Failure of oral administration of single rising doses of bromocriptine to produce acute anti-Parkinsonian effects

The optimal dose of bromocriptine in the treatment of Parkinson's disease has remained controversial. While most investigators have used daily doses of 40 mg several reports have since claimed success with oral dose regimens of less than 20 mg. The United Kingdom Bromocriptine Research Group has recently confirmed the puzzling finding that with a fast introductory regime higher doses of bromocriptine are needed than with a slower titration schedule to produce similar degrees of clinical improvement in de novo patients with Parkinson's disease.

We have studied the acute anti-Parkinsonian effect of single rising doses of bromocriptine in an open experimental study in seven patients admitted to hospital with fluctuating Parkinson's disease (three females, four males; mean age 57-7 (41-69) years; mean duration of disease 10.9 (8-15) years; mean daily dose of levodopa 1014 (500-1400) mg plus peripheral decarboxylase inhibitor (PDI). All but two had never been treated with bromocriptine.

In one patient concomitant bromocriptine (30 mg/d) was discontinued one day before the study while a second had received bromocriptine (40 mg/d) as an adjunct to levodopa over a 14 months period until one year previously. All showed a predictable wearing-off pattern in response to oral levodopa and during the study period the first daily dose of 200 mg of levodopa was taken at 8 am after a minimum drug free period of eight hours and one hour after a standard hospital breakfast. On alternate days this morning dose was replaced by single rising doses of bromocriptine following the dose schedule depicted in the figure, and oral domperidone (20 mg) was added if nausea and/or hypotension had occurred at the previous dose level. Efficacy assessments of levodopa or bromocriptine test doses were performed using the motor score (section 111) of the Unified Parkinson's Disease Rating Scale (UPDRS) beginning 30 minutes before dosing with half-hourly ratings until acute drug effects had worn off or up to a maximum of four hours.

The results are shown in the figure. While 200 mg of oral levodopa led to a mean 50% reduction of the UPDRS motor score, usually within 30 to 45 minutes, there were no acute anti-Parkinsonian effects following any of the single oral doses of bromocriptine employed in this study. The only exception was the patient to whom bromocriptine had been given as a chronic treatment for up to one year before the study. The patient experienced an acute dyskinesia on one occasion during the study period: a coarse resting tremor and moderate peak dose chorea 120 minutes following a single 12.5 mg dose of bromocriptine and lasting for 115 minutes.

Using a similar single rising dose substitution model, acute anti-Parkinsonian effects have been demonstrated for the non-ergot dopamine agonist PHNO\(^+\) and also for the ergot derivative CA299-1, which is structurally related to bromocriptine.\(^3\) The fact that bromocriptine, however, was never employed in the majority of patients in this study may indicate that the doses employed were subthreshold for anti-Parkinsonian efficacy.

It is, however, remarkable that several clinical studies have demonstrated the effectiveness of bromocriptine monotherapy with chronic administration at doses of between 12.5 and 25 mg/d,\(^5\) that is, daily doses in the range of the upper dose level examined in this single dose trial. A possible explanation for this apparent discrepancy might be that bromocriptine is capable of inducing delayed effects with chronic treatment, possibly via modulatory effects on central dopamine receptors. Such delayed effects have been noted in one patient in this study (case 7, who received combined treatment with bromocriptine until 24 months after the start of the study). He complained of increased severity of levodopa-induced dyskinesias on the days following bromocriptine challenges of 10, 15, 20 and 25 mg and experienced enhanced dyskinesias for the remainder of the study when receiving his pre-study daily levodopa regimen. But even this patient failed to show acute anti-Parkinsonian effects from single bromocriptine doses as high as 25 mg. Other reasons for the observed failure of single bromocriptine doses to induce acute effects could lie in the pharmacokinetics of the drug. Thus the extensive first pass effect of bromocriptine means that only 5% of the parent drug will reach the systemic circulation, and its high lipophilicity could further reduce the free concentration of bromocriptine in the extracellular space. Only after saturation of the lipid compartment following repeated dosing might active biological concentrations be attained within the soluble compartment. Accordingly bromocriptine exerts acute effects in the Unngerstedt rat model only following high oral doses of above 9 mg/kg, but with repeated dosing response latencies of a given dose decrease with simultaneous augmentation of efficacy (R Markstein, personal communication). Whether such pharmacokinetic properties of bromocriptine or pharmacodynamic receptor changes in the CNS form the pathophysiological basis for the different dose requirements with "fast" versus "slow" introductory regimes of bromocriptine remains unclear.

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**Figure.** Bromocriptine single dose challenges in seven patients. Each patient represented by one symbol indicating minimum scores (UPDRS part III) over a four hour rating period following each dose. Mean minimum scores for each dose level represented by horizontal bars. Effects of a single oral dose of 200 mg levodopa are shown for comparison. \(* \cdots \cdots \cdots \cdots = 0.001\) for comparison between baseline ("off") and drug scores.
Neurovascular paralysis in vipera aspis envenomation: pathogenetic mechanisms

Vipera aspis is the most common agent of snake envenomation in Italy and Western Europe.¹ Its bite affects coagulation and causes a shock syndrome with severe cardiovascular failure.

Neurotoxicity, clinically characterised by external ophthalmoalgia, is uncommon (two cases out of 205 patients bitten by vipera aspis)² and difficult to explain because overt neurotoxic substances have not been detected in vipera aspis venom.³ Our case suggests that the venom is neurotoxic.

A 20 year old herpetologist was bitten by a vipera aspis at the distal extremity of the index finger of the left hand. When he was admitted to the intensive care unit (30 minutes later) he was unconscious (Glasgow Coma Scale 7), pale, tachycardic (170 beats/min), tachypnoeic (50 breaths/min), without detectable peripheral pulses and blood pressure.

There was a metabolic acidosis (pH 7.26) and disseminated intravascular coagulation. The left hand was oedematous. Centrifugal venous compression was applied on the left arm. Shock, metabolic failure and disseminated intravascular coagulation syndrome were treated with fresh frozen plasma, albumin, dextran, dopamine and adrenaline, NaHC0₃, and heparin iv infusions. Cardiac, respiratory function, metabolic balance and consciousness returned to normal within the following three hours.

Neurological examination revealed facial diplegia, pharyngolaryngeal paresis, bilateral ptosis and external ophthalmoalgia, with concomitant ocular immobility.

The strength of the trunk, limb and respiratory muscles, deep tendon reflexes, plantar and abdominal reflexes, and sensory functions were normal. Symptoms were not modified by iv administration of 10 mg of edrophonium.

Neurophysiological studies of the facial nerves showed a low amplitude muscle action potential (0.9 mv-nv > 3 mv), with normal latency. Repetitive stimulation at low and high frequencies, tetanisation and stimulation with paired stimuli at stimulus intervals of less than 10 ms gave normal responses without any sign of neuromuscular transmission defects. Blink reflex showed responses with normal latencies. Similar neurophysiological studies performed on other nerves (median, common peroneal and sural) were normal.

Five days from the onset of the disease the patient improved considerably and after 10 days, neurological examination and neurophysiological tests were normal. He was discharged after 10 days.

The lack of clinical involvement of motor, sensory and cerebellar pathways within the brainstem, together with the normal latency of blink reflex responses in this case, do not suggest an involvement of the brainstem possibly caused by oedema and/or disseminated intravascular coagulation.⁴

The electrodiagnostic signs and the quick improvement of the clinical picture also lead us to exclude a neuropathic lesion and to hypothesise that a transient functional block of activation of a number of muscle fibres.⁵ This could be related to three possible mechanisms in particular: 1) a neuromuscular block; 2) a direct action on muscle fibres; 3) a block of depolarisation in the terminal portions of a number of motor nerve fibres.

A neuromuscular block may be related either to a presynaptic site of action of the venom, such as beta-bungarotoxin⁶ and anticholinesterase, or to a postsynaptic site of action, like alpha-bungarotoxin.⁷ None of these substances has been detected in vipera aspis and the electrophysiological findings of the reported case are neither consistent with a presynaptic nor a postsynaptic defect of neuromuscular transmission.

A direct myotoxic effect of animal toxin has been related to phospholipase A2 activity, which has been detected in all viperidae venoms so far investigated.² Moreover some authors⁸ suggest that some toxins, like cardiotoxin of Dendroaspis jamesoni, can induce muscle fibre necrosis with a structural damage of the subneural apparatus. Nevertheless myonecrotic action is shown to be confined to the site of injection.

The action of the toxin on the terminal portions of motor fibres could transiently block the conduction of a number of motor fibres by preventing their depolarisation. A lesion in this location is consistent with normal tests of neuromuscular transmission and with the rapid recovery of the amplitude of the muscle action potential as observed in our case. This mechanism has been hypothesised also in the neuromuscular paralysis induced by tick envenomation⁹ and by other biotoxins such as tetrodotoxin.¹⁰

Why the neurotoxic action of the vipera aspis venom appears to remain strictly localised in cephalic muscles remains unexplained. Preliminary physiological characteristics of cephalic motor units might be an explanation.

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