Repetitive tachycardia

Effects of exercise tests and amyl nitrite

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Six patients with repetitive tachycardia are presented, 4 of whom were aged between 15 and 19 years. Two patients were over 60 years of age. The patients were gathered in a relatively short period of 5 years, and all of them satisfied the electrocardiographical and clinical criteria of repetitive tachycardia. Two of the patients had ventricular repetitive tachycardia while the other 4 had a supraventricular pattern.

The good tolerance to effort is stressed. All the patients underwent exercise tests; in 5 the rhythm converted transiently during effort to sinus. Three patients were given amyl nitrite and/or nitroglycerin, and in them, too, a transient sinus rhythm appeared at the height of the drug effect.

In 2 patients who were treated with propranolol, permanent sinus rhythm was restored. The significance of these tests and the effect of propranolol on the possible mechanism of repetitive tachycardia are discussed.

Repetitive tachycardia is the most popular name given to the arrhythmia characterized by bouts of ectopic tachycardia usually of supraventricular origin, but also at times originating from the ventricles. The bouts of 5 to 20 beats are usually separated by one or several normal sinus complexes (Parkinson and Papp, 1947; Cass, 1967).

In most cases, the rate of the ectopic tachycardia is not constant, i.e. the rate increases towards the middle of the bout and then progressively slows. The bouts of tachycardia are characteristic for each patient as to their length and pattern. They repeat in stereotypic form throughout the entire electrocardiogram. It is a condition that may continue for months and even years.

In ordinary paroxysmal tachycardia, the paroxysms are the exception, and usually there is normal sinus rhythm. However, in repetitive tachycardia, a continuous normal rhythm is almost never seen.

As reported, repetitive tachycardia is an illness that strikes young people with no known organic disease (Parkinson and Papp, 1947; Morgan and Nadas, 1964). The prognosis is considered good and the arrhythmia disappears spontaneously within a few months or at the latest, a few years (Morgan and

Nadas, 1964). However, cases with congestive heart failure in children with this condition have been reported (Adams, 1962).

The disease is rare though Parkinson and Papp (1947) were able to report 40 cases. Cass, in reporting 2 cases in 1967, reviewed the published reports from 1900 and could only find 38 additional cases. Some authors stress that in addition to the rarity of the arrhythmia, and age-group affected, the patients cannot support effort, and complaints of palpitation, dizziness, and syncope are noted (Parkinson and Papp, 1947; Langendorf and Pick, 1954). The illness is considered to be resistant to the usual anti-arrhythmic treatment (Cass, 1967; Morgan and Nadas, 1964).

The purpose of this paper is to report 6 cases and to emphasize certain features that were unexpected in view of the published reports. Within a relatively short period of 5 years, we have found these 6 cases, 4 of which were aged between 15 and 19 years. The other 2 cases were over 60 years of age.

In contrast to the cases reported earlier, our patients supported effort very well. Furthermore, in most of them a return to normal sinus rhythm could be seen while exercising. Normal sinus rhythm was achieved transiently in 3 patients tested with amyl nitrite inhalation. Finally, in the 2 patients who were treated with propranolol (orally)

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permanent success was achieved; the arrhythmia disappeared and the patients remained in normal sinus rhythm until now for a period of about 2 years or more.

Case reports

Case 1 An 18-year-old girl of Yemenite origin was referred for investigation of an arrhythmia that was found on routine examination. Her general condition was good, with no complaints, and the patient did not feel her own abnormal cardiac rhythm. Except for the presence of tachycardia, the clinical examination did not reveal any pathological findings and the chest x-ray was normal. The electrocardiogram showed the characteristic pattern of supraventricular repetitive tachycardia: the ventricular rate was 130 to 175, with 10–20 beats a bout (Fig. 1A). During the third year of this patient's study, she became pregnant and on electrocardiographic examination was in normal sinus rhythm. Since then, she has not returned for follow-up (2 years).

Case 2 A 19-year-old youth, born in Rumania, was referred to us after enrolment in the army because of strong palpitations accompanied by dizziness. It is interesting to note that these complaints occurred especially while at rest, but not during effort. Apart from the arrhythmia, his clinical examination and chest x-ray were normal. All the laboratory findings were within normal limits. Electrocardiogram showed the supraventricular repetitive tachycardia pattern with a rate of 130 to 165 (Fig. 1B). This patient was on quinidine therapy for a long time without response. However, he had an excellent response to propranolol (oral), and after discontinuing treatment for several months the patient is still in normal sinus rhythm.

Case 3 An 18-year-old youth of Polish origin, in whom an arrhythmia was discovered on routine examination, was free of complaints even on effort. His past history was negative and, except for the arrhythmia, the clinical examination and the chest x-ray were normal. The electrocardiogram showed a ventricular repetitive tachycardia pattern: after every 1 to 2 sinus beats, bouts of 3 to 4 ventricular premature contractions from one focus appeared at the rate of 150 beats a minute (Fig. 2B). He was given antiarrhythmic treatment (quinidine, pronestyl) for a prolonged period without success. When seen three years later, though he had received no drug therapy for a long time, the electrocardiogram showed normal sinus rhythm.

Case 4 A 15-year-old boy was referred to us because of tachycardia. He is well developed and his activity is not limited in any way. The clinical investigation including chest x-ray was quite normal except for the arrhythmia. The electrocardiogram showed the typical characteristic pattern of ventricular repetitive tachycardia with bouts of 10 to 20 beats interrupted by one or two normal sinus beats. The ventricular rate varied

FIG. 1 Three cases of supraventricular repetitive tachycardia.

(A) Case 1, (B) Case 2, and (C) Case 5.

between 120 and 150 beats a minute (Fig. 2A). On propranolol, 10 mg. 3 times daily, his rhythm reverted to normal, but with interruption of treatment, even for one day, the arrhythmia returned.

Case 5 A 66-year-old woman was admitted to hospital because of dizziness and an increased rate of palpitations during the last year. Except for the arrhythmia, her physical examination, laboratory tests, and chest x-ray were normal. Blood pressure was 170/80 mm. Hg. The electrocardiographic pattern was a supraventricular repetitive tachycardia with a few beats a bout and a ventricular rate of 120 to 160 (Fig. 1C). After treatment with dimenhydrinate her rhythm reverted to sinus.

Case 6 A 66-year-old man from Eastern Europe with a history of palpitations for 5 years.

FIG. 2 Two cases of ventricular repetitive tachycardia.

(A) Case 4, (B) Case 3, and (C) Case 6. Case 6 shows, in addition to supraventricular repetitive tachycardia, a bout which seems to be of ventricular origin.

He was admitted to hospital because of complaints of dizziness, weakness, and general worsening of his condition. Blood pressure was 150/90 mm. Hg. Apart from tachycardia, the clinical examination, laboratory, and x-ray investigations were normal. On electrocardiogram, we found a supraventricular repetitive tachycardia pattern with a bout of 5 to 15 beats and a ventricular rate of 140 to 240 (Fig. 2C). When the patient returned for follow-up 2 years later he was in normal sinus rhythm. He had received no treatment during this period.

Special examinations

Effort tests We were impressed with the story of the first patient, the young girl aged 18: not only did she deny any subjective complaints, but she stressed feeling especially well during intense physical effort. We therefore investigated the effect of effort on her arrhythmia. She was subjected to an ergometric examination with increasing work loads. During the whole performance she felt well, and starting with a load of 50 watts, the rhythm changed to sinus with a rate of 130 beats a minute in contrast to the rate of 150 to 175 during the ectopic rhythm at rest (Fig. 3). After subcutaneous injection of 0.5 mg. atropine, the rhythm remained ectopic, but the rate slowed to 90 beats a minute. Unfortunately, intravenous atropine was not attempted.

All the young patients underwent similar ergometric trials, while the two older patients performed the Master two-step test. In 5 of the 6 patients normal sinus rhythm appeared on effort with a much slower rate than during their arrhythmia at rest. The one patient (Case 2) who did not convert to sinus rhythm reported no complaints during exercises.

Amyl nitrite When the 66-year-old man was admitted to hospital (Case 6), the presumptive diagnosis was arteriosclerotic coronary heart disease. The bouts of tachycardia were thought to be the presenting symptom of his coronary insufficiency, possibly due to transient ischaemia of the sinu-atrial node. The patient was therefore given a trial of coronary vasodilatory drugs. After the inhalation of amyl nitrite, when he felt flushed, his rhythm returned to sinus briefly, and as soon as the effect of the drug ceased he reverted to the arrhythmia (Fig. 4). This test with amyl nitrite or nitroglycerin was performed several times and always yielded a positive, though transient, result.

Two more patients were so tested, Case 1, the 18-year-old girl, and Case 5, the 66-year-old woman. Both patients passed transiently from ectopic to sinus rhythm at the height of the drug activity.

Treatment Two patients (Cases 1 and 6) received no treatment. Two patients (Cases 2 and 3) received quinidine or pronestyl (procainamide) with no change in the arrhythmia. Case 5, with complaints of dizziness, received dimenhydrinate and sinus rhythm returned. Two patients (Cases 2 and 4) were given propranolol (oral). Case 2

FIG. 3 Case 1 during exercise test (see text).

suffered from palpitations for several years, and was under our observation for over one year during which time all his examinations revealed repetitive tachycardia. He received quinidine therapy for a long period, and only on one occasion converted to sinus rhythm for two days. In spite of continuation of quinidine therapy at even higher doses, he remained in arrhythmia. However, a short time after he received one dose of propranolol - 10 mg. (oral), he returned to sinus rhythm which he maintained on a 20 mg. dosage daily. After several months he stopped treatment and remained in normal sinus rhythm for a few weeks after which the arrhythmia reappeared. At that time he again responded to propranolol. At the last examination he had been without propranolol for three months and was still in sinus rhythm.

Case 4, the 15-year-old boy, active, without complaints despite rapid ectopic rhythm, was also treated with propranolol. After a dosage of 30 mg. (oral) a day, he returned to and remained in sinus rhythm. When the dose was decreased to 20 mg. a day, the ectopic rhythm returned, only to disappear when the dose was again raised to 30 mg. a day. Since then he has taken the drug almost continuously with good and persistent results. However, if treatment is stopped for one day, the arrhythmia returns only to convert to sinus when medication is resumed.

Discussion

The characteristic pattern of repetitive tachycardia is that of bouts of ectopic tachycardia which are separated by a few beats of sinus rhythm. All our cases fulfil this criterion.

It is known that the ventricular type of repetitive tachycardia is rare. In this report two of our cases had ventricular repetitive

FIG. 4 Case 6, effect of amyl nitrite.

tachycardia while the other four showed the supraventricular pattern. It is worth while mentioning that in one of the four cases of supraventricular repetitive tachycardia, bursts of what seemed to be ventricular tachycardia also appeared on two occasions (Fig. 2C, Case 6). But even with this characteristic pattern, it is often difficult to decide if we are dealing with multiple repeated attacks of 'ordinary' paroxysmal tachycardia rather than the repetitive form. Persistence of the arrhythmia of at least 30 days is most usually required by most authors for the diagnosis of repetitive tachycardia (Cass, 1967). All our cases conform to this criterion: 2 of them had the arrhythmia for at least 3 months and the remaining 4 for over 1 year.

In accordance with the diagnostic criterion, the 4 young patients did not show any signs of organic heart disease. Though the 2 older patients were routinely diagnosed as arteriosclerotic coronary heart disease, their clinical examination, chest x-ray, and laboratory investigations failed to reveal any pathological findings except for the tachycardia.

Most authors stress the fact that patients with repetitive tachycardia are intolerant to effort causing increased tachycardia, palpitations, weakness, and dizziness (Langendorf and Pick, 1954; Bellet, 1953), though out of 40, only in 7 were the symptoms severe enough to restrict physical activity (Parkinson and Papp, 1947). Our first patient remained in excellent condition during strenuous effort. Indeed, graded exercise proved not only her good tolerance but the conversion to sinus rhythm. This proved to be true in all the other patients as well.

As mentioned before, the 2 older patients reacted well to amyl nitrite or nitroglycerin with transient conversion to sinus rhythm. So did the young girl aged 18. It is obvious that in the latter the suspicion of coronary heart disease is untenable.

It is known that both vagal and sympathetic influences may cause or terminate arrhythmias (Scherf and Chick, 1951; Daggett and Wallace, 1966). We believe that in our patients we are dealing with an imbalance of the autonomic nervous system which causes the ectopic action of the heart. The good effect of effort and amyl nitrite seems to indicate vagal predominance. Acetylcholine depresses the automaticity in the sinus node by decreasing the slope of phase 4 of the transmembrane action potential and increasing maximum diastolic potential favouring the appearance of ectopic atrial foci (Daggett and Wallace, 1966; Gibson and Sowton, 1969). In addition, the stimulation of the vagus causes a

FIG. 5 Case 2, effect of propranolol.

non-uniform recovery of the atria with the appearance of ectopic beats, increasing thereby the possibility of repeated discharges and fibrillation. The influence of catecholamines is antagonistic to vagal stimulation and neutralizes the effects of acetylcholine. During the depression of the sinus node by the vagus, the action of the blood catecholamines may accelerate the return of the sinus rhythm (Singer and Ten Eick, 1969). Both effort and nitrites cause liberation of catecholamines—the effort directly and the nitrites by reflex (Goodman and Gilman, 1965; Stuckey, Levine, and Vassalle, 1969).

It is reasonable to assume that the influence of nitrites is similar to that of effort, and that both by their sympathomimetic influence depress the vagal cholinergic hyperfunction. In this connexion, it is worth while mentioning the apparently paradoxical action of the injection of atropine in the first patient, with slowing of the ventricular rate, as well as the conversion of the ectopic rhythm to sinus with dimenhydrinate (an anticholinergic drug) in the elderly woman described.

Two patients were successfully treated with propranolol. At first, there seems to be a contradiction between the action of this drug (beta-adrenergic blocking – sympatholytic) and the explanation of the good effects of effort and nitrites (sympathomimetic), as suggested above. We have no explanation for this contradiction unless some vague supposition of autonomic dysfunction is considered. The fact is that both patients who responded well to propranolol also showed transient interruption of the tachycardia upon effort. The best explanation seems to be that of direct action of the propranolol on the myocardium with a specific antifibrillatory effect on the atrial muscle which is distinct from the beta blockade. It should be emphasized that a low dosage of propranolol (10–30 mg./day) was given with success to our patient in order to establish normal sinus rhythm in contrast to the high dosage necessary to achieve the beta blocking effect.

References

- Adams, C. W. (1962). Functional paroxysmal ventricular tachycardia. *American Journal of Cardiology*, **9**, 215.
- Bellet, S. (1953). *Clinical Disorders of the Heart Beat*. Lea and Febiger, Philadelphia.
- Cass, R. M. (1967). Repetitive tachycardia. A review of 40 cases with no demonstrable heart disease. *American Journal of Cardiology*, **19**, 597.
- Daggett, W. R., and Wallace, A. G. (1966). Vagal and sympathetic influences on ectopic impulse formation. In *Mechanisms and Therapy of Cardiac Arrhythmias: The Fourteenth Hahnemann Symposium*, p. 64. Ed. by L. S. Dreifus, W. Likoff, and J. H. Moyer. Grune and Stratton, New York.
- Gibson, D., and Sowton, E. (1969). The use of beta-adrenergic receptor blocking drugs in dysrhythmias. *Progress in Cardiovascular Diseases*, **12**, 16.
- Goodman, L. S., and Gilman, A. (1965). *The Pharmacological Basis of Therapeutics*, 3rd ed. Macmillan, New York.
- Langendorf, R., and Pick, A. (1954). Cardiac arrhythmias in infants and children. *Pediatric Clinics of North America*, p. 215.
- Morgan, C. L., and Nadas, C. L. (1964). Chronic ectopic tachycardia in infancy and childhood. *American Heart Journal*, **67**, 617.
- Parkinson, J., and Papp, C. (1947). Repetitive paroxysmal tachycardia. *British Heart Journal*, **9**, 241.
- Scherf, D., and Chick, F. B. (1951). Abnormal cardiac rhythms caused by acetylcholine. *Circulation*, **3**, 764.
- Singer, D. H., and Ten Eick, R. E. (1969). Pharmacology of cardiac arrhythmias. *Progress in Cardiovascular Diseases*, **11**, 488.
- Stuckey, J. H., Levine, M. J., and Vassalle, M. (1969). On the sympathetic control of ventricular automaticity. *American Journal of Cardiology*, **23**, 822.