

# Audit of sepsis in neonatal surgeries at tertiary-care level hospital in India

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## Abstract

**Background:** Postoperative sepsis, which has high morbidity and mortality, is a major problem affecting the outcome of neonatal surgeries. Adequate treatment and preventive measures for sepsis can decrease the morbidity and mortality in neonatal surgeries.

**Objective:** (1) To study the incidence of sepsis in neonatal surgical patients and (2) To study the causative organisms and their sensitivity to antibiotics in such sepsis.

**Materials and Methods:** A prospective, observational study was carried out in the tertiary-care level neonatal intensive care unit of SSG Hospital, Vadodara, Gujarat. Eighty newborns having a major surgery within the first 30 days of life were included in the study. Baseline data of the study participants were collected including antenatal and perinatal histories and evidence of postoperative sepsis. Complete examination and investigations including quantitative C-reactive protein (QCRP), WBC counts, blood culture, and treatment were also included.

**Conclusion:** Incidence of postoperative sepsis in neonates was found to be 73.75%. We found coagulase-negative *Staphylococcus aureus* to be the most common organism (38%) cultured from blood, followed by *Klebsiella* (19%) and *Acinetobacter* (18.2%), which was sensitive to cefotaxime, amikacin, and piperacillin/tazobactam.

**KEY WORDS:** Neonatal surgeries, postoperative sepsis, blood culture, QCRP

## Introduction

There are a number of factors that can affect the outcome of neonatal surgeries, and postoperative sepsis has been regarded as a major problem.<sup>[1]</sup> Although the incidence of sepsis is low in many sophisticated centers, postoperative wound infection and sepsis are, nonetheless, still the major causes of mortality and morbidity, which increase the length

of hospitalization and the cost of treatment in the developing countries.<sup>[2-4]</sup> Poorly developed cell-mediated and humoral immunities may increase the risk of sepsis, which poses a major challenge in the newborn, especially in those delivered preterm,<sup>[5]</sup> and this is compounded by the presence of surgical pathology that may require invasive intervention, which exposes the neonate to infection. Because of this, the morbidity and mortality of postoperative sepsis have been reported to be particularly high in neonates.<sup>[6]</sup> Thus, preventing and treating sepsis remains a major challenge to the pediatrician in the postoperative neonates. Multiple investigations are required in a combined fashion to diagnose postoperative sepsis, which includes quantitative C-reactive protein (QCRP), WBC count, and gold standard blood culture.

In order to avoid postoperative sepsis, empirical antibiotic therapy is commonly performed. Initiation of prophylactic antibiotic(s) before the onset of sepsis has resulted in a

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considerable reduction in postoperative infections in neonates with excellent surgical outcomes.<sup>[7]</sup> But, there is large heterogeneity in the use of perioperative antibiotics. Moreover, their application might enhance selection of otherwise less harmful germs and predispose the patients to superinfection. Besides this, antibiotic prophylaxis might produce resistance to commonly used antibiotics. Thus, a fixed neonatal intensive care unit (NICU) protocol has to be made regarding the use of antibiotics in surgical NICUs. For that, an observational study of different site cultures and a corresponding use of appropriate antibiotics are required, which we have taken care of during this study.

Despite the emergence of newer broad spectrum antibiotics, no single agent has been discovered to give equally effective coverage against all the possible infective bacteria,<sup>[6]</sup> and this is notably so, in many developing countries, where the rarity of such a single agent requires combinations of antibiotic(s) with proven effectiveness against aerobic and anaerobic bacteria that often cause polymicrobial infections.<sup>[6]</sup> Therefore, knowledge of adequate combinations of antibiotics that give the best outcome is important when managing surgical neonates. This makes the base for the study of combination antibiotic therapy.

In view of all these and with the availability of two full-time pediatric surgeons and increased number of referred surgical neonates owing to 108 ambulance service, a study was carried out in the NICU of SSG Hospital, Vadodara, to evaluate the profile of postoperative sepsis in neonates.

### Objective

- (1) To study the incidence of sepsis in neonatal surgical patients.
- (2) To study the causative organisms and their sensitivity to antibiotics in such sepsis.

## Materials and Methods

### Study Setting

The study was conducted at the tertiary-care level NICU of the Department of Pediatrics, SSG hospital, Vadodara, Gujarat, India.

The cohort consisted of neonates admitted in the NICUs (intramural and extramural) from July 2010 to September 2011.

The study was discussed and passed through departmental ethical committee.

### Study Design

This is a prospective, observational study.

### Inclusion Criteria

All neonates in the extramural or intramural intensive care units and wards were included in the study if they satisfied the following criteria:

- Major surgery within the first 30 days of life (surgeries done at operation theaters at surgery wards).

### Exclusion Criteria

- Minor surgical procedures done in NICUs or wards.

These NICU graduates were either inborn (born at Obstetrics Department, SSG Hospital, Vadodara) or outborn and referred to the extramural NICU for further management.

A total of 80 newborns satisfying our inclusion criteria were enrolled in the study. A pro forma was charted out and filled up for each newborn enrolled in the study. Detailed antenatal and perinatal histories were taken. Complete systemic and local examinations were done. Vital signs were noted pre- and postoperatively. The surgical interventions were described in detail with any associated surgical complications. Appropriate investigations for sepsis were applied both pre- and postoperatively. Condition of the baby during transportation, from operation theatres to NICU, was recorded.

### Data Analysis

Data were recorded on a predesigned detailed pro forma and entered on Microsoft Excel worksheet.

## Result

During the study period (July 2010 to September 2011), a total of 4,686 newborns were admitted, of which 3,054 were admitted in the intramural NICU and 1,632 in the extramural NICU. About 80 newborns satisfying the inclusion criteria were enrolled for the study. Incidence of postoperative sepsis in neonates in our study was found to be 73.75%. The rate of postoperative sepsis was high in surgeries of anorectal malformation (37.5%), followed by tracheoesophageal fistula repair (25%). Incidence of sepsis on the basis of blood culture was reported to be 75%. We found coagulase-negative *Staphylococcus aureus* to be the most common organism (38%) cultured from blood.

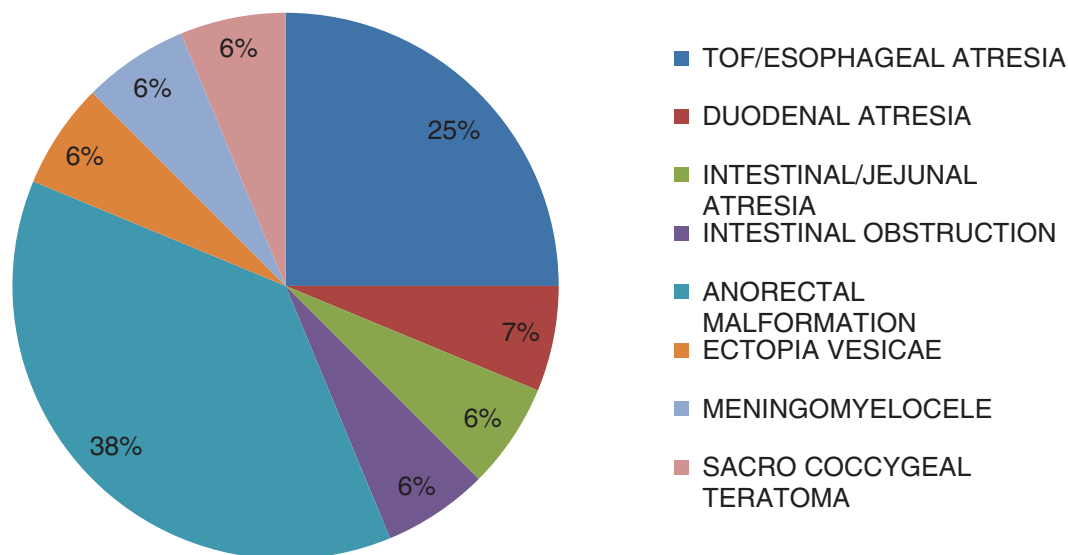
## Discussion

In our study, incidence of postoperative sepsis in neonates was found to be 73.75%.

Kessler et al.<sup>[9]</sup> in their study, reported an incidence of 6.9%, and in the study done by Madden et al.,<sup>[11]</sup> it was 9.8%. These data indicate higher sepsis rate in our setup. The other two studies were done at Switzerland and London, respectively, in well-developed setups; so, their sepsis rate is much low. Hence, precise and well-organized strategies are required in developing countries such as India for the prevention of postoperative sepsis rates. Postoperative sepsis is defined clinically and by laboratory parameters, which include total WBC count, QCRP and blood cultures. Table 1 shows that, of 42 negative QCRP reports preoperatively, 30 turned to be positive postoperatively after 48 hours. According to the study by Chwals et al.,<sup>[10]</sup> CRP levels were clearly superior to all other variables in predicting postoperative infection. So, from these data, we can predict 71.4% cases of postoperative sepsis on the basis of QCRP value, which is very high. These helped us in starting and changing over the antibiotics

**Table 1:** Postoperative sepsis on the basis of QCRP, WBC count, and blood culture

	QCRP, N (%)	WBC counts (<5,000 or >15,000), N (%)	Blood culture, N (%)
Preoperative negative	42	70	16
Postoperative positive	30 (71.4)	19 (27.14)	12 (75)

**Figure 1:** Sepsis in different surgeries.

for the particular cases. Neonates, usually, respond by decreasing total WBC count in infection. So, we have taken postoperative WBC count <5,000 or >15,000 (neonatal sepsis, AIIMS protocol) as a marker of infection. Of 70 normal WBC counts recorded preoperatively, response to infection occurred in 19 cases postoperatively. So, it showed that 27.15% of the total patients were affected by postoperative sepsis on the basis of total WBC count. As per the study by Chwals et al., total WBC count is less reliable in predicting postoperative sepsis. Our data of total WBC count were not comparable with QCRP and blood culture data; so, we did not consider it as a marker for starting and changing antibiotics in postoperative sepsis patients. Of 16 blood culture reports showing no growth preoperatively, 12 turned out to be positive postoperatively. So, there were 75% confirmed cases of postoperative sepsis on the basis of blood culture reports. It is also comparable with QCRP results. From this interpretation, it is evident that QCRP, and not the total WBC count, is a reliable indicator for predicting sepsis. We can directly start antibiotics on the basis of QCRP report itself and need not have to wait for blood culture reports. However, blood culture is the gold standard for diagnosis of septicemia and should be performed in all cases of suspected sepsis. In the study by Kessler et al., coagulase-negative staphylococcal sepsis (CONS) (53%) and, in the study by Osifo et al.,<sup>[11]</sup> *E. coli* and *K. pneumoniae* were the most common organisms in postoperative sepsis. Figure 1 data showed that the rate of

post-operative sepsis was high in surgeries of anorectal malformation (37.5%), followed by tracheo esophageal fistula repair (25%). During our study, total 152 samples (both preoperative and postoperative) of blood were sent for culture and sensitivity test. Of which, 20 showed no growth, 11 samples were grossly contaminated, and so not considered, and 121 samples showed growth of different organisms as shown in Tables 2 and 3. From the data, we found coagulase negative *S. aureus* to be the most common organism (38%) for overall sepsis followed by *Klebsiella* (19%) and *Acinetobacter* (18.2%). In the study by Kessler et al., CONS (53%) and, in the study by Osifo et al.,<sup>[11]</sup> *E. coli* and *K. pneumoniae* were found to be the most common organisms in postoperative sepsis. Considering them as the most common organisms for sepsis in our setup and from their antibiotic sensitivity profile, we recommended combination of any two of cefotaxime, amikacin, and piperacillin/tazobactam as the first line of antibiotic, while imipenem and vancomycin combination as the second-line antibiotic. Linezolid will be reserved as the third-line antibiotic for the management of neonatal sepsis in our setup.

#### Limitations of the Study

1. Facilities for complicated surgeries including congenital heart diseases were not performed in the hospital. So, such patients have to be referred to higher centers for further management.

**Table 2:** Comparison of blood culture and sensitivity: postoperative

	Amikacin, N (%)	Gentamicin, N (%)	Cefotaxime, N (%)	Imipenem, N (%)	Ampicillin + sulbactam, N (%)	Piperacillin + sulbactam, N (%)	Ofloxacin, N (%)	Netilin, N (%)	Ciprofloxacin, N (%)
<i>Acinetobacter</i> (22/121), 18.2%	13 (59.1)	13 (59.1)	15 (68.2)	21 (95.5)	16 (72.7)	20 (90.9)	17 (77.3)	17 (77.3)	16 (72.7)
<i>Klebsiella</i> (23/121), 19%	10 (43.5)	9 (39.1)	8 (34.8)	19 (82.6)	9 (39.1)	18 (78.3)	13 (56.5)	10 (43.5)	9 (39.1)
<i>E. coli</i> (6/121), 4.96%	5 (83.3)	4 (66.7)	4 (66.7)	6 (100)	4 (66.7)	4 (66.7)	4 (66.7)	4 (66.7)	6 (100)
<i>Pseudomonas</i> (3/121), 2.48%	1 (33.3)	0 (0)	0 (0)	2 (66.7)	0 (0)	1 (33.3)	1 (33.3)	0 (0)	0
No organisms (20)									0%

**Table 3:** Comparison of blood culture and sensitivity: postoperative sepsis

	Cefazolin, N (%)	Vancomycin, N (%)	Cefotaxime, N (%)	Ciprofloxacin, N (%)	Ofloxacin, N (%)	Penicillin, N (%)	Amoxicillin clavunolate, N (%)	Cloxacillin, N (%)	Linezolid, N (%)
CONS (46/121), 38%	40 (87)	46 (100)	36 (78.3)	38 (82.6)	43 (93.5)	32 (69.6)	42 (91.3)	37 (80.4)	40 (100) (in 6, sensitivity not done)
<i>S. aureus</i> (16/121), 13.22%	10 (62.5)	16 (100)	7 (43.8)	6 (37.5)	7 (43.8)	5 (31.3)	7 (43.8)	5 (31.3)	13 (100) (in 3, sensitivity not done)
<i>S. pyogenes</i> (2/121), 1.7%	1 (50)	2 (100)	1 (50)	2 (100)	2 (100)	1 (50)	1 (50)	1 (50)	2 (100)
<i>Enterococcus</i> (3/121), 2.5%	1 (33.3)	3 (100)	1 (33.3)	1 (33.3)	1 (33.3)	1 (33.3)	2 (66.7)	1 (33.3)	3 (100)

2. All the investigations for septic screen were not possible owing to nonavailability in the hospital and nonaffordability.
3. Facilities of blood culture and sensitivity for fungus were not available in the hospital; so, fungal sepsis has to be treated clinically and preemptively.

## Conclusion

Precise and well-organized strategies such as prevention of sepsis by handwashing, use of disposables, safe transport of newborn, continuous monitoring, and surveillance of sepsis in NICU and early detection and treatment with sensitive antibiotics according to each NICU's own protocol are required in developing countries such as India for the prevention of postoperative sepsis rates.

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