Clinics in Surgery

Case Series
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Revision Spine Surgery as Additional Risk Factor for Postoperative Visual Loss (POVL) – Report of Two Cases

Giovanni Andrea La Maida, Andrea Della Valle, Enrico Gallazzi, Francesco Luceri, Gaetano Terranova and Bernardo Misaggi*

Department of Spine Surgery, Orthopedic Institute Gaetano Pini, Italy

Abstract

Introduction: Visual loss in non-ocular surgery occurs infrequently from 0.001% to 1% depending on the type of surgery. In spine surgery patients are often placed in prone position with relatively low incidence of complications position related. Postoperative Visual Loss (POVL) is a very rare catastrophic complication of spine surgery that must be considered when we treat our patients and it's of great importance to identify potentially risk factors.

Methods: We report two cases of unilateral visual loss due to Central Retinal Artery Occlusion (CRAO) after revision spine surgery. Papers were systematically reviewed and additional articles were selected based on cited references.

Results: During the last 15 years of spinal surgery, we reported only 2 cases (<0.001%) of POVL due to CRAO, both after long time revision surgery with multiple spinal osteotomies. Both patients had unilateral visual loss after the surgery despite adequate eye protection. Both of them had multiple complication risk factors.

Conclusion: This very rare but catastrophic complication must be considered when we plan a challenging revision spine surgery. Patients must be adequately informed about this tremendous risk even in the presence of correct eye protection. Our report will help spine surgeons and anesthesiologists to focus on interprofessional cooperation to obtain an effective informed consent form for prone spinal surgery, especially for revision spine surgery.

Keywords: Revision Spine surgery; Postoperative visual loss; Central Retinal artery occlusion; Prone position

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Correspondence:
Giovanni Andrea La Maida, Department of Spine Surgery, Orthopedic Institute Gaetano Pini - CTO, Milan, Italy, E-mail: lamaida.ga@gmail.com

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Introduction

Postoperative Visual Loss (POVL) is a very rare complication of spine surgery and the incidence of this devastating complication reported in the literature varies from 0.094% to 0.2%. POVL is mostly reported in the literature as case reports or series but recently Shillingford et al. [1] reported a retrospective review of the Scoliosis Research Society morbidity and mortality database reporting an overall incidence of 0.01% on 167,972 spinal deformity patients. Although the incidence of complications associated with the prone position in spine surgery is relatively low, position-related complications can be devastating and life changing to patients. Spine surgery in prone position remains the most common procedure associated with POVL, with an estimated incidence of 65% compared to other surgeries. Patient positioning during spine surgery is a crucial factor and an accurate setting of the patient is very important to prevent injuries. Many other factors play an important role in the genesis of POVL as the type and length of surgery, the presence of comorbidities like obesity, hypertension and diabetes. Hypertension seems to be the most common preoperative risk factor for POVL; however its true role as a predisposing factor remains unclear [1]. High Intraocular Pressure (IOP) is believed to correlate with decreased perfusion to the optic nerve and the prone position plays an important role in changes of the IOP as described by Emery et al. [2]. Patients with high risk are those undergoing prolonged procedures (over 6 h) in prone position with substantial blood loss (over 1000 mL) [3], as it may happened during challenging revision spine surgeries. An analysis of published case reports indicates a growing association between POVL and lumbar surgery [4] but the etiology of POVL is not yet entirely understood. Possible causes of POVL are anterior or Posterior Ischemic Optic Neuropathy (A-ION, P-ION), Central Retinal Artery Occlusion (CRAO) and Cortical Blindness (CB). ION is the most frequently cited cause of postoperative visual loss following general anesthesia, representing approximately 89% of the causes [5]. The cause of the ischemic damage to the optic nerve is still not completely understood, but

perioperative anemia, perioperative hypotension, increased venous pressure, head-down operative position, increased IOP, embolism, facial or orbital edema, and direct ocular pressure are reported as the most common etiological factors [6]. We report two cases of patients who developed postoperative unilateral visual loss after revision spine surgery.

Case Series

Case 1

A 62-years-old man treated for sagittal imbalance after spinal implant failure. The patient had multiple cardiovascular risk factors as hypertension, ischemic heart disease and he was a smoker. He had two previous spine surgery procedures of neural decompression and spinal stabilization with hardware failure and consequent sagittal imbalance (Figure 1). We planned a revision surgery of L3 Pedicular Subtraction Osteotomy (PSO) and long stabilization with fusion (from T3 to ileum), in order to correct the imbalance of the spine and to achieve a solid fusion (Figure 2). It was a very long and challenging surgery (the length of the surgery was over 6 h) with a big amount of blood loss (about 2000 ml). The patient's prone position during spine surgery was obtained with the use of standard supports for the trunk, for the upper and lower limbs and with the use of high-density foam slotted headrest (Figure 3) with eye protection device (Figure 4). Surgeons and anesthesiologist checked preoperative positioning to make sure that the trunk's weight was distributed on the abdominal support, face and abdomen were free and that head, elbows, knees and feet were protected against gravity. General anesthesia with intubation was performed and controlled hypotension was conducted trying to maintain blood pressure between 70-mmHg and 130-mmHg. At the end of operation, the patient was rolled over, presenting red left conjunctiva and swollen left eyelid. On discontinuation of sedation the patient woke up appropriately and he reported a complete visual loss in his left eye. Ophthalmologic examination revealed anisocoria, pupils round and the absence of photomotor reflex. The retinal examination showed slowed retinic blood flow. The optic disc appeared discolored and edematous. In a suspected CRAO we performed an intravenous treatment with a high dose of corticosteroids (Prednisolone 50 mg oral administration

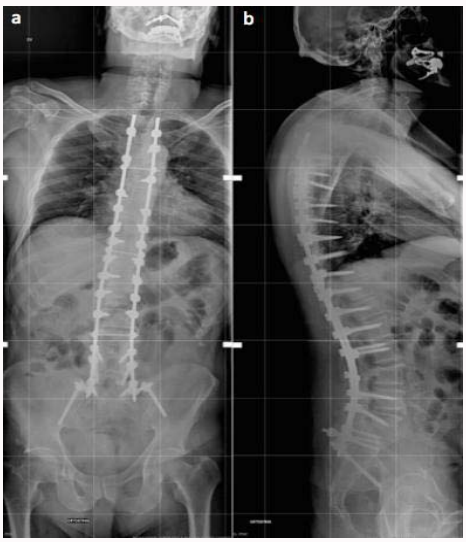

Figure 1: AP an LL X-rays of the first patient before the revision surgery showing hardware failure with rod breakage and sagittal imbalance of the spine.

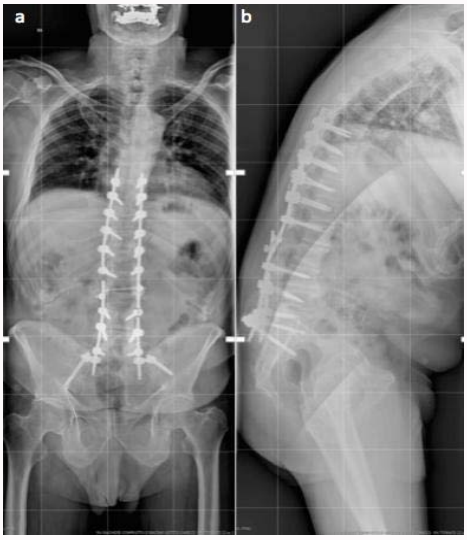

Figure 2: AP and LL x rays of the first patient after the revision surgery of L3 PSO with long instrumentation (T3-ileum) showing a good sagittal profile restoration with a slight coronal imbalance.

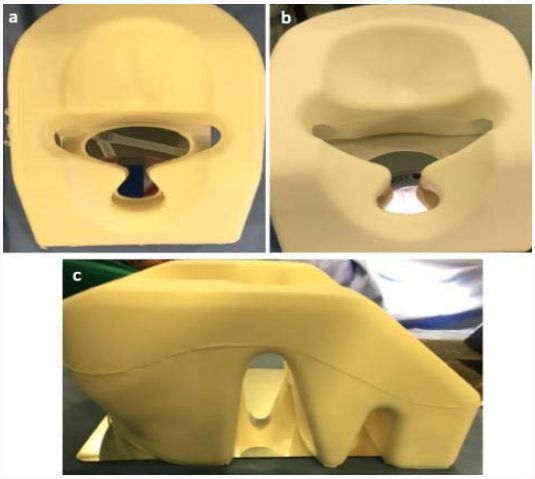

Figure 3: The pictures show the high-density foam slotted headrest we always use during spine surgery.

Figure 4: Eye protection device.

once a day for 10 days) and anticoagulant therapy (Enoxaparin sodium 4000 U.I. subcutaneous injection once a day for 30 days). Echocardiogram and cardiac evaluation showed no evidence of embolic phenomenon. Eight days after surgery the patient underwent retinal fluoroangiography that reported normal findings in the right eye and a delay in retinal arterial filling with hypofluorescence of the optic disc in the left eye (Figure 5). Daily examinations at 3 months follow-up showed a decrease in edema without any improvement in

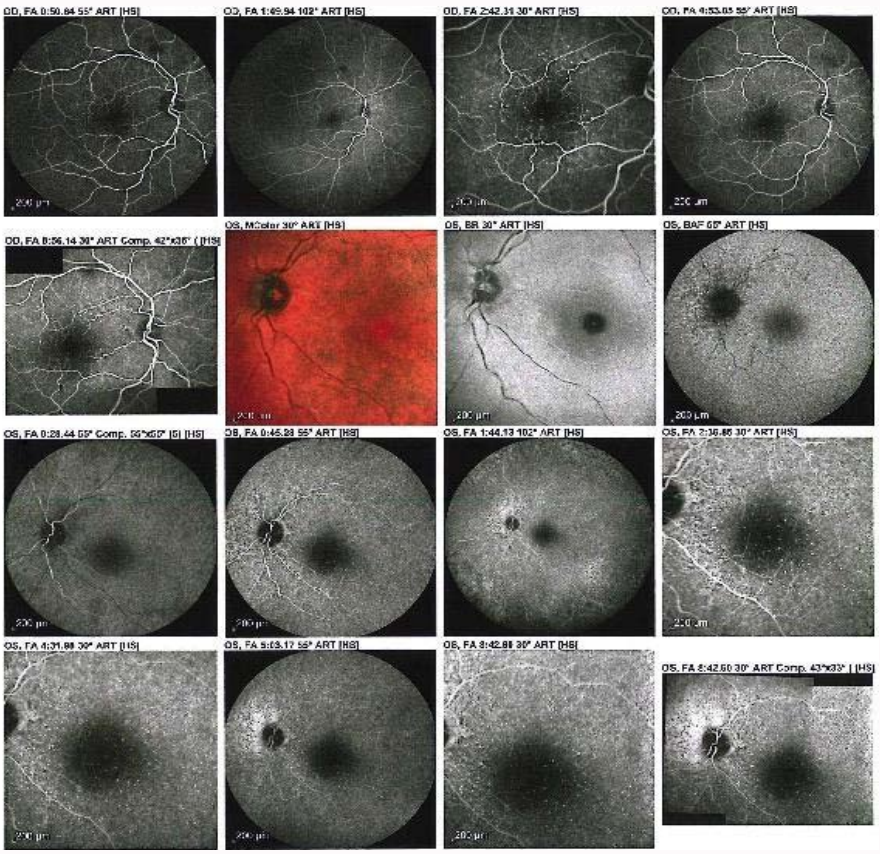

Figure 5: Retinal fluoroangiography of the first patient 8 days after the surgery showing a normal finding in the right eye and a delay in retinal arterial filling with hypofluorescence of the optic disc in the left eye.

visual acuity, with no improvement at the one-year follow-up.

Case 2

A 70-years-old woman treated for low back and leg pain in lumbar spinal stenosis with signs of instability and neurologic deficits. She had a previous spine surgery of decompression and positioning of an interspinous device in L4-L5 segment (Figure 6). The revision surgery was necessary to obtain decompression and lumbar spine stability. The patient presented with diabetes and hypertension as risk factors. We removed the interspinous implant and we performed posterior spinal decompression and long instrumentation with fusion from L1 to the sacrum using ostaPek rods and multiple Smith-Petersen osteotomies (Figure 7). We positioned the patient in standard prone position with the head supported by a high-density foam slotted headrest with eye protection device (Figure 3, 4). The operating time was approximately 5 h. General anesthesia with intubation was performed. The patient mean blood pressure was maintained between 70-mmHg and 120-mmHg. At the end of operation, the patient was rolled over. She presented swollen left eyelid. On discontinuation of sedation the patient woke up appropriately and she reported left amaurosis without any other neurologic deficit. Ophthalmologic and ultrasound study of eyes suggested the diagnosis of CRAO. We started intravenous treatment with a high dose of corticosteroids (Prednisolone 50 mg oral administration once a day for 10 days) and anticoagulant therapy (Enoxaparin sodium 4000 U.I. subcutaneous injection once a day for 30 days). Three days after surgery the patient underwent retinal fluoroangiography that reported normal findings in right eye and retinal artery occlusion with hypoperfusion in the left eye. Echocardiogram and cardiac evaluation were normal.

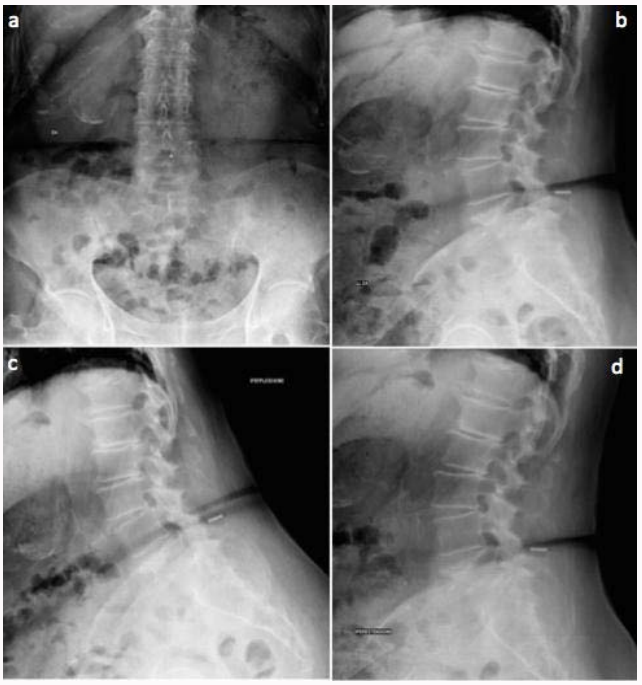

Figure 6: Standard and dynamic x rays of the second patient showing a multiple lumbar degenerative disc disease previously treated with L4-L5 microdecompression and interspinous device positioning.

Carotid ultrasound showed stenosis of left internal carotid arteries. Embolic phenomenon was suspected. Ophthalmologic evaluation at

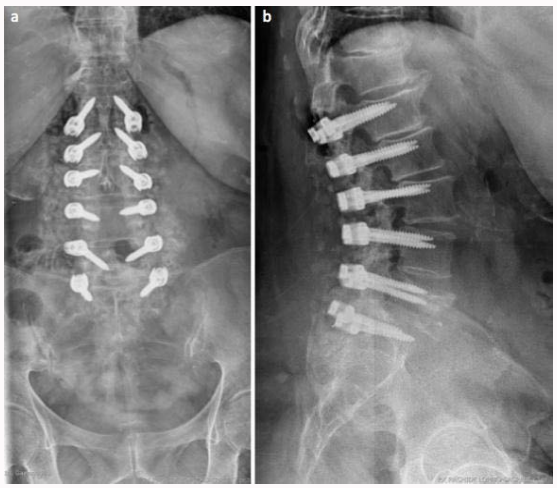

Figure 7: AP and LL lumbar x rays of the second patient after the revision surgery of L3-L5 decompression with L1-S1 stabilization with posterolateral fusion showing a good restoration of the lumbar lordosis.

two years follow-up showed no improvement in visual acuity.

Discussion

The incidence of POVL associated with spine surgery in the prone position under general anesthesia has increased over the past several decades [7], because of the increasing number of spine procedures. In our experience over the last 15 years of spinal surgery we reported only 2 cases (<0.001%) of perioperative visual loss, both after revision surgery with multiple spinal osteotomies. The factors leading to visual loss following spine surgery have been explored in many international scientific publications but are still not well understood. Many risk factors have been identified, including hypertension, diabetes mellitus, smoking, and hypercoagulable state in sickle cell disease. In addition, there are many factors related to surgery including direct pressure on the eye, length of surgery, intraoperative hypotension, and excessive blood loss leading to anemia [8]. An understanding of the changes in physiology and the particular risks associated with the prone position is fundamental. Ocular damage is primarily caused by two mechanisms: the first is a direct pressure to the eye due to the weight of the head being supported by the globe will intuitively result in damage secondary to ischemia; the second is a result of hypoperfusion due to hypotension and/or vascular occlusion disease. In the same way that cerebral perfusion pressure equals Mean Arterial Pressure (MAP) minus the intracranial pressure, ocular perfusion pressure can be defined as MAP minus the Intraocular Pressure (IOP). Occlusion to the venous drainage or any generalized rise in venous pressure will raise the IOP, as the use of a head-down position. MAP may be reduced either by deliberate hypotension or an increase amount of blood loss. If ocular perfusion pressure is too low to adequately perfuse the eyes, then ischemic damage will result [9]. The most popular pathophysiologic explanations used today for ischemic optic neuropathy in prone position are the elevation of venous pressure and development of interstitial edema [10]. Theoretically, these two processes cause damage to the optic nerve by compression of the vessels that feed the optic nerve, venous infarction or direct mechanical compression. The most common cause of POVL after spine surgery is PION resulting in permanent unilateral or bilateral visual loss while CRAO following surgery is a rare complication and not many cases have been reported in literature [11]. CRAO after spine surgery is likely due to excessive pressure on the eye during surgery [12] but our two cases were both operated with the use of high-density foam slotted headrest and eye protection shield, suggesting us another possible cause of blindness in these patients. There are limited studies in the literature of CRAO development after spine surgery, in particular lumbar spine surgery. However, published case reports of lumbar surgery patients can offer insight into potential risk factors for CRAO development. According to Lee [13] CRAO is thought to have three possible etiologies, direct pressure on the globe in the prone position, by emboli or by low perfusion pressure in the retina. In 1997 Myers et al. [14] reported one of the largest series of visual loss after spine surgery concerning 37 cases collected through a survey of the members of SRS. He found that 92% of the patients with visual loss had an instrumented posterior fusion with an average time of surgery of 410 min and blood loss of 3500 ml. These data suggests that instrumented spine surgery with long time procedures and high value of blood loss represent major risk factors for visual loss risk after spine surgery. Our experience seems to confirm these suggestions. Another possible etiology for postoperative vision loss is cerebral embolism. Cerebral microemboli have been found to occur during cardiac surgery and also during some cases of spine surgery [15]. An identification of potential risk factors for POVL is relevant to clinicians and patients planning spinal surgery. Several preoperative and intraoperative risk factors have been identified, including hypertension, diabetes, vascular diseases, intraoperative hypotension and surgical positioning [10]. It is important for spine surgeons to be aware of POVL and to practice in safe. In 1999, the ASA committee on professional liability established the ASA POVL registry to identify predisposing factors and intraoperative risk factors. High-risk patients for POVL are those expected to undergo prolonged procedures on multiple vertebral levels in the prone position with a significant blood loss. The ASA task force for the prevention of POVL considers a surgery prolonged when it exceeds 6.5 h and significant blood loss when the patient's blood loss exceeds 44.7% of estimated blood volume [16]. In addition to the speculation regarding the intraoperative causes of these problems we must consider several patient risk factors. These include chronic hypertension, diabetes mellitus, smoking, vascular disease (arteriosclerosis and collagen vascular disorders), hyperviscosity syndromes (sickle cell anemia, polycythemia vera), narrow angle glaucoma, heart disease [17]. The evidence for the key role of these risk factors in the pathogenesis of visual loss has been determined from studies in different clinical settings. We reported two over 60 year's old patients with cardiovascular risk factors who both underwent revision spinal surgery with multiple posterior osteotomies therefore blood loss was important. According to international scientific publications, a high incidence of perioperative complication rate is described in elderly patients underwent a spinal correction surgery with osteotomies [18]. It is advisable to discuss POVL with these patients when obtaining informed consent. It is also important to inform patients about the multifactorial etiology of POVL, the lack of clear understanding of the etiology, anatomical differences between individuals and the very low incidence of this complication. Which physician should be responsible for disclosure to the patient, and the setting and timing for this disclosure, remains a matter of much debate? The surgeon may make the clinical diagnosis and discuss surgical options with the patient all in the same clinical visit. At that point, the patient is beginning to contemplate surgical treatment as an option, and the disclosure of all surgery complications must be a high priority for the surgeon. Importance should be given to staging surgery in high-risk

patients, as this may reduce the risk of POVL [16]. However, the decision to perform spine surgery for high-risk patient must be individualized and weighed against other perioperative risks. No definitive practice advisory exists for prevention of POVL. Recommendations for patient management of POVL often include the identification of high-risk patients on an individual basis and a clinician-patient discussion of POVL as a possible major complication of surgery. Though slight perfusion deviations are normally combated by autoregulatory mechanisms, ischemic complications can arise from the external compression of vessels by edematous fluids. Baig et al. [19] proposed useful practical guidelines for overall POVL prevention that largely focused on reducing the fluid pressure associated with prone positioning and lengthy operations; they suggested that a 3-min head elevation every 30 min can help decrease orbital edema and lessen the risk of ischemia in prolonged surgeries. In addition, IOP can be lowered by elevating the head 10° during a prone spine procedure as reported by Emery et al. [2]. The use of an adequate head support and eye protection is of fundamental importance to avoid direct compression of the eyes but as well demonstrated by our two cases not enough to avoid POVL due to CRAO. Low head positioning and the use of eye protection device, which unintentionally can create orbital vacuum, could play an important role in eye congestion and edema increasing the possible risk of ocular damage. The etiology of POVL is probably multifactorial; however patients with a large amount of blood loss producing hypotension and anemia along with prolonged operative time are at greater risk [20]. Our report of two cases of challenging revision spine surgery confirms this hypothesis. This catastrophic complication of spine surgery leads to many medical liability issues. Informed consent should be obtained from patients regarding their understanding of the risks of postoperative visual loss as a major complication. Anesthetist and surgeon carry out their respective tasks independently of each other, each bearing full responsibility for their own work. Spinal surgery is a complex field in which different physicians work in team. Patient positioning on the operating table is a joint responsibility between surgeon and anesthesiologist. During surgical practice, surgeon cannot control the real patient position and it is a major responsibility of the anesthesiologist to control the correct position of head and eyes status.

Conclusion

Looking back on our experience we can consider revision spine surgery with multiple osteotomies in old patients as additional risk factor of perioperative unilateral visual loss due to CRAO. Our prevalence rate of POVL after spine surgery was <0.001% as reported in the literature. Understanding this uncommon complication and its etiology is fundamental to prevent it and to obtain a truly informed consent from the patient. In conclusion it is important to be alert to this rare complication in preoperative planning of revision spine surgery especially in those patients with high risk factors. Our report will help spine surgeons and anesthesiologists to focus on interprofessional cooperation to obtain an effective informed consent form for prone spinal surgery, especially for revision surgery.

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