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Quantitative study of ischemic cerebral damage from ^{99m}Tc -hexamethylpropylenaminoxyme (^{99m}Tc -HMPAO) SPECT.

Use of Technetium - labelled radiopharmaceuticals, primarily of ^{99m}Tc -hexamethylpropyleneamineoxym (HMPAO) for qualitative diagnosis of cerebrovascular disease is nowadays routinely employed.

We have here designed a method for quantitative in vivo calculation of volume of cerebral ischemic damage, that is based on ^{99m}Tc -HMPAO single photon emission computer tomography (SPECT) data. 64 patients with chronic cerebrovascular disease were studied. 740 MBq of ^{99m}Tc -HMPAO (from Diamed Ltd, Moscow) were injected at rest. Axial 16 mm thick slices were reconstructed immediately from 64-128 planar projections acquired over 360° in 64×64 matrix. Quantitative ^{99m}Tc -HMPAO distribution maps were calculated for every slice. Normal uptake was derived before from SPECT performed in 16 neurologically healthy subjects. Also ^{99m}Tc -HMPAO cerebral extraction fraction was calculated from dynamic studies which was in ranges 0.82 - 0.93 and did not differ between ischemic and normal regions. Values below $\{(\text{regional normative of uptake}) - 2 \cdot \text{SD} \}$ had been postulated as border value for recognition of cerebral ischemia. The volume of cerebral ischemic damage (VCI, cm^3) was calculated as integral:
$$\text{VCI} = V_{\text{vox}} \cdot \int (N_r - U_r) dV$$
 where N_r - regional normative of ^{99m}Tc -HMPAO accumulation, U_r - actual uptake of ^{99m}Tc -HMPAO, V_{vox} - volume of voxel. VCI values were calculated for anterior, middle and posterior cerebral arteries vascular regions as well as for both hemispheres and for the brain as a whole.

The mean value of whole brain VCI was in patients who underwent repeat multiple transient ischemic attacks as much as $80 \pm 16 \text{ cm}^3$, in patients after cerebral stroke with moderate functional deficit as much as $213 \pm 38 \text{ cm}^3$, and in patients with severe post-stroke neurologic functional deficit $339 \pm 42 \text{ cm}^3$.

In patients treated by carotid endarterectomy (CE) the local and global VCI values decreased as a result of surgery by 12-25 %. Nevertheless, the effective functional restoration of neurologic state by CE was possible only in patients, whose whole brain VCI value was before CE lower than 100 cm^3 .

Thus we conclude, that ^{99m}Tc -HMPAO provides quantification of volume of cerebral ischemic damage in various forms of cerebrovascular disease.