European Journal of

Nuclear Medicine

Supplement
to Volume 21
Number 10 1994

Abstracts of the 6th World Congress of the World Federation of Nuclear Medicine & Biology

23–28 October 1994
Sydney, Australia

Evaluated and abstracted for Energy on STN

Springer International

289

THE ROUTINE USE OF SURFACE PERFUSION MAPPING FOR SEMIQUANTITATIVE AND QUANTITATIVE BRAIN SPECT EVALUATION. D.G. Pavel, C.J. Thompson, J. Sychra, A. Manasrah, and P. Briandet. University of Illinois Hospital, Chicago, IL. and SOPHA Medical Systems, Columbia, MD., USA

Routine interpretation of a brain SPECT can be difficult because : a) need of mental integration in order to describe a lesion according to topographic lobar surfaces; b) lack of standardization of displays, and/or of color scales; c) lack of distinguishable, meaningful color shades; d) lack of agreement concerning the normalization of quantitative data. Consequently evaluating subtle abnormalities, quantifying, as well as conveying meaningful pictorial information to referring MD can be difficult.

In order to solve such difficulties the 3 standard SPECT views were supplemented, on a combined color printout, with a Surface Relative Perfusion Value Map shown as nine 2-D projections of the 3-D surface generated from a spherically emanating search originating at an internal point. An edge detection on each profile determines radii which after smoothing are converted into cartesian x, y, z vertices characterized by location, radius and perfusion value. The surface normal for each vertex is calculated and activity profiles are resampled along it. The maximum activity (perfusion value) encountered along a specified distance is then associated with its respective vertex. The mapping of the normalized perfusion value onto the projected object surface represents a completely opaque display. A color code with 17 clearly distinguishable shades is used, above the threshold, and allows an easy visual semiquantitative evaluation of symmetrical, or asymmetrical areas with an accuracy of $\pm$ 3% . ROI's of any shape can be drawn and thus tailoring ROI's to the actual lesion is made possible, by following the contours of any presumed abnormal area on any one of the 9 surface views, and mirroring it on the opposite side.

For the physician this routine display represents a surface integration of the information contained in the cortical area of all available 3-D slices. The routine interpretation is significantly helped by the advantages offered on this combined display and by the quantification it enables.

290

QUANTITATION OF PERCENT CHANGE IN BRAIN PERFUSION DERIVED FROM REGISTERED HMPAO SCANS OF EPILEPSY PATIENTS. I. G. Zubal, S.S. Spencer, K. Imam, J. Seibyl, E.O. Smith, G. Wisniewski, P.B. Hoffer, Yale University, New Haven, CT.

A sequence of 3-D image registration, re-normalization, and difference calculations were applied to HMPAO human brain scans of epilepsy patients. Each ictal scan was registered to the same patient's interictal scan. A normalization of the 3D data was applied to account for global percent brain uptake. Functional difference images were computed which demonstrate areas of altered perfusion during ictus. Areas of elevated perfusion differences were identified as suspected areas of seizure foci. Percent-change images were calculated, (which give a quantitative measure of perfusion alterations during ictus) by computing the normalized change within SPECT transverse slices on a pixel by pixel basis. The resulting difference images were also registered with each patient's MRI scan which permits a localization of perfusion changes onto anatomical structures. Areas in the brain, where strong perfusion differences occur, correlate with areas suspected to be seizure foci. A subgroup of patients monitored with implanted depth electrodes support this correlation. When compared to side by side visual interpretation of the ictal and interictal SPECT images, registration of SPECT and MRI images together with calculated difference maps greatly enhances the ability to localize epileptic seizure foci. From the group of 20 epilepsy patients studied, single foci hyperperfusion during ictus consistent with EEG were corroborated in extratemporal patients using this method. This offers the potential to locate epileptic seizure foci using a non-invasive and inexpensive imaging procedure and data processing algorithm.

291

A COMPARISON OF FOUR METHODS OF ASSESSING ABNORMALITIES IN HMPAO rCBF SPECT IMAGES. A S Houston, P M Kemp and M A Macleod. Royal Naval Hospital Haslar, Gosport, Hants, U.K.

This paper describes four methods of defining 'normality' in HMPAO rCBF SPECT images and investigates their potential for differentiating between images of abnormal patients and normal controls.

Images of 50 normal control subjects were first registered with respect to a reference image and normalised with respect to the region of the cerebellum. Normality was defined by these images using (a) a univariate approach to a region-of-interest analysis;(b) a univariate approach to a voxel-by-voxel analysis; (c) a multivariate approach to a region-of-interest analysis; and (d) a multivariate approach to a voxel-by-voxel analysis. Region-of-interest analysis involved the left and right frontal, parietal and temporal regions. The multivariate approach involved using principal components analysis to extract correlated normal variants which could be used to determine a 'nearest normal' estimate for subsequent studies.

Images of a further 40 normal control studies were then used to evaluate the methods, together with images of 100 patients referred for confirmation of Alzheimer's disease and 100 patients referred for confirmation of multi-infarct dementia. These images were registered and normalised and abnormalities identified using standard criteria for significance.

The results indicated that a multivariate approach to a voxel-by-voxel analysis provides the best differentiation between normal and abnormal classes.

292

VALUE OF A VERTEX VIEW FOR BRAIN SPECT. W.L. Rogers, N.H. Clinthorne, J.A. Fessler, Y. Zhang, L. Hua, C. Ng, M. Usman, A.O. Hero. Division of Nuclear Medicine, Bioengineering Program and EECS Department, University of Michigan, Ann Arbor, Michigan, USA.

Availability of new agents for brain imaging has increased the need for improved resolution and sensitivity for SPECT brain imaging. It is relatively simple to simultaneously acquire a stationary vertex view data set during a conventional SPECT study. Not only can one increase the count rate by at least 25%, but the collimator may be placed in contact with the head, and the vertex data is essentially orthogonal to the SPECT data. This suggests that the vertex data might carry more information per detected photon. These gains will be offset by background originating outside the brain and viewed by the vertex detector but not the SPECT system.

The effect of adding vertex data was studied by evaluating the unified lower bound on estimates of single pixel activity for a cylindrical phantom as a function of depth and background level. The uniform bound, which is a plot of the minimum achievable variance as a function of bias, showed the vertex view reduced the standard deviation approximately a factor of 4 over a wide range of bias in the top plane. There was weak dependence on total number of planes and magnitude of a known mean background. Images showed a much finer grained noise structure for the top plane. Improvement degraded as a function of distance, and only marginal improvement was observed for the bottom plane. Whether the diminished gain as a function of slice distance from the vertex detector is more strongly dependent on attenuation increase or resolution decrease is yet to be determined.

Addition of a vertex view to a SPECT data set shows dramatic variance reduction for a given bias for a plane close to the vertex detector. This should lead to improved cortical imaging, but only moderate improvement for deep structures.