# Fluid Management in Surgery

Deltex medical

| | Stroke Volume Optimisation | | Minimise respiratory swing SVV or PPV | $DO_2$ /CI target |
|---|---|---|---|---|
| | ODM-guided | PPWA-guided | | |
| RCTs | 12 [1-12] | 3 [13-15] | 4 [16-19] † | 2 [20-21] |
| RCT patients | 1,126 | 259 | 207 † | 77 |
| Other published trials/audits | 5 [22–26] | - | 1 [27] | - |
| Patients | 2,407 | - | 50 | - |
| Reduce complications | ✓✓✓ | ? | ✓† | ? |
| Reduce hospital stay | ✓✓✓ | ✗ | ? † | ✗ |
| Reduce ICU stay | ✓✓ | ✗ | ✗ | ✗ |
| Reduce operating times | ✓✓ | ✗ | ✗ | ✗ |
| Clinical meta-analyses | 5 [24, 28-31] | ✗ | - | ✗ |
| Types of surgery | Cardiac, orthopaedic, colorectal, renal urological, other abdominal, gynaeco-logical, plastic, vascular, transplant: elective & emergency | Vascular, orthopaedic: elective | Abdominal: elective | Vascular, orthopaedic: elective |
| Government systematic reviews | 6 [32-37] (UK, USA & Spain) | - | †† | - |
| Non-Government systematic reviews | - | 1 x LiDCO ('C' rating*) [38] | | |
| Technologies used (RCTs and audits) | 15 x CardioQ-ODM - 1 x TECO, 1 x Hemosonic | 3 x LiDCO*plus* | 3 x FloTrac †, 1 x LiDCO*plus*, 1 x PiCCO | 1 x FloTrac |

**KEY** ODM, Oesophageal Doppler Monitor; PPWA, Pulse Pressure Waveform Analysis; SVV, Stroke Volume Variation; PPV, Pulse Pressure Variation; $DO_2$, Delivered Oxygen; CI, Cardiac Index.

✓✓✓ Level 1A evidence: RCTs, meta-analyses, & government sponsored systematic reviews

✓✓ Level 1A evidence: Some RCTs & government sponsored systematic reviews

✓ Individual trials with statistically significant results

? Individual trials with non-significant results or some significant results but contradicted by other trials

✗ Absence of impact reported or not examined

* Potential but unproven benefit. Some published evidence suggests that safety and impact on health outcomes are at least comparable to standard treatment/testing. However, substantial uncertainty remains about safety and/or impact on health outcomes because of poor-quality studies, sparse data, conflicting study results, and/or other concern.

**NOTES** † Mayer, Boldt et al [39] study using FloTrac excluded: subject to retraction †† NICE commissioned review concluded CardioQ-ODM is dominant. CardioQ-ODM delivers both better outcomes and lower cost.

## Randomised Controlled Trials

| Lead author | Type of surgery | Technology | Fluid management strategy | No. of patients | Additional colloid given | Reduction in post-operative complications | Reduction in hospital stay | Reduction in ICU stay |
|---|---|---|---|---|---|---|---|---|
| Mythen, 1995 [1] | Cardiac | ODM – CardioQ-ODM | Stroke volume optimisation | 60 | ~ 650 mL | 100% reduction | 3.7 days – 37% | 0.7 days – 41% |
| Sinclair, 1997 [2] | Orthopaedic | ODM – CardioQ-ODM | Stroke volume optimisation | 40 | 750 mL | Not reported | 5 days – 36% in fit for discharge | Not reported |
| Venn, 2002 [3] | Orthopaedic | ODM – CardioQ-ODM | Stroke volume optimisation | 90 | 759 mL | 54% reduction in post-operative complications | 6.2 days – 45% in fit for discharge | Not reported |
| Gan, 2002 [4] | General, Urological & Gynaecological | ODM – CardioQ-ODM | Stroke volume optimisation | 100 | 565 mL | 45% reduction | 2 days – 29% | Not reported |
| Conway, 2002 [5] | Colorectal | ODM – TECO | Stroke volume optimisation | 57 | 632 mL | Not reported | 1 day increase – 9% | 3 day reduction (3 vs 0) |
| Wakeling, 2005 [6] | Colorectal | ODM – CardioQ-ODM | Stroke volume optimisation | 128 | 500 mL | 37% reduction – 38 vs 24 patients | 1.5 days – 13% | Not reported |
| Noblett, 2006 [7] | Colorectal | ODM – CardioQ-ODM | Stroke volume optimisation | 108 | 131 mL | 100% reduction in life threatening complications (n=4) and mortality (n=1) vs zero | 3 days – 33% in fit for discharge | Not reported |
| Senagore, 2009 [8] | Colorectal | ODM – CardioQ-ODM | Stroke volume optimisation – adjusted | 64 | Not reported | None re crystalloid, increase re colloid | No difference between groups | Not reported |
| Challand, 2011 [9] | Colorectal | ODM – CardioQ-ODM | Stroke volume optimisation | 179 | 1,360 mL | Non-significant reductions in serious complications and increases in other complications | 2 day increase – 31% (not significant) | Not reported |
| Pillai, 2011 [10] | Urological | ODM – CardioQ-ODM | Stroke volume optimisation | 66 | Not reported - estimate 300 mL | Reduced PONV, wound infection etc | 4 day – 18% (not significant) | Not reported |
| Brandstrup, 2012 [11^] | Colorectal | ODM – CardioQ-ODM | Stroke volume optimisation | 150 | 335 mL | No difference between groups | No difference between groups | Not reported |
| Srinivasa, 2013 [12^] | Colorectal | ODM – CardioQ-ODM | Stroke volume optimisation | 84 | 294 mL | No difference between groups | No difference between groups | Not reported |
| Bartha, 2012 [13] | Orthopaedic | PPWA - LiDCOplus | Stroke volume optimisation (with additional $DO_2$ target) | 149 | 430 mL | No difference in total number of complications, or in the relative risk of complications in survivors. | No difference between groups | No difference between groups |
| Bisgaard, 2012 [14] | Vascular | PPWA - LiDCO*plus* | Stroke volume optimisation | 70 | 72 mL (intra-op) + 262 mL (first 6 h post-op) | No difference between groups | No difference between groups | No difference between groups |
| Bisgaard, 2012 [15] | Vascular | PPWA - LiDCO*plus* | Stroke volume optimisation | 40 | 250 mL (intra-op) + 500 mL (first 6 h post-op) | 55% reduction in patients with complications | No difference between groups | No difference between groups |
| Harten, 2008 [16] | Abdominal | PPWA - LiDCO*plus* | Minimisation of respiratory swing | 29 | 750 mL | 39% increase in post-operative complications (not significant) | 5.5 day increase – 46% (not significant) | Not reported |
| Buettner, 2008 [17] | Abdominal | PPWA - PiCCO | Minimisation of respiratory swing | 80 | 500 mL | Not reported | 1 day – 6% non significant | 16 hour reduction – 40% (not significant) |
| Benes, 2010 [18] | Abdominal | PPWA - FloTrac | Minimisation of respiratory swing | 120 | 425 mL | 48.5% reduction in patients with complications | 1 day – 10% non significant | No difference between groups |
| Ramsingh, 2012 [19] | Abdominal | PPWA - FloTrac | Minimisation of respiratory swing | 38 | 122 mL | Not reported | 2.5 days - 33% | Not reported |
| Van der Linden, 2010 [20] | Vascular | PPWA - FloTrac | $DO_2$/CI Target | 37 | 250 mL | No difference between groups | 4 day increase - 30% increase (not significant) | Not reported |
| Cecconi, 2011 [21] | Orthopaedic | PPWA - FloTrac | $DO_2$/CI Target | 40 | 1,544 mL | Yes – complications in 100% of control group vs 80% of intervention | No difference between groups | Not reported |

^ Both studies are comparisons of ODM-guided fluid management vs. 'restrictive'/'zero-balance' fluid administration. These differ from the previous ODM RCTs where the control groups received 'routine' fluid administration (typical of the more traditional definition of a 'control' group).

## Non Randomised Trials Reporting Outcomes

| Lead author | Type of surgery | Technology | Fluid management strategy | No. of patients | Additional colloid given | Reduction in post-operative complications | Reduction in hospital stay | Reduction in ICU stay |
|---|---|---|---|---|---|---|---|---|
| NHS National Technology Adoption Centre [22] | Colorectal, Urological, Vascular, Orthopaedic, Transplant, [other] | ODM - CardioQ-ODM | Stroke volume optimisation | 1,307 | 252 mL | Not reported except non-significant reductions in readmissions to critical care and to hospital, reoperations and mortality | 3.6 days – 19% based on increase in usage from 11% to 65% | 5.3 days – 45% in ICU; no change in HDU |
| Figus, 2011 [23] | Plastic | ODM - CardioQ-ODM | Stroke volume optimisation | 104 | Not reported | Yes - strong trend towards a reduction (44%) in the risk of flap-related complications | 1.9 days - 18% (not significant) | Not reported |
| Feldheiser, 2012 [24] | Non-cardiac | ODM - CardioQ-ODM | Stroke volume optimisation (with additional maintenance of MAP >70 mm Hg, and Cardiac Index >2.5 L/min/m2) | 658 | Not reported | Not reported, although significant reductions in the need for postoperative ventilator therapy (4.8% of Doppler group vs. 18.3% of conventional care group) | 8.2 days - 32% | Not reported |
| Chattopadhyay, 2013 [25] | Gynaecological | CardioQ-ODM | Stroke volume optimisation | 198 | ~150 mL | 73% reduction in postoperative nausea and vomiting in advanced stage disease patients (n=106/198). Use of ODM associated with earlier postoperative recovery: odds ratio = 2.83 ($P$=0.02) | Use of ODM associated with earlier 'time to fitness for discharge': odds ratio = 2.81 ($P$=0.05) | Not reported |
| Mannova, 2013 [26] | Vascular | ODM - Hemosonic | Stroke volume optimisation | 140 | Not reported | 62% reduction in major post-operative complications | 1 day - 9% | 2 days - 33% |
| Wang, 2012 [27] | Transplant | PPWA - FloTrac | Minimisation of respiratory swing | 50 | 144 mL | No difference in the incidence of acute kidney injury, or in 30-day or 1-year survival | Not reported | Not reported |

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