INVESTIGATION OF THE URINARY TRACT

- Urological conditions are most likely to be diagnosed from the history or by investigations.

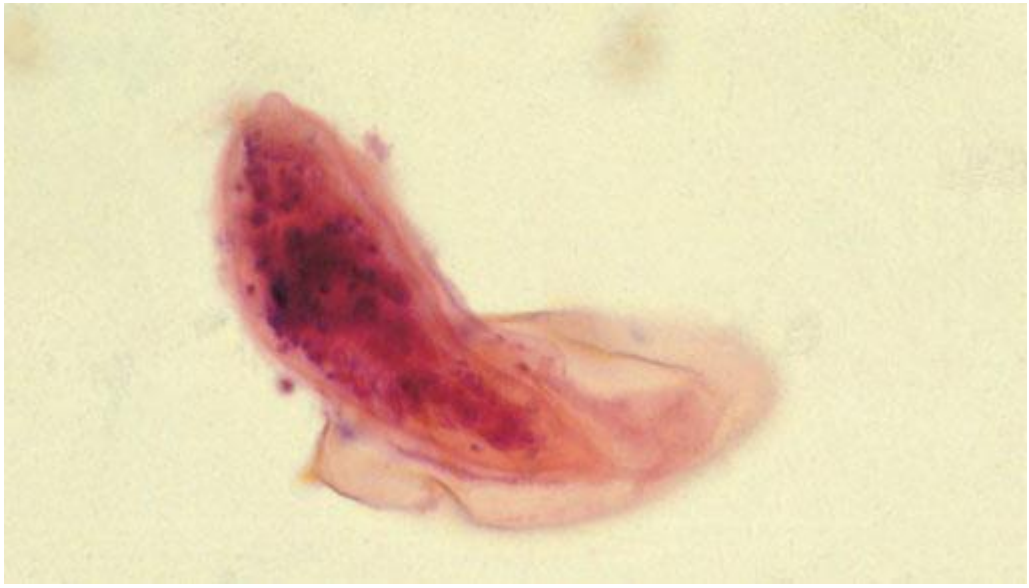
Urine

1. **Dipsticks impregnated with chemicals:-**
   - Change colour in the presence of ***blood, protein or nitrites***.
   - Ask for a midstream specimen.
   - The presence of protein and nitrites (which are a product of the activity of organisms in the urine) indicates the likelihood of infection.
   - Some dipsticks also give an indication of the ***pH*** and ***specific gravity*** of the urine.

2. ***Microscopy Confirm the presence of:-***
   - white and red blood cells in the urine
   - Bacteria.
   - Protein casts suggesting disease affecting the renal parenchyma.
   - Schistosoma ova have a typical appearance
   - Vegetable or meat fibres may be present if there is a fistula connecting the bowel with the urinary tract.

3. **Cytological examination of the urinary sediment:-**
   - Sensitive and specific for poorly differentiated transitional cell tumours anywhere in the urinary tract. However, false negatives are common in the 50% of these cancers that are well differentiated.

4. **Bacteriological culture of a clean midstream specimen of the urine:-**
   - It is the standard means of identifying urinary pathogens.
   - The presence of organisms at a level of > 10□/ml indicates the presence of infection rather than contamination of the urine by bacteria.
   - If there are pus cells in the urine but there is no growth on the routine culture media (sterile pyuria), it is worth testing for more ***fastidious organisms*** (organism that grows only in a specially fortified artificial culture media under specific culture conditions).
   - ***Chlamydia*** is another common urinary pathogen that will not be detected on routine culture.
5. **Biochemical examination for:-**
   - Electrolytes,
   - Glucose,
   - Bilirubin,
   - Haemoglobin and myoglobin.
   - Analysis of a 24-hour specimen of urine will quantify the rate of loss, and is especially useful in the investigation of calculus disease caused by abnormal excretion of calcium, oxalate, uric acid and other products of metabolism.



Schistosoma ovum

Tests of renal function

- More than 70% of kidney function must be lost before renal failure becomes evident.
- It follows that renal damage must be extensive before changes occur in blood constituents whose level is controlled by renal excretion.
- Such damage is of three main types:
  - **A.** Reduction of renal plasma flow,
  - **B.** Destruction of glomeruli and
  - **C.** Impairment of tubular function.
- In severe hypertension or renal artery stenosis, the plasma flow is impaired.
- In glomerulonephritis or acute cortical necrosis, there is a loss of glomeruli,
- In pyelonephritis, tubular function is most severely affected.
- In obstructive nephropathy, back pressure on the renal parenchyma causes all three types of damage.

- Levels of blood urea and serum creatinine can be affected by various factors
- But, in practice, when taken together they serve as a useful clinical guide to overall renal function.
- A creatinine clearance test will give an approximate value for glomerular filtration rate but is prone to error.
- A more accurate assessment of glomerular function can be obtained from an estimate of the clearance of chromium-51-labelled ethylenediaminetetraacetic acid.
- The specific gravity of the urine is fixed at a low level when the kidney loses the power to concentrate because of renal tubular dysfunction.
- Estimation of the urinary loss of sodium, β2- microglobulin or the tubular enzyme *N*-acetylglucosamine (NAG) will further define the nature of any functional impairment.

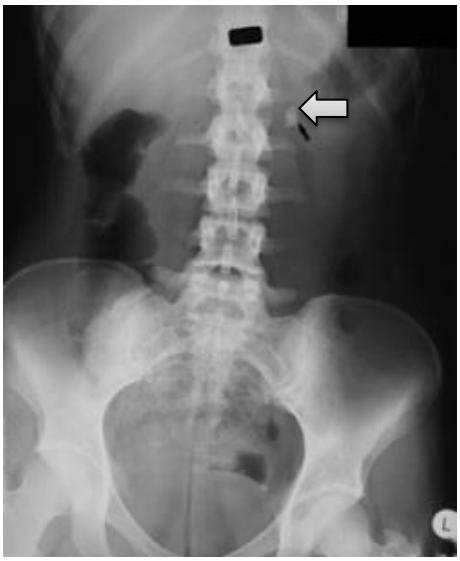
Imaging

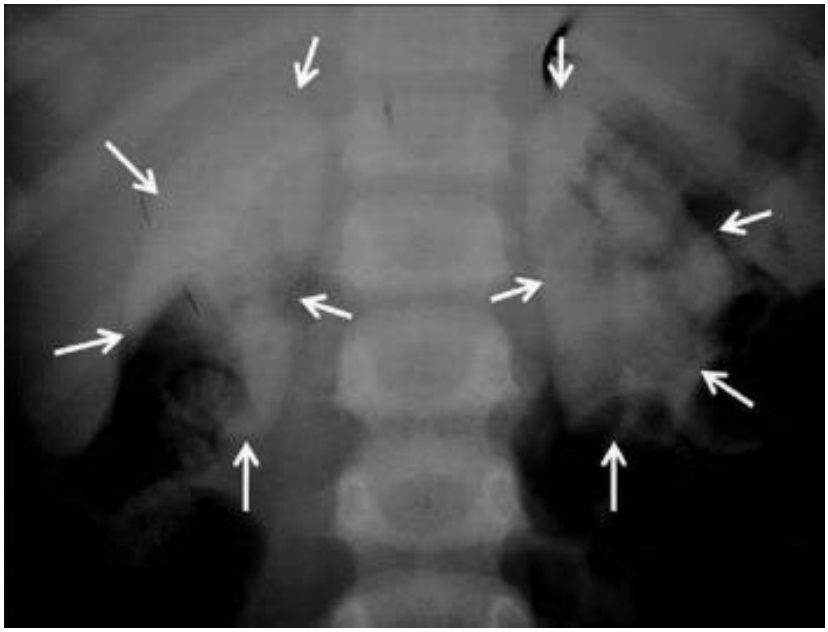
Plain abdominal radiograph (the KUB)

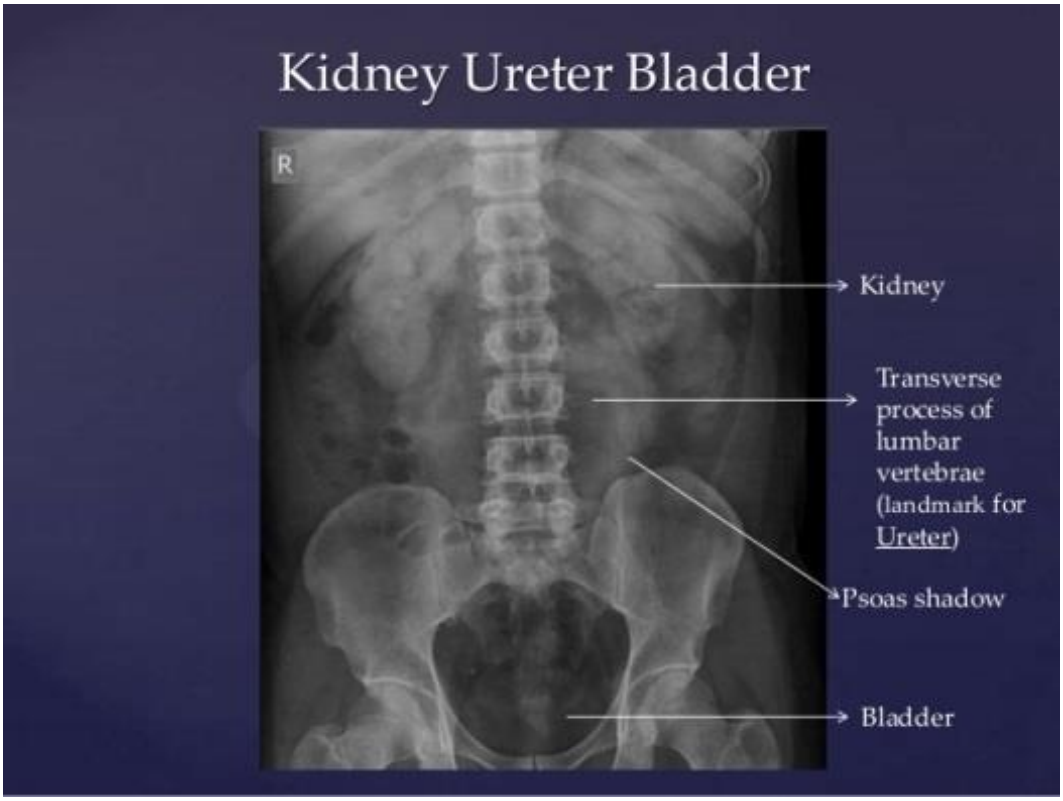
- Shows the kidneys, ureters and bladder (the KUB).
- KUB may reveal the presence of ***scoliosis***, ***spina bifida***, d***egenerative disease of the spine***, ***metastases***, ***fractures*** and ***arthritis***. All of these may have relevance to the urological diagnosis.
- The soft-tissue shadows of the kidneys, outlined to a greater or lesser extent by their more radiolucent fatty coverings.
- A full bladder often presents a hazy outline arising from the pelvis.
- Most urinary calculi absorb X-rays and should be sought in the region of the renal shadows and along the course of each ureter.
- Stones with low calcium content and those overlying bony structures may be difficult to see on the plain film.
- Uric acid stones are the most common radiolucent calculi.

Straight abdominal radiograph (Box)

- Most urinary calculi are radiodense
- Uric acid calculi are typically radiolucent

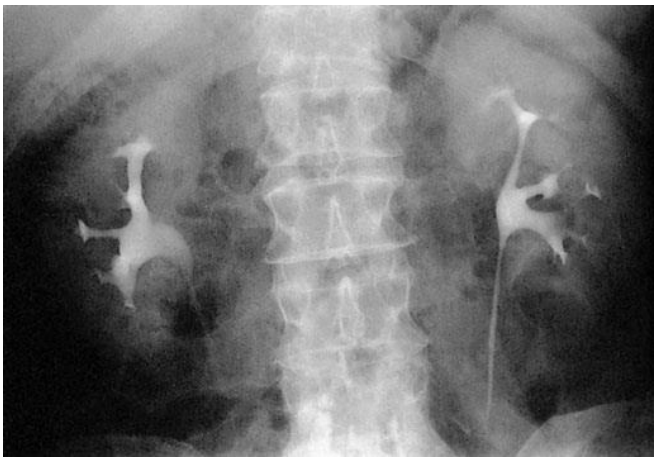






Intravenous urography (urography)

- Excretion renography has been a mainstay of urological investigation.
- When the contrast is injected, usually into a vein in the antecubital fossa, it is filtered from the blood by the glomeruli and does not undergo tubular absorption. As a result, it rapidly passes through the renal parenchyma into the urine, which it renders radio-opaque.
- Although intravenous urography (IVU) gives excellent images of the urinary tract, its use should be restricted because in a few patients the ***iodine*** in the contrast medium may provoke a potentially life-threatening anaphylactic reaction.
- Patients with a history of ***allergy, atopy and eczema*** are particularly vulnerable, but severe reactions may occur without warning.



Normal intravenous urogram showing the outline of both kidneys with the collecting system and upper ureters highlighted by the contrast medium

Preparation for IVU

1. Give a laxative to clear faeces that might otherwise obscure details of urinary tract anatomy.
2. Modest fluid restriction is permissible, but dehydration is dangerous because it may precipitate acute renal failure.

Technique

1. The patient is observed carefully while the first few drops of contrast medium (Urografin or Niopam 370) are injected.
2. After a few minutes, the contrast is excreted into the collecting system, opacifying the calyces and the renal pelvis.
1. Later films show the ureters and, at the end of the study, the patient is asked to pass urine and a final film is taken to show detail of the bladder area.
2. ***The earliest films***, taken within minutes of the injection, show the renal parenchyma opacified by contrast medium – ***the nephrogram phase***.
3. ***A delayed nephrogram*** on one side indicates unilateral functional impairment.
4. Distortion of the renal outline or failure of part of the kidney to function suggests a space-occupying lesion caused by a tumour or by harmless simple cysts. In each of these cases, more information can be obtained from ultrasonography or computerised tomography (CT).

- IVU is particularly valuable to demonstrate ***tumours and calculi*** within the urinary tract, which are sometimes difficult to see on ultrasonography.
- It may also be useful to show details of ***abnormal anatomy*** that are difficult to interpret on an ultrasonogram.
- As ultrasonography and other forms of scanning have become more sophisticated, the indications for the urogram are fewer.
- Obstruction to the upper urinary tract interferes with transport of contrast medium into the urine, which will show up as a nonfunctioning kidney on the standard urogram films. In these circumstances, a further radiograph taken many hours

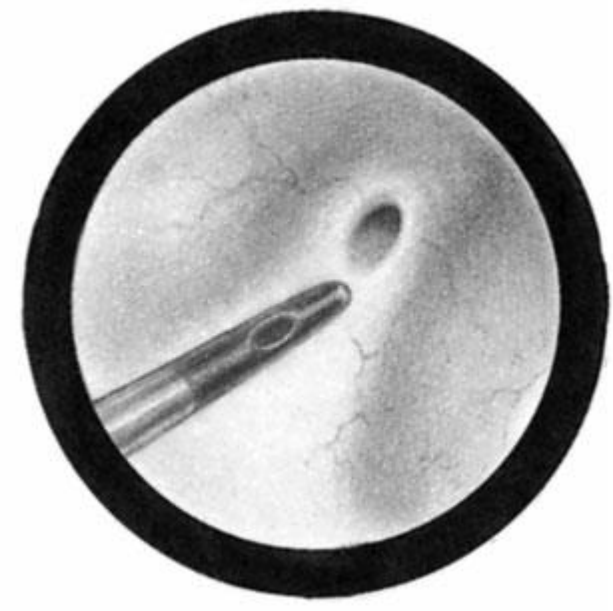
after injection of the contrast medium may show hazy opacification of a dilated system.

Retrograde ureteropyelography (retrograde ureterogram)

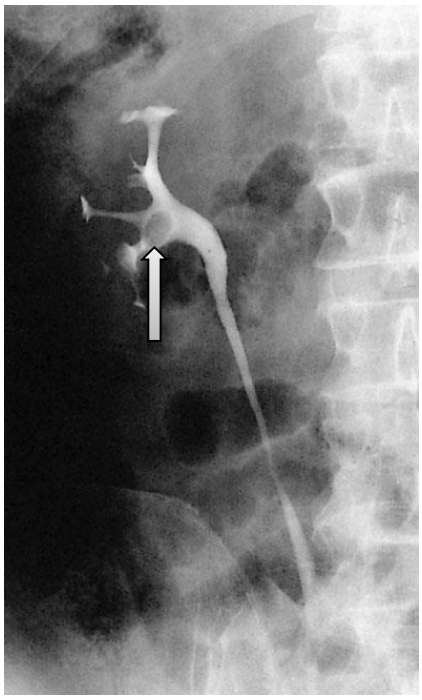
- A fine ureteric catheter can be passed into the ureteric orifice through a cystoscope. Contrast medium injected through the catheter

Advantages:-

- Demonstrate the anatomy of the upper urinary tract.
- It can shows intraluminal lesion e.g. pelviureteric junction obstruction.
- When a transitional tumour is found, it can be sampled by aspiration of urine from the upper tract or by brush biopsy.



Ureteric catheter about to enter the left ureteric orifice (Cystoscopic view)



Retrograde ureterogram demonstrating the collecting system. The radiolucent filling defect in the renal pelvis is caused by a uric acid calculus.

Antegrade pyelography

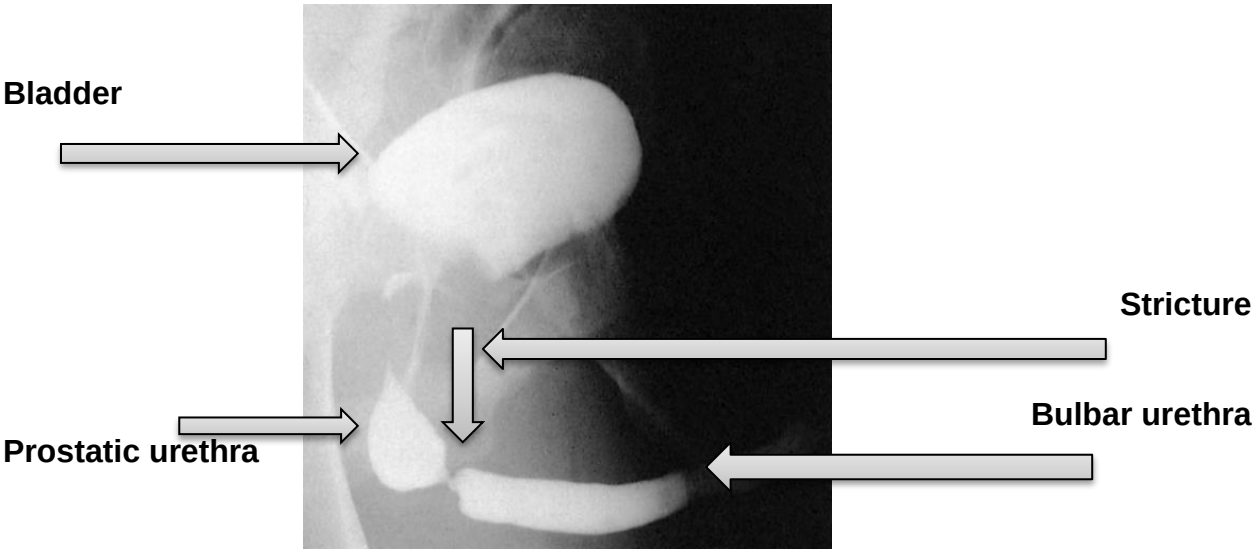
- Achieved through percutaneous puncture of a dilated renal collecting system.
- The most common indication is the placement of a nephrostomy tube to drain an obstructed infected kidney or to provide access for percutaneous nephrolithotomy.
- Antegrade pyelography – in which contrast medium is introduced through the nephrostomy – can be ***helpful when retrograde studies are prevented by obstruction at the extreme lower end of the ureter***.

Venograph

- Flush venogram is useful when CT suggests tumour invasion of the renal vein and vena cava. But because extension of a renal carcinoma from the renal vein into the vena cava can usually be demonstrated by ultrasound, venography is now infrequently used for this purpose.

Urethrography

- Ascending urethrography is valuable to demonstrate:-
  1. The extent of a urethral stricture
  2. The presence of false passages
  3. Diverticula.
  4. Assess the extent of urethral trauma, but there is a serious danger that contrast medium may pass into the circulation.
  5. Lipiodol carries the danger of fat embolus and should never be used, and death has followed the use of barium emulsion.
  6. Umbradil viscous V is a radio-opaque water-soluble gel that contains the local anaesthetic lignocaine can be injected gently and safely.



Ascending urethrogram demonstrating a tight stricture in the bulbar urethra (arrowed). Above the stricture the contrast outlines the prostatic urethra and bladder.

Ultrasonography

- Ultrasonography is the imaging technique most widely used in urology.
- It can show:-
  1. The size of the kidney,
  2. The thickness of its cortex
  3. The presence and degree of hydronephrosis.
  4. Intrarenal masses can be diagnosed as smooth walled and fluid filled (simple cysts) or solid and complex (possible tumours).
  5. Stones

6. volume of urine in the bladder before and after micturition can be calculated (as in patient with BPH),
7. Tiny filling defects within the bladder can also be detected
8. Scrotal contents.

Ultrasound scanning provides broadly similar anatomical information to an intravenous urogram but without the risks

Renal stone on ultrasound

Transrectal ultrasonography

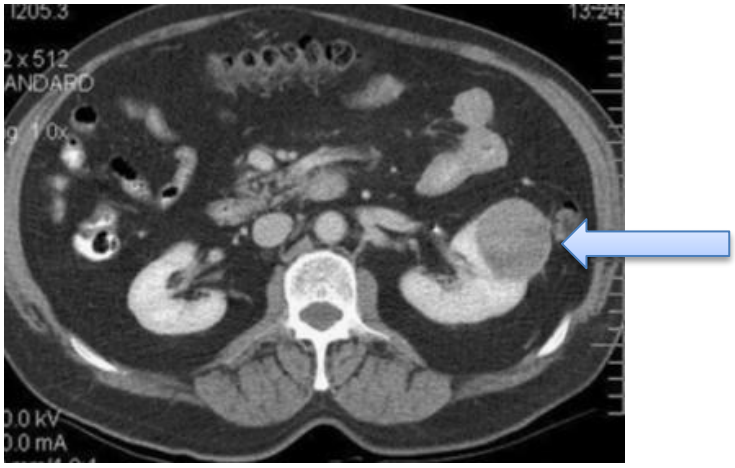
- For investigating suspected carcinoma of the prostate. Most commonly, suspicion has arisen because the level of prostate-specific antigen (PSA) is raised or there is an abnormality of the texture or outline of the prostate on digital rectal examination.

Computerised tomography

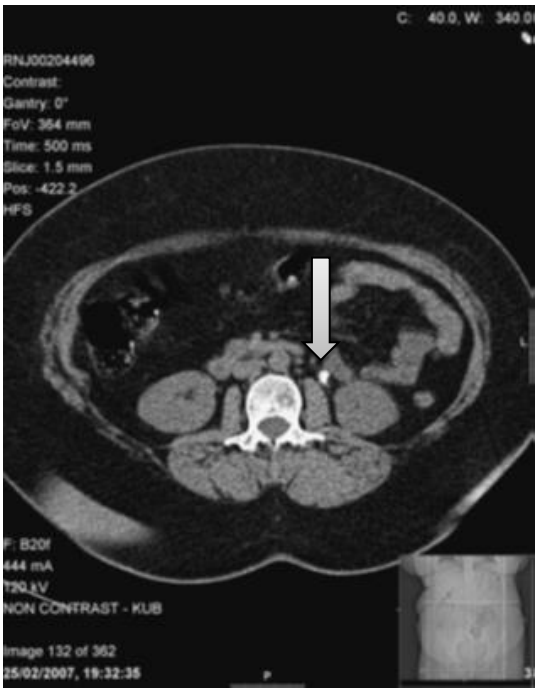
CT is particularly useful to assess structures in the retroperitoneum. In renal carcinoma it will show:

1. The size and site of the tumour and the degree of invasion of adjacent tissue;
2. The presence of enlarged lymph nodes at the renal hilum;
3. Invasion of the renal vein and vena cava.

4. For initial staging and follow-up of men with testicular cancer, in whom the presence of retroperitoneal lymph node masses is a feature of advanced disease.
5. For staging bladder and prostate cancer.
6. Non-contrast CT is also used routinely in the diagnosis of urinary calculi



CT scan shows typical renal cell carcinoma



A non-contrast CT clearly shows a calculus in the left upper ureter

Magnetic resonance imaging and positron emission tomography

- These technologies give information about:-
  1. The function of organs
  2. Detailed structural images.

Endoscopy

- Allow the urologist to visualise the upper and lower urinary tracts for diagnosis and therapy.
- This allows simple diagnostic ***cystourethroscopy***, ***bladder biopsy*** and ***retrograde ureterography*** to be performed under topical urethral anaesthesia with minimal discomfort to the patient.

بسم الله الرحمن الرحيم

رَبِّ اشْرَحْ لِي صَدْرِي (٢٥) وَيَسِّرْ لِي أَمْرِي (٢٦) وَاحْلُلْ عُقْدَةً مِنْ لِسَانِي (٢٧) يَفْقَهُوا قَوْلِي

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