A Computer Service for Analyzing Clinical Scintigraphic Data

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Using the scintillation camera and computer assembly described here, clinical and research scintigraphic data can be processed by a computer and a videotape transfer system. This assembly can provide a full computer capability to hospital clinics which are not equipped with a computer but still require convenient and rapid data analysis. Tomographic and anatomic marker data can also be accessed to the computer.

The advantages of a computer for the analysis of scintigraphic data have been amply demonstrated by data-quantitation studies, dynamic-function studies, and other general data manipulations that have appeared in the literature *(1,2)*. However, the expense of small dedicated computers prohibits most hospital clinics from having their own. Other less expensive means of analyzing scintigraphic data, such as multichannel analyzers and solitary real-time videotape systems, are usually too slow or too cumbersome for the already time-limited clinician.

As part of the developing program in nuclear medicine at the Armed Forces Radiobiology Research Institute (AFRRI), a system has been assembled whereby scintigraphic data that are recorded at local hospitals may be entered into a small computer that is dedicated to clinical and research studies in nuclear medicine. The clinical data are recorded onto videotape, which is then brought to the AFRRI and replayed on a Searle videotape unit, which is coupled to a Nuclear Data Med-II computer system through a Searle Pho/Gamma HP scintillation camera. The data are transferred to the computer in real time, as originally recorded onto the videotape. However, once the data are stored by the computer, analysis may be done conveniently and rapidly in computer time. This report describes the components of a scintillation camera and computer and how the integrated assembly of these two systems is made available and used for the analysis of research and scintigraphic data.

Instrumentation

The components and assembly of the complete computer and scintillation camera systems are shown in Fig. 1. At the heart of the computer system is a central processor with a capacity for 16K, 12-bit words. The core memory is divided into two 8K segments, one segment for data storage and the other for software storage. All the software is written in NUTRAN *(3)*, a computer language that is similar to FORTRAN but is not as powerful. The NUTRAN allows the user to communicate with the computer in a simple conversational language and also provides the ability to conveniently add new computer programs to the existing repertoire. Of the 8K of core memory devoted to data storage, only 4K may be visualized at a time on a cathode-ray tube (CRT) either as one 64 × 64 matrix or as four 32 × 32 matrices.

Peripheral devices include a disk pack with a capacity for 750,000 words of data, a magnetic tape unit for bulk data storage, a high-speed paper tape reader with a speed of 120 characters per second, and a standard teletype unit. Instructions are normally given to the computer through a CRT keyboard terminal which provides a display of the instructions as well as information that is requested by the computer for the execution of an operation.

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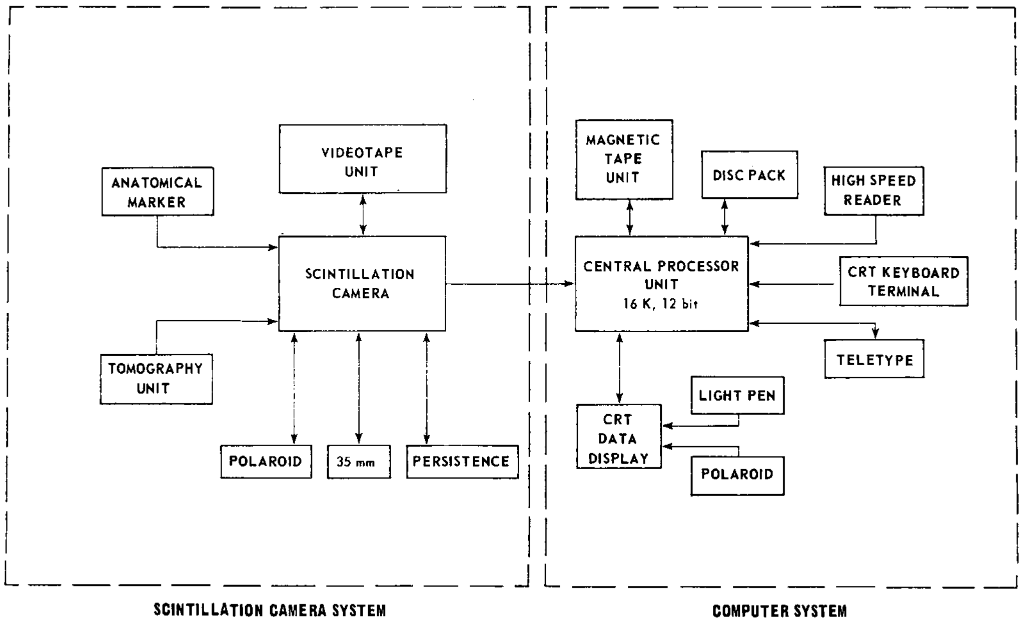

FIG. 1. Systems assembly of scintillation camera and computer.

Image data may be displayed in a variety of formats on a 5-in. oscilloscope from which it may be recorded photographically. A light pen is also available for rapidly defining regions of interest of any size and shape.

Scintigraphic data may be recorded by the videotape unit, by the computer, or by both at the option of the user. The videotape unit serves not only to replay clinical data for storage by the computer but also allows the computer to be processing data off-line while the videotape unit is storing data from the scintillation camera. Although the transcription of such videotape data will employ both the scintillation camera and the computer, it can be performed by a technologist during slack periods or after the normal working schedule. This arrangement provides a much more efficient use of the entire system in contrast to the situation in which the scintillation camera and computer are simultaneously engaged by one study during peak demand hours.

The camera is also equipped with a tomography unit, which allows simultaneous imaging of five planes of interest, each of which is effectively focused to a different depth within an organ. When such data are stored by the computer or by the videotape unit, planes at other depths may also be brought into focus from the original recorded data, thereby eliminating the need to repeat the experiment should additional information be needed. Finally, the anatomic marker, which is an attachment to the scintillation camera, allows position markers as reference points to be registered by the three oscilloscope outputs (Polaroid, 35-mm film, and persistence) of the camera as well as by the videotape unit and the computer.

Discussion

This totally integrated assembly consisting of the scintillation camera system and the computer system provides the capability for conducting state-of-the-art research and for supporting a plethora of clinical studies. Once the data have been stored in the computer, the necessary analysis can be quickly performed using simple and easy-to-learn two-letter mnemonic instructions. The simplicity of the total assembly is such that a technologist is able to operate the scintillation camera, transfer videotape data to the computer, and perform all the standard computer operations. However, should he desire, the physician may personally operate the computer and perform his own data analysis. This may be done conveniently and quickly since little preparation is required for one to become proficient with the computer and since data analysis is done in computer time in contrast to real time with the videotape unit.

In addition to basic clinical and research applications, this type of integrated operation is well suited for other purposes. For example, a compendium of interesting or unusual research and clinical data can be cataloged at a central computer location for use in training programs. This gives a capability for wider dissemination and use of pertinent educational information. Physicians having a need for computer processing of clinical laboratory data from nonambulatory patients can use this system to particular advantage. Such studies may be conveniently performed within the scheduled routine of the clinic by storing the data on videotape and subsequently sending it to the computer facility for transcription and analysis. Finally, the integrated system is a means of conveniently filing clinical case histories that can be recalled later in quantitative form and re-analyzed in any manner, in contrast to the hard copies of film data storage.

In conclusion, a method has been demonstrated by which hospital clinics can obtain computer services without incurring the present expense of purchasing and maintaining their own computer. Major advantages of this system include a computer that is dedicated on a full-time basis to nuclear medicine, easy and rapid data analysis, accessibility by the physician, and virtually no delay from instrumentation-scheduling conflicts. The concept of a central computer and independent clinical recording units is particularly well suited for areas in which an adequate number of clinics can share the purchase and operating costs of the computer system.

References

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