Recognition, investigation and causes of kidney disease in hypertensive children and adolescents

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Etiology of Hypertension

- **Primary hypertension**: 90%
- **Secondary hypertension**: 10%

Age:
- Neonate
- Baby
- Infant
- Child
- Adolescent
- Adult
Renal Hypertension
Most common form of secondary hypertension

<table>
<thead>
<tr>
<th>Causes</th>
<th>Total no. (%)</th>
<th>Age at diagnosis, y, median (range)</th>
<th>Male sex, no. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autoimmune</td>
<td>3 (1)</td>
<td>10.5 (9–17)</td>
<td>2 (67)</td>
</tr>
<tr>
<td>Cardiac</td>
<td>4 (3)</td>
<td>4.5 (1–11)</td>
<td>3 (75)</td>
</tr>
<tr>
<td>Endocrine</td>
<td>9 (6)</td>
<td>13 (6–17)</td>
<td>2 (22)</td>
</tr>
<tr>
<td>Gastrointestinal</td>
<td>2 (1)</td>
<td>0.5 (0.17–0.75)</td>
<td>2 (100)</td>
</tr>
<tr>
<td>Hematological</td>
<td>1 (1)</td>
<td>8</td>
<td>1 (100)</td>
</tr>
<tr>
<td>Medications</td>
<td>21 (13)</td>
<td>13 (0.08–18)</td>
<td>16 (76)</td>
</tr>
<tr>
<td>Neurological</td>
<td>19 (12)</td>
<td>10 (0.25–18)</td>
<td>14 (74)</td>
</tr>
<tr>
<td>Renal</td>
<td>53 (34)</td>
<td>10 (0.08–19)</td>
<td>33 (62)</td>
</tr>
<tr>
<td>Respiratory</td>
<td>32 (20)</td>
<td>1 (0.01–17)</td>
<td>20 (63)</td>
</tr>
<tr>
<td>Sleep disordered breathing</td>
<td>12 (8)</td>
<td>14 (4–17)</td>
<td>10 (83)</td>
</tr>
</tbody>
</table>

423 children referred with diagnosis -> 275 confirmed HTN -> 156 (57%) secondary HTN
mean age 10 ± 5.4y

# Evaluation for Secondary Hypertension

- Newborns and infants with hypertension stage 1 und 2
- Children and adolescents with hypertension stage 2

<table>
<thead>
<tr>
<th>Age at Hypertension Onset and Underlying Disease</th>
<th>Renoparenchymal Disease</th>
<th>Renovascular Disease</th>
<th>Primary Hypertension</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 1 month</td>
<td>Renal artery/vein thrombosis</td>
<td>Aortic coarctation</td>
<td>Exogenic hypertension (drugs)</td>
</tr>
<tr>
<td></td>
<td>Congenital renal disease</td>
<td>Renovascular disease</td>
<td>Endocrine disease</td>
</tr>
<tr>
<td></td>
<td>Umbilical artery/vein catheters</td>
<td></td>
<td>Aortic coarctation</td>
</tr>
<tr>
<td></td>
<td>Bronchopulmonary dysplasia</td>
<td></td>
<td>Monogenic disease</td>
</tr>
<tr>
<td>&gt; 1 month - &lt; 6 years</td>
<td>Renoparenchymal disease</td>
<td>Renovascular disease</td>
<td>Primary hypertension</td>
</tr>
<tr>
<td>&gt; 6 - 10 years</td>
<td>Renoparenchymal disease</td>
<td>Renovascular disease</td>
<td>Primary hypertension</td>
</tr>
<tr>
<td>&gt; 10 years</td>
<td>Renoparenchymal disease</td>
<td>Renovascular disease</td>
<td>Primary hypertension</td>
</tr>
</tbody>
</table>

Lurbe et al., Journal of Hypertension 2016; 34(10):1887-920
Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents

„In children and adolescents being evaluated for high BP, the provider should obtain a

- perinatal history, appropriate nutritional history, physical activity history, psychosocial history, and family history
- perform a physical examination to identify findings suggestive of secondary causes of HTN.“

Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents

„Children and adolescents ≥6 y of age do not require an extensive evaluation for secondary causes of HTN if they

• have a positive family history of HTN,
• are overweight or obese,
• and/or do not have history or physical examination findings suggestive of a secondary cause of HTN.“

Evidence for underlying renal disease

Family history

• Hereditary renal disease (polycystic kidney disease and Alport syndrome)

Clinical history

• History or symptoms of secondary hypertension
  – Perinatal history: oligohydramnios, renal artery/vein thrombosis
  – Renal or urologic disease, trauma, recurrent urinary tract infections, edema, weight loss, failure to thrive, thirst/polyuria, nocturia and hematuria

• Drug/substance intake: steroids, calcineurin inhibitors,

• Risk factors: Diabetes mellitus, Age at presentation

Lurbe et al., Journal of Hypertension 2016; 34(10):1887-920
Physical Examination

General: poor growth, pallor, edema

Abdomen: mass -> recessive or dominant polycystic kidney disease, multicystic dysplastic kidney, obstructive uropathy, acute renal venous thrombosis, Wilms tumor,

Lurbe et al., Journal of Hypertension 2016; 34(10):1887-920
Routine Laboratory Tests

• Plasma creatinine, urea, electrolytes and uric acid, BGA
• Urinalysis and culture
  (red cell casts -> glomerular disease; white cell casts -> interstitial disease)
• Quantification of albuminuria (albumin/creatinine ratio) and proteinuria (protein/creatinine ratio)
• Fasting plasma glucose
• Plasma cholesterol (total, HDL and LDL) and triglycerides

Lurbe et al., Journal of Hypertension 2016; 34(10):1887-920
Special Laboratory Tests

• PRA and aldosterone
• Urine and plasma catecholamines or metanephrines
• Urinary free cortisol, Urinary steroid profiles and more complex endocrine investigations, Plasma cortisol, ACTH, 24 h urinary free cortisol
• Molecular genetic studies
• Thyroid function tests: FT4 and TSH Thyrotoxicosis
• Plasma deoxycorticosterone and corticosterone, 18-hydroxycorticosterone, 18-hydroxy deoxycorticosterone and 11 deoxycortisol
• Drug levels

Lurbe et al., Journal of Hypertension 2016; 34(10):1887-920
# Imaging Diagnostics

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Suspicious for</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultrasound of kidneys and urinary tract</td>
<td>Enlarged, hyperechogenic kidneys - glomerulonephritis? pyelonephritis?</td>
</tr>
<tr>
<td>(basic diagnostic procedure)</td>
<td>Renal cysts - polycystic kidney disease?</td>
</tr>
<tr>
<td></td>
<td>cystic dysplasia? multicystic kidney disease?</td>
</tr>
<tr>
<td></td>
<td>renal hypoplasia or dysplasia?</td>
</tr>
<tr>
<td></td>
<td>tumor?</td>
</tr>
<tr>
<td></td>
<td>side difference - unilateral renal hypo/dysplasia?</td>
</tr>
<tr>
<td></td>
<td>vesicoureteral reflux with scars?</td>
</tr>
<tr>
<td></td>
<td>indirect evidence for renal artery stenosis?</td>
</tr>
<tr>
<td>Renal scintigraphy</td>
<td>renal scars, segregated function?</td>
</tr>
<tr>
<td>MRI abdomen</td>
<td>tumor localization and size?</td>
</tr>
</tbody>
</table>

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Lurbe et al., Journal of Hypertension 2016; 34(10):1887-920
Renal diseases with high hypertension prevalence

• **Acute kidney disease**
  – Acute glomerular disease (e.g. poststreptococcal glomerulonephritis)
  – Hemolytic uremic syndrome

• **Chronic kidney disease**
  – Autosomal recessive or dominant polycystic kidney disease
  – Glomerulopathies (FSGS, IgA nephropathy, MPGN,...)
  – Congenital anomalies of kidney and urinary tract (CAKUT)
  – Dialysis and renal transplant patients

• **Renovascular disease**
CASE REPORT

8 year old boy, medical history so far unremarkable

May 4: admitted to hospital with 4 episodes of focal, secondary generalized seizures, vomiting, severe headache for 2 days, fever

➡️ Suspicion of meningoencephalitis

➡️ Start of antibiotic treatment

Lumbar puncture: spinal fluid cytology and culture w/o pathological findings

MRI: signs of meningoencephalitis and cerebellitis, parainfectious? (rota virus, EBV?, not typical for HSV)
• Clinical monitoring: hypertension °II (164/107, 170/114 mmHg)
• Lab: CrP 11 mg/l (N < 5), creatinine 90 µmol/l
  all other findings at time of admission unremarkable

• Red-brown urine, urine analysis: hematuria, gross proteinuria
• Renal ultrasound: hyperechogenic, slightly enlarged kidneys
• Extended lab: C3 ↓, anti-streptolysin ↑
Diagnosis

- Poststreptococcal glomerulonephritis
- Hypertensive crisis
- Posterior reversible encephalopathy syndrome (PRES)

Therapy

antihypertensive treatment (ACEI, CCB)
fluid and salt restriction, diuretics

Normalization of blood pressure and renal function
Almost complete remission
Acute Kidney Disease in Hypertensive Children

Poststreptococcal glomerulonephritis

- Incidence 9 - 28 / 100,000
  Previous infection with nephritogenic strains of Streptococcus A, antigen-antibody reaction, complement activation, immune complex deposits with ‘hump’ formation

- Hypertension prevalence 60 - > 75 %, in severe cases life-threatening hypertension and hypertensive encephalopathy (PRES)

- Impairment of microcirculation, reduction of GFR, retention of salt and water, resulting in fluid overload and hypertension.

- Treatment: salt and fluid restriction, diuretics, RAAS blockade
Acute Kidney Disease in Hypertensive Children

Hemolytic uremic syndrome

Incidence 1.1 / 1.000.000

Thrombotic Mikroangiopathy (TMA)

• Microangiopathic hemolytic anemia (MAHA)
• Thrombozytopenia
• Acute renal failure
• Hypertension
  by overexpansion of intravascular volume and/or ischemia-induced RAAS activation

Treatment: acute phase: CCB, long-term: ACEi
Diagnostics of HUS

Fakhouri et al., Lancet 2017
Congenital Kidney Disease in Hypertensive Newborns

Autosomal recessive polycystic kidney disease (ARPKD)

Incidence  1: 20,000
Mutation in *PKHD1*

**Symptoms:**
- **intrauterine:** oligohydramnios, enlarged, hyperechogenic kidneys (US)
- **postpartum:** perinatal respiratory distress, chronic renal insufficiency, (severe) hypertension, hepatosplenomegaly/portal hypertension/cholangitis/biliary dysgenesis/liver fibrosis
Hypertension in ARPKD Patients

• Hypertension prevalence: 33 – 75%

• Marked HTN often observed in the first months of life, severe cases may require bilateral nephrectomy

• Suggested mechanisms: activation of the intra-renal RAAS fluid retention, dysregulation of collecting duct epithelial Na-channel

• Treatment: RAAS blockade (ACEI or ARB)

Guay-Woodford et al., J Pediatr 2014;165:611-17
Autosomal Dominant Polycystic Kidney Disease (ADPKD)

Incidence 1: 500 - 1: 1000 (approx. 2% early manifestation)
Mutation in PDK1, PKD2,…

Symptoms:
• hypertension (often first symptom)
• chronic renal insufficiency (50% ESRD at age 60 yrs)
• hepatic cysts / pancreatic cysts
• intracranial aneurysms

Bergmann, Pediatr Nephrol 2015;30:15-30
Hypertension in Pediatric ADPKD Patients

- Prevalence: 10 – 35%, particularly common in very early onset ADPKD
- 30% of children show exclusively nocturnal HTN (ABPM!)
- Pathogenesis involves the RAAS, NO, and the SNS
- Strong correlation with kidney size
- HTN is associated with decrease in eGFR over time
- HTN in an affected parent is associated with increased frequency and earlier age of HTN onset in ADPKD offsprings

Hypertension in ADPKD Patients
Distribution of ABPM results in 310 ADPKD children

Hypertension in ADPKD Patients
Distribution of ABPM results in 310 ADPKD children

Hypertension prevalence
(hypertensive and/or antihypertensive drugs)

- Daytime 31%
- Nighttime 42%
- 24h 35%

- 52% non-dipper, 18% isolated nocturnal hypertension.

Effect of Kidney Length on BP in ADPKD Children

Hypertension in Pediatric CKD

**Definition of CKD**

- **Stage 1**  
  GFR > 90 mL/min/1.73m²
- **Stage 2**  
  GFR 60-89
- **Stage 3A**  
  GFR 45-59
- **Stage 3B**  
  GFR 30-44
- **Stage 4**  
  GFR 15-29
- **Stage 5**  
  GFR <15 or RRT

**Underlying renal diseases**

- Glomerulopathies (10-30%)  
  congenital NS, FSGS, MPGN, IgAN, ...
- CAKUT (50-70%)  
  renal aplasia, hypo/dysplasia ± cysts, uropathies, PUV,...
- Polycystic kidney disease, ciliopathies, ...
- Tubulointerstitial kidney disease
- Aquired kidney diseases
Hypertension Prevalence in Children with CKD
ABPM screening in 500 children with CKD II-V

- Glomerulopathies
- Hypo/dysplastic disease
- Other congenital/heredit. disease
- Polycystic kidneys

- No antihypertensive Rx
- Antihypertensive Rx

Calculated GFR (ml/min/1.73 m²)
Diastolic Blood Pressure SDS
95th pct
50th pct

Schaefer & Mehls, Pediatric Hypertension 2004
## Prevalence of Hypertension among Children with CKD and ESRD

<table>
<thead>
<tr>
<th></th>
<th>Study population</th>
<th>Method of BP measurement</th>
<th>Definition of HTN</th>
<th>% Hypertensive</th>
<th>% Controlled</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CKD</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mitsneffes, 2003</td>
<td>NAPRTCS (n=3861)</td>
<td>cBP</td>
<td>BP &gt; 95th percentile</td>
<td>28-67%</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28-41 % (BP only)</td>
<td>33 %</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>67 % (BP and/or meds)</td>
<td></td>
</tr>
<tr>
<td>Flynn, 2008</td>
<td>CKiD (n=432)</td>
<td>cBP</td>
<td>BP &gt; 90th percentile + meds or history of HTN</td>
<td>54 %</td>
<td>53 %</td>
</tr>
<tr>
<td>Samuels, 2012</td>
<td>CKiD (n=332)</td>
<td>ABPM</td>
<td>Mean BP ≥ 95th percentile OR blood pressure ≥ 25 %</td>
<td>52 % abnormal ABPM</td>
<td>Not reported</td>
</tr>
<tr>
<td><strong>ESRD</strong></td>
<td></td>
<td></td>
<td></td>
<td>68-84%</td>
<td></td>
</tr>
<tr>
<td>Chavers, 2009</td>
<td>USRDS (n=624)</td>
<td>cBP</td>
<td>BP &gt; 95th percentile or meds</td>
<td>79 %</td>
<td>26 %</td>
</tr>
<tr>
<td>Halbach, 2012</td>
<td>NAPRTCS (n=3447)</td>
<td>cBP</td>
<td>BP &gt; 95th percentile or meds</td>
<td>81-84 %</td>
<td>15-26 %</td>
</tr>
<tr>
<td>Kramer, 2011</td>
<td>ESPN/ERA-EDTA (n=1315)</td>
<td>cBP</td>
<td>BP &gt; 95th percentile or meds</td>
<td>68-70 %</td>
<td>26-45 %</td>
</tr>
<tr>
<td><strong>Transplant</strong></td>
<td></td>
<td></td>
<td></td>
<td>56-93%</td>
<td></td>
</tr>
<tr>
<td>Sonof, 1999</td>
<td>NAPRTCS (n=4821)</td>
<td>n/a</td>
<td>Medication use</td>
<td>60 %</td>
<td>n/a</td>
</tr>
<tr>
<td>Sinha, 2012</td>
<td>Multicenter, UK (n=564)</td>
<td>cBP</td>
<td>BP &gt; 95th percentile or meds</td>
<td>56-66 %</td>
<td>67 %</td>
</tr>
<tr>
<td>Seeman, 2006</td>
<td>Single-center, Czech Republic (n=36)</td>
<td>ABPM</td>
<td>BP &gt; 95th percentile or meds</td>
<td>89 %</td>
<td>47 %</td>
</tr>
<tr>
<td>Gulhan, 2014</td>
<td>Single-center, Turkey (n=29)</td>
<td>ABPM</td>
<td>BP &gt; 95th percentile or meds</td>
<td>93 %</td>
<td>18.5 %</td>
</tr>
</tbody>
</table>

Halbach & Flynn, Curr Hypertens Rep 2015;17:503
Hypertension in Pediatric CKD Stage II-IV

• High prevalence of (uncontrolled) hypertension

• Glomerulopathies have higher blood pressure levels compared to CAKUT

• Hypertension and proteinuria independent risk factors for CKD progression

• Antihypertensive drug classes similar effective in lowering blood pressure, but RAAS antagonists with superior antiproteinuric properties

• Renal failure progression in CKD children on fixed dose ACE inhibition can be slowed by intensified BP control targeting to low-normal 24h MAP
Strict blood pressure control improves renal survival
intention-to-treat analysis

Glomerulopathies

Hypo/Dysplasia

Conventional

Intensified

Observation Period [years]

% patients reaching primary endpoint

No. at Risk

Intensified

Conventional

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ESCAPE

Wühl et al, NEJM 2009
Management of High Blood Pressure in Children and Adolescents: Recommendations of the European Society of Hypertension

Blood Pressure Targets

In general

- BP <90th age, sex and height specific percentile

Chronic kidney disease

- BP <75th percentile in children without proteinuria and <50th percentile in children with proteinuria
- 24-hour ABP strongly recommended.
  - Goals: <75th percentile in children without proteinuria and <50th percentile in children with proteinuria

Lurbe et al. J Hypertens 2016
Hypertension in the Child on Dialysis

- Diagnosis by ABPM (44 h recommended), casual BP not well correlated with CV outcome

- Etiology
  - Fluid overload
  - Salt overload
  - Underlying renal disease
  - Activation of RAAS, SNS, increased vascular stiffness
  - Hyperparathyroidism, Epo therapy

Katsoufis et al., Clin Kidney J (2014) 7: 33–39
Hypertension in the child on dialysis

• Therapeutical approaches
  – Attainment of ’real‘ dry weight!
    • Optimization of dialysis
      (adjustment of treatment time, sodium and water removal)
    • Parameters for studying volume excess: inferior v. cava diameter, lung ultrasound, online hematocrit measurement, bioimpedance
    • Interdialytic restriction of water and salt intake
  – Pharmacological treatment (ACEi, ß-Blocker)
Abnormalities of blood pressure rhythmicity in pediatric CKD

**Multicystic dysplastic kidney disease:**
- 60% isolated nocturnal hypertension

  *Seeman et al., Eur J Pediatr 2001*

**Renal scarring associated with urinary tract infections or reflux:**
- 39% hypertensive, 23% isolated nocturnal hypertension

  *Patzer et al., J Pediatr 2002*

**CKD III-V (4C-Study; 44% AHT):**
- 13% isolated nocturnal HT, 18% masked HT

  *Duzova, J Hypertens 2019*

**Renal transplantation:**
- 82% hypertensive, 100% nocturnal hypertension, 64% normal daytime BP
- 50% isolated nocturnal hypertension! 33% attenuated dipping

  *Lingens et al., Kidney Int 1996*
## Prevalence of Ambulatory Hypertension in Pediatric Renal Transplant Recipients

<table>
<thead>
<tr>
<th>Author (reference)</th>
<th>N</th>
<th>Mean age (range)</th>
<th>% HTN overall by ABPM</th>
<th>% masked HTN*</th>
<th>% non-dipping</th>
<th>Other findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lingens et al. (2)</td>
<td>27</td>
<td>15 yr (MED) (6.3–24.3 yr)</td>
<td>26% SBP 22% DBP</td>
<td>9%</td>
<td>30% MAP</td>
<td>Blunted dipping associated with renal parenchymal or renovascular disease</td>
</tr>
<tr>
<td>Calzolari et al. (3)</td>
<td>30</td>
<td>16.1 ± 3.6 yr (10–26 yr)</td>
<td>63%</td>
<td>NA</td>
<td>27% reversed</td>
<td>ABP parameters correlated with LVMI</td>
</tr>
<tr>
<td>Matteucci et al. (4)</td>
<td>74</td>
<td>14.2 ± 2.9 yr (10–22 yr)</td>
<td>52% SBP 29% DBP</td>
<td>14%</td>
<td>25% asymptotic</td>
<td>Higher ambulatory with lower diastolic</td>
</tr>
<tr>
<td>Sorof et al. (5)</td>
<td>31</td>
<td>15 yr (MED) (9–20 yr)</td>
<td>54% SBP 28% DBP</td>
<td>27%</td>
<td>33% non-dipping</td>
<td>Increased</td>
</tr>
<tr>
<td>Giordano et al. (6)</td>
<td>14</td>
<td>11.5 ± 3.5 yr (6–21 yr)</td>
<td>67% SBP 33% DBP</td>
<td>16%</td>
<td>28% non-dipping</td>
<td>Higher ambulatory with lower diastolic</td>
</tr>
<tr>
<td>Morgan et al. (7)</td>
<td>16</td>
<td>12.1 ± 3.7 yr (8–18 yr)</td>
<td>44% SBP 31% DBP</td>
<td>20%</td>
<td>27% non-dipping</td>
<td>Higher ambulatory with lower diastolic</td>
</tr>
<tr>
<td>Mitsnefes et al. (8)</td>
<td>100</td>
<td>13.6 ± 4.3 yr (8–21 yr)</td>
<td>57% SBP 30% DBP</td>
<td>16%</td>
<td>29% non-dipping</td>
<td>Higher ambulatory with lower diastolic</td>
</tr>
<tr>
<td>Kitzmueller et al. (9)</td>
<td>12</td>
<td>12.6 ± 2.4 yr (8–18 yr)</td>
<td>45% SBP 31% DBP</td>
<td>19%</td>
<td>27% non-dipping</td>
<td>Higher ambulatory with lower diastolic</td>
</tr>
<tr>
<td>Seeman et al. (10)</td>
<td>100</td>
<td>13.6 ± 4.3 yr (8–18 yr)</td>
<td>57% SBP 30% DBP</td>
<td>16%</td>
<td>29% non-dipping</td>
<td>Higher ambulatory with lower diastolic</td>
</tr>
<tr>
<td>McGlothan et al. (11)</td>
<td>21</td>
<td>12.1 ± 3.7 yr (8–18 yr)</td>
<td>44% SBP 31% DBP</td>
<td>20%</td>
<td>27% non-dipping</td>
<td>Higher ambulatory with lower diastolic</td>
</tr>
<tr>
<td>Ferraris et al. (12)</td>
<td>65</td>
<td>14.3 ± 2.8 yr (10–22 yr)</td>
<td>53% SBP 29% DBP</td>
<td>27%</td>
<td>33% non-dipping</td>
<td>Higher ambulatory with lower diastolic</td>
</tr>
<tr>
<td>Sethna et al. (13)</td>
<td>33</td>
<td>14.5 ± 2.8 yr (8–19 yr)</td>
<td>36%</td>
<td>NA</td>
<td>58% SBP 42% DBP</td>
<td>Higher ABP associated with lower adiponectin</td>
</tr>
<tr>
<td>Basiratnia et al. (14)</td>
<td>66</td>
<td>17.4 ± 4.3 yr (7–25 yr)</td>
<td>75.7%</td>
<td>70%</td>
<td>73% overall</td>
<td>ABP parameters correlated with LVMI</td>
</tr>
</tbody>
</table>

58 % hypertensive
41 % masked hypertension
76 % non-dipper
50% progression rate to hypertension in non-hypertensive children following renal transplantation

Long-term kidney graft survival in relation to systolic blood pressure

<140 or ≥140 mmHg at 1 and 3 years posttransplant.

Opelz and Döhler, American Journal of Transplantation 2005; 5: 2725–2731
**Better** graft function in pediatric Rtx patients with normotension compared to patients with hypertension

*Seeman et al., Pediatr Transplant 2007: 11: 491–497*
Effect of Steroid Withdrawal on BP in Children after Renal Transplantation

Hoecker et al, Nephrol Dial Transpl 2010
Therapeutic approach for prevention of hypertension in pediatric renal transplant recipients

• effective blood pressure control!
• RAAS-antagonists seem to be favorable
• Chronotherapy to restore circadian blood pressure rhythm (dipping)?
• consider steroid withdrawal, where possible.
Renovascular Disease in Hypertensive Children
Renovascular Hypertension

Prevalence 1 / 1000 children or 5 - 10% of all childhood hypertension

- fibromuscular dysplasia 35%
- Mid-aortic Syndrome 25%
- Neurofibromatosis 15%
- Williams-Beuren Syndrome 10%
- Takayasu Arteritis 10%
- Trauma 5%

Steven Marks 2009
Indicators for renal artery stenosis

- Malignant hypertension
- Hypertensive end-organ damage
- Uncontrolled hypertension (≥ 2 antihypertensive drugs)
- Syndromes with associated renal artery stenosis
  - e.g. NF-1, tuberous sclerosis, Williams-Beuren syndrom
- Vasculitis
  - e.g. Takayasu arteriitis
- Vascular damage
  - e.g. renal artery thrombosis, trauma
- Bruit over renal artery
- Increased plasma renin (PRA) or mild hypokalemia

Tullus et al., Lancet 2008
Summary

• The younger a child the higher the risk of secondary HTN
• Non-dipping /altered BP rhythmicity suspicious for secondary HTN
• Renal hypertension is the most common form of secondary HTN

-> comprehensive work up, especially for renal disease, required in all patients with suspected secondary hypertension
Summary

• High prevalence of hypertension in children with acute or chronic kidney disease
  -> Screening for hypertension in all kidney patients

• Blood pressure control important for renal survival and prevention of CV end-organ damage

• First-line therapy in CKD stage II-IV patients is RAAS-blockade, in dialysis patients correction of fluid overload by adjustment of post-dialytic weight (dry weight)
Hypertensive Kidney Damage

Hypertension itself may affect kidney function!

First symptom of renal end-organ damage is microalbuminuria (albumin/creatinine quotient > 30 mg/g creatinine or > 3 mg/mmol creatinine)
Arterial Hypertension

Glomerular Hyperfiltration → Proteinuria

Glomerulosclerosis

Renal Function ↓
Glomerular Hyperfiltration

Proteinuria

Glomerulosclerosis

Arterial Hypertension

Renal Function ↓
Thank you!