Section: Paediatrics

Original Research Article

A CLINICO-EPIDEMIOLOGICAL STUDY AND OUTCOME OF BRONCHOPULMONARY DYSPLASIA AMONG PRETERM NEONATES IN A TERTIARY CARE HOSPITAL IN KOLKATA

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ABSTRACT

Background: Introduction: Bronchopulmonary dysplasia is a result of complex process involving multiple prenatal and postnatal factors. It is an important cause of mortality and long term morbidity in surviving preterm infants. Various therapeutic modalities are being implemented to prevent and treat this condition. **Purpose:** To study various factors contributing to BPD, clinical course and follow up the involved babies. **Materials and Methods:** The study was a single institution based Prospective observational study, conducted at Sick Neonatal Care Unit and Neonatal Intensive Care Unit in a tertiary health care hospital for a duration of 16 months. It was noted if these neonates were kept in any kind of invasive or non-invasive ventilator or if they were on supplemental oxygen. The clinical outcome of neonates were followed during their hospital stay period as well as they were followed up in high risk clinic OPD. Readmission was also considered. **Result:** 25% of ELBW, 38.89% of VLBW and 36.11% of Low birth weight neonates were diagnosed to have BPD. 19.44% Extreme preterm, 52.78% Very preterm and 27.78% late preterm neonates suffered from BPD. 36.11% babies did not receive any antenatal steroid. 36.11% neonates with BPD had NICU stay of more than 60 days. Significant association was found between NICU stay and requirement of mechanical ventilation. 28.58% of readmissions were due to Obstructive Airway Syndrome, 35.71% were due to pneumonia. **Conclusion:** Neonates with greater disease severity and who required aggressive management with prolonged oxygen or mechanical ventilation, later developed BPD.

INTRODUCTION

Bronchopulmonary dysplasia is the consequence of a deviation from the normal lung developmental pattern and associated with persistent lung impairment later in life with frequent respiratory diseases and reduced in quality of life. According to Jobe "the injury resulting in BPD likely begins as altered lung development before delivery in many infants and can be initiated by resuscitation at birth and then amplified by postnatal exposures".[1] The National Institute of Child Health and Human Development (NICHD), NHLBI and Office of Rare Diseases (ORD), in 2000, proposed the current (NIH consensus) definition of BPD, "Infants born < 32 weeks, who require supplemental oxygen for at least 28 days and at 36 weeks postmenstrual age (PMA)".[2]

Most BPD cases usually occur in babies born before the 32nd week of gestation, when the lung is in the canalicular (from the 17th to 26th week of gestation) or saccular (from the 27th to 36th week of gestation) stage of development. Complications are very common in extremely pre-term (EPT; i.e., < 28 wks of gestational age) and very preterm infants (VPT; i.e., 28–31 wks of gestational age).[3] BPD, as initially described (i.e., old BPD) usually occurs due to an aggressive mechanical ventilation approach in terms of peak pressures and oxygen concentrations on a relatively mature lung lacking surfactant (i.e., ≥ 32 weeks of gestation).[4,5] Recently a new type of BPD has emerged due to interaction between various foetal or postnatal factors like mechanical trauma and oxygen toxicity with disruption in lung development. In comparison with old BPD, new BPD has more severe alveolar damage, fewer severe

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arterial/arteriolar vascular lesions, and negligible airway epithelial lesions.[6] Husain et al. studied a group of neonates divided into three groups, surfactant-treated BPD patients (S-BPD), non-surfactant-treated (NS-BPD) and age-matched controls.[7] In study less and more diffuse alveolar septal fibrosis was found in S-BPD than in NS-BPD. The new BPD is seen more in surfactant-treated extremely LBW (ELBW) infants.

Multiple pharmacologic and non-pharmacologic treatment strategies like from protective ventilation strategies, optimal oxygen saturation goals, surfactant supplementation, and the use of antenatal corticosteroids are available, aiming to not only support the survival but also minimize further lung injury and facilitate recovery.[8,9] Aside from these strategies, there has been a lack of efficacy of new therapies like inhaled nitric oxide, vitamin A supplementation, caffeine, diuretics, bronchodilators etc. Thus, a re-evaluation of previous therapies is important as our understanding of the pathobiology of the disease evolves. Hence in our study we tried to find out association of various factors like prematurity, gravida, gestational age, APGAR score, hypoxia, use of mechanical ventilation with development of BPD and revaluate various treatment strategies for early prevention of BPD and thus reducing overall length of hospital stay.

Objective of research:

1. To find incidence of occurrence of BPD among new-born infant
2. To identify various maternal and neonatal factors contributing to BPD (predisposing factors)
3. Clinical course and outcome of suspected BPD affected infants during stay at hospital
4. Follow up of babies discharged at high risk clinic (recurrent respiratory infections and neurodevelopmental outcome during follow up at OPD).

MATERIALS AND METHODS

The study was a single institution based Prospective observational study, conducted at Sick Neonatal Care Unit (SNCU) and Neonatal Intensive Care Unit (NICU), High risk clinic for a duration of 16 months. Study population were viable live born premature babies of <=36 weeks gestation who developed BPD. The study was approved by institutional ethical committee and written informed consent was obtained from parents of all neonates enrolled in the study. Neonates having full consent from parents, diagnosed cases of BPD in preterm neonates of gestational age <= 36 wk gestational age, who received treatment for BPD (e.g vitamin A, caffeine, corticosteroids), Neonates who have become oxygen dependent/ ventilator dependent to maintain respiratory effort were included in the study. Neonates with gestational age >37 weeks (term babies), congenital malformations incompatible to life where ventilator support is not indicated, maintaining stable vitals and saturation without prolonged oxygen support, lost due to attrition were excluded from the study. Taking proportion of Preterm babies who developed BPD to be 11% from previous study,[19] 95 percent confidence interval, alpha error of 1.96 , power of the study to be 80 we calculated sample size to be approximately 40. The gestational age was determined by LMP or by USG dating scan or by the new Ballard's score. Maternal baseline demography details such as age, parity, medical conditions such as hypertensive disorders of pregnancy, gestational as well as overt diabetes, cardiac, renal diseases, premature rupture of membrane (PROM), IUGR, multiple gestation, antepartum hemorrhage etc. in the mother were included as they may contribute to early delivery of the baby. Perinatal risk factors like intrapartum asphyxia, meconium-stained amniotic fluid etc, and the number of doses of corticosteroids in mothers receiving it, administration of oxygen and the need for resuscitation were observed and variables were collected. Invasive mechanical ventilation following endotracheal intubation was done in severe distress. The duration of oxygen support needed was calculated in number of days and those babies who needed moist oxygen support for more than 28 days or 36 weeks CGA were noted. Duration of oxygen therapy use was defined as the number of days for which oxygen was used at concentrations above 21% in order to maintain a transcutaneous saturation above 90%. The duration of stay in the NICU was noted and any baby admitted for an extended period i.e., more than 60 days were taken into account. The neonates were then followed up after discharge in the high-risk clinic on OPD basis. At each OPD visit, a physical examination was performed to assess if any respiratory morbidity is present and information was obtained from the parents regarding any intercurrent respiratory conditions in between the follow-ups. Parents were asked about the presence of coughing, wheezing, need for bronchodilators. For infants who suffered from intercurrent respiratory morbidities - the number of OPD visits due to respiratory issues, and the need for further hospitalizations for respiratory morbidities (number of such along with duration of stay) were noted. All collected data were expressed as frequency, percentage, mean ± standard deviation and range depending on distribution. Test for independence were carried out either using Chi Square Test or Fisher exact test when data deviated from normality or had very less frequency. Statistical significance was accepted at the level of $p < 0.05$.

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RESULTS

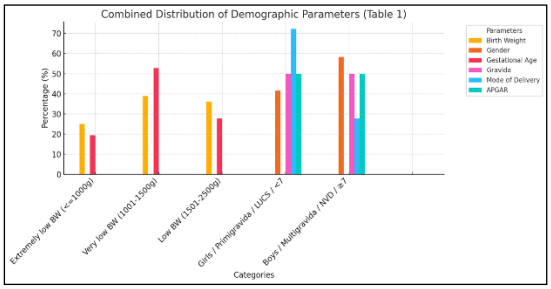

TABLE 1: Graph

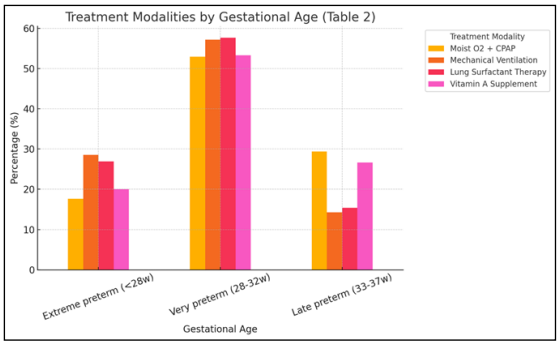

TABLE 2: Graph

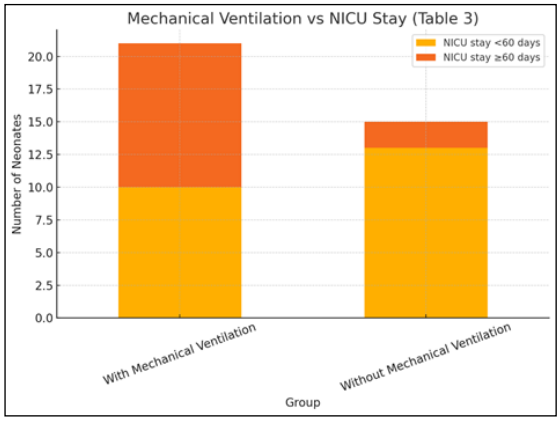

TABLE 3: Graph

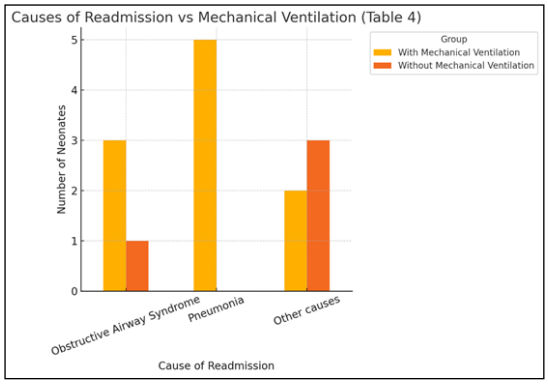

TABLE 4: Graph

Table 1: Demographic parameters of neonates (Distribution of study participants according to Birth weight, gender, gestational age, gravida among mothers, mode of delivery, mean APGAR score).

Parameters		N(%)
Birth weight(grams)	Extremely low (<=1000)	9(25%)
	Very low (1001-1500)	14(38.89%)
	Low (>=1500-2500)	13(36.11%)
Gender	Girls	15(41.67%)
	Boys	21(58.33%)
Gestational age	Extreme preterm(<28 weeks)	7(19.44%)
	Very preterm(28-32 weeks)	19(52.78%)
	Late preterm(33-37 weeks)	10(27.78%)
Gravida	Primigravida	18(50%)
	Multigravida	18(50%)
Mode of delivery	LUCS	26(72.22%)
	NVD	10(27.78%)
Mean APGAR score	<7	18(50%)
	>7	18(50%)

From table 1 it is evident that among the 36 babies, Only 9 (25%) of the babies had extremely low birth weight, 14 (38.89%) had very low birth weight and 13 (36.11%) had low birth weight. Out of total study population 15(41.67%) were girls, whereas 21(58.33%) were boys respectively. In the total population of babies, 7 (19.44%) were between 27-28+6 (extreme preterm), 19 (52.78%) were between 29-32+6 weeks (Very late preterm) and 10 (27.78%) were between 33-34+6 weeks (low preterm) of gestational age. 18 (50%) of mothers were primigravida whereas the remaining 18 (50%) were multi gravida. That means equal number of gravida among mothers has been shown. The mode of delivery of 10 (27.78%) babies were spontaneous (NVD) while 26 (72.22%) babies had indicated (LUCS) preterm delivery. Out of 36 babies, 18 (50%) had mean APGAR score of greater than and equal to 7 and the remaining 18 (50%) had mean APGAR score of less than 7.

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Table 2. Dependency of study population with different treatment modalities (Moist o2 + CPAP, Mechanical Ventilation, Lung surfactant Therapy, Vitamin A supplement).

	Moist o2 + CPAP	With Mechanical Ventilation	Lung Surfactant Therapy	Vitamin A Supplement
Gestational Age (Weeks)	N(%)	N(%)	N(%)	N(%)
Extreme preterm (<28 weeks)	6(17.65%)	6(28.57%)	7(26.93%)	6(20%)
Very preterm(28-32 weeks)	18(52.94%)	12(57.14%)	15(57.69%)	16(53.33%)
Late preterm(33-37weeks)	10(29.41%)	3(14.29%)	4(15.38%)	8(26.67%)

Table 2. Need for various treatment modalities like moist o2+CPAP, mechanical ventilation, lung surfactant therapy, vitamin A supplementation in different gestational age of study population is evident from table 2. Out of 34 babies, 6 babies (17.65%) in 27-28+6 weeks, 18 babies (52.94%) in 29-32+6 weeks and 10 babies (29.41%) in 33-34+6 weeks of gestation needed both CPAP and moist O2 via hood as respiratory support for their distress. Out of 21 babies, 6 babies (28.57%) in 27-28+6 weeks, 12 babies (57.14%) in 29-32+6 weeks and 3 babies (14.29%) in 33-34+6 weeks of gestation needed mechanical ventilation. Out of 26 babies who were given Surfactant Replacement Therapy, 7 (26.93%) in 27-28+6 weeks, 15 (57.69%) in 29-32+6 weeks and 4 (15.38%) in 33-34+6 weeks of gestation needed administration of exogenous surfactant. Out of 30 babies who were given vitamin A supplement, 6 (20%) in 27-28+6 weeks, 16 (53.33%) in 29-32+6 weeks and 8 (26.67%) in 33-34+6 weeks of gestation needed administration of exogenous surfactant.

Table 3: Association between Mechanical ventilation and different treatment modalities with NICU stay.

		NICU stay<60 days	NICU stay>=60 days	P value
Association Between mechanical ventilation & NICU	With mechanical ventilation (58.33%)	10	11	0.0021
	Without mechanical ventilation (41.67%)	13	2	
Association among Moist o2 , N-CPAP ,Vitamin A with NICU	Moist o2	21	13	0.0023
	Nasal CPAP	21	13	0.0068
	Vitamin A	17	13	0.02

Table 3: Babies who were mechanically ventilated had more than or equal to 60 days stay in NICU compared to babies who were not mechanically ventilated which is statistically significant. (p=0.0021). Also babies who received various treatment modalities like moist o2, nasal CPAP, Vitamin A supplementation had significantly less stay (p value less than 0.05) in NICU days and overall hospital morbidity compared to babies who did not received these treatment in NICU, as seen in table 3..

Table 4: Association between various causes of readmission at hospital with mechanical ventilation.

	With Mechanical Ventilation (71.43%)	Without Mechanical Ventilation (28.57%)	P value
Obstructive airway Syndrome	3	1	0.21
Pneumonia	5	0	0.002
Other causes	2	3	0.44

Table 4 showed that pneumonia was most common cause of repeat hospital admission followed by obstructive airway Syndrome (Bronchiolitis, Recurrent wheeze) and other causes. In our study we also found out that among all the causes of readmission only pneumonia had significant association with need for mechanical ventilation (p<0.05).

Table 5: Distribution of Z scores for weight for age among the study participants who had extended NICU stay and who needed hospital re-admission.

Weight(Kg)		NICU>=60		Hospital Re-admission	
		N	%	N	%
3 months	Z-score>0	1	7.69	0	0
	Z-score<0	12	92.31	8	100
6 months	Z-score>0	5	38.46	4	50

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	Z-score<0	8	61.54	4	50

From Table 5, we observed that those children with smaller z-scores for weight both at 3 months and 6 months were frequently hospitalized and also were more among those who had spent more than 60 days in NICU. At 3 months, among those who had more than 60 days stay at NICU 12 (92.31%) had lower z-scores for weight and similar prevalence was observed for hospital readmission. At 6 months a similar pattern was seen 8 (61.54%) and 4 (50%) babies lower z scores among those who stayed longer in NICU and got readmitted respectively.

Table 6: Distribution of Z scores for length for age among the study participants who had extended NICU stay and who needed hospital re-admission.

Length(cm)		NICU>=60		Hospital Re-admission	
		N	%	N	%
3 months	Z-score>0	5	38.46	4	50
	Z-score<0	8	61.54	4	50
6 months	Z-score>0	6	46.15	5	61.54
	Z-score<0	7	53.85	3	38.46

From Table 6 we observed that those children with smaller z-scores for length both at 3 months and 6 were more among those who had spent more than 60 days in NICU. But from the table it cannot be specified that z-score can determine the frequency of hospital readmission. At 3 months, among those who had more than 60 days stay at NICU 8 (61.54%) had lower z-scores for length and 4(50%) needed hospital readmission. At 6 months 7 (53.85%) and 3 (38.46%) babies had lower z scores among those who stayed longer in NICU and got readmitted respectively.

DISCUSSION

The study was conducted on 36 neonates with diagnosed BPD to study relation between different antenatal factors, modes of ventilation, various treatment procedures and outcome with occurrence of BPD. In this study we found that majority (38.89%) babies were belonged to the VLBW category and 36.11 % babies to LBW respectively. Majority of the preterm babies belong to very preterm group (52.78%), while 19.44% babies were extremely preterm & 27.78% babies were moderately to late preterm. It was seen that boys were affected by BPD more than girls (21 boys' vs 15 girls). This goes in accordance with the study conducted by Joseph M. Collaco et all (2017).[10] Seaborn et al. found the lungs of male babies to be immature by approximately one week when compared to their female counterparts.[11] Equal number of mothers were primigravida & multi gravida (50% both). On analysis of antenatal risk factor 80.6% mother had significant antenatal risk factors. Majority of maternal age ranged from 17 to 22 years. Most of the mothers had poor nutritional status, belong to families of low socioeconomic class which may have contributed to preterm deliveries. We found that PROM, PIH, IUGR, being three of the antenatal risk factor mostly associated BPD in this study. We also observed that that babies of a lot of women who receive a just one single dose of corticosteroid latter developed BPD. This was maybe because early gestational age is itself an independent risk factor for RDS which is in accordance to a study by Gyamfi-Bannerman C published in 2018 where even after Betamethasone administration to mothers, significant number of babies developed BPD.[12] However, In our study we observed that among who had received antenatal steroids 52.17% were given mechanical ventilation, whereas among those who had not received steroids 69.23% had received mechanical ventilation, favouring the fact that administration of prenatal corticosteroids aims to reduce the incidence of complications and morbidities associated with preterm birth including BPD, a study carried out by oreoluwa olaloko et el.[13] Out of 36 babies moist oxygen & CPAP support were mostly needed for very preterm babies (52.94%) compared to 29.41 % of late preterm babies & 17.65% of extremely preterm babies. Also the need of Mechanical ventilation and exogenous lung surfactant therapy were highest in the very preterm neonates (57.14% and 57.69% respectively), compared to other 2 groups. Therefore we found out that very preterm babies are the most vurnerable group for development of BPD among all three groups and use of Moist o2+CPAP for the delivery room stabilization of the preterm infant, selective surfactant replacement therapy, initiation of caffeine therapy soon after birth, and early use of NIPPV in the neonatal intensive care unit are recommended cornerstones which are all proven to decrease BPD, the fact already established by study conducted by Vineet Bhandari et el (2021).[14] It has been found out that interventions like moist o2 inhalation, N- CPAP, vitamin A supplementation had significant impact on outcomes of babies with BPD in term of NICU stay (less than or equal to 60 days), p value<0.05 as all the above mentioned modalities significantly reduced NICU stay establishing their prominent role in treatment of BPD. Among all the Cause of readmission in the hospital, pneumonia was most common followed by obstructive airway Syndrome (Bronchiolitis, Recurrent wheeze) and other causes. In our study we also found out that among all the causes of readmission only pneumonia had significant association with need for mechanical

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ventilation ($p<0.05$). It was observed that those children with smaller z-scores for weight both at 3 months and 6 months were frequently hospitalized and also were more among those who had spent more than 60 days in NICU. At 3 months and 6 months, among those who had more than 60 days stay at NICU 92.31% and 61.54% respectively had lower z-scores for weight and similar prevalence was observed for hospital readmission, signifying the fact that reduced weight gain and nutritional status of child are associated with higher respiratory comorbidities and increased length of hospital stay. We also observed that, those children with greater disease severity in the neonatal period and who received more aggressive management for the same (like extended O2 use till 36 weeks CGA and beyond, mechanical ventilation) were more often admitted in the period of infancy with respiratory symptoms. They presented with significantly greater rates of respiratory morbidity, recurrent wheezing, and pneumonia and hospital admission when compared to infants who did not receive aggressive forms of management post birth. These findings are consistent with the study published by Vincent C Smith et al. published in 2004.[15] In our study, probable biomarkers for early diagnosis, genetic association, scope of novel treatment strategies like inhaled NO, Leukotriene receptor antagonist, inositol, cell therapy could not be explored. Time constraint was also a limitation in our study and sample size was inadequate to justify the findings with less margin of error, as study was conducted during COVID 19 pandemic causing inadequate follow up due to lack of communication. Therefore, large multicentre trial including large population will be required where impact of new treatment options and disease progression of BPD will be further evaluated with ultimate goal of understanding accurate pathophysiology, establishing standard treatment protocol and ultimately improving patient's outcome.

CONCLUSION

Bronchopulmonary dysplasia is associated with persistent lung impairment later in life because of frequent respiratory diseases causing reduced life expectancy. Among all the risk factors we found out that prematurity alone is associated with increased risk of long term lung problems like BPD due to impaired fetal lung maturity and endogenous lung surfactant production. Therefore, treatment modalities like moist O2, nasal CPAP, Vitamin A supplementation improved outcomes of babies affected with BPD in terms of mechanical ventilation support and long term NICU stay. Aside from protective ventilation strategies, optimal o2 saturation goal, surfactant supplementation and the use of antenatal steroids there is lack of efficacy of new therapies. Currently multiple therapies like inhaled nitric oxide , caffeine administration ,diuretics ,bronchodilators, even cell therapy etc. are being studied for treatment options for BPD and further studies are required establish efficacy of these treatment options in BPD in terms of reducing mechanical ventilation dependence and long term hospital stay.

REFERENCES

1. Jobe AH. Mechanisms of lung injury and bronchopulmonary dysplasia. Am J Perinatol. 2016;33:1076–8.
2. Jobe, A. H. & Bancalari, E. Bronchopulmonary dysplasia. Am. J. Respir. Crit. Care Med. 163, 1723–1729 (2001).
3. Blencowe H, Cousens S, Oestergaard MZ, Chou D, Moller AB, Narwal R, Adler A, Vera Garcia C, Rohde S, Say L, Lawn JE. National, regional, and worldwide estimates of preterm birth rates in the year 2010 with time trends since 1990 for selected countries: a systematic analysis and implications. Lancet. 2012;379:2162–72.
4. Bhandari A, Bhandari V. Pitfalls, problems, and progress in bronchopul-monary dysplasia. Pediatrics. 2009;123:1562–73.
5. Auten RL, Mason SN, Auten KM, Brahmajothi M. Hyperoxia impairs post- natal alveolar epithelial development via NADPH oxidase in newborn mice. Am J Physiol Lung Cell Mol Physiol. 2009;297:L134–42.
6. Klinger G, Sokolover N, Boyko V, Sirota L, Lerner-Geva L, Reich-man B. Perinatal risk factors for bronchopulmonary dysplasia in a national cohort of very-low-birthweightinfants. Am J Obstet Gynecol. 2013;208:115.e1–9.
7. Husain, A. N., Siddiqui, N. H. & Stocker, J. T. Pathology of arrested acinar devel- opment in postsurfactant bronchopulmonary dysplasia. Hum. Pathol. 29, 710–717 (1998)
8. Jain D, Bancalari E. Bronchopulmonary dysplasia: clinical perspective. Birth Defects Res A Clin Mol Teratol. 2014;100:134–144.
9. Bronchopulmonary Dysplasia: An Update of Current Pharmacologic Therapies and New Approaches Zoe Michael, Fotios Spyropoulos, Sailaja Ghanta and Helen Christou .
10. The Influence of Gender on Respiratory Outcomes in Children With Bronchopulmonary Dysplasia During the First 3 Years of Life: Joseph M. Collaco, MD, PhD, Angela D. Aherrera, MPH, and Sharon A. McGrath-Morrow, MD, MBA
11. Seaborn T, Simard M, Provost PR, et al. Sex hormone metabolism in lung development and maturation. Trends Endocrinol Metab. 2010;21:729-38.
12. Gyamfi-Bannerman, Cynthia. 590: Respiratory morbidity after betamethasone (BMZ) treatment in infants of women at risk for late preterm delivery (LPD). American Journal of Obstetrics & Gynecology, Volume 218, Issue 1, S353.
13. Evaluating the use of corticosteroids in preventing and treating bronchopulmonary dysplasia in preterm neonates: Oreoluwa Olaloko, Raihan Mohammed, and Utkarsh Ojha
14. Non-Invasive Ventilatory Strategies to Decrease Bronchopulmonary Dysplasia—Where Are We in 2021? by Vikramaditya Dumpa and Vineet Bhandari.
15. Rehospitalization in the first year of life among infants with BPD.: Vincent C Smith et al. 2004.

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