

Does early administration of Fresh Frozen Plasma (FFP) in the operating room decrease blood loss and transfusion needs?

Ben J Pieters, MD; Virender K Singhal, MD, MBA

INTRODUCTION: Surgery for craniosynostosis is often undertaken in the first two years of life and involves remodeling of surrounding bone. Reported averages of EBL during surgery are 80-150% of EBV. The majority of blood is replaced within four hours in the operating room, usually with plasma-poor PRBCs. This leads to a dilutional coagulopathy, adversely impacting blood loss requiring more PRBCs and thus establishing a negative feedback cycle. Based on retrospective trials, some centers currently use 1:1 plasma: blood for craniosynostosis surgeries. To verify this practice, we undertook a prospective, randomized controlled trial to test the hypothesis that early and consistent administration of FFP in the OR improves hemostasis in children undergoing correction of craniosynostosis and thereby decreases blood loss and transfusion needs.

METHODS: In this approved IRB study, 77 patients have undergone frontal orbital advancement and/or total calvarial reshaping and expansion. Exclusion criteria included age over two years at the time of surgery, a history of CHD, coagulopathy, liver or kidney disease. Patients were randomized to one of two groups, with the intervention group receiving PRBC and FFP in equal volumes (10 ml/kg) while the control group receiving only PRBC (10 ml/kg).

Goal Hct for the end of the surgery was 28%. A CBC and coagulation panel (Protime, activated partial thromboplastin time, and Fibrinogen) were obtained at four times for each patient and blood loss was calculated as previously described (REF) according to the formula:

$$ERCV_{lost} = ERCV_{preop} + ERCV_{transfused} - ERCV_{postop}$$

Power analysis was undertaken with the assumption that a 20% reduction in transfusion would be clinically significant. Two-sided α was assigned at 0.05.

RESULTS: Although more albumin and less FFP was administered in the control group the two groups were not significantly different for total colloid (FFP plus albumin). Coagulation values were significantly improved with the use of prophylactic FFP as reflected by improved PT, aPTT, and fibrinogen values in the treatment group at T2-T4 (Fig.1). The need for FFP or cryoprecipitate postoperatively was less in the treatment group (17% vs. 0%; $P < 0.05$) (Fig.2). Donor exposures in the OR and postoperatively were comparable.

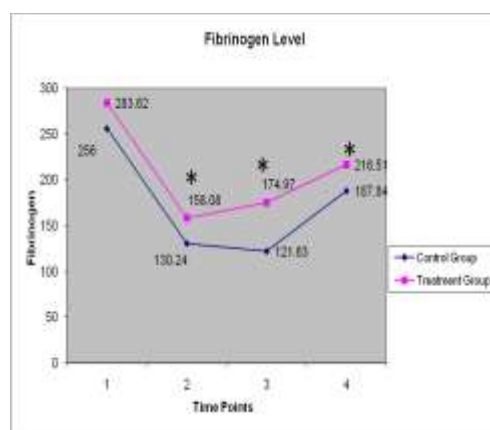


Figure 1

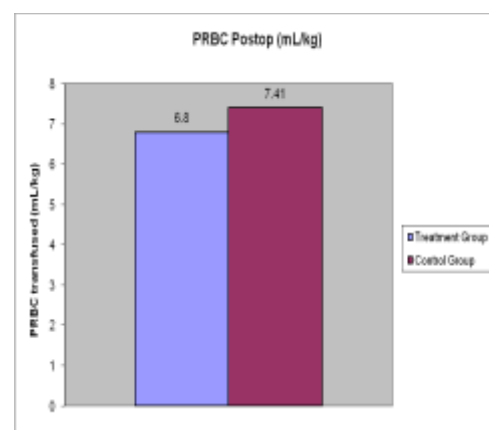


Figure 2

CONCLUSIONS: The use of prophylactic FFP in patients undergoing primary repair of craniosynostosis is associated with improvement in intra and postoperative coagulation values and a significant reduction in the need for postoperative FFP or cryoprecipitate.

REFERENCES

1. Johnson JO, Jimenez DF, Barone CM. Blood loss after endoscopic strip craniectomy for craniosynostosis [letter]. *J Neurosurg Anesthesiol.* 2000;12:60.
2. Eaton AC, Marsh JL, Pilgram TK. Transfusion requirements for craniosynostosis surgery in infants. *Plast Reconstr Surg.* 1995;95(2):277-283.
3. Faberowski LW, Black S, Mickle JP. Blood loss and transfusion practice in the perioperative management of craniosynostosis repair. *J Neurosurg Anesthesiol.* 1999;11:167-172.
4. Kang JK, Lee SW, Baik MW, et al. Perioperative specific management of blood volume loss in craniosynostosis surgery. *Childs Nerv Syst.* 1998;14:297-301.
5. Meyer P, Renier D, Arnaud E, et al. Blood loss during repair of craniosynostosis. *Br J Anaesth.* 1993;71:854-857.
6. Orliaguet GA, Meyer PG, Blanot S, et al. Non-invasive aortic blood flow measurement in infants during repair of craniosynostosis. *Br J Anaesth.* 1998;81:696-701.
7. Williams GD, Ellenbogen RG, Gruss JS. Abnormal Coagulation during Pediatric Craniofacial Surgery. *Pediatric Neurosurgery.* 2001;35:5-12.
9. Velardi F, Di Chirico A, Di Rocco C. Blood salvage in craniosynostosis surgery. *Childs Nerv Syst.* 1999;15:695-710.
10. Kearney RA, Rosales JK, Howes WJ. Craniosynostosis: an assessment of blood loss and transfusion practices. *Can J Anaesth.* 1989;36:473-477
11. Hardy JF, de Moerloose P, Samama CM. Massive transfusion and coagulopathy: pathophysiology and implications for clinical management. *Can J Anaesth.* 2006;53(6 Suppl 6):S40-58.
12. Counts RB, Haisch C, Simon TL, Maxwell NG, Heimbach DM, Carrico CJ. Hemostasis in massively transfused trauma patients. *Ann Surg.* 1979 Jul;190(1):91-99.
13. Hiippala ST, Myllyla GJ, Vahtera EM. Hemostatic factors and replacement of major blood loss with plasma-poor red cell concentrates. *Anesth Analg.* 1995;81:360-365.
14. Murray DJ, Pennell BJ, Weinstein SL, Olson JD. Packed red cells in acute blood loss: dilutional coagulopathy as a cause of surgical bleeding. *Anesth Analg.* 1995;80:336-342.
15. Practice guidelines for perioperative blood transfusion and adjuvant therapies: an updated report by the American Society of Anesthesiologists Task Force on Perioperative Blood Transfusion and Adjuvant Therapies. *Anesthesiology.* 2006;105:198-208
16. Dahmani S, Orliaguet GA, Meyer PG, Blanot S, Renier D, Carli PA. Perioperative blood salvage during surgical correction of craniosynostosis in infants. *Br J Anaesth.* 2000;85:550-555.
17. Fearon JA. Reducing allogenic blood transfusions during pediatric cranial vault surgical procedures: a prospective analysis of blood recycling. *Plast Reconstr Surg.* 2004;113:1126-1130.

18. Deva AK, Hopper RA, Landecker A, Flores R, Weiner H, McCarthy JG. The use of intraoperative autotransfusion during cranial vault remodeling for craniosynostosis. *Plast Reconstr Surg*. 2002;109:58-63.
19. Fearon JA, Weinthal J. The use of recombinant erythropoietin in the reduction of blood transfusion rates in craniosynostosis repair in infants and children. *Plast Reconstr Surg*. 2002;109:2190-2196.
20. Steinbok P, Heran N, Hicdonmez T, Cochrane DD, Price A. Minimizing blood transfusions in the surgical correction of coronal and metopic craniosynostosis. *Childs Nerv Syst*. 2004;20(7):445-452.
21. Hans P, Collin V, Bonhomme V, Damas F, Born JD, Lamy M. Evaluation of acute normovolemic hemodilution for surgical repair of craniosynostosis. *J Neurosurg Anesthesiol*. 2000 Jan;12(1):33-36.
22. Laine E, Steadman R, Calhoun L, et al. Comparison of RBCs and FFP with whole blood during liver transplant surgery. *Transfusion*. 2003;43:322-327.
23. Manno CS, Hedberg KW, Kim HC, et al. Comparison of the hemostatic effects of fresh whole blood, stored whole blood, and components after open heart surgery in children. *Blood*. 1991;77:930-936.
24. Mou SS, Giroir BP, Molitor-Kirsch EA, et al. Fresh whole blood versus reconstituted blood for pump priming in heart surgery in infants. *N Engl J Med*. 2004;351(16):1635-1644.
25. Kauvar DS, Holcomb JB, Norris GC, Hess JR. Fresh whole blood transfusion: a controversial military practice. *J Trauma*. 2006;61:181-184.