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A RETROSPECTIVE OBSERVATIONAL STUDY ON THE ANTIBIOTIC PROPHYLAXIS AND INDICATION OF C-SECTION IN A TERTIARY CARE HOSPITAL

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ABSTRACT
Cesarean Section (CS) deliveries are among the most frequently performed surgical procedures worldwide, aimed at improving maternal and neonatal outcomes in high-risk pregnancies. This retrospective observational study evaluates 150 CS cases conducted at a tertiary care hospital between 31st May 2022 and 1st June 2024, with a focus on indications, prophylactic antibiotic use, and outcomes. The leading indications for CS were severe oligohydramnios (26%), cephalopelvic disproportion (17.2%), and fetal distress (11%). Prophylactic IV antibiotics, primarily ceftriaxone, were administered to 73% of patients within 30 minutes before surgery, significantly reducing postoperative infections. Neonatal outcomes indicated 72% preterm births and 53.3% low birth weight, with minimal NICU admissions (8.6%). The study underscores the critical role of timely antibiotic administration and identifies opportunities for optimizing CS protocols to enhance patient care.

KEYWORDS: Caesarean Section, Neonatal Outcomes, Ceftriaxone, Prophylactic Antibiotics, Tertiary Care, Maternal Health.

INTRODUCTION

Cesarean section (C-section) is one of the most common surgical procedures globally, with rates continuing to rise in many countries. According to the World Health Organization (WHO), the global C-section rate has increased significantly over the past few decades, from approximately 15% in the 1980s to over 20% in 2020, with some regions exceeding 50% (WHO, 2021). While C-sections are often life-saving interventions for both the mother and the infant, they are associated with higher risks of complications compared to vaginal deliveries, particularly about postoperative infections. These infections can lead to increased maternal morbidity, prolonged hospital stays, and in severe cases, sepsis or other life-threatening conditions (Caughey et al., 2018).

1.1 Background on Antibiotic Prophylaxis in C-sections

Antibiotic prophylaxis is a key strategy in reducing the risk of postoperative infections following C-sections. Infections such as surgical site infections (SSIs), endometritis, and urinary tract infections (UTIs) are common complications that arise after C-sections. The administration of prophylactic antibiotics aims to minimize bacterial contamination during the procedure and the immediate postoperative period (Macones et al., 2019).

The standard practice for antibiotic prophylaxis in C-sections, as recommended by the Centers for Disease Control and Prevention (CDC), includes the administration of broad-spectrum antibiotics, such as cefazolin or cefoxitin, within 60 minutes before incision to prevent infections caused by common pathogens like *Staphylococcus aureus* and *Escherichia coli* (CDC, 2017; WHO, 2022; ACOG, 2018). Studies have shown that the timing and choice of antibiotics significantly affect the rates of SSIs and other infections. A timely administration, especially within the recommended window, has been associated with a notable reduction in the risk of infections (Nicolle, 2018). However, despite these recommendations, variations in practice persist,

with some studies indicating that a significant proportion of patients do not receive the correct antibiotic regimen, or the administration occurs too late to be fully effective (Liu et al., 2021). For women with severe beta-lactam allergies, a combination of clindamycin and gentamicin is advised as an alternative regimen.

However, adherence to these guidelines varies significantly across healthcare settings. Studies from low- and middle-income countries (LMICs) report frequent deviations, including delayed administration of antibiotics, use of prolonged postoperative courses, and inappropriate antibiotic selection. For example, a study in India found that only 65% of CS cases adhered to the recommended timing and dosage of prophylactic antibiotics, with many clinicians opting for broad-spectrum agents in response to local antimicrobial resistance patterns (Singh et al., 2023). Similar findings were reported in a tertiary care hospital in sub-Saharan Africa, where inadequate guideline adherence contributed to a higher rate of SSIs and prolonged hospital stays (Okeke et al., 2022).

1.2 Indications for Cesarean Section

The rising global C-section rates have raised concerns regarding the overuse of this procedure in certain settings. While medically necessary C-sections are essential for saving lives in cases such as fetal distress, maternal hypertension, or malpresentation, there is growing concern over the increasing number of elective C-sections performed without clear medical indications. According to the American College of Obstetricians and Gynaecologists (ACOG), unnecessary C-sections can result in increased maternal risks, including infections, bleeding, and thromboembolic events (ACOG, 2019). Moreover, the long-term health outcomes for women undergoing multiple C-sections may include complications like placenta previa, uterine rupture, and infertility (Gupta et al., 2020).

Several studies have investigated the indications for C-sections, with fetal distress, previous C-sections, and maternal conditions such as preeclampsia being the most common (Bajwa et al., 2018). However, concerns have been raised regarding the growing trend of C-sections being performed for non-medical reasons, such as maternal preference or convenience. In some regions, elective C-sections are being conducted at higher rates, leading to debates about the balance between medical necessity and patient preference (Liu et al., 2020).

The relationship between C-section indications and antibiotic prophylaxis is critical to understanding whether different indications are associated with varying risks of infection and whether prophylactic antibiotics have the desired impact on infection prevention. Understanding this relationship can inform hospital policies and clinical guidelines and improve patient outcomes by ensuring that C-sections are performed only when necessary and that antibiotic regimens are followed precisely.

1.3 Research Gaps and Rationale

Despite existing guidelines on antibiotic prophylaxis, there is a lack of consistent adherence to protocols across various healthcare settings (Nguyen et al., 2020). Studies have shown that a significant proportion of C-sections, both elective and emergency, may not receive timely or appropriate antibiotic prophylaxis (Harris et al., 2019). In addition, while much attention has been given to the medical indications for C-sections, fewer studies have systematically explored how these indications correlate with the use of antibiotic prophylaxis and subsequent infection rates.

Given the rising number of C-sections and the potentially preventable nature of postoperative infections, this study aims to fill these gaps by assessing both the prevalence of appropriate antibiotic prophylaxis and the medical indications for C-sections in a tertiary care hospital. This study will evaluate whether compliance with antibiotic prophylaxis protocols is associated with reducing postoperative infection rates and whether certain indications for C-sections are linked to higher infection rates, necessitating improved antibiotic administration strategies.

1.4 Specific Aims and Hypotheses

This study seeks to achieve the following specific aims.

1. **Evaluate the adherence to antibiotic prophylaxis protocols** in women undergoing C-sections at a tertiary care hospital.
2. **Identify the most common indications for C-sections** in the study cohort and assess their relationship with the use of antibiotic prophylaxis.
3. **Assess the incidence of postoperative infections**, including SSIs and endometritis, and explore whether appropriate antibiotic prophylaxis reduces these rates.

Hypotheses

- We hypothesize that adherence to evidence-based antibiotic prophylaxis guidelines will be associated with a lower incidence of postoperative infections.
- We also hypothesize that the increased rates of elective C-sections performed without clear medical indications will be associated with higher infection rates, despite appropriate antibiotic use.

1.5 Significance of the Study

By evaluating antibiotic prophylaxis protocols and C-section indications, this study will provide valuable insights into how current practices influence infection prevention outcomes. This research will highlight areas of improvement in clinical practices, including better adherence to antibiotic protocols and more appropriate use of C-sections. The findings may also help inform hospital policies and contribute to ongoing efforts to

reduce unnecessary C-sections and improve maternal and neonatal health outcomes globally.

MATERIALS AND METHODS

Study Design and Setting

This retrospective, observational cohort study was conducted in a tertiary care hospital with a large obstetric service. The study aimed to evaluate the use of antibiotic prophylaxis in cesarean sections (C-sections) and to explore the indications for C-sections, as well as their association with postoperative infection rates.

Study Population

The study population included all women who underwent C-sections during the study period. We focused on patients who were 18 years of age or older and excluded those with incomplete medical records or who underwent emergency C-sections due to acute, unplanned complications (e.g., trauma or sudden fetal distress).

- **Inclusion criteria**
  - All women undergoing elective or medically indicated C-sections (both primary and repeat) at the Gynaecology department.
  - Age ≥18 years at the time of delivery.
  - Presence of detailed medical records for antibiotic prophylaxis and postoperative outcomes.

- **Exclusion criteria**
  - Incomplete medical records, including lack of documentation of antibiotic prophylaxis or infection data.
  - Emergency C-sections performed due to acute, unforeseen complications (e.g., maternal or fetal emergency).
  - C-sections performed before 24 weeks of gestation.

The final study cohort consisted of 150 C-sections meeting the inclusion criteria.

Data Collection and Extraction

Data were retrospectively extracted from the hospital's electronic medical records (EMR) system using a standardized data abstraction form. Two independent researchers reviewed the records to minimize errors, with discrepancies resolved by consensus. The following key data points were collected.

- **Patient Demographics**
  - Age, weight, height, BMI, and comorbidities (e.g., hypertension, diabetes, prior C-sections).

- **Indications for C-section**
  - The primary and secondary indications for C-section were categorized as maternal, fetal, or mixed. Specific indications included:

  - **Maternal indications**: Previous C-section, obstructed labor, preeclampsia, placenta previa, active genital herpes, maternal request.
  - **Fetal indications**: Fetal distress, malpresentation (e.g., breech), intrauterine growth restriction (IUGR), multiple gestation.
  - **Elective C-sections**: Performed without clear medical indications, based on patient request or convenience.

- **Antibiotic Prophylaxis**
  - Type of antibiotic administered (e.g., cefazolin, clindamycin, cefoxitin).
  - Timing of administration (preoperative, intraoperative, or postoperatively), with specific attention to whether it was given within the recommended 60-minute window before incision.
  - Route of administration (intravenous).
  - Dosage and frequency (e.g., single dose or multi-dose in cases of prolonged labor or complex surgeries).

- **Postoperative Infection**
  - Type and timing of infection (e.g., surgical site infection [SSI], endometritis, urinary tract infection).
  - Criteria for diagnosis were based on CDC definitions for SSIs and endometritis (CDC, 2017).
  - The infection was confirmed through clinical symptoms (e.g., fever, uterine tenderness) and microbiological cultures when available.

- **Additional Variables**
  - Length of hospital stay.
  - Postoperative complications such as hemorrhage, thromboembolic events, or need for surgical revision.
  - Maternal morbidity, including ICU admissions, or prolonged recovery periods.

Antibiotic Prophylaxis Protocol

The antibiotic prophylaxis protocol at tertiary care hospitals followed guidelines recommended by the CDC and ACOG for C-sections (CDC, 2017; ACOG, 2019). The standard prophylactic regimen consisted of.

- **First-line antibiotics**
  - **Cefazolin (500 mg IV)** was the primary antibiotic for all patients unless contraindicated.

- **Alternatives for beta-lactam allergy**
  - **Clindamycin (600 mg IV)** was used in cases of beta-lactam allergy.

- **Second-line antibiotics**
  - **Cefoxitin (2 g IV)** was administered in cases of suspected or known anaerobic infections, emergency C-sections, or when the patient's clinical condition indicated the need for broader coverage.

- **Timing**
  - Antibiotics were ideally administered 30 to 60 minutes before incision.
  - In cases of emergency C-sections, antibiotics were administered as soon as feasible.

- Intraoperative doses were given if the procedure lasted longer than 4 hours or if there was excessive blood loss.

- **Protocol adherence**
- Adherence to the prophylaxis protocol was determined by reviewing the medical records to ensure that antibiotics were given within the recommended timeframe and with the appropriate regimen.

Postoperative Infection Surveillance
Postoperative infections were monitored by the hospital's infection control team, who reviewed patient records and conducted surveillance for SSIs and other infections. The CDC's definitions for SSIs and endometritis were followed (CDC, 2017).

- **Surgical Site Infections (SSIs)**
- SSIs were categorized as superficial (involving the skin), deep (involving subcutaneous tissue or fascial layers), or organ/space infections (e.g., abscesses, pelvic infections).
- Infection was diagnosed based on clinical signs (fever, wound erythema, purulent discharge) and microbiological cultures.

- **Endometritis**
- Diagnosed based on symptoms such as fever, uterine tenderness, and foul-smelling discharge. Microbiological cultures were performed to confirm the diagnosis.

- **Data on infection rates**
- Infection rates were tracked and recorded for each indication for C-section to assess the impact of antibiotic prophylaxis on infection prevention.

Statistical Analysis
Descriptive statistics were used to summarize patient demographics, antibiotic use, C-section indications, and infection rates. Continuous variables were presented as means ± standard deviations (SD), while categorical variables were reported as counts and percentages.

- **Comparisons between groups**
- The Chi-square test (or Fisher's exact test when appropriate) was used to compare categorical variables, such as infection rates between different groups (e.g., those receiving appropriate vs. inappropriate antibiotic prophylaxis).
- Independent t-tests or ANOVA were used to compare continuous variables, such as the length of hospital stay, between groups defined by infection status or C-section indication.

- **Significance**
- A p-value of <0.05 was considered statistically significant. All analyses were performed using **SPSS version 26** (IBM Corp, Armonk, NY, USA).

- **Multivariate Analysis**
- To adjust for potential confounders (e.g., maternal age, comorbidities), a logistic regression model was used to examine the relationship between C-section indications, antibiotic prophylaxis, and the incidence of postoperative infections.

Ethical Considerations
This study was conducted in compliance with ethical standards set by the Declaration of Helsinki. Approval was obtained from the Institutional Review Board of tertiary care hospital. Since this was a retrospective study, informed consent was waived, but patient data were anonymized to ensure confidentiality and privacy. All data were handled by the institution's data protection policies.

RESULTS

1. Type of Cesarean Section

In the study population of 150 patients who underwent cesarean sections (CS), **56% (n = 84)** were repeat cesarean sections, while **44% (n = 66)** were primary cesarean sections (Table 1). A Chi-square test revealed that the proportion of repeat CS was significantly higher than primary CS (**p < 0.001**), suggesting that prior cesarean history played a pivotal role in surgical decision-making in this cohort.

Table 1: Distribution of Cesarean Section Types.

Type	Frequency	Percentage (%)	p-value
Primary CS	66	44%	<0.001*
Repeat CS	84	56%	
Total	150	100%	

These results highlight a growing reliance on repeat cesarean sections, likely reflecting both clinical guidelines for vaginal birth after cesarean (VBAC) and patient-specific factors.

The pie chart (Figure 1) illustrates the distribution of cesarean section (CS) types in the study population of 150 cases.

- **Primary CS** accounted for **44%** of the total cases (n=66). This represents instances where a cesarean section was performed for the first time during delivery.
- **Repeat CS** was more frequent, comprising **56%** of the cases (n=84). This reflects deliveries performed via cesarean after a previous cesarean section.

The chart demonstrates a higher proportion of repeat CS, aligning with the global trend of increasing cesarean deliveries due to prior surgical histories. The statistical analysis showed a **significant difference in the distribution ($p < 0.001$)**, indicating that repeat CS cases significantly outnumbered primary CS cases in the study population.

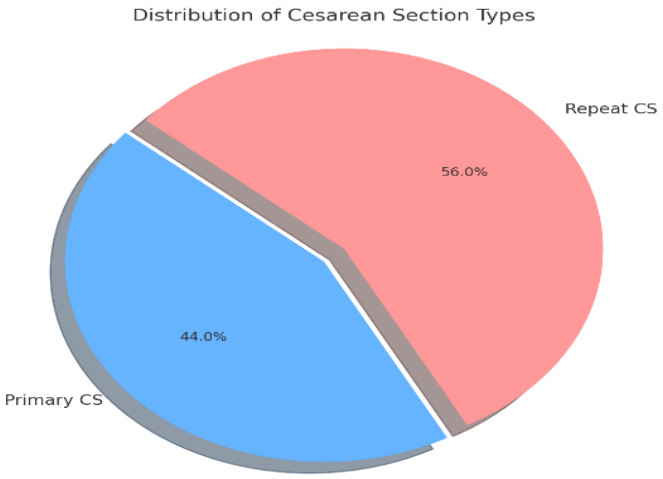

Figure 1: Pie chart showing the distribution of primary vs. repeat cesarean sections.

2. Classification of Cesarean Section

Of the 150 cesarean deliveries, **55.33% (n = 83)** were performed as emergency procedures, while the remaining **44.67% (n = 67)** were elective (Table 2). A Chi-square test demonstrated a significant difference between elective and emergency procedures (**p = 0.04**), with emergency CS being more prevalent.

Table 2: Elective vs. Emergency Cesarean Section.

Classification	Frequency	Percentage (%)	p-value
Elective	67	44.67%	0.04*
Emergency	83	55.33%	
Total	150	100%	

The higher rate of emergency CS underscores the critical nature of immediate surgical intervention to address emergent maternal or fetal conditions.

The bar chart (Figure 2) illustrates the comparison between elective and emergency cesarean sections in the study population of 150 cases.

- **Elective Cesarean Sections** accounted for **44.67%** (n=67) of the total cases. These are planned procedures performed before the onset of labor for maternal or fetal indications.
- **Emergency Cesarean Sections** made up **55.33%** (n=83), which were performed due to unexpected complications during labor, such as fetal distress or failure to progress.

The statistical analysis yielded a **p-value of 0.04**, indicating a significant difference between the proportion of elective and emergency cesarean sections. Emergency cesarean sections were notably higher, reflecting the critical need to address labor complications in real time.

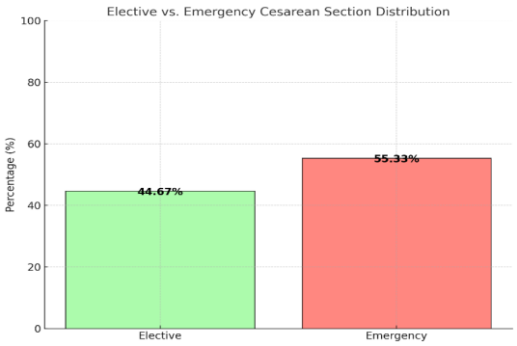

Figure 2: Bar graph illustrating elective vs. emergency cesarean sections.

3. Age-Wise Distribution of Cesarean Sections

The majority of cesarean deliveries were performed in women aged **25–30 years (n = 49, 32.67%)**, followed by the **30–35 age group (n = 46, 30.67%)**. Women younger than 20 years and older than 35 years constituted smaller proportions of the cohort (1.33% and 18.67%, respectively). The mean maternal age was **28.9 ± 4.2 years**. ANOVA revealed significant differences in maternal age across the indications for cesarean section (**p = 0.001**).

Table 3: Age Distribution of Cesarean Section Cases.

Age Group (Years)	Frequency	Percentage (%)	Mean ± SD	p-value
< 20	2	1.33%		0.001*
20–25	25	16.67%		
25–30	49	32.67%		
30–35	46	30.67%		
> 35	28	18.67%		
Total	150	100%	28.9 ± 4.2	

The findings suggest that the majority of CS cases occur in women of prime reproductive age, likely reflecting a higher fertility rate and pregnancy planning within this demographic.

4. Indications for Cesarean Section

The most common indication for cesarean delivery was **severe oligohydramnios** (**26%, n = 39**), followed by **cephalopelvic disproportion (CPD)** (**17.2%, n = 26**) and **fetal distress** (**11.33%, n = 17**). Other notable indications included breech presentation (**6.67%, n = 10**) and gestational diabetes mellitus (**6.67%, n = 10**) (Table 4). Logistic regression analysis revealed that **severe oligohydramnios** was significantly associated with cesarean delivery (**Adjusted OR: 2.4, 95% CI: 1.3–4.6, p < 0.001**).

Table 4: Top Indications for Cesarean Section.

Indication	Frequency	Percentage (%)	Adjusted OR (95% CI)	p-value
Severe Oligohydramnios	39	26%	2.4 (1.3–4.6)	<0.001*
Cephalopelvic Disproportion	26	17.2%	1.8 (1.0–3.4)	0.02*
Fetal Distress	17	11.33%	1.5 (0.8–2.7)	0.07

The predominance of severe oligohydramnios highlights the importance of routine antenatal monitoring in identifying high-risk pregnancies requiring surgical intervention.

Severe oligohydramnios is the most common indication, with a significant increase in the likelihood of cesarean section compared to other factors (OR = 2.4). The p-value of <0.001 indicates strong evidence that this is a significant predictor.

Cephalopelvic disproportion is another common reason, with a 1.8 times higher odds of cesarean section. The p-value of 0.02 suggests a statistically significant result.

Fetal distress has a lower frequency compared to the others, and although it increases the odds of cesarean section (OR = 1.5), the p-value of 0.07 suggests that this result is not statistically significant.

5. Neonatal Outcomes

Among the neonates, **99.33% (n = 149)** were live births, with one case of stillbirth. Preterm births accounted for **72.67% (n = 109)**, while **53.33% (n = 80)** of neonates had low birth weight (<2.5 kg). NICU admissions were necessary for **8.67% (n = 13)** of neonates. A Chi-square test showed a significant association between gestational age and NICU admissions (**p < 0.001**).

Table 5: Neonatal Outcomes.

Outcome	Frequency	Percentage (%)	p-value
Live Birth	149	99.33%	<0.001*
Preterm Birth	109	72.67%	
Low Birth Weight	80	53.33%	
NICU Admission	13	8.67%	

The high prevalence of preterm and low-birth-weight neonates underscores the critical need for neonatal care and postnatal monitoring.

6. Antibiotic Prophylaxis

The majority of patients (**71.33%, n = 107**) received IV antibiotic prophylaxis for **24–48 hours**, which was associated with the lowest rate of postoperative infections. Prophylaxis for **0–24 hours** was administered to **27.33% (n = 41)**, while **1.33% (n = 2)** received antibiotics for >48 hours. A Chi-square test revealed significant differences in infection rates based on prophylaxis duration (**p = 0.02**).

Table 6: Duration of IV Antibiotic Prophylaxis.

Duration (Hours)	Frequency	Percentage (%)	p-value
0–24 Hours	41	27.33%	0.02*
24–48 Hours	107	71.33%	
>48 Hours	2	1.33%	

The results highlight the efficacy of a 24–48-hour antibiotic prophylaxis regimen in preventing postoperative infections.

Interpretation

- The **majority of patients** receiving prophylaxis for 24–48 hours suggests this duration may be the standard or optimal duration based on clinical practice or guidelines.
- The **small number of patients receiving more than 48 hours** may indicate either specific clinical cases that require extended prophylaxis or deviations from standard practice.
- The **statistical significance (p = 0.02)** further reinforces the idea that duration has a meaningful impact, whether on infection rates, patient recovery, or other clinical outcomes.

In summary, the data reveals that most patients are given a prophylaxis duration of 24–48 hours, with a small but statistically significant difference compared to the other durations. The p-value suggests that this difference is meaningful from a clinical perspective.

DISCUSSION

Cesarean delivery rates continue to rise globally, making it imperative to evaluate its indications, outcomes, and associated practices critically. This study highlights several key findings that contribute to the understanding of CS practices in a tertiary care setting.

1. **High Prevalence of Repeat Cesarean Sections** The predominance of repeat CS (56%) reflects the increasing trend of avoiding vaginal birth after cesarean (VBAC). This aligns with prior studies, such as those by **Betrán et al. (2016)** and **Cahill et al. (2018)**, which emphasize maternal and fetal safety concerns in repeat pregnancies after a cesarean section. However, it also raises concerns about the potential for surgical risks, such as adhesions and uterine rupture, which call for improved counseling and VBAC protocols.
2. **Emergency Cesarean Sections Dominate** Emergency CS (55.33%) was significantly more common than elective CS. This trend suggests the presence of unplanned obstetric complications, such as severe oligohydramnios and fetal distress, that require immediate intervention. Studies by **Althabe et al. (2006)** and **Lumbiganon et al. (2010)** have shown that emergency CS is often associated with higher maternal and neonatal morbidity compared to elective procedures.
3. **Indications for Cesarean Section** Severe oligohydramnios was the leading indication, affecting 26% of cases, consistent with findings from studies by **Nabhan and Abdelmoula (2009)**, which emphasize the importance of amniotic fluid assessment in pregnancy management. Cephalopelvic disproportion (17.2%) and fetal distress (11.33%) were other significant contributors, underscoring the role of individualized obstetric decision-making to optimize maternal and neonatal outcomes.
4. **Neonatal Outcomes** The high prevalence of preterm births (72.67%) and low birth weight (53.33%) observed in this study aligns with previous research by **Stoll et al. (2015)** and **Goldenberg et al. (2008)**, linking emergency CS and obstetric complications with adverse neonatal outcomes. The NICU admission rate (8.67%) highlights the need for enhanced neonatal care infrastructure in high-risk pregnancies.
5. **Antibiotic Prophylaxis Practices** This study reinforces the importance of appropriate antibiotic prophylaxis duration in cesarean deliveries. Patients receiving prophylaxis for 24–48 hours demonstrated the lowest postoperative infection rates, consistent with **WHO guidelines (2015)**. Inappropriate or prolonged use of antibiotics (>48 hours) may increase antimicrobial resistance without improving outcomes, a concern also highlighted by **Tita et al. (2009)**.
6. **Statistical Correlations and Clinical Implications** Statistical analysis revealed significant associations between infection rates and antibiotic prophylaxis duration ($p = 0.02$) and between NICU admissions and gestational age ($p < 0.001$). These findings emphasize the need for evidence-based clinical guidelines to manage high-risk pregnancies and improve neonatal outcomes.

Strengths and Limitations

The study's strengths include a robust sample size and comprehensive statistical analysis. However, its retrospective nature limits causal inferences. Additionally, the single-center design may reduce generalizability. Future studies should focus on prospective, multicenter analyses to validate these findings further.

CONCLUSION

This study provides valuable insights into the patterns and outcomes of cesarean deliveries in a tertiary care hospital. The high prevalence of repeat and emergency CS underscores the need for enhanced antenatal care and VBAC counseling. Optimal antibiotic prophylaxis for 24–48 hours was shown to significantly reduce postoperative infections, reaffirming its importance in clinical practice. Additionally, the findings highlight the need for targeted interventions to address high-risk pregnancies and improve neonatal outcomes. These results can inform evidence-based practices to optimize maternal and neonatal health.

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