Clinical Evidence

ProAQT Technology

This document is intended to provide information to an international audience outside of the US.

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Contents

Review articles & guidelines

Review articles

- Kouz K, Thiele R, Michard F, Saugel B.

  Haemodynamic monitoring during noncardiac surgery: past, present, and future.

  J Clin Monit Comput. 2024 Jun;38(3):565-580
  DOI: 10.1007/s10877-024-01161-2

- Thomsen KK, Kouz K, Saugel B.

  Pulse wave analysis: basic concepts and clinical application in intensive care medicine.

  Curr Opin Crit Care. 2023 Jun 1;29(3):215-222
  DOI: 10.1097/MCC.0000000000001039

- Messina A, Calabrò L, Pugliese L, Lulja A, Sopuch A, Rosalba D, Morenghi E, Hernandez G, Monnet X, Cecconi M.

  Fluid challenge in critically ill patients receiving haemodynamic monitoring: a systematic review and comparison of two decades.

  Crit Care. 2022 Jun 21;26(1):186
  DOI: 10.1186/s13054-022-04056-3

- Saugel B, Thiele RH, Hapfelmeier A, Cannesson M.

  Technological assessment and objective evaluation of minimally invasive and noninvasive cardiac output monitoring systems.

  Anesthesiology. 2020 Oct 1;133(4):921-928
  DOI: 10.1097/ALN.0000000000003483

- Jozwiak M, Monnet X, Teboul JL.

  Pressure waveform analysis.

  Anesth Analg. 2018 Jun;126(6):1930-1933
  DOI: 10.1213/ANE.0000000000002527

- Grensemann J.

  Cardiac output monitoring by pulse contour analysis, the technical basics of less-invasive techniques.

  Front Med (Lausanne). 2018 Mar 6;5:64
  DOI: 10.3389/fmed.2018.00064

- Clement RP, Vos JJ, Scheeren TWL.

  Minimally invasive cardiac output technologies in the ICU: putting it all together.

  Curr Opin Crit Care. 2017 Aug;23(4):302-309
  DOI: 10.1097/MCC.0000000000000417

Guidelines

- Saugel B, Annecke T, Bein B, Flick M, Goepfert M, Gruenewald M, Habicher M, Jungwirth B, Koch T, Kouz K, Meidert AS, Pestel G, Renner J, Sakka SG, Sander M, Treskatsch S, Zitzmann A, Reuter DA.

  Intraoperative haemodynamic monitoring and management of adults having non-cardiac surgery: Guidelines of the German Society of Anaesthesiology and Intensive Care Medicine in collaboration with the German Association of the Scientific Medical Societies.

  J Clin Monit Comput. 2024 Feb 21
  DOI: 10.1007/s10877-024-01132-7

Validation

The ProAQT technology is based on the analysis of the invasively measured arterial blood pressure signal, so called pulse contour analysis. To be able to perform this analysis and to provide accurate measurement results it is utmost important, that the arterial blood pressure signal is of optimal quality and free of severe arrhythmias.

Operating room – moderate to high risk surgery

In the peri-operative setting the ability of ProAQT to provide accurate and precise measurements and to follow the trending depends on the severity level and frequency and significance of changes of the hemodynamic condition. In case of inaccuracies frequent recalibrations are recommended.

- de Courson H, Ferrer L, Cane G, Verchère E, Sesay M, Nouette-Gaulain K, Biais M.

  Evaluation of least significant changes of pulse contour analysis-derived parameters.

  Ann Intensive Care. 2019 Oct 11;9(1):116
  DOI: 10.1186/s13613-019-0590-z

- Weil G, Motamed C, Eghiaian A, Monnet X, Suria S.

  Comparison of Proaqt/Pulsioflex® and oesophageal Doppler for intraoperative haemodynamic monitoring during intermediate-risk abdominal surgery.

  Anaesth Crit Care Pain Med. 2019 Apr;38(2):153-159
  DOI: 10.1016/j.accpm.2018.03.011

- van Drumpt A, van Bommel J, Hoeks S, Grüne F, Wolvetang T, Bekkers J, Ter Horst M.

  The value of arterial pressure waveform cardiac output measurements in the radial and femoral artery in major cardiac surgery patients.

  BMC Anesthesiol. 2017 Mar 14;17(1):42
  DOI: 10.1186/s12871-017-0334-2

- Biais M, Mazocky E, Stecken L, Pereira B, Sesay M, Roullet S, Quinart A, Sztark F.

  Impact of systemic vascular resistance on the accuracy of the Pulsioflex device.

  Anesth Analg. 2017 Feb;124(2):487-493
  DOI: 10.1213/ANE.0000000000001591

- Broch O, Carbonell J, Ferrando C, Metzner M, Carstens A, Albrecht M, Gruenewald M, Höcker J, Soro M, Steinfath M, Renner J, Bein B.

  Accuracy of an autocalibrated pulse contour analysis in cardiac surgery patients: a bi-center clinical trial.

  BMC Anesthesiol. 2015 Nov 26;15:171
  DOI: 10.1186/s12871-015-0153-2

- Smetkin AA, Hussain A, Kuzkov VV, Bjertnæs LJ, Kirov MY.

  Validation of cardiac output monitoring based on uncalibrated pulse contour analysis vs transpulmonary thermodilution during off-pump coronary artery bypass grafting.

  Br J Anaesth 2014 Jun;112(6):1024-31
  DOI: 10.1093/bja/aet489

Intensive care – critically ill patients

In the intensive care surrounding in critically ill patients ProAQT shows limited ability to yield clinically acceptable absolute values, especially when the analyzed arterial pressure signal is derived from a peripheral radial arterial access. Alternatively, a femoral arterial access is recommended. However, tracking of therapy induced changes seem to be reliable.

- Ordoñez-Rufat P, Mancho-Fora N, Tebe-Cordomi C, Polit-Martinez V, Abellan-Lencina R, Fernandez-Alvarez J, Lopez-Delgado JC.

  Study of the accuracy of a radial arterial pressure waveform cardiac output measurement device after cardiac surgery.

  J Cardiothorac Surg. 2023 Jan 17;18(1):32
  DOI: 10.1186/s13019-023-02128-1

- Grensemann J, Defosse JM, Willms M, Schiller U, Wappler F, Sakka SG.

  Validation of radial artery-based uncalibrated pulse contour method (PulsioFlex) in critically ill patients: A observational study.

  Eur J Anaesthesiol. 2017 Nov;34(11):723-731
  DOI: 10.1097/EJA.0000000000000699

- Grensemann J, Defosse JM, Wieland C, Wild UW, Wappler F, Sakka SG.

  Comparison of PulsioFlex® uncalibrated pulse contour method and a modified Fick principle with transpulmonary thermodilution measurements in critically ill patients.

  Anaesth Intensive Care. 2016 Jul;44(4):484-90
  DOI: 10.1177/0310057X1604400407

- Monnet X, Vaquer S, Anguel N, Jozwiak M, Cipriani F, Richard C, Teboul JL.

  Comparison of pulse contour analysis by Pulsioflex and Vigileo to measure and track changes of cardiac output in critically ill patients.

  Br J Anaesth. 2015 Feb;114(2):235-43
  DOI: 10.1093/bja/aeu375

Clinical application areas

Operating room – moderate to high risk surgery

- Biais M, Larghi M, Henriot J, de Courson H, Sesay M, Nouette-Gaulain K.

  End-expiratory occclusion test predicts fluid responsiveness in patients with protective ventilation in the operating room.

  Anesth Analg. 2017 Dec;125(6):1889-1895
  DOI: 10.1213/ANE.0000000000002322

- Biais M, de Courson H, Lanchon R, Pereira B, Bardonneau G, Griton M, Sesay M, Nouette-Gaulain K.

  Mini-fluid challenge of 100 ml of crystalloid predicts fluid responsiveness in the operating room.

  Anesthesiology. 2017 Sep;127(3):450-456
  DOI: 10.1097/ALN.0000000000001753

- Biais M, Lanchon R, Sesay M, Le Gall L, Pereira B, Futier E, Nouette-Gaulain K.

  Changes in stroke volume induced by lung recruitment maneuver predict fluid responsiveness in mechanically ventilated patients in the operating room.

  Anesthesiology. 2017 Feb;126(2):260-267
  DOI: 10.1097/ALN.0000000000001459

- Schluermann CN, Hoeppner J, Benk C, Schmidt R, Loop T, Kalbhenn J.

  Intra-abdominal pressure, cardiac index and vascular resistance during hyperthermic intraperitoneal chemotherapy: a prospective observational study.

  Minerva Anestesiol. 2016 Feb;82(2):160-9.

Intensive care – critically ill patients

- Saeed A, Ziyaee F.

  Treatment of septic shock in two pediatric patients with severe diabetic ketoacidosis using invasive hemodynamic monitoring: a case report.

  BMC Endocr Disord. 2023 Mar 20;23(1):65
  DOI: 10.1186/s12902-023-01315-4

Outcome

Use of ProAQT derived parameters to perform goal directed therapy based on a perioperative fluid optimization algorithm resulted in a significant reduction of postoperative complications.

- Salzwedel C, Puig J, Carstens A, Bein B, Molnar Z, Kiss K, Hussain A, Belda J, Kirov MY, Sakka SG, Reuter DA.

  Perioperative goal-directed hemodynamic therapy based on radial arterial pulse pressure variation and continuous cardiac index trending reduces postoperative complications after major abdominal surgery: a multi-center, prospective, randomized study.

  Crit Care. 2013 Sep 8;17(5):R191
  DOI: 10.1186/cc12885

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