Treatment of Cardiac Tachy arrhythmias with Intravenous Verapamil

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Verapamil (Cordilox, Isoptin) is a base, soluble in water, alcohol and chloroform but insoluble in ether with the chemical structure *C'^'J^^N^O^HCI* (Haas and Hartfelder, 1962). This drug was initially introduced as a coronary vasodilator (Hoffman, 1964; Sandier et al., 1968). However, it was found later to have antiarrhythmic properties (Melville et al., 1964; Bender et al., 1966; Schmid and Hanna, 1967; Kaumann and Aramendia, 1968). It acts by preventing the calcium inflow across the myocardial cell membrane (Nayler et al., 1968; Nayler and Szeto, 1972; Singh and Vaughan Williams, 1972). Intra-cardiac studies have shown that verapamil prolongs the atrioventricular nodal conduction time and consequently terminates the supraventricular tachy-cardias due to atrioventricular nodal re-entry mechanism (Husaini et al., 1973; Roy et al., 1974; Schamroth et al., 1972).

Although the initial clinical reports were favourable (Schamroth et al., 1972), its inadequacy for some specific forms of tachycardias and its serious side-effects have been recently emphasised (Benaim, 1972; Boothby et al., 1972; Sacks and KenneUy, 1972; Krikler and Spurrell, 1974). The drug has been given, so far, in cardiac dysrhythmias following a variety of diseases (Schamroth et al., 1972) but its action was influenced by the nature of the underlying illness and the previous medication (Krikler and Spurrell, 1974).

Therefore, we have undertaken the following prospective study on the effects of verapamil on various tachyarrhythmias, including patients with myocardial and pulmonary conditions.

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Patients and Methods

One hundred and one patients with various tachyarrhythmias (Table 1) were treated by slow intravenous injections of verapamil (Cordilox, Abbott Laboratories Ltd., Queenborough, Kent, England). Sixty-one patients were men and forty women. The mean age of male patients was 46 years and that of the female patients 57 years. Sixty-two of these patients were receiving various drugs at the time of verapamil treatment, including digoxin (Table 2). The nature of the underlying heart disease and the possible cause of the tachyarrhythmias are shown in Table 3.

Verapamil was given in aliquots of 2.5mg to a maximum of 15mg intravenously over a period of one minute. The patients were treated in the cardiac, medical, surgical or emergency departments. Before any treatment was given each patient was in recumbent position, had a 12-lead electrocardiogram recorded and had his blood pressure taken. A continuous electrocardiographic recording was started before the treatment and was continued until sinus rhythm had occurred. In the case of failure, the electrocardiographic monitoring was maintained until other measures had been successful. The blood pressure was recorded before, immediately after and, on several occasions, subsequent to the injection. Before verapamil was given, several vagal manoeuvres, such as carotid massage and eye bulb pressure, or precordial blow had been applied, unsuccessfully, in all patients. In 20 cases, in which verapamil had failed, direct current counter shock applied successfully.

Twenty patients with paroxysmal supraventricular tachycardia and paroxysmal ventricular tachycardia, diagnosed by intracardiac electrocardiograms, had

Table 1
Tachyarrhythmia, effects and duration of the effect after intravenous verapamil administration

Tachyarrhythmia	Number	Effect	Duration
Sinus tachycardia	10	Slowing in all	1 hour
Idionodal tachycardia	2	Sinus rhythm	No recurrence
Idioventricular tachycardia	2	No effect	—
Atrial flutter	14	Slowing in 10 Sinus rhythm in 4	45 minutes 2 hours
Atrial fibrillation	35	Slowing in 20 Sinus arrest in 1 No effect in 14	45 minutes
Paroxysmal supraventricular tachycardia	36	Sinus rhythm in 30 Slowing in 6	No recurrence 1 hour
Paroxysmal ventricular tachycardia	2	No effect	—

Table 2
Medication before intravenous verapamil administration. Most of the patients were receiving more than one drug.

Medication	No. of Cases
Digoxin	31
Frusemide	58
Potassium supplements	58
Beta-blockers	10
Diazepam	30
Nitrazepam	23
Epanutin	2
Hydrocortisone	10
Aminophylline	10
Diamorphine	12

Table 3
The possible cause of tachyarrhythmia

Disease	No. of Cases
Acute myocardial infarction	12
Ischaemic heart disease	14
Following open heart surgery	15
Hypertension	6
Wolff-Parkinson-White syndrome	6
Chronic rheumatic heart disease	17
Myocarditis	2
Cardiomyopathy	4
Acute asthmatic bronchitis	10
Thyrotoxicosis	4
Unknown cause	11

their systolic time intervals measured before and after the treatment. These intervals were measured by simultaneous recording of electrocardiogram, phono-cardiogram and carotid artery pulsation in a four-channel direct writing electrocardiograph at a paper speed of lOOmm/sec.

Patients who had been successfully treated with verapamil injection were put on oral dose of 25mg q.i.d. verapamil and were followed regularly, after their discharge, in the outpatient clinic.

Results

The effects of intravenous verapamil administration on various tachyarrhythmias are shown in Table 1. Thirty (83%) of the 36 cases of paroxysmal supraventricular tachycardia were converted to sinus rhythm which lasted, at least, until their discharge from the hospital. Sinus rhythm was achieved in the patients with idionodal tachycardia with no recurrence and in 4 of the 14 patients with atrial flutter, but this recurred in two hours' time. Verapamil did not affect the patients with idio-ventricular tachycardia and paroxysmal ventricular tachycardia. Fourteen patients with atrial fibrillation were not affected. However, all patients with sinus tachycardia, 10 of the 14 patients with atrial flutter, 20 of the 35 patients with atrial fibrillation and 6 of the 36 patients with paroxysmal supraventricular tachycardia had their ventricular rate slowed, but only temporarily. All patients with atrial flutter, sinus tachycardia and paroxysmal supraventricular tachycardia complicating heart surgery had their ventricular rate slowed temporarily and did not revert to sinus rhythm. All patients with paroxysmal supraventricular tachycardia complicating Wolff-

Parkinson-White syndrome responded promptly to verapamil. One patient with atrial fibrillation, of ischaemic origin, receiving digoxin, developed sinoatrial block and asytole after 5mg of verapamil but recovered with external cardiac massage (Kounis, 1979). All patients with acute asthmatic attack had received vigorous treatment with hydrocortisone and aminophylline before intravenous verapamil. Five patients with sinus tachycardia and 5 patients with supraventricular tachycardia had their rate slowed temporarily. No obvious deterioration of their dyspnoea was noticed. From the patients with acute myocardial infarction, one with supraventricular tachycardia developed ventricular extrasystoles culminating in ventricular fibrillation after 5mg of intravenous verapamil. The ventricular fibrillation was corrected by direct electric countershock. This patient, however, had previously received intravenous practolol.

The response to verapamil was either abrupt change to sinus rhythm or by preceding short period of bradycardia and some ventricular extrasystoles. Only one patient receiving propranolol had his systolic pressure dropped to 60mm Hg but with no further sequelae. There was a difference of total electro-mechanical systole (QS^), left ventricular ejection time (LVET) and pre-ejection period in patients with paroxysmal supraventricular and paroxysmal ventricular tachycardia.

Discussion

It appears that verapamil is highly effective in cases of paroxysmal supraventricular tachycardia due to re-entry processes through the atrioventricular node alone or together with an anomalous pathway (Krikler and Spurrell, 1974). This applies, especially, in cases of Wolff-Parkinson-White syndrome. In tachycardias, during period following heart surgery, verapamil slows the heart rate temporarily. In these patients rapid atrial stimulation (Pittman and Gay, 1977) or direct current countershock are preferable. Under normal circumstances, verapamil has very little effect on sinoatrial nodal activity (Roy et al., 1974). However, the slowing effect of sinus tachycardia and the abolition of idionodal tachycardia shows that some primary slowing action on pacemaker auto-maticity may have taken place. Verapamil should be given with caution in patients with supraventricular tachycardia and "sick sinus syndrome" (Husaini et al., 1973). Patients with this sinoatrial disease have an inherent tendency for sinoatrial nodal suppression and, therefore, the risk of sinus arrest and asystole is greater. Digitalized patients should also receive this drug with caution because there may be a synergistic action of both drugs on the atrioventricular node resulting in dangerous bradycardia or asystole (Boothby et al., 1972; Sacks and Kennelly, 1972; Kounis, 1979). Although verapamil has not any beta-blocking action or quinidine-like effect, its administration in patients receiving beta-blockers may be dangerous and one case of collapse and asystole has been reported (Krikler and Spurrell, 1974).

In our study, the successfully treated patients with intravenous verapamil received this drug orally afterwards and this seemed to maintain the sinus rhythm for at least six months. It is anticipated, therefore, that this drug might be suitable for prophylaxis against cardiac tachyarrhythmias following their initial suppression by intravenous administration. However, a complete trial is necessary to determine whether oral verapamil can prevent cardiac tachy-arrhythmias. It should be emphasised that maximum blood levels of verapamil are reached 3 to 12 minutes after injection and the concentration then falls rapidly to zero within 20-30 minutes.

In post-infarction arrhythmias, verapamil can be beneficial, but the development of ventricular fibrillation which was observed in one patient was alarming. The same applies to tachyarrhythmias during asthmatic attack and following open heart surgery. It seems that patients with electro-mechanically deranged cardiac and pulmonary function from necrosis or anoxia are "high risk" patients for taking the drug. These patients are likely to have catecholamine depletion and may well react adversely to verapamil or indeed any substance that decreases the amount of calcium entering or available within the myocardial cell.

Our experience suggests that verapamil is a good drug in controlling supraventricular arrhythmias, but it should be given with caution in patients receiving digoxin or beta-blockers and to severely ill patients.

Summary

One hundred and one patients, including patients with tachyarrhythmias following acute myocardial infarction, acute asthmatic attacks and open heart surgery, were treated with intravenous verapamil administration. Intravenous verapamil was effective in 83% of the cases of paroxysmal supraventricular tachycardia but there was no effect in cases of ventricular tachycardia. In cases of atrial flutter and atrial fibrillation there was a temporary slowing of the ventricular rate. One patient on propranolol developed profound hypotension, one receiving digoxin developed sinoatrial block and asystole and another suffering from myocardial infarction developed salvos of ventricular ectopics culminating in ventriculat fibrillation.

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