

PULSION PiCCO-Technology – Literature list

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- Very Highly Recommended
- Highly Recommended
- Recommended

1. REVIEWS

1.1 GENERAL

Malbrain M, De Potter P, Deeren D.

Cost Effectiveness of minimally invasive hemodynamic monitoring

In: Vincent JL (Ed.), Yearbook of Intensive Care and Emergency Medicine 2005: 603-18

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[Invasives Kreislaufmonitoring: Vier Methoden im Vergleich] (Article in German)

Anästhesiol Intensivmed Notfallmed Schmerzther 2006; 41(9):550-4

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Volumetric monitoring: principles of application

Minerva Anesthesiol 2005; 71:303-6

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Genahr A, McLuckie A.

Transpulmonary thermodilution in the critically ill

Brit J Int Care 2004: 6-10

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Cottis R, Magee N, Higgins DJ.

Haemodynamic monitoring with pulse-induced contour cardiac output (PiCCO) in critical care

Intensive Crit Care Nurs 2003; 19: 301-7

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Michard F, Perel A.

Management of circulatory and respiratory failure using less invasive hemodynamic monitoring

In: Vincent JL (Ed.), Yearbook of Intensive Care and Emergency Medicine 2003: 508-20

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Bellomo R, Uchino S.

Cardiovascular monitoring tools: use and misuse

Curr Opin Crit Care 2003; 9(3): 225-9

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1.2 CARDIAC OUTPUT

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[Messung des Herzzeitvolumens] (Article in German)

Anaesthesist 2005; 54:1135-53

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1.3 PRELOAD

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How to measure and interpret volumetric measures of preload

Curr Opin Crit Care 2007; 13(3): 297-302

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Intrathoracic Blood Volume: Clinical Applications

In: Vincent JL (Ed.), Yearbook of Intensive Care and Emergency Medicine 2006: 143-52

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Michard F.

Do we need to know cardiac preload?

In: Vincent JL (Ed.), Yearbook of Intensive Care and Emergency Medicine 2004: 694-701

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1.4 LUNG WATER

Groeneveld ABJ.

Value and limitations of measuring extravascular lung water

Int J Intensive Care 2007; Autumn: 84-6

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Khan S, Trof RJ, Groeneveld ABJ.

Transpulmonary dilution-derived extravascular lung water as a measure of lung edema

Curr Opin Crit Care 2007; 13 (3):303-7

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Fernandez-Mondejar E, Guerrero-López F, Colmenero M.

How important is the measurement of extravascular lung water?

Curr Opin Crit Care 2007; 13: 79-83

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Michard F.

Bedside assessment of extravascular lung water by dilution methods: temptations and pitfalls

Crit Care Med 2007; 35(4):1186-92

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Isakow W, Schuster DP.

Extravascular lung water measurements and hemodynamic monitoring in the critically ill: bedside alternatives to the pulmonary artery catheter

Am J Physiol Lung Cell Mol Physiol 2006; 291: 1118-33

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Kirov MY, Kuzkov VV, Bjertnaes LJ.

Extravascular lung water in sepsis

In: Vincent JL (Ed.), Yearbook of Intensive Care and Emergency Medicine 2005: 449-60

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1.5 PAEDIATRIC

Tibby SM, Murdoch IA.

Measurement of cardiac output and tissue perfusion

Curr Opin Pediatr 2002; 14(3):303-9

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2. GUIDELINES AND STANDARD OPERATING PROCEDURES

Goepfert M, Reuter D, Akyol D, Lamm P, Kilger E, Goetz A.

Goal directed fluid management reduces vasopressor and catecholamine use in cardiac surgery patients

Intensive Care Medicine 2007; 33: 96-103

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Kortgen A, Niederprün P, Bauer M.

Implementation of an evidence-based “standard operating procedure” and outcome in septic shock

Crit Care Med 2006; 34(4):939-9

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[Diagnose und Therapie der Sepsis: S2-Leitlinien der Deutschen Sepsis-Gesellschaft e.V. (DSG) und der Deutschen Interdisziplinären Vereinigung für Intensiv- und Notfallmedizin (DIVI)] (Article in German)

Internist 2006;1-40

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Hensel M, Schwenk W, Bloch A, Raue W, Stracke S, Volk T, v. Heymann C, Müller JM, Kox WJ, Spies C.

[Die Aufgabe der Anästhesiologie bei der Umsetzung operativer „Fast track-Konzepte“] (Article in German)

Der Anesthesist 2006; 5(1):80-92

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Dellinger RP, Carlet JM, Masur H, Gerlach H, Calandra T, Cohen J, Gea-Banacloche J, Keh D, Marshall JC, Parker MM, Ramsay G, Zimmerman JL, Vincent JL, Levy MM.

Surviving Sepsis Campaign guidelines for management of severe sepsis and septic shock

Crit Care Med 2004; 32(3): 858-77

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3a. PICCO PARAMETERS – METHODOLOGY

3a.1 FLOW (Cardiac Output)

Faybik P, Hetz H, Baker A, Yankovskaya E, Krenn CG, Steltzer H.

Iced versus room temperature injectate for assessment of cardiac output, intrathoracic blood volume, and extravascular lung water by single transpulmonary thermodilution

J Crit Care 2004; 19(2):103-7

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Segal E, Katzenelson R, Berkenstadt H, Perel A.

Transpulmonary thermodilution cardiac output measurement using the axillary artery in critically ill patients

J Clin Anesth 2002; 14(3):210-3

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Sakka SG, Meier-Hellmann A.

Evaluation of cardiac output and cardiac preload

In: Vincent JL (Ed.), Yearbook of Intensive Care and Emergency Medicine 2000: 671-9

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3a.2 PRELOAD (Intrathoracic Blood Volume and Global End Diastolic Volume)

Hofer CK, Furrer L, Matter-Ensner S, Maloigne M, Klaghofer R, Genoni M, Zollinger A.

Volumetric preload measurement by thermodilution: a comparison with transoesophageal echocardiography

Br J Anaesth 2005; 94(6):748-55

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Buhre W, Buhre K, Kazmaier S, Sonntag H, Weyland A.

Assessment of cardiac preload by indicator dilution and transoesophageal echocardiography

Eur J Anaesthesiol 2001; 18(10):662-7

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McLuckie A, Bihari D.

Investigating the relationship between intrathoracic blood volume index and cardiac index

Intensive Care Med 2000; 26(9):1376-8

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3a.3 CONTRACTILITY (Global Ejection Fraction, Cardiac Function Index & Left Ventricular Contractility)

Michard F, Perel A.

Management of circulatory and respiratory failure using less invasive hemodynamic monitoring

In: Vincent JL (Ed.), Yearbook of Intensive Care and Emergency Medicine 2003: 508-20

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Wisner-Euteneier AJ, Lichtwarck-Aschoff M, Zimmermann G, Bluemel G, Pfeiffer U.

Evaluation of the cardiac function index as a new bedside indicator of cardiac performance

Intensive Care Med 1994; 20(S2):21

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3a.4 VOLUME RESPONSIVENESS (Stroke Volume Variation and Pulse Pressure Variation)

Reuter DA, Goepfert MS, Goresch T, Schmoeckel M, Kilger E, Goetz AE.

Assessing fluid responsiveness during open chest conditions

Br J Anaesth 2005; 94(3):318-23

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Rex S, Brose S, Metzelder S, Huneke R, Schalte G, Autschbach R, Rossaint R, Buhre W.

Prediction of fluid responsiveness in patients during cardiac surgery

Br J Anaesth 2004; 93 (6):782-8

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Reuter DA, Felbinger TW, Kilger E, Schmidt C, Lamm P, Goetz AE.

Optimizing fluid therapy in mechanically ventilated patients after cardiac surgery by on-line monitoring of left ventricular stroke volume variations. Comparison with aortic systolic pressure variations

Br J Anaesth 2002; 88(1):124-6

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3a.5 PULMONARY EDEMA (Extravascular Lung Water)

Phillips, C., Chesnutt M, Smith, M.

Extravascular lung water in sepsis-associated acute respiratory distress syndrome: indexing with predicted body weight improves correlation with severity of illness and survival

Crit Care Med, 2007(epub): 1-5

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Isakow W, Schuster DP.

Extravascular lung water measurements and hemodynamic monitoring in the critically ill: bedside alternatives to the pulmonary artery catheter

Am J Physiol Lung Cell Mol Physiol 2006; 291(6):1118-33

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Kuzkov V, Kirov M, Sovershaev M, Kulkin V, Suberov E, Waerhaug K, Bjertnaes L.

Extravascular lung water determined with single transpulmonary thermodilution correlates with the severity of sepsis-induced acute lung injury

Crit Care Med 2006; 34(6):1647-53

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Kirov MY, Kuzkov VV, Bjertnaes LJ.

Extravascular lung water in sepsis

In: Vincent JL (Ed.), Yearbook of Intensive Care and Emergency Medicine 2005: 449-60

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Sakka SG, Klein M, Reinhart K, Meier-Hellmann A.

Prognostic value of extravascular lung water in critically ill patients

Chest 2002; 122(6):2080-6

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3b. PICCO PARAMETERS – VALIDATION

3b.1 FLOW (Cardiac Output CO)

Felbinger TW, Reuter DA, Eltzschig HK, Bayerlein J, Goetz AE.

Cardiac index measurements during rapid preload changes: a comparison of pulmonary artery thermodilution with arterial pulse contour analysis

J Clin Anesth 2005; 17(4):241-8

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Marx G, Schuerholz T, Sumpelmann R, Simon T, Leuwer M.

Comparison of cardiac output measurements by arterial trans-cardiopulmonary and pulmonary arterial thermodilution with direct Fick in septic shock

Eur J Anaesthesiol 2005; 22(2):129-34

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Bein B, Worthmann F, Tonner PH, Paris A, Steinfath M, Hedderich J, Scholz J.

Comparison of esophageal Doppler, pulse contour analysis, and real-time pulmonary artery thermodilution for the continuous measurement of cardiac output

J Cardiothorac Vasc Anesth 2004; 18(2):185-9

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Godje O, Hoke K, Goetz AE, Felbinger TW, Reuter DA, Reichart B, Friedl R, Hannekum A, Pfeiffer UJ.

Reliability of a new algorithm for continuous cardiac output determination by pulse-contour analysis during hemodynamic instability

Crit Care Med 2002; 30(1):52-8

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Sakka SG, Reinhart K, Wegscheider K, Meier-Hellmann A.

Is the placement of a pulmonary artery catheter still justified solely for the measurement of cardiac output?

J Cardiothorac Vasc Anesth 2000; 14(2):119-24

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3b.2 PRELOAD (Global Enddiastolic Volume GEDV /Intrathoracic Blood Volume ITBV)

Renner J, Gruenewald M, Brand P, Steinfath M, Scholz J, Lutter G, Bein B.

Global End-Diastolic Volume as a Variable of Fluid Responsiveness During Acute Changing Loading Conditions

J Cardiothorac Vasc Anesth 2007; 21(5): 650-4

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Kozieras, J, Thuemer O, Sakka SG.

Influence of an acute increase in systemic vascular resistance on transpulmonary thermodilution-derived parameters in critically ill patients

Intensive Care Med 2007; 33:1619-23

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Michard F, Alaya S, Zarka V, Bahloul M, Richard C, Teboul JL.

Global end-diastolic volume as an indicator of cardiac preload in patients with septic shock

Chest 2003; 124(5):1900-8

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Reuter DA, Felbinger TW, Moerstedt K, Weis F, Schmidt C, Kilger E, Goetz AE.

Intrathoracic blood volume index measured by thermodilution for preload monitoring after cardiac surgery

J Cardiothorac Vasc Anesth 2002; 16(2):191-5

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3b.3 CONTRACTILITY (Global Ejection Fraction GEF, Cardiac Function Index CFI & Left Ventricular Contractility dPmx)

de Hert S, Robert D, Cromheecke S, Michard F, Nijs J, Rodrigues IE.

Evaluation of Left Ventricular Function in Anesthetised Patients Using Femoral Artery dP/dtmax

J Cardio Thor Vasc Anes 2006; 20(3): 325-30

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Combes A, Berneau JB, Luyt CE, Trouillet JL.

Estimation of left ventricular systolic function by single transpulmonary thermodilution

Intensive Care Med 2004; 30(7):1377-83

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3b.4 VOLUME RESPONSIVENESS (Stroke Volume Variation SVV and Pulse Pressure Variation PPV)

Kubitz JC, Annecke T, Forkl S, Kemming GI, Kronas N, Goetz AE, Reuter DA.

Validation of pulse contour derived stroke volume variation during modifications of cardiac afterload

Br J Anaesth 2007; 98(5): 591-7

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Hofer CK, Muller SM, Furrer L, Klaghofer R, Genoni M, Zollinger A.

Stroke volume and pulse pressure variation for prediction of fluid responsiveness in patients undergoing off-pump coronary artery bypass grafting

Chest 2005; 128(2):848-54

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Reuter DA, Kirchner A, Felbinger TW, Weis FC, Kilger E, Lamm P, Goetz AE.

Usefulness of left ventricular stroke volume variation to assess fluid responsiveness in patients with reduced cardiac function

Crit Care Med 2003; 31(5):1399-404

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Michard F, Boussat S, Chemla D, Anguel N, Mercat A, Lecarpentier Y, Richard C, Pinsky MR, Teboul JL.

Relation between respiratory changes in arterial pulse pressure and fluid responsiveness in septic patients with acute circulatory failure

Am J Respir Crit Care Med 2000; 162(1):134-8

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3b.5 PULMONARY EDEMA (Extravascular Lung Water EVLW)

Monnet X, Anguel N, Osman D, Hamzaoui, Richard C, Teboul JL.

Assessing pulmonary permeability by transpulmonary thermodilution allows differentiation of hydrostatic pulmonary edema from ALI / ARDS

Intensive Care Medicine 2007; 33(3):448-53

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Kuzkov VV, Suborov EV, Kirov MY, Kuklin VN, Sobhkezh M, Johnsen S, Waerhaug K, Bjertnaes LJ.

Extravascular lung water after pneumonectomy and one-lung ventilation in sheep

Crit Care Med 2007; 35 (6):1550-9

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Michard F, Schachtrupp A, Toens C.

Factors influencing the estimation of extravascular lung water by transpulmonary thermodilution in critically ill patients

Crit Care Med 2005; 33(6):1243-7

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Kirov MY, Kuzkov VV, Kuklin VN, Waerhaug K, Bjertnaes LJ.

Extravascular lung water assessed by transpulmonary single thermodilution and postmortem gravimetry in sheep

Crit Care 2004; 8(6):R451-8

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Katzenelson R, Perel A, Berkenstadt H, Preisman S, Kogan S, Sternik L, Segal E.

Accuracy of transpulmonary thermodilution versus gravimetric measurement of extravascular lung water

Crit Care Med 2004; 32(7):1550-4

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Sakka SG, Ruhl CC, Pfeiffer UJ, Beale R, McLuckie A, Reinhart K, Meier-Hellmann A.

Assessment of cardiac preload and extravascular lung water by single transpulmonary thermodilution

Intensive Care Medicine 2000; 26 (2):180-7

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4. FIELDS OF APPLICATION

4.1 MEDICAL INTENSIVE CARE

Kortgen A, Niederprün P, Bauer M.

Implementation of an evidence-based „standard operating procedure“ and outcome in septic shock

Crit Care Med 2006; 34 (4):939-9

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Martin GS, Eaton S, Mealer M, Moss M.

Extravascular lung water in patients with severe sepsis: a prospective cohort study

Crit Care 2005; 9(2):R74-82

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Mitchell JP, Schuller D, Calandrino FS, Schuster DP.

Improved outcome based on fluid management in critically ill patients requiring pulmonary artery catheterization

Am Rev Respir Dis 1992; 145(5):990-8

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4.2 SURGICAL INTENSIVE CARE

Sato Y, Motoyama S, Maruyama M, Hayashi K, Nakae H, Tajimi K, Ogawa J.

Extravascular Lung Water Measured Using Single Transpulmonary Thermodilution Reflects Perioperative Pulmonary Edema Induced by Esophagectomy

Eur Surg Res 2006; 39(1): 7-13

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Roch A, Michelet P, D'Journo B, Brousse D, Blayac D, Lambert D, Auffray JP.

Accuracy and limits of transpulmonary dilution methods in estimating extravascular lung water after pneumonectomy

Chest 2005; 128(2):927-33

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Deja M, Hildebrandt B, Ahlers O, Riess H, Wust P, Gerlach H, Kerner T.
Goal-directed therapy of cardiac preload in induced whole-body hyperthermia
Chest 2005; 128(2):580-6

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Michard F, Schachtrupp A, Toens C.
Factors influencing the estimation of extravascular lung water by transpulmonary thermodilution in critically ill patients
Crit Care Med 2005; 33(6):1243-7

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Junghans T, Neuss H, Strohauser M, Raue W, Haase O, Schink T, Schwenk W.
Hypovolemia after traditional preoperative care in patients undergoing colonic surgery is underrepresented in conventional hemodynamic monitoring
Int J Colorectal Dis 2005; 21(7): 693-7

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Della Rocca G, Costa, MG, Coccia C, Pompei L, Pietropaoli P.
Preload and haemodynamic assessment during liver transplantation: a comparison between the pulmonary artery catheter and transpulmonary indicator dilution techniques
Eur J Anaesthesiol 2002; 19(12):868-75

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[The PiCCO system with brachial-axillary artery access in hemodynamic monitoring during surgery of abdominal aortic aneurysm] (Article in Italian)
Minerva Anesthesiol 2001; 67(6):447-56

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4.3 CARDIAC SURGERY

Goepfert M, Reuter D, Akyol D, Lamm P, Kilger E, Goetz A.
Goal directed fluid management reduces vasopressor and catecholamine use in cardiac surgery patients
Intensive Care Medicine 2007; 33: 96-103

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Kirov MY, Lenkin AI, Kuzkov V, Suburov EV, Slastilin VY, Borodin VV, Chernov II, Shonbin AN, Bjertnaes LJ.
Single transpulmonary thermodilution in off-pump coronary artery bypass grafting: haemodynamic changes and effects of different anaesthetic techniques
Acta Anesthesiol Scand 2007; 51: 426-33

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Wouters PF, Quaghebeur B, Sergeant P, Van Hemelrijck J, Vandermeersch E.
Cardiac output monitoring using a brachial arterial catheter during off-pump coronary artery bypass grafting
J Cardiothorac Vasc Anesth 2005; 19: 160-4

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Reuter DA, Goepfert MS, Goresch T, Schmoeckel M, Kilger E, Goetz AE.
Assessing fluid responsiveness during open chest conditions
Br J Anaesth 2005; 94(3):318-23

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Bettex DA, Hinselmann V, Hellermann JP, Jenni R, Schmid ER.
Transoesophageal echocardiography is more unreliable for cardiac output assessment after cardiac surgery compared with thermodilution
Anesthesia 2004; 59:1184-92

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Mielck F, Buhre W, Hanekop G, Tirilomis T, Hilgers R, Sonntag H.

Comparison of continuous cardiac output measurements in patients after cardiac surgery

J Cardiothorac Vasc Anesth 2003; 17(2):211-6

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Brock H, Gabriel C, Bibl D, Necek S.

Monitoring intravascular volumes for postoperative volume therapy

Eur J Anaesthesiol 2002; 19(4):288-94

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Buhre W, Weyland A, Kazmaier S, Hanekop GG, Baryalei MM, Sydow M, Sonntag H.

Comparison of cardiac output assessed by pulse-contour analysis and thermodilution in patients undergoing minimally invasive direct coronary artery bypass grafting

J Cardiothorac Vasc Anesth 1999; 13(4):437-40

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Godje O, Hoke K, Lamm P, Schmitz C, Thiel C, Weinert M, Reichart B.

Continuous, less invasive, hemodynamic monitoring in intensive care after cardiac surgery

Thorac Cardiovasc Surg 1998; 46(4):242-9

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4.4 TRANSPLANTATION

Della Rocca G, Costa GM, Coccia C, Pompei L, Di Marco P, Pietropaoli P.

Preload index: pulmonary artery occlusion pressure versus intrathoracic blood volume monitoring during lung transplantation

Anesth Analg 2002; 95(4):835-43

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Della Rocca G, Costa MG, Coccia C, Pompei L, Pietropaoli P.

Preload and haemodynamic assessment during liver transplantation: a comparison between the pulmonary artery catheter and transpulmonary indicator dilution techniques

Eur J Anaesthesiol 2002; 19(12):868-75

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Della Rocca G, Costa MG, Pompei L, Coccia C, Pietropaoli P.

Continuous and intermittent cardiac output measurement: pulmonary artery catheter versus aortic transpulmonary technique

Br J Anaesth 2002; 88(3):350-6

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Goedje O, Seebauer T, Peyerl M, Pfeiffer UJ, Reichart B.

Hemodynamic monitoring by double-indicator dilution technique in patients after orthotopic heart transplantation

Chest 2000; 118(3):775-81

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Krenn CG, Plochl W, Nikolic A, Metnitz PG, Scheuba C, Spiss CK, Steltzer H.

Intrathoracic fluid volumes and pulmonary function during orthotopic liver transplantation

Transplantation 2000; 69(11):2394-400

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4.5 TRAUMA

Berkenstadt H, Friedman Z, Preisman S, Keidan I, Livingstone D, Perel A.

Pulse pressure and stroke volume variations during severe haemorrhage in ventilated dogs

Br J Anaesth 2005; 94 (6): 721-6

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Friedman Z, Berkenstadt H, Margalit N, Segal E, Perel A.

Cardiac output assessed by arterial thermodilution during exsanguination and fluid resuscitation: experimental validation against a reference technique

Eur J Anaesthesiol 2002; 19(5):337-40

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4.6 BURNS

Holm C, Mayr M, Horbrand F, Tegeler J, Henckel von Donnersmarck G, Muhlbauer W, Pfeiffer UJ.

Reproducibility of transpulmonary thermodilution measurements in patients with burn shock and hypothermia

J Burn Care Rehabil 2005; 26(3):260-5

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Holm C, Tegeler J, Mayr M, Pfeiffer U, Henckel von Donnersmarck G, Muhlbauer W.

Effect of crystalloid resuscitation and inhalation injury on extravascular lung water: clinical implications

Chest 2002; 121(6):1956-62

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Holm C, Melcer B, Horbrand F, Henckel von Donnersmarck G, Muhlbauer W.

Arterial thermodilution: an alternative to pulmonary artery catheter for cardiac output assessment in burn patients

Burns 2001; 27(2):161-6

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Holm C, Melcer B, Horbrand F, Worl H, von Donnersmarck GH, Muhlbauer W.

Intrathoracic blood volume as an end point in resuscitation of the severely burned: an observational study of 24 patients

J Trauma 2000; 48(4):728-34

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4.7 PEDIATRIC

Fakler U, Pauli Ch, Balling G, Lorenz HP, Eicken A, Hennig M, Hess J.

Cardiac index monitoring by pulse contour analysis and thermodilution after pediatric cardiac surgery

J of Thorac Cardiovasc Surg 2007; 133(1):224-8

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López-Herce J, Rupérez M, Sánchez C, Garcia C, Garcia E.

Estimation of the parameters of cardiac function and of blood volume by arterial thermodilution in an infant animal model

Pediatric Anesthesia 2006; 16: 635-40

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Lopez-Herce J, Ruperez M, Sanchez C, Garcia C, Garcia E.

Hemodynamic response to acute hypovolaemia, rapid blood volume expansion and adrenaline administration in an infant animal model

Resuscitation 2006; 68: 259-65

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Egan J, Festa M, Cole A, Nunn GR, Gillis J, Winlaw DS.

Clinical assessment of cardiac performance in infants and children following cardiac surgery

Intensive Care Med 2005; 31(4):568-73

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Torgay A, Pirat A, Akpek E, Zeyneloglu P, Arslan G, Haberal M.

Pulse contour cardiac output system use in pediatric orthotopic liver transplantation: preliminary report of nine patients

Transplant Proc 2005; 37(7):3168-70

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Ruperez M, Lopez-Herce J, Garcia C, Sanchez C, Garcia E, Vigil D.

Comparison between cardiac output measured by the pulmonary arterial thermodilution technique and that measured by the femoral arterial thermodilution technique in a pediatric animal model

Pediatr Cardiol 2004; 25(2):119-23

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Cecchetti C, Stoppa F, Vanacore N, Barbieri MA, Raucci U, Pasotti E, Tomasello C, Marano M, Pirozzi N.

Monitoring of intrathoracic volemia and cardiac output in critically ill children

Minerva Anesthesiol 2003; 69:907-18

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Pauli C, Fakler U, Genz T, Hennig M, Lorenz HP, Hess J.

Cardiac output determination in children: equivalence of the transpulmonary thermodilution method to the direct Fick principle

Intensive Care Med 2002; 28(7):947-52

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Schiffmann H, Erdlenbruch B, Singer D, Singer S, Herting E, Hoeft A, Buhre W.

Assessment of cardiac output, intravascular volume status, and extravascular lung water by transpulmonary indicator dilution in critically ill neonates and infants

J Cardiothorac Vasc Anesth 2002; 16(5):592-7

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4.8 SHOCK – SEPSIS

Osman D, Ridet C, Ray P, Monnet X, Anguel N, Richard C, Teboul JL.

Cardiac filling pressures are not appropriate to predict hemodynamic response to volume challenge

Crit Care Med 2007; 35(1):64-9

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