MR decreasing the after-load on the muscular element and resulting in an increase in the velocity and extent of myocardial fiber shortening. Implication of ballooning of the posterior leaflet as a mechanism of MR in IHSS would explain several peculiarities: 1) the end systolic mitral regurgitation and the absence of a pansystolic murmur are due to late systolic occurrence of ballooning; 2) pharmacologic intensification of the MR is probably due to a reduction in LV volume. A vicious circle may ensue with the MR reducing the volume of the left ventricle and this reduction resulting in an increase in the MR and in the obstruction; 3) MR in IHSS is asymmetrical and occurs across the posterior leaflet (Fig 1).

In summary, mitral ballooning is probably a common denominator in various entities and may be primary or secondary. Elucidation of its mechanism calls for further investigation.

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**References**


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**Polyparametric Electrocardiography: The Electrocardiography of the Future?**

During the past decade the major changes in medical education have been directed toward integrating the curriculum and assigning "relevance" to educational endeavors. These goals have often been elusive either because the student finds it difficult to master several related disciplines at one time or because the instructor is unable to convey meaningful information outside his own narrow discipline. Dr. Sodi Pallares has overcome the latter problem masterfully in his new book *Deductive and Polyparametric Electrocardiography.*

Dr. Sodi's scientific contributions to electrocardiography, as well as his deductive analysis of electrocardiograms, have stimulated and entertained physicians and electrocardiographers throughout the world. Polyparametric electrocardiography represents a new perspective in electrocardiographic teaching. It is an attempt not only to correlate electrocardiographic changes with alterations in the activation of the myocardium, but with other parameters such as coronary flow, oxygenation of the heart at the cellular level, cellular metabolism, sodium and potassium pump mechanisms, and energy production and utilization.

Changes that occur during the inscription of the QRS-T complex are correlated with the ultrastructure of the cell membrane and its microduct system which facilitates rapid calcium ion transport. The contractile changes that occur during this time interval are discussed in terms of the Huxley sliding filament theory of muscle contraction and mechanism of electromechanical coupling. The energy production and utilization occurring during systole and diastole are discussed in terms of the Krebs cycle and Embden-Myerhof pathways so that the reader will have an understanding of high energy phosphate production and utilization. The failure of these mechanisms in disease states is discussed.

As a specific example, when a current of injury occurs on the ECG, the following polyparametric concomitants occur:

1. The transmembrane action potential becomes shorter and smaller until it disappears.
2. Mechanically this is associated with decreased contractility and systolic ballooning of the injured area.
3. The electrolyte and water balance is upset by an increase in intracellular sodium, a decrease in intracellular potassium, an increase in intracellular water and chloride, and a decrease in intracellular magnesium. The sodium and potassium pumps are upset.
4. Metabolically there is a decrease in ATP formation, pyruvic and lactic acid increase, ADP and AMP increase, anaerobic glycolysis.

increases, glycogen decreases, ketone bodies increase.

5) Ultrastructural changes include relaxation of myofibrils with increase in I bands and separation of the Z lines, disruption of the bridges between large and small fibrils, mitochondrial aggregation and granulation.

Some cardiologists may feel that these polyparametric correlations are not justified or that the science of electrocardiography is being abused, but most will find this entertaining, intellectually stimulating and an excellent technique of reviewing parameters which are not frequently considered in a clinical situation. With the focus on the electrocardiogram, this is an excellent technique for reviewing cardiac physiology, electrophysiology, biochemistry and pathology.

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Cardiac Catheterization

Fritz Bleichroeder in 1905 was the first to pass catheters, with no x-ray control, in arteries and veins of dogs and his own veins. It served to document that catheters could be passed through human veins up to the axilla in the forearm and high inferior vena cava from the thigh without ill effect. In 1912 interest was revived in this procedure with the idea of injecting drugs directly into the heart. For this purpose Bleichroeder and Unger studied the effect of inserting catheters in canine arteries and leaving them for several hours. No clot formation or any other complications were observed. Forssmann, in 1929, although not aware of the above work, repeated the procedure with the same object of intracardiac injection of drugs. He also dissected his own forearm, but has the further credit of guiding the catheter up to the right atrium. This was done under fluoroscopic control in front of a mirror held by his nurse in the operating room, and then be walked to the radiology department with the catheter in place for x-ray pictures and described no discomfort connected with the whole procedure. Later, in 1931, becoming aware of Bleichroeder’s work, he pushed the catheter through his own veins. This was done for the purpose of opacifying the heart by injection of radiopaque material. Although he was the first to obtain such “angiogram” in dogs, his attempt on his own heart remained futile. In the mean time Kline, in 1930, had already earned the credit of being the first to take venous blood samples from the right ventricle and apply the Fick principle for determination of cardiac output. It was not until 1941 that Cournand and Ranges in this country popularized the procedure for its wide application.

Zimmerman H A (ed): Intravascular Catheterization (2nd ed), Springfield, C C Thomas, 1966