

Study of efficacy of chest radiograph as an Index for early diagnosis of neonatal septicemia

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Abstract: Septicemia is a generalized bacterial infection documented by positive blood culture. Rapid diagnosis in suspected cases of neonatal septicemia still continues to be challenge to the most neonatologists. Present study was aimed to evaluate the utility of chest radiographs, as an index for early diagnosis of neonatal septicemia. **Material and Methods:** Present study was single-center, prospective, observational study, conducted in neonates (1 to 28 days) with bacteriologically proven septicemia & chest X ray details of 100 radiographs. **Results:** In the present study, there were 63 (63.00%) males and 37 (37.00%) females. Male Female ratio was 1.71. Out of 100 cases 53 were preterm whereas 47 were full terms. In present study, abnormal chest radiographs were in 65.1% male patients and 62.2% female patients. Sex of patient has no relationship with radiographs. the abnormality of chest. ($p>0.05$) We noted a statistically significant relationship in preterm neonates & abnormal chest radiographs, neonates who were having signs of respiratory distress & abnormal chest radiographs, day of onset of illness was more than 3 days, & abnormal chest radiographs. 55 % cases were expired whereas 45 % were improved. In neonates who were having abnormal chest radiographs, mortality was significantly more (72.7%) than those who were having normal chest radiographs. (27.3%) **Conclusion:** The result of present study appears to emphasize the utility of chest radiographs as a tool for early diagnosis of neonatal septicemia, it helps in spot diagnosis.

Keywords: chest radiographs, early diagnosis, neonatal septicemia, spot diagnosis

Introduction:

Septicemia is a generalized bacterial infection documented by positive blood culture.¹ Sepsis is the most common hazards faced by the newborn in our country. Bacterial infection in the newborn still account for a considerable morbidity and mortality. This is partly because the newborn and especially the premature are prone to serious infections by organisms mainly gram negative and partly because (inflammatory) the signs of infections both local and

general (fever etc.) may be absent or minimal and hard to detect.^{2,3} Thus fatal septicemia may occur with little subtle warning.

Neonatal septicemia is preventable and if diagnosed early, the out-come is better. Prognosis /Outcome depends upon the maturity and weight of the baby, promptness and adequacy of therapy and choice of proper antibiotic. Damage. by infective organism during this period of rapid growth may leave lasting effects on the ultimate size and function of various organs in survivors.

Rapid diagnosis in suspected cases of neonatal septicemia still continues to be challenge to the most Neonatologists. Various direct and indirect methods have been used for early diagnosis, but until now no method is up to date. The screening test should be simple, quick, reliable and capable of performed inside the hospital without trained personnel. Also it should be convenient for wide application. Chest radiographs in neonatal septicemia fulfils all such criteria.^{5,6} Present study was aimed to evaluate the utility of chest radiographs, as an index for early diagnosis of neonatal septicemia.

Material And Methods

Present study was single-center, prospective, observational study, conducted in department of paediatrics, at Indira Gandhi Medical College and General Hospital, Nagpur, India. Study duration was of 1 year (May 1992 to April 1993). Study approval was obtained from institutional ethical committee.

Study was explained to parents in local language & written consent was taken for participation & study. In this study, chest of 100 radiographs and clinical neonates (1 to 28 days) with

details bacteriologically proven septicemia were studied. All the newborns presented with poor feeding, vomiting, diarrhea, convulsions, lethargy, abdominal distention, irritability, respiratory distress, apneic spells, jaundice, fever, sclerema etc. were considered for this present study.

A detailed history, clinical examination, investigations and outcome was noted. Complaints presented by mother with duration (for e.g. Refusal of feed, Vomiting, Lethargy, Abdominal distension, Diarrhea, Irritability, Breathlessness, Jaundice, Fever, etc.) history of receiving antibiotics before hospitalization and/or before taking blood sample and x-ray chest, maternal obstetrical history, prenatal history, etc., was recorded. All neonates underwent detailed physical examination (maturity, heart rate, pallor, sclerema, respiratory rate, anterior fontanelle, umbilicus erythema or discharge, dehydration), systemic examination (Heart sounds. Chest-crepitations, Abdominal distension or Hepatomegaly/Intestinal Sounds, Lethargy Meningeal signs Deep tendon reflexes, etc.). Necessary Laboratory Investigations such as Hemoglobin, Total leucocyte count, Differential leucocyte count, LFTs, RFTs, Blood Culture & X-ray chest were done in all cases. Other investigations such as Lumbar puncture were done if required.

All the newborns suspected of having neonatal septicemia were subjected to X-ray chest AP view in lying down position and blood culture was obtained before giving antibiotics. Those cases with

positive blood culture were considered for the study. A blood culture was considered positive only if the growth of microorganisms were seen in both of the culture bottles. The antibiotic sensitivity was disc diffusion technique.

All x-rays were reported by a single radiologist without knowledge of patient's identity, clinical history and bacteriology reports. Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi-square test or Fisher exact test as applicable. P value less than 0.5 was considered as statistically significant.

Results

In this study, 100 neonates with bacteriologically proven septicemia were studied for their chest radiographs and the relationship between abnormal chest radiographs and various clinical parameters like sex, birth weight, gestational age, signs of respiratory distress, day of onset of illness, causative organisms and outcome. In the present study, there were 63 (63.00%) males and 37 (37.00%) females. Male Female ratio was 1.71. Out of 100 cases 53 were preterm whereas 47 were full-term.

Table 1: General characteristics

	No. of patients	Percentage
Gender		
Male	63	63.00 %
Female	37	37.00 %
Age groups (in years)		
Preterm	53	53.0 %
Full term	47	47.0 %

In present study, abnormal chest radiographs were in 65.1% male patients and 62.2% female patients. Sex of patient has no relationship with radiographs. the abnormality of chest. ($p > 0.05$)

Table 2 - Relationship between Sex and Chest Radiographs.

Gender	No. of cases	Chest radiograph	
		Normal	Abnormal
Male	63	22 (34.9%)	41 (65.1%)
Female	37	14 (37.8%)	23 (62.2%)
Total	100	36	64

$\chi^2 = 0.086$, $df = 1$; $P > 0.05$ N.S.

Full term (> 37 weeks) neonates with septicemia had significantly more number of abnormal chest radiographs i.e. 80.85% than preterm (< 37 wks.) neonates i.e. 49.06 %. This difference was found significant. ($P < 0.05$).

Table 3: Relationship between Gestational age and Chest Radiographs.

Gestational age	No. of cases	Chest radiograph	
		Normal	Abnormal
Preterm	53	27 (50.94%)	26 (49.06%)
Full-term	47	9 (19.15%)	38 (80.85%)
Total	100	36	64

$\chi^2 = 0.24$; $df = 1$; $P < 0.05$ Significant.

Abnormal chest radiographs were present in 61.54% cases in whom birth weight was more than 2500 gms. and in 64.37% cases in whom weight was 2500 gms. or less. This difference was not significant ($P > 0.05$).

Table 4: Relationship between Birth weight and Chest Radiographs.

Birth Weight	No. of cases	Chest radiograph	
		Normal	Abnormal
> 2500 gms.	13	5 (38.46%)	8 (61.54%)
≤ 2500 gms.	87	31 (35.63%)	56 (64.37%)
Total	100	36	64

$\chi^2 = 0.01$; $df = 1$; $P > 0.05$ Not Significant

Neonates who were having signs of respiratory distress had significantly more number of abnormal chest radiographs i.e. 83.1% than the neonates in whom signs of respiratory distress were absent i.e. 28.57%. This difference was found to be highly significant statistically. ($P < 0.001$).

Table 5: Relationship between signs of Respiratory distress and Chest Radiographs.

Signs of Respiratory distress	No. of cases	Chest radiograph	
		Normal	Abnormal
Present	65	11 (16.9%)	54 (83.1%)
Absent	35	25 (71.43%)	10 (28.57%)
Total	100	36	64

$\chi^2 = 27.01$; $df = 1$; $P < 0.001$ H.S.

Cases in whom the day of onset of illness was more than 3 days, 70.76% had abnormal chest radiographs. In 51.43 % cases chest radiographs were abnormal and day of onset of illness was 3 days or less. This difference was significant ($P < 0.05$).

Table 6: Relationship between Day of onset of illness and Chest Radiographs.

Day of onset of illness.	No. of cases	Chest radiograph	
		Normal	Abnormal
> 3 days	65	19 (29.24%)	46 (70.76%)
≤ 3 days	35	17 (48.57%)	18 (51.43%)
Total	100	36	64

$\chi^2 = 3.69$; $df = 1$; $P < 0.05$ Significant.

It was found that Right sided infiltrates were present in 40 (40%), Bronchopneumonia in 14 (14%), Consolidation in 7 (7%) and Pneumothorax in 3 (3%) cases of neonatal septicemia. Right sided infiltrates was the commonest finding with klebsiella (62.5%) whereas pneumothorax was present only in patients with staph. aureus (100%) septicemia.

Table 7: Radiological features of various organisms isolated from blood culture.

Causative Organisms	No. of cases	Chest radiograph				
		Normal	Rt infiltrate	Broncho pneumonia	Consolidation	Pneumothorax
Klebsiella	53	18	25 (67.5 %)	6 (42.86%)	4 (57.14 %)	-
E. Coli	17	10	6 (15.0%)	1 (7.14 %)		
Staph aureus	16	1	3 (7.5 %)	6 (42.86%)	3 (42.86%)	3 (100.0%)
Strept. faecalis	8	4	4 (10.0%)			

Pseudomonas	5	3	2 (5.0 %)			
B-hemolytic streptococci	1	-	-	1 (7.14 %)		
Total	100	36	40	14	7	3

55 % cases were expired whereas 45 % were improved. In neonates who were having abnormal chest radiographs, mortality was significantly more (72.7%) than those who were having normal chest radiographs. (27.3%)

Table 8: Relationship between Outcome and Chest Radiographs.

Outcome	No. of cases	Chest radiograph	
		Normal	Abnormal
Expired	55	15 (27.3%)	40 (72.7%)
Improved	45	21 (46.67%)	24 (53.33%)
Total	100	36	64

$\chi^2 = 4.04$; $df = 1$; $P < 0.05$ Significant

Discussion

Newborn is predisposed to the development of infection in the presence of factors like fetal membranes ruptured for more than 24 hours, labour lasting more than 24 hours, foul smelling liquor or the mother having signs of infection a few days before, during or after delivery, unclean or frequent vaginal examinations during labour, birth asphyxia, low birth weight or preterm baby and presence of more than ten polymorphs per high power field in the baby's gastric aspirate taken soon after birth.

The infection in newborn could be superficial like pyoderma, umbilical sepsis, conjunctivitis, deep infections like pneumonia, septicemia, meningitis, urinary tract infections etc. The physical signs are often those of generalized infection rather than particularly pointing to the main organ of involvement, especially in the early stages of illness. So the minimum workup of suspected case of infection in newborn includes complete blood counts, blood culture and X ray chest.^{7,8}

In present study, male Female ratio was 1.71. Washburn⁹ observed that septicemia was more common in male than female neonates. Faridi and Gupta¹⁰ also reported 42 (66.67%) males and 21 (33.33%) females, out of 63 cases of neonatal septicemia. Male Female ratio in their series was 2:1. This male predominance is probably because X chromosome has got a gene for production 30 of immunoglobulins, suggesting the possibility of sex linked factor in host susceptibility.

In the present study, out of 100 cases 53 were preterm whereas 47 were full terms. Similar observations were made by Orinsky¹¹, Modanlau & Basu¹² and Faridi & Gupta¹⁰. Septicemia is common in preterm because premature infant has quantitative and qualitative host immune deficits that predisposes to infection. Very low birth weight infant may have

low Ig G levels (< 100 mg/dl) owing to diminished transfer early in gestation.¹³

In present study, abnormal chest radiographs were in 65.1% male patients and 62.2% female patients. In Faridi and Gupta's¹⁰ study, abnormal chest radiographs were reported in 42.85% of male and female patients each.

Full term (>37 weeks) neonates with septicemia had significantly more number of abnormal chest radiographs i.e. 80.85% than preterm (< 37 wks.) neonates i.e. 49.06 %. This difference was found significant. ($P < 0.05$). In Modanlau & Bosu's¹² study, the abnormality in chest radiographs was more common in patients with mean gestational age. Similar findings were observed by Faridi & Gupta¹⁰. Poor immune status in early days of life probably accounted for nonlocalization of infection to respiratory system in preterms.¹⁰

Abnormal chest radiographs were present in 61.54% cases in whom birth weight was more than 2500 gms. and in 64.37% cases in whom weight was 2500 gms. or less. This difference was not significant ($P > 0.05$). Ronald Ablow¹⁴ revealed that abnormality of chest radiographs was common in babies with mean birth weight 2205 gms. Modanlau and Bosu¹² found that abnormality of chest radiographs was common in neonates with higher birth weight. Contrary to these findings, Faridi & Gupta¹⁰ observed that abnormality in chest radiographs was not related with the birth weight of the baby.

Neonates who were having signs of respiratory distress had significantly more number of abnormal chest radiographs i.e. 83.1% than the neonates in whom signs of respiratory distress were absent i.e. 28.57%. This difference was found to be highly significant statistically. ($P < 0.001$). Similar relationship between abnormality in chest radiographs and signs of respiratory distress was observed by

Singh M.¹⁵ and Krishnaswamy¹⁶.

Cases in whom the day of onset of illness was more than 3 days, 70.76% had abnormal chest radiographs. In 51.43 % cases chest radiographs were abnormal and day of onset of illness was 3 days or less. This difference was significant ($P<0.05$). Similar findings were observed by Faridi & Gupta¹⁰.

Somu and Shetty¹⁷ isolated gram positive and gram negative organisms from blood culture in which coliform group was the commonest followed by staph. aureus, pseudomonas, proteus, enterococcus and bacillus faecalis. X- ray chest showed hyperaerated lungs, narrow pedicle and minimal cardiomegaly in 79.6% cases. Faridi & Gupta¹⁰ revealed that right sided infiltrate was present in 27%, hyperinflation in 7.9%, extensive bilateral pneumonia 6.3% and pneumothorax in 1.6% cases. They also reported that right sided infiltrate was the commonest abnormality in klebsiella septicemia, hyperinflation in pseudomonas septicemia whereas pneumothorax in septicemia due to staph aureus. Similar findings were observed in present study.

In present study, neonates who were having abnormal chest radiographs, mortality was significantly more (72.7%) than those who were having normal chest radiographs. (27.3%) This found contrary was study by Faridi & Gupta¹⁰ in which the abnormality of chest radiographs was not related to mortality. In Guha's¹⁸ study, the mortality was 24.3 % in patients who had abnormal chest radiographs and it was 13.2 % in Haffeejee's¹⁹ study.

In present study, 80 were treated with combination of Ampicillin, Cloxacillin and Gentamicin whereas 20 were treated with Cefotaxime and Gentamicin combination. Out of 80 patients treated with Ampicillin, Cloxacillin and Gentamicin combination, 49 (61.25%) were expired whereas 31 (38.75%) were survived. Out of 20 patients treated with combination of Cefotaxime and Gentamicin, only 6 (30 %) whereas 14 (70%) were survived. It can be seen from the above findings that with Cefotaxime and Gentamicin resulted in higher survival rate i.e. 70 %. combination

Bhakoo and Agarwal³ revealed higher survival rate (45%) among babies treated with Gentamicin. In Somu and Shetty's¹⁷ study, Gentamicin was the drug of choice for both gram negative and gram positive organisms.

Though presence of respiratory distress has got positive relationship with abnormal chest radiographs, it should also be done in patients of neonatal septicemia irrespective of presence of respiratory distress.²⁰ Chest radiograph in neonatal

septicemia helps in spot diagnosis and it is simple, rapid and reliable method, it should be done routinely in every patient of neonatal septicemia.

Conclusion

The result of present study appears to emphasize the utility of chest radiographs as a tool for early diagnosis of neonatal septicemia, it helps in spot diagnosis. This method is simple, rapid, reliable and can be done inside the hospital where facilities for radiography. are available and can be done without trained personnel.

Conflict of Interest: None to declare

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