

Prevention of Ocular Complications in Spine Surgery Patients in the Prone Position

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Abstract: *Objective:* To investigate the causes and preventive methods for blindness after spine surgery in the prone position. *Methods:* A retrospective analysis was conducted on the data of three patients who developed blindness after prone-position spinal surgery. *Results:* One patient died. Two patients were followed up 5 to 6 months after discharge, with no recovery of vision. Both patients remained blind in both eyes. *Conclusion:* Postoperative blindness in patients undergoing prone-position spine surgery is rare and difficult to treat once it occurs. Early recognition and prevention are essential to avoid this catastrophic complication.

Keywords: Ocular complications; Blindness; Spine; Prone-position surgery

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1. Introduction

Spinal surgeries are generally performed in the supine, prone, or lateral decubitus position, with the prone position being the most commonly used. Various complications may arise from the surgical position, particularly ocular complications, which often include pressure injuries to the periocular skin and postoperative visual loss (POVL).

POVL is an extremely rare but devastating postoperative complication. The first case of blindness after spinal surgery in the prone position was reported by Slocum *et al.* in 1948^[1]. The incidence of POVL in spinal fusion surgeries is about 3.09/10,000 according to the literature^[2]. Most studies on POVL are retrospective or case reports, with varying opinions on its causes and pathophysiology. Currently, there is no effective treatment, and once it occurs, the prognosis is extremely poor, often leading to permanent blindness.

Between December 2020 and January 2022, our department treated three cases of POVL. These included one case of posterior cervical spine surgery, one case of combined anterior and posterior cervical surgery, and one case of posterior lumbar spine surgery. This paper reviews the causes and preventive measures for POVL in these cases.

2. General information

2.1. Patient 1

A 71-year-old male was admitted on December 27, 2020, with “3 days of neck and shoulder pain and 1 day of limb weakness.” Upon admission, his vision was normal in both eyes. The patient underwent emergency surgery under general anesthesia for “posterior cervical laminectomy and bilateral screw fixation.” After surgery, he was placed in the supine position and noted to have severe swelling of the left eyelid, corneal epithelial defects, conjunctival congestion, and sluggish pupillary reflex. Following anesthesia recovery, the patient reported complete loss of vision in the left eye. A 3D CT of the optic nerve canal on January 2, 2021, revealed no significant bony abnormalities in the optic nerve canals bilaterally. However, left eye muscle hypertrophy was noted. The diagnosis of left central retinal artery occlusion was considered. Symptomatic treatments, including corticosteroid therapy, were given. Two weeks after surgery, the left eye had no light perception, slight exophthalmos, ptosis, and conjunctival congestion. The right eye appeared normal. The patient died on the 23rd day after admission due to systemic complications.

2.2. Patient 2

A 67-year-old male was referred from a local hospital on December 17, 2021, due to “sudden loss of vision and eye pain in the right eye for 2 days.” Prior to surgery, his vision was normal. He underwent “posterior lumbar decompression and internal fixation” at the local hospital. Postoperatively, he developed sudden loss of vision and eye pain in the right eye, along with limited ocular movements, without symptoms such as redness, photophobia, or tearing. Upon examination, the right eye had no light perception, limited ocular movement, conjunctival edema, mild corneal edema, and absent pupillary light reflex. The right retina showed gray-white edema, macular discoloration, and retinal hemorrhages. The left eye was normal. A diagnosis of right central retinal artery occlusion was made. The patient was treated with antibiotics (e.g., tobramycin eye drops, timolol eye drops) and supportive care. After 2 weeks, the patient was discharged with no recovery of vision in the right eye. Follow-up in June 2022 showed no light perception in the right eye and normal vision in the left.

2.3. Patient 3

A 59-year-old male was transferred to our hospital after experiencing sudden vision loss in the left eye for 1 week, following a fall. On December 24, 2021, he underwent “posterior cervical open reduction and fixation, combined with anterior decompression and interbody fusion” for cervical spine fractures at the local hospital. Prior to surgery, his vision was normal. Postoperatively, he developed sudden loss of vision in the left eye, with conjunctival edema, limited eye movement, and no pain, photophobia, or tearing. Examination revealed no light perception in the left eye, limited ocular movement, incomplete eyelid closure, conjunctival edema, clear cornea, and absent pupillary reflex. The fundus showed retinal pallor and edema. A 3D CT scan of the optic nerve canal suggested left extraocular muscle hypertrophy and a possible old fracture of the right orbital medial wall. A diagnosis of left central retinal artery occlusion was made. Despite treatment, the left eye did not recover vision. Follow-up in June 2022 showed no light perception in the left eye, with normal vision in the right.

3. Results

One patient died. Two patients were followed up for 5 to 6 months after discharge, with no recovery of vision. Both patients are permanently blind.

4. Discussion

Postoperative visual loss (POVL) is an extremely rare complication but often devastating. Once it occurs, treatment is usually ineffective, with almost no success rate^[3]. Although the mechanisms behind POVL have been recognized in recent years, it remains underappreciated by many surgeons due to its rarity.

POVL can be classified into three types based on the mechanism of blindness: ischemic optic neuropathy (ION), central retinal artery occlusion (CRAO), and cortical blindness^[4].

ION is caused by acute ischemia of the optic nerve, resulting in optic nerve fiber damage, often involving both eyes. Prolonged prone positioning during surgery is a significant risk factor for ION, likely related to increased intraocular pressure and head venous pressure, both of which reduce ocular perfusion pressure and can lead to ischemic optic nerve injury, resulting in vision loss^[5].

Hypotensive shock is another risk factor for ION. Significant intraoperative blood loss can cause hypovolemia and reduced mean arterial pressure, resulting in insufficient ocular perfusion and ischemia of the optic nerve^[6,7].

CRAO typically causes ischemic damage to the entire retina, leading to complete vision loss in the affected eye. The clinical presentation is characterized by sudden, painless loss of central and peripheral vision in one eye, accompanied by a relative afferent pupillary defect (RAPD). Fundus examination typically shows retinal pallor and edema, particularly in the macula, with a characteristic “cherry red spot” appearance. CRAO is most commonly caused by direct mechanical compression of the eye during surgery, which leads to a significant increase in intraocular pressure and occlusion of the central retinal artery^[8].

Cortical blindness is a rare complication of spinal surgery and is caused by damage to the visual centers in the occipital cortex.

The three patients in this study were all diagnosed with CRAO, likely due to prolonged intraoperative pressure on the eyes^[9]. Since all cases occurred after the 240-minute window, treatment was unsuccessful, and vision did not recover.

The prognosis of POVL is poor, with most cases leading to irreversible blindness. Therefore, prevention is crucial. The following preventive measures should be implemented^[4]:

- (1) Preoperative assessment: Evaluate patients for risk factors such as hypertension and diabetes. Ensure appropriate perioperative cardiovascular management. For high-risk patients, consider staging surgery and shortening operation times.
- (2) Positioning: Minimize the use of horseshoe headrests and avoid direct ocular pressure. Use Mayfield headrests to secure the head, and adjust positioning carefully to avoid relative movement of the head and pillow that may lead to ocular pressure^[10].
- (3) Intraoperative management: Continuously monitor blood pressure and hemoglobin levels, maintaining circulatory stability and avoiding severe hypotension.
- (4) Postoperative visual monitoring: Immediately check vision upon anesthesia recovery in high-risk patients, particularly those undergoing prolonged surgeries or at risk of significant blood loss^[11].

Postoperative ocular complications, especially POVL, are severe and difficult to reverse. Effective prevention, including optimal positioning, eye protection, careful patient selection, and monitoring, is essential to reduce the incidence of POVL and ensure patient safety.

5. Conclusion

Postoperative blindness following prone-position spine surgery, though rare, is a devastating complication with limited treatment options. Therefore, early recognition and proactive preventive measures are critical to minimizing the risk and ensuring patient safety.

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