

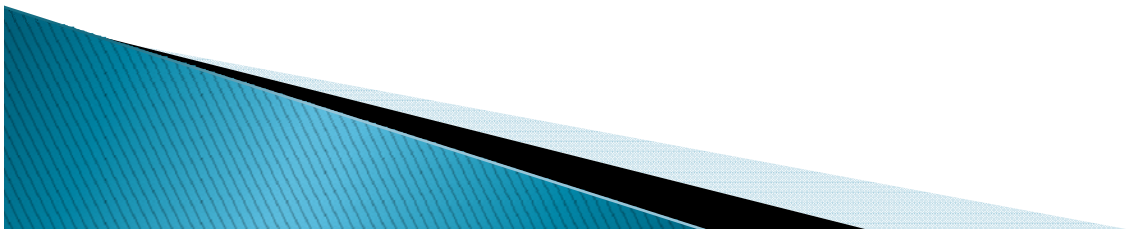
Neurodevelopmental Outcomes and Bronchopulmonary Dysplasia

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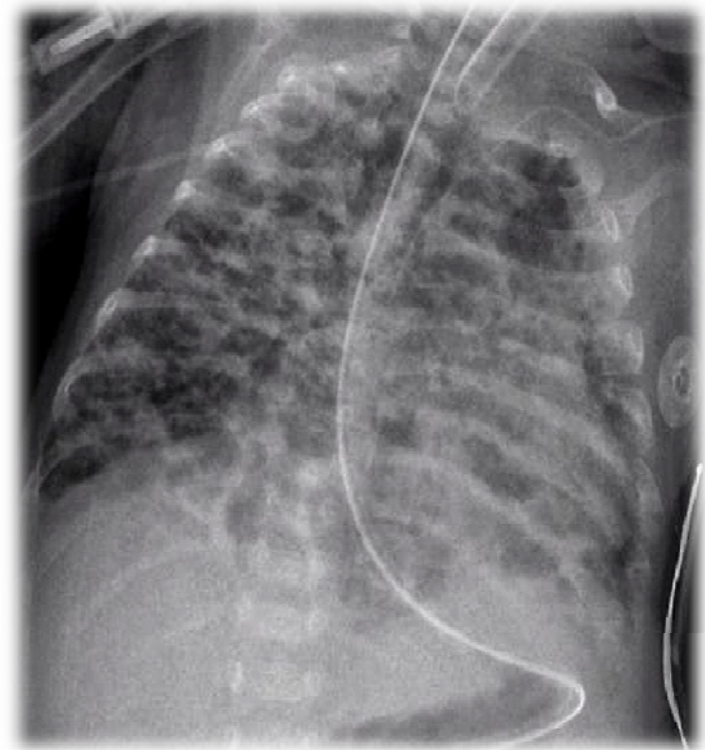
Learning objectives

- ▶ Identify why bronchopulmonary dysplasia (BPD) may be associated with worse long term outcomes
- ▶ Recognize the adverse outcomes associated with BPD



Definition of BPD

- ▶ **Epidemiological**
 - Supplementary oxygen or respiratory support at >28 days
 - Supplementary oxygen or respiratory support at >36 wks
 - Spectrum of severity
- ▶ **Clinical**
 - Xray findings and clinical deterioration may start earlier at 7-14 days of life

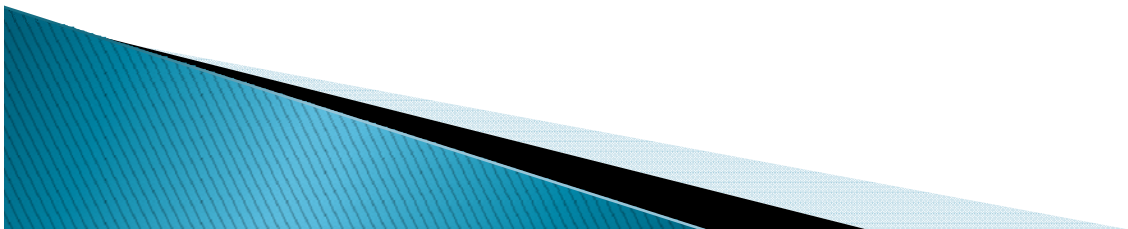


Wikipedia

Characteristics of BPD

- ▶ Higher rates with lower gestational age
- ▶ Comorbidities:
 - IVH and periventricular leukomalacia
 - Pneumothoraces
 - Sepsis
 - Poor growth and feeding problems
 - Hypoxia
 - Increased pain and stress
 - Prolonged hospital stay

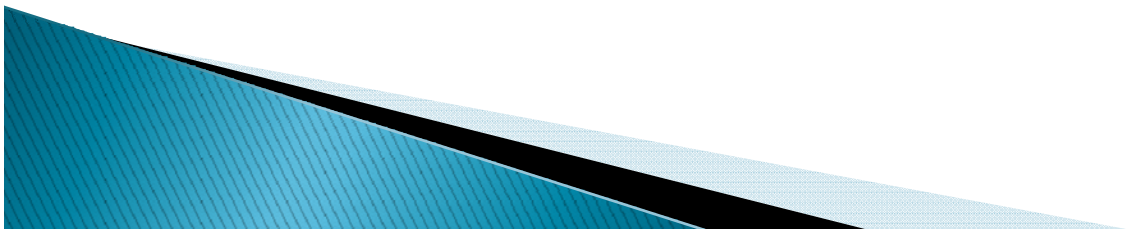
(Anderson PJ, DoyleLW. Seminars in Perinatology 2006)



Types and Severity of BPD

- ▶ “Old” BPD (Northway 1967)
 - Typically > 32 wks GA, ventilated, barotrauma
 - CXR: hyperlucent cystic areas
 - Autopsy: pulmonary fibrosis and epithelial metaplasia

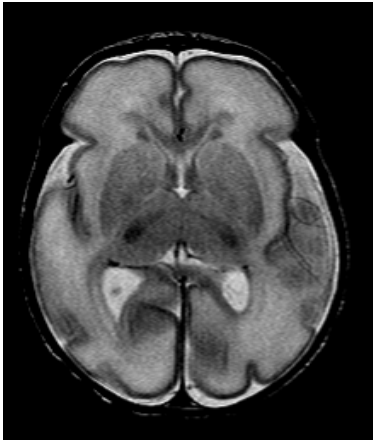
- ▶ “New” BPD NICHD consensus (Jobe 2001)
 - < 32 wks GA vs > 32 wks GA
 - Mild, moderate and severe
 - Alveolar arrest



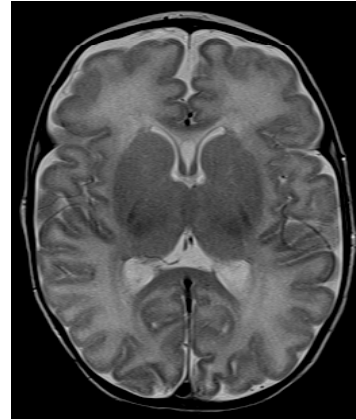
Mechanisms of Injury

- ▶ “Brain injury” vs “brain dysmaturity”
 - IVH, PVL

32 weeks



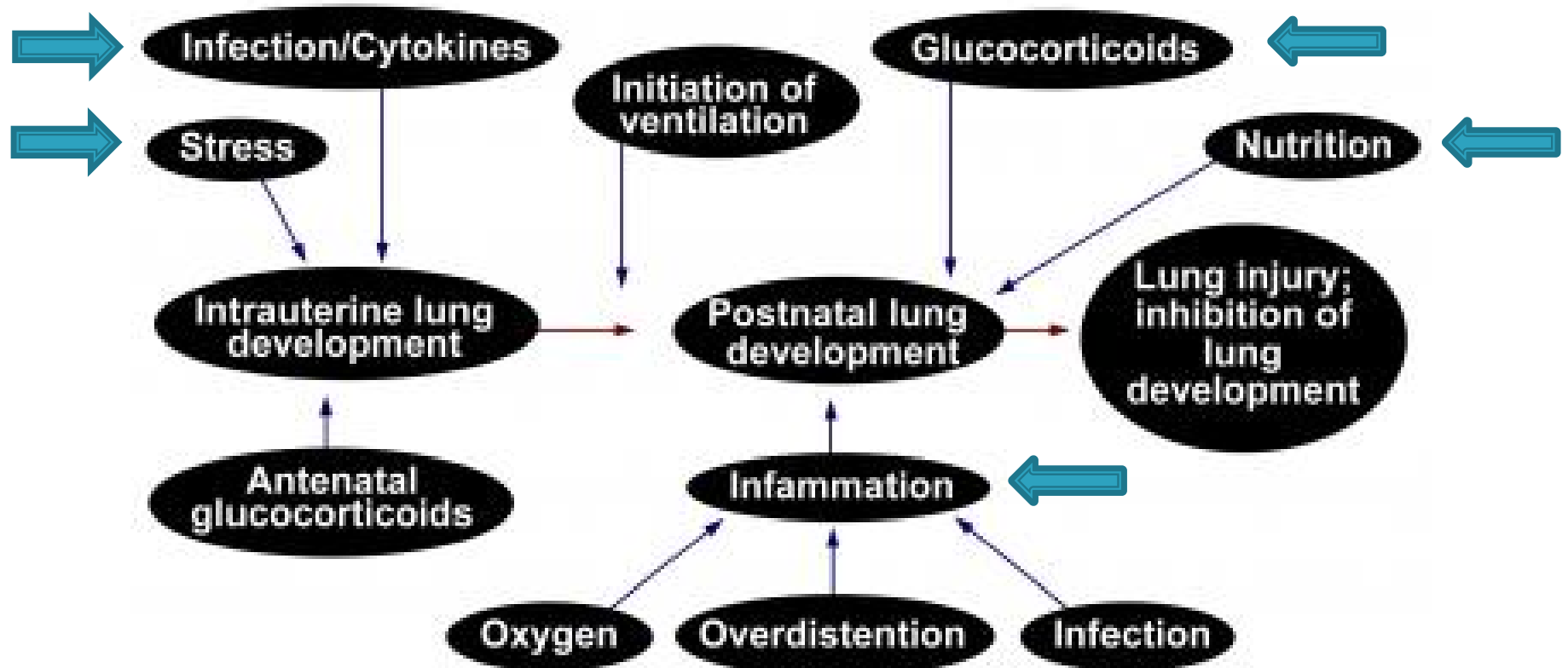
40 weeks



- ▶ Environmental:
 - Parent bonding
 - Noise, bright light, painful procedures
 - Parental education and socioeconomic status

Factors that Cause BPD and Affect Brain Maturation

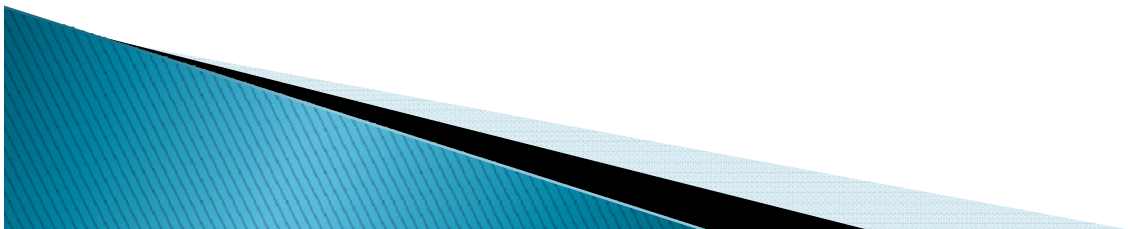
Pathogenesis of BPD



N Ambalavanan, Chief Editor: Ted Rosenkrantz, Medscape

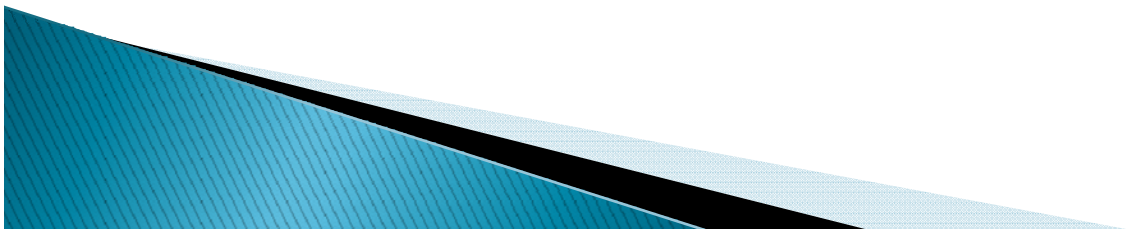
Complications & Treatments for BPD

- ▶ Respiratory support
 - Increased risk of pneumothoraces
 - Periods of hypoxia or variable oxygen saturation
 - More sedation and analgesia
- ▶ Sepsis or ventilator associated pneumonia
- ▶ Poorer Nutrition
- ▶ Treatments
 - Diuretics
 - Postnatal steroids



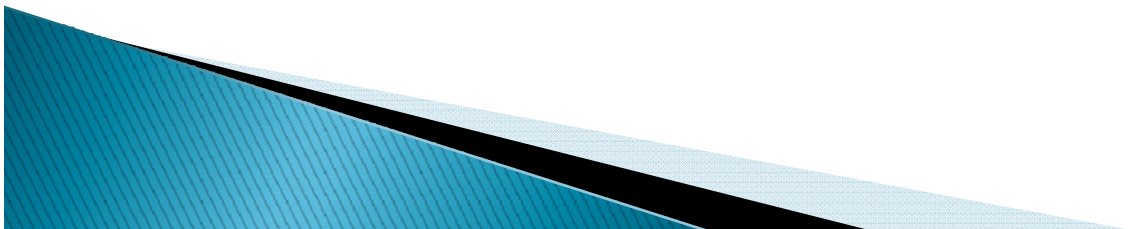
BPD and Cerebral Palsy (CP)

- ▶ < 1500 g Rates of CP (Skidmore 1990)
 - BPD (O₂ > 27 days): 15%
 - No BPD: 3-4%
- ▶ NICHD < 25 wks GA 1993-1999 (Hintz 2005)
 - BPD and CP after adjustment for other risk factors:
 - OR 1.66 (95% CI 1.01-2.74)
- ▶ TIPP trial < 1000 g 1996-1998 (Schmidt 2001)
 - BPD and CP: OR 2.5 (95% CI 1.9-3.4)



BPD and other Motor Impairments

- ▶ BPD is a risk factor for DCD (Developmental Coordination Disorder)
 - motor impairment that interferes with the child's activities of daily living and academic achievement
 - No other neurological explanation
 - Motor worse than cognitive impairment
 - Defined using the MABC-2 or Bruininks-Oseretsky
- ▶ Poorer fine and gross motor skills (Vohr, 1991 and Short 2003)



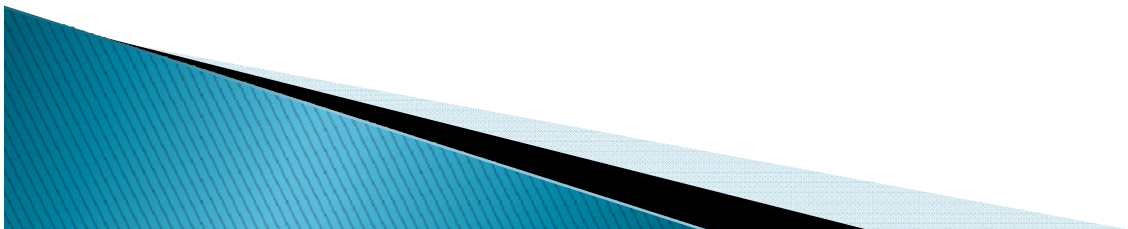
BPD and Sensory Outcomes

▶ Visual:

- Blindness is uncommon (CNFUN = 1.6%)
- Strabismus: 19 % in VLBW cohort
 - BPD is a risk factor

▶ Hearing

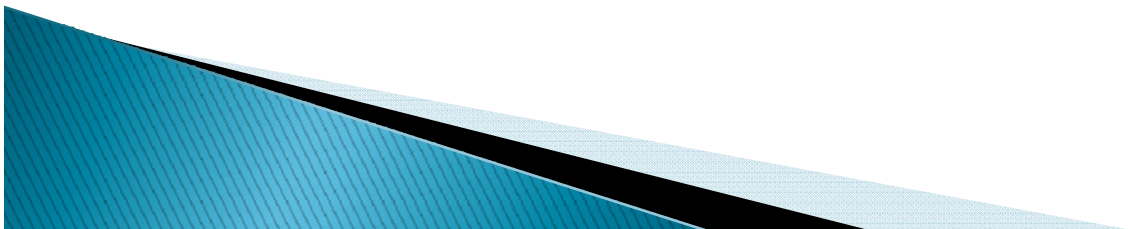
- Sensorineural Hearing Loss CNFUN = 2.6%
 - Use of loop diuretics, increased aminoglycosides, hypoxia
- Conductive and other hearing losses CNFUN= 8.2%
 - BPD is a risk factor for conductive hearing loss



BPD and Cognitive Functioning

- ▶ Lower scores on the Bayley with BPD (2X)
- ▶ Lower IQ (80-90)
- ▶ BPD associated with loss of 4-10 IQ points
- ▶ Preterm with BPD:
 - 40% with IQ < 85
 - 20% with IQ < 70

(Doyle et al. Seminars in Fetal & Neonatal Med 2009)



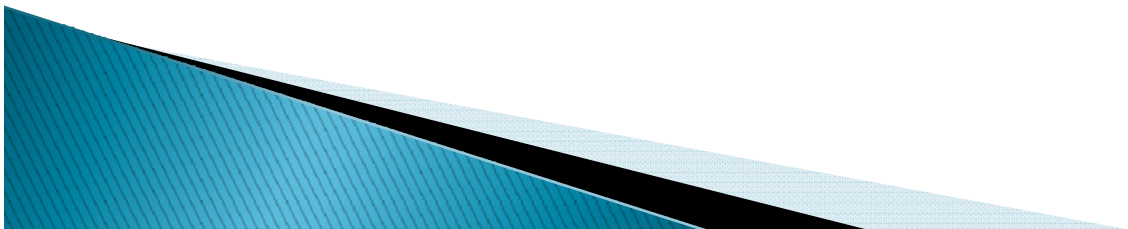
BPD & Other Cognitive Outcomes

- ▶ Attention (Farel 1998)
 - BPD: 59% scored < -1 SD
 - No BPD: 32% scored < -1 SD
- ▶ Attention Deficit
 - In 8 yr olds BPD 15% (2x non-BPD) (Short 2003)
- ▶ Memory (Farel 1998)
 - BPD: 65% scored < -1 SD
 - No BPD: 29% scored < -1 SD
- ▶ Visual-Spatial Perception (Doyle 2009)
 - Children with BPD do worse on a variety of visual-spatial tasks (VMI, Perceptual motor, Rey Complex figure and Judgment of Line Orientation Test)



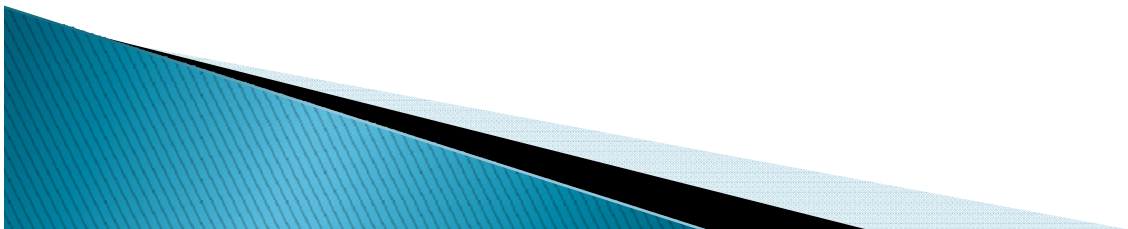
BPD & Language Problems

- ▶ Language problems (Doyle 2009)
 - Increased about two-fold with BPD:
 - Preschoolers (3-5 years):
 - Expressive language 43%
 - Receptive language 49%
 - School age
 - Expressive language 15%
 - Receptive language 9%
 - Worse articulation
 - About 50% receive speech and language therapy



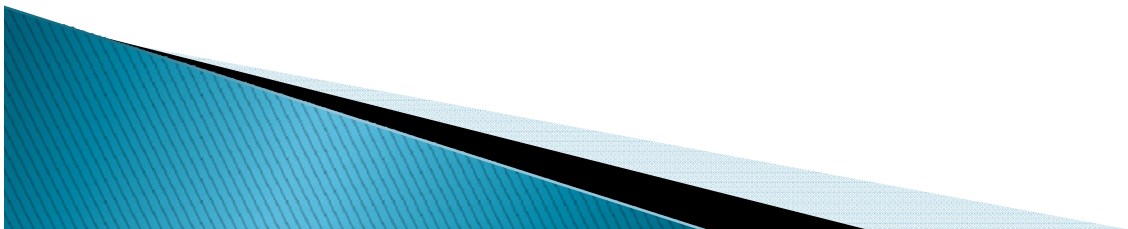
Executive Functions: Definition

- ▶ A set of general purpose control mechanisms, often linked to the prefrontal cortex of the brain, that regulate the dynamics of human cognition and action (Miyake 2000; Miyake 2012)
- ▶ Core EF abilities (Diamond 2007; Miyake 2000)
 - ▶ Inhibitory Control
 - ▶ Working Memory
 - ▶ Cognitive Flexibility



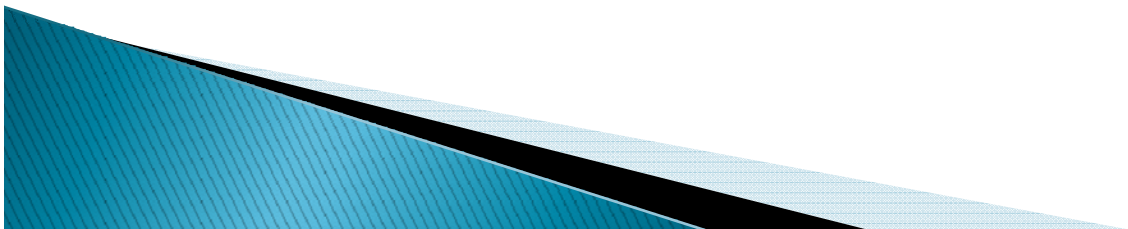
BPD & Other Cognitive Outcomes

- ▶ Executive Skills (Doyle 2009)
 - Negative correlation with executive function and weeks on oxygen
- ▶ Academic performance (Doyle 2009)
 - Delays and increased learning disabilities especially in math and reading- up to 47% in BPD



BPD and Psychological Problems

- ▶ Internalizing problems
 - ▶ Attention Deficit Hyperactivity Disorder
 - ▶ Autism Spectrum disorder
 - ▶ Schizophrenia
 - ▶ Social difficulties
- (Anderson 2006)



Conclusions

- ▶ BPD is associated with global neurodevelopmental delay rather than a specific pattern of impairments
- ▶ Though BPD is associated with prematurity and multiple other risk factors, BPD is independently associated with worse outcome.
- ▶ BPD is not dichotomous but a spectrum
 - Do we need a calculator to determine outcomes based on age at which baby is weaned off respiratory support ?

