

Enhancing Recovery after Cardiac Surgery

Randomized controlled trials showing a benefit from Perioperative Goal-Directed Therapy (PGDT) in cardiac surgery

More than 3500 patients have been enrolled in these 13 positive RCTs.

#	Title, author, year, publication	n	Parameters optimized	Surgery	Tool	Main benefits of PGDT
1	Goal-directed resuscitation following cardiac surgery reduces acute kidney injury: a quality initiative pre-post analysis. Johnston, et al. 2019 Journal of Thoracic and Cardiovascular Surgery	1,979	CI, MAP, PVI, SvO ₂	Cardiac	PAC	37% reduction in odds of AKI post-surgery and reduced RIFLE injury or failure post-surgery (7.8% vs 12.4%)
2	Prevention of cardiac surgery-associated AKI by implementing the KDIGO guidelines in high risk patients identified by biomarkers: the PrevAKI randomized controlled trial. Meerch, et al. 2017 Inten Care Med	276	SVV, CI, MAP	Cardiac	PICCO	Reduced occurrence of AKI (55.1 vs. 71.7%) Reduced rate of moderate to severe AKI (29.7% vs. 44.9%) Reduced occurrence of hyperglycemia (50.7% vs. 75.4%) and use of ACEi/ARBs (10.9% vs. 30.4%)
3	Goal-directed therapy improves the outcome of high-risk cardiac patients undergoing off-pump coronary artery bypass. Kapoor, et al. 2017 Ann Card Anaesth	142	CI, SVRI, DO ₂ I, SVV, ScVO ₂ , GEDV, EVLW	High-risk OPCAB	FloTrac, EOCVC, EV1000	Reduced length of hospital stay (5.61d vs. 7.42d) Reduced length of ICU stay (2.53d vs. 4.2d) Reduced duration of inotropes (2.89h vs. 3.24h)
4	Perioperative utility of goal-directed therapy in high-risk cardiac patients undergoing coronary artery bypass grafting: "a clinical outcome and biomarker-based study." Kapoor, et al. 2016 Ann Card Anaesth	130	CI, SVI, ScvO ₂ , SVRI, SVV, DO ₂ I	CABG on CPB	FloTrac, EOCVC, Vigileo	Shorter average duration of ventilation (18.05h vs. 19.89h) Shorter hospital stay (7.17d vs. 7.94d) Shorter ICU stay (3.41d vs. 3.74d) Earlier decline of lactate levels (6h vs. 12h) Lower levels of brain natriuretic peptide, neutrophil gelatinase-associated lipocalin levels



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5	Effect of perioperative goal-directed hemodynamic resuscitation therapy on outcomes following cardiac surgery: a randomized clinical trial and systematic review. Osawa, et al. 2016 <i>Crit Care Med</i>	126	CI, SVI	CABG, valve repair	LiDCO rapid	Reduced composite endpoint of 30-day mortality and major postoperative complications (27.4% vs. 45.3%) Reduced infection rate (12.9% vs. 29.7%) Reduced cardiac output syndrome (6.5% vs. 26.6%) Reduced ICU cumulative dosage of dobutamine (12mg/kg vs. 19mg/kg) Reduced ICU length of stay (3d vs. 5d) Reduced hospital length of stay (9d vs. 12d)
6	A randomised feasibility study to assess a novel strategy to rationalise fluid in patients after cardiac surgery. Parke, et al. 2015 <i>BJA</i>	144	SVV	Cardiac	FloTrac, EV1000	Less bolus fluid and less total overall fluid volume administered from ICU admission to extubation
7	Early goal-directed therapy based on endotracheal bio-impedance cardiography: a prospective, randomized controlled study in coronary surgery. Fellahi, et al. 2015 <i>J Clin Monit Comput</i>	100	SVV, CI	Elective primary CABG	ECOM	Reduced time to extubation (approx. 1h)
8	Individually optimized hemodynamic therapy reduces complications and length of stay in the intensive care unit: a prospective, randomized controlled trial. Goepfert, et al. 2013 <i>Anesthesiology</i>	100	CI, SVV, GEDI, MAP, ELWI	CABG, aortic valve replacement	PiCCO plus	Decreased intraoperative need for norepinephrine ($9.0 \pm 7.6 \mu\text{g/kg}$ vs. $14.9 \pm 11.1 \mu\text{g/kg}$) Reduced postoperative complications (40 vs. 63) Reduced time to reach ICU discharge criteria ($15 \pm 6\text{h}$ vs. $24 \pm 29\text{h}$) Reduced length of ICU stay ($42 \pm 19\text{h}$ vs. $62 \pm 5\text{h}$)
9	Single transpulmonary thermodilution and continuous monitoring of central venous oxygen saturation during off-pump coronary surgery. Smetkin, et al. 2009 <i>Acta Anaesthesiol Scand</i>	40	Intrathoracic blood volume index, MAP, HR, ScvO ₂ , CI, CVP	OPCAB	PiCCO plus	Decreased time to "fit for discharge" status 15% Decreased post-operative hospital stay 25%
10	Early goal-directed therapy in moderate to high-risk cardiac surgery patients. Kapoor, et al. 2008 <i>Ann Card Anaesth</i>	30	CI, CVP, MAP, SVI, ScvO ₂ , SVRI, SVV, DO ₂ I	CABG on CPB	FloTrac, EOCVC, Vigileo	Shorter average duration of ventilation (13.8h vs. 20.7h) Fewer days of inotropic agent use (1.6d vs. 3.8d) Shorter ICU stay (2.6d vs. 4.9d) Shorter hospital stay (5.6d vs. 8.9d)
11	Randomised controlled trial assessing the impact of a nurse delivered, flow monitored protocol for optimisation of circulatory status after cardiac surgery. McKendry, et al. 2004 <i>BMJ</i>	174	SVI	Cardiac	Esophageal Doppler	Reduced postop morbidity and mortality (p=0.08) Reduced median hospital stay (9d vs. 7d) Reduced mean hospital stay (13.9d vs. 11.4d, 18% savings in hospital bed days) ICU bed use reduced by 23%

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12	A prospective, randomized study of goal-oriented hemodynamic therapy in cardiac surgical patients. Polonen, et al. 2000 Anesth Analg	403	SvO ₂ , Lactate	Elective cardiac	TD PAC, radial arterial	Shortened median hospital stay (6d vs. 7d, P=0.05) Faster discharge (P=0.05) Reduced morbidity at time of discharge (1.1% vs. 6.1%)
13	Perioperative plasma volume expansion reduces the incidence of gut mucosal hypoperfusion during cardiac surgery. Mythen, et al. 1995 Arch Surg	60	SV	Elective cardiac	Esophageal Doppler	Reduced incidence of gut mucosal hypoperfusion at the end of surgery (7% vs. 56%) Reduced major complications (0 vs. 6) Reduced mean hospital stay (6.4d vs. 10.1d) Reduced mean ICU stay (1d vs. 1.7d)

CABG: Coronary artery bypass graft

CPB: Cardiopulmonary bypass

ECOM: Endotracheal cardiac output monitor

EOVC: Edwards oximetry central venous catheter

OPCAB: Off-pump coronary artery bypass

RIFLE: Risk, injury, failure, loss of kidney function, end-stage kidney disease

TD PAC: Thermodilution pulmonary arterial catheter

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