Serotonergic modulation of the anterior cingluate and STS during emotion processing

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Introduction

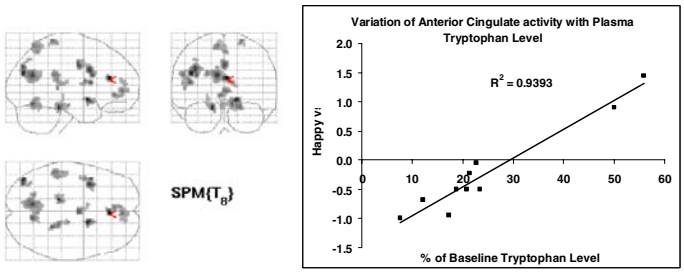
Effective processing of emotional signals is essential for human survival. However, the identification of facial emotion may be impaired in a number of psychopathological conditions associated with disruption to serotonergic function.

Methods

Ten young males, aged 18-35 years, with normal IQ participated in an fMRI study that required them to observe and identify whether an emotion (fear or happiness) was present in static images of faces viewed either from the front or the side. In each condition faces were neutral, 50% or 100% expressive of the emotion. They performed the experiment on two occasions following double-blind administration of a tryptophan depletion protocol (TDP) where tryptophan was absent or present. Tryptophan depletion significantly lowered total plasma tryptophan concentration by 76%. Functional MR imaging was performed using a 1.5 T scanner (NVi, General Electric Medical Systems, Milwaukee, WI) 4 hours following administration of the TDP. High-resolution images were collected using a T1 weighted sequence with the following parameters: field of view, 24cm; 20/6, (TR/TE); flip angle, 35°; slices, 124; slice thickness, 1.6mm; and matrix, 256x256. Functional MR images were acquired in axial planes with a T2*-weighted single shot, gradient-echo, echo-planar pulse sequence with the following parameters: field of view, 24cm; 3000/33, (TR/TE); flip angle, 90°, slices, 24; slice thickness, 5mm; and matrix, 128x128. BOLD responses were analysed using Statistical Parametric Mapping 2 (1).

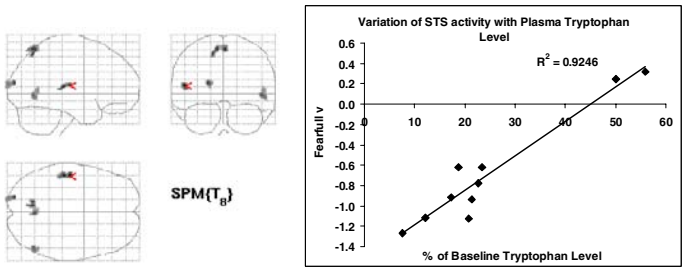
Results

Group wise comparisons showed tryptophan depletion to be associated with reduced activity in areas of anterior cingulate and insula that have been associated with empathic processing in previous studies (2). Furthermore, regression analyses found that an individual's relative change in serum tryptophan was a strong predictor of differences for processing of happiness in anterior cingulate (Fig. 1), and fear in superior temporal sulcus and posterior temporal cortex (Fig. 2). These are areas that have also previously been associated with empathy (2) and mentalising (3).



(a) (b)

Figure 1: Whole brain analysis showing regions of positive correlation between activity while processing happy faces and plasma tryptophan level (a), and ROI analysis of anterior cingulate (b).



(a) (b)

Figure 2: Whole brain analysis showing regions of positive correlation between activity while processing fearful faces and plasma tryptophan level (a), and ROI analysis of superior temporal sulcus (b).

Discussion and conclusions

The anterior cingulate is the region where attentional and emotional functions are integrated and plays a major role in modulating emotional responses (4). During the reading of emotional expression, serotonergic manipulation reduces activity in brain structures that serve emotional processing activities. Empathic function is likely to be affected by serotonergic function, which may have implications for our understanding of autism, depression and other conditions where serotonergic function could be compromised.

References

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