

Klebsiella Pneumoniae sepsis , clinical features and early outcome among
Newborns in neonatal intensive care unit Zawia teaching hospital

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Abstract

Background:

Klebsiella pneumonia is one of the most common infection that cause neonatal sepsis globally. It is responsible for a significant proportion of hospital-acquired infections including septicemias, urinary tract infections, pneumonia, and soft tissue infections especially in the immunocompromised hosts such as the neonate .

Aim of study:

to identify,clinical features and the outcomes associated with K. pneumonia, in all newborn at NICU at Zawia teaching Hospital – Libya.

Materials and Methods :

Retrospective case series study conducted at neonatal intensive care unit in Zawia teaching hospital /Libya. during one year period(1st of January -30st December 2012) . Four hundred and eleven neonates who were admitted to Intensive Care Unit(ICU) in pediatric department were selected. The following data was obtained from the patient's medical records sex, birth weight, gestational age, mode of delivery, time of admission(Season), blood cultures strain of the isolates ,maternal history, clinical diagnosis and features association problems mechanical ventilator, blood exchange ,umbilical vein catheterization ,respiratory distress syndrome , birth asphyxia, CRP for risk patient, CRP on deterioration ,platelets concentrate transfusion and outcome.

Result:

The study results reported that 13 neonates had positive klebsiella pneumonia. 9 (69.2%) preterm, 9(69.2%) were males 4(30.8%) were females with 2:1 male to female ratio, 10 (76.9%) had low birth weight, 8(61.5%) were delivered by caesarean section, regarding maternal age 53.8% were between 31-40 years with mean maternal age 32.15 years and 5.5 standard deviation, 61.5% were infected at the second half of the year p value, History of PROM in 6(46%), pre eclampsia (30.8 %) maternal fever in 1(7.7%), maternal infection (7.7%). 9(69.5%) had respiratory distress, 53.8%, 7 (53.8%) developed hyperbilirubemia, 4(30%) had necrotizing enterocolitis, 1(7%) had acute myocarditis, 1 patient presented with fever and proved to have UTI with sepsis, mechanical ventilation was needed in 8 (61.5%). one patient developed Pneumothorax (7.7%) and drained under water seal by insertion of chest tube. Umbilical vein catheterization inserted only in one patient 7.7%. Exchange blood transfusion was done in one baby 7.7%. all had negative CRP test on admission 13 (100%) and CRP was positive in all patients (100%) with positive klebsiella pneumoniae (p value 0.0001) when sepsis was suspected. 10 (76.9%) of the neonates required platelets transfusion which indicate the higher rate of thrombocytopenia. Regarding neonatal outcome, the result reported that 10(76.9%) of neonates with positive klebsiella pneumonia were alive and only 3 (23.1%) died, Two due to respiratory failure and the 3rd one died due acute myocarditis complicated by heart failure. The mortality rate about 23%. 66.6% were preterm low birth weight. 100% were males and due to ESBL producing strains.

Conclusion: The main risk factors for the infection was preterm babies, males gender, low birth weight, caesarean section delivery, prolonged pre labor rupture of membrane (PROM). mostly infected at the second half of the year and hospital stay, The clinical presentations are non specific, Acute myocarditis is a rare presentation with fatal prognosis. CRP is valuable for early detection of klebsiella pneumoniae infection. Thrombocytopenia is very common The mortality rate was relatively high and all deaths were male, due to ESBL producing K.pneumoniae strains which was similar to many studies in other countries.

Keywords: klebsiella pneumonia, sepsis, risk factors, clinical features, outcome, mortality rate, neonatal intensive care,

Background

Neonatal sepsis remains one of the leading causes of morbidity and mortality both among term and preterm infants.⁽¹⁾ Although advances in neonatal care have improved survival and reduced complications in preterm infants, sepsis still contributes significantly to mortality and morbidity among very-low-birth-weight (VLBW, <1500 g) infants in Neonatal Intensive Care Units (NICUs).^(2,3) The signs and symptoms of neonatal sepsis are nonspecific.^(3,4) These include fever or hypothermia, respiratory distress including cyanosis and apnea, feeding difficulties, lethargy or irritability, hypotonia, seizures, bulging fontanel, poor perfusion, bleeding problems, abdominal distention, hepatomegaly, guaiac-positive stools, unexplained jaundice, or more importantly, “just not looking right.”^(3,5,6) Infants with hypoxia–acidosis may gasp in utero and lead to pneumonia and meconium aspiration.⁽⁷⁾ The incidence of neonatal sepsis or bacteremia in asymptomatic infants is low, but not negligible.⁽⁴⁾ Voora et al. reported a 1% prevalence of fever in term newborns with 10% of the febrile (≥ 37.8 °C rectal or core body temperature) infants having culture-proven sepsis.⁽⁷⁾ While term newborns were described as being more likely to react to a

bacterial infection with fever, preterm newborns were more likely to react with hypothermia, because of transitional difficulty with temperature control especially in the first 2 days.^(9,10) In contrast, the lack of clinical relevance of body temperature in diagnosing sepsis later in preterm infants might be attributable to the use of incubators.^(10,11)⁽¹²⁾ Respiratory distress including tachypnea, grunting, nasal flaring, and retraction of respiratory muscles can be the sole manifestation of sepsis with or without pneumonia and can be confused with transient tachypnea of newborn initially^(10,11,12). Rapid clinical deterioration ensues unless prompt antibiotic management is started in neonates with sepsis^{11,12}. Neonatal sepsis can be complicated by metastatic foci of infection, disseminated intravascular coagulation, congestive heart failure and shock.⁽¹³⁾ Necrotizing enterocolitis (NEC) is an acute inflammatory necrosis of the bowel and may be the underlying cause of neonatal sepsis. The probability of the latter is high when a neonate presents with gram-negative sepsis and has nonspecific intestinal and radiological signs.^(13,14,15,16) Schabrg et al. reported 12 of 51 neonates with nonspecific abdominal findings had positive blood

cultures.⁽¹⁷⁾ Rates are especially higher in premature sick infants. Thirty-four percent of infants with <1000 g birth weight and 51% of infants with <29 week gestational age had concurrent bloodstream infections

Klebsiella pneumoniae in Neonatal Sepsis:

Bacteremia remains a significant cause of morbidity and mortality. In the United States alone, it is estimated that 200,000 cases of bacteremia occur annually, with mortality as high as 50%. The treatment of patients with bacteremia is becoming more complicated in an era of increasing anti-microbial resistance among frequently occurring pathogens. Furthermore, the increased complexity of the cases requiring hospitalization and the widespread use of indwelling devices has created higher risk for bacteremia. Newborns, especially premature newborns, are at risk for developing blood-stream infections before birth, shortly after birth, or later if hospitalization is prolonged.⁽²¹⁾

Gram-negative bacillary sepsis is a common nosocomial problem in neonatal units and accounts for the majority of cases of nosocomial infections worldwide. *Klebsiella*, a normal member of the gastrointestinal tract flora, has emerged as a significant nosocomial pathogen in neonatal units. Nosocomial *Klebsiella* infections are also remarkably troublesome, particularly in

in a study of NEC.⁽¹⁵⁾ In fact, depending on severity, 40–60% of NEC cases have concurrent bloodstream infections.^(18,20) Gram-negative bacteremia and sepsis are the most common.^(14,15)

premature infants and intensive care units (ICU)^(20,21). Pediatric patients are easily colonized by *Klebsiella* spp. Intestinal and oropharyngeal colonization acts as the main reservoir for nosocomial outbreaks. Most studies of bacteremia have not focused on *Klebsiella* spp. as a single entity, but rather have included it in the category of Gram-negative bacteremia.^(21,22) Once the diagnosis of *K. pneumoniae* infection is established, the antibiotic regimen is usually determined by the results of susceptibility testing. Additional factors impacting treatment are multidrug resistance. The antibiotic regimen for infections with *K. pneumoniae* is usually determined by the results of susceptibility testing. Outbreaks of strains that produce an extended-spectrum beta-lactamase or a carbapenemase have been reported worldwide.^(19, 26,27,28, 29) The short term complications of neonatal sepsis include respiratory failure, pulmonary hypertension, cardiac failure, shock, renal failure, liver dysfunction and cerebral edema. Some of the long term complications

include; developmental delays, sensory and

Aim of study:

To identify the clinical features and outcomes associated with *K. pneumoniae*, in

Materials and methods:

Retrospective case series study, was conducted at neonatal intensive care unit (NICU)-pediatric department in Al-Zawia teaching hospital /Libya, from 1st January - 31 December 2012, Four hundred and eleven neonate were admitted to(NICU) . The following data was obtained from the patients medical records: gestational age, sex ,birth weight ,mode of delivery, time of admission(Season), ,maternal history, CRP for pateint at risk, CRP on deterioration, blood cultures, clinical presentation, mechanical ventilator, blood exchange ,umbilical vein Catheterization, respiratory distress syndrome , birth asphyxia , anemia and thrombocytopenia which necessitate

The results:

The overall sample showed that,the percentage of males (54.7%) are more than females (45.3%). The majority of the newborn were from Zawia (85.2%), about 62.1% were admitted in the second half of the year. Most of the newborn were preterm and most of them were delivered by

neurological dysfunction. ^(29,30)

all newborns at NICU of Zawia Hospital – Libya.

blood and platelet concentrate transfusion ,outcome. Ethical approval was gained from the ethical committee in the hospital to conduct the study,Statistical analysis was computerized using the Statistical Program for Social Sciences (SPSS version 24) that used for data entry and analysis. Descriptive statistics were used and all results are presented as frequencies, means standard \pm deviation and percentages. Quantitative data were analyzed using student T test. Categorical data were compared using the Chi-square test and Fisher's exact test if appropriate. A P-value of less than or equal to 0.05 was considered statistically significant.

CS. Most of the neonates had negative CRP on admission (94.4%) before deterioration and suspicion, after the deterioration the percentage of negative CRP decreased to 71%. Regarding the outcome about 16.5% of the neonates died for various reasons.

| | Variable | Frequency (n) | Percent (%) |
|----------------------|--|---------------|-------------|
| Sex | - Male | 225 | 54.7 % |
| | - Female | 186 | 45.3 % |
| Time of admission | - 1HY (First Half-Year) | 156 | 37.9 % |
| | - 2HY (Second Half –year) | 255 | 62.1 % |
| Gestational Age | - FT | 198 | 48.2 % |
| | - PT | 213 | 51.8 % |
| Mode of Delivery | - C/S | 228 | 55.5 % |
| | - NVD | 182 | 44.3 % |
| CRP for risk patient | - Positive | 23 | 5.6 % |
| | - Negative | 388 | 94.4 % |
| CRP on Deterioration | - Positive | 119 | 29.0 % |
| | - Negative | 292 | 71.0 % |
| Outcome | - Alive | 343 | 83.5 % |
| | - Dead | 68 | 16.5 % |
| | Birth weight (Kg) (mean ± SD) | 2.5 ± 0.9 | |
| | Gestational Age Duration by weeks | 34.4 ± 3.4 | |

Table1: Characteristics of the included neonates (inborn)

Regarding the gestational age at delivery, 69.2% of neonates with positive klebsiella pneumonia were preterm and 30.8% were

full term. The result was statistically insignificant with p value > 0.05.

| Gestational age | klebsiella pneumonia | |
|------------------|----------------------|-------------|
| | Positive | Negative |
| Full term | 4 (30.8%) | 149 (48.7%) |
| Preterm | 9 (69.2%) | 204 (51.3%) |
| P value | 0.202 | |

Table 2:Relation between klebsiella pneumoniae and gestational age.

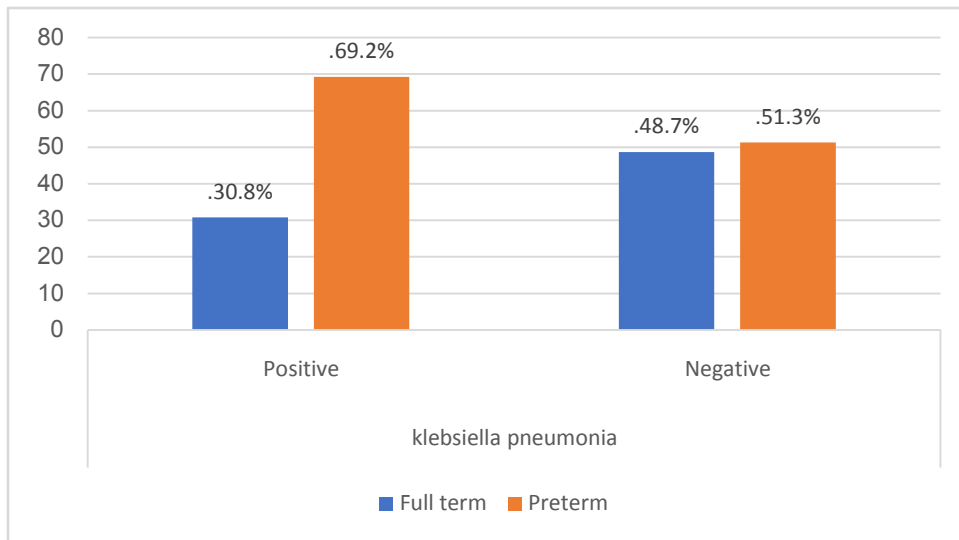


Figure 1:Relation between klebsiella pneumoniae and gestational age

Regarding the sex of the neonate, 69.2% of neonates with positive pneumoniae were male and 30.8% were female. The male to

female ratio is 2:1. The result was statistically insignificant with p value > 0.05.

| Sex of neonate | klebsiella pneumonia | |
|----------------|----------------------|-------------|
| | Positive | Negative |
| Male | 9 (69.2%) | 216 (54.3%) |
| Female | 4 (30.8%) | 182 (45.7%) |
| P value | 0.286 | |

Table3 : Relation between klebsiella pneumoniae and sex of the neonates

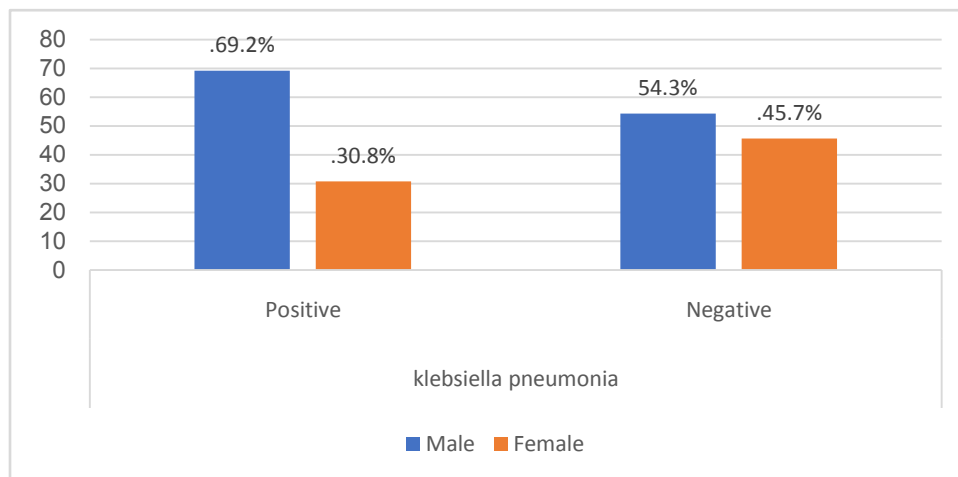


Figure 2: Relation between klebsiella pneumoniae and sex of the neonates.

Regarding the seasons of the year, 61.5% of neonates with positive klebsiella pneumoniae had the infection in the fall season (mostly on October), 15.4% in spring, 15.4% in the summer and 7.7% in the winter. The result was statistically significant with p value < 0.05.

In respect to the birth weight, most of the neonates with positive klebsiella pneumonia had low birth weight (76.9%). About 15.4% had normal weight and only 7.7% were large for gestational age .The result was statistically insignificant with p value > 0.05

| Birth weight | klebsiella pneumonia | |
|----------------------------------|----------------------|-------------|
| | Positive | Negative |
| Low birth weight ≤2.5kg | 10(76.9%) | 199 (50%) |
| Normal weight | 2 (15.4%) | 169 (42.5%) |
| Large for gestational age | 1 (7.7%) | 30 (7.5%) |
| P value | 0.134 | |

Table 4: Relation between klebsiella pneumonia and birth weight.

In respect to the mode of delivery, about 61.5% of the neonates with positive klebsiella pneumonia were delivered by caesarean section and about 38.5% were

born by normal vaginal delivery. The result was statistically insignificant with p value > 0.05.

| Mode of delivery | klebsiella pneumonia | |
|------------------|----------------------|-------------|
| | Positive | Negative |
| CS | 8(61.5%) | 220 (55.4%) |
| NVD | 5 (38.5%) | 177 (44.6%) |
| P value | 0.662 | |

Table 5: Relation between klebsiella pneumoniae and Mode of delivery

In respect to maternal age ,the mean age of the mothers of neonates with positive klebsiella pneumonia was 32.15 years with standard deviation of 5.5. the highest percentage was mother age between 31 and

40 years which account for 53.8%. The result was statistically insignificant with p value > 0.05.

| Maternal age | klebsiella pneumonia | |
|---------------|----------------------|-------------|
| | Positive | Negative |
| ≤ 20 years | 0 (0%) | 14 (3.5%) |
| 21 – 30 years | 5 (38.5%) | 185 (46.5%) |
| 31 – 40 years | 7 (53.8%) | 183 (46%) |
| > 40 years | 1 (7.7%) | 16 (14%) |
| Mean ± SD | 32.15 ± 5.5 | 30.87 ± 5.6 |
| P value | 0.944 | |

Table 6 :The relation between maternal age and k.pneumoniae.

| | klebsiella pneumonia | | |
|--|----------------------|-------------|---------|
| | Positive | Negative | P value |
| Male sex | 9(69.2%) | 216(54.3%) | 0.286 |
| Preterm | 9 (69.2%) | 204(51.3%) | 0.202 |
| Low birth weight | 10(76.9%) | 199(50%) | 0.134 |
| Caesarian section | 8(61.5%) | 220(55.4 %) | 0.662 |
| Maternal age (31-40 years) | 7(53.8.%) | 183 (46%) | 0.944 |
| Fall season | 8(61.5%) | 98 (24.6%) | 0.025 |
| Hospital stay(3-7 days) | 11(84.6%) | 74(18.4%) | 0.0001 |
| positive CRP at suspision of sepsis | 13(100%) | 106 | 0.0001 |

Table7. Summarizing the demographic features of patients with k.pneumoniae infection.

Antenatal history of PROM in 5 (38.4%),maternal history pregnancy induced hypertension PET in 3 patients (23%),maternal fever 1 (7.7%) maternal infection(UTI)in one patient (7.7%). Regarding CRP result ,all of neonates with positive klebsiella pneumonia had negative CRP result at admission when they screened for early detection of sepsis . The

result was statistically insignificant with p value > 0.05.

Regarding time of deterioration the result showed that most of neonates with positive klebsiella pneumonia deteriorated in 3 to 7 days (84.6%). The result was statistically significant with p value < 0.05.

| Time of deterioration | klebsiella pneumoniae | |
|------------------------------|-----------------------|--------------|
| | Positive | Negative |
| No deterioration | 0 (0%) | 248 (62.3 %) |
| Same day of admission | 1 (7.7%) | 67 (16.8%) |
| 3– 7 days | 11 (84.6%) | 74 (18.6%) |
| 8 – 15 days | 1 (7.7%) | 8 (2%) |
| > 15 days | 0 (0%) | 1 (0.3%) |
| P value | 0.0001 | |

Table8: Relation between klebsiella pneumonia and time of deterioration(hospital stay)

| CRP | klebsiella pneumonia | |
|-----------------|----------------------|-------------|
| | Positive | Negative |
| Positive | 0 (0%) | 23 (5.8%) |
| Negative | 13 (100%) | 375 (94.2%) |
| P value | 0.372 | |

Table 9: Relation between klebsiella pneumonia and CRP before deterioration

Relation between klebsiella pneumonia and CRP after deterioration:

Regarding to CRP result after deterioration , the result reported that all of neonates with

positive klebsiella pneumonia had positive CRP result. The result was statistically significant with p value < 0.05.

| CRP after deterioration | klebsiella pneumonia | |
|-------------------------|----------------------|-------------|
| | Positive | Negative |
| Positive | 13 (100%) | 106 (26.6%) |
| Negative | 0 (0%) | 292 (73.4%) |
| P value | 0.0001 | |

Table 10: Relation between klebsiella pneumonia and CRP after deterioration

| Clinical diagnosis | k. pneumonia | medical interventions needed |
|----------------------|--------------|------------------------------|
| | n=13 | n=13 |
| Respiratory distress | 9(69.5%) | Ventilation8(61.5%) |
| NEC | 4 (30.8%) | Ex.transfusion1(7.7%) |
| HIE | 1 (7.7%) | Chest tube 1(7.7%) |
| Neonatal jaundice | 7(53.8%) | UVC 1(7.7%) |
| Acute Myocarditis | 1(7.7%) | |
| U.T.I | 1(7.7%) | |

Table 11. Clinical features of k.pneumoniae .

Regarding the clinical presentation 9(69.5)patient had respiratory distress, 7(53.8%) had Hyperbilirubinemia,4(30.8%)had necrotizing enterocolities(NEC).one patient get acute myocarditis (7.7%)he is full term baby appropriate weight for his gestational age 3.5KG.mother had history of PROM and fever ,the strain was ESBL producer, one patient presented with fever and proved to have UTI(7.7%),one patient had HIE(Hypoxic Ischemic Encephalopathy) . Mechanical ventilation was needed in 8(

61.5 %).one patient developed Pneumothorax 7.7%and drained under water seal by insertion of chest tube. Umbilical vein catheterization inserted only in one patient7.7% Exchange blood transfusion was done in one baby 7.7%.Our result reported that about 76.9% of neonates with positive klebsiella pneumoniae received platelet concentrate transfusion due to sever thrombocytopenia., 15.4% had no transfusion and only 7.7% had whole blood transfusion. The result was statistically significant with p value < 0.05.

| Transfusion | klebsiella pneumonia | |
|-----------------------|----------------------|-------------|
| | Positive | Negative |
| Platelet | 10 (76.9%) | 15 (3.7%) |
| Blood | 1 (7.7%) | 51 (12.8%) |
| No transfusion | 2 (15.4%) | 332 (83.5%) |
| P value | 0.0001 | |

Table 12: Relation between klebsiella pneumonia and the need for platelet and blood transfusion

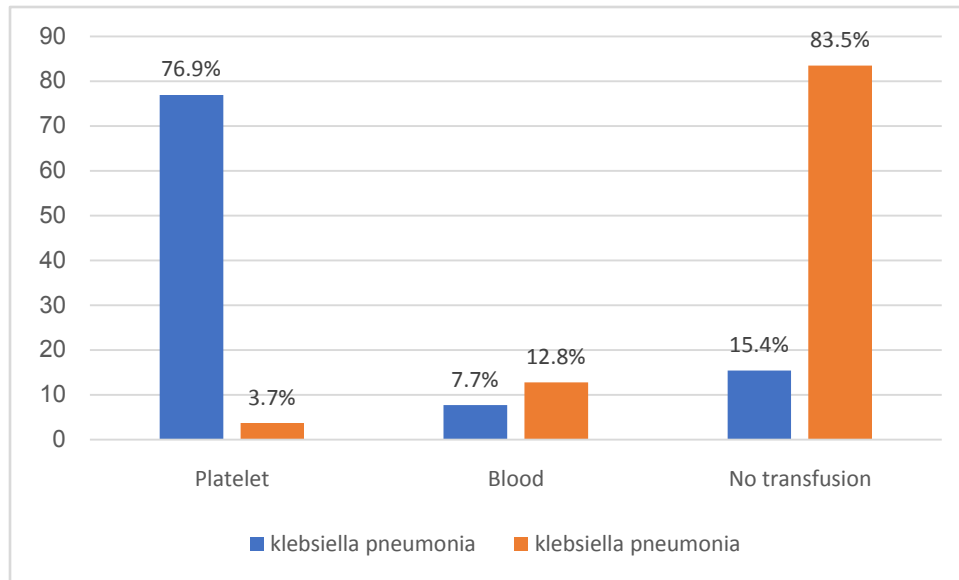


Figure 3: Relation between klebsiella pneumoniae and platelet, blood transfusion.

klebsiella pneumoniae outcome:

Regarding neonatal outcome, the result reported that 10(76.9%) of neonates with positive klebsiella pneumonia were alive and only 3(23.1%) died. The 3 died babies were (100%) males, 2 of them were low birth weight, one baby died due to heart failure due to acute myocarditis, two due to severe

respiratory failure. The result was statistically insignificant with p value > 0.05. The three patients who died were males, 2 were pre term and very low birth weight, the phenotype of klebsiella pneumoniae isolates were extended spectrum β lactamase (ESBL) Producing strains.

| Outcome | klebsiella pneumonia | |
|----------------|----------------------|-------------|
| | Positive | Negative |
| Alive | 10 (76.9%) | 343 (83.5%) |
| Dead | 3(23.1%) | 68 (16.5%) |
| P value | 0.520 | |

Table 13: Relation between klebsiella pneumoniae and outcome

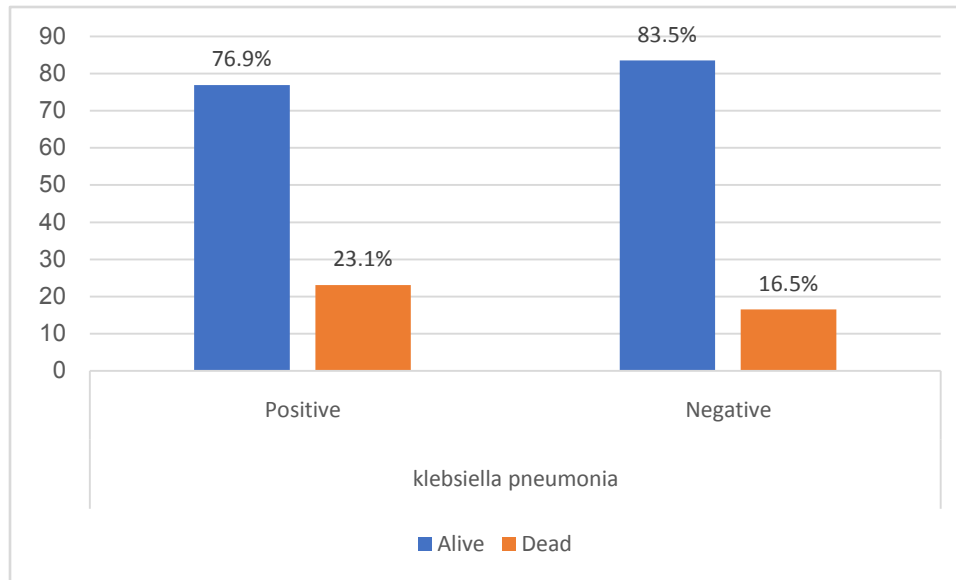


Figure 4 :Relation between klebsiella pneumoniae and outcome

| Outcome | klebsiella pneumonia | |
|----------------|----------------------|-------------------|
| | ESBL Positive n=10 | ESBL Negative n=3 |
| Alive | 7 (70%) | 3(100%) |
| Dead | 3(30%) | 0 |
| P value | 0.0003 | |

Table 14 .Outcome according to the K. pneumoniae strain phenotypes.

Discussion:

Klebsiella pneumoniae is the most commonly reported cause of neonatal sepsis in several studies from developing countries' 30,32,3537 There are also frequent reports of outbreaks of neonatal sepsis due to Klebsiella pneumoniae in nursery and NICUs. (27,28,30,37)Newborns, especially

those born preterm, are prone to bacteremia. Infections may be acquired around the time of birth (early onset), or be acquired after admission to hospital (late onset). Gram-negative bacteremia is a well-recognized cause of nosocomial infection in NICU; Klebsiella spp. are one of the most

common gram-negative bacteria isolated from neonates, causing colonization as well as invasive infections. Unsurprisingly, *Klebsiella* spp. have been reported to be as the most common cause of neonatal bacteremia in some studies. (26,27,28,37) It may be due to a strong correlation between colonization of neonates at sites such as the respiratory and gastrointestinal tracts and subsequent development of infection.⁽³¹⁾ Our study results reported that neonates who had positive *klebsiella pneumoniae* tend to be preterm, males more than females, mostly infected at the second half of the year, had low birth weight, delivered by caesarean section, hospital stay more than 48 hours, and had negative CRP test on admission. Similar results were reported in Malaki and Zakariya et al studies in which strong correlation was found between *klebsiella pneumoniae* and preterm babies, low birth weight, male gender, hospital stay and caesarean section delivery. (26,27) In Qazi et al study the result showed that the main risk factors for *klebsiella pneumoniae* were preterm babies, low birth weight, prolonged labor, and birth asphyxia.⁽³⁹⁾ The study of Ghotaslou et al reported that risk factors for bacteremia were catheterization, hyperalimentation, and mechanical

ventilation a predominance were seen in male neonates, low birth weight⁽³⁵⁾. In overall clinical features Respiratory distress was reported in 69.5% of the patients it was 40% in Ghotaslou et al study and also seen in other studies,^(21,23,24,25,31,38,43) 61.5% need Mechanical ventilation as many other study^{26,43,44} Hyper bilirubemia in 53.8% in malaki study it was 86% 14.3% in Ghotaslou et al study^(27,35). Necrotizing enterocolitis was 30.8% in our study. concurrent blood stream infection in infants with necrotizing enterocolitis was seen in 43.7% in Bizzarro et al study.⁽⁴⁵⁾ many other studies described *K.pneumoniae* in NEC outbreaks with nosocomial origin^(38,45,46,47,48) as well as Gregersan reported an association between ESBL producing *K.pneumoniae* and NEC outbreak⁽⁴⁶⁾. Acute myocarditis was reported in this study in baby with maternal fever and PROM who was admitted blood for culture and sensitivity and primary investigation was taken empirical antibiotics were started the baby was stable at the end of the 3rd day of life suddenly deteriorated showing signs of shock and died rapidly, in this patient it was maternal acquired infection, in the literature no studies reported *klebsiella pneumoniae* as a cause of acute myocarditis in neonates and their other causes of acute myocarditis

in neonates as enterovirus, coxsackie and paraechovirus^(49,50,51,52). and there is a case of rapidly fatal acute myocarditis caused by klebsiella pneumoniae was reported in adults by Tzu-Yi Chang et al in previously healthy 52- years man patients⁽⁵³⁾ in malaki study was 29% our study we observe that C-reactive protein(CRP)was positive in all patient(100%)P value 0.0001 with positive klebsiella pneumonia in blood culture this finding had been seen in Qazi et al study were 95%of the cases had positive CRP⁽³⁹⁾.and it was 68% in malaki study^(27,39) The current study showed that most of the neonates required platelets transfusion which indicate the higher rate of thrombocytopenia. A low platelet count is a common laboratory abnormality in critically ill patients especially neonatal sepsis patients. Thrombocytopenia was found to be an independent risk factor for mortality in the present study, which was confirmed by several other studies^(49,59) as in Malaki study it was 60% Studies showed that the rate of thrombocytopenia in patients with bacteremia was 79.6%^(,26,27,31,40). The mechanism by which thrombocytopenia occurs in patients with infection is not clear. The most common cause of thrombocytopenia is severe infection and/or inflammation:Other related causes of

thrombocytopenia are thrombotic microangiopathy, disseminated intravascular coagulation, massive blood loss, and drug-induced thrombocytopenia⁽⁵¹⁾ Regarding neonatal outcome, the result reported that 10 of neonates with positive klebsiella pneumonia were alive and only 3 dead due to varies complication. The mortality rate in the current study is about 23%. This result was lower than in reports of gram-negative bacteremia (Escherichia coli or Klebsiella spp.) in developing countries where mortality rates of around 40% have been reported.^(41,42) The result of Malaki study showed that the mortality rate was 25% which was similar to the current study result.⁽³¹⁾ Qazi et al study also showed mortality rate of 25%.³⁹ high mortality rate was reported in Ghotaslou et al in which the rate of dead neonates due to klebsiella pneumonia was 66.6%.⁽⁴⁰⁾ The crude mortality rate due to klebsiella pneumonia reported in previous studies was within the range 23% to 46%.⁽⁴³⁾ A study of Korean population found the mortality rate of hospital-acquired and community-acquired infections to be 22% and 11%, respectively. In Qazi study mortality rate among newborn in North India was 25%^{39,41}. A study of patients in Hong Kong found the mortality rate of hospital-acquired and community-

acquired infections to be 43% and 20.2%, respectively.⁽⁴¹⁾ Similar studies reported the crude mortality rate to be 20% to 45% in European and North American populations^(55,56) and 26% in China.⁽⁴²⁾ The high range might be related to the population studied and the source of infection. Also we have demonstrated that neonates infected with

Conclusion:

The main risk factors for the infection was preterm babies, males gender, mostly infected at the second half of the year, low birth weight, caesarean section delivery and hospital stay. Clinical manifestation of neonatal sepsis caused by *K.pneumoniae* are usually non specific, Acute myocarditis is a rare fatal presentation caused by ESBL producing strains. Detection of Positive

Recommendations: Prevention of neonatal sepsis:

Strategies to reduce rates of infection includes, promote antenatal management and prevention of premature delivery clean and safe deliveries, adherence to universal precautions in all patient contact, strict postnatal cleanliness, early and exclusive breastfeeding, avoiding nursery overcrowding and limiting nurse to patient ratios. Other measures include strict compliance to hand washing, decreasing the number of venepuncture and heel pricks and

ESBL producing *K.pneumoniae* had significantly higher mortality than those with non ESBL producer *K.pneumoniae* which is high virulent and multi drug resistant strains. Similar finding was reported previously as in in Abdel-Hady et al study⁶¹ as well as in other studies^(31,54, 55,56, 57,58,59,60)

CRP is valuable for early diagnosis of neonatal sepsis. Thrombocytopenia a necessitating platelet concentrate transfusion is high in neonatal sepsis due to *k.pneumoniae* infection. The mortality rate was high and significantly higher in neonates infected with ESBL producing *K.pneumoniae* in this study which was similar to many studies in other countries.

providing education to nursery personnel. As *Klebsiella pneumoniae* is known to cause outbreaks among inborn babies in neonatal units, Prevention through implementation of strict infection control guidelines, effective hand washing. Relatively high mortality rate among neonates with *Klebsiella pneumoniae* emphasizes the importance of adequately treating this infection. Continuous education and training, infection prevention practices. This is best done in the format of

professional audits. These should be run as a province-wide program, addressing all major areas of infection prevention.

Continued monitoring of susceptibility pattern is necessary to detect true burden of resistance for proper management.

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