COMPUTERIZED TOMOGRAPHY IN UROLOGY

Essay

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IN UROLOGY

By

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CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION

I N T R O D U C T I O N

THE PURPOSE OF THIS STUDY

1. To evaluate the reliability of CT.
2. To study the sensitivity and specifity of CT and to compare it with the other methods.
3. To study cost efficacy relationship.
4. The advantages of CT, and its drawbacks if it is there.
5. The progress CT has introduced to diagnostic urology.
6. What are the new advances in diagnostic radiology.

IMPORTANCE OF THIS STUDY

The methods in use to diagnose urolggical diseases are many.

First is the history, clinical examination, routine examinations of urine and blood, also bimanual examination under anasethia, endoscopic examination, retrograde pyelography through cystoscope, percutaneus aspiration of biobsy or injection of dye there is also; renal function tests, macroscopic and microscopic histopathology of biobsies taken either by open surgery or through endoscope.

Some of the radiological methods in use also mentioned, like plain xray of the abdomen and pelvis,(IVP ,intravenous pyelography) or excretory urography, also venography, angiography, selective arteiography, lymphngiography, ultrasonography and radio istope studies and intra and perivesical gas insufflation.

But all of these methods are inadequate and inaccurate, and many areas of the body in which large amounts of information were theoretically available, but the technique of presentation used were so inefficent that most of the available data were wasted.

were installed in the united kingdom and North America by 1973.

The first body scanner was developed at 1974.

Whilst most of the early machines were dedicated head scanners, bodyscanners which are also capable of head scanning have now largely taken over and are established in clinical practise.

Its use in diagnostic urology had started in 1977-1978.

Since 1973 North America, European and Japaness and Israel commercial companies have produced alternative Versions of the original computed tomography scanner and a large competitive industry has developed.

A major milestone for computed tomography came with dramatic announcement that the 1979 Nobel proze in medicine was awarded jointly to Dr. Godfrey Hounsfield of EMI and professor A.M. Cormark of Tufts univaersity.

Many people regard this invention as the greatest step forward in organ imaging since the discoveryof xray by Roentgen in 1895. It has started as research by British ministry of Health and EMI limited.

After proving the principal Dr. Hounsfield spent several years developing the method clinicaly with Dr. James Ambrose of the Atkinson morley Hospital, London using a proton producer machine.

So obvious and so vast was the potential of the method in cerebral work that by 1979 over 1000 of these expensive machines were in use each costing £250,000.

PHYSICAL PRINCIPLE OF CT SYSTEM.

The basic and revolutionary assumption was that measurement taken by xray transmitted through the body contained information on all constituents of the body in the path of the beam. The scanner consits basically of an xray tube rigidly mounted opposite a detectory array (fanbeam), the xray beam finely collimated passes through the body.

The system rotates in a 360^{o} arround the body.

After passing through the patient it is partially absorbed, and the remaining photons of the xray beam fell on radiation detectors instead of xray film. The detector response is directly related to the number of photons imprignating on it and so to the tissue density since a greater proportion of xray photons passing through dense tissues are absorped than are absorped by the less dense tissues.

Presentation is in the form of greyscale in which whiteness is proportional to the xray attenuation Coefficient of tissues of each point of scan. Thus radio opaque material appear white and radio transluscent tissues appears black.

When they strike the detector, the xray protons are converted to scintillations. These can be quantified by a numberical readout representing the absorption in each tiny segment of the section traversed. (Hounsfield units) (Hounsfield scale), shows the normal density of some normal body tissues, air at -1000 and water at 0 units as fixed points, bone + 200 e.g. air presented as black.

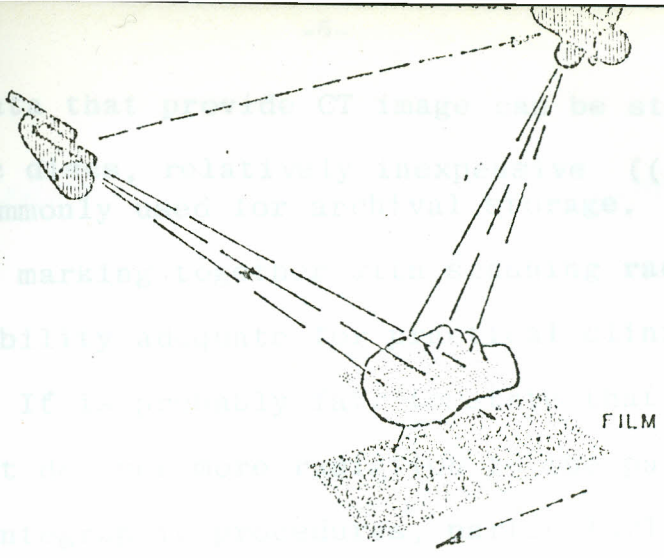


Fig. 1 Diagram illustrating the principle of longitudinal radiographic tomography (reproduced from *Semin Roentgenol* 12: 13–25, 1977).

They are recorded digtally, their interpretation must be processed by a suitable computer algorithm* to perform the calculations and mathematical reconstruction of the image of the cross section rep esenting the pattern of attenuation coefficients. The pictures are presented in series of slices The same idea of the "tomography" machine used now).

The thickness of a slice is 2-13 mm.

The image displayed on the oscilloscope can be permanently recorded by various photographic emulsion.

The majority of hard copy imaging now performed using multiformat camera that are capable of recording simultaneous number of images on xray film development in xray department.

*Algorithm:- A procedure for computation from AL- Khworismi, a ninth century mathematician in the court of AL-Nomun, Son of Harun AL- Rashid (the Arabian Nights) Caliph of Baghdad.

The numerical data that provide CT image can be stored on video tape of magnetic discs, relatively inexpensive ((Floppy)) discs are now commonly used for archival storage.

Careful external marking together with scanning radiographs enable reproducibility adequate for practical clinical purpose to be achieved. If is probably fair to state that CT examination in general do not deliver more radiation to the patient than conventional reontegraphic procedures, particularly if the radiation dose is assesed as integral dose.

EQUIPMENT AND DEVELOPMENTS.

The computerized tomography system consists of the patient handling table, operator, viewing console, a computer, the xray generator and a scanning gantry.

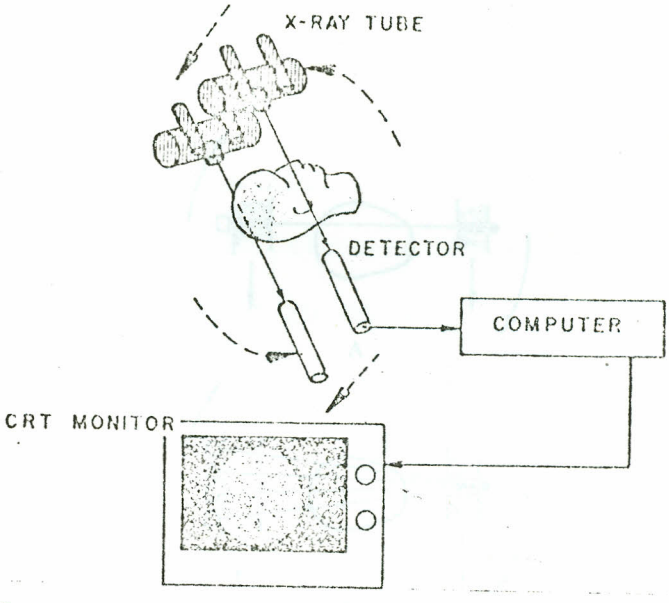


Fig. 2 Diagram illustrating the principle of CT (reproduced from *Semin Roentgenol* 12:13--25, 1977).

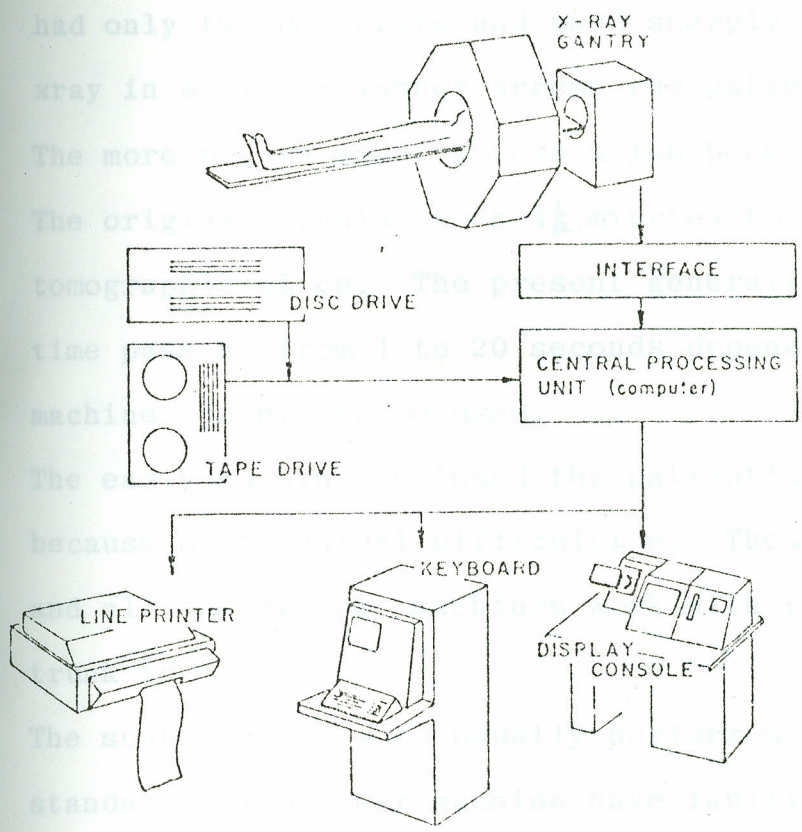


Fig. 3 Diagram illustrating the components o a CT system (reproduced from *Semin Roent genol* 12:13–25, 1977).

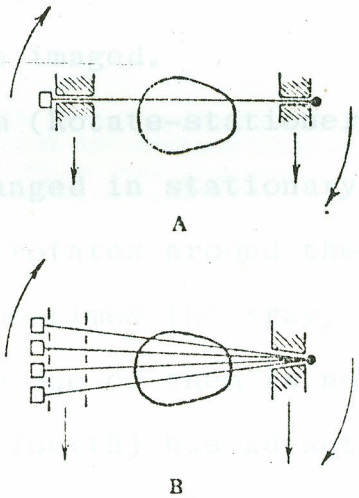


Fig. 4 Rotate and translate systems. (A) Single beam, single collimator. (B) Modified fan beam and an array of detectors.

The computed tomography has many developments, the early machine had only two detectors and used sharply collomiated beams of xray in a linear manner across the patient.

The more modern machines use a fan beam and multible detectors.

The original machine took 4½ minutes to perform a single tomographic slice. The present generation can obtain cuts in time passing from 1 to 20 seconds depending on the type of machine and programme used.

The early machine enclosed the patient's head in water bag because of technical difficulties. These were rapidly overcome and all the present machines work with the patients head or trunk in air.

The scan section were usually performed at 13 mm width as standard. The newer machine have facility for narrower section, 10, 8, 7, 5, mm to be more accurate.

The most commonly used systems are the third and fourth generation.

The third generation (Rotate-Rotate).

The xray tube and the array of detectors rotate synochronously around the patient to be imaged.

Fourth generation system (Rotate-stationery detector array)

The detectors are arranged in stationary ring encircling the patient and xray tube rotates around the patient usually within the detector array, sometimes the xray source is outside the detectors ring, either one of them is not superior to the other.

Each design (third or fourth) has advantages and disadvantages but all represent methods of collecting sets of transmittion measurements across a body section limited thickness.

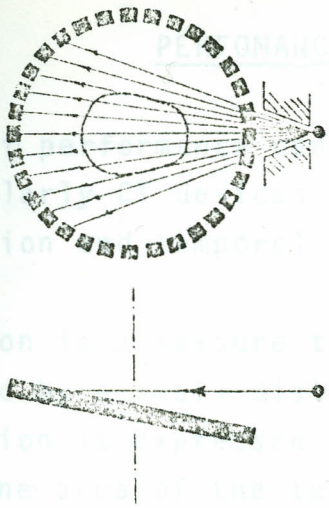


Fig. 5 Nutating geometry. Fixed ring of detectors. X-ray source outside the ring.

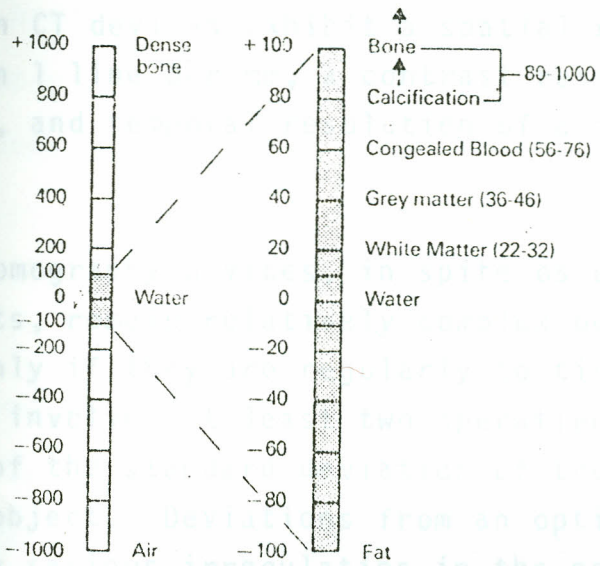


Fig 6 Hounsfield's scale. The full scale on the left extends over 2,000 units. The expanded scale on the right extends over 200 units and includes all body tissues. Head scans are usually done routinely at a window level (L) of 34–40 and a window (W) covering 0–75.

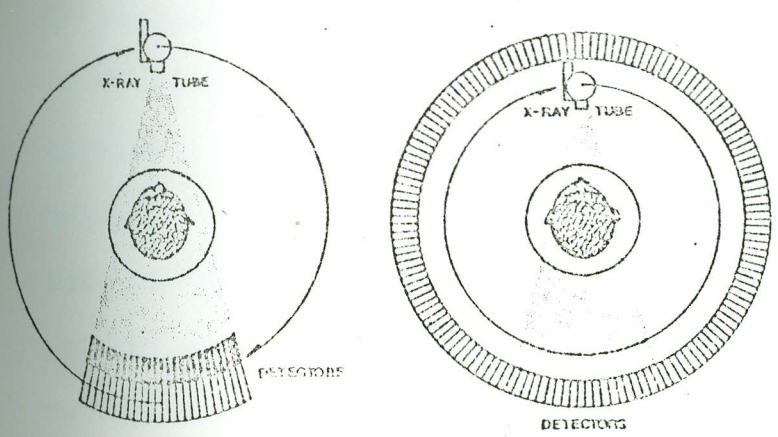


Fig 7 Two configurations commonly used for data acquisition in current CT devices. Left: Rotate-moving detector array (3rd generation) configuration. Right: Rotate-stationary detector array (4th generation) configuration (reproduced from *Semin Roentgenol* 12:13–25, 1977).

PERFOMANCE OF CT DEVICES

Three criteria of performance can be applied to most imaging systems, particularly CT devices. They are spatial resolution, contrast resolution and temporel resolution.

Spatial resolution is a measure to discreminate images of objects separated by a small distance.
Contrast resolution is expressed as percentage of X-radiation transmitted in one area of the image with respect to the radiation transmitted by the surrounding of adjacent area.
Temporal resolution is the length of time required by the system to yiled an image of predetermined quality.

Most modern CT devices exhibit a spatial resolution of somewhat better than 1 line per mm, a contrast resolution of better than 0.5 %, and temporal resolution of a approximately 1 to 4 seconds.

Computed tomography devices, in spite os extensive engineering improvements, remain relatively complex devices that operate properly only if they are regularly to tight quality control. It usually involves at least two operations. The first one is a measure of the standard deviation of the Hounsfield values for a uniform object. Deviations from an optimal value indicate potentially serious irregulaties in the performance of the system. Another quality control test consists of obtaining CT images of a well - designed phantom. Phatoms are commercially available and can provide a convenient measure of field uniformity, spatial resolution, and calibration of the Hounsfield scale. Both of these tests ideally should be carried out daily.

T E C H N I Q U E

The patient are scanned in supine position. A first series of plus or minus eight sections is performed without contrast medium. The scanning is repeated after contrast enhancement. The scans of the kidney as an example is done with slice sickness of 13 mm, taken at 15 mm intervals along the long axis of the kidney. Selected slice may then be repeated when indicated after enhencement by intravenous urographic contrast medium given either by bolus injection or intravenous continous infusion or biphasic, 50- 100 ml of iodinated solution given into t vascular system, the iodine enters the extravascular spaces in most body organs with the exception of the normal brain and spinal cord. CT measures total iodine concetration in tissues.

ANGIO COMPUTERIZED TOMOGRAPHY

Large blood vessels both normal and abnormal are demonstrated immediately following large doses of intravenous contrst, so rapid high dose of contrast medium, may be used to demonstrate the renal parenchyma.

ECONOMICS AND POLITICS OF CT.

In january 1976 a study was done and obtained data from multiple CT users in the united states. The typical unit had an annual technical cost of 325,000$ to 371,000$ depending on patient volume.

Data on charges indicated the net technical revenue was $138 per patient as compared to net technical cost of $130 per patient making of total charges of 26$$.

By November 1978 another study in U.S.A. was done. The dedicated

head units were generating excess profit of $123,000 per year, while body CT scanners each unit operating of an average economic loss $77,000 per year.

Although the politicians and planners made CT a scapegoat because of its high cost, and described the danger of (CAT fever) and it became the symbol of ((Technology run wild)). This approach was serious mistake as CT has proven to be a major revolution in diagnostice imaging, so beneficial, in fact that it could not be stopped by legislation and guidelines.

D R A W B A C K

With such a complicated apparattus using xray, sophistcated photon recording systems and computer programming, there are many possible sources of error which can produce artefacts and erroneous results, they are:-

1. Noise; e.g. gas in gastrointestinal tract.
2. Motion artefacts.
3. Artefacts due to high differential absorption in adjacent tissue.
4. Technical erros and computer artefacts.

Also one of the drawbacks are the well recognized side affects for the contrast medium ranging from minor reactions requiring no treatment to death, so careful selection is therefore required. Also one of the major challenge for the CT is the high cost of equipment, maintanance and for one diagnostic procedure.

CASE MATERIAL AND SOURCES

The source of this study is from the international journals of urology and radiology in the last ten years, the radiology journals included the American Journal of Roentgenology AJR in diagnostic imaging related sciences, also journal of Radiology which is printed by the radiology society of North America.

Clinical radiology which is the journal of royal college of radiologists, also ACTA radiologica diagnosis, which is the scandinavian Journal of radiology.

Also from computerized tomography which is the official journal of computed tomography society, also computerized RADIOLOGY the official of the computerized radiologica society, also the journal of computer Assisted Tomography.

The urological journals were the Journal of Urology association, also the British Journal of urology. Also the Scandinavian Journal of urology and nephrology.

The textbooks which were used as sources of this study are:

A TEXTBOOK OF RADIOLOGY AND IMAGING

By David Sutton, Third Edittion, 1980, publisher is Churchul Livingstone, Edinburgh, which was having various chapter on methods of examination of the urinary tract and computed tomography was one of them.

ANOTHER BOOK IS: ADVANCES IN DIAGNOSTIC UROLOGY

by C.C. schulman, published by Springer_Verlog Berlin Heidelberg, New-York 1981, where he had discused many aspects of computerized tomography of the kidney, adrenals, bladder,

prostate and discussed in detail the value of angioscan with density curves in renal tumours, and also discussed the value of CT in diagnosis of renal abscess.

ANOTHER TEXTBOOK: IS COMPUTED BODY TOMOGRAPHY

By Joseph K.T. Lee, stuart S.Sagel, Robert J. Stanley. second printing at February 1983, Raven press, New-York, which has discussed all recent trends of computerized tomography and the physical principle, also about the radiation oncology and the economics and polities of CT.

- The sections in this study was obtained from the Department of computerized tomography of KASR- Eini medial school, Cairo University.

CHAPTER 11

KIDNEY

K I D N E Y

Because of the cross-sectional anatomic display possible with C T , areas previously considered blind to most imaging technique can now be demonstrated.

The anterior and posterior surfaces of the kidney and the medial (Hilar) and lateral aspects of the kidney as they relate to the renal vascular pedicle can be clearly imaged. In addition the paranephric fascial compartments are vividly displayed. The nonvisualised kidney at urography is no longer an enigmatic problem since C T is able to demonstrate the site and cause of most casses of obstructive Hydronephrosis, Azotemia is no longer the stumbling block to adequate urora-diologic diagnosis, since C T can be performed instead of the urogram without the need for intravenous contrast material. Likewise, C T can serve to evaluate the kidney in patients with contrast media sensitivity.

Computed tomography is superior to convetional radiography in determining tissues with only minor differences in their attenuation values. Because of the increase contrast sensitivity, C T can differentiate benign renal cyst from a solid renal mass.

Computed tomography now has a specific acceptable role in the imaging decision tree for the renal mass.

Renal C T is quick and easy to perform and free from operator dependance. It is noninvasive with little or no risk except that related to the use of intravenous water soluble contrast material.

INDICATORS FOR RENAL CT

Renal masses
Cyst, tumour, abscess, hematoma, cortical nodule (pseudotumor), calcification.
Renal failure
Hydronephrosis-degree and cause; parenchymal disease
Juxtarenal processes (peri-pararenal)
Blood, pus. urine, lymph, effusion, tumor, fat, air
Oncologic management
Tumor detection, staging, treatment planning, and follow-up
Miscellaneous
Trauma, contrast media sensitivity, congenital anomalies, allografts

Table 1

NORMAL ANATOMY OF THE KIDNEY BY C.T.

The cross sectional anatomy of the normal kidney is clearly demonstrated by C T. The presence of perinephric and renal sinus fat provides the tissue contrast neede to define the renal contours and collecting system complex. Renal margins especially along the anterior and posterior surfaces are seen entirely. On noncontrast scans, the renal tissue density is uniform throughout with attenuation values measuring 30 to 60 Hounsefield units. Segments of the urine filled renal pelvis and calyces with a near water density can be visualized on precontrast scans and better after contrast medium. The hilar vascular structures are frequently identified.

The diagnostic criteria employed in the C T evaluation of the kidney are:-

Alteration in the normal contour, visualization of a renal mass, disappearance of perinephric outline and measurement of the attenuation coeffiecent in a region of interest.

CONTRAST MEDIA UTILIZATION

In renal C T , intravenous contrast material is a fundamental requirement. It improves lesion detection and definition, whether vascular or avascular.

Bolus injection of 10 to 40 cc of a 50 to 60 % solution contrast material are usually sufficent for assesment. There is linear relationship between iodine concentration of contrast material which will increase the C T number of the renal parechyme.

The renal handling of contrast material as observed by serial dynamic C T is really triphasic, namely, major vascular

opacification (atery vein) followed by a nephrogram and the pyelogram.

C T renal angiogram will show the aorta, renal atery and renal vein, followed by an intense vascular nephrogrm outlining the corticomedully junction, which quickly becomes a tubular nephrogram identical to that seen during intravenous urography. The attenuation value of the renal parenchyma may increase to 80 to 120 HU after contrast material adminstration.

NORMAL VARIANTS AND CONGENITAL ANOMOLIES.

Persistan foetal lobulation, congenital anomolies of fusion such as horseshoe kidneys as well as renal agenesis , hypoplasia and simple ectopia all have characteristic C T appearance. Differntiation between renal agenesis and a small nonfunctioning kidney is important.

In cases of agenesis there is no any renal function even minimal by C.T. and also abscence of renal pedicle.

While in renal hypoplasia C.T. can identify even minimal degree of function when it cannot be detected by excretory urography or dynamic isotope studies.

RENAL MASSES.

Excretory urography with routine tomography sitll remains the major screening test for detection of the renal mass, but once detected, furhter definition and diagnosis are best performed using C T.

The modern grey scale ultrasonography plays a significant role in the work up of the renal mass, but the position of C T scanning in the evaluation of renal masses is much clearer

The diagnostic accuracy of C T for separating cyst from neoplasm is extremely high,well over 90%.

RENAL CYSTIC DISEASE,

Simple cysts.

The most common renal mass is the renal cyst, mostly cortical in location., may be solitary or multible and often on the front or back surfaces. These masses are extremely diff icult to detect by excretory urography even with linear tomography. Cortical cysts increase with age and 50% of patients over the age of 50 have one or more cortical cysts seen at autopsy. Criteria for diagnosing benign renal cysts are:-

(a) Homogeneous near-water density -10 HU to +10 HU.

(b) No enhancement with contrast material.

(c) No detectable wall, rounded structures.

(d) Smooth interface with parenchyma.

Renal cysts are often small, less than 1cm, but using current generations C T scanners can diagnose down to 5 mm in diameter. If the wall are thick, then the diagnosis may still be renal cyst i.e. infected cyst, hemorhgic cyst, cystic neoplasm but not the true ((blue domed)) cyst familiar to urologic surgeon.

ADULT POLYCYSTIC KIDNEY DISEASE

They are almost invariably bilateral. These patients often present without evidence of renal failure. Abdominal mass or hypertension maybe the clinical finding. In patients with a

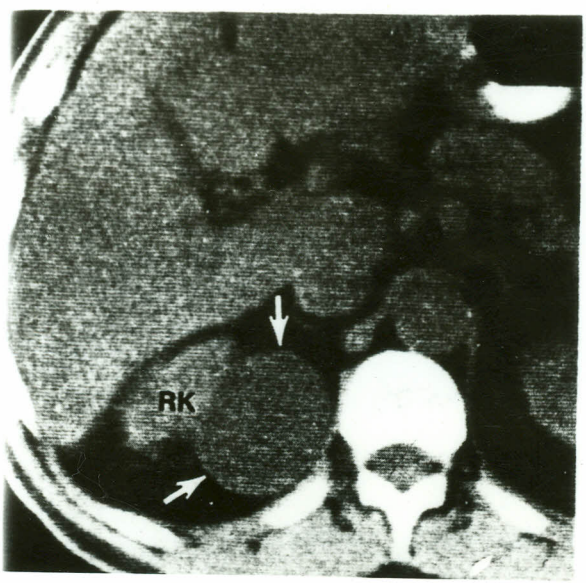


Fig.8: Simple renal cyst. Precontrast CT scan demonstrates a well-marginated mass (arrows) arising from the medial aspect of the upper pole of the right kidney (RK).

Fig. 9: Adult polycystic kidney disease asymmetric involvement. Postcontrast CT scan demonstrates extensive cystic involvement of the left kidney. Small cysts are present in the right kidney (arrowheads).

known diagnosis the search for focal neoplastic change or abcess often prompts C.T. evaluation. The cysts vary in size and are usually seen throughout the entire substance of the kidney. Most cysts are near water density.
A symmetrical renal involvement such as the liver, the spleen, and the pancreas, can be evaluated similary.
C.T. can detect the renal masses in familial polycystic kidney disease at a stage before renal enlargement or calyceal deformities.
Also characteristic appearance can be seen even in the prescence of grossly impaired renal function.
Ultrasound is the procedure of choice in the routine follow-up of patients with polycystic kidney disease and an initial screening of their family members.
C.T. should be reserved for evaluation of possible haemorhage or malignment transformation.

CYSTIC DISEASE OF CHRONIC DIALYSIS

A recently recognized cause of diffuse acquired cystic renal disease is chronic dialysis.
The kidney not only decrease in overall mass and volume during the first three years of chronic dialysisi, but also cystic degeneration occurs throughout the remaining native kidneys.

MALIGNANT RENAL TUMOURS

RENAL CELL CARCINOMA

Staging of renal cell carcinoma requires accurate information regarding local extension, venous invasion, lymphtic involvement and distant metastasis. Many of these features have important prognostic implications. Accurate preoperative staging determines the surgical approach and may preclude curative surgery in patients with advanced lesions. With increased experience and technological advances, it has become apparent that sufficent anatomic detail is avialable from CT scans for accurate nonivasive staging of renal neoplasms.

Adenocarcenoma are diagnosed on CT scan by the distortion created in the renal outline, collecting system or renal sinus fat.

The criteria for the diagnosis of renal tumour by CT include Often heterogenous attenuation value close to but normally less than that of renal parenchyma, definite contrast enhancement but alwaus less than the surrounding normal parenchyma. When encapsulated the wall is thich and irregular.

Secondry characteristics, such as renal vein and renal atery enlargement, nodular areas of soft tissue attenuation within the perinephric space, enlarged regional lymph nodes, gross invasion of the inferior venacava or main renal vein and hepatic metastosis could be diagnosed easily by CT.

In one study done by (Weyman et al 1980)

To compare resualts of computed tomography and angiography in the evaluation of renal cell carcinoma.

All the patients with final clinical diagnosi of renal cell carcinoma who had confirmed diagnosis by nephrectomy or open renal biobsy were investigated by both computerized tomography

and angiography. Staging of the tumour by the two methods were done commenting on the perinephric extension to the perirenal fascia (Gerota's fascia), lymph node involvement. A correct diagnosis of renal malignancy was made by CT alone in 59 of 62 confirmed cases, of the 49 renal cell carcinomas examined angiography five were avascular and six was hypovascular preventing accurate angiographic assesment of tumour extension, that is because approximately 15% of renal cell carcinoma are avascular giving high flase (negative, while false positive in) angiography was also high due to parasitic arterial supply from visceral or retroperitoneal arteries.

A tendency for the left renal vein to be compressed between the aorta and superior mesentric artery the so called, nut cracker phenomenon, must be recognized because mild proximal dilatatiom of the left renal involvement.

Although venous and lymphatic involvement may be detected by ultrasonography, the accuracy of this method has not been established. Preoperative staging of renal tumours has relied on angiography staging for detection of direct perinephric extension and venous or lymphatic involvement, but recent studies reporting only 38% to 60 % accuracy.

In this series CT was more accurate and more sensitive in detecting extracapsular extension of tumour then angiography, although the inability of CT to distinguish hyperplastic enlargement from tumour metastasis (because it is based on the enlargement of the nodes), also inability of CT to diagnose microscopic tumour involvement of normal sized lymph nodes and had caused some false positive and negative results.

Lymphangigraphy was tried by others but the lymph nodes in and above the renal hilus are not well opacified by lymphangiography and many lymph node metastasis which were not opacified by lymphangiography were detected by CT.

Information concerning the normal and collateral renal vascular anatomy is best provided by angiography.

C O N C L U S I O N

Preoperative staging of renal cell carcinoma can be performed by CT, which is more sensitive and accurate in predicting extracapsular extension of tumour. True tumour bulk and extent are more easily appreciated by CT, due to direct visualization of the tumour independent of vascularity. With appropriate use of bolus or infusion techniques for contrast enhancement, CT is highly sensitive and comparable to angiography in evaluating main renal vein or vena caval involvement. CT is more sensitive than angiography and lymphangiography in detecting lymph node involvement and alerts the surgeon to its site. However false positive and false negative results will occur due to the inability of CT to evaluate intranodel archtecture. Preoperative angiography is not necessary in most patients with renal cell carcinoma, but should be performed when clarification of equivocol CT findings would alter the surgical approach.

TABLE 2 : PERINEPHRIC EXTENSION

	CT	ANGIOGRAPHY
True positive	19	10
True negative	26	17
False positive	3	3
False negative	2	4
Indeterminated	4	6
TOTAL	54	40
Accuracy	83%	68%
Sensitivity (true positive)	83%	59%
Specificity (true negative)	84%	74%
Predictive value positive examination	85%	76%
Predictive value Negative examination	94%	81%

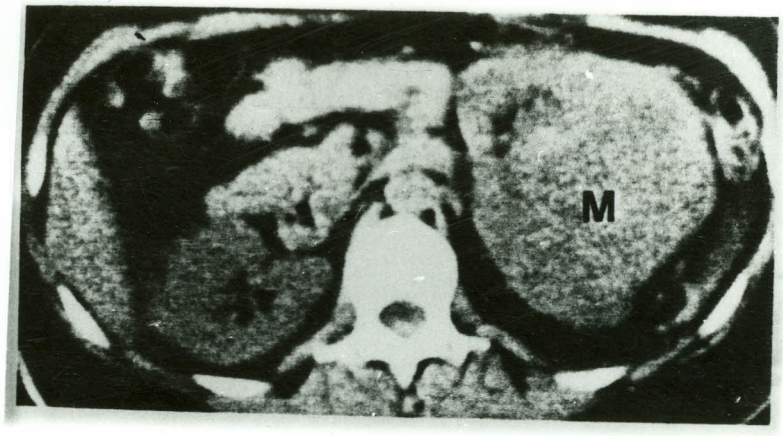


Fig. 10: Renal cell carcinoma. Precontrast CT scan shows a large mass (M) arising from the posterolateral surface of the left kidney.

In addition to diagnosis and staging C.T. plays important role in the follow-up of these patients who are treated with surgical resection, especially who are at risk of post operative recurrence benefit most from follow-up C T. Extensive bulky renal tumours, and lymph node of ipsilateral adrenal metastosis all place the patient at risk for recurrence. Early detection of local recurrence would allow prompt surgical resection. Features that suggest recurrence are a large soft tissue mass in the renal fossa, enlargement or irregularity of the psoas muscle on the side of the resction, and other local organ involvement.

TRASITIONAL CELL CARCENOMA

Are the next most common renal neoplasm after adenocarcenoma. The role in diagnosis by C T falls in two folds:- Firstly is used to solve the diagnostic problem of a radiolucent filling defect in the renal pelvis or ureter seen by urography. Although C T cannot be histospecific, it can usually differentiate soft tissue masses from fresh blood clot or stone. Secondly C T is often used to delineate the actual tumour extent after its initial diagnosis by excretory urography or retrograde pyelography.

Since conservative surgery i.e. local resection is becoming a more popular therapy for transitonal cell carcenoma C T plays an important role in preoperative staging of transtional cell tumours.

In C T they either appear as sessile, intraluminal masses (most common) or ureteral wall thickening or large infiltrating masses.

Although charecteristically avascular on angiography, C T may show slight contrast enhancement.

C T can show periureteric and intrarenal extension.

Nonetheless, C T plays an important role in defining transitional cell carcinoma and is an effective complementary imaging method to urography.

Accuracy of the technique is about 95%

BENIGN RENAL TUMOURS

Angiomyolipoma appear as well circumscribed fat density masses either totalling or partially within the renal parenchyma. Known by its fat content. Renal fibroma, adenomas and hemangiomas appear as well circumscribed, soft tissue density masses. Specific diagnosis is ready made by C T Surgical exploration is often required for a definite diagnosis in these cases.

INDETERMINATED MASSES

Technically indeterminate masses having many C T features of a simple cyst but one or more features not consistent with the diagnosis.

1. Technically indeterminate scans:-

The technical problems resulted in an altered, confusing C T image of the renal lesion were:-

(a) Mass smaller than the scan collimator.

(b) Motion, causing gross artifacts.

(c) Data poor to C.T. scanning of large patients.

in resolving these technically indeterminate masses, ultrasound and needle aspiration have proven to be most helpful, as most of these masses were benign cysts. Angiography was usually of little help

2. Cysts like masses without technical problems:-

In the absence of scan artifacts or other technical problems, Cyst like renal mass may still be considered indeterminate on C.T. scans because:-

(a) Uniformly thick wall.

(b) Wall calcification.

(c) Central attenuation higher than a bening cyst.

(d) Irregular contour or poor delineation from sorrounding tissue.

Still in this group ultrasound and needle aspiration were most helpful in clasification.

3. Solid masses with complex features:-

These last C T indeterminancy includes cases that closely resemble neoplasms but exhibit confusing C T features. These are large, complex renal masses with ill-defined contours extending to the perirenal spaces. Unlike typical renal cell carcinomas the involvement of peripheral structures was ill-defined rather than nodular. Secondary features such as renal vein invasion or lymph node involvement were abscent. Lesions in this category requires surgical intervention for definitive diagnosis and treatment.

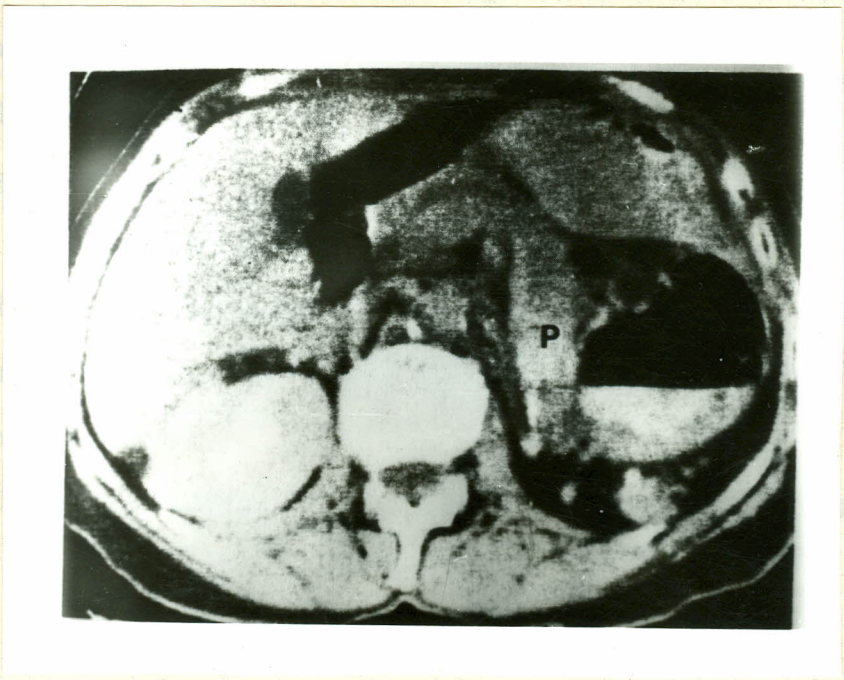


FIG. 11 Normal posthephrectomy changes: The left kidney has been removed for renal cell carcinoma. Compensatory hypertrophy of the right kidney is seen. Note vertical orientation of body and tail of pancreas(P).a frequent finding after left nephrectomy.

Most of these casses were found to be xenthogranulomatosus pyelonephritis of renal cell carcinoma complicated by external haemorhage or urinoma.

The approach to diagnose these indeterminate casses are:-

(a) If an obvious technical difficulty is present and can be remedied, a repeat C T scan is performed. If not, ultrasound or aspiration is suggested.

(b) If the mass or masses are cyst like on C T but have any or all of the features previously described e.g. thick wall, ultrasound and needle aspiration of the mass is suggested.

(c) If the mass has complex C T features and is apparently solid, even though not typical of neoplasm, surgical evaluation is indicated occasionally preceded by percuteneous biobsy.

THE VALUE OF ANGIOSCAN WITH DENSITY CURVES IN CAT SCAN FOR RENAL TUMOURS.

This is a technique that provided additional dynamic information to conventioned CAT scan. This technique can only be used with third generation CAT scan. The type which can make 4-8 mm thick section within 2-4 minutes.

PROCEDURE:-

After location of the suspicious area on unprepared conventional CAT scan sections, injection of embolus within six seconds of 60 ml iodized water soluble opacifier for urinary excrection (with the help of pump). CAT scan sections are then performed every 15 seconds. All sections are made in the same plane and marked when the examination started. Thus eight sections are made within two minutes.

The results are either static or dynamic

Static results

For each section the observed denseness are carried out to a curve plotted.

The first peak of the curve corresponds to the cortical and the second to the medullary the two peaks are very regular showung the homogeneousness of the two parenchyma with different dynamics.

The curve obtained in case of renal cancer are entirely different. There is widening be fore and after of the contrast material which is typical of a very heterogeneous tissue.

Dynamic results with a survey of denseness development with time

This investigates the contrasting material dynamics in each tissue.

They show an initial upward portion that corresponds to the absorption of the contrast material by the tissues.

Renal cancer has a very special dynamic, It is a very heterogeneous tissue each point shall evolve in a very peculiar way.

Some will have a vascular type dynamic and some(necrosis) will show no change in denseness with any possible intermediate aspects.

A kidney cyst that is not visualized will have a constant denseness.

INFLAMMATORY MASSES

ACUTE:- When a patient with fever, chills, flank pain and focal mass or swollen kidney on excretory urography, inflammatory renal disease is strongly considered.

Acute focal bacterial nephritis (A F BN) describes the early, more edematous phase of renal inflammatory process, usually caused by a gram negative organism. This case used to be called severe acute lobar nephronia.

Although most patients with acute pyelonephritis will not come to C T , those patients with focal process(es) on excretory urography may be referred for C T examination to evaluate the possibility of frank renal or perirenal abscess.

On C T scans, acute focal bacterial nephritis appears as a focal mass, without definable walls, frequently wedge shaped corresponding to the renal tubule. The areas of involvement can be either isodence or slightly less dense than normal parenchyma on noncontrast scans. After intravenous contrast medium administration, there is patchy and enhomogenous enhancement, similar to the striated nephrogram on excretory urography.

Most of these cases resolves under antibiotic where some of them progress into an abscess cavity, which then requires percutaneus or surgical draiage. On C T scans, an abscess is often well defined, of lower density than normal renal parenchyma, has a thick irregular wall. Besides benig capable of differentiating a renal abscess from acute focal bacterial neprhitis, C T can also provide detailed information as to the possible perinephic extension.

C H R O N I C

Xanthogranulamatous pyelonephritis is an interesting pathologic conditions that results from chronic infection in an obstructed kidney.

The usual xanthogranulomatous pyelonephritis (XGPN) c T appearance includes these features:-

(a) Large calculus in the renal pelvis or collecting system.

(b) Absence of contrast material excretion in the kidney or area of focal involvement.

(c) Multiple non enhancing, round areas within the medullary space having higher attenuation then urine drainged in a hydronephrotic pattern.

(d) Discrete (solid) masses.

(e) Frequent involvement of the perirenal space.

Larger masses infiltrating the blank and air containing intrarenal abscesses have also been seen with XGPN.

This is not to be confused with emphysematous pyelonephritis.

A high attenuation pyohydronephrosis may mimic XGPN, and only pathologic evaluation will reveal the typical inflammatory changes and lipid (loilen) macrophages of XHPN. Concomitant XGPN and renal cell carcinoma has been reported.

Because (XGPN) may be focal, renal sparing can be performed if the disease is suitable staged.

A staging system has been suggested similar to the criteria for renal cell carcinoma.

C T can precisely define the full extent of XGPNand assist in the planning of surgical therapy. Total fatty replacement of the kidney is a rare form of chronic renal inflammatory disease. Frequently this is seen in conjunction with the prescence of a large staghorn calculus and XGPN.

This condition can be well displayed on C T. scan.

Extensive proliferation of ranal sinus fat is thought to be the etiology, and pathologic examination reveals no remaining renal parenchyma.

THE USE OF COMPUTED TOMOGRAPHY IN THE DIAGNOSIS OF RENAL ABSCESS:

Renal abscess (RA) is a rare and frequently severs infection durin renal sepsis, with or without obstruction or during a sepsis of unknown origin. The discovery of RA may dramatically modify theraputic strategy. However, the diagnosis of RA is often difficult by conventional investigations. So the potential contribution of a nonivasive, precise, and rapid procedure such as computed tomography (CT) must be studied. The diagnosis of RA was made in patients with severe renal sepsis.

Usually after a failure of conventional investigations.

C.C. Abbou 1981 et al has done a study the aim of the study is to discuss and comment the indications for C T in the diagnosis of RA, and to compare the procedure with conventional methods of diagnosis.

METHOD:-

They used a third generation C T scanner, with a scanning time of 4 seconds. The interspace between two (slices) is 7-9 mm. Opacification of the gastrodudenal tract was accomplished with Gastrografin.

Two or three slices were made initially, and then an opacification of the vessels was made with a bolus of intravenous water soluble contrast media (60% lmg/kg). The total duration of the procedure was 15 to 30 minutes..

	AGE	COMPLAIN	CLINCALLY	UROGRAPHY & OTHERS	C.T.
se 1.	75 Y	Febrile, left flank-pain	fever &sponteneous elimination of calculus.	urography: Obstructive lithiasis.	very Heterogeneous parenchyma
se 2	73Y	Septic shock	Septicemia culture sensitivity of E. Coli in urine	Urography: Bilateral delay, retrograde puelography was normal.	small numerus defects in left with a larger cavity under cortex, confirmed by nephrecto
se 3	37Y	Haematuria: fever, Rt. flankpain.	septicemia: culture sensitivity of E.Coli.	Urography: tumoural aspect of the upper part of Rt. kidney. Arteriography: This formation was a nonvascular one.	isolated cavity, very dense, connected to renal cavity.
se 4	57Y	Right flankpain,	Septicemia, and hyperparathyrodism in past history.	Ureteral calculus and distension of right cavities. Ureteral catheter failed because of calculus.	Heterogenous of right aspect of parenchyma Two defects discovered.
se 5	53Y	Right flankpain and fever.	Urine and blood cultures positive for enterobacter cloaca .	Right kidney did not show any secretion.	Heterogenous parenchyma with a lot of small defects.
se 6	31Y	Right flankpain & fever.	Urine E. coli	Right late secretion enlarged left with a lower pole difficult to see.	Right numerus defects. Antibiotic then repeat, normal CT findings.
se 7	52Y	Right lumbar pain, fever and chills.	Closed renal biobsy for glomerulopathy.	Right kidney not visualized. Retrograde pyelography: was normal.	irregular vascularization bilaterally. Right with round small defect.

Table: 3.

DISCUSSION

RADIOLOGIC PATTERN OF RA IN C T:-

The elementary lesion is a round defect with a variable size always smaller than 25 mm in this study. Its density (10-28 in Hounsfield units) is spontaneously smaller than the normal renal parenchyma. The density is however higher than the liquid one and increase slightly after the bolus of intravenous water soluble contrast.

In these seven patients the abscess was single in one patient and multiple in six patients, unilateral in five patients and bilateral in two patients. These round defects seems to be very characteristic of renal abscess but not pathognomonic, and it is imperative to correlate radiologic, clinical and bacteriologic patterns. Other diagnostic criteria by C T.:-

(a) Irregularities of the cortex due to microabscess.

(b) Thickening heterogenicity of the parecnchyma.

(c) Alternating zones of low and high densities usually triangular.

A recent prospective study emphasizes the frequency of perirenal haemqtoma after renal biobsy. (85%) usually without any clinical symptoms.

VALUE OF C T , COMPARISON TO OTHER AVAILABLE PROCEDURE IN THE DIAGNOSIS OF RA.

COMPARISON WITH UROGRAPHY:

The superiority of C T over standard radiography is due to its greater ability to discriminate the densities (0.5% for C T and 5-10% of radiography) if the contrast is strong enough. C T is able to descriminate defects 3 mm in diameter. C T in nonaggresive and does not require more contrast media than urography.

THE UROGRAPHY SHOWS:-

1. A nonvisualization of the kidney in two patients.
2. A tumour aspect in one patient.
3. An enlarged kidney, with a late secretion in three patients.
4. A normal kidney in one patient.

Urography allows the diagnosis of renal abscess in two patients. in the other five it was not possible to make the diagnosis. In one patient the C T demonstrated bilateral abscesses while the clinical signs indicated unilateral. In another patient the clinical examination was normal and C T showed bilateral renal abscesses. Even if renal abscess is suspected upon urography, the superiority of C T is evident. Particularly incase of a nonvisualization of the kidney, demonstrating the exact size of the kidney, its functional unit and any radiotransparent calculi.

C T visualizes precisely abscesses with a 5 mm diameter, their unit or bilateral localization, and any possible communication with the renal cavities. C T easily demonstrates hydronephrosis and avoids ureteropyelography which may be dangerous investigation. Finally C T because of its nonivasive character may be

repeated. In this study second C T was performed in two patients showing total recovery. Thus, C T seems to be more helpful than urography in the diagnosis of pyelonephritis with or without obstruction of the cavities. Arteriography is more dangerous and may be avoided altogether in most cases.

COMPARISON WITH ECHOGRAPHY:

Echography is less expensive, easily repeated and without irradiation. But C T is able to show very small abscess with a diameter less than 15 mm which is frequently the case, and appreciate the functional state of the kidneys. C T is not complicated by obesity. C T may demonstrate the nature and the exact localization of an obstraction. C T is less dependent on the operatar than echography.

Finally:-

Both methods permit a transcutaneous drainge of hydronephrosis and perhaps of abscess.

INDICATION OF C T IN RENAL ABSCESS.

The detection of RA is very important step in the investigation of septicemia, a renal septic state or a septic state of unknown origin.

In this study C.T. was performed for the following clinical patterns:-

1. Severe septic state with septicemia of unknown origin requiring an immediate diagnosis.
2. Renal septic state persisting in spite of correct antibiotic theraphy often in spite of drainge of the distended cavities.
3. Sepsis and abscence of secretion in the urography.
4. Tumoural mass.

The abscence of any parallel between the anatomic and clinical patterns is well known during renal sepsis. some patiens exhibit severe septic state with shock due to micro-abscesses, and other patients present a mild fever coexisting with irreversible damage of the kidney. Such as pyelomephrosis. The drainge of the cavities, if they are distended, is always an emergency, but the mangment of the infected parenchyma is not clearly specified. In some patients the antibiotic treatment allows a total recovery and on the contrary, the presence of microabscesses may explain the persistence of a severe septic shock in other patients.
In the latter an immediate nephectomy should be considered.
C T may be extremely useful in such an emergency situation.

However the theraputic mangment must be based not on the radiologic pattern of RA but on the clinical pattern.
Infact, the presence of RA is probably very common during an acute obstrction of the cavities and the conastation of RA using CT must not increase theraputic aggressivity.

PRACTICAL IMPLICATION OF C.T. IN RENAL ABSCESSES:

This study underline the importance of C.T. in the three following condition.

1. Severe septic state with unilateral renal syptomatology. The correlation between clinical pattern and C.T. constataions may be useful in deciding whether immediate nephrectomy is necessary.
2. Septic state of renal origin, without any obstruction or persistly despite drainge of the cavities. C.T. may prove essential in the decision between antiotic therapy, drainge of the abscess and nephrectomy.
3. Severe septic state of unknown origin. C.T. permits the localization of the sepsis (kidney, liver, intraperitoneal, extra abdominal, e t c)

C O N C L U S I O N

Computed tomography seems to be the most logical approach in the diagnosis of renal abscess. This is due to the vasculization of the kidney, to its position among fatty formations which increase the contrast of the images, and to the harmless of the procedure. The main obstacle is economic. However it is logical to assume that C.T. will dramatically modify the classical hiererchy of radiological procedures and thus the future cost of this examination.

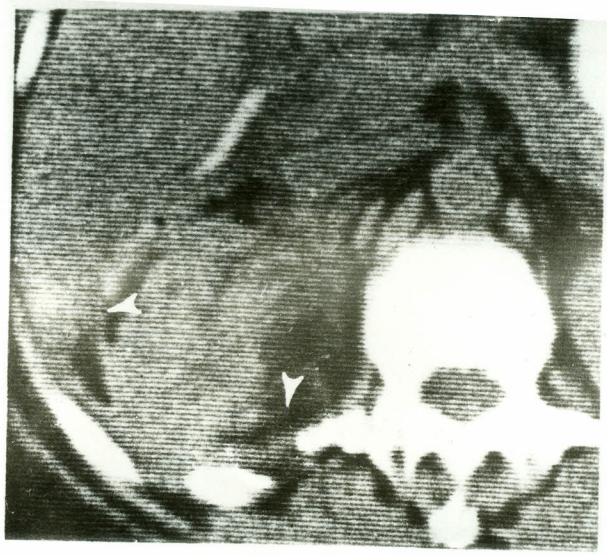


Fig. 12: Perirenal abscess. Precontrast CT scan through upper pole of right kidney demonstrates two small air pockets (arrowheads), thickened renal fascia.

C.T. in solitary kidney

(After nephrectomy) To asses post operative complication of renal bed infection, tumour recurrences and evaluating the contralateral kidney. C T is very important, because it is safe and non-invasive.

Especially in the immediate post operative period where there is still drains and fresh wounds where the ultrasound cannot be used.

IMPAIRED RENAL FUNCTION (RENAL FAILURE)

Renal evaluation using C.T. to determine the size, location, and contour of the kidney in the azotemic patient is feasible in almost all adult patients.

However, due to its nonionizing radiation, ease of performance and lower cost, grey scale ultrasonography is the procedure of choice in differentiating obstructive uropathy from renal parenchymal disease. Computed tomography is reserved for cases in which ultrasound is technicall unsucceful due to extreme obesity or cases in which ultrasound fails to define the level and atiology of renal obstruction.

A C.T. diagnosis of hydronephrosis can be made without the use of intravenous contrast medium although the identification is much easier on post contrast medium.

A small dose of contrast (10-20 c.c. of 50-60% iodinated solution) may be all that is required to separate parenchyma from dilated calyces.

On noncontrast enhanced C.T. scans, the dilated urine-filled calyces appear as areas of low attenuation value within a normal or enlarged renal outline.

After intravenous contrast, material, a faint nephrogram and pyelogram may be seen, often when not apparent at urography. The characteristic prolonged ((obstructive nephrogram)) is also occassionally seen on C.T. Persistent nephrogram may also be seen in patients with acute glomerulonephritis, leukaemia and acute tubular necrosis. Parenchymal thickness can easily be assesed, thus providing information regarding thr potential for diagnosing the obstructing process.

Besides hydronephrosis, a variety of renal parenchymal disease that reault in impaired renal function also have been evaluated with C.T. Although chronic atrophic pyelonephritis often results in an irregular contour with deep cortical scars and calyceal distortion, renal ischemia leads to a small, smooth kidney. Cystic disease of the kidney and renal parenchymal calcification, as in acute cortical necrosis, chronic glomerulonephritis and stag renal oxylosis, similarly can be imaged by C T. The C T finding of small end-stage kidneys implies irreversibility and often terminates the imaging work-up of an azotemic patient.

C.T. can also be used in the nephrology casses like acute cortical necrosis, kidney eschemia and infarctions, and all these can be differentiated acording to difference of attenuation according to the densities of the tissue affected.

Actually C T reduces health expenditure by eliminating patient hospital days otherwise required, by obviating use of other expensive diagnostic procedures, by eliminating necessity

for surgery in certain casses, by assisting the surgeon in determining the precise location and extent of the lesion, and by indirectly eliminating many medical laboratory procedures.

CALCIFIED RENAL MASSES

Calcification in a renal mass may appear in both bening or maligment conditions. It is important to stress that not all calcified renal masses fell into an indeterminate category. Because of the ability of C T to localize calcification more accuratelly than conventional radiographic methods and to determin the cystic or solid composition of a mass, C T allows for the distinction of benign from maligment categories of calcified renal masses with more certainity.
Based on their C.T. appearancies, calcified renal masses can be categorized into the following three groups:-

(i) Tumours of primarly soft tissue density.
(ii) Cystic lesions with mural calcification
(iii) Indeterminate masses. The distinguishing feature of the case in the soft tissue group is the presence of calcification that are not truly peripheral in location.

Calcification in this group are curvilinear, emorphous, punctuate, or a combination therefore, there of. There is always a soft tissue component to the mass outside the confiness of the calcification.
In other words, the calcifacation, even when appearing peripheral on radiographic, does not truly define the periphery of the renal mass. Although the correct diagnosis of renal cell carcenoma can be suspected by excretory urography and, further

provides valuable staging information. It should be noted that a calcified renal cell carcenoma has a better prognosis than a noncalcified renal cell carcenoma.

The major distinguishing features of the cystic lesions include the absence of any detectable soft tissue mass, other than the usually uniformly thickwall and the homogeneous, near-water attenuation value of the fluid in the central area of the lesion. The calcification are largely curvilinear and ocassionally punctuate, but they all trully define perimeter of the mass where present. The calcified cystic masses are mostly benign.

Renal hydatid cystic disease has strickingly similar C T features to the second group of calcified renal masses C T can display the solitary or diffuse forms of renal involvement of hydatid cyst when present. The prescence of daughter cysts within a larger cyst coupled with calcification in the walls of the cyst is pathognomonic for this entity. The cysts have thin or thick walls that enhance with contrast material. The fluid content has a density higher than water (greater than 10HU).

The indeterminate calcified renal masses are those with peripheral calicification and central attenuation values above those acceptable for uncomplicated fluid filled cysts, with minimal or abcent enhancement after administration of intravenous contrast material. This group comprises a wide spectrum of pathological conditions ranging from papillary cyst adeno carcenoma to hemorrhagic cyst. Other conditions such as adults wilm's tumour, transitional cell carcenoma, and metastosis all may have similar C.T. features. Although aneurysms, and calcified angiolopomatomas also may have similar C.T. findings, these

can be more precisely diagnosed by proper C T methodology.

RENAL TRAUMA

Trauma to the kidney as an isolated event or as a concomitant injury in the patient with multible abdominal trauma in an every event. Motor vehicle accidents account for a large number of cases and patients in the younger age groups are frequently the victims.

Most renal trauma to day is of the blunt type. Penterating abdominal injuries usually require rapid mangment with a minimum of radiologic evaluation, therefore experience with C T in pernterating injuries to the urinary tract is currently limited. Conservative, nonoperative mangment of the renal trauma patient is becoming the rule in many institutions. Computed tomography is complementary to excretory urography in evaluating the extent of the renal damage.

If the intravenous urogram with tomography is technically satisfactory and normal, then there is a little need for C T. However, in the patient with an unsatisfactory urogram or labile clinical conditions, i.e., persistant hematuria or declining hematocrit, a C T examination should be the next imaging study considered. Extravasction of urine may be detected by CT when not visible on a convetional urogram with tomography. The presence and extent of subcapsular perinephric hematoma or urinoma formation can be accurately deficted with C T. Other associated abdominal injuries, particularly hepatic, splenic, and retroperitoneal, often are optimally displayed as well.

RENAL TRANSPLANTS

Radionuclide imaging and grey scale ultrasound are the procedures of choice in evaluating renal transplant patients with real or suspected complications. Computed tomography is reserved for cases in which ultrasound fails, because of either an open surgical wound or excessive overlying bowel gas.

As previously mentioned, C T is capable of differentiating between acute hematoma, urinoma or abscesses. Distinction between gas in an abscess from normal residual gas in the immediate postoperative bed can be difficult and a follow-up scan may be necessary in these situations.

While normal postoperative gas invariably decreases with time, gas in the abscess cavity has been shown to increase on serial scans.

Andrew C et al 1981 evaluated 53 patients with CT of renal transplantation.

The diagnostic value of computerized tomography scanning was primarly in differentiating between patients with acute rejection and those with obstructive uropathy urinary fistule or signi-ificent perinephric fluid collction. There are many causes for impaired allograft function following renal transplantation, including rejection, vasomoter nephropathy, obstructive uropathy, urinary fistule, vascular complications and systemic infe ction. Accurate diagnosis of these patients and prompt appropriate mangment are essential to minimize the morbidity and determine ultimately the outcome of transplantation.

In this study the indication for computerized tomography scanning included fever, enlargement and/or tenderness of the graft; ipsilateral leg of genital ordema, an unexplained decrease

in the serum hemoglobin, drainge of fluid through a portion of the transplant incision and impaired allograft function. Serial isotope radiography with ^{131} Iodine orthoiohippurate provides and excellent, non-invasive, functional assesment and can differentiate reliably vasomotor nephropathy from acute rejection. But clinical stigmas of acute rejection may be identical to post operative complications such as ureteral obstruction, urinary fistula or perinephric fluid collections that are not diagnosed readily by istotope renography. Computeriz tomography scanning has to be an accurate, noninvasive complementary method to evaluate such patients by demonstrating in details the cross-sectional anatomy of the graft in relation to surrounding pelvic structuers.

An advantage of CT is the ability to image mirror density not dependant on contrast material, which can be with-held. Computed tomography scan characterizes accurately the location extent and density of otherwise undetectable perinephric fluid collection. Attenuation values of 0 ± 10 HU indicate lymph, serum, or urine, while higher values suggest hematome or abscess. The CT scan also has been helpful in enabling safe performance of invasive diagnostic procedures when these are indicated. Percutaneus allograft biobsy can be facilitated guidance in patients who are obese, or in whom the graft recipients with hydronephrosis and azotemia IVP may be difficult. Under CT guidance percutaneous antegrade pyelography can be performed accurately and easily to provide this information. In summary the CT scan provides an effective, non-invasive method of evaluating posttransplant dysfunction. Its major value is in differentiating between patients with acute rejection and those with obstructive uropathy, urinary fistula or significant perinephric fluid collections.

RARE CYSTIC DISORDERS.

CT can also diagnose a lot of rare cystic disease.

Tuberus sclerosis:-

When it involves the kidney is usually in the form of multiple hamartomas, commonly called angiomyolipomas. Cystic involement is a part of the specimen of this disease as well, but the cysts are usually small. CT differentiation of the cysts from small fatty tumours may be difficult if 1-cm collimation is used. Repeat scan using narrower collomintation e.g. 2 to 5 mm, can often resolve this problem. Furthermore the need to separate cyst from small angiolipoma is in essence academic when renal involvement if diffuse. Renal failure is associated with tuberus sclerosis and can be severe. This is thought to be due to the cystic involvement of the kdney. In this case, confusion with adult polycystic kidney disease may exist but the cyst in tuberus sclerosis rarely got larger than 3 mm.

VON HIPPEL - LINDAUS DISEASE.

Patients with von Hippel_lindaus disease, with its frequent cystic renal involvement and, more importantly, frequent concurrent renal cell carcenoma, are optimaly imaged with CT. Often, however, the renal call carcenoma is diffuse through-out the kidney rather than a focal tumorous process. Compessed renal parenchyma may be difficult to differentiate from carcenomatous involvement, especially when cystic involvemen is extensive.

RENAL PELVIS FILLING DEFECT.

The differential diagnosis of a filling defect in the renal pelvis includes a tumour, a blood clot, fungus bell, and a radiolucent stone. Because of its improved contrast resolution compared with conventional radiography. CT is capable of differentiating among these entities based on differences in their attenuation values.

Nonr adioopaque calculi include urate , xanthine, cystine, matrix, or struvite stones.

Due to the high effective atomic number (z) of urate and cystine, the attenuation value of these calculi, often in the range of 300 to 600 Hounsfield units, is sufficiently higher than soft tissue and therefore basily identifiable by CT scans. An acute hematoma, often with an attenuation value of 70 HU, can be differentiated from uroepithelial tumours that have a density of soft tissue (40-50HU). However, if a mass has a soft tissue density, an exact histology of the tumour cannot be predicted based on CT findings.

Computed tomography significantly changes the work-up of the radiolucent filling defect in the renal pelvis or ureter seen at urography. More invasive procedures. Such as retrograde pyelography may frequently be obviated.

COMPUTED TOMOGRAPHY LOCALIZATION OF INTRARENAL CALCULI PRIOR TO NEPROLITHOTOMY.

The intraoperative localization of small peripheral renal stones within the collecting system may be the most difficult part in the operation of nephrolythotomy.

The position of stones within the renal collecting systems

may be localized to some extent with the urography but it is often a problem to know whether stones lie in the anterior or posterior raw of calices. Although it is easy to remove large portion of staghorn calculi, one may be faced with the task of locating one or more residual calculi situated in the periphery of the kidney. It may then be difficualt to determine whether these lie anteriorly or posteriorly and hence whether nephrotomy approach should be made on the anterior or posterior surface of the kidney. The principle advantages of preoperative CT scanning were found to be:-

1. A peripheral stone could be localized to the anterior or posterior calceal series.
2. The direction of calceal extensions of staghorm calculi could be determined.
3. The parenchymal thickness overlying calculi was easily demonstrated.
4. Stones of low radio-density that were poorly visualized on plain X-rays were much more clearly demonstrated and localized on the CT scan.
5. Residual calculi on the post-operative film could be differentiated from fragments of calculi lying outside the kidney in perirenal fat.

CT pre-operatively adds nothing to patient morbidity but may be criticised because of the cost. But the increased speed and accuracy of operative localization of renal stones justifies the use of this procedure.

JUXTA RENAL PROCESSES

Many juxta renal process began as primary renal process. As diseases extend out from the kidney to involve contigous areas, the CT appearance reflects the size, extent and source of the process. Computed tomography can clearly delineate involvement of the extraperitoneal spaces around the kidney and often may provide a precise diagnosis.

CT can demonstrate the various fascial planes that divide the retroperitoneal area at the level of the kidneys into three separat compatments, an anterior pararenal, a perirenal and a posterior parerenal space.

The posterior and perirenal spaces are filled with fat, whereas the anterior pararenal space is mostly a potential space.

The processes that frequently affect the extraperitoneal pararenal spaces are hemorhage, infection (occasionally gaseous) urine or lymph extravesation, tumour spread, fat deposition and pancreatic pseudocysts (extrapancreatic fluid collctions).

Although the spread of the various types of effusions may be similar, CT is often able to detect the origin and nature of the extraperitoneal process..

HEMORRHAGE.

Hemorrhage into the peritoneal or posterior pararenal spaces may be extensive without causing any significant changes in excretory urography. Trauma, either blunt or penterating, is the most common cause of hoemorhage into perirenal space. In patients with penterating injury, which includes renal biobsy blood most commonly accumulate in the inferior perirenal space followed by posterior pararenal and subcapscular collections.

Other causes of perirenal hemorrhage include arteritis, interstitial nephritis (lupus Erythemotosis), Cystic degeneration with chronic dialysis, anticoagulants and small renal cell cancers. Although most aortic aneurysms rupture into the retroperitoneum, psoas muscles, intraperitoneal compartment on rare occsions. On CT scans, a hematoma appears as a soft tissue mass either conforming to or enlarging the perirenal space. An acute hematoma measures 60 to 80 HU whereas chronic hematoma has an attenuation value in the 20 to 40 HU range.

URINOMA

Urine extravasation into the the perirenal spaces occurs spontaneously, secondly to urinary tract obstruction, after renal trauma including that resulting from interventional procedures. Computed tomography has been shown to be superior to excretory urography in defining the size and location of urinoma formation. On CT scans, urinoma is a low density mass with attenuation values ranging from -10 to 20. The CT appearance of urinoma is similar to a chronic hematoma or an abscess. On rare occasions, the walls of urinoma may even calcify..

ABSCESSES

Most perirenal inflammatory disease is an extension of renal inflammatory disease and is generally confined within Gerota's fascial planes and involve near spaces or organs. A perirenal (perinephric) abscess has the appearance of a low density mass, usually with a thick irregular wall that may contrast enhance. Unless gas is present within the mass,

an abscess cannot be differentiated from a hematoma, a urinoma or a necrotic neoplasm.

CT IN RETROPERITONEAL FIBROSIS.

Computed tomography provides excellent visulization of the retroperitoneal space and gives direct information about disease in which conventional radiographic methods only show nonspecific changes. This also seems to be true in retroperitoneal fibrosis. This disease which is caused be fibrous connective tissue formation in the retroperitoneum. appears at operation as a mass or as a fibrous plate.

The fibrosis usually reaches from kidney hilus level to the pelvic brim.

At a study done by Biergitte et al 1981 on 23 patients, and in all cases the diagnosis was established surgically and verified histologically. Eleven were examined preoperatively, while twelve were examined be CT in a retrospective study. The fibrosis appeared as a prevertebral retroperitoneal mass or as a fibrous sheet covering the central vessles and the ureters in fifteen patients. The CT appearance corresponded well with the surgical findings in these cases. CT failed to visualize the fibrosis in eight cases mainly when the fibrosis was limited to the pelvis surrounding the distal ureters. Excretory urography has so far been the most important examination in retroperitoneal fibrosis. Bilateral hydronephrosis and dilatation of upper parts of ureters and medial deviation of tapered ureters often have been considered diagnostic of retroperitoneal fibrosis. However, the urography findings are very heterogenous nearly normal to severe, often a symetric obstruction. Furthermore may present with ureamia and non-

functionig kidney, even anuric, and excretory urography is often useless in these situations. Retrograde pyelography can reveal this site and the length of the ureteral obstruction but like the excretory urography it only provides information about the urinary tract not about the actual fibrosis. Retroperitoneal fibrosis has been demonstrated by sonography but reported numbers are two small for an evaluation. But still CT cannot differentiate between benign lesions and malignancy in retreperitoneum such as lymphoma, sarcoma or lymph node metastosis. Although malignancy is usually higher and in mediastimum while benign is down the hilus of the kidney, and benign never push the muscles, but still to be worked out. So CT is considered valuable in the evaluation of patients with suspected retroperitoneal fiborsis. It gives direct information about the fibrosis and is usable also in uremic patients.

COMPUTER TOMOGRAPHY SCANNING OF ADRENAL TUMOURS.

Hormonally active adrenal tumours suspected on clinical grounds can be confirmed by biochemical investigation. Exact anatomic localization is of course mandatory if surgical treatment is to be undertaken.

Most of these tumours are either hormonally active adrenal adenoma (including cushing's syndrome) and pheochromocytoma others are conn's syndrome, adrenal cysts, adrenal neuroblastoma carcenoma of the adrenal, the largest number is adrenal metastasis. A study done by Zingg et al between 1978 and 1980, 96 patients with adrenal tumours confirmed at operation or autopsy were investigated by computer tomographic scanning.

BREAKDOWN OF ADRENAL TUMOURS

Table (4):

Pheochromocytoma	14
Hormonall active adrenal adenoma (including cushing's Sydrome)	21
Conn's syndrome	2
Adrenal cysts	3
Adrenal neuroblastoma	8
Carcinoma of the adrenal	3
Adrenal metastases	45
Total	96

The fourteen pheochromocytoma were all demonstrated as unilateral tumours upto 10 cm in diameter, and occasional necrotic areas were idential.

The CT appearance of adrenal adenoma were stricking in always showing well circumscribed changes in the contour with increase in the volume of the adrenal. In each case the diameter exceeded 1 cm. These caused few diagnostic difficulties.

Neuroblastoma as a rule showed intratumoral calcification.

A diffuse increase in the size of the adrenals on the CT scan was difficult to interpret. Normal variation in adrenal morphology could only be distiquished from hyperplasia by referrence to clinical features.

The sources of diagnostic difficulty in CT scanning of the adrenal gland are:-

1. Scanty retroperitoneal adipose tissue, and the margins of the adrenal gland obscured.
2. Overlying dorsomedial hepatic lobe: The right sided adrenal

tumour obscured.

3. Prominent blood vescles near the adrenal galnds, misleading evidence of adrenal tumours.

4. Anadequate examination techniques: false negatie findings only in ectopic pheochromacytoma and in carcenoma of the adrenal with extension of invasive growth into surrounding tissue of questionable degree are selective angiography and hormone measurements on venous effluent indicated.

This study shows that whole body CT scanning is the most useful diagnostic method available. It has obvious advantages of being nonivasive and in over 90 % of cases is the key investigation providing the diagnosis in early stages.

CHAPTER 111

PELVIS

PELVIS

Computed tomography is well suited for evaluation of pelvic pathology because the genitourinary organs, pelvic muscle groups, blood vessels, the lymph nodes are either midline or bilateraly symmetrical structures within this framework.

TECHNIQUE:- Scaning when the urinary bladder is distended is often helpful since some bowel loops can be displaced out of the pelvis. A vaginal tampon is often useful in female patients to facilitate the identification of the vaginal canal.

Furthermore tissue plans and organs generally are well defined by normal acumulation of pelvic fat, and the quality of C.T. scans even with units having slower scanning times, is not degraded by respiratory motion.

Despite these advantages, a successful C.T. examination of the pelvis still depends on meticulous patient preparation as in other parts of the body.

Because multible small bowel loops reside in the pelvis, complete opacification of the alimentary tract is essential lest may they may be misinterpreted as mass lesions.

A dense contrst material in the bldder sometimes results in scan artfact and obscures adjacent structures, it is generally best to obtain scans when the bladder is filled with unopacified urine.

Rectosiqmoid opacification frequently can be obtained by giving oral contrast material several hours before the examination, a contrast material enema occasionally may be necessary to expedite opacification of this region.

Intravenous contrast medium is used in casses where there are uncertainties about soft tissue densities on precontrast scans in order to identify blood vessels and ureters positively.

Although disagreement exists among disparate groups as to the best contrast agents suitable bladder distension in staging bladder cancer, results from different investigators do not differ significantly from one another.

Although some advocate instillation of 150 cc of carbon dioxide via a Foley catheter followed by intrevanous adminstration of 50cc of iodinated contrast medium, others recommend intravenous injection of 30 cc of iodinated contrast medium without gas insufflation.

Others found that scanning through a bladder filled with urine or dilute iodinated contrast media instilled via a Foley catheter provides an adequate contrast between the bladder tumour and the normal bladder wall, lumen, e.g. (10 c.c. conray 60 mixed with 500 c.c. of H_2O)

Dense opacification of the bladder should be avoided since the resultant artifacts may obscure the perivesicle space.

STAGING OF URINARY BLADDER TUMOURS

Clinical staging of bladder carcenoma has ussually been done under general anesthesie by bimanual palpation before and after transurethrol resection or biopsy of the tumour.

The reported accuracy in staging these tumours with perivesical growth is discouraging.

Most neoplasms of the urinary bladder are uroepithelial origin transitional cell carcenoma. In general there is a higher tendency for the poorly differentiated tumours to infiltrate the bladder wall than the well differentiated types: Because cystoscopy is very sensitive in detecting small bladder tumours

and biobsy at cystoscopy quite adequatly defines the depth of the tumour extension into the submucosa and deep muscle layers, these method remain the primary diagnostic procedure in patients with suspected bladder carcinomas.

The clincial role of C.T. in bla dder cancer is therfore to determine the presence or absence of invasion into the surrounding peripelvic fat, adjacent viscera and pelvic lymph nodes.

On C.T. scans, extravesical extension of the tumour is recognized as blurring of obscuration of the perivascicle fat planes. In more advanced casses a soft tissue mass can be seen extending from the bladder.

Into adjacent viscera or muscles. Invasion of the bone can be readily seen by C.T. Invasion of the seminal vesicles can be predicted when the normal angle between the seminal vesicles and the posterior wall of the bladder is obliterated. Because no distinct fat plane is present between the urinary bladder and vagina or prostate in normal subjects a confident C.T. diagnosis of early invasion into the neighbouring structures is difficult.

Metastasis to the pelvic lymph nodes can be diagnosed only when the lymph nodes are enlarged.
C.T. is capable of differntiating bladder neoplasms with extra-vesical extention from those confined to the wall but is incapable

STAGING OF BLADDER TUMOURS ACCORDING TO THE MARSHALL SYSTEM

O:	Epithelial
A:	Lamina propria
B_1:	Superficial muscle
B_2:	Deep muscle
C:	Perivesicle fat
D_1:	Adjacent organs, lymph nodes
D_2:	Distant metastases

Table 5

of distinquishing tumours in the letter group (stages O, A, B_1, and B_2) from each other.

The overal accuracy in detecting perivesicle and seminal vesicle involvement is in the range of 65 to 85 %. The accuracy in detecting lymph node metastasis ranges from 70 to 90% with a false negative rate of 25 to 40%. The major limitation of C.T. in staging bladder cancer is in its inability to detect microscopic invasion of the perivesicle fat and to recognize normal but neoplastically involved lymph nodes as abnormal.

C.T. provides a noninvasive method of differentiating early from advances stages of bladder neoplasms and therefore helps avoid needles radical surgery in advanced casses. Lymphangiography may be helpful in detecting normal sized lymph nodes that are involved with metastotic disease.

Richic et al 1975 commoneted upon the weakness of preoperative staging, clinical and pathological stages agreed in only 46 of 134 patients 34%, 40% of the tumours were clinically understaged and 26% were overstaged.

The more invasive lesion were more apt to be underestimated 51% of the underestimated patients was having perivesical spread.

Prout 1977 reported an understaging of tumours in 31 of 62 (50%) patients who were estimated to have clinical cancer.

Most authors believe that the role of C.T. should be to delineate the extent of extravesical spread.

This was the aim of one of the many studies done by E.M. Sager et al (1982). He had stagged Carcinoma of the bladder clinically by C.T. in 32 patients before they underwent total cystectomy. Eleven of the patients had perivesical growth demonstrated of histopathological examination of the

cystectomy specimens. This was diagnosed by C T in all eleven of these patients before cystectomy, but it was discovered by clinical staging in only four patients prior to cystectomy. Seven patients was overstaged by C T as having perivesical growth. But histologicall did not proof, three of them had perivesical fibrosis that was misinterpreted as perivesical tumour growth. In all the seven patients the perivesical change were adjacent to the area of present or previous changes in bladder wall. C T is a valuable addition to clinical staging because it demonstrates perivesical tumours growth.

In one study done by L. Giulian Seventy-Two patients with bladd cancer underwent C T scanning for preoperative staging. The clinical staging was perfoemed according to the suggestion of UICC without considering the results of C T.

The theraphy was radical cystectomy in forty-two cases, transurethal resection in fourteen cases, transurethral resection plus radiothraphy in twelve cases. The pathological staging was available in sixty-eight cases.

The clinical staging has an accuracy rate of 51% with a 20% degree overstaging and a 29% degree of understaging. In low stage tumours (Intravesical tumours the percentage of errors of clinical and C T is nearly the same) Infact in the stages PT_1, PT_2, PT_3, the percentage of inacurracy of C T due to overstaging was very high (28%) on the contrary in advanced stage tumours C T showed the highest degree accuracy 100% in making evident the extravesical spreading of tumours.

From this point of view, the C T scanning is much more accurate because it showed extravesical spreading of the tumour in all the cases in which it was confirmed by the pathologic examination. The clinical staging in the same cases showed 26.6% degree of understaging.

DISCUSSION:-

The analysis of these data shows that presently scanning cannot solve all the problems of preoperative staging of bladder tumours The bladder wall is too thin and the power of discrimination of C.T. scanning between normal and tumoral tissue too little to make possible any preoperative assessment of low stage tumours (T_1 versus T_2 and T_2 versus T_3).

n these tumours C.T. tends to increase the stage compared with clinical examination. (The overstaging is usually due to localize thickening of the bladder wall being interpretated as tumour invading deep muscle while it is fibrosis or other non -tumour pathology.

C.T. overstaging if not recognized, would exclude some patients from undergoing radical cystectomy, a potentially curative procedure. Therefore when clinical staging suggests low stage, it is probably useless to perform C.T. scanning.

On the contrary when there is also a minimal suspicion of extravesical infiltholion C.T. scanning can solve the diagnostic problem with great accuracy. Finally we can state that C.T. scanning is a valuable diagnostic aid in the preoperative study of the bladder cancer patients provided that one wants to know if a tumour is still intravesical or is already infiltrating the perivesical fat or the adjacent organs.

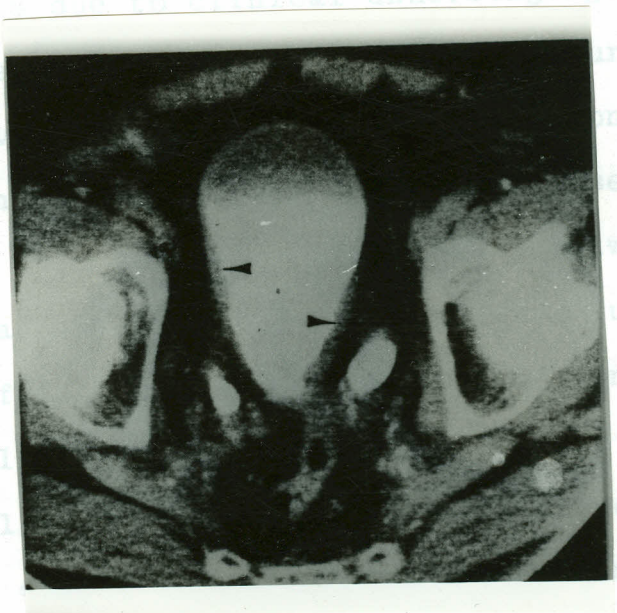


Fig. 13: Transitional cell carcinoma of the bladder, irregular, focal thickening (arrowheads) is noted along both lateral walls of the bladder. There is no tumor extension into the perivesicle fat.

RADIATION OF : CARCENOMA OF BLADDER

In staging of carcenoma of bladder, the clinical staging differs from the pathological staging in a large percentage of casses, the error is due to clinical understaging.

Since patients with deeply invasive tumour usually receive preoperative radiotherapy, indentification of these prior to exploration resection (cystectomy) is essential. Several reports indicate a high degree of correlation between C.T. staging and pathological staging in deeply invasive tumours. However, C.T. is not useful in assesing the depth of peneteration in more superficial tumours.

A potentially promising area of C.T. aplication radiotherapy of bladder cancer in the evaluation of tumours response following preoperative irradiation. In patients whose tumours regress significantly following a course of preoperative radiotherapy to moderate doses, cystectomy may be avoided if additional radiotheraphy to full doses is given.

P R O S T A T E

STAGING OF PROSTATIC CARCENOMA

Bimanual examination is the primary diagnostic technique in the evaluation of prostatic pathology. Adenocarcenoma comprises more than 95% of prostatic malignancies with the rest being transitional or squomus cell carcenoma oa sarcoma.

C.T. is not used as a screening procedure for detection of prostat carcenoma because of its inability to differentiate among normal, hyperplastic and cancerous glands.

Nevertheless, C.T. does provide useful information as to the exten of the tumour once a histological diagnosis of malignancy is established. C.T. is capable of differentiating patients with stage A&B disease from those with stage C&D disease.

The criteria used to diagnose extracapsular extention from prostati carcenoma are essentially the same as those used in the staging of bladder carcenomas namely, symmetry of peripelvic fat planes and seminal vesicle angles. Metastatic pelvic lymph nodes can also be detected if they cause nodal enlargement.

As with other tumours understaging by C.T. occur in the cases when there ia microscopic invasion into periprostatic fat or involved but normal sized pelvic lymph nodes.

The overall accuracy of C.T. in detecting pelvic lymph nodes metastasis from prostatic carcenoma is in the range of 70 t0 80%.

Although the sensitivity in detecting extracapascular extensio is low the specifity is high.

Due to its low sensivity in detecting extracapascular extension of the prostatic carcenoma especially in the early clinical stages, it seems reasonable to reserve C.T. for cases in which there is high clinical suspicion of advanced disease (staged Cand D).

In patients scheduled to receive theraphy for prostatic carcenoma CT can help to design the plan of theraphy. CT is also valuable in the evaluation of patients with suspected recurrent disease.

It must be emphasized that CT reveals extreme accuracy in the evaluation of the vesicoseminal angle, whose obliteration represents a very important indication of extra glandular tumour extension. Also CT allow one to explore lymph node in those areas which primarly involved in prostatice cancer pathology, are not commonly visualized during lymphangiography (hypogastric, obturator-presacral areas).

CONCLUSION:
Computerized tomography cann't differentiate tumoral from normal of hyperplastic prostatic tissue and cannot reveal the infiltration of prostatic capsule but can show accurately the vesicoseminal angle.
On the contrary it can identifies tumour infiltrating pelvic floor and evaluates their extension and could visualize the hypogastric presacral lymph nodes which is not visualized by lymphangiography. CT is useless in advanced stages, on the early stages CT cann't diagnose cancer prostate and needle biobsy is still superior with bimanual examination.
Therefore it should be added to the accepted staging modalities prior to a planned radical prostoctomy.

CLINICAL STAGING CLASSIFICATION FOR PROSTATIC CARCINOMA

A: Occult cancer
B: Cancer nodule confined within prostatic capsule
C: Cancer with extracapsular extension into surrounding structures or confined withini capsule with elevation of serum acid phosphatase. Pelvic nodes may be involved
D: Bone or extrapelvic involvement.

Table 6

VALUE OF COMPUTED TOMOGRAPHY IN INTERSTITIAL ^{125}1 BRACHYTHERAPHY OF PROSTATIC CARCINOMA

Clinical staging is largely dependant on the findings of the rectual examination, tumour extent is often underestimated. With the exception of early stage B(B_1) which is usually treated by radical prostatectomy, most potentially curable patients 20 patients with localized prostatic carcenoma before and after intesstitiol implanation of radio active iodine seeds (^{125}1) Scans were analysed to determine prostate volume, seed location, tumour response and periprostatic tumour spread.

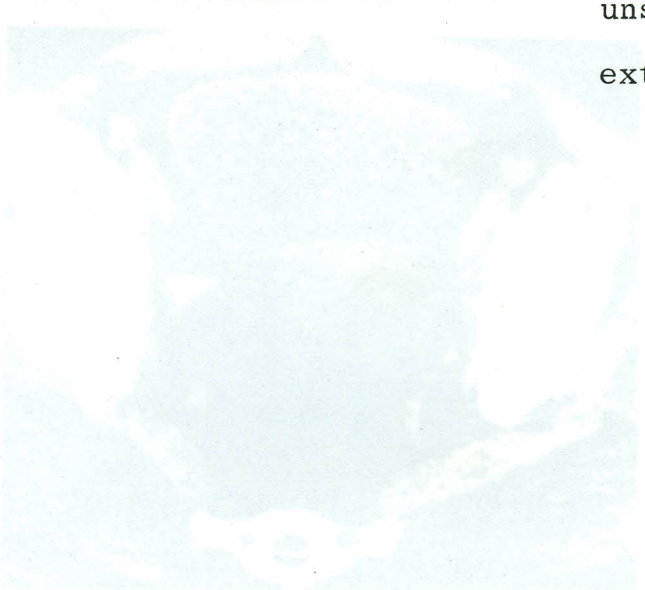
C.T. volumewere an average of 25% to 30% greater than clinical estimates. C.T. demonstrated errors in implantation, including extraprostatic implantation in 17 patients (35%). Serial post implantation scans showed no change in prostate volume in twelve patients (60%), a decrease in seven patients (35%) and an increase in one (5%).

In two patients, clinically unsuspected tumour spread was identified on the C.T. scan. This was a study done by Richard M. Gore February 1983.

Value of C.T. in interstitiol ^{125}1 Brachytherapy of prostatic carcenoma.

	. +ve effect &%	. -ve effect & %	. Remarks
rostate volume			25% (6patients) greater than estimat volume.
ite of plantation	(15%) perfect	85% (17 patients) errors in	

	+ve effect&%	-ve effect &%	Remarks
mour response	(35%) (7 patie- nts) decrease in size	5% (lpatient) increase in size	60% (12 patients) no change in volume
eriprostatic			10% (patients) unsuspected extraglandular extensi



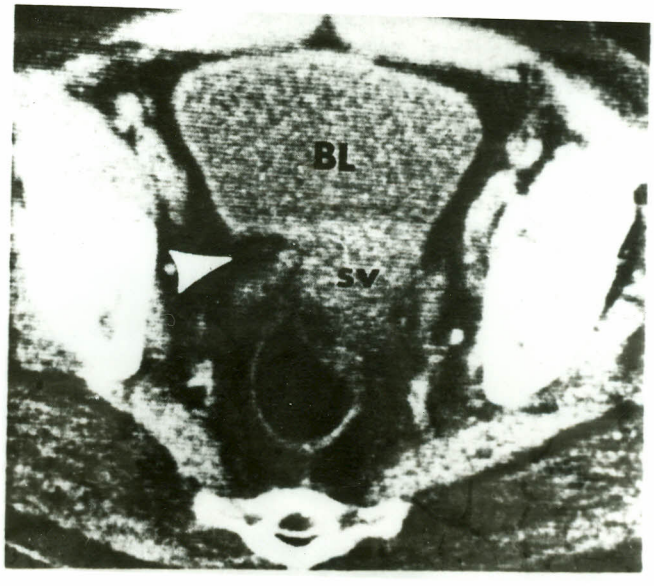


Fig. 14: Prostatic cancer invading a seminal vesicle. The left seminal vesicle (SV) is markedly enlarged in addition, the left seminal vesicular angle is obliterated by the tumor invasion. Note that the right seminal vesicular angle (arrowhead) is sharply delineated with fatty tissue. BL, bladder.

ASSESMENT OF POST OPERATIVE PELVIS POST CYSTECTOMY

The detection of possible surgical complications and local neoplastic recurrencies has been difficult by conventional radiologic methods in patients with prior cystectomy for bladder cancers. Barium gastrointestinal studies are insensitive in detecting masses not closely related to the bowel, gallium radionucleide imaging is of little help in the immediate postoperative period. Since the ability to detect pelvic pathology bysonography is highly dependant on the presence of distended urinary bladder, sonography also is of limited use. Furthermore the presence of surgical wounds with or without drain, further constrains its usefulness.

C.T. is well suited for evaluation of such patients. Normal anatomy and pathologic alterations likewise can be delineated in patients with prior cystectomy.

In male patients after radical cystectomy, the bladder, the prostat and the seminal vesicles are absent. In females patients, the uterus and both fallopian tubes as well the urinary bladder are absent.

Although the perivescle fat plan often is disturbed in post cystectomy patients, the muscle groups lining the pelvic side wall, namely the obturator internus in the lower pelvis and the iliopsoes in the upper pelvis, remain symmetrical. Recognition of symetry of the remaining structure enables diagnosis of pathologic conditions of much earlier stage than formely possible. Local recurrence, surgical complication (i.e. urinoma, lymphoceles, abscesses) and distant metastases all can be recognized on postoperative C.T. examination.

An abscess cavity can be confidently diagnosed if an extra-elementary tract mass containing gas is shown of C.T. scans. Correlation with clinical information and sometimes chemical analysis of the aspirated fluid is needed for such a differentiation.

CLARIFICATION OF KNOWN AND SUSPECTED PELVIC ABNORMALITIES

When the lateral aspect of the urinary bladder is noted to be compressed on an excretory urogram, either unilaterally or on both sides, the differential diagnosis usually includes pelvic lipomatosis, pelvis lymph node enlargement, hypertrophic iliopsoas muscle, lymphocele , urinoma, hematoma, or pelvic venous thrombosis. Documentation of a urinoma hematoma or pelvic lymphadenopathy can be accomplished quickly with sonography.

Pelvic lipomatosis is often suspected from apparent increased Lucency on the plain radiograph. A diagnosis of venous thrombosis and pelvic collateral venous congestion causing bladder deformity usually required venography previously.

Because of its superior contrast sensivity, C.T. is capable of differentiating among fat, water, and soft tissue. Since neutral fat has a characteristic C.T. density, a definite diagnosis of pelvic lipomatosis can be made by C.T. and surgical exploration or percutaneous biobsy obviated.

The true nature of venous collateral can be established on C.T. scans by adminstring contrast medium intravenously. In cases where the bladder deformity is on the basis of compression by enlarged pelvic lymph nodes, C T may be valuable to asses the status of the retroperitoneal and mesentric lymph nodes as well.

CHAPTER IV

TESTIS

TESTICULAR TERATOMES.

Testicular tumours are the commonest malignat solid tumours in young males, and prior to C.T.the standard technique for staging disease spread was the lympangiogram suplemented by execretory urogram. The inadequency of this techniques is well recognized , and in an age of increasing coasts and larg work loads it is necessary to rationalise a radiological approach in order to obtain the optimum information without performing unnecessary investigations.

The anatomical drainge of the testis and the recognized pattern of spread testicular tumours directly to the para aortic lymph nodes at the L½ level imposes well recognized limitations on the lymphangiogram for the staging of these tumours. New staging systems and the treatment protocols rely not only on detection but also on demonstration of bulk disease. This further highlights the limitations of the tradional radiological techniques.

It has been estimated that as many as 25% of patients with negativ lymphograms have lymph node deposits (wallace and jing 1970).

This is easily understood when the normal anatomical drainge of the testis is considered. The ascending lymphogram only shows the para-aortic lymph nodes accurately retrogradely to L¾. The left chain opacities to L1 in only 50% of cases, while on the right side only 30% show nodal opacification of the L1 level (Kinmonth. 1972). The lymphogram is a very sensitive indicator of diseases in the external and common iliac lymph and in the low para-aortic chain.

These areas are however, rarely involved in metastatic disease in testicular teratoma and when they are involved it is usually due to the unusual occurance of tumour invasion of the scrotum,

when drainge may go to the inguinal lymph nodes, or due to retrograde spread of tumour from upper aortic disease.

In contrast to lymphogram, the high para-aortic region is well suited to examination by C.T. as the content in this region provide good contrast for C.T. interpretation.

The introduction of staging systems incorporating extent, sites and tumour volume allows prognostically different subgroups to be defined.

The stricking difference in the result of treatmen observed between substages based on tumour volume as well as extent of disease underline the importance of dispalying the total bulk of disease as well as the full extent.

In a study done by (Kotz and Fasianos 1981) C.T. scans performed in 30 patients with histologically confirmed malignant teratoma of the testis. Intial scans well performed after the orchidectomy but before the onset of further treatment. Follow-up scans were done at various intervals during the course of therapy, totaling sixty-three CT scan.

Sections were taken at 2cm intervals through the thorax and abdomen and the slice thickness was 1.3cm.

Also bowel was prepared. in all patients lymphangiograms and chest xrays with or without whole lung tomography were performed intially and follow-up films obtained in 13 of 15 (85%) of cases with positive lymphograms, the lymphangiograms did not show the full extent of disease and in several cases the lymphogram gave no indication of what was sometimes considerable disease volume. In two cases the lymphogram was positive and C.T. nagative. Both thes cases would have been staged as sbugroup 2A i.e. disease less than 2 cm in size and treatment and prognosis would not have been altered It seem unlikely that disease of more than 2 cm bulk which would alter treatment and prognosis would be missed on C.T.

ANALYSIS OF RESULTS

Total number of patients	30
CT and lymphogram positive	15*
CT and lymphogram negative	11
CT positive, lymphogram negative	2
CT negative, lymphogram positive	2+

*CT chowed additional bulk disease in 13 of these patients.

+One case false positive lymphogram. Lymph nodes involved less than 2 cm.

Table- 8-

The ease with which patients can be followed up has been advocated as a reason for continuation of the lymphangiogram in testicular tumours. However, lymphographic contrast media can usually only assesed with confidence up to a maximum of one year after the examination and as it is desirable to have follow-up for at least five years, this would necessitate multible repeat lymphography. A limited C.T. examination of the area of drainge provides a more accurate and less time consuming examination in addition to being non-invasive.

As well as its superiority in lymph node assesment, the ability of C.T. to asses the full extent of disease in a single non-invasive examination is of great benefit in staging and treatment planning.

C.T. showed liver secondaries in three cases and indicated bone abnormalities in a further five cases, subsequent follow-up suggested that in three of these patients the abnormality was infact due to metastotic disease. Within the thorax C.T. is superior to other methods like chest xray and tomography in detecti both the parechymal lung metastosis and mediastinal lymph node disease.

Where there is gross intrathoraeic disease, monitoring is easy on plane chest xray.

From this study it is suggested that C.T. should be the primary imaging investigation for staging and monitoring metastotic disease in the abdomen in patients with testicular teratomas, and that lymphangiography should be reserved for those cases in which C.T. is difficult to interpret due to factors sych as poor fat planes or arterfacts due to bowel gas movement, or where Biochemical markers are raised despite a normal C.T. scan. In the thorax, C.T. is advocted where the plain xray reveals no abnormality or where less than three extensive metastatic is present follow-up with plain chest xray is sufficient.

LOCALIZATION OF UNDESCENDED TESTIS

Grayscale sonography is the procedure choice in evaluation of patients with suspected testicular pathology when the testis lies within the scrotal sac.

However, C.T. can almost qccurately depict the presence and location of the testies when it is not palpable on physical examination.

The testis develop from the elongated embryonic gonad lying ventral to the mesonephric ridge. It migrates from its intra-abdominal position to the scrotal scac during the latter third of gestation. Interruption of this normal migratory process results in ectopic positioning of the testies. Because malignancy occurs 12 to 40 times more commonly in the undescended (intra-abdominal) than in the descneded testis, it is widely agreed that orchi dopexy be performed in patients yonger than ten years of age and orchiectomy be performed in patients who are seen after puberty. Preoperative localizatio of a nonpalpable testis byradiologic methods oftern helps in planning the surgery. Undescended testis by C.T. is based on recognition of a mass, which is of soft tissue density and oval in shape, along the expected course of testicular descent.

When the undescended testis is unusually large, it may be liable to malignant transformation. Usually it is easier to detect an undescended testis in the inguinal canal or in the lower pelvis where structures are usually symetrical. An undescended testis as small as 1cm has been accurately located in these areas. Detection of such an atrophic testis and differentiation from adjacent structures are more difficult in the upper pelvis and lower abdomen because of bowel loops, vascular structures, and lymph nodes are more abundant.

Despite thses limitations, C.T. has proven accurate in localizati of nonpalpable testis.

Other radiologic methods that have been used to localize an undescended testis include testicular arteriography, venography, and gray scale ultrasound.

Testicular arteriography in not only technically difficult but also painful.

Although testicular venography is less traumatic than arteriography, is also associated with a high radiation dose and some morbidity, although the false negative rate is relatively low. Selective catheterization of the right testicular vein is technically difficult, selective venography of either testicular vein can be unsuccessful due to the prescence of venous valves. Although ultrasound is useful in localizing an undescended testis within the inguinal canal, it is usually not reliable in the pelvis or abdomen. Because of its ease of performance and nonivasive nature, we believe C.T. is the procedure of choice in the preoperative localization of a nonpalpable testis. In cases where C.T. cannot res olve the problem, testicular venography or arteriography can still be employed for further evaluation.

RADIATION OF TESTICULAR TUMOURS

ccuracy of the retroperitoneal lymph nodes in seminoma determines the xtent of the radiation field and the total dose. In carcinoma the nodal tatus determines the need for lymphdenectomy, radiotherapy and hemotherapy.

astly one can anticipate that in the future C.T. capability might be ntegrated into radiotherapy machines directly and that this capability ould provide for more dynamic treatment.

CHAPTER V

DIAGNOSIS OF UNKNOWN ABDOMINAL MASSES

Diagnosis of unknown abdominal masses

There are many masses in the abdomen which can be diagnosed by the help of CT.
These masses could be a diagnostic problem some times and after doing the normal routine investigatory methods still diagnosis can be difficult.

Some of these examples are malignant change in undescended testis, lymph node metastasis, malignant change in ectopic kidney, pancreatic pseudocyst, allograft transplant after rejection, and hydatid cyst in different organs.

These cases could be diagnosed by the help of CT by the following:
Malignant change in undescended testis is thought when it is not palpable on physical examination. Because malignancy occurs 12 to 40 times more commonly in the undescended testis, and when the child is more than 10 years old the position of the undescended testis must be found. Detection by CT is based on recognition of a mass, which is of soft tissue density oval in shape, along the expected course of the testicular descent. When the mass is unusually large it may be due to malignant transformation.
Lymph node metastasis is diagnosed easily by CT especialy in casses of testicular teratoma which is drained to lumbar lymph nodes especillay L 1/2 which can not be diagnosed by lymphangiography.
Also lymph node metastasis from renal tumours or any other intraabdominal organ can be diagnosed by CT . In Casses of lymphomas and hodjkin's the enlarged lymph nodes could be located and this could facilitate the operation of biobsy for diagnosis or staging of hodjkin's

disease.

One of the causes of unknown abdominal masses is malignant change of ectopic kidney especially if the kidney is in failure and not excreting the dye . By using contrast media the remaining function of the kidney even very small could be seen and indicate the nature of the mass,.Also diagnosis of malignant change could be diagnosed early before the excretry urography is affected .

Another mass where CT can be usefull is alloograft transplant after rejection Which can be dignosed by CT.

Hydatid cyst diseases of the liver and kidney could be diagnosed by CT. The renal hydatid cyst disease has striking similar CT features to the calcified renal masses.

CT can display the solitary or diffuse form of renal involvment present,the presence of daugter cysts with a larger cyst is pathognomoinc for this entity .

One of the masses which could be confused with kidney masses and diagnosed by CT are pancreatic pseudocyst especially involving the posterior paraenl space.

The mass in the CT is on the Lateral surface of the quadratus lumborum and left psoas muscles and displaces the kidny anteriorly,

can be diagosed by the prescence of calcifictions in the head of pancreas.

C H A P T E R VI

RECENT ADVANCES IN CT

RECENT ADVANCES IN CT

The Computerized Tomography machines is of great help in diagnosis the normal and abnormal anatomy of the body sections.

There are three new develoments in the cT field

A - The nuclear magnetic resonance (N.M.R) which makes basic biochemical measurments at the subatomic level and these data be translated to histopathologic diagnosis.

B - positron Emission tomography (P. E. T) which measures the metabolic activty of radioactive substances in the brain and translating these data into pathophysiologic diagnosis which is of great help in study of the body physiology, but still it is in the expiremental stage.

C - Radiation Oncology One of the expected developments in cT machines is its integration with the radiotherapy machines to be one unit to improve the performance of the radioterapy machines by calculating the dose of radiation to the tumour volume, and the limiting dose to the surrounding normal tissue, to avoid over or under estimation of the dose.

NEUCLEAR MAGNETIC RESONANCE

NMR proton imaging has the potential to replace xray, C.T. from the standpoint of the clinical information NMR conveys.

The NMR procedure measure the concentrations of some nuclei e.g: $H,^{1}$ $^{23}Na,$ ^{32}P as well as their chemical state and the local physical chemical enviroment of the resolution volume.

The major potential of NMR thus in its analytical power to make basic biochemical measurements at the subatomic level, non-invasivly in vivo, and as a potential basis for increased diagnostic accuracy.

NMR scanner is a large uniform magnetic field in which hydrogen ions behave like tiny magnets and produce a net magnetization aligned with the field. Then the magnetization reverts to its original after such disturbance, the time constant characterizing this period is T_1.

The magnetization induces an electrical signal to a wire wrapped around the body, which can therefore measure the strength of magnetization in the body. In a uniform field this signal delays with a time constant T_2, which characterizes the sharpness of the resonance process and which depends on the intercection of the neighbouring nuclei.

By using combination of magnetic field gradients and RF radiation of different frequencies the hydrogen nuclei in a section through the body can be excited and their NMR properties sparially encoded and recorded.

The images obtained could be of the concentration of hydrogen nuclei or depend on the relaxation time to various degrees.

Clinical uses it is ideal for examination of the vescle anatomy and measure the tissue characteristics of diseased vessels.

It can readily distiquish between cortex and medulla of the kidney although the difference may be lost in glomerular disease.

NMR ia at least as sensitive as C.T. in the demonstration of pathology. In abdomen solid and hollow Viscera could be clearly outlined as could the muscle fat and fascial planes. Experimental ascites and haematoma could be easily seen in animal NMR images of normal upper extremity claerly defined bone cortex and marrow, muscles, connective tissue bundles fat and vesscles.

The images correlated well with standard radio. graphy and pathology specimens.

BIOLOGICAL HAZARDS OF NMR:

The possible harmful effects results from radiofrequency heating or from electric currents induced with the body. Howevek evidence from animal exposure and few human volunters suggest that these fields are not hazardens at the level used at present.

POSITRON EMISSION TOMOGRAPHY (PET)

The main idea of PET is the capability of labeling metabolically active agents which distinquishes positron strategies from those of standard nucleat medicine techniques. Because positron emission tomography can show quantitative cerebral blood flow and metabolic data in transverse section, it provides Physiologic information unobtainable with X-ray computed tomography and nuclear magnetic resonance.

Dynamic CT using regional transit times of contrast as estimates of cerebral blood flow cannot provide quantitative flow values, dynamic CT using the rate of stable xenon can give precise quantitative information about cerebral blood flow but not metabolic data.

For the foreseeable future NMR will not have the capability of usefully imaging metabolism, but might provide images of cerebral blood flow.

The possibility of obtaininig quantitative cerebral blood flow and metablic data with PET comes, however at high cost.

The price of a commercial position camera is $900,000, a cyclotron that makes the short lived radionclides used in PET studies costs about 2 million dollars, and a successful position facility requires and expensive team of physicists, radiochemists, engineers, programers and clinicians.

Higher sensivity scanners allow faster scanning time permit one to monitor the uptake and clearance of radionuclides as well as the tracer in equilibrium in tissues.

The clinical advantages of a high sensitivity divice lies in the capability to do more rapid studies so that one may follow acutely changing physiology at rest and after pharmacologic of activation challanges - and study the kinetics of a tracer agent. The most immediate application of PET are in the measurement of cerebral blood flow and oxygen and glucose metabolism. thes are called "Final common pathway" parameters. Stratiges that examine more specific tissue phenomena "highly differentiated tracer techniques" that would monitor do paminergic receptors or cholinergic receptor activity, tissue PH, Opiate receptor population, protein synthesis of the tissue uptake and clearance of theraputic agents.

Current human application of posit on imaging fall into five categories of study neuropsychology, stroke disease, seizure disorders, tumours, and disorders of mentation.
This brief discussion emphasizes the difficulties in undertaking meaning full PET studies in human subjects. It also explain the small number of PET centers that exist in the united States today. Only two centers in the united states have had more than two years experience in routinely examining a diverse range of patients.

RADIATION ONCOLOGY

In treatment it has become á useful tool in radiotherapy planning by:-

(a) Accurate localization of tumour volume and surrounding normal structurein relation to bones as well as to key organs i.e. (heart, liver, kidney and spinal cord.)

(b) Prescribing the dose to be delivered to tumour volume.

(c) The defination of limiting doses to normal tissues.

(d) By accurate computation of dose distribution within the treatme volume of the patient.

(e) Precise delivery of radiation dose on the entire course of treatment, C.T. is used in the treatment of some tumours in urology, some of the tumours where C.T. is used in the mangmer are carcenoma of the bladder, carcenoma of the prostate and testicular tumours.

CHAPTER VII

CONCLUSION

SUMMARY

C O N C L U S I O N

It is clear that CT cannot replace convetional excretion Urography nor ultrasonography in demonstration of renal tumours but is complimentary to this imaging methods.

CT can diagnose most morphological diseases of the kidney . It is a noninvasive technique and obviate the need of ateriography in a significant number of cases.

The diagnostic accuracy is excellent when compared with ultrasound and selective renal arteriography. CT scan provide the diagnosis and define the extent of neoplastic process , it is considered an excellent screening procedure since it has a high level of accuracy. The cost of the procedure remains quite high, but where it is available it should become part of the urologic armentarium for the diagnosis in selected cases.

It seems to be the most logical approach in diagnosis of renal abscess.

This is due to the vascularization of the kidney, to its position among fatty formation which increase the contrast of the images.

The CT is having an importan role in the investigation of severe septic states with septicemia of unknown origin and in renal septic state persisting inspite of correct antibiotic and often inspite of drainge of the distended cavities. Also CT is very important in cases of sepsis and abscence of secretion and tumoural masses in the urography. The corrolation between the clinical picture and the CT findings can be very useful in deciding whether immediate nephrectomy is necessary, or antibiotic therapy or drainge of the abscess. Also CT in severe septic state of unknown origin permits the localization of the sepsis either kidney, liver, intraperitoneal, extra abdominal etc.

The effect of CT on the diagnostic imaging evaluation of renal masses has been substantial. Invasive diagnostic procedures such as angiography and cyst aspiration have been markedly reduced. The character and extent of renal masses whether malignant or inflammatory have never been better illustrated than with CT. There are casses in which computed tomography can actually replace ultrasound as the primary triage imaging method for masses detected by excretory urography and tomography. When nephromegaly is associated with nonfunctioning, CT can often identify the specific course of condition. Multible renal masses for example adult polycystic kidney disease or multible corical cysts, may also be best imaged first with CT Before kidney enlarges, left upper pole renal masses or masses less than 1½ cm in diameter, especially in obeese patients are difficult to examine by sonography and therefore should be studied first with CT. Additionally most casses considered intermediate or unresolved by ultrasound can often be resolved using CT using such technique has markedly declined the actual number of angiograms and primarly high-dose nephrotomograms. CT is reserved in evaluating renal transplants casses when ultrasound fails because of either an open surgical wounds or excessive overlying bowel gas. But ultrasound remains the procedure of choice in the routine follow-up of patients with polycystic kidney diseases and an initial screening of their family members. CT should be reserved for evaluation of possible haemorrhage or malignant transformation. In the renal tumours CT has proven more accurate and sensitive than angiography in

detecting perirenal extention and lymph node metastasis, and angiography should be reserved for casses where vascular anatomy is essential. CT is an effective complimentary imaging method in detecting renal tumours and accuracy reaches about 95%. CT scanning of the whole body is the most useful diagnostic method available for diagnosis of adrenal tumours. In over 90% of casses is the key investigation providing the diagnosis in early stages. Pheochromocytomas can be demonstrated, hormonally active adrenal adenoma including cushing's syndrome, conn's syndroma, carcenoma of adrenal and adrenal metastasis all can be localized anatomically if surgical treatment is to be undertaken. Selective angiography and hormone assays used in casses of ectopic pheochromocytoma and extensive invasion of carcenoma to surrounding tissue.

The process that frequently affect the extra-peritoneal pararenal spaces are harmorhage, infection, urine or lymph, although the pattern of spread of the various types of effusion may be similar, CT is often able to detect the origin and nature of the extra peritoneal process.

e.g.

PATHOLOGY	ATTENUATION VALUE
Acute haematoma	60 to 80 HU
Chronic haematoma	20 to 40 HU
Urinoma	-10 to 20 HU
Abscess	10 to 28 HU
Stone	300 to 600 HU

CT has great accuracy of preoperative localization of renal stones. It can localize the site in the anterio or posterio row of calices, the parenchyma thickness overlying calculi, stones of low radio-density that were poorly visualized on plain xray were much more clearly demonstrated and localized, and residual postoperative calculi could be differentiated from fragments of calculi lying outside the kidneyin the perirenal fat.

In the urinary bladder there is high degree of corrolation between CT staging and pathological staging in deeply invasive tumours. However, CT is not useful in assesing the depths of penetration in more superficial tumours. Although CT can show grossly enlarged lymph node metastasis it will not indicate spread within normal sized lymph node resulting in understaging. Finally we can state that CT is valuable diagnostic aid in the preoperative study of bladder cancer patients. Provides that one want to know if a tumour is still intravesical or is already infilterating the perivesical fat or the adjacent organs. Therefore, when clinical staging suggests a low stage it is probably useless to perform CT scanning. On the contrary, when there is also a minimal suspicion of extravisical infil-teration, CT scanning can solve the diagnostic problem with great accuracy.

In post cystectomy patient it is very useful to diagnose any local recurrence, or surgical complications e.g. urinoma, lymphoceles, abscesses and distance metastasis.

When the lateral aspects of the urinary bladder is noted to be compressed on excretory urography CT can clarify the suspected pelvic abnormality.

Differential diagnosis of pelvic lipomatosis, lymph node enlargement, hypertropic iliopsoas muscle, lymphocele, urinoma, haematoma or pelvic venous thrombosis.

The analysis of the present data shows that presently CT scanning can not solve all the problems of preoperative staging of bladder tumours. In the prostate CT cannot differentiate normall from hypertrophic or tumour prostatic tissue, and does not reveal the infiltration of prostatic capsule, but can show involvement of vesicoseminal angle which is very importan in the diagnosis of extraglandular extension. CT identifies tumours infiltrating pelvic floor and evaluates their extention more than rectal examination. CT can show hypogastric-presacral lymph node involvement not visualized by lymphangiography. CT is very useful as preoperative staging procedure prior to a planned radical prostatectomy. But in diagnosis of prostatic tumour the rectal examination and the needle biobsy still remains the first choice.

In diagnosis of testicular teratoma computed tomography has created a new dimension in the radiology of both the thorax and abdomen, but it has been used largely as an additional examination to supplement plethora of investigations already available to the diagnostic radiologist. The anatomical drainge of the testis and the recognized pattern of spread of testicular tumours to the para-aortic lymph nodes at the level of lumbar 1/2, and the new staging system and treatment protocols which rely on the demonstration of bulk disease, imposes limitations to lymphangiography and the other traditional radiological techniques.

This is why CT should be the primary imaging investigation for staging and monitaring metastatic disease in the abdomen in patients with testicular teratoma, CT can ascess the areas not visualized on lymphangiography primaly those in the renal hilum and above the lumbar 2 level.

Lymphangiography should be reserved for those casses in which CT is difficult to interpret, artefacts or where biochemical markers are raised despite a normal CT scan.

In the thorax CT is advocated where the plain chest xray reveals no abnormality or where less than 3 metastasis are shown in plain xray, but where extensive metastasis is present, follow-up with plain chest xray is sufficient.

In retroperitoneal fibrosis CT is considered valuable in the evaluation of the actual fibrosis not like the excretory urography where it only ascess the urinay system, also it could be used safely in the uremic patients to diagnos the cause.

Because of its ease of performance and noninvasive natuer, it is believed that CT is the procedure of choice in the preoperative localization of a nonpalpable testis. In casses where CT cannot resolve the problem, testicular venography or arteiography can still be employed for further evaluation.

S U M M A R Y

The subject of this essay is computrized tomography in urology the work in this machine had started at the sixsties but the first machine was installeted by 1973.

The scanner consist basically of an x-ray rigidly mounted opposite a detectory array, and the system rotates around the body, then the finely collimated x-ray beam passes through the body, and partially absorped this is impregnated oń greyscale detectors acording to the densities and trans lated by the help of the computer into body sections. Where the radio-opaque material appears white and the radiotranslucent appears black and the cross section of the body is formed on a display monitor. This is done for the whole body in a very small thickness of every slice is 2 - 13 mm, the distance between two slices is very small, that a small lesion of less than 1 cm can be diagnosed.

Initially it was used as a headscanner but soon it had become useful for the whole body and a lot of developments and modifications was introduced.

The main uses of computerized tomography in urology is in kidney diseases to diagnose renal abscesses, renal cysts when it is very small and in more than one organ. Also differentiating solid from cystic renal masses, and extrarenal extension of any renal pathology.

In the urinary baldder, prostate it is used in staging of tumours and assesing the depth of penteration and extension.

In the testis it is used to identify the lymph node metastasis and the volume of the tumour, CT also diagnose undescended testis position, and pathology like atrophy or malignancy. It can not be claimed that CT will replace the conventional methods like I.V.P., ultrasonography but it will act as a complelentary method in diagnosis, used only when the other methods either fails or become technically difficult to interprete.

الملخص العربي

تتناول هذه الرساله موضوع الاشعه القطعيه بالكمبيوتر فى المسالك البوليه

بدأ العمل فى هذا الجهاز فى الستينيات

وقد انشىء اول جهاز للاشعه المقطعيه بالكمبيوتر فى عام ١٩٧٣ ـ

يتكون الجهاز من مصدر لاشعه (x) يتم مرورها خلال الجزء المفحوص من الجسم ثم تستقبل على لوح من ماده معينه لتسجيل الاشعه التى لم يتم امتصاصها ويدور الجهاز دوره كامله حول الجسم لتسجيل المعلومات يتم ترجمه هذه المعلومات بواسطه جهاز كمبيوتر لكى ما تظهر هذه المعلومات على شاشه تليفزيونيه على شكل قطاعات عرضيه بجسم الانسان وسمك هذا القطاع والاخر صغيره جدا حتى ان الجهاز قادر على اكتشاف اى تغيير غير طبيعى ولو كان صغيرا جدا .

كان استعمال هذا الجهاز محصورا فى الكشف على امراض الرأس ولكن فى فتره بسيطه تم تطويره الى جهاز شامل للكشف على الجسم ايضا .

استعمال هذا الجهاز فى الكلى هو تشخيص خراج الكلى وتحديد مدى انتشاره حولها ايضا تشخيص التكيسات الكليويه حتى لو كان حجمها صغيرا جدا وفى اكثر من عضو واحد .

والتمييز بين التكيس الصلب والسائل منها ايضا تشخيص امتداد الامراض الكليويه خارج الكلى بأنواعها .

ايضا اورام المثانه البوليه والبروستاتا اصبح من الممكن تشخيص مرحله انتشارها ودرجه اختراقها للاعضاء المجاوره .

حالات اورام الخصيه اصبح من الممكن معرفه درجه انتشارها بالبطن وحجم الورم لكى ما يتم اعطائه جرعه الاشعاع العلاجى الكافيه لمقاومه المرض.

ليس من المتوقع ان يحل هذا الجهاز محل الطرق التقليديه فى التشخيص بل انه مكملا لها ويستعان به فى الحالات التى يصعب فيها الوصول الى تشخيص بالطرق العاديه.