Intraocular Pressure in Lumbar Spine Fusion Patients – A Prospective Study

Brian Grose MD, Mathew Ellison MD, Sanford E. Emery, MD, MBA
Manuel Vallejo, MD, Ralph Harding, DO, David Graf, MD, Nina B. Clovis
West Virginia University School of Medicine - Department of Anesthesiology

Introduction

Postoperative visual loss is a rare but devastating complication in spine surgery with an incidence of 0.013–1%.1,8 Prolonged procedure time, substantial intraoperative blood loss, prone position, and systemic factors may contribute to the risk of perioperative blindness. Ocular perfusion pressure is commonly defined as the difference between mean arterial pressure (MAP) and intraocular pressure (IOP).2 Elevated IOP results in decreased perfusion and may lead to postoperative visual loss. Previous studies have shown that IOP increases with prone positioning during anesthesia.3,4 The purpose of this study was to assess IOP at regular intervals throughout the procedure to determine when IOP changes occurred and to quantify the amount/level of change.

Materials and Methods

Lumbar spine fusion surgeries were performed on 26 patients at one institution in patients 18-80 years old. Exclusion criteria included eye disease or injury, history of cervical stenosis, neck pain with extension, or current neoplasm. All patients had the head in neutral position with the face parallel to the floor and were managed with Gardner-Wells tongs and ten pounds of traction on a Jackson table. All IOP measurements were made using an applanation tonometer (Tono-Pen, Reichtert Technologies, Depew, NY) in the preoperative holding area, supine after anesthetic induction, prone after positioning, and at regular intervals throughout the case. IOP measurements were recorded with respective time points and corresponding blood pressure and ETCO2 values. The anesthetic technique was standardized for the procedure. All patients received an arterial line after induction but prior to surgical incision. Study parameters for intraoperative maintenance included: crystalloid ≤ 3 liters, tidal volumes 6-10 cc/kg, peak airway pressures 25-35 mm, 5 mmHg PEEP, ETCO2 30-34 mmHg, Sevoflurane concentration 0.8 to 1.3 MAC, blood pressure within ± 25% of patient’s preoperative value and/or a MAP above 60 mmHg, intraoperative hemoglobin ≥ 10 g/dl, and bispectral (BIS) levels between 40-60 during the procedure. Independent variables included age, gender, duration of procedure, and blood loss.

Results

Left and right eye measurements were so similar that the results are presented as the average of both ocular readings per patient. The initial average IOP reading in pre-operative holding in the sitting position were 16.93. After induction of anesthesia in the supine position, the average IOP value decreased to 14.24. After prone positioning, the average IOP measurement increased to 23.96. Mean values for IOP measurements in the prone position reached significance (vs. prone baseline) at 30 minutes (P = 0.04) and continued to increase throughout the case. For any point in time after 30 minutes, this statistically significant difference was maintained throughout the operative procedures (Figure 1). Duration of surgery was the only factor that significantly influenced the change in intraocular pressure over time. Colloid and crystalloid amounts, estimated blood loss, transfusions, and gender had no correlation with the rise in IOP over time. No patient had any complaints of visual loss, nor were there any complications from the tonometer measurements or use of tond traction.

Discussion

Though still a rare event, postoperative visual loss is believed to occur more frequently in spine surgery than most operative procedures. The type of perioperative visual loss associated with prone spine procedures is typically posterior ischemic neuropathy (PION). The incidence is estimated to range from less than 0.02 percent to as high as 1.0 percent depending on the study.1,8 Risk factors that have been identified by retrospective studies include spine surgery, prone operative position, long case duration, increased blood loss and volume of crystalloid administered, obesity, male gender, and use of certain spine frames.5,6 Perfusion pressure of the optic nerve is the difference between pressures of the ciliary arteries in the nerve and the venous drainage of the eye, which according to Hayreh are approximated by mean arterial blood pressure and intraocular pressure, respectively.7 Normal intraocular pressure is 10-20 mmHg, and major contributors to variations in IOP include arterial pCO2 tension, fluid status, prone positioning, and body inclination.4 In this study, IOP rapidly increased above the baseline value after prone positioning and progressively increased throughout the duration of the procedure, becoming significant within 30 minutes.

Elevated IOP results in decreased ocular perfusion and may lead to postoperative visual loss in susceptible patients. These findings show that intraocular pressure increases with prone positioning and the magnitude of the effect increases with time.

References