method, up to 40 m*l* of Renografin-76 were injected into the superior vena cava at 20 m*l* per second. The entire first transit of the contrast material through the right heart, lungs, and left heart was recorded on low-noise video tape using fluoroscopic exposure factors (70 KVP, 6 MA). Selected cardiac cycles were digitized at 30 frames per second using an R-wave trigger. Agreement between the area-length determinations of left ventricular end-diastolic and end-systolic volumes by digital intravenous ventriculography and conventional contrast ventriculography was excellent ($\gamma=0.87$, 0.89 respectively).

Evaluation of regional wall motion was facilitated by special computer programs such as "mask mode", "time-interval-difference" and stroke volume imaging, phase and amplitude analysis and percent and rate of radial dimension shortening. Many of the computer methods used to assess regional function were adapted from programs originally developed for radionuclide ventriculography. Conversely, new computer programs developed for digital ventriculography are applicable to radionuclide angiography.

There are many similarities between digital intravenous ventriculography and first-pass and gated radionuclide ventriculography. These will be illustrated and compared. The question whether digital intravenous contrast ventriculography may someday replace radionuclide angiography as the preferred minimally invasive procedure to evaluate cardiac function will be addressed. There are several advantages of the digital fluroscopic approach including: (1) lower radiation exposure, (2) the potential for contamination from spilled radioactive material is avoided, and (3) cardiology personnel are generally more familiar with x-ray equipment than with nuclear imaging equipment. The implications of this new procedure to the specialty of Nuclear Medicine will be discussed.

《招待講演 X》

NMR Proton Imaging: A Status Report

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Nuclear magnetic resonance (NMR) imaging technology has now been advanced to a level where reasonably good anatomical images of the body can be obtained in scan times of the order of a few minutes. The method appears to hold great promise for medical diagnosis but clinical efficacy still has to be proved. A number of proton imaging machines are currently being used clinically throughout the world to collect the necessary data.

The University of Pennsylvania and the General Electric Company are collaborating on the evaluation of an experimental NMR proton imaging machine which is located in the Department of Radiology at the Hospital of the University of Pennsylvania. The imaging machine uses a resistive magnet operating at 0.12 Tesla which is equivalent to a proton resonant frequency of 5.1 MHz.

The major advantage of NMR over presently available diagnostic imaging methods is that it may have the capacity to characterize tissues more accurately. This is possible because the NMR signal reflects three properties of the protons in the tissue that is being imaged; the proton density, the spin-lattice relaxation time (T1) and the spin-spin relaxation time (T2). The proton density is in many ways analogous to the electron density that is for the most part responsible for x-ray images. The relaxation times, however, are unique properties measurable by NMR that depend on the biophysical state of the water in the tissues. It is the information about the state of tissue water that may make more accurate tissue characterization possible. For example, tumor can be separated from normal tissue or inflammation from edema. The extent to which tissues can be characterized from data about the distribution of these parameters in tissue is still to be determined and is one of the major goals of the collaborative research.

Another goal is the measurement of regional blood flow. Since proton relaxation times are long compared to the rate of blood movement in tissue, the NMR signal is either attenuated or augmented by the moving blood. Although the effect is very complicated it may be possible to extract movement data from the signals that can then be used to construct blood flow images.

The research program at the University of Pennsylvania includes studies of brain tumors, inflammation and edema. It also includes studies of cardiac, lung and kidney imaging and studies of blood flow measurement.

This presentation will review briefly the work that is going on with emphasis on the clinical evaluations that are in progress.