MAGNETIC RESONANCE IMAGING VERSUS COMPUTED TOMOGRAPHY IN HEAD AND NECK LESIONS

ESSAY

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BY

MAGDY SHEDID SAYED

(M.B., B. Ch.) Diploma of E.N.T

SUPERVISED BY

Prof. Dr. MOHAMED NASSAR

Professor of Ear, Nose, and Throat

Ain Shams University

FACULTY OF MEDICINE

AIN SHAMS UNIVERSITY

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بسم الله الرحمن الرحيم

قالــــوا سبحانــــك لا علـــم لنا
إلا ما علمتنا إنك أنت العليم الحكيم

سورة البقرة آية ٣٢

بسم الله الرحمن الرحيم

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INTRODUCTION

INTRODUCTION

Magnetic Resonance Imaging is a new extremely promising imaging modality that combines the advantages of X-ray computed tomography by giving high resolution tomograms, of ultrasound by allowing imaging in any desired plane without the dangers from ionising radiation and of nuclear medicine by offering information about physiology and metabolic processes *(Margulis et al., 1983).*

When comparing computed tomography (CT) and magnetic resonance imaging (MRI) as imaging modalities in the head and neck region, certain considerations must be kept in mind. First of all, the two technologies are at very different stages in their development, therefore in discussing situations where MR scanning is now considered to be inferior to C.T. one must add the caveat that the limitation is only for the present and may not be true as MR technology rapidly changes over the next months. The second consideration is the point of certain proponents of MR. These groups maintain that the real strength of MR does not be in producing images that compare favourably with spatial and contrast resolution of CT scanning images but rather rests in the full utilization of the capability of MR to obtain biochemical and physiological data. This may involve the use of coils tuned to atoms other than to protons such as phosphorus and sodium *(Barbara, 1985).*

Information about the location of the lesion, presence or absence of palpable adenopathy, and even the histology of the lesion is frequently available to the radiologist before the CT or MR examination. With this knowledge, the radiologist can decide on either CT or MR and perform a high-quality examination with special attention to the area in question *(Hudgins and Gussuck 1992).*

MR is superior to CT for imaging many malignant lesions in the head and neck because of its superior soft-tissue contrast. Lesion conspicuity, interface between tumor and normal tissue, and local extension are best seen on MR, especially when the tumor is located in the oropharynx, nasopharynx, skull base or neck. *(Schaefer and Purty 1989).* Malignant tumors are generally isointense or hyperintense relative to muscle and hypointense relative to fat on T_1-weighted images and slightly hyperintense relative to both muscle and fat on T_2- weighted images. Some degree of enhancement is seen in most malignant tumors in head and neck regions, resulting in increased conspicuity of tumor boundaries at muscle interfaces, but enhancement may obscure tumor borders at tumor fat interfaces unless fat-suppress on sequences are used. Peripheral enhancement with lack of central enhancement suggests necrosis either in the primary tumor or metastatic nodes. This is important preoperative information, as the surgeon will use particular care in excising these lesions to avoid puncture of the tumor and potential spillage and seeding of the surgical bed *(Crawford et al., 1989).*

The MRI technique may be applied in any plane, and images are routinely produced from axial, coronal and sagittal planes. An advantage of MRI over CT in the imaging of sagittal and coronal planes is that images are constructed from data acquired in the chosen image plane and not reconstructed from data acquired in another plane *(Sandler et al., 1990).*

PRINCIPLES OF MRI

HISTORY OF MRI

Magnetic Resonance (MR) is a phenomenon that was discovered independently by Purcell and Bloch in 1946. They received the Nobel prize for physics in 1952 for the discovery and subsequent development of spectroscopic methods based on this phenomenon. Since that time. MR instrumentation has become increasingly more sophisticated and has proved to be a valuable investigational tool in physical chemistry and biochemistry *(Bydder et al., 1986).*

After the discovery of differences in the proton NMR (nuclear magnetic resonance) parameters (relaxation times) of normal and malignant tissues by *Damadion (1971),* imaging techniques to depict the magnetic behaviour of protons were developed by *(Lauterbur, 1973 and Ernst, 1975)* among others, disclosing the field of MRI, since then image quality has improved steadily *(Koops, 1985).*

Theory of the machine :

The theory of NMR (nuclear magnetic resonance) is based on the magnetic properties of certain atomic nuclei. The nucleus which is used for MRI is the hydrogen atom, and because the nucleus of the hydrogen atom contains only a single proton the technique of NMR may sometimes be referred to as proton NMR *(Kean and Smith 1986).* The nucleus of an atom is composed of neutrons, and protons the proton has one unit of positive charge (equal to the unit of negative charge on the electron) while the neutron has none. The collection of protons and neutrons is collectively nucleons*(Curry et al., 1984).*

The technique of NMR cannot be applied to all nuclei. Only nuclei which are (a) rotating and therefore possessing the property known as spin and (b) possess either an odd number of protons or neutrons, can be made to resonate. Such nuclei have an intrinsic magnetism, or magnetic moment, that makes each nucleus a magnetic dipole-in effect, a bar magnet *(Kean and Smith 1986).*

Magnetic Dipole Moment (MDM) :

In nuclei in which an unpaired proton or neutron exist, a net spin is produced and, because there is an associated net electrical charge, a magnetic field is generated that can act as if it were a bar magnet. A result of this phenomenon is that the nucleus will act like a small magnet, and it can interact with magnetic fields e.g. Hydroge (^{1}H), phosphorus (^{21}p), sodium (^{23}Na) and calcium (^{43}Ca).

Magnetic dipole moment is that property or characteristic of a magnet that indicates how quickly the magnet will align itself along a magnetic field. The MDM of nuclei depend on the number and arrangement of the protons and neutrons. The MDM have been measured. We can note that if the nucleus has no spin it will have no MDM. Nuclei with no MDM will not be detectable by NMR *(Curry et al., 1984).*

It should be noted that before placement a sample within the main magnetic field there is no net magnetization with a