Intravenous Urography

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Key Contents

Definition of IVU.
Indication of IVU.
Steps of IVU.
Preparation of IVU.
Complications of IVU.

Learning Objectives

To understand pathophysiology of IVU.
To enumeration reasons for IVU.
To explain the process of IVU.
To interpret IVU films.
To be aware of complications.

Key words: IVU, Anaphylactic, Shock, Emergency Urography.

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Intravenous urogram (excretory urogram) is the contrast medium radiological study of the urinary system. It has been primary imaging technique for investigation of urinary system disorders since early 1930\(^1\).

Many imaging modalities such as ultrasonography, C.T scanning and M.R.I scanning are used with increasing frequency. All these have their own limitations. An ideal global urinary imaging still remains controversial.

I.V.U is performed to assess the renal function and to see the anatomy of the kidneys, ureters and urinary bladder.

The kidneys excrete fluids, electrolytes and metabolic breakdown products. The glomeruli filter various substances. The tubules secrete or reabsorb these substances. The clearance of different substances is different. Objectively performed IVU is still one of the most valuable urinary imaging. It may provide diagnostic details beyond the current capabilities of other imaging modalities\(^2\).

It is very important to understand the renal physiology carefully before performing and interpreting the intravenous urogram\(^3\).

Radio-opaque solution of iodine containing compounds is used for intravenous urography\(^3\).

The radio-opacity of these materials depends upon their iodine content. Commonly used substances and their iodine contents are as follows;\(^4\)

- Conray 60: 28% iodine
- Conray 400: 40% iodine
- Hypaque M90: 46% iodine
- Hypaque 25: 15% iodine
- Renographin 60: 29% iodine
- Reno M-60: 28% iodine
- Reno M-Dip: 14% iodine
- Reno vist II: 31% iodine
- Isopaque 280: 28% iodine

The medium is brought to the kidneys through circulating blood and is filtered in the glomeruli, concentrated in the renal tubules. Then it is delivered to the pelvis, ureter and bladder where it is seen as radio opaque shadow on x-ray films.

**INDICATIONS**

I.V.U is becoming an investigation of past due to its hazards and availability of better and simpler methods such as sono-uography, CT urography and M.R urography. The use of I.V.U is being reduced in many indications and
it is no more used as a primary investigation for urinary imaging.

URINARY STONES
- Renal stones.
- Ureretic stones.
- Vesical stones.
- Urethral stones.

URINARY NEOPLASIA
- Benign renal, ureteric and vesical tumors
- Malignant renal, ureteric and vesical tumors
- Carcinoma of prostate

URINARY INFLAMMATIONS
- Acute pyelonephritis
- Chronic pyelonephritis
- Glomerulonephritis
- Cystitis
- Urinary tuberculosis

URINARY TRAUMA AND OBSTRUCTION
- Enlarged prostate
- Urethral stricture
- Post operative ureteric injury or ligation
- Congenital urethral valves
- Ureteric stricture
- Stab wounds involving the urinary system
- Renal injuries
- Vesical injuries

MISCELLANEOUS
- Vesico vaginal fistula
- Uretero vaginal fistula
- Recto vesical fistula
- Vesico colic fistula
- Vesical diverticulae
- Ectopia vesicae
- Epispadias
- Patent urachus

CONTRAINDICATIONS
- Renal failure
- Hepatic failure
- Raised serum creatinine level (above 7 mg/100 ml)
- Raised blood urea level
- Allergy to the dye
- Generalized allergic conditions
- Multiple myeloma

METHOD
PREPARATION OF THE PATIENT
Complete urine and blood examination (specially the serum urea and creatinine levels) of the patient is performed to rule out any other problem and to assess the renal function as urography is occasionally not possible in the cases of renal failure.

The patient is given mild laxatives about twelve to twenty four hours before the proposed x-ray examination. (A night before the urographic examination)

The patient is kept nil by mouth over night and is dehydrated by stopping the fluid intake.

The dehydration helps in better concentration of the dye and clearer x-ray pictures.

The patient should not be dehydrated if suffering from renal failure as it may lead to severe fluid and electrolyte imbalance.

Sensitivity to the dye (Hypaque or Urographin) is checked. Necessary precautions are taken to avoid the allergic reactions.
Intravenous Urography

If the preparation is unsatisfactory showing lot of gas and faeces in the plain film and the urinary system anatomy is obscured, it is preferable to postpone the urography till adequate preparation of the patient can be achieved.

Urographic imaging is optimized by performing and interpreting it objectively and in order of sequence.

**EMERGENCY UROGRAM**

The emergency urogram is performed without preparation because in these cases the preparation may be hazardous. In these cases the diagnosis has to be differentiated from other acute abdominal emergencies such as:

- Acute appendicitis
- Renal injuries
- Calculus Anuria

IVU is almost no more used in emergency for investigating renal colic or conditions mimicking it. Ultrasound scan has good sensitivity and is non invasive in detecting biliary lithiasis, acute pancreatitis, acute appendicitis and abdomino-pelvic masses causing pain similar to renal colic.

Helical CT urography is used as an investigation of first choice in patients with renal colic. If it is not available, ultrasound scanning and plain x-ray film can be used very effectively.

**FIRST X-RAY FILM**

(PLAIN X-RAY ABDOMEN K.U.B)

A plain x-ray of abdomen (K.U.B) is exposed. This exposure includes almost whole of the abdomen and pelvis (kidneys, ureters, bladder). It is an indispensable part of urography sequence.

The x-ray exposure of KUB should include the
area from supra-renal region to the level below the symphysis pubis. The patient should pass urine before x-ray examination.

SECOND X-RAY FILM (IMMEDIATE EXPOSURE)

NEPHROGRAM

The patient is given slow intravenous injection of the contrast medium. The amount of the contrast medium is calculated by patient's size and weight.

It also depends upon every radiologists's own choice. Large amounts of contrast medium can be used as well. Commonly 40 mls of radio opaque dye is used intravenously for a 70 kg adult.

In patients with poor renal function or obstructive uropathy, bolus infusion urography is performed.

Larger quantity of radio opaque dye is infused intravenously. The x-ray pictures are clear and of better quality.

The injected contrast medium is carried through the veins, lungs, heart and the aorta to the renal arteries.

Some of this contrast is immediately filtered in the kidneys.

The exposure immediately after the injection shows this phase and shows diffuse opacification of the renal parenchyma.

The optimal visualization of renal parenchyma is achieved 1-3 minutes after bolus injection.
The density of the nephrogram reflects the ability of the proximal tubules to reabsorb water and thus concentrate the radio opaque dye. The nephrogram films are exceedingly useful. These show the outline of the renal parenchyma and reveal scars and translucencies in its substance.
Intravenous Urography

Tomograms (well focused focal area films) supplement the radiographic pictures in the nephrogram phase. The normal kidney size ranges between 9-13 cms in cephalocaudal length. The left kidney is 0.5 cms larger than the right kidney. The kidneys are larger in men than in women. Renal parenchymal thickness ranges between 3-3.5 cms.

If a cyst is suspected, ultrasound examination is performed to confirm the diagnosis. If the lesion is solid, CT examination is performed for confirmation.

The films should include whole of the abdomen and pelvis so that the kidneys present at ectopic sites should not be missed.

In obstructive uropathy, there is persistent filtration and reabsorption of the filtered urine. The nephrogram tends to persist for hours after the injection of dye in these patients. In fact a persistent nephrogram after more than half an hour of injection is pathological.

THIRD X-RAY FILM (PYELOGRAM FILMS)
The film is exposed approximately five minutes after the injection of contrast medium. Most of the dye has reached the collecting tubules and excretory passages by then. The contrast medium enters the pelvi-calyceal system. It gives useful information about the architecture and function of the kidney.

FOURTH X-RAY FILM
Another x-ray film is exposed after fifteen minutes of the injection of contrast medium.

This film shows the pelvis and upper part of the ureters.

FIFTH X-RAY FILM (CYSTOGRAM)
Another x-ray film is exposed approximately thirty to forty five minutes after the injection of contrast medium.

This film shows the lower part of ureters and bladder. The ureters are outlined from top to bottom and finally the urinary bladder is filled.

It takes about twenty five minutes to half an hour normally for the contrast medium to be excreted to the bladder after the injection. The bladder film is called cystogram.

SIXTH X-RAY FILM (POST MICTURITION FILM)
The patient is asked to pass urine. Then the film is exposed and the bladder area is specially focussed to see the amount of urine present in the bladder after complete voluntary act of micturition.

This film gives approximate measurement of
the residual urine if present. This film should never be missed in patients with suspected bladder outlet obstruction. (urethral stricture, enlarged prostate and posterior urethral valves).

**DELAYED X-RAY FILMS**
Many extra exposures may be required to visualize the anatomy and assess the physiology of urinary system in patients with abnormal renal functions (obstruction, renal failure etc.)

These films are exposed at two hours, four hours, eight hours, twelve hours, eighteen hours and twenty four hours after the injection of the contrast medium. The delayed films may be taken up to seventy two hours after the injection.

**COMPLICATIONS**
Due to injection of the contrast medium, many patients show following unwanted symptoms.
- Nausea.
- Minor urticarial rashes.
- Occasionally severe laryngeal oedema.
- Anaphylactic shock.
- Cardiac arrest.

As soon as any sign of allergy is seen, the injection of contrast medium should be stopped immediately. Active resuscitation should be started without wasting any time. Parenteral antihistamines and steroids are given.

Less severe anaphylactic reactions are relieved with these measures, but severe anaphylactic reactions require intensive treatment for shock.

**MR UROGRAPHY**

CT-UROGRAPHY
Non enhanced CT scanning finds more stones and upper urinary tract diseases. CT-urography is a better alternative for investigating patients with haematuria and renal tumours.

MR-urography and CT-urography provide refined imaging of the upper urinary tract which is not possible with conventional I.V Urography.

T2-weighted MR-urograms have proved excellent in visualizing dilated urinary tract even in non excreting kidneys.

T1-weighted excretory MR-urogram provides impressive urograms of both non dilated and obstructed collecting systems in patients with normal or moderately impaired renal function.

I.V.U can be abandoned as an investigation because of cost, risks associated with contrast media and radiation exposure. It can easily be replaced with simpler and less hazardous imaging techniques.

Although I.V.U is still examination of choice to visualize the entire urinary system and to evaluate the state of papillae and calyces. CT urography and M R urography are ready to replace I.V.U in near future.

M R - urography is a new imaging technique for upper urinary tract, well suited for children, young persons and pregnant women.
Intravenous Urography

REFERENCES


