Concomitant fragile X-associated tremor ataxia syndrome and Parkinson’s disease: a clinicopathological report of two cases

INTRODUCTION
Parkinsonism is common in fragile X-associated tremor/ataxia syndrome (FXTAS) but its underlying pathophysiology remains unknown. Our group reported a patient with FXTAS and parkinsonism, and in vivo evidence of presynaptic and postsynaptic nigrostriatal dysfunction. We report the histological findings of this case (case 1) and another case with dual pathologies of FXTAS and Lewy body Parkinson’s disease (PD).

METHODS
Genetic testing for FXTAS was requested in seven cases from the Queen Square Brain Bank for Neurological Disorders (QSBB) based on the characteristic radiological ‘middle cerebellar peduncle’ (MCP) sign (case 1, diagnosis confirmed in life) and histological findings of round, eosinophilic...
p62-positive neuronal intranuclear inclusions in the hippocampus or unexplained cerebellar degeneration (6 postmortem cases were tested). Two cases were positive for FMR1 premutation and both showed histological features of FXTAS and PD. The QSBB brain donor programme was approved by a Research Ethics Committee and written consent for research was obtained from all cases.

**CASE REPORTS**

**Case 1**
A 68-year-old man presented with a 10-year history of slowly progressive right-hand tremor. There was no family history of neurological disorders or mental retardation. Examination showed hypomimia, asymmetric rest and kinetic tremor, rigidity, mild bradykinesia and inability to tandem walk. The patient was diagnosed with tremor-predominant PD but did not respond to L-dopa (600 mg/day). Over the next few years he developed mild cognitive impairment, gait ataxia and intention tremor. Brain MRI demonstrated the MCP sign and diffuse atrophy. Genetic analysis confirmed FMR1 premutation with 87 CGG expansions. 

**NEUROPATHOLOGICAL EXAMINATION**
In both cases, histological examination demonstrated widespread p62-positive and ubiquitin-positive and 1C2-negative neuronal and glial intranuclear inclusions with mild Purkinje cell depletion consistent with FXTAS. There was loss of pigmented neurons in the substantia nigra with α-synuclein-positive Lewy bodies, in keeping with PD. Lewy body pathology conformed to Braak stage 5 in case 1 and stage 3 in case 2. Age-related neurofibrillary tangle pathology was also noted in both cases (Braak and Braak stage II in case 1 and stage I in case 2). An acute left middle cerebral artery territory infarction was observed in case 2.

**DISCUSSION**
In the literature, only 13 of 29 (45%) cases with FMR1 premutation and parkinsonism had abnormal dopamine transporter scans (see online supplementary table) and it is likely that these 13 cases may have had concomitant PD pathology akin to the two cases in this series. On the other hand, IBZM scans were only available in four cases with FMR1 premutation including our case and all had abnormal findings (see online supplementary table). We propose that postsynaptic dopaminergic striatal pathway dysfunction is responsible for parkinsonism in individuals with FXTAS. FMR1 premutation carriers with an abnormal dopamine transporter scan probably signifies the presence of concomitant PD pathology and may have a rapidly progressive disease course due to the dual pathologies. These patients may benefit from L-dopa therapy.

Of the 22 FXTAS cases with postmortem data (table 1), concomitant pathologies were identified in nine cases (41%): four had Alzheimer’s disease pathology,2 one had multiple sclerosis (MS)3 and four had PD pathology including the two cases presented here.4

**Table 1 Features of 22 reported postmortem FXTAS cases**

<table>
<thead>
<tr>
<th>Duration from onset (years)</th>
<th>Wheelchair</th>
<th>Death</th>
<th>CCG repeats</th>
<th>MCP sign</th>
<th>Additional neuropathological findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greco et al5; 11 males6</td>
<td>6</td>
<td>10</td>
<td>113</td>
<td>–</td>
<td>–</td>
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<tr>
<td>–</td>
<td>13</td>
<td>80</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>NA</td>
<td>5</td>
<td>80</td>
<td>Y</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>13</td>
<td>14</td>
<td>71</td>
<td>–</td>
<td>PD</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>19</td>
<td>105</td>
<td>–</td>
<td>–</td>
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<tr>
<td>7</td>
<td>13</td>
<td>77</td>
<td>Y</td>
<td>–</td>
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<tr>
<td>5</td>
<td>6</td>
<td>88</td>
<td>Y</td>
<td>–</td>
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<tr>
<td>NA</td>
<td>3</td>
<td>92</td>
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<tr>
<td>13</td>
<td>16</td>
<td>88</td>
<td>Y</td>
<td>–</td>
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<tr>
<td>4</td>
<td>6</td>
<td>93</td>
<td>Y</td>
<td>–</td>
<td></td>
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<tr>
<td>NA</td>
<td>1</td>
<td>65</td>
<td>–</td>
<td>–</td>
<td></td>
</tr>
<tr>
<td>Tassone et al8; 8 females</td>
<td>NA</td>
<td>NA</td>
<td>70</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>–</td>
<td>10</td>
<td>80</td>
<td>N</td>
<td>AD (B&amp;B V-VI)</td>
<td></td>
</tr>
<tr>
<td>–</td>
<td>6</td>
<td>87</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<tr>
<td>–</td>
<td>14</td>
<td>75</td>
<td>Y</td>
<td>MS</td>
<td></td>
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<tr>
<td>–</td>
<td>7</td>
<td>65</td>
<td>–</td>
<td>AD (B&amp;B V-VI)</td>
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</tr>
<tr>
<td>4</td>
<td>7</td>
<td>N</td>
<td>AD (B&amp;B V-VI)</td>
<td></td>
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</tr>
<tr>
<td>4</td>
<td>6</td>
<td>59</td>
<td>N</td>
<td>PD</td>
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<tr>
<td>–</td>
<td>8</td>
<td>78</td>
<td>–</td>
<td>AD (B&amp;B V-VI)</td>
<td></td>
</tr>
<tr>
<td>Louis et al; 1 male7</td>
<td>7</td>
<td>9</td>
<td>90</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Present series: De Pablo-Fernandez et al; 2 males</td>
<td>13</td>
<td>14</td>
<td>72</td>
<td>Y</td>
<td>PD (Braak 5)</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>100</td>
<td>N</td>
<td>PD (Braak 3)</td>
<td></td>
</tr>
<tr>
<td>Total: 8 females; 14 males</td>
<td>8</td>
<td>9</td>
<td>Y</td>
<td>64% (7/11)</td>
<td></td>
</tr>
</tbody>
</table>

AD, Alzheimer disease; B&B, Braak and Braak stage for Alzheimer; Braak, Braak stage for Parkinson’s disease; FXTAS, fragile X-associated tremors/ataxia syndrome; MCP, middle cerebellar peduncle; MS, multiple sclerosis; N, no; NA, not applicable; PD, Parkinson’s disease; Y, yes.
It is difficult to ascertain the exact contribution of each pathology to the clinical course of parkinsonism in our cases. In case 2, the long-term use of neuroleptics complicated the clinical picture, thus the long-standing hand tremor could have been caused by a combination of FXTAS and neuroleptics. However, at age 51, the deterioration of hand tremor, relentless progression of parkinsonism and motor disability leading to death. This rapid deterioration is atypical for either FXTAS or PD. Among the four patients with dual FXTAS and PD pathology in the literature, the time from onset to use of walking aid (median: 7.5 years) and life expectancy (median: 11 years) are much shorter than in other patients with isolated FXTAS, in whom the median time to walking aid is 15 years and median survival is 21 years. These data suggest that the synergistic effect of more than one neurodegenerative condition might have contributed to an accelerated disease course. Carriers of FMR1 premutation with concomitant Alzheimer’s disease, heterozygous Parkin mutation or MS have been reported and these secondary pathological processes have been postulated to modulate the effect of FMR1 premutation.


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Contributors ED-PF contributed to project conception and organisation, and data collection, and wrote the first draft; KMD contributed to project conception and organisation, and data collection, and critically reviewed the manuscript; JH and TR performed histological analysis, contributed to pathology content and critically reviewed the manuscript; AD, PL, KPB, TTW and AJL contributed to clinical assessment, diagnostic process and critically reviewed the manuscript; HL contributed to project conception and organisation, and critically reviewed the manuscript.

Competing interests None.

Ethics approval The brain donor programme of the Queen Square Brain Bank for Neurological Disorders was approved by a London Multi-Centre Research Ethics Committee and tissue is stored under a license from the Human Tissue Authority. Consent for use of tissue for research was obtained from donors and/or their next of kin.

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