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POST-CESAREAN ADHESIONS AND INTERPREGNANCY INTERVAL: IMPLICATIONS FOR MATERNAL AND NEONATAL HEALTH

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ABSTRACT

Background: Cesarean sections (CS) are increasingly common worldwide. A significant complication is intra-abdominal adhesion formation, which can lead to long-term morbidities such as chronic pelvic pain, infertility, and bowel obstruction, potentially impacting women's health. The interpregnancy interval (IPI) may influence adhesion severity.

Aims: To investigate the correlation between the degree of intra-abdominal adhesions and IPI in women undergoing repeat CS, and to explore the potential implications for maternal and neonatal health.

Methods: This prospective observational study was conducted at a tertiary care center from 2022-2024. A total of 253 women with one prior CS, gestational age ≥37 weeks, and no other major abdominal surgeries were included. Intra-abdominal adhesions were assessed intraoperatively using the standardized C.G Adhesion Scoring System. Data on IPI, maternal demographics, intraoperative findings, and complications were collected. Statistical analysis involved Chi-square tests, ANOVA, and correlation coefficients.

Results: Adhesions were present in 63.6% of participants, with dense adhesions in 42.7%. A highly significant correlation was found between IPI and adhesion severity ($p < 0.001$; Cramér's V = 0.265). Women with an IPI of 19–59 months had the highest rate of dense adhesions (52.0%). Shorter IPIs (<18 months) were associated with more flimsy adhesions but also a higher incidence of thinned-out lower uterine segments (46.5%). Longer IPIs (≥60 months) showed a bimodal pattern with both high rates of no adhesions (55.0%) and high mean adhesion scores when present. Dense adhesions were significantly associated with increased incision-to-delivery time ($p < 0.001$) and greater intraoperative blood loss ($p < 0.001$).

Conclusion: The interpregnancy interval is a significant factor influencing the severity of post-cesarean adhesions. These adhesions contribute to immediate surgical morbidity and have the potential for long-term sequelae, such as chronic pain and organ dysfunction, which can impair quality of life. Optimal birth spacing and meticulous surgical techniques are crucial in mitigating these risks.

KEYWORDS: Cesarean Section; Intra-abdominal Adhesions; Interpregnancy Interval; Maternal Morbidity; Midlife Health; Chronic Pelvic Pain.

INTRODUCTION

The global rise in caesarean section (CS) rates has brought increased attention to associated maternal morbidities. [1] One of the most common and impactful sequelae is the formation of intra-abdominal adhesions—fibrous bands of scar tissue that develop between organs and the abdominal wall. [2] While often an immediate surgical challenge, the consequences of these adhesions can extend far beyond the puerperium, potentially leading to chronic pelvic pain, secondary infertility, small bowel obstruction, and the need for further complex surgeries, thereby significantly impacting a woman's quality of life and health status. [3,4]

The interpregnancy interval (IPI), the time between one delivery and the conception of the next, is a modifiable factor that may influence uterine healing and subsequent adhesion formation. [5] A shorter IPI might not allow sufficient time for tissue repair and resolution of inflammation, potentially predisposing to more severe adhesions. [6] Conversely, very long IPIs might also be associated with certain adverse outcomes, possibly due to age-related changes in tissue healing. [7] Women undergoing repeat CS, particularly those who start childbearing later or have multiple pregnancies, may experience the chronic effects of adhesions during their midlife years, a period already characterized by various physiological and health transitions. [8]

This study aims to investigate the correlation between the degree of intra-abdominal adhesions encountered during repeat CS and the IPI following the previous CS. Furthermore, it seeks to highlight the potential implications of these adhesions for maternal and neonatal health.

MATERIALS AND METHODS

Study Design and Setting:

This hospital-based prospective observational study was conducted at the Department of Obstetrics and Gynaecology, Pt. J. N. M. Medical College and Dr. B. R. Ambedkar Memorial Hospital, Raipur (Chhattisgarh), a tertiary care centre in India. The study period was from 2022 to 2024.

Study Population and Sampling:

A total of 253 pregnant women with a history of one prior CS, a gestational age of ≥37 weeks, and scheduled for a repeat CS were enrolled using convenience sampling.

Inclusion Criteria:

1) History of one prior CS.
2) Gestational age ≥37 weeks.
3) Singleton pregnancy.
4) Willingness to provide written informed consent.

Exclusion Criteria:

1) More than one previous CS.
2) Gestational age <37 weeks.
3) History of other abdominal or pelvic surgeries (e.g., myomectomy, ovarian cystectomy), abdominal tuberculosis.
4) Pregnancy complicated by significant systemic illness.
5) Known pre-existing extensive adhesive disease.

Data Collection:

Detailed demographic data, obstetric history (including IPI, calculated from the date of previous CS delivery to the first day of the last menstrual period of the current pregnancy), and general physical examination findings were recorded. Intraoperatively, the presence, site, extent, and severity (dense or flimsy) of adhesions were meticulously assessed and scored using the C.G Adhesion Scoring System (a site-specific scoring system evaluating adhesions between skin layers, uterus-anterior abdominal wall, bilateral tubes/ovaries, uterus-bladder, uterus-bowel/omentum, and omentum/bowel-abdominal wall/peritoneum, with scores for

presence/absence, density, and impact on delivery time; maximum score: 14, minimum: 0). Other intraoperative findings such as scar thickness (preoperatively assessed by ultrasound), condition of the lower uterine segment (LUS), estimated blood loss, incision-to-delivery time, total operative time, and any surgical complications (e.g., bladder/bowel injury, uterine rupture, placenta accreta spectrum) were documented. Neonatal outcomes (APGAR scores, NICU admission) were also recorded.

C.G ADHESION SCORE

ADHESION	PRESENT/ABSENT	DENSE (SCORE)	FLIMSY (SCORE)
BETWEEN LAYERS OF SKIN	1/0	2	1
UTERUS WITH ANTERIOR ABDOMINAL WALL	1/0	2	1
BILATERAL TUBES AND OVARIES	1/0	2	1
UTERUS WITH BLADDER	1/0	2	1
UTERUS WITH BOWEL OR OMENTUM	1/0	2	1
OMENTUM OR BOWEL ADHERED WITH ABDOMINAL WALL OR PERITONIAL LAYER	1/0	2	1
SKIN INCISION TO DELIVERY TIME DUE TO ADHESION >4MIN	2		

MAXIMUM SCORE: 14
MINIUMUM SCORE: 00

Outcome Variables:

The primary outcome was the correlation between IPI (categorized as Group 1: <18 months; Group 2: 19–59 months; Group 3: ≥60 months) and the degree of intra-abdominal adhesions (none, flimsy, dense) and the total C.G Adhesion Score. Secondary outcomes included the association of adhesions with maternal age, BMI, scar characteristics, type of CS (emergency vs. elective), intraoperative complications, and selected neonatal outcomes.

Ethical Considerations:

The study protocol was approved by the Institutional Ethics Committee of Pt. J. N. M. Medical College and Dr. B. R. Ambedkar Memorial Hospital, Raipur. Written informed consent was obtained from all participants. Confidentiality and anonymity were maintained.

Statistical Analysis:

Data were entered into MS EXCEL and analysed using SPSS version 20.0. Continuous variables were presented as mean ± standard deviation (SD) and categorical variables as frequencies and percentages. The Chi-square test or Fisher's exact test was used for categorical variables. ANOVA or Kruskal-Wallis test (with post-hoc tests where appropriate) was used for comparing means across groups. Pearson's correlation coefficient or Spearman's rank correlation was used to assess correlations. A p-value <0.05 was considered statistically significant. Cramér's V was used to assess the strength of association for Chi-square tests.

RESULTS

Participant Characteristics:

A total of 253 women participated in the study. The mean age of the participants was 26.5 ± 4.2 years, with the largest group (41.9%) aged 25–30 years. A small proportion (1.98%) were aged >35 years. The mean BMI was 26.8 ± 4.5 kg/m2, with 29.6% classified as obese (BMI ≥30 kg/m2). The majority (70.75%) were gravida 2. Most participants (59.29%) had an IPI of 19–59 months (Group 2), followed by ≥60 months (23.72%, Group 3), and <18 months (17.00%, Group 1). Emergency CS was performed in 55.34% of cases.

Prevalence and Severity of Adhesions:

Intra-abdominal adhesions were observed in 161 (63.6%) participants. Of these, 108 (42.7% of total) had dense adhesions, and 53 (20.9% of total) had flimsy adhesions. No adhesions were found in 92 (36.4%) participants. The uterus-anterior abdominal wall was the most common site for adhesions (55.73%).

Correlation between Interpregnancy Interval (IPI) and Adhesion Severity:

A highly significant association was found between IPI groups and adhesion severity (Dense, Flimsy, None) ($\chi^2 = 30.65$, $p < 0.001$; Cramér's V = 0.265).

- **Group 1 (<18 months, n=43):** Dense adhesions in 18.6%, flimsy in 46.5%, no adhesions in 34.9%. Mean C.G Adhesion Score was relatively lower but this group had the highest rate of thinned-out LUS (46.5%, $p < 0.001$).
- **Group 2 (19–59 months, n=150):** Highest rate of dense adhesions (52.0%), flimsy in 18.7%, no adhesions in 29.3%. Though the sample size was large.
- **Group 3 (≥60 months, n=60):** Dense adhesions in 36.7%, flimsy in 8.3%, and the highest rate of no adhesions (55.0%). However, when adhesions were present in this group, the mean C.G Adhesion Score was the highest (7.45 ± 2.24 for dense adhesions).

Correlation of Adhesions with Other Factors:

- **Scar Thickness**: Adhesions were significantly more frequent with thicker scars (>2.3 mm, 73.6% adhesion rate) compared to thinner scars (≤2.3 mm, 49.5% adhesion rate). Dense adhesions were predominant in the >2.3 mm group (58.8%) ($p < 0.001$, Cramér's V = 0.386).
- **Maternal Age:** Women aged >35 years showed an 80% adhesion rate, mostly dense, though the sample size was small. The 25-30 years group had a 66% adhesion rate. No statistically significant association was found between age group and adhesion type overall (p=0.959).
- **BMI:** Obese women (BMI ≥30) had a dense adhesion rate of 46.7%, slightly higher than other BMI categories, but this was not statistically significant (p=0.989).
- **Type of CS**: Adhesion rates were similar between emergency (63.6%) and elective (63.7%) CS. Dense adhesions were slightly more common in emergency CS (45.0% vs 39.8%), but this was not significant (p=0.538).

Impact of Adhesions on Intraoperative and Neonatal Outcomes:

- **Incision-to-Delivery Time**: Significantly longer with adhesions. Mean time was 9.94 ± 1.38 minutes for dense adhesions, 8.07 ± 1.13 minutes for flimsy adhesions, and 6.77 ± 0.97 minutes for no adhesions (ANOVA, $p < 0.001$).
- **Intraoperative Blood Loss**: Increased significantly with adhesion severity. For blood loss >800 mL, dense adhesions were present in over 88% of cases ($p < 0.001$).
- **Intraoperative Complications**: Thinned-out LUS was noted in 20.95% of all cases, most frequently in women with no adhesions (37/53 cases with thinned LUS) but also significantly higher in the short IPI group (<18 months, 46.5%). Placenta accreta spectrum (PAS) occurred in 2 cases (0.79%), both in Group 2 IPI and associated with adhesions.
- **Neonatal Outcomes:** Dense adhesions were associated with lower APGAR scores at 1 minute ($p < 0.001$) and 5 minutes ($p = 0.012$), and higher NICU admission rates (59.6% of NICU admissions were from mothers with dense adhesions, $p = 0.018$).

DISCUSSION

This study confirms a high prevalence of intra-abdominal adhesions (63.6%) in women undergoing repeat CS, with a significant proportion being dense (42.7%). A key finding is the strong correlation between IPI and adhesion severity. The optimal IPI for minimizing dense adhesions appears complex; while the 19-59 month interval showed the highest rate of dense adhesions, very short intervals (<18 months) were linked to flimsy adhesions but compromised LUS integrity, suggesting incomplete healing. Longer intervals (≥60 months) presented a mixed picture, with many women having no adhesions, but those who did often had severe adhesions, possibly reflecting age-related fibrotic tendencies or other unmeasured confounders. This nuanced relationship underscores the importance of individualized counselling regarding birth spacing.

The long-term consequences of such adhesions are a significant concern for women's health extending into midlife. Chronic pelvic pain, a common sequela of adhesions, can severely diminish quality of life, impact daily functioning, and contribute to psychological distress. [9] Adhesions are also a leading cause of secondary infertility and small bowel obstruction, conditions that may require further surgical interventions and can manifest or persist well into the midlife years. [3,10] The women in our study, with some aged >35 years, are at the cusp of or entering midlife, making these findings particularly relevant. The development of adhesions earlier in their reproductive lives sets the stage for potential chronic health issues that they may carry into their 40s, 50s, and beyond.

Our findings on increased operative time and blood loss with severe adhesions are consistent with previous literature. [Morales et al., 2007; Poole JH, 2013]. These immediate surgical difficulties can also contribute to a more challenging postoperative recovery. The association between dense adhesions and adverse neonatal outcomes (lower APGAR scores, higher NICU admissions) further highlights the broad impact of this complication.

The observation that thinned-out LUS was more common with shorter IPIs, even if adhesions were flimsy, points to a different aspect of poor healing that also carries risks for future pregnancies and deliveries. [Shipp et al., 2001]. This suggests that IPI influences not only peritoneal healing (adhesion formation) but also myometrial scar integrity.

The C.G Adhesion Scoring system proved to be a useful tool for quantifying adhesion severity, demonstrating good correlation with clinical outcomes. Standardized scoring is essential for comparing data across studies and for developing targeted preventive strategies.

Clinical Recommendations:

Preoperative Risk Assessment.

Optimized Surgical Techniques.

Birth Spacing Interval.

Enhanced Postoperative Monitoring.

Strengths and Limitations:

The primary strength of this study is its **prospective observational design**, which allows for a more direct and accurate assessment of the relationship between IPI and adhesion severity compared to a retrospective study. By collecting data in real-time during surgery, the researchers could meticulously and systematically document adhesion presence, site, and severity.

Key strengths include:

- **Use of a Standardized Scoring System:** The use of the **C.G. Adhesion Scoring System** is a major strength. It provides an objective, site-specific, and quantitative method for assessing adhesions, which helps to standardize data collection and allows for meaningful comparisons and statistical analysis. This minimizes the subjective bias that can occur when surgeons simply describe adhesions.

- **Comprehensive Data Collection:** The study collected a wide range of data points, from pre-operative factors like demographics and IPI to intra-operative details (adhesion scores, operative time, blood loss) and even neonatal outcomes. This holistic approach allows for a richer analysis of the implications of adhesions on both maternal and neonatal health.
- **Highly Significant Findings:** The study found a statistically significant correlation between IPI and adhesion severity ($p < 0.001$), lending strong support to the main hypothesis. The use of **Cramér's V** also provides a measure of the strength of this association, indicating a meaningful relationship.

Limitations

- **Lack of Control for Confounding Variables:** The discussion mentions that the bimodal pattern for long IPIs (≥60 months) might be due to "age-related fibrotic tendencies or other unmeasured confounders." This indicates that there could be other factors, not accounted for in the analysis, that affect adhesion formation.
- **Small Sample Size in Subgroups.**
- **Short-Term Follow-up.**
- **Potential for Observer Bias.**

Clinical Implications and Future Directions:

The findings reinforce the need for strategies to reduce primary CS rates and to promote optimal IPI (likely >18 months but perhaps avoiding excessively long intervals without other risk factors). Preoperative counselling should include the risks of adhesion formation and its potential long-term impact on health. For women identified with severe adhesions, meticulous surgical technique is paramount, and they should be counselled about potential future complications. Future research should include longitudinal studies tracking women with post-CS adhesions into their midlife years to directly quantify the burden of related health problems. Investigating the efficacy of various adhesion prevention strategies in different IPI groups is also warranted.

CONCLUSION

The interpregnancy interval significantly correlates with the severity of intra-abdominal adhesions following a previous caesarean section. Dense adhesions are associated with increased immediate surgical morbidity and have the potential to cause long-term complications such as chronic pelvic pain, infertility, and bowel obstruction, which can adversely affect women's health and quality of life well into midlife. Clinicians should counsel women on optimal birth spacing and employ meticulous surgical techniques to minimize adhesion formation. Further research is needed to fully elucidate the long-term impact of these adhesions on women as they age and to refine preventive strategies.

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Tables and Figures:

Table 1: Correlation between Interpregnancy Interval (IPI) Groups and Adhesion Severity (Dense, Flimsy, None).

: Association between Adhesion by Interpregnancy Interval Group Among Study Subjects.

IPI Group	Dense n (%)	Dense Mean±SD	Dense Median (Min–Max)	Flimsy n (%)	Flimsy Mean±SD	Flimsy Median (Min–Max)	None n (%)	None Mean±SD	None Median (Min–Max)	Row Total (n)
Group 1	8 (18.6%)	5.50 ± 2.07	4.0 (4–8)	20 (46.5%)	1.75 ± 0.44	2.0 (1–2)	15 (34.9%)	0.00 ± 0.00	0.0 (0–0)	43

Group 2	78 (52.0%)	4.83 ± 2.51	4.0 (2–10)	28 (18.7%)	2.43 ± 0.74	3.0 (1–3)	44 (29.3%)	0.00 ± 0.00	0.0 (0–0)	150
Group 3	22 (36.7%)	7.45 ± 2.24	7.0 (4–10)	5 (8.3%)	2.00 ± 0.00	2.0 (2–2)	33 (55.0%)	0.00 ± 0.00	0.0 (0–0)	60
Total	**108 (42.7 %)**			**53 (20.9 %)**			**92 (36.4 %)**			**253**

- **Chi-Square p-value**: **0.00000036** (highly significant). **Cramér's V (Effect Size)**: **0.265**
- In this study, **dense adhesions peaked in the 19–59 month group (52%)** followed by **≥60-month group (36.7%) and 18.6% in** <18-month group**. Flimsy adhesions dominated** the <18-month group. Notably, **no adhesions were common in the ≥60-month group (55%) followed by 34.9% in <18 month group**. Chi square test revealed association was **statistically significant (p = 0.000)** with a **moderate strength (Cramer's V = 0.265)** — suggesting that **interpregnancy interval has a meaningful impact** on adhesion severity.

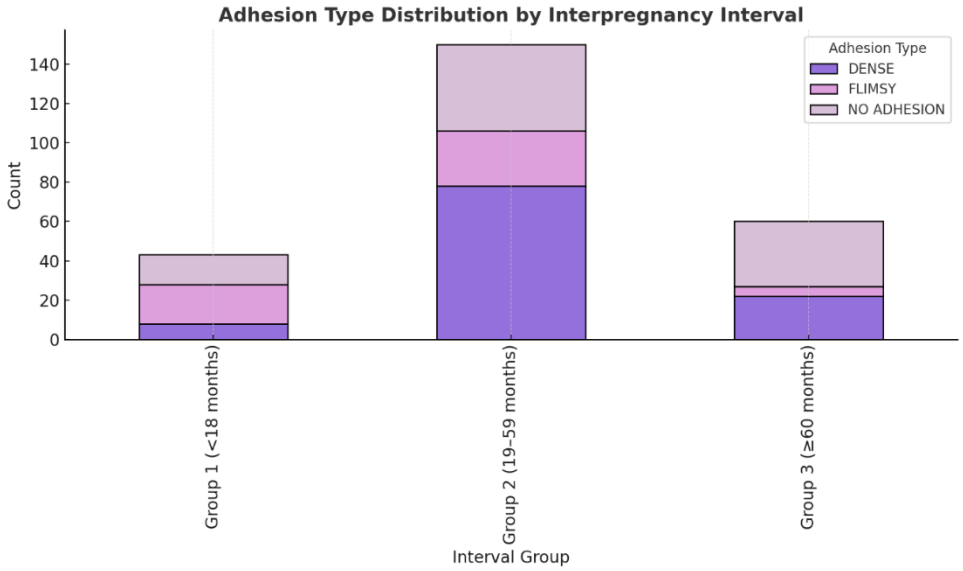


Table 2: Impact of Adhesion Severity on Mean Incision-to-Delivery Time.

General distribution of Adhesion vs No Adhesion by Site among study subjects.

Adhesion Site	Adhesion Yes (n)	Yes (%)	Adhesion No (n)	No (%)	Total (n)
BETWEEN LAYERS OF SKIN	55	21.74%	198	78.26%	253
UTERUS WITH ANTERIOR ABDOMINAL WALL	141	55.73%	112	44.27%	253
BILATERAL TUBES AND OVARIES	47	18.58%	206	81.42%	253
UTERUS WITH BLADDER	74	29.25%	179	70.75%	253
UTERUS WITH BOWEL AND OMENTUM	22	8.70%	231	91.30%	253

OMENTUM/BOWEL ADHERED TO ABDOMINAL WALL	50	19.76%	203	80.23%	253

- In this study, adhesion was most prevalent at the uterus–anterior abdominal wall, with 55.73% of cases showing either Dense or Flimsy adhesions (141 out of 253). In contrast, the bowel and omentum region showed the lowest adhesion rate at just 8.70% (22 cases). The space between skin layers , bladder interface had moderate rates of adhesion at 21.74% and 29.25%, respectively.

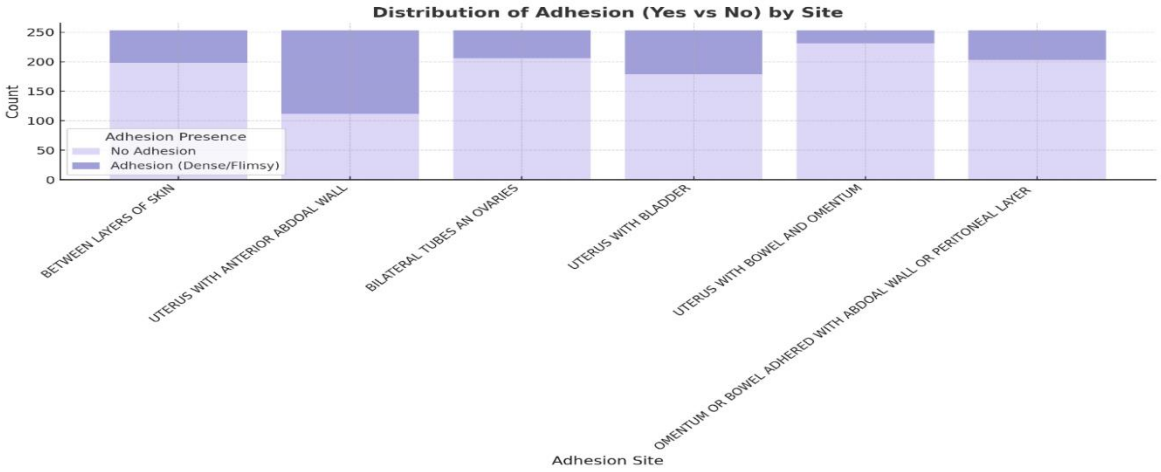


Table 3: Distribution of Mean Incision-to-Delivery Time by Adhesion Status among study subjects.

Adhesion Type	Incision-to-Delivery Time (Mean)
Adhesion	**4.89 minutes**
No Adhesion	**2.91 minutes**

- In this study, patients with adhesions experienced a significantly longer incision-to-delivery time, averaging 4.89 minutes, compared to 2.91 minutes in those without adhesions. This ~2-minute increase may reflect additional surgical difficulty during dissection and fetal extraction. And add to the higher score on C.G adhesion score.

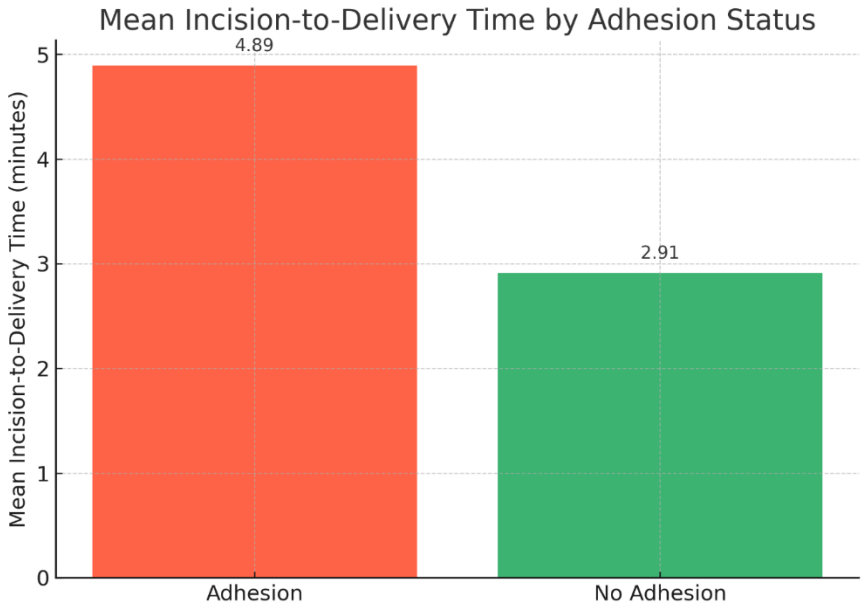
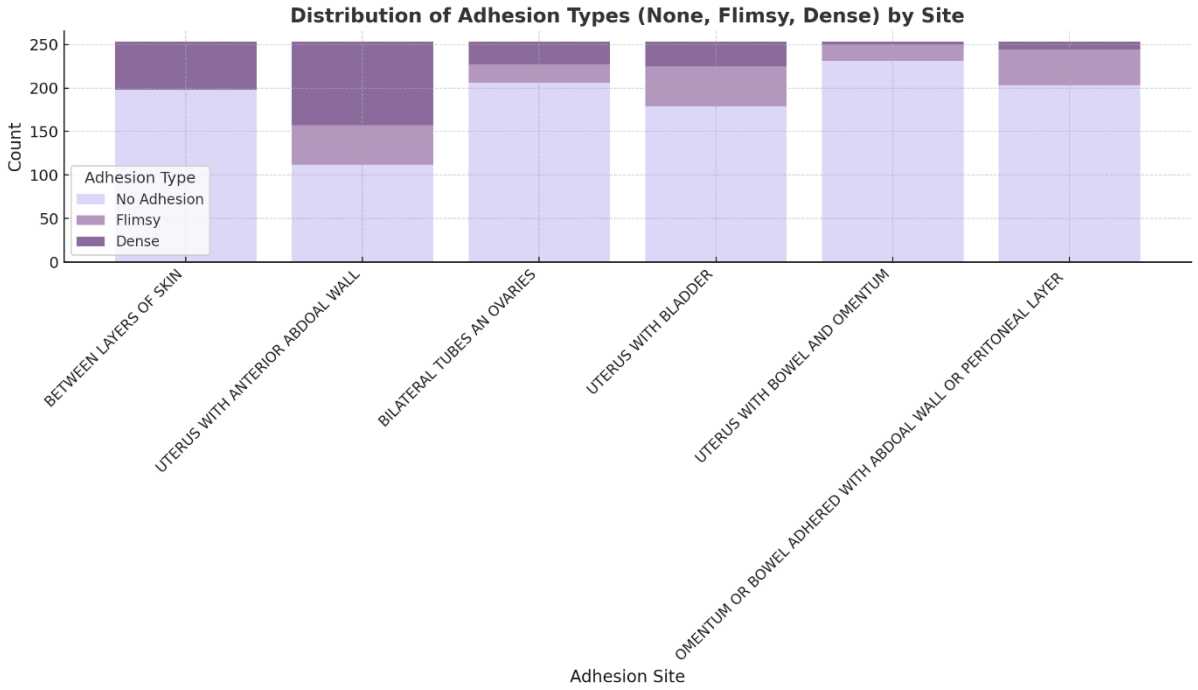


Table 4: Correlation Between Specific Adhesion Site and Degree of Adhesion

Adhesion Site	Dense n	Dense Mean±SD	Dense Median (Min–Max)	Flimsy n	Flimsy Mean±SD	Flimsy Median (Min–Max)	None n	None Mean±SD	None Median (Min–Max)
BETWEEN LAYERS OF SKIN	55	6.58 ± 2.81	6.0 (2–10)	0	0.00 ± 0.00	0 (0–0)	198	0.00 ± 0.00	0 (0–0)
BILATERAL TUBES AND OVARIES	26	8.92 ± 1.52	10.0 (6–10)	21	4.10 ± 0.83	4.0 (3–5)	206	0.00 ± 0.00	0 (0–0)
OMENTUM/BOWEL ADHERED TO ABDOMINAL WALL	9	5.78 ± 2.11	4.0 (4–8)	41	2.49 ± 0.90	3.0 (1–6)	203	0.00 ± 0.00	0 (0–0)
UTERUS WITH ANTERIOR ABDOMINAL WALL	96	5.78 ± 2.55	5.0 (2–10)	45	2.27 ± 0.72	2.0 (1–4)	112	0.00 ± 0.00	0 (0–0)
UTERUS WITH BLADDER	28	8.00 ± 2.88	10.0 (2–10)	46	3.91 ± 1.94	3.0 (2–9)	179	0.00 ± 0.00	0 (0–0)



- The stacked bar chart reveals clear variation in adhesion severity across anatomical locations. The uterus–anterior abdominal wall showed the most extensive involvement, with 96 Dense and 45 Flimsy cases, comprising over half of its total (141 out of 253). In contrast, omental and bowel-related areas exhibited overwhelmingly No Adhesion, with minimal Flimsy or Dense types (e.g., only 9 Dense cases). Sites like

the bladder showed a moderate spread, with 28 Dense and 46 Flimsy adhesions. These findings reinforce that Dense adhesions concentrate in deeper, central pelvic planes, aligning with areas of repeated surgical manipulation.

Statistical Test: Kruskal-Wallis H

Adhesion Site	**H-Statistic**	**p-value**	**Significance**
UTERUS WITH ANTERIOR ABDOMINAL WALL	176.28	0.0000	**Significant**
BILATERAL TUBES AND OVARIES	85.09	0.0000	**Significant**
UTERUS WITH BLADDER	82.45	0.0000	**Significant**
UTERUS WITH BOWEL AND OMENTUM	17.53	0.0002	**Significant**
OMENTUM/BOWEL ADHERED TO ABDOMINAL WALL/PERITONEUM	10.92	0.0042	**Significant**

- All anatomical sites showed **statistically significant** differences in CG adhesion scores among Dense, Flimsy, and None categories. This strongly supports that **adhesion severity is reflected in CG scores across all locations**.

Post-Hoc Pairwise CG Score Comparison by Adhesion Site

Adhesion Site	Comparison	Adjusted p-value	Significance
BETWEEN LAYERS OF SKIN	None vs Dense	0	Significant
UTERUS WITH ANTERIOR ABDOMINAL WALL	None vs Flimsy	0	Significant
UTERUS WITH ANTERIOR ABDOMINAL WALL	None vs Dense	0	Significant
UTERUS WITH ANTERIOR ABDOMINAL WALL	Flimsy vs Dense	0	Significant
BILATERAL TUBES AN OVARIES	None vs Flimsy	0	Significant
BILATERAL TUBES AN OVARIES	None vs Dense	0	Significant
BILATERAL TUBES AN OVARIES	Flimsy vs Dense	0	Significant
UTERUS WITH BLADDER	None vs Flimsy	0	Significant
UTERUS WITH BLADDER	None vs Dense	0	Significant
UTERUS WITH BLADDER	Flimsy vs Dense	0	Significant
UTERUS WITH BOWEL AND OMENTUM	None vs Flimsy	0.0023	Significant
UTERUS WITH BOWEL AND OMENTUM	None vs Dense	0.0337	Significant
UTERUS WITH BOWEL AND OMENTUM	Flimsy vs Dense	0.0146	Significant
OMENTUM OR BOWEL ADHERED WITH ABDOMINAL WALL OR PERITONEAL LAYER	None vs Flimsy	0.4597	Not Significant
OMENTUM OR BOWEL ADHERED WITH ABDOMINAL WALL OR PERITONEAL LAYER	None vs Dense	0.0209	Significant
OMENTUM OR BOWEL ADHERED WITH ABDOMINAL WALL OR PERITONEAL LAYER	Flimsy vs Dense	0	Significant

- Post-hoc analysis using the Mann–Whitney U test with Bonferroni correction revealed statistically significant differences in CG adhesion scores between adhesion types across multiple anatomical sites. In the uterus with anterior abdominal wall, all three pairwise comparisons (None vs Flimsy, None vs Dense, and Flimsy vs Dense) were highly significant ($p = 0.0000$), demonstrating that CG scores clearly differentiate levels of adhesion severity. Similarly, the bilateral tubes and ovaries site showed a significant difference between None and Flimsy adhesions ($p = 0.0000$), as did the space between skin layers for None

vs Dense (p = 0.0000). These findings confirm that the CG Adhesion Score reliably reflects the gradation of adhesion types, especially in high-risk anatomical locations. Thus, CG scoring serves as a robust tool for surgical planning and risk assessment.

Table 5: Association between Adhesion Severity and Intraoperative Blood Loss Categories.

Correlation between degree of adhesion and intraoperative blood loss.

Blood loss	N	Dense adhesion	Flimsy adhesion	No adhesion
</ 500ML	**129(71.93%)**	**4(3.1%)**	**39(30.23%)**	**86(66.66%)**
501–800	47(19.76%)	**35(74.46%)**	**8(17.02)**	**4(8.51%)**
801–1000	71(5.92%)	**63(88.73%)**	**4(5.63%)**	**2(2.81%)**
>1000	6(2.37%)	**4(66.66%)**	**2(33.33%)**	**0**
TOTAL	253	108	53	92

Chi-square statistic (χ^2): 69.06, **p-value**: **2.25×10^{-7}** (HS)

In this study, as the severity of adhesions increases, intraoperative blood loss increases. Among patients with blood loss between 501–800 mL, 74% had dense adhesions. This proportion further increased in the 801–1000 mL group, where 88.7% exhibited dense adhesions, and in cases with >1000 mL blood loss, 66% had dense adhesions. Overall, there was a highly significant association between estimated intraoperative blood loss and adhesion severity (p < 0.001).

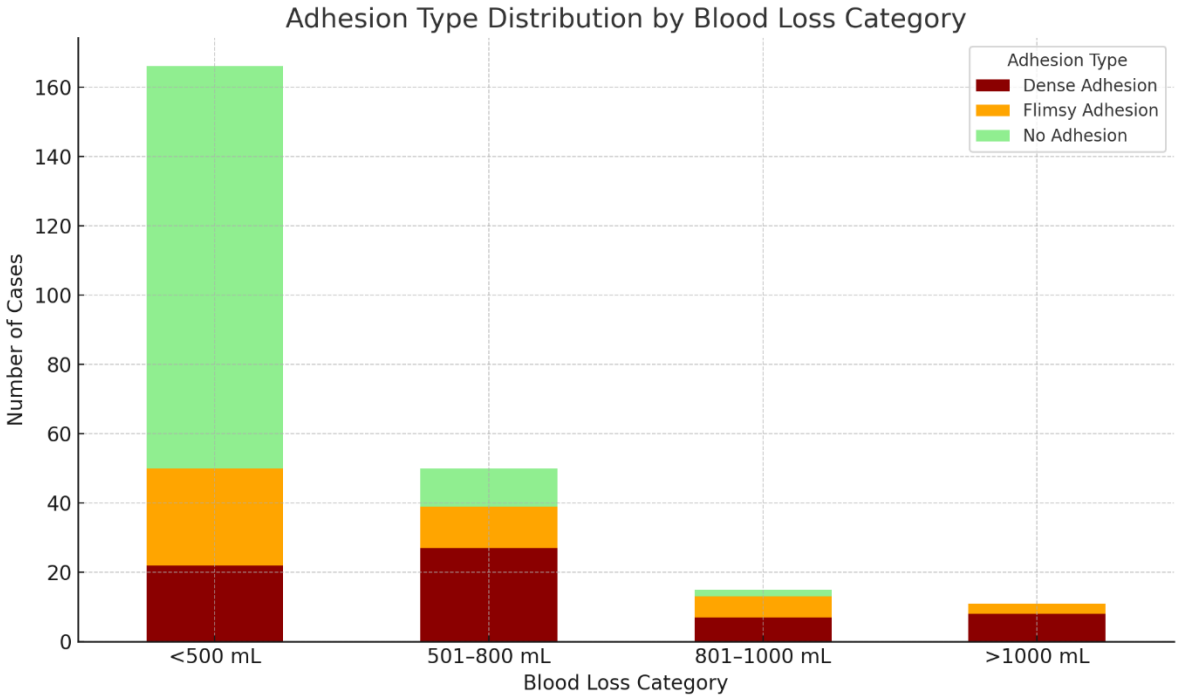


Table 6: Association between Adhesion Severity and Neonatal ICU Admission.

Association Between Adhesion severity and Neonatal ICU Admission Among Study Subjects.

NICU Admission	Dense	Flimsy	No Adhesion	Total	p-value (Cramér's V)
Admitted	31 (59.6%)	9 (17.3%)	12 (23.1%)	52 (100%)	**0.018 (0.178)**
Not Admitted	77 (38.3%)	44 (21.9%)	80 (39.8%)	201 (100%)	
Total	108 (42.7%)	53 (20.9%)	92 (36.4%)	253 (100%)	**0.018 (0.178)**

- In this study, among NICU-admitted neonates, 59.6% were delivered via dense adhesions, compared to 38.3% in the non-admitted group. This difference was statistically significant (p = 0.018) with a Cramér's V of 0.178, indicating a moderate association.