

**Title:** A CLINICAL MEASUREMENT ROTATION

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**Introduction.** Because complex patient monitoring is commonplace in a tertiary care hospital, we have instituted a rotation called "Clinical Measurement" which is required for all first year residents. The trainee spends one month in the cardiac surgery operating room and devotes his or her time only to preoperative evaluation of the patient and gathering and interpreting data from sophisticated monitoring systems. Conduct of anesthesia is performed by a senior anesthesiology resident.

**Methods.** Specific objectives of the rotation are listed in Table 1.

Table 1. OBJECTIVES OF THE ROTATION

1. Preoperatively assess cardiac patients
2. Understand and interpret cardiac catheterization data
3. Competently perform all aspects of commonly used invasive and noninvasive monitoring
4. Set up, calibrate, and understand sophisticated monitors
5. Calculate and interpret derived hemodynamic parameters
6. Understand complex cardiovascular physiology and pharmacology
7. Observe anesthetic techniques for cardiac patients

To accomplish these goals, at the beginning of the rotation each resident is supplied with a copy of a renowned cardiac anesthesiology textbook,<sup>1</sup> a Hewlett Packard HP-33C calculator and a comprehensive syllabus. The calculator was chosen because it is reasonably complex (programmable), inexpensive (less than \$100), and it was felt that any properly trained anesthesiologist should be able to use this tool.<sup>2</sup> A description of the program has appeared elsewhere<sup>2</sup> and the derived hemodynamic parameters which it will calculate are shown in Table 2.

Table 2. CALCULATOR-DERIVED HEMODYNAMIC VARIABLES

Cardiac index
Rate Pressure Product
Stroke Volume
Stroke Volume Index
Left Ventricular Stroke Work Index
Systemic Vascular Resistance
Pulmonary Vascular Resistance

The first four sections of the syllabus consist of reprints of key articles covering the subject matter shown in Table 3. Preceding each reprint is a sheet giving the complete reference and a brief description of the significance of the paper, along with space for notes. The last section of the syllabus contains instructions for programming and operating the calculator, and blank flow sheets for recording measured and derived hemodynamic, blood gas, hematologic, and electrolyte data. On the back of the flow sheets are ventricular function curves. Residents are encouraged to make and record hemodynamic measurements each time a clinical intervention occurs and to plot patient values on the

function curves. This serves as a basis for discussion with a staff anesthesiologist. The flow sheets are retained by the resident and following the rotation they serve as a self-written textbook of clinical experience.

Table 3. CONTENTS OF SYLLABUS

- I. EQUIPMENT
  - Thermometers
  - Blood Gas and pH Electrodes
  - Transducers
  - Electrical Safety
- II. MONITORING TECHNIQUES
  - Arterial Catheter Complications
  - Allen's Test
  - Dorsalis Pedis Catheterization
  - Internal and External Jugular Vein Catheterization
  - Subclavian Venipuncture
  - Complications of Swan Ganz Catheter
  - Cardiac Output Management
- III. DATA INTERPRETATION
  - Cardiac Catheterization Data
  - Angiography
  - Pulmonary Artery Catheter Data
  - Cardiac Risk Index
  - Rate Pressure Product
  - Electrocardiographic Lead V<sub>5</sub>
  - Blood Gases
  - Pulmonary Shunt
  - Hemodynamic Tracking
- IV. ANESTHETIC TECHNIQUES
  - Halothane Versus Morphine
  - High Dose Fentanyl
  - Cardioplegia
  - Valvular Heart Disease
- V. FLOW SHEETS & CALCULATOR PROGRAM

**Results.** Twenty-four residents have gone through the Clinical Measurement rotation. Upon completion of the first trial year, this rotation was continued at the request of residents and staff anesthesiologists who found the derived hemodynamic data a valuable aid to administering safe anesthesia. Senior residents and faculty members have also requested the syllabus. The format has been used as a model for other rotations offered in our department.

**Discussion.** With the increasing complexity of patient monitoring, it is imperative that a comprehensive exposure to clinical measurement be offered to residents early in their training. We have found that a rotation on the Clinical Measurement service has fulfilled this function. The author will be pleased to provide a list of the articles, calculator program and flow sheets included in the syllabus to interested colleagues.

#### References.

1. Kaplan JA, ed: Cardiac Anesthesia. New York, Grune & Stratton, 1979
2. Nahrwold ML: Rapid calculation of derived hemodynamic parameters using a programmable calculator. *Anesth Rev* 8:7,15-19, 1981