CHAPTER 2

BLOOD PRESSURE MEASUREMENT

An appreciation in the 18th century that blood in the arterial system is under considerable pressure was cited at the beginning of the previous chapter. In the subsequent two centuries techniques emerged for both the direct and indirect measurement of arterial blood pressure. Today, there is a continuing appraisal of these methods since indirect methods are vulnerable to error while the direct techniques require invasive procedures. The question of exactly what values for pressure should be considered abnormal has not yet been settled. Use of "mmHg" and "cm H2O" as standard units of pressure is slowly being replaced by the more scientific "Pascal."

A BRIEF HISTORY OF BLOOD PRESSURE MEASUREMENT

Measurement of blood pressure is now a commonplace diagnostic tool. Several historical accounts of the evolution of pressure measuring techniques are available (967), (346) but probably the best account is provided by Booth (97). Realistically, the overall development of pressure measuring techniques was the result of diverse contributions by a great many individuals; however, in retrospect several individuals and events stand out.

Stephen Hales (born 1677 - died 1761) studied biology at Cambridge and his measurement of arterial pressure in the horse in 1733 in all likelihood followed directly from an interest in the movement of sap in plants.

Jean Leonard Marie Poiseuille (born 1799 - died 1869) was a French physician and physicist who is best known for his description of the viscous and geometric components of the vascular resistance to blood flow (Poiseuille's Law). But, as a medical student in Paris in the 1820's, he devised the mercury manometer and fully demonstrated its utility.

Karl Friedrich Wilhelm Ludwig (born 1816 - died 1895) was a renown German teacher and physiologist who along with
Bowman advanced early ideas on the formation of urine by glomerular filtration. He was also an inventor who devised the kymograph for making (relatively) permanent recordings of arterial pressure and other physiological data. His idea was to add a float to a mercury manometer and to use this to create a tracing on a rotating drum. The kymograph remained the standard laboratory instrument in blood pressure research until the relatively recent development of electronic recorders.

Some alternative to direct measurement of intravascular pressure was obviously needed for human investigations. During the last half of the 19th century several indirect methods were explored. The most successful was that of Samuel Siegfried Karl Ritter von Basch (born 1837 - died 1905). His device developed an external counterpressure over an artery and the pressure needed to just produce vascular collapse was noted and recorded. Von Basch's device was widely used but the measurement errors that attend such an approach rendered it less than perfect.

Then in 1896, Scipione Riva-Rocci (born 1863 - died 1936) an Italian physician invented a pneumatic cuff that encircled the arm; it remains basically unchanged today. The cuff was progressively deflated until pulsations could be pulrated and the (systolic) pressure was noted. Diastolic pressure could not be measured.

In 1905, N. C. Korotkoff (born 1874 - died 1920) a Russian surgeon described the auscultatory method. A stethoscope was used to detect sounds distal to a Riva-Rocci pressure cuff that could characteristically be associated with both systolic and diastolic pressure. This method was slowly accepted as a superior way to measure blood pressure in humans.

There have been two additional significant events in recent years. One was the development of the modern electronic recorder or polygraph. The other was the development of compact pressure transducers which offer sensitivity and frequency response that are superior to the mercury manometer.

ACCURACY OF PRESSURE MEASUREMENTS

Two problems must be addressed when accuracy is being considered. One is whether or not a particular method of pressure measurement will give an accurate value for