

**Nuclear Medicine and Acupuncture:
A Study on the Migration of Radioactive Tracers after Injection at Acupoints**
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Objective: This paper reports on the authors investigation of the pathways of acupuncture meridians in the human body through the injection of radioactive tracers (isotopes) at acupuncture points.

Design: The radioactive tracer used was the most common radioactive tracer, technetium-99m (^{99m}Tc), as sodium pertechnetate. The experiment was conducted with a gamma camera, a Siemens SAM (small-area mobile) digital scintillation camera. Image analysis was conducted by a computer system built into the camera. Morphological studies and quantitative dynamic studies were conducted.

The morphological studies consisted of analytical and differential studies. For the analytical studies, the radioactive tracer is injected at a control point located outside any acupoint. Then, another injection is given at an acupoint.

The differential analysis was conducted in order to establish the specific and unique characteristics of the pathways observed in the analytical studies and thus eliminate a vascular or lymphatic explanation. To investigate the vascular pathways, two radiotracers of different energies and therefore discernible by spectrometry were utilised: Technetium-99m was injected as an acupoint and Thallium (^{201}Tl) was injected in a small vein situated next to that acupoint. To study the possible relationship between the lymphatic pathways and those demonstrated by the radiotracer, the same dose (20 MBq) and volume (0.05ml) of pertechnetate was simultaneously injected at an acupoint and the first interdigital space of the foot. A quantitative study of the previous data was conducted after selecting two mirror regions of identical shape and size on the leg along the Liver meridian (an acupuncture meridian) and similar "background noise regions" outside the pathways.

Sequential study and stimulation studies were conducted as part of quantitative dynamic studies. The goal of the sequential study was to evaluate the speed of radiotracer migration along preferential pathways. In healthy control subjects and patients with unilateral renal pathology, two sodium pertechnetate injections of identical volume and activity were given simultaneously at the left and right acupoints K-7. In the stimulation study, mechanical, electrical, and thermal stimulation were performed on certain acupoints after the injection of radiotracers to study the migration of the radiotracers.

Laboratory experiments conducted in collaboration with the Cytology Laboratory of the Military Hospital of Percy in Paris tested modifications of granulocyte membrane potentials during stimulation of an acupoint using either a needle or a laser beam. The cell membrane potential was measured with a fluorometric method on blood sampled one minute after the end of injections or stimulation's, and compared with control blood from the same subject.

Setting: The work was conducted on patients from the Department of Urology and from the Acupuncture Department of Biophysics and Nuclear Medicine from the Necker Hospital in Paris. Each experiment was repeated several times.

Patients and Other Participants: The work was conducted on over 250 healthy control subjects and on 80 patients with renal pathology.

Main Outcome Measures: The authors expected to find that the preferential pathways taken by the radiotracers coincide with the acupuncture meridians as described in Chinese traditional medicine and that these pathways are distinguishable from either lymphatic or vascular routes.

Results: Morphological studies found those tracer migrations from acupoints in both healthy and sick patients followed the same identical pathways with those described as "meridians" in Chinese traditional medicine. The results suggest that these pathways are different from vascular and lymphatic pathways.

The quantitative dynamic studies found that in injections at bilateral K-7, there was a faster diffusion on the healthy side, and slower diffusion on the diseased side. In inflammatory organ disease, there was increased migration speed of the radiotracer in the meridian of the related organ. A reduced tracer migration speed is indicative of a degenerative disease, such as cancer. Such findings could be used as the basis of a therapeutic evaluation or diagnosis.

The laboratory experiments with cell membranes suggests that acupoint stimulation could be used to provoke constant and reproducible change in cellular physiology.

Conclusion: The migration speed and patterns of a radioactive tracer along pathways which coincide with the Chinese acupuncture meridians show that these routes have neither a vascular nor a lymphatic origin. These pathways are very likely related to the connective tissue diffusion following the neurovascular bundles along the extremities. Findings suggest the hypothesis of the intervention of a neurochemical mechanism in information transmission.