Invitation Lecture II

An Integrated Imaging Approach to the Diagnosis of Diseases Involving the Thyroid, Liver, Pancreas and Kidneys

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This presentation will discuss an integrated approach to the diagnosis of diseases involving the thyroid, liver, pancreas and kidneys. It will commence with a brief description of the physical principles underlying imaging by radionuclides, ultrasound, computerised X-ray tomography and nuclear magnetic resonance. The ability of these techniques to produce complementary information will be emphasised and illustrated by examples of various diseases in the different organs.

The paper will then discuss the limited number of definite features produced by each technique in different types of disease. The difficulty in making a firm differential diagnosis by a single modality will be emphasised and the value of using different modalities to achieve better differential diagnosis will be clarified.

The paper will conclude with a brief discussion on how diagnosis might be better made on the basis of priorities taking into account disease prevalence and the probability of finding a specific feature in a particular disease. The way in which this approach can be particularly well carried out using computerised reporting will become clear.

Invitation Lecture III

The Analysis of Myocardial Function Using Blood Pool Scans

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The paper deals with radionuclide ventriculography (RNV), its prerequisites, performance (data acquisition and processing), clinical indications and results.

Imaging of heart motion by gated blood pool scans (GBP) was developped in the USA (STRAUSS and ZARET, 1971). In contrast GBP in Europe started with a probe system and resulted in a time-activity curve of one heart cycle. (HOFFMANN and KLEINE, 1965). Application of a camera system and the region of interest technique (ADAM and BITTER, 1971) finally resulted in a matrix of pixel curves and parametric scans (Systolic, diastolic difference scans, con-

tract., relaxat., velocity scans, Fourier Amplitude (FA) and Fourier Phase (PH) scans). In this way imaging of heart motion was reached by a detour. FA- and PH-scans meanwhile have obtained greater acceptability.

Prerequisites of the pixel concept: "Correlation scans" have proven the reliability of the pixel curves (PC). Correlation $\gamma = 0.8$ is present in more than 80% of all LV pixels of the normal heart.

Data acquisition and processing: In frame mode exact correction of the PC is necessary. Exact outlining of the contour of ventricle and atria is perfomed by functional parameters (FA and PH). Akinetic LV regions are completed by gradient scans. Routine scans in the Ulm Department are: FA, PH, Syst. Diff., diastol. Diff., Reg. Eject. Fraction (REF).

Quantitative evaluation of the various parameters utilizes

1) Histograms (HG) of the parameters within the LV. In a normal group FA, Syst., Diastol. Diff. and REF show empirical distribution, PH reveals a strong Gaussian distribution with a SD of 2.5%. Deviation from the normal group of one parameter yields the "defect area".
2) The LV is divided into 9 sectors. The sector sum of all parameters is calculated and compared with a group of normals.

Normalization of the parametric scans is necessary for inter- and intraindividual comparison; e.g. PH are normalized to the global phase of the normal LV area.

Clinical indications and results:

1) **Incompetence of the heart valves and atrial shunts** results in differing stroke volumes. The ratio of count rate differences (LV: RV) in a normal group is 1.43 ± 0.27. Shunt size and regurgitation assessment is reliable (Correlation with invasive procedures $\gamma = 0.75$).
2) **Failures of myocardial pump function:** Global LV parameters in the normal group: EF 67.7 ± 8.1%; peak ejection rate (PER) 3.37 ± 0.64 EDV/sec; peak filling rate (PFR) 3.3 ± 0.9% EDV/sec.

   Detection and localization of regional wall motion abnormalities (RWMA): Quantit. FA and PH scans—accuracy 83%, (sensit. 85.2%, specific. 81.9%). Extension of the RWMA as compared with laevocardiography $\gamma = 0.803$ (FA-scans). Correlation of EF and number or regions with RWMA proves higher sensitivity of parametric scans: RWMA in one region is compatible with EF of 71%, and even RWMA in 2 regions are compatible with a still normal EF of 62%.
3) **Failures of the excitation and conduction system (ECS):** The PH scan allows mapping of ECS in both ventricles due to the electro-mechanical coupling. Results of various failures of the ECS are demonstrated.