**PHYSIOLOGY ASSIGNMENT**

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**QUESTION 1**

**Discuss the pathophysiological process involved in renal failure.**

Kidney failure, also called **end-stage renal disease (**ESRD), is the last stage of chronic kidney disease. When your kidneys fail, it means they have stopped working well enough for you to survive without dialysis or a kidney transplant.

**Acute kidney failure occurs** when your kidneys suddenly become unable **to** filter waste products from your blood. When your kidneys lose their filtering ability, dangerous levels of wastes may accumulate, and your blood's chemical makeup may get out of balance.

Initially, as renal tissue loses function, there are few noticeable abnormalities because the remaining tissue increases its performance (renal functional adaptation).

Decreased renal function interferes with the kidneys’ ability to maintain fluid and electrolyte homeostasis. The ability to concentrate urine declines early and is followed by decreases in ability to excrete excess phosphate, acid, and potassium. When renal failure is advanced (glomerular filtration rate [GFR] ≤ 15 mL/min/1.73 m2), the ability to effectively dilute or concentrate urine is lost; thus, urine osmolality is usually fixed at about 300 to 320 mOsm/kg, close to that of plasma (275 to 295 mOsm/kg), and urinary volume does not respond readily to variations in water intake.

**Creatinine and urea**

Plasma concentrations of creatinine and urea (which are highly dependent on glomerular filtration) begin a hyperbolic rise as GFR diminishes. These changes are minimal early on. When the GFR falls below 15 mL/min/1.73 m2 (normal > 90 mL/min/1.73 m2), creatinine and urea levels are high and are usually associated with systemic manifestations (uremia). Urea and creatinine are not major contributors to the uremic symptoms; they are markers for many other substances (some not yet well defined) that cause the symptoms.

**Sodium and water**

Despite a diminishing GFR, sodium and water balance is well maintained by increased fractional excretion of sodium in urine and a normal response to thirst. Thus, the plasma sodium concentration is typically normal, and hypervolemia is infrequent unless dietary intake of sodium or water is very restricted or excessive. Heart failurecan occur due to sodium and water overload, particularly in patients with decreased cardiac reserve.

**Potassium**

For substances whose secretion is controlled mainly through distal nephron secretion (eg, potassium), renal adaptation usually maintains plasma levels at normal until renal failure is advanced or dietary potassium intake is excessive. [Potassium-sparing diuretics](https://www.merckmanuals.com/professional/cardiovascular-disorders/hypertension/drugs-for-hypertension#v11695517), [angiotensin-converting enzyme inhibitors](https://www.merckmanuals.com/professional/cardiovascular-disorders/hypertension/drugs-for-hypertension#v11695969), [beta-blockers](https://www.merckmanuals.com/professional/cardiovascular-disorders/hypertension/drugs-for-hypertension#v11695694), [nonsteroidal anti-inflammatory drugs,](https://www.merckmanuals.com/professional/neurologic-disorders/pain/treatment-of-pain#v1032751) cyclosporine, tacrolimus, trimethoprim/sulfamethoxazole, pentamidine, or [angiotensin II receptor blockers](https://www.merckmanuals.com/professional/cardiovascular-disorders/hypertension/drugs-for-hypertension#v11696120) may raise plasma potassium levels in patients with less advanced renal failure.

**Calcium and phosphate**

Abnormalities of calcium, phosphate, parathyroid hormone (PTH), and [vitamin D metabolism](https://www.merckmanuals.com/professional/nutritional-disorders/vitamin-deficiency-dependency-and-toxicity/vitamin-d-deficiency-and-dependency) can occur, as can renal osteodystrophy. Decreased renal production of calcitriol (1,25(OH)2D, the active vitamin D hormone) contributes to [hypocalcemia](https://www.merckmanuals.com/professional/endocrine-and-metabolic-disorders/electrolyte-disorders/hypocalcemia). Decreased renal excretion of phosphate results in [hyperphosphatemia](https://www.merckmanuals.com/professional/endocrine-and-metabolic-disorders/electrolyte-disorders/hyperphosphatemia). Secondary hyperparathyroidism is common and can develop in renal failure before abnormalities in calcium or phosphate concentrations occur. For this reason, monitoring PTH in patients with moderate CKD, even before hyperphosphatemia occurs, has been recommended.

**Renal osteodystrophy** (abnormal bone mineralization resulting from hyperparathyroidism, calcitriol deficiency, elevated serum phosphate, or low or normal serum calcium) usually takes the form of increased bone turnover due to hyperparathyroid bone disease (osteitis fibrosa) but can also involve decreased bone turnover due to adynamic bone disease (with increased parathyroid suppression) or osteomalacia. Calcitriol deficiency may cause osteopenia or osteomalacia.

**pH and bicarbonate**

Moderate [metabolic acidosis](https://www.merckmanuals.com/professional/endocrine-and-metabolic-disorders/acid-base-regulation-and-disorders/metabolic-acidosis) (plasma bicarbonate content 15 to 20 mmol/L) is characteristic. Acidosis causes muscle wasting due to protein catabolism, bone loss due to bone buffering of acid, and accelerated progression of kidney disease.

**Anemia**

Anemia is characteristic of moderate to advanced CKD (≥ stage 3). The anemia of CKD is normochromic-normocytic, with an Hct of 20 to 30% (35 to 40% in patients with [polycystic kidney disease](https://www.merckmanuals.com/professional/genitourinary-disorders/cystic-kidney-disease/autosomal-dominant-polycystic-kidney-diseaseadpkd)). It is usually caused by deficient erythropoietin production due to a reduction of functional renal mass (see [Overview of Decreased Erythropoiesis](https://www.merckmanuals.com/professional/hematology-and-oncology/anemias-caused-by-deficient-erythropoiesis/overview-of-decreased-erythropoiesis)). Other causes include [deficiencies of iron](https://www.merckmanuals.com/professional/nutritional-disorders/mineral-deficiency-and-toxicity/iron-deficiency), [folate](https://www.merckmanuals.com/professional/nutritional-disorders/vitamin-deficiency-dependency-and-toxicity/folate-deficiency), and [vitamin B12](https://www.merckmanuals.com/professional/nutritional-disorders/vitamin-deficiency-dependency-and-toxicity/vitamin-b12-deficiency).

**QUESTION 2**

 **With the aid of suitable diagrams discuss the types of dialysis you know.**

**Dialysis** is defined as a treatment that does some things done by healthy kidneys. You need **dialysis** when you develop end stage kidney failure (ESRD). There are two main types of dialysis, which includes:
**HEMODIALYSIS** uses an external machine and a special type of filter to remove excess waste products and water from the blood.

During hemodialysis, blood passes from the patient's body to the [**dialysis machine**](https://www.medicinenet.com/kidney_disease_quiz/quiz.htm) through sterile tubing and into a filter, called a dialysis membrane. For this procedure, the patient has a specialized vascular tube placed between an artery and a vein in the arm or leg (called a gortex graft). Sometimes, a direct connection is made between an artery and a vein in the arm. This procedure is called a Cimino fistula. Needles are then placed in the graft or fistula, and blood passes to the dialysis machine, through the filter, and back to the patient. If the patient requires dialysis before a graft or a fistula is placed, a large diameter catheter (hemodialysis catheter) is placed directly into a large vein in the neck or leg in order to perform dialysis. In the dialysis machine, a solution on the other side of the filter receives the waste products from the patient.



**PERITONEAL DIALYSIS**  uses a fluid that is placed into the patient's abdominal cavity through a [**plastic**](https://www.medicinenet.com/plastic/article.htm) tube (peritoneal dialysis catheter) to remove excess waste products and fluid from the body.

Peritoneal dialysis uses the patients own body tissues inside of the belly (abdominal cavity) to act as the filter. The abdominal cavity is lined with a special membrane called the peritoneal membrane. A plastic tube called a peritoneal dialysis catheter is placed through the abdominal wall into the abdominal cavity. A special fluid called dialysate is then flushed into the abdominal cavity and washes around the [**intestines**](https://www.medicinenet.com/image-collection/intestines_picture/picture.htm). The peritoneal membrane acts as a filter between this fluid and the blood stream. By using different types of solutions, waste products and excess water can be removed from the body through this process.

