PET Images of Blood Flow Changes During Anxiety: Correction

Positron emission tomographic imaging of regional cerebral blood flow changes during panic and anticipatory anxiety has permitted the investigation of the functional brain anatomy of anxiety (*1*, *2*). The largest blood flow change found in these studies occurred bilaterally in the vicinity of the pole of the temporal lobe. This was thought to represent emotionally induced neurophysiologic activity in the temporopolar cortex.

Recently, Benkelfat *et al.* (*3*) used positron emission tomography (PET) to measure blood flow changes during a cholecystokinin-induced panic attack. Their findings were similar to those reported in (*1*); however, magnetic resonance (MR) imaging showed these changes to be extracranial. We subsequently compared PET images (Fig. 1) made during a teeth-clenching task with images of the same subjects resting with their eyes closed as the control task to detect and localize blood flow changes associated with temporalis and masseter muscle contraction. We found increases in blood flow of 25 and 23% in the vicinity of the left and right temporal poles, respectively, during teeth clenching (*4*). We compared these PET images with MR images and found that these changes do in fact represent contraction of these extracranial muscles during anxiety. The similar location of these changes to those observed in previous anxiety studies (*1*, *2*) suggests that data in these studies also represent contraction of these muscles during anxiety.

To distinguish changes in muscle blood flow from potential flow changes in the paralimbic temporopolar cortex, we suggest that investigators record EMG activity from the temporalis muscle to detect contraction during anxiety induction, have subjects keep their mouth open during the 40-second scan to prevent teeth clenching, and incorporate a teeth-clenching task into the scanning sequence of anxiety paradigms. Until these issues have been addressed, the blood flow increase previously reported in the temporopolar cortex during anxiety (*2*) must be attributed to muscle blood flow.

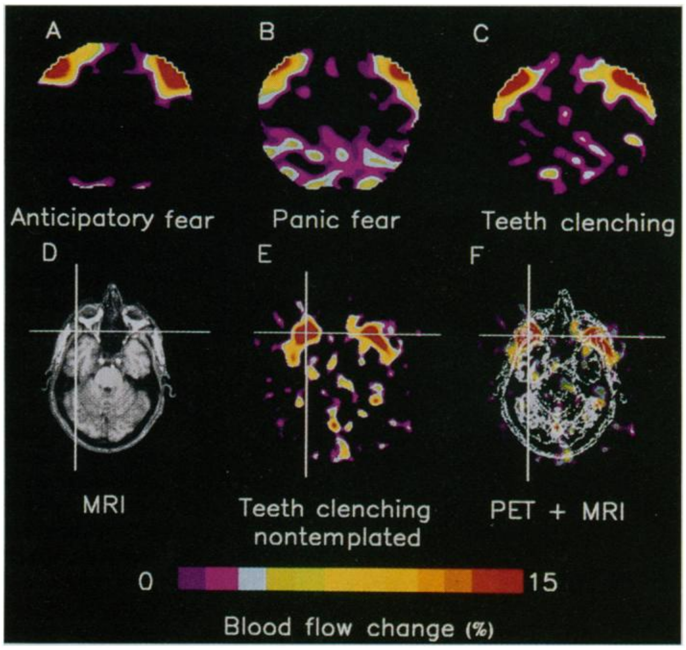

Fig. 1. PET and MR images of blood flow changes, created by subtracting PET scans made during the control task (resting condition) from scans made during (**A**) the anticipation of a painful electric shock, (**B**) a lactate-induced panic attack, and (**C**) a teeth-clenching task. Mean changes in regional blood flow are shown as related to (A) anticipatory fear, (B) panic fear, and (C) temporalis muscle contraction. These images represent the summed image data from all subjects participating in each study. Areas where blood flow increased during the experimental task are shown for the horizontal image plane 24 mm ventral to the bicommissural line. In (A) to (C), image voxels outside the mean brain boundary (based on 40% of whole brain maximum PET counts) were excluded, as in the original image analyses of the two anxiety paradigms (*1*, *2*). (**D**) MR image of a subject from the teeth-clenching study from approximately the same image plane shown in (A) to (C). (**E**) Regions of increased blood flow associated with teeth clenching in the same subject, as in (D). In contrast to the images displayed in (A) to (C), this image was not templated to exclude voxels outside the mean brain boundary so that the anterior and lateral extent of this flow change could be shown. (**F**) Blood flow difference image from (E) superimposed on a binary MR image created from (D), which shows the increase during teeth clenching located in the extracranial musculature.

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2. E. M. Reiman, M. J. Fusselman, P. T. Fox, M. E. Raichle, *Science* **243**, 1071 (1989).
3. C. Benkelfat *et al.*, *Am. Coll. Neuropsychopharmacol. Abstr.* (1991), p. 150.
4. The primary motor cortex was not sampled, as the axial field-of-view of PETT VI is only 10 cm, and we chose to evaluate more ventral regions where blood flow changes were found in earlier studies of anxiety.
5. We thank A. Snyder, F. Miezin, W. Perman, and the staff of the Division of Radiation Sciences, Washington University School of Medicine, for technical assistance. Supported by NIH grants HL 13851 and NS 06833 and by the MacArthur Foundation.

24 February 1992; 20 March 1992