Table-4, Chart-4]

Table 4: Distribution of Study Participants Based on Type of LSCS

Type of LSCS	Number	Percentage
Elective	45	22.50
Emergency	155	77.50
Total	200	100.00

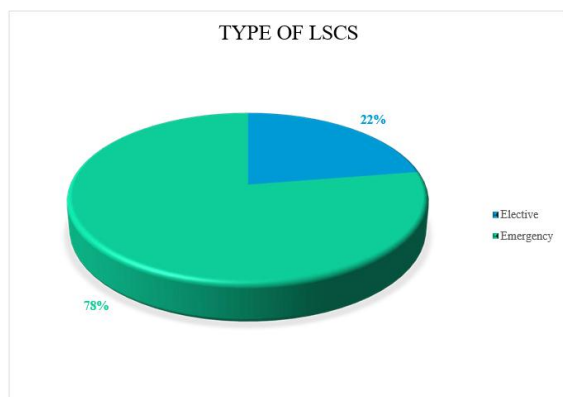


Chart 4: Distribution of Study Participants Based on Type of LSCS

5. DISTRIBUTION OF STUDY PARTICIPANTS BASED ON TYPE OF ANAESTHESIA USED DURING LSCS

In the present study, the majority of the patients 187 cases (93.50%) received regional anesthesia and only 13 women (6.50%) underwent the procedure under general anesthesia. [Table-5, Chart-5]

Table 5: Distribution Based on Type of Anaesthesia Used During LSCS

Type of Anaesthesia	Number	Percentage
Regional	187	93.50
General	13	6.50
Total	200	100.00

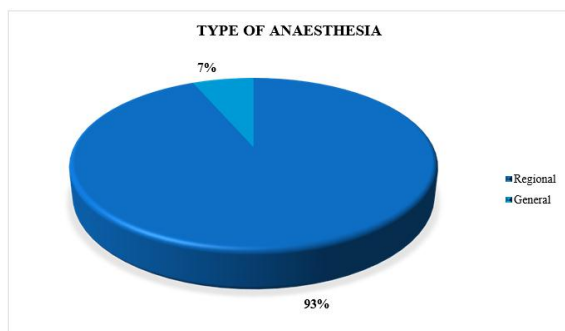


Chart 5: Distribution Based on Type of Anaesthesia Used During LSCS

Table 6: Aspiration Pneumonia among Post-LSCS Women

Aspiration Pneumonia	Number	Percentage
Yes	2	1
No	198	99
Total	200	100

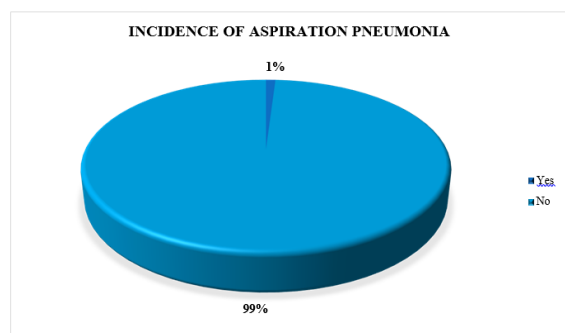


Chart 6: Aspiration Pneumonia among Post-LSCS Women

7. INCIDENCE OF POST-LSCS PULMONARY COMPLICATIONS:

In the present study, the most commonly observed postoperative complication was postoperative fever,

6. ASPIRATION PNEUMONIA AMONG POST-LSCS WOMEN

In the present study comprising 200 women who underwent lower segment caesarean section (LSCS), the incidence of aspiration pneumonia was observed in only 2 cases (1%), while 99% (198 cases) of the participants did not develop this complication. [Table-6, Chart-6]

occurring in 63 patients, accounting for 31.50% of the total cases. Among respiratory complications, non-aspiration pneumonia was reported in 5 patients (2.50%), while aspiration pneumonia and acute respiratory distress syndrome (ARDS) were each observed in 1 patient (0.50%). Pleural effusion was noted in 3 patients, representing 1.50% of the study population. Other serious complications such as pulmonary embolism, pneumothorax, and respiratory failure were not observed in any patient during the study period (0.00%). These findings indicate that while respiratory complications following caesarean section are relatively uncommon, post operative fever remains a frequent occurrence and warrants careful evaluation to distinguish benign febrile responses from early infectious processes. [Table-7, Chart-7]

Table 7: Incidence of Post LSCS Pulmonary Complications

Complication	Number	Percentage
Aspiration Pneumonia	1	0.50
Pneumonia non-aspiration	5	2.50
ARDS	1	0.50
Pleural Effusion	3	1.50
Pulmonary Embolism	0	0.00
Pneumothorax	0	0.00
Respiratory Failure	0	0.00

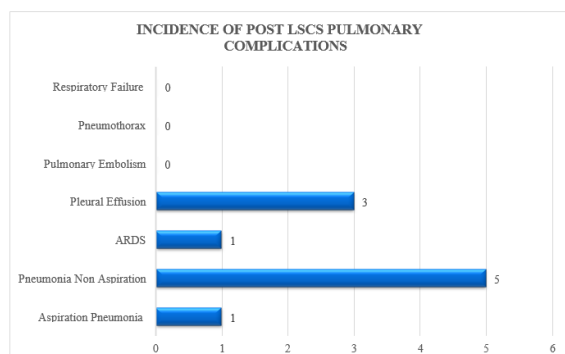


Chart 7: Incidence of Post LSCS Pulmonary Complications

8. CT IMAGING FINDINGS AMONG POST-CAESAREAN SECTION PATIENTS:

In this study, reactive pleural effusion was the most commonly observed CT change among postoperative patients, present in 47 cases, accounting for 23.5%. Ground-glass opacities, indicative of partial alveolar filling or interstitial involvement, were seen in 21 patients (10.5%). Basal atelectasis, was observed in 17 cases (8.5%). Consolidation, suggestive of alveolar pathology such as infection or aspiration, was noted in 3 patients (1.5%). Interestingly, no significant

radiological abnormalities were detected in the majority of patients —112cases, comprising 56% of the study population —indicating that a large

proportion either had no pulmonary complications or had changes not detectable on CT at the time of imaging. [Table-8, Chart-8]

Table 8: CT Imaging Findings Among Post-Caesarean Section Patients

CT changes	Number	Percentage
Reactive effusion	47	23.5
Ground glass opacity	21	10.5
Basal atelectasis	17	8.5
Consolidation	3	1.5
No changes	112	56

9. REQUIREMENT

OF MECHANICAL VENTILATION IN POST-CAESAREAN PATIENTS:

Out of a total of 200 patients, 12 (6%) required mechanical ventilation. Among them, 11 patients

(5.5%) were managed with Continuous Positive Airway Pressure (CPAP), while 1 patient (0.5%) required intubation. The remaining 188 patients (94%) did not require any form of ventilatory support. [Table-9, Chart-9] Chart 8: CT Imaging Findings Among Post-Caesarean Section Patients

Table 9: Requirement of mechanical Ventilation

Type of Ventilation	Number	Percentage
CPAP	11	5.50
Intubation	1	0.50
Total Ventilated	12	6
Not Ventilated	188	94
Grand Total	200	100

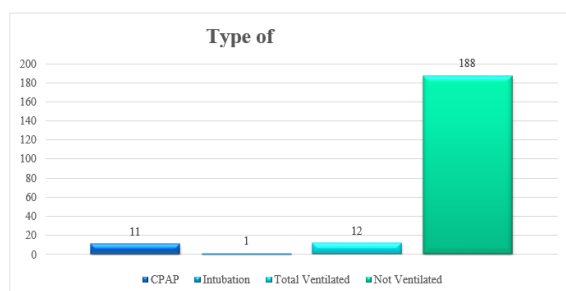


Chart 9: Requirement of mechanical ventilation

10. MATERNAL MORTALITY AMONG POST-CAESAREAN PATIENTS

In this study, there was no maternal death, all the 200 patients survived the postoperative period. [Table-10, Chart-10]

Table 10: Maternal Mortality

Maternal Death	Number	Percentage
Yes	0	0
No	200	100
Total	200	100



Chart 10: Maternal Mortality

DISCUSSION

In the present study involving 200 post-caesarean section women, the majority (40.50%) were between 26–30 years of age, consistent with reproductive age trends. Similar demographic trends were observed in the

study by Ancyetal, where the majority (64%) of women were in the 26–35 years age group, highlighting that caesarean sections are most common among women in their late twenties and early thirties. Regarding gravidity, 69.50% were multi gravida and 70.50% were P2L2, indicating that repeat caesareans formed a significant proportion of the cases. Ancyetal. also observed similar parity patterns, with 55% being multi-gravida.

Only 10% of the women had prior medical or obstetric risk factors. Most patients (70.50%) had a normal BMI, while 16.50% were overweight and 8.50% obese. These findings emphasize that while obesity is a known risk factor for thrombo embolic and respiratory complications, it was not the predominant feature in this cohort. However, as Pandeyetal noted, even single risk factors such as

obesity in the postpartum period can significantly increase the risk of venous thrombo embolism, which may remain under diagnosed due to non-specific symptoms.

Most deliveries occurred at term (79%), followed by preterm (14.5%) and post- term (6.5%). Emergency LSCS constituted 77.5% of cases, indicating the common clinical scenario of unplanned surgical interventions due to evolving maternal or fetal risks. The findings align with Ancy et al., who also reported that a majority (70%) of LSCS deliveries occurred at term. The leading indication in our study was repeat LSCS (61.67%), particularly under emergency conditions, again reflect in great-world obstetric practice.

The predominant anaesthesia used was regional (93.50%), with only 6.50% undergoing general anaesthesia. However, among the 74 complications reported, a disproportionately higher number occurred in the general anaesthesia group, which had only 13 patients. All the patients had complications. Chi-square analysis confirmed this association to be highly significant ($p < 0.00005$), suggesting that general anaesthesia is an independent risk factor for postoperative complications. This is in line with Guglielminotti et al., who found general anaesthesia to be significantly associated with increased risk of pulmonary complications, surgical site infections, and VTEs. Likewise, Ikeda et al. reported a reduction in such complications following the introduction of an obstetric anaesthesia team that minimized the use of general anaesthesia.

Postoperative desaturation occurred in 16% of patients, and 17% required supplemental oxygen. Among these, the majority required oxygen for less than 6 hours, indicating that early postoperative hypoxia is generally transient and manageable. Only 2.94% needed oxygen for more than 24 hours, possibly due to significant complications like pneumonia or ARDS. This emphasizes the importance of routine post operative SpO₂ monitoring to detect early hypoxic changes and prevent progression.

In this study, Non-aspiration pneumonia (2.50%), pleural effusion (1.50%), and sepsis (0.50%) were reported. Serious complications like ARDS (0.50%) and aspiration pneumonia (0.50%) were rare, but their occurrence exclusively in general anaesthesia cases reinforces the concern raised in Palanisamy et al. and Stourac et al., regarding the higher risk of airway compromise and delayed recognition in GA cases. Notably, no cases of pulmonary embolism, pneumothorax, respiratory failure, or shock were observed, which may reflect good intraoperative and postoperative surveillance.

Although Pandey et al. emphasized the risk of VTE and PE in post-LSCS patients, our study did not encounter any such cases. This could be due to effective thrombo prophylaxis practices or limitations in diagnostic resources and underreporting of subclinical events.

CT thorax revealed that over half (56%) of the patients had no abnormalities, but among those with findings, reactive pleural effusion (23.5%), ground-glass opacities (10.5%), and basal atelectasis (8.5%) were most common. These subtle signs often precede overt respiratory symptoms and warrant close follow-up. Consolidation was rare (1.5%) but likely indicative of aspiration or infection.

Only 3.50% required High Dependency Unit (HDU) observation, and most of these stayed for ≤ 2 days, suggesting that complications were manageable with short-term supportive care. Similarly, Palanisamy et al. reported that with improved perioperative planning and early identification of risk, ICU or HDU admissions were rare and usually not prolonged.

Most patients (67%) were discharged within 10 days, indicating good recovery. No Maternal mortality was observed in the current study and there were 4 readmissions within 30 days (2%), reflecting a relatively safe postoperative course. Zhang et al. highlighted that some pulmonary or allergic complications can be subtle and mimic other causes (e.g., delayed anaphylaxis misdiagnosed as AFE), and thus careful differential diagnosis and documentation during readmission is essential. Emergency LSCS (63/155 cases) was significantly associated with higher complication rates compared to elective cases (11/45 cases). This study reinforces the understanding that emergency LSCS and general anaesthesia are associated with higher postoperative pulmonary and febrile complications. Most complications were mild and manageable, but the data underline the need for early identification, risk stratification, and multidisciplinary perioperative care. Findings are consistent with national and international studies, further highlighting the critical role of standardized protocols, especially regarding anaesthesia choice and postoperative monitoring.

CONCLUSION

SUMMARY

- The majority of patients (40.50%) were in the 26–30 years age group, aligning with the typical reproductive age range.
- Multiparous women constituted 70.50% of the study population.
- Most patients (70.50%) had a normal BMI, while 16.50% were overweight and 8.50% obese.
- Only 10% had prior medical or obstetric risk factors, suggesting the majority were low-risk pregnancies.
- Term deliveries (37–40 weeks) were most common, observed in 79% of cases.
- Emergency LSCS accounted for 77.50%, while elective LSCS made up 22.50%.
- The most common indication for LSCS was previous caesarean section (47.50%), followed by CPD and foetal distress.

- Regional anesthesia was used in 93.50% of patients, and general anesthesia in 6.50%.
- Among the 200 cases,
 - Non-aspiration pneumonia was reported in 5 cases (2.50%)
 - Pleural effusion in 3 cases (1.50%)
 - Sepsis, Aspiration pneumonia and ARDS in 1 case each (0.50%)
- No cases of pulmonary embolism, pneumothorax, or respiratory failure were reported.
- Post-operative oxygen desaturation occurred in 16 % of patients.
- Supplemental oxygen was required in 29% of cases, mostly for <6 hours; only 2.5% required oxygen >24 hours.
- CT chest findings revealed:
 - Reactive pleural effusion in 23.50%
 - Ground-glass opacities in 10.50%
 - Basal atelectasis in 8.50%
 - Consolidation in 1.50%
 - No changes in 56%
- HDU admission was required in 3.50% of cases, mostly for ≤ 2 days.
- Most patients (67%) had a hospital stay ≤ 10 days, while 4.50 % stayed > 14 days.
- No maternal death was observed in the current study.
- Re admission within 30 days was reported in 4 patients (2%).
- Postoperative complications were significantly more common in general anaesthesia cases (all 19 cases), with $p < 0.00005$, indicating a strong association.
- Complications were also more frequent in emergency LSCS cases (40.50%).

CONCLUSION

This hospital-based prospective analytical study evaluated the incidence and pattern of postoperative pulmonary complications following caesarean section among 200 postpartum women. The findings highlight that while most patients were young, multigravida, and underwent term emergency LSCS under regional anaesthesia, postoperative complications were not uncommon. Postoperative fever (31.50%) was the most frequent complication, followed by non-aspiration pneumonia, pleural effusion, and sepsis. Although the majority of LSCS were performed under regional anaesthesia, complications were significantly higher in patients who received general anaesthesia ($p < 0.00005$), reinforcing the preference for regional techniques whenever

feasible. Emergency LSCS also showed a higher rate of complications, though this was not statistically significant. CT imaging revealed early pulmonary changes such as reactive effusion and basal atelectasis, emphasizing the role of radiology in detecting subtle complications. Based on these findings, it is recommended to continue promoting regional anaesthesia, ensure early postoperative monitoring (including pulse oximetry and respiratory assessment), and adopt standard protocols for thrombo prophylaxis and infection control. Future studies with larger sample sizes and long-term follow-up can help identify high-risk predictors and evaluate the effectiveness of preventive interventions, thereby improving maternal outcomes after caesarean delivery.

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