Học Phần Tốt Nghiệp
Hệ Thận – Tiết Niệu Nhi

ThS.BS. Đỗ Đăng Trí

Giảng viên Bộ môn Nhi, ĐHYD TP.HCM

Khoa Thận – Nội Tiết, BV Nhi Đồng 1

Y2017

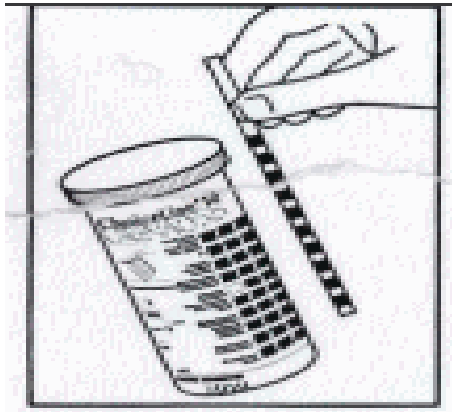
Nội dung ôn tập

1. Tiếp cận tiểu máu
2. Tiếp cận tiểu đạm
3. Tiếp cận phù

1. Tiếp cận tiểu máu

- Hb is detected by a dipstick based on the pseudoperoxidase activity of the heme moiety of Hb, which catalyzes the reaction of a peroxide and a chromogen to form a colored product [1].
- Hematuria [2]:
  + > 5 red blood cells (RBCs)/high power field (HPF) in uncentrifuged urine
  + in 4–6% of urine samples from school-age children

1. *Comprehensive Clinical Nephrology. 6th 2019*
2. *Nelson Textbook of Pediatrics, 21st 2020*



IVD

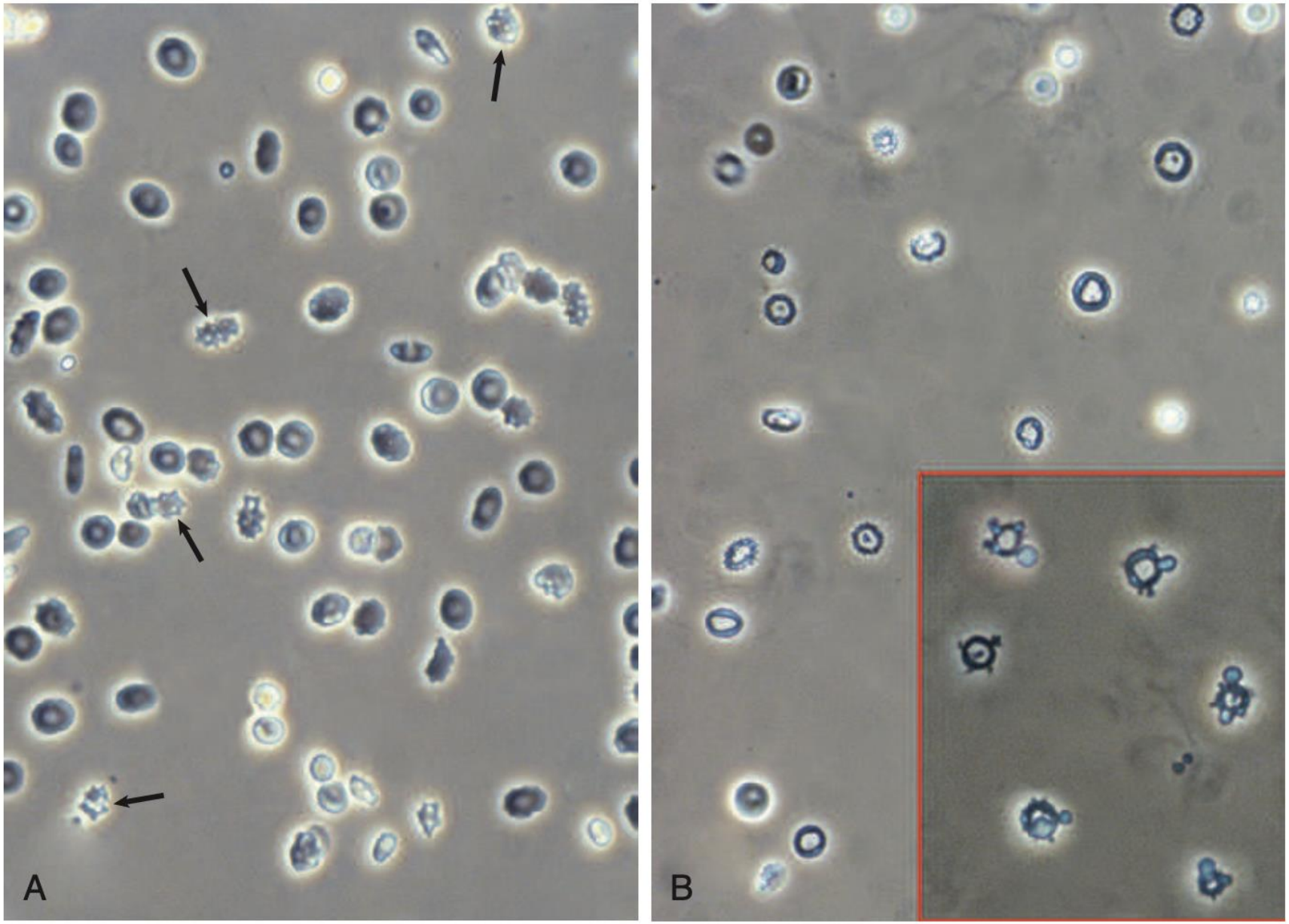
+30°C
+2°C

2011-02

23054941

LOT

TỈ TRỌNG	1.000	1.005	1.010	1.015	1.020	1.025	1.030	
pH	5.0	6.0	6.5	7.0	8.0	9.0		
BẠCH CẦU	neg.	ca. 15	ca. 75	ca. 125	ca. 500	Leuko/µL		
HỒNG CẦU	neg.	ca. 5-10	ca. 10	ca. 25	ca. 25	ca. 50	ca. 50	ca. 250 Ery/µL
NITRITE	neg.	+	++					
KETONE	neg.	5 (0.5)	15 (1.5)	50 (5)	150 (15)	mg/dL (mmoL/L)		
BILIRUBIN	neg.	+	++	+++				
UROBILINOGEN	normal	1 (17)	4 (70)	8 (140)	12 (200)	mg/dL (µmol/L)		
PROTEIN	neg.	15 (0.15)	30 (0.3)	100 (1)	300 (3)	1000 (10)	mg/dL (g/L)	
GLUCOSE	normal	100 (5.5)	300 (17)	1000 (55)	mg/dL (mmol/L)			



Comprehensive Clinical Nephrology. 6th 2019

Tiểu máu nguồn gốc cầu thận

- Unfortunately, there is no agreement on the criteria to classify hematuria as glomerular or nonglomerular.
- Glomerular hematuria is diagnosed when:
  + > 80% of erythrocytes being dysmorphic
  + ≥ 5% of erythrocytes examined are *acanthocytes*
  + red blood cell casts

Comprehensive Clinical Nephrology. 6th 2019

Tiểu máu vi thể và đại thể

- **Microscopic hematuria** is found in up to 5% of healthy children but in most cases is a transient finding and resolves on repeated testing.
- Persistent microscopic hematuria may indicate a number of conditions including glomerular disease, crystalluria, or inherited disorders such as sickle cell trait/disease or polycystic kidney disease.
- **Macroscopic (gross) hematuria** indicates visible blood in the urine and may be seen in conditions such as urolithiasis, urinary tract infection, and **acute glomerulonephritis (GN).**
- **Postinfectious glomerulonephritis (PIGN)** is the most common form of acute GN and immunoglobulin A (IgA) nephropathy is the most common form of chronic GN; however, many other types of GN can occur.

Nelson Essentials of Pediatrics. 9th 2023

Table 536.3

Common Causes of Gross Hematuria

Urinary tract infection
Meatal stenosis with ulcer
Perineal irritation
Trauma
Urolithiasis
Hypercalciuria
Obstruction
Coagulopathy
Tumor
Glomerular disease
Postinfectious glomerulonephritis
Henoch-Schönlein purpura nephritis
IgA nephropathy
Alport syndrome (hereditary nephritis)
Thin glomerular basement membrane disease
Systemic lupus erythematosus nephritis

Nelson Textbook of Pediatrics, 21st 2020

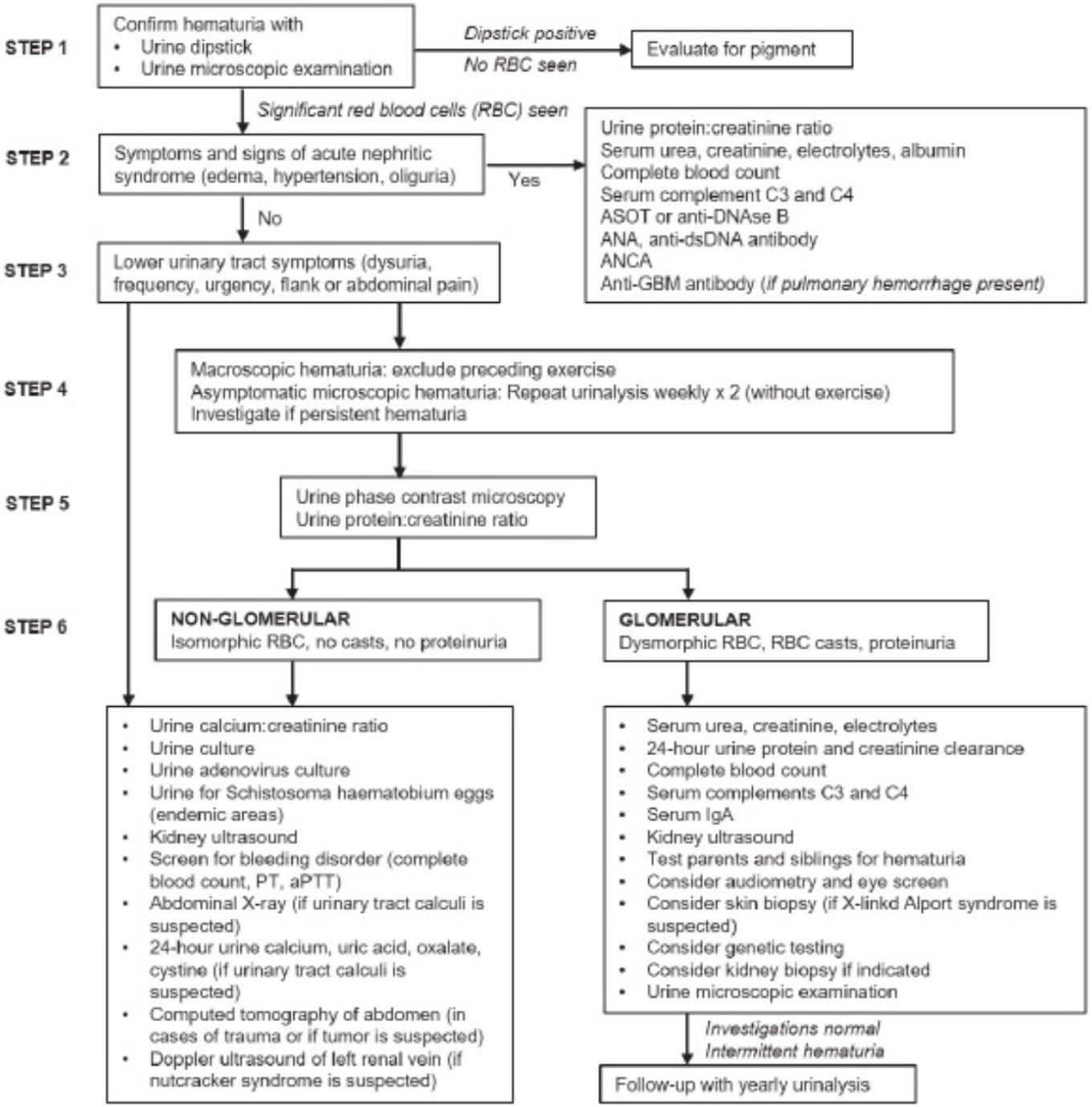
Theo dõi tiểu máu

- Children with isolated, asymptomatic microscopic hematuria with negative evaluation may be observed with yearly urinalyses.
- If hematuria is persistent, or the child develops proteinuria, hypertension, or loss of kidney function, nephrology referral for additional evaluation is appropriate.

Nelson Essentials of Pediatrics. 9th 2023

- Children with persistent asymptomatic isolated hematuria and a completely normal evaluation should have their blood pressure and urine checked every 3 mo until the hematuria resolves.
- Referral to a pediatric nephrologist should be considered for patients with persistent asymptomatic hematuria greater than 1 yr in duration and is recommended for patients with nephritis (glomerulonephritis, tubulointerstitial nephritis), hypertension, renal insufficiency, urolithiasis or nephrocalcinosis, or a family history of renal disease such as polycystic kidney disease or hereditary nephritis.

Nelson Textbook of Pediatrics, 21st 2020



Pediatric Nephrology On-The-Go. 4th 2021

Chỉ định sinh thiết thận

- Presence of significant proteinuria (> 1 g/1.73m/day) except in PIGN
- Persistently low serum complement C3
- Unexplained azotemia
- Systemic disease with significant proteinurias, such as systemic lupus erythematosus, IgA vasculitis, ANCA-associated vasculitis.
- Family history of significant kidney disease suggestive of Alport syndrome.
- Recurrent gross hematuria of unknown etiology.
- Persistent glomerular hematuria and parental anxiety about diagnosis and prognosis.

Note: A kidney biopsy is usually not indicated in isolated glomerular hematuria.

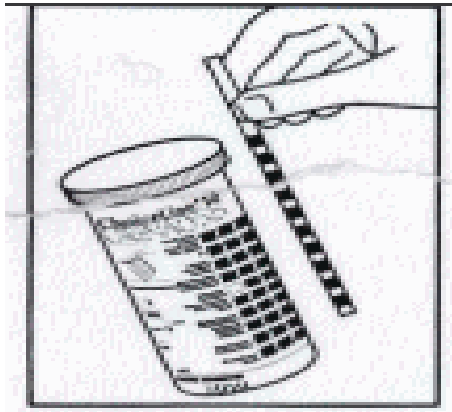
Pediatric Nephrology On-The-Go. 4th 2021

2. Tiếp cận tiểu đạm

Abnormal amounts of protein may appear in the urine from 3 possible mechanisms:

- **glomerular proteinuria,** which occurs as a result of disruption of the glomerular capillary wall
- **tubular proteinuria,** a tubular injury or dysfunction that leads to ineffective reabsorption of mostly low-molecular- weight proteins
- **increased production of plasma proteins** —in multiple myeloma, rhabdomyolysis, or hemolysis—which may cause the production or release of very large amounts of protein that are filtered at the glomerulus and overwhelm the absorptive capacity of the proximal tubule

Nelson Textbook of Pediatrics, 21st 2020



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Các phương pháp xét nghiệm đạm niệu

- **Dipstick testing:**
  + Normal: Negative or trace in a concentrated urine specimen (SG ≥ 1.020)
  + False-positive: urine is very alkaline (pH > 8.0) or very concentrated (SG > 1.025)
- **24 hr urine for protein:**
  + Normal: < 100 mg/m2/24hr (neonates: < 300 mg/m2/24hr, ↓ reabsorption of filtered proteins)
  + Note: the creatinine content should be measured to determine whether the specimen is truly a 24 hr collection (24 hr specimen: females 15-20 mg/kg; males 20-25 mg/kg)
  + More accurate than spot urine analysis; inconvenient for patient; limited use in pediatric practice
  + Timed urine collections are cumbersome to obtain, and the sensitivity and specificity of the test can be influenced by fluid intake, the volume of urine output, and the importance of including a complete collection without missed voids.
- **Spot urine for protein/creatinine ratio:**
  + < 0.2 mg/mg in children > 2 yrs, < 0.5 mg/mg in those 6–24 mo old
  + Simplest method to quantitate proteinuria; less accurate than 24 hr proteinuria.
  + It should be ideally performed on a first morning voided urine specimen to eliminate the possibility of orthostatic proteinuria.

Nelson Textbook of Pediatrics, 21st 2020

Đạm niệu qua TPTNT

Dipstick results	Proteinuria
Negative	0 to < 15 mg/dL
Trace	15 to < 30 mg/dL
1+	30 to < 100 mg/dL
2+	100 to < 300 mg/dL
3+	300 to < 1000 mg/dL
4+	≥ 1000 mg/dL

Pediatric Nephrology, 7th 2016

Đạm niệu qua TPTNT

- The dipstick is reported as:
  + negative, trace (10-29 mg/dL)
  + 1+ (30-100 mg/dL), 2+ (100-300 mg/dL), 3+ (300-1000 mg/dL), and 4+ (>1000 mg/dL).
- **False-positive:**
  + very high urine pH (> 7.0)
  + highly concentrated urine specimen
  + contamination of the urine with blood
  + the presence of pyuria or prolonged dipstick immersion
- **False-negative:**
  + low urine pH (< 4.5)
  + dilute urine or a large volume of urine output
  + in disease states in which the predominant urinary protein is not albumin
- **Positive urine dipstick test for protein:**
  + > trace (10-29 mg/dL) if specific gravity < 1.010
  + must ≥ 1+ (> 30 mg/dL) if specific gravity is > 1.015

Nelson Textbook of Pediatrics, 21st 2020

Tiểu đạm thoáng qua

Transient Proteinuria

- Fever
- Exercise
- Dehydration
- Cold exposure
- Congestive heart failure
- Seizure
- Stress
- Recent use of epinephrine

Orthostatic (Postural) Proteinuria

Nelson Textbook of Pediatrics, 21st 2020

Urine Test	Normal Protein Excretion	Abnormal Protein Excretion	Nephrotic Range Proteinuria
Dipstick	Negative or trace	≥1+	≥3+ for 3 consecutive days
Sulfosalicylic acid test	Negative	≥1+	≥3+ for 3 consecutive days
Protein:creatinine ratio (g/mmol) Aged >2 years: Aged 6 months to 2 years:	 ≤0.02 ≤0.05	 >0.02 >0.05	 >0.22
24-hour protein excretion Aged >6 months old: ($g/1.73m^2/day$): ($mg/m^2/hr$): Aged <6 months old: ($g/1.73m^2/day$): ($mg/m^2/hr$):	 ≤0.15 ≤4 ≤0.3 ≤8	 >0.15 >4 >0.3 >8	 >3 >40 >3 >40
Albumin:creatinine ratio Aged >2 years: (g/mmol): (mg/g):	 ≤0.003 ≤30	 >0.003 >30	 >0.220 >2220
24-hour albumin excretion ($mg/1.73m^2/day$)	 ≤30	 >30	 >2200

Pediatric Nephrology On-The-Go. 4th 2021

Tiểu đạm ngưỡng thận hư ở trẻ em

- TPTNT: 3+, 4+
- UPCR:
  + 2 mg/mg hay 2 g/g
  + 200 mg/mmol
- Đạm niệu 24 giờ:
  + 40 mg/m^2/giờ hay 1 g/m^2/ngày
  + 50mg/kg/ngày

Expert Group of Indian Society of Pediatric Nephrology. Steroid Sensitive Nephrotic Syndrome: Revised Guidelines. Indian Pediatr. 2021 May 15;58(5):461-481.
IPNA clinical practice recommendations for the diagnosis and management of children with steroid-resistant nephrotic syndrome. Pediatric nephrology. 2020 May 7
Pasini et al. Italian Journal of Pediatrics (2017) 43:41

Chọn lựa các xét nghiệm đạm niệu

1.2. Assessment of kidney function

Practice Point 1.2.1: Obtain 24-hour urine collection to determine total protein excretion in patients with glomerular disease for whom initiation or intensification of immunosuppression is necessary, or who have a change in clinical status.

Practice Point 1.2.2: For pediatrics, 24-hour urine collection is not ideal as it may not be accurate and is cumbersome to collect. Instead, monitor first morning protein–creatinine ratio (PCR).

Practice Point 1.2.3: Random "spot" urine collections for PCR are not ideal as there is variation over time in both protein and creatinine excretion.

Practice Point 1.2.4: First morning urine collections may underestimate 24-hour protein excretion in orthostatic proteinuria.

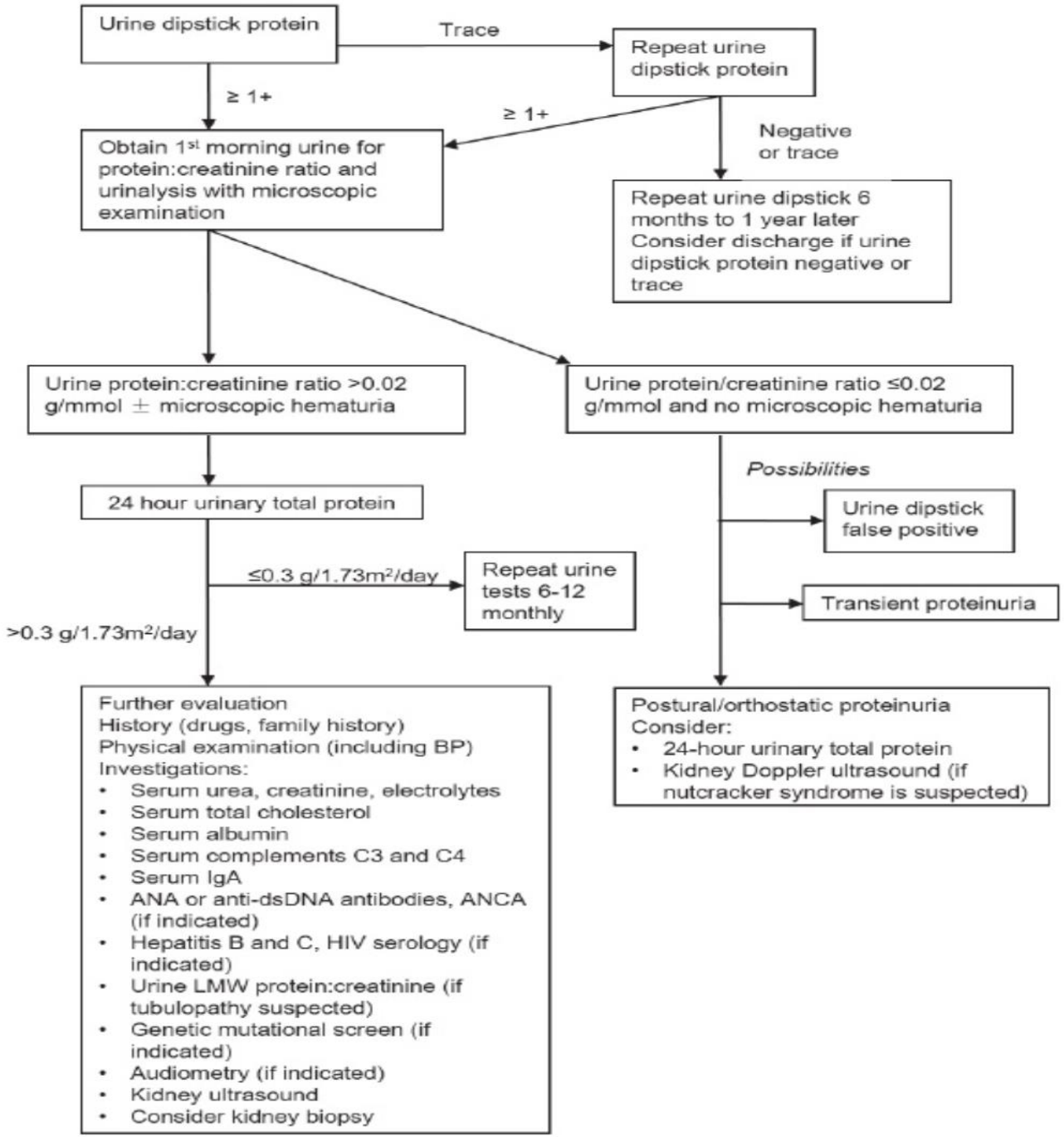
Practice Point 1.2.5: When feasible, a reasonable compromise is to collect an "intended" 24-hour urine sample and measure PCR in an aliquot of the collection.

KDIGO 2021 CLINICAL PRACTICE GUIDELINE FOR THE MANAGEMENT OF GLOMERULAR DISEASES

Chọn lựa các xét nghiệm đạm niệu

- Urinary dipstick analysis is useful for screening and at home monitoring of proteinuria, but therapeutic decisions should be based on at least one precise quantification of proteinuria, i.e., UPCR on a first-morning urine sample, or 24-h urine collection after treatment for > 4 weeks with full-dose PDN.
- First morning urine samples are preferred over random spot samples to reduce the influence of orthostatic proteinuria.
- Given the linear relationship between UPCR in spot and 24-h urine protein, determination of UPCR is recommended. If either UPCR measurement is ≥ 200 mg/mmol (2 mg/mg), then treatment for SRNS should begin.

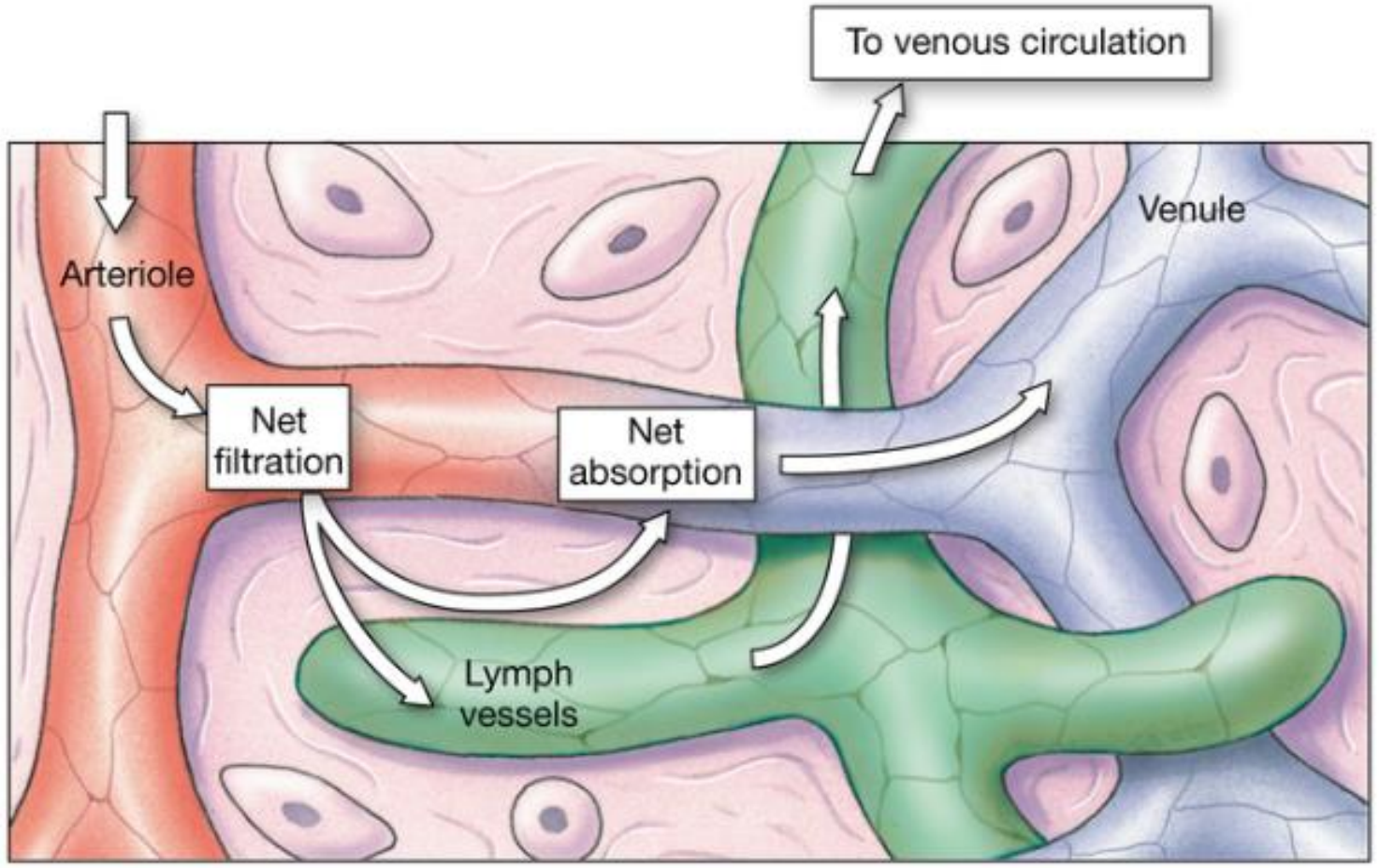
IPNA clinical practice recommendations for the diagnosis and management of children with steroid-resistant nephrotic syndrome. Pediatric nephrology. 2020 May 7



Pediatric Nephrology On-The-Go. 4th 2021

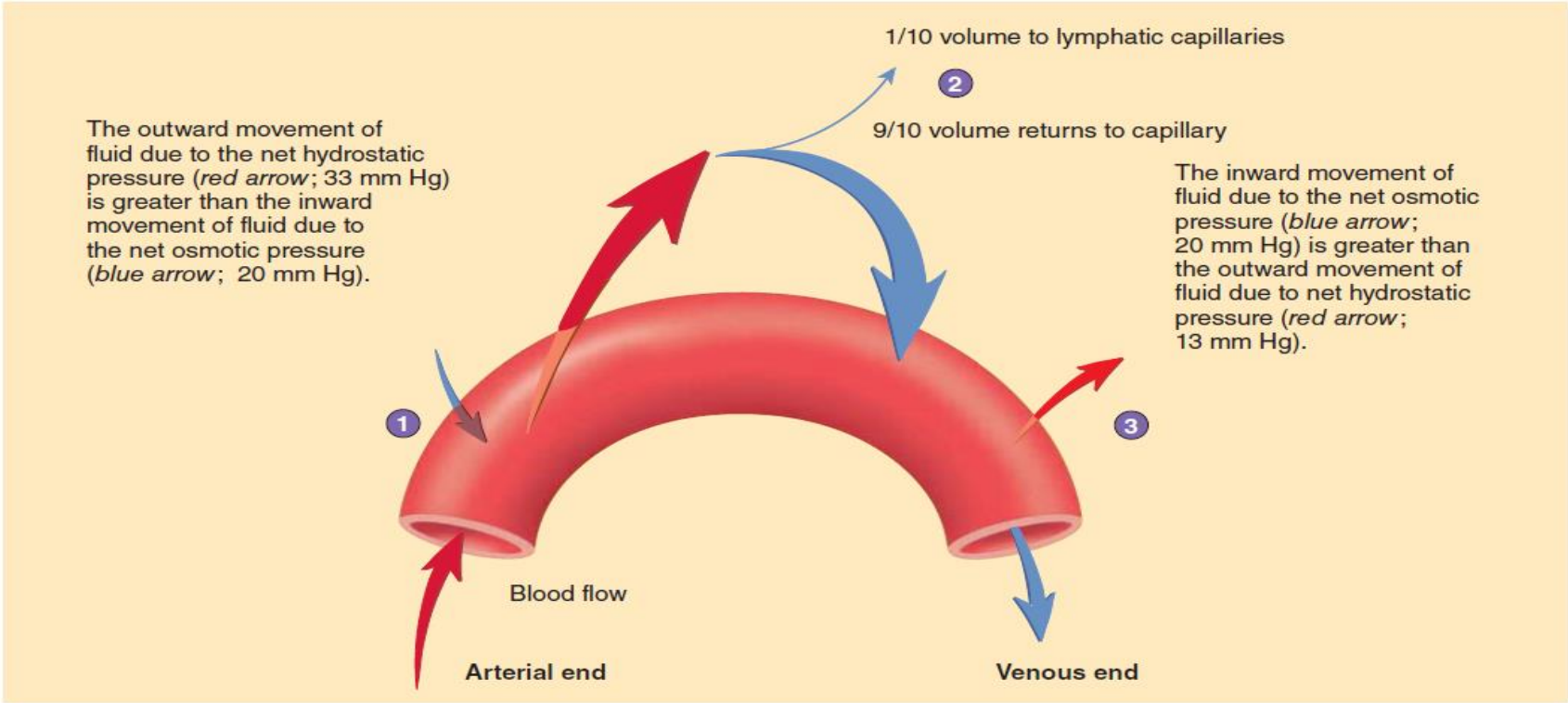
3. Tiếp cận phù

Microcirculation - Capillary Fluid Exchange



SEELEY'S ANATOMY & PHYSIOLOGY, 11th 2017

3. Tiếp cận phù



1 At the arterial end of the capillary, the **net hydrostatic pressure** is greater than the **net osmotic pressure.** When the net osmotic pressure is subtracted from the net hydrostatic pressure, the result is a positive **net filtration pressure** that causes fluid to move out of the capillary.

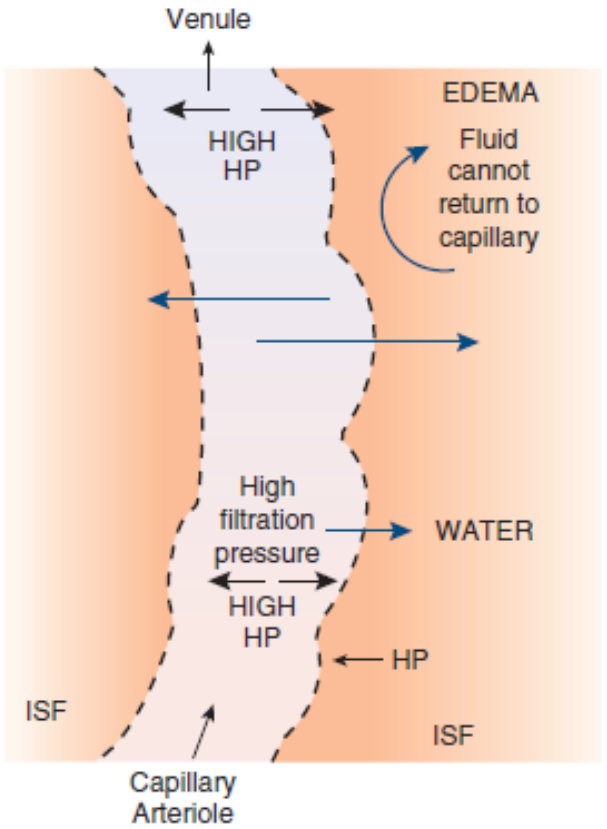
33 mm Hg (Net hydrostatic pressure)
−20 mm Hg (Net osmotic pressure)
13 mm Hg (Net filtration pressure)

2 Approximately nine-tenths of the fluid that leaves the capillary at its arterial end reenters the capillary at its venous end. About one-tenth of the fluid passes into the lymphatic capillaries.

3 At the venous end of the capillary, the **net hydrostatic pressure** is less than the **net osmotic pressure.** When the net osmotic pressure is subtracted from the net hydrostatic pressure, the result is a negative **net filtration pressure** that causes fluid to move into the capillary.

13 mm Hg (Net hydrostatic pressure)
−20 mm Hg (Net osmotic pressure)
−7 mm Hg (Net filtration pressure)

SEELEY'S ANATOMY & PHYSIOLOGY, 11th 2017



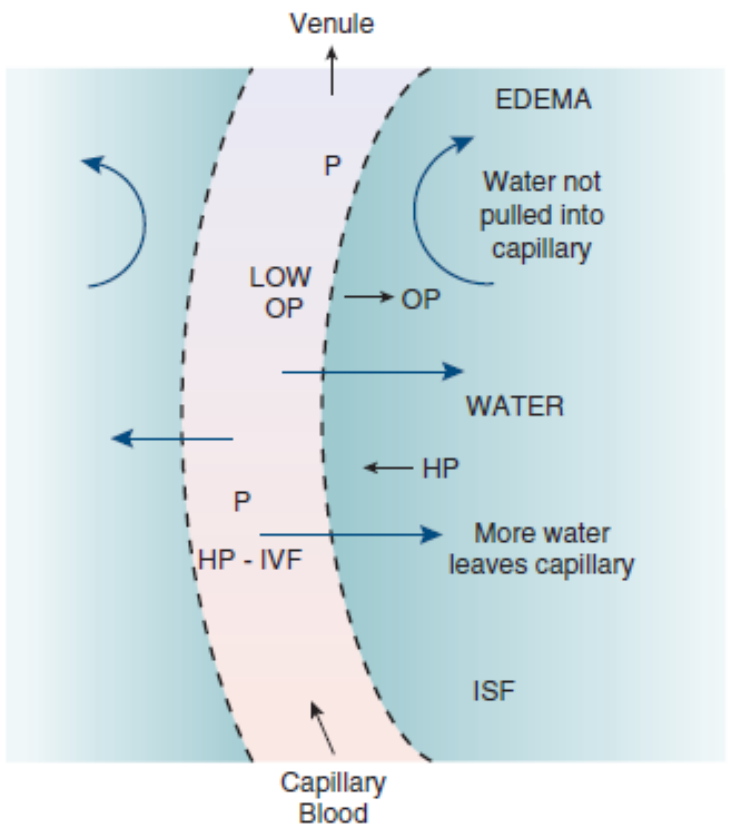
A. HIGH CAPILLARY HYDROSTATIC PRESSURE

INCREASED CAPILLARY HYDROSTATIC PRESSURE

- Systemic venous hypertension
  - Heart failure (myocarditis, cardiomyopathy, ischemic heart disease)
  - Constrictive pericarditis
  - Note: right-sided failure results in peripheral edema, left-sided failure results in pulmonary edema.
  - Cirrhosis/liver failure
  - High output failure [anemia (ABO and Rh incompatibility), arteriovenous fistulas, hyperthyroidism]
- Localized venous hypertension (localized edema)
  - Deep vein thrombosis, compression of venous return (localized edema)

INCREASED PLASMA VOLUME

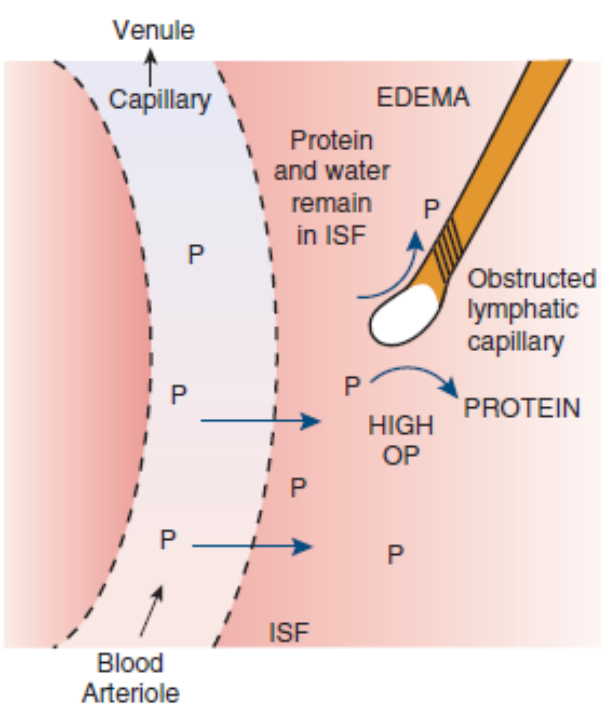
- Heart failure
- Renal failure



B. LOSS OF PLASMA PROTEINS LOW CAPILLARY OSMOTIC PRESSURE

DECREASED CAPILLARY ONCOTIC PRESSURE

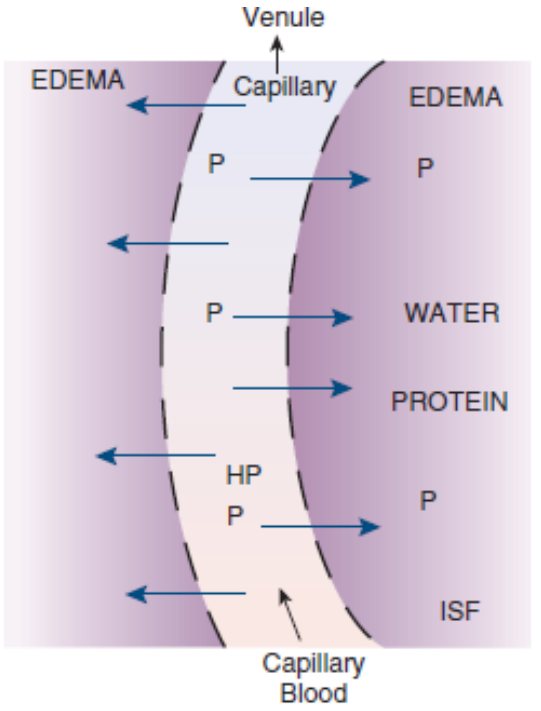
- Protein loss (nephrotic syndrome, congenital lymphangectasia, inflammatory bowel disease)
- Decreased synthesis (cirrhosis, malabsorption, malnutrition)



C. LYMPHATIC OBSTRUCTION

LYMPHATIC OBSTRUCTION AND INCREASED INTERSTITIAL ONCOTIC PRESSURE

- Lymphedema, leakage of protein into the interstitium.



D. INCREASED CAPILLARY PERMEABILITY

INCREASED CAPILLARY PERMEABILITY

- Inflammation (localized or systemic edema)
- Burns (localized edema)
- Trauma (localized edema)
- Allergic reaction (localized or systemic edema)

Pathophysiology for the Health Professions. 4th 2011

AAP Textbook of Pediatric Care. 2nd 2017

TABLE 19.5 Causes of Edema

Kidney Diseases
Acute glomerulonephritis
Nephrotic syndrome
Acute renal failure
Chronic renal failure

Heart Failure

Liver Failure

Nutritional and Gastrointestinal Disorders
Protein-calorie malnutrition
Protein-losing enteropathy
Nutritional edema (especially on refeeding)

Endocrine Disorders
Hypothyroidism
Mineralocorticoid excess

Miscellaneous
Hydrops fetalis
Venocaval obstruction
Capillary leak syndrome (systemic inflammatory response syndrome)
Turner syndrome (lymphedema)
Allergic reaction (periorbital edema)

Nelson Pediatric Symptom-Based Diagnosis. 2018

5 hội chứng cầu thận ở trẻ em

- Acute nephritis
- Isolated nephrotic syndrome
- Macroscopic hematuria
- Rapidly progressive glomerulonephritis
- Chronic glomerulonephritis

Glomerular disease: Evaluation in children

Author: Patrick Niaudet, MD
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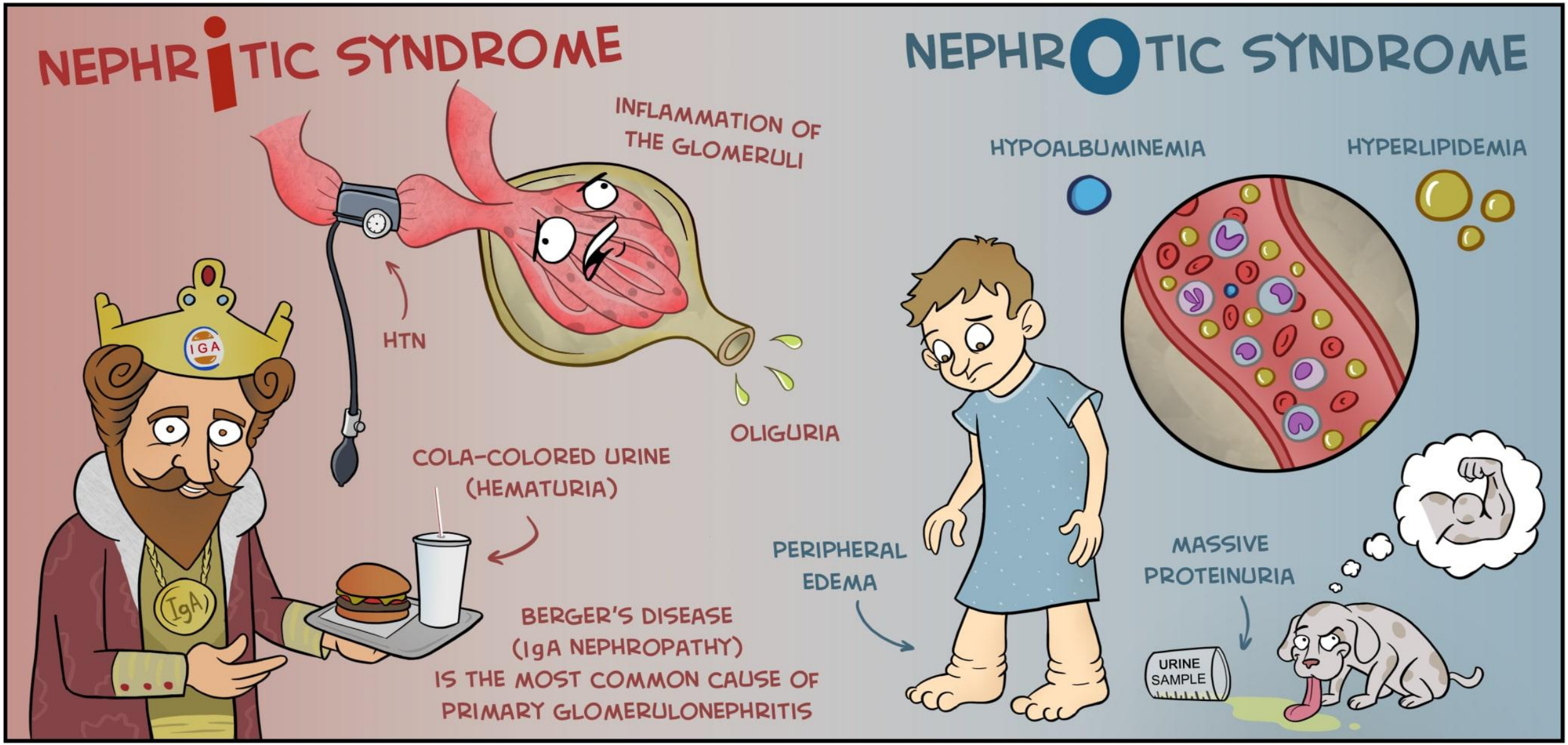
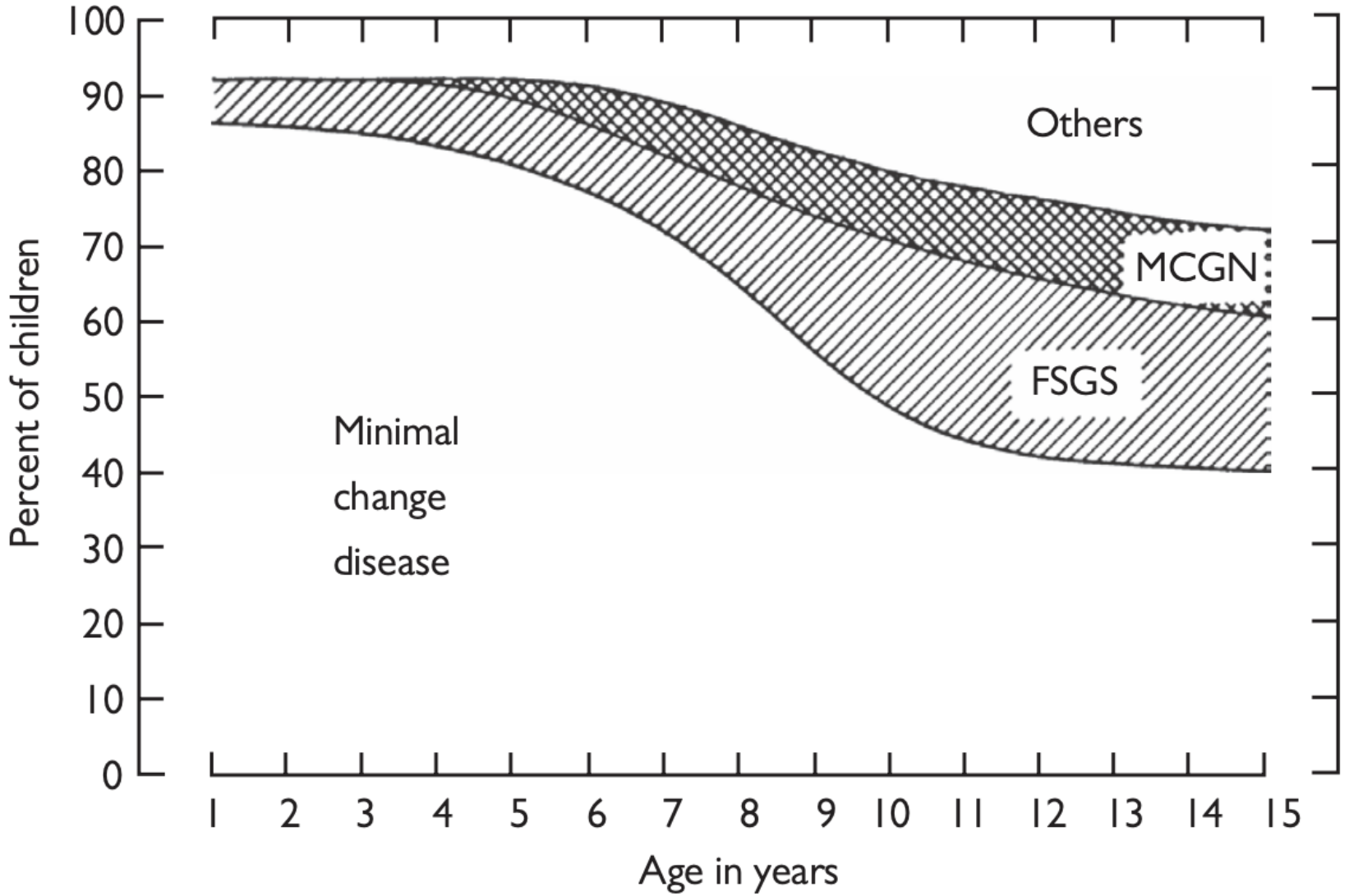
Contributor Disclosures

All topics are updated as new evidence becomes available and our peer review process is complete.

Literature review current through: **Jul 2022.** | This topic last updated: **Sep 14, 2021.**





'Smoothed' representation of the distribution of major causes of childhood nephrotic syndrome by age. Based on pooled data from the ISKDC and patients investigated at Guy's hospital, London (*n* = 566).

Oxford Specialist Handbook in Paediatrics. Paediatric Nephrology. 3rd 2019


ĐÀO TẠO
ĐẠI HỌC Y DƯỢC TP.HCM
BỘ MÔN NHI
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