The Kidneys

What are the kidneys?

The kidneys are bean-shaped, approximately fist-sized organs that are located on each side of the mid back, just below the rib cage (figure 1). The kidneys function is to filter the blood and get rid of excess water and waste in the urine. Your kidneys are part of the urinary tract which contains also two ureters, bladder, prostate and urethra. Urine collects in a hollow space (renal pelvis) in the middle of each kidney. Urine passes from your renal pelvis into your bladder through a long tube called a ureter. Urine leaves your bladder through a shorter tube (the urethra).

Your kidneys also make substances to help control blood pressure and to make red blood cells. Attached to the top of each kidney is an adrenal gland. A layer of fatty tissue and an outer layer of fibrous tissue surround the kidney and adrenal gland.

What are Kidney tumors?

Tumors in the kidney can be *benign* (not cancer) or *malignant* (cancer). Benign tumors are not as harmful as malignant tumors:

- **Benign tumors** (such as *cysts*):
  - are usually not a threat to life
  - can be treated or removed and usually don’t grow back
  - don’t invade the tissues around them
  - don’t spread to other parts of the body
- **Malignant growths**:
  - may be a threat to life
  - usually can be removed but can grow back
—can invade and damage nearby tissues and organs
—can spread to other parts of the body

What are the Benign Kidney Tumors
Benign tumors are noncancerous. Most are asymptomatic, are discovered incidentally, and are not life threatening.

Renal Adenoma
Renal adenomas are the most common form of benign, solid kidney tumor, and are typically small, low-grade growths. Their cause is unknown. In fact, while they are considered benign, there is presently no known cellular classification to differentiate them from RCCs. Many researchers and physicians regard them as early stage precancers, to be treated accordingly.

Renal Oncocytoma
Oncocytoma is a benign, usually asymptomatic tumor that can grow quite large. They can develop throughout the body and are not unique to the kidneys. Their cause is unknown, and they appear with greater frequency in men than in women. Under a microscope, many oncocytomas resemble early-stage RCCs.

Angiomyolipoma
Also known as renal hamartoma, angiomyolipomas are rare benign tumors usually caused by an inherited genetic mutation. They can occur on an isolated, individual basis, but most often are associated with a rare genetic disease called tuberous sclerosis, which can cause tumors in the skin, kidneys, brain, and other organ systems. Asymptomatic patients and those with small tumors usually are not treated; instead, they are observed periodically with an eye toward surgery if the tumors grow or produce symptoms. Because of the potential for spontaneous rupture and life-threatening hemorrhage, patients with large tumors usually are considered candidates for some form of surgical treatment, ranging from partial nephrectomy to arterial embolization.

What are the malignant kidney tumors?
Renal Cell Carcinoma (RCC)
Several types of cancer can develop in the kidneys. Renal cell carcinoma (RCC), the most common form, accounts for approximately 85 percent of all
cases. In RCC, cancerous (malignant) cells develop in the lining of the kidney's tubules and grow into a mass called a tumor. In most cases, a single tumor develops, although more than one tumor can develop within one or both kidneys.

Early diagnosis of kidney cancer is important. As with most types of cancer, the earlier the tumor is discovered, the better a patient's chances for survival. Tumors discovered at an early stage often respond well to treatment. Survival rates in such cases are high. Tumors that have grown large or spread (metastasized) through the bloodstream or lymphatic system to other parts of the body are more difficult to treat and present an increased risk for mortality.

**Transitional Cell Carcinoma**

About 6 to 7 percent of kidney cancers begin not in the kidney itself, but in the renal pelvis, the point where the kidney joins the tube that carries urine form the kidney to the bladder (ureter). These tumors are called transitional cell carcinomas and are made up of cancer cells different from those that characterize RCC. Research indicates these tumors are caused by cigarette smoking. The symptoms of transitional cell carcinoma are quite similar to those of RCC, and include hematuria and back or flank pain. If found early, these cancers have a 90 percent cure rate. Treatment usually involves surgical removal of the kidney, ureter, and portion of the bladder connecting to the ureter. Depending on the stage of the cancer, chemotherapy and radiation may be used as adjuvant treatments.

**Wilms' Tumor**

A relatively rare form of kidney cancer, Wilms' tumor (also known as nephroblastoma) accounts for about 5 to 8 percent of kidney tumors in children. It occurs in about 7 out of every 1 million children around the world per year, It typically first appears in children between 2 and 5 years of age but has been known to occur rarely in adolescents as old as 15. Wilms' tumor can arise anywhere within the kidney's tissues. Untreated, it can spread to the veins, lymph nodes, adrenal glands, large or small bowel, and liver. Fortunately, advances in radiation and chemotherapy over the past few decades, pediatric anesthesia, and surgery have made Wilms' tumor one of the most curable of all childhood cancers. Today the 5-year survival rate approaches 90 percent.
What are the Risk factors for kidney cancer?

- **Age.** The risk of kidney cancer significantly increases with age, most kidney cancers occur in people over 45 years of age; with the highest incidences between the ages of 55 and 84.
- **Gender.** Men are twice as likely to develop **kidney cancer** as women.
- **Race.** African American men have a slightly higher risk than Caucasian men of developing renal cell carcinoma.
- **Smoking.** Smokers are at greater risk than nonsmokers. The risk increases the longer you smoke and decreases after you quit, although it takes years to reach the same risk level as someone who has never smoked.
- **Obesity.** Studies have found a strong link between excess weight (in both men and women) and renal cell carcinoma.
- **High blood pressure (hypertension).** Having high blood pressure increases the risk of developing renal cell carcinoma. The risk is even greater if you are also overweight.
- **Dialysis.** People who receive long-term dialysis for treatment of chronic renal failure are at greater risk of developing kidney cancer, possibly because renal failure depresses the immune system. People who have a kidney transplant and receive immunosuppressant drugs also are more likely to develop kidney cancer.
- **Radiation.** In some cases, exposure to radiation may increase your risk of kidney cancer.
- **Heredity.** Tuberous sclerosis (a disease characterized by several bumps on the skin, seizures, mental retardation, and cysts in the kidneys, liver and pancreas) and von Hippel-Lindau disease (a disease caused by a genetic mutation that leads to multiple tumors in the kidney, often at an early age) are both associated with an increased risk of developing kidney tumors. Most often in tuberous sclerosis the tumors are benign. However, in von Hippel-Lindau disease, the tumors are usually malignant.
What are the Symptoms of kidney cancer?

Common symptoms of kidney cancer include:
• Blood in your urine (which may make urine look rusty or darker red)
• Pain in your side that doesn’t go away
• A lump or mass in your side or abdomen
• Weight loss for no known reason
• Fever
• Feeling very tired

These symptoms may be caused by kidney cancer or by other health problems, such as an infection or a kidney cyst. People with these symptoms should tell their doctor so that any problem can be diagnosed and treated as early as possible.

Diagnosis

Because kidney cancer may spread to other parts of your body, it is important to be very thorough in testing for its presence. Your doctor may order some or all of a variety of tests that are available to determine the extent of your cancer and to develop your treatment plan.

Your doctor may use different approaches to diagnose RCC, depending on the symptoms you display. All approaches begin with a careful physical examination, combined with a complete discussion of past and present medical problems.

Certain tests may be done to assist your doctor in determining the correct diagnosis. The most common tests that may be ordered include:

Computed Tomography (CT scan)

A CT scan is a highly specialized x-ray that is used to visualize internal organs and provides a very accurate cross section picture of specific areas of the body. It is used as one of the primary imaging tools for the assessment of RCC. If the initial sign of the tumor is a mass or thickening in the kidney area detected on an x-ray taken for other reasons, or seen or felt from the outside of the body, a CT scan is often ordered.

CT scans are more detailed than ordinary x-rays, taking pictures of your organs one thin slice at a time from different angles. Then a computer puts the images together to show the size and location of any abnormalities. To enhance the
image of the abdominal organs, dye may be taken orally (by mouth) before the scan. An IV may also be placed for injection of additional contrast dye. CT scanning technology has recently been improved by development of a method called spiral CT scanning. This type of CT scan is faster and gives a better image than older CT methods.

**Magnetic resonance imaging (MRI)**

An MRI is a highly specialized scan that is similar to a CT scan, but may be better suited for assessing certain areas of the body, such as the bones. It creates an accurate cross-section picture of specific organs within the body, to allow for a layer-by-layer examination. An MRI is usually not a painful procedure. Because it uses a powerful magnet to produce the images, people with metal within their body — such as prosthetic hip replacements, pacemakers, or metal plates — should discuss the use of an MRI with their physician and the MRI technician before the scan is performed. The test may require the patient to lie still for a long time usually in a narrow space, which may be difficult for some people who do not like closed in spaces. MRI scans are often used in cases where CT scans may not be able to view an area of the body well enough.

**Bone scan**

A bone scan is used to check for the spread of cancer to the bones. It is done by injecting small amounts of a special radioactive material through a vein into your bloodstream. This material is carried to the bone, where it collects in areas where there is a lot of bone activity. The test can identify both cancerous and non-cancerous diseases but the test can’t distinguish between cancer and other conditions such as arthritis when used it is used alone. Therefore other tests may be needed, such as x-rays or CT scans.

**PET scan (Positron Emission Tomography)**

A PET scan is a very specialized diagnostic study that provides information about how extensively a cancer has spread, based on certain activities of the cells. PET scans are typically used for breast, colorectal, ovarian, lymphoma, lung, melanoma, and head & neck cancer. The effectiveness of PET scans for kidney cancer is still being studied.

**Ultrasonography (ultrasound or US)**
If there is blood in the urine, an ultrasound of the abdomen with special attention to the kidneys, ureters, and bladder may be ordered. Usually no preparation is needed for this test, and it is generally not uncomfortable. It utilizes sound waves to produce images of internal organs, helping the radiologist detect any masses that may be present. This test may be used for initial diagnosis of a kidney mass or to help visualize a mass when a fine needle biopsy is done.

The Role of Staging and Grading

Staging of a cancer is the process of classifying how far a cancer has spread, while grading determines the characteristics and make up of the cancer’s cells. The two systems play different roles, but both staging and grading are important predictors of the course of the disease and treatment effectiveness (prognosis). They are useful tools in determining what therapy is appropriate and the chance of treatment success.

Staging

Certain imaging tests, including CT and MRI scans, can help determine staging. Blood tests will also be done to evaluate your overall health and to detect whether the cancer has spread to certain organs.

A staging system is a standardized way in which the cancer care team describes the extent of the cancer. The most commonly used staging system was developed by the American Joint Committee on Cancer (AJCC)

The stage depends on

- The size of the tumor
- Spread of the cancer to the nearby lymph nodes
- If there are signs of cancer in other organs (liver, lung, bone)

RCC stages range from stage I, meaning the tumor is smaller than 7 cm (approximately 3 inches) and has not spread outside the kidney, to stage IV, meaning the tumor has spread to the outer layers of the kidney or to distant lymph node(s) or other organ(s).
In general, lower stage cancers are less aggressive or advanced and less likely to come back after treatment compared with higher stage cancers. Stage I, II, and III RCCs are referred to as localized RCCs, while stage IV is referred to as an advanced or metastatic RCC.

How is the kidney cancer treated?

After the evaluation of the tumor size, stage and general health your urologist will discuss with you the best option for management of your kidney tumor.

Surgery: it is the gold standard management of all localized kidney tumors. Moreover it is a main step in management of advanced kidney tumors.

It included

**Surgery**

Surgery is the most common treatment for people with kidney cancer. The type of surgery depends on the size and stage of the cancer, whether you have two kidneys, and whether cancer was found in both kidneys. You and your surgeon can talk about the types of surgery and which may be right for you:

- **Removing all of the kidney** (*radical nephrectomy)*: The surgeon removes the entire kidney along with the adrenal gland and some tissue around the kidney. Some lymph nodes in the area may also be removed.

- **Removing part of the kidney** (*partial nephrectomy*) (Nephron-sparing treatment) — surgery for RCC that do not remove the entire kidney. Normally, the kidneys filter waste out of the blood with tiny structures, known as nephrons. Nephron-sparing treatments allow some of the nephrons to continue working. This treatment is generally preferred if it is feasible and especially if your kidneys do not work well, a situation in which preserving as many nephrons as possible is a priority. The surgeon removes only the part of the kidney that contains the tumor. People with a kidney tumor that is smaller than a tennis ball may choose this type of surgery.

There are two approaches for removing the kidney. The surgeon may remove the tumor by making a large incision into your body (open surgery). Or the surgeon
may remove the tumor by making small incisions (laparoscopic surgery). The surgeon sees inside your abdomen with a thin, lighted tube (a laparoscope) placed inside a small incision. The decision on the best way for your treatment depends on the size of your tumor, your previous surgeries and the doctors experience.

Other nephron sparing procedures
Destructive treatments for small tumors by either burning it (called radiofrequency ablation) or freezing it (called cryoablation). These are usually used for patients who are not fit for surgery or do not want it.

TREATMENT OF ADVANCED RENAL CELL CARCINOMA

For people with advanced (cancer growing outside the kidney) or metastatic renal cell carcinoma (RCC), treatment with a medicine (called medical treatment) may be recommended instead of or along with surgery. Medical treatment may also be recommended if your cancer recurs after surgery.

Surgery to remove the kidney or areas outside the kidney where the cancer has spread (metastases) may be done before medical treatment. For someone with advanced RCC, surgery does not usually cure the cancer, but it can reduce symptoms or delay systemic medical treatment.

The three most commonly used medical treatments for advanced RCC are:

● Immune therapy (also called immunotherapy) – This is the name for drugs that work with your immune system to stop or slow the growth of cancer cells, including interleukin-2 (IL-2) and nivolumab.

● Anti-angiogenic therapies – This is a class of medicines that reduce the blood supply to the tumor, slowing or stopping growth of the tumor.

● Targeted therapies – This is a class of medicines that directly inhibit the growth of the cancer.