

Cardiac Arrhythmias during Anesthesia and Operation

Ronald L. Katz, M.D., and J. Thomas Bigger, Jr., M.D.

A REVIEW of cardiac arrhythmias during anesthesia and operation may produce a distorted picture of the incidence and significance of arrhythmias. To provide a proper perspective for the reader, the conclusions of this review are stated at the outset:

1) Although arrhythmias frequently are seen even in well-managed patients, those requiring treatment are rare.

2) With less-than-optimal anesthetic management, cardiac arrhythmias can be a warning that the patient is in physiologic or pharmacologic distress and that rapid remedial action is necessary. Thus, the onset of an arrhythmia should initiate an immediate evaluation of anesthetic management and surgical events.

3) In general, slow supraventricular rhythms, such as atrial rhythm, AV junctional rhythm, and wandering pacemaker, are benign and do not require treatment. Ventricular arrhythmias should be considered a sign of serious derangement until proven otherwise.

4) The electrocardiographic appearance of an arrhythmia does not necessarily identify the mechanism responsible for the arrhythmia or the circulatory effects of the arrhythmia.

5) Most arrhythmias can be explained in terms of autonomic nervous system imbalances. Sympathetic predominance may occur by increase in sympathetic activity or decrease in parasympathetic activity. Parasympathetic predominance may be absolute or relative.

6) Arrhythmias may be due not only to changes occurring primarily in the heart but also to primary changes in the central nervous system or in the periphery.

History and Incidence

Interest in cardiac arrhythmias during operation goes back at least to the early 1900's. Levy's work on arrhythmias associated with

chloroform is now classic.¹⁻⁴ Heard and Strauss, in 1918,⁵ and Levine, in 1920,⁶ published case reports of arrhythmias in the perioperative period. The focus then changed from individual case reports to reports of groups of patients monitored continuously by electrocardiogram. Lenox *et al.* reported 50 cases in 1922,⁷ Marvin and Poster, 30 in 1925,⁸ Hill, 41 in 1932,⁹ and Kurtz *et al.*, 109 in 1936.¹⁰ More recent studies have reported cardiac arrhythmias in hundreds or thousands of patients.¹¹⁻¹⁴

Dodd *et al.* in 1962,¹¹ reported a 29.9 per cent incidence of cardiac arrhythmias in 569 patients. This incidence was somewhat lower than those reported by others because monitoring was by oscilloscope rather than by examination of permanent tracings. Most of the arrhythmias were slow supraventricular rhythms (atrial rhythm, AV junctional rhythm, wandering pacemakers, sinus arrest with supraventricular escape beats) which occurred in 16.2 per cent of the patients. Premature ventricular contractions were observed in 12.5 per cent of the patients, approximately half of whom had had ventricular extrasystoles preoperatively. The incidence of arrhythmias was higher in patients with heart disease (51.4 per cent) than in those without heart disease (19.9 per cent). Increasing age did not increase the incidence of arrhythmia in patients without heart disease. There were no significant differences in incidence when the primary anesthetic agent was ether, nitrous oxide, cyclopropane, halothane or tetracaine (spinal).

Reinikainen and Pöntinen¹² studied the incidence of arrhythmias in 1,196 patients. With halothane 13 per cent of the patients developed arrhythmias during maintenance. With epidural prilocaine the incidence was 18 per cent, and with neuroleptanalgesia and spontaneous respiration the incidence was 16 per cent. These figures are low compared with the results of other studies, since they represent arrhythmias seen during maintenance of anesthesia. Incidences of arrhythmias associated with intubation varied from 25 per cent to 61

Received from the Departments of Anesthesiology, Pharmacology and Medicine, Columbia University, College of Physicians and Surgeons, and The Presbyterian Hospital in the City of New York, New York, N. Y.

per cent. Thus, the total incidence of arrhythmias probably was greater than 50 per cent.

The best data on incidence of cardiac arrhythmias are probably those of Kurer *et al.*¹³ They used the Holter monitor system to record the electrocardiogram continuously on magnetic tape. A detailed analysis of every beat occurring during anesthesia was made. A hundred and fifty-four consecutive patients undergoing operation were studied. Arrhythmias were recorded during operation in 61.7 per cent of the patients. Preoperative electrocardiograms disclosed that 8 per cent of the patients had arrhythmias before induction of anesthesia. Most arrhythmias were slow supraventricular rhythms; next most common were premature ventricular contractions. In this study there were no significant relationships between arrhythmias and 1) physical status, 2) age, or 3) sex. There were no significant differences between the incidences of new arrhythmias in patients with and patients without preoperative arrhythmias. Interestingly, there was no significant difference between the incidences of arrhythmias in patients with and patients without pre-existing heart disease, and arrhythmias were as common during general anesthesia as during regional anesthesia. Arrhythmias occurred more frequently in patients undergoing operations which lasted more than three hours than in those with shorter operations. There was also a higher incidence in patients whose tracheas were intubated (72.2 per cent vs. 43.9 per cent).

Vanik and Davis¹⁴ recently reported electrocardiographic studies of 5,013 patients. They found the incidences of new arrhythmias were 16.3 per cent in patients with no known preoperative heart disease, 26.6 per cent in patients with known preoperative arrhythmias, and 34.4 per cent in patients with known preoperative heart disease, but without preoperative arrhythmias. The overall incidence was 17.9 per cent. The commonest arrhythmias were slow supraventricular rhythms, with premature ventricular contractions next most common. There were no differences between sexes in incidence of arrhythmias. Arrhythmias were less common in patients less than 30 years old and more common in patients who were intubated (19.8 per cent vs. 15.2

per cent). Twenty per cent of all the arrhythmias occurred during induction (first five minutes of anesthesia). The incidence of arrhythmias during halothane anesthesia was 18.9 per cent; cyclopropane, 24.9 per cent; conduction anesthesia, 19.1 per cent. In patients receiving digitalis preoperatively the incidence of arrhythmias was 43.2 per cent, compared with 17.3 per cent in those not receiving digitalis. In an effort to place the arrhythmia problem in perspective, Vanik and Davis¹⁴ classified arrhythmias as serious or not serious. Only 0.9 per cent of their 5,012 patients had serious arrhythmias.

Several important points emerge from consideration of these representative studies. The reported incidences of arrhythmias have been higher when the ECG was recorded continuously than when it was only observed on the oscilloscope. Higher incidences occurred 1) when the patients had pre-existing arrhythmias or heart disease; 2) when they were intubated; 3) when they had received digitalis; 4) when the operations lasted more than three hours. The type of operation may also affect incidence. For example, in the study of Reinikainen and Pöntinen,¹² a large number of patients underwent eye operations known to be associated with high incidences of arrhythmias (see below). In addition, experience with a given anesthetic agent may affect the incidence. Vanik and Davis¹⁴ reported more arrhythmias with cyclopropane than with halothane, but suggested that this might be due to their greater use and skill in administration of halothane. Of obvious importance, but not always reported, is the adequacy of respiration. Reinikainen and Pöntinen¹² found twice as many arrhythmias with spontaneous breathing as with controlled respiration.

It is interesting that, contrary to expectations, the reported incidence of arrhythmias with regional anesthesia did not differ from that with inhalation anesthetics. Hughes *et al.*,¹⁵ studying patients who received lidocaine for dental anesthesia, found that cardiac arrhythmias occurred in 23 per cent of operations in 65 patients undergoing 77 procedures. The incidence was 33 per cent in patients with known heart disease; it was 17 per cent in patients with normal cardiovascular systems.

In a study of thyroid operations in 220 pa-