Effect of nifedipine on cystometry-induced elevation of blood pressure in patients with a reflex urinary bladder after a high level spinal cord injury

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In 10 patients with a reflex urinary bladder after a cervical or high thoracic spinal cord injury, the effect of nifedipine on the cystometry-induced elevation of blood pressure was studied. The blood pressure was measured every 30 s in four consecutive cystometries before and after administration of 10 mg nifedipine sublingually. In each patient there was a decrease in the maximum systolic and diastolic blood pressure after the administration of nifedipine. In the whole group the mean maximum systolic pressure decreased significantly from 147 mmHg (range 119–165, SD 14) to 118 mmHg (range 99–145, SD 14). The mean maximum diastolic pressure decreased from 110 mmHg (range 96–124, SD 10) to 83 mmHg (range 71–99, SD 10). The effect of nifedipine was significant in each of the four cystometries that were performed. The decrease in blood pressure was due to both a significant decrease of the baseline pressure and a significant decrease of the blood pressure reaction during cystometry. Nifedipine may be useful in order to prevent dangerous blood pressure reactions, e.g. during cystoscopy and other diagnostic or therapeutic procedures in spinal cord injured patients with autonomic dysreflexia.

Keywords: blood pressure; neuropathic bladder; nifedipine; spinal cord injuries; urodynamics; autonomic dysreflexia.

Introduction

A sudden uninhibited reflex elevation of blood pressure is a well recognised and sometimes serious problem in patients with a spinal cord injury above the fifth thoracic level.¹ Attacks are induced by stimuli below the level of the lesion, most often from the urinary bladder. Stimulation of the urinary bladder has also been used in order to evaluate the effect of pharmacological prevention and treatment of blood pressure elevation, and among other substances the calcium channel blocking agent nifedipine has been tried. Sublingual administration of nifedipine seems to be effective in the prevention of an expected attack, eg during cystoscopy, but methodological problems, like small numbers of comparable measurements, lack of standardised stimuli and unspecified intervals of blood pressure measurement make the interpretation of previous studies difficult.^{2–5} We have previ-

ously described the blood pressure response in repeated cystometries,⁵ and the aim of this study was to evaluate the effect of nifedipine with this improved technique.

Patients

Ten patients with a spinal cord injury above the fifth thoracic segment were included. The neurological functional level and classification according to Frankel is shown in Table I. All patients who were classified as Frankel B had an anterior cord syndrome. The patient who was classified as Frankel C had some touch sensation in his feet and some voluntary flexion of his toes. All patients had a reflex urinary bladder, according to Lapides' classification, with neither sensation for filling nor voluntary control of the bladder on clinical examination and cystometry. All patients had experienced some symptoms of autonomic

Table I Neurological functional level and classification according to Frankel

	Patients									
	1	2	3	4	5	6	7	8	9	10
Level	C5	C4	C8	C7	C6	C6	T3	C6	C5	C7
Frankel grade	B	A	B	A	A	A	B	C	A	B

dysreflexia and also a reflex blood pressure elevation had been demonstrated during cystometry. All patients were male with ages ranging from 16 to 53, and a median of 24. The post lesion time ranged from 0.5 to 16 years, with a median of 4 years. No additional disease was known in the group of patients and there was no other medication with known or suspected effect on blood pressure, except a daily dose of 150 mg baclofen in one patient.

Methods

The blood pressure was measured every 30 s during a series of four consecutive cystometries before and four consecutive cystometries after administration of 10 mg nifedipine sublingually. In this study, one cystometry is defined as measurement of the detrusor pressure during one filling phase and the following detrusor contraction, ie the emptying phase.⁵

The systolic and diastolic blood pressure was measured in the left arm with a 12 cm cuff, a mercury column and auscultation of the Korotkoff sounds.⁵ In order to perform the repeated measurements in a convenient way, the cuff valve was connected to compressed air, making it possible to fill the cuff quickly. The systolic pressure was defined as the pressure at which the first sound was heard. The diastolic pressure was defined as the pressure at which the last sound was heard (phase V). The blood pressure measurements were rounded to the nearest 5 mmHg. The blood pressure was measured during both the filling and emptying phases and also during 3 min after the contraction of the bladder. At each cystometry there were also 3 consecutive measurements at rest, before the filling started. The mean systolic and the mean diastolic pressure

from these three measurements was called the baseline blood pressure. The difference between the maximum blood pressure recorded and the baseline blood pressure, in each cystometry, was called the blood pressure reaction.

The heart rate was measured by auscultation of the heart during 1 min before each filling of the bladder. In most of the patients, the heart rate was not measured during the filling and emptying phases of the cystometries.

Cystometries were performed with a suprapubic technique that has been described in previous methodological studies.^{5–7} There is no systematic change of the detrusor or blood pressures of consecutive cystometries with 10 min intervals.^{5,7} A filling rate of 50 ml/min with 37 °C normal saline was used. Filling was stopped as soon as a detrusor contraction was observed and the detrusor pressure exceeded 2 kPa. The interval between the end of one cystometry and the start of the next one was about 10 min. After four cystometries, 10 mg nifedipine was given sublingually and the second series of cystometries was started 10 min later.

Wilcoxon's signed rank test was used to test differences.

Results

Blood pressure

In each patient there was a decrease of the maximum blood pressure after administration of nifedipine (Table II). In the group of patients the mean maximum systolic pressure, in four cystometries, decreased ($p = 0.003$) from 147 mmHg (range 119–165, SD 14) to 118 mmHg (range 99–145, SD 14). The mean maximum diastolic pressure also decreased significantly ($p = 0.003$)

Figure 1 Maximum systolic and diastolic blood pressure in four cystometries before and after administration of nifedipine. Each bar shows the mean value and the standard deviation in the group of patients ($n = 10$).

difference was not statistically significant ($p = 0.07$).

Symptoms

Two patients reported a feeling of sweating in their necks and faces and a 'feeling of intracranial pressure', during the emptying phases before nifedipine. The feeling of intracranial pressure was specified by both patients as something like a headache but less severe. Both symptoms disappeared in one of the patients and the feeling of sweating disappeared in the other, with nifedipine.

After administration of nifedipine one patient reported a warm feeling in his face.

Discussion

After administration of nifedipine, the maximum blood pressure during cystometry decreased in all patients. In a previous study we found a correlation between the blood pressure increase and the duration of the detrusor pressure elevation.⁵ In the present

study, the maximum detrusor pressure or the time during which the detrusor pressure exceeded 4 kPa decreased after nifedipine in most of the patients. Hence, it seems that, at least in some patients, the cause of the weaker blood pressure reaction might be a combination of a direct vasodilator effect of nifedipine⁸ and an indirect effect via relaxation of smooth muscles of the urinary bladder and urethra.⁹ Our results support the observation by Lindan *et al*² and Dykstra *et al*³ that calcium channel blockers are effective against reflex elevation of blood pressure in patients with a high level spinal cord injury.

After sublingual administration of nifedipine the plasma concentration is maximal after 30 min.¹⁰ The vasodilator effect in essential hypertension¹¹ and in healthy subjects¹² is closely correlated with the plasma levels. Further studies would be needed in order to predict the extent of the hypotensive effect of the drug in patients with a spinal cord injury.⁵ In those clinical situations where reflex hypertension is a severe problem the stimulus probably is stronger

and of longer duration than in this study. On the other hand the stimulus can also elicit a short and moderate hypertensive response compared to the dose of nifedipine. A resulting prolonged hypotensive period would be difficult to tolerate for the patients, especially when there is already a neurogenic hypotension with poor compensatory vasomotor mechanisms.

Therefore, to cope with the paroxysmal hypertension, eg during cystoscopy,³ on one hand, and the adverse effects of nifedipine^{2,5,13,14} on the other hand, it is necessary

to determine the dosage on an individual basis.

Conclusions

Nifedipine has a prophylactic effect on reflex elevation of the blood pressure in spinal cord injured patients with autonomic dysreflexia. The medication can be given a short time before an anticipated attack and the duration of the effect seems to be long enough to be useful, eg in cystoscopy and other diagnostic or therapeutic procedures.

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