


# Pediatric Physiology for the General Anesthesiologist

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## Conception to Neonate

- ◆ Birth
- ◆ Body water composition
- ◆ Heart function
- ◆ Lung function
- ◆ Liver function
- ◆ Kidney function

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## First Breath

- ◆ With birth lungs are filled with amniotic fluid and need to empty
- ◆ The first breath can generate up to -70 mmHg and water moves from lungs into the circulation
- ◆ PVR falls
- ◆ Air stimulates ductal closure

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## First Breath

- ◆ Ductal closure raises SVR
- ◆ Cord clamping increases SVR
- ◆ Increased LA pressure closes foramen ovale
- ◆ Voila! Series circulation and functioning lungs

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## Newborn Circulation

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## Newborn Heart Function

- ◆ Suddenly one low pressure side and one high pressure side
- ◆ Ventricles "see" different loads
- ◆ But the myocardium isn't ready for Prime Time
- ◆ High MVO<sub>2</sub> requires high cardiac output
- ◆ Makes the heart mainly rate dependent

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### Newborn Lung Function

- ◆ Large airways mostly complete
- ◆ Alveoli mostly lacking
- ◆ Very tender tissues
- ◆ Soft chest wall
- ◆ Brain can't remember to breathe regularly

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### Newborn Liver Function

- ◆ Hasn't really been doing too much
- ◆ Suddenly responsible for everything
- ◆ High red blood cell breakdown
- ◆ Hyperbilirubinemia disturbs drugs and monitors
- ◆ Birth uses much of the stored glycogen

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### Newborn Kidney Function

- ◆ Tubular structures present at birth
- ◆ Salt and urea gradients deficient
- ◆ Low blood flow before birth
- ◆ Operates at about 20% in utero
- ◆ Need to get rid of body water from fetal life

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### Newborn Renal Function

- ◆ 70% water at term
- ◆ Drops 10% weight in first 2 days
- ◆ Starts urinating on the first day
- ◆ Recovers body weight by 7 days by taking in solids and developing renal gradients
- ◆ Lower T<sub>max</sub> for glucose

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### Newborn Neurological Function

- ◆ Pain pathways are integrated into neuroendocrine, somatic and autonomic systems early in gestation
- ◆ Newborns may have an exaggerated response to pain
- ◆ Neural tissue, CSF are higher in proportion to body mass
- ◆ Myelination is incomplete

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### Temperature Maintenance

- ◆ Large surface area that doesn't vasoconstrict well
- ◆ Less shivering and sweating
- ◆ Less subcutaneous fat to insulate
- ◆ Less muscle mass to shiver with
- ◆ Less tolerant of thermal stress
- ◆ Thermal neutral temperature 10 degrees higher

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## Neonate to Infant

- ◆ One week to one month
- ◆ Ductus still only physiologically closed
- ◆ Lungs dried out
- ◆ Kidney function approaching 50%
- ◆ Ventilatory control stabilizes
- ◆ Sympathetic cardiovascular responses appear

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## Neonate to Infant

- ◆ Higher O<sub>2</sub> consumption than adults
  - ◆ Requires higher resting cardiac output
  - ◆ Causes rapid desaturation by consuming FRC faster
- ◆ Brain grows accustomed to regular breathing
- ◆ Still can't concentrate or dilute urine as well

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## Infant to Toddler

- ◆ 6 months to one year
- ◆ Ventricular function and pulmonary resistance stabilize
- ◆ PDA closed anatomically
- ◆ Lung function and ventilatory control stabilize
- ◆ Liver and kidney function exceed 50%

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### Toddler to School Age

- ◆ Brain – not done cooking
- ◆ Heart – pretty much done
- ◆ Lungs – still making alveoli
- ◆ Liver – functions at high level
- ◆ Kidneys – good to go

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### Adolescence

- ◆ Brain – the teen years, need I say more?
- ◆ Heart – frequently broken, but no longer a child's
- ◆ Lungs – fully developed
- ◆ Liver – getting ready for adult beverages, I suppose
- ◆ Kidneys

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### AFLOAT

- ◆ A airway/apnea
- ◆ F fluids
- ◆ L ytes/glucose
- ◆ O oxygen
- ◆ A atropine-friendly heart
- ◆ T temperature

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