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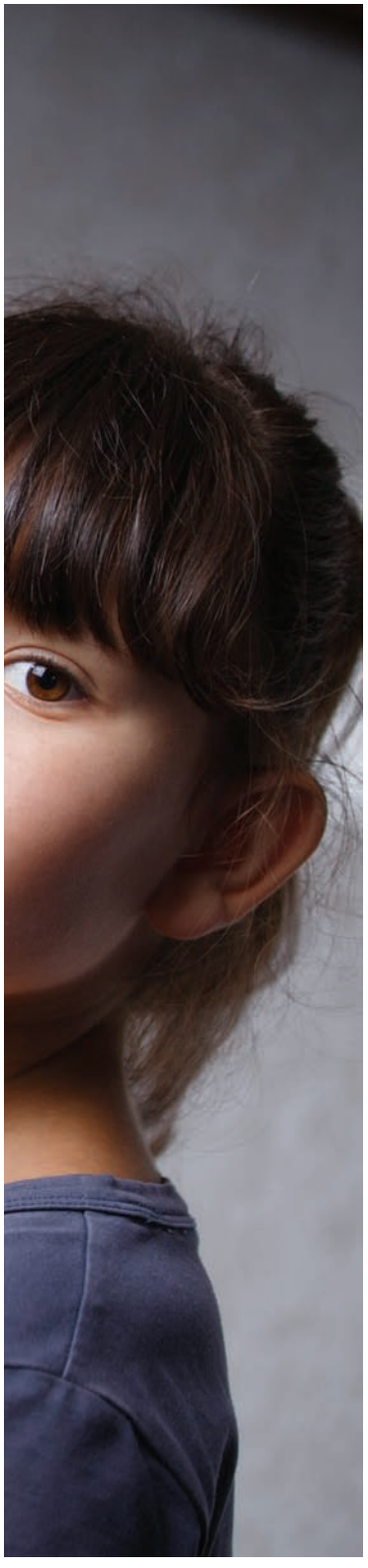

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Hypertension across the lifespan: Pediatrics

How can nurses facilitate cardiovascular care for our young patient population?

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Editor's Note: We begin our three-part series on hypertension across the lifespan with a look at pediatric patients. Stay tuned for a discussion of adult patients in the next issue, followed by geriatric patients in the July/August issue.

The prevalence and diagnosis of hypertension (HTN) in the pediatric population has significantly increased over the past decade. Pediatric patients with elevated BP progress to an HTN diagnosis at a rate of 7% per year. Approximately 3.5% of the pediatric population has been diagnosed with HTN. Increased incidence of HTN occurs in children who were born premature and those who are obese, as well as Hispanic and Black children. Up to 41% of pediatric patients with undiagnosed HTN will demonstrate evidence of left ventricular hypertrophy (LVH) and may show signs of early atherosclerotic disease. In addition, pediatric patients with untreated HTN are at higher risk for congestive heart failure, seizures, kidney injury, and stroke.

Early detection, diagnosis, and management of HTN in pediatric patients can prevent long-term complications as they transition into adulthood. This article explores HTN in pediatric patients older than age 1.

Case studies

The practitioner has been seeing JK since her premature birth at 30 weeks' gestation. JK was on oxygen for a short period after birth. After reaching the 10th percentile in length and weight at age 9 months, she continued to do well. Slight speech and language delays were diagnosed at age 2, and she received speech and language therapy from age 2 to 4. Her BP readings at her well-child visits at age 3 and 4 were within recommended ranges and she continued in the 10th percentile for height, weight, and body mass index (BMI).

JK is now in kindergarten and presents for her well-child visit. The provider sees that JK has dropped into the fifth percentile range for height, and her weight and BMI are plotted just below the 10th percentile. Her BP during the visit is 102/54 mm Hg. Because she's getting vaccinations today, the practitioner feels that JK may feel more anxious, which could affect her BP. She's scheduled back for an evaluation and BP check in 2 weeks.

At the follow-up visit, JK's BP is 104/68 mm Hg. A BP check is scheduled 2 weeks later and recorded at 107/65 mm Hg. She's referred to pediatric nephrology for her increased risk of renal etiology with an

elevated BP at an age younger than 6. She's also referred to pediatric cardiology due to her high risk of cardiac conditions related to HTN and prematurity at birth.

MG, a 12-year-old Hispanic patient, is seen for an athletic physical and found to have a BP of 138/88 mm Hg. His BMI is 31.4 (99th percentile for age), with a weight of 135 lb (61.2 kg) and height of 55 in (140 cm). He has no previous elevated BP readings. A family history of diabetes and HTN is verified on both the maternal and paternal side of the family. As per guidelines for a stage 1 BP reading, he's scheduled to be seen back in the clinic for a BP check in 2 weeks. At the recheck, his BP is recorded at 131/82 mm Hg.

MG and his parents are instructed on the DASH diet (lower sodium food choices, a variety of food groups, and portion control) and to continue 30 to 60 minutes of activity 3 to 5 days of the week, which is more than met with football practice. He's scheduled to be seen in the clinic in 3 months and encouraged to have the school nurse check and record his BP once or twice a week until the scheduled appointment.

At his follow-up appointment, MG is found to have lost 5 lb (2.26 kg) and his BP is recorded at 136/86 mm Hg. Subsequent visits at 6, 9, and 12 months show continued BP readings consistent with stage 1 HTN. With the confirmation of a diagnosis of HTN, a comprehensive metabolic panel, thyroid panel, lipids, hemoglobin A1C, and urinalysis are ordered. Consideration of a sleep study is deferred to cardiology after the patient denies snoring or excessive daytime drowsiness. He's referred to cardiology for further evaluation and treatment.

Factors associated with obesity in children

- Genetics
- Metabolism
- Nutrition
- Physical activity
- Sleep
- Community and neighborhood design and safety
- Negative childhood events

RL, a 12-year-old female patient, is seen by her primary care provider for a well-child visit. She has recently been having trouble sleeping because of a disagreement with her group of friends. Assessment reveals a BP of 144/92 mm Hg. The visit is associated with increased life stressors, so "white coat" HTN is considered. Pediatric guidelines for stage 2 HTN are followed and her BP is measured in both arms. Both measurements are greater than 140/90 mm Hg.

Family history of HTN is positive in the mother and maternal grandparents. RL is at the 50th percentile for height and weight, she's active, and she routinely follows a healthy diet. She isn't taking any medications, such as nonsteroidal anti-inflammatory drugs or pseudoephedrine, that would cause secondary HTN. Per guidelines, a follow-up BP recheck is scheduled in 1 week.

At the follow-up visit, RL reports that she and her friends are getting along better and her sleep patterns are back to normal. Her BP is measured at 140/92 mm Hg, which is consistent with stage 2 HTN. She's scheduled for a 24-hour ambulatory BP measurement to diagnose stage 2 HTN. According to pediatric HTN guidelines, this patient's age (older than age 6) makes her more likely to have primary HTN, but secondary HTN remains more common as a possible etiology and must be ruled out. RL is referred to a pediatric cardiologist for further evaluation and treatment.

Significant epidemiology

A history of HTN as a child correlates with a diagnosis of HTN in adulthood. Whereas only half of all adults are aware that they have HTN, fewer adolescents with comorbidities such as diabetes and chronic kidney disease (CKD) know their BP status.

Obesity significantly increases the rates of HTN in youth, with rising BP associated with an increase in adipose tissue, waist circumference, and BMI. Even in infancy, an elevated BMI is related to the

development of HTN in adulthood. Calculating BMI is different in children and adults. The calculations include the child's age, sex, height, and weight. It's normal for the BMI to increase with age. For example, a 10-year-old boy of average height with a BMI of 23 would be considered obese, whereas an adult with a BMI of 23 would be considered a healthy weight.

In the US, the obesity rate has more than tripled since the 1970s. In 2016, one in five US children between the ages of 6 and 9 was considered obese (see *Factors associated with obesity in children*). Studies reveal that an estimated 18.5% of children are obese, with 5.6% of that group considered severely obese. Almost half of children diagnosed with HTN are classified as being obese. Cardiovascular risk increases in the presence of multiple comorbid conditions, especially in children who are obese and diagnosed with HTN.

Other significant risks contributing to HTN in children include CKD, prematurity at birth, and sleep-disordered breathing (SDB). Up to 20% of children diagnosed with HTN have CKD as the primary etiology, and among children with CKD, approximately half are diagnosed with HTN. The diagnosis increases to up to 79% for pediatric patients with end-stage renal disease. Preterm birth is associated with cardiovascular risks and HTN in adults. Studies indicate a higher prevalence of HTN in young children and adolescents who have a history of prematurity at birth. Children identified with SDB have a 3.6% to 14% prevalence of HTN. SDB may include a variety of symptoms, such as snoring, sleep fragmentation, or sleep apnea. There's a correlation between the severity of symptoms and the chances of a child having HTN.

Guideline for diagnosis

It's recommended to begin routine BP monitoring annually starting at age 3 unless concerns are noted. If the child has risk factors, such as obesity, taking medications that increase BP, renal disease, diabetes, or a history of aortic arch obstruction or coarctation, then BP should be taken at every healthcare visit.

HTN stages for children ages 1 to 13

Elevated BP: 90th to 95th percentile
Stage 1 HTN: greater than the 95th percentile or 120/80 mm Hg to less than the 95th percentile, whichever is lower
Stage 2 HTN: greater than the 95th percentile + 12 mm Hg or greater than 140/90 mm Hg

The updated American Academy of Pediatrics (AAP) HTN guidelines define normal BP for children ages 1 to 13 as being less than the 90th percentile for BP on the basis of age, sex, and height percentiles. HTN in children ages 1 to 13 is divided into three classifications where percentiles are looked at for age, sex, and height: Elevated BP (90th to 95th percentile), stage 1 HTN (greater than the 95th percentile or 120/80 mm Hg to less than the 95th percentile, whichever is lower), and stage 2 HTN (greater than the 95th percentile + 12 mm Hg or greater than 140/90 mm Hg). Many pediatric HTN cases were being overlooked related to the complexity of previous BP tables. That's why the AAP developed a simplified BP table for ages 1 to 13 as an initial screening tool (see *HTN stages for children ages 1 to 13*).

For adolescents ages 13 and older, optimal BP and HTN categories are now the same as the American Heart Association/American College of Cardiology adult guidelines. Normal BP is less than 120/80 mm Hg, elevated BP is 120 to 129/less than 80 mm Hg, stage 1 HTN is 130 to 139/80 to 89 mm Hg, and stage 2 HTN is greater than or equal to 140/90 mm Hg.

It's important to remember that BP can vary greatly from visit to visit. Therefore, serial BP readings obtained in the healthcare setting should be evaluated over time. Home- or school-based BP readings shouldn't be used to diagnose HTN but

did you know?

Diagnosing HTN in infants (children younger than age 1) is complex and often missed due to lack of symptoms or adequate history to identify risk factors. The AAP doesn't recommend routine BP evaluations for full-term infants. HTN in infants may be due to issues such as congenital disorders, renovascular conditions, neurologic disorders, umbilical artery catheterization, aortic coarctation, or kidney injury. Bronchopulmonary dysplasia increases the incidence of HTN, particularly in very low birth weight and preterm infants. Exposures to medications, such as antenatal treatment with steroids, and illicit substances, such as cocaine or heroin, are also risk factors for HTN in infants.

HTN in infants is diagnosed when the systolic and/or diastolic BP is persistently greater than the 95th percentile for postconceptional age. BP norms are based on gestational age, postnatal age, sex, weight, and height. Elevated BP may be found during routine monitoring and can be masked by other medical issues. If symptoms are present, the infant may exhibit poor feeding, irritability, and/or lethargy. Infants with significantly elevated BP may present with life-threatening cardiopulmonary, neurologic, and renal changes.

Attention must be given to the size of the infant's arm and cuff size when obtaining a BP reading using an automated oscillometric device. A falsely elevated BP can occur with a cuff that's too small for the infant's arm. The BP cuff bladder should be a minimum of 80% in length of the upper arm, and the width should be a minimum of 60% of the circumference of the arm. A calf BP reading may be considered in the first few days of life; otherwise, the right upper arm is recommended for oscillometric measurements. Direct monitoring through an indwelling intra-arterial catheter is the gold standard for measuring BP in infants, especially when critically ill. Crying, being fed, and/or pain can raise the systolic BP in infants, and this information should be documented when the BP is taken.

Treatments for HTN in infants should be considered for a BP greater than the 95th percentile. The type and route of treatment is dependent on the severity of the HTN and comorbid conditions. In severe and emergent cases, I.V. infusions are recommended, with continuous BP monitoring. In less severe cases and for long-term treatment, a thiazide diuretic is the first-line treatment for HTN in infants. Other common medications include vasodilators, calcium channel blockers, and alpha- or beta-blockers.

can be used as an adjunct in monitoring diagnosed HTN. If the patient has auscultatory confirmed BP readings of greater than the 95th percentile for age/sex at three different visits, then HTN is diagnosed. Emphasis is also placed on the use of 24-hour ambulatory BP monitoring to confirm an HTN diagnosis.

Guidelines for treatment

Once a diagnosis of HTN is established, the clinician can develop a treatment plan. Treatment guidelines are specifically designed to fit each category of pediatric HTN.

Elevated BP is treated with lifestyle modifications and monitoring. Lifestyle modifications includes the DASH diet, appropriate exercise, and adequate sleep patterns. The AAP recommends that children participate in exercise for 30 to 60 minutes, 3 to 5 days per week. BP should be rechecked after 6 months of lifestyle modifications. If BP remains elevated after 6 months, it should be checked in an upper and lower extremity. If BP remains elevated, the patient should continue lifestyle modifications and BP should be rechecked 6 months later. If at 12 months BP remains elevated, the clinician should consider ambulatory BP monitoring and specialist referral.

Stage 1 HTN management also includes lifestyle modifications for the asymptomatic patient. BP should be rechecked every few weeks in the provider's office. If the patient remains in the stage 1 range for 12 months, then a diagnostic workup should be initiated, which includes a lipid profile, an electrolyte panel, renal function studies, and urinalysis. Hemoglobin A1C can be considered for patients who are obese. If HTN secondary to renovascular disease is suspected, a renal ultrasound should be considered.

Stage 2 HTN treatment in the asymptomatic patient incorporates lifestyle modifications, along with BP verification in an upper and lower extremity. The abovementioned diagnostic workup should also be

implemented. Patient variables may indicate the need for additional testing. If the patient remains in the stage 2 category for 1 week, pharmacologic treatment should be initiated.

Four classes of antihypertensive medications are included in the treatment guidelines for pediatric patients: angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, long-acting calcium channel blockers, and thiazide diuretics. A single agent at the lowest dose should be started initially. The patient should be evaluated at 2- to 4-week intervals until BP is normalized. Then, follow-up can be stretched to 4 to 6 weeks. The dosage of a single agent should be maximized before the addition of a second medication.

Potential adverse drug reactions should be monitored at each follow-up appointment. Examples include photosensitivity when taking thiazide diuretics, nightmares with calcium channel blockers, and a dry cough with angiotensin-converting enzyme inhibitors. Due to limited safety data on antihypertensive use in pediatric patients, referral to specialty care is critical for close and ongoing monitoring to achieve the goal BP.

An echocardiogram should be ordered at the initiation of pharmacologic therapy to detect LVH. If LVH, wall motion abnormalities, or a depressed ejection fraction is noted, a follow-up echocardiogram should be done in 6 months. If at 6 months following therapy the abnormality has resolved, the echocardiogram may be repeated in 12 months. In the event that an initial echocardiogram shows no abnormality, it doesn't need to be repeated.

Additional recommendations include a fundoscopic eye exam at the initiation of pharmacologic treatment and annually thereafter. Further vascular evaluation, including carotid intima-media thickness, isn't recommended in children. This evaluation is utilized in adults to track end-organ damage; however, it hasn't been proven useful in the pediatric population. Due to lack of sufficient evidence leading to improved outcomes, serial microalbumin levels also aren't recommended for pediatric patients with HTN.

key points

Nursing implications

- Make sure that all equipment used to measure BP is properly calibrated and validated for use in pediatric patients.
- Select the correct cuff size for the patient's stature. For example, an infant cuff for newborns or a thigh cuff for a patient who's obese.
- Place the cuff mid-limb on the arm, with the shoulder in a neutral position. (If placed on the thigh, the leg must be straight and the legs uncrossed).
- Ensure that the patient is calm before BP measurement.
- If the BP is elevated, obtain two additional auscultatory measurements and average the two readings.
- Emphasize realistic diet and lifestyle modifications appropriate for the patient's age to prevent the need for pharmacologic intervention.

Nursing implications

Multiple nursing implications exist in the diagnosis and management of pediatric HTN. Pediatric patients ages 3 and older should have routine BP measurements at each annual well-child visit. All equipment used to measure BP must be properly calibrated and validated for use in the pediatric population.

Selection of the correct cuff size is paramount in obtaining the correct BP reading. The healthcare provider's office should stock a wide range of cuff sizes to support the variations in patient stature. Some examples include an infant cuff for newborns with sizes up to and including a thigh cuff for children or adolescents who are obese. The cuff must be correctly placed mid-limb on the arm, with the shoulder in a neutral position. If placed on the thigh, the leg must be straight and the legs must be uncrossed.

All patients should be in a calm state before BP measurement. If the BP is elevated, two additional auscultatory measurements should be obtained and the two readings averaged. Patient education should emphasize realistic diet and lifestyle modifications appropriate for the patient's age to prevent the need for pharmacologic intervention.

Catch it early

Many variables impact the detection, diagnosis, and management of HTN in pediatric patients. With the significant rise in the number of HTN cases, nurses should be acutely aware of the risk factors, diagnostic parameters, and treatment guidelines. The AAP streamlined guidelines to simplify classifications and parameters for stratifying stages of HTN with the primary goal of facilitating early diagnosis and treatment to lessen the risk of associated comorbidities and end-organ damage in adulthood. Identification of children with risk factors and/or elevated BP in the clinical setting, timely referral, and appropriate treatment are keys to successful patient outcomes. ■

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