7.1 Thoracic Surgery

7.1.1 Introduction

Fluid and electrolyte balance is of paramount importance for patients undergoing major non-cardiac intrathoracic surgery. The intravenous fluid resuscitation profoundly influences perioperative morbidity and mortality [1]. Despite significant differences in anesthetic techniques during these operations, the approach to the fluid therapy seems to follow the same direction.

7.1.2 How Much Fluid?

7.1.2.1 Pulmonary Resection Surgery

Specific areas of concern in the management of patients undergoing one-lung ventilation (OLV) for pulmonary resection include fluid management, intraoperative tidal volume, and acute lung injury post-surgery, which together lead to the concept of protective lung ventilation [2].

Fluid administration after major lung resection remains an issue. In an early retrospective report by Zeldin et al. [3], the authors evaluated the risk factors for the development of Acute Lung Injury (ALI) after pulmonary resection, more specifically evaluating the incidence of post-pneumonectomy pulmonary edema. They concluded that a right-sided pneumonectomy is associated with an increased incidence of postoperative pulmonary edema (6.9%
This procedure was also shown to be associated with increased perioperative intravenous fluid administration and increased urine output in the postoperative period. In anesthetized dogs, the same study demonstrated that, following a pneumonectomy, blood flow can increase up to six-fold. Therefore, any increase in blood volume, following excessive fluid administration, would injure the capillary endothelium, with the leakage of protein-rich fluid into the alveolar space. A more recent study by Licker et al. consisted of a retrospective analysis of 879 patients, showing that ALI was associated with four risk factors: high ventilatory pressure, excessive administration of intravenous fluid in thoracic surgical patients (in that case more than 3L in the first 24 h), pneumonectomy, and preoperative alcohol abuse [4]. Thus, an excessive amount of fluid can lead to ALI, which, after pneumonectomy, has a high mortality rate [5].

In patients undergoing pneumonectomy, respiratory failure is one of the most significant causes of postoperative morbidity and mortality. In most cases, it is associated with a decrease in respiratory function (FEV1 or DLCO) in those patients who are particularly at risk [6]. A significant correlation between ALI and high tidal volume was previously reported. A retrospective report [7] by Fernandez-Perez, involving 170 pneumonectomy patients, showed that patients receiving median tidal volumes higher than 8 mL/kg had a major risk of developing respiratory failure following pneumonectomy compared to patients who received tidal volumes < 6 mL/kg.

Schilling et al [8] reported that a tidal volume of 5 mL/kg during OLV significantly reduces the inflammatory response induced by alveolar cytokines.

The incidence of ALI after pneumonectomy is only 4, but the mortality rate is 30–50%.

The clinical picture of post–pneumonectomy pulmonary edema is usually related to other complications, such as aspiration, bronchopleural fistula, and surgical complications. Currently, only symptomatic management is appropriate. This includes fluid restrictions, use of diuretics, low ventilatory pressures and tidal volumes (when mechanical ventilation is used), and measures to reduce pulmonary arterial pressure. Even if pulmonary resection results in a slight postoperative pulmonary hypertension during exercise, right ventricular systolic function is normally minimally affected [9].

A serious concern for anesthesiologists is that fluid restriction in thoracic surgery may contribute to postoperative renal dysfunction, previously reported as being associated with a very high (19%) mortality [10]. In a recent review by Reimer et al., of over 100 pneumonectomies acute kidney injury (AKI), as defined by the RIFLE classification, occurred in 22% of the patients [11]. However, there was no association between AKI and fluid balance; neither was there an increased mortality of AKI patients. AKI is associated with preoperative hypertension and complex surgical procedures such as extrapleural pneumonectomy.