THE VALUE OF COMPUTED TOMOGRAPHY IN RENAL AND PERIRENAL DISEASES .

Essay

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By

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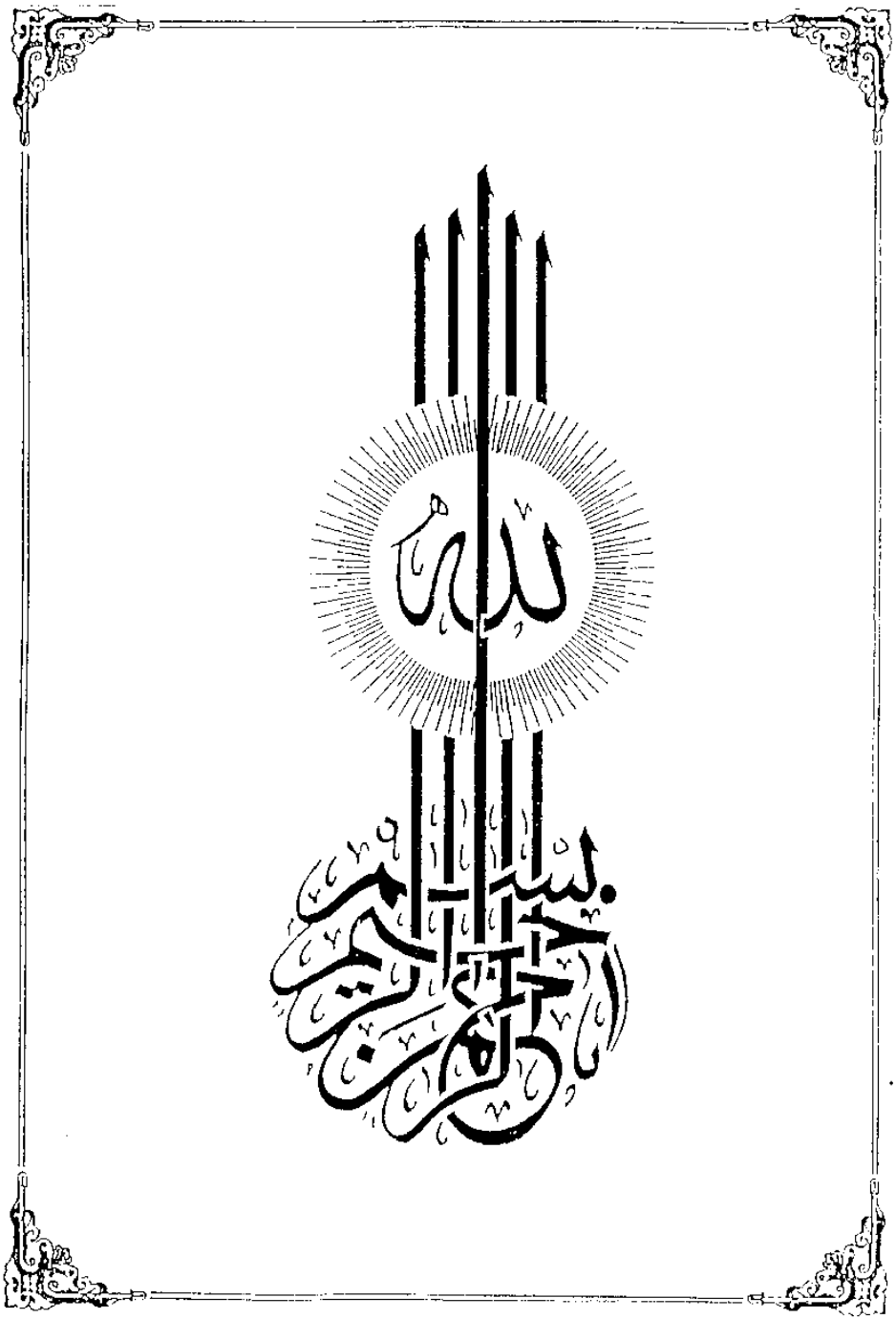

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INTRODUCTION

Computed tomographic (CT) scanning is considered to be an exciting new development in the field of high - technology imaging . The invention of CT scanners, the subsequent improvement in scanning techniques, and considering the advantages over other imaging modalities, all together, have compelled the investigators to rearrange the roles that other diagnostic studies previously used to play (Goldman and Siegelman ,1982 ; Richie et al., 1983) . With the increasing use of CT alone, or combined with ultrasonography, there has been a sharp decrease in the use of many long - established uroradiologic studies (Seltzer et al. 1986 ; Johnson et al.. 1987 ; Thompson and Cheung . 1987) .

CT scanning is currently considered to be the best available way to image the retroperitoneal compartment, the kidneys. and the adrenal gland (Moss. 1983 ; Degesys et al .. 1986) . CT scanning gives a remarkable definition of organ morphology. fascial planes and cross - sectional body anatomy in a relatively easy way to interpret. and without exhaustingly special training (Palubinskas ,1984 ; Edwards and Beggs . 1987) .

The CT images are highly sensitive . Lesions as small as 1 cm. in diameter or even less, can be identified on CT scanning (Hussain , 1986 ; Suttun , 1987 ; Thompson and Cheung , 1987) .

Although CT scanning can be used to image all retroperitoneal organs and compartments, the priority of its use largely depends upon the site as well as the nature of the lesion to be investigated (Korobkin , 1983 ; Palubinskas , 1984) .

This study is focusing on the value of CT scanning as an imaging method chosen for the diagnosis and / or treatment planning of different renal and perirenal diseases .

History of computed tomography(CT) :-

Although the commercial development of CT began in the early 1970's, a complete history of CT must include the outstanding development in various technologies during many decades preceding its first implementation including the development of X- ray technology, general radiology, mathematical achievements, as well as the introduction of mini - and microcomputers. Development in each of these technologies occurred in such a way that by the late 1960 s, all the technical elements required for the invention of CT scanners were in place (Linuma, 1983; and lipuma and Hagaa, 1983) .

A variety of mathematical techniques for reconstruction were developed . During 1950s and 1960s. these techniques were applied in many scientific feilds including radio - astronomy and electron - microscopy
(Li Puma and Hagaa 1983)

Cormack, A. M., first applied the mathematical techniques for " image reconstruction from projection " in the field of radiography; and , Hounsfeild, G. N. , the first viable medical CT scanner, which achieved an immediate success. Cormack and Hounsfield later shared the " Nobel prize " for medicin in 1980 . Shortly after the tre-

mendous diagnostic capabilities of CT had been recognised, the performance and sophistications of CT equipment evolved rapidly in an intense competitive atmosphere between many interested manifacturing companies (Boyd and Parker, 1983) .

The main advantages of CT scanning

CT is a rapid, easily performed and a safe noninvasive diagnostic imaging procedure (Moss, 1983). It does not need neither complicated patient preparation, nor hospitalization, hence, CT can be performed as an outpatient procedure (Korobkin, 1983; and dekernion, 1986) .

The **quality of CT images** are relatively standard and uniform, so that they are easy to interpret. The image quality does not depend on the skill of the operator. The images are not affected by bones or gases. Because of these advantages, CT scans of the abdomen are less often incomplete or indeterminate than ultrasound studies (Korobkin, 1983; and Palubinskas, 1984) .

Although the administration of contrast material ensures the greatest diagnostic yeild (Love et al., 1979), a satisfactory CT examination **can be obtained without**

contrast administration (Moss, 1983). Such an option is valuable in patients with known sensitivity and in cases of renal failure (Edwards and Beggs, 1987).

CT has become **the method of choice in the examination of the retroperitoneum.** There is no imaging modality able to deliver as much informations about the retroperitoneum as CT does (Stephens et al., 1977; and Goldman and Siegelman, 1982). CT clearly demonstrates the anterior and posterior layers of the renal fascia, together with the perirenal and pararenal spaces in unique, anatomical, cross - sectional images (Parienty et al., 1984 and Edwards and Beggs, 1987).

CT is **superior in the demonstration of the renal surfaces** which have been considered as " blind areas " on other imaging modalities. This is particularly true in cases of ventral or dorsal renal surface lesions (Edwards and Beggs, 1987).

CT scanning is able to **demonstrate differences in radiologic contrast (density resolution) as little as 0.5 per cent**, while conventional radiography, difference less than 3 or 4 per cent are usually undetectable.Such a remarkable density resolution allows CT to be capable of the identification of many lesions as small as

1cm or even less (korobkin, 1983). Hence, CT has revolutionized thediagnostic work - up particularly in cases of mass lesions. CT has replaced the more traditional studies such as excretory urography, nephrotomography, arteriography and venography in the diagnosis of many mass lesions (Sutton , 1987; and Thompson and Cheung, 1987).

CT yeilds the greatest amount of informations per - single examination (LiPuma and Hagaa, 1983). During typical CT examinations of any abdominal organ, accurate diagnostic informations regarding the surrounding tissues and neighbouring organs are also available (korobkin, 1983). This criterion renders CT significantly useful in the precise staging of malignant diseases and abdominal traumas (Bretan et al., 1986, and Johnson et al ., 1987) .

CT provides an alternative method for fluoroscopic or ultrasonic **guidance for percutaneous procedures** (e. g. antegrade urography, aspiration, puncture, drainage, biopsy taking, etc.) (Cronan et al., 1984, Amis et al., 1987 ; and Edwards and Beggs, 1987).

CT is not only useful in the diagnosis, but also in the **treatment planning**. when CT is employed in radiation therapy, it becomes possible to control the beam so

that only the tumour is radiated and adequate doses are delivered (Goldman and Siegelman, 1982; and Iinuma, 1983). Also, pre operative CT examinations can assist in reducing the scale of many operations, particularly in cases of malignancies or abdominal traumas that require surgical exploration (de kernion, 1986; and Bretan et al., 1986) .

The main disadvantages and limitations of CT scanning

The high cost, the big size, and the immobility af the CT scanners render CT scanning procdure not generally available except in large medical centers (Korobkin, 1983; and Palubinskas, 1984).

On performing contrast- enhanced CT scans, the examination carries the risk of reactions to contrast media (Moss, 1983), which range from minor reactions including rash and urticaria up to major reactions including anaphylaxis together with the risk of contrast agents' - induced renal failure (Seltzer et al., 1986) .

The CT scanning procedure is based upon ionizing radiation (Iinuma, 1983). The radiation dose used for CT studies on the kidneys or adrenals is similar to that received during excretory urography. So that, ultrasonographic studies are more suited for children and pregnant women whenever comparable informations can be obtained with either examanitations (Korobkin, 1983) .

The black CT - image of fat throws the tissues and organs with higher CT - numbers into sharp relief. The most eye - pleasing CT scans are in patients with large amount of body fat (Palubinskas, 1984). On the contrary, the image quality and CT reliability are less in patients with little retroperitoneal fat. So that, ultrasonographic studies in infants, young children, thin and cachectic adult patients are superior to CT studies (Sutton, 1987; and Edwards and Beggs, 1987).

The quality of CT images can be affected by many movements even physiological ones. Breathing , peristalsis, cardiac pulsations, and vascular pulsations, during data acquisition, can give rise to image artefacts in the form of radiating streaks (Isherwood et al., 1987).

A typical CT examination is a series of cross - sectional slices imaging, so that a single whole system image is not available for perusal (korobkin, 1983). Although new scanners have the ability of " **multiplanar reconstruction** " , such computer - generated images have a lower quality which can be improved by performing very thin slices, or by a considerable overlap between the sections; however, both techniques inevitably incure radiation dose penalty (Isherwood et al., 1987) .

Inspite of the ability of CT to distinguish certain density differences (heterogencity in composition) , simple analysis of attenuation values does not permit precise histological characterization. The combination of the clinical data and the CT - findings usually allows a good chance for a correct diagnosis, meanwhile, the final diagnosis is completed, particularly in cases of neoplasms, on histopathological examination (LiPuma and Hagaa, 1983; Lang, 1986; and Isherwood et al., 1987) .

CT scanning is regarded as an expensive diagnostic study . The cost for a C T examination is higher than that for excretory urography or ultrasonography, but still lower than that for angiography (Korobkin, 1983). However, a cost - benifit analysis in medicin cannot be easily evaluated. This is because CT truely saves much costs by reaching the proper diagnosis. in many instances. by cancelling the need for many other investigations, continued hospitalization. and even exploratory surgeries. In addition. the recovery of patient's health on proper diagnosis and specialized therapy is more important than the expenses (Iinuma, 1983) .