Cheetah Non-Invasive Cardiac Output Monitor (NICOM)
For Perioperative Fluid and Vasoactive ‘Goal Directed’ Therapy
TOH Recommendations for Perioperative Use

Goals

MAP > 65 mm Hg
CI > 2.5 L/min/m²
SVI > 35 mL/m²/beat
HR 50 - 90 bpm
Temp 36 C
Minimal base deficit

Normal Values

MAP Mean Arterial Pressure 70 - 105 mm Hg
CO Cardiac Output 4 - 8 L/min
CI Cardiac Index 2.5 - 4 L/min/m²
SV Stroke Volume 60 - 100 mL/beat
SVI Stroke Volume Index 33 - 47 mL/m²/beat
TPR Total Peripheral Resistance 800 - 1200 dynes·sec/cm³
TPRI Total Peripheral Resistance Index 1970 - 2390 dynes·sec/cm³/m²
SVV Stroke Volume Variability
  < 10% - unlikely to be preload (fluid) responsive
  > 10% - likely to be preload (fluid) responsive

Intraoperative crystalloid fluid administration with a balanced crystalloid (e.g., Ringer’s Lactate) is preferred over 0.9% Saline.1

An increase in Stroke Volume Index (∆SVI > 10%) with an intravenous fluid challenge suggests the patient is responsive to IV fluid administration.

In the perioperative period a positive passive leg raise test (PLR) with an increase in SVI of > 10% is highly predictive of the patient responding to IV fluids. The NICOM sensors should remain on the patient in the PACU to reconnect to the monitor as needed.

A bolus of 4 mL/kg of RL (approximately 250 - 400 mL) or other IV fluid administered in < 5 minutes is recommended to assess the change in SVI and fluid responsiveness. IV fluids should not be administered based on theoretical third space losses.

Recommended maintenance intraoperative crystalloid administration is 2 - 3 mL/kg/hr of RL (approximately 150 - 300 mL/hr).

Provided the goals are met, additional IV fluid administration may not be required even if the patient is fluid responsive.

Propofol, volatile anesthetic agents and neuraxial anesthesia commonly result in arterial and venous vasodilation. In the setting of a decrease in mean arterial pressure (MAP) of < 70 mm Hg with a normal or increased cardiac index (CI), a decrease in the anesthetic depth or an infusion of a vasoactive agent may be appropriate.

Colloids such as Volulyte, albumen or plasma may be appropriate if intravenous crystalloid fluid administration exceeds 50 mL/kg (approximately 3 - 5 L). Synthetic colloids such as Volulyte should be used with caution in the setting of sepsis or renal impairment. Albumen is available from transfusion medicine (in 5% 250 mL and 500 mL bottles). Albumen requires a requisition, but is classified by TOH as a medication and unlike blood products does not require consent for administration.

The stroke volume variability (SVV) can be used as a predictor of fluid responsiveness, provided the patient is in normal sinus rhythm, with a closed chest and on controlled mechanical ventilation. Provided these three criteria are met, a SVV of > 10% suggests that the patient will respond to the administration of IV fluids with an increase in CO. The clinician must then decide whether additional fluids are indicated.

The NICOM monitor estimates the patients total peripheral resistance (TPR) by assuming the central venous pressure contribution is negligible (i.e., equal to zero) using the same calculation for systemic vascular resistance (SVR) where SVR = (MAP - CVP) x 80 / CO. Hence TPR = MAP x 80 / CO. The TPR slightly overestimates the SVR when MAP is low and the CVP is high. TPRI = MAP x 80 / CI.

Laparoscopic surgery and trendelenburg position commonly result in an increase in afterload and a depression of cardiac output.2,3 This is believed to reflect an increase in mesenteric afterload and reduced mesenteric perfusion. Observed changes on the NICOM monitor includes an increase in total peripheral resistance (TPR), depression of cardiac index (CI) and preservation of mean arterial pressure (MAP). If significant depression of the cardiac index occurs, consider releasing the peritoneal insufflation and allowing the patient to recover. Consider optimizing muscle relaxation to permit the use of lower insufflation pressures and monitoring acid base status and lactate as an global indicator of tissue perfusion. With release of the peritoneal insufflation, a rapid increase in SVI and CI typically occurs accompanied by a fall in TPR.

Vasoactive medications such as norepinephrine can be infused safely in a central or peripheral vein. When infusing in a peripheral vein, a large anticubital vein is preferred. The site should be visible for repeated examination to ensure the catheter is not interstitial.

If the NICOM NIBP cuff is not used, the MAP can be manually entered into the NICOM monitor to permit calculations of TPR and TPRI.

When using an arterial line, consider using the NICOM NIBP cuff to allow automated updating of TPR and TPRI.