Hemodynamic optimization through Perioperative Goal-Directed Therapy

Protocol summary

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Evidence-based Perioperative Goal-Directed Therapy (PGDT) protocols

This protocol summary is designed to help inform clinicians of key published protocols used to guide hemodynamic monitoring in moderate-to high-risk surgery.

It is not intended to recommend a specific protocol, but to guide hemodynamic optimization through perioperative goal-directed therapy protocols that have been shown to reduce the number of peri- and postoperative complications, and improve patient outcomes.[1-3]

Since every case is different, physicians must weigh the risks and benefits of initiating any specific protocol.

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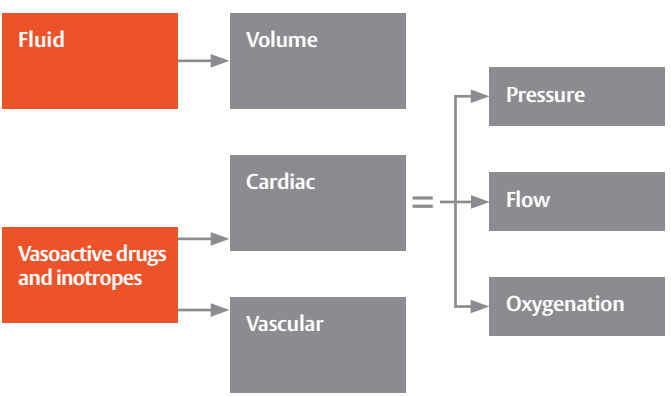
The physiologic principles of fluid support

"A patient's physiologic status in general and hemodynamic stability in particular define the need for cardiovascular support, including fluid therapy and use of vasoactive drugs (vasopressors, vasodilators) and inotropes. Specific hemodynamic goals include maintaining adequate blood volume and sustaining perfusion pressure so as to maintain cardiac output, tissue blood flow, and adequate oxygen delivery. Fluid therapy is often the first line of hemodynamic support because decreased effective circulating blood volume often accompanies induction of anesthesia and surgical trauma. However, fluid therapy only indirectly impacts cardiac and vascular function. Optimizing oxygen delivery and assuring the removal of metabolic bioproducts may require a combination of individualized fluid therapy, pharmacotherapy, and occasionally mechanical cardiovascular support."

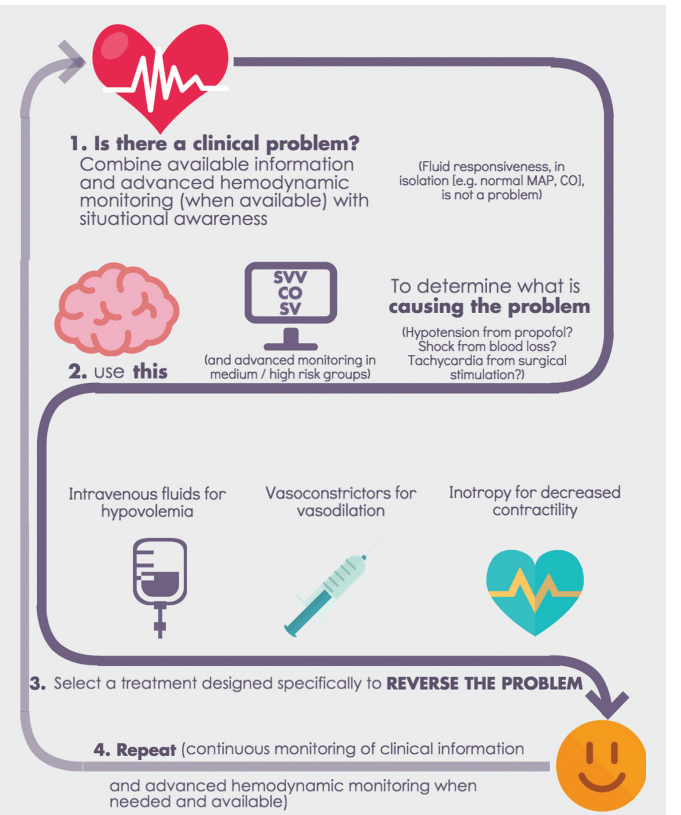
Perioperative fluid therapy: a statement from the international Fluid Optimization Group

Lais Helena Camacho Navarro,corresponding author Joshua A Bloomstone, Jose Otavio Costa Auler, Jr, Maxime Cannesson, Giorgio Della Rocca, Tong J Gan, Michael Kinsky, Sheldon Magder, Timothy E Miller, Monty Mythen, Azriel Perel, Daniel A Reuter, Michael R Pinsky, and George C Kramer



Hemodynamics Framework

by the POQI Fluids Subgroup
a rational, step-wise approach



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

Robert H. Thiele[1], Karthik Raghunathan[2], C. S. Brudney[3], Dileep N. Lobo[4], Daniel Martin[56], Anthony Senagore[7], Maxime Cannesson[8], Tong Joo Gan[9], Michael Monty G. Mythen[10], Andrew D. Shaw[11], Timothy E. Miller[12*] and For the Perioperative Quality Initiative (POQI) I Workgroup

Notes:

Pressure and Flow-based Protocols

Overview

Study design
Multicenter randomized controlled trial

Patient population
Low-to moderate risk patients undergoing major elective surgery (abdominal, urological, gynecological or orthopedic)

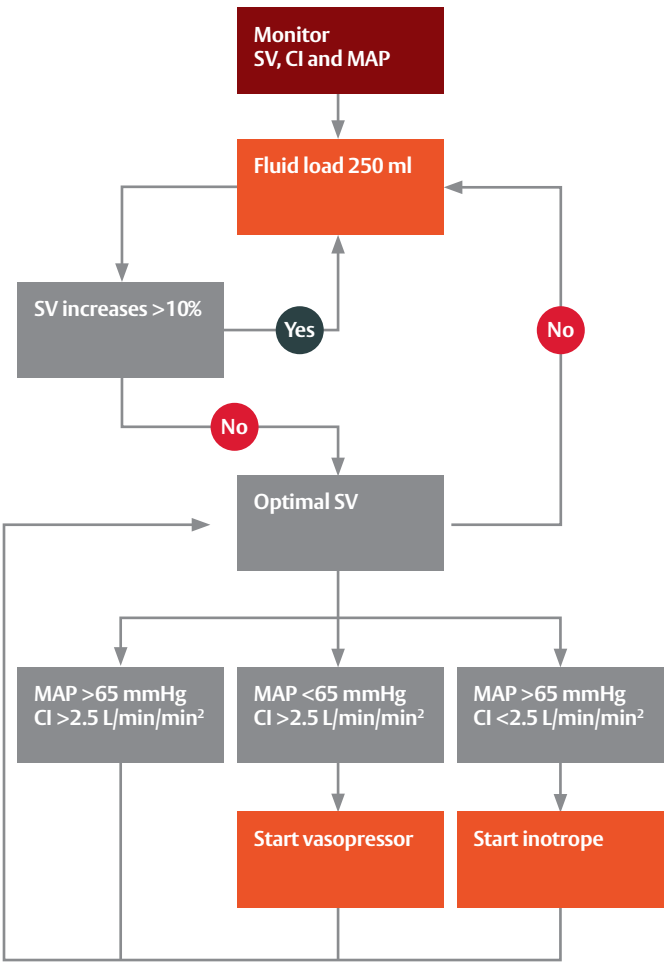
Target parameters
Stroke volume, cardiac index, mean arterial pressure

Intervention
Fluid, vasopressors, inotropes

Primary outcomes
Decrease in postoperative complications (8.6% vs 16.6%) and decrease in hospital length of stay (4-10 days vs 5-12 days)

A total of 450 patients participated in this study

During the intraoperative period, patients randomized to the control group received continuous infusion of balanced crystalloid fluids (Ringer's lactate) at 3-5 ml kg/ h for laparoscopic surgery, or 5-7ml kg/ h for open surgery


Monitor
SV, CI and MAP
Fluid load 250 ml
SV increases >10%
Yes
No
No
Optimal SV
MAP >65 mmHg
CI >2.5 L/min/min²
MAP <65 mmHg
CI >2.5 L/min/min²
MAP >65 mmHg
CI <2.5 L/min/min²
Start vasopressor
Start inotrope

Overview

Study design
Single-center randomized controlled trial

Patient population
Undergoing head and neck oncologic surgery with primary FTT (free tissue transfer) reconstruction

Target parameters
Stroke volume variation, cardiac index, systemic vascular resistance, mean arterial pressure

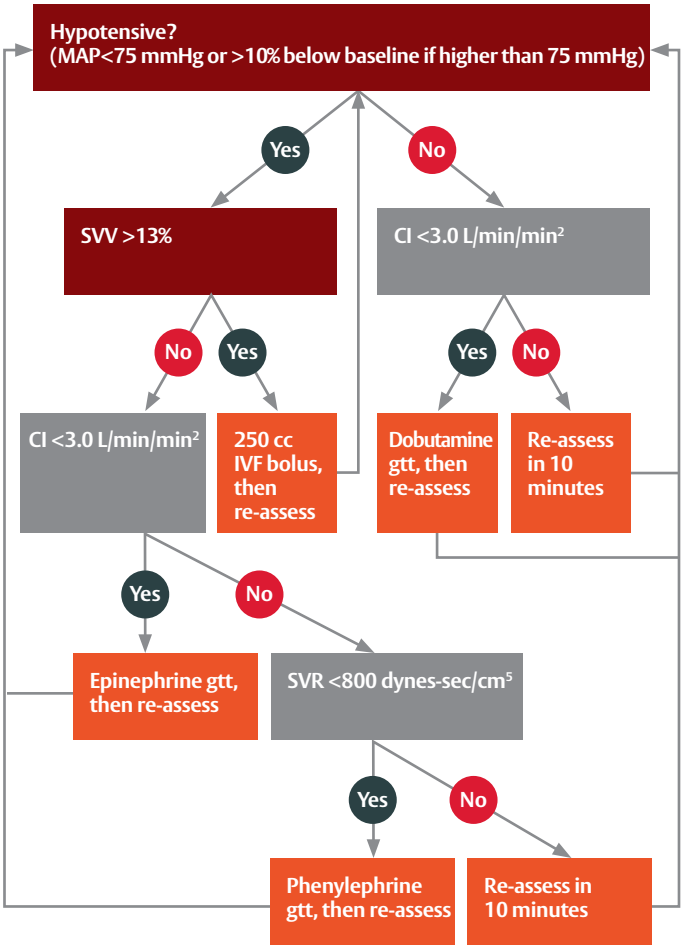
Intervention
Fluid, vasopressor, inotrope

Primary outcomes
Decrease in ICU length of stay (1.4 days vs 2.4 days) and decrease in duration of mechanical ventilator requirement (1.72 days vs 0.81 days)

A total of 94 patients participated in this study

Maintenance of plasmalyte-A was administered based on the patient's body weight and estimated evaporative losses based on incision

Albumin (25%) was given if the patient's preoperative albumin is <2.5 g/dL based on the following formula: (2.5 g/dL – actual albumin g/dL) x weight (kg) x 0.8


Hypotensive?
(MAP<75 mmHg or >10% below baseline if higher than 75 mmHg)
Yes
No
SVV >13%
CI <3.0 L/min/min2
No
Yes
Yes
No
CI <3.0 L/min/min2
250 cc IVF bolus, then re-assess
Dobutamine gtt, then re-assess
Re-assess in 10 minutes
Yes
No
Epinephrine gtt, then re-assess
SVR <800 dynes-sec/cm5
Yes
No
Phenylephrine gtt, then re-assess
Re-assess in 10 minutes

Overview

Study design
Randomized, controlled trial

Patient population
Undergoing elective craniotomy for brain tumor resection, brain abscess or intracranial aneurysm

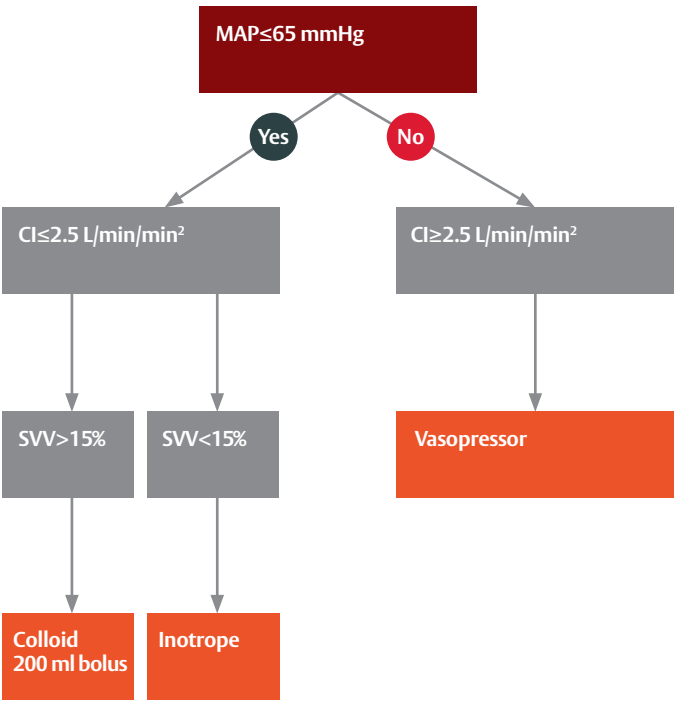
Target parameters
Cardiac index, stroke volume variation, mean arterial pressure

Intervention
Fluid (colloid), vasopressor, inotrope

Primary outcomes
Decreased ICU length of stay (3 days vs 6 days) and decrease in total number of postoperative complications (46 vs 99)

A total of 145 patients participated in this study

Maintenance fluid: crystalloid 3 mL/kg/hr, with a maximum of 2 colloid boluses in the case of hypotension with low CI and high SVV


MAP≤65 mmHg
Yes
No
CI≤2.5 L/min/min²
CI≥2.5 L/min/min²
SVV>15%
SVV<15%
Vasopressor
Colloid
200 ml bolus
Inotrope

Overview

Study design
Single-center randomized controlled trial

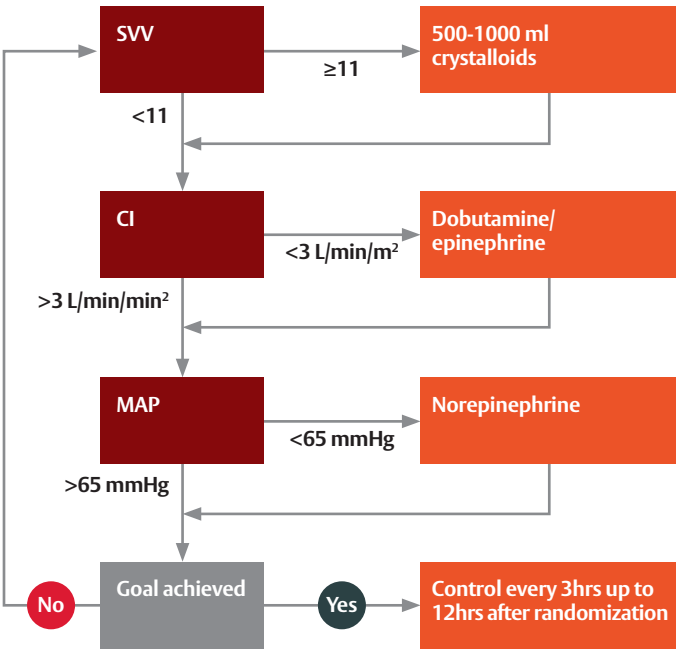
Patient population
Undergoing major cardiac surgery with the use of cardiopulmonary bypass and at high risk for AKI (acute kidney injury)

Target parameters
Stroke volume variation, cardiac index, mean arterial pressure

Intervention
Fluid, vasopressor, inotrope

Primary outcomes
Decrease in occurrence of AKI within 72 hours after surgery (55.1% vs 71.7%)

A total of 276 patients participated in this study


SVV
≥11
500-1000 ml crystalloids
<11
CI
<3 L/min/m²
Dobutamine/ epinephrine
>3 L/min/min²
MAP
<65 mmHg
Norepinephrine
>65 mmHg
No
Goal achieved
Yes
Control every 3hrs up to 12hrs after randomization

Overview

Study design
Randomized, controlled trial

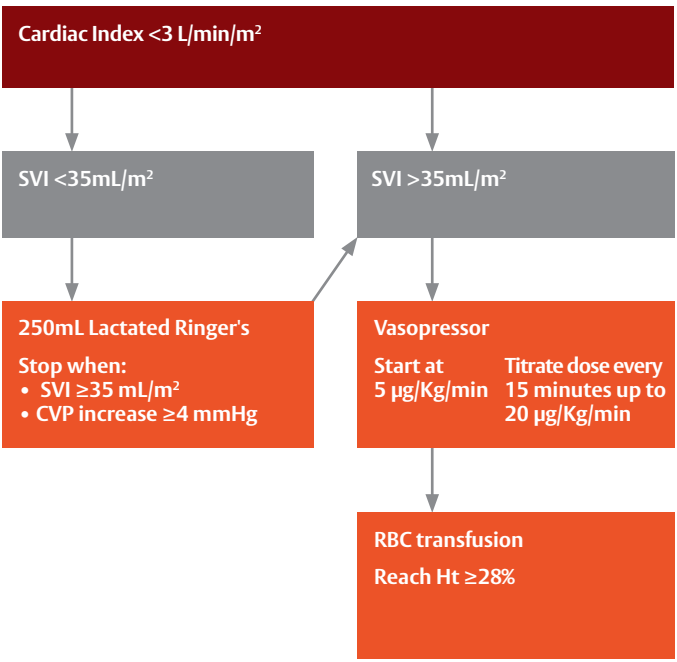
Patient population
High-risk patients undergoing coronary artery bypass surgery or valve repair

Target parameters
Cardiac index, stroke volume index, central venous pressure

Intervention
Fluids, inotropes, RBC transfusions

Primary outcomes
Decrease in overall rate of complications (11% vs 22%) and decrease in hospital length of stay (9 days vs 12 days)

A total of 126 patients participated in this study


Cardiac Index <3 L/min/m²
SVI <35mL/m²
SVI >35mL/m²
250mL Lactated Ringer's
Stop when:
• SVI ≥35 mL/m²
• CVP increase ≥4 mmHg
Vasopressor
Start at 5 µg/Kg/min
Titrate dose every 15 minutes up to 20 µg/Kg/min
RBC transfusion
Reach Ht ≥28%

Overview

Study design
Randomized, controlled trial

Patient population
Undergoing elective major orthopedic surgery including total hip arthroplasty, spinal fusion surgery, femoral fracture surgery and sacral tumor surgery and with an anticipated blood loss >800 ml

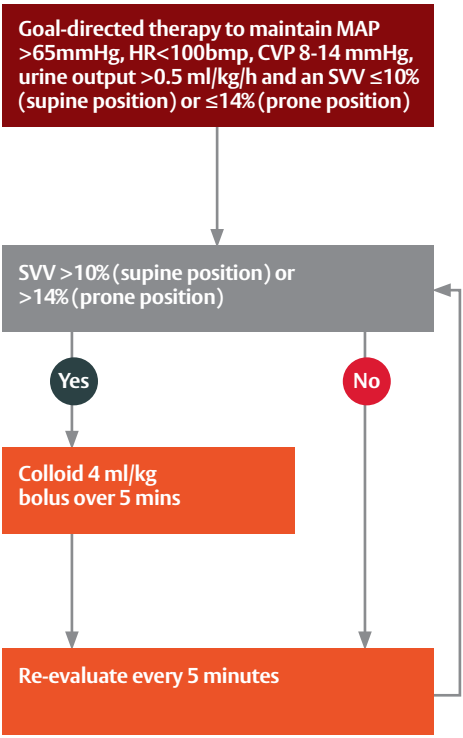
Target parameters
Stroke volume variation, MAP, HR, CVP, urine output

Intervention
Fluid (colloid)

Primary outcomes
Decreased volume of intraoperative fluids, maintained intraoperative hemodynamic stability and improved perioperative gastrointestinal function

A total of 80 patients participated in this study

Maintenance fluid: crystalloid 5ml/kg/hr


Goal-directed therapy to maintain MAP >65mmHg, HR<100bmp, CVP 8-14 mmHg, urine output >0.5 ml/kg/h and an SVV ≤10% (supine position) or ≤14% (prone position)
SVV >10% (supine position) or >14% (prone position)
Yes
No
Colloid 4 ml/kg bolus over 5 mins
Re-evaluate every 5 minutes

Overview

Study design
Single-center, prospective, randomized trial

Patient population
ASA II & III patients undergoing cytoreductive surgery (CRS) with hyperthermic intraperitoneal chemotherapy (HIPEC)

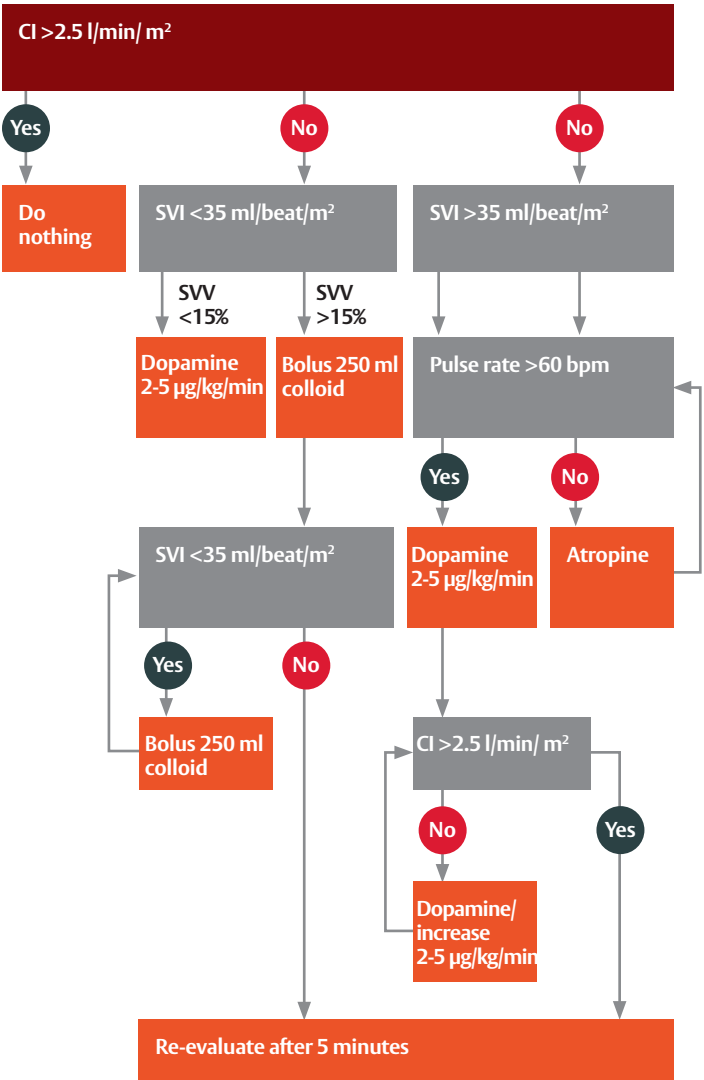
Target parameters
Cardiac index, stroke volume index, stroke volume variation

Intervention
Fluid (colloid), inotrope, chronotrope

Primary outcomes
Decrease in postoperative major abdominal complications (10.5% vs 38.1%) and decrease in hospital length of stay (19 days vs 29 days)

A total of 80 patients participated in this study

Maintenance fluid crystalloid 4ml/kg/h



End protocol

Overview

Study design
Quality improvement program
(before-after comparison)

Patient population
Undergoing emergency or elective abdominal, orthopedic, gynecologic, urologic or vascular surgery

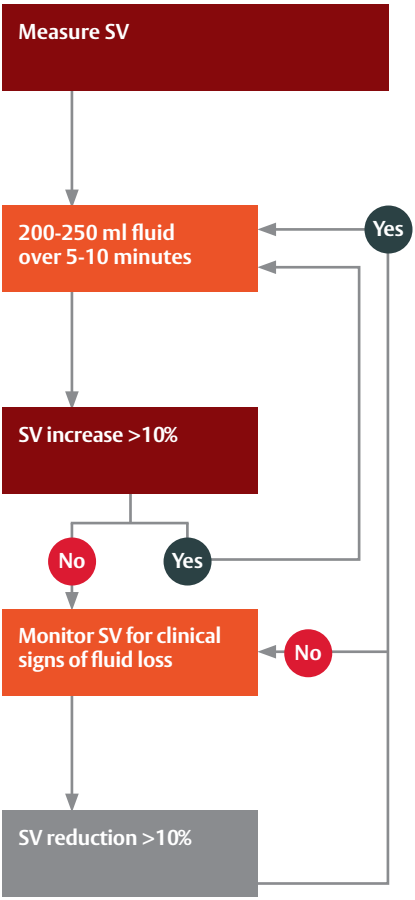
Target parameters
Stroke volume

Intervention
Fluid

Primary outcomes
3.7-day decrease in hospital length of stay (25%)

A total of 1,307 patients participated in this study

Abbreviation: SV: Stroke Volume.


Measure SV
200-250 ml fluid over 5-10 minutes
Yes
SV increase >10%
No
Yes
Monitor SV for clinical signs of fluid loss
No
SV reduction >10%

Overview

Study design
Prospective quality improvement study

Patient population
Undergoing open colectomy, pancreatectomy, pelvic surgery with cancer debulking or liver resection and equipped with an arterial line

Target parameters
Stroke volume variation, blood pressure, cardiac index

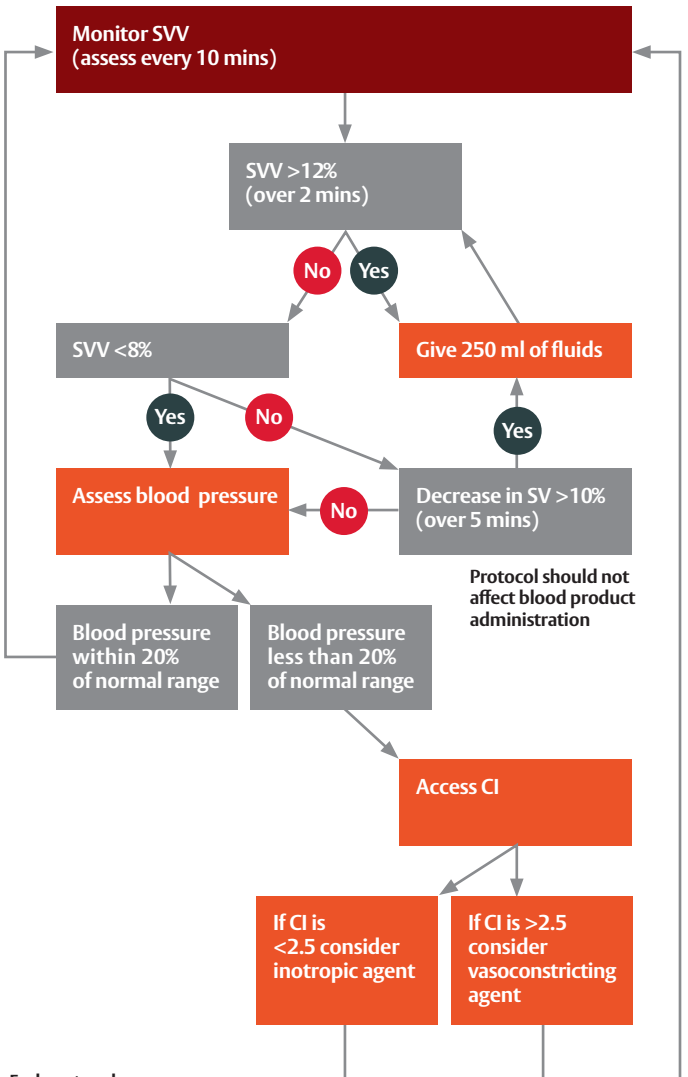
Intervention
Fluid

Primary outcomes
Decrease in hospital length of stay by 18% and decrease in ICU length of stay by 16%

A total of 327 patients participated in this study

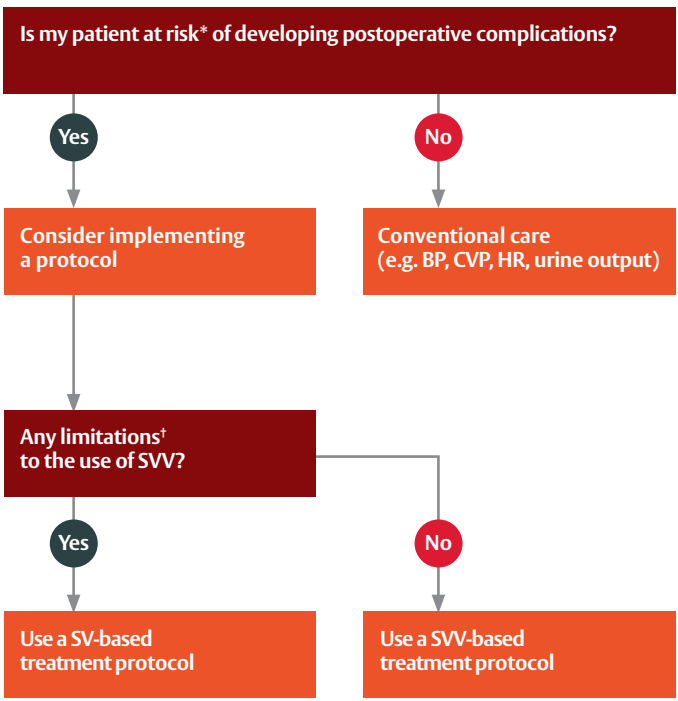
Maintenance fluid: crystalloid 3cc/kg/hr

Abbreviations: CI: Cardiac Index; **SV:** Stroke Volume; **SVV:** Stroke Volume Variation.


Monitor SVV
(assess every 10 mins)
SVV >12%
(over 2 mins)
No
Yes
SVV <8%
Give 250 ml of fluids
Yes
No
Yes
Assess blood pressure
No
Decrease in SV >10%
(over 5 mins)
Protocol should not affect blood product administration
Blood pressure within 20% of normal range
Blood pressure less than 20% of normal range
Access CI
If CI is <2.5 consider inotropic agent
If CI is >2.5 consider vasoconstricting agent
End protocol

Application of stroke volume versus stroke volume variation protocols

The following algorithm is provided to help you select the most appropriate perioperative goal-directed therapy (PGDT) protocol for your patient. When choosing a protocol, the clinician should consider method of ventilation as well as other patient variables (positioning, minimally-invasive surgery, etc.).



*At risk due to comorbidities or the surgical procedure itself.

†Factors that may impact reliability of SVV: Spontaneous breathing, tidal volume <8 ml/kg, open chest, cardiac arrhythmias, right ventricular failure and abdominal pressure.

Abbreviations: BP: Blood Pressure; **CVP:** Central Venous Pressure; **HR:** Heart Rate; **SV:** Stroke Volume; **SVV:** Stroke Volume Variation.

References

Protocol summaries

1. Calvo-Vecino J, Ripolles-Melchor J, Mythen M, Casans-Frances R, Balik A, Artacho J, Martinez-Hurtado E, Serrano Romero A, Fernandez Perez C, Asuero De Lis S. Effect of goal-directed haemodynamic therapy on postoperative complications in low-moderate risk surgical patients: a multicentre randomised controlled trail (FEDORA trial). *BJA*. 2018. doi:10.1016/j.bja.2017.12.2018.
2. Hand W, Stoll W, McEvoy M, McSwain J, Sealy C, Skoner J, Hornig J, Tennant P, Wolf B, Day T. Intraoperative goal-directed hemodynamic management in free tissue transfer for head and neck cancer. *Wiley Online Library* [published 2016]. doi: 10.1002/hed.24362.
3. Luo J, Xue J, Liu J, Liu B, Liu L, Chen G. Goal-directed fluid restriction during brain surgery: a prospective randomized controlled trial. *Ann. Intensive Care* 2017. doi:10.1186/s13613-017-0239-8.
4. Meersch M, Schmidt C, Hoffmeier A, Van Aken H, Wempe C, Gerss J, Zarbock A. Prevention of cardiac surgery-associated AKI by implementing the KDIGO guidelines in high risk patients identified by biomarkers: the PrevAKI randomized controlled trial. *Intensive Care Med*. 2017. doi:10.1007/s00134-016-4670-3.
5. Osawa E., Rhodes A, Landoni G, Filomena G, Fukushima J, Park C, Almeida J, Nakamura R, Strabelli T, Pileggi B, Leme A, Fominskiy E, Sakr Y, Lima M, Franco R, Chan R, Piccioni M, Mendes P, Menezes S, Bruno T, Gaiotto F, Lisboa L, Dallan L, Hueb A, Pomerantzeff P, Filho R, Jatene F, Auler J, Hajjar L. Effect of perioperative goal-directed hemodynamic resuscitation therapy on outcomes following cardiac surgrey: a randomized clinical trial and systematic review. *Society of critical care medicine and wolters kluwer heath inc.* 2016. doi: 10.1097/CCM.0000000000001479
6. Peng K, Li J, Cheng H, Ji F. Goal-directed fluid therapy based on stroke volume variations improves fluid management and gastrointestinal perfusion in patients undergoing major orthopedic surgery. *Med Princ. Prat.* 2014. doi: 10.1159/000363573.

Flow-based protocols

7. Colantonio L, Claroni C, Fabrizi L, Marcelli M, Sofra M, Giannarelli D, Garofalo A, Forastiere E. A randomized trial of goal directed vs standard fluid therapy in cytoreductive surgery with hyperthermic intraperitoneal chemotherapy. *J Gastrointest Surg.* 2015. doi: 10.1007/s11605-015-2743-1.
8. Kuper M, Gold SJ, Callow C, et al. Intraoperative fluid management guided by oesophageal Doppler monitoring. BMJ. 2011;342:d3016.
9. Cannesson M, Ramsingh D, Rinehart J, Demirjian A, Vu T, Vakharia S, Imagawa D, Yu Z, Greenfield S, Kain Z. Perioperative goal-directed therapy and postoperative outcomes in patients undergoing high-risk abdominal surgery: a historical prospective, comparative effectiveness study. et al. critical care 2015. doi: 10.1186/s13054-015-0945-2.

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