

## Recent Advances in Understanding the Causes of Post-Operative Vision Loss after Spine Surgery

Ehab Farag\*, Carina Cheung and Andrea Kurz

Department of General Anesthesiology and Outcomes Research, Cleveland Clinic Foundation, Cleveland, Ohio, USA

Postoperative Vision Loss (POVL) after spine surgery is a rare but devastating complication. The incidence of POVL after spine surgery ranges from 0.03% to 0.2% based on national databases and multicenter studies [1]. The causes of POVL after spine surgery are mainly Ischemic Optic Neuropathy (ION), either anterior or posterior, central vision loss due to occipital lobe infarction, and central retinal artery occlusion due to globe compression during surgery. This editorial will discuss the recent findings for the causes of ION after spine surgery.

In the recently published multicenter case-control study the authors compared 80 adult patients with ION from the American Society of Anesthesiologists (ASA) Postoperative Visual Loss Registry with 315 adult control subjects after spinal fusion surgery from 17 centers. The risk factors for ION were identified as obesity, male sex, Wilson frame use, longer anesthetic duration, greater estimated blood loss and decreased colloid administration [1].

The prone position in which most of the spinal fusion surgeries are being performed causes progressive increase in Intraocular Pressure (IOP). During prone position the impaired venous return from the head due to increased intrathoracic pressure results in ophthalmic veins congestion. The ophthalmic venous congestion impairs the aqueous humor drainage and results in increased IOP. The Ocular Perfusion Pressure (OPP) is usually approximated as mean arterial blood pressure (MAP) minus IOP. The progressive increase in IOP will certainly impair the OPP. ION caused by venous congestion and increased IOP has been observed in other procedures with similar physiology such as bilateral radical neck operations with bilateral internal jugular veins ligation and robotic prostatectomies with steep trendelenburg positions. The auto-regulation enables the eye to maintain constant flow over a wide range of perfusion pressures. The auto-regulation becomes deficient in maintaining the constant flow when the IOP reaches 45 mmHg and at this point ocular blood flow becomes pressure dependent. Pillunat and colleagues have shown in their recently published report that ocular auto-regulation might be deficient in some healthy individuals, rendering them unable to maintain normal blood flow to the optic nerve head in the presence of low ocular perfusion pressure [2]. This finding could explain why hypotension was not found to be an independent risk factor in case control studies. Low OPP can be tolerated in some patients due to their intact ocular auto-regulation.

The results of our recently published could explain to great extent the results of the above mentioned case control for POVL after spine fusion surgeries. In our study we factorially randomized patients undergoing complex spine surgeries in prone position into four groups: albumin and topical brimonidine ( $\alpha$ -2 agonist used for glaucoma treatment to lower the IOP); albumin and topical placebo; Lactated Ringer's solution (LR) and topical placebo; and LR and topical brimonidine. IOP was measured with a pneumotonometer [3]. Prone position increased IOP on average by  $12 \pm 6$  mmHg. IOP was  $38 \pm 10$  mm Hg at the end of anesthesia (approximately 5.5 h). In twelve of 65 patients IOP exceeded 50 mm Hg after approximately five hours of surgery [3]. The increased IOP during surgery and consequently decreased OPP would explain the prolonged anesthesia time as risk factor for POVL after spine fusion surgeries. Large blood loss usually accompanies prolonged surgeries

followed by periods of hemodynamic instability, which further jeopardizes OPP.

The use of a Wilson frame was identified as risk factor for POVL due to its enhanced effect on decreasing head venous drainage and thus further increasing IOP. Obesity is the third risk factor for POVL. In our study we did not find a relation between BMI with either preoperative or intraoperative IOP. However, the obese patients had less cardiac index than non-obese patients in prone positions and it was difficult to keep their MAP within the target levels during surgery. Therefore, obese patients had less OPP than non-obese patients, making them more vulnerable to develop POVL than non-obese ones. The other important risk factor for POVL mentioned in the report was the decreased percent of colloid administration. In our study using goal-directed fluid administration to guide crystalloid or colloid fluid management, we found, that IOP increased at the rate of  $2.0(0.4)$  mmHg/h in patients receiving albumin, which was significantly slower than in the patients receiving LR  $3.1(0.4)$  mmHg/h [3]. This finding could explain that the use of less colloid was independent risk factor for POVL after spine fusion surgeries. However, time-weighted IOP was similar in patients receiving crystalloid or colloid fluid replacement. Avoiding anemia is another very important factor during spine fusion surgery as choroidal blood flow, which is responsible for up to 70% of retinal requirement of oxygen and glucose, decreases during experimental isovolemic hemodilution to hematocrit levels of 20-22% [4]. Therefore, the latest practice advisory for perioperative visual loss associated with spine surgery recommends keeping hemoglobin or hematocrit levels at approximately 9 g/dl or 28% respectively [5].

The diagnosis of AION in the perioperative period might be underestimated, as some patients, especially the elderly ones, might develop peripheral vision loss without noticing it in the immediate postoperative period. The diagnosis of AION needs a full perimetry examination for vision field defects diagnosis. In addition, even a brief period of low OPP can present later with low pressure glaucoma.

Maintaining proper OPP during complex spine surgery in prone position is crucial to avoid POVL. The most important methods used to decrease IOP are: 1. Brimonidine as it decreases intraoperative time-weighted average IOP by 4 mmHg [3], 2. Use of more colloid especially albumin as it has minimal effects on coagulation; the use of goal directed fluid therapy during spine surgery in prone position is very helpful

\*Corresponding author: Ehab Farag, M.D., FRCA, Department of General Anesthesiology and Outcomes Research, Cleveland Clinic Foundation, Cleveland, Ohio, USA, E-mail: [FARAGE@ccf.org](mailto:FARAGE@ccf.org)

Received April 16, 2012; Accepted April 20, 2012; Published April 22, 2012

Citation: Farag E, Cheung C, Kurz A (2012) Recent Advances in Understanding the Causes of Post-Operative Vision Loss after Spine Surgery. J Anesth Clin Res 3:e105. doi:10.4172/2155-6148.1000e105

Copyright: © 2012 Farag E, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

during long procedures to ensure normovolemia and avoid fluid overload [3]; 3. Lastly, keeping MAP within 10% of preoperative value is an indispensable factor for maintaining the perfusion of the optic nerve head in the face of increased IOP.

#### Financial Disclosure

None of the authors have any financial or proprietary interest in the subject matter of this article.

#### Reference

1. Postoperative Visual Loss Study Group (2012) Risk factors associated with ischemic optic neuropathy after spinal fusion surgery. *Anesthesiology* 116: 15-24.
2. Pillunat LE, Anderson DR, Knighton RW, Joos KM, Feuer WJ (1997) Autoregulation of human optic nerve head circulation in response to increased intraocular pressure. *Exp Eye Res* 64: 737-744.
3. Farag E, Sessler DI, Kovaci B, Wang L, Mascha EJ, et al. (2012) Effects of Crystalloid versus Colloid and the  $\alpha$ -2 Agonist Brimonidine versus Placebo on Intraocular Pressure during Prone Spine Surgery: A Factorial Randomized Trial. *Anesthesiology* 116: 807-815.
4. Roth S (1992) The effects of isovolumic hemodilution on ocular blood flow. *Exp Eye Res* 55: 59-63.
5. American Society of Anesthesiologists Task Force on Perioperative Visual Loss (2012) Practice advisory for perioperative visual loss associated with spine surgery: an updated report by the American Society of Anesthesiologists Task Force on Perioperative Visual Loss. *Anesthesiology* 116: 274-285.