

- Furuhata, H., Kanno, R., Kodaira, K., Aoyagi, T., Hayashi, J., Matsumoto, H. and Yoshimura, S. (1978). An ultrasonic blood flow measuring system to detect the absolute volume flow. *Jpn. J. Med. Electron. Biol. Eng.* 16 (Suppl.):334.
- Keller, H.M., Meier, W.E., Anliker, M. and Kumpe, D.A. (1978). Noninvasive measurement of velocity profiles and blood flow in the common carotid artery by pulsed ultrasound. *Stroke* 7:370-377.
- Ho, K., Roessmann, U., Straumfjord, V. and Monroe, G. (1980). Analysis of brain weight. I. Adult brain weight in relation to sex, race and age. *Arch. Pathol. Lab. Med.* 104: 635-639.
- Melamed, E., Lavy, S., Bentin, S., Cooper, G. and Rinot, Y. (1980). Reduction of regional cerebral blood flow during normal aging in man. *Stroke* 11:31-35.
- Muller, H.R. (1981). Evaluation of cranial blood flow by means of ultrasonic Doppler techniques. In *Cerebrovascular Diseases: New Trends in Surgical and Medical Aspects*. (Edited by H. Barnett, P. Paoletti, E. Flamm and G. Brambilla). Elsevier North Holland, Amsterdam. 77-90.
- Narotimi, H., Meyer, J.S., Sakai, F., Yamaguchi, F. and Shaw, T. (1979). Effects of advancing age on regional cerebral blood flow. Studies in normal subjects and subjects with risk factors for atherothrombotic stroke. *Arch. Neurol.* 36:410-416.
- Payen, D.M., Levy, B.I., Menegalli, D.J., Layat, Y.I., Levenson, J.A. and Nicolas, F.M. (1982). Evaluation of human hemispheric blood flow based on non-invasive carotid blood flow measurement using the range-gated Doppler technique. *Stroke* 13:392-398.
- Simon, A., Levenson, J., Safar, M., Diebold, B. and Peronneau, P. (1982). Non-invasive pulsed Doppler measurement of blood flow: Investigation of internal carotid stenosis. *Abstr. 3rd Meeting WFUMB. Ultrasound Med. Biol.* 8 (Suppl. 1):180.
- Wood, C.P.L., Smith, B. and McKinney, W.M. (1981). Evaluation of a computerized pulsed Doppler instrument for quantifying blood flow: Initial experimental results. *Abstr. 4th Eur. Congr. Ultrasonics in Med.* (Edited by V. Latin). Excerpta Medica, Amsterdam. 120-121.
- Uematsu, S. (1981). Determination of volume of arterial blood flow by an ultrasonic device. *J. Clin. Ultrasound* 9:209-216.
- Uematsu, S. and Yang, A. (1981). Transcutaneous measurement of carotid artery volume flow by an ultrasonic device. In *IEEE 1981. Frontiers of Engineering in Health Care*. Proc. 3rd Ann. Conf. Eng. Med. and Biol. Society of IEEE (Edited by B.A. Cohen). 154-158.

A Brief Provocative Statement On Ultrasound Bioeffects.

Sir:

The following arguments have been expressed orally during many informal technical occasions to willing listeners, but they have not as yet, appeared in written form. Such is the purpose of this note.

It may be argued that any biological effects of ultrasound that could result from clinical diagnostic exposures, can be divided into two categories, viz., short-term effects and long-term effects (it will be seen below that precise definition of these terms is not essential to the discussion). It is taken as axiomatic in the following that the clinical diagnostic exposures referred to herein were carried out under acknowledged appropriate procedures, that the instrument operators were suitably skilled, and that the instruments used functioned according to manufacturers' specifications.

Clear and unambiguous reports of deleterious effects following clinical diagnostic ultrasound exposures have not appeared (it is in the nature of such a state of affairs that a literature does not exist enabling reference support). Thus, it may be stated that "there are no short-term effects of diagnostic ultrasound in humans since none have been reported". The statement is not made cavalierly, but following more than 20 years of rather intense medical employment, for an extremely broad range of observations involving virtually all anatomic structures, and including nearly all branches of the medical profession. It must be presumed, if short-term effects occurred, that irrespective of frequency of occurrence, of patient sensitivity, of seriousness, etc., most certainly reports of such observations would have appeared in the appropriate medical literature. As they have not, the statement that no such effects occur in humans can be accepted as a guideline for further clinical usage of this form of instrumentation, within the framework of current accepted procedures.

As regards long-term effects as may occur well after a diagnostic procedure as, for example post adolescent progeny events, it is obvious that a complete program of exposure reportings, follow-up campaigns, etc., must be organized and carried out with diligence, with attention to all details, for a very long period of time if such findings are to be made. As such complete and comprehensive programs have not been undertaken, it can be stated that "any long-term effects of diagnostic ultrasound will not be observed".

Perhaps these remarks will stimulate directed inquiry and activity such that more profound statements may be made in the future.

Abstract:

It is argued that, with regard to appropriately employed clinical diagnostic ultrasound, (1) there are no short-term effects and (2) any long-term effects that may occur will not be observed as they are not being sought by appropriately designed programs.

I am, etc.

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