containing a balanced electrolyte system. The proposed benefit of colloids in balanced solutions and not in saline-based fluids is avoidance of clinically relevant hyperchloremic acidosis. However, as we have seen from the published article by Awad and colleagues, administration of 6% HES, and not the unbalanced 4% succinylated gelatine, was associated with a significant and sustained hyperchloremia and tendency to hyperchloremic acidosis. A recent review of balanced solutions vs isotonic saline fluids, including crystalloids and colloids, concluded that dilutional hyperchloremic acidosis is a side-effect, mainly observed after the administration of large volumes of isotonic saline as a crystalloid and not colloid and that there is a relative paucity of data documenting the detrimental effects of this acidosis. There is currently little published data on the effects of balanced colloid solutions on outcome and therefore until such time, their routine use is questionable.

**Declaration of interest**

None declared.

N. Lawrence*  
N. Levy  
*Suffolk, UK  
E-mail: natasha.lawrence@wsh.nhs.uk

1 Awad S, Dharmavaram S, Waern CS, Dube MG, Lobo DN. Effects of an intraoperative infusion of 4% succinylated gelatine (Gelofusine) and 6% hydroxyethyl starch (Voluven) in blood volume. Br J Anaesth 2012; 109: 168–76  
5 Beacon Pharmaceuticals. Achieve the right balance, ISOLEX Product Details. Available from www.beaconpharma.co.uk/AAHIsoplex/ (accessed 20 August 2012)  

doi:10.1093/bja/aet317

**Haemodilution made difficult**

Editor—I have read the BJA article comparing the effects of Gelofusine and Voluven on the blood volume (BV). The variations in BV were assessed by changes in haematocrit. As I have an interest in dilution kinetics, I inserted arbitrary data into the presented equations to see if they yield logical results. Unfortunately, that is not the case.

Suppose that we infuse a patient having a BV of 5 litres (BV₀) with enough Gelofusine to decrease the haematocrit from 0.40 to 0.36. The second equation reading ΔHct₁ (%) = 100 × (Hct₀ – Hct₁)/Hct₀ then gives 100 × (0.40–0.36)/0.40 = 10%. So far, so good.

The third equation is intended to convert ΔHct₁ into the percentage increase in BV (ΔBV₁). In my example, one would expect ΔBV₁ to be something in the range of 10%, or 0.5 litres. However, the equation reads ΔBV₁ = 100 × BV₀ × ΔHct₀/Hct₀ which yields 100 × 5 × 0.1/0.36, that is, that the BV increases by 139%, or by almost 7 litres. With this result half-way through the math section, it is time to review the accuracy of all presented equations.

I find one minor error, one major error, and one ambiguity.

The minor error is introduced already in the first equation where BV₀ is derived from anthropometric measures. The referred paper by Nadler and colleagues proposes different equations for males and females. The one used here is applicable for males only, although the number of females in the present study outnumbered the males by 3:1.

This major error is that conversion from the percentage increase in BV to the corresponding volume increase is made twice, both in the third and fourth equations. In fact, the third equation gives BV₁ instead of ΔBV₁, and the fourth equation is therefore superfluous.

The ambiguity is that ΔHct₁ in the third equation must represent the absolute difference in haematocrit, that is, Hct₀ – Hct₁, to make sense. However, the authors have already defined ΔHct₁ as the relative difference in the second equation. This fooled me in my example. I perceive the percentage sign as a scaling factor, while the authors probably mean that ΔHct₁ is the absolute difference and that ΔHct₀ (%) is the relative difference. If not, ΔBV₁ in the third equation (which is, in fact, BV₁) is obtained by dividing Hct₀–Hct₁ by both Hct₀ and Hct₁ while it should be divided only by Hct₁.

The series of five equations is constructed so that any error will be perpetuated and affect the final result, which is ΔBV₁ (litre). The same set was recently used by the same group in another high-impact journal, the Annals of Surgery. Both articles refer to a previous work to support the accuracy of the equations used, but the critical conversion of ΔHct₁ to ΔBV₁ is made differently there.

These mathematical problems suggest that authors, reviewers, editors, and/or journal statisticians should insert simple assumed data into equations to see if they yield logical results. Equations must also be clear enough to preclude variability in interpretation. The results presented later in the cited papers show that the actual calculations have been carried out by following a course different from the one outlined in the Methods section.

**Declaration of interest**

R.G.H. is a researcher in the field of dilution kinetics.

R. G. Hahn*  
Linkoping University, Sweden  
E-mail: r.hahn@telia.com

1 Awad S, Dharmavaram S, Waern CS, Dube MG, Lobo DN. Effects of an intraoperative infusion of 4% succinylated gelatine (Gelofusine) and


4 Lobo DN, Stanga Z, Aloysius MM, et al. Effect of volume loading with 1 liter intravenous infusions of 0.9% saline, 4% succinylated gelatine (Gelofusine) on blood volume and endocrine responses: a randomized, three-way cross-over study in healthy volunteers. Crit Care Med 2010; 38: 464–70
doi:10.1093/bja/aet321

Reply from the authors

Editor—We thank Dr Hahn for his letter on our Clinical Investigation.1 We agree that determining changes in blood volume through calculations derived from haematocrit changes is not an ideal situation. However, there is presently no other methodology that could be easily utilized to determine such acute serial changes in blood volume as would be required in a clinical investigation such as ours. Specifically, the use of radioisotope tracers in patients undergoing surgery would not be feasible. Furthermore, as we used the same equations to determine changes in blood volume after infusion of both fluids, any error inherent in the equations would be applied to both arms of the study. Rather than the absolute values derived, it is the relative changes in blood volume that are of importance in this comparative clinical investigation. We did, however, note a typographical error in one of the formulae described in our manuscript.1 The incorrect formula on page 170 should be replaced with the correct one as described in our previous manuscript.2

The incorrect formula

\[
\Delta BV(t\%) = BV_0 \left( \frac{\Delta Hct}{Hct_0} \right) \times 100
\]

The correct formula

\[
\Delta BV(t\%) = \left( \frac{100}{100 - \Delta Hct(t\%)} \times 100 \right) - 100
\]

However, the formulae utilized in the spreadsheets for calculations were the correct ones. Hence, while we apologize for this error, we would like to state that this did not affect the results of our calculations.

Declaration of interest

None declared.

S. Awad*
D. N. Lobo
Nottingham, UK
E-mail: sherif.awad@nottingham.ac.uk

1 Awad S, Dharmavaram S, Wearn CS, Dube MG, Lobo DN. Effects of an intraoperative infusion of 4% succinylated gelatine (Gelofusine®) and 6% hydroxyethyl starch (Voluven®) on blood volume. Br J Anaesth 2012; 109: 168–76

2 Lobo DN, Stanga Z, Aloysius MM, et al. Effect of volume loading with 1 liter intravenous infusions of 0.9% saline, 4% succinylated gelatine (Gelofusine) and 6% hydroxyethyl starch (Voluven) on blood volume and endocrine responses: a randomized, three-way crossover study in healthy volunteers. Crit Care Med 2010; 38: 464–70
doi:10.1093/bja/aet322