Neonatal Nursing Education Brief: Neonatal Hypertension


| Neonatal hypertension is not a common finding in healthy neonates. However, high-risk infants requiring NICU care are at elevated risk. There are several factors that can contribute to the development of hypertension. Optimal outcomes depend on prompt recognition and treatment. |
| Hypertension, NICU, cardiovascular system, thrombus, vascular disease |

## Neonatal Hypertension

**Purpose and Goal: CNEP # 2081**

- Learn about hypertension in the neonate.
- Learn about best practices for treating hypertension.

None of the planners, faculty or content specialists has any conflict of interest or will be presenting any off-label product use. This presentation has no commercial support or sponsorship, nor is it co-sponsored.

**Requirements for successful completion:**

- Successfully complete the post-test
- Complete the evaluation form

**Date**

- July 2018 – July 2020
Learning Objectives

- Describe the risk factors for neonatal hypertension
- Describe the clinical presentation of neonatal hypertension
- Describe 2 approaches for the treatment of neonatal hypertension

Introduction

- Hypertension is not common in neonates
  - But the incidence rises in NICU infants
- Standard definitions of hypertension have been identified
- Identifying hypertension is important
  - Identification can lead to:
    - Appropriate etiology
    - Appropriate evaluation
    - Appropriate management
    - Appropriate pharmacotherapy

Neonatal Hypertension

- Hypertension is seen in less than 0.2% of infants
- The incidence rises in high-risk NICU infants
  - Up to 3% in infants requiring NICU care
- Kidney development continues until 36 weeks
  - Preterm birth interrupts nephrogenesis
  - Neu
  - Preterm infants are already at risk
- Other additional risk factors include:
  - Umbilical arterial catheters
  - Bronchopulmonary dysplasia
  - Intraventricular hemorrhage
- Acute renal failure
- Chronic renal failure
- Congenital heart disease
- Congenital anomalies
  - Kidneys
  - Urinary tract
- There is growing evidence genetics plays a role
- Hypertension is diagnosed based on:
  - Systolic or diastolic values
  - Persistently greater than 95th percentile
    - On 3 separate occasions
    - Based on post-conceptual age

**Normal Infant Blood Pressure Ranges**

- Normal BP ranges have been established
- Ranges are based on post-conceptual age
- BP normal ranges increase with PCA
- 26 weeks PCA
  - 50th percentile 55/30 MAP 38
  - 95th percentile 72/50 MAP 57
  - 99th percentile 77/56 MAP 63
- 28 weeks PCA
  - 50th percentile 60/38 MAP 45
  - 95th percentile 75/50 MAP 58
  - 99th percentile 80/54 MAP 63
- 30 weeks PCA
  - 50th percentile 65/40 MAP 48
  - 95th percentile 80/55 MAP 63
  - 99th percentile 85/60 MAP 68
- 32 weeks PCA
  - 50th percentile 68/40 MAP 49
  - 95th percentile 83/55 MAP 64
  - 99th percentile 88/60 MAP 69
• 34 weeks PCA
  • 50\textsuperscript{th} percentile 70/40 MAP 50
  • 95\textsuperscript{th} percentile 85/55 MAP 65
  • 99\textsuperscript{th} percentile 90/60 MAP 70
• 36 weeks PCA
  • 50\textsuperscript{th} percentile 72/50 MAP 57
  • 95\textsuperscript{th} percentile 87/65 MAP 72
  • 99\textsuperscript{th} percentile 92/70 MAP 77
• 38 weeks PCA
  • 50\textsuperscript{th} percentile 77/50 MAP 59
  • 95\textsuperscript{th} percentile 92/65 MAP 74
  • 99\textsuperscript{th} percentile 97/70 MAP 79
• 40 weeks PCA
  • 50\textsuperscript{th} percentile 80/50 MAP 60
  • 95\textsuperscript{th} percentile 95/65 MAP 75
  • 99\textsuperscript{th} percentile 100/70 MAP 80
• 42 weeks PCA
  • 50\textsuperscript{th} percentile 85/50 MAP 62
  • 95\textsuperscript{th} percentile 98/65 MAP 76
  • 99\textsuperscript{th} percentile 102/70 MAP 81
• 44 weeks PCA
  • 50\textsuperscript{th} percentile 88/50 MAP 63
  • 95\textsuperscript{th} percentile 105/68 MAP 80
  • 99\textsuperscript{th} percentile 110/73 MAP 85

**Standardized Method for Measuring BP**

• Position prone or supine
• Use a standard oscillometric device
• Use an appropriate cuff size
  • Cuff width to arm circumference
    • 0.45 – 0.70 ratio
• Use a preferred site
  • Right upper arm
• Use preferred timing
  • Infant should be asleep
  • If awake, infant should be quiet
  • Infant should not be disturbed
    • For 15 minutes after cuff placed
  • Feeds or interventions
    • Should have been at least 1.5 hours before
• Obtain the preferred number of BP readings
  • At least 3 readings
  • Taken 2 minutes apart

Etiology and Risk Factors for Neonatal Hypertension

• Several factors are associated with hypertension
• The most commonly involved factors are:
  • Renal parenchymal disease
  • Renal vascular anomalies
• Congenital anomalies may also be involved:
  • Polycystic kidney disease
  • Multi-cystic dysplastic kidneys
  • Ureteropelvic junction obstruction
  • Urethral obstruction
• The most common non-renal factors are:
  • Chronic lung disease
  • Bronchopulmonary dysplasia
    • Occurs in 13 – 43%
• Factors associated with hypertension include:
  • Maternal factors
    • Maternal hypertension
    • Heroin or cocaine use
• Antenatal steroid exposure
• Maternal BMI >30
• Maternal diabetes
• Abnormal utero-placental perfusion

• Prematurity
• Low birthweight
• Perinatal hypoxia
• Renal vascular thrombosis
  • Renal artery thrombosis
  • Renal vein thrombosis
    • Occurs in 10%
  • From umbilical catheter placement
    • Occurs in 2 – 9%
    • Vascular endothelial disruption
    • Thrombi form at the tip of the catheter
    • Thrombi form adjacent to catheter tip
    • Thrombi can occlude aortic blood flow
    • Most common with prolonged use

• Renal artery stenosis
• Renal artery compression
  • From tumors
• Renal parenchymal disease
  • Polycystic kidneys
  • Acute tubular necrosis
  • Acute kidney injury
• Cardiac disease
  • Patent ductus arteriosus
  • Coarctation of the aorta
• Medications
  • Steroids
  • Caffeine
  • Phenylephrine
  • Indomethacin
• Vasopressors
• Bronchodilators
• Parenteral nutrition
  • Excess volume
  • Sodium overload
  • Hypercalcemia
• ECMO
• Bronchopulmonary dysplasia
• Endocrine disorders
  • Congenital adrenal hyperplasia
  • Hyperaldosteronism
  • Hyperthyroidism
  • Pseudohypoaldosteronism type II
• Seizure disorders
• Neoplastic disorders
  • Neuroblastoma
  • Wilms tumor
• Intraventricular hemorrhage
• Acquired
  • Acute tubular necrosis
  • Cortical necrosis
  • Interstitial nephritis
  • Nephrocalcinosis
  • Hemolytic uremic syndrome
• Unmanaged pain

Clinical Manifestations of Neonatal Hypertension

• Clinical manifestations include:
  • Asymptomatic
  • Most infants shown no signs
  • Cardiorespiratory signs
- Tachypnea
- Cyanosis
- Cardiomegaly
- Hepatomegaly
- Heart failure
- Mottled color
- Unequal pulses
- Deceased pulses
- Neurologic signs
  - Lethargy
  - Tremors
  - Seizures
  - Hypertonicity
  - Hypotonicity
  - Apnea
  - Opisthotonos
  - Hemiparesis
  - IVH
  - Asymmetric refluxes
  - Retinopathy
- Renal signs
  - Renal enlargement
  - Sodium wasting
  - Oligoanuria
    - Polyuria
- Other signs
  - Failure to thrive
  - Abdominal distension
  - Edema
  - Adrenal mass
  - Fever
Diagnostic Evaluation of Neonatal Hypertension

- Most infants with hypertension are asymptomatic
- Diagnosis is made by routine serial BP monitoring
- Once recognized, an evaluation should occur
- A general approach includes:
  - Was the BP cuff the right size?
  - Was the BP taken using standard methods?
  - Does the BP meet criteria for hypertension?
  - Are there risk factors in the infant’s history?
  - Does the physical exam indicate a cause?
    - Focus on cardiovascular exam
    - Focus on abdominal exam
    - Focus on genitourinary exam
  - Order appropriate labs and ultrasounds
  - Address the etiology and treat appropriately
- A specific approach includes:
  - History
    - Maternal
      - Steroids
      - Cocaine
      - Heroin
      - Hypertension
      - Diabetes
      - Obesity
    - Prenatal
      - Oligohydramnios
      - Polyhydramnios
      - Renal anomalies
    - Postnatal
      - Steroids
      - Adrenergic agonists
      - Indomethacin
- Caffeine
- Umbilical catheters

- Targeted physical exam
  - Volume status
  - Weight trends
  - Dysmorphic features
    - Genetic abnormality
      - External ear abnormality
    - Genetic syndrome
  - Cardiovascular
    - 4 extremity BPs
    - Murmurs
    - Femoral pulses
    - Brachial pulses
  - Genitourinary and renal
    - Abdominal masses
    - Abdominal bruits
    - Abdominal wall anomalies
    - Genitalia
      - Congenital adrenal hyperplasia

- Laboratory investigation
  - Urinalysis
  - Electrolytes
  - Calcium
  - BUN
  - Creatinine
  - Additional investigations
    - Thyroid studies
    - Plasma renin activity
    - Aldosterone
    - Cortisol
    - 11-deoxycortisol
    - 11-deoxycorticosterone
- Plasma catecholamines
- Urine catecholamines
- Metanephrines
- Normetanephrines

- Radiologic studies
  - Aortic ultrasound
    - With Doppler flow
  - Renal ultrasound
    - With Doppler flow
  - VCUG
  - CT angiogram
    - Evaluate aorta
    - Evaluate renal arteries
- Nuclear medicine studies
  - DMSA or MAG3 scans
  - Captopril renal scan
- Cranial ultrasound
- Cranial MRI

- Cardiology
  - Echocardiogram

Management of Neonatal Hypertension

- Management should be individualized
- Optimal management remains uncertain
- The timing of antihypertensive therapy is controversial
- Most infants require treatment for short periods
  - Some for only 10 days
  - Six months is average
- Most experts agree hypertension should be treated
- Untreated hypertension can lead to:
  - Retinopathy
• Encephalopathy
• Left ventricular hypertrophy
• Reversible and treatable factors should be addressed
  • A pediatric nephrologist should be consulted
  • A pediatric cardiologist should be consulted as needed
• Severe hypertension should be treated with IV drugs
• Milder hypertension can be treated with oral drugs
• The most commonly used IV drugs include:
  • Vasodilators
    • Hydralazine
    • Sodium nitroprusside
  • Calcium channel blockers
    • Nicardipine
  • Beta-adrenergic blockers
    • Esmolol
    • Propranolol
  • Alpha- and Beta-adrenergic blockers
    • Labetalol
  • ACE-inhibitors
    • Enalaprilat
• The most commonly used oral drugs include:
  • Calcium channel blockers
    • Amlodipine
  • ACE-inhibitors
    • Captopril
    • Enalapril
    • Lisinopril
  • Beta-adrenergic blockers
    • Propranolol
  • Alpha- and Beta-adrenergic blockers
    • Labetalol
  • Diuretics
    • Chlorothiazide
• Spironolactone
• Central alpha-agonist
  • Clonidine
• Vasodilators
  • Hydralazine
  • Minoxidil
• Surgical treatment for hypertension is uncommon
• To date, no data have been published about outcomes

Renal Vein Thrombosis

• Thrombotic disease is uncommon in neonates
  • But it can cause serious morbidity
• Neonates have altered levels of:
  • Procoagulant factors
  • Anticoagulant factors
  • Fibrinolytic factors
• Neonates are at increased risk of bleeding
  • Especially in the presence of umbilical catheters
• Risk factors for thrombosis include:
  • Umbilical catheter
  • Central venous catheter
  • Elevated hematocrit
  • Sepsis
  • Major surgery
  • Metabolic disorders
  • Prothrombotic disorders
    • Antithrombin deficiency
    • Protein C deficiency
    • Protein S deficiency
    • Plasminogen deficiency
    • Factor V Leiden mutation
• Prothrombin mutation
• MTHFR mutation
• Elevated homocysteine
• Elevated lipoprotein
• Clinical presentation of thrombosis is variable
• Signs and symptoms depend on location and size:
  • Catheter associated thrombosis
    • Loss of patency of catheter
    • Ischemia or organ dysfunction
    • Poor perfusion of limbs
    • Coolness of limbs or toes
    • Blanching of limbs and toes
    • Swelling of affected limbs, neck or head
    • Color changes of affected extremity
  • Renal vein or artery thrombosis
    • Gross hematuria
    • Thrombocytopenia
    • Palpable abdominal mass
  • Renal vein thrombosis may present
    • With a classic triad:
      • Hypertension
      • Thrombocytopenia
      • Palpable flank mass
    • Occurs in 13%
  • The presence of any of these should prompt investigation

Summary

• Neonatal hypertension is not common
• However, high-risk NICU infants are at elevated risk
• Management should be targeted to etiology if known
  • Umbilical catheters should be minimized
  • Nephrotoxic drug use should be minimized
Most infants only require short courses of treatment
Long-standing hypertension can lead to end organ damage

References


