# Perioperative Fluid Therapy

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**KEYWORDS**

• Fluid responsiveness • Cardiac output • Anesthesia • Perioperative time

**KEY POINTS**

- Anesthesia can lead to pathophysiologic changes that dramatically alter the fluid balance of the body compartments and the intravascular space.
- Fluid administration can be monitored and evaluated using static and dynamic indexes.
- Guidelines for fluid rates during anesthesia begin with 3 mL/kg/h in cats and 5 mL/kg/h in dogs.
- If at all possible, patients should be stabilized and electrolyte disturbances should be corrected before general anesthesia.

## INTRODUCTION

Fluid administration during anesthesia is necessary to control vascular tone, maintain circulating volume, and improve cardiac output (CO). Overhydration and excessive fluid administration can be detrimental to patients just as dehydration and hypovolemia can lead to adverse consequences.[1] Potential adverse effects of overly aggressive fluid therapy include volume overload, pulmonary edema, detrimental fluid shifts (eg, edema of the brain, kidneys, and intestinal tract), electrolyte and acid base derangements, exacerbation of hemorrhage, and hemodilution coagulopathy.[2] The decision to cease or decrease fluid administration can be as important as the decision to start or increase fluid administration. The ideal rate of fluid administration during anesthesia must be tailored to a patient's volume status as well as serum electrolyte and acid base status. Although fluid therapy is routinely performed in most anesthetized patients, little progress has been made on estimation of circulating blood volume status and fluid responsiveness. The volume status of patients typically is

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evaluated indirectly by means of parameters that reflect perfusion, but the limitations of such methods do not assure adequate volume maintenance in many situations.

Blood pressure, urine output, and heart rate are parameters frequently used to estimate the adequacy of blood volume and the response to fluid administration.[3,4] Other parameters, such as peripheral pulses, mucous membrane color, capillary refill time, and tissue turgor, also are used to evaluate circulating blood volume. Sole use of these parameters, however, can lead to clinically relevant errors in blood volume estimation. Furthermore, sick patients under anesthesia can develop pathophysiologic changes that dramatically alter fluid balance within the body's fluid compartments. Hypoproteinemia, electrolyte disturbances, renal disease, hepatic insufficiency, and cardiovascular dysfunction are common conditions encountered in surgical patients that can markedly affect fluid balance.

For all of these reasons, a comprehensive understanding of the factors that influence hemodynamic stability and new concepts regarding the evaluation of fluid administration and circulating blood volume status is crucial to successful administration of fluids in the perioperative period.

## HEMODYNAMIC STABILITY

Hemodynamic stability is the primary therapeutic goal in every patient and the main reason fluids are administered to surgical high-risk patients. If a patient is hemodynamically stable and blood oxygen content is adequate for the clinical situation, oxygen demand is met. In situations in which oxygen content decreases (eg, acute hemorrhage), increasing venous return by fluid loading assures oxygen demand.[3,5,6] Conversely, if the hemodynamic state is compromised, the oxygen demand may not be adequately met. To understand this basic equilibrium, it is important to define the constituents of hemodynamic stability. If there is awareness of the clinical relevance of each constituent, the importance of adequate assessment of circulating blood volume and the role of fluid therapy in maintaining it is readily apparent.

Hemodynamic stability depends on heart rate and stroke volume, which together generate CO (**Fig. 1**). Stroke volume in turn is the result of preload, afterload, and myocardial contractility, and all of these variables are closely related. Preload is the result of venous return and venous tone, afterload depends on arterial vascular resistance and aortic impedance, and contractility is an intrinsic property of the myocardium. Blood pressure ultimately reflects CO because it is the product of peripheral vascular resistance and CO. For this reason, blood pressure can be normal, despite low CO, if peripheral vascular resistance is high. The elements that determine CO can be altered during anesthesia by different conditions and also in sick patients. For example, vasodilatation caused by administration of inhaled anesthetic agents decreases afterload and if heart rate does not increase accordingly, CO decreases. This is common during inhalation anesthesia because the ability to increase heart rate to

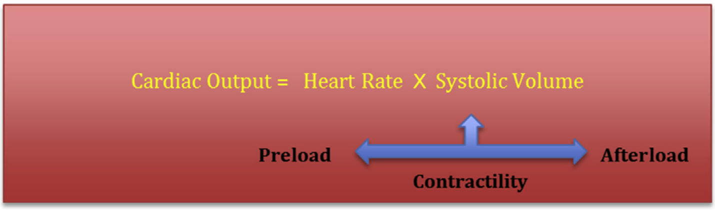


**Fig. 1.** Hemodynamic stability.