Conrad Hansen-Quartey

Mr. Tynes

AP CSP 6B

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Bronchopulmonary Dysplasia

Abstract

The purpose of this research paper is to investigate the causes of Bronchopulmonary Dysplasia (BPD) (also known as neonatal chronic lung disease (nCLD)[3])as well as measure which can prevent or alleviate it. BPD is a chronic lung disease that develops mostly among premature infants who use mechanical ventilation or supplemental oxygen for breathing difficulties [4]. BPD can also develop in some low-weight infants as a result of Patent Ductus Arteriosus (PDA) or sepsis [2]. Premature infants are diagnosed with BPD if they are dependent on supplemental oxygen after reaching their original due date [2]. Research indicates that 3 in 10 premature infants under 1,000 g develop BPD [5].

BPD was discovered in 1967 by Northway who examined premature newborns who developed chronic pulmonary disease after they were placed on ventilation [1]. Advances in medical technology have increased the number of infants surviving BPD, but have had little impact on decreasing the rate of new cases of BPD [1]. BPD remains the most common disease for premature infants under 30 weeks and most common chronic lung disease for infants [1].

Steroids and supplemental surfactant have reduced complications from BPD and scar tissue[4] but have resulted in stunted lung development [1]. Infants who survive BPD may develop apnea, poor muscle tone and coordination, poor eyesight, hearing, and delayed speech, learning challenges, and gastroesophageal reflux disease (GERD) later on [2]. This paper will look at the causes of BPD, preventative measures, and long term impacts of BPD survivors

Causes

BPD results from a combination of prenatal and postal factors harming lung development[1]. BPD development may be influenced from incomplete lung development or lung injury at a crucial stage of lung development[1]. Factors leading to stunted development of alveoli (the air sacs in the lung) include mechanical ventilation, excessive oxygen concentration, inflammation, infection, hindered growth, lack of proper nutrition, and genetic predisposition[1]. Injuries can result from delayed or hindered lung development caused by genetic predisposition, steroid exposure before birth chorioamnionitis, and growth restrictions in uterus (considered a new form of BPD)[1]. Injuries can also result from physical damage to the lungs caused by ventilator injuries, oxidative stress, infection, steroid exposure after birth, excess lung fluid, and lack of proper nutrition (considered the traditional form of BPD)[1].

Prevention

Different ventilation and medical strategies are used to prevent lung injury and reduce the risk of BPD. There are currently two ventilation strategies: high-frequency jet ventilation (HFJV) and oscillatory ventilation (HFOV)[1]. While both show potential to decrease the risk of developing BPD, there are concerns with both[1]. HFOV was shown to minimally reduce the

risk of developing BPD in a Cochrane review[1]. HFJV remains controversial because of the need for more sedation[1].

CPAP was investigated as an alternative initial breathing support and showed a decrease in the combined rate of BPD development and death[1]. More facilities are testing CPAP use as the initial breathing support in premature infants to manage RDS[1]. Some studies indicate a decreased risk of BPD development with earlier removal of ventilator tubes even if later re-inserted, through support from more research is necessary[1].

Antenatal steroids and surfactant are shown to be effective in decreasing the risk of developing respiratory distress syndrome (RDS) and increasing the odds of survival[1]. However, these are not shown to decrease the risk of developing BPD[1]. The optimal concentration for supplemental oxygen is still being investigated for preventing BPD, though many facilities use higher concentrated oxygen in premature infants with confirmed BPD to decrease BPD-induced pulmonary hypertension[1].

Steroids (specifically glucocorticoids given after birth) decreases the risk of developing BPD by reducing inflammation and causing the lungs to mature[1]. However, systemic steroids such as these can result in brain development issues such as cerebral palsy[1]. Studies indicate systemic steroids may still benefit a high risk subpopulation when given in lower doses for a shorter period of time[1]. Giving premature infants budesonide with surfactant has been viewed

as a more reliable method to transfer corticosteroids straight into lung alveoli, though more studies are needed to confirm this decreases in BPD development or death[1].

Caffeine has shown through research to reduces risk of developing BPD as effectively as shorter time spans of respiratory support, though how it protects from lung injury is currently unknown[1]. Vitamin A is suggested to decrease the combined rate of BPD development and death, though injection (by which supplemental vitamin A is given) may cause discomfort and increase the risk of infection[1]. Oral supplements are being studied as an alternative method for giving vitamin A to infants[1].

Long Term Impacts

There is a lack of data on the long term impact of new methods, as current adults who survived BPD from infanthood were treated with now outdated methods[1]. Extremely premature infants weighing under 1000 grams spend an average of 60 days in the hospital, and many require more support such as rehospitalization[1]. 49% of premature infants with BPD return to the hospital within 1 year, with high risks of dying from complications[1] such as pulmonary hypertension [3]. 71%-81% of infants with BPD survive, with ventilation support at home required for those with severe BPD[1]. Sudden infant death syndrome is 7 times more likely for sufferers of BPD[1]. Though infants with BPD improve over time, they may require years of treatment for resulting ailments [2]. Long-term studies present concerns of young adults having improperly functioning lungs, symptoms resembling asthma, and difficulties with heavy

exercise as a result of prior BPD. [1] Those who survive BPD may develop lung infection due to pathogens, tobacco, and pollution, which results in severe illness or death [1].

Conclusion

BPD is a chronic lung disease seen with inflammation, and caused by RDS or other conditions such as PDA or sepsis. Several methods have been investigated to both prevent and treat BPD, including new ventilation strategies, CPAP, steroids, and doses of caffeine and Vitamin A. BPD survivors are predisposed to other diseases, and are a potential strain to the healthcare industry. BPD differs from RDS in that RDS is one of several causes than can trigger BPD. However, RDS is a condition infants are born with, while BPD is not. More research is needed to produce solutions which allow for more infants diagnosed with BPD to survive as well as BPD survivors to thrive in their later years.

Sources

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[2] https://www.nhlbi.nih.gov/health-topics/bronchopulmonary-dysplasia

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