COMPUTERIZED TOMOGRAPHY IN UROLOGY

Essay

SUBMITTED IN PARTIAL FULFILMENT FOR THE DEGREE OF (M.Sc.) IN UROLOGY

By

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1983
ACKNOWLEDGMENT

I am very thankful to Professor Mohamed Safwat the head of the urology department for his continuous guidance.

I feel much honoured to express my indebtedness to my professor Dr. Magdy El-Tanawy, who sacrificed a good deal of his valuable time to guide throughout.

I owe special thank to all staff members of urology department Kasr El-Eini Hospital for their help and co-operation.

Also I wish to thank Dr. Samir El-Tatawy Professor of CT unit for his suggestions and generous advise.
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CHAPTER 1

INTRODUCTION
INTRODUCTION

THE PURPOSE OF THIS STUDY
1. To evaluate the reliability of CT.
2. To study the sensitivity and specificity 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 urological diseases are many. First is the history, clinical examination, routine examinations of urine and blood, also bimanual examination under anaesthesia, endoscopic examination, retrograde pyelography through cystoscope, percutaneous aspiration of biopsy or injection of dye. There are also renal function tests, macroscopic and microscopic histopathology of biopsies taken either by open surgery or through endoscope.

Some of the radiological methods in use also mentioned, like plain x-ray of the abdomen and pelvis, (IVP, intravenous pyelography) or excretory urography, also venography, angiography, selective arteriography, lymphangiography, ultrasonography and radioisotope studies and intra and peri vesical 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 inefficient 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 Japanese 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 prize in medicine was awarded jointly to Dr. Godfrey Hounsfield of EMI and professor A.M. Cormack of Tufts university. Many people regard this invention as the greatest step forward in organ imaging since the discovery of x-ray 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 clinically 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 x-ray transmitted through the body contained information on all constituents of the body in the path of the beam. The scanner consists basically of an x-ray tube rigidly mounted opposite a detector array (fanbeam), the x-ray beam finely collimated passes through the body.

The system rotates in a 360° around the body.

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

Presentation is in the form of greyscale in which whiteness is proportional to the x-ray attenuation coefficient of tissues of each point of scan. Thus radio opaque material appear white and radio translucent tissues appears black.

When they strike the detector, the x-ray protons are converted to scintillations. These can be quantified by a numerical 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.
They are recorded digitally, their interpretation must be processed by a suitable computer algorithm* to perform the calculations and mathematical reconstruction of the image of the cross section representing 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-Khwarismi, a ninth century mathematician in the court of AL-Wumun, 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. It is probably fair to state that CT examination in general do not deliver more radiation to the patient than conventional roentgenographic procedures, particularly if the radiation dose is assessed as integral dose.

EQUIPMENT AND DEVELOPMENTS.

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

![Diagram of CT System](image-url)

*Fig. 2* Diagram illustrating the principle of CT (reproduced from *Semin Roentgenol* 12:13–25, 1977).
Fig. 3. Diagram illustrating the components of a CT system (reproduced from Semin Roentgenol 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 collimated beams of xray in a linear manner across the patient.
The more modern machines use a fan beam and multiple 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 patient's 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-stationary 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 transmission measurements across a body section limited thickness.
Spatial resolution is increased by increasing the number of objects separated by a given distance. Contrast resolution, on the other hand, is increased by reducing the amount of radiation transmitted in one direction. Temporal resolution is increased by improving the system to yield a faster scan.

Most modern CT systems provide better than 0.5% accuracy in most body parts, usually in less than 0.5 sec.

Computed tomography has shown continuous improvement. However, it usually takes too much time to compute these tomograms, which is a measure of the time required to produce a computed image. The time required depends on the number of body tissues. Computed tomography is usually done routinely at a window level (L) of 34-40 and a window (W) covering 0-75.

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

**Fig. 6** Hounsfield's scale. The full scale on the left extends over 2000 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: Rotating-detector array (3rd generation) configuration. Right: Rotating-stationary detector array (4th generation) configuration (reproduced from Semin Roentgenol 12:13-25, 1977).
PERFORMANCE OF CT DEVICES

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

Spatial resolution is a measure to discriminate 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 yield 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 approximately 1 to 4 seconds.

Computed tomography devices, in spite of 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 irregularities 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.
TECHNIQUE

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 enhancement by intravenous urographic contrast medium given either by bolus injection or intravenous continuous infusion or biphasic, 50-100 ml of iodinated solution given into the 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 concentration in tissues.

ANGIO COMPUTERIZED TOMOGRAPHY

Large blood vessels both normal and abnormal are demonstrated immediately following large doses of intravenous contrast, 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 proved to be a major revolution in diagnostic imaging, so beneficial, in fact that it could not be stopped by legislation and guidelines.

**DRAWBACK**

With such a complicated apparatus using x-ray, sophisticated 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 errors 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, maintenance and for one diagnostic procedure.
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 Edition, 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 politics of CT.

-The sections in this study was obtained from the Department of computerized tomography of KASR- Eini medical school, Cairo University.
CHAPTER 11
KIDNEY
Because of the cross-sectional anatomic display possible with CT, 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 CT is able to demonstrate the site and cause of most cases of obstructive hydronephrosis.

Azotemia is no longer the stumbling block to adequate uroradiologic diagnosis, since CT can be performed instead of the urogram without the need for intravenous contrast material.

Likewise, CT can serve to evaluate the kidney in patients with contrast media sensitivity.

Computed tomography is superior to conventional radiography in determining tissues with only minor differences in their attenuation values. Because of the increase contrast sensitivity, CT 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 needed 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 coefficient 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 sufficient for assessment. There is linear relationship between iodine concentration of contrast material which will increase the C T number of the renal parenchyme.

The renal handling of contrast material as observed by serial dynamic C T is really triphasic, namely, major vascular
opacification (artery vein) followed by a nephrogram and the pyelogram.

CT renal angiogram will show the aorta, renal artery and renal vein, followed by an intense vascular nephrogram outlining the corticomedullary 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 administration.

NORMAL VARIANTS AND CONGENITAL ANOMALIES.

Persistent foetal lobulation, congenital anomalies of fusion such as horseshoe kidneys as well as renal agenesis, hypoplasia and simple ectopia all have characteristic CT appearance. Differentiation 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 absence 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 still remains the major screening test for detection of the renal mass, but once detected, further 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 CT 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 multiple and often on the front or back surfaces. These masses are extremely difficult 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 1 cm, but using current generations CT 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, hemorrhagic 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).
known diagnosis the search for focal neoplastic change or abscess 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. Asymmetrical renal involvement such as the liver, the spleen, and the pancreas can be evaluated similarly.

C.T. scan of adult polycystic kidney disease also can be performed to assess renal deformities. Ultrasound of the pancreas can be used as a follow-up of patients on dialysis. A cystic lesion should be followed closely as it may hemorrhage, or malignancy transformation.

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 abscess 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. Asymmetrical renal involvement such as the liver, the spleen, and the pancreas, can be evaluated similarly. 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 presence 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 haemorrhage or malignity 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 dialysis, 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, lymphatic 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 sufficient anatomic detail is available from CT scans for accurate noninvasive staging of renal neoplasms.

Adenocarcinoma 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 always less than the surrounding normal parenchyma. When encapsulated the wall is thick and irregular.
- Secondary characteristics, such as renal vein and renal artery enlargement, nodular areas of soft tissue attenuation within the perinephric space, enlarged regional lymph nodes, gross invasion of the inferior vena cava or main renal vein and hepatic metastasis could be diagnosed easily by CT.

In one study done by (Weyman et al 1980)

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

All the patients with final clinical diagnosis of renal cell carcinoma who had confirmed diagnosis by nephrectomy or open renal biopsy 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 assessment of tumour extension, that is because approximately 15% of renal cell carcinoma are avascular giving high false (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 dilatation 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. Lymphangiography 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.

**CONCLUSION**

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 intranodal architecture.

Preoperative angiography is not necessary in most patients with renal cell carcinoma, but should be performed when clarification of equivocal CT findings would alter the surgical approach.
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<td>TOTAL</td>
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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%
In addition to diagnostic and staging role, C T plays important role in the follow-up of these patients who are treated with surgical resection, especially when they are at risk of postoperative recurrence. Benefits from following C T, especially if surgical recurrence is detected, and the role of retroperitoneal and adrenal imaging.

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

Firstly, is used to evince the diagnosis 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 extent of involvement after pathological diagnosis by percutaneous biopsy or retrograde catheterization.

Mass conservation and surgical palliation have become a more popular treatment for transitional cell carcinoma. C T plays an important role in preoperative staging of transitional cell tumors.
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 metastasis 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 resection, 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 transitional cell carcinomata C.T. plays an important role in preoperative staging of transitional cell tumours.
In CT they either appear as sessile, intraluminal masses (most common) or ureteral wall thickening or large infiltrating masses.

Although characteristically avascular on angiography, CT may show slight contrast enhancement.

CT can show periureteric and intrarenal extension.

Nonetheless, CT 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 totally 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 CT.

Surgical exploration is often required for a definite diagnosis in these cases.

**INDETERMINATED MASSES**

Technically indeterminate masses having many CT 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 CT 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 benign cyst.

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

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

3. Solid masses with complex features:

These last CT indeterminancy includes cases that closely resemble neoplasms but exhibit confusing CT 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 absent. Lesions in this category requires surgical intervention for definitive diagnosis and treatment.
The approach to diagnose these indeterminate masses are:

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

(2) If the mass or masses are cyst-like on CT but have any e.g. thick mass is.

(3) If the mass is apparently radiological by percuta-
    neous SCAN FOR RENAL

This is convensioned CAT scan. This technique can only be used

with third generation CAT scan. The type which can make 1-3 mm

slice section within 2-4 minutes.

FG. 11 Normal post nephrectomy 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 cases were found to be xanthogranulomatous pyelonephritis of renal cell carcinoma complicated by external haemorrhage or urinoma.

The approach to diagnose these indeterminate cases are:

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

(b) If the mass or masses are cyst like on CT 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 CT features and is apparently solid, even though not typical of neoplasm, surgical evaluation is indicated occasionally preceded by percutaneous biopsy.

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 excretion (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

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**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 showing the homogeneity of the two parenchyma with different dynamics.

The curve obtained in case of renal cancer are entirely different. There is widening before 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 (AFBN) 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 CT, those patients with focal process(es) on excretory urography may be referred for CT examination to evaluate the possibility of frank renal or perirenal abscess.

On CT 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 isodense or slightly less dense than normal parenchyma on noncontrast scans. After intravenous contrast medium administration, there is patchy and inhomogenous enhancement, similar to the striated nephrogram on excretory urography.

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

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

The usual xanthogranulomatous pyelonephritis (XGPN) CT 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 drained 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.

CT can precisely define the full extent of XGP Nand 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 presence of a large staghorn calculus and XGPN.

This condition can be well displayed on CT scan.
Extensive proliferation of renal 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 severe infection during renal sepsis, with or without obstruction or during a sepsis of unknown origin. The discovery of RA may dramatically modify therapeutic strategy. However, the diagnosis of RA is often difficult by conventional investigations. So the potential contribution of a noninvasive, 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 CT in the diagnosis of RA, and to compare the procedure with conventional methods of diagnosis.

**METHOD:**

They used a third generation CT scanner, with a scanning time of 4 seconds. The interspace between two (slices) is 7-9 mm. Opacification of the gastroduodenal 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% 1mg/kg). The total duration of the procedure was 15 to 30 minutes.
<table>
<thead>
<tr>
<th>AGE (Y)</th>
<th>COMPLAIN</th>
<th>CLINICALLY</th>
<th>UROGRAPHY &amp; OTHERS</th>
<th>C.T.</th>
</tr>
</thead>
<tbody>
<tr>
<td>se 1</td>
<td>75</td>
<td>Fever, left flank pain, fever &amp; spontaneous elimination of calculus.</td>
<td>Urography: Obstructive lithiasis.</td>
<td>very heterogeneous parenchyma</td>
</tr>
<tr>
<td>se 2</td>
<td>73</td>
<td>Septic shock</td>
<td>Septicemia culture sensitivity of E. Coli in urine</td>
<td>Urography: Bilateral delay, retrograde pyelography was normal.</td>
</tr>
<tr>
<td>se 3</td>
<td>37</td>
<td>Haematuria, fever, Rt. flank pain.</td>
<td>Septicemia: culture sensitivity of E. Coli.</td>
<td>Urography: tumoural aspect of the upper part of Rt. kidney. Arteriography: This formation was a nonvascular one.</td>
</tr>
<tr>
<td>se 4</td>
<td>57</td>
<td>Right flank pain, Septicemia, and hyperparathyrodism in past history.</td>
<td>Ureteral calculus and distension of right cavities. Ureteral catheter failed because of calculus.</td>
<td>Heterogenous of right aspect of parenchyma. Two defects discovered.</td>
</tr>
<tr>
<td>se 5</td>
<td>53</td>
<td>Right flank pain and fever.</td>
<td>Urine and blood cultures positive for enterobacter cloaca</td>
<td>Right kidney did not show any secretion.</td>
</tr>
<tr>
<td>se 6</td>
<td>31</td>
<td>Right flank pain &amp; fever.</td>
<td>Urine E. coli</td>
<td>Right late secretion enlarged left with a lower pole difficult to see.</td>
</tr>
<tr>
<td>se 7</td>
<td>52</td>
<td>Right lumbar pain, fever and chills.</td>
<td>Closed renal biopsy for glomerulopathy.</td>
<td>Right kidney not visualized. Retrograde pyelography: was normal.</td>
</tr>
</tbody>
</table>

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 parenchyma.

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

A recent prospective study emphasizes the frequency of perirenal haematoma after renal biopsy. (85%) usually without any clinical symptoms.
VALUE OF CT, COMPARISON TO OTHER AVAILABLE PROCEDURE IN THE DIAGNOSIS OF RA.

COMPARISON WITH UROGRAPHY:
The superiority of CT over standard radiography is due to its greater ability to discriminate the densities (0.5% for CT and 5-10% of radiography) if the contrast is strong enough. CT is able to discriminate defects 3 mm in diameter. CT is nonaggressive 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 CT demonstrated bilateral abscesses while the clinical signs indicated unilateral.

In another patient the clinical examination was normal and CT showed bilateral renal abscesses. Even if renal abscess is suspected upon urography, the superiority of CT is evident. Particularly incase of a nonvisualization of the kidney, demonstrating the exact size of the kidney, its functional unit and any radiotransparent calculi.

CT visualizes precisely abscesses with a 5 mm diameter, their unit or bilateral localization, and any possible communication with the renal cavities. CT easily demonstrates hydronephrosis and avoids ureteropyelography which may be dangerous investigation. Finally CT because of its noninvasive character may be
repeated. In this study second CT was performed in two patients showing total recovery. Thus, CT 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 CT 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. CT is not complicated by obesity. CT may demonstrate the nature and the exact localization of an obstruction. CT is less dependent on the operator than echography.

Finally:

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

INDICATION OF CT 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 therapy often in spite of drainage of the distended cavities.

3. Sepsis and absence of secretion in the urography.

4. Tumoural mass.

The absence of any parallel between the anatomic and clinical patterns is well known during renal sepsis. Some patients 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 drainage of the cavities, if they are distended, is always an emergency, but the management 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 micro-abscesses may explain the persistence of a severe septic shock in other patients.

In the latter an immediate nephrectomy should be considered. C.T. may be extremely useful in such an emergency situation. However the therapeutic management 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 obstruction of the cavities and the constatation of RA using CT must not increase therapeutic 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. consta-
taions may be useful in deciding whether immediate nephrectomy is necessary.

2. Septic state of renal origin, without any obstruction or persistly despite drainage of the cavities. C.T. may prove essential in the decision between antibiotic therapy, drainage 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, etc.)

CONCLUSION

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 hierarchy of radiological procedures and thus the future cost of this examination.
**C.T. in solitary kidney**

(After nephrectomy) To assess post-operative complication of renal bed infection, tumour recurrence, and evaluating the contralateral kidney. C.T. is very important, because it is safe and non-invasive, especially in the immediate post-operative period when there is still drainage. Ultrasound may not be used.

**IMPAIRED RENAL FUNCTION**

Renal excretory function, metabolic status, location, and contoured sections of the kidneys are necessary to be feasible in almost all cases of impaired renal function. However, renal excretory function of performance and imaging of the kidneys are useful in differentiating obstructive uropathy from renal parenchymal disease. Computed tomography is reserved for cases in which ultrasound and imaging studies are not feasible.

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**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 assess 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 (RENAI 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 technically unsuccessful due to extreme obesity or in cases in which ultrasound fails to define the level and etiology 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 occasionally 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 assessed, thus providing information regarding the potential for diagnosing the obstructing process.

Besides hydronephrosis, a variety of renal parenchymal disease that result 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 cases like acute cortical necrosis, kidney ischemia and infarctions, and all these can be differentiated according 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 cases, 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 benign or malignant conditions. It is important to stress that not all calcified renal masses fell into an indeterminate category. Because of the ability of CT to localize calcification more accurately than conventional radiographic methods and to determine the cystic or solid composition of a mass, CT allows for the distinction of benign from malignant categories of calcified renal masses with more certainty.

Based on their CT appearances, calcified renal masses can be categorized into the following three groups:-

(i) Tumours of primarily 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 confines of the calcification.

In other words, the calcification, even when appearing peripheral on radiographic, does not truly define the periphery of the renal mass. Although the correct diagnosis of renal cell carcinoma can be suspected by excretory urography and, further
provides valuable staging information. It should be noted that a calcified renal cell carcinoma has a better prognosis than a noncalcified renal cell carcinoma.

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 CT features to the second group of calcified renal masses CT can display the solitary or diffuse forms of renal involvement of hydatid cyst when present. The presence 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 calcification 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 carcinoma to hemorrhagic cyst. Other conditions such as adults wilm's tumour, transitional cell carcinoma, 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 CT methodology.

RENAL TRAUMA

Trauma to the kidney as an isolated event or as a concomitant injury in the patient with multiple 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 management with a minimum of radiologic evaluation, therefore experience with CT in pernterating injuries to the urinary tract is currently limited. Conservative, nonoperative management 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 CT. However, in the patient with an unsatisfactory urogram or labile clinical conditions, i.e., persistant hematuria or declining hematocrit, a CT examination should be the next imaging study considered. Extravasction of urine may be detected by CT when not visible on a conventional urogram with tomography. The presence and extent of subcapsular perinephric hematoma or urinoma formation can be accurately deficted with CT. 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, CT 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 primarily in differentiating between patients with acute rejection and those with obstructive uropathy urinary fistula or significant perinephric fluid collection. There are many causes for impaired allograft function following renal transplantation, including rejection, vasomotor nephropathy, obstructive uropathy, urinary fistula, vascular complications and systemic infection. Accurate diagnosis of these patients and prompt appropriate management 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 edema, an unexplained decrease
in the serum hemoglobin, drainage of fluid through a portion of the transplant incision and impaired allograft function. Serial isotope radiography with Iodine orthoiohippurate provides and excellent, non-invasive, functional assessment 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. Computerized 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 structures.

An advantage of CT is the ability to image mirror density not dependant on contrast material, which can be withheld. Computed tomography scan characterizes accurately the location, extent and density of otherwise undetectable perinephric fluid collection. Attenuation values of $0 \pm 10$ 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. Percutaneous allograft bioby 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.

Tuberous sclerosis:--

When it involves the kidney is usually in the form of multiple hamartomas, commonly called angiomyolipomas. Cystic involvement 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 collomination 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 kidney. 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 carcinoma, are optimally imaged with CT. Often, however, the renal call carcinoma is diffuse through-out the kidney rather than a focal tumorous process. Compessed renal parenchyma may be difficult to differentiate from carcinomatous involvement, especially when cystic involvement is extensive.
RENEAL PELVIS FILLING DEFECT.

The differential diagnosis of a filling defect in the renal pelvis includes a tumour, a blood clot, fungus ball, 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.

Non-radiopaque 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 easily 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 row 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 difficult 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 staghorn 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.
Many juxta renal processes began as primary renal processes. As diseases extend out from the kidney to involve contiguous 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 separate compartments, an anterior pararenal, a perirenal and a posterior pararenal 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 hemorrhage, infection (occasionally gaseous) urine or lymph extravesation, tumor spread, fat deposition and pancreatic pseudocysts (extrapancreatic fluid collections). 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 penetrating, is the most common cause of hemorrhage into perirenal space. In patients with penetrating injury, which includes renal biopsies, blood most commonly accumulate in the inferior perirenal space followed by posterior pararenal and subcapsular collections.
Other causes of perirenal hemorrhage include arteritis, interstitial nephritis (lupus Erythematosus), 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 occasions.

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.

Computed tomography provides excellent visualization 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 by 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.

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 vessels 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 heterogeneous nearly normal to severe, often a symetric obstruction. Furthermore may present with ureamia and non-
functioning 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 too small for an evaluation. But still CT cannot differentiate between benign lesions and malignancy in retroperitoneum such as lymphoma, sarcoma or lymph node metastasis. Although malignancy is usually higher and in mediastinum 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 fibrosis. 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 carcinoma 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>
<thead>
<tr>
<th>Type of Tumour</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pheochromocytoma</td>
<td>14</td>
</tr>
<tr>
<td>Hormonally active adrenal adenoma (including Cushing's Syndrome)</td>
<td>21</td>
</tr>
<tr>
<td>Conn's syndrome</td>
<td>2</td>
</tr>
<tr>
<td>Adrenal cysts</td>
<td>3</td>
</tr>
<tr>
<td>Adrenal neuroblastoma</td>
<td>8</td>
</tr>
<tr>
<td>Carcinoma of the adrenal</td>
<td>3</td>
</tr>
<tr>
<td>Adrenal metastases</td>
<td>45</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>96</strong></td>
</tr>
</tbody>
</table>

The fourteen pheochromocytoma were all demonstrated as unilateral tumours up to 10 cm in diameter, and occasional necrotic areas were identical.

The CT appearance of adrenal adenoma were striking 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 distinguished from hyperplasia by reference 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 vessels near the adrenal glands, misleading evidence of adrenal tumours.

4. Inadequate examination techniques: false negative findings only in ectopic pheochromocytoma and in carcinoma 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 noninvasive and in over 90% of cases is the key investigation providing the diagnosis in early stages.
CHAPTER III

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 bilaterally symmetrical structures within this framework.

TECHNIQUE: Scanning 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 accumulation 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 multiple small bowel loops reside in the pelvis, complete opacification of the alimentary tract is essential lest they may be misinterpreted as mass lesions. A dense contrast material in the bladder sometimes results in scan artifact and obscures adjacent structures, it is generally best to obtain scans when the bladder is filled with unopacified urine. Rectosigmoid 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 cases where there are uncertainties about soft tissue densities on pre-contrast 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 intravenous administration of 50 cc 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 H2O)

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 carcinoma has usually been done under general anesthesia by bimanual palpation before and after transurethral 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 carcinoma. 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 biopsy at cystoscopy quite adequately defines the depth of the tumour extension into the submucosa and deep muscle layers, these methods remain the primary diagnostic procedure in patients with suspected bladder carcinomas.

The clinical role of C.T. in bladder cancer is therefore 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 perivesicle fat planes. In more advanced cases 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 differentiating bladder neoplasms with extravesical extension from those confined to the wall but is incapable
STAGING OF BLADDER TUMOURS ACCORDING TO THE MARSHALL SYSTEM

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Epithelial</td>
</tr>
<tr>
<td>A</td>
<td>Lamina propria</td>
</tr>
<tr>
<td>B₁</td>
<td>Superficial muscle</td>
</tr>
<tr>
<td>B₂</td>
<td>Deep muscle</td>
</tr>
<tr>
<td>C</td>
<td>Perivesicle fat</td>
</tr>
<tr>
<td>D₁</td>
<td>Adjacent organs, lymph nodes</td>
</tr>
<tr>
<td>D₂</td>
<td>Distant metastases</td>
</tr>
</tbody>
</table>

Table 5

The accuracy in detecting perivesicle and seminal vesicle invasion was in the range of 65 to 75%. The accuracy in evaluating lymph node metastasis ranges from 70 to 90% with a definite negative rate of 25 to 40%. The major limitation of C.T. is the inability to recognize abnormal but non-enucleously involved lymph nodes as abnormal.

Table 5

The accuracy of staging bladder carcinomas and the ability to avoid unnecessary radical surgery depends upon the awareness of preoperative disease extent. A percentage of patients was having perivesical spread but a 30% degree of understaging was described. Histopathological examination revealed an understaging of tumours in about 32% of patients. The estimation of the rate of understaging of bladder tumours was 50% in patients who were understaged patients were having perivesical spread. The most frequent of the understage of tumours was analyzed by P. A. Adler et al (1982). He had staged Carcinoma by the bladder estimated by C.T. in 32 patients before they underwent radical cystectomy. Eleven of the patients had perivesical spread at histopathological examination of the
of distinguishing tumours in the letter group (stages 0, A, B, and B2) from each other.

The overall 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 cases. Lymphangiography may be helpful in detecting normal sized lymph nodes that are involved with metastotic disease.

Richic et al 1975 commented 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 staged 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 CT 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 CT as having perivesical growth. But histologically did not proof, three of them had perivesical fibrosis that was misinterpreted as perivesical tumour growth. In all the seven patients the perivesical changes were adjacent to the area of present or previous changes in bladder wall. CT is a valuable addition to clinical staging because it demonstrates perivesical tumours growth.

In one study done by L. Giulian Seventy-Two patients with bladder cancer underwent CT scanning for preoperative staging. The clinical staging was performed according to the suggestion of UICC without considering the results of CT. The therapy was radical cystectomy in forty-two cases, transurethral resection in fourteen cases, transurethral resection plus radiotherapy 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 CT is nearly the same) Infact in the stages PT1, PT2, PT3, the percentage of inaccuracy of CT due to overstaging was very high (28%) on the contrary in advanced stage tumours CT showed the highest degree accuracy 100% in making evident the extravesical spreading of tumours.
From this point of view, the CT 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 CT 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 $T_3$). In these tumours CT tends to increase the stage compared with clinical examination. (The overstaging is usually due to localized thickening of the bladder wall being interpreted as tumour invading deep muscle while it is fibrosis or other non-tumour pathology. CT 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 CT scanning.

On the contrary when there is also a minimal suspicion of extravesical infiltration CT scanning can solve the diagnostic problem with great accuracy. Finally we can state that CT 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.
In staging of carcinoma of bladder, the clinical staging differs from the pathological staging in a large percentage of cases, due to the inherent difficulty in the accurate assessment of the extent of the tumour. Several reports indicate a discrepancy between C.T. staging and pathological staging in certain patients. However, C.T. is not used for routine staging of superficial tumours, but is reserved for deep or recurrent tumours. In patients whose tumours are initially responding to preoperative radiotherapy, a curative response following preoperative radiation treatment is often achieved, following a course of preoperative radiotherapy.

**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.
In staging of carcinoma of bladder, the clinical staging differs from the pathological staging in a large percentage of cases, 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 assessing the depth of penetration in more superficial tumours.

A potentially promising area of C.T. application radiotherapy of bladder cancer is 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 radiotherapy to full doses is given.
Bimanual examination is the primary diagnostic technique in the evaluation of prostatic pathology. Adenocarcinoma comprises more than 95% of prostatic malignancies with the rest being transitional or squamous cell carcinoma or sarcoma.

C.T. is not used as a screening procedure for detection of prostatic carcinoma because of its inability to differentiate among normal, hyperplastic and cancerous glands. Nevertheless, C.T. does provide useful information as to the extent 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 extension from prostatic carcinoma are essentially the same as those used in the staging of bladder carcinomas 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 is 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 carcinoma is in the range of 70 to 80%.

Although the sensitivity in detecting extracapsular extension is low the specificity is high.

Due to its low sensitivity in detecting extracapsular extension of the prostatic carcinoma 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 C and D).
In patients scheduled to receive therapy for prostatic carcinoma CT can help to design the plan of therapy. 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 areas which primarily involved in prostatic cancer pathology, are not commonly visualized during lymphangiography (hypogastric, obturator-presacral areas).

CONCLUSION:
Computerized tomography can'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 can't diagnose cancer prostate and needle biopsy is still superior with bimanual examination. Therefore it should be added to the accepted staging modalities prior to a planned radical prostatectomy.

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 within capsule with elevation of serum acid phosphatase. Pelvic nodes may be involved
D: Bone or extrapelvic involvement.
Clinical staging is largely dependant on the findings of the rectal examination, tumour extent is often underestimated. With the exception of early stage B(B1) which is usually treated by radical prostatectomy, most potentially curable patients 20 patients with localized prostatic carcinoma before and after interstitial implantation of radio active iodine seeds (125I). Scans were analysed to determine prostate volume, seed location, tumour response and periprostatic tumour spread.

C.T. volume were 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 interstitial 125I Brachytherapy of prostatic carcinoma.

<table>
<thead>
<tr>
<th>+ve effect &amp;%</th>
<th>-ve effect &amp; %</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate volume</td>
<td>25% (6 patients)</td>
<td>25% (6 patients)</td>
</tr>
<tr>
<td>+ve effect</td>
<td>greater than estimated volume.</td>
<td></td>
</tr>
<tr>
<td>Tumour volume</td>
<td>(15%) perfect</td>
<td>85% (17 patients)</td>
</tr>
<tr>
<td>-ve effect</td>
<td>errors in implantation</td>
<td></td>
</tr>
<tr>
<td>+ve effect &amp;%</td>
<td>-ve effect &amp;%</td>
<td>Remarks</td>
</tr>
<tr>
<td>--------------</td>
<td>--------------</td>
<td>---------</td>
</tr>
<tr>
<td>(35%) (7 patients)</td>
<td>5% (1 patient)</td>
<td>60% (12 patients)</td>
</tr>
<tr>
<td>increase in size</td>
<td>no change in volume</td>
<td></td>
</tr>
<tr>
<td>decrease in size</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Unprostatic.

**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 extraglandular invasion. Note that the right seminal vesicle (SV, arrowhead) is almost obliterated with fatty masses, less rounded.
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 vesiculular angle (arrowhead) is sharply delineated with fatty tissue. BL, bladder.
The detection of possible surgical complications and local neoplastic recurrences 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 radionuclide 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 prostate and the seminal vesicles are absent. In females patients, the uterus and both fallopian tubes as well the urinary bladder are absent.

Although the perivescicle 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 iliopsoas in the upper pelvis, remain symmetrical. Recognition of symmetry 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, pelvic 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 sensitivity, 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 biopsy obviated.

The true nature of venous collateral can be established on C.T. scans by administering 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 assess the status of the retroperitoneal and mesentric lymph nodes as well.
CHAPTER IV

TESTIS

Testicular tumours are the commonest malignant solid tumours in young males, and prior to C.T., the standard technique for staging disease spread was the lymphangiography supplemented by excretory urography. The limitations of this technique is well recognized, and in an age of increasing costs and large work loads it is necessary to rationalize a radiological approach in order to obtain the maximum information without performing unnecessary investigation.

The usual site of drainage of the testis is the inguinal and the preaortic lymph nodes at the point of entry of spermatic vessels. Very significant limitations on the lymphangiography in the staging of these tumours. New staging systems have been developed not only on detection but also on demonstration of bulk disease. This further highlights the limitations of the traditional radiological techniques.

It has been estimated that as many as 25% of patients with negative lymphograms have lymph node deposits (Wallace and Jing 1970).

This is easily understood when the normal anatomical drainage of the testis is considered. The ascending lymphogram only shows the para-aortic lymph nodes accurately retrogradely in 15%. The left spermatic vein drains in only 50% of cases, whereas on the right side only 25% (ilio-femoral opacification of the iliac vessels - Simmons, 1973). The lymphogram is a very sensitive indicator of diseases in the external and common iliac lymph nodes and in the low para-aortic chain.

These areas are however, rarely involved in metastatic disease in testicular teratomas, and when they are involved it is usually due to the unusual occurrence of tumour invasion of the peritoneum.
Testicular tumours are the commonest malignant solid tumours in young males, and prior to C.T. the standard technique for staging disease spread was the lymphangiogram supplemented by excretory urogram. The inadequacy of this techniques is well recognized, and in an age of increasing costs and large work loads it is necessary to rationalise a radiological approach in order to obtain the optimum information without performing unnecessary investigations.

The anatomical drainage of the testis and the recognized pattern of spread testicular tumours directly to the para-aortic lymph nodes at the L1 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 traditional radiological techniques.

It has been estimated that as many as 25% of patients with negative lymphograms have lymph node deposits (Wallace and Jing 1970). This is easily understood when the normal anatomical drainage of the testis is considered. The ascending lymphogram only shows the para-aortic lymph nodes accurately retrogradely to L1. 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 occurrence of tumour invasion of the scrotum,
when drainage 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 provides 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 striking difference in the result of treatment observed between substages based on tumour volume as well as extent of disease underline the importance of displaying 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. Initial scans well performed after the orchiectomy but before the onset of further treatment. Follow-up scans were done at various intervals during the course of therapy, totaling sixty-three C.T. 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 x-rays with or without whole lung tomography were performed initially 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. negative. Both these cases would have been staged as subgroup 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

<table>
<thead>
<tr>
<th>Total number of patients</th>
<th>30</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT and lymphogram positive</td>
<td>15*</td>
</tr>
<tr>
<td>CT and lymphogram negative</td>
<td>11</td>
</tr>
<tr>
<td>CT positive, lymphogram negative</td>
<td>2</td>
</tr>
<tr>
<td>CT negative, lymphogram positive</td>
<td>2+</td>
</tr>
</tbody>
</table>

CT showed liver secondaries in three cases and occult bone abnormalities in a further five cases, subsequent follow-up confirmed these pathological changes.

CT showed 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 assessed 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 multiple repeat lymphography. A limited C.T. examination of the area of drainage provides a more accurate and less time consuming examination in addition to being non-invasive.

As well as its superiority in lymph node assessment, the ability of C.T. to assess 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 in fact due to metastatic disease. Within the thorax C.T. is superior to other methods like chest x-ray and tomography in detecting both the parenchymal lung metastasis and mediastinal lymph node disease.

Where there is gross intrathoracic disease, monitoring is easy on plane chest x-ray.

From this study it is suggested that C.T. should be the primary imaging investigation for staging and monitoring metastatic 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 such as poor fat planes or artefacts due to bowel gas movement, or where biochemical markers are raised despite a normal C.T. scan. In the thorax, C.T. is advocated where the plain x-ray reveals no abnormality or where less than three extensive metastatic is present follow-up with plain chest x-ray 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 accurately depict the presence and location of the testes 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 sac during the latter third of gestation. Interruption of this normal migratory process results in ectopic positioning of the testes. Because malignancy occurs 12 to 40 times more commonly in the undescended (intra-abdominal) than in the descended testis, it is widely agreed that orchiopexy be performed in patients younger than ten years of age and orchiectomy be performed in patients who are seen after puberty. Preoperative localization of a nonpalpable testis by radiologic methods often 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 symmetrical. An undescended testis as small as 1 cm 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.
accuracy of the retroperitoneal lymph nodes in seminoma determines the
tent of the radiation field and the total dose. In carcinoma the nodal
status determines the need for lymphadenectomy, radiotherapy and
emotherapy.

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

RADIATION OF TESTICULAR TUMOURS

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

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

Testicular arteriography is not only technically difficult but
also painful.

Although testicular venography is less traumatic than arterio-
graphy, it 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 presence 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 perfor-
mane and noninvasive nature, we believe C.T. is the procedure
of choice in the preoperative localization of a nonpalpable testis.

In cases where C.T. cannot resolve the problem, testicular
venography or arteriography can still be employed for further evalua
tion.
CHAPTER V

DIAGNOSIS OF UNKNOWN ABDOMINAL MASSES

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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 testicular descent. When the mass is unusually large it may be due to malignant transformation.

Lymph node metastasis is diagnosed easily by CT especially in cases of testicular teratoma which is drained to lumbar lymph nodes especially L1/2 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 cases of lymphomas and hodgkin's the enlarged lymph nodes could be located and this could facilitate the operation of biopsy for diagnosis or staging of hodgkin's
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 useful is alloograft transplant after rejection which can be diagnosed 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 involvement present, the presence of daughter cysts with a larger cyst is pathognomonic 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 pararenal space. The mass in the CT is on the lateral surface of the quadratus lumborum and left psoas muscles and displaces the kidney anteriorly, can be diagnosed by the presence of calcifications in the head of pancreas.
The Computerized Tomography machine is of great help in diagnosing the normal and abnormal anatomy of the body sections.

There are three new developments in the CT field:

1. Nuclear magnetic resonance (N.M.R.) which makes basic biochemical measurements at the molecular level and these data be translated to histopathologic diagnosis.

2. Positron Emission Tomography (P.E.T.) which measures the rate of activity of radioactive substances in the body and how time it takes to metabolize.

3. Magnetic Resonance Imaging which has a great role in study of the body which has not yet been in the experimental stage.

CHAPTER VI
RECENT ADVANCES IN CT

The expected developments in CT machine in its integration with the radiology machine to form one unit to improve the performance of the radiology machine by calculating the dose of radiation to the tumour volume, and the limiting dose in non-irradiating normal tissues, to avoid over or under estimation of the dose.
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 developments in the CT field

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

B - positron Emission tomography (P.E.T) which measures the metabolic activity of radioactive substances in the brain and translating these data into pathophyslogic diagnosis which is of great help in study of the body physiology, but still it is in the experimental 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 radiotherapy 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.
NMR proton imaging has the potential to replace X-ray, C.T. from the standpoint of the clinical information NMR conveys.

The NMR procedure measures the concentrations of some nuclei e.g. $^1\text{H}$, $^{23}\text{Na}$, $^{32}\text{P}$ as well as their chemical state and the local physical chemical environment of the resolution volume. The major potential of NMR thus in its analytical power to make basic biochemical measurements at the subatomic level, non-invasively, 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 interception of the neighboring 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 spatially 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 vesicle anatomy and measure the tissue characteristics of diseased vessels.
It can readily distinguish between cortex and medulla of the kidney although the difference may be lost in glomerular disease.

NMR is 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 clearly defined bone cortex and marrow, muscles, connective tissue bundles fat and vessels.

The images correlated well with standard radiography and pathology specimens.

**BIOLOGICAL HAZARDS OF NMR:**

The possible harmful effects results from radiofrequency heating or from electric currents induced with the body. However, evidence from animal exposure and few human volunteers suggest that these fields are not hazardous at the level used at present.
The main idea of PET is the capability of labeling metabolically active agents which distinguishes positron strategies from those of standard nuclear 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 obtaining quantitative cerebral blood flow and metabolic 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 radionuclides used in PET studies costs about 2 million dollars, and a successful position facility requires and expensive team of physicists, radiochemists, engineers, programmers and clinicians.

Higher sensitivity 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 device lies in the capability to do more rapid studies so that one may follow acutely changing physiology at rest and after pharmacologic or activation challenges - 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. These are called "final common pathway" parameters. Strategies that examine more specific tissue phenomena "highly differentiated tracer techniques" that would monitor dopaminergic receptors or cholinergic receptor activity, tissue pH, opioid receptor population, protein synthesis of the tissue uptake and clearance of therapeutic agents.
Current human application of positron 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 meaningful PET studies in human subjects. It also explains 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 a useful tool in radiotherapy planning by:

(a) Accurate localization of tumour volume and surrounding normal structures in 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 definition of limiting doses to normal tissues.

(d) By accurate computation of dose distribution within the treatment 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 management are carcinoma of the bladder, carcinoma of the prostate and testicular tumours.
C H A P T E R VII

C O N C L U S I O N

SUMMARY

It is clear that CT cannot replace conventional urography. Urography and ultrasonography in demonstration of renal tumours
but is complimentary to this imaging method.
CT can diagnose most morphological diseases of the kidney.
It is a noninvasive technique and obviates the need for urography in a significant number of cases.
The diagnostic accuracy is excellent when compared with ultrasonography and selective renal arteriography. It can provide the diagnosis and define the extent of urological disease. It is considered an excellent screening procedure even if not a true level of accuracy; it reduces the number of the procedures to be quite high, but
where it can be used as one of the urologic armamentarium in the diagnosis in selected cases.

It seems to be the most important step in diagnosis of renal abscesses.

This is due to the localization of the kidney, to its position among fatty structures which increase the contrast of the images.
The CT in having an important role is the investigation of
severe pyogenic states with sepsisemia of unknown origin and in renal pyogenic state persisting inspite of correct antibiotic
and optimal drainage of the distended collecting units.

CT is very important in cases of sepsis and obstruction of excretion and renal masses in urography. The correlation between
the clinical picture and the CT finding can be very useful in deciding whether immediate nephrectomy is necessary or antibiotic
therapy or drainage of the abscess. That CT in certain states
state of doubtful origin permits the localization of abscesses either intraperitoneal, extra-renal, extraperitoneal.
CONCLUSION

It is clear that CT cannot replace conventional 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 arteriography 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 armamentarium 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 important 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 drainage of the distended cavities. Also CT is very important in cases of sepsis and absence of secretion and tumoural masses in the urography. The correlation between the clinical picture and the CT findings can be very useful in deciding whether immediate nephrectomy is necessary, or antibiotic therapy or drainage 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 cases 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. Multiple renal masses for example adult polycystic kidney disease or multiple cortical cysts, may also be best imaged first with CT before kidney enlarges, left upper pole renal masses or masses less than 1 cm in diameter, especially in obese patients are difficult to examine by sonography and therefore should be studied first with CT. Additionally most cases considered intermediate or unresolved by ultrasound can often be resolved using CT using such technique has markedly declined the actual number of angiograms and primarily high-dose nephrotomograms.

CT is reserved in evaluating renal transplants cases 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 extension and lymph node metastasis, and angiography should be reserved for cases 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 cases 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, carcinoma of adrenal and adrenal metastasis all can be localized anatomically if surgical treatment is to be undertaken. Selective angiography and hormone assays used in cases of ectopic pheochromocytoma and extensive invasion of carcinoma to surrounding tissue.

The process that frequently affect the extra-peritoneal pararenal spaces are hemorrhage, 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.

<table>
<thead>
<tr>
<th>PATHOLOGY</th>
<th>ATTENUATION VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute haematoma</td>
<td>60 to 80 HU</td>
</tr>
<tr>
<td>Chronic haematoma</td>
<td>20 to 40 HU</td>
</tr>
<tr>
<td>Urinoma</td>
<td>-10 to 20 HU</td>
</tr>
<tr>
<td>Abscess</td>
<td>10 to 28 HU</td>
</tr>
<tr>
<td>Stone</td>
<td>300 to 600 HU</td>
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</table>
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 correlation between CT staging and pathological staging in deeply invasive tumours. However, CT is not useful in assessing 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 a 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 infiltrating 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 extravesical infiltration, 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 normal 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 important in the diagnosis of extraglandular extension. CT identifies tumours infiltrating pelvic floor and evaluates their extension 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 biopsy 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 drainage of the testis and the recognized pattern of spread of testicular tumours to the para-aortic lymph nodes at the level of lumbar \( \frac{1}{2} \), 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 monitoring metastatic disease in the abdomen in patients with testicular teratoma, CT can access the areas not visualized on lymphangiography primarily those in the renal hilum and above the lumbar 2 level.

Lymphangiography should be reserved for those cases 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 x-ray reveals no abnormality or wherever metastasis are shown in plain x-ray, but where extensive metastasis is present, follow-up with plain chest x-ray is sufficient.

In retroperitoneal fibrosis CT is considered valuable in the evaluation of the actual fibrosis not like the excretory urography where it only access the urinary system, also it could be used safely in the uremic patients to diagnos the cause. Because of its ease of performance and noninvasive nature, it is believed that CT is the procedure of choice in the preoperative localization of a nonpalpable testis. In casess where CT cannot resolve the problem, testicular venography or arteiography can still be employed for further evaluation.
The subject of this essay is computerized tomography in urology. The work in this machine had started in the sixties but the first machine was installed by 1973.

The scanner consists basically of an x-ray rigidly mounted opposite a detector array, and the system rotates around the body, then the finely collimated x-ray beam passes through the body, and partially absorbed. This is impregnated on greyscale detectors according to the densities and translated by the help of the computer into body sections. Where the radio-opaque material appears white and the radiolucent 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 2-13mm, 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 bladder, prostate it is used in staging of tumours and assessing the depth of penetration 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 complementery method in diagnosis, used only when the other methods either fails or become technically difficult to interprete.
لا يمكنني قراءة النص العربي من الصورة المقدمة.