Focused Renal and Urinary Assessment

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Purpose

The multiple roles that our urinary tract and kidneys play are incredibly important in maintaining homeostasis within our bodies. This course will discuss specific renal and urinary history questions and exam techniques for an adult patient.

Throughout the course, you will learn how alterations in your renal and urinary assessment findings could indicate potential renal or urinary problems.

Introduction

The renal and urinary system is critical to the function of the entire body. An accurate assessment will help to ensure that any impact on the renal system is recognized and addressed to prevent damages to the kidneys or other components of the urinary system.

Glossary

Definitions from *Tabers®* dictionary (Venes, 2017) and *Mosby's* dictionary (Mosby Co., 2016)

Term	Description
Adrenal glands	Triangle-shaped glands located on top of the kidneys.
Aerobic	Taking place in the presence of oxygen.
Afferent	Transporting toward a center; opposite of efferent.
Anaerobic	Taking place in the absence of oxygen.
Anuria	Complete suppression of urine formation and excretion.
Ascend	To move from the lower part of the body toward the head; to move in a cephalic direction.
Asterixis	A motor disturbance marked by intermittent lapses of an assumed posture as a result of intermittency of sustained contraction of groups of muscles.
Atonic	Relating to, caused by, or exhibiting lack of muscle tone.
Autoregulation	Control of an event such as blood flow through a tissue by alteration of the tissue.
Azotemia	An excess of urea or other nitrogenous compounds in the blood; see also uremia.
Bladder calculi	Stones in the urinary bladder; also known as vesical calculi, bladder stones, or cystoliths.
Blood urea nitrogen (BUN)	A waste product that is formed in the liver and collects in the bloodstream.
Bowman's capsule	Part of the renal corpuscle. It consists of a visceral layer of podocytes closely applied to the glomerulus and an outer parietal layer. The podocyte layer is part of the filter for the formation of renal filtrate in the space between the two layers.
Catabolism	The metabolic breakdown of complex molecules into simpler ones, often resulting in a release of energy.
Creatinine	An anhydride of creatine, the end product of phosphocreatine metabolism; measurements of its rate of urinary excretion are used as diagnostic indicators of kidney function and muscle mass.
Diabetes insipidus	An uncommon condition that occurs when the kidneys are unable to conserve water as they perform their function of filtering blood.

Diabetes mellitus	A condition in which the pancreas no longer produces enough insulin or cells stop responding to the insulin that is produced.
Diffusion	The tendency of the molecules of a substance (gas, liquid, or solid) to move from a region of high concentration to one of lower concentration.
Diuresis	Increased excretion of urine.
Duct	A narrow enclosed channel containing a fluid.
Efferent	Carrying away from a central organ or section; opposite of afferent.
Embolus	A mass of clotted blood or other material brought by the blood from one vessel and forced into a smaller one, obstructing the circulation.
Endocrine	Pertaining to a gland that secretes directly into the bloodstream.
Erythropoietin	A cytokine made by the kidneys that stimulates the proliferation of red blood cells.
Extracellular fluid	Fluid outside the cell.
Glomerular filtration rate	The rate of urine formation as plasma passes through the glomeruli of the kidneys.
Glomerulonephritis	A form of nephritis characterized by inflammation of the renal glomeruli.
Glomerulus	One of the capillary networks that are part of the renal corpuscles in the nephrons of the kidney. Each is surrounded by a Bowman's capsule, the site of renal (glomerular) filtration, which is the first step in the formation of urine.
Hematocrit	A measure of the packed cell volume of red cells, expressed as a percentage of the total blood volume.
Hematuria	Blood in the urine.
Hepatorenal syndrome	A condition in which acute renal failure occurs with disease of the liver or biliary tract, the cause of which is believed to be either a decrease in renal blood flow or damage to both the liver and the kidneys; also called hepatonephric syndrome.
Hydrostatic pressure	The pressure exerted by a liquid.
Hypervolemia	Increased volume of circulating blood in the body.
Hypothalamus	Brain structure that monitors internal environment and attempts to maintain balance of these systems. Controls the pituitary gland.
Hypovolemia	Diminished volume of circulating blood in the body.
Intracellular fluid	Fluid within a cell.
Kidney	One of a pair of purple-brown organs situated at the back (retroperitoneal area) of the abdominal cavity; each is lateral to the spinal column. The kidneys form urine from blood plasma. They are the major regulators of the water, electrolyte, and acid-base content of the blood and, indirectly, all body fluids.
Kussmaul’s respirations	An abnormal respiratory pattern characterized by rapid, deep breathing.
Loops of Henle	The U-shaped portion of a renal tubule lying between the proximal and distal convoluted portions. It consists of a thin descending limb and a thicker ascending limb.
Lymphatic	Pertaining to lymph and to the system of endothelial vessels that carry it.
Nephritis	Acute or chronic inflammations of the kidneys.
Nephron	The structural and functional unit of the kidney, consisting of a renal (malpighian) corpuscle (a glomerulus enclosed within Bowman's capsule), the proximal convoluted tubule, the loop of Henle, and the distal convoluted tubule. These connect by arched collecting tubules with straight collecting tubules. Urine is formed by filtration in renal corpuscles and selective reabsorption and secretion by the cells of the renal tubule. There are approx. one million nephrons in each kidney.
Nephrotoxic	Toxic, or damaging, to the kidney.
Nocturia	Excessive urinating at night.
Oliguria	Diminished urine production and excretion in relation to fluid intake.
Osmolality	The concentration of a solution in terms of osmoles of solute per kilogram of solvent.

Peristalsis	A progressive wavelike movement that occurs involuntarily in hollow tubes of the body, esp. the alimentary canal. It is characteristic of tubes possessing longitudinal and circular layers of smooth muscle fibers.
Posterior	In human anatomy, pertaining to or located at or toward the back; dorsal. In human anatomy, "caudal," "dorsal," and "posterior" mean the same thing.
Prostatitis	Inflammation of the prostate gland.
Pyelonephritis	Inflammation of the kidney and its pelvis, caused by bacterial infection.
Reabsorption	The process of absorbing again. It occurs in the kidney when some of the materials filtered out of the blood by the glomerulus are reabsorbed as the filtrate passes through the nephron.
Renal	Pertaining to the kidney.
Renal corpuscle	A glomerulus and Bowman's capsule of the nephron of a kidney, the site of glomerular filtration.
Renal cortex	The outer layer of an organ (kidney) as distinguished from the inner medulla.
Renal medulla/pyramid	The inner mass of the kidney consisting of 5 to 11 conical renal pyramids separated by renal columns. The renal pyramids contain the loops of Henle and the collecting ducts. The renal columns contain interlobar arteries and veins.
Renal pelvis	Any basin-shaped structure or cavity; pertaining to kidneys.
Sediment	A precipitate, especially one that formed spontaneously.
Stricture	An abnormal narrowing or tightening of a body passage.
Sympathetic	Pertaining to the sympathetic nervous system.
Tubule	A small tube or canal.
Urea	A normal metabolic waste product from protein metabolism.
Uremia	The presence of excessive amounts of urea and other waste products in the blood.
Ureter	The tube that carries urine from the kidney to the bladder. It originates in the pelvis of the kidney and terminates in the posterior base of the bladder.
Urethra	The tube for the discharge of urine extending from the bladder to the outside.
Urinary bladder	A muscular, membranous, distensible reservoir that holds urine situated in the pelvic cavity. It receives urine from the kidneys through the ureters and discharges it from the body through the urethra.
Urinary stasis	Stoppage of the flow or discharge of urine, at any level of the urinary tract.
Urinary tract infection	An infection of the kidney, ureter, bladder, and/or urethra.
Urinary tract obstruction	Blockage or constriction at any point in the urinary tract that impedes the normal flow of urine and causes urine to be retained in the bladder or kidneys.
Urine	The fluid and dissolved solutes (including salts and nitrogen-containing waste products) that are eliminated from the body by the kidneys.
Urochrome	The end product of hemoglobin breakdown.

History and Physical Examination

According to the Centers for Disease Control and Prevention (CDC), kidney disease is the ninth leading cause of death in the United States, with more than 30 million adults who are living with chronic kidney disease (CDC, 2019). Diabetes and high blood pressure (hypertension) are the leading causes of kidney failure, with an estimated one in three adults with diabetes and one in five with hypertension developing kidney disease (CDC, 2017).

History and Physical Examination
Early treatment of renal failure makes a difference. As part of the focused assessment, healthcare professionals need to recognize who is at risk and provide information to the physician that will ensure appropriate testing. In conjunction with gathering information about a patient's history of hypertension and diabetes, healthcare professionals should also be aware that heredity can contribute to the possibility for developing renal and urinary disease (CPM Resource Center, 2016a & b).

Communication during the history and physical must be respectful and performed in a culturally-sensitive manner. Privacy is vital, and the healthcare professional needs to be aware of posture, body language, and tone of voice while interviewing the patient (Jarvis, 2016). Take into consideration that a patient's ethnicity and culture may affect the history that the patient provides.

Health History

When conducting a health history for a healthy adult patient, always remember to ask focused renal/urinary questions.

Focused questions, no matter when asked, can alert you to potential renal or urinary problems.

Some of the renal or urinary system-focused questions to ask your patients include:

- Do you urinate more than usual (frequency, urgency, nocturia)?
- Any pain or burning upon urination?
- Any difficulty starting or maintaining the stream of urine?
- Any blood in your urine?
- Any difficulty controlling your urine?

(Jarvis, 2016)

The Assessment

Patients with renal or urinary problems will often complain about frequent, difficult or painful urination, or blood in their urine. When your patient verbalizes these complaints, refer to this information to help you focus your assessment.

Symptom: Frequent Urination
More questions to ask:
Have you increased the amount of fluid you are drinking?
What is your daily caffeine intake?
Any nausea, vomiting, or diarrhea?
Any history of diabetes in your family?

What medications do you take?
Is your urine dark or light-colored?
What is the volume of urine you pass each time?
Do you have any pain on urination?

Examination tips:
Assess skin turgor for dehydration, which may accompany diabetes or diuretic use.
Palpate abdomen for bladder distention.
Inspect urine specimen for color and odor.

Possible cause:
Urinary tract infection
Urinary tract obstruction
Prostatitis
Urinary retention
Excessive fluid intake
Alcohol or caffeine consumption
Diabetes mellitus
Diabetes insipidus
Bladder calculi
Bladder cancer
(Jarvis, 2016)

Symptom: Difficult or Painful Urination
More questions to ask:
Do you have difficulty starting or maintaining the stream of urine?
Any pain with or after urination?
What is your normal daily fluid intake?

Examination tips:
Inspect urine for signs and symptoms of infection (clarity, odor).
Palpate abdomen for signs of bladder distention.

Possible cause:
Urinary tract infection
Urinary tract obstruction
Urethral obstruction
Bladder calculi
Prostatitis
Sexually transmitted disease
(Jarvis, 2016)

Symptom: Hematuria

More questions to ask:
Does the blood appear at the beginning, end, or throughout urination?
Any new bruises or bleeding from gums?
What medications do you take?
Any changes in exercise pattern?
Any recent abdominal trauma?
Any recent sore throat or infection?

Examination tips:
Assess skin for signs of bruising or petechiae.
Assess abdomen for trauma.
Palpate abdomen for masses.

Possible cause:
Renal cell carcinoma
Trauma to the kidney
Thrombocytopenia
Bladder infection
Renal calculi
Glomerulonephritis
Anticoagulant use
Smoking
Strenuous exercise
(Jarvis, 2016)

Patients with Alteration in Renal Function

When assessing a patient with a history of renal dysfunction, **determine the degree of renal dysfunction** they are experiencing and current treatment modalities they are using.

Ask your patient about the following:

- ❒ What treatments or tests have you received for your illness (medications, x-rays, chemotherapy, dyes)?
- ❒ Current medication list?
- ❒ Diet?
- ❒ Sleep disturbances?
- ❒ Habits?
- ❒ General weakness, fatigue, lethargy, or headaches?
- ❒ Dry, flaky, gray-bronze coloration to skin?
- ❒ Bruise easily?
- ❒ Delayed wound healing time?
- ❒ Dry, brittle hair and nails?

- ❒ Hypertension, palpitations, or chest pain?
- ❒ Ulcerations, edema, or peripheral vascular disease?
- ❒ Heartburn, nausea, or vomiting?
- ❒ Constipation or diarrhea?
- ❒ Polyuria, nocturia, and urine output?
- ❒ Asterixis (a flapping type of tremor, usually of the wrist)?
- ❒ Decreased pedal pulses?
- ❒ Decreased hearing, generalized weakness, or decreased reflexes?

(Jarvis, 2016)

Test Your Knowledge

When a patient complains of urinary symptoms, such as frequent urination, which examination technique should be performed?

a. Assess skin turgor for dehydration.
b. Palpate abdomen for bladder distention.
c. Inspect urine specimen for color and odor.
d. All of the above.

Urinalysis

Urinalysis can indicate pathology of the urinary tract and may identify metabolic abnormalities as well. Review the following components of the urinalysis and learn which abnormal values may be indicative of urinary dysfunction.

Color: Urochrome gives urine its color. Factors that may alter color include specific gravity, foods, bilirubin, and drugs (e.g. the medication pyridium causes orange stains that are permanent).

Character: If urine is cloudy or hazy instead of normally clear, it may be due to white blood cells, bacteria, fecal contamination, prostatic fluid, or vaginal secretions.

Specific gravity: The weight of urine. A low specific gravity indicates dilute urine and a high specific gravity indicates concentrated urine. Normal values are 1.015-1.030.

pH: Changes seen with acid base imbalances. Values will increase with urinary tract infections and if the specimen is old. Normal values are 6.5-7.5.

Glucose: The renal threshold for glucose is 160-180 mg/dL. Pregnancy, endocrine, and renal problems can lower the renal threshold for glucose and then glucose spills over more easily.

Ketones: Ketones are a product of fat metabolism. Causes of ketonuria include diabetic ketoacidosis (DKA), starvation, fasting, vomiting, strenuous exercise, and dehydration.

Protein: Benign conditions that increase protein in urine are stress, pregnancy, cold, fever, strenuous exercise, and vaginal secretions. Non-benign conditions are hypertension, diabetes (renal damage), post-renal infection (renal damage), and multiple myeloma (serum and urine protein elevated, albumin/globulin ratio abnormal).

Bilirubin: Bilirubin in urine is water-soluble. When bilirubin is present in the urine, it is usually due to a hepatobiliary obstruction.

Urobilinogen: Normal in urine. When decreased or absent, it may be due to hepatobiliary duct obstruction. Increased urobilinogen may mean liver damage or hemolytic disease.

Blood: If positive, urine is usually cloudy. If a dipstick is positive, the urine must be examined microscopically in the lab for:

- Red blood cells (RBCs) (due to urinary tract infection, pyelonephritis, glomerulonephritis, renal cancer, bladder cancer, strenuous exercise, or menses)
- Myoglobin (due to myocardial infarction, trauma, crush injuries, or burns)
- Hemoglobin (due to transfusion reaction, sickle cell, disseminated intravascular coagulation, or hypertension)

Nitrite: Bacteria is broken down into urinary nitrites and nitrate. Nitrites are positive when bacteria are in urine.

Leukocyte esterase: Reflects presence of white blood cells. Positive findings suggest urinary tract infection.
Bacteria: If positive, suspect either your patient has a urinary tract infection or the specimen was contaminated.

RBCs (red blood cells): If > 5 million/uL, consider glomerulonephritis, pyelonephritis, renal trauma, tumor, kidney stones, cystitis, or genitourinary malignancy.

WBCs (white blood cells): If > 50,000/uL, suspect urinary tract infection. If < 50, it is usually due to exercise, fever, renal disease, or urinary tract disease.

Epithelial cells: When present in large to moderate amounts, consider either acute tubular necrosis or acute glomerulonephritis.

Casts: When present may be due to nephrotic syndrome, glomerulonephritis, kidney failure, or renal malignancy.

Epithelial cells and casts: Line the renal tubules & slough off in kidney infections

(Burns & Delgado, 2019; Rush Medical University Center, 2019).

Test Your Knowledge

Fill in the blank: Nitrites are positive when _____ are in the urine.

Answer: Bacteria

Examples of Common Renal and Urinary Disorders: Pyelonephritis

Diagnosis is made with a urine test to identify bacteria and formations of white blood cells, called casts, shaped like tubes in the kidney, ureters, and bladder. A kidney infection is treated with an appropriate antibiotic, and abnormalities may need to be surgically treated. An untreated or recurrent kidney infection can lead to chronic pyelonephritis, scarring of the kidneys, and permanent kidney damage (National Institute of Diabetes and Digestive and Kidney Diseases, 2019).

Pyelonephritis, commonly known as a kidney infection, usually occurs from bacteria that have spread from the bladder.

Possible causes of pyelonephritis include the following:

Bladder infections
Use of a catheter to drain urine
Use of a cystoscope to examine the bladder and urethra
Surgery on the urinary tract
Conditions such as prostate enlargement and kidney stones that prevent the flow of urine from the bladder

Signs and symptoms include:

Back, side, and groin pain
Urgent, frequent urination
Pain or burning during urination
Fever
Nausea and vomiting
Pus and blood in the urine.

Examples of Common Renal and Urinary Disorders: Kidney Stones

A kidney stone is a hardened mass that has developed from crystals that separate from the urine and build up on the inner surfaces of the kidney.

Normally, urine contains chemicals that inhibit the crystals from forming. Kidney stones may contain various combinations of chemicals; the most common type of stone contains calcium in combination with either oxalate or phosphate. If the crystals remain small enough, they will travel through the urinary tract and pass out of the body in the urine without causing symptoms. (National Institute of Diabetes and Digestive and Kidney Diseases, 2019).

Possible causes of kidney stones include the following:

Dietary factors, such as high calcium or oxalate
Gastric bypass surgery
Metabolic disorders
Urinary tract infection
Dehydration
Gout
Hereditary disorders

Signs and symptoms include:

Pain: The first symptom of a kidney stone is usually extreme pain, which occurs when a stone acutely blocks the flow of urine. Typically, a person feels a sharp, cramping pain in the back and side in the area of the kidney or in the lower abdomen.

Nausea and vomiting

Hematuria: If the stone is too large to pass easily, pain will continue as the muscles in the wall of the ureter try to squeeze the stone along into the bladder. As a stone grows or moves, blood is likely to appear in the urine

(National Institute of Diabetes and Digestive and Kidney Diseases, 2019).

Did You Know?
Uric acid normally breaks down in the blood, is processed through the kidneys, and excreted. Gout is a disorder where uric acid builds up in the blood rather than being excreted. The uric acid forms crystals in the joints, which causes pain. When uric acid builds up in the kidneys, kidney stones can form (National Kidney Foundation, 2019).

Kidney and Renal Pelvis Cancer

Approximately 16.1 people out of every 100,000 are newly diagnosed with kidney or renal pelvis cancer each year in the United States.

Kidney and renal pelvis cancer makes up 3.8% of cancers in adults in the U.S., and compose 2.4% of all cancer-related deaths. It is currently estimated that 74.8% of patients with kidney and renal pelvis cancer survive five years (National Cancer Institute, 2019).

Risk factors include:
- Male gender
- Smoking
- Age over 50 years
- Chemical exposure
- Obesity
- History of stones in bladder or kidney
- History of parasitic infections

Symptoms of bladder and kidney cancer are similar:
- Blood in the urine
- Pain may or may not be present- flank pain, pain with urination (dysuria)
- Frequency of urination
- Urgency
- Fever
- Weight loss

(National Institute of Diabetes and Digestive and Kidney Diseases, 2019)

Assessment of Renal Dysfunction

In order to determine the degree of renal dysfunction your patient is experiencing, you must first evaluate whether the patient is experiencing **acute renal failure or chronic renal failure**.

You will need to identify the signs and symptoms associated with varying types and degrees of renal failure in order to individualize a plan of care for all of your patients.

Acute Renal Failure

Acute renal failure is defined as any sudden severe impairment or cessation of kidney function characterized by electrolyte imbalances and an accumulation of fluid and nitrogenous wastes (CPM Resource Center, 2016a).

Acute renal failure is potentially reversible if caught and treated in time. There are three categories of acute renal failure:

- Pre-renal
- Renal
- Post-renal

Acute Renal Failure - Pre-renal Failure

Pre-renal failure can be described as any process that significantly decreases renal perfusion.

With pre-renal failure, the kidneys themselves are not damaged. Pre-renal causes of renal failure usually occur by reduced glomerular filtration. This may be due to vasoconstriction or a reduction in mean arterial pressure. It may be from a local cause such as a thrombus, embolus, surgery, or hepatorenal syndrome.

Other systemic causes of pre-renal failure include:
Hypovolemia
Burns
Cardiac failure
Medications such as peripheral vasodilators
Septic shock
(CPM Resource Center, 2016a)

With pre-renal failure you may see:

- Oliguria: (<400 mL in 24 hours).
- Fluid volume deficit: hypotensive, tachycardia, flat jugular veins, lethargy.
- Altered hemodynamics: hypotension, tachycardia, peripheral and systemic edema, and low cardiac output.

Lab Finding	Rationale
↓ Urine sodium (Na) (<10-15 mEq/24 h) (Normal 22-40 mEq/24 h)	Tubule reabsorbs sodium and water in an effort to maintain effective blood volume. Value is not reliable if your patient is taking loop or osmotic diuretics because these medications increase urine sodium values.
↑ Specific gravity: (>1.015) (Normal 1.015-1.030)	The body is trying to hold onto water to maintain blood pressure so the urine is more concentrated.
BUN ↑ (Normal 10-26 mg/dL)	BUN is the best indicator of renal perfusion.

Creatinine slightly elevated (Normal 0.6-1.3 mg/dL)	Best indicator of tubular function. It slowly increases as failure progresses.
↑ Urine osmolality: (>500 mOsm/kg) (Normal 600-1400 mOsm/kg)	This is indicative of concentrated urine.
Urine sediment: Normal (Normal: none)	Tubules are intact, so there is no abnormal sediment in sample

(CPM Resource Center, 2016a; Rush Medical University Center, 2019)

Acute Renal Failure Patient Care Complications

When your patient is experiencing acute renal failure, assess for potential life-threatening complications according to which phase of renal failure they are exhibiting.

The following table summarizes life-threatening assessment findings you may note in the oliguric phase of renal failure:

Potential Complication	Assessment Findings
Change in fluid status or distribution	Pulmonary edema, peripheral edema, congestive heart failure CHF
Fluid overload	Pulmonary edema, peripheral edema, CHF, daily weights increase
Electrolyte changes	↑ Phosphate ↓ Calcium ↑ Magnesium ↓ Sodium ↓ Potassium
Infection (uremia depresses cellular immune response)	↑ temperature, WBC and differential changes, altered skin integrity, urinary catheters and pulmonary sites frequent areas for infection
Altered acid base balance	Usually respiratory acidosis - mental changes, Kussmaul's respirations, ↓ arterial pH and ↓ arterial bicarbonate levels
Tissue catabolism	↑ BUN, ↑serum protein, ↑ serum albumin with no parenteral nutritional support
Build up of toxins	Nervous system dysfunction, peripheral neuropathy, seizures, uremic frost (build up of urea that deposits white crystals in and on the skin), pericarditis,
Anemia or bleeding	↓ erythropoietin, impaired platelets, ↓ hemoglobin and hematocrit (hematocrit may be increased initially due to hemoconcentration)
GI malfunction	Anorexia, diarrhea or constipation, stomatitis, gastritis, nausea, vomiting

(CPM Resource Center, 2016a; Rush Medical University Center, 2019)

Test Your Knowledge

Which lab value is the best indicator of renal perfusion?

a. Osmolality
b. Specific gravity
c. BUN

Acute Renal Failure - Intra-renal Renal Failure

Causes of acute intra-renal failure are usually due to cellular changes resulting from nephrotoxic agents that reduce renal function. Ischemia may cause intra-renal failure to occur when perfusion to the kidney is decreased below a mean arterial pressure of 60-70 mmHg in the afferent arterioles. Acute glomerulonephritis and other infectious processes that may damage the glomerular membrane may also cause intra-renal failure. Acute tubular necrosis is the most common type of intra-renal failure seen in critical care settings (CPM Resource Center, 2016a).

Signs and Symptoms The clinical presentation of a patient in intra-renal failure is similar to the patient in the pre-renal stage of acute renal failure. The patient may or may not be oliguric. Nephrotoxic causes of intra-renal failure will often result in non-oliguric failure and the patient will have a better recovery with less fluid and electrolyte abnormalities. Nephrotoxins that have caused ATN may mimic pre-renal failure, especially in the very young and elderly, due to the increased sensitivity of their nephrons to glomerular flow rates (CPM Resource Center, 2016a).

Acute Tubular Necrosis

Acute tubular necrosis (ATN) is characterized by destructive changes in the tubular epithelium due to ischemia or exposure to nephrotoxins. You may need to ascertain which phase of ATN your patient is experiencing.

There are four phases of ATN.

1. **Phase one: Onset**
   This is the pre-renal phase when blood flow to the nephrons is diminished.
2. **Phase Two: Oliguric**
   This phase usually occurs within two days of the insult and may last one to two weeks.
3. **Phase Three: Diuretic**
   Urine output generally increases during this phase. Urine output may be up to 125 mL/hour. You may even need to think about volume replacement for your patient in this phase. This phase usually indicates returning tubular function. The tubules are still healing however, and cannot yet concentrate urine. This phase also usually lasts one to two weeks.
4. **Phase Four: Recovery**

When diuresis slows, recovery phase begins. It may take up to two years for the kidneys to completely recover.

Associated Laboratory Findings in Intra-renal Renal Failure:

Lab Finding	Rationale
Urine Na (> 30 mEq/24h) (Normal 22-40 mEq/24h)	Tubules have lost their ability to retain sodium.
Specific gravity: (<1.010) (Normal 1.015-1.030)	Tubules lose their ability to concentrate urine.
BUN >25 mg/dL (Normal 10-26 mg/dL)	Buildup of nitrogen occurs.
Creatinine ↑ (Normal 0.6-1.3 mg/dL)	Tubules are no longer able to reabsorb.
Urine osmolality: (<350 mOsm/kg) (Normal 600-1400 mOsm/kg)	Reflects dilute urine.
Urine sediment: RBC casts and cellular debris (Normal: none)	Reflects damage to tubular structures.
BUN/creatinine ratio <20:1 (Normal 10:1-20:1)	BUN and creatinine now rise at the same rate. Creatinine may not rise as high in the critically ill.

(CPM Resource Center, 2016a; Rush Medical University Center, 2019)

The following table summarizes life-threatening assessment findings you may note in the diuretic phase of renal failure:

Potential Complication or Assessment Findings	Signs/Symptoms related to assessment findings
Fluid loss	Hypotension, tachycardia, orthostatic changes Daily weights decrease
Electrolyte changes	↓ or ↑ potassium (depends on rate of excretion) ↓ Phosphate ↓ Calcium

(CPM Resource Center, 2016a; Rush Medical University Center, 2019)

Interactive Activity

Match the phase of ATN with the correct description:

Phase One	Oliguric phase; occurs within two days of the insult

Phase Two	Diuretic phase; increased urine output, lasting one to two weeks
Phase Three	Onset phase; blood flow to nephrons is diminished
Phase Four	Recovery phase; up to two years for kidneys to completely recover

Answers:
Phase One= Onset phase;
Phase Two= Oliguric phase;
Phase Three= Diuretic phase;
Phase Four= Recovery phase

Acute Renal Failure - Post-renal Failure

Post-renal renal failure is usually caused by a lower urinary tract obstruction. This causes increased hydrostatic pressure in the tract. This increased pressure opposes glomerular filtration pressures, thus decreasing the glomerular filtration rate (GFR).

The obstruction is often mechanical and can cause urinary stasis that in turn can predispose to infection and structural damage. Mechanical obstructions may involve an obstruction of the ureters, bladder, or urethra. This may be due to stones, strictures, tumors, prostatic changes or blood clots.

The obstruction may also be functional. Functional causes of obstructions may be neurogenic in nature, such as diabetic neuropathy, spinal cord injuries, or an atonic bladder (CPM Resource Center, 2016a).

Signs and Symptoms
Your patient may be anuric or oliguric. They will usually have a urine output of less than 75 mL in 24 hours. They may also begin to experience signs of hypervolemia, such as bilateral crackles, S3 extra heart sound, vascular congestion, cerebral edema, confusion, and congestive heart failure.

Associated Laboratory Findings in Post-renal Renal Failure

Lab Finding	Rationale
Urine Na varies (Normal 22-40 mEq/24h)	Usually high normal
Specific gravity: variable (Normal 1.015-1.030)	Tubules lose their ability to concentrate urine

BUN ↑ (Normal 10-26 mg/dL)	Nitrogen buildup still exists
Creatinine ↑ (Normal 0.6-1.3 mg/dL)	Tubules are no longer able to reabsorb.
Urine osmolality: (<350 mOsm/kg) (Normal 600-1400 mOsm/kg)	Reflects dilute urine.
BUN/creatinine ratio <20:1 (Normal 10:1-20:1)	BUN and creatinine now rise at the same rate. Creatinine may not rise as high in the critically ill.

(CPM Resource Center, 2016a; Rush Medical University Center, 2019)

Chronic Renal Failure - Stages

Chronic renal failure is a slow, progressive, damaging process that eventually destroys the nephrons of the kidneys.

There are four stages in chronic renal failure.

Diminished Renal Reserve - Diminished renal reserve is a result of approximately fifty percent nephron destruction. The patient's baseline creatinine is typically twice that of normal. The patient is also usually asymptomatic
(CPM Resource Center, 2016b).

Renal Insufficiency - Renal insufficiency is a result of seventy-five percent nephron loss. Your patient may be manifesting exam findings such as mild azotemia or uremia, slightly impaired urine concentrating ability, anemia, and dehydration. Factors that will worsen kidney function in this stage include infection, dehydration, and heart failure (CPM Resource Center, 2016b).

End Stage Renal Disease - End Stage Renal Disease (ESRD) results when there is ninety percent (90%) nephron loss. Your patient may be experiencing chronic and persistent signs and symptoms of accumulated waste products in the body. The signs and symptoms include: confusion, peripheral neuropathy, neuromuscular irritability, anemia, bleeding, pericarditis, hyperkalemia (high potassium), pulmonary edema, fluid overload, pneumonia, peptic ulcers, malabsorption syndromes, infections, and bruising (CPM Resource Center, 2016b).

Uremic Syndrome - Uremic Syndrome is when urea levels in the patient's sweat begin to rise. Urea crystals form in the skin. These crystals can cause persistent, uncomfortable itching, a thin, white coating over the patient's skin, and a urine odor to the skin (CPM Resource Center, 2016b).

Test Your Knowledge

ESRD results when there is what percent nephron loss?

a. 70%
b. 80%
c. 90%

Conclusion

Prior to performing a focused renal/urinary history and physical exam, the healthcare professional should be cognizant of not only the patient's history but the patient's familial history as well.

As the patient's nurse, you must critically analyze all of the data you are obtaining, synthesize the data into relevant problem focus, and identify a plan of care for your patient based upon this synthesis.

As the plan of care is being carried out, reassessments must occur on a periodic basis. How often these reassessments occur is unique to each patient, based upon their physical disorder.

Knowing when and how often to reassess is another critical thinking skill that comes with patient care experience.

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