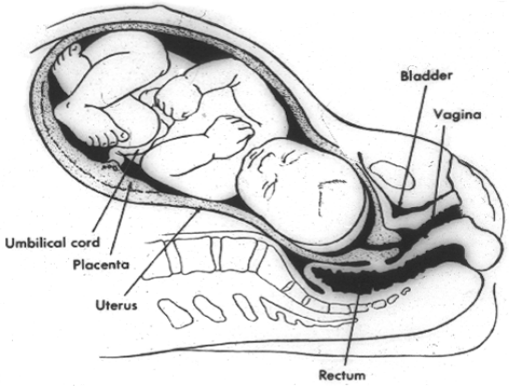
The Preterm Neonate

S. David Rubenstein, MD
Professor of Clinical Pediatrics
sdr26@columbia.edu



The Preterm Neonate

- Gestational age less than or equal to:
  37 weeks
- Usual birth weight of less than:
  2500 grams
- Definition by birth weight

LBW	1000-1500 grams
VLBW	750-1000 grams
ELBW	500-750 grams

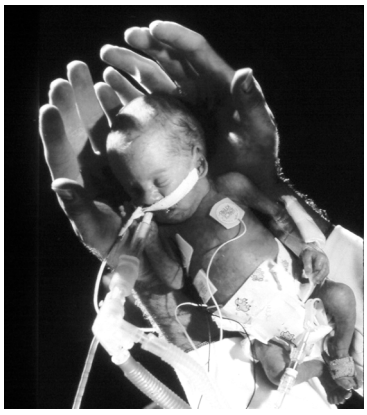
The Preterm Neonate

- Has unique problems not usually seen in term neonates, although disorders seen in term neonates may also occur in neonates born prematurely
- Problems usually are related to gestational age; more frequent and severe at the earlier gestational ages

The Preterm Neonate

- Some disorders/diseases of prematurity are:
  - Hypothermia and/or hypoglycemia*
  - Hypernatremia and/or hyperkalemia*
  - Respiratory distress syndrome (RDS)*
  - Bacterial sepsis*
  - Periventricular leukomalacia* (PVL)
  - Intracranial hemorrhage* (IVH)
  - Necrotizing enterocolitis* (NEC)
  - Patent ductus arteriosus* (PDA)
  - Retinopathy of prematurity* (ROP)
  - Hyperbilirubinemia*

* Not uncommon



The Preterm Neonate - Infection

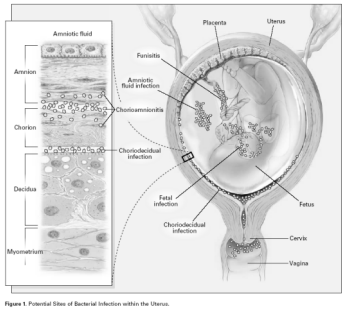
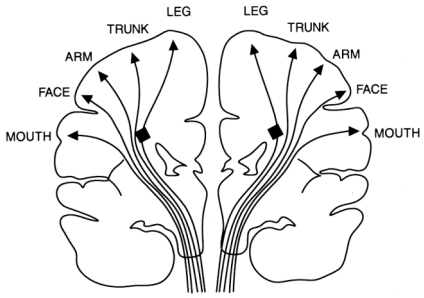


Figure 1. Potential Sites of Bacterial Infection within the Uterus.



The Preterm Neonate – Fluid Balance

- Fluid balance in the preterm neonate
  - ***Insensible*** water loss (cannot be measured easily)
    - Usual losses relate to: skin, GI or respiratory
    - Usual loss of about 35 ml/kg/day
    - Increased significantly for the first few postnatal days of life in ELBW neonates (skin losses); can approach 100-175 ml/kg/day
  - ***Sensible*** water loss (can be measured easily)
    - Usual losses relate to: urine output
    - Usual loss of about 65 ml/kg/day

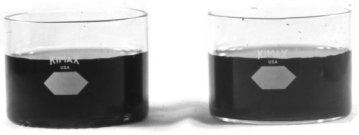
The Preterm Neonate – Fluid Balance

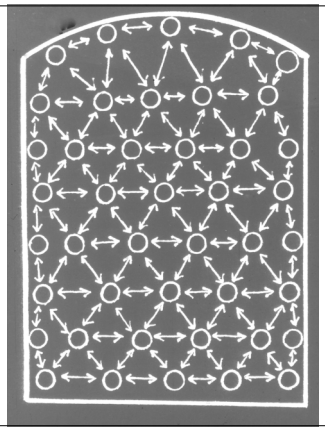
- Maintenance fluid therapy
  - amount of water necessary to maintain balance (I/O)
  - IWL + SWL (usually 100-210 ml/kg/day)
- Complications caused by increased water needs of ELBW neonates
  - Hypernatremia and hyperosmolality if water needs not met (lose water in excess of sodium)
  - Hyperglycemia
  - PDA

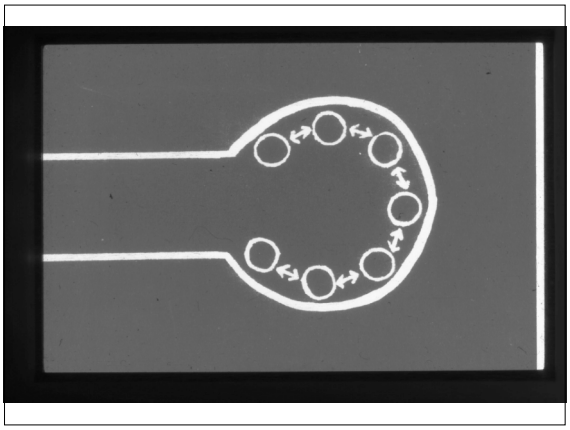
The Preterm Neonate

	Adult	Term	Preterm
	70 kg	3,000 grams	750 grams
Blood volume	5000 ml	270 ml	65 ml
C.O.	5000ml/min	450 ml/min	110 ml/min
Heart rate	70/min	160/min	160/min
S.V.	70 ml	2.8 ml	0.7 ml
B.P.	120/80	60/40	40/25

The Preterm Neonate – RDS

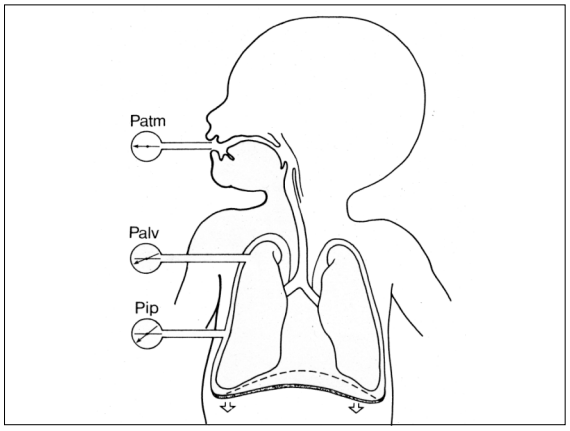


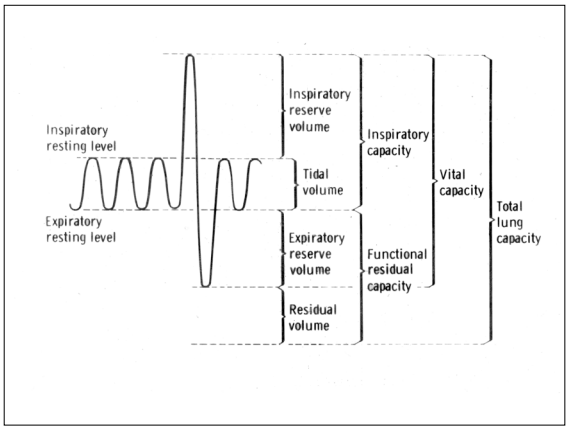


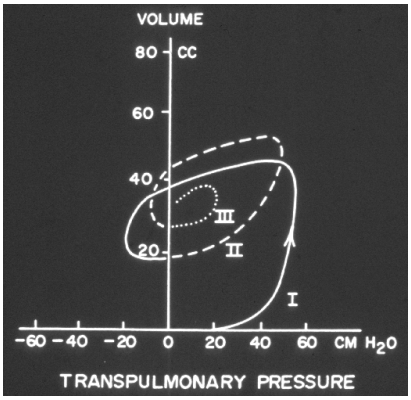


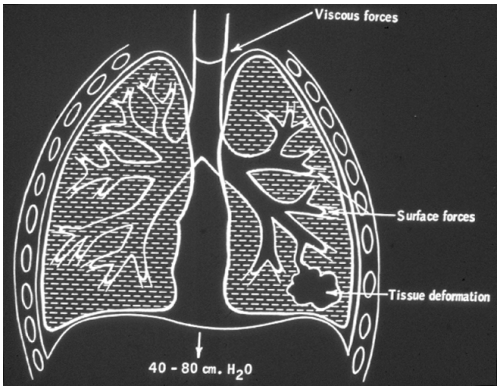
LaPlace's Relationship

$$\text{Pressure} = \frac{2 \times \text{Surface Tension}}{\text{Radius}}$$









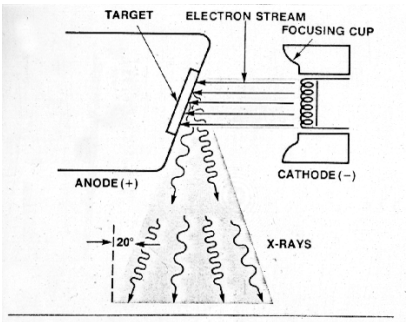
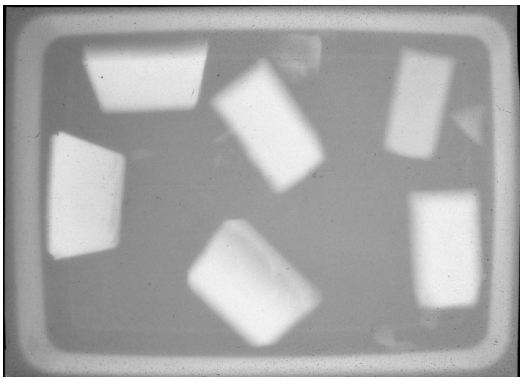
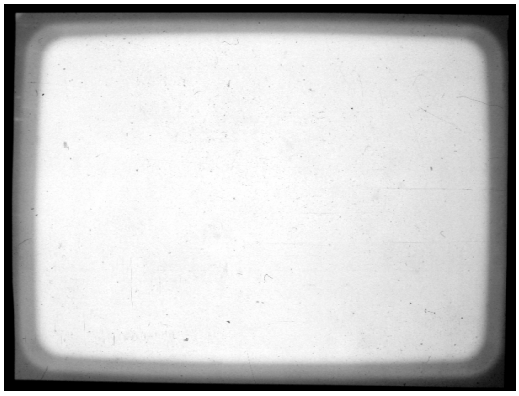
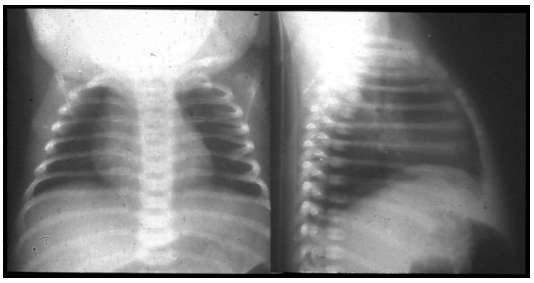
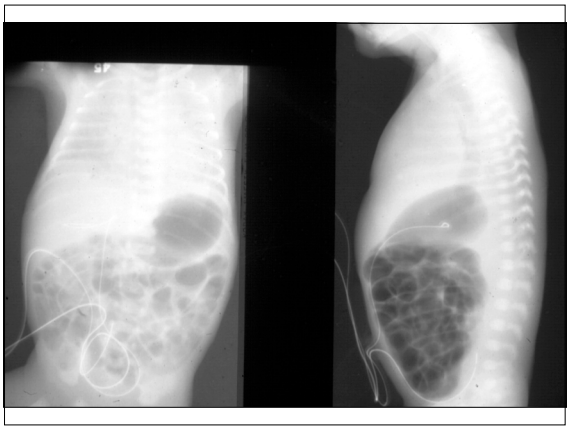


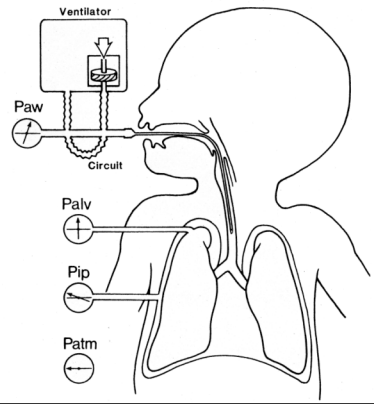
Figure 5 Emission of electrons from the heated filament of the cathode. The electrons strike the stationary target of the anode and x-rays are produced at the actual focal spot of the anode. Rays of different wavelengths and penetrating power are shown schematically.



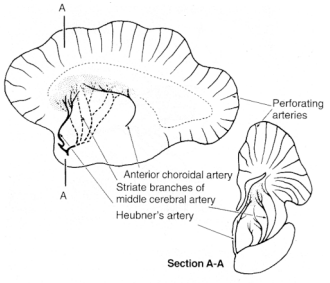






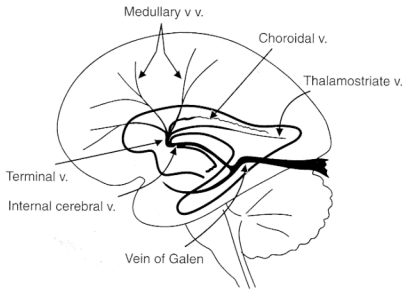


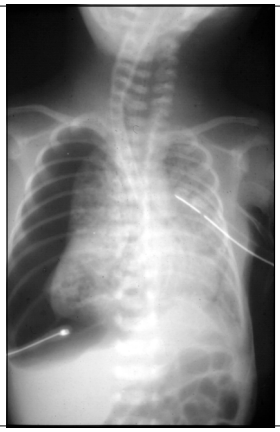
The Preterm Neonate – IVH

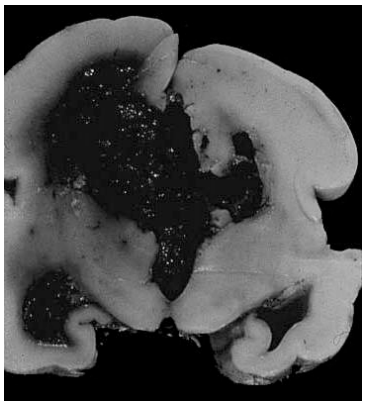


Cerebral Blood Flow

- Increases with:
  - Hypoxia (cerebral vasodilator)
  - Hypercarbia (cerebral vasodilator)
  - Hypertension (not autoregulated)
- Decreases with:
  - Hyperoxia (cerebral vasoconstrictor)
  - Hypocarbia (cerebral vasoconstrictor)







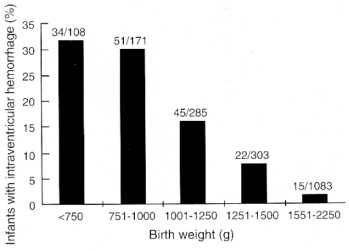
Intracranial Hemorrhage in Preterm Neonates

- Grading of hemorrhage
  - I limited to germinal matrix
  - II into ventricles, no enlargement
  - III into ventricles, with enlargement
  - IV into parenchyma and white matter

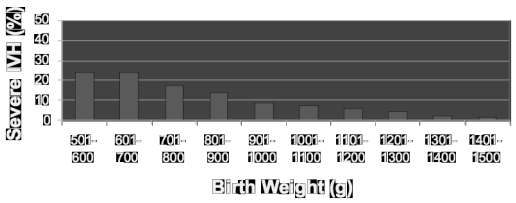
  PVL periventricular leukomalacia

Papille et al

The Preterm Neonate – IVH and BW



Severe IVH by Birth Weight
Vermont Oxford 2002



Neurodevelopmental Outcomes in Preterm Neonates (500-1500g)

- Intelligence quotient (IQ)
  4,000 preterm c/w 1570 term neonates
  - LBW: 5-7 IQ points lower
  - VLBW: 4-9 IQ points lower
  - ELBW: 12-17 IQ points lower

Neurodevelopmental Outcomes in Preterm Neonates (500-1500g)

IQ less than 70	odds ratio
birth weight < 750	9.54
birth weight 750-1500	2.15

SES has little impact upon IQ in ELBW

Neurodevelopmental Outcomes in Preterm Neonates (500-1500g)

- Contribute disproportionately to M&M
- Account for less than 1% of all deliveries
- 25% incidence of disability in survivors
- Highest incidence in most immature neonates
- Low severity cerebral dysfunction on the rise
- < 4% incidence of disability in term neonates

OUTCOME of EXTREME PREMATURITY

gestational age	death[1]	Survival with disability[2]	Survival w/o disability
22 weeks	100 %	?	?
23 weeks	52 %	18 %	30 %
24 weeks	33 %	21 %	46 %
25 weeks	24 %	20 %	56 %
26 weeks	19 %	17 %	64 %

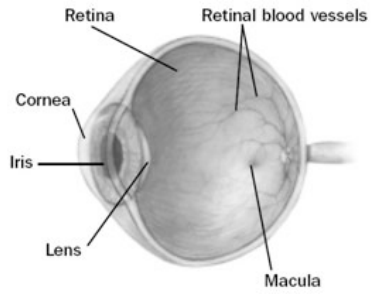
[1] MSCHONY 2004-2006
[2] 11 reports from tertiary perinatal centers in Canada, USA, & Australia from 1977-1995

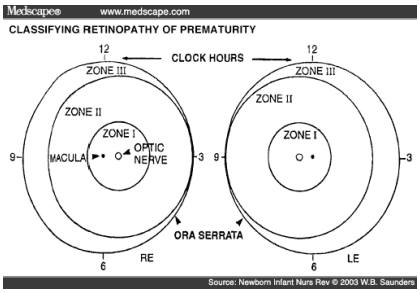
OUTCOME of EXTREME PREMATURITY

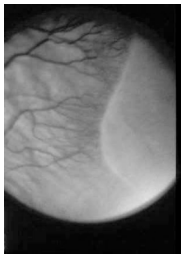
gestational age	Survival[1]	% of survivors w/disability[2]	% of survivors w/o disability
22 weeks	0 %	?	?
23 weeks	48 %	37 %	63 %
24 weeks	67 %	32 %	68 %
25 weeks	76 %	26 %	74 %
26 weeks	81 %	21 %	79 %

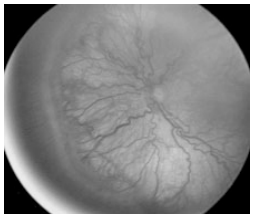
[1] MSCHONY 2004-2006
[2] 11 reports from tertiary perinatal centers in Canada, USA, & Australia from 1977-1995

The Preterm Neonate – ROP

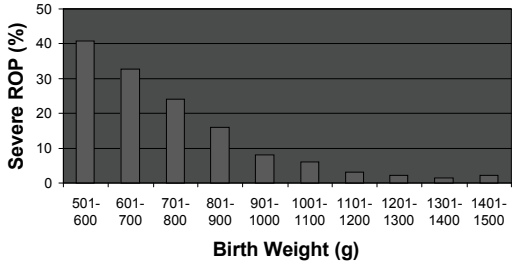








Severe ROP by Birth Weight
Vermont Oxford 2002




WARNING


That's all Folks!