Electrocardiographic Alterations Observed During Fractional Pneumoencephalography

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The occurrence of electrocardiographic changes during pneumoencephalography has been well documented.1–3,8,29 There have been variations in the reported electrocardiographic changes both in type and frequency. Many types of electrocardiographic changes have been reported as occurring during subarachnoid air studies of the intracranial cavities. These include sinus tachycardia and bradycardia, sinus arrhythmia, atrioventricular disassociation, nodal rhythm, atrial flutter, and premature ventricular and premature atrial contractions. In addition to the changes in rhythm, alterations in contour of P-waves, QRS complexes, S-T segments, T-waves, U-waves, QRS amplitude and electrical axis shifts have been observed.

Previous reports have indicated the use of a parasympatholytic drug as part of premedication in all patients. The majority of the electrocardiograms were taken preceding and following the air studies. Very few electrocardiograms have been taken serially during the pneumoencephalographic study and in association with the technique of fractional air study.

This report will include a review of the literature regarding electrocardiographic changes in association with pneumoencephalography and the results of our observation of the serial electrocardiographic changes occurring during fractional pneumoencephalography without the patients having received atropine or atropine-like drugs. This will be a group of patients who are in a good state of general health and having air studies for evaluation of cerebral seizures or as preliminary study to demonstrate anatomical landmarks preceding thalamotomy for involuntary movements, and for precocious puberty in one case.

Procedure

The patients received nothing by mouth at midnight on the night preceding their study. If the study was 1:00 p.m., they received clear liquids at 8:00 a.m.; if the air study was 9:00 a.m., they received nothing by mouth. Premedication was given 1 hour preceding the study and consisted of Demerol 35 to 75 mg. and Sodium Nembutal 60 to 120 mg., depending on weight and age.

Twelve lead electrocardiograms were taken on admission to the hospital, immediately preceding the air study, and immediately after completion of the air study. The limb leads remained attached to the patient during the air study and VS was applied periodically. Serial tracings were obtained during and following the fractional air-cerebrospinal fluid exchange.

The patients were seated in a pneumoencephalographic chair and the L3–L4 interspace was infiltrated with 1 per cent Xylocaine and a 18 spinal needle was inserted into the lumbar subarachnoid space. Five cc. of air were injected very slowly with the head flexed forward to 30° to 45° so as to fill the 4th ventricle and aqueduct. This first tracing would be taken usually during the time air was in the 4th ventricle, aqueduct and entering the 3rd ventricle.

Fractional exchange of 10 cc. aliquots then would be performed, keeping 10 cc. more of air in than amount of cerebrospinal fluid removed. Serial electrocardiograms, always lead II with other leads intermittently, would be obtained. The amount of air injected varied from 35 to 75 cc.

Analysis of Patients

This study includes 12 patients varying in ages from 7 to 60 years; 9 were males and 3 were females. All of their initial electrocardiograms were within normal limits; none had significant complaints or symptoms referable to their cardiovascular systems. Their basal blood pressures, pulses, clinical diagnoses, electroencephalographic tracings,
medications, and pneumoencephalographic and arteriographic findings are reported in Table 1.

Results

The electrocardiographic changes observed in pneumoencephalography are listed in Table 2.

The major changes in 12 patients during fractional pneumoencephalography are summarized in Table 3. Continuous electrocardiographic tracings were obtained and their analysis was summarized at intervals corresponding to the injection of 5 cc., 15 cc., 30 cc., 40 cc., and 55 cc. or more air into the lumbar subarachnoid space.

With the exception of 2 patients there were no significant changes in the electrocardiogram during the injection of 15 cc. of air except minimal changes in rate with corresponding Q-T and T-P interval changes. In 1 patient (R.S.) P-wave changes developed after the injection of 5 cc. of air. There was an increment in the duration and amplitude (Fig. 1). The marked changes occurred in patient G.U., a 7-year-old boy with precocious puberty and radiographic evidence of a pinealoma. His rate dropped from 148 to 88, his P-R interval from .16 to .14, a depression of the S-T segment developed, and there were striking T-wave and T-P interval changes. A sinus arrhythmia developed also with sinus arrest and A-V nodal escape beats (Fig. 2).

At the 15 cc. injection interval, 11 patients had a change in rate: in 1 a sinus bradycardia developed, and in 10 there was a sinus tachycardia. Patient G.U. continued to have sinus arrhythmia with a shifting atrial focus and a pattern of aberrant intraventricular conduction developing (Fig. 3).

After 30 cc. of air were injected, there were minor changes in rates and their corresponding Q-T and T-P intervals. Two patients gradually slowed from a sinus tachycardia to a normal sinus rhythm. Accentuation and development of Q-waves in leads II, III and AVF occurred after 38 cc. of air in patient T.T. (Fig. 4).

After injection of 40 cc. of air, only 6 patients had a sinus tachycardia, 3 had a sinus bradycardia, 5 additional patients demonstrated changes in rhythm other than fluctuation in rate. There were T-wave changes in 5 patients, P-wave changes in 3, and P-R interval changes in 2 patients. Fig. 5 illustrates P-wave changes suggestive of an ectopic focus.

After the injection of 55 cc. or more of air, a total of 5 patients had a sinus bradycardia, only 1 had a sinus tachycardia, 5 demonstrated changes in rhythm, there were S-T segment changes in 4, T-wave changes in 5 patients, and P-wave changes in 3. The P-R interval demonstrated changes in 3 patients.

The changes in rhythm consisted of sinus arrhythmia, and a premature auricular contraction in 1 case. Nodal rhythm with retrograde P-wave conduction occurred in 1 patient (Fig. 6). Sinus arrest occurred in 3 patients. In 3 patients a transient wandering pacemaker developed with an ectopic focus (Figs. 7 and 8). Fig. 8 also illustrates an A-V nodal beat followed by a premature ventricular contraction.

In this study there were P-wave changes in 4 patients. One patient had the pattern of P-pulmonale demonstrated in Fig. 1. The P-wave in 3 patients showed changes in amplitude, duration and contour.

The T-wave changes that occurred in 5 patients were characterized by flattening in 3 and by inversion in 1. Another patient demonstrated enlargement of T-waves. The S-T segment changes were characterized by nonspecific flattening and changes in levels of take-off from the initial tracing. Two patients had minimal true depression of the S-T segments 2 mm. below the isoelectric line. There were 2 patients who had minimal changes in the QRS amplitudes during the air injection.

Discussion

Ambrosi, in a study of 10 patients, reported only alteration in heart rate. Abeles and Schneider, commenting on 20 patients, reported electrocardiographic alterations in