Chapter 30
Physiologic Monitoring

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ABSTRACT

This chapter will provide a review of modern concepts of cardiovascular monitoring with emphasis on essential hemodynamic variables in the early post cardiac surgery patient. When defining circulatory function, importance of the entire circulatory system is underscored. This includes the function and interaction of the heart, blood vessels and circulatory blood volume to deliver sufficient amount of oxygenated blood to tissue beds. In post cardiac surgery patients, the pulmonary artery catheter remains the most widely used technology to assess cardiac function. This chapter highlights the importance of validation of less invasive and noninvasive hemodynamic monitors for the management of critically ill patients and early post cardiac surgery patients. In addition, this chapter describes the evolution of monitoring of post cardiac surgery and critically ill patients, examines different monitoring technologies and address controversial questions in modern practice as well as future directions.

INTRODUCTION

Hemodynamic monitoring is fundamental to early post cardiac surgery care and patient recovery after cardiac surgery. Historically, the pulmonary artery catheter (PAC) has been the principal hemodynamic monitor for intraoperative and early post cardiac surgery patient management. In the last two decades, technological developments, in particular the development of less invasive and noninvasive methodologies for hemodynamic monitoring, contributed to the establishment of controversial opinions in this rapidly developing field. Although the PAC remains the most widely used technology for decision making in early post cardiac surgery monitoring, potential for complications and diagnostic limitations have laid the foundations for the development of other ways to monitor and care for early post cardiac surgery patients.

This chapter will review the exciting history of cardiac output monitoring. It will examine the established surrogates of organ and tissue perfusion monitored by the bedside physician in respect to available

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published studies. This chapter will give a review of different methods and therefore relatively new monitors for cardiac output and hemodynamic monitoring with emphasis on method validation and associated clinical trials. This chapter will further attempt to address future directions in this rapidly growing field.

BACKGROUND

The success of a cardiac operation is determined by the events in the operating room and in the postoperative period. Hemodynamic monitoring of the early post cardiac surgery patient is of great importance during normal and complicated convalescence. Determination of adequate blood flow to meet metabolic demands is essential in the early post-cardiac surgery period.

Surrogates of Adequate Tissue Perfusion in the Postoperative Cardiac Surgery Patient

Monitoring post cardiac surgery patients includes: Continuous telemetry, invasive continuous blood pressure monitoring, monitoring of cardiac performance, laboratory and radiology assessment central laboratory and point-of care analysis, (e.g. blood gas analysis), temperature monitoring and close observation for postoperative blood loss.

In the early postoperative period it is essential to ensure adequate blood flow to meet organ and tissue metabolic demands.

Commonly used surrogates to assess adequate tissue perfusion are:

1. Arterial blood pressure
2. Urine output
3. Mental status
4. Cardiac output and cardiac index
5. Mixed venous oxygen saturation
6. Lactic Acid

Arterial Blood Pressure, Urine Output, and Mental Status

Arterial blood pressure, urine output and a mental status change can all provide information about organ and tissue perfusion. Arterial blood pressure is an insensitive measure of adequate blood flow and perfusion. Similarly, urine output and mental status change can be late signs of inadequate perfusion and cannot be used alone to guide resuscitation, titration of vasopressors and inotropes in the early post cardiac surgery period and in critically ill patients.

IMPORTANCE OF ARTERIAL WAVEFORM INTERPRETATION

Careful observation of pressure tracing characteristics can provide useful diagnostic information. Interpretation of invasive pressure tracings requires an understanding of dampening and natural frequency of pressure waveforms. The shape, timing and changes with respiration should not be overlooked. Pressure