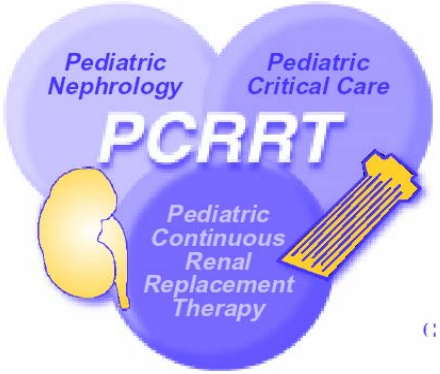
Hypertensive Crisis

Timothy E. Bunchman
Professor and Director
Pediatric Nephrology & Transplantation
Children's Hospital of Richmond
Virginia Commonwealth Univ. School of Medicine
Timothy.bunchman@vcuhealth.org
pedscrrt@gmail.com
www.pcrrt.com



Hypertension

- Whether end organ symptoms or damage is present or not – is more important than the **absolute degree of BP elevation**
- The renin angiotensin system plays an important role in the genesis of hypertension crisis
- Important to asses whether the HT is chronic, acute, or acute on chronic

Definitions

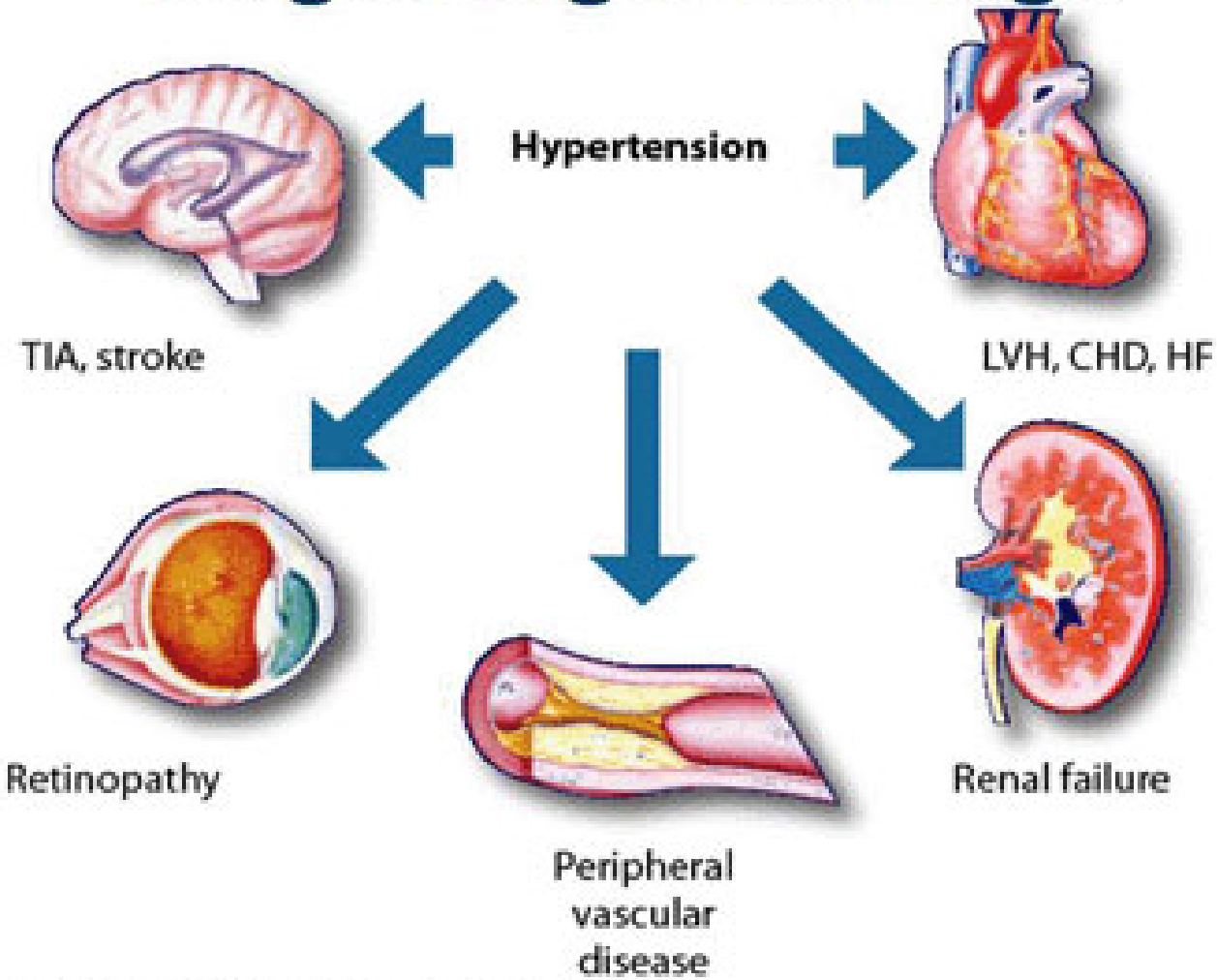
- SEVERE HYPERTENSION: defined as 20 mm hg above the 95th centile

- HYPERTENSIVE CRISIS : defined as a sudden and abrupt elevation in blood pressure from baseline- generally 50% above normal- or >180/120

- HYPERTENSIVE EMERGENCY – a severe symptomatic elevation in BP with evidence of potentially life threatening symptoms or acute target organ damage

- HYPERTENSIVE URGENCY is severe hypertension with no target organ damage

Complications of Hypertension: Target-Organ Damage



TIA, transient ischemic attack; LVH, left ventricular hypertrophy; CHD, coronary heart disease; HF, heart failure

Medscape

Clinical evidence of End organ damage

- **CNS:** altered mental status-lethargy, coma, confusion, seizures, irritability, Facial N palsy, hemiplegia
  (Exclude Head trauma or mass lesion)

- **Eye:** Papilloedema, retinal hemorrhages

- **Heart:** LVF, Pulmonary edema, S 3 gallop, new heart murmurs, LV hypertrophy

- **Renal:** Hematuria, proteinuria (Acute GN)

Hypertensive Encephalopathy

Most Emergencies manifest as ENCEPHALOPATHY which is defined by

-Severe BP elevation with cerebral edema

- Neurological symptoms of lethargy, coma and seizures

Caused by cerebro vascular endothelial break down secondary to failure of cerebral autoregulation

Presentation to review

- Etiology
- Evaluation
- Treatment options

Neonatal Hypertension

- Renovascular disease
  - UA cath and TE
- Congenital renal anomalies
- Coarctation of Aorta
- Broncho pulmonary dysplasia
- CAH
- Renal vein thrombosis
- Renal parenchymal disease
- Iatrogenic Fluid overload
- ARPKD
- Tumours
- Hypercalemia

Childhood Hypertension

- Most often secondary to an underlying disease

  - Renal parenchymal disease: 60-70%

    Ac GN, Reflux N

  - Renovascular disease : 5-25%

    Renal A stenosis

- Coarctation of aorta – important cause in infancy
- Essential hypertension - emerging health concern in adolescents- **but rarely causes HT crisis**

HT in CKD patients-and Chronic Dialysis

- ECF expansion
- Salt intake
- Increased cardiac output and peripheral resistance
- High AT-II levels
- Sympathetic over activity
- Hyper PTH
- Uremic toxins
- Erythropoietin
- Non-compliance with antihypertensives
- Endothelial dependent Vd

HTN post transplant pts

- Acute CNI toxicity
- TMA
- Effect of sirolimus
- High dose steroids
- Fluid overload
- Severe rejection and MA

Renovascular hypertension

RENAL ARTERY STENOSIS

- FMD, NF 1, TS
- Takayasu's arteritis
- Middle aorta syndrome
- William syndrome

Examination

- Anthropometry
  - weight
  - height
  - BMI
- All peripheral pulses to be palpated
- Four limb BP
- Good general and systemic examination
- Neurocutaneous markers
- Peripheral edema

- Waist/Hip Ratio
- Waist circumference - Abdominal obesity

- Birth weight
- Post natal growth pattern
- High salt intake

EVALUATION

Phase 1

CBC
Urinalysis
Urine Culture
Na/K/creat/BUN/Ca/Uric acid
Lipid profile
Chest Xray
Renal USG, Doppler
ECHO,ECG

Phase 2

Renal scan with ACE inhibitor
Renin profile
MCU, DMSA
Urine catecholamines
Plasma and urine steroids

EVALUATION

Phase 3

- Renal artery imaging
- Renal vein renin sampling

CO MORBIDITY

Fasting lipid profile
Fasting Glucose
Drug screen
Polysomnography

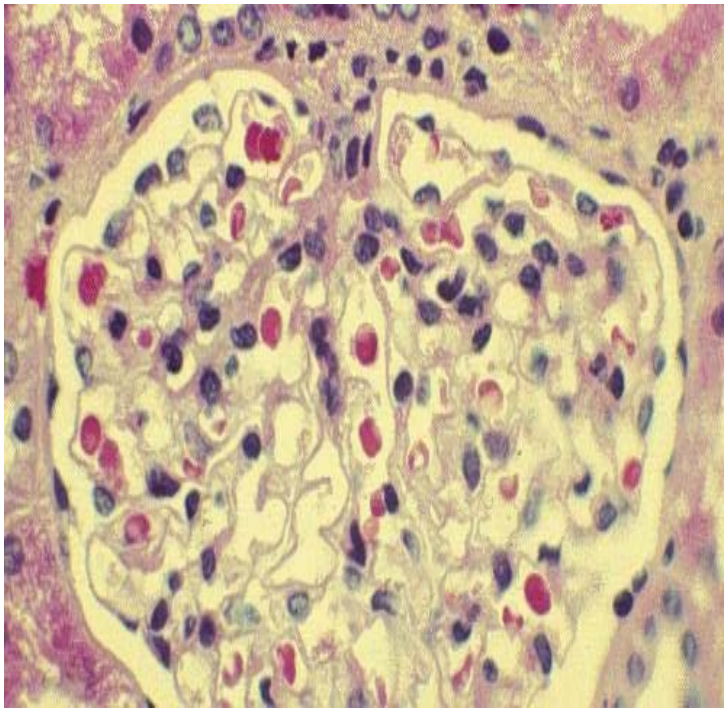
U/A

- Specific Gravity
- Proteinuria
  - Prot/Cr
  - UPEP
- + Hematuria + RBC
- + Hematuria – RBC
  - CPK
  - LDH

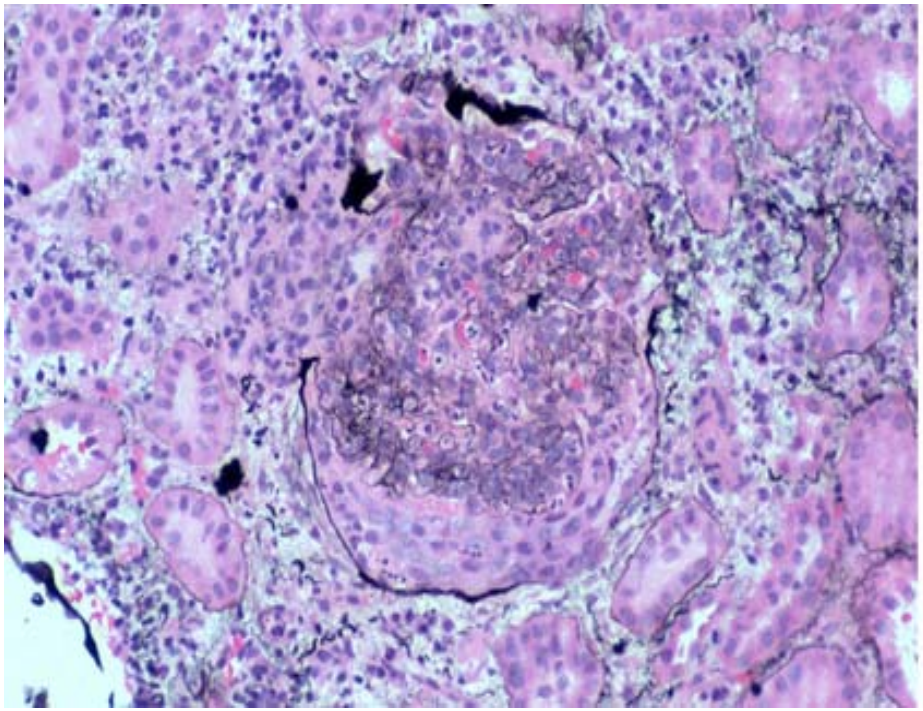
If

- Hypochloremic Metabolic Alkalosis
  - Adrenal induced Htn
  - RAS
- Renal insufficiency, low plasma proteins/albumin due to renal loss
  - bx
- Low complement
  - PIGN, SLE, MPGN may need to be bx

Normal



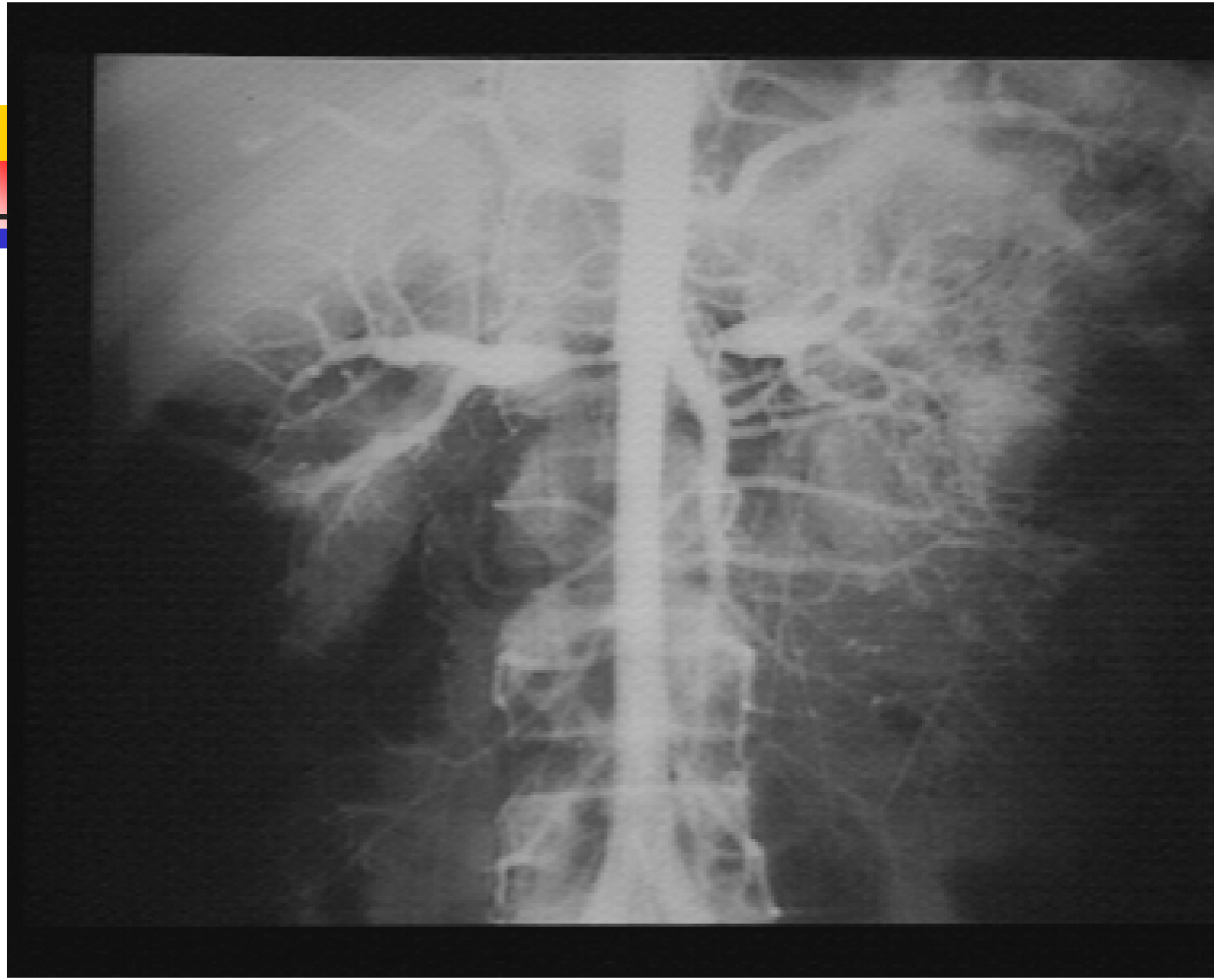
Crescentric GN

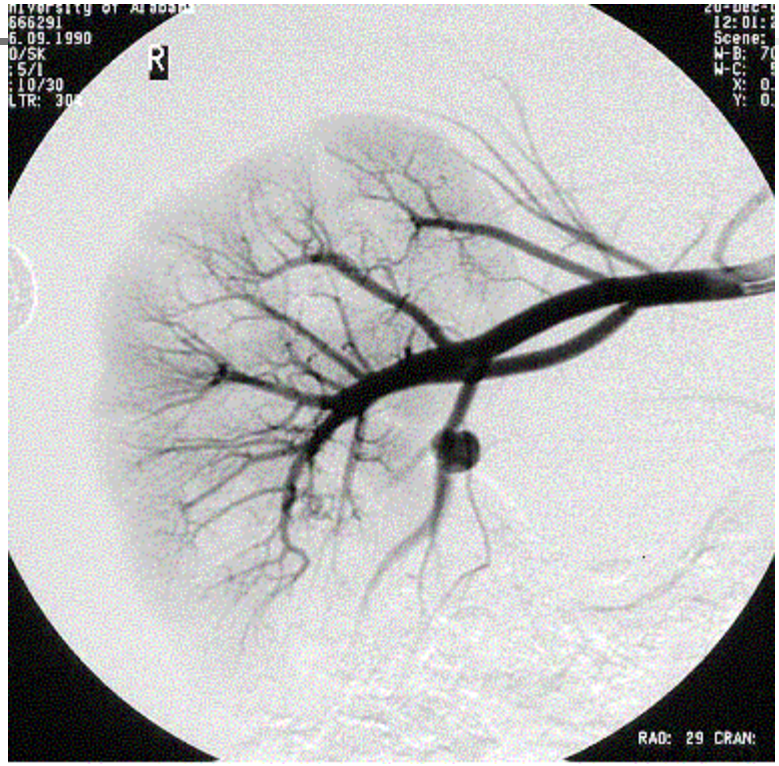


Copyright © 1998 by the National Kidney Foundation

Renal imaging

- If there is a discrepancy in renal size
  - Angiogram with renal vein renins
    - Avoid use of diuretics, ACE, ARB or Beta blockers 1-2 weeks prior to this setting
  - DMSA scan for scar
  - Thin cut CT




666291
6.09.1990
R
Scene:
RAO: 29 CRAN:

Renal Vein Renins

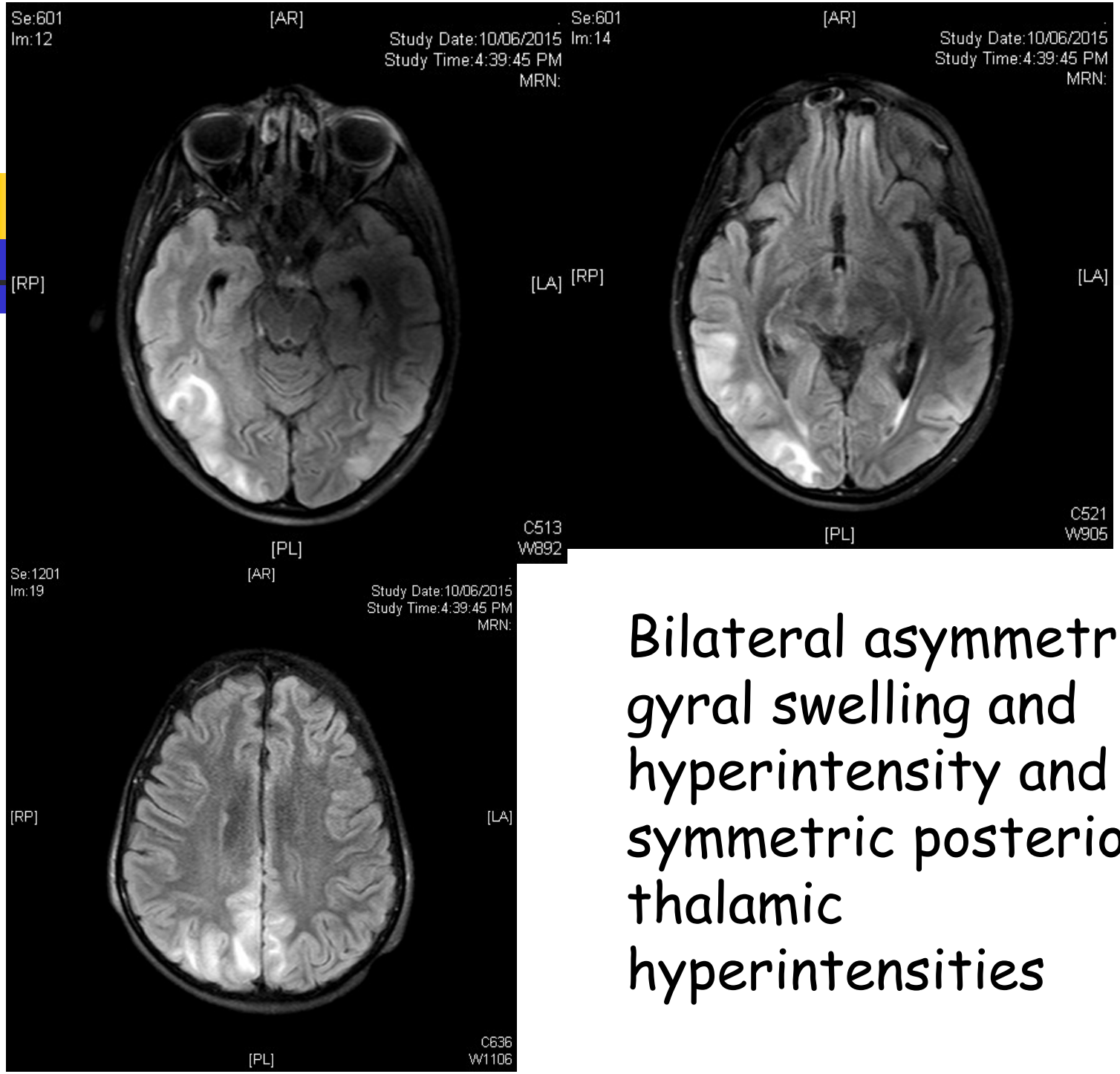
	High IVC 12 ng/ml/hr	
Rt Renal Vein 20 ng/ml/hr		Left Renal Vein 5 ng/ml/hr
	Low IVC 3 ng/ml/hr	

Why not draw ?

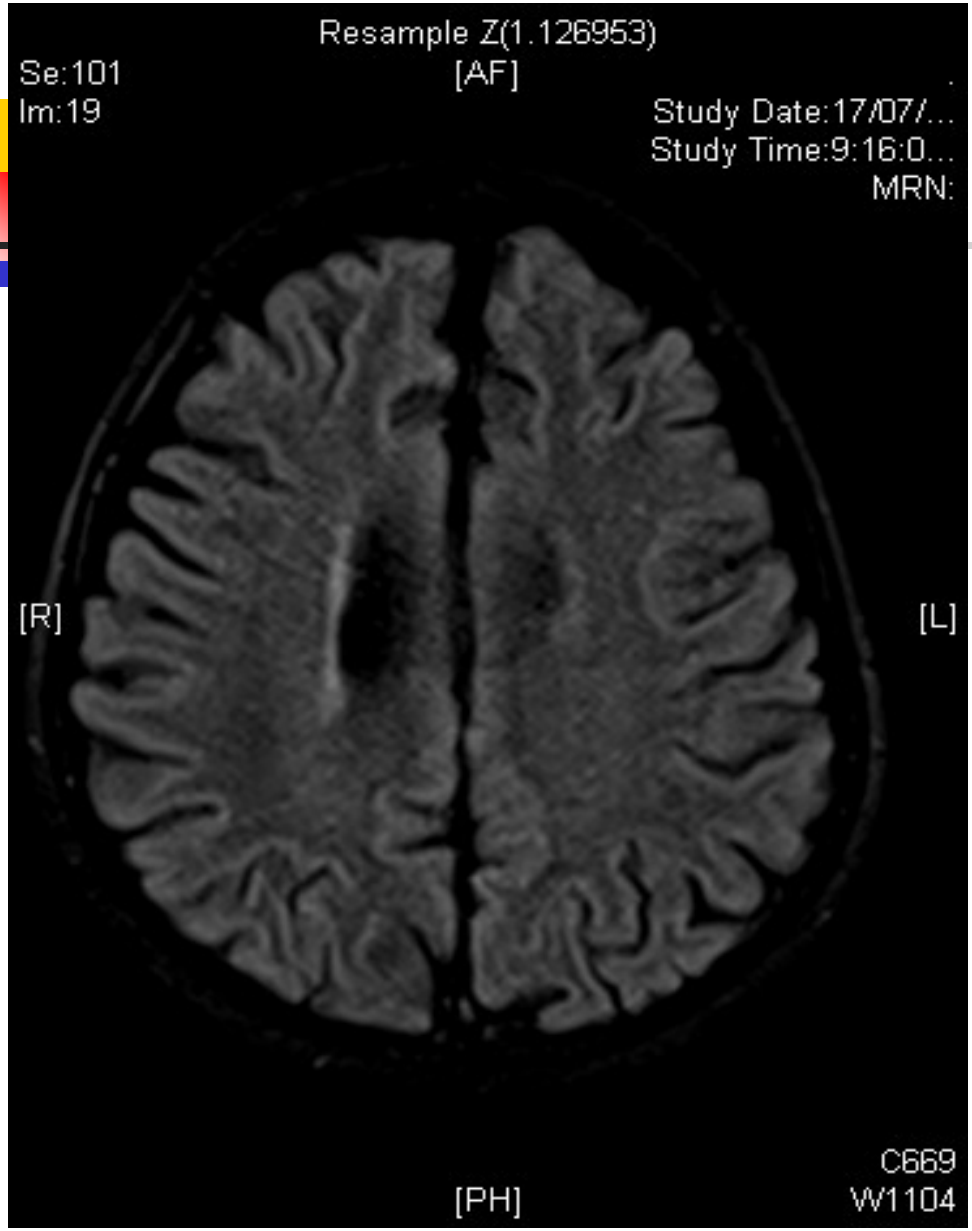
- Renins
  - Random renins have not been found to be diagnostic…
    - effected by volume status, ACE inhibitors, ARBs, Beta blockers
- Aldosterone
  - May be helpful if evidence of a hypochloremic metabolic alkalosis

Case 1

- 6 years old male child with SRNS was diagnosed to have hypertension outside, started on Enalapril
  - Had one episode of change in is mental status
  - Intubated due to worsening of sensorium
  - He developed irrelevant speech and unable to bear weight after extubation
  - Referred here for further management.
- In casualty he had one episode of seizure for which he was started on antiepileptic
- EEG done was suggestive of bilateral epileptiform discharges
- MRI Brain with MRA was done



Bilateral asymmetric gyral swelling and hyperintensity and symmetric posterior thalamic hyperintensities



After a month - resolution of findings

DIAGNOSIS ???

PRES

POSTERIOR REVERSIBLE
ENCEPHALOPATHY SYNDROME

PRES

- Hypertensive encephalopathy occurs due to
  - Cerebral hyper perfusion
  - Endothelial dysfunction
  - Microvascular injury
  - Cerebral edema
- These manifests as PRES in imaging studies

PRES

- Occurs due to vasogenic edema, onset of hypertension is acute
- Often a trigger in other conditions like
  - Treatment with immunosuppressive drugs
  - Vasculitis
  - Renal insufficiency
- Endothelial dysfunction and NO depletion are proposed mechanisms
- Symptoms
  - Altered mental status, Headache, Seizures

Treatment Options for acute HTN

- Angiotensin Receptor Blockade (ARB)-avoid
- Central Action
- Diuretics-avoid
- Vasodilators/alpha blockers
- Beta Blockers-avoid if hyperkalemia
- Calcium Channel blockers
- ACE inhibitors-avoid

Angiotensin Receptor Blockade (ARB)

- Newer generation of class of drugs
- Not a role in the Rx of malignant Hypertension
- Used best in patients with CKD (chronic kidney disease)
- Avoid if CKD/AKI/hyperkalemia

Central Action

- Not a role as a primary agent
- PO/Transdermal Clonidine good option for sedation withdrawal hypertension
- Problem with patch is at the time of hypotension a patch can be forgotten
- If on po Clonidine (data on patch less clear) and drug abruptly stopped, one is at risk for rebound significant hypertension

Diuretics

- Use as an adjunct to other agents only
- Not a role as a primary antihypertensive
- Side effects of electrolyte disturbances, elevated uric acid, lipids

Beta Blockers

- Pure Beta blockers have limited role in hypertensive crisis
- Avoid if hyperkalemia, bradycardia

Beta Blockers

- Esmolol-good for tachycardia
  - Ld 100-500 mic/kg then 50-500 mic/kg/min
    - Wiest et al, J Thor Cardiov Sg 1998 4:890
- Labetalol (Alpha/Beta)
  - Ld 0.2-1 mg/kg then 0.5 – 2 mg/kg/hr
    - J Peds 1992 120:140
- Metoprolol infusions
  - 1-5 mics/kg/min to titrate to effect
  - Peds Nephrol 2017 32:2107-2113

ACE inhibitors

- Should be limited as a primary agent due to the risk of
  - Influencing renin data if measured
  - Risk of AKI, hyperkalemia
  - Avoid in severe coarctation of the aorta or in bilateral renal artery stenosis due to risk of AKI

ACE inhibitors

- The only IV option is enalaprilat
  - 5-10 mic/kg/dose q 4-8 hrs
    - Wells et al, Pediatr 1988 113:403
- Preferred drug in micro embolic states with associated Htn
  - UAC induced
  - Renal vein thrombosis

Vasodilators/alpha blockers

- Nitroprusside
  - Direct arterial vasodilator
  - Use with caution in AKI
    - Cyanide toxicity
  - Replaced by newer generation
- Nitroglycerin
  - Arterial and veno dilator
  - Intravenous or Transdermal (0.5-2 inches)

Vasodilators/alpha blockers

- Fenoldopam
  - Dilator with improvement in renal blood flow
  - 0.1 mic/kg/min to max 5 mic/kg/min
    - Stauser et al, AM J Ther 1999, 6:283
- Use in patients <u>without</u> Htn to enhance Renal Blood Flow and UO has not been well studied but may decrease BP to much to offset benefit of RBF preference

Vasodilators/alpha blockers

- Phentolamine
  - Used exclusively in Rx of Pheochromocytoma
  - 0.1-0.2 mg/kg bolus and q 2-4 hrs
  - Use preop to effect systemic symptoms of flushing, significant BP swings
- Bholah R et al, Review of Pediatric Pheochromocytoma and Paraganglioma.
  - Front Pediatr. 2017 Jul 13;5:155. doi: 10.3389/fped.2017.00155. eCollection 2017.

Calcium Channel Blockers

- Primary drug used for Malignant Htn
- Safe as an intravenous agent
- Class of drug of choice in patients on calcinurin inhibitors (tacro, csa, rapamycin)
- Nifedipine SL
- Nicardipine IV

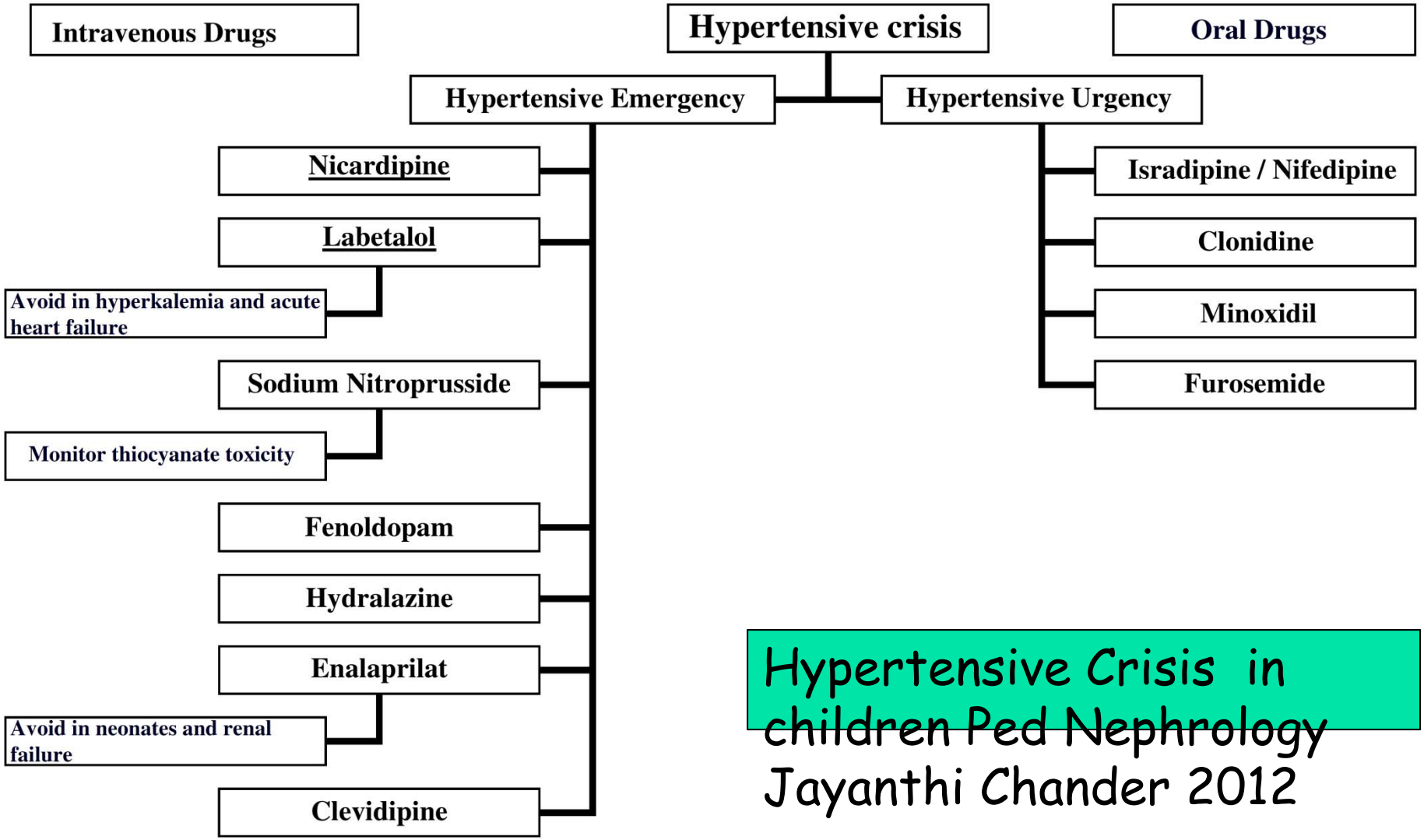
SL Nifedipine

- Immediately effective but watch for rapid and worsening rebound
- No longer used in adult due to sudden death
- Leonard et al Ped Emg Med 2001 17:435
  - 2 children given SL due to Malignant Htn in the ED..both improved but within 30 mins both rebound and had strokes!

Nicardipine

- Immediate on set of action
- Easy to titrate at bedside
  - 0.5-5 mic/kg/min as a continuous gtt
  - J Pediatr 2001 139:38
- Perhaps a role as an intermittent bolus
  - 10-20 mic/kg/dose IV/5 mins every 1-3 hrs

Algorithm for Treatment of Hypertensive Crisis



Hypertensive Crisis in children Ped Nephrology
Jayanthi Chander 2012

Algorithm for treatment of hypertensive crisis

Treatment Strategy

- Like antibiotics decision making learn one from each class and stay with it
- If the goal is to get the patient improved but to get them to the ward
  - Begin oral, Transdermal therapy soon after beginning IV therapy if the patient can tolerate it

Drugs that are easy to use

- Consider CCB or vasodilators as the first line drugs for Htn for these have low risk profiles, less influence on interpretation of other data

Thank you

- Timothy.bunchman@vcuhealth.org
- pedscrrt@gmail.com
- www.pcrrt.com
  - Contains all talks given at the PCRRT meetings from 2000 to the most recent in 2017 in Orlando

Signs and symptoms of hypertensive crisis includes

- seizures
- Heart failure
- Pulmonary edema
- All of the above

With a child has a bilateral renal artery stenosis with renal insufficiency then the intravenous drug to avoid is

1. IVNicardipine
2. IV enalaprilat
3. IV atentolol
4. IV nitroglycerine

If a child has a seizure from a hypertensive crisis then the priority (of the first thing to do) is to

- Check a head CT scan
- Treat with seizure medications
- Bring the blood pressure down
- All of the above