IMPACT OF COMPUTERISED TOMOGRAPHY
ON THE MANAGEMENT OF POSTERIOR FOSSA TUMOURS IN CHILDHOOD

THESIS

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TO :

THE FATHER OF NEUROSURGERY IN SUDAN.

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بسم الله الرحمن الرحيم

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INTRODUCTION AND REVIEW OF LITERATURE

HISTORICAL AND TECHNICAL ASPECT

HISTORICAL

Computed-Aided back projection has been used in image construction in a number of fields including those of electron microscopy, brain-scanning and bone density measurement. Kuhl and Edwards (1968) successfully applied the method to brain scanning in transverse axial plane. However, the first successful demonstration of intracrainial anatomical structure was achieved by Hounsfield (1973), the originator of the concept that the use of computor could permit recovery of large amount of information concerning soft tissue which hitherto had been lost, due to superimposition of data and insensitivity of traditional methods of recording radiographic image, quoted in Ambrose et al (1975).

The technique and the equipment were the result of the research initiated in 1969 by the Central Research Laboratories of E.M.I., Ltd., England. This research was a joint project with the department of Health and Social Security, as a result, a clinically practical system had been in use. The prototype equipment was tested on patients with wide variety of pathological conditions at Atkinson-Morley's Hospital for approximately 18 months before the clinical results were made public at the Annual Congress of British Institute of Radiology on April 19, 1972, by Ambrose J. neuroradiologist in the above mentioned hospital (quoted in Sutton (1980).

In October 1973, only two EMI scanners have been operating for any length of time in North America. The first was installed at Mayo Clinic in June 1973, and the second at the Massachusetts General Hospital in July the same year, Backer and his co-workers (1974).

So obvious and so vast were the potentials of the method in cerebral work that, by 1979 over one thousand of these expensive machines were in use, each costing about 250,000 Pounds Sterling. At the same time in 1979, it resulted in Nobel Prize for Medicine being awarded jointly to Dr. Hounsfield and Professor A.M. Cormack quoted in Sutton (1980). Now most of the early machines which were dictated head scanners have been largely taken over by body scanners capable of head scanning as well, Parker (1980).

In Egypt, the first E.M.I. was installed in 1979 by late Professor Talat Abd El Hamid, Professor of Neurology, Ain Shams University; Cairo. Since then other units have been installed. Salama (1983).

TECHNICAL ASPECT

Current CAT machines employed narrow beams of X-rays in parallel planes. After trough the head, these are detected by sodium iodide crystales and the electrical signals fed into a computer. A complex algorhythm causes these thousands of tiny electrical signals to be interpreted as X-ray absorption values for some 20.000 points in each of the two adjacent parallel planes. These digitized bits of information can be displayed as corresponding shades of gray on an oscilloscope, thus producing a black-and - white (or colour) picture of cross sections of the cranium. High X-ray absorption values are printed as white and low values as black, just as in conventional radiographs. The major difference is that very small variations in absorption can be shown so that structures not visible on plain roentgenograms, such as ventricles, sulci, blood clots are readily shown by the CAT, as white, black, or different shades of gray. This information is also magnetically recorded on videotape for permanent storage (Fig.1a,b). The manner in which the equipment functions has been described in several reports, (Baker et al., 1974; New et al 1974; Baker et al 1975; Pressman et al., 1975; New 1975; Aidinis et al 1976; Dyment et al 1976; Bachman et al 1977; Parker 1980; Sutton 1980).

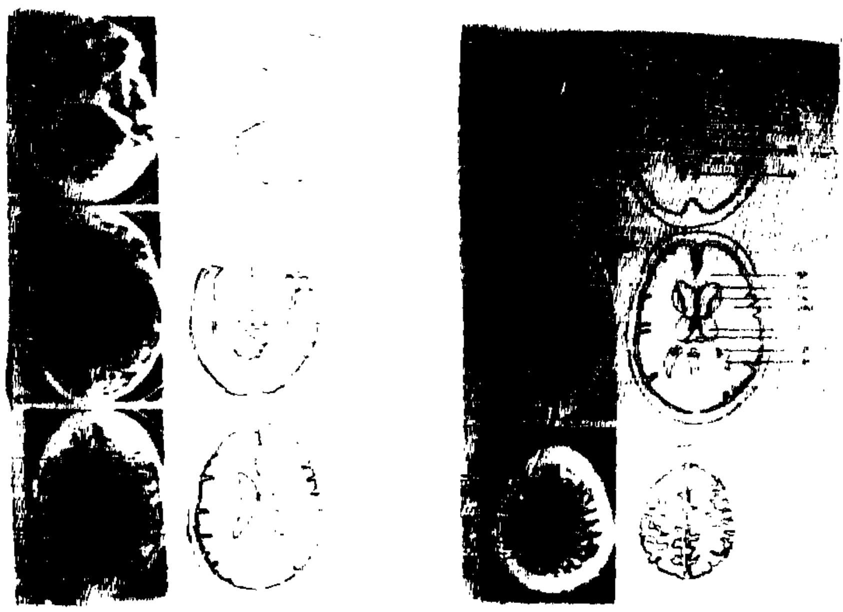

Fig. [illegible]

[illegible] enhanced scan [illegible] which [illegible] plain [illegible] cortical [illegible] black [illegible] of [illegible] is, from [illegible]

NORMAL SCAN

COMPUTED TOMOGRAPHY ANATOMY

The standard position for the head scanning makes a 10 degrees angle with the anthropomorphologic line. This line connects the superior aspect of the external auditory canal to the inferior lateral margin of the orbit. Its angle is approximately 10 degrees caused to the orbito-meatal or O-M line. This position allows for the examination of the posterior fossa, New et al (1974). Therefore, the chin must be depressed sufficiently to allow this new line to be parallel to the CAT X-ray beam. This position allows for examination of the superior aspect of the posterior fossa. For brain study the patient should be examined from skull base to vertex (Fig.2 a,b).

The scan of the mid-facial view (was obtained with the anthropomorphologic line parallel to the CAT x-ray beam is particularly appropriate in the study of the middle and posterior inferior portion of the base of skull. Fig. 3 . The foramen magnum is shown in its entirety. The medulla and cerebellar tonsils can be demonstrated by adjusting the window level and the width of the scanner display. One of the advantages of this view is the projection of jagular fossa. The upper focal level allows optimum visualization of foramen magnum without superimposition of the entire base of the skull. Just lateral to the midline and anterior to the occipital [illegible] lateral fossae of the inferior petrosal sinus, pevsner (1978). (Fig.4).

On routine brain scan (with the O + 10 degree line parallel to the CAT X-ray beam) demonstrates the mid portion of the posterior fossa. The fourth ventricle will appear approximately halfway between the dorsum sellae and the internal occipital protuberance. The cerebello-pontine angle and pre-pontine cistern should be symmetrical (Fig.5). Mass lesions involving the fourth ventricle intrinsically or the vermis or the pons itself produce a decreased pre-potine cisternal space as a result of mass effect. According to Pevsner (1978) shifft of the pons to the controlateral side is an indication to an extra-axial mass in the cere-bello-pontine angle (CPA). Segall et al (1982) found that the sagittal dimension of the pons is less than that of structures behind the fourth ventricle in normal children. They stated that any altration of this ratio on axial scan cannot be accepted as normal.

When an adequate study of the posterior fossa in a child has been performed, Segall and his Co-workers (1982), stated that the fourth ventricle should always be seen. Furthermore, at least one slice, a rounded configuration of the fourth ventricle (convex anteriorly) may be appreciated (Fig. 6). Thus, as stated by pevsner (1978) cerebellar and CPA lesions generally cause partial collapse of the fourth ventricle which often shows a banana deformity, with the convexity facing the side opposite the lesion (Fig. 7). The brain stem with the lower portion of the crural and ambient cisterns surrounding it are visualized with sella turcica (with the - 5 degrees line parallel to the CAT X-ray beam).

The basilar artery can be appreciated within the pontine cistern at the level of the dorsum sellae (Fig. 8). Segall and his colleagues found that the ventral surface of the pons did not project anterior to the ventral surface of the basilar artery on axial CAT in 88 patients in whom contrast CAT was performed. In most cases the basilar artery was in contact with pons while projecting in front of it. In two instances, the basilar artery appeared to be free within the pontine cistern, Segall et al., (1982).

According to Zee, Segall and others (1978), it was possible to identify the medulla oblongata by identifying surrounding fluid in the perimedullary cisterns in 60 percent cent of cases, and the vallecula was less often seen. High-resolution scanners should improve identification of these normal anatomic structures, quoted in Segall et al., (1982).

In instances of cerebellar mass lesions, upward herniation of cerebellum can occur which immediately produces narrowing of the quadrigeminal cistern and compression of the