Processing facial emotions in adults with velo-cardio-facial syndrome: functional magnetic resonance imaging

THERESE VAN AMELSVOORT, NICOLE SCHMITZ, EILEEN DALY, QUINTON DEELEY, HUGO CRITCHELEY, JAYNE HENRY, DENE ROBERTSON, MICHAEL OWEN, KIERAN C. MURPHY and DECLAN G. MURPHY

Summary We studied the functional neuroanatomy of social behaviour in velo-cardio-facial syndrome (VCFS) using a facial emotional processing task and functional magnetic resonance imaging in adults with this syndrome and controls matched for age and IQ. The VCFS group had less activation in the right insula and frontal brain regions and more activation in occipital regions. Genetically determined abnormalities in pathways including those involved in emotional processing may underlie deficits in social cognition in people with VCFS.

Declaration of interest None. The study was part funded by the Stanley Foundation and the Medical Research Council.

Velo-cardio-facial syndrome (VCFS) is associated with intellectual impairments and with IQ-independent deficits in visuo-perceptual function and social and abstract reasoning (Henry et al., 2002). These deficits may underlie the social impairments of VCFS (Swielen et al., 1997). Facial expressions are important social cues. As explicit processing of facial expressions, with instructions to attend to social cues. As explicit processing of facial expressions, with instructions to attend to and judge the gender of each face. During this task 100 T1-weighted whole-brain anatomical images, depicting blood oxygenation level-dependent contrast (14 non-continuous slices, thickness 7 mm (gap 0.7 mm), in-plane resolution 3.1 mm, echo time (TE) 40 ms, repetition time (TR) 3000 ms), and one T1-weighted whole-brain anatomical image (43 continuous slices, thickness 3 mm, in-plane resolution 1.5 mm, TE=73 ms, TR=1600 ms) were acquired using a 1.5T GE Signa System 7 (General Electric, Milwaukee, Wisconsin, USA). Data were analysed using Statistical Parametric Mapping 99 (http://www.fil.ion.ucl.ac.uk/spm). Functional images were movement corrected, normalised into standard space and smoothed with 12 mm FWHM (full width at half maximum) gaussian kernel prior to statistical comparisons. Condition-specific task effects were assessed by comparing the ‘on’ phases of each task with their respective ‘off’ condition. Changes in regional blood flow were determined by applying the general linear model. Between-group comparisons of brain activation patterns were performed using t statistics. The resulting statistical parametric (SPM) maps were transformed to SPM Z values.

RESULTS

Participants were task-compliant, and debriefed after scanning. Responses were made in the required time window, and there was no group difference in task performance. Between-group analysis revealed an anterior–posterior dichotomy in activation patterns during emotional processing (on→off). Compared with the control group, the VCFS group showed less activity in the right insula and frontal regions. In contrast, people with VCFS had more activity in bilateral occipital regions (Table 1).

DISCUSSION

To our knowledge this is the first fMRI study investigating facial emotional processing in VCFS. Compared with controls, people with VCFS had more activation of the bilateral occipital brain regions.

Table 1: Between-group differences in brain activity during emotional processing task in the velo-cardio-facial syndrome group (n=8) compared with IQ-matched controls (n=9)

<table>
<thead>
<tr>
<th>Brain region</th>
<th>Talairach coordinates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insula</td>
<td>R 28 12 8</td>
</tr>
<tr>
<td>Insula</td>
<td>R 28 8 16</td>
</tr>
<tr>
<td>Frontal (precentralis)</td>
<td>R 52 -4 24</td>
</tr>
<tr>
<td>Frontal (postcentralis)</td>
<td>R 56 -12 20</td>
</tr>
<tr>
<td>Lingual/cuneus</td>
<td>R 8 -76 -12</td>
</tr>
<tr>
<td>Lingual/cuneus</td>
<td>R 16 -76 12</td>
</tr>
<tr>
<td>Lingual/fusiform</td>
<td>L -20 -72 -8</td>
</tr>
<tr>
<td>Middle temporal gyrus</td>
<td>L -32 -56 12</td>
</tr>
</tbody>
</table>

L, left; R, right; VCFS, velo-cardio-facial syndrome.
1. For all group comparisons Z > 2.95 with a minimum number of voxels above significant threshold (P < 0.001) of 10 voxels (applied voxel extend threshold).
involved in early visual processing (including face perception) (Haxby et al, 2002). In contrast, people with VCFS showed less activation in the right insula and premotor cortex – areas implicated in emotional processing (Critchley et al, 2000; Haxby et al, 2002).

The neural network mediating face perception includes a ‘core system’ for visual face analysis, in which occipital gyri provide input into fusiform and superior temporal regions. These then interact with an extended system (e.g. amygdala, insula, limbic system) to process the meaning of information (including emotions) from faces (Haxby et al, 2002). Ventral stream disruption could be one explanation for social impairments in VCFS (Lainess-O’Neill et al, 2005). Moreover, adults with VCFS perform poorly on object perception tasks (relying on the ventral ‘what’ pathway), whereas they perform better on space perception tasks (relying on the dorsal ‘where’ pathway) (Henry et al, 2002). Our results suggest that in VCFS the pathways between ‘face perception’ areas and the extended ventral ‘what’ pathway for processing emotional expressions may be dysfunctional.

A consistent finding in face expression neuroimaging research is increased extrastriate activation in association with facial emotional expressions. Hence, our results may also reflect greater modulation of visual cortices by emotional faces in VCFS compared with controls, with downstream areas involved in attributing the social significance of faces being hypoactive. Hence, people with VCFS may show normal or enhanced affective responses to facial expressions (intact affective empathy), but an impaired ability to identify the social and contextual significance of socio-emotional cues (impaired cognitive empathy). This could partially explain why people with VCFS have high levels of anxiety and affective symptoms.

In our between-group analysis, we observed an anterior–posterior dichotomy in brain activation patterns. This dichotomy has been reported previously in anatomical studies of VCFS (Kates et al, 2001) and might be partially explained by dysmaturity of white-matter tracts in this syndrome (van Amelsvoort et al, 2004). White-matter integrity is associated with better performance on cognitive tasks; for example, improvement in working memory is associated with increased frontal fractional anisotropy (Nagy et al, 2004). Thus, people with VCFS may need to activate occipital brain regions more in order to process visual stimuli, owing to reduced white-matter integrity or connectivity. This ‘compensation’ hypothesis is supported by the findings of Eliez et al (2001), who reported increased activation in parietal regions of children with VCFS compared with controls during mathematical reasoning.

Limitations of our study include the use of a block design including both ‘happy’ and ‘angry’ faces; we are therefore unable to comment on brain activations to separate emotions or neutral faces. Event-related FMRI is needed to evaluate this. Our results did not survive correction for multiple comparisons and should be interpreted as preliminary. Men and women were included in the study, but there was no difference in gender distribution. Inclusion in the VCFS group of three people receiving medication for psychosis could have confounded our results. Given the high prevalence of psychiatric disorders in VCFS, however, a population without any psychiatric problem is rare.

In summary, the results of our preliminary study of emotional processing in VCFS suggest that social impairments in this syndrome may be associated with abnormal connectivity between early visual processing areas and limbic brain regions.

REFERENCES


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References
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