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How to avoid perioperative visual loss following prone spinal surgery

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Abstract

Background: In a prior article, "Perioperative visual loss (POVL) following prone spinal surgery: A review," Epstein documented that postoperative visual loss (POVL) occurs in from 0.013% to 0.2% of spine procedures performed in the prone position. POVL is largely attributed to ischemic optic neuropathy (ION), central retinal artery occlusion (CRAO), cortical blindness (CB), direct compression (prone pillows/horseshoe, eye protectors), and rarely, acute angle closure glaucoma.

Methods: Risk factors for ION include prolonged surgery, extensive fusions, anemia, hypotension, hypovolemia, diabetes, obesity, use of the Wilson frame, male sex, and microvascular pathology. CRAO may result from improper prone positioning (e.g., eye compression or rotation contributing to jugular/venous or carotid compression), while CB more typically results from both direct compression and obesity.

Results: Several preventive/prophylactic measures should limit the risk of POVL. The routine use of an arterial line and continuous intraoperative monitoring document intraoperative hypotension/hypovolemia/anemia that can be immediately corrected with appropriate resuscitative measures. Application of a 3-pin head holder completely eliminates direct eye compression and maintains the neck in a neutral posture, thus avoiding rotation that can contribute to jugular/venous obstruction and/or inadvertent carotid compression. In addition, elevating the head 10° from the horizontal directly reduces intraocular pressure.

Conclusions: The best way to avoid POVL following prone spine surgery is to prevent it. Routine use of an arterial line, intraoperative monitoring, a 3-pin head holder, and elevation of the head 10° from the horizontal should limit the risk of encountering POVL after spinal procedures performed in the prone position.

Key Words: Blindness, central retinal artery occlusion, cortical blindness, glaucoma, ischemic optic neuropathy, postoperative visual loss, prone position, spinal surgery

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FREQUENCY OF POVL FOLLOWING PRONE SPINE SURGERY

In an analysis of forty articles by Epstein, entitled perioperative visual loss (POVL) following prone spinal surgery: A review, the frequency of POVL ranged from 0.013% to up to 1%, with most studies citing a frequency of 0.2%.[3,4,8] In 2009, Shen *et al.* studied the frequency of POVL over a 10-year period (1996–2005) involving >5.6 million patients in a nationwide inpatient sample (NIS) undergoing eight types of surgery; POVL occurred in 3.09/10,000 spinal fusions.[7] In 2014, Nandyala *et al.* also utilizing the NIS database, documented that out of 541,485 patients undergoing spinal fusions, POVL occurred in 1.9/10,000 cases (56.2% had spinal deformity surgery).[5]

RISK FACTORS CONTRIBUTING TO POVL WITH PRONE SPINE SURGERY

In 2014, The American Society of Anesthesiologists postoperative visual loss registry database determined that posterior ischemic optic neuropathy (PION) was responsible for 89% of cases of POVL.[6] Risk factors correlating with ION in general included; prolonged prone surgery, long operative times, long-segment spinal instrumentation, acute blood loss anemia, intraoperative hypotension and/or hypovolemia, diabetes, obesity, male sex, the Wilson frame, direct compression (horseshoe, prone pillows, eye protectors Dupaco Opti-Gard), a history of cancer, the administration of pressors (e.g., catecholamines or nefopam), and a patent foramen ovale (allowing for right to left shunt). Central retinal artery occlusion (CRAO) was also largely attributed to poor prone positioning (direct eye compression and/or rotation of the neck with jugular/carotid compromise), while cortical blindness (CB) was attributed to both poor prone positioning and obesity. Rarely, POVL was due to acute angle closure glaucoma (AACG).

ETIOLOGIES OF POVL IN CASE STUDIES AND REVIEW ARTICLES

For 21 single case studies, POVL was attributed to acute angle closure glaucoma (AACG) (three patients), ION (three patients), CB (three patients), CRAO (four patients), ischemic orbital compartment syndrome/compression (one patient), central retinal artery branch occlusion CRA (one patient), or general POVL (six patients).[3] For five studies, involving from 2 to 55 patients per study, POVL was attributed to ION (80 patients), CRAO (20 patients), CB (five patients), and rarely, posterior reversible encephalopathy syndrome (two patients).[3] In 15 review articles (2004–2015), comparable etiologies of POVL were reported.[3] Of interest, however, was Berg *et al.* review in which there were 111 cases of anterior ION (AION) (most due to cardiac surgery), 165 cases of PION (mostly due to prone spine surgery), 526 cases of either AION/PION, 933 cases of CRAO, 33 cases of pituitary apoplexy, and 245 cases of CB.[1]

PERIOPERATIVE MEASURES TO LIMIT THE RISKS OF POVL WITH PRONE SPINE SURGERY

POVL is a rare but devastating complication of prone spine surgery that can be largely averted utilizing four major and several minor prophylactic measures. Routine use of an arterial line and continuous intraoperative monitoring (somatosensory and/or motor evoked potentials) signal the acute onset of hypotension/hypovolemia/anemia, directly or indirectly, allowing for their immediate correction with appropriate resuscitative measures. Application of a 3-pin head holder avoids direct eye compression and maintains the neck in a neutral posture, avoiding rotation that may contribute to jugular (venous congestion) and/or carotid compression (embolization). Finally, as pointed out by Emery *et al.* in 2015, elective elevation of the head 10° from the horizontal directly reduces intraocular pressure (IOP) during prone spine surgery.[2] Other adjunctive measures that limit the risk of POVL include greater utilization of crystalloids versus colloids (especially for acute blood loss anemia), administration of α-2 agonists (e.g., decreases IOP), and avoidance of catecholamines (e.g., avoid vasoconstrictors). Furthermore, glaucoma patients or those who are glaucoma suspects should consult their ophthalmologists preoperatively as they can be screened with provocative "prone tests" to determine whether they are at risk for AACG. In select cases, appropriate prophylactic measures may be taken.

CONCLUSIONS

It is critical to understand the risks, etiologies, and measures readily available to avoid POVL following prone spinal surgery. The first line of defense is to choose your patients carefully, analyzing the import of their comorbid risk factors. If they are about to undergo a prone spinal procedure, does it really have to be that extensive? Is an instrumented fusion really necessary? Furthermore, are there substantial risk factors for POVL that can be addressed prior to surgery (e.g., ophthalmological evaluation of the glaucoma patient, correction of anemia, better control of diabetes)? Most importantly, routine prophylactic measures should be carefully considered and should include placing an arterial line, utilization of intraoperative monitoring, applying the 3-pin head holder, and elevating the head 10°.

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Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Berg KT, Harrison AR, Lee MS. Perioperative visual loss in ocular and nonocular surgery. Clin Ophthalmol 2010;4:531-46.
2. Emery SE, Daffner SD, France JC, Ellison M, Grose BW, Hobbs GR, *et al.* Effect of head position on intraocular pressure during lumbar spine fusion: A randomized, prospective study. J Bone Joint Surg Am 2015;97:1817-23.
3. Epstein NE. Perioperative visual loss following prone spinal surgery: A review. Surg Neurol Int 2016;7;365-78.
4. Kamming D, Clarke S. Postoperative visual loss following prone spinal surgery. Br J Anaesth 2005;95:257-60.
5. Nandyala SV, Marquez-Lara A, Fineberg SJ, Singh R, Singh K. Incidence and risk factors for perioperative visual loss after spinal fusion. Spine J 2014;14:1866-72.
6. Nickels TJ, Manlapaz MR, Farag E. Perioperative visual loss after spine surgery. World J Orthop 2014;5:100-6.
7. Shen Y, Drum M, Roth S. The prevalence of perioperative visual loss in the United States: A 10-year study from 1996 to 2005 of spinal, orthopedic, cardiac, and general surgery. Anesth Analg 2009;109:1534-45.
8. Zimmerer S, Koehler M, Turtschi S, Palmowski-Wolfe A, Girard T. Amaurosis after spine surgery: Survey of the literature and discussion of one case. Eur Spine J 2011;20:171-6.