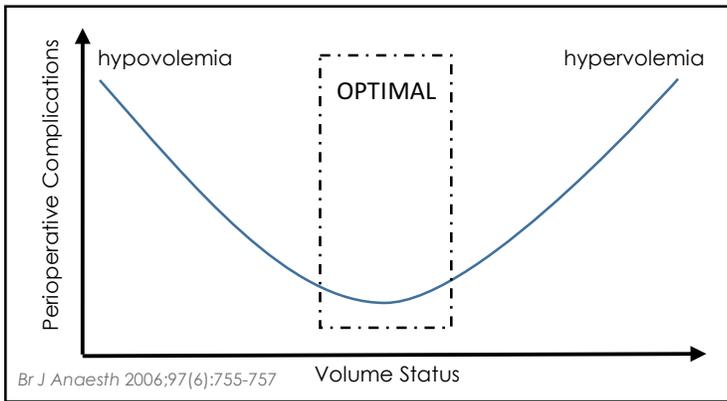


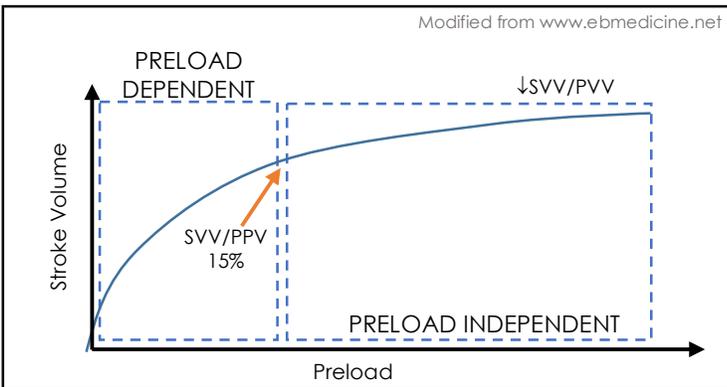
Zero-Balance and Goal-Directed Fluid Therapy Protocol

Overview:

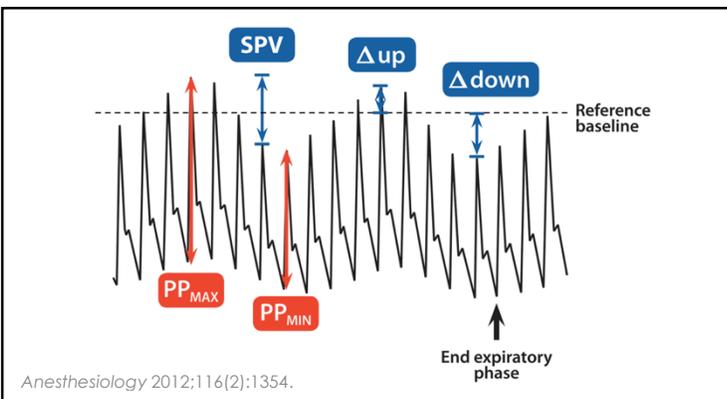
The goals of perioperative fluid resuscitation are to achieve optimal stroke volume and cardiac output by maintaining fluid and electrolyte balance, maintaining sufficient circulatory volume, and continuing appropriate oxygen delivery. Goal-Directed Fluid Therapy (GDFT) has been shown in multiple meta-analyses to decrease minor and major GI, respiratory, and renal complications; decrease time to normal GI function, and decreased hospital length of stay^{1,2,3,4,5}. Thus, the intraoperative goals for patients undergoing major abdominal surgery are to achieve 1) Zero-Balance (maintaining pre-procedural weight/fluid status) and 2) resuscitate with Goal-Directed Fluid Therapy. This protocol outlines the approach to achieve 1) the desired volume status in this patient population and 2) management of hypotension appropriately with fluids or vasopressors.



Goal-Directed Fluid Therapy Goals related to fluid resuscitation levels. Complications related to suboptimal fluid resuscitation. Considerations related to hypovolemia: hypotension, hypoperfusion, organ dysfunction and failure, low cardiac output, tachycardia. Considerations related to hypervolemia: pulmonary edema, prolonged mechanical ventilation, hemodilution, worse wound healing, coagulopathy.



Frank-Starling Curve illustrating stroke volume (SV) and preload dependence. Decreased preload correlates to a decreased stroke volume. Pulse pressure variation (PPV) or Stroke Volume Variation (SVV) increases and suggest responsiveness to increasing preload with fluid resuscitation. Conversely, increased preload results in decreased PPV or SVV suggesting volume overload and minimal response to fluid resuscitation.



Perfusion Index (PI) is the ratio of non-pulsatile blood flow through the peripheral capillary beds. **Pulse Variability Index (PVI)** is the automatic measure of the dynamic change in PI that occurs during respiratory cycles.

The greater the PVI, the more likely the patient will be fluid responsive.

$$PVI = \frac{PI_{max} - PI_{min}}{PI_{max}} \times 100\%$$

¹ Cecconi M, Corredor C, Arulkumaran N, Abuella G, Ball J, Grounds RM, Hamilton M, Rhodes A. "Clinical review: Goal-directed therapy-what is the evidence in surgical patients? The effect on different risk groups." Crit. Care 2013 Mar 5;17(2):209.

² Carcoran T, Rhodes JE, Clarke S, Myles PS, Ho KM. "Perioperative fluid management strategies in major surgery: a stratified meta-analysis." Anesth Analg. 2012;114(3):640.

³ Giglio MT, Marucci M, Testini M, Brienza N. "Goal-directed haemodynamic therapy and gastrointestinal complications in major surgery: a meta-analysis of randomized controlled trials." Br J Anaesth. 2009;103(5):637.

⁴ Thiele RH, Raghunathan K, Brudney CS, Lobo DN, Martin D, Senagore A, Cannesson M, Gan TJ, Mythen MM, Shaw AD, Miller TE. "American Society for Enhanced Recovery (ASER) and Perioperative Quality Initiative (POQI) joint consensus statement on perioperative fluid management within an enhanced recovery pathway for colorectal surgery." Perioper Med (Lond). 2016;5:24.

⁵ Meng L, Heerd PM. "Perioperative goal-directed haemodynamic therapy based on flow parameters: a concept in evolution." Br J Anaesth. 2016;117(5):iii3.

University of Colorado Hospital GDFT Guidelines*

(*These are general guidelines only and are suggested for use at the discretion of the attending anesthesiologist. Always rule out other causes of hypotension despite volume status.)

General Instructions (see below on set-up guidelines)	Utilize Ideal Body Weight (IBW) for all calculations <ul style="list-style-type: none"> • Males: $IBW = 50 \text{ kg} + 2.3 \text{ kg} \times (\text{height} - 60 \text{ inches})$ • Females: $IBW = 45.5 \text{ kg} + 2.3 \text{ kg} \times (\text{height} - 60 \text{ inches})$ Two large-bore IVs ± A-line see Pathway #1 vs. #2 below)
Zero-Balance Fluid Therapy	Crystalloid (Plasmalyte or Lactated Ringers (LR)) on IV pump <ul style="list-style-type: none"> • Maintenance infusion: <ul style="list-style-type: none"> ○ Laparoscopic: 3 mL/kg/hr ○ Open: 5 mL/kg/hr
Goal-Directed Fluid Therapy (crystalloid or colloid may be use)	<p>Pathway #1: Arterial Line and Edwards FloTrac (SV and SVV). **Requires initial set-up with patient height and weight inputs.</p> <ul style="list-style-type: none"> • Record baseline SV and SVV • Evaluate fluid responsiveness status after induction and prior to incision <ul style="list-style-type: none"> ○ Administer 250 mL bolus over 90 seconds <ul style="list-style-type: none"> ▪ If SV >10 % change, pt is fluid responsive. Administer a second 250 mL bolus and record the SV. This will be the goal SV when the patient is hypotensive. ▪ If SV < 10% change, pt has optimal fluid balance. Record SV for new baseline. • Monitor SV and SVV. If patient shows signs of hypotension, consider the following: <ul style="list-style-type: none"> ○ If current SV < goal SV: fluid responsive ○ If SVV ≥ 13-15%: fluid responsive ○ Otherwise, consider adding vasoactive medications. <hr/> <p>Pathway #2: No Arterial Line and Medtronic Masimo (PI and PVI)</p> <ul style="list-style-type: none"> • Record baseline PI and PVI <ul style="list-style-type: none"> ○ PI needs to be > 0.2 for accurate PVI evaluation • Evaluate fluid responsiveness status after induction and prior to incision for PVI > 10 % <ul style="list-style-type: none"> ○ Administer 250 mL bolus over 90 seconds for PVI ≥ 15% ○ If PVI continues to be ≥ 15%, give a 2nd 250 mL bolus • Monitor PI and PVI. If patient shows signs of hypotension, consider the following: <ul style="list-style-type: none"> ○ If PVI ≥ 13-15%: fluid responsive ○ If PVI < 10%: consider adding vasoactive medications.
Other considerations for hypotension	Epidural infusions causing sympathectomy Acute blood loss anemia requiring transfusion Excessive anesthetic Hypoglycemia Sepsis Surgical compression of vena cava NOTE: Oliguria (urine output of < 0.5 mL/kg/hr) <u>should not</u> guide your fluid therapy. However, anuria does require immediate attention.

<p>Setting up the Edwards FloTrac</p>	<p>The FloTrac device will be found in the anesthesia workroom. In preparation for your set-up:</p> <ul style="list-style-type: none"> • Pressure Transducer bag • FloTrac specific pressure tubing • 500 mL NS fluid bag • FloTrac Sensor • FloTrac monitor (and databox) <ol style="list-style-type: none"> 1. Connect power adapter of FloTrac monitor (and databox if available). 2. Turn on the power button. 3. Enter patient specific biometric data (height, weight, gender). 4. Prime your pressure tubing and ensure all connections are secure. Make sure that all the air is removed from the NS fluid bag prior to priming your tubing. 5. Connect the FloTrac monitor green cable with the disposable corresponding cable found on your pressure tubing. 6. Connect the FloTrac monitor red cable with the anesthesia machine A-line cable. 7. Zero the A-line on both the FloTrac monitor and anesthesia monitor. <ol style="list-style-type: none"> a. On the FloTrac monitor, select the button that looks like a suitcase with a red cross. Then select "Zero & Waveform." b. Zero by selecting "-0- Zero." c. You will know that you have appropriately zeroed the system when you see "Zero Complete" <u>and</u> a tracing consistent with 0 mmHg. 8. Connect to patient. <p>NOTE: The FloTrac cables and tubing are incompatible with PACU and ICU monitors, you will need a second pressurized arterial line system for transport.</p>
<p>Setting up the Medtronic Masimo</p>	<ol style="list-style-type: none"> 1. Ensure that device is plugged in, power on. 2. Connect patient sensor to Masimo Radical 7 and place sensor on patient. 3. Follow instructions on Masimo for setup. 4. For assistance, call Anesthesia Tech.

Acronyms:

GDFT	Goal-directed fluid therapy
IBW	Ideal body weight
PI	perfusion index
PVI	pulse variability index
SV	stroke volume
SVV	stroke volume variation

Additional Reading:

- Cannesson M, Gan TJ. "PRO: Perioperative goal-directed fluid therapy is an essential element of an enhanced recovery protocol." *Anesth Analg.* 2016;122(5):1258.
- Joshi GP, Kehlet H. "CON: Perioperative goal-directed fluid therapy is an essential element of an enhanced recovery protocol?" *Anesth Analg.* 2016;122(5):1261.

Goal Directed Fluid Therapy:

1. Place two PIVs
2. Follow zero-balance fluid therapy administration recommendation and ventilator settings
 - a. Laparoscopic: 3 mL/kg/hr
 - b. Open: 5 mL/kg/hr
3. After induction, begin GDFT as below:

