to islands of neurotoxicity. A contribution from the otherwise insignificant basal ganglia calcification to the extrapyramidal features in our patient is doubtful.

The highest concentrations of lithium in the CNS are found in the white matter of thepons. At one stage, our patient was totally immobile except for eyelid blinks and eye movements, with which she could communicate. A normal MRI ruled out central pontine myelinolysis. Could this state, therefore, be attributed to the high concentration of lithium in the pons?

In conclusion, lithium neurotoxicity usually develops after chronic treatment. Permanent sequelae are rare but the occasional occurrence of acute and persistent neurological symptoms warrants a note of caution, especially when lithium is used in combination with antipsychotic drugs. Lithium, preferably intracellular (red blood cells) should be carefully monitored to avoid neurotoxicity. Rarely, neurological sequelae may develop even at therapeutic serum concentrations. Therefore, the need for keen clinical vigilance in addition to routine drug monitoring, especially during combination treatment with antipsychotics, cannot be overemphasised.

Figure 1 Dorsal vagal nucleus (dotted outlines) showing severe neuronal loss (haematoxylin-eosin × 120).

Pure autonomic failure with motor neuron disease: report of a clinical study and postmortem examination of a patient

From clinical and pathological viewpoints, primary chronic autonomic failure is divided into three types: pure autonomic failure without other neurological conditions, autonomic failure with multiple system atrophy, and autonomic failure with Parkinson's disease.1 In pure autonomic failure, the main pathological findings were neuronal loss in the intermediolateral columns of the spinal cord and the occurrence of eosinophilic bodies in the sympathetic ganglia. Furthermore, Lewy bodies in the substantia nigra or locus coeruleus were also described.2 Because the necropsied cases of pure autonomic failure always showed Lewy bodies in the brainstem, it has been considered as an extrapyramidal variant of autonomic failure with Parkinson's disease.1 Our patient was a man with pure autonomic failure whose prominent symptom was orthostatic hypotension, and who showed the neuropathological changes reported in pure autonomic failure as well as those in a familial form of motor neuron disease.

A 78 year old man had claimed dizziness on standing for the past five years. At the age of 76, he had noted frank syncope which gradually increased in frequency. No other symptoms had been experienced until the last year, when he was admitted to our hospital. He had had chronic bronchitis for the past 10 years. There was no family history suggesting neuromuscular diseases. On admission, physical examination disclosed severe orthostatic hypotension and diffuse mild weakness of the limb muscles. Muscle tone and deep tendon reflexes were normal. Pathological reflexes, muscle atrophy, fasciculation, cerebellar ataxia, and sensory disturbance were not seen.

Laboratory studies of blood, urine, and CSF were within normal limits. A chest radiograph showed mild reticular changes in the lower fields of the lungs. Cranial CT, MRI, and ECG showed no abnormal findings. Needle EMG and nerve conduction studies were not performed. A blood pressure of 106/30 mm Hg in the supine position decreased to 50/30 mm Hg on head up tilt, with no change in the heart rate (58 bpm). There was no postural change in serum noradrenaline concentration (0.03 ng/ml) (controls: 0.05–0.40 ng/ml)), although plasma renin activity and serum arginine vasopressin were appropriately increased. The cold pressor test caused a decrease in blood pressure, from 104/54 to 90/50 mm Hg. An exaggerated increase in blood pressure (from 100/40 to 186/100 mm Hg) was obtained after treatment with intravenous noradrenaline. The coefficient of variation of the mean R-R interval of the ECG was reduced to 0.39% (controls > 1.14%). Intravenous infusion of atropine induced no change in heart rate. The phase IV overshoot of blood pressure after a Valsalva manoeuvre was absent. The pupillary responses to the instillations of both 5% tyramine and 1:25% noradrenaline were normal. The Schirmer test showed decreased lacrimation. Volume of residual urine was 10 ml and cystometry was normal. The patient died of subacute interstitial pneumonia eight months after admission.

His brain weighed 1020 g. Macroscopic findings were not remarkable. Paraffin sections were stained with haematoxylin-eosin, cresyl violet/Luxol fast blue, and silver impregnation (Bodian stain, Gallyas stain). Immunohistochemical staining with the avidin-biotin peroxidase procedure for identification of ubiquitin and phosphorylated high molecular weight neurofilaments was carried out. Multiple sections from various cortical areas including the precentral gyrus were unremarkable. No neuronal inclusions could be identified. Neuritic plaques were absent. Neurofibrillary tangles were noted only in the hippocampus. The striatum, globus pallidus, thalamus, subthalamic nucleus, and hypothalamic nucleus appeared normal. The cerebral white matter was unremarkable. No glial cytoplasmic inclusions were noticed. The substantia nigra and locus coeruleus were examined at two and four different levels, respectively. Several sections from each level were stained with haematoxylin-eosin and immunohistologically with antibodies against ubiquitin and neither neuronal nor Lewy bodies were detected. The oculomotor and Edinger-Westphal nuclei showed normal appearances. Mild neuronal loss and gliosis had occurred in the facial and hypoglossal nuclei. In both nuclei, chomatolytic neurons and intracytoplasmic Lewy body-like hyaline inclusions were occasionally seen. Almost total neuronal loss was found in the dorsal motor nuclei of the vagal nerve (fig 1). The accessory cuneate nuclei showed mild neuronal loss. The reticular formation in the medulla exhibited mild astrogliosis as well as a few hyaline inclusions. The red nuclei, raphe nuclei, pontine nuclei, inferior olivary nuclei, and pyramids were not affected. In the cerebellum, Purkinje cells were slightly decreased in number, and the dentate nucleus showed a mild degree of grumose degeneration. There was no noticeable myelin pallor of the cerebellar white matter. In the spinal cord, there was severe loss of sympathetic neurons of the intermediolateral columns. This was accompanied by moderate loss of anterior horn motor neurons throughout the thoracic and lumbar cord. Clarke's columns also showed neuronal loss (fig 2A). In the anterior horns, chromatolytic neurons, spheroids, intraneuronal conglomerates, and hyaline inclusions were occasionally encountered. Swollen cord-like axons were seen in the intramedullary portion of the spinal anterior root. Astrogliosis and a few hyaline inclusions were also noted in the intermediate zone of the spinal cord. No pathological findings were recognised in Omnit's nucleus.
Glutaric aciduria type 1 in adulthood

Glutaric aciduria type 1 (GA-1) is an autosomal recessive disorder caused by deficiency of the mitochondrial enzyme glutaryl CoA dehydrogenase, which oxidises and carboxylates glutaryl CoA, an intermediate step in the metabolism of lysine and tryptophan. The onset of clinical manifestations is usually within the first year of life with an acute encephalopathic illness, often triggered by intercurrent infection. A severe dystonic-dyskinesic syndrome develops in most patients, but others are less severely affected and asymptomatic cases have been described. It is a rare condition with only about 100 cases reported in the medical literature since its original description in 1975. However, it has been suggested that GA-1 is underdiagnosed and may exist undetected in populations of children and adults labelled as having cerebral palsy. We report a patient with GA-1 in whom the diagnosis was made at the age of 50 years when she was referred for reassessment of chronic neurological disability.

The patient was the product of a full term normal delivery and there were no problems in the neonatal period. Motor development was mildly delayed, and she did not start to walk until the age of 18 months when she was noted to drag her right leg. At the age of 7 years she was admitted to hospital with a "paralytic illness". She remained in hospital for four months and at the time of discharge required callipers to walk. Her manual dexterity was poor and her speech was slurred. These neurological disabilities subsequently remained stable. At the age of 12 a right subthalamic fusion was performed, and eight years later the left femur was shortened. She was able to complete her education at a normal school and then worked for 10 years in a factory before getting married. She was referred to us at the age of 50 because of increasing difficulty in walking caused by pain in the right ankle. There were no new neurological symptoms and no symptoms of autonomic dysfunction. She was being treated with a non-steroidal anti-inflammatory drug and was on hormone replacement therapy. She had not received any neuroleptic medication. Both her parents were caucasian and had died in their 80s. They had had no neurological illnesses, and there was no consanguinity. The patient has two siblings and three children of her own, all of whom are well with no neurological disorder.

Examination showed a severe dysarthria which made her speech very difficult to comprehend. Psychometric testing, however, showed her performance to be in the average range, with a mildly elevated non-verbal part of the WAIS-R was not performed because of limited manual dexterity, but good average scores were achieved on the verbal parts of non-verbal reasoning. There was a left exotropia, but the measurements were otherwise normal. There was pronounced lingual dystonia and orofacial dyskinesia. Her right leg was hypoplastic and she used callipers and two sticks to walk. There

Figure 2: (A) Neuronal loss is apparent in the intermediolateral column, Clarke's column, and anterior horn of the thoracic spine (cresyl violet/Luxol fast blue × 80). (B) Myelin pallor in the pyramidal tracts of the thoracic spine is accompanied by symmetric patches of myelin loss in the posterior columns (cresyl violet/Luxol fast blue × 22).

There was myelin pallor of the lateral corticospinal tracts and posterior columns, and the latter assumed the symmetric butterfly shape of the middle zone (fig 2B). Spino-cerebellar tract degeneration was noted at the level of the pyramidal decussation. The posterior root ganglia were normal. The cervical sympathetic ganglia showed no apparent neuronal loss. Increases in satellite cells were not noticed. A few Lewy bodies and round or elongated eosinophilic bodies were occasionally encountered in the interstitium. Immunohistochemically, hyaline inclusions in α-motor neurons of the brainstem and spinal cord, and eosinophilic bodies in the cervical sympathetic ganglia were stained positive for ubiquitin. A few intraneuronal conglomerates appeared to stain in a granular fashion. Spherosides and conglomerates were positive for neurofilaments.

This patient had pure autonomic failure with the features of motor neuron disease, which is not usually complicated by primary autonomic failure. The patient clinically showed autonomic failure, mainly manifested by orthostatic hypotension. The low resting noradrenaline concentration and impaired heart rate response to atropine with low mean R-R interval of ECG suggested dysfunction of the postganglionic adrenergic and the cardiac parasympathetic laryngeal tract involvement and hyaline inclusions in the anterior horn cells. Arch Neurol 1967; 16:232-43.