Arrhythmias from Fiberoptic Bronchoscopy*

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The electrocardiogram was monitored in 51 patients during fiberoptic bronchoscopic procedures and was compared to recordings made before premedication. Sixteen of the patients had heart disease. During the bronchoscopic procedure, the heart rate increased by 154 ± 5 percent (± SE). The frequency of atrial ectopic beats was minimally increased, by an average 0.15 ± 0.12 beats per minute (not significant). Ventricular ectopic beats became less frequent during the bronchoscopic procedure (−0.17 ± 0.41 beats per minute; not significant), and there was no ventricular tachycardia. Frequent ventricular ectopic beats were seen mainly during bronchoscopic procedures in patients with coronary heart disease, but even in this group, ventricular ectopic beats became less frequent than at rest (−1.13 ± 1.46 beats per minute; not significant). The nearly uniform sinus tachycardia that was observed was well tolerated but could predispose coronary patients to ischemia; however, the fiberoptic bronchoscopic procedure per se does not enhance prior ectopy.

Major complications during fiberoptic bronchoscopic procedures are unusual (0.08 percent), and mortality is rare (0.01 percent).1 Cardiac arrhythmias account for the majority of the serious complications and deaths reported.2 Bradycardias, ventricular ectopic beats, ventricular tachycardia, and “cardiac arrest” have been described1,2

The arrhythmias described during fiberoptic bronchoscopic procedures have been associated with general anesthesia, administration of tetracaine, hypoxia, and unsuspected acute myocardial infarction.1,4 The procedure itself may not have caused the arrhythmias observed. The purpose of this investigation is to determine whether the fiberoptic bronchoscopic procedure itself enhances ectopy or endangers patients at risk for serious tachycardias.

MATERIALS AND METHODS

Cardiac rhythm was evaluated in 51 consecutive patients undergoing fiberoptic bronchoscopic procedures. Thirty-five patients had no clinical evidence of heart disease. Thirteen had coronary heart disease, ten of whom had electrocardiographic evidence of an old infarction. Three patients with other forms of heart disease were separately considered. The clinical features of the patients studied are summarized in Table 1.

Therapy with bronchodilator and cardioactive medications was discontinued at least 24 hours prior to the bronchoscopic procedure. Premedication administered intramuscularly 30 minutes before the bronchoscopic procedure consisted of 0.5 to 1.0 mg of hydromorphone hydrochloride (Dilaudid) and, in 43 patients, 0.5 to 0.6 mg of atropine sulfate. Four milliliters of a 4 percent solution of lidocaine was used to anesthetize the pharynx, and 2 ml of a 2 percent solution of lidocaine was used to anesthetize the vocal cords. Supplemental lidocaine was given as needed to suppress coughing.

No more than 400 mg of lidocaine was administered topically (average dose, 274 mg). These doses of lidocaine, when applied to the respiratory mucosa, are thought not to result in antiarrhythmic levels (>1 μg/ml) in the blood.4–8

The bronchoscopic procedure was performed with a 6-mm flexible fiberoptic bronchoscope (Olympus BF-5B/2). A direct transnasal approach was used in 50 patients and an approach via a tracheostomy tube in one. The mean duration of the procedure was the same for those with and without heart disease (Table 1).

A resting 12-lead ECG was recorded before premedication.

Table 1—Clinical Features of Patients Monitored during Bronchoscopic Procedures

<table>
<thead>
<tr>
<th>Data</th>
<th>No Heart Disease</th>
<th>Coronary Heart Disease</th>
<th>Other Heart Disease</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>35</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>Sex ratio, M/F</td>
<td>21/14</td>
<td>11/2</td>
<td>2/1</td>
</tr>
<tr>
<td>Mean age, yr (± SD)</td>
<td>55±17</td>
<td>70±12</td>
<td>35±6</td>
</tr>
<tr>
<td>No. with chronic pulmonary disease</td>
<td>8</td>
<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Mean duration of bronchoscopic procedure, min (± SD)</td>
<td>19±8</td>
<td>22±11</td>
<td>25±10</td>
</tr>
</tbody>
</table>

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and included five to ten continuous minutes of lead 2 or lead V₁ (or both). The monitored lead was also continuously recorded throughout the bronchoscopic procedure, and both recordings were carefully analyzed by direct inspection. Atrial and ventricular ectopic beats were separately described in terms of their frequency (number of ectopic beats per minute recorded).

Statistical comparisons were made with an unpaired t-test, and the frequencies of ectopic beats before and during the bronchoscopic procedure were compared with a paired t-test. The frequency of ectopic beats was compared with the heart rate and the dose of lidocaine using linear regression analysis.

RESULTS

Heart Rate

The fiberoptic bronchoscopic procedure caused sinus tachycardia in 46 of 51 patients (Fig 1). Maximal heart rates ranged from 78 to 166 beats per minute (average, 125 beats per minute), representing an increase in heart rate of 154 ± 5 percent (± SE). The increase in the heart rate was not significantly greater among patients receiving atropine (158 ± 5 percent).

Thirteen patients had coronary heart disease, with two suffering myocardial infarction one and two weeks subsequent to the bronchoscopic procedure. The maximum heart rate among patients with coronary heart disease averaged 128 beats per minute, an increase of 146 ± 8 percent; however, no patient achieved 90 percent of the maximum heart rate predicted for his age (from data obtained by exercise testing for angina pectoris⁹). None had pain in the chest during the procedure.

There were 27 patients with neither heart disease nor chronic pulmonary disease, and their average maximum heart rate was 127 beats per minute. The maximum heart rate was not greater among those with chronic pulmonary disease (122 beats per minute) or with hypertension (118 beats per minute).

Asymptomatic bradycardia (30 beats per minute) was observed briefly in one patient without cardiac disease during the passage of the bronchoscope to the carina. His resting heart rate had been 60 beats per minute, he had received atropine, and he later achieved a heart rate of 130 beats per minute. Atrioventricular block was never observed.

Atrial Arrhythmias

Atrial ectopic beats were recorded in 20 patients (Fig 2) and were observed for the first time during the bronchoscopic procedure in 14 of these patients. One patient had a four-beat run of atrial tachycardia; however, overall, there was only a small increase in the frequency of atrial ectopic beats during the fiberoptic bronchoscopic procedure ( +0.15 ± 0.12 atrial ectopic beats per minute; not significant).

Figure 2 suggests that the bronchoscopic procedure caused atrial ectopic beats primarily in the group with coronary heart disease; however, five of the seven patients with coronary heart disease who had enhanced atrial ectopy also had obstructive pulmonary disease. In fact, the frequency of atrial ectopic beats increased to a greater extent in the group with chronic pulmonary disease ( +0.57 ±
0.43 beats per minute) than in other patients ($P < 0.025$).

Patient 38 (Fig 2) had the most striking increase in atrial ectopy. Although atrial ectopic beats were not recorded on the ten-minute tracing before the bronchoscopic procedure in patient 38, paroxysmal atrial flutter had previously been documented; however, flutter was not seen during the bronchoscopic procedure. Two other patients with a history of paroxysmal atrial fibrillation had only infrequent atrial ectopic beats (0.03 and 0.5 per minute) during the bronchoscopic procedure.

**Ventricular Arrhythmias**

Ventricular ectopic beats were observed in 19 patients during the fiberoptic bronchoscopic procedure (Fig 3) but were recorded for the first time during the bronchoscopic procedure in only six patients. Nine of the 19 patients with ventricular ectopic beats and two of the six with ventricular bigeminy during bronchoscopic procedure. Patient 48 had sustained two previous cardiac arrests.

**Figure 2.** Frequency of atrial ectopic beats before and during fiberoptic bronchoscopic procedure. *Arrowheads* point toward frequency recorded during bronchoscopic procedure, and *double arrowheads* indicate patients without ectopic beats. Patient 38 had previously demonstrated atrial flutter.

**Figure 3.** Frequency of ventricular ectopic beats before and during fiberoptic bronchoscopic procedure. *Arrowheads* point toward frequency recorded during bronchoscopic procedure, and *double arrowheads* indicate patients without ectopic beats. Patients 36, 40, and 51 had ventricular bigeminy during bronchoscopic procedure. Patient 48 had sustained two previous cardiac arrests.
ectopic beats restricted to the bronchoscopic period had coronary heart disease. Overall, there was actually a reduction in the frequency of ventricular ectopic beats during the fiberoptic bronchoscopic procedure (−0.17 ± 0.41 ventricular ectopic beats per minute; not significant). In the group with coronary heart disease, there was also a reduction in the frequency of ventricular ectopic beats during the bronchoscopic procedure (−1.13 ± 1.46 ventricular ectopic beats per minute; not significant). One patient had 18 ventricular ectopic beats per minute before and only 0.3 ventricular ectopic beats per minute during the bronchoscopic period. Excluding that patient from analysis, there remained no significant difference in the frequency of ventricular ectopic beats during bronchoscopic procedures in patients with heart disease.

Of particular interest was patient 48 (Fig 3), a 55-year-old man with prior myocardial infarctions. He subsequently survived two cardiac arrests with ventricular fibrillation. His resting ECG showed five unifocal ventricular ectopic beats per minute. This patient underwent 40 minutes of bronchoscopic examination with 3.1 multifocal ventricular ectopic beats per minute but had neither couplets nor ventricular tachyarrhythmias.

There was also no significant change in the frequency of ventricular ectopic beats in the group with chronic pulmonary disease (+0.22 ± 0.37 ventricular ectopic beats per minute; not significant).

The diminished frequency of ventricular ectopic beats during the fiberoptic bronchoscopic procedure might have been related to overdrive suppression by the sinus tachycardia; however, when there were decreases in the frequency of ventricular ectopic beats, these did not correlate linearly with the increases in heart rate (r = 0.03). Furthermore, ventricular ectopic beats often persisted at peak heart rates. Ventricular ectopic beats were reduced to a greater extent in the group receiving atropine but not significantly so. Among those receiving atropine and developing sinus tachycardia, the patients with coronary heart disease showed a greater reduction in the frequency of ventricular ectopic beats than those without heart disease (P < 0.05), but the difference was not significant when the patient changing from 18 to 0.3 beats per minute was excluded.

The diminished frequency of ventricular ectopic beats might have been related to the lidocaine administered during the bronchoscopic procedure, despite the fact that antiarrhythmic levels in the blood are not to be anticipated with the mucosal doses of lidocaine used.1-8 Levels of lidocaine in the blood were not measured; however, patients with extensive ventricular ectopy before the bronchoscopic procedure that tended to disappear during the procedure (patients 10, 42, and 45 of Fig 3) did not receive higher than average mucosal doses of lidocaine (220, 200, and 280 mg, respectively). Moreover, reduction in the frequency of ventricular ectopic beats did not linearly relate to the dose of lidocaine administered (r = 0.12).

Two patients with coronary heart disease (patients 36 and 40 in Fig 3) had runs of ventricular bigeminy during passage of the bronchoscope to the carina (patient 36 also had ventricular bigeminy prior to the bronchoscopic procedure). A patient with mitral regurgitation (patient 51 in Fig 3) had bigeminy before and throughout the procedure. However, despite the fact that 13 patients had ventricular ectopy prior to the bronchoscopic procedure (seven with coronary heart disease), repetitive beating in the form of ventricular tachycardia was never observed.

**Discussion**

One might anticipate that the fiberoptic bronchoscopic procedure presents a serious risk for life-threatening arrhythmias. The population of patients undergoing bronchoscopic procedures tends to be elderly, with a high prevalence of obstructive pulmonary disease and coronary heart disease. These factors are associated with serious arrhythmias.10,11 The procedure is frightening, and the ensuing tachycardia may signal catecholamine stimulation, as well as enhanced myocardial requirements for oxygen. The arterial oxygen tension may decrease as much as 15 to 20 mm Hg.12 Indeed, cardiac arrest and catastrophic arrhythmias have been described during the fiberoptic bronchoscopic procedure.4,8

This study demonstrated frequent ectopic beats during fiberoptic bronchoscopic procedures, but sustained ectopic tachycardias were not seen. The most "serious" arrhythmias recorded were three episodes of ventricular bigeminy; however, avoidance of life-threatening arrhythmias probably resulted in part from the selection of patients; patients were not excluded from the bronchoscopic procedure because of a preexistent arrhythmia, but patients with unstable angina pectoris or severe hypoxia were avoided.

There was nearly uniform sinus tachycardia engendered by the fiberoptic bronchoscopic procedure. We suspect that tachycardia was mediated by a catecholamine response to anxiety and possibly to hypoxia. It seemed not to be caused by premedication with atropine; however, sinus tachycardia was well tolerated, even by patients with coronary heart...
disease, as evidenced by the absence of angina or associated ventricular arrhythmias.

Most of the ectopic beats were recorded in patients with coronary heart disease. Our data suggest that this was because the patients with coronary heart disease were prone to ectopy and not because of the fiberoptic bronchoscopic procedure per se. This conclusion is reached because the fiberoptic bronchoscopic procedure did not cause a significant increase in the frequency of atrial or ventricular ectopic beats. We could not relate the sinus tachycardia engendered by the bronchoscopic procedure to the frequency of ectopic beats. Atropine used as premedication did not seem to accentuate ventricular ectopy. These data are consistent with that of Dahm and colleagues, who performed pulmonary lavage in very young patients via the fiberoptic bronchoscope without noting cardiac irregularities. Thus, the main determinant of arrhythmia appears not to be the procedure itself, but rather the underlying cardiopulmonary status.

Large doses of lidocaine were used topically in our patients. The dosage of lidocaine could not be related to the ectopy seen and was not expected to yield antiarrhythmic levels in the blood, presumably because hepatic metabolism is faster than mucosal absorption; however, we cannot be certain that the failure of the bronchoscopic procedure to enhance ectopic arrhythmias was not in part due to an effect of lidocaine. The prophylactic use of lidocaine in antiarrhythmic doses might even be considered in selected patients.

The true incidence of serious arrhythmias during fiberoptic bronchoscopic procedures will be determined only by monitoring a very large series of patients, because the procedure appears to be safe when careful selection of patients and technique are employed; however, the results of our monitoring suggest the following approach to the arrhythmogenic potential of the fiberoptic bronchoscopic procedure: (1) the fiberoptic bronchoscopic procedure per se did not cause arrhythmia in the absence of heart disease, and in the absence of heart disease, electrocardiographic monitoring appears not to be requisite; (2) preexistent ectopic beats were not a predictor of worsened ectopy during the fiberoptic bronchoscopic procedure, and a previously documented arrhythmia does not contraindicate the procedure; and (3) the fiberoptic bronchoscopic procedure was not shown to consistently enhance prior ectopy in patients with coronary heart disease, and the procedure is not contraindicated when angina is stable. Nevertheless, patients with coronary heart disease probably should still be monitored during the bronchoscopic procedure because the sinus tachycardia that we have observed raises concern about precipitating unheralded ischemic events, with attendant arrhythmias.

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REFERENCES
6. Cohn ML, Smith RB, Sievenpiper T: Concentrations of lidocaine and its metabolites in the blood after endotracheal administration. In The Proceedings of the Fifth World Congress of Anaesthesiologists (publication 261). Amsterdam, the Netherlands, Excerpta Medica, 1972, pp 118-119