DIAGNOSTIC IMAGING TECHNIQUES OF LOWER URINARY TRACT DISORDERS

THESIS

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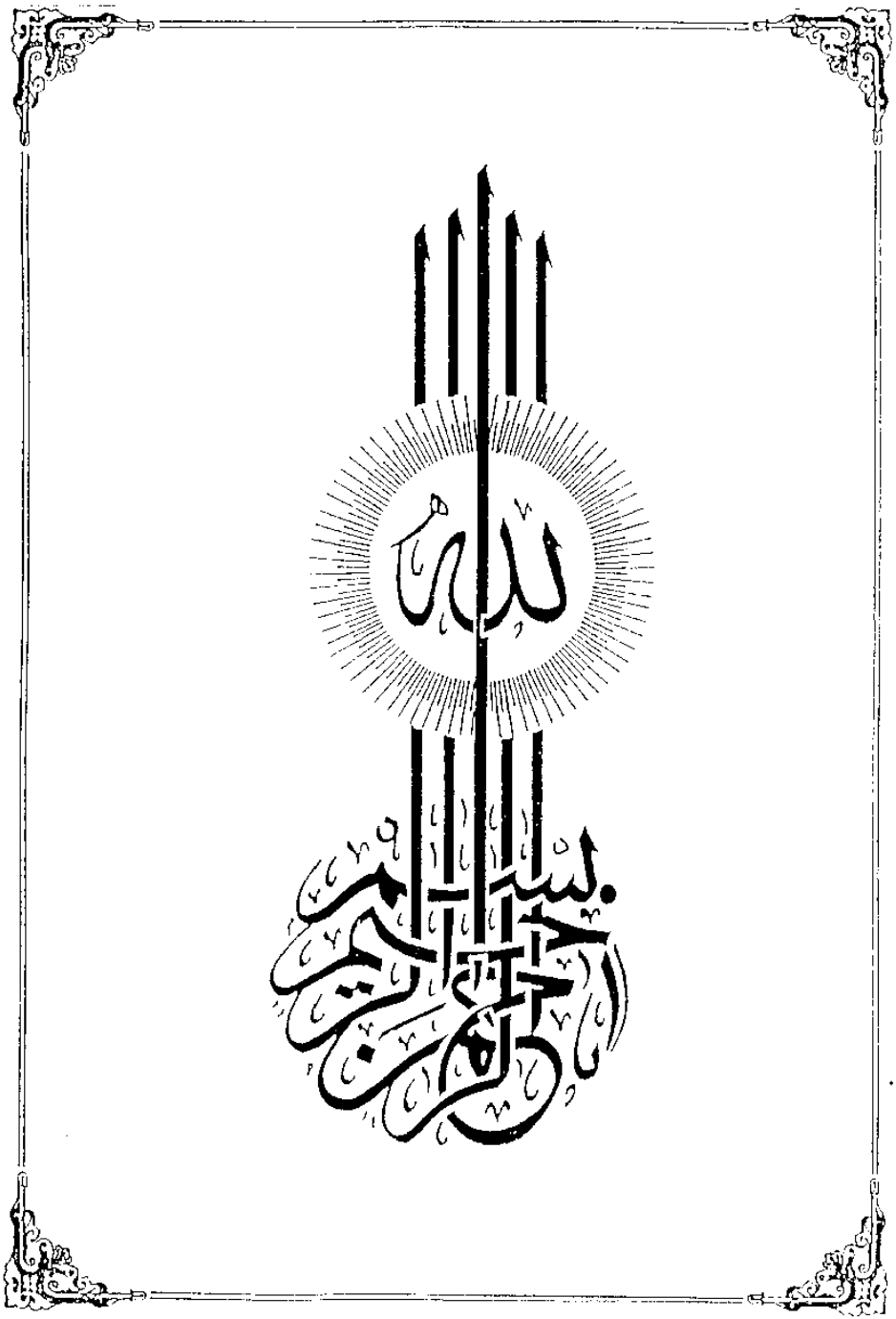

CONTENTS

Contents (cont.)

INTRODUCTION

This review is devoted to the study of diagnostic imaging techniques and procedures which are increasingly available and utilized in the diagnosis of most of the lower urinary tract lesions.

The aim of this review is to study, in short, and to evaluate the efficiency of both the conventional radiographic techniques and the modern techniques of imaging, in the diagnosis of most of the lower urinary tract lesions.

PART I

DIAGNOSTIC IMAGING TECHNIQUES

THE PLAIN X-RAY FILM

The diagnostic use of the plain film is essential within its limited application, its main value is as a preliminary film to intravenous urography to observe :

(1) The state of bowel preparation.

(2) The presence of calcified shadows in relation to the urinary tract before the use of contrast media which may later obscure them.

(3) To define soft tissue masses in or outside the urinary tract.

(4) To observe the abdominal parietes such as, psoas outlines splenic shadow and pelvic contents.

(5) It may also be used to assess the presence, number, size or position of calculi, in follow up of patients in which a diagnosis has already been established.

(6) To check the exposure factors and the positioning for later examination.

It is an inescapable fact that if urinary tract disease is to be excluded, the minimal acceptable investigation is excretory urography.

Positive information in the lower tract include :

In the bladder : apart from stones, calcifications are commonly seen in schistosomiasis, they do not appear to

interfere with the flexibility of the bladder wall. Calcium encrustation of bladder tumours is often a valuable diagnostic sign. The pre-urographic plain bladder film also ensures that the bladder has been emptied.

Prostatic calcifications are common in the old age groups and in some times indicative of T.B. in younger ones, also the calcification of the seminal vesicles can be identified and points to T.B.

Calcification of structures outside the urinary tract which may mimic urinary conditions are commonly present and they include; calcified pelvic veins (phleboliths), foreign bodies in the bowel particularly the appendix (Hodson and Edwards, 1970).

The details of various abnormalities in the plain film of the lower urinary tract are discussed separately later on.

EXCRETORY UROGRAPHY

Despite the advent of new imaging techniques, the excretory urogram remains the examination most frequently performed in uroradiology. Correctly performed, it provides much useful information, but if it is not, much vital information may be lost (Saxton, H.M., 1969).

Preparation of the patient : This includes the following :

(1) Bowel preparation using castor oil the day before the examination, enemata or high colonic washouts.

(2) Preliminary dehydration : this was done to limit the amount of water excreted during the course of the urographic examination and thus increase the concentration of the contrast material. Comparison between the effects of preliminary hydration and fluid restriction on urinary osmolality before and after equal doses of contrast material have been administered, these produce a similar plasma contrast concentration, but for the urinary contrast concentration is higher with preliminary fluid restriction. So, it seems that routine overnight fluid restriction will lead to an overall improvement in urographic results.

(3) The bladder should be emptied prior to the examination. The reasons for this are : to assess the size of the emptied bladder, to get rid of non-opacified urine so

that bladder details are better shown and a good mucosal definition obtained in the post-voiding film, and finally to differentiate between the filled bladder and a pelvic soft tissue mass.

(4) Preliminary plain film as discussed before (Hodson and Edwards, 1970).

Conventional dosage urography :

A strict routine cannot be laid down for excretory urography. Each examination must be carefully supervised by a radiologist at every stage and modified according to the results obtained. 20 ml of conray (8 gm of iodine) or an equal iodine dosage with some other contrast medium will produce a satisfactory urogram in a normal well dehydrated patient. Greatly improved results are obtained with the use of 40 ml of conray for routine examination of average adult of 70 kg, in obese patients the dose should be increased to 60 or 80 ml. For neonates, infants and small children, a dose of 2.2 ml per kg up to a maximum of 20 ml, is recommended (Sutton, D., 1980).

Bladder views :

The preliminary plain film of the bladder region should be exposed immediately after voiding, any remaining bladder shadow is then evidence of a tumour or failure of emptying, whilst any other residual soft tissue shadow lying within the pelvis will indicate a tumour or cyst of other pelvic structure.

A full bladder film at the end of 30 minutes is important to detect a deformity in bladder filling, or a filling defect within the bladder. This film also shows the amount of urine formed during the period of examination (assuming complete preliminary emptying). The routine antero-posterior view will need to be supported by oblique or lateral views to show diverticulae or ureteric problems.

The post-voiding film is of great value, it provides useful information which include :

1. The degree of emptying achieved and the presence of a post-voiding residue.
2. The presence or absence of trabeculations.
3. The thickness of bladder wall and bladder wall deformity.
4. The normality or otherwise of bladder mucosa.
5. The presence of non-opaque stones, foreign bodies, small papillomata, ureterocele, blood clots, etc..
6. The relationship of small stones in the lower ureter to the bladder wall.
7. The size of the prostate.
8. The presence of a tumour.

(Hodson and Edwards, 1970)

High dosage methods :

Modern contrast media used for urography have such a low toxicity that, apart from myelomatosis, they can be used without apparent harm to the kidney in extremely large doses. Three main benefits are to be derived from these methods. Firstly, intense nephrographic effect obtained allows detailed examination of the renal substance especially when combined with tomography.

Secondly, whenever preliminary dehydration, abdominal preparation and ureteric compression are contraindicated, a very adequate examination of the whole renal tract can be obtained.

Thirdly, adequate diagnostic information can very often be obtained in cases of advanced renal failure whether due to obstructive uropathy or primary renal disease, particularly where the retrograde method is impossible because of trauma or stricture.

Various patterns of administration have been described, ranging from a single large dose given rapidly, through a large dose given at intervals after a preliminary loading dose to the drip infusion method (Fry and Cattel W., 1971).

Excretory urography for micturating cysto-urethrography :

The use of a bladder full of contrast-laiden urine to investigate micturition, particularly after administration of a

large dose of contrast, is reasonable procedure when confined to the examination of the bladder outflow tract and urethra, but as a method of defining vesico-ureteric reflux, it has two drawbacks, namely; that in a proportion of patients reflux (often severe) only occurs when the bladder is filled to a maximum distension, and secondly, it is not possible to be certain that any urine found in the ureters has not arrived from the kidneys (Hodson and Edwards, 1970).

Contraindications of excretory urography :

There are very few contraindications to excretory urography

1. Advanced renal failure which is considered to be hopeless. No fixed limits can be given on this point.
2. Known sensitivity to organic iodides is not objection, providing desensitization is first carried out.
3. Multiple myelomatosis with proteinuria.
4. Advanced liver and kidney diseases and acute disorders have been always quoted as contraindications in the past. With modern contrast media, there no longer appear to be a serious danger in this respect. However, it is a wise precaution to limit the dosage as far as possible compatible with a satisfactory results, under these circumstances.
5. As with parentral administration of any organic iodides, subsequent studies of thyroid iodine uptake must be delayed for 2 months. (Hodson and Edwards, 1970).

Complications of excretion urography :

It is divided into minor and major complications :

Minor complications :

a) Minor side effects due to contrast agent, those consist of angino-neurotic oedema, transient rashes, pain in the vein injected (vasospasm), an abnormal sensation in the tongue and mild syncope (vasovagal attack), they can be treated satisfactorily by antihistaminics and positioning in bed in the head down position.

b) Effects due to ureteric compression, Nausea and faintness may develop due to ureteric compression. Release of the compression results in a rapid recovery.

c) Evidence of renal damage, this is so rare today as to be almost negligible, even in advanced renal failure. The one exception is multiple myelomatosis.

d) Perivenous injection, the severe local reaction which once followed misplaced injection no longer occurs, there is local stinging pain, which passes off rapidly with massage Venous thrombosis very rarely occurs. (Hodson and Edwards, 1970).

Major complications :

Approximately one in 14,000 patients will develop a serious reaction to the contrast materials, and approximately one in 40,000 will die from causes directly attributable to the injection of the contrast material. It is useful to subdivide