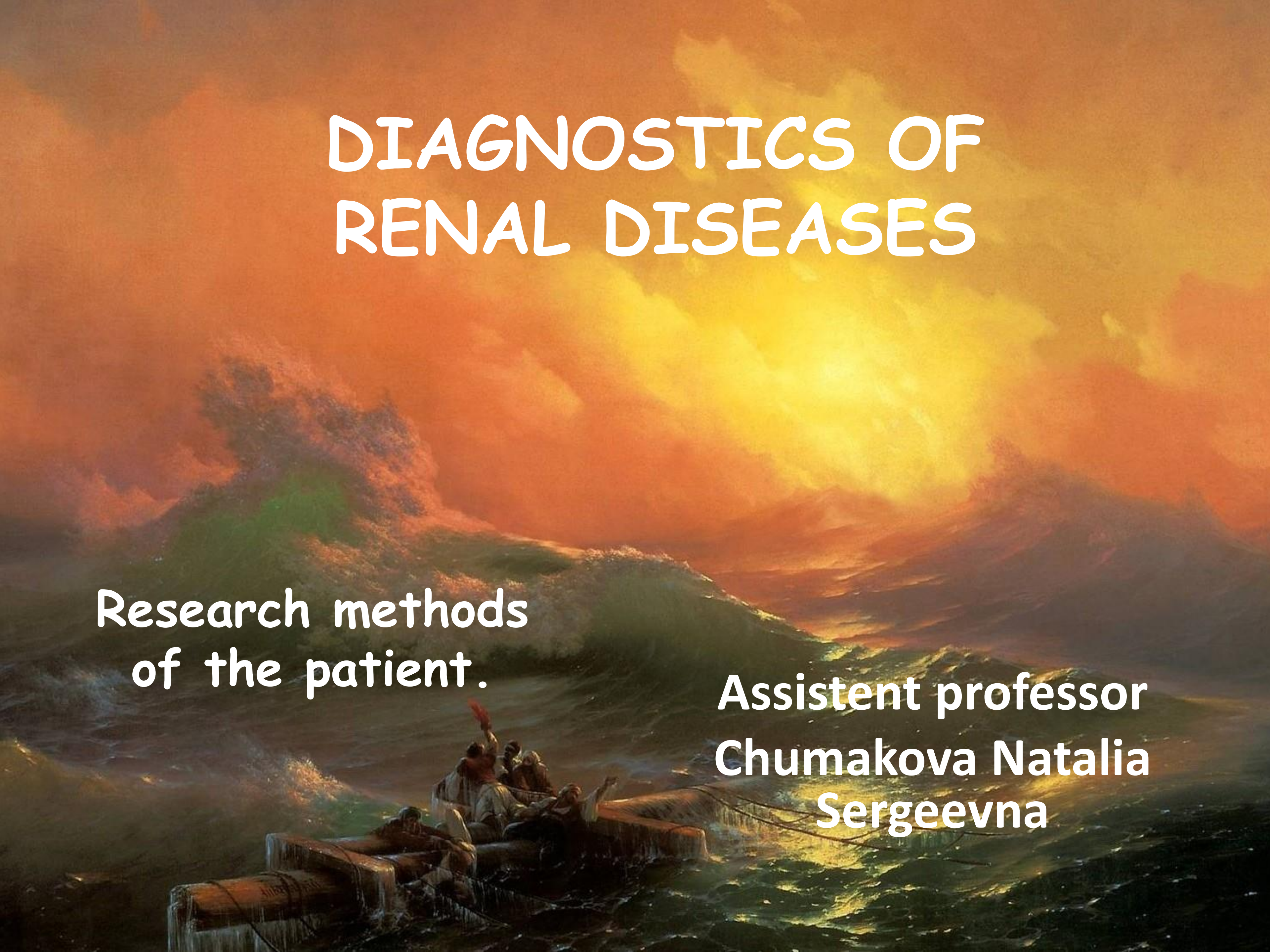


DIAGNOSTICS OF RENAL DISEASES

Research methods of the patient.

Assistent professor
Chumakova Natalia Sergeevna

CLINICAL EVALUATION OF RENAL DISORDERS

Symptoms and Signs

- Urinary disorders may present nonspecifically but usually do so as abnormal clinical or laboratory manifestations suggesting a primary renal abnormality or a systemic disease associated with renal pathology. Normally, adults void about 4 to 6 times/day, mostly in the daytime, totaling 700 to 2000 mL/day.

Symptoms and Signs

- Asymptomatic patients with renal disease may have hypertension or abnormal blood or urine findings. They may have a family history of renal disorders.
- In symptomatic patients, fever, weight loss, and malaise are common findings with renal carcinoma, advanced renal failure, and urinary tract infection (UTI).
- Typically, renal symptoms include changes in micturition, urinary output, or appearance; or pain, edema, and nonspecific symptoms and signs related to renal insufficiency.

Violations of urination

- Frequent micturition **(pollakyuria)** without an increase in urine volume is a symptom of reduced bladder filling capacity. Infection, foreign bodies, calculi, or tumors may injure the bladder mucosa or underlying structures, leading to inflammatory infiltration and edema. Mild stretching of the bladder, reduced bladder elasticity, a pelvic mass, or a gravid uterus functionally reduces bladder capacity, resulting in pain and urgency (a compelling need to urinate).
- **Polyuria** (> 2000 mL/day voided) may be caused by increased water intake (eg, compulsive water drinking), osmotic diuresis (eg, glycosuria from uncontrolled diabetes mellitus), decreased vasopressin release due to hypothalamic or posterior pituitary disease, or decreased renal tubular response to ADH from hypercalcemia, K deficiency, or congenital or acquired nephrogenic diabetes insipidus (NDI).

Violations of urination

- **Oliguria** (< 500 mL/day voided) tends to be acute and caused by decreased renal perfusion (prerenal factors), ureteral or bladder outlet obstruction (postrenal factors), or primary renal disease. Uremia may occur. Anuria (< 50 mL/day voided), although rare, may signal acute renal failure, the end stage of chronic progressive renal insufficiency, or, rarely, renal infarction or cortical necrosis. It may also be due to reversible urinary obstruction. Prolonged anuria inevitably results in uremia.
- **Nocturia** (voiding during the night) is an abnormal but nonspecific symptom. It may occur without disease; eg, due to excessive fluid intake in the late evening. It may result from urine retention secondary to bladder neck obstruction (eg, prostatism). Less commonly, nocturia may reflect early renal disease and polyuria from a decrease in concentrating capacity or heart and liver failure without evidence of intrinsic urinary system disease

Dysuria (painful urination)

- **Dysuria (painful urination)** suggests irritation or inflammation in the bladder neck or urethra, usually due to bacterial infection. Obstructive symptoms (hesitancy, straining, decrease in force and caliber of the urinary stream, terminal dribbling) are commonly due to obstruction distal to the bladder. In men, such obstruction is usually due to prostatic obstruction. Similar symptoms may suggest meatal stenosis in either sex.

Urine changes

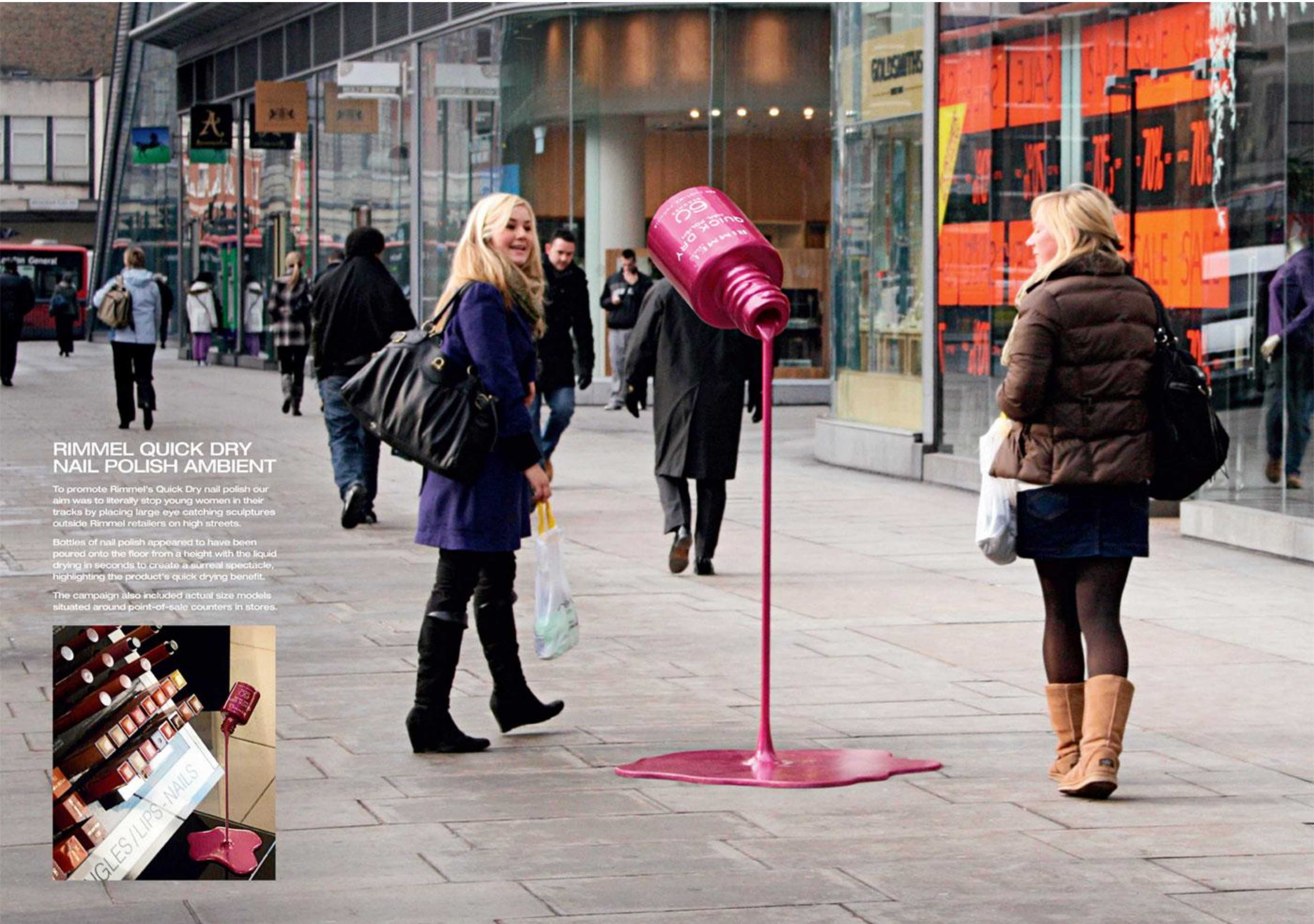
- Abnormal color or appearance of urine has many causes.
- Urine may be clear during water diuresis or may be a deep yellow color when maximally concentrated due to chromogens (eg, urobilin).
- If excretion of food pigments (usually red urine) or drugs (brown, black, blue, green, or red) can be excluded, non-yellow urine suggests the presence of hematuria, hemoglobinuria, myoglobinuria, pyuria, porphyria, or melanoma.
- Cloudy urine is commonly due to precipitated amorphous phosphate salts 6 in an alkaline urine; less frequently, it suggests pyuria due to a UTI.
- Milky urine may be caused by precipitated phosphates in an alkaline urine.
- Brick dust urine usually is produced by precipitated urates in an acid urine. Urine microscopy and chemical analysis usually identify the cause.

RIMMEL QUICK DRY NAIL POLISH AMBIENT

To promote Rimmel's Quick Dry nail polish our aim was to literally stop young women in their tracks by placing large eye catching sculptures outside Rimmel retailers on high streets.

Bottles of nail polish appeared to have been poured onto the floor from a height with the liquid drying in seconds to create a surreal spectacle, highlighting the product's quick drying benefit.

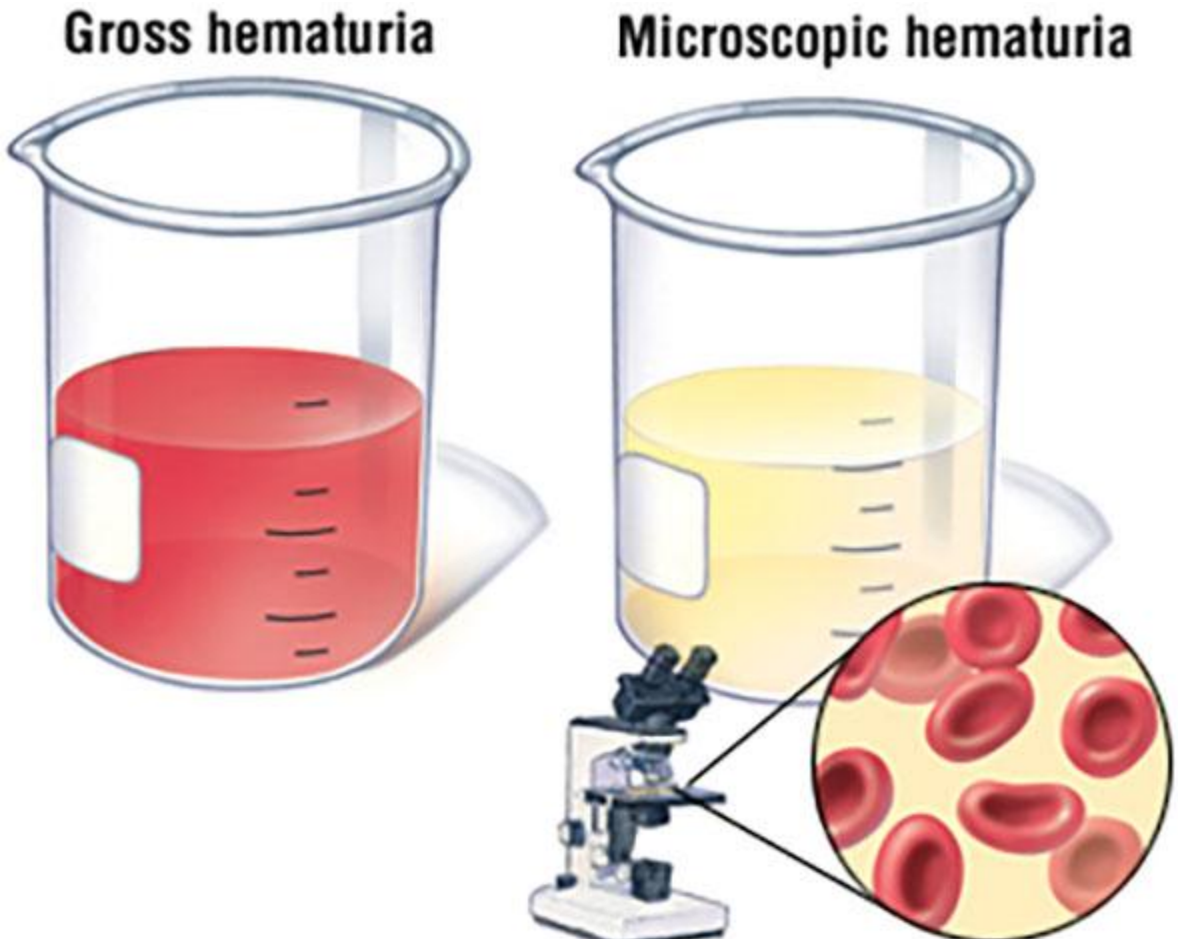
The campaign also included actual size models situated around point-of-sale counters in stores.



Hematuria

- **Hematuria** (blood in the urine) can produce red to brown discoloration depending on the amount of blood present and the acidity of the urine. Slight hematuria may cause no discoloration and may be detected only by microscopy or chemical analysis. Hematuria without pain usually is due to renal, vesical, or prostatic disease. In the absence of RBC casts (which usually indicate glomerulonephritis), silent hematuria may be caused by bladder or kidney tumor. Such tumors usually bleed intermittently, and complacency must not occur if the bleeding stops spontaneously. Other causes of asymptomatic hematuria include calculi, polycystic disease, hydronephrosis, and benign prostatic hyperplasia. Hematuria accompanied by excruciating pain (renal colic) suggests passage of a ureteral calculus or a clot from renal bleeding. Hematuria with dysuria is also associated with bladder infections or lithiasis.

Hematuria



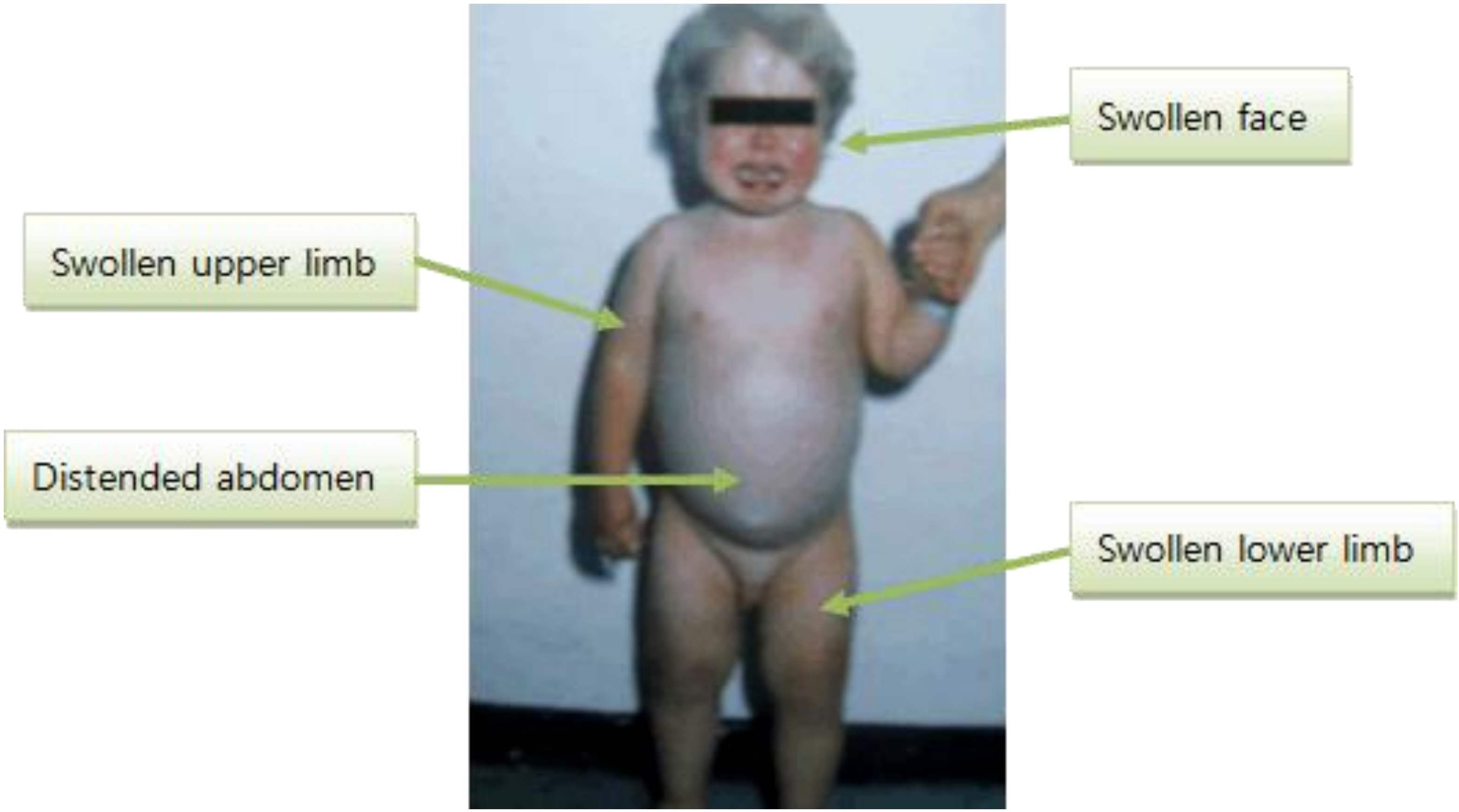
Kidney pain

- Kidney pain usually is felt in the flank or back between the 12th rib and the iliac crest, with occasional radiation to the epigastrium. Stretching of the pain-sensitive renal capsule is the probable cause and may occur in any condition producing parenchymatous swelling (eg, acute glomerulonephritis, pyelonephritis, acute ureteral obstruction). There is often marked tenderness over the kidney in the costovertebral angle formed by the 12th rib and the lumbar spine. Inflammation or acute distention of the renal pelvis or ureter causes pain in the flank and hypochondrium, with radiation into the ipsilateral iliac fossa and often into the upper thigh, testicle, or labium. The pain is intermittent but does not completely remit between waves of colic. Chronic obstruction is usually asymptomatic.
- Bladder pain is most commonly caused by bacterial cystitis; it is usually suprapubic and referred to the distal urethra during urination.

Edema

- Edema usually represents excessive extracellular water and Na due to abnormal renal excretion, but it may also be caused by heart or liver disease. Initially, edema may be evident only by weight gain but later becomes overt. Edema associated with kidney disease is sometimes noted first as facial puffiness (Fig.1) rather than swelling in dependent or lower parts of the body. If fluid retention continues, anasarca (generalized edema) with fluid transudates (effusions) in the pleural and peritoneal cavities may occur (Fig.2); it is most frequently associated with continuous, heavy proteinuria (nephrotic syndrome).

- Fig.1. Acute nephritis. The generalized facial puffiness and the erythematous periorbital oedema are typical, and this boy also had ankle oedema and hypertension.

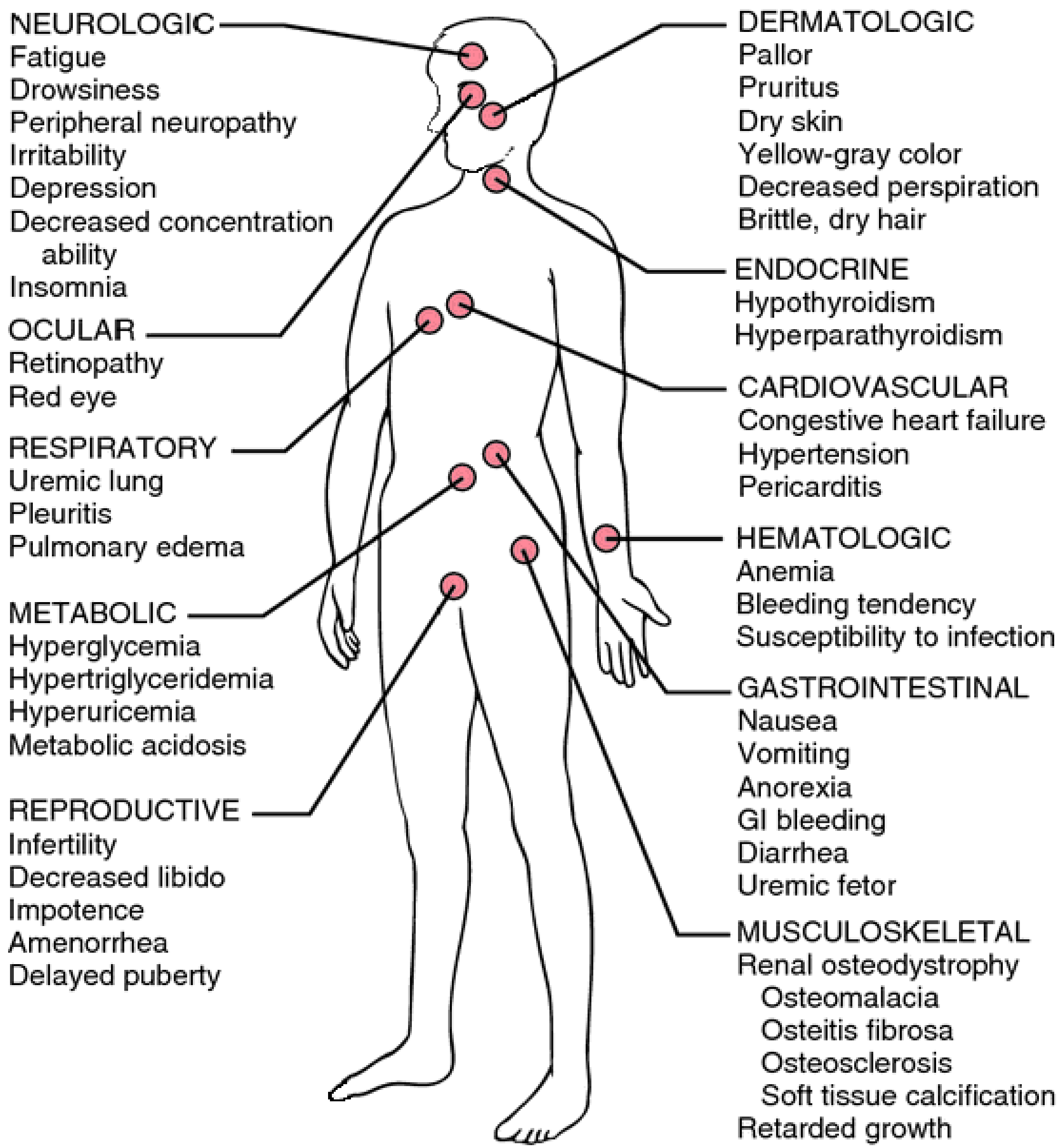


- Fig.2. Nephrotic syndrome in a young boy. Note the severe generalized facial and body oedema. The facial oedema gives him a cushingoid appearance, but this picture was taken before he started on steroid therapy. He also had ascites.

Uremia

- Uremia (a toxic condition associated with excessive accumulation in the blood of protein metabolism by-products) occurs when GFR declines to < 10% of normal, with resultant disturbances of multiple organ systems (Fig.3). Weight loss, weakness, fatigue, dyspnea, anorexia, nausea and vomiting, itching, failure to grow, tetany, peripheral neuropathy, pericarditis, and convulsions are the usual symptoms and signs; most can be ameliorated or reversed by dialysis or renal transplantation and appropriate diet.

SYMPTOMS OF UREMIA

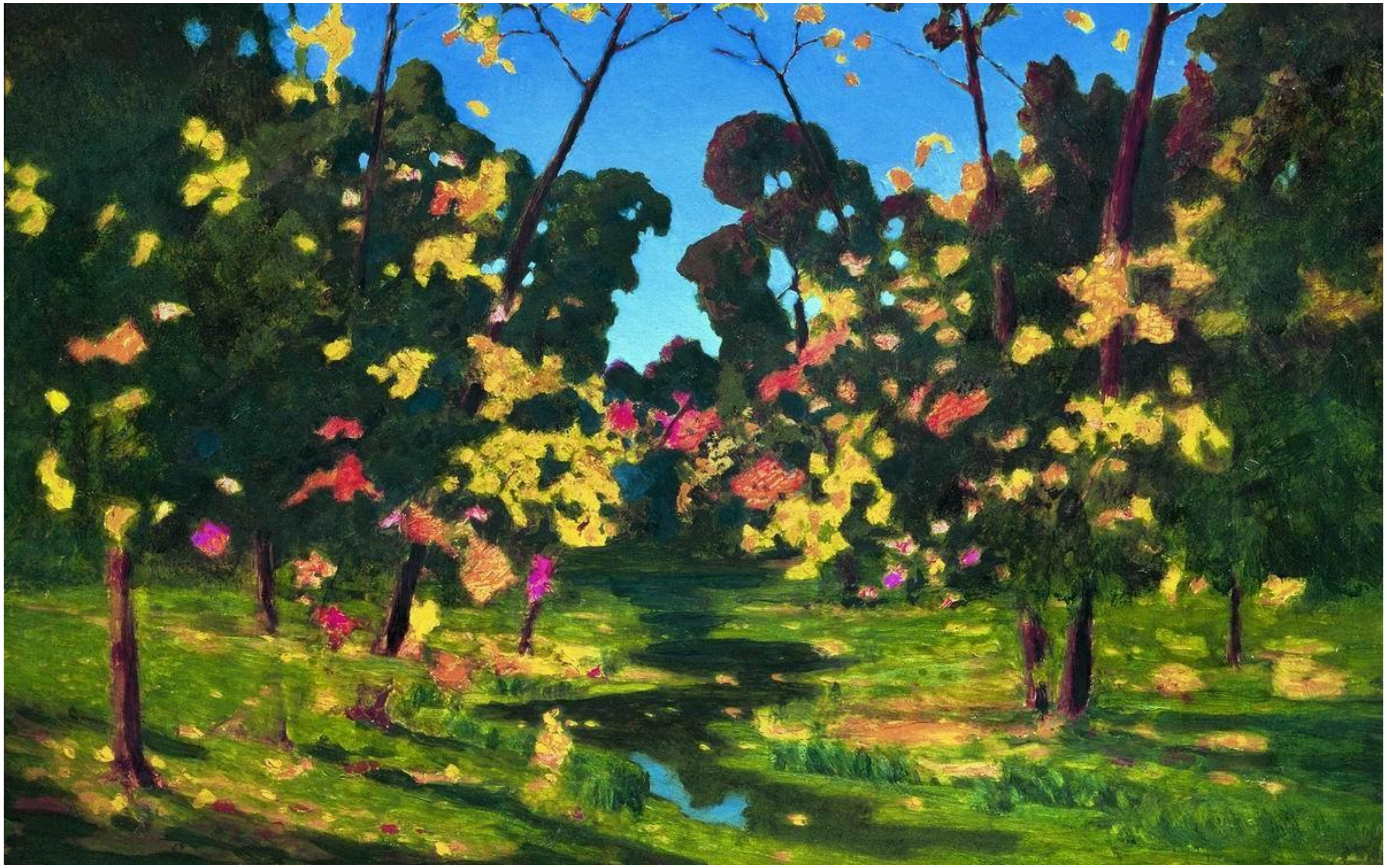


- Fig.3. Uremic facies. Note the pale, sallow, yellow-brown appearance of the skin and the anaemic pallor of the sclerae.

Hypertension

- **Hypertension** may be secondary to renal disease (eg, vascular anomalies or occlusion, glomerulonephritis, progressive renal failure). However, <= 5% of adult hypertension is due to renovascular causes (with major renal artery or segmental artery obstruction and demonstrable increased renin secretion from the obstructed side).
- Skin changes may include pallor, suggesting anemia, commonly associated with renal disease; excoriations, suggesting pruritus; and infections (eg, carbuncles, cellulitis), which may be due to glomerulonephritis.
- Retinal abnormalities on ophthalmoscopy may include hemorrhages, exudates, and papilledema as signs of cerebral edema associated with malignant hypertension or metabolic abnormalities.
- Other abnormalities suggesting urinary system disease include stomatitis; an ammoniacal breath odor; and enlargement of the kidneys, bladder, or prostate on palpation.

The investigation of patients with suspected renal disease



INVESTIGATION IN RENAL DISEASES

- Initial investigations:

Urine stick test

- specific gravity
- Blood
- Protein
- Glcose
- Nitrite
- pH

Initial investigations:

Urine microscopy:

- Red and white cells
- Casts
- Crystals
- Epithelial cells
- Parasites
- bacteria

Initial investigations:

Midstream urine for culture.

Plasma:

- Urea
- Creatinine
- Electrolytes
- Sodium,potassium,chloride,bicarbonate,

calcium, phosphate

Haematology: full blood count

Investigations used selectively

- **24-hour urine collectoin:**
- creatinine clearance, protein excretion
- **Ultrasound**
- **Plain X-ray of renal tract,**
- Intravenous urogram (IVU)

Specialized investigations

- **Further radiology, including CT and MRI**
- **Isotope scans**
- **Specialized renal tubule function tests**
- **Biopsy**
- **Endoscopy**
- **Tests for multisystem diseases**

LABORATORY FINDINGS

- **Blood studies:** Hematologic assessment may suggest renal disease. Anemia (particularly normocytic normochromic from a lack of erythropoietin) may be a clue to renal failure. Serum chemistries often are abnormal in renal dysfunction, but changes are nonspecific In the absence of acute muscle damage, a persistent increase in serum creatinine is highly specific for renal dysfunction.

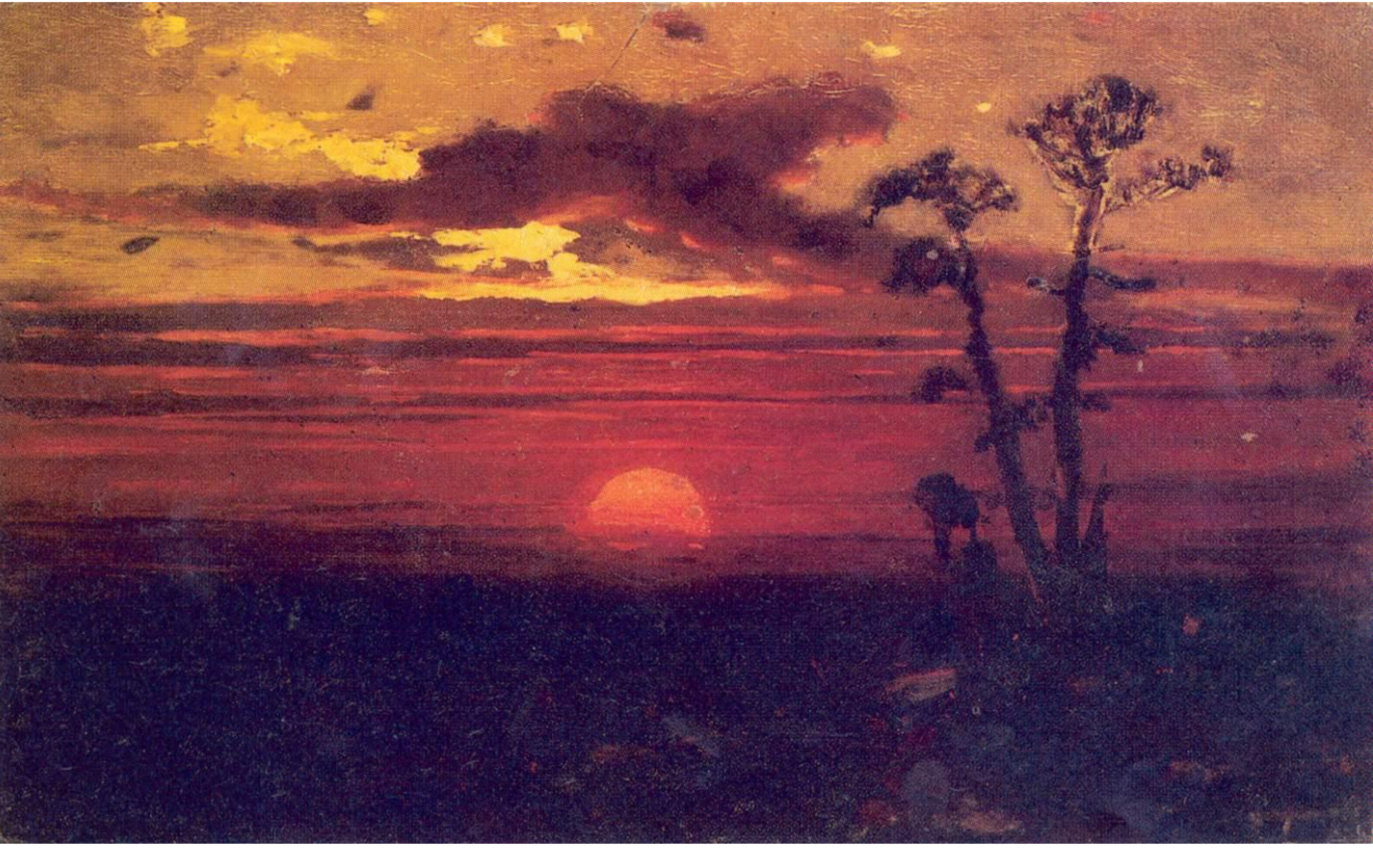
LABORATORY FINDINGS

- **Urinalysis:** Urinalysis is the best guide to intrinsic renal disease and includes microscopic examination of sediment and qualitative evaluation of protein, glucose, ketones. Under standardized conditions, the solute concentration of urine or urine pH may have diagnostic significance. Routine urinalysis in asymptomatic patients is infrequently positive and rarely leads to additional testing or changes in therapy. Routine urinalysis misses about 2% of patients with bacteriuria, and quantitative urine cultures are recommended instead. A semiquantitative estimation of these formed elements is made by a high-power or low-power field count (eg, 10 to 15 WBCs/high-power field).

LABORATORY FINDINGS

- **Normal urine contains** a few cells and other formed elements shed from the entire urinary tract. With disease, these cells are increased and may help localize the site and type of injury. Voided urine in women contains genital tract cells. Urinary system disease is suggested in a male by > 1 WBC, RBC, or epithelial cell/high-power field (400×), ie, > 1000 cells/mL, or in a female by > 4 WBCs/high-power field, ie, > 4000 cells/mL in centrifuged urine. Excessive WBCs may indicate infection or other inflammatory diseases. In symptomatic patients, the finding of > 10 WBCs/µL strongly suggests significant bacteriuria. Occasional bacteria in a centrifuged urine sediment do not necessarily indicate UTI. However, bacteria in an uncentrifuged fresh urine sample together with urine cultures of > 105 colony-forming units (CFU)/mL of voided urine suggest UTI rather than contamination

Excessive RBCs may indicate infection, tumor, calculi, or inflammation anywhere in the kidney or urinary tract. When >= 80% of the RBCs are dysmorphic (Fig.5) (wide range of morphologic variation), hematuria is likely to be glomerular in origin. In some clinical conditions, analysis of RBC morphology may be unreliable. For example, isomorphic erythrocyturia can be found in forced diuresis, in glomerulonephritis with gross hematuria, or in renal insufficiency. A mixed morphologic pattern of urinary RBCs may occur in IgA nephritis, a frequent cause of glomerular hematuria. Recent identification of acanthocytes (ring-formed RBCs with one or more protrusions of different shapes and sizes) is a more specific marker of glomerular bleeding. Studies suggest that if 5% of the total urinary RBCs are acanthocytes, then an underlying glomerular disease can be diagnosed with high sensitivity (71%) and specificity (98%).



Crystals of various salts (eg, oxalate, phosphate, urate) or drugs (eg, sulfonamides) may be found when their concentrations and urinary pH exceed the limits of their solubility.

Casts (cylindric masses of mucoprotein in which cellular elements, protein, or fat droplets may be entrapped) in urine sediment are most important in distinguishing primary renal disease from diseases of the lower tract.

Proteinuria is simply and rapidly detectable by commercially available dipsticks (Fig.6). This technique is sensitive to as little as 5 to 20 mg/dL of albumin, the predominant protein in most renal diseases, but is less sensitive to globulins and mucoproteins and may be negative in the presence of Bence-Jones proteins.

- The major mechanisms producing proteinuria are elevated plasma concentrations of normal or abnormal proteins (overflow proteinuria; eg, Bence-Jones proteinuria); increased tubular cell secretion (Tamm-Horsfall proteinuria); decreased tubular resorption of normal filtered proteins; and an increase of filtered proteins caused by altered glomerular capillary permeability. In adults, proteinuria is usually found incidentally during a routine physical examination. Proteinuria may be intermittent, orthostatic (occurring only when upright), or constant (persistent). Most patients with intermittent or orthostatic proteinuria do not show any deterioration of renal function, and in about 50% the proteinuria ceases after several years. Constant proteinuria is more serious. Although the course is indolent without other indicators of renal disease (eg, microscopic hematuria), most patients demonstrate proteinuria over many years; many develop an abnormal urine sediment and hypertension; and a few progress to renal failure.

Measurements of protein excretion

Measurements of protein excretion are useful for diagnosis and follow-up, especially in constant proteinuria. A 24-h measurement of total protein excretion (normal, < 150 mg/day) may be done. Heavy proteinuria (> 2 g/m2 /day) is found in patients with glomerulopathy producing the nephrotic syndrome. Proteinuria usually is minimal, intermittent, or absent in diseases primarily involving the tubulointerstitial area (eg, pyelonephritis). Exercise proteinuria sometimes occurs in joggers, marathon runners, and boxers. It is accompanied by elevation of catecholamines and may be associated with hemoglobinuria, hematuria, or even myoglobinuria. For glucosuria, testing by dipstick is specific and very sensitive, detecting as little as 100 mg/dL (5.5 mmol/L) of glucose. The most common cause of glucosuria is diabetic hyperglycemia with normal renal glucose transport. However, if glucosuria persists with normal blood glucose concentrations, renal tubular dysfunction should be considered.

- Fig.6. A typical urine test stick, which provides instant measurement of a range of possible abnormalities in the urine.


Big Bubbles
Hubba Bubba

- For ketonuria, the dipstick reagent is more sensitive to acetoacetic acid than to acetone. Ketonuria usually is nonspecific, and acetoacetic acid, acetone, and -hydroxybutyric acid are excreted in the urine. Finding any of these three compounds in urine generally is satisfactory for diagnosis of ketonuria. Ketonuria offers clues to the causes of metabolic acidosis. It is present in starvation, in uncontrolled diabetes mellitus, and occasionally in ethanol intoxication. It is not specific for intrinsic urinary system disease.
- For hematuria, the dipstick reagent is sensitive to free Hb and myoglobin. A positive test in the absence of RBCs on microscopic examination suggests 12 hemoglobinuria or myoglobinuria--an important etiologic clue in the patient with acute renal failure.

- For nitrituria, the dipstick test depends on the conversion of nitrate (derived from dietary metabolites) to nitrite by the action of certain bacteria in the urine. Normally no detectable nitrite is present. When bacteriuria is significant, the test will be positive in 80% of cases in which the urine has incubated for >= 4 h in the bladder. Thus, a positive test is a reliable index of significant bacteriuria. However, a negative test does not exclude bacteriuria.
- **Urinary specific gravity** (sp gr) is measured by a urinometer or estimated by a sp gr reagent strip method. Although the correlation with osmolality is not linear, it is satisfactory for clinical use. Urinary pH is measured by a dipstick impregnated with various dyes that change color when the pH is 5 to 9.

Measurement of renal function

- Renal function tests are useful in evaluating the severity of kidney disease and in following its progress. Serum creatinine can be used as an index of renal function because creatinine production and excretion are reasonably constant in the absence of muscle disease.
- Serum concentration of creatinine varies inversely with the GFR and therefore is a useful index of the GFR if production (related to muscle mass and age) and metabolism (increased in uremia) are considered. The upper limit of serum creatinine concentration in men with normal GFR is 1.2 mg/dL (110 µmol/L); in women, 1 mg/dL (90 µmol/L).

Glomerular filtration rate (GFR)

- Glomerular filtration rate (GFR) reflects amount of plasma ultrafiltrate (i.e. primary urine), resultant from blood during definite time interval (normally GFR is 115—125 ml/min). In most cases of renal disease GFR is precise summary index of renal function. More subtle methods of renal function evaluation are based on the use of clearance principle. Clearance (depuration) — is conditional notion, characterized by blood depuration rate; it is defined by plasma volume, which is entirely cleaned with kidneys from that or another substance (creatinine) during 1 min. Creatinine clearance in men is 140 to 200 L/day (70 ± 14 mL/min/m2) and in women, 120 to 180 L/day (60 ± 10 mL/min/m2). The creatinine clearance (Clcreat) can be calculated from the serum creatinine concentration in men as:

Formula creatinine clearance

- **Clcreat (ml/min)=** $$\frac{\textbf{(140-age[yr](body wt[kg])}}{\textbf{(72) (serum creatinine [mg/dL]}}$$

Creatinine clearance (mL/min) =

$$\frac{(140 - age\ [years])\ x\ weight\ [kg]}{serum\ creatinine\ [\mu mol/L]} \quad \text{(Females)}$$

$$\frac{(140 - age\ [years])\ x\ weight\ [kg]\ x\ 1.2}{serum\ creatinine\ [\mu mol\ /L]} \quad \text{(Males)}$$

Cockcroft-Gault

$$\text{Cr clearance, ml/min} = \frac{[140-\text{age, years}]\times\text{weight, kg}]}{[72\times\text{Cr, mg/dl}]} \ (\times 0.85 \text{ women})$$

MDRD-4 (abbreviated)

$$\text{GFR (ml/min/1,73 m}^2) = 186\times\text{Cr}^{-1.154}\times\text{age}^{-0.203}\times(0.742 \text{ if women and/or } 1.210 \text{ if African-Americans})$$

CKD-EPI

	SCr	Formula GFR* estimation
Women	≤0.7	$GFR=144\times(SCr/0.7)^{-0.329}\times(0.993)^{age}$
	>0.7	$GFR=144\times(SCr/0.7)^{-1.20}\times(0.993)^{age}$
Men	≤0.9	$GFR=144\times(SCr/0.7)^{-0.411}\times(0.993)^{age}$
	>0.9	$GFR=144\times(SCr/0.7)^{-0.411}\times(0.993)^{age}$

Creatinine clearance

- In women, the calculated values are multiplied by 0.85. After loss of 50 to 75% of the normal glomerular filtration surface, a decrease in creatinine clearance is clearly detectable. Thus, a normal creatinine clearance cannot exclude the presence of mild renal disease. Tests of renal concentrating capacity are simple and diagnostically helpful. The loss of concentrating ability frequently is present long before a depression of GFR is measurable.

Zimnitsky test

- Renal concentrating capacity is best tested by **Zimnitsky test.**
- **The sample of urine by Zimnitskiy allows to estimate the concentration renal function (i.e. the ability of the kidneys to the concentration and dilution of urine).**
- **In the laboratory, they assess the following indicators:**
- **the amount of urine in each of the 3-hour portions; the relative density of urine per serving**
- **Daily diuresis (amount of urine that is allocated per day); daily urine output (urine volume from 6 a.m. till 18 p.m. (1-4 servings)); nocturnal diuresis (urine volume from 18 PM to 6 am (5-8 servings)).**

Zimnitsky test

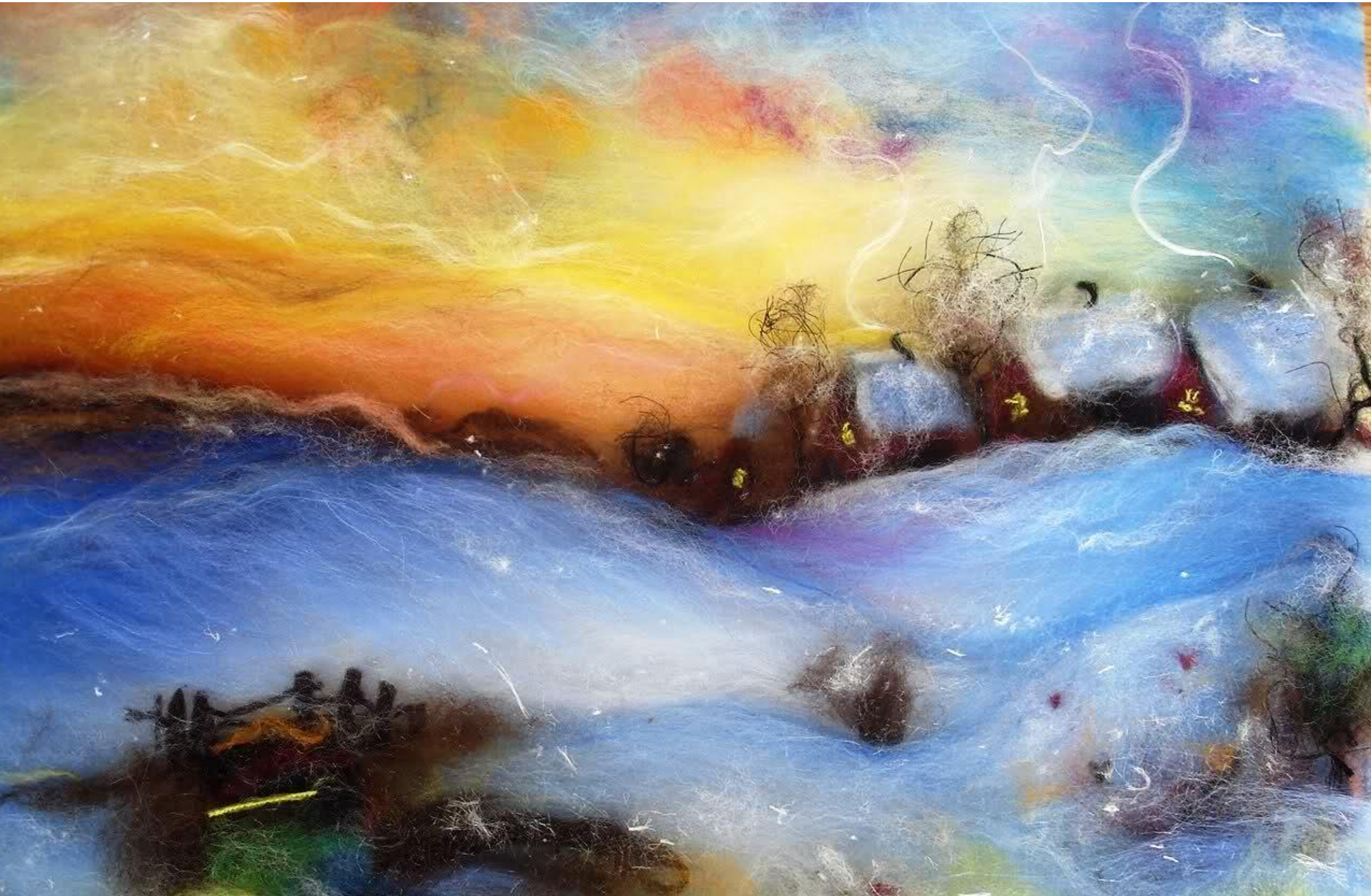
- You must exclude the day of the study receiving diuretics. Test performed during normal drinking regime and diet of the patient, advance preparation not required, but it is advisable to warn the patient that it is desirable that the amount of fluid in these days did not exceed 1-1,5 l. Violation of these conditions leads to the artificial increase in the number of detachable urine (polyuria) and reduced its relative density, which makes it impossible for the correct interpretation of the study results. For the same reason, the test in General is impractical in patients with diabetes insipidus and diencephalic disorders (stemming from pathology of the diencephalon).

Zimnitsky test results

- Normal concentration function of the kidneys is characterized by the ability increases during the day relative density of urine to the maximum values (over 1020), and normal ability to breed – the possibility of reducing the relative density of urine lower osmotic concentration (osmolarity) protein-free plasma, equal 1010-1012.

Zimnitsky test results

- In pathology the decrease of renal concentration function, and the ability to urine dilution may occur. The ability of kidneys to concentrate urine is reduced the maximum values of relative density, while none of the portions of urine during the trial in General, including at night, relative density does not exceed 1020 (hyposthenuria). This long time preserved the ability of the kidneys to dilute the urine, so the minimum relative density of urine can be achieved as in the norm, 1005.
- Reduction of renal concentrating ability leads to lower relative density of urine (hyposthenuria) and increase the amount of urine (polyuria).



Zimnitsky test results

- Low density of urine and its small fluctuation during the day can depend on extrarenal factors:
- - if there is swelling of the density fluctuations can be reduced;
- - prolonged adherence to a protein-free and salt-free diet is the density of urine can also stay during the day at low figures;

low density of urine, with small fluctuations (1000-1001), with occasional climbs up 1003-1004 is observed in diabetes insipidus.

Zimnitsky test results

- Significantly less often in the clinic there is an increase in the relative density of urine, detected during the trial in General. The reasons for this increase are: a pathological condition accompanied by decreased renal perfusion with preserved renal concentrating ability (congestive heart failure, the initial stage of acute glomerulonephritis), etc.; diseases and syndromes accompanied by severe proteinuria (nephrotic syndrome); conditions associated with fluid loss; diabetes mellitus occurring with severe glycosuria; toxemia of pregnancy.

Nechiporenko test

- **The urine analysis offered by Nechiporenko •**
- A urine analysis by Nechiporenko is laboratory examination of urine, with which the doctor can assess the condition of the kidneys and urinary tract.
- • Analysis of urine Nechiporenko usually appointed after the General analysis of urine, if in the clinical analysis identified deviations from the norm. Analysis of urine on Nichiporenko allows better understanding of these disorders for a proper diagnosis. With this analysis the doctor can also monitor the effectiveness of the treatment.
- • After a careful toilet of genitals collect the middle portion of urine: first, the number of allocated urine (15-20 ml) is passed, and the average portion of morning urine is placed in a prepared clean container.
- • For analysis of urine Nechiporenko use 1 ml of commissioned patient urine samples and count the number of components of urine (1 ml) of erythrocytes, leukocytes and cylinders

Nechiporenko test

- **Standards for the analysis of urine by Nechiporenko:**
- **• – red blood cells – no more than 1000; leucocytes – not more than 2000; cylinders – no more than 20.**
- **•   Increase of those or other corpuscles can confirm or deny the results of urinalysis tests. The conducted research provide the most accurate diagnosis.**

The urine analysis offered by Addis – Kakovsky

- For calculation of formed elements in the daily quantity by the method of Addis – Kakovsky`s restrict fluid intake in the period of the survey: the patient must not drink at night and drink less during the day. When this is standardised relative density of urine (1020-1025) and pH (5,5), which is very important for this analysis. Urine is collected over 10-12 hours. The patient urinates before going to bed (this urine is poured), notes the time and after 10-12 hours urinating in the prepared dishes. This portion of urine taken to the lab for analysis. If you are unable to hold urine for 10-12 hours, the patient urinates into prepared dishes in a number of techniques and notes time of last urination.

Addis - Kakovsky`s test results

- by the method of Addis – Kakovsky`s normal urine amounts to about 1 000 000 for erythrocytes, 2 000 000 for leucocytes, up to 20,000 cylinders in the daily quantity of urine.
- Some authors have reported different figures for the Addis – Kakovsky`s method: erythrocytes – up to 2-3 million, of leukocytes – up to 4 million, cylinders – up to 100 thousand.

Method of Amburge

- • In the study of this method the patient limit fluid intake in the afternoon and night eliminates. Urine is collected for 3 hours. In the morning the patient empties the bladder (urine is discarded), notes the time and exactly after 3 hours collect urine for research.
- • Amberge`s method belongs to methods of quantitative determination of formed elements in the urine. This is determined by the number of formed elements allocated with urine in 1 minute.

Amburge`s test results

- • Normally, the number of leukocytes in the urine minute volume is 2000, erythrocytes – 1000. Sometimes in the literature one can find other figures rules: blood in the urine minute volume – 2500, erythrocytes – 2000.

- Additional special tests of renal tubular function usually require research laboratories and are reserved for patients with specific problems. However, tests that measure plasma phosphate and urate, urinary amino acids, and urine pH are readily available and may prove useful in screening specific clinical problems.

Imaging procedure.

Plain x-ray of the abdomen

Plain x-ray of the abdomen (kidney, ureter, bladder [KUB] film) can demonstrate the size and location of the kidneys but has been superseded by ultrasonography (US). Because gastrointestinal and urinary diseases tend to mimic each other, KUB film may be helpful in the differential diagnosis. However, the renal outline can be obscured by bowel content, lack of perinephric fat, or a perinephric hematoma or abscess. This difficulty may be overcome by CT. Congenital absence of a kidney may be suggested.. If both kidneys are unusually large, polycystic kidney disease, amyloid disease, or hydronephrosis may be present. If both are small, the end stage of bilateral renal dysplasia or sclerosing disease (eg, glomerulonephritis, tubulointerstitial nephritis, nephroangiosclerosis) must be considered. Normally, the left kidney is 0.5 cm longer than the right.

Plain x-ray of the abdomen

- In 90% of cases, the right kidney is lower than the left because of displacement by the liver. The long axes of the kidneys are oblique to the spine and tend to parallel the borders of the psoas muscles. If both kidneys are parallel to the spine, the possibility of horseshoe kidneys should be considered. If only one kidney is displaced, a tumor or cyst may be present. Because x-ray film is two-dimensional, a calculus in the urinary tract is practically impossible to diagnose unless it is a staghorn calculus. However, suspicious opaque bodies may be noted in the region of the adrenal, kidney, ureter, bladder, or prostate. Oblique and lateral films and visualization of the urinary tract with 14 radiocontrast agents, US, or CT are necessary to place the calcification specifically within these organs.

- Fig.7. Plain X-ray of the kidney, ureter and bladder (KUB) is a useful initial investigation in many patients. Here it has revealed a rather unusual combination of calculi in both kidneys (more prominent on the right), in the lower right ureter (arrowed) and in a bladder diverticulum.

Intravenous urography

- Intravenous urography (IVU; excretory urography) is often used to visualize the kidney and lower) urinary tract (Fig.8)
- Studies are done by IV infusion of an iodinated benzoic acid derivative. The iodine provides radiopacity, while the benzoic acid is rapidly filtered by the kidney. A contrast agent, after IV injection, becomes concentrated in the renal tubules in <= 5 min, providing a nephrogram. Later, the contrast agent appears in the collecting system, outlining the renal pelvis, the ureters, and finally the bladder. Visualization depends on the concentration of the contrast agent in the kidneys and the urinary collecting system. Therefore, the best radiograms are obtained in patients with a normal GFR.

Intravenous urogram

- Fig 8.

Retrograde pyelography

- In retrograde pyelography, radiopaque agents similar to those used in IVU are introduced directly into the urinary tract after cystoscopy and catheterization of the ureter. Retrograde pyelography provides more intense opacification of the collecting and voiding system when IVU has been unsuccessful because of poor renal function, a nonvisualized kidney by IVU, upper urinary tract bleeding with normal IVU, or filling defect in the upper urinary tract.

Retrograde pyelogram

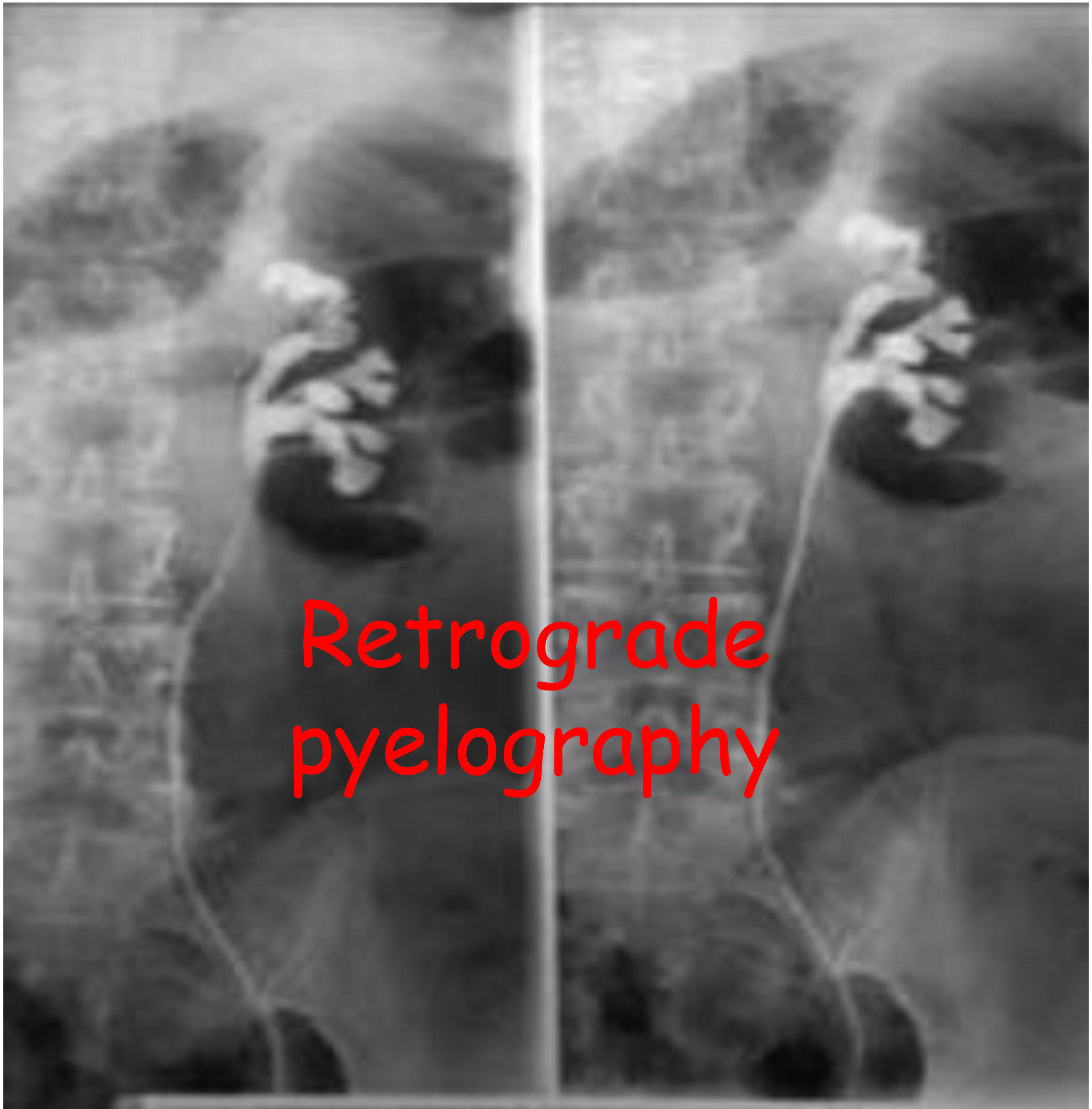


Figure-C: Filling defect in the left upper calyx.

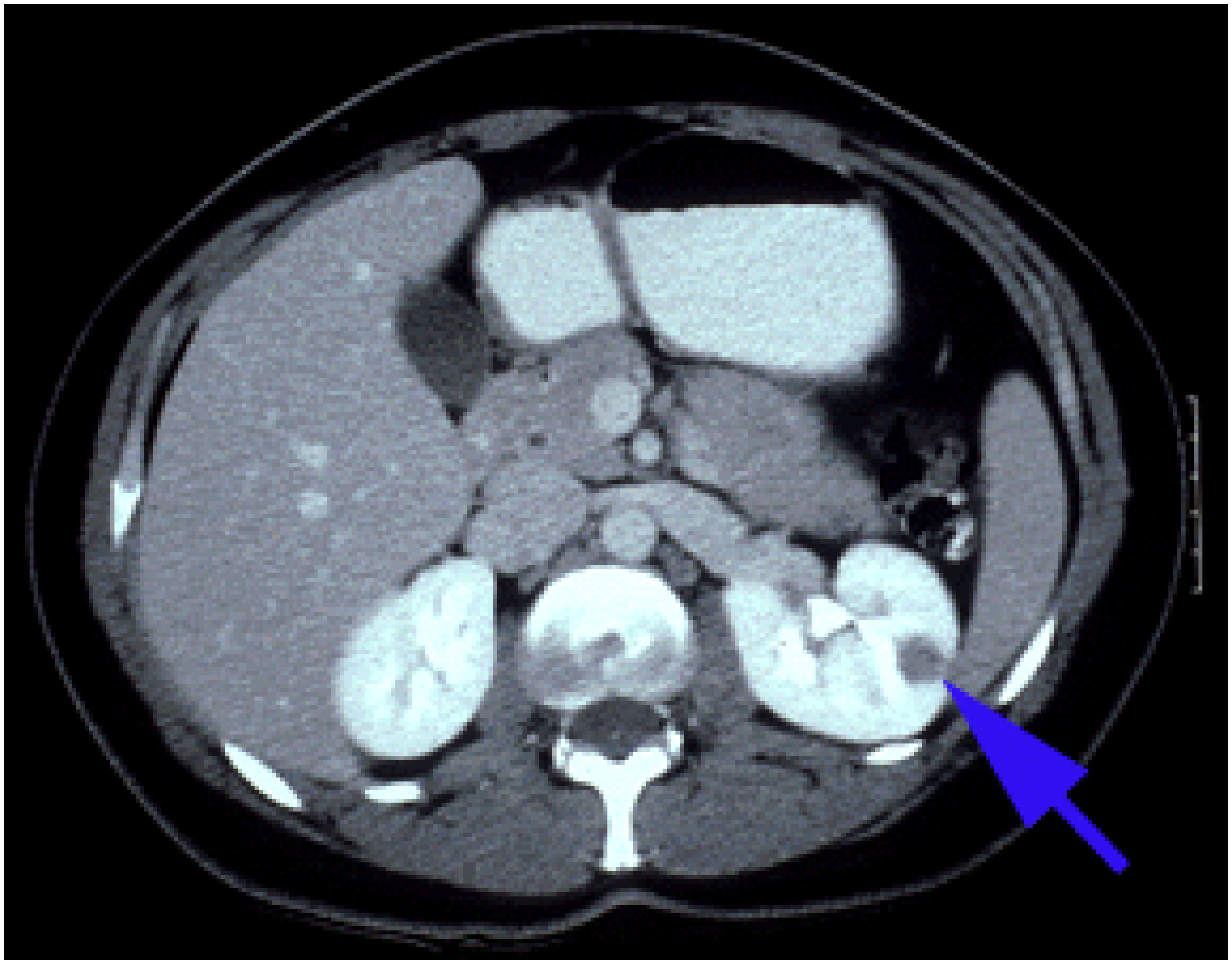
Anterograde pyelography

- In anterograde pyelography, radiocontrast agents are introduced into the renal pelvis by radiographic visualization. This procedure may be indicated when retrograde pyelography cannot be done because of inability to catheterize a ureter, severe bladder disease, ectopic or reimplanted ureter, or inability to inject radiocontrast above an obstructed site in a ureter.

Computer tomogram

- CT is more expensive than US and IVU. However, CT is most useful in evaluating the character and extent of renal masses or determining the cause of a retroperitoneal mass distorting the normal urinary tract (eg, an enlarged abdominal lymph node).

CT of kidney (Kidney cancer)



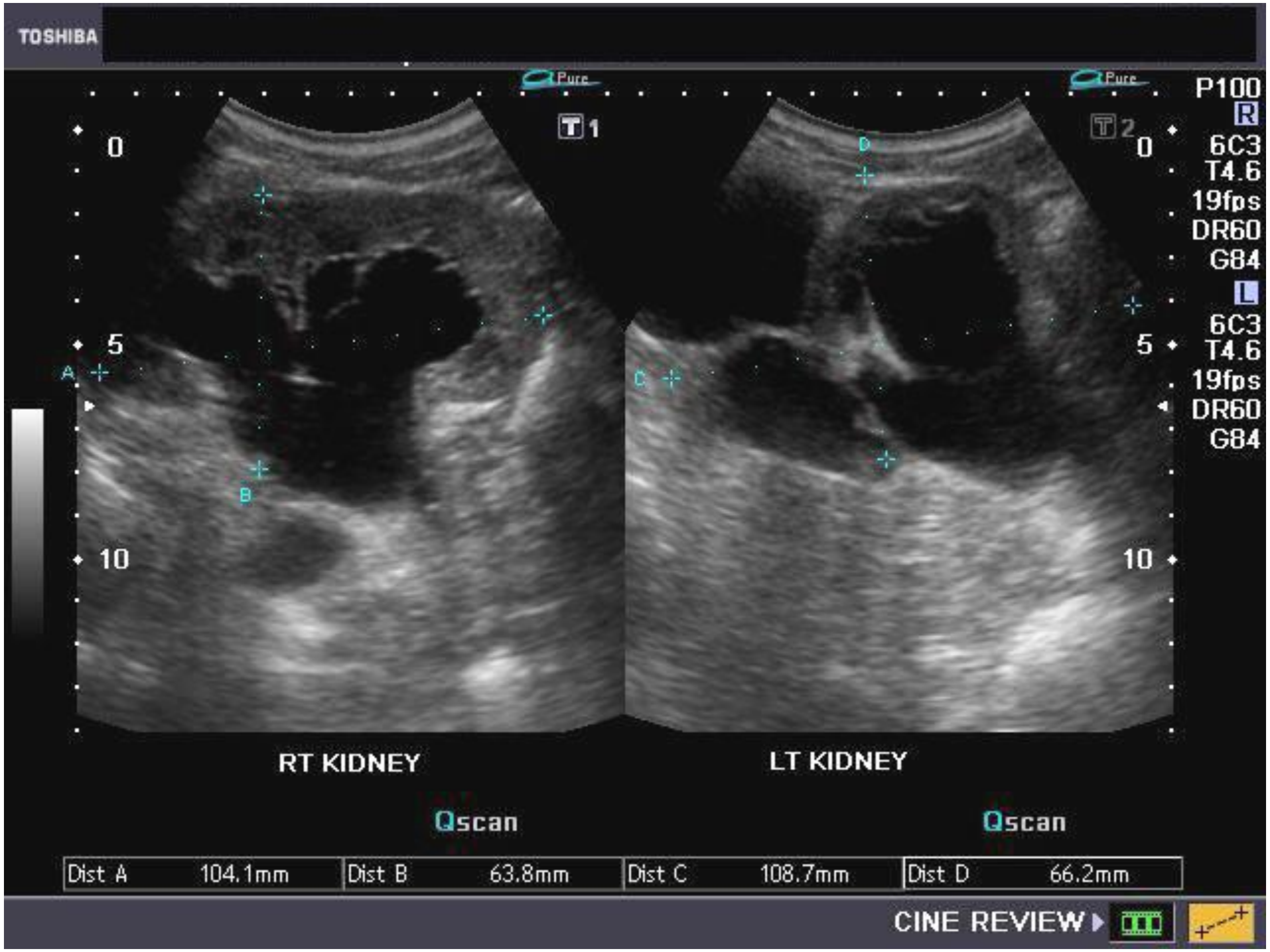
Angiography

- Angiography is the most invasive renal imaging procedure and is reserved for special indications. Angiography is best reserved for investigating possible vascular lesions (eg, aneurysm); it may also be useful for suspected renal hypertension; congenital renal anomalies of structure, position, or vascular supply.

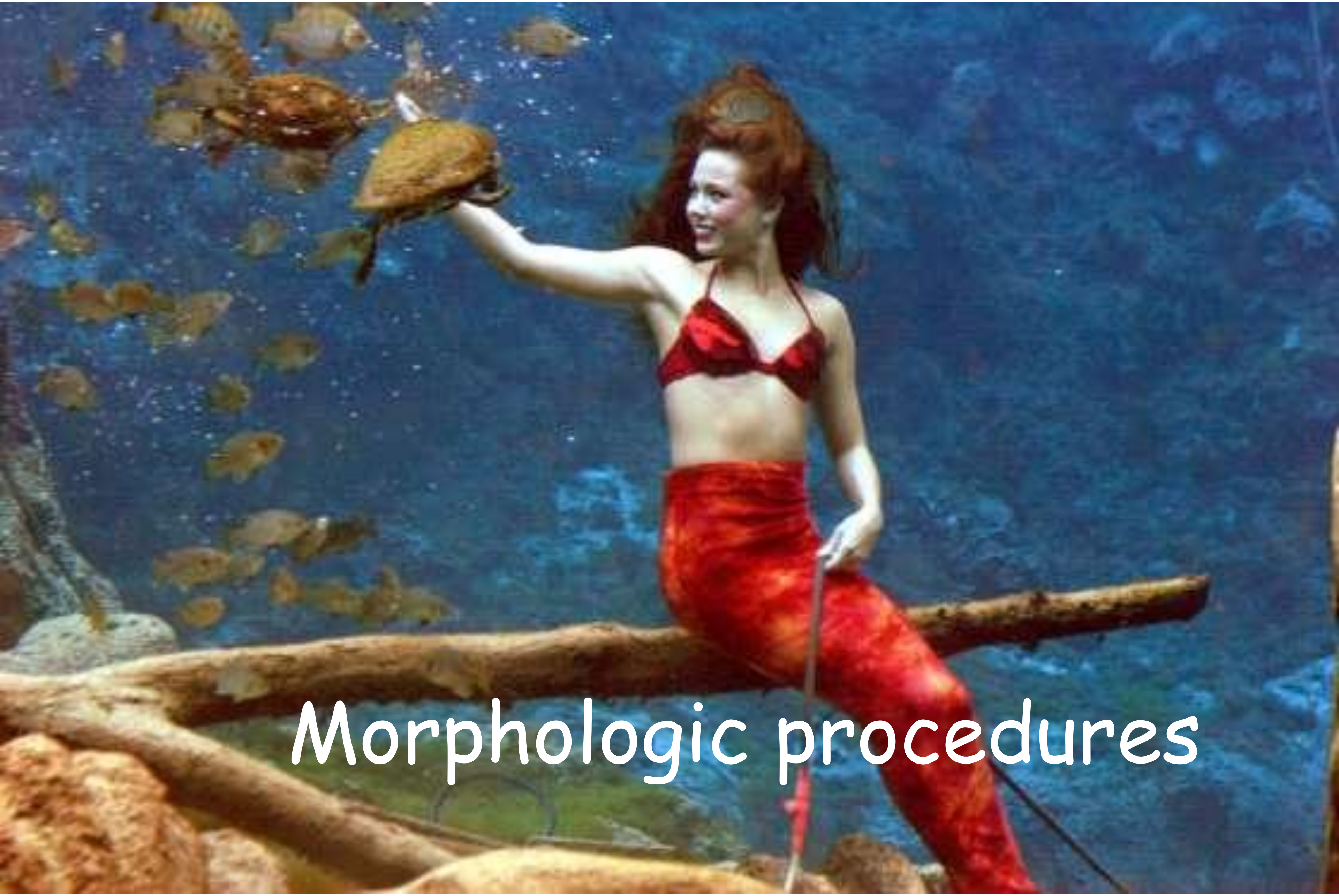
Renal arteriography (aorotography)

- **In venography,** the inferior vena cava is usually visualized for diagnostic purposes by percutaneous puncture of the femoral vein.
- **Ultrasonography (US),** a noninvasive, relatively innocuous technique, is advantageous in that visualization does not depend on function. The kidney can be effectively outlined and the pelvicalyceal echo pattern critically examined by scanning in multiple positions. US is particularly effective in diagnosing polycystic kidney disease, differentiating renal cysts and tumors, detecting hydronephrosis and perirenal fluid collections or intrarenal hemorrhage, estimating renal size and parenchymal thickness, and locating the optimal site for percutaneous renal biopsy or nephrostomy. US is the preferred diagnostic method in a uremic patient when uptake of contrast agent or isotope is impaired. Doppler US may show patency of arteries and veins and the amount and speed of blood flow, which is useful in evaluating kidney transplant patients or selected patients with hypertension.

Ultrasound of kidney



- The urine-filled bladder is readily outlined by US. Normally, bladder wall contour changes depend on the amount of urine present. MRI offers information about renal masses that cannot be determined by other techniques. It allows direct imaging in the transverse, coronal, and sagittal planes. Morphologic data are obtained from three-dimensional reconstruction of the tissue.
- **MRI** with contrast using gadolinium pentetic acid administered by bolus injection and rapid sequence imaging is increasingly used. This technique provides information about GFR and tubular function.


Morphologic procedures

Morphologic procedures

- **Renal biopsy** is performed to establish a histologic diagnosis, help estimate prognosis and the potential reversibility or progression of the renal lesion, estimate the value of therapeutic modalities, and determine the natural history of renal diseases. The only absolute contraindication to biopsy is uncontrollable bleeding.
- For the percutaneous technique the patient is sedated, and the kidney is visualized by radiography or US. With the patient in the prone position, after the overlying skin and muscles of the back are anesthetized, the biopsy needle is inserted and tissue is obtained for light, electron, and immunofluorescent microscopy.
- Urine cytology is useful in screening for possible urinary tract neoplasia in highrisk populations (eg, petrochemical workers, patients with painless hematuria from nonrenal causes) and in following patients after resection of bladder tumors.


THANK YOU !