INTRODUCTION

Since the beginning of modern anesthesia, in 1846, the anesthetist has relied on his natural senses to monitor the patient, aided more recently by simple technical devices such as the stethoscope. There has been a tremendous increase in the availability of monitoring devices in the past 30 years. Modern technology has provided a large number of sophisticated monitors and therapeutic instruments, particularly in the past decade. Most of these techniques have enhanced our understanding of the mechanism of the patients' decompensation and have helped to guide appropriate therapeutic interventions. As surgery and critical care medicine have developed rapidly, patient monitoring capability has become increasingly complex. The most important aspect in monitoring the critically ill patient is the detection of life-threatening derangements of vital functions. ***(sandham,etal; 2003)***

Appropriate hemodynamic monitoring and assessment are fundamental keys to improving patient safety by goal directed hemodynamic management. One of the basic problems that we frequently face is the lack of hemodynamic monitoring. This deficit is compounded by our being into a false sense of security when patients have an "acceptable" blood pressure and pulse. Unfortunately it is not always possible to have a reliable hemodynamic assessment with blood pressure and pulse measurements alone, and we may be unaware of significant developing hemodynamic problems using these measurements. We need to be able to evaluate and prevent hemodynamic derangement at its onset in order to improve patient safety. This begins with the realization that blood pressure monitoring can be misleading and incomplete, and that blood flow data are also necessary to have complete hemodynamic understanding**. *(mayer,etal;2008)***

Central venous pressure (CVP)

Measurement of CVP has been a mainstay for over 50 years since it had been invented by Aubaniac, seldinger and Wilson. While the CVP is simply a pressure ideally measured in the superior vena cava, it is a false but widely held belief that it indicates, and or correlates to, the intravascular volume status. from a physiologic standpoint it makes sense that volume status cannot be inferred form the statically measured CVP or from its change overtime **.(Gelman ,2008)**

Pulmonary Artery catheter (PAC)

The PACS has ability to measure cardiac output (Co) and pressure in the pulmonary artery was a great physiologic advance. These easily obtained measurements combined with the basic concept that the wedge pressure should equal the left atrial and left ventricular pressure during diastole, and the ability to measure a mixed venous oxygenation, lead to a rapid widespread acceptance of this technique within only a few years of its clinical introduction.**(sandham , etal;2003)**

Non invasive cardiac output (NICO)

Flick's principle states "the total uptake or release of a substance by an organ is the product of the blood flow to the organ and the arteriovenous concentration difference of the substance." physicians are most familiar with the Fick's principle applied C.O. to oxygen and its use to calculate CO Clinically this principle can be used to determine C.O when the oxygen consumption is determined using a metabolic cart and an arterial sample and mixed venous sample of blood can be obtained and their oxygen contents determined **(sandham , etal;2003)**

Pulsion contour cardiac output (PICCO)

The PICCO device (pulsion Medical systems, Germany) is widely used in Europe and was recently introduced in the United States the device relies on several principles that are relatively new to most Anesthesiologist and intensivists. The primary physiologic assumption that the technology utilizes is that the contour of the arterial pressure waveform can be analyzed and the stroke volume equals the integral of the area under the curve divided by the impedance of the aorta**. (uchino ,etal;2006).**

Pulse contour devices

These devices employ computer driven algorithms to translate the arterial pressure tracing into a CO as well as other variables. the PICCO and LIDCO require that the CO of the devices be calibrated to another accepted, albeit unconventional, method first, while the FLOTRAC/ VIGELEO employs a more mathematically advanced algorithm permitting no required calibration, they all allow continuous monitoring of the arterial pulse pressure. Variation which alone, even in the absence of other functionality, may be quite useful, **(chancy, etal;2002).**

Lithium dilution cardiac output (LIDCO)

the LIDCO device (LIDCO LTD, UK), much like the PICCO device requires the CO to be determined in order to "calibrate" its internal algorithm, it utilizes a peripheral injection of lithium ion 0.15-0.3 mMol with a 15ml saline flush combined with arterial line containing a lithium sensor just outside of the arterial line that is used to construct a dilution curve for the lithium ion. ***(Pears, etal; 2004).***

Flotrac/ vigleo

Flotrac\ vigleo system (Edwards life sciences, Irvine CA) differs significantly from the PICCO and LIDCO devices in that no external calibration for CO is required at all and the device can be used with a standard arterial line, instead of calibrating the device to a measured CO (transpulmonary thermo dilution CO in the case of PICCO and lithium dilution CO in the case of LIDCO), the arterial pressure waveform is analyzed in conjunction. With demographic data consisting of age, height, weight and gender, this device has recently had its algorithm updated and improved its bias, precision and limits of agreement, the underlying mathematics and physics employed quit sophisticated and difficult for the non- engineer to comprehend, as opposed to the PICCO which is a relatively straightforward algorithm. **(Mayer et al; 2008)**

Esophageal Doppler

CO can also be determined completely noninvasively. the basic Technical premise relies on the fact that flow throw a tube is equal to the cross section of the tube (in the case of the aorta it is a cylinder) times the velocity of the fluid. **(Berase, etal; 2005).**