The background features several realistic water droplets of various sizes scattered across the page. In the upper center, there is a faint, circular fingerprint-like pattern. The overall aesthetic is clean and clinical.

DATA INTERPRETATION

GENITOURINARY SYSTEM

JOEL F. VAUGHAN, M.D.

Uses of urinalysis

Use	Indication	Of value in:
Screening	Random	Diabetes mellitus
		Asymptomatic bacteriuria
	Selective	Antenatal care
		Hypertensive patients
Diagnosis	Primary renal disease	Glomerulonephritis
	Secondary renal disease	Bacterial endocarditis
	Non-renal disorders	Diabetes mellitus
Monitoring	Disease progression	Diabetic nephropathy
	Drug toxicity	Gold therapy
	Drug compliance	Rifampicin therapy
	Illicit drug use	Opioids, benzodiazepines

EXAMINE THE URINE IN ALL PATIENTS WITH RENAL DISEASE

Investigation	Comment
Specific gravity	Reflects urine solute concentration. Varies between 1.002 and 1.035; ↑ when kidneys actively reabsorb water, e.g. fluid depletion or renal failure due to ↓ perfusion. Abnormally low values indicate failure to concentrate urine
pH	Normally 4.5–8.0. In renal tubular acidosis pH never falls <5.3 despite acidaemia
Glucose	Small amounts may be excreted by normal kidneys
Ketones	Test is specific for acetoacetate and does not detect other ketones, e.g. β-OH butyrate, acetone. Ketonuria occurs in diabetic ketoacidosis, starvation, alcohol use and very-low-carbohydrate diets
Protein	Readings > 'trace' (300 mg/L) indicate significant proteinuria. Proteinuria >2 g/day suggests glomerular disease
Blood	The test does not differentiate between haemoglobin and myoglobin. If you suspect rhabdomyolysis, measure myoglobin with specific laboratory test
Bilirubin and urobilinogen	Bilirubin not normally present. Urobilinogen may be up to 33 μmol/L in health. Abnormalities of bilirubin and urobilinogen require investigation for possible haemolysis or hepatobiliary disease
Leukocyte esterase	Indicates presence of leukocytes in urine. Seen in urinary tract infection or inflammation, stone disease and urothelial cancers
Nitrite	Most Gram-ve bacteria convert urinary nitrate to nitrite. A positive result indicates bacteriuria, but a negative result does not exclude its presence

Urinary tract infection in women

In a woman with one or more relevant symptoms (dysuria, frequency, haematuria, back pain), the probability of (culture-positive) urinary tract infection is ~50%. This increases to ~80% with a positive dipstick urinalysis for nitrite and leukocyte esterase.

Bent S, Nallamotheu BK, Simel DL et al. Does this woman have an acute uncomplicated urinary tract infection? In: Simel D, Rinne D (eds) *The rational clinical examination*. New York: JAMA and Archives Journals/McGraw-Hill Professional, 2008, pp. 675–685.

RENAL FUNCTION

- GLOMERULAR FILTRATION RATE (GFR)
 - PRIMARY WAY OF MEASURING KIDNEY FUNCTION
 - DIFFICULT TO MEASURE
 - CAN BE ESTIMATED BY AVAILABLE EQUATIONS
- PLASMA CREATININE (P_{CR})
 - USED TO ESTIMATE GFR, KIDNEY FUNCTION
 - EASY TO MEASURE
 - VARIES BY PATIENT FACTORS (SIZE/MUSCLE MASS, AGE, SEX)
- AZOTEMIA, KIDNEY FAILURE, CAN RESULT FROM:
 - PRERENAL CAUSES (VOLUME DEPLETION)
 - INTRARENAL CAUSES
 - POSTRENAL CAUSES (E.G. OBSTRUCTION)

GU INVESTIGATIONS

Investigation	Indication/Comment
Plasma urea, plasma creatinine	Levels generally \uparrow as GFR \downarrow , but values are affected by diet and muscle mass and do not measure renal function accurately.
Creatinine clearance	A good measurement of GFR, but requires a 24-hour urine collection and a blood sample.
Estimated Glomerular Filtration Rate (eGFR)	Calculate the eGFR from an equation. Normal eGFR is ~ 100 ml/min/1.73 m ² .

- CHRONIC KIDNEY DISEASE (CKD) IS CLASSIFIED ON THE BASIS OF EGFR AS SEEN HERE.

Stage	Description	GFR in ml/min/1.73 m²
CKD1	Kidney damage with normal or ↑ GFR	≥90
CKD2	Kidney damage with mild ↓ GFR	60-89
CKD3	Moderate ↓ GFR	30-59
CKD4	Severe ↓ GFR	15-29
CKD5	End-stage kidney disease (dialysis-requiring)	<15

RADIOLOGIC STUDIES

Investigation	Indication/Comment
Plain abdominal X-ray	Assesses renal outline/size, stones (>90% are radio-opaque), gas in the urinary collecting system
Ultrasound scan	Assesses kidney size/shape/position; evidence of obstruction; renal cysts or solid lesions; stones; ureteric urine flow; gross abnormality of bladder, post-micturition residual volume Used to guide kidney biopsy
Doppler ultrasound of renal vessels	Assesses renovascular disease, renal vein thrombosis Arterial resistive index may indicate obstruction
IV urography	Haematuria; renal colic; renal mass; renal, ureteric or bladder stones; cysts; tumours; hydronephrosis NB In many hospitals IVU has been replaced by CT and other imaging forms
CT urogram	Stone disease; renal mass; ureteric obstruction; tumour staging; renal, retroperitoneal or other tumour masses or fibrosis
Angiography/CT or MR angiography	Hypertension ± renal failure, renal artery stenosis; angioplasty and/or stenting
Isotope scan	Suspected renal scarring, e.g. reflux nephropathy; diagnosis of obstruction Assessment of GFR in each kidney - measures renal uptake and excretion of radio-labelled chemicals
Renal biopsy	Used to diagnose parenchymal renal disease

KIDNEYS, URETER, AND BLADDER (KUB) FILM

- PLAIN RADIOGRAPH OF THE ABDOMEN
- USUALLY ORDERED TO INVESTIGATE ABDOMINAL PAIN OR TO ASSESS ORGANS OF THE GASTROINTESTINAL (GI) OR GENITOURINARY (GU) SYSTEMS



KUB – FIRST STEPS

KEY PRINCIPLE – ALWAYS FOLLOW A ROUTINE WHEN INTERPRETING IMAGING AND CLINICAL TESTING TO ENSURE TO YOU DO NOT MISS ANYTHING

FIRST STEPS:

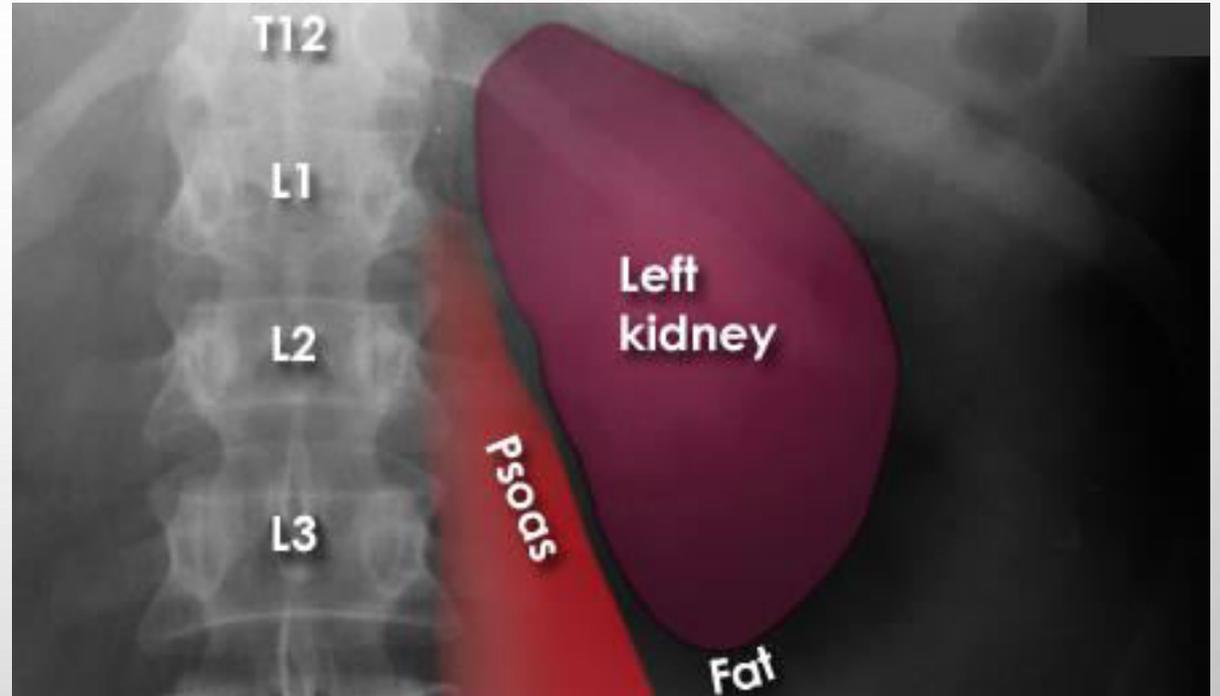
- CHECK FOR PATIENT DATA
- ASSESS IMAGING QUALITY
- CHECK PATIENT'S POSITION FOR THE FILM (AP OR SUPINE) – WANT ERECT TO LOOK FOR FREE AIR IN THE ABDOMEN (PERFORATION)

KUB – FOR WHAT AM I LOOKING?

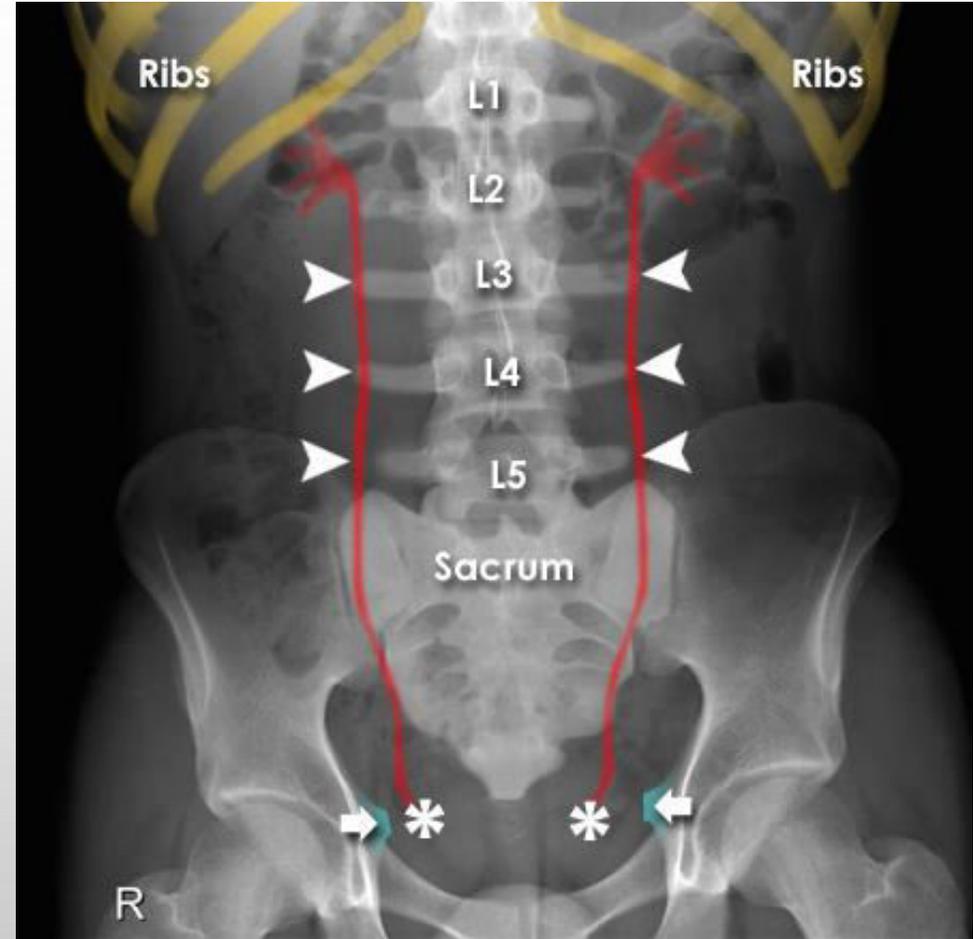
“ALTHOUGH ANATOMY OF THE ABDOMEN IS COMPLICATED, MANY STRUCTURES ARE NOT CLEARLY DEFINED ON A RADIOGRAPH OF THE ABDOMEN, AND THEREFORE CANNOT BE FULLY ASSESSED,” RADIOLOGY MASTERCLASS

- BOWEL GAS PATTERN
- SOFT TISSUE STRUCTURES
- BONES
- LOOK FOR ABNORMAL CALCIFICATION OR ARTIFACT

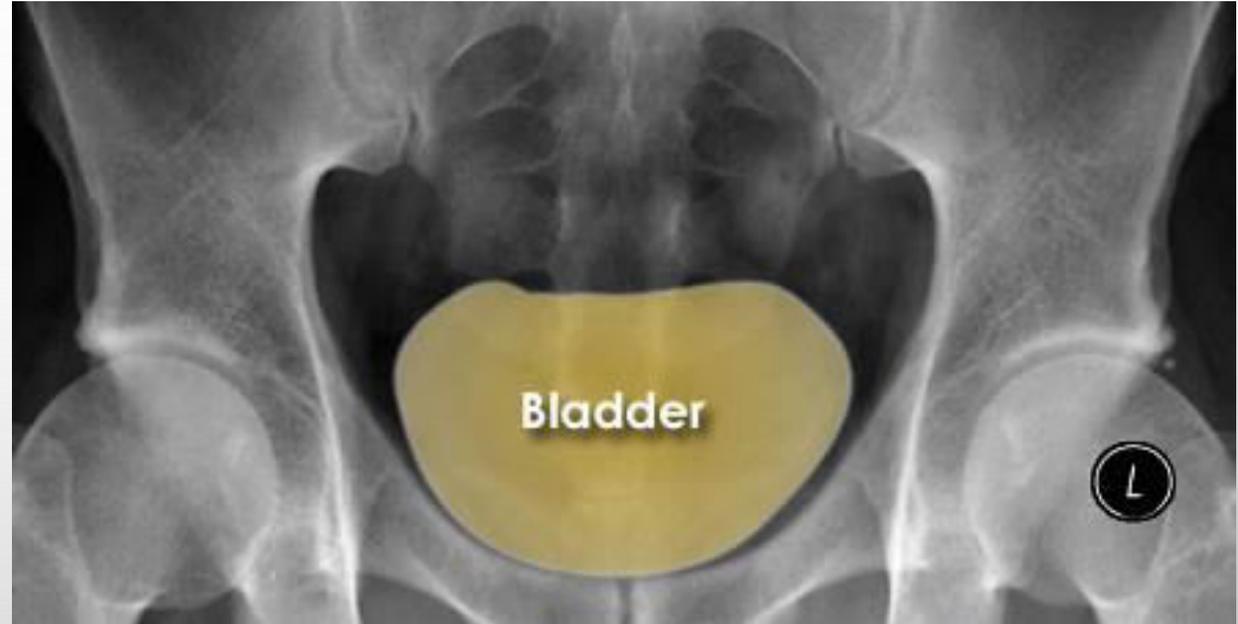
KIDNEY ON X-RAY



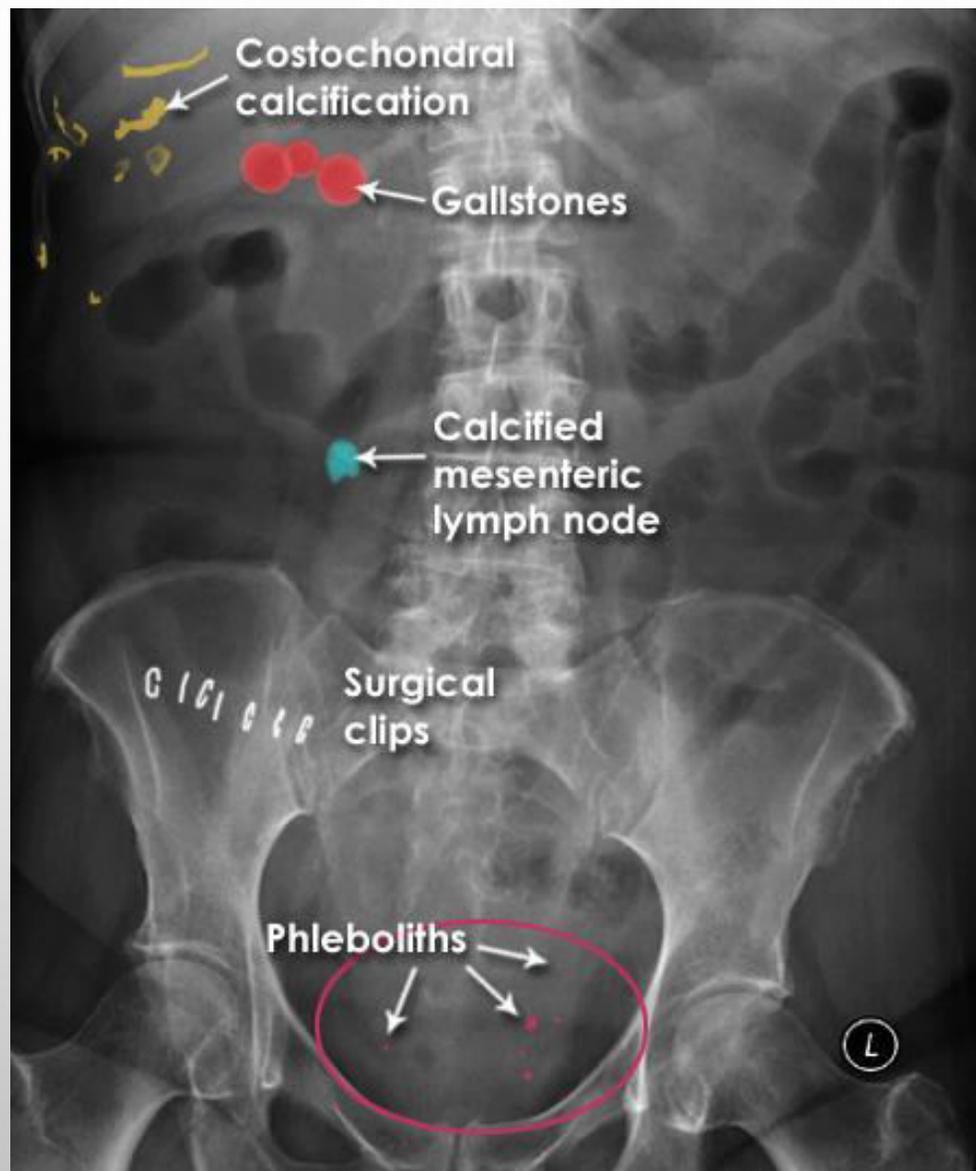
URETER ON X-RAY



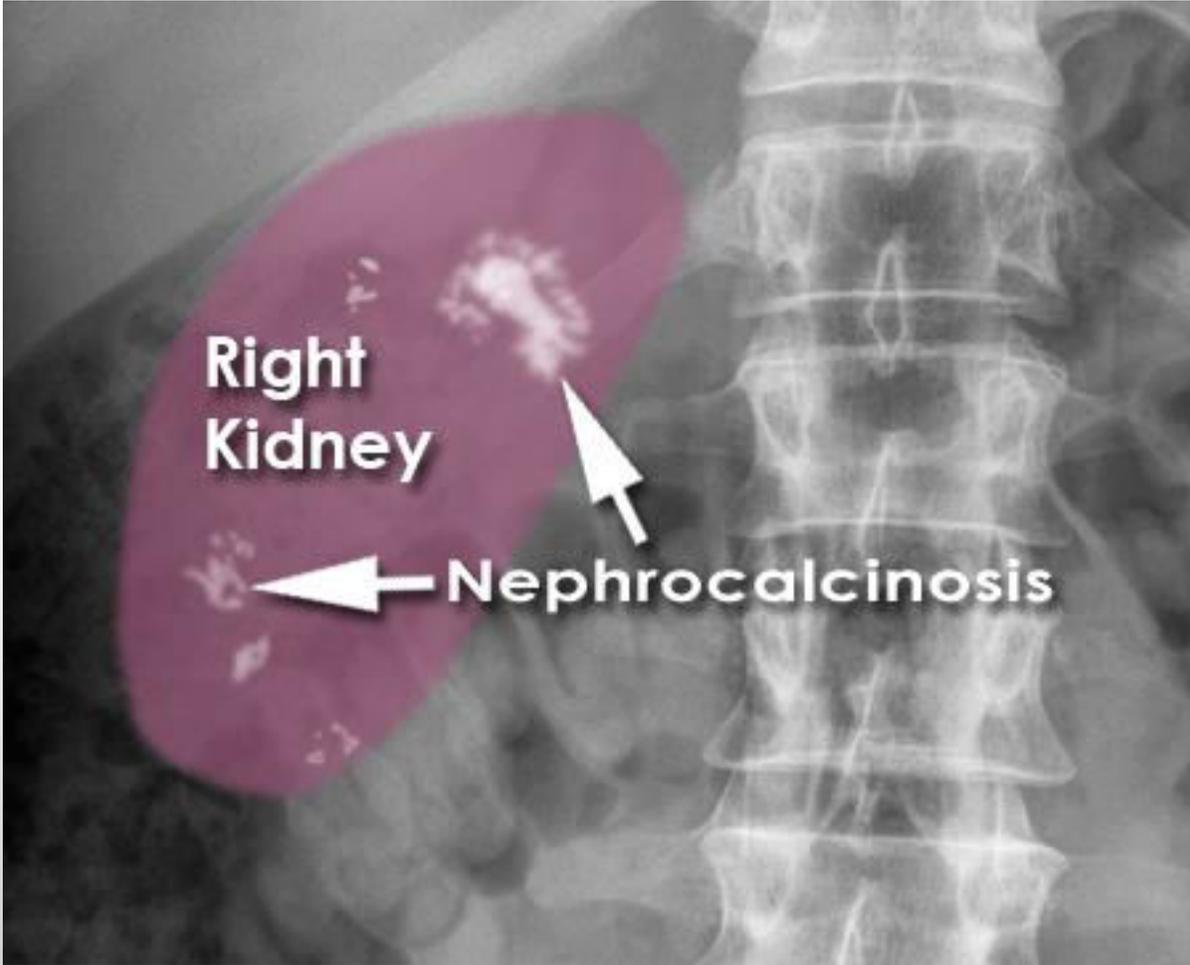
BLADDER ON X-RAY



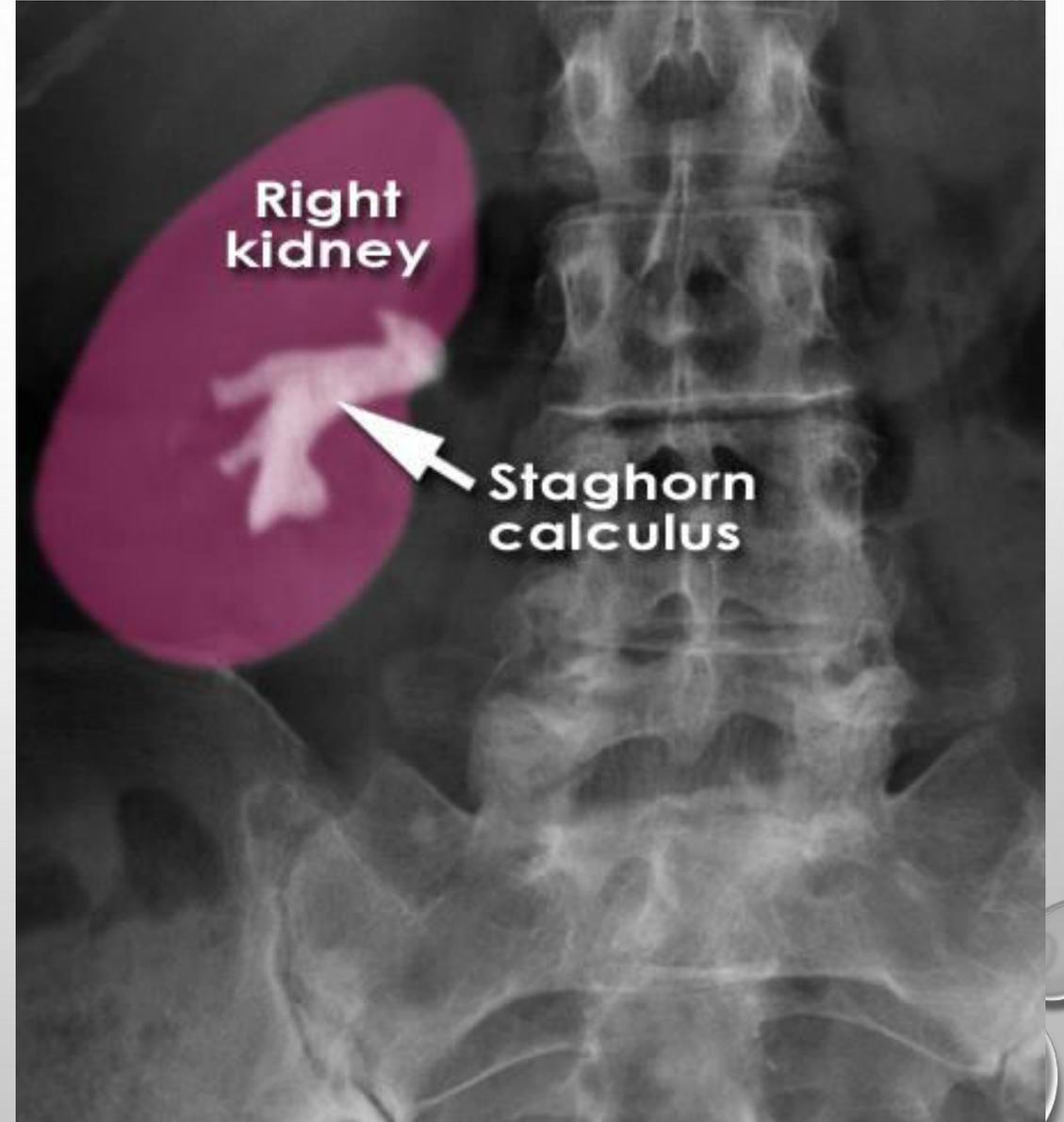
CALCIFICATIONS



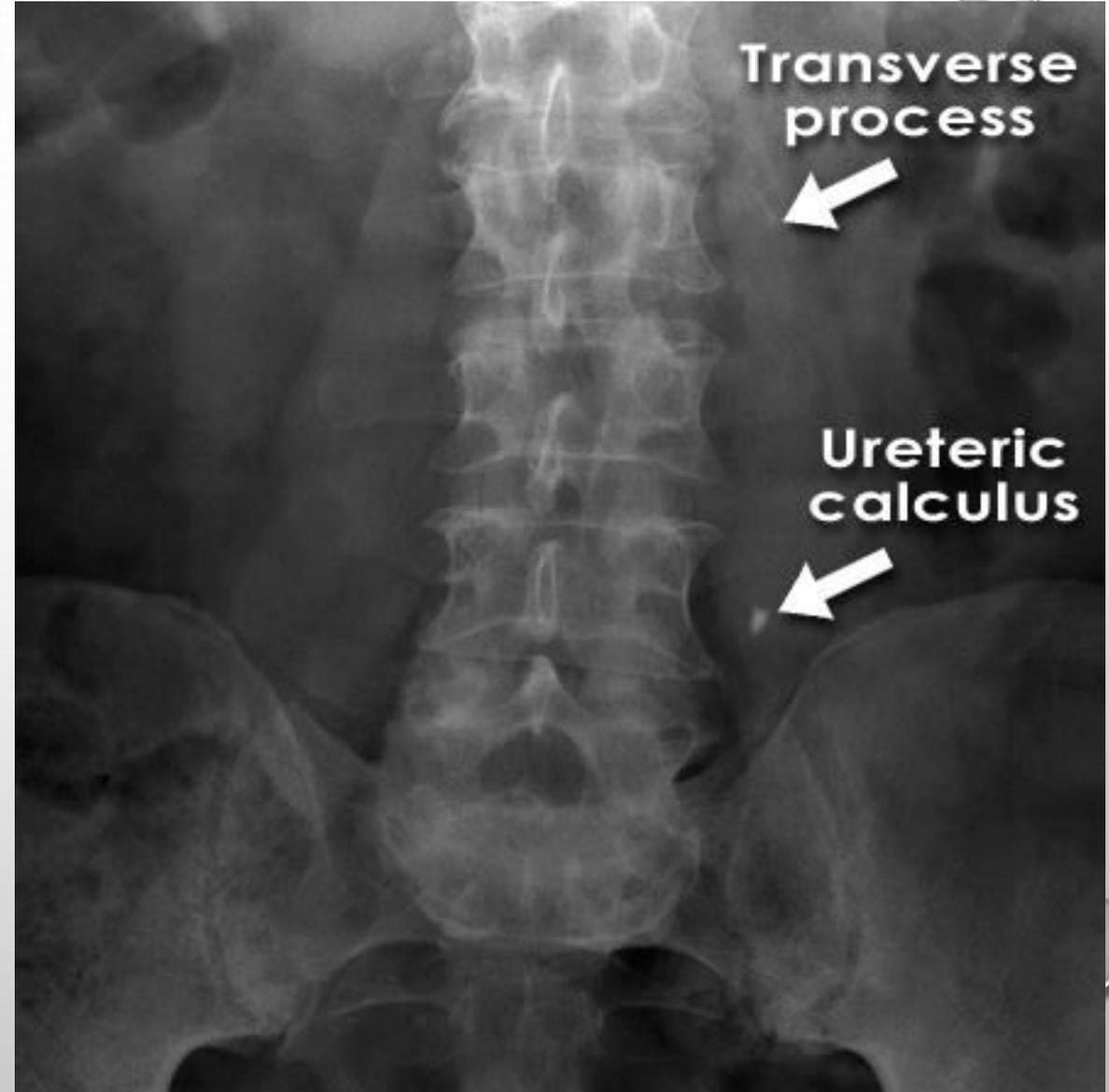
NEPHROCALCINOSIS



STAGHORN CALCULUS



NEPHROLITHIASIS (KIDNEY STONE)



PROSTATE-SPECIFIC ANTIGEN (PSA)

- PSA IS A PROTEIN SECRETED BY PROSTATE CELLS
- RISING LEVELS ARE ASSOCIATED WITH CANCER
- ALSO RISES IN BENIGN PROSTATIC HYPERTROPHY (BPH) AND WITH ACUTE BACTERIAL PROSTATITIS
- USE FOR CANCER SCREENING IS CONTROVERSIAL
- 0.1-4 NG/ML IS LOW, 4-10 NG/ML IS INTERMEDIATE, >10 NG/ML IS HIGH
- BIOPSY WILL BE PERFORMED >10 NG/ML
- ALSO, RATE OF DOUBLING IS HELPFUL TO DECIDE IF BIOPSY NEEDED
- PERFORMANCE AS SCREEN FOR CANCER BETTER WHEN ADDED TO DIGITAL RECTAL EXAM (DRE)

GU INVESTIGATIONS – OTHER

Investigation	Indication/Comment
Urine osmolality	<p>The definitive measurement of renal concentrating ability in unexplained hyponatraemia. If the plasma osmolality is low, the urine osmolality should be lower still (<150 mosmol/kg); in the absence of hypovolaemia, any other finding is consistent with syndrome of inappropriate antidiuretic hormone (ADH) secretion. In patients with unexplained polyuria, test the concentrating ability of the kidneys by an overnight fluid deprivation test. In healthy subjects, urinary osmolality should rise to >800 mosmol/kg; any other finding suggests lack of ADH or renal tubular unresponsiveness to ADH.</p>

GU INVESTIGATIONS - OTHER

Plasma Electrolytes	Indication/Comment
Plasma electrolytes	<ul style="list-style-type: none">• ↑ Potassium (↓ excretion) occurs in acute, and advanced chronic kidney disease• ↓ Bicarbonate (↓ H⁺ excretion) common in acute and chronic kidney disease• ↓ Calcium (impaired renal vitamin D3 activation) and ↑ phosphate (↓ excretion) in chronic kidney disease• ↑ Urate common in chronic kidney disease (but seldom associated with gout).
Alkaline phosphatase and parathyroid hormone	↑ In secondary hyperparathyroidism related to ↓ calcium and ↑ phosphate levels.
Antinuclear antibodies (ANA), antinuclear cytoplasmic antibodies (ANCA)	Systemic lupus erythematosus and vasculitis may affect the kidney.

SOURCES

- *HARRISON'S PRINCIPLES OF INTERNAL MEDICINE*, 19TH EDITION, SECTION 7, "ALTERATIONS IN RENAL AND URINARY TRACT FUNCTION"
- *MACLEOD'S CLINICAL EXAMINATION*, 13TH EDITION
- WEB SITE, RADIOLOGY MASTER CLASS, READING ABDOMINAL X-RAYS
([HTTP://RADIOLOGYMASTERCLASS.CO.UK/TUTORIALS/ABDO/ABDOMEN X-RAY/ANATOMY INTRODUCTION.HTML](http://radiologymasterclass.co.uk/tutorials/abdo/abdomen_x-ray/anatomy_introduction.html))
- WEB SITE, UNITED STATES PREVENTATIVE SERVICES TASK FORCE, SCREENING FOR PROSTATE CANCER WITH PSA
([HTTP://WWW.USPREVENTIVESERVICESTASKFORCE.ORG/PAGE/DOCUMENT/UPDATESUMMARYFINAL/PROSTATE-CANCER-SCREENING](http://www.uspreventiveservicestaskforce.org/page/document/updatesummaryfinal/prostate-cancer-screening))
- WEB SITE, MEDSCAPE, PROSTATE-SPECIFIC ANTIGEN TESTING ([HTTP://EMEDICINE.MEDSCAPE.COM/ARTICLE/457394-OVERVIEW](http://emedicine.medscape.com/article/457394-overview))