Paroxysmal Atrial Tachycardia with Atrioventricular Block
Its Frequent Association with Chronic Pulmonary Disease

By Leonard M. Goldberg, M.D., J. David Bristow, M.D., Brent M. Parker, M.D., and Leonard W. Ritzmann, M.D.

Paroxysmal atrial tachycardia with atrioventricular block (PAT with block) has been recognized more often in recent years since Lown and Levine clarified its diagnostic criteria and emphasized its important relation to digitalis excess. The present report was prompted by the increasing frequency with which this diagnosis has been made at our hospital and its common association with chronic pulmonary disease.

Methods and Materials
The electrocardiographic files at the Portland, Oregon, Veterans Administration Hospital were reviewed for records demonstrating PAT with block. The 5-year period from January 1954 to April 1959 was covered. In those cases found, the clinical, laboratory, and autopsy data were abstracted from the hospital charts. Emphasis was placed upon the type of heart disease present, details of digitalis and diuretic therapy, treatment and course of the arrhythmia, and outcome of the basic disease process. The electrocardiograms were analyzed for details of the arrhythmia, including atrial and ventricular rates, configuration of the atrial complexes, types of A-V block, and associated rhythm disturbances.

The diagnosis of PAT with block was made solely on the basis of the electrocardiogram (fig. 1). We utilized the criteria of Lown and Levine, which include atrial rates of 150 to 250 per minute; varying degrees of atrioventricular block (usually 2:1, Wenckebach, or varying in type); P waves that are upright in leads II, III, and aV F, and altered in configuration from those preceding development of the arrhythmia; an isoelectric baseline between the P waves and a P-P interval that may be slightly irregular. The degree of A-V block may be increased by carotid massage or decreased by atropine or exercise. Ventricular premature contractions may be present. Since quinidine may slow the atrial rate of atrial flutter to below 250, we did not include cases in which quinidine had been given prior to development of the arrhythmia.

Results
The diagnosis of PAT with block was established in 37 cases. The patients ranged in age from 33 to 89. Although only 1 patient was female, this sex distribution is consistent with the total population of our hospital. In general, the patients were seriously ill with advanced heart disease. Thirty-four patients had organic heart disease with atherosclerotic, the most common type, present in over one third of the cases. Cor pulmonale was almost as frequent, occurring in 10 cases. In addition, there were 4 cases of hypertensive cardiovascular disease, 2 of rheumatic heart disease, and 1 case each of myocarditis, polyarteritis, congenital heart disease, and dystrophic heart disease (i.e., progressive muscular dystrophy). There were only 3 patients in whom no heart disease could be demonstrated. Two of these were digitalized because of atrial tachycardia and subsequently developed PAT with block. The heart disease was accompanied by congestive heart failure in 33 cases.

An unexpected finding was the high frequency of serious pulmonary disease (table 1); over one half of the patients had significant lung lesions. The most common was advanced obstructive emphysema, present in 10 patients; other types included pneumonia, pulmonary embolism, bronchogenic carcinoma, and tuberculosis. A total of 22 lung lesions was found in 20 patients. That the pulmonary...
Paroxysmal atrial tachycardia with A-V block

Figure 1

Characteristics of PAT with block—lead II. The atrial rate is 166. The A-V block is of Wenckebach type. The second, third, and fourth QRS complexes are preceded by P-R intervals of increasing duration. A P wave is buried in the fourth QRS; its ventricular response is blocked. The P waves are notched, peaked, and separated by isoelectric baselines. Two premature ventricular contractions are present.

process was the primary disease in many instances is attested to by the fact that definite electrocardiographic, clinical, or postmortem evidence of cor pulmonale was present in over 25 per cent of the total series. Although we have no statistical data as to the frequency of pulmonary disease in our digitalized patients, it is our impression that the occurrence of PAT with block in this group represents a higher incidence than would be expected by chance alone, since the distribution of diagnostic categories in our institution is approximately that seen in most general medical and surgical Veterans Administration Hospitals.

The basic electrocardiographic diagnosis of the series encompassed a wide variety of abnormalities. Fourteen cases had nonspecific ST-T abnormalities consistent with myocardial disease or associated digitalis effect. The second most frequent abnormality was right ventricular hypertrophy, present in 7 cases, confirming the previously mentioned high incidence of cor pulmonale. "P-pulmonale" (tall peaked P waves in leads II, III, and aVr) was also seen to be frequent after the arrhythmia disappeared. P-pulmonale and right ventricular hypertrophy did not always coexist. The remaining electrocardiograms demonstrated left bundle-branch block, right bundle-branch block, myocardial infarction, and left ventricular hypertrophy, all in approximately equal numbers.

The PAT with block was characterized most commonly by atrial rates between 120 and 200 per minute (table 2). Two patients had atrial rates of 115 and 6 had rates between 200 and 240 (fig. 2). These cases were otherwise typical of PAT with block. In almost two thirds of the group the ventricular rate was less than 100, and in only 1 instance was it above 150 per minute. All types of A-V block, from first degree to complete, were recorded, and in many cases there was a shift from one type to another. The predominant type of A-V block was 2:1 (15 cases); changing block and Wenckebach phenomenon were present in almost equal numbers. As a consequence of the relatively slow ventricular rate and the occasionally regular ventricular rhythm (2:1 block) an arrhythmia was frequently unsuspected at the bedside. Indeed, it was often discovered in an electrocardiogram obtained for other purposes. When the rate was more rapid and the block changing, atrial fibrillation was occasionally simulated.

PAT with block was the sole rhythm disturbance in only 6 instances. Premature ventricular contractions, often a sign of digitalis excess, occurred concomitantly in 18 cases. A variety of other arrhythmias, predominantly
PAROXYSMAL ATRIAL TACHYCARDIA

Table 1

<table>
<thead>
<tr>
<th>Types of Pulmonary Disease</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstructive emphysema</td>
<td>10</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>3</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>2</td>
</tr>
<tr>
<td>Bronchogenic carcinoma</td>
<td>2</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>2</td>
</tr>
<tr>
<td>Fibrothorax*</td>
<td>1</td>
</tr>
<tr>
<td>Polyarteritis</td>
<td>1</td>
</tr>
<tr>
<td>Granulomatosis</td>
<td>1</td>
</tr>
</tbody>
</table>

*Chronic tuberculous pleuritis with absent expansion of the right hemithorax.

supraventricular, either preceded or followed by the PAT with block. Some of these, such as A-V dissociation and A-V nodal rhythm, also were thought to corroborate the suspicion of digitalis intoxication.

At the time of development of PAT with block all but 1 of the patients were receiving digitalis. Although it was often difficult to establish the presence of digitalis toxicity, especially in retrospect, review of the records revealed that in 22 patients there were clinical reasons in addition to the arrhythmia to suspect digitalis toxicity. It was of interest that all types of digitalis preparations were represented in the group. In 22 cases diuretics had also been administered shortly before the arrhythmia appeared. Nevertheless, the serum potassium was reduced (less than 3.5 mEq. per liter) in only 4 of the 23 patients in whom it was measured prior to potassium therapy.

PAT with block was managed by stopping digitalis or by administering potassium salts in 31 cases. Nine patients received procaine amide or quinidine in addition. Of this total of 31, only 3 died with the arrhythmia persisting. In the remaining 6 patients the rhythm disorder was not recognized and therefore not treated, and 4 of this group died with it still present. Despite the fact that only 7 patients died without conversion of the arrhythmia, 18 were dead within 1 month after development of the PAT with block, and a total of 22 died within 1 year. These figures point out the seriousness of the underlying heart disease with which PAT with block is usually associated.

Table 2

| Electrocardiographic Characteristics of Thirty-seven Cases of PAT with Block |
|-------------------------------|---|---|---|---|---|
|                               | Rate per minute | Less than 100 | 100-200 | 121-150 | More than 200 |
| Atrial                        |               | 2 | 10 | 19 | 6 |
| Ventricular                   |               | 23 | 5 | 8 | 1 |
| Type of A-V block             |               | 2:1 | 15 |
|                               |               | Varying | 11 |
|                               |               | Wenekebach | 9 |
|                               |               | Complete | 2 |

Discussion

The principal arrhythmias with which PAT with block may be confused are atrial flutter, atrial tachycardia, and sinus tachycardia. The absence of a constantly undulating baseline, the presence of upright P waves in leads II, III, and aVF, and an atrial rate less than 250 are features that help to distinguish PAT with block from atrial flutter. Occasionally there may be confusion when the atrial rate in flutter is slowed by quinidine therapy. In this instance, however, the previous records and the clinical history will be of diagnostic importance. Careful examination of the electrocardiograms will reveal the evidences of A-V block that separate the disorder under discussion from paroxysmal atrial tachycardia or sinus tachycardia. A changed configuration of the P waves will also help to differentiate this entity from sinus tachycardia with A-V block.

Although the atrial rate in PAT with block is ordinarily said to be 150 to 250,1,3 12 of our cases had rates less than 150 per minute. In 2 of these the rate was 115 per minute, but all the other criteria for the diagnosis were met. Indeed, Lown et al.3 in their recent series of 23 cases listed 9 in which the atrial rates were less than 150, with one as low as 100. Thus, we think that the usually stated range should be broadened to encompass slower atrial rates.

Since the ventricular rates in our cases were rarely greater than 120 and generally less than 100 per minute, it seems unlikely that the arrhythmia itself was directly detri-
PAT with block displaying rapid atrial and ventricular rates in a patient with cor pulmonale. PAT with Wenckebach type of A-V block developed on 9/27/55 and was present the following day with a more rapid ventricular rate. Lead V2 best shows the P waves. Sinus rhythm was restored 10 minutes after procaine amide and potassium therapy was begun.

Treatment started with infusion of 40 meq KCl in 5% G/DW, I.V., and 0.5 gm. Pronestyl, IM.

10 min. later: - A - 150. V - 150

35 min. later: - A - 120. V - 120

PAROXYSMAL ATRIAL TACHYCARDIA WITH BLOCK
T.M., age 53. Emphysema with Cor Pulmonale. Digitalis Intoxication.

9-14-55.
Sinus rhythm.
A - 107. V - 107

9-27-55. Atrial tachycardia with block and PVC's.
A - 214. V - 160

9-28-55.
A - 214. V - 200

ARTIFACT

Figure 2

mental to cardiac function and blood flow. Its importance, rather, was that it denoted potentially dangerous digitalis toxicity. Because PAT with block accompanied serious heart disease, the prognosis for the patients in whom it occurred was usually, though not always, grave.

The association of PAT with block and digitalis toxicity has been clearly elucidated, as has the response to potassium therapy.\textsuperscript{1-11} Our results are confirmatory in both respects (fig. 3). There was evidence of digitalis toxicity in almost two thirds of the patients, and the arrhythmia ceased after withdrawal of digitalis and administration of potassium in 28 of 31 patients. A low serum potassium was not demonstrated in most of our patients despite prior diuretic therapy. It is known, however, that in nearly all chronic diseases, including congestive heart failure, the total body exchangeable potassium is low,\textsuperscript{15} a state well known to potentiate rhythm disorders by increasing the effect of digitalis.\textsuperscript{5, 16}

Although digitalis toxicity is usually incriminated as a mechanism in the genesis of this arrhythmia, a number of cases have been reported in which digitalis was not being given at the time this rhythm disturbance...
occurred.\textsuperscript{13, 17} At least 2 of our cases fit this category.

One of the most interesting features of our group was the association of PAT with block and serious pulmonary disease. As stated previously, there were 20 patients in whom the conditions coexisted and 10 in whom the major cardiologic diagnosis was cor pulmonale. An association of PAT with block and chronic lung disease has not been described heretofore. Although some authors have expressed the opinion that arrhythmias are infrequent in the presence of cor pulmonale,\textsuperscript{12, 18, 19} our view is to the contrary. Recent studies tend to confirm this impression. Corazza and Pastor\textsuperscript{20} reported that 31 per cent of 122 patients with pulmonary heart disease had arrhythmias. It is known that acidosis, anoxia, pulmonary hypertension, and distention of the right atrium and great veins, any or all of which may exist in the presence of serious pulmonary heart disease, may be associated with increased atrial irritability and stimulation of ectopic pacemakers. In addition, patients with cor pulmonale tend to respond poorly to medical measures, so that digitalis may be given in larger than usual amounts in an attempt to improve right heart failure. Baum et al.\textsuperscript{22} have reported that of 29 patients with pulmonary insufficiency, 8 exhibited evidences of digitalis toxicity that they attributed to anoxia. Whatever the cause, we think that one should be especially assiduous in watching for PAT with block in digitalized patients with cor pulmonale.

**Summary**

Paroxysmal atrial tachycardia with block is a cardiac arrhythmia that is usually a manifestation of digitalis toxicity in patients with
serious heart disease. The arrhythmia generally ends promptly after potassium administration and withdrawal of digitalis. Since the ventricular rates may be slow and regular, the arrhythmia may be difficult to recognize clinically. Atrial rates as slow as 115 per minute may be seen in cases which are otherwise typical of the condition.

In our series associated pulmonary disease was present in 54 per cent and cor pulmonale in 27 per cent of the cases.

**Summario in Interlingua**

Paroxysmiae tachyeardia atrial con bloco es un arrhythmia cardiæ que usualmente representa un manifestation de toxicitate per digitalis in patientes con serie morbo cardiæ. Iste arrhythmia se termina promptemente in le majoritate del casos post le administration de kalium e le suppression de digitalis. Proque le frequentia ventricular pote esser lente e regular, il occurre que iste arrhythmia es difficile a reconocere clinicamente. Frequentias atrial de non plus que 115 per minuta ha esite observe in casos que es alteremente typic del condition.

In nostre serie, associate morbo pulmonar esseva presente in 54 pro cento e corde pulmonale in 27 pro cento del casos.

**References**

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LEONARD M. GOLDBERG, J. DAVID BRISTOW, BRENT M. PARKER and LEONARD W. RITZMANN

Circulation. 1960;21:499-504
doi: 10.1161/01.CIR.21.4.499

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