Hematuria in children

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Causes of red urine

- Hemoglobinuria : G6PD deficiency
- Myoglobinuria :trauma,seizures,rhabdomyolysis
- Drugs (rifampicin),food,dyes
- Inborn errors of metabolism(porphyria,bilirubin)
- Urate crystals
- Hematuria :macroscopic

Analysis of hematurea

- onset
- Color :Red if fresh(bladder), or brown color as Hb converted to acid haematin by urinary acids in renal causes
- Timing :Early hematuria:urethral cause ,Terminal hematuria:bladder causes,continous
- Presense of clots : extrarenal causes

History and associated symptoms

- Fever, urinary symptoms ,dysuria, frequency, loin pain/ suprapubic pain .(looking for cystitis,pyelonephritris/stones
- Age/gender
- Periorbital edema,lower limb edema, decreased urine output
- Preceding URTI…..PSGN,IgA nephropathy

- History of previous attacks of red urine
- Rash,arthritis …HSP,SLE
- Coagulopathy,bleeding tendency,sickle cell
- Trauma
- drugs
- FH of hematuria,deafness,renal failure…Alport,FH of renal stones
- exercise

Hematuira

Gross	microsocpic
Painful	Painless
Transient	Persistent
Isolated	Hematuira with proteinurea
Glomerular	Extraglomerular

Examination

- Vital signs: fever for UTI, hypertension for glomerulonephritis
- Looking for edema :lower limbs,eyes
- Abdomen exam : masses ,(PCKD) ,tenderness
- Genitalia exam:
- Skin rashes

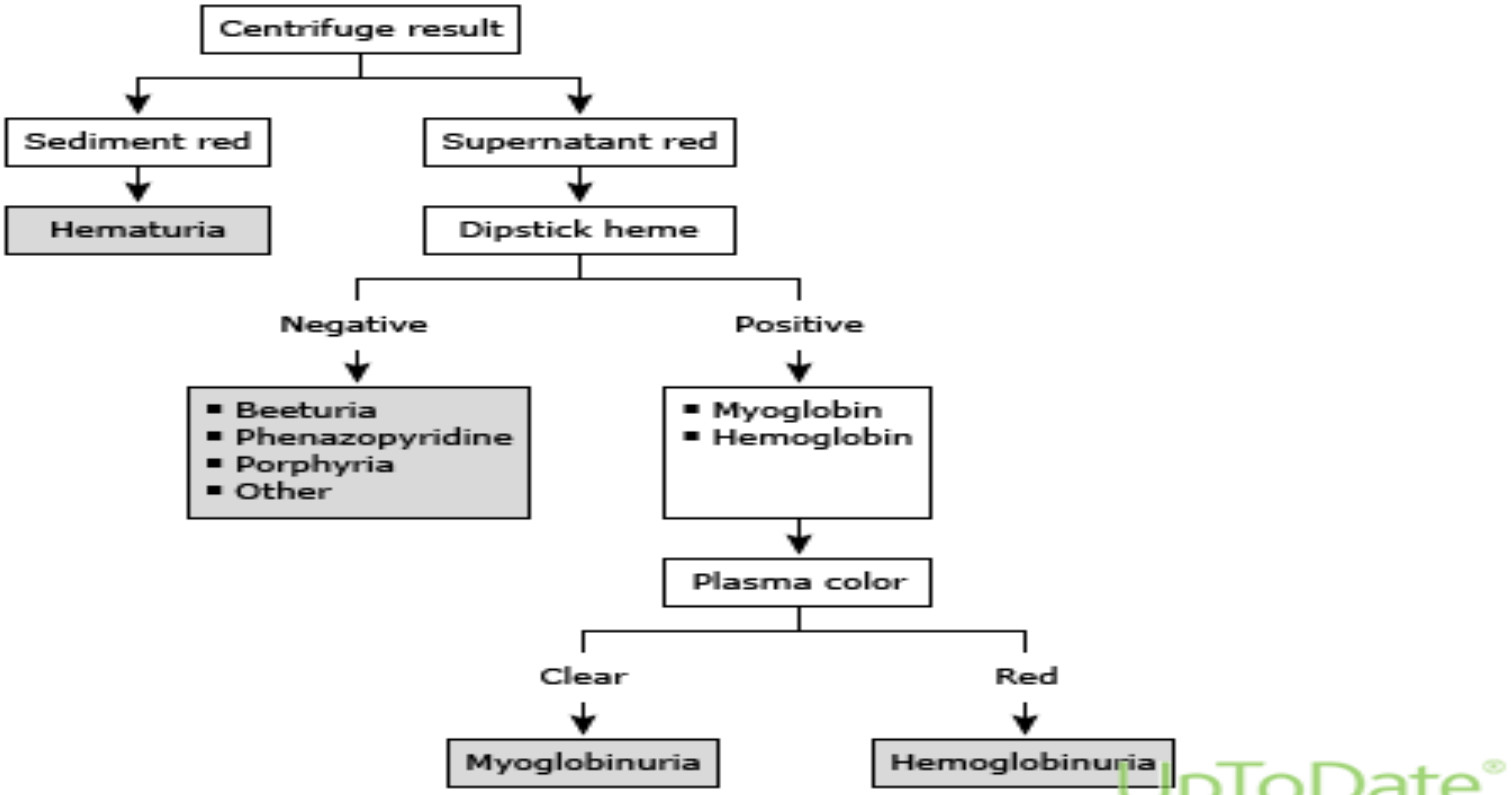
Investigation

- Urine dipstick positive for heme,negative analysis (hemoglobinuria,myoglobin)
- Negative dipstick and UA (factitious)
- Positive dipstick and UA (hematuria)

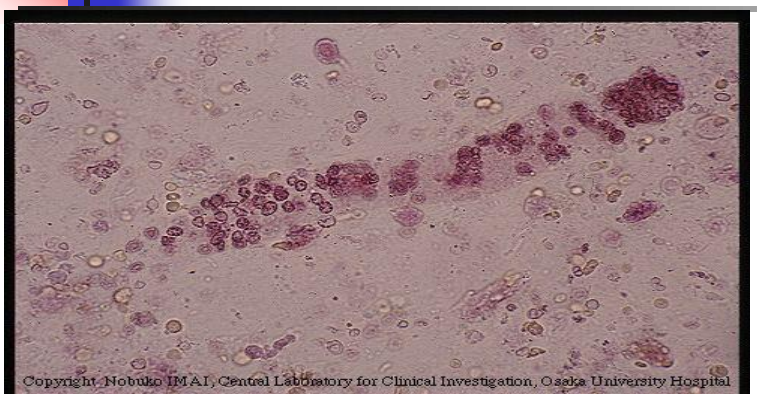
- Microscopy: look for RBC, wbc,bacteria (uti), high grade proteinurea (GN) ,crystals

- dysmprhic RBC by phase contrast microscopy ,RBC cast:glomerular bleeding

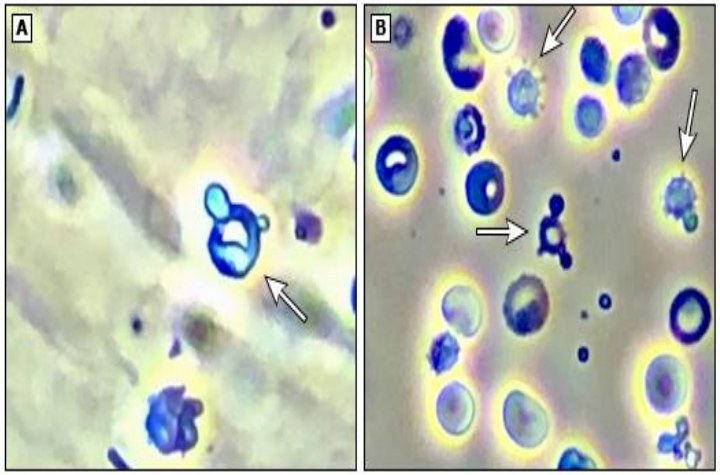
Approach to the patient with red or brown urine



Glomerular or extraglomerular



Phase-contrast micrograph showing dysmorphic RBCs in urine sediment



Distinguishing extraglomerular from glomerular hematuria

	Extraglomerular	Glomerular
Color (if macroscopic)	Red or pink	Red, smoky brown, or "Coca-Cola"
Clots	May be present	Absent
Proteinuria	Usually absent	May be present
RBC morphology	Normal	Dysmorphic
RBC casts	Absent	May be present

RBC: red blood cell.

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Prevalence

Definition of hematuria is the presense of more than 5 cells per high power field of centrifuged urine

Prevelance of isolated microscopic hematuria .5-2%which falls to 1 % for two or more positive samples

Transient hematuria seen with fever and exercise

Persistant asymptomatic hematuria weekly for three times needs to be investigated

Urethrorrhagia:urethral bleeding associated with blood spots after voiding,prepubertal

Pathophysiology

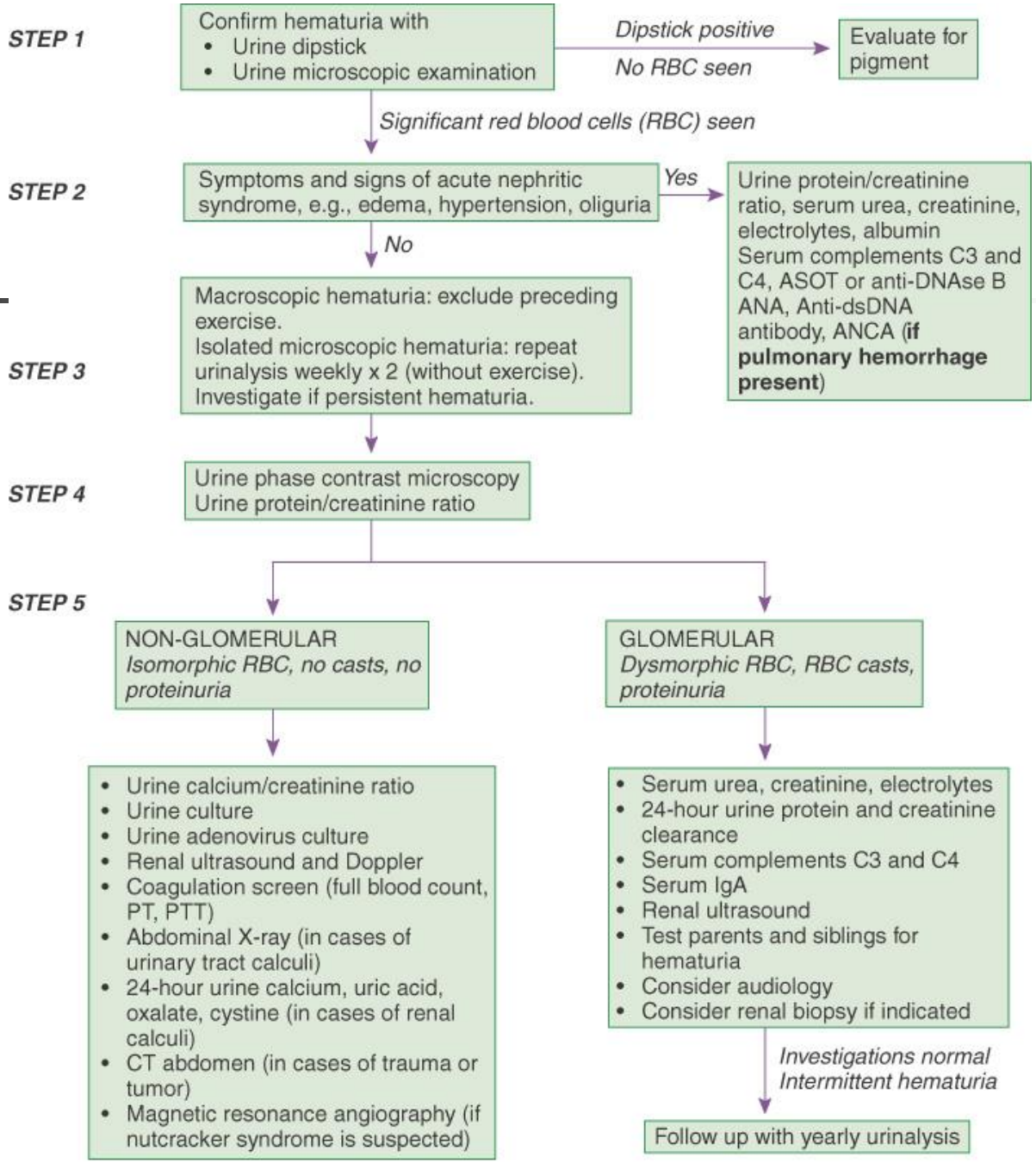
Structural disruption in the integrity of GBM caused by inflammatory or immunologic process

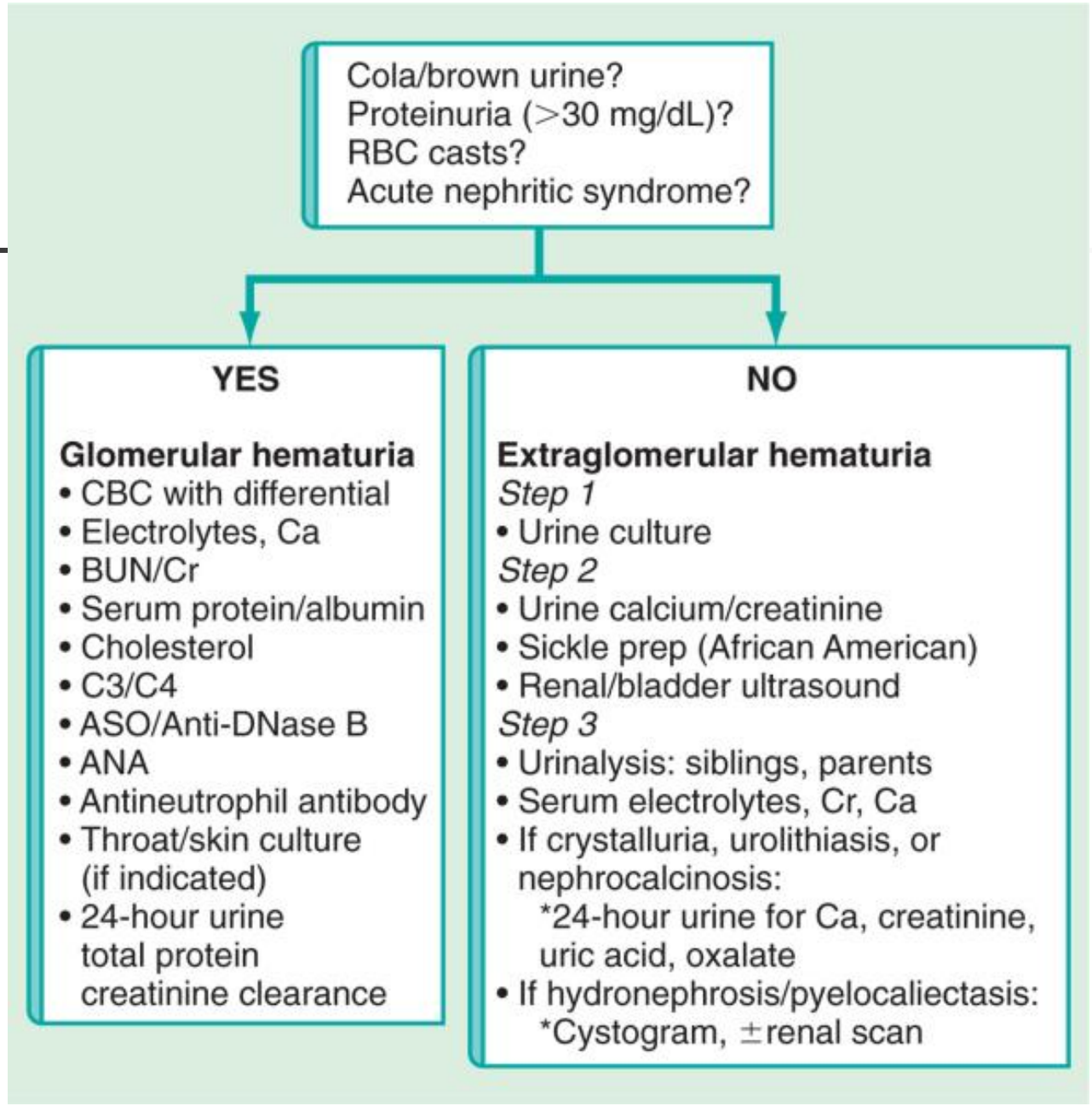
Toxic disruption of renal tubules

Mechanical erosion of mucosal surfaces in the genitourinary tract

Investigations

- Urine protein/creat ratio ,Electolytes,albumin,kft ,ASOT,C3,C4,ANA for GN causes
- Urine culture if UTI
- CBC if infection ,PT,PTT
- Urine calcium/creat ratio, 24 h urine collection
- U/S ,XRAY, spiral CT
- Later :Urine analysis on parents ,cystoscopy
- Renal biobsy




Cola/brown urine?
Proteinuria (>30 mg/dL)?
RBC casts?
Acute nephritic syndrome?
YES
Glomerular hematuria
• CBC with differential
• Electrolytes, Ca
• BUN/Cr
• Serum protein/albumin
• Cholesterol
• C3/C4
• ASO/Anti-DNase B
• ANA
• Antineutrophil antibody
• Throat/skin culture (if indicated)
• 24-hour urine total protein creatinine clearance
NO
Extraglomerular hematuria
Step 1
• Urine culture
Step 2
• Urine calcium/creatinine
• Sickle prep (African American)
• Renal/bladder ultrasound
Step 3
• Urinalysis: siblings, parents
• Serum electrolytes, Cr, Ca
• If crystalluria, urolithiasis, or nephrocalcinosis:
*24-hour urine for Ca, creatinine, uric acid, oxalate
• If hydronephrosis/pyelocaliectasis:
*Cystogram, ±renal scan

Gross hematuria

UTI

Irritation of meatus

Trauma

Stones /hypercalcuira

Glomerulonephritis

Recurrent

IgA nephropathy

Hypercalcuira

Alport syndrome

Nut cracker syndrome

Causes of hematuria

Upper urinary tract disease

Familial benign hematuria

GN: primary as postinfectious, MPGN, IgA nephropathy, Alport,

Multisystem disease

SLE,Hencoh scholein purpura
Hemolytic uremic syndrome

Tubulinterstitial disease

Acute tubular necrosis

Interstitial nephritis

Papillary necrosis

Pyelonephritis

Vascular :

Hemoglobinopathy as sickle cell

Vascular malformations (hemangioma)

Renal vein thrombosis

Nut cracker syndrome:seen in thin,compression of renal vein between SMA and aorta

anatomic :

Malignancy of the kidney (Wilms tumor) or bladder tumors

Cystic renal disease

Lower urinary tract disease

Cystitis

Urolithasis,hypercalcuira

Trauma

Exercise

A 7 year old child presents with dark cola colored urine of three days duration all through urination without clots.There was no history of fever ,urinary symptoms,abdominal pain,trauma.The child has decreased urine output and periorbital edema

FH: negative family history of renal disease

DH: mother gave him amoxcillin before one month because he had tonsillitis

examination

BP 140/90

There is mild lower limb edema

The child was admitted for observation and workup

His urine output was .7 ml/kg/hour

Urine analysis :+3 protein,numerous RBC,RBC casts

Kft : creat 1 mg/d

What is diagnosis ?

ASOT was positive

C3 was low

Diagnosis : Poststreptoccal glomerulonephritis

Management : Fluid restriction,diuretics ,anti hypertensive (vasodilators,Ca channel blockers)

Follow up

Gross hematuria resolved after one week and proteinuria decreased from +3 to +1

Acute kidney normalized with a week

Hypertension resolved

Upon discharge he was still having microscopic hematuria

6-8 weeks later complements were repeated and they rose to normal levels

Microscopic hematurea resolved in few month

There were no long term sequele

Epidemiology of PSGN

Follows GABHS pharyngitis in winter,pyodrema in summer

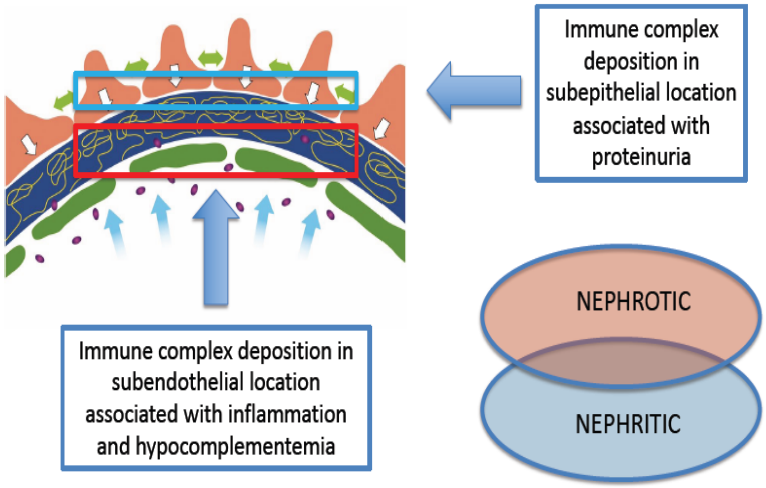
Certain nephritogenic M types,age 5-15 y,M:F 2:1

Risk of PSGN following GABHS is 15%

Antibiotic treatment doesn't prevent PSGN

Clinical features:latent period 10-14 days after pharyngitis, 3-6 wk pyoderma

Pathophysiology



Clinical Characteristics at Presentation

Hematuria

- Microscopic or gross
- Discolored urine reported in up to 80%

Hypertension

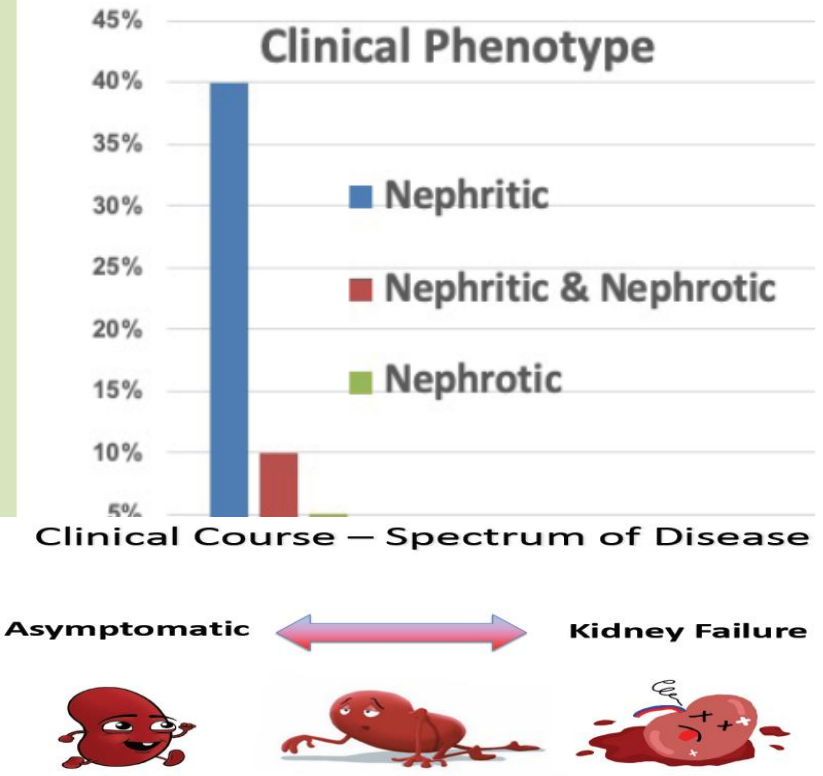
- Reported in 60-75%

Azotemia/Increased Cr

- Reported in 30-40%

Oliguria

- Reported in 25-35%



Laboratory investigations

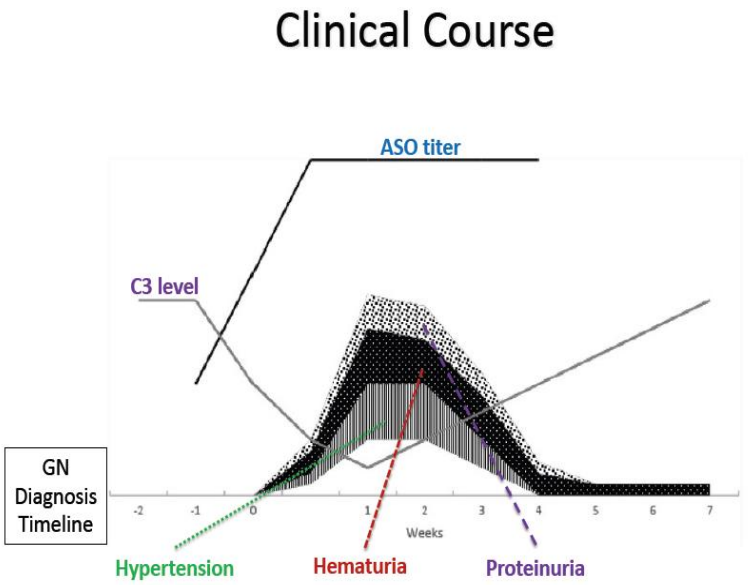
Urine : RBC casts

Low C3

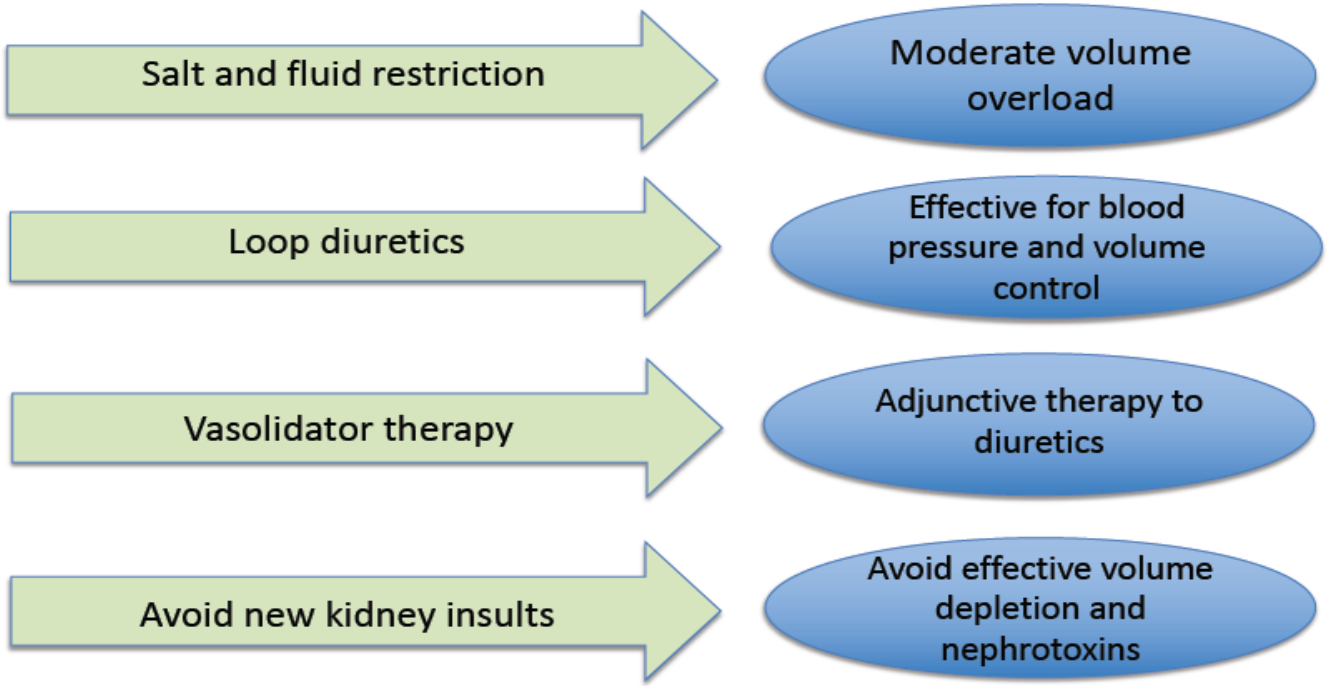
Positive ASOT

Renal azotemia

Hematuria and proteinurea stays for months



Management:
General Medical Care



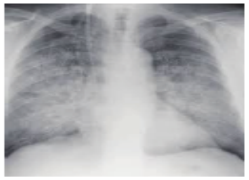
Clinical Course: Serious Sequelae

Encephalopathy/Seizures

- Around 5% of most large cohorts
- Generally related to hypertension

Symptomatic Pulmonary Edema/CHF

- 5-15% of most large cohorts
- Chest radiograph changes in up to 50%



Dialysis

- 1-2% of most large cohorts
- Most often related to RPGN

General Clinical Expectations

Most clinical signs and symptoms resolve spontaneously and within weeks

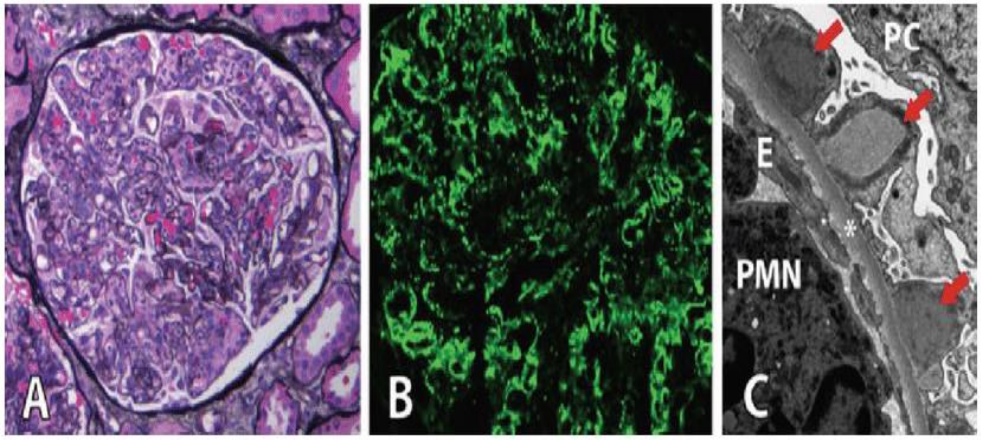
Hypocomplementemia >3 months should raise concern for a chronic hypocomplementemic GN

Recurrent gross hematuria is common with new acute illness early after diagnosis

Recurrent APSGN is quite rare

ESKD from APSGN is uncommon

APSGN: Immune Complex Nephritis



A. **Light microscopy:** proliferative and often exudative GN; findings vary within clinical spectrum; crescents less common

B. **Immunofluorescence:** diffuse C3 and IgG is typical; C3 deposition often described as "starry sky"

C. **Electron microscopy:** subepithelial electron-dense humps as well as subendothelial deposits

Pathology pictures from Rodriguez-Iturbe B et al, "Acute postinfectious glomerulonephritis in children," in Pediatric Nephrology, 7th ed. Berlin: Springer-Verlag, 2015

TABLE 20-2 Indications for Renal Biopsy

Early Stage	Recovery Phase
Short latent period	Depressed GFR >4 weeks
Severe anuria	Hypocomplementemia >12 weeks
Rapid progressive course	Persistent proteinuria >6 months
Hypertension >2 weeks	Persistent microhematuria >18 months
Depressed GFR >2 weeks	
Normal complement levels	
Nonsignificant titres of antistreptococcal antibodies	
Extrarenal manifestation	

Alport Syndrome

80% XL,20% AR

Deficiency of α5 of type 4 collagen

Renal failure, high frequency sensorineural deafness,ocular change as anterior lenticonus,retinal changes

Present as microscopic and rarely macroscopic hematauria with URTI

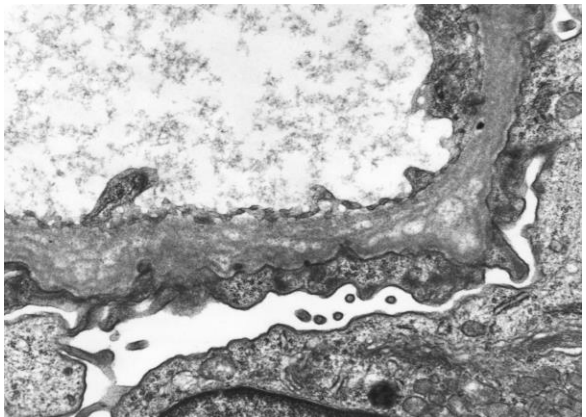
Proteinura,HTN later age

Diagnosis and course

Diagnosis by EM:Thinning of GBM,split and duplicated lamina densa,basket weave

Males progress to ESRD,deafness by 30y

ACEI may delay progression to ESRD



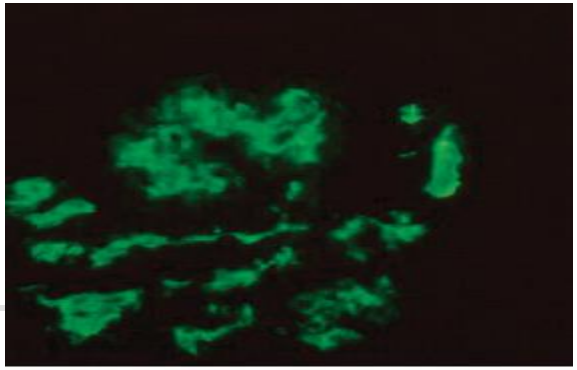
Benign Familial hematuira (TBMN)

- AD inheritance
- Present as microscopic hematuria,no proteinuria or renal failure
- EM:thinning of GBM
- Follow up for proteinuria,HTN

IgA nephropathy

- Recurrent macroscopic hematuria,loin pain 1-2 days following URTI,last < 3 days.
- Persistent microscopic hematuria ±proteinuria
- Nephritic,nephrotic syndrome rare
- Present second decade,more in males

Diagnosis and course



IgA high in 35-50%

Diagnosis: LM:focal or diffuse mesangial cell proliferation,expansion of mesangial matrix

IM:IgA,C3 deposits

Heavy proteinuria and hypertension are risk factors for progression to ESKD.

Progression to ESRD is slow

Prognosis for children better than adults

Young children without macroscopic hematuria have the best long term outcome

Treatment of IgA nephropathy

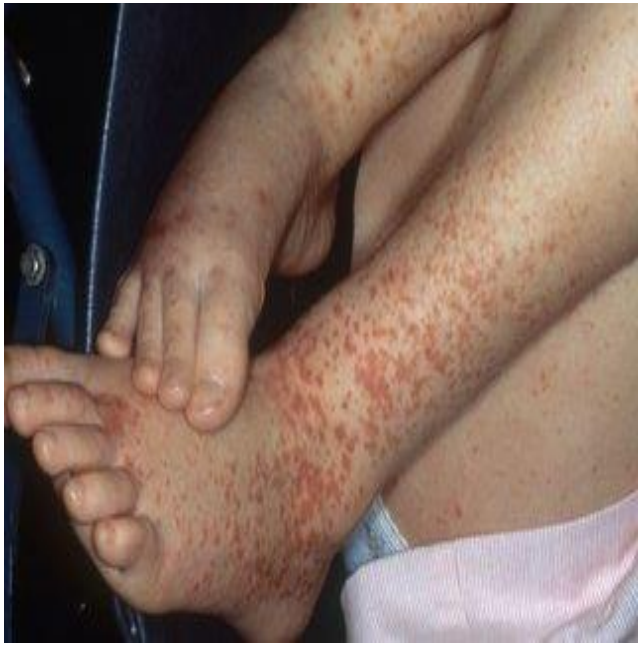
KDIGO 2021

Treatment

- There is strong evidence suggesting a benefit of RAS blockade in children.[132] All children with IgAN and proteinuria >200 mg/d or PCR >200 mg/g (>0.2 g/g [20 mg/mmol]) should receive ACEi or ARB blockade, advice on a low-sodium diet, and optimal lifestyle and blood pressure control (systolic blood pressure [SBP] <90th percentile for age, sex, and height).

In children with proteinuria >1 g/d or PCR >1 g/g (100 mg/mmol) and/or mesangial hypercellularity, most pediatric nephrologists will treat with glucocorticoids in addition to RAS blockade from time of diagnosis.

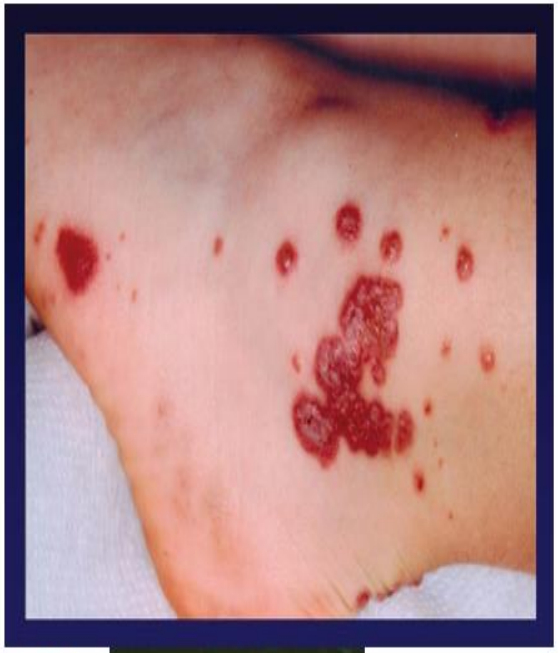
A 7 year old child presents with skin rash and hematuria



Criterion	Description
Mandatory criterion	Purpura or petechiae with lower limb predominance
Minimum 1 out of 4 criteria	1. Diffuse abdominal pain with acute onset 2. Histopathology showing leukocytoclastic vasculitis or proliferative glomerulonephritis, with predominant immunoglobulin A (IgA) deposits 3. Arthritis or arthralgia of acute onset 4. Renal involvement in the form of proteinuria or haematuria

EULAR/PRINTO/PRES: the European League Against Rheumatism, the Paediatric Rheumatology International Trials Organization and the Paediatric Rheumatology European Society (8, 9).

IgA Vasculitis (Henoch-Schoenlein purpura) is a vasculitis whit IgA-dominant immune deposits affecting small vessels (capillaries, venules, arterioles) Involving skin, gut and glomeruli and associated with arthralgia or arthritis



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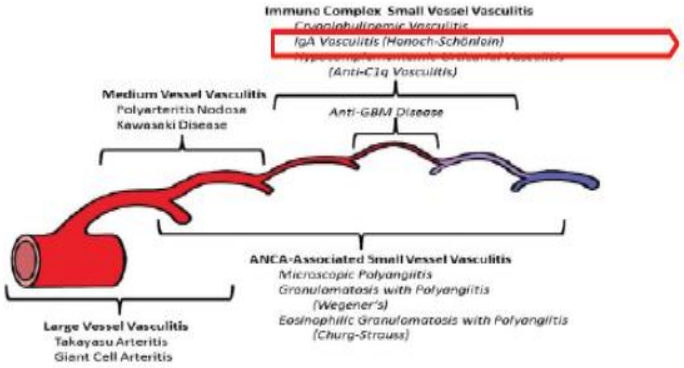
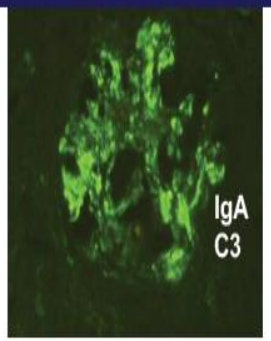


IgAVN



Onset:

- **Palpable purpura and multiorgan signs with hematuria and proteinuria**

Natural history.

- **Most common in children**
- **In children most frequent remission, in rare cases rapid progression, possible progression over decades**

HSP

Renal involvement seen in 20-55%

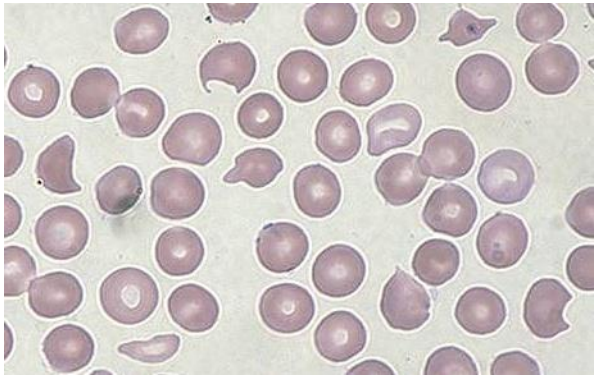
Most common is isolated microscopic hematuria with and without proteinurea

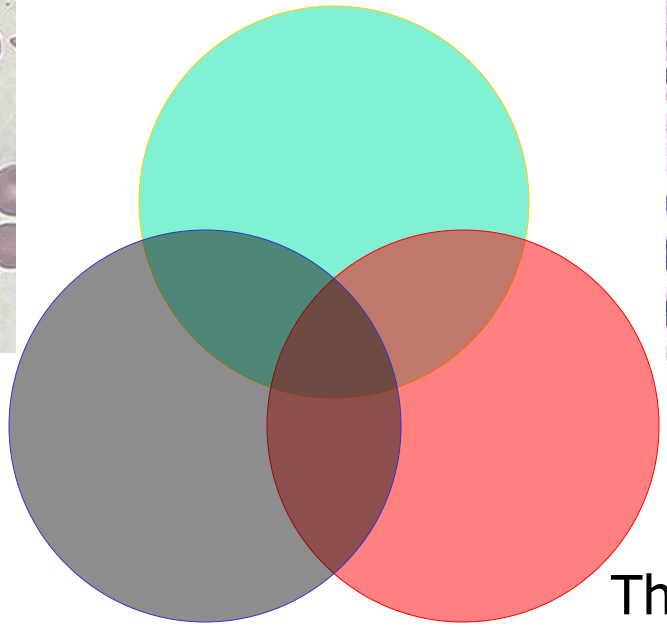
Nephrotic syndrome,hypertension,elevated creatinine are rare manifestations

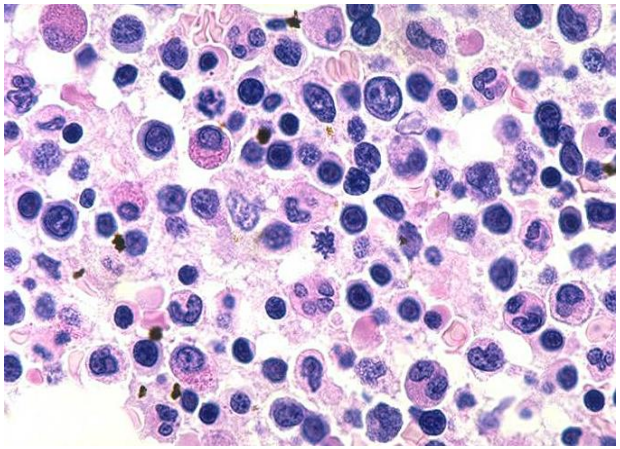
Monthly urine analysis is needed in the first 3-6 month

HUS

Acute haemolytic anaemia







Reduced GFR

Thrombocytopaenia

Classification of HUS

- Infectious (Stx)
  - E coli 0157:H7
  - Shigella dysenteriae type I (D+ HUS)
- Hereditary
  - Factor H deficiency, VWF proteinase def,ADAMTS-13
- Secondary
  - Pregnancy
  - Malignancy
- Medication
  - CNIs

Diarrhae + HUS

- D+HUS:follows STEC, shigella
- Transmitted undercooked hamburgers,milk,person to person
- O157:H7 E. coli most common serotype
- 5-15% of kids infected STEC develop HUS

- Risk of HUS increase with age <5y, WBC >13,000/mm^3,antimotiliy drugs (retention of toxin
- Antibiotic can increase risk?? Release toxin

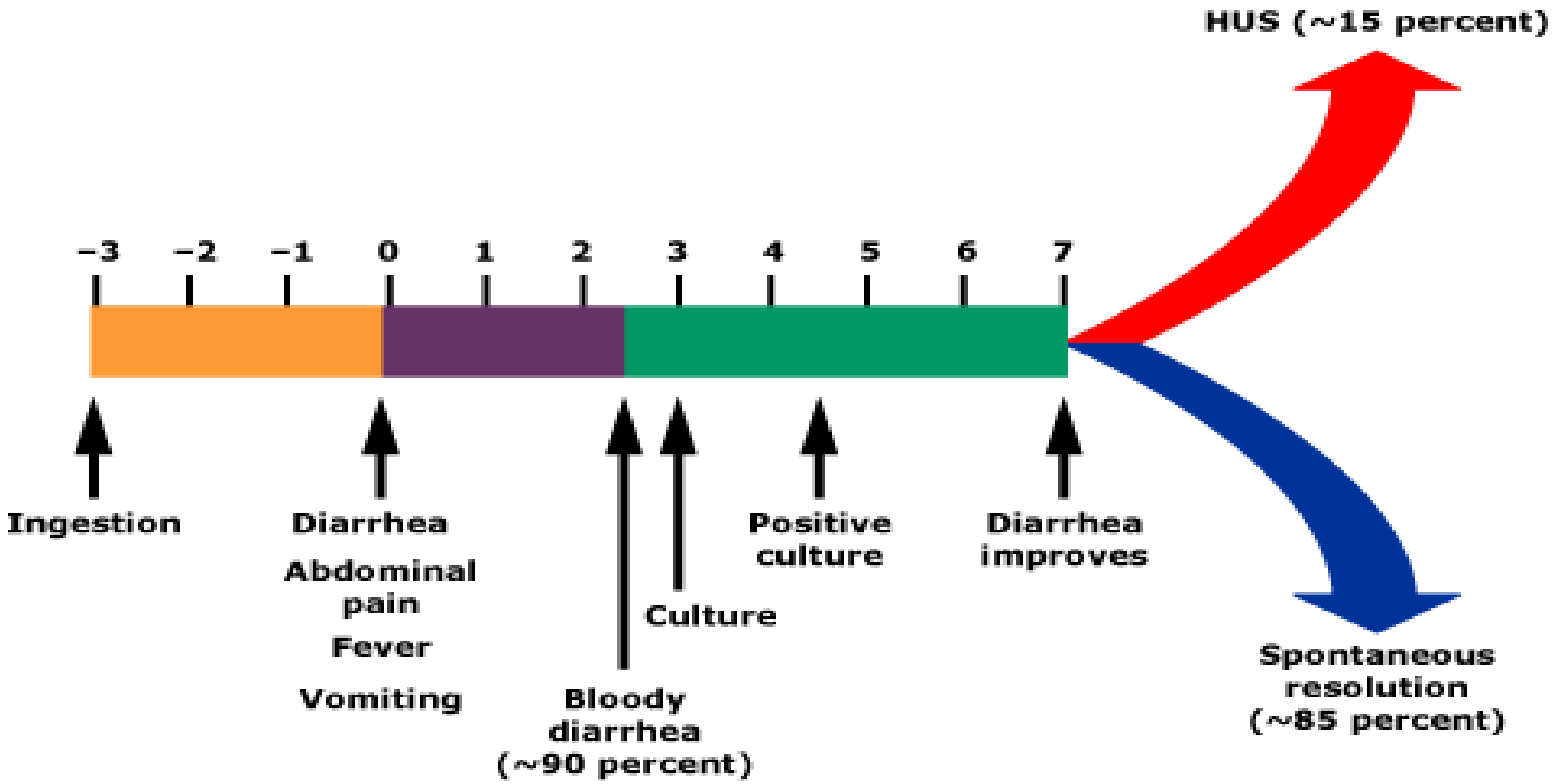
Clinical Manifestations

- Diarrhea 3-7 d after exposure to STEC,mostly bloody
- Pallor,oliguria 4-7 d post diarrhoea
- GIT:severe colitis,transmural necrosis,perforation
- Hepatitis,jaundice

Pancreatitis

- Glucose intolerance,IDDM
- CNS: seizures,irritability,confusion
- HTN,renal cortical necrosis, 50% are anuric,75% needs dialysis due to microthrombi

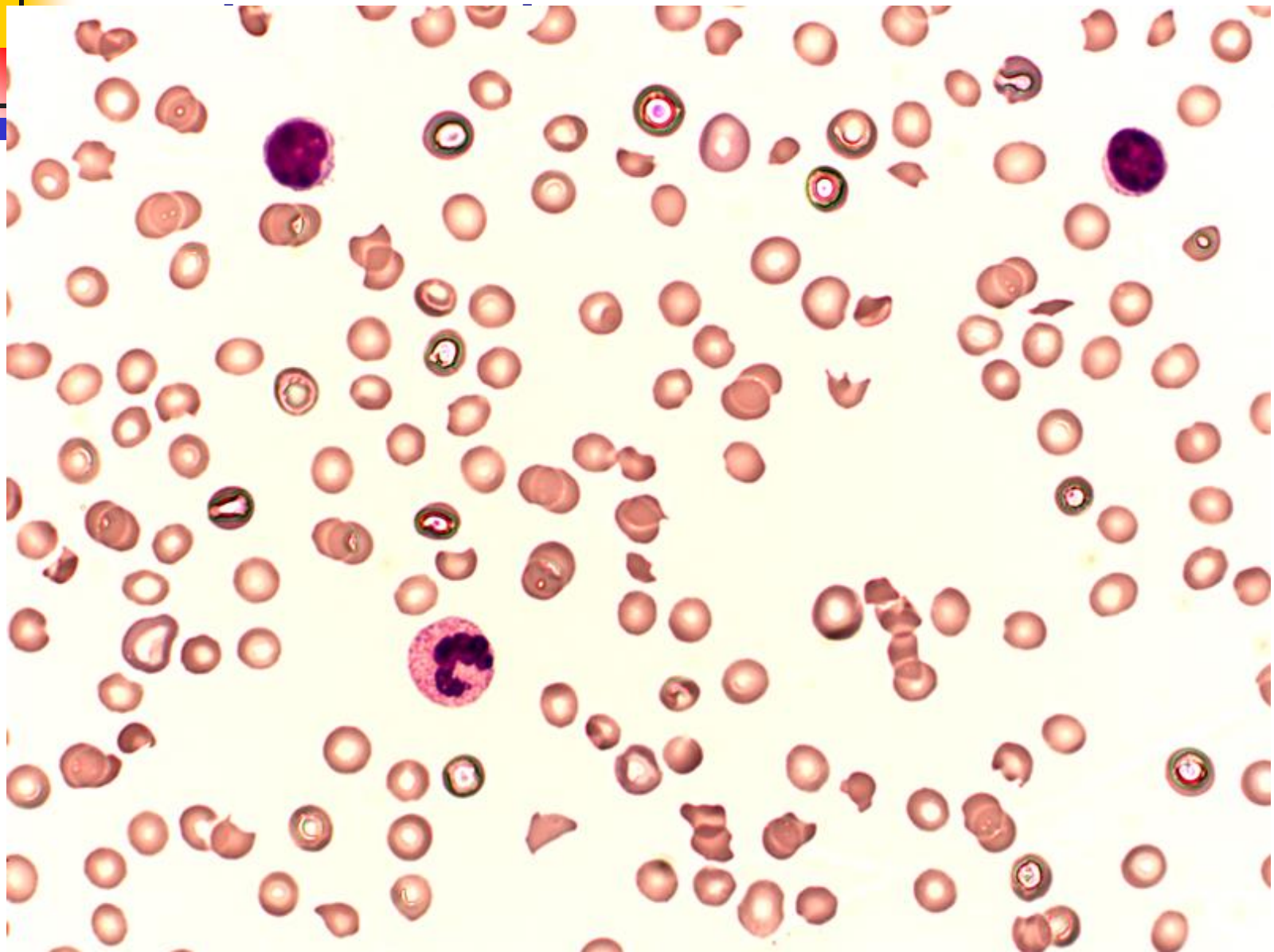
Progression of E coli O157:H7 infections in children



Investigations

- CBC,showes anemia and low platelets.
- LDH high,blood film shows schistocytes,fragmented RBC
- High urea and creatinine
- Elevated liver enzymes hematuria,proteinuria

Microangiopathic hemolytic anemia



Management

- Transfusion if severe hemolysis,slowly 4h
- Monitor fluid and electrolyte status and manage acute kidney injury
- Platelet if bleeding, because can accelerate microthrombi formation


THANK YOU