Perfusion concepts to decrease neurological complications: Evidence-based guidelines for best practice CPB[1]

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As the mechanisms of perioperative CNS injury are increasingly understood, strategies to minimize cerebral embolization avoid cerebral hypoperfusion, minimize whole body inflammatory processes and offer the best hope for decreasing the risk of adverse CNS events and associated costs in an increasingly elderly and high risk surgical population. An evidence-based review of best practices for cardiac surgical patients has recently been published [1].

These authors, a consortium of physicians, epidemiologists, and perfusionists, sought to develop and share evidence-based reviews for conducting CPB through a rigorous, structured, and expert-driven analysis of the peer-reviewed literature. The mission of this consortium was to promote literature-supported, evidence-based perfusion practice to improve patient care and enhance clinical outcomes. Development of the findings contained below was achieved through presentation at regional and national meetings focused on the practice of CPB. A summary of the recommendations of which is found in Table 1. The development of the following findings evolved from a structured MEDLINE search coupled with critical review of the peer-review literature and debates stemming from presentations at regional and national conferences, including the *Connecticut Society of Perfusion (2004), Outcomes 2004: The Key West Meeting, New York State Society of Perfusion (2004), 12th Annual Meeting on Optimization of Blood Management During Surgery (2004), Florida State Society of Perfusion (2004), Tennessee State Society of Perfusion (2004), American Academy of Cardiovascular Perfusion (2005), and Outcomes 2005: The Key West Meeting.*

In addition, there is now recently published data that applied neuromonitoring, specifically cerebral near-infrared spectroscopy, facilitates detection and treatment of cerebral ischemia and is associated with a lower incidence of morbidity and shorter postoperative hospitalization [2]. Consistent with this result, in an-

Table 1[1].

I) The clinical team should manage adult patients undergoing moderate hypothermic CPB with alpha-stat pH management. (Class I, Level A)
II) Limiting arterial line temperature to 37°C may be useful for avoiding cerebral hyperthermia. (Class IIa, Level B)
III) The clinical team should maintain perioperative blood glucose concentration within an institution's normal clinical range in all patients including non-diabetics. (Class I, Level B)
IV) Direct reinfusion to the cardiopulmonary bypass circuit of unprocessed blood exposed to pericardial and mediastinal surfaces should be avoided. (Class I, Level B) *Blood cell processing and filtration may be considered to decrease the deleterious effects of reinfused shed blood. (Class IIb, Level B) ???Review in light of more recent studies*
V) In patients undergoing cardiopulmonary bypass at increased risk of adverse neurological events, strong consideration should be given to intraoperative TEE or epiaortic ultrasound scanning of the aorta: 1. to detect nonpalpable plaque (Class I, Level A) 2. for reduction of cerebral emboli (Class IIa, Level B)
VI) Arterial line filters should be incorporated in the CPB circuit to minimize the embolic load delivered to the patient. (Class I, Level A).
VII) Efforts should be made to reduce hemodilution including reduction of prime volume in order to avoid subsequent allogenic blood transfusion. (Class I, Level A)
VIII) Reduction of circuit surface area and the use of biocompatible surface modified circuits may be useful/effect at attenuating the systemic inflammatory response to cardiopulmonary bypass, and improve outcomes. (Class IIa, Level B)

other recent large but non-randomized series of 1698 cardiac surgical patients reported by Goldman and colleagues, a significant reduction in perioperative stroke rate, from 2.01% to 0.97%, was observed in patients in whom rSO_2 cerebral oximetry was used to optimize and maintain intraoperative cerebral oxygenation in comparison to an untreated comparator group of 2077 similar patients operated on in the immediately preceding 18 month interval [15]. These results indicate that active NIRS cerebral oximetry monitoring can substantially improve clinical outcomes following CABG surgery. Understanding the mechanisms of perioperative cerebral injury facilitates the development of effective clinical management strategies designed to decrease risk in an ever aging and progressively sicker surgical population.

As part of the ongoing audit of these recommendations, the results of 2 recently published prospective randomized studies which have assessed the impact of recommendation: IV) direct reinfusion to the CPB circuit of unprocessed blood should be avoided, are detailed. In the study from Djainai et al., a total of 226 patients > 60 years age undergoing CABG surgery were randomly allocated to either cell saver or control groups [4]. Anesthesia and surgical management were standardized. Epiaortic scanning of the proximal thoracic aorta was performed in all patients and transcranial Doppler was used to measure cerebral embolic rates. Standardized neuropsychological testing was conducted 1 week before and 6 weeks after surgery. Cognitive dysfunction was present in 6% of patients in the cell saver group and 15% of patients in the control group 6 weeks after surgery (P=0.038). However, significantly (p = 0.018) more patients in the cell saver group required FFP transfusion (25%) versus in the control group (12%). In the study from Rubens et al., patients undergoing coronary and/or aortic valve surgery using cardiopulmonary bypass were randomized to receive unprocessed blood (control, n=134) or cardiotomy blood that had been processed by centrifugal washing and lipid filtration (treatment, n=132). The treatment group received more intraoperative red blood cell transfusions (0.23 ± 0.69 U versus 0.08 ± 0.34 U, P=0.004) and both red blood cell and nonred blood cell blood product use was greater in the treatment group and postoperative bleeding was greater in the treatment group. Patients also underwent neuropsychometric testing before surgery and at 5 days and 3 months after surgery. There was no difference in the incidence of postoperative cognitive dysfunction in the 2 groups (relative risk: 1.16, 95% CI: 0.86 to 1.57 at 5 days postoperatively; relative risk: 1.05, 95% CI: 0.58 to 1.90 at 3 months). Similarly, there was no difference in the quality of life nor was there a difference in the number of emboli detected in the 2 groups. These authors concluded that processing of cardiotomy blood before reinfusion results in greater blood product use with greater postoperative bleeding in patients undergoing cardiac surgery and that there was no clinical evidence of any neurologic benefit with this approach in terms of postoperative cognitive function. In summary, both these studies showed an increase in utilization of allogeneic blood products and perioperative blood loss as a consequence of routine cell saver usage, with either no or minor improvements in incidence of postoperative cognitive decline. In view of the detrimental impact of perioperative allogeneic transfusion in this population [6], routine usage of cell saver for cardiotomy suction blood is probably unwarranted.

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