CASE STUDIES:
Renal and Urologic Impairments

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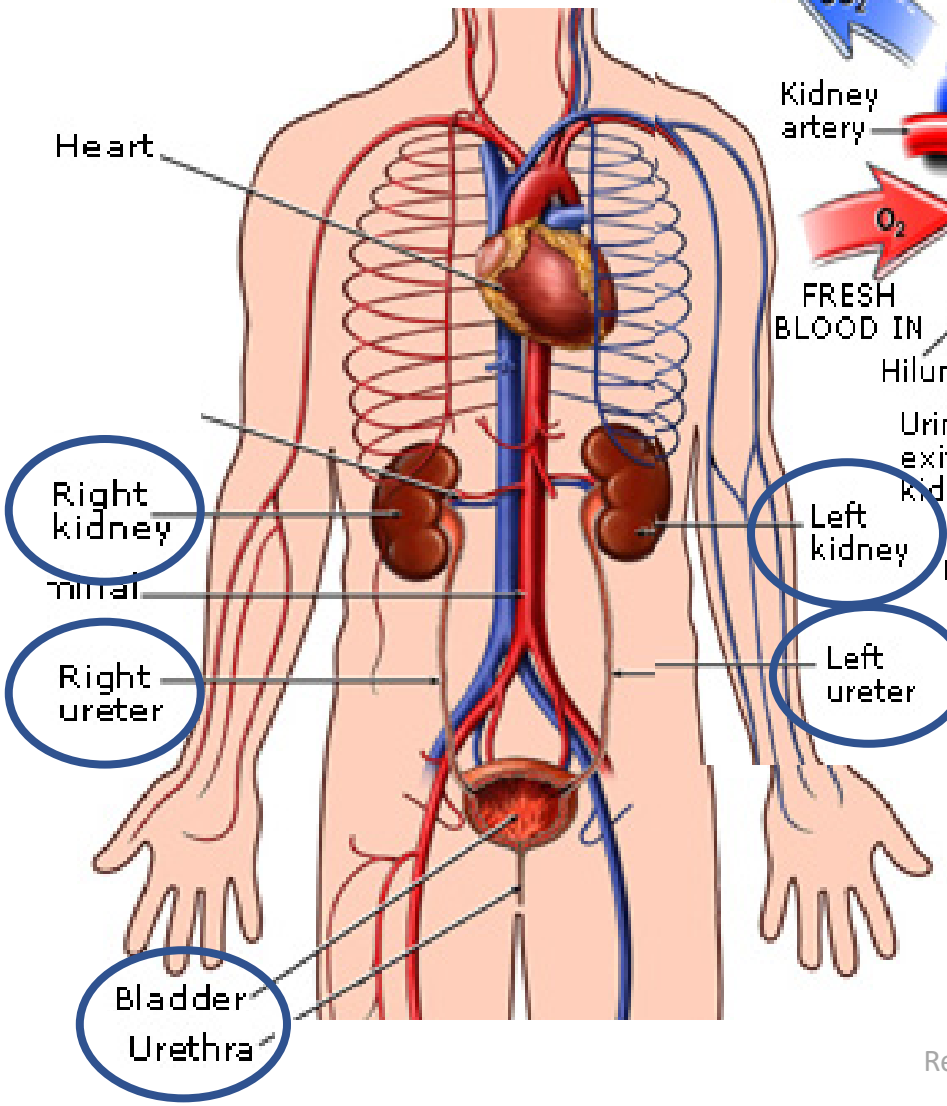
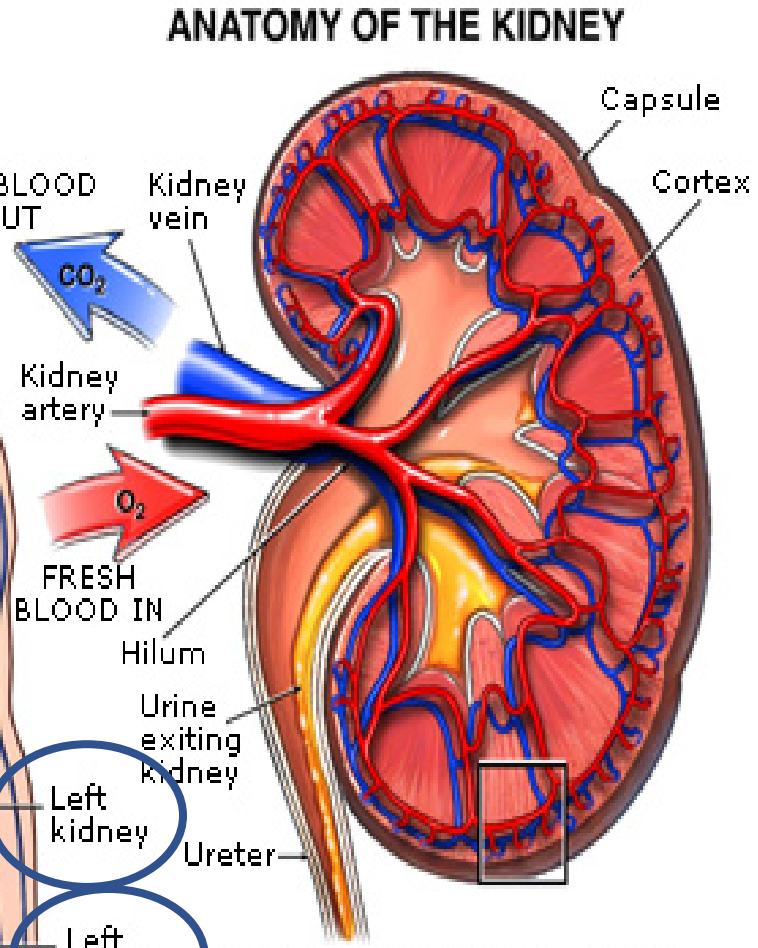
RGA

Munich RE

GU System

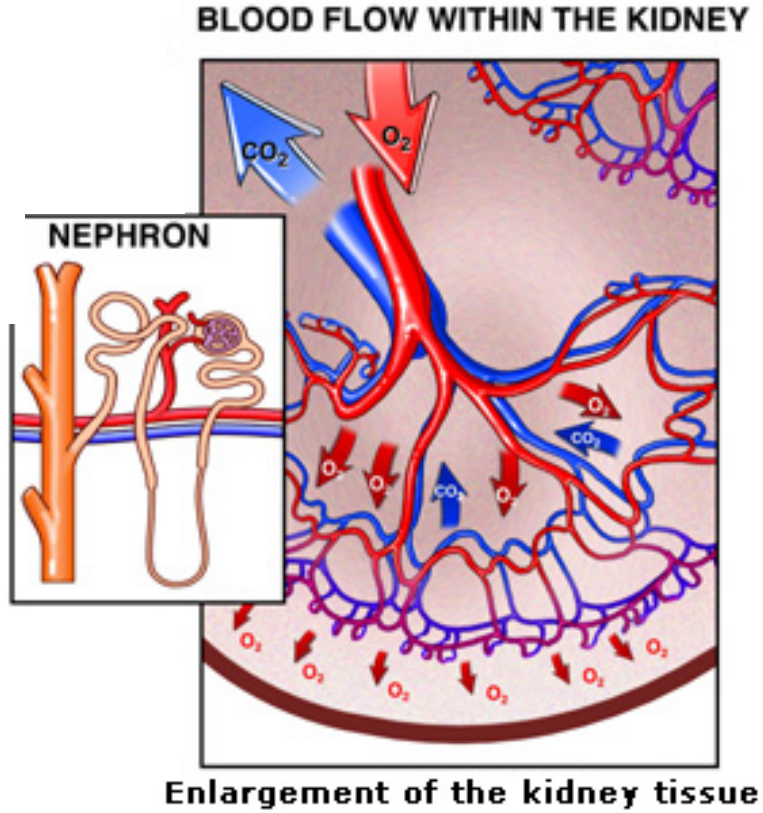
UROLOGY
NEPHROLOGY





Enlarged cut-away view of left kidney

Male reproductive system



Enlargement of the kidney tissue

Indicators of possible GU System issues

- Urine abnormalities
  - albuminuria/proteinuria
  - hematuria
- Abnormal renal function tests
  - Serum creatinine
  - eGFR
  - Cystatin C
- Abnormal imaging studies

Agenda

- Urine abnormalities
  - Define albuminuria, proteinuria and hematuria
  - Review differential diagnosis of each
- Chronic kidney disease (CKD)
  - Define different modes of evaluating renal function
  - Review current definitions and staging for chronic kidney disease and assess prognostic implications
- Benign and Malignant Lesions

URINE ABNORMALITIES

Urine testing

A sample of human urine

24-hour urine collection

Cumbersome

Unreliable

Dipstick

Chemical strips change color when dipped into urine

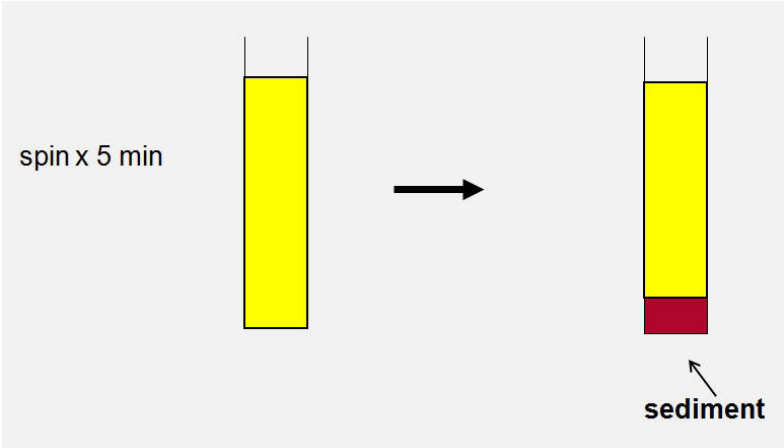
★ “Spot” urine

Measures the amount in random urine sample

Greater specificity

Urinalysis: Microscopic exam

- Microscopic exam – few drops of spun urine examined under the microscope



- WBCs (leukocytes)
- RBCs (erythrocytes)
- Epithelial cells
- Casts

Urinalysis Result

URINE SPECIMEN RESULTS

DATE/TIME VOIDED : 05-12-22/08:30 AM DATE PERFORMED : 05-13-22
EXAMINER : APP

MICROSCOPIC EXAM		CHEMICAL EXAM	
WBC :	0/HPF	PROTEIN :	0 MG% 1.025
RBC :	0/HPF	PROTEIN/CREATININE RATIO :	0.00
GRAN. CAST :	0 LPF	MICROALBUMIN :	-- MG%
HYAL. CAST :	0 LPF	MICROALBUMIN/CREATININE RATIO:	--
		GLUCOSE :	.00 GM%
URINALYSIS SPECIAL TESTING :	BETA BLOCKERS		NEG
	NICOTINE		0.3 MCG/ML
	COTININE REFLEX		NOT PERFORMED

.	RESULT/STATUS		CUTOFF/EXPECTED VALUE
URINALYSIS----------			
LEUKOCYTE ESTERASE		NEGATIVE	
URINE TEMPERATURE	96.0		90.5-99.8 F
URN CREATININE	257.0		10.0-300.0 mg%
URN GLUCOSE	0.00		0.00 g/dL
URN TOTAL PROTEIN	17.0	HIGH	0.0-14.9 mg/dL
URN PROTEIN/CREATININE	0.06		0.00-0.20 g/gCREA
URN RED BLOOD COUNT	0		0-4 HPF
URN WHITE BLOOD COUNT	0		0-9 HPF
URN HYALINE CASTS	0		0 LPF
URN GRANULAR CASTS	0.00		0.00 LPF
URN BLOOD		NEGATIVE	
DRUG SCREENING----------			
COCAINE METABOLITES, URN		NEGATIVE	300 ng/mL
OXYCODONE, URN		NEGATIVE	100 ng/mL
HYDROCODONE, URN		NEGATIVE	300 ng/mL
NICOTINE METABOLITES, URN		NEGATIVE	0.000-0.299 ug/mL
BETA BLOCKER		NEGATIVE	
THIAZIDE (AHT)		NEGATIVE	
OPIATES(2,000), URINE		NEGATIVE	2000 ng/mL
AMPHETAMINE/METHAMPHETAM.,URN		NEGATIVE	1000 ng/mL
FENTANYL, URN		NEGATIVE	1.00 ng/mL
6-ACETYLMORPHINE,URN		NEGATIVE	10 ng/mL
METHADONE, URN		NEGATIVE	300 ng/mL

Critical Thinking Questions

1. What is the abnormality?
2. What are the possible etiologies?
3. What other information would be helpful to know?
4. What is the underwriting mortality/morbidity concern?
5. Would your decision change if there were other medical conditions present?
6. What is your recommendation?

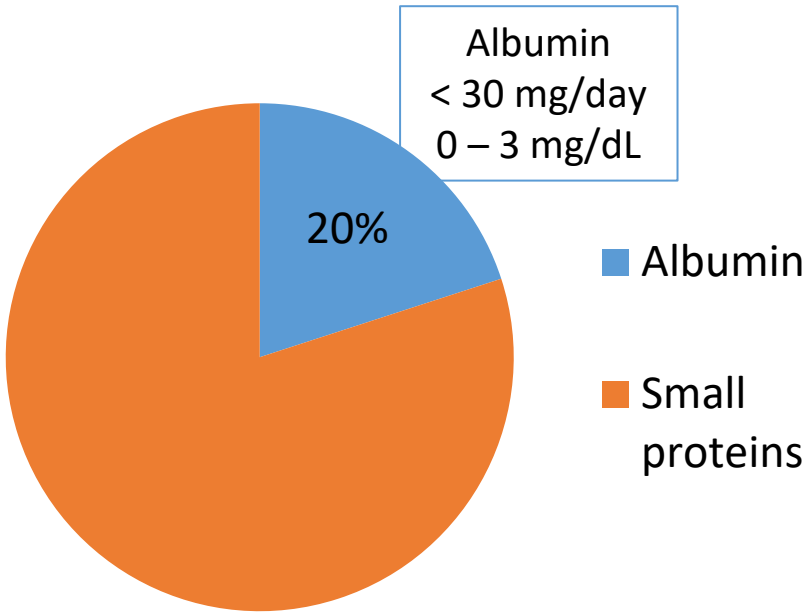
48-year-old male. No admitted medical history

URINALYSIS				
GLUCOSE	NEGATIVE		0.00 - 0.24	(GM%)
PROTEIN		66 H	0 - 30	(MG%)
MICROALBUMIN		39.0 H	0 - 3	(MG/DL)
MALB/CREATININE RATIO		374.2 H	0 - 30.0	(MG/GMCR)
LEUKOCYTE SCREEN	NEGATIVE		NEGATIVE	
HEMOGLOBIN SCREEN	NEGATIVE		NEGATIVE	
WHITE BLOOD CELLS	0		0 - 9	(/HPF)
RED BLOOD CELLS	1		0 - 4	(/HPF)
GRANULAR CASTS	0		0	(/40LPF)
HYALINE CASTS	0		0 - 10	(/40LPF)
SPECIFIC GRAVITY	1.023		1.003 - 1.035	
URINE TEMPERATURE	96.0		90.5 - 99.6	(FAHR.)
CREATININE	104.2		27.0 - 260.0	(MG/DL)
PROT/CREATININE RATIO		0.63 H	0.00 - 0.20	(MG/MGCR)
ADULTERANT TESTS WITHIN NORMAL LIMITS				

Proteinuria vs. Albuminuria

Not the same! Albumin is a type of Protein

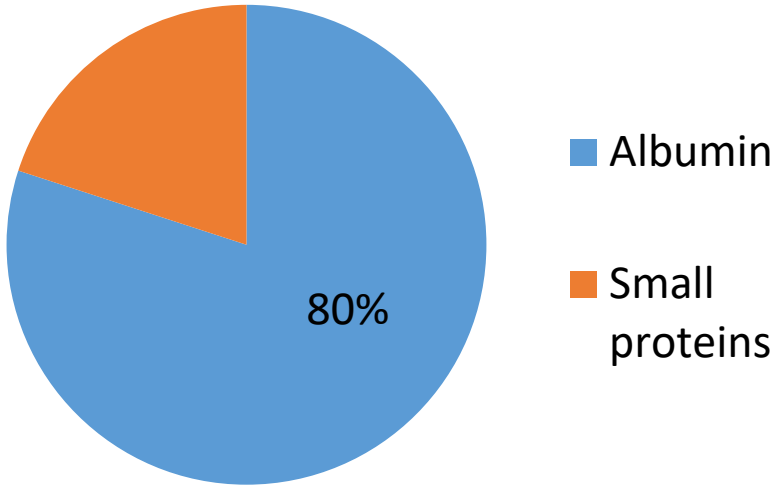
Normal



Total Urine Protein
< 150 mg/day
0 – 30 mg/dL

Abnormal

*** **Albuminuria is a specific marker for kidney disease** ***



With abnormal proteinuria, albumin becomes the bulk of protein excreted abnormally in the urine

Benign Proteinurias

Often transient with lower levels of proteinuria (< 1 – 2 g/day)

- **Orthostatic** or **Postural**
  - Present when upright (after prolonged standing)
  - Absent when supine (after overnight rest)
- **Exercise-induced**
- **Fever-induced**
  - Isolated episodes after strenuous exertion or with fever
- **Contamination** of urine may occur from prostate, vaginal or seminal fluid secretion, skin, or menses

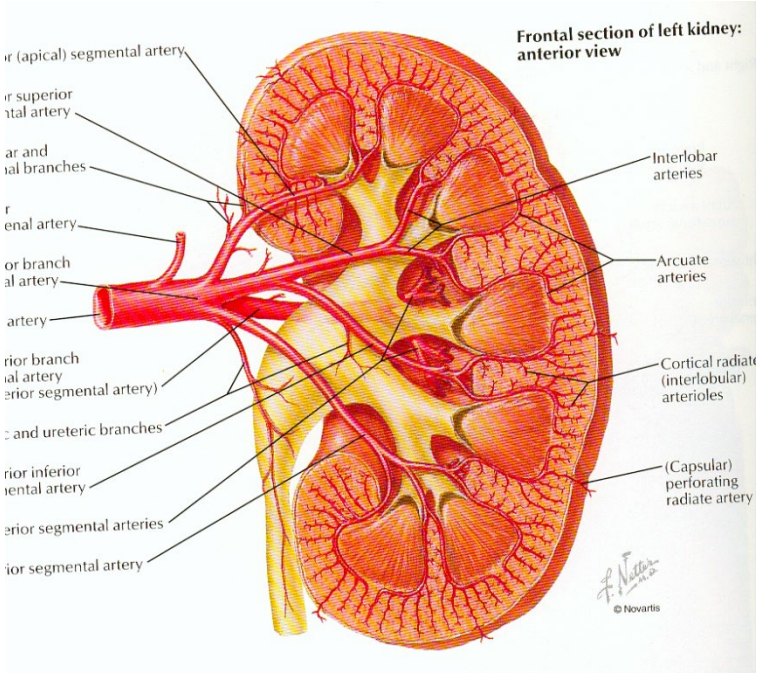
Suspect with a young person with no medical history

Generally, may be disregarded if subsequent urine is normal

Pathological Proteinurias

Often persistent

- **Glomerular**
  - Glomerulonephritis (FSGN)
  - Hypertension
  - Diabetes
- **Tubular**
  - Interstitial nephritis
  - Autoimmune nephritis
- **Overflow diseases** (e.g., multiple myeloma)
- **Urinary tract disorders** (e.g., infection, stones, tumor)



CLUES: Hypertension, Diabetes, ABN Serum Cr,

ABN urine sediment (RBC, WBCs, casts), albuminuria

48-year-old male. No admitted medical history

(same case)

URINALYSIS

GLUCOSE	NEGATIVE		0.00 - 0.24	(GM%)
PROTEIN		66 H	0 - 30	(MG%)
MICROALBUMIN		39.0 H	0 - 3	(MG/DL)
MALB/CREATININE RATIO		374.2 H	0 - 30.0	(MG/GMCR)
LEUKOCYTE SCREEN	NEGATIVE		NEGATIVE	
HEMOGLOBIN SCREEN	NEGATIVE		NEGATIVE	
WHITE BLOOD CELLS	0		0 - 9	(/HPF)
RED BLOOD CELLS	1		0 - 4	(/HPF)
GRANULAR CASTS	0		0	(/40LPF)
HYALINE CASTS	0		0 - 10	(/40LPF)
SPECIFIC GRAVITY	1.023		1.003 - 1.035	
URINE TEMPERATURE	96.0		90.5 - 99.6	(FAHR.)
CREATININE	104.2		27.0 - 260.0	(MG/DL)
PROT/CREATININE RATIO		0.63 H	0.00 - 0.20	(MG/MGCR)

ADULTERANT TESTS WITHIN NORMAL LIMITS

Hgb A1C 8.4

B/P 140/90

Serum Cr 1.7

CLUES for PATHOLOGICAL PROTEINURIA
Hypertension, Diabetes, ABN Serum Cr,
ABN urine sediment (RBC, WBCs, casts), albuminuria

26-year-old female. No admitted medical history

URINALYSIS				
GLUCOSE	NEG		NEGATIVE	(GM%)
PROTEIN		23 H	0 - 20*	(MG%)
MICROALBUMIN		3.5 H	0 - 3	(MG/DL)
MALB/CREATININE RATIO	6.0		0 - 30.0	(MG/GMCR)
LEUKOCYTE SCREEN	NEGATIVE		NEGATIVE	
HEMOGLOBIN SCREEN	NEGATIVE		NEGATIVE	
WHITE BLOOD CELLS	1		0 - 10*	(/HPF)
RED BLOOD CELLS	0		0 - 6*	(/HPF)
GRANULAR CASTS	0		0 - 5*	(/40LPF)
HYALINE CASTS	0		0 - 5*	(/40LPF)
SPECIFIC GRAVITY		> 1.035 H	1.002 - 1.035*	
URINE TEMPERATURE	96.0		90.5 - 99.6	(FAHR.)
CREATININE		578.5 H	10 - 300*	(MG/DL)
PROT/CREATININE RATIO	40		0 - 200*	(MG/GMCR)

Serum vs. Urine Creatinine

- Derived from the metabolism of creatine (skeletal muscle, dietary meat intake)
- Released into the blood circulation at constant rate
- Freely filtered in the kidney and secreted by the renal tubules
- Can be measured in both blood and urine specimens

Merely a marker (along with Specific Gravity) for urine concentration status
No prognostic significance!

	Serum Creatinine (blood)	**Urine Creatinine**
Traditional units	0.6 – 1.5 mg/dL	27 – 260 mg/dL
Prognostic Significance	YES	NO
Increased	Marker for reduced renal function, renal failure Inversely related to eGFR	CONCENTRATED urine specimen
Decreased	Not common; not usually a cause for concern Decreased muscle mass	DILUTE urine specimen

So why is it important? Need value in order to calculate the Protein/Creatinine ratio

Protein/Creatinine Ratio

(PROT/CREAT ratio, P/C ratio)

- Measured protein divided by the measured creatinine
- Represents a fair approximation of a person's 24-hr protein excretion
- **More accurate** valuation over the absolute urine protein
- **Takes into account the concentration of the urine**
- **Independent** of specific gravity or urinary volumes
- **More prognostic** than looking at individual values alone

When reviewed in underwriting, **P/C ratios take precedence over the absolute protein values**

Same goes for A/C ratios

58-year-old male. No admitted medical history.

URINALYSIS				
GLUCOSE	NEGATIVE		0.00 - 0.15*	(GM%)
PROTEIN	4		0 - 20*	(MG%)
ALBUMIN	1.6		0 - 3	(MG/DL)
ALB/CREATININE RATIO		131.1 H	0 - 30.0	(MG/GMCR)
LEUKOCYTE SCREEN	NEGATIVE		NEGATIVE	
HEMOGLOBIN SCREEN	NEGATIVE		NEGATIVE	
WHITE BLOOD CELLS	0		0 - 10*	(/HPF)
RED BLOOD CELLS	1		0 - 2*	(/HPF)
GRANULAR CASTS	0		0 - 5*	(/40LPF)
HYALINE CASTS	0		0 - 5*	(/40LPF)
SPECIFIC GRAVITY	NOT PERFORMED		1.002 - 1.035*	
URINE TEMPERATURE	96.0		90.5 - 99.6	(FAHR.)
CREATININE	12.2		10 - 300*	(MG/DL)
PROT/CREATININE RATIO		330 H	0 - 200*	(MG/GMCR)

34M non-smoker. No medical history.

- All labs normal. No history of proteinuria.
- Current exam shows normal BP readings
- Urinalysis
  - protein of 66 mg/dl (H)
  - P/C ratio of 0.415 (H)

- Reflex testing
  - albumin 0.6 mg/dL (normal)
  - A/C ratio normal

*** **Albuminuria is a specific marker for kidney disease** ***

Non-albuminuric proteinuria

Bence-Jones proteinuria
Light chains proteinuria
Multiple Myeloma

REMARKS: SPERM PRESENT.

41M auto body technician

RESULT NAME	NORMAL	ABNORMAL	REFERENCE/CUTOFF	UNITS
URINALYSIS				
GLUCOSE	NEGATIVE		0.00 - 0.24	(GM%)
PROTEIN		32 H	0 - 30	(MG%)
ALBUMIN		7.1 H	0 - 3	(MG/DL)
ALB/CREATININE RATIO		69.4 H	0 - 30.0	(MG/GMCR)
LEUKOCYTE SCREEN	NEGATIVE		NEGATIVE	
HEMOGLOBIN SCREEN		POSITIVE	NEGATIVE	
WHITE BLOOD CELLS	1		0 - 9	(/HPF)
RED BLOOD CELLS		10 H	0 - 4	(/HPF)
GRANULAR CASTS	0		0	(/40LPF)
HYALINE CASTS	0		0 - 10	(/40LPF)
SPECIFIC GRAVITY	1.022		1.003 - 1.035	
URINE TEMPERATURE	95.0		90.5 - 99.6	(FAHR.)
CREATININE	102.3		27.0 - 260.0	(MG/DL)
PROT/CREATININE RATIO		0.31 H	0.00 - 0.20	(MG/MGCR)
ADULTERANT TESTS WITHIN NORMAL LIMITS				

REMARKS: SPERM PRESENT.

BP 160/90

CLUES for PATHOLOGICAL PROTEINURIA
Hypertension, Diabetes, ABN Serum Cr,
ABN urine sediment (RBC, WBCs, casts), albuminuria

43F teacher

No admitted medical history. Blood Pressure is normal. Serum Creatinine is normal.

No evidence of diabetes (A1C is normal)

Urinalysis

- Protein 99 mg/dL (< 30 mg/dL)
- P/C ratio 0.55 (< 0.200)
- RBC 66

Lab slip indicates menses.

No menses.

History of Hypertension.

52M, non-smoker, Type 2 DM for one year

- Renal function (BUN, Creatinine) normal on blood profile

- Urinalysis
  - protein 33 mg/dL (H)
  - P/C ratio normal

- Reflex testing
  - albumin 6.8 mg/dL (H)
  - A/C ratio of 58.8 mg/gCr (H)

Albuminuria: Underwriting Significance

Negative Prognostic Factors

- Associated with an increased risk of cardiovascular disease
- Known adverse prognostic factor in diabetics and those with HTN
- Standard of care for clinicians to routinely screen these patients with urine albumin

Positive Prognostic factors

- Can regress with treatment
  - ACE inhibitors or angiotensin II receptor blockers (ARBs)
- Can improve with better diabetic and blood pressure control
- Can improve the excess mortality risk
- Many underwriting manuals include guidance on albuminuria

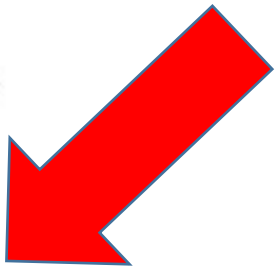
Key Points for Proteinuria/Albuminuria

- **Albuminuria** is a specific marker for kidney disease
- **Benign proteinuria** is often transient with lower levels of proteinuria (< 1 – 2 g/day)
- **Pathologic proteinuria** is often persistent
  - Suspect with comorbid medical conditions e.g., **Hypertension, Diabetes**
  - Suspect with **ABN serum Creatinine** or **ABN eGFR**
  - Suspect with **ABN urine sediment** (RBCs, WBCs, casts)
  - Suspect with albuminuria
- Urine Creatinine has no prognostic significance
- P/C and A/C Ratios take precedence over absolute values
- Be aware of possible **contamination** as “proteinuria” may be due to extra-renal causes
  - Prostatitis
  - Seminal fluid
  - Vaginal secretions

Epithelial cells

- Found on skin and most inner body cavities/organs
- Having a few in urine = normal
- With larger amounts, most often represents SKIN CONTAMINATION (especially in a female)

Urine color	amber
Urine appearance	slightly cloudy
Specific gravity	1.023
pH	6.5
Urine ketone	none
Urine protein	none
Urine glucose	none
Urine nitrite	negative
Leukocyte esterase	none
RBC	32/HPF
WBC	4/HPF
Squamous epithelial	<2



WBCs in urine – Pyuria

- UTI or cystitis most common cause
- Asymptomatic bacteriuria common

WBCs	
Isolated	Often insurable without further investigation
+ Epithelial cells	Think contamination (skin, vaginal secretions)
+ protein/albumin + RBCs + casts	Think RENAL issue! Always needs investigation

CLUES for PATHOLOGICAL PROTEINURIA
Hypertension, Diabetes, ABN Serum Cr,
ABN urine sediment (RBC, WBCs, casts), albuminuria

Urinary casts

- Tiny tube-shaped particles formed in the kidney (always renal in origin)
- Molded in the shape of the tubules
- Casts often indicate pathologies: glomerular/tubular damage, inflammation, infection

Types of Casts	
Hyaline	Rarely of significance Concentrated urine Fever, exercise *Ignore
Granular	KIDNEY disease!
RBC casts	KIDNEY disease! Usually GN
WBC casts	Infection/Inflammation Sometimes kidney disease

55M, non-smoker, no adverse medical history

- Renal function (BUN, Creatinine) normal on blood profile

- Urinalysis
  - all normal EXCEPT
  - HEME severe positive
  - RBC 2 (within normal range)

- Discrepancy in results between dipstick urinalysis and urine sediment microscopy
  - False negative microscopy could be suspected when dipstick is strongly positive for hematuria and a normal number of RBCs is found on microscopy
  - This occurs due be lysis (disintegration) of urine RBCs often encountered due to delays in processing of the urine specimen
  - Rarely, a very dilute urine produces osmotic lysis of almost all the urinary RBCs, the dipstick detects hemoglobin, but no RBCs are visible

https://www.crlcorp.com/wp-content/uploads/2016/11/OTR-Isolated-Hematuria-as-a-Mortality-Risk-Predictor.pdf

60 M. No admitted medical history.

Blood pressure is 120/80 (normal)
Blood Urea Nitrogen (BUN) 22 mg/dL (7.85 mmol/L) (normal)
Creatinine 0.8 mg/dL (70.7 umol/L) (normal)

All the rest of the chemistries are normal.

<u>Urinalysis</u>

Heme moderate
RBC = 25 per HPF
WBC = 0 per HPF
Protein/Creatinine = 0.03 (normal)
Cotinine Heavy

RBCs (Blood) in Urine – Hematuria

May come from anywhere

in the Urinary Tract

(kidney, ureter, bladder, prostate, urethra)

Microhematuria: ≥ 3 RBCs per HPF on microscopic evaluation

Gross Hematuria: Blood in the urine that can be seen with the naked eye

Kidney

Renal tumor (benign/malignant)

Glomerular (IgA, Alport's)

Structural disease (APCKD, Med Sponge)

Pyelonephritis

Renal Vein Thrombosis

Ureter

Malignancy, Stone, Stricture, Polyp, Fistula

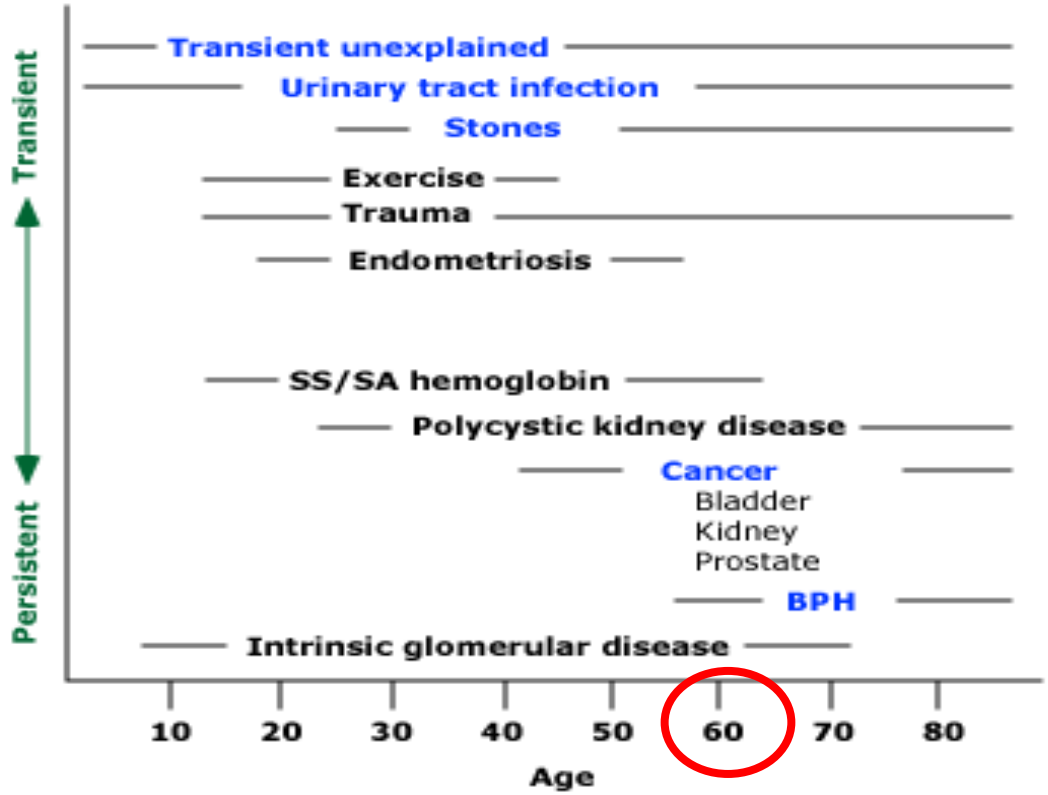
Bladder

Malignancy, Cystitis

Prostate/Urethra

BPH, Cancer, Post-procedure, Urethritis

Major causes of hematuria by age and duration



Schematic representation of the major causes of hematuria in relation to the age at which they usually occur (horizontal axis), transience or persistence (vertical axis), and frequency (blue implies more frequent).
BPH: benign prostatic hyperplasia.

9-15% of normal people have “benign” transient hematuria

(J Urol 1989;141(2):350
JAMA 1986 Jul 11;256(2):224-9)

Initial Microhematuria Workup

- **History and Physical Exam** (assess risk factors, gyne history, etc.)
- **Blood tests** (eGFR, creatinine, BUN)
- **Urine culture** to r/o UTI (if clinically indicated)
- **Risk factor assessment** with work-up based on risk

AUA MICROHEMATURIA RISK STRATIFICATION SYSTEM

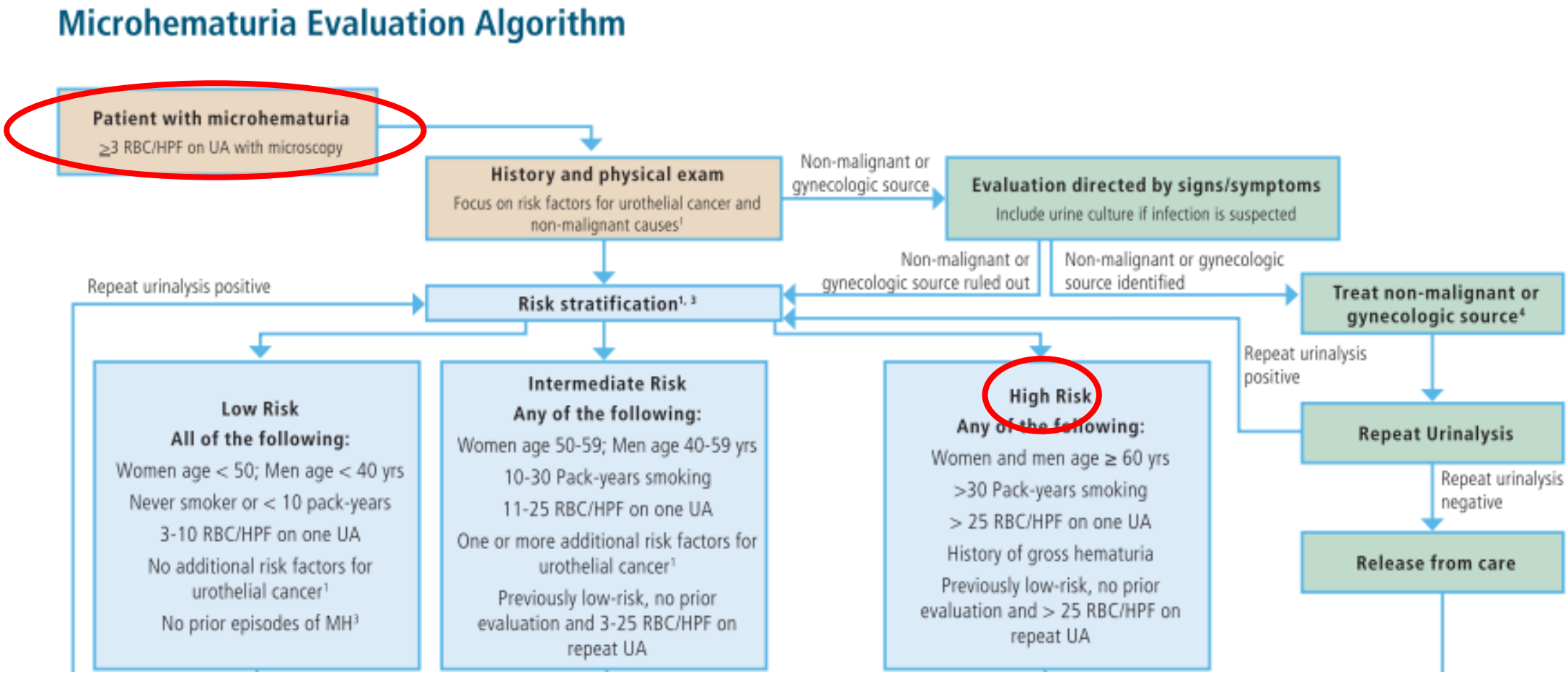
Low (patient meets all criteria)	Intermediate (patients meets any one of these criteria)	High (patients meets any one of these criteria)
• Women age <50 years; Men age <40 years • Never smoker or <10 pack years • 3-10 RBC/HPF on a single urinalysis • No risk factors for urothelial cancer (see Table 3)	• Women age 50-59 years; Men age 40-59 years • 10-30 pack years • 11-25 RBC/HPF on a single urinalysis • Low-risk patient with no prior evaluation and 3-10 RBC/HPF on repeat urinalysis • Additional Risk factors for urothelial cancer (Table 3)	• Women or Men age >60 years • >30 pack years • >25 RBC/HPF on a single urinalysis • History of gross hematuria

UROTHELIAL CANCER RISK FACTORS

Risk Factors Included in AUA Microhematuria Risk Stratification System	Additional Urothelial Cancer Risk Factors
Age	Irritative lower urinary tract symptoms
Male sex	Prior pelvic radiation therapy
Smoking use	Prior cyclophosphamide/ifosfamide chemotherapy
Degree of microhematuria	Family history of urothelial cancer or Lynch Syndrome
Persistence of microhematuria	Occupational exposures to benzene chemicals or aromatic amines (e.g., rubber, petrochemicals, dyes)
History of gross hematuria	Chronic indwelling foreign body in the urinary tract

Barocas DA, Boorjian SA, Alvarez RD et al: Microhematuria: AUA/SUFU guideline. J Urol 2020; 204: 778.

2020 AUA Hematuria Guidelines



[Microhematuria: AUA/SUFU Guideline (2020) - American Urological Association (auanet.org)]

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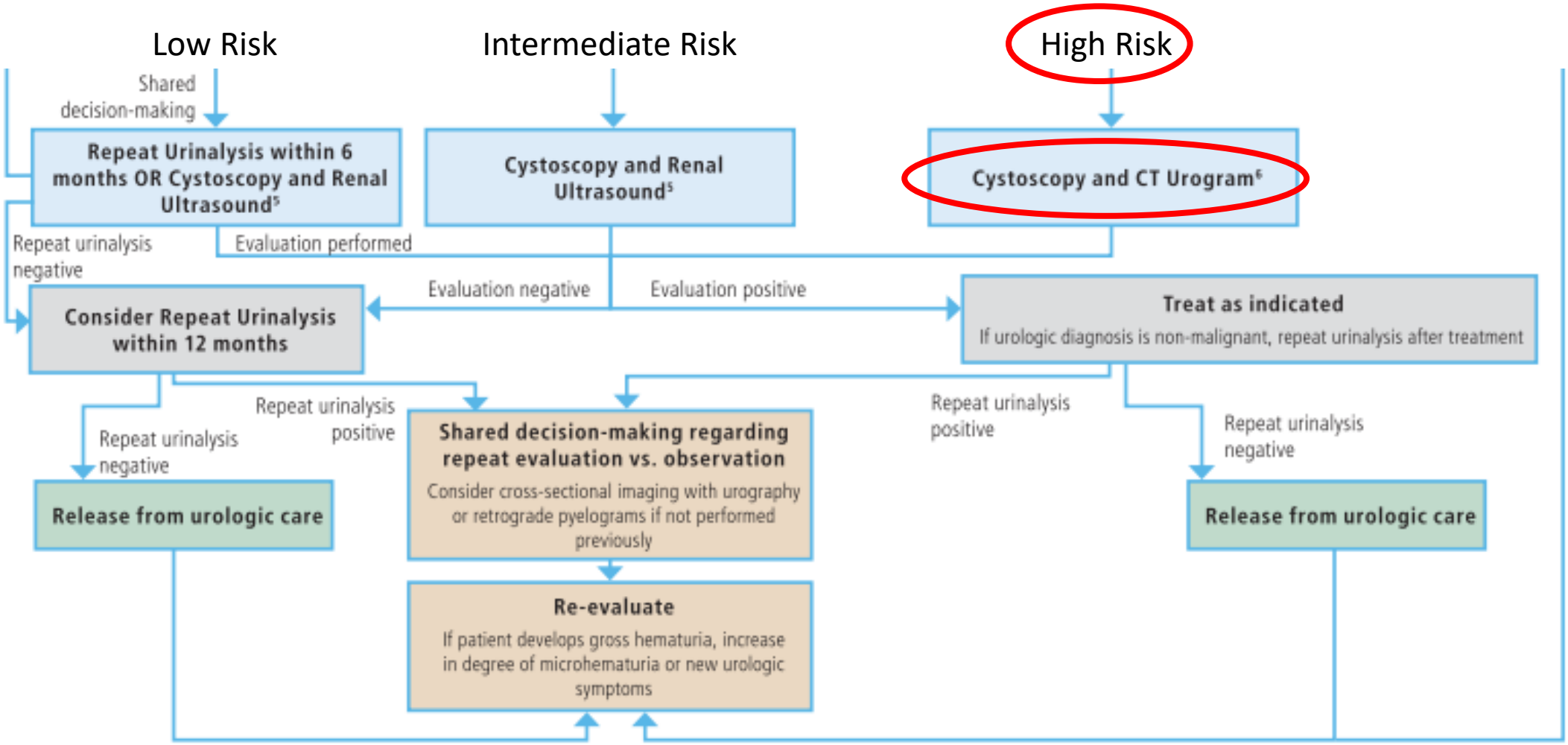
Urologic Work-up



[Microhematuria: AUA/SUFU Guideline (2020) - American Urological Association (auanet.org)]

Urine Cytology and Biomarkers

- **Urine cytology and urine biomarkers are NOT recommended as part of routine w/u for microhematuria,** but may be helpful for persistent microhematuria with negative w/u
- **Urine cytology**
  - Consider as an “adjunct” test; less sensitive than cystoscopy (11-76% vs 90+%)
  - Higher sensitivity for high grade TCC bladder and Tis (>90%); false positives are RARE
  - Not great for low grade and upper tract lesions; 65-95% false NEG rate
- **Urine biomarkers** identify proteins, antigens, or genetic alterations associated with cancer cells (over 30 reported for use, only six commercially available)
  - NMP22, BTA stat, BTA TRAK, uCyt, and UroVysion FISH (fluorescent in situ hybridization)
  - None have sufficient sensitivity to replace cystoscopy for screening

WHAT IF UROLOGIC W/U IS NEGATIVE?

48-year-old male, for life and DI coverage, physician

- Family history of hematuria (mother), personal history of microscopic and macroscopic hematuria, favorable urological workup in 2014
- Current labs:
  - Normal RFTs, urinalysis with 26 rbcs/hpf, PCR 300 mg/g, 1% dysmorphic rbcs
- Client provided medical reports from 2014
  - History of macroscopic hematuria, urological referral, normal CTU and cystoscopy; no proteinuria, normal blood pressure readings

Case Analysis

1. Do we have a diagnosis?
2. Identify red flags, clinical clues
3. Are there any tips in the history that would suggest a particular disease?

RBCs (Blood) in Urine – Hematuria

May come from anywhere

in the Urinary Tract

(kidney, ureter, bladder, prostate, urethra)

Microhematuria: ≥ 3 RBCs per HPF on microscopic evaluation

Gross Hematuria: Blood in the urine that can be seen with the naked eye

Kidney

Renal tumor (benign/malignant)

Glomerular (IgA, Alport's)

Structural disease (APCKD, Med Sponge)

Pyelonephritis

Renal Vein Thrombosis

Ureter

Malignancy, Stone, Stricture, Polyp, Fistula

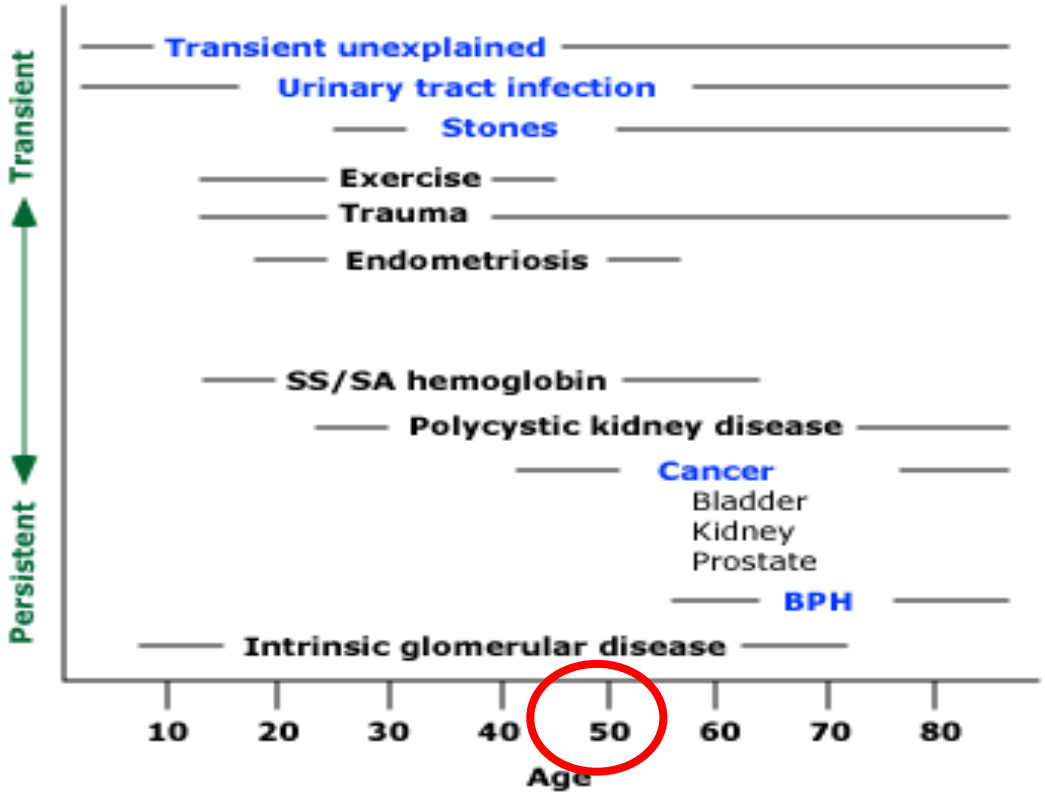
Bladder

Malignancy, Cystitis

Prostate/Urethra

BPH, Cancer, Post-procedure, Urethritis

Major causes of hematuria by age and duration



Schematic representation of the major causes of hematuria in relation to the age at which they usually occur (horizontal axis), transience or persistence (vertical axis), and frequency (blue implies more frequent).
BPH: benign prostatic hyperplasia.

9-15% of normal people have “benign” transient hematuria

(J Urol 1989;141(2):350
JAMA 1986 Jul 11;256(2):224-9)

Key Underwriting Questions

- Are we dealing with glomerular or extra-glomerular bleeding?
  - Unclear, even though microscopy suggests non-glomerular bleeding
- What else do we want to know?
  - Does he have persistently abnormal urines? Does he have any other urine abnormalities?

➢ Does he require a current workup?

➢ Differential diagnosis

Risk stratifying asymptomatic microscopic hematuria

Loo et al

- 2,630 patients, full evaluation for asymptomatic microscopic hematuria during a 2-year period: 2.1% had a cancer detected
- Hematuria Risk Index (0-11 points)
  - 4 points for gross hematuria and/or age at least 50 years
  - 1 point for a history of
    - Smoking
    - male gender, and/or
    - greater than 25 RBC/HPF on recent urinalysis
- Low risk (0-4 points) 0% cancer
- Moderate risk (5-8 points) 2.5% cancer
- High risk (9-11 points) 10.7% cancer

Loo et all, **Stratifying Risk of Urinary Tract Malignant Tumors in Patients With Asymptomatic Microscopic Hematuria** January 11, 2013 DOI:https://doi.org/10.1016/j.mayocp.2012.10.004

Signs of glomerular bleeding include

- RBC casts
- Dysmorphic appearance of some RBCs
- Proteinuria exceeding 500 mg/day that is temporally related to the onset of hematuria
- One study found that a urine albumin-to-protein ratio of ≥590 mg/g had a sensitivity of 97.1 percent for glomerular hematuria

If client is diagnosed with Alport's syndrome

- What was the course of the syndrome in his family members?
- What other organs can be affected?
- What is his prognosis?

Outcomes of Male Patients with Alport Syndrome Undergoing Renal Replacement Therapy

- 456 patients with ESRD due to Alport syndrome started RRT
- Improved patient survival during dialysis and following kidney transplantation compared to patients receiving RRT due to other causes of kidney failure
- Why?
  - Lack of additional essential organ system involvement in Alport Syndrome
  - Non recurrent nature of disease in their kidney allografts

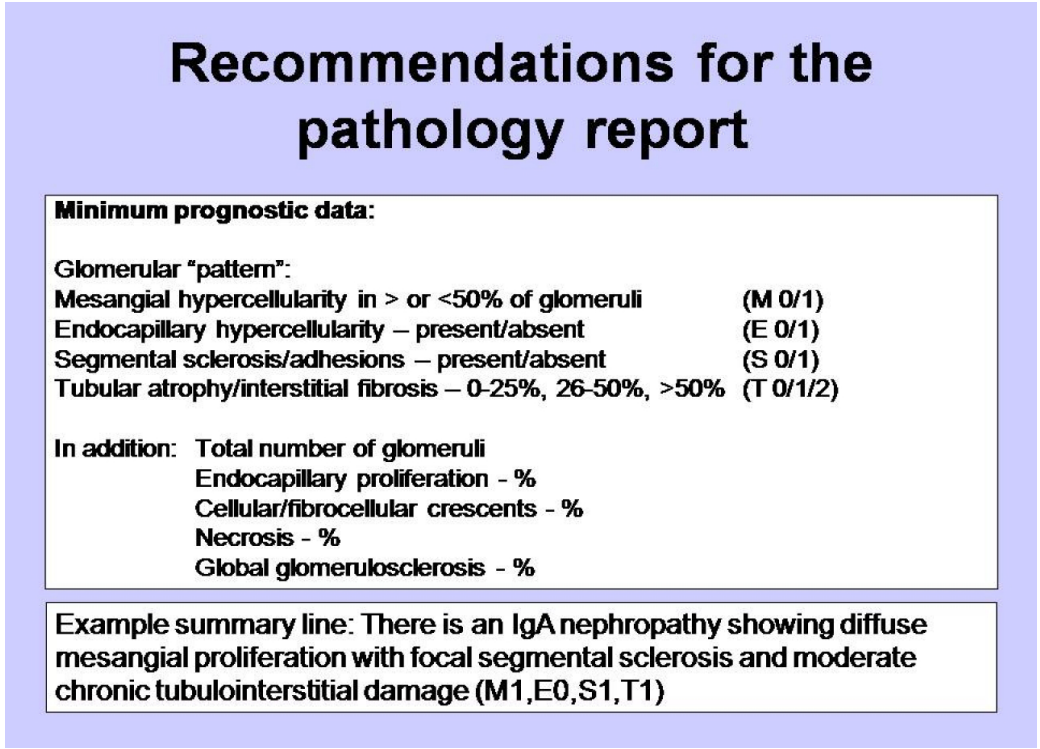
Temme, J et al. Clin J Am Soc Nephrol 7: 1969–1976, 2012. doi: 10.2215/CJN.02190312

Risk Stratification in IgAN

- **Clinical predictors** of progression of IgA nephropathy include
  - elevated serum creatinine
  - hypertension
  - persistent protein excretion above 1000 mg/day. (Patients who have recurrent episodes of gross hematuria without proteinuria are at low risk for progressive kidney disease.)

- **Oxford classification**

Oxford classification of IgAN



The Oxford classification of IgA nephropathy: pathology definitions, correlations, and
Reproducibility, A Working Group of the International IgA Nephropathy Network and the Renal Pathology Society: Kidney International (2009) 76, 546–556

Take away points

- If no diagnosis is apparent from the history, urinalysis, imaging examinations, or cystoscopy
  - most likely causes of persistent isolated hematuria are
    - a glomerulopathy
    - a predisposition to stone disease, particularly in young and middle-aged patients
- Screening for hematuria with routine urinalysis in patients who have no symptoms suggestive of urinary tract disease is not recommended
- A cause for hematuria is often not identified
- Further follow ups for persistent hematuria:
  - Annual urinalysis
    - if negative for two years -> stop
    - If positive -> repeat evaluation

KIDNEY FUNCTION TESTS

October 2022

Case

- Female age 44
- 2021 Labs: **serum creatinine** 118 µmol/l(45-90 µmol/l), 1.3 mg/dl (0.5-1.1 mg/dl)
- History of **hypertension** controlled on 10 mg of Ramipril
- **Build** 153cm/51kg (5 feet/112 lbs)

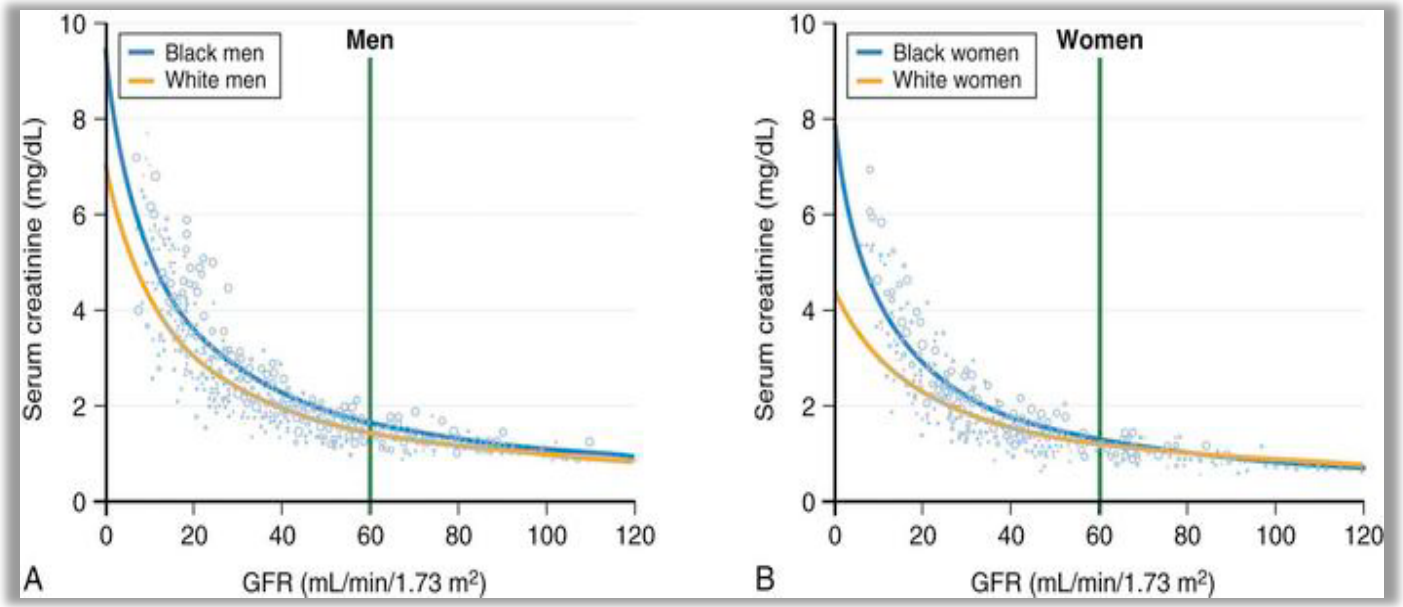
Key Questions

1. What do you think of her serum creatinine level, and does it correlate well with her GFR/renal function?
2. Does she have CKD? What stage?
3. What else would you like to know?

Renal Function Tests and Estimation of GFR

- **Serum creatinine** and Blood Urea Nitrogen
- Serum Cystatin C
- Creatinine Clearance measurement and estimation
- eGFR

Serum Creatinine



Relation between serum creatinine levels and measured glomerular filtration rate (GFR) by 125I-iothalamate GFR among black and white men and women.
Note how a significant decrease in GFR can occur, despite normal or near-normal serum creatinine values.

Levey AS, Bosch JP, Lewis JP, et al: A more accurate method to estimate glomerular filtration rate from serum creatinine: a new prediction equation. Ann Intern Med 1999;130:461-470.

Key limitations in using creatinine to estimate GFR

- Issues associated with **creatinine measurement**
  (^ temperature, hemolysis, transportation)
- Variations in **creatinine production** (diet, gender, **ethnicity?**, creatine supplements)
- Variations in **creatinine secretion** (drugs)
- Issues associated with extrarenal creatinine excretion
- Certain substances may interfere with **the assay** (Cefoxitin)

Factors affecting serum creatinine level independent of GFR

FACTOR	MECHANISM
Age, sex, ethnicity, body habitus, malnutrition, deconditioning, exercise, amputation, paralysis.	Lower muscle mass generates less creatinine and hence has lower serum creatinine levels.
Pregnancy	Decreases S.Cr due to increase in plasma volume (dilutional) and increase in GFR.
Extrarenal creatinine excretion	Intestinal creatinine degradation and creatinine excretion in other bodily fluids increases in advanced CKD.
Dietary protein intake	Diets heavy in meats can increase creatinine level. Vegetarians have lower S.Cr.
Cimetidine, trimethoprim	Blocks tubular Cr secretion raising S.Cr values.
Fibrates	May increase Cr production by muscles. (?)
Flucytosine, hemoglobin	Falsely increases S.Cr values by interfering with enzymatic assay.
Metamizole, methyldopa, ethamsylate	Falsely decreases S.Cr values by interfering with enzymatic assay.

Another Case

- Male age 57
- build 6.1/232 with hx of HTN dx in 2012
- 2021 serum creatinine 137 µmol/l or 1.55 mg/dL

- Female age 44
- 2021 labs: serum creatinine 118 µmol/l(45-90 µmol/l) or 1.3 mg/dL (0.5-1.1 mg/dL)

Labs

- Her **measured creatinine clearance** is 59 ml/min
- Do you think it estimates well her GFR?
- CrCl = (Urine volume X Urine Creatinine concentration) / Serum Creatinine

  - The volume of blood passing through the kidneys that is completely cleared of creatinine
  - Traditionally calculated from a 24 hr urine collection
  - Drawbacks of CrCl
    - Adequacy of a 24-hour urine collection
    - 10-20% of Cr in urine is secreted creatinine clearance consistently overestimates GFR by 10-20 %

Inker, Lesley et all, Assessment of Kidney Function, June 12 2018; https://www.uptodate.com

Estimated Creatinine Clearance Cockcroft-Gault equation

$$CCr\ (mL/min) = \frac{(140 - age) \times \text{lean body weight [kg]}}{Cr\ [mg/dL] \times 72}$$

- For women, the formula requires multiplication by 0.85 to account for smaller muscle mass compared with men
- To compare with normal values, the result should be adjusted for body surface area. (Divide by 1.73m2)
- Developed in 1976 with data from **249 men**, primarily in an inpatient setting, with a wide range of renal function.
- Overestimates GFR by 10-40 %

Cockcroft DW, Gault MH. Prediction of creatinine clearance from serum creatinine. Nephron. 1976, 16: 31-41.

Labs: eGFR

- eGFR by CKD EPI formula = 48 ml/min/ 1.73m2
- eGFR by MDRD equation = 43 ml/min/ 1.73m2

GFR and eGFR

- Considered the best overall index of kidney function
- Normal GFR varies according to age, sex, and body size, and declines with age
- No methods to estimate GFR unless patient is in steady state
- All are of limited value for patients
  - at extremes of age
  - very low protein diet, very high animal protein diet
  - very high or very low muscle mass
  - certain ethnicities
  - chronic illness

http://www.kidney.org/professionals/KDOQI/gfr_calculator

MDRD

$$\text{eGFR} = 170 \times \text{Serum Creatinine}^{-0.999} \times \text{Age}^{-0.176} \times [0.762\ if\ Female] \times [1.180\ if\ Black] \times \text{BUN}^{-0.170} \times \text{Albumin}^{+0.318}$$

$$\text{eGFR} = 186 \times \text{Serum Creatinine}^{-1.154} \times \text{Age}^{-0.203} \times [1.212\ if\ Black] \times [0.742\ if\ Female]$$

- Developed in 1999 using data from **1628 patients with established CKD**.
- GFR measured by ^{125}I-iothalamate urinary clearance
- MDRD GFR is already normalized to BSA
- The MDRD Study equation was derived from primarily
  - Outpatients (no hospitalized patients)
  - **white subjects**
  - **“middle age”** (mean age 51 years +/- 12.7 years)
  - **nondiabetic kidney disease**
  - mean GFR of 40 mL/min per 1.73 m2.

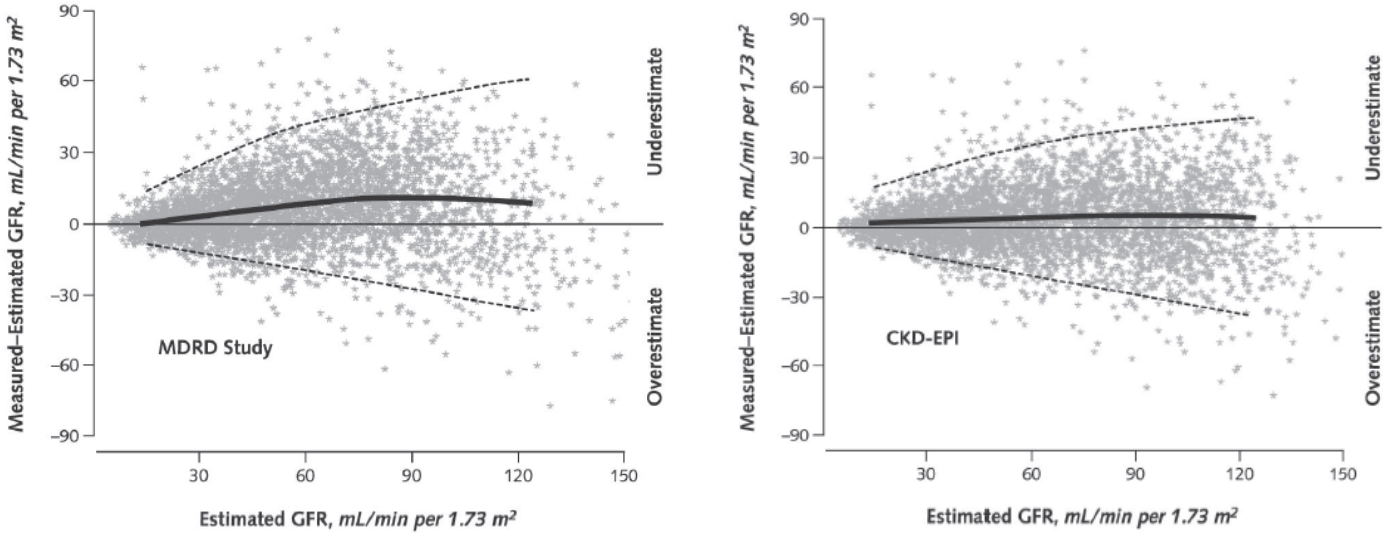
Levey AS, et al: A more accurate method to estimate glomerular filtration rate from serum creatinine: A new prediction equation. Modification of Diet in Renal Disease Study Group. Ann Intern Med. 1999

CKD-EPI equation

- Was developed using data pooled from 10 studies and validated against data derived from 16 additional studies
- Large study population which included people with and without kidney disease who had a wide range of GFRs
- CKD-EPI equation should be used for general population as it performs better than MDRD in patients with normal or near-normal GFR
- CKD-EPI results in lower prevalence of CKD and better risk prediction for adverse outcomes compared with the MDRD study equation

Andrew S. Levey, et al; A New Equation to Estimate Glomerular Filtration Rate, Ann Intern Med 2009

Performance of the CKD-EPI and MDRD Study Equations



Andrew S. Levey, et al; A New Equation to Estimate Glomerular Filtration Rate, Ann Intern Med 2009

Cystatin C

- Male age 57
- build 5.11/185 (181cm/ 84kg) with hx of hypertension dx in 2012
- 2021 serum creatinine 137 µmol/l or 1.49 mg/dL
- Cystatin C performed 3 months later, 0.99mg/l (reference values: 0.62-1.11)

My 2018 slide on Cystatin C

- Protein that is produced by all nucleated cells and found in bodily fluids
- Filtered at the glomerulus and not reabsorbed but metabolized in the proximal renal tubule
- Cystatin C-based estimates for GFR are believed to be less influenced by muscle mass or diet than creatinine-based estimates
- Thought to be either less influenced by certain demographic factors (e.g., age, race, gender)
- Some studies showed that correlates better with gfr than serum creatinine especially at higher levels of GFR

Inker, Lesley et all, Assessment of Kidney Function, June 12 2018; https://www.uptodate.com

Non-GFR determinants of serum cystatin C (2022)

- Higher cystatin C levels are associated with
  - male sex, greater height and weight, higher lean body mass, higher fat mass
  - diabetes
  - higher levels of inflammatory markers
  - hyper- and hypothyroidism, and glucocorticoid use

Cystatin C and Creatinine Equation

- Cystatin C in combination with creatinine:
  - should be used in certain situations where serum creatinine-based equations are less accurate (specific ethnic groups, unusual weight, etc.)
- 2021 CKD-EPI creatinine-cystatin C equation
  - used for confirmation of the diagnosis of CKD in patients with an estimated GFR of 45 to 60 mL/min per 1.73 m^2 and no other evidence of kidney disease
- https://www.kidney.org/professionals/kdoqi/gfr_calculator

➢ eGFR 68mL/min/1.73m^2 by CKD-EPI creatinine-cystatin C equation

Inker, Lesley et all, Assessment of Kidney Function, June 12 2018; https://www.uptodate.com

Summary: understanding the limitations of eGFR equations

- Creatinine clearance consistently overestimates GFR by at least 10-20 %
- The MDRD study and the Cockcroft-Gault equations are less accurate in populations with normal or near-normal GFR and are not longer recommended
- CKD EPI and MDRD equations **overestimate** GFR in Asian populations possibly related to differences in body mass and diet
- KDIGO 2021 guidelines on CKD recommend using the creatinine-based CKD-EPI equation as an initial test
- **Cystatin C and creatinine equation** is more accurate for the assessment of GFR than serum creatinine in certain populations and can be used as a confirmatory test for diagnosis of CKD

Glomerular filtration rate estimation without inclusion of a race coefficient

- Older equations: race variable resulted in a higher eGFR for Black individuals as compared with other individuals
- Difference was thought to reflect biologic variations in such as muscle mass, diet or creatinine handling
- 2021 revised CKD-EPI equation
  - excludes race
  - was developed in the same dataset used for development of the 2009 CKD-EPI creatinine equation
  - slightly less accurate then the 2009 formula, underestimates GFR in Black individuals but overestimates GFR in other individuals by approximately the same amount (3.9 mL/min per 1.73 m^2)

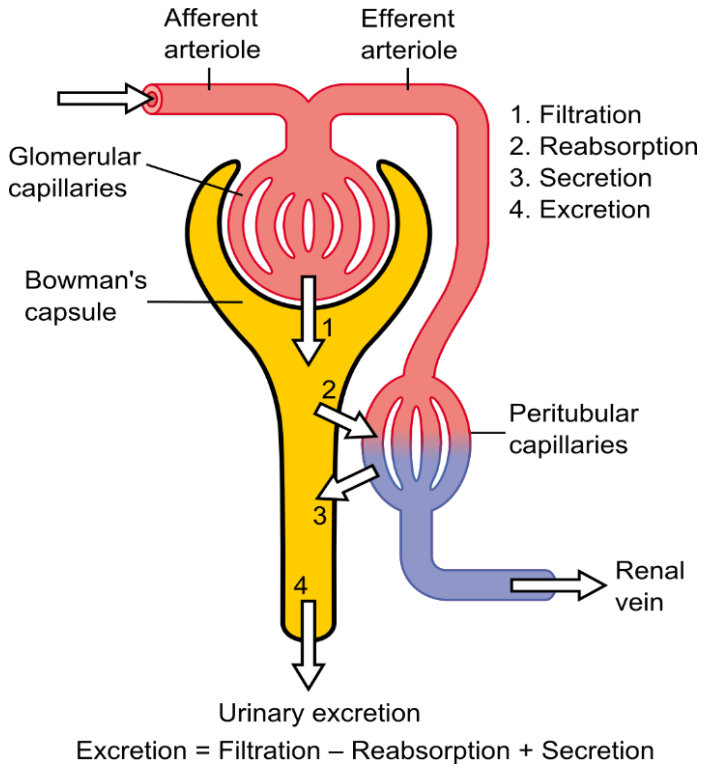
➢ Implications for our industry? Outstanding questions about eGFR calibration in Eastern Asian populations

Nephrological Consult

- June 2021 Labs: Serum creatinine 139µmo/L, PCR 500 mg/g, ACR 45 mg/g, no hematuria but aseptic leukocyturia in the context of recent NSAID use
- No clinical arguments in favor of another etiology of interstitial nephritis
- July 2021: leukocyturia and proteinuria disappeared and there was a slight improvement in serum creatinine to 120 µmol/L
- Normal renal ultrasound
- Cystatin C ordered as “because of his important sports activity, the creatinine underestimates the glomerular filtration rate”

Kidneys

- Continuous filtration and cleansing of the blood, removes waste, impurities
- Filtrate: first urine which leaks out of the blood vessels into the Bowman capsule and into tubules
  - What can be in the filtrate?
    - Glucose
    - AA
    - Na
  - What doesn't get filtered?
    - RBCs (small amounts only)
    - Larger proteins, e.g., albumin (small amounts only)



Conclusion

- eGFR 52 ml/min by ckd-epi creatinine formula and 68 ml/min by CKD-EPI creatinine-cystatin equation
- History of HTN, poorly controlled, mild-moderate LVH on echo

➢ Working dx: CKD due to hypertensive nephropathy and interstitial nephritis

Recent nephrological consult

- Female age 44
- 2021 Labs: serum creatinine 118 µmol/l(45-90 µmol/l), 1.3 mg/dl (0.5-1.1 mg/dl)
- egfr by CKD EPI 48 ml/min/ 1.73m2 and by MDRD 43 ml/min/ 1.73m2

- Left kidney atrophy since 1980, HTN since 1980 on Ramipril
- Serum creatinine
  - was higher in the past at 152 umol/L
  - has improved and has been more or less stable for the past 13 years

- **Renal u/s**: left kidney hypotrophic at 6cm, right 10.3cm with segmental atrophy
- **Urinalysis** with albuminuria at 150 mg/g, no serial measurements

Predicting Prognosis of CKD

- In predicting risk outcomes, identify:
- Cause of CKD
- GFR category
- Albuminuria category
- Other risk factors and co-morbid conditions

Staging of CKD since 2012

CKD Classification and Staging

- **Green:** Low risk (LR)
- **Yellow:** Moderate risk (MR)
- **Orange:** High risk (HR)
- **Red:** Very high risk (VHR)

Kidney function stage GFR (ml/min/1.73m²) Description and range				Kidney damage stage Urine albumin/creatinine ratio Description and range		
				A1	A2	A3
				Normal to mild increase <30mg/g	Moderate increase 30-300 mg/g	Severe increase >300mg/g
	G1	Normal or high	≥90	LR	MR	HR
	G2	Mild decrease	60-89	LR	MR	HR
	G3a	Mild to moderate decrease	45-59	MR	HR	VHR
	G3b	Moderate to severe decrease	30-44	HR	VHR	VHR
	G4	Severe decrease	15-29	VHR	VHR	VHR
	G5	Kidney failure	<15	VHR	VHR	VHR

KDIGO CKD Work Group Kidney Int Suppls 2013;3:1-150

Causes of CKD

	Systemic diseases	Primary kidney diseases
Glomerular diseases	Diabetes, systemic autoimmune diseases, systemic infections, drugs, neoplasia (including amyloidosis)	Diffuse, focal or crescentic proliferative glomerulonephritis; focal and segmental glomerulosclerosis; membranous nephropathy, minimal change disease
Tubulointerstitial diseases	Systemic infections, autoimmune, sarcoidosis, drugs, urate, environmental toxins (e.g. lead), neoplasia (myeloma)	Urinary tract infections, stones, obstruction
Vascular diseases	Atherosclerosis, hypertension, ischemia, cholesterol emboli, systemic vasculitis	ANCA-associated renal limited vasculitis, fibromuscular dysplasia
Cystic and congenital diseases	Polycystic kidney disease, Alport's syndrome, Fabry's disease	Renal dysplasia, medullary cystic disease

Fatehi, Pedram et. All, Diagnostic approach to the patient with newly identified chronic kidney disease; Aug. 2018: https://www.uptodate.com

CKD Patient Approach

1. Does she have CKD?
2. Stage: assess GFR, albuminuria
3. Determine etiology
4. **Assess for evidence of progression**
5. Assess for associated complications
6. Assess life expectancy and future treatment

BENIGN AND MALIGNANT LESIONS

60 M. NIC+. Hematuria case, continued.

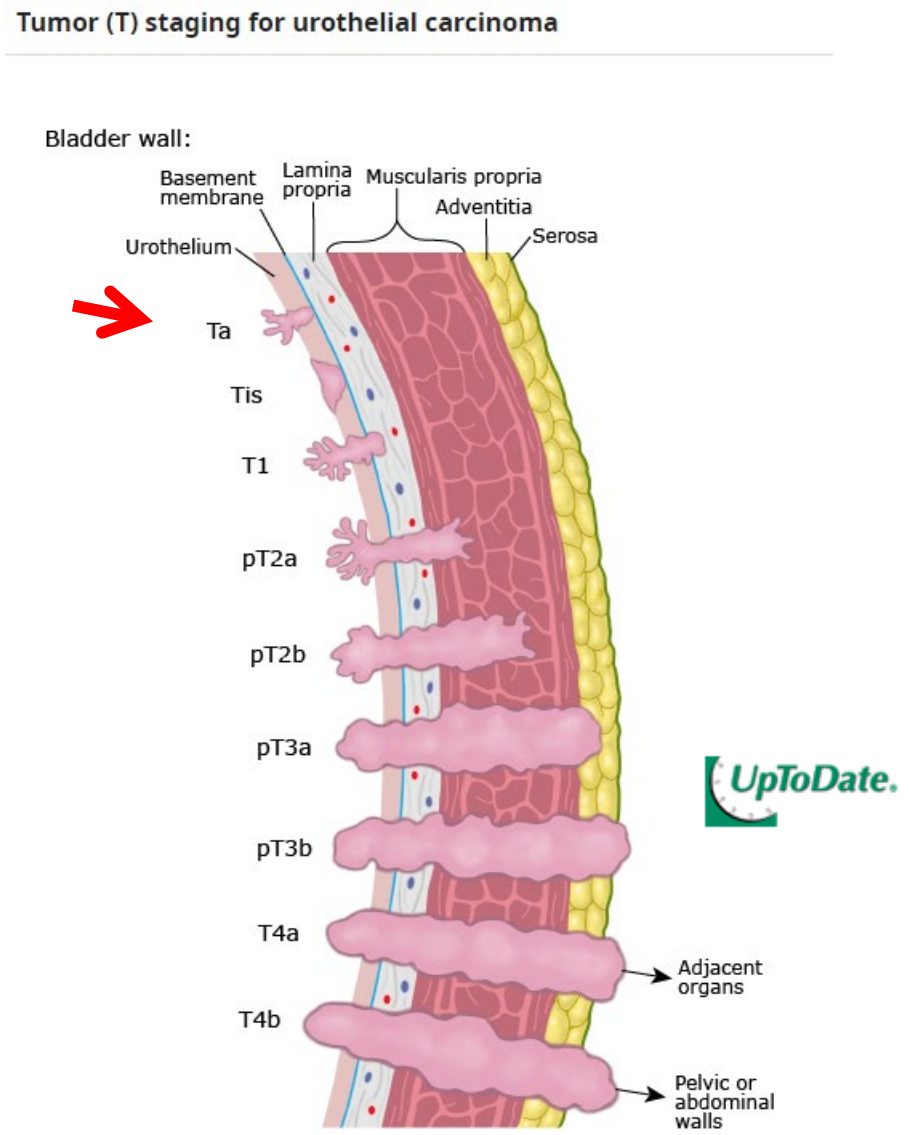
A cystoscopy done in the urologist's office reveals a **single small 1 cm papillary lesion**. He is scheduled for TUR (transurethral resection). Pathology from his TUR reveals **low grade transitional cell carcinoma of the bladder with no invasion of the submucosa or lamina propria**. There is no muscular propria present in the specimen.

What is the stage of his bladder cancer?

Is there any significance with the lack of muscular propria in the specimen?

Importance of Accurate Staging

- Disease-appropriate therapy is based on accurate staging
- In the absence of muscularis propria in the specimen, data suggests 20-40% will either have residual tumor and/or unrecognized muscle invasive disease (J Urol 2001;166;490)
- A restaging TUR should be done 4-6 weeks after initial resection if the tumor is high-grade-T1, esp. if muscularis propria is absent in initial specimen
- The most important prognostic determinant is whether the tumor is
  - "organ-confined" (≤T2) or
  - "non-organ confined" (≥T3)



Used with permission of the American College of Surgeons, Chicago, Illinois. Original illustration revised and redrawn for this publication. The original source for this information is the AJCC Cancer Staging Manual, Eighth Edition (2017) published by Springer International Publishing.

Discussion Questions, cont.

- *Is he considered "high-risk" or "low-risk" for disease recurrence?*
- *How would his risk change if there were multiple papillary tumors?*
- *What risk factors can he eliminate to decrease his risk of recurrence?*

Risk for Progression (vs. Recurrence)

- **LOW RISK (0-4%)**
  - Single lesion < 3 cm
  - Low grade, Stage Ta disease
  - No carcinoma in situ (CIS)
- **INTERMEDIATE RISK (10-15%)**
  - All tumors not meeting the criteria for low or high risk
- **HIGH RISK (30-40%) ANY of the following:**
  - Carcinoma in situ
  - High grade or Stage T1 and higher
  - Low-grade Ta with ALL of the following:
    - Multiple tumors
    - Recurrent tumors
    - > 3 cm

2019 European Association of Urologists (EAU) guidelines

Bladder Tis – also called CIS – unique subtype of nonmuscle invasive TCC

- Commonly associated with irritative voiding symptoms (frequency, urgency, dysuria)
- Flat, erythematous, “velvety” lesions, sometimes difficult to visualize
- Can be patchy, diffuse
- Considered *High grade*, non-invasive tumors
- Consider “ominious” due to occult, multicentric nature, difficulty in diagnosis
- The majority are associated with other high-grade nodular tumors (Ta, T1), only 3-5% occur in isolation; > 5% associated with urothelial cancers within ureter/intrarenal collecting system
- **The presence of Tis, especially if diffuse, is associated with a high frequency for recurrence and progression to invasion (up to 83% if left untreated)** J Urol 1995;153:564

Stop Smoking!

- Cigarette smoke is responsible for 50% of urothelial cancer in both men and women
- Risk correlates with extent of exposure
- Smoking cessation decreases risk, but ^ risk remains even after 20 years

  (JAMA 2011;306(7);737. Int J Cancer. 2000;86(2):289)

  - > 30% decrease at one to four years
  - 60% decrease at 25 years
- Must encourage all smokers to stop!

Discussion Questions, cont.

What is the appropriate treatment and follow-up?

	Surgery	Intravesical Chemotherapy
Low Risk	TUR	Single-dose
Intermediate Risk	TUR	Induction + Maintenance x 1 year
High Risk	TUR Possible restaging TUR +/- Cystectomy	Induction + Maintenance x 3 years

Intravesical Immunotherapy and Chemotherapy

- **Bacillus Calmette-Guerin** (BCG)
  - Most commonly used agent for intravesical therapy
  - Live, attenuated strain of *Mycobacterium bovis*, first used as a TB vaccine
  - Widespread use since 1970s
  - Triggers an inflammatory host response, release of cytokines
  - First line treatment for high-grade disease (Ta, T1,Tis)
  - Dose: weekly x 6 weeks, then maintenance over 36 months
- **Mitomicin C**
  - Chemotherapeutic agent
  - Antibiotic that inhibits DNA synthesis
  - Dose: weekly x 8 weeks; then monthly x 1 year

Surveillance Recommendations

- Absolutely required!
- Recurrent disease can develop ANYWHERE in the GU tract
- Repeat **cystoscopy** with **urine cytology/biomarkers** q 3 months x 1-2 years, q 3-6 months x 4 years, then yearly, progressively declining as time passes
- **MDCT** q 1-2 years for at least 5 years (assess upper tracts) for low-risk; lifelong for high-risk disease

Discussion Questions, cont.

What if the repeat cystoscopy revealed a recurrent papillary tumor? If this was removed by another TURBT and the pathology confirmed a similar non-muscle-invasive bladder tumor, would his prognosis be worse than if this lesion never recurred?

Ta tumors, like all bladder tumors, have a high rate of recurrence after TURBT, but the risk of stage progression, particularly for low-grade papillary Ta tumors, remains LOW (less than 5%)
Urol Clin North Am 1992;19:435

58-year-old male. Non-smoker. Disclosed prior history of renal cell carcinoma treated with surgery 7 years ago. Doing well.

- Blood pressure, Renal Function, and UA – **all normal** on insurance exam.
- Review of APS shows he presented 7 years ago with a **6 cm right renal mass** found incidentally during a CT scan for presumed diverticulitis
- He underwent successful laparoscopic radical nephrectomy

What is the most common initial presentation for renal cell carcinoma?

>50% cases => Incidental finding on imaging (CT abdomen, US) done for another reason

The classic triad (flank pain, hematuria, palpable mass) is now RARE (~9 %) and is indicative of more advanced disease

What is the prognosis for renal cell carcinoma?

Surgery is curative in the majority with localized disease;
an asymptomatic renal mass, more likely to be organ-confined with improved prognosis

Simple Cyst vs. Tumor

- **Ultrasound** findings:
  - Round, sharply demarcated with smooth walls
  - No echoes within the cyst
  - Good transmission through the cyst with a posterior wall echo
- **CT with/without contrast**
  - Smooth appearance
  - No ***enhancement*** with contrast ($\leq$ 10-15 HU with contrast)
  - Same density as water

Bosniak Classification of Renal Cysts (by CT scanning)

Bosniak Classification	•CT scan findings with/without contrast
Category I Simple benign cyst	•Hairline thin wall •Density < 20 Hounsfield units (similar to water) •Does not contain septa, calcification, or solid components •**Does NOT enhance with contrast**
Category II Benign cystic lesion	•Few hairline thin septa •"Perceived" enhancement may be present, but NO MEASUREABLE enhancement •Uniformly high-attenuation lesion < 3 cm, well-marginated, that does NOT enhance
Category IIF Minimally complicated cyst	•Multiple hairline thin septa or minimal smooth thickening of the wall/septa •Thick and nodular calcification of the wall/septa •Totally intrarenal, non-enhancing, high attenuation lesions ≥ 3 cm •Well-marginated, but some suspicious features that **require f/u**
Category III True Indeterminate cystic mass	•Thickened irregular or smooth walls or septa •Measurable enhancement •**Typically require surgical evaluation**
Category IV Presumed malignant	•All Category III criteria •Enhancing soft-tissue components

Adapted from Israel GM, Bosniak MA. An update of the Bosniak Renal Cyst Classification System. Urology 2005; 66:484.

Case

- Female age 42, clean application, life and TPD coverage
- Medical reports:
  - long history of large, bilateral kidney cysts, Bosniak 2 and 2F, closely followed up since 2006
  - Symptomatic cysts: recurrent symptoms of abdominal pain, UTIs, due to cyst hemorrhage and possibly compression of the surrounding structures
  - 2012 abdominal imaging: largest cyst is 10cm, she also has evidence of a small renal infarction

Additional history

- History of headaches with vomiting and hx of retinal detachment
- Diagnosed with HTN, serum creatinine 1.25 mg/dl
- Liver cysts also detected on imaging

➢ What other diagnosis would you suspect?

Death claim: The applicant died at age 47, of a subarachnoid haemorrhage secondary to cerebral aneurysm rupture

Adult Polycystic Kidney Disease

Patient without a family history of ADPKD — There are no established imaging-based criteria for diagnosis of ADPKD in patients without a family history. We diagnose these individuals with ADPKD if they have **10 or more cysts (≥5 mm) in each kidney**

- Autosomal Dominant – so detailed family history is important
- Diagnosis confirmed predominantly by imaging tests

Diagnostic purpose	Age (years)*	Imaging findings	Family history of *PKD1*	Family history of *PKD2*	Family history with unknown gene type
Confirmation					
	15 to 29	Total of ≥3 cysts¶	PPV, 100% Sensitivity, 94.3%	PPV, 100% Sensitivity, 69.5%	PPV, 100% Sensitivity, 81.7%
	30 to 39	Total of ≥3 cysts¶	PPV, 100% Sensitivity, 96.6%	PPV, 100% Sensitivity, 94.9%	PPV, 100% Sensitivity, 95.5%
	40 to 59	≥2 cysts in each kidney	PPV, 100% Sensitivity, 92.6%	PPV, 100% Sensitivity, 88.8%	PPV, 100% Sensitivity, 90.0%

¶ Unilateral or bilateral

Ultrasound-based criteria for diagnosis and exclusion of ADPKD among patients with a positive family history

Exclusion					
	15 to 29	No kidney cyst	NPV, 99.1% Specificity, 97.6%	NPV, 83.5% Specificity, 96.6%	NPV, 90.8% Specificity, 97.1%
	30 to 39	No kidney cyst	NPV, 100% Specificity, 96.0%	NPV, 96.8% Specificity, 93.8%	NPV, 98.3% Specificity, 94.8%
	40 to 59	No kidney cyst	NPV, 100% Specificity, 93.9%	NPV, 100% Specificity, 93.7%	NPV, 100% Specificity, 93.9%

CKD Patient Approach

1. Does she have CKD?
2. Stage: assess GFR, albuminuria
3. Determine etiology
4. Assess for evidence of progression
5. **Assess for associated complications**
6. **Assess life expectancy and future treatment**

ESRD Outcomes in GN patients

- 84,301 patients with ESRD attributed to GN
- Median follow up 2.5 years
- **IgAN patients**
  - **Fewest** comorbidities and lowest use of hemodialysis (70.1%).
  - Lowest crude mortality (3.7 deaths/100 person years).
- **Adjusted mortality highest in LN** (AHR=1.75; 95% CI)
- **Adjusted mortality in PCKD AHR 1.22**
- Other GN subtypes
  - Membranous nephropathy: AHR=1.23;
  - FSGS: AHR=1.37;
  - Membranoproliferative GN: AHR=1.38;
  - Vasculitis: AHR=1.51;

O'Shaughnessy, M.M et al. Clin J Am Soc Nephrol. 2015 Jul 7; 10(7): 1170–1178

Thank you for your attention!

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