

## Original Research Article

# Gastric aspirate cytology as a screening tool for neonatal sepsis: a prospective study from a tertiary care centre

Ranjith Kumar\*, Bhaskar Reddy, Chapay Soren, Venkataramana Reddy, Raheemunisa

Department of Pediatrics, SVS Medical College, Mahabubnagar, Telangana, India

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### \*Correspondence:

Dr. Ranjith Kumar,

E-mail: [ranjithnenavath@gmail.com](mailto:ranjithnenavath@gmail.com)

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## ABSTRACT

**Background:** Neonatal sepsis is a clinical syndrome of bacteremia characterized by systemic signs and symptoms of infection in the first 28 days of life. It is responsible for 30-50% of the total neonatal deaths each year in developing countries. Gastric aspirate cytology has been used for neonatal infection. The presence of more than five polymorphs per high power field co-relate with neonatal infection. The objective of the present study was to evaluate the utility of gastric aspirate cytology as a screening tool for neonatal sepsis and to determine the polymorphonuclear leukocytes count in smear of gastric aspirate and correlating it with culture proven sepsis.

**Methods:** This prospective observational study was conducted from February 2017 to January 2018 at level III Neonatal intensive care Unit of Sri Venkata Sai Medical College and Hospital, Mahabubnagar, Telangana. A total of 108 neonates with risk factor and / or clinical features of sepsis were included in the study.

**Results:** Out of 108 neonates, 40 were blood culture positive and 68 were culture negative. Gastric aspirate smear showed  $\geq 5$  polymorphs in 30 and  $< 5$  polymorphs in 10 neonates with positive blood culture. Among blood culture negative cases, 20 had  $\geq 5$  polymorphs and 48 had  $< 5$  polymorphs in gastric aspirate smear. Gastric aspirate culture was positive in 48 neonates and negative in 60 neonates. Of the 48 gastric aspirate positive neonates, 45 had  $\geq 5$  polymorphs and 3 had  $< 5$  polymorphs in gastric aspirate smear. Similarly, among 60 gastric aspirate culture negative neonates, 55 had  $\geq 5$  polymorphs and 3 had  $< 5$  polymorphs in gastric aspirate smear. This was statistically significant ( $P < 0.000001$ ). Of 48 neonates with positive gastric aspirate culture, 30 had positive blood culture and 18 had negative blood culture.

**Conclusions:** Gastric aspirate cytology is a good screening tool for neonatal sepsis added to a detailed perinatal history and clinical examination but does not completely substitute the present day available screening parameters.

**Keywords:** Blood culture, Gastric aspirate, Neonatal sepsis

## INTRODUCTION

Neonatal sepsis is a clinical syndrome of bacteremia characterized by systemic signs and symptoms of infection in the first month of life. It is responsible for 30-50% of the total neonatal deaths each year in developing countries.<sup>1,2</sup> As per National Neonatal Perinatal Database 2002-2003, the incidence of neonatal sepsis in India was 30/1000 live birth.<sup>3</sup> Early diagnosis and treatment of neonatal sepsis is necessary to prevent

serious morbidity and mortality. Blood culture is the gold standard for the diagnosis of neonatal sepsis. However, its positivity rate is low and is affected by blood volume inoculated, prenatal antibiotic use, and level of bacteremia and laboratory capabilities.<sup>4</sup> Neonatal sepsis screening parameters include leucopenia or leucocytosis, toxic granules, and immature neutrophil to total neutrophil ratio, micro-ESR and C-reactive protein. In spite of presence of these screening parameters, there is always an ongoing scrutiny for parameters with ideal

sensitivity and specificity. The present study “gastric aspirate cytology as a screening tool for neonatal sepsis” is least explored and there are very few studies regarding this compared to several established studies.

The objective of the present study was to evaluate the utility of gastric aspirate cytology as a screening tool for neonatal sepsis. And to determine the polymorphonuclear leukocyte count present in peripheral smear of gastric aspirate and correlating it with culture proven sepsis.

## METHODS

This prospective observational study was conducted from February 2017 to January 2018 at level III Neonatal intensive care Unit of Sri Venkata Sai Medical College and Hospital, Mahabubnagar, Telangana.

### Inclusion criteria

- Neonates with risk factor for sepsis: All neonates born to mothers with a history of premature rupture of membranes, prolonged rupture of membranes (>18 hrs), spontaneous preterm onset of labor, clinical chorioamnionitis (maternal fever, tachycardia, purulent vaginal discharge, uterine tenderness), foul smelling liquor, unclean vaginal examinations, maternal fever, maternal urinary or other systemic infections, frequent (>3) per vaginal examinations in labor.
- Neonates with clinical features of sepsis: And all neonates with refusal of feeds, convulsions, lethargy / poor cry, decreased activity, respiratory rate of 60 breaths/ minute or more, grunting, severe chest indrawing, fever (axillary temperature of 37.5°C or more), hypothermia (axillary temperature less than 35.5°C), prolonged capillary refill time (CRT), cyanosis, birth asphyxia, and meconium stained amniotic fluid and /or meconium aspiration syndrome.

### Exclusion criteria

- Neonates born to mothers who were started on antibiotics <4 hrs prior to delivery.
- Neonates who were started on antibiotics prior to the procedures
- Neonates with upper GI tract anomalies like oesophageal atresia, TEF etc; as gastric aspirate could not be collected from them effectively
- Neonates who were fed (breastfed or other feeds) prior to aspiration of gastric fluid.

A detailed antenatal and natal history was obtained. The newborns were examined for vital signs and signs of neonatal sepsis.

5ml of gastric aspirate was obtained in two sterile bottles through nasogastric tube; one for smear with a drop of

heparin (clearing agent) and the other for culture and sensitivity. Gastric aspirate was centrifuged and a drop of it was spread on a clean glass slide with the help of other glass slide. The smear was stained with Leishman stain and was examined for polymorphonuclear leukocytes under light microscopy at high power field (100X) in five fields consecutively and average taken.

The other gastric aspirate was sent for culture and sensitivity simultaneously and cultured by standard microbiological technique.

### Statistical analysis

Data entry was done using MICROSOFT EXCEL 2007. Data analysis was done using EPI. INFO.3.5-3. Data presented as percentages. Chi-square tests applied wherever necessary to find out association between variables.  $p < 0.05$  was taken as significant.

Written consent was obtained from parents of neonates and the study was approved by institutional ethical committee.

## RESULTS

A total of 108 neonates were included in the study, 40 (37.03%) had blood culture proven sepsis and 68 (62.97%) were culture negative. Among the 40-blood culture positive sepsis neonates, 30 (75%) had  $\geq 5$  polymorphs and 10 (25%) had  $< 5$  polymorphs in gastric aspirate smear. Similarly, among 68 culture negative cases, 20 (29.94%) had  $\geq 5$  polymorphs and 48 (70.06%) had  $< 5$  polymorphs in gastric aspirate smear (Table 1). This was statistically significant  $p < 0.00001$ .

**Table 1: Gastric aspirate cellularity and blood culture proven sepsis.**

Gastric aspirate cellularity	Sepsis	No sepsis	Total
$\geq 5$	30	20	50
$< 5$	10	48	58
	40	68	108

Gastric aspirate culture was positive in 48 (44.45%) neonates and negative in 60 (55.55%) neonates. Of the 48 gastric aspirate positive neonates, 45 (93.75%) had  $\geq 5$  polymorphs and 3 (6.25%) had  $< 5$  polymorphs in gastric aspirate smear. Similarly, among 60 gastric aspirate culture negative neonates, 55 (91.67%) had  $\geq 5$  polymorphs and 3 (8.33%) had  $< 5$  polymorphs in gastric aspirate smear (Table 2). This was statistically significant ( $P < 0.000001$ ).

Of 48 neonates with positive gastric aspirate culture, 30 (62.5%) had positive blood culture and 18(37.5%) had only positive gastric aspirate culture with negative blood culture (Table 2).

**Table 2: Correlation between blood culture, gastric aspirate cellularity and gastric aspirate culture.**

Blood culture (sepsis)	Gastric aspirate cellularity		Gastric aspirate culture	
	≥5	<5	+	-
+	30	10	30	10
-	20	48	18	50

## DISCUSSION

Neonatal sepsis is one of the important causes of mortality among neonates. An early diagnosis not only helps in early institution of antibiotic therapy to reduce mortality due to neonatal sepsis but also helps in avoiding the unnecessary treatment of non-infected neonates. Although the blood culture is gold standard in diagnosis, it takes time and often complicated and has low yield.<sup>5</sup> The readily achievable complete blood count and the differential leukocyte count have a relatively poor specificity for diagnosing sepsis.

The associated band count and a leftward shift of the myeloid immaturity measurements may improve the diagnostic yield, but their subjective measurement is problematic. Therefore, the need persists for improved diagnostic indicators of neonatal sepsis. Studies have shown presence of polymorphs in gastric aspirate to represent a fetal intra-amniotic inflammatory response.<sup>6,7</sup> Gastric aspirate cytology is simple and can be done without specially trained staff even in rural hospital settings. This is of great importance in a developing country like ours with a high infection rate and limited resources. In the present study, we evaluated the utility of gastric aspirate cytology as a screening tool for neonatal sepsis.

Forty (37.03%) of 108 neonates had blood culture positive sepsis and 68 (62.97%) were culture negative. Of the blood culture positive sepsis neonates, 30 (75%) had ≥5 polymorphs and 10 (25%) had <5 polymorphs in gastric aspirate smear. This shows gastric aspirate cytology sensitivity of 75% and specificity of 70%. Gastric aspirate cellularity correlates directly with the occurrence of clinical infection. C-reactive protein with gastric aspirate was found to be the best combination with sensitivity of 80% and specificity of 70%.<sup>8</sup>

The combination of C-reactive protein (0.10 mg/l) with abnormal film and/or I/T ratio >0.2 and/or gastric aspirate cytology has been reported to have a sensitivity of 97%, specificity of 61%, NPV of 98%, and likelihood ratio of 49 for early onset neonatal sepsis.<sup>9</sup> The results of the study done by Leivobich et al gastric aspirate cytology had a sensitivity of 75% and specificity of 68%, which is closely approaches with the results of present study.<sup>10</sup>

Gastric aspirate culture was positive in 48 (44.45%) neonates and negative in 60 (55.55%) neonates. Most of

the samples (93.75%) with positive gastric aspirate cultures had polymorph count >5. The correlation between gastric aspirate cytology and gastric aspirate culture was well studied. There was strong correlation between both. Gastric aspirate culture had a sensitivity of 75%, specificity of 73.5%, positive predictive value of 62.25%, and negative predictive value of 83.34%.

In the study done by Kim et al Gastric aspirate cultures positivity had a sensitivity of 14.8%, specificity of 90.2%, and positive predictive value of 13.3% and negative predictive value of 91.2%.<sup>11</sup> The result of this study is in close liaison with the results of present study, which depicts gastric aspirate culture has high specificity and negative predictive values.

## CONCLUSION

Neonatal sepsis is one of the major causes of neonatal mortality and morbidity. High index of suspicion helps in arriving at early diagnosis and appropriate management. Gastric aspirate cytology as a screening tool for neonatal sepsis with intermediate sensitivity, specificity, positive predictive value and negative predictive values serves as good tool, added to a detailed antenatal history and clinical examination of the neonate. Gastric aspirate cytology with its relatively high specificity and negative predictive values serves as a good screening tool to rule out neonates unaffected by sepsis and prevent unnecessary antimicrobial usage.

The value of gastric aspirate cytology as screening tool for neonatal sepsis increases when it is used in conjunction with gastric aspirate culture. Gastric aspirate cytology as a screening tool for neonatal sepsis supplements but does not completely substitute the present day available screening parameters.

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