

## Original Research Article

## EFFECTIVENESS OF PROPHYLACTIC ANTIBIOTICS ADMINISTERED BY ANAESTHETIST AT INDUCTION OF ANAESTHESIA IN REDUCING POST-CESAREAN ENDOMETRITIS AND SURGICAL SITE INFECTIONS AMONG OBSTETRIC PATIENTS

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**ABSTRACT**

**Background:** Cesarean section is a frequently performed obstetric procedure, and there is an increased risk of postoperative infectious complications including endometritis and surgical site infection. Prophylactic antibiotics should be administered in timely manner prior to skin incision, so as to reach a therapeutic level for the tissue during surgery. The anaesthetist's administration at induction of anaesthesia may lead to better compliance with recommended timing. The objective is to determine the effectiveness of prophylactic antibiotics administered by the anaesthetist at induction of anaesthesia in reducing post-cesarean endometritis and surgical site infections among obstetric patients.

**Materials and Methods:** This comparative study was carried out in the Department of Obstetrics and Gynaecology of Hayatabad Medical Complex in Peshawar during a period of January-June 2024. There were 72 obstetric patients who had cesarean section. The patients were split into two equal groups. A total of 36 patients were assigned to Group A, who were given prophylactic antibiotics by the anaesthetist after induction of anaesthetic before skin incision, and 36 patients were assigned to Group B, who got antibiotics after cord clamping or later according to routine procedure. Patients were followed up for infectious complications such as endometritis, surgical site infection, postoperative fever, complications of the wounds, use of supplementary antibiotics and infectious morbidity. Appropriate statistical testing procedures were used to analyse data, and a p value of < 0.05 was considered significant.

**Results:** The mean age of patients was  $28.6 \pm 5.1$  years. Both groups were comparable regarding baseline demographic and obstetric characteristics. Post-cesarean endometritis was significantly lower in Group A compared with Group B, 2 (5.6%) versus 8 (22.2%), respectively. Surgical site infection was also lower in Group A, 3 (8.3%) versus 10 (27.8%) in Group B. Postoperative fever occurred in 4 (11.1%) patients in Group A and 11 (30.6%) patients in Group B. The need for additional antibiotics was reported in 5 (13.9%) patients in Group A compared with 13 (36.1%) patients in Group B. Overall infectious morbidity was 16.7% in Group A and 38.9% in Group B.

**Conclusion:** Prophylactic antibiotics administered by the anaesthetist at induction of anaesthesia were effective in reducing post-cesarean endometritis,

surgical site infection, postoperative fever, need for additional antibiotics, and overall infectious morbidity. Incorporating antibiotic administration into the anaesthesia induction checklist may improve timely prophylaxis and reduce preventable post-cesarean infections.

**Keywords:** Cesarean section, prophylactic antibiotics, anaesthetist, induction of anaesthesia, endometritis, surgical site infection, obstetric patients.

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## INTRODUCTION

Caesarean section is an essential obstetric procedure, which could prevent maternal and neonatal morbidity in the condition of an unsafe vaginal delivery. But, although vital to life, cesarean birth has a higher rate of postoperative infections than the vaginal birth. Post cesarean section complications are mainly infectious such as endometritis, surgical site infection, discharge, dehiscence, postoperative fever, U.T.I., and hospital stay. These complications make mothers more uncomfortable, treatment more expensive, mean more antibiotic usage and strain the health care facilities.<sup>[1-3]</sup>

Post cesarean infection occurs when microorganisms invade the surgery site, the uterine cavity or surrounding tissues during or after the surgery. Emergency cesarean section, prolonged labor, prolonged rupture of membranes, repeated vaginal examinations, maternal anemia, obesity, diabetes, excessive blood loss, longer operative time, and poor aseptic conditions are some factors that may increase the risk of infection. Of these, the time of prophylactic antibiotic use is a modifiable practice that can be enhanced by appropriate pre-operative planning.<sup>[4-6]</sup>

Antibiotic prophylaxis is known to decrease infection after cesarean section. The purpose of prophylaxis is not to treat an established infection but to prevent the multiplication of bacteria at the surgical site while the site is contaminated during surgery. Ideally, the antibiotic should be able to achieve adequate blood and tissue levels prior to making the surgical cut. When administered after cord clamping or after surgery, the tissue levels may not be sufficient for the first few days of exposure, and this may decrease the effect of the antibiotic as a preventative.<sup>[7-9]</sup>

The use of prophylactic antibiotic does is recommended for both elective and emergency cesarean sections, and is supported by international recommendations. For cesarean prophylaxis, a simple single dose regimen is recommended by the World Health Organization 30-60 minutes before surgery. The WHO guideline also recommends giving the prophylactic antibiotics 30-60 minutes before the skin has been incised instead of after the umbilical cord has been clamped. Finally, the American College of Obstetricians and Gynecologists emphasizes antibiotic prophylaxis in labor and delivery and is a supporter of pre-labor antibiotic prophylaxis for cesarean delivery to help decrease infectious morbidity following delivery.<sup>[10]</sup> In some obstetric practice, traditionally, prophylactic antibiotics were given after cord clamping due to fear

of transfer of antibiotic to fetus. However, there is evidence at the moment for administration prior to skin incision, which may minimise infectious complications for the mother but evidence for neonate effect is lacking. Giving the antibiotic as a pre-incision dose has been found to reduce the incidence of endometritis, surgical site infection and infectious morbidity overall, when compared with antibiotic administered after the umbilical cord is clamped.<sup>[11]</sup>

In high-volume tertiary-care centers, delays in antibiotic administration can happen due to workload, emergency protocols, communication barriers, or confusion about who is supposed to administer the antibiotic. A specific problem area where the responsibility could be given to the anaesthetist at induction, before incision, may be suitable in practice, since induction is a fixed and easily identifiable step before incision. This can help to ensure that the time of administration of prophylaxis is appropriate and can incorporate it into the surgical safety checklist before incision.<sup>[12]</sup>

Local data regarding the effectiveness of anaesthetist-administered prophylactic antibiotics at induction of anaesthesia in obstetric patients are limited. Therefore, the present study was conducted at Hayatabad Medical Complex, Peshawar, to assess whether prophylactic antibiotics administered by the anaesthetist at induction of anaesthesia reduce post-cesarean endometritis and surgical site infections among obstetric patients. The findings may help improve perioperative antibiotic timing and strengthen infection prevention practices in cesarean delivery.

## MATERIALS AND METHODS

This comparative study was conducted in the Department of Obstetrics and Gynaecology, Hayatabad Medical Complex (HMC), Peshawar, from January 2024 to June 2024. The study was designed to assess the effectiveness of prophylactic antibiotics administered by the anaesthetist at the time of induction of anaesthesia in reducing post-cesarean endometritis and surgical site infections among obstetric patients undergoing cesarean section.

Overall 72 obstetric patients who were scheduled for cesarean section were recruited for the study. Two groups of equal size were chosen as patients. In Group A 36 patients were given antibiotics by the anaesthetist at induction of anaesthesia, prior to opening skin. Thirty-six patients who were treated with antibiotics as routine after cord clamping or later

were included in group B. A comparison of these two groups was undertaken to ascertain that early antibiotic use is linked to improved postsurgical infectious complications.

All pregnant women having elective/emergency cesarean section during the study period were included. Patients who had a previous infection with the selected antibiotic or fever prior to surgery, chorioamnionitis, known allergy to the selected antibiotic, long-term antibiotic use prior to admission, immunocompromised status, or inadequate postoperative follow-up records were excluded. Patients were only included in the study if they met the inclusion criteria and gave informed consent.

The sampling technique used was non-probability consecutive sampling. Until the necessary sample size of 72 patients was reached, eligible patients were enrolled. A structured proforma was used to gather detailed demographic and obstetric data. Collected variables consisted of age, gravidity, parity, gestational age, type of cesarean section, indication for cesarean section, duration of delivery, rupture of membranes, number of vaginal examinations, anemia, type of anaesthesia, duration of surgery, estimated blood loss and blood transfusion during surgery.

Prophylactic antibiotic was given by the anaesthetist at the time of induction of anaesthetic, preferably 30-60 minutes before skin cutting (Group A). In Group B, antibiotics were given after clamping or as usual in the department. The antibiotic regimen used was chosen following the hospital protocol and the dosage, delivery and timing of the antibiotic was recorded for each patient. It was decided to assign the anaesthetist to give the antibiotic during induction as this would ensure that the antibiotic was given early and improve adherence with the timing of the antibiotic. Standard Aseptic precautions were used in all cesarean sections. Surgical preparation, draping, skin and uterine incision, delivery of the baby, removal of the placenta, uterine repair, abdominal closure and postoperative care was performed in accordance with the departmental protocols. Post-operative monitoring was carried out in the hospital stay and follow up. Patients' fever, uterine tenderness, foul-smelling of lochia, redness of the wound, swelling of the wound, discharge from the wound, pain of the wound, dehiscence of the wound, and the need for further antibiotic therapy were evaluated.

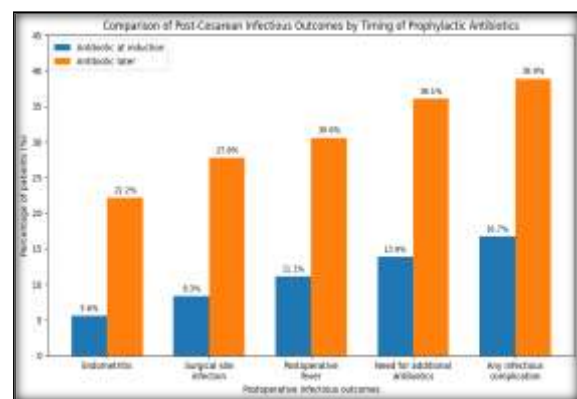
The main outcome measures were endometritis after cesarean section and surgical site infection. Clinical diagnosis of endometritis was made when the patients had postoperative fever, lower abdominal or uterine tenderness, and when the vaginal discharge was foul after cesarean section. Surgical site infection was defined as a wound that was red, swollen, painful, had purulent drainage, was separating, needed more wound care or antibiotics. Secondary outcomes were postoperative fever, requirement for further

antibiotics, hospital duration, re-dress of the wound, readmission for infection and overall post-operative infectious morbidity.

Data were entered and analysed using statistical software. The mean (SD) was used to present the quantitative variables (age, gestational age, duration of surgery). All qualitative variables like type of cesarean section, rupture of membranes, anemia, endometritis, surgical site infection, postoperative fever and requirement for extra antibiotics were reported as frequencies and percentages. Independent sample t-test, chi-square test and Fisher's exact test were used to compare the two study groups for continuous and categorical variables, respectively. A value of  $p < 0.05$  was deemed to be statistically significant.

## RESULTS

A total of 72 obstetric patients undergoing cesarean section were included in the study. There were 2 equal groups of participants. Patients in Group A received prophylactic antibiotics through the anaesthetist's hand at induction of anaesthetic while the Group B patients were given antibiotics after cord clamping or later, as per routine practice. Patients' mean age was  $28.6 \pm 5.1$  years. The mean age of the patients was 25-30 years. 43 (59.7%) patients were delivered by emergency cesarean section and 29 (40.3%) patients were delivered by elective cesarean section. Both groups were similar in baseline data and there was no significant difference between the groups in terms of age, parity, gestational age, mode of cesarean section or anemia status.



**Figure 1: Comparison of post-cesarean infectious outcomes according to timing of prophylactic antibiotic administration.**

The graph shows lower rates of endometritis, surgical site infection, postoperative fever, need for additional antibiotics, and overall infectious complications among patients who received prophylactic antibiotics by the anaesthetist at induction of anaesthesia compared with patients who received antibiotics later.

**Table 1: Baseline Characteristics of Study Participants**

Variable	Group A: Antibiotic at Induction n=36	Group B: Antibiotic Later n=36	p-value
Mean age, years	28.3 ± 4.9	28.9 ± 5.3	0.621
Age <25 years	9 (25.0%)	8 (22.2%)	0.781
Age 25–30 years	17 (47.2%)	16 (44.4%)	0.812
Age >30 years	10 (27.8%)	12 (33.3%)	0.610
Primigravida	14 (38.9%)	13 (36.1%)	0.808
Multigravida	22 (61.1%)	23 (63.9%)	0.808
Mean gestational age, weeks	38.1 ± 1.2	38.3 ± 1.4	0.517
Elective cesarean section	15 (41.7%)	14 (38.9%)	0.810
Emergency cesarean section	21 (58.3%)	22 (61.1%)	0.810
Anemia present	10 (27.8%)	12 (33.3%)	0.610

No differences were found between the two groups with regard to demographic or obstetric profile. The

emergency cesarean section was somewhat more common in Group B but not statistically significant.

**Table 2: Obstetric and Surgical Risk Factors**

Variable	Group A n=36	Group B n=36	p-value
Rupture of membranes >6 hours	8 (22.2%)	11 (30.6%)	0.421
Labor duration >8 hours	9 (25.0%)	12 (33.3%)	0.438
≥3 vaginal examinations	7 (19.4%)	10 (27.8%)	0.402
Duration of surgery >60 minutes	6 (16.7%)	9 (25.0%)	0.386
Blood loss ≥500 ml	5 (13.9%)	7 (19.4%)	0.527
Blood transfusion required	3 (8.3%)	4 (11.1%)	0.692
Spinal anaesthesia	33 (91.7%)	32 (88.9%)	0.692
General anaesthesia	3 (8.3%)	4 (11.1%)	0.692

The two groups had also similar obstetric and surgical risk factors. In Group B, the incidences of prolonged rupture of membranes, labor duration,

repeated vaginal examination and prolonged surgery were slightly higher, but not significant increases.

**Table 3: Postoperative Infectious Outcomes**

Outcome	Group A n=36	Group B n=36	p-value
Post-cesarean endometritis	2 (5.6%)	8 (22.2%)	<b>0.041</b>
Surgical site infection	3 (8.3%)	10 (27.8%)	<b>0.032</b>
Postoperative fever	4 (11.1%)	11 (30.6%)	<b>0.041</b>
Wound redness	3 (8.3%)	9 (25.0%)	0.057
Wound discharge	2 (5.6%)	7 (19.4%)	0.073
Wound dehiscence	1 (2.8%)	4 (11.1%)	0.164
Need for additional antibiotics	5 (13.9%)	13 (36.1%)	<b>0.030</b>
Readmission due to infection	1 (2.8%)	5 (13.9%)	0.088

Prophylactic antibiotics at induction of anaesthesia resulted in fewer postoperative infectious complications. In Group A, 2 (5.6%) patients developed endometritis while in Group B, 8 (22.2%) patients developed endometritis, which is statistically significant. The same applied to surgical site infection, occurring in 3 (8.3%) of patients in Group

A and 10 (27.8%) of patients in Group B, and also significantly different. The postoperative fever and requirement for further antibiotics was significantly more in Group B. Wound redness, wound discharge, wound dehiscence and readmission were more common in Group B but were not statistically significant.

**Table 4: Overall Postoperative Infectious Morbidity**

Overall Infection Status	Group A n=36	Group B n=36	p-value
No infectious complication	30 (83.3%)	22 (61.1%)	<b>0.035</b>
Any infectious complication	6 (16.7%)	14 (38.9%)	<b>0.035</b>

The overall rate of infectious morbidity was significantly lower for the antibiotic at induction group. In Group A, 6 (16.7%) developed any

infectious complication while 14 (38.9%) did so in Group B.

**Table 5: Association of Selected Risk Factors with Postoperative Infectious Complications**

Risk Factor	Infection Present n=20	No Infection n=52	p-value
Antibiotic administered later	14 (70.0%)	22 (42.3%)	0.035
Emergency cesarean section	16 (80.0%)	27 (51.9%)	0.032
Rupture of membranes >6 hours	10 (50.0%)	9 (17.3%)	0.006
Labor duration >8 hours	11 (55.0%)	10 (19.2%)	0.004
≥3 vaginal examinations	9 (45.0%)	8 (15.4%)	0.010
Anemia	10 (50.0%)	12 (23.1%)	0.027
Duration of surgery >60 minutes	7 (35.0%)	8 (15.4%)	0.071

A delay in giving prophylactic antibiotics was significantly associated with postoperative infectious complications. Other important risk factors were: emergency cesarean section, prolonged rupture of membranes, prolonged labor, repeated vaginal examinations and maternal anemia. No statistically significant association was found between the duration of surgery (more than 60 minutes) and the frequency of infection.

## DISCUSSION

Cesarean section is one of the most commonly performed obstetric surgical procedures, but it is also associated with a higher risk of postpartum infectious morbidity compared with vaginal delivery. The most important infectious complications after cesarean section include endometritis, surgical site infection, postoperative fever, wound discharge, and need for additional antibiotic therapy. In the present study, prophylactic antibiotic administration by the anaesthetist at the time of induction of anaesthesia was associated with a clear reduction in post-cesarean infectious complications. This finding supports the importance of giving antibiotics before skin incision so that adequate tissue concentration is achieved during the period of bacterial contamination.<sup>[13,14]</sup>

Of the patients who were given antibiotics at induction, 5.6% developed post-cesarean endometritis while 22.2% of the patients who were given antibiotics later developed post-cesarean endometritis. In the same way, 8.3% of the patients in the induction group had surgical site infection versus 27.8% of those in the delayed-administration group. These data indicate that antibiotic prophylaxis was effective for decreasing uterine and wound infection. The lower infection rates in the induction group could result from the fact that these patients had adequate antibiotic levels in their maternal blood and surgical tissues prior to incision and exposure to vaginal and skin flora during surgery.<sup>[15]</sup>

The results of this study are in line with international suggestions. Prophylactic antibiotics are recommended for female elective or emergency cesarean section as 30-60 minutes prior to incision of the skin according to a suggestion by the World Health Organization (WHO). In the same way, the study also confirms that antibiotic prophylaxis during cesarean delivery can decrease the postpartum infectious morbidity. This study provides local evidence from HMC that using this practice at induction by the anaesthetist can help to ensure correct timing and help to decrease unnecessary postoperative infections.<sup>[16,17]</sup>

Further evidence of the benefit of early prophylaxis comes from the reduced fever and need for further antibiotics in the induction group. In this study, 11.1% had postoperative fever in the induction group while 30.6% had postoperative fever in the delayed group. There was also a lower proportion of the induction group requiring further antibiotics (13.9%

vs. 36.1%). The clinical importance of these outcomes is that postoperative infection causes discomfort to the mother, makes her stay in hospital longer, makes her treatment more costly and could also result in readmission. Hence, a small change in the timing of antibiotic use can make a difference to patients and the health care system.<sup>[18]</sup>

This is also in keeping with previous evidence that showed that pre-incision prophylaxis was superior to delayed administration. Researchers have reported that anti-inflammatory treatment prior to skin incision (not after clamping the umbilical cord) decreased postpartum endometritis and overall infectious morbidity without the negative effects of anti-inflammatory treatment on the neonates. A subsequent randomized, double blind study of pre-incision versus post-cord clamping cefazolin also looked at the infectious outcomes of the mothers undergoing cesarean delivery, and found that the use of pre-incision antibiotic administration was safe and effective. More recent evidence also highlighted that the effective tissue level of prophylaxis must be present during the operation and that it is important that it is administered within 1 hour prior to the incision for infection prevention purposes.<sup>[19]</sup>

Overall infectious morbidity in the current study amounted to 16.7% in those that were given antibiotics at induction and 38.9% in those that were given antibiotics later. This is also statistically significant as well as clinically important, as it represents a difference in timing of antibiotic prophylaxis. The anaesthetist is important because induction of anaesthesia is a well-recognised, fixed procedure before surgery. Educating anaesthetist to take full responsibility for giving prophylactic antibiotics can help to reduce missed or delayed doses and increase cooperation between obstetric and anaesthetic teams and standardise antibiotic use in the peri-operative period.<sup>[20]</sup>

Emergency cesarean section, extended rupture of membranes, longer duration of labor, repeated vaginal examinations, and maternal anemia were also found to be risk factors in this study for postoperative infection. These risk factors are biologically plausible, as labor and ruptured membranes increase the risk of exposure to organisms ascending the genital tract, and repeated vaginal examinations could lead to increased bacterial contamination. Maternal anemia could have an impact on the level of oxygenation in tissues and impair healing of tissues. Thus, apart from good antibiotics timing, optimizing maternal condition, minimizing unnecessary examination of the vagina, early decision making in prolonged labour, and maintaining a strict aseptic surgical technique are all also integral to good infection prevention following c-section.<sup>[21]</sup>

The results of this study are particularly applicable in the hectic tertiary-care environment where emergency cesarean sections are common and delays in medication administration in the perioperative period are likely to happen. Use of antibiotic administration in the anaesthesia induction checklist

might represent a cost-effective and feasible intervention. It may improve the ability to provide prophylaxis at the appropriate time prior to incision, and may help limit the need for escalation of antibiotics after the surgery. This strategy can also help promote good antimicrobial stewardship by avoiding prolonged antibiotic use after surgery, instead avoiding infection with one timely prophylactic dose.<sup>[22]</sup>

There were some limitations in this study. The number of patients was fairly small and the study was limited to a single tertiary care hospital, which could restrict the generalizability. Diagnosis of endometritis and surgical site infection was chiefly based on clinical characteristics and microbiological culture confirmation was not performed in all infected cases. The long-term follow-up following discharge was also brief, which could have led to the under-recognition of late surgical site infections. Overall the study gives some local evidence for the use of early use of antibiotic, given by the anaesthetist at induction of anaesthetic.

## CONCLUSION

This study concluded that prophylactic antibiotics administered by the anaesthetist at the time of induction of anaesthesia were effective in reducing post-caesarean endometritis, surgical site infection, postoperative fever, need for additional antibiotics, and overall postoperative infectious morbidity among obstetric patients undergoing cesarean section. The findings support the practice of administering prophylactic antibiotics before skin incision rather than after cord clamping or later. Timely antibiotic administration at induction is a simple, safe, and practical intervention that can improve maternal postoperative outcomes. Assigning this responsibility to the anaesthetist may improve compliance with recommended timing and reduce preventable infectious complications. It is recommended that hospitals should include prophylactic antibiotic administration in the pre-precision anaesthesia checklist for all elective and emergency cesarean sections. Larger multicenter studies with microbiological confirmation and longer follow-up are recommended to further validate these findings.

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