Chapter 19
Infection and Immune System

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ABSTRACT

Infections are a major cause of mortality in intensive care unit (ICU) patients and the most common non-cardiac complications after cardiac surgery. Commonly encountered infections in the cardiothoracic ICU include pneumonia, bloodstream infections, and surgical site infections. At the beginning of this chapter, general measures of infection control and prevention are introduced. Those can help reduce infections and are best implemented in a bundled care fashion. Specifically for ICU patients, care bundles aimed at ventilator-associated pneumonia and central line-associated bloodstream infection have been successfully implemented, studied, and revised. In the next section, antibiotic treatment principles are described. Treatment with antibiotic drugs is an important part of therapy for infectious complications and is under continuous revision given the changing and diverse spectrum of microorganisms and the emergence of multidrug-resistance. In the central part of the chapter, specific infections are discussed in detail with regards to etiology, incidence, diagnosis, and therapy. Finally, the concept of systemic inflammatory response is described which is a common clinical problem after cardiac surgery, particularly with the use of cardiopulmonary bypass. Several immunologic mechanisms have been found to be associated with this and the clinical picture can be confused with sepsis.

INTRODUCTION

Infections remain a major cause of mortality in patients admitted to the intensive care unit (ICU). Most infections encountered following cardiothoracic surgery are hospital-acquired or nosocomial with an incidence of around 5% (Gelijns et al., 2014; Michalopoulos, Geroulanos, Rosmarakis, & Falagas, 2006). The majority of infectious complications concern the lungs, the blood stream, or the surgical site.

Systemic inflammatory response and interaction with the immune system play an important role after cardiac surgery, particularly with the use of cardiopulmonary bypass (CPB) (Larmann & Theilmeier, 2004; Paparella, Yau, & Young, 2002). While the pathophysiology is somewhat different, the clinical picture can resemble that of sepsis or septic shock.

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In this chapter, we will first discuss measures to control and prevent infections in the ICU environment and basic concepts of antibiotic therapy. The second focus will be on the epidemiology, pathophysiology, diagnosis, and clinical management of common infections in the cardiothoracic surgical population. Lastly, the incidence, pathophysiology, and management of systemic inflammation as a non-specific host response with or without evidence of infection will be addressed.

BACKGROUND

Postoperative care on the ICU has improved significantly over the last decade, particularly with the advent of protocols and checklists guiding early extubation, glucose control, and blood conservation, to mention a few. Major healthcare-acquired infections, however, remain an important factor, as they do significantly contribute to morbidity, mortality, and cost (Stone et al., 2014).

The overall rate of infections following cardiac surgery has also improved over the years (Kollef et al., 1997), but the incidence now remains constant at around 5% (Michalopoulos et al., 2006). Unfortunately, studies looking at overall infection rates are rare, so epidemiologic data in this population is limited. More commonly, studies focus on specific infections and subgroups of patients, and clinical risk factors for acquiring major infections after cardiac surgery have been described (Fowler et al., 2005; Lola et al., 2011). One reason for a stable infection rate despite more aggressive measures to prevent infection is the fact that the population of patients undergoing major cardiothoracic surgery today is older and shows more comorbidities than ten years ago. Surgical practice also underwent a significant shift with a decrease in so-called routine operations and an exponential increase in complexity, i.e. surgery for adult congenital heart disease and end-stage heart failure.

Antibiotic drugs are a mainstay of therapy for infections and are more commonly used in the ICU than in other patient populations. Adequate perioperative prophylaxis using antibiotics is a well-accepted practice and drug choice and duration of prophylaxis is outlined in the respective guidelines put forward by the Society of Thoracic Surgeons (Edwards, Engelman, Houck, Shahian, & Bridges, 2006; Engelman et al., 2007). Conversely, overuse and uncritical initiation of therapy has significantly increased resistance to antibiotic drugs in the last 20 years (Livermore, 2005; Fournier et al., 2013). Multi-resistant bacteria are more and more present, and there are very few therapeutic options to treat infections caused by those highly pathogenic organisms. Absence of an indication for antibiotic therapy and wrong drug choices increase selection and promote development of resistant bacteria. It is therefore of utmost importance to limit and rationalize the use of antibiotic drugs to reduce further selection and maintain therapeutic options for the treatment of the most severe infections for our patients and the entire population. Most likely, there will not be any new antibiotic drug development in the near future particularly for the treatment of gram-negative bacteria, so preserving the effectiveness of existing drugs is an important principle. In addition to overuse, inadequate dose and duration of therapy, using the same antibiotic drug for the same indication over a long period of time can also increase selection.

In addition to the inappropriate use of antibiotics, other factors like indwelling catheters, immunosuppression, uncontrolled hyperglycemia, and non-adherence to infection control measures predispose the patient in the ICU to healthcare-acquired or nosocomial infections. Aside from perioperative antibiotic prophylaxis, interventions to prevent nosocomial infections include strict and adequate hand hygiene and the use of gloves and other protective accessories like gowns and masks when indicated (Pincock, Bernstein, Warthman, & Holst, 2012). Patient isolation may become necessary when colonization or