AL- Mustaqpal University

Science College

Dep. Medical physics

Third Stage

Lec 9

Lithotripsy

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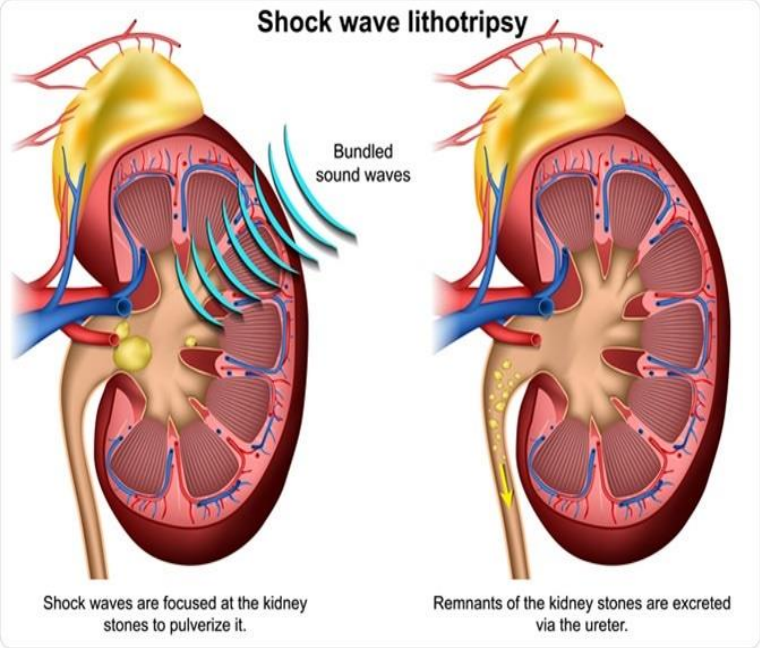
Lithotripsy

What is lithotripsy?

Lithotripsy is a noninvasive (the skin is not pierced) procedure used to treat kidney stones that are too large to pass through the urinary tract. Lithotripsy treats kidney stones by sending focused ultrasonic energy or shock waves directly to the stone first located with fluoroscopy (a type of X-ray "movie") or ultrasound (high frequency sound waves). The shock waves break a large stone into smaller stones that will pass through the urinary system. Lithotripsy allows persons with certain types of stones in the urinary system to avoid an invasive surgical procedure for stone removal. In order to aim the waves, the doctor must be able to see the stones under X-ray or ultrasound.

The introduction of lithotripsy in the early 1980s revolutionized the treatment of patients with kidney stone disease. Patients who once required major surgery to remove their stones could be treated with lithotripsy, and not even require an incision. As such, lithotripsy is the only non-invasive treatment for kidney stones, meaning no incision or internal telescopic device is required.

Lithotripsy involves the administration of a series of shock waves to the targeted stone. The shock waves, which are generated by a machine called a lithotripter, are focused by x-ray onto the kidney stone. The shock waves travel into the body, through skin and tissue, reaching the stone where they break it into small fragments. For several weeks following treatment, those small fragments are passed out of the body in the urine.

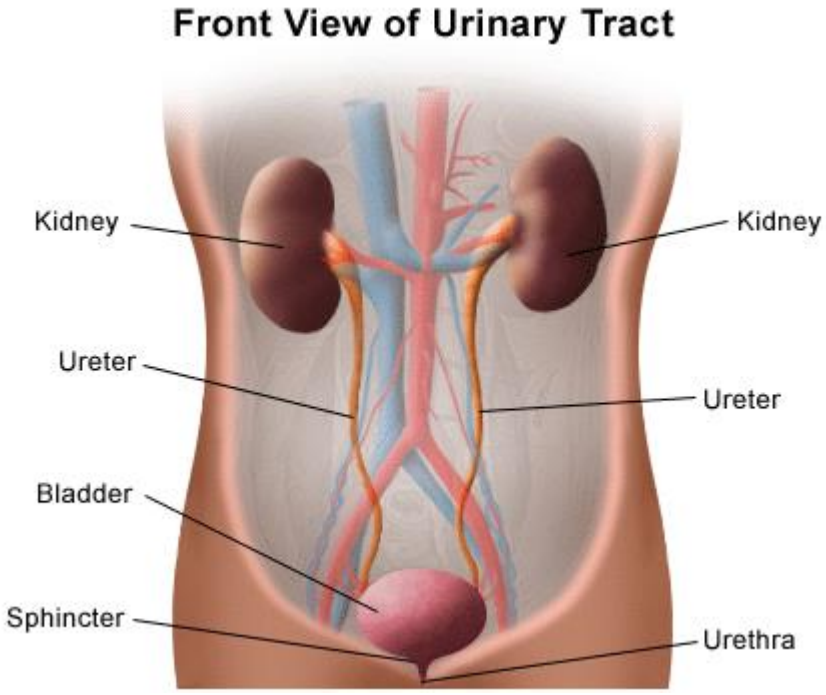


In the two-plus decades since lithotripsy was first performed in the United States, we have learned a great deal about how different patients respond to this technology. It turns out that we can identify some patients who will be unlikely to experience a successful outcome following lithotripsy, whereas we may predict that other patients will be more likely to clear their stones. Although many of these parameters are beyond anyone's control, such as the stone size and location in the kidney, there are other maneuvers that can be done during lithotripsy treatment that may positively influence the outcome of the procedure.

Other procedures that may be used to treat kidney stones include:

- **Urethroscopy or ureteroscopy.** Endoscopic procedures in which stones in the urethra or ureter may be removed with a device inserted through a short, flexible, lighted tube, called an endoscope.
- **Percutaneous nephrolithotomy (tunnel surgery).** A surgical procedure for stones that cannot be treated with lithotripsy or endoscopic procedures. It involves the removal of a stone through a thin tube tunneled through a small incision in the back into the kidney.

- **Open surgery.** A more invasive surgical procedure using a larger incision to directly access the stone.
- **Stent.** A synthetic, tubular device that may be used along with other procedures. A stent may be inserted through a special scope into the urinary tract to allow stones to pass more easily.

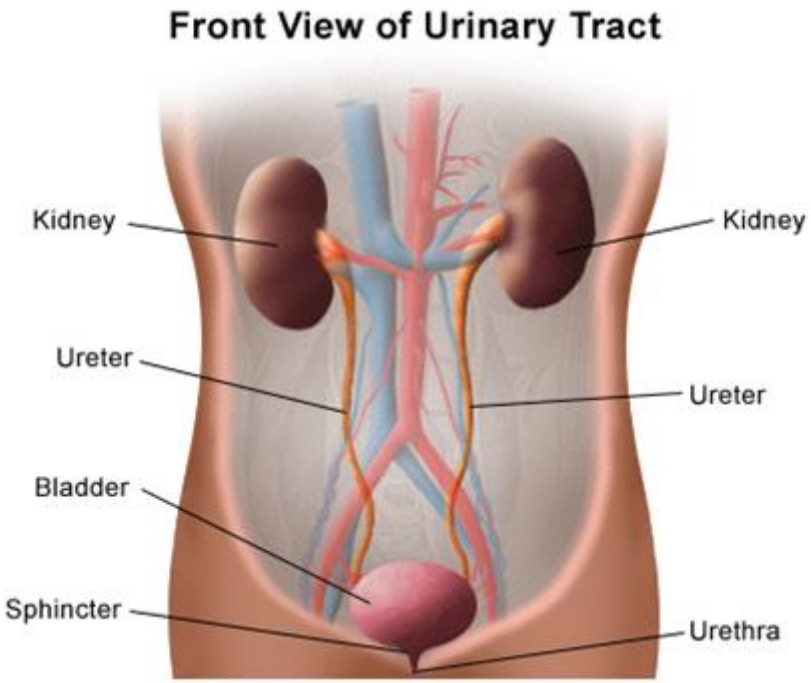


About kidney stones

When substances that are normally excreted through the kidneys remain in the urinary tract, they may crystallize and harden into a kidney stone. If the stones break free of the kidney, they can travel through, and get lodged in, the narrower passages of the urinary tract. Some kidney stones are small or smooth enough to pass easily through the urinary tract without discomfort. Other stones may have rough edges or grow as large as a pea causing extreme pain as they travel through or become lodged in the urinary tract. The areas most prone to trapping kidney stones are the bladder, ureters, and urethra.

Most kidney stones that develop are small enough to pass without intervention. However, in about 20 percent of cases, the stone is greater than 2 centimeters (about one inch) and may require treatment. Most kidney stones are composed of calcium; however, there are other types of kidney stones that can develop. Types of kidney stones include:

- **Calcium stones.** Calcium, a normal part of a healthy diet used in bones and muscles, is normally flushed out with the rest of the urine. However, excess calcium not used by the body may combine with other waste products to form a stone.
- **Struvite stones.** Struvite stones, composed of magnesium, phosphate, and ammonia, may occur after a urinary tract infection.
- **Uric acid stones.** Uric acid stones may occur when urine is too acidic, as in certain conditions, such as gout or malignancies.
- **Cystine stones.** Cystine stones consist of cystine, one of the building blocks that make up muscles, nerves, and other parts of the body.



How does the urinary system work?

The body takes nutrients from food and converts them to energy. After the body has taken the food that it needs, waste products are left behind in the bowel and in the blood.

The urinary system keeps chemicals, such as potassium and sodium, and water in balance, and removes a type of waste, called urea, from the blood. Urea is produced when foods containing protein, such as meat, poultry, and certain vegetables, are broken down in the body. Urea is carried in the bloodstream to the kidneys.

Urinary system parts and their functions:

- **Two kidneys**. A pair of purplish-brown organs located below the ribs toward the middle of the back. Their function is to:
    - Remove liquid waste from the blood in the form of urine
    - Keep a stable balance of salts and other substances in the blood
    - Produce erythropoietin, a hormone that aids the formation of red blood cells
    - Regulate blood pressure

The kidneys remove urea from the blood through tiny filtering units called nephrons. Each nephron consists of a ball formed of small blood capillaries, called a glomerulus, and a small tube called a renal tubule. Urea, together with water and other waste substances, forms the urine as it passes through the nephrons and down the renal tubules of the kidney.

- **Two ureters.** Narrow tubes that carry urine from the kidneys to the bladder. Muscles in the ureter walls continually tighten and relax forcing urine downward, away from the kidneys. If urine backs up, or is allowed to stand still, a kidney infection can develop. About

every 10 to 15 seconds, small amounts of urine are emptied into the bladder from the ureters.

- **Bladder.** A triangle-shaped, hollow organ located in the lower abdomen. It is held in place by ligaments that are attached to other organs and the pelvic bones. The bladder's walls relax and expand to store urine, and contract and flatten to empty urine through the urethra. The typical healthy adult bladder can store up to two cups of urine for two to five hours.
- **Two sphincter muscles.** Circular muscles that help keep urine from leaking by closing tightly like a rubber band around the opening of the bladder
- **Nerves in the bladder.** These alert a person when it is time to urinate, or empty the bladder
- **Urethra.** The tube that allows urine to pass outside the body. The brain signals the bladder muscles to tighten, which squeezes urine out of the bladder. At the same time, the brain signals the sphincter muscles to relax to let urine exit the bladder through the urethra. When all the signals occur in the correct order, normal urination occurs.

Reasons for the procedure

The primary advantage of lithotripsy is that it is completely non-invasive. Lithotripsy is well suited to patients with small kidney stones that can be easily seen by x-ray.

When kidney stones become too large to pass through the urinary tract, they may cause severe pain and may also block the flow of urine. An infection may develop. Lithotripsy may be performed to treat certain types of kidney stones in certain locations within the urinary tract.

There may be other reasons for the doctor to recommend lithotripsy.

Risks of the procedure

We may want to ask the doctor about the amount of radiation used during the procedure and the risks related to the specific condition. It's a good idea to keep a record of our past history of radiation exposure, such as previous scans and other types of X-rays, so we can report this to the doctor. The risks associated with radiation exposure may be related to the cumulative number of X-ray examinations and/or treatments over a long period of time.

Complications of lithotripsy may include, but are not limited to, the following:

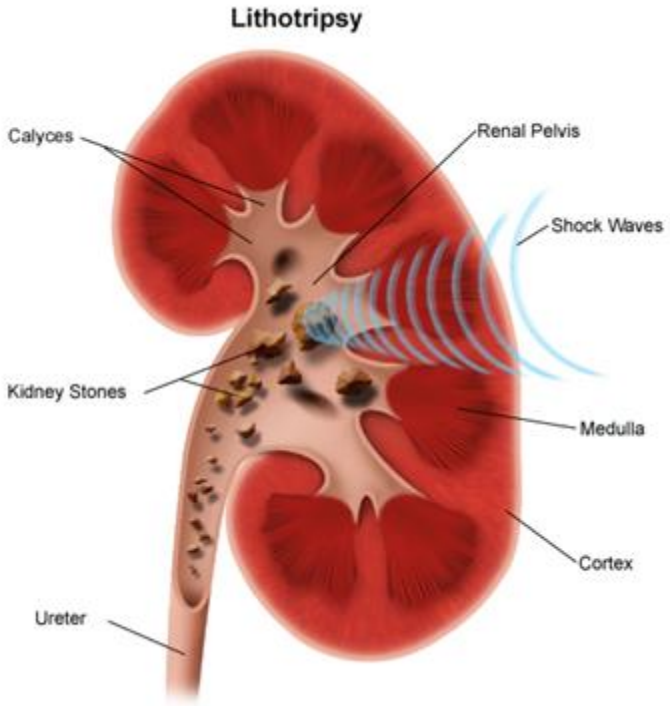
- Bleeding around the kidney
- Infection
- Obstruction of the urinary tract by stone fragments
- Stone fragments left that may require more lithotripsies

Contraindications for lithotripsy include, but are not limited to, the following:

- Pregnant patients
- Patients on "blood thinners" or patients with bleeding disorders. Aspirin or other blood thinners must be discontinued for at least 1 week prior to lithotripsy.
- Patients with chronic kidney infection, as some fragments may not pass, so the bacteria will not be completely eliminated from the kidney.
- Patients with obstruction or scar tissue in the ureter, which may prevent stone fragments from passing.
- Patients who require immediate and/or complete clearance of stone material.
- Patients with stones composed of cystine and certain types of calcium, as these stones do not fragment well with lithotripsy

Patients with cardiac pacemakers should notify their doctor. Lithotripsy may be performed on patients with pacemakers with the approval of a cardiologist and using certain precautions. Rate-responsive pacemakers that are implanted in the abdomen may be damaged during lithotripsy.

There may be other risks depending on the specific medical condition. Be sure to discuss any concerns with the doctor prior to the procedure. Obesity and intestinal gas may interfere with a lithotripsy procedure.



During the procedure

Because lithotripsy is a completely non-invasive therapy, most lithotripsy treatments are performed on an outpatient basis.

Although the use of anesthesia does depend on patient and physician preference, recent data suggest that the results of lithotripsy may be improved with the administration of a mild anesthetic.

When the patient has been adequately anesthetized, a computerized x-ray machine is used to pinpoint the location of the stone within the kidney. A series of shock waves (several hundred to two thousand) is administered to the stone.

Discussion

1. What is lithotripsy?

A) A Surgical Procedure For Kidney Stones

B) A Noninvasive Procedure To Treat Kidney Stones

C) A Method To Prevent Kidney Stones

D) A Technique To Enhance Kidney Function

E) A Type of kidney transplant surgery

Correct Answer: b)

2. How does lithotripsy treat kidney stones?

A) By Dissolving Them With Medication

B) By Passing Electric Currents Through The Stones

C) By Using Shock Waves To Break Them Into Smaller Pieces

D) By Surgically Removing Them

E) By flushing them with high-pressure water

Correct Answer: c)

3. Which imaging techniques are used to locate kidney stones before lithotripsy?

A) MRI And PET Scan

B) Fluoroscopy And Ultrasound

C) CT Scan And Echocardiogram

D) X-Ray And Mammography

E) None of the above **Correct Answer: B)**

4. What machine generates the shock waves used in lithotripsy?

A) Lithotripter

B) Ultrasonicator

C) Endoscope

D) Laser Device

E) Dialysis Machine

Correct Answer: a)

5. Which of the following is NOT a type of kidney stone?

A) Calcium Stones

B) Struvite Stones

C) Uric Acid Stones

D) Sodium Stones

E) Cystine Stones

Correct Answer: d)

6. What percentage of kidney stones typically require treatment?

A) 10%

B) 20%

C) 30%

D) 50%

E) 70%

Correct Answer: b)

7. What is a nephron?

A) A Type Of Kidney Stone

B) A Filtering Unit In The Kidney

C) A Blood Vessel In The Kidney

D) A Urinary Tract Infection

E) A Type of shock wave

Correct Answer: b)

8. What are the main components of struvite stones?

A) Calcium And Uric Acid

B) Magnesium, Phosphate, And Ammonia

C) Sodium And Potassium

D) Oxalate And Cystine

E) Cholesterol and bile salts

Correct Answer: B)

9. What is the role of erythropoietin, produced by the kidneys?

A) Regulating Blood Pressure

B) Aiding Red Blood Cell Formation

C) Breaking Down Proteins

D) Filtering Toxins From Blood

E) Balancing body salts

Correct Answer: b)

10. Which type of kidney stone forms in acidic urine?

A) Calcium Stones

B) Struvite Stones

C) Uric Acid Stones

D) Cystine Stones

E) Magnesium Stones

Correct Answer: c)

11. Which patients are NOT suitable for lithotripsy?

A) Patients With Uric Acid Stones

B) Pregnant Patients

C) Patients With Calcium Stones

D) Patients With Kidney Infections

E) Both B And D

Correct Answer: e)

12. What is the function of the ureters in the urinary system?

A) Filter Blood

B) Store Urine

C) Carry Urine From Kidneys To Bladder

D) Remove Waste From The Body

E) Regulate blood pressure

Correct Answer: c)

13. What is the typical size of the bladder in a healthy adult?

A) One Cup

B) Two Cups

C) Four Cups

D) Half A Cup

E) Five Cups

Correct Answer: b)

14. What substance forms the majority of kidney stones?

A) Sodium

B) Calcium

C) Magnesium

D) Potassium

E) Uric Acid

Correct Answer: b)

15. What is the primary advantage of lithotripsy over other treatments?

A) Faster Recovery Time

B) Completely Non-Invasive

C) No Imaging Required

D) Suitable For All Stone Types

E) Prevents future stones

Correct Answer: b)

16. What is a stent used for in kidney stone treatment?

A) To Break The Stone

B) To Dissolve The Stone

C) To Allow Stones To Pass More Easily

D) To Locate The Stone

E) To prevent infection

Correct Answer: c)

17. What are the risks of lithotripsy?

A) Bleeding Around The Kidney

B) Infection

C) Obstruction By Stone Fragments

D) Stone Fragments Left Behind

E) All of the above

Correct Answer: e)

18. What hormone do the kidneys produce to regulate blood pressure?

A) Insulin

B) Renin

C) Erythropoietin

D) Cortisol

E) Aldosterone

Correct Answer: b)

19. What type of anesthesia is often used during lithotripsy?

A) General Anesthesia

B) Local Anesthesia

C) Mild Anesthesia

D) No Anesthesia

E) Spinal Anesthesia

Correct Answer: c)

20. What is a contraindication for lithotripsy?

A) Large Stones Over 2 Cm

B) Chronic Kidney Infection

C) Small Bladder Capacity

D) High Blood Pressure

E) Low Bone Density

Correct Answer: b)

21. What is lithotripsy?

A. A surgical procedure for kidney stones

B. A non-invasive procedure to treat kidney stones

C. A method to dissolve kidney stones chemically

D. A therapy for urinary tract infections

E. None of the above

Correct Answer: B

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22. What type of energy is used in lithotripsy?

A. Laser energy

B. Shock waves

C. Electrical energy

D. Heat waves

E. Magnetic waves

Correct Answer: B

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23. Which imaging techniques are used to locate stones during lithotripsy?

A. CT scan and MRI

B. Ultrasound and fluoroscopy

C. PET scan and Doppler

D. X-ray and CT scan

E. MRI and ultrasound

Correct Answer: B

24. Lithotripsy was introduced in the early:

A. 1970s

B. 1980s

C. 1990s

D. 2000s

E. 2010s

Correct Answer: B

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25. What is the purpose of a lithotripter?

A. To dissolve kidney stones

B. To locate kidney stones

C. To generate shock waves

D. To surgically remove stones

E. To prevent stone formation

Correct Answer: C

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26. What happens to kidney stones after lithotripsy?

A. They dissolve into liquid

B. They turn into smaller fragments

C. They remain intact

D. They disappear completely

E. None of the above

Correct Answer: B

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27. What is the most common type of kidney stone?

A. Uric acid stones

B. Struvite stones

C. Calcium stones

D. Cystine stones

E. Magnesium stones

Correct Answer: C

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28. Struvite stones are associated with:

A. High calcium levels

B. Urinary tract infections

C. Gout

D. Dehydration

E. Obesity

Correct Answer: B

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29. What is a contraindication for lithotripsy?

A. Calcium stones

B. Pregnancy

C. Small kidney stones

D. Stone fragments

E. All of the above

Correct Answer: B

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30. What percentage of kidney stones typically require treatment?

A. 10%

B. 20%

C. 30%

D. 40%

E. 50%

Correct Answer: B

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31. Uric acid stones are caused by:

A. High magnesium levels

B. Acidic urine

C. Excess phosphate

D. Calcium deficiency

E. Excess cystine

Correct Answer: B

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32. The primary advantage of lithotripsy is that it is:

A. Cost-effective

B. Pain-free

C. Non-invasive

D. Fast-acting

E. Completely risk-free

Correct Answer: C

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33. The urinary system removes waste products such as:

A. Potassium

B. Urea

C. Sodium

D. Calcium

E. Phosphorus

Correct Answer: B

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34. How much urine can a healthy bladder typically store?

A. 1 cup

B. 2 cups

C. 3 cups

D. 4 cups

E. 5 cups

Correct Answer: B

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35. The hormone produced by the kidneys is:

A. Insulin

B. Adrenaline

C. Erythropoietin

D. Estrogen

E. Thyroxine

Correct Answer: C

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36. What part of the urinary system carries urine from the kidneys to the bladder?

A. Urethra

B. Nephrons

C. Ureters

D. Glomerulus

E. Renal tubules

Correct Answer: C

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37. What muscle prevents urine from leaking?

A. Bladder muscle

B. Sphincter muscle

C. Ureter muscle

D. Abdominal muscle

E. Pelvic muscle

Correct Answer: B

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38. Patients with what condition should avoid lithotripsy?

A. Obesity

B. Chronic kidney infection

C. High blood pressure

D. Diabetes

E. High cholesterol

Correct Answer: B

39. Which condition increases the risk of uric acid stones?

A. Gout

B. Urinary tract infections

C. Kidney infection

D. Dehydration

E. High protein diet

Correct Answer: A

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40. What is the medical term for the filtering units in the kidneys?

A. Renal tubules

B. Nephrons

C. Ureters

D. Glomerulus

E. Bladder

Correct Answer: B

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41. A severe complication of lithotripsy is:

A. Hair loss

B. Kidney bleeding

C. Skin rash

D. Nausea

E. Fatigue

Correct Answer: B

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42. Shock waves during lithotripsy are:

A. Directed at the bladder

B. Focused on the kidney stone

C. Spread across the kidney

D. Aimed at the urethra

E. Focused on the ureters

Correct Answer: B

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43. Which kidney stones do not fragment well with lithotripsy?

A. Struvite stones

B. Uric acid stones

C. Calcium stones

D. Cystine stones

E. None of the above

Correct Answer: D

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44. Obesity and intestinal gas may:

A. Improve lithotripsy outcomes

B. Have no effect on lithotripsy

C. Interfere with lithotripsy

D. Be a reason to perform lithotripsy

E. Reduce the risk of stones

Correct Answer: C

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45. After lithotripsy, stone fragments are:

A. Removed surgically

B. Dissolved with medication

C. Passed out in urine

D. Absorbed by the body

E. Left in the kidney

Correct Answer: C