Description of the "Shunt Determination CLinIMApp"

The "Shunt Determination CLinIMApp™" has been designed in order to generate precise and accurate readouts of shunt as a percentage of cardiac output in real-time. It incorporates a complex polynomial equation initially developed by G. Richard Kelman in 1966. Kelman's equation yields a value for the oxygen saturation of (adult) human blood as a function of the prevailing: 1) partial pressure of oxygen (p_aO_2); 2) pH (pH_a); 3) partial pressure of carbon dioxide (p_aCO_2); and 4) body temperature (T). When p_aO_2 (ordinate) is plotted on a rectilinear co-ordinate axis system against percent saturation (abscissa), a sigmoid curve (the so-called "oxyhemoglobin dissociation curve") results. The position of this curve is known to vary in response to changes in pH_a, p_aCO_2, and temperature. Kelman's equation is notable in that it incorporates correction factors which quantifies these shifts precisely and accurately. Once an accurate figure for percent saturation is in hand, the (pulmonary capillary, arterial, and mixed venous) oxygen content values of a blood sample, and its' prevailing shunt, expressed as a percent of cardiac output, can be determined.

The app solicits certain digital inputs. The user proceeds to enter each item of data in sequence by means of the keyboard. The value of those parameters are extracted from various sources, such as: arterial blood gas, or"ABG", reports (pH_a, p_aCO_2, p_aO_2); measurements of vital signs (T); mechanical ventilator settings (F_IO_2); barometer readings (P_B); measurements embedded within the patient's most recent complete blood count, or "CBC", report (hemoglobin concentration); and readouts from electronic clinical monitors (a-v difference). Of these, three are preset to default values: T defaults to 37° C; P_B defaults to 760 torr; and a-v difference defaults to 3.5 mL oxygen per deciliter of blood. If the user chooses, s/he can override these defaults.

After the user keys each input into its' respective field within the entry grid, a spreadsheet is applied in the background under computer control. The resultant percent shunt referable to those inputs is then displayed in accordance with the following functionality. The app is coded to generate serial p_aO_2 values, from the maximum p_aO_2 that applies to the prevailing F_IO_2 down to 10 torr, where each successive p_aO_2 level represents the p_aO_2 that preceded it decremented by five torr. "Arterial oxygen tension, in torr" is plotted along the ordinate, and "Shunt, in percent of Cardiac Output" is plotted along the abscissa. A point is scribed at the co-ordinates determined as just described for each p_aO_2, and a smooth curve is drawn connecting the points. For reference purposes, the p_aO_2-versus-shunt curve pertaining to a healthy subject breathing pure oxygen is scribed (in black) in the background, while the curve that pertains to the patient at hand is scribed in blue.

When this series of tasks is completed under computer control, the app displays a dialogue box, asking the user whether or not s/he wishes to generate a hard copy of the display. It is important to note that, due to the constraints imposed by the Health Insurance Portability and Accountability Act (HIPAA), no patient identifiable data displays.

One final caveat must be mentioned. Because of the mathematical configuration of the shunt equation, it has been observed that any changes in the F_IO_2 for a patient or subject will elicit an artifactual change in the measured shunt. For this reason, if the ICU Team wishes to compare serial determinations of shunt, such determinations are only valid to the extent that **F_IO_2 is held constant**. For example, if a patient's serial shunt figures on three successive days were observed to be 25%, 25%, and 22%, while F_IO_2 was kept at a constant 0.70, these serial shunt values could be validly compared. If, however, the ICU Team chose to decrease the F_IO_2 to 0.50 at that point, any subsequent shunt values could be compared to each other (provided, of course, that the F_IO_2 were to remain at 0.50), but NOT to the shunt figures that had been determined at the F_IO_2 of 0.70.