IV MAINTENANCE FLUIDS
Supporting information

This guideline has been prepared with reference to the following:

Powell-Tuck, J., Gosling, P, Lobo, D. N et al. British Consensus Guidelines on Intravenous Fluid Therapy for Adult Surgical Patients. Redditch, Worcs, British Association for Parenteral and Enteral Nutrition (BAPEN). 2011

https://www.bapen.org.uk/pdfs/bapen_pubs/giftasup.pdf

NICE. Intravenous fluid therapy in adults in hospital. 2017. London. NICE

https://www.nice.org.uk/guidance/cg174

If signs of fluid overload in any patient, review need for IV fluids?
A review of the subject of fluid overload (Holte, 2002) observed that "So far, no widely accepted recommendations are available for the optimal perioperative fluid regimen. A large variability in fluid regimen has been noted throughout the surgical specialties." The authors suggested that: "To clarify the implications of perioperative fluid excess, randomized, prospective clinical studies are needed where `high' vs `low' fluid regimen are undertaken in well-defined surgical procedures."
Two responses to this paper (Mitchell, 2002; Sartain, 2002) cautioned against the possibility of over-compensation for fluid overload, leading to equally serious problems caused by fluid restriction.
In the opinion of Mitchell: "We suggest that a better conclusion would be to call for more randomized, prospective clinical studies comparing fluid regimens guided by appropriate perioperative haemodynamic monitoring with current practice. Current practice tends to rely on fluid therapy being guided by changes in heart rate and arterial blood pressure, which are insensitive of occult hypovolaemia and are able to detect only major circulatory losses."
Decisions on fluid management must therefore be made on an individual, patient-by-patient basis, guided by appropriate monitoring.
A prospective study in 71 patients representing 173 patient days of intravenous fluid therapy (Walsh, 2005) found that 5 patients (7%) developed fluid overload, associated with excessive fluid volume and sodium administration. The authors recommended the introduction of fluid prescribing protocols to improve practice.

Holte K, Sharrock NE, Kehlet H. Pathophysiology and clinical implications of perioperative fluid excess. Br J Anaesth 2002; 89:622-32
http://bja.oxfordjournals.org/content/89/4/622.long

Mitchell G, Hucker T, Venn R. Pathophysiology and clinical implications of perioperative fluid excess. Br J Anaesth 2003;90:395
http://bja.oxfordjournals.org/content/90/3/395.full

Sartain J. Pathophysiology and clinical implications of perioperative fluid excess. Br J Anaesth 2003;90:395
http://bja.oxfordjournals.org/content/90/3/395.full

Walsh SR, Walsh CJ. Intravenous fluid-associated morbidity in postoperative patients. Ann Roy Coll Surg Eng 2005;87:126-30
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1963879/pdf/15826425.pdf

Evidence Level: V

Which type of fluid should be administered in elective surgery patients?
A 2020 narrative review found no difference in hospital-free days when comparing colloids and crystalloids (Heming, 2020). However, balanced crystalloids were associated with a reduced risk of major adverse kidney events and so are increasingly being considered as the first-line fluid therapy in the operating theatre.
A 2016 systematic review compared the use of colloids and crystalloids for fluid administration during major elective surgery to examine the impact on perioperative coagulation competence and haemorrhage (Rasmussen). Thirty RCTs including 2287 patients were reviewed and it was found that more patients admitted to administration of hydroxyethyl starches were exposed to decrease coagulation competence, compared to perioperative crystalloids and albumin administration.

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A 2014 review (Van Regenmortel) concluded that isotonic salt solutions are a pragmatic choice in the majority of elective surgery settings, and that colloids should only be used after careful deliberation. A review on this subject (Holte, 2010) stated that: "A systematic review concluded that present evidence does not allow final recommendations on which type of fluid to administer in elective surgery."

Heming N, Moine P, Coscas R et al. Perioperative fluid management for major elective surgery. Br J Surg. 2020;107:e56-e62

Holte K. Pathophysiology and clinical implications of perioperative fluid management in elective surgery. Dan Med Bull 2010;57:B4156
http://www.ncbi.nlm.nih.gov/pubmed/20591343

Rasmussen KC, Secher NH, Pedersen T. Effect of perioperative crystalloid or colloid fluid therapy on hemorrhage, coagulation competence, and outcome: A systematic review and stratified meta-analysis. Medicine. 2016;95:e4498
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4979852/

Van Regenmortel N, Jorens PG, Malbrain ML. Fluid management before, during and after elective surgery. Curr Opin Crit Care. 2014;20:390-5

How does the action of compound sodium lactate (Hartmann's) differ from that of sodium chloride 0.9%?

A double-blind crossover study (Reid, 2003) looked at the effects of bolus infusions of 0.9% saline (NaCl) and Hartmann's solution on serum albumin, haematocrit and serum and urinary biochemistry in 9 healthy adult male subjects. Each received 2-litre intravenous infusions of 0.9% saline and Hartmann's solution on separate occasions, in random order, over 1 h. Body weight, haematocrit and serum biochemistry were measured pre-infusion and at 1 h intervals for 6 h. Biochemical analysis was performed on pooled post-infusion urine. Blood and plasma volume expansion, estimated by dilutional effects on haematocrit and serum albumin, were greater and more sustained after saline than after Hartmann's solution (P <0.01). At 6 h, body weight measurements suggested that 56% of the infused saline was retained, in contrast with only 30% of the Hartmann's solution. Subjects voided more urine (median: 1,000 compared with 450 ml) of higher sodium content (median: 122 compared with 73 mmol) after Hartmann's than after saline (both P =0.049), despite the greater sodium content of the latter. The time to first micturition was less after Hartmann's than after saline (median: 70 compared with 185 min; P =0.008). There were no significant differences between the effects of the two solutions on serum sodium, potassium, urea or osmolality. After saline, all subjects developed hyperchloraemia (>105 mmol/l), which was sustained for >6 h, while serum chloride concentrations remained normal after Hartmann's (P <0.001 for difference between infusions). Serum bicarbonate concentration was significantly lower after saline than after Hartmann's (P =0.008). Thus excretion of both water and sodium is slower after a 2-litre intravenous bolus of 0.9% saline than after Hartmann's solution, due possibly to the more physiological [Na(+)]/[Cl(-)] ratio in Hartmann's solution (1.18:1) than in saline (1:1) and to the hyperchloraemia caused by saline.

Reid F, Lobo DN, Williams RN, et al. (Ab)normal saline and physiological Hartmann's solution: a randomized double-blind crossover study. Clin Sci 2003;104:17-24
http://www.clinsci.org/cs/104/0017/cs1040017.htm

Evidence Level: II

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