7. Fischer SP, Schmiesing CA, Guta CG, Brock-Utne JG. General anaesthesia and chronic amphetamine use: should the drug be stopped preoperatively? *Anesth Analg* 2006; **103**: 203–206.
8. Brostoff JM, Plymen C, Birns J. Khat – a novel cause of drug-induced hepatitis. *Eur J Int Med* 2006; **17**: 383.
9. Connor J, Makonnen E, Rostom A. Comparison of analgesic effects of khat (*Catha edulis* forsk) extract, D-amphetamine and ibuprofen in mice. *J Pharm Pharmacol* 2000; **52**: 107–110.
10. Heymann TD, Bhupulan A, Zureikat NE *et al*. Khat chewing delays gastric emptying of a semi-solid meal. *Aliment Pharmacol Ther* 1995; **9**: 81–83.

Presurgical hypervolaemic haemodilution for saving blood transfusion?

doi: 10.1017/S0265021507001378

EDITOR:

Homologous blood transfusion is established as common clinical practice, yet continues to be associated with residual risks of serious complications. Socio-economic pressures, in addition to ethical pressures, have contributed to the development and instigation of blood-saving techniques and now form a priority for anaesthetists and surgeons alike. Among these techniques, presurgical hypervolaemic haemodilution (HHD) is considered very simple to perform, yet continues to attract controversy with regard to its efficacy [1].

In a prospective randomized controlled trial, we analysed the influence of presurgical HHD with 6% hydroxyethyl starch solution (HES) 130/0.4 on intraoperative blood loss, rate of transfusion, haemodynamic and laboratory parameters, complications and costs in comparison to a control group without presurgical haemodilution.

The Ethics Committee approval for the study and informed consent of 80 ASA I–II patients planned for total prostatectomy or total cystectomy for cancer were obtained. Patients were randomized into two equal groups. Group A ($n = 40$) received 15 mL kg^{-1} HES 130/0.4 and 6% (Voluven®; Fresenius Kabi, Germany) presurgical infusion at a constant infusion rate of 30 mL min^{-1}. Group B ($n = 40$) did not receive HHD. Patients of both groups underwent intraoperative infusion with a maximal HES dose of 33 mL kg^{-1} as required. The threshold for transfusion was defined as either haemoglobin <8 g dL^{-1} or haematocrit $<24\%$. All patients received fentanyl, rocuronium and thiopental for induction of general anaesthesia and isoflurane as maintenance.

Preoperative values of haemoglobin and haematocrit showed no significant difference between the two groups. Average blood loss was also comparable (Group A 1954 ± 917 mL vs. Group B 1685 ± 796 mL, n.s.). In Group A, only five patients (12.5%) received a total of 10 units of packed red blood cells. In Group B there was a need for transfusion in 10 patients (25%) with a total amount of 24 units. However, this difference only became statistically significant in a subgroup of patients with an observed blood loss of $>30\%$ total blood volume (estimated as 70 mL kg^{-1}). Postoperative values of haemoglobin were comparable in both groups, allowing exclusion of practice differences in transfusion.

After HHD, central venous pressure (CVP) increased significantly from 2.5 (0–9) mmHg up to 7 (3–15) mmHg ($P < 0.01$) in Group A. No patient showed clinical signs of cardiac decompensation. Coagulation parameters including prothrombin time (Quick-Test), activated partial thromboplastin time, thrombin time, fibrinogen and antithrombin III were evaluated with respect to the influence of HHD. A statistically significant change in these parameters was observed, yet all remained within normal physiological limits and there was no evidence that HHD induced abnormal bleeding. Postoperative measured coagulation parameters in both groups showed normal values.

No adverse effects or postoperative wound complications were noted in any patients. Cost analysis included direct costs for transfused blood components (packed red cells and fresh frozen plasma) and HES. Costs were calculated in total at 1426 € (36 €/patient) in Group A compared to 2726 € (68 €/patient) in Group B.

Correspondence to: Jochen Gille, Department of Anaesthesiology, Intensive Care Medicine and Pain Therapy, St Georg Hospital GmbH Leipzig, Delitzscher Strasse 141, 04129 Leipzig, Germany. E-mail: Jochen.Gille@sanktgeorg.de; Tel: +49 341 9092570; Fax: +49 341 9092568

Accepted for publication 1 August 2007 EJA 4397
First published online 21 September 2007

A positive effect of HHD with respect to minimizing blood transfusion is supported by the literature, but results are inconsistent. Saricoagaoglu and colleagues [2] found a significant decrease in demand for homologous blood after HHD in comparison to a control group (40% vs. 100%) in patients undergoing hip replacement, although the small number of patients ($n=20$) limits the validity of their study.

Leininger and colleagues [3] found higher postoperative values of haemoglobin and haematocrit after HHD in patients with total prostatectomy for cancer in comparison to a control group in cases of blood loss >2 L. However, saving of blood transfusion was non-significant. Our study only showed a significant lower transfusion rate for patients with a blood loss $>30\,\mathrm{mL\,kg^{-1}}$ of total blood volume.

Clinical studies support evidence for improved haemodynamic stability of patients after HHD [4,5]. In patients without pre-existing cardiac disease, Van Daele and colleagues [6] noted an increase in pulmonary arterial occlusion pressure and cardiac output during HHD, but there was no progressive cardiac dilatation as a sign of beginning of decompensation. The low initial CVP in this study may be related to a preoperative volume deficit due to presurgical fasting. Following HHD, the CVP increased significantly but did not exceed physiological values. HHD may promote haemodynamic stability during anaesthesia by augmenting preload. Although the theoretical risk of iatrogenic hypervolaemic pulmonary oedema exists, no patient demonstrated cardiac decompensation. This emphasizes the indispensable requirement of adequate perioperative monitoring of vital physiological systems.

The influence of colloids on blood coagulation continues to be debated. As recently highlighted in the literature, low substituted HES (as the solution 130/0.4) has demonstrated the lowest impairment of blood coagulation in comparison with other HES solutions [7]. In the present study, a dilutional effect of HES on coagulation factors was noted, but these remained within normal physiological limits.

In conclusion, the role of preoperative HHD in the reduction of perioperative blood transfusion remains unclear. Potential benefits may best be exhibited in cases of high volume blood losses (>30% total blood volume); further, the method can be considered as safe for ASA I–II patients, lowering also the financial burden. Nevertheless, as blood loss cannot be reliably predicted before surgery, the indication for HHD remains limited in clinical practice.

J. Gille, V. Winter, A. Sablotzki, B. Wiedemann
Department of Anaesthesiology
Intensive Care Medicine and Pain Therapy
St Georg Hospital GmbH
Leipzig, Germany

A. Richter, R. Serfas
Department of Urology
St Georg Hospital GmbH
Leipzig, Germany

Acknowledgements

This study was supported in part by a grant from Fresenius. Results of the study were published in part in Anesteziol Reanimatol. 2006 March-April:43–7 in Russian. The present study constitutes part of Viktor Winter's MD thesis. Special thanks to Dr Hischam Taha for the review of the manuscript.

References

1. Singbartl K, Schleinzer W, Singbartl G. Hypervolemic hemodilution: an alternative to acute normovolemic hemodilution? A mathematical analysis. *J Surg Res* 1999; **86**(2): 206–212.
2. Saricaoglu F, Akinci SB, Aypar U. The effect of acute normovolemic hemodilution and acute hypervolaemic hemodilution on coagulation and allogenic transfusion. *Saudi Med J* 2005; **26**: 792–798.
3. Leininger S, Leopoldsberger T, Kirschner A, Feustel H, Schäfer G, Herbert MK. Benefit der hyper- versus normovolämischen Hämodilution. Prospektive Studie mit einer Kontrollgruppe. *Anästh Intensivmed* 2001; **42**: 492.
4. Mielke L, Entholzer EK, Kling M *et al*. Preoperative acute hypervolemic hemodilution with hydroxyethylstarch: an alternative to acute normovolemic hemodilution? *Anesth Analg* 1997; **84**: 26–30.
5. Kumar R, Chakraborty I, Sehgal R. A prospective randomized study comparing two techniques of perioperative blood conservation: isovolemic hemodilution and hypervolemic hemodilution. *Anesth Analg* 2002; **95**: 1154–1161.
6. van Daele ME, Trouwborst A, van Woerkens LC, Tenbrinck R, Fraser AG, Roelandt JR. Transoesophageal echocardiographic monitoring of preoperative acute hypervolemic hemodilution. *Anesthesiology* 1994; **81**: 602–609.
7. Van der Linden P, Ickx BE. The effects of colloid solutions on hemostasis. *Can J Anesth* 2006; **53** (Suppl. 6): 30–39.