

Review Article

Analysis of Risk Factors and Some Treatment Plans for Permanent and Temporary Non-ocular Surgical Blindness

Xufeng Zhang^{1,*} , XiaYu² 

¹Department of Thoracic Surgery, General Hospital of Heilongjiang Forest Industry Group, Harbin, China

²Department of Thoracic Surgery, The 2nd Affiliated of Harbin of Medical University, Harbin, China

Abstract

This review systematically analyzed the risk factors for perioperative vision loss (POVL) and temporary perioperative vision loss (TPOVL) from the perspectives of anatomy and pathophysiology in non-ophthalmic surgeries. The study confirmed that in cases of POVL, the prognosis of TPOVL is the best, because the damaging factors causing TPOVL are reversible and can heal on their own under medical intervention or without intervention, while POVL may lead to irreversible severe consequences because its damaging factors are irreversible. This article also summarizes the current effective treatment plans for individual cases. The conclusion emphasizes that the development of postoperative POVL has strong individual differences. Patients undergoing different surgeries not only share common perioperative POVL risk factors, but also have different risk characteristics and unique pathophysiological features. Personalized strategies should be developed based on the individual patient's condition and surgical method to control risk factors, thereby reducing the incidence of POVL or converting it into TPOVL, and ultimately achieving the best therapeutic effect. At the same time, in the future, with more data support, it may be possible to establish a risk prediction model for POVL and TPOVL, so that more precise medical interventions can be taken during the perioperative period to reduce the probability of occurrence of these two complications and evaluate the prognosis. This is one of our important future work directions.

Keywords

Perioperative Visual Loss, Ischemia Optic Nerve, Surgical Operation, Cortical Blindness

1. Introduction

Perioperative visual loss associated with non-ophthalmic surgery (POVL) is a serious and rare complication that can lead to lifelong blindness in patients after surgeries other than those in the ophthalmology department. Its pathology mainly consists of retinal vascular occlusion (RVO), ischemia optic nerve (ION), including anterior ischemic optic nerve (AION), posterior ischemic optic nerve (PION), cortical blindness (CB), central retinal artery occlusion (CRAO), and posterior reversible encephalopathy (PRES). A large number of studies have found

that this complication is most common after cardiac surgery [1, 2] and spinal surgery [3, 4], and also occurs in a considerable number of cases in brain surgery [5, 6] and cerebral vascular intervention [7, 8]. Although the incidence of other surgeries is extremely low, case reports have been seen in various surgeries [9-12]. Despite years of case summaries, multiple risk factors have been found that may increase its incidence, and medical staff have also tried to minimize these risks during the perioperative period. However, POVL still occurs in various surgeries,

*Corresponding author: xfzhang7605@126.com (Xufeng Zhang)

Received: 21 November 2025; **Accepted:** 3 December 2025; **Published:** 31 December 2025



and its prognosis varies greatly. POVL is generally classified into three types: inflammatory arthralgia caused by giant cell arteritis, non-inflammatory arthralgia caused by non-giant cell arteritis, and POVL caused after surgery [13]. This article only discusses POVL caused after surgery. Some patients with POVL may still not regain their vision after treatment, while others may lose part of their visual field. However, some patients can recover their vision after treatment and without obvious complications [5, 14]. These patients are called temporary perioperative visual loss associated with non-ophthalmic surgery (TPOVL).

A ten-year-long epidemiological study involving 5.6 million patients in the United States, covering nine common surgical procedures in cardiology, orthopedics, and general surgery, found that the incidence in postoperative of POVL was the highest in cardiac and spinal fusion surgeries. The national estimated value for the former was 8.64 per 10,000, and for the latter it was 3.09 per 10,000 [15]. Although other studies reported different epidemiological data, the conclusions remained largely unchanged [16, 17]. Patients under 18 years old, especially males, are prone to CB, while patients over 50 years old are more likely to develop ION and RVO [17, 18]. Overall, the incidence of PVOL shows a downward trend [15]. Some studies have proposed that the occurrence of POVL in patients is the result of the combined effect of multiple risk factors, and the prognosis is often poor [19]. Therefore, there are relatively more reports on POVL. TPOVL can be regarded as the best prognosis after POVL occurs. However, due to the different prognoses, it suggests that there must be different pathological physiological conditions between the two. Moreover, because the prognosis of TPOVL is good, studies on it are rare, its risk factors are not completely clear, and the relationship between it and surgical treatment also needs to be clarified.

This review attempts to summarize the diagnosis and treatment of surgical cases with two different prognoses of POVL, including disease types, risk factors, surgical plans, treatment conditions, and other data. It aims to identify the differences in risk factors between patients with different surgical outcomes and the corresponding disease progression. The main purpose is to provide a theoretical summary for the clinical goal of controlling these risk factors as much as possible during the perioperative period to reduce the occurrence of the above complications or to adopt corresponding treatment strategies in a timely manner after their occurrence to achieve the best prognosis.

2. The Anatomy of the Visual Nerve Pathway Is the Basis for the Occurrence of POVL and TPOVL

2.1. The Composition of the Visual Pathway and Its Anatomical Relationship with Surrounding Tissues

The optic nerve is composed of the axons of the inner

ganglion cells of the retina that converge at the posterior part of the retina. It runs backward and inward through the orbit, passes through the optic canal and enters the middle cranial fossa, forming the optic chiasm. Then it forms the left and right optic tracts, which mainly project to the lateral geniculate body and recombine to form the optic radiation. This radiation projects through the posterior limb of the internal capsule to the visual cortex of the occipital lobe. Thus, the entire visual pathway of the lesion area is formed. In this pathway, any damage to any part will cause corresponding visual disorders [20]. The optic nerve generally runs along with the ophthalmic artery and is mainly composed of the intraocular segment, the orbital segment, the canalicular segment, and the intracranial segment. The intraocular segment is within the optic nerve at the optic disc and mainly spreads in a fan-shaped manner behind the retina. The orbital and canalicular segments are mostly surrounded by the membranes composed of dura mater, arachnoid mater, and pia mater and are provided with part of the blood supply by them. The cavity between the dura mater and arachnoid mater is the subdural cavity, and the cavity between the arachnoid and pia mater is the subarachnoid cavity, which contains cerebrospinal fluid. Therefore, an increase in intracranial pressure can directly lead to an increase in intraocular pressure. The intracranial segment is adjacent to the sphenoid small wing, oculomotor nerve, abducens nerve, and ophthalmic artery.

2.2. The Circulatory System of the Visual Pathway

2.2.1. Arterial Blood Circulation

The blood supply of the optic nerve mainly comes from the ophthalmic artery and its branches. The surface of the optic disc is mainly supplied by the Zinn-Haller ring formed by the central retinal artery, the short posterior chamber ciliary artery, and the choroidal artery, as well as the branches of the posterior communicating artery. The blood vessels are distributed in a fan shape at the optic nerve head, which can well explain the segmental vision loss seen in ischemic diseases [21]. The orbital segment and the intracanalicular segment are mainly supplied by the branches of the ophthalmic artery, the branches of the optic nerve meningeal artery, and the branches of the posterior short ciliary artery. The intracranial segment is mainly supplied by the branches of the internal carotid artery and the anterior cerebral artery. Overall, the blood supply to the optic nerve shows a segmental distribution, and the interconnections between different sources of blood vessels are relatively few. This makes it difficult for the optic nerve to obtain compensation from other vessels if the blood supply at a certain location decreases. Relatively speaking, the middle part of the optic nerve is more prone to ischemia. Based on this, there is a view that this part of the nerve has a greater correlation with PION [22].

The blood supply to the occipital visual cortex is mostly

provided by the posterior cerebral artery as the main supplying vessel, supplying the visual cortex on both sides of the occipital sulcus (striate area, Brodmann area 17), as well as the surrounding areas of the occipital lobe (striate parietal area and striate peripheral area, areas 18 and 19). Additionally, the middle cerebral artery and the anterior artery both have a few branches supplying the visual center. It should be noted that the complex blood supply of the visual system shows significant individual differences [21]. This individual difference also makes POVl and TPOVL that occur clinically more uncontrollable.

2.2.2. Venous Blood Circulation

The venous return of the ocular vessels generally consists of the central retinal venous system and the vortex venous system. The former collects the venous blood from the inner layer of the retina and exits through the optic nerve canal, then flows into the superior ophthalmic vein or the cavernous sinus. The latter collects the venous blood from the choroid, iris, and ciliary body, and flows into the superior ophthalmic vein or the infraorbital vein, eventually returning to the cavernous sinus. The venous anastomoses are slightly better than the arteries. If there is a major venous obstruction, the anastomoses can perform drainage [22].

3. The Pathophysiology of POVl and TPOVL Determines Their Prognosis

The pathophysiology of POVl and TPOVL caused by different diseases shows that they have extremely similar injury mechanisms. According to the literature reports, the main occurrence time of POVl is during surgery. Under the combined effect of related risk factors, local ischemia and hypoxia [23] or mechanical compression [20] occur in a certain part of the visual pathway, leading to dysfunction in the transmission or processing of visual signals. The most common injury site for POVl and TPOVL is ION [24]. The characteristics of ION are painless and asymptomatic vision loss in one eye; it is divided into AION and PION. Both may occur simultaneously or separately. However, the risk factors that induce them have a clear individualized tendency, and different diseases may have different risk factors.

3.1. The Pathophysiological Characteristics of ION

It has a higher incidence rate in patients under 18 years old and over 65 years old. Its risk factors include male gender [17], anemia [28], surgery duration exceeding 6 hours, and intraoperative hypotension [25]. For patients with long-term prone position, an increase in intraocular pressure occurs. If not promptly treated, the continuous increase in intraocular pressure may lead to ION and subsequently develop into POVl. Additionally, improving anemia before surgery,

minimizing the surgery duration [26], and reducing the time spent in Trendelenberg position during the operation all help to reduce the occurrence of ION [27].

3.2. The Pathophysiological Characteristics of AION

Regarding AION, it mainly originates from cardiac surgery. RVO and ION could all be its causes. RVO is the most common cause [1]. RVO includes occlusion of the ocular artery itself, failure to remove tiny tissue emboli during left heart surgery to rinse the heart cavity, surgical-formed thrombi or other tissue emboli, emboli formed during cardiopulmonary bypass (CPB), calcified emboli formed during coronary artery bypass surgery (CABG) when operating on the aorta, etc. These tiny emboli can embolize in all organs, but due to their small size, their impact on organ function is extremely limited, and it is difficult to detect clinically. However, due to the anatomical characteristics of the ocular artery, even a tiny embolism can be immediately detected clinically in the eye [1]. Moreover, once the embolus is embolized into the main blood vessels supplying the anterior visual system, it may constitute AION. Some studies have also found that simultaneous occlusion of the central retinal artery and vein can cause AION [28]. This may be related to long-term abnormal elevation of eye venous pressure during the operation, slow blood flow, high coagulation state of blood, and eventually the formation of venous thrombosis.

3.3. The Pathophysiological Characteristics of PION

Regarding PION, it is commonly seen in spinal surgeries [BG] and radical cervical dissections [29], especially bilateral cervical dissections [30]. The former occurs due to common reasons such as prolonged prone position and excessive time in Trendelenberg position, long operation duration, and significant blood loss, etc. The latter occurs when the arteries and veins related to the eyes are cut during the surgery, leading to AION and PION, which is an important risk factor for post-operative POVl [31]. Other related risk factors are also as mentioned earlier [32]. Some believe that PION is relatively an independent risk factor, and its diagnosis requires excluding all other causes that lead to POVl before it can be confirmed [33]. PION is more likely to occur in cases with severe perioperative anemia and severe hypotension, and the condition is severe and has a poor prognosis [32]. Its pathological manifestations are ION, RVO, CB or extensive infarction of the bilateral ophthalmic nerve orbital segments [19, 30]. Only a few patients can occasionally recover [34].

3.4. The Pathophysiological Characteristics of CB

Regarding CB, CB refers to visual loss caused by bilateral

occipital lobe lesions. However, the causes of CB are numerous. It is closely related to ischemia, injury, obesity, direct compression of cervical blood vessels, etc. [35]. Even in the supine position, CB can occur even if there are obvious risk factors before the surgery. There is a case report of a patient who developed CB during spinal surgery in the supine position. After a brain MRI, it was shown that there was a transverse artery infarction and a left vertebral artery dysplasia. After anticoagulation treatment, the patient's vision recovered only after one year [36]. For CB caused by unilateral occipital visual center lesion, with treatment, patients may also experience functional recovery [36]. Additionally, the occurrence of CB is sometimes closely related to psychology, cognitive psychology, neurophysiology, and neuropsychiatry [37]. Therefore, in surgical procedures, the psychological changes of patients may also lead to transient CB. In conclusion, the occurrence of CB is a complex process involving both physiological and psychological factors. Therefore, for some CB patients, the cause may not be clear after surgery and they may recover spontaneously, which may be related to this.

3.5. Regarding the Rehabilitation of POVL

Regarding the rehabilitation of POVL, this should be related to the re-opening of the blocked blood supply vessels, compensation, or recovery of the corresponding nerve damage. If the harmful factors can be removed or improved before the permanent damage to the visual pathway tissue occurs, the visual pathway tissue can return to normal, and vision can be fully or partially restored, resulting in TPOVL or the recovery of part of POVL [5, 12, 14].

4. Risk Factors of POVL and TPOVL in Surgical Procedures

4.1. Surgery Related to the Brain Region

4.1.1. General Neurosurgery

In neurosurgical procedures, there are numerous literature reports of the occurrence of POVL and TPOVL. A case report states: A patient with a unilateral parieto-occipital meningioma experienced complete blindness after the successful surgery. Flash visual evoked potentials confirmed no response in the retina, optic nerve, and visual center. It was not until 24 hours later that the patient gradually began to recover [5]. Based on the anatomical characteristics of the visual nervous system, the most likely scenario is that during the resection of the occipital meningioma, the blood vessels that entered the visual nervous system (including the visual center) from the meninges were partially cut off and then lucky compensated by other blood vessels. Additionally, this surgery had a significant amount of bleeding, and both of these risk factors simultaneously led to TPOVL. Shahriari M et al. reported a

case of a pediatric patient with frontal epidural abscess caused by total sinusitis, which occurred after the treatment with supine bilateral frontal craniotomy. The specific risk factors are unknown, and they should be similar to those described earlier [34].

4.1.2. Endovascular Therapy and Optic Nerve Sheath Decompression Surgeries

One piece of evidence related to blood supply is that among 19 patients with cerebellar tentorium dural arteriovenous fistulas treated with endovascular embolization, one patient experienced permanent limited left visual field loss after the surgery, and another patient suffered temporary vision impairment (double vision). The risk factors for these complications in these two patients might be due to the permanent loss of arterial blood supply to part of the visual system and the short-term transient insufficiency caused by the embolization [7]. Besides, the reduction of arterial blood supply to the optic nerve pathway can cause POVL and TPOVL, while venous obstruction can also cause POVL and TPOVL. In patients with progressive cerebral venous sinus thrombosis, vision gradually declines. After the percutaneous cerebral venous sinus stent implantation and the combination of anticoagulation and mannitol for reducing intracranial pressure drugs, nearly 80% of the patients' vision was stabilized or improved. Clearly, with the implantation of the stent, the intraocular venous pressure decreased, the arterial blood supply increased accordingly, and the ocular blood flow circulation was improved, resulting in significant improvement of the visual disorders or visual loss and other complications. This indirectly proves that the improvement of vision is related to the blood supply of the visual pathway tissues [8]. Similarly, for patients with progressive cerebral venous sinus thrombosis, regardless of anticoagulation treatment and intracranial pressure reduction therapy, progressive visual loss cannot be prevented. However, through optic nerve sheath fenestration surgery, the visual function of the patients can be improved or stabilized. This is because fenestration and decompression of the optic nerve sheath improves the blood circulation of the intracranial visual system, thereby reversing the trend of vision decline [38, 39].

4.1.3. Surgery Near the Optic Nerve

The most common tumor near the optic nerve is a pituitary tumor. Due to the continuous growth and enlargement of the pituitary tumor, it directly compresses the optic chiasm, resulting in the impairment of blood supply and nerve function of the optic chiasm, thus causing POVL [23]. This is significantly different from the clinical manifestations of visual impairment caused by surgical operations. However, after the pituitary tumor resection surgery, 91% of patients experienced improvement or stability in their vision [40]. Clearly, relieving the compression of the blood vessels and nerves of the optic chiasm can stabilize or improve vision. In another

study on samples of pituitary tumor resection, it was found that approximately 0.6% of patients experienced vision loss due to POVl after the surgery. The cause is unknown, and it is speculated that the reason for vision loss is the unintentional injury to the blood vessels leading to the visual nerve pathway or the visual chiasm itself during the pituitary tumor resection [41]. Inaccurate clinical operations causing compression of the patient's eyes is also one of the reasons for postoperative visual impairment [42]. In a Le fort I osteotomy case, due to the use of a curved bone chisel to achieve the separation of the sphenomandibular joint, the sphenoid bone was subjected to force, causing a change in the position of the sphenoid small wing, which could lead to indirect damage to the optic nerve and its vascular structure, thereby causing POVl [20].

4.2. Angiography

If the contrast agent enters the blood supply of the visual nerve system, it can cause transient ischemia in some parts of the visual nerve tissue [1]. However, as the contrast agent is expelled from the corresponding blood vessels of the visual nerve, the patient's vision can recover. In a case where a patient underwent angiography treatment, the patient developed POVl, but through methods such as hyperbaric oxygen therapy, the patient's vision could be restored to normal [43]. Clinical analysis suggests that it may be because the time for the contrast agent to enter the blood supply of the visual nerve system exceeded its tolerance limit. This indicates that, on the one hand, the blood supply vessels of the visual nerve system are small and the formed vascular network is extremely fragile and difficult to compensate for local ischemia; on the other hand, it is not ruled out that the patient's own visual nerve system is more sensitive to ischemia and hypoxia than the average person.

Overall, surgeries on the head, surgeries involving blood vessels, or angiographic procedures, whether close to or not close to the optic nerve pathway, may cause POVl or TPOVl due to various reasons (mainly because the nerves of the visual system or the blood vessels supplying them have been damaged).

5. Cardiac Surgery and CPB

5.1. Cardiac Surgery

5.1.1. General Cardiac Surgery

Regarding POVl caused by cardiac surgery, there have been numerous clinical reviews discussing this issue [1, 44, 45]. This article will not elaborate on it further. However, cardiac surgery is a type of surgery with a relatively high incidence of POVl and TPOVl. Based on the characteristics of the surgery, the most dangerous factor is the presence of various microemboli that block a blood supply vessel in the visual pathway during blood circulation. If the surrounding

vascular network cannot compensate, this part will experience ischemia and hypoxia, leading to POVl. If the emboli are smaller, they may cause more distant, even retinal sectoral visual disturbances. Cardiac surgery causes AION, mostly due to RVO also. [46, 47]. Additionally, according to the research of Shen et al., the main cause of POVl in cardiac surgery is spontaneous RVO, ION, and the risk factors of the surgery itself [15, 48]. Regarding spontaneous RVO, the three main mechanisms are: (1) compression of the ocular blood vessels; (2) reduction of arterial blood supply leading to RVO, followed by vasospasm and/or thrombosis; (3) obstruction of venous return. RVO accounts for the majority in cardiac surgery, with others being less common. The causes of TPOV and TPOVl induced by cardiac surgery are as mentioned above [15].

5.1.2. Regarding Coronary Artery Bypass Grafting Surgery

The pathogenesis of Coronary Artery Bypass Grafting (CABG) surgery is also different. For most patients who underwent CABG and subsequently developed POVl, it is usually due to the presence of multiple predisposing factors in the patients, including low blood pressure, anemia, internal carotid artery stenosis, a temporary decrease in blood supply to the heart during the bridge operation, and the aforementioned risk factors such as calcified emboli [1, 49]. These risk factors may play a decisive role. However, some studies have found that CABG may reduce vision without affecting the ocular structure. Postoperative vision loss may be attributed to changes in cells, visual pathways, or cell molecules in the central nervous system [34]. At the same time, it has also been discovered that the choroidal thickness under the macula significantly increases after CABG, which may be beneficial for some high-risk patients [50].

5.2. Regarding CPB

During cardiac surgery when using CPB, gas emboli may form. Studies have confirmed that bubble-type oxygenators are associated with increased retinal microembolism and postoperative neurocognitive deficits [51, 52]. During the CPB support process, there is an extremely close contact opportunity between gas and blood. Occasionally, gas may enter the blood and form gas emboli. Sometimes, tiny gas emboli may "escape" the filtration device and enter the arteries, thus appearing in the human blood circulation. If these gas emboli happen to occlude the blood vessels in the visual pathway, they may cause clinical symptoms to be discovered quickly. However, gas emboli can be absorbed, and the blood circulation may recover quickly. The emboli are also very small, so this kind of damage is generally reversible.

In summary, the risk of POVl after cardiac surgery is higher than that after general surgeries. Moreover, AION is the most common type, and the risk factors are quite clear, mainly including conventional factors such as embolism,

hypotension, anemia, and internal carotid artery stenosis. However, the causes of visual abnormalities caused by CABG are completely different from this. It is not necessarily caused by ocular anatomical changes. It may also be caused by molecular changes in retinal cells, visual pathways, or cells in the central nervous system.

6. Orthopedic Surgery

Regarding orthopedic surgeries, especially spinal surgeries, there are quite a number of reports and reviews in the literature [15, 19]. Other orthopedic surgeries also have case reports [53, 54]. In general, the complications caused by orthopedic surgeries are mostly POVL, while TPOVL is reported less [55].

6.1. Spinal Surgery

Including cervical surgery [56], spinal surgery is the most related surgery to ION [15]. Especially, the incidence of POVL during surgeries with prolonged prone position and Trendelenburg position is relatively high. The main clinical manifestation is PION [19], because these two positions cause prolonged elevation of intraocular pressure [57]. However, statistically, POVL occurring in spinal surgeries covers all visual nervous system injuries: such as AION, PION, CRAO, CB, and PRES. But the most common causes are AION and PION, accounting for about 89% of the cases. RVO, CB, and PRES account for only a few cases [19]. Long-term surgical operations in Trendelenburg position or prone position by patients, as well as combined anesthesia factors and patients' own sensitivity, can all lead to POVL [58]. Similarly, various high-risk factors play an undeniable role in causing POVL in spinal orthopedic surgeries. One patient failed to correct the original cardiovascular problems before the surgery, had severe anemia and bilateral posterior communicating artery and occipital lobe infarction as risk factors, underwent laminectomy at the L2-L4 level in the lumbar spine, and experienced hemodynamic instability during the operation, and then their vision was immediately impaired [59]. In orthopedic surgeries, patients undergoing spinal correction or posterior lumbar fusion surgery seem to face the highest risk [61]. Regarding TPOVL caused by spinal surgeries, there are fewer reports. There was a case of a 11-year-old female patient with muscular dystrophy who developed TPOVL during a posterior spinal fusion surgery under spinal decompression and internal fixation due to hypotensive anesthesia during anesthesia. The cause was temporary CB [55].

6.2. Other Orthopedic Surgeries

Literature reports have indicated that total hip arthroplasty can cause AION and shoulder arthroplasty can cause PION [53]. The former led to bilateral blindness in a patient who was normal before the operation. The occurrence of AOV

might be due to intraoperative blood loss and transient hypotension. The latter had vascular risk factors, hypertension and diabetes, resulting in PION. Another report described a case of blindness after orthognathic surgery, with an unclear cause. It might be the result of the surgery itself or the combined effect of general anesthesia, intraoperative bradycardia, significant blood loss and volume resuscitation with colloid and crystalloid fluids. Postoperative examination diagnosed RVO [60]. However, some studies have found that general anesthesia and/or surgical injury during orthopedic surgeries do not necessarily cause retinal damage (measured by optical coherence tomography) [61]. Therefore, as one of the risk factors, the pathophysiological mechanism of general anesthesia and/or surgical injury in the occurrence of AION still needs further research. In addition, POVL also has a certain lag. A patient with a midshaft femoral fracture who underwent internal fixation surgery became blind in both eyes 14 hours after the operation and was eventually diagnosed with Purtscher's retinopathy. Anticoagulant treatment (oral low-molecular-weight heparin and Vasonit® 400 mg bid) was given, and it eventually transformed into TPOVL [54]. However, no other risk factors were found except for the long operation time.

In conclusion, most cases of POVL in orthopedic surgery are still related to ION. Even with all preventive measures taken, ION can still occur and there is no effective treatment plan. Therefore, it is only possible to minimize perioperative risk factors as much as possible, pay special attention to changes in intraocular pressure of both eyes, and take emergency measures when necessary for treatment, or appropriately raise the head during the operation to reduce intraocular pressure, which may help reduce the occurrence of POVL [57].

7. Surgery on Other Parts of the Body

The incidence of POVL or TPOVL caused by surgery on other parts of the body is extremely low. However, individual case reports can be found in various types of surgeries. These cases can be used to identify the causes or risk factors.

7.1. Laparoscopic Surgery

Since the surgery requires pneumoperitoneum, injecting CO₂ into the abdominal cavity will increase the CO₂ content in the blood, which may lead to dilation of cerebral blood vessels and an increase in cerebral blood volume [58]. The final result is an increase in venous pressure [19]. This will cause an increase in intraocular pressure, leading to POVL or TPOVL [58]. Laparoscopic surgeries of various types can all cause POVL. In a case of laparoscopic cesarean section, a patient developed POVL. After investigation, the visual loss was due to the combined obstruction of the central retinal artery and vein [9]; Colonic surgery can also cause POVL, and its onset is related to an increase in intraocular pressure

[62]. A patient underwent laparoscopic bilateral hernia repair surgery. After the operation, the vision of the left eye decreased, accompanied by visual field loss. The diagnosis was that the left eye developed AION due to hypovolemia. Three months later, partial optic nerve atrophy occurred in the affected eye [63]. This indicates that the damage to this part of the optic nerve system is permanent.

7.2. Radical Neck Dissection

POVL can occur during bilateral radical neck dissection and can lead to permanent blindness [30, 64]. A 52-year-old male with type 2 diabetes developed POVL after undergoing unilateral radical neck dissection, contralateral modified radical neck dissection, and hemilaryngectomy. Postoperatively, he suffered total blindness due to POVL. Risk factors include prolonged hypotension and bleeding during the surgery. Other factors such as the formation of AION or PION after the destruction of the vessels that connect the visual nerve pathway in the neck are also important risk factors, and their effects vary depending on the scope of the surgical operation. However, if both internal jugular veins are retained after the surgery, vision loss may be reversible; if either one is removed, it may be permanent [65]. Even in cases of unilateral radical neck dissection, if AION develops, it can cause vision loss [66]. This indicates that the blood vessels in the neck and those in the visual pathway must be interconnected through certain branches.

Other surgeries. For some surgeries, it is almost impossible to systematically explain the exact risk factors. For instance, a 36-year-old patient with no significant medical history suffered from pneumothorax and then experienced temporary CB after the surgery [14]. Another case was a 53-year-old woman with no significant medical history who developed POVL after a ureteroscopy procedure. After treatment, her vision recovered and it was diagnosed as TPOVL [67]. In these cases, it is almost impossible to determine any perioperative risk factors for the occurrence of POVL and TPOVL.

There are some randomly occurring cases with relevant risk factors. In the treatment of some radical prostatectomies and gynecological surgeries using laparoscopy, increased intraocular pressure is an important risk factor for POVL [58]. After prostatectomy, the indicators such as blood pressure, hemoglobin, and hematocrit of the patients significantly decreased compared to before the operation, eventually developing into POVL [68]. A patient with 10% third-degree burns on the back and neck developed ION after prone position resection of necrotic tissue and autologous transplantation surgery. After treatment, the vision improved slightly, although it was barely noticeable [27]. Other risk factors include smoking, obesity, malnutrition, and decreased blood pressure during the operation. Long operation time, large blood loss, etc. POVL can occur in various clinical diseases.

In summary, most of these cases are reported as surgeries. Some may have unverifiable risk factors, while others are theoretical risk factors. However, during the perioperative

period, efforts should be made to minimize or eliminate known risk factors in order to reduce the probability of POVL and TPOVL occurrence.

8. Surgical Patients with Special Diseases and Special Constitutions

For instance, patients with antiphospholipid antibody syndrome often have enhanced coagulation dysfunction, and they are prone to form blood clots during surgery, which is an important risk factor for POVL [69]. Similarly, surgical patients with giant cell arteritis may develop POVL after surgery [49]. Patients with Cushing's syndrome may experience centripetal obesity, which may cause increased abdominal pressure and lead to PION [32]. Primary progressive multifocal leukoencephalopathy-induced primary vasculitis of the central nervous system has a higher risk of causing POVL [50]. For such patients, special attention should be paid during the perioperative period to reduce other potential risk factors that may induce POVL and to lower the overall risk. For patients with Flammer syndrome, there is a relatively high probability of experiencing vision loss during the surgical procedure. This is an independent risk factor. The insufficient internal perfusion around the eye is the key pathological and physiological core for all patients, which leads to an unstable blood flow in the eye. Combined with a high reactivity to pharmacological stimulation, it causes a disorder in the self-regulation of blood supply, thereby resulting in occlusion of the eye [70].

In addition, before the operation, patients should avoid using catecholamine drugs that can cause vasoconstriction [4], such as drugs containing synephrine, compound ephedra, etc. [71]. Some patients developed RVO after taking synephrine supplements, although it eventually progressed to TPOVL, causing irreversible damage to the retina. The optic nerves of some patients, especially their vascular systems, may be particularly vulnerable to hemodynamic changes during the prone position. Such risk factors that cannot be detected before the operation can only be hoped to be controlled during and after the operation [2]. Therefore, Hayreh et al. attributed AION to individual differences in optic nerve blood supply [72].

In summary, the susceptibility of such patients' nervous system in terms of physiology and anatomy can all lead to POVL [24]. Other factors such as carotid artery stenosis, lacunar cerebral infarction, diabetic or hypertensive retinopathy, macular degeneration, and glaucoma are all potential risk factors for this disease.

9. Treatment Plan

9.1. Quickly Restore Blood and Oxygen Supply to the Optic Nerve Pathway

Efforts should be made to quickly restore blood and oxygen

supply to the optic nerve pathway. The majority of POVL cases are caused by ischemia and hypoxia in the visual nervous system. The use of hyperbaric oxygen [43] can alleviate symptoms until vision is restored. Rapid restoration of blood and oxygen supply is an important measure for improving symptoms.

9.2. Glucocorticoids

Glucocorticoids can temporarily reduce the degree of tissue damage caused by ischemia and hypoxia and prolong the time of their anti-ischemia and anti-hypoxia effect. This is equivalent to providing more time for diagnosis and treatment of the disease, so the early use of glucocorticoids is of great significance [43]. In a sample of a surgery for head tumors, vision loss accounted for (0.7%), but nearly 70% of the patients could recover their vision through glucocorticoid treatment, and their conditions were relieved [6].

9.3. Recombinant Human Erythropoietin (rhEPO)

There are reports that in a patient who underwent lumbar surgery in the prone position, the right eye developed POVL after the operation. Three doses of rhEPO were given at 4h, 30h, and 60h after the operation, and the patient's vision recovered [73].

9.4. Anticoagulation, Antiplatelet Aggregation, Microcirculation Improvement Therapy, and Blood Transfusion Therapy

Anticoagulation therapy and antiplatelet aggregation therapy [36] are also an important treatment option, both of which are used to reduce thrombosis or to some extent dissolve thrombus to prevent or treat POVL caused by thrombosis. These two measures are generally effective. Clinically, preoperative use of tranexamic acid (TXA) for preventive treatment of POVL [74] and cases where Purtscher's retinopathy occurs after femoral fracture and receiving anticoagulation therapy (oral low molecular weight heparin and Vasonit® 400 mg bid) have achieved satisfactory results [75]. However, some literature indicates that the efficacy of antiplatelet aggregation therapy is controversial [43]. Microcirculation improvement therapy can to some extent improve the vascular network of the visual nerve pathway and increase the ability to supply blood to the ischemic area [14]. The efficacy of blood transfusion is controversial. Some literature reports that using blood transfusion during the postoperative attack as a treatment plan, its efficacy is not satisfactory [68], and even massive blood transfusion during the operation may even become a risk factor [2]. However, preoperative use of blood transfusion to correct severe anemia and appropriate blood transfusion during massive bleeding during the operation is still an indispensable treatment option.

9.5. The Clinical Significance of Early Identification and Early Intervention

Before the operation, measures should be taken to treat the possible risk factors of POVL and adopt various preventive measures to control the risk of POVL. During the perioperative period, fluid and blood management, blood pressure management, and close postoperative ophthalmic examinations are of great significance for preventing and early detection of vision loss [64, 66]. If risk factors are found during the operation, measures should be actively taken to adjust them immediately, and appropriate resuscitation measures should be used; there should be no form of ocular compression, attention should be paid to adjusting the neck posture, and attempts to avoid possible carotid vein/venous obstruction and/or accidental carotid artery compression should be avoided. Early identification and early intervention can bring a relatively good prognosis [67]. In emergency situations, raising the head from the horizontal plane by 10° can directly reduce intraocular pressure [35]. Or rotating the head to one side by 45° alternately, then the intraocular pressure of the upper eye will significantly decrease [33]. This is only one of the schemes for directly reducing intraocular pressure during the operation. During implementation, special attention should be paid to the intraocular pressure of the lower eye.

10. Conclusion

Although POVL is a rare postoperative complication, its best prognosis is TPOVL. However, in general, there are no universal prevention and treatment measures for POVL. It shows significant individual differences. Different patients have the same or different perioperative risk factors, and different treatment plans may lead to different prognoses. Clinically, special attention should be paid. Before the surgery, the known risk factors of POVL should be minimized as much as possible, and then the surgery can be performed. During and after the surgery, active preventive measures should be taken. Once POVL occurs, it should be diagnosed early, and active measures should be taken for treatment to strive for the best prognosis. In the future, with the support of more data, we may be able to develop a POVL and TPOVL prediction model based on the available data. This will be more conducive to more accurately predicting the probabilities of these two complications during the surgical perioperative period. Based on this, more precise medical measures can be taken during the perioperative period for clinical intervention to reduce their occurrence probabilities, and further assess the prognosis. This is also one of our next research directions.

Abbreviations

POVL	Perioperative Visual Loss in Non-ophthalmic Surgeries
------	---

TPOVL	Temporary Perioperative Visual Loss Associated with Non-ophthalmic Surgery
RVO	Retinal Vascular Occlusion
ION	Ischemia Optic Nerve
AION	Anterior Ischemic Optic Nerve
PION	Posterior Ischemic Optic Nerve
CB	Cortical Blindness
PRES	Posterior Reversible Encephalopathy
CRAO	Central Retinal Artery Occlusion
CPB	During Cardiopulmonary Bypass
CABG	Coronary Artery Bypass Grafting

Author Contributions

Xufeng Zhang: Formal Analysis, Writing – original draft, Writing – review & editing

XiaYu: Data curation, Formal Analysis, Validation

Funding

This work is supported by Scientific Research Fund of Heilongjiang Provincial Health Commission. China. Grant/Award Number: (Grant No.20210202040114).

Conflicts of Interest

The authors declare no conflicts of interest.

References

- [1] Raphael J, Moss HE, Roth S. Perioperative Visual Loss in Cardiac Surgery. *J Cardiothorac Vasc Anesth*. 2019, 33(5), 1420-1429. <https://doi.org/10.1053/j.jvca.2018.11.035>
- [2] Newman NJ. Perioperative visual loss after nonocular surgeries. *Am J Ophthalmol*. 2008, 145(4), 604-610. <https://doi.org/10.1016/j.ajo.2007.09.016>
- [3] Kla KM, Lee LA. Perioperative visual loss. *Best Pract Res Clin Anaesthesiol*. 2016, 30(1), 69-77. <https://doi.org/10.1016/j.bpa.2015.11.004>
- [4] Epstein NE. Perioperative visual loss following prone spinal surgery: A review. *Surg Neurol Int*. 2016, 17, 7(Suppl 13): S347-60. <https://doi.org/10.4103/2152-7806.182550>
- [5] Dereine T, van Pesch V, Van Boven M, Hantson P. Transient perioperative visual loss after an elective neurosurgical procedure. *Acta Anaesthesiol Belg*. 2013, 64(3), 109-113.
- [6] Cardinal T, Brunswick A, Strickland BA, Micko A, Shiroishi M, Liu CJ, Wrobel B, Carmichael JD, Zada G. Safety and Effectiveness of the Direct Endoscopic Endonasal Approach for Primary Sellar Pathology: A Contemporary Case Series of More Than 400 Patients. *World Neurosurg*. 2021, 148, e536-e546. <https://doi.org/10.1016/j.wneu.2021.01.018>
- [7] Zhang G, Zhang W, Chang H, Shen Y, Ma C, Mao L, Li Z, Lu H. Endovascular treatment strategy and clinical outcome of tentorial dural arteriovenous fistula. *Front Neurol*. 2024, 14, 1315813. <https://doi.org/10.3389/fneur.2023.1315813>
- [8] Bai C, Chen J, Wu X, Ding Y, Ji X, Meng R. Perioperative mannitol intensive use may avoid the early complication of cerebral venous sinus stenting. *Ann Transl Med*. 2020, 8(11), 672. <https://doi.org/10.21037/atm-20-3021>
- [9] Pandey N, Chandrakar AK, Garg ML. Perioperative visual loss with non-ocular surgery: case report and review of literature. *Indian J Ophthalmol*. 2014, 62(4), 503-505. <https://doi.org/10.4103/0301-4738.116464>
- [10] Price TP, Ivashchenko A, Schurr MJ. Perioperative visual loss after excision and autografting of a thermal burn to the back. *Burns*. 2014, 40(4), e31-34. <https://doi.org/10.1016/j.burns.2013.12.022>
- [11] Elkoundi A, Bensghir M, Meziane M, Haimeur C. Perioperative visual loss following transurethral resection surgery: not always a transurethral resection syndrome. *Can J Anaesth*. 2016, 63(11), 1295-1296. <https://doi.org/10.1007/s12630-016-0710-2>
- [12] Song HJ, Jun JH, Cha DG, Lee YS. Temporary postoperative visual loss associated with intracerebral hemorrhage after laparoscopic appendectomy: a case report. *Korean J Anesthesiol*. 2014, 67(3), 221-224. <https://doi.org/10.4097/kjae.2014.67.3.221>
- [13] Hayreh SS. Posterior ischaemic optic neuropathy: clinical features, pathogenesis, and management. *Eye (Lond)*. 2004, 18(11), 1188-1206. <https://doi.org/10.1038/sj.eye.6701562>
- [14] Yu Xia, Zhang LY, Li Yang, Zhang XF. Emergency treatment of blindness after non-ophthalmic surgery following pneumothorax surgery: A case report. *Chinese Journal of Thoracic and Cardiovascular Surgery*. [Chinese] 2023, 39(6), 372-373.
- [15] 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: 1534-1545.
- [16] Paille MT, Stockl F, Mutter TC. Postoperative vision loss and visual disturbances in a Canadian provincial administrative data repository. *Can J Anaesth*. 2025, 72(6), 923-933. English. <https://doi.org/10.1007/s12630-025-02974-8>
- [17] De la Garza-Ramos R, Samdani AF, Sponseller PD, Ain MC, Miller NR, Shaffrey CI, Sciubba DM. Visual loss after corrective surgery for pediatric scoliosis: incidence and risk factors from a nationwide database. *Spine J*. 2016, 16(4), 516-522. <https://doi.org/10.1016/j.spinee.2015.12.031>
- [18] Larrea J, Villota-Deleu E, Fernández-Vega B, Fernández-Vega Sanz Á. Late retinal and optic nerve vascular complications due to COVID-19 in young individuals. *Am J Ophthalmol Case Rep*. 2022, 25, 101327. <https://doi.org/10.1016/j.ajoc.2022.101327>
- [19] Nickels TJ, Manlapaz MR, Farag E. Perioperative visual loss after spine surgery. *World J Orthop*. 2014, 18, 5(2): 100-106. <https://doi.org/10.5312/wjo.v5.i2.100>

- [20] Rodríguez-Navarro A, Gonzalez-Valverde FM. Unilateral blindness after orthognathic surgery: hypotensive anaesthesia is not the primary cause. *Int J Oral Maxillofac Surg.* 2018, 47(1), 79-82. <https://doi.org/10.1016/j.ijom.2017.07.006>
- [21] Hayreh SS. The blood supply of the optic nerve head and the evaluation of it - myth and reality. *Prog Retin Eye Res.* 2001, 20, 563–593. [https://doi.org/10.1016/s1350-9462\(01\)00004-0](https://doi.org/10.1016/s1350-9462(01)00004-0)
- [22] Goepfert CE, Ifune C, Tempelhoff R. Ischemic optic neuropathy: are we any further? *Curr Opin Anaesthesiol.* 2010, 23, 582–587. <https://doi.org/10.1097/ACO.0b013e32833e15d0>
- [23] Biousse V, Newman NJ, Oyesiku NM. Precipitating factors in pituitary apoplexy. *J Neurol Neurosurg Psychiatry.* 2001, 71(4), 542–545. <https://doi.org/10.1136/jnnp.71.4.542>
- [24] Shmygalev S, Heller AR. Erblindung nach nichtophthalmologischen Eingriffen [Perioperative visual loss after nonocular surgery]. *Anaesthesist.* 2011, 60(7), 683-694. German. <https://doi.org/10.1007/s00101-011-1908-x>
- [25] Chwalisz B, Gilbert AL, Gittinger JW Jr. Perioperative Vision Loss after Non-Ocular Surgery. *Semin Ophthalmol.* 2018, 33(1), 17-22. <https://doi.org/10.1080/08820538.2017.1353807>
- [26] Kaeser PF, Borruat FX. Perioperative visual loss: a rare complication of general surgery. *Klin Monbl Augenheilkd.* 2008, 225(5), 517-519. <https://doi.org/10.1055/s-2008-1027348>
- [27] Kumar G, Vyakarnam P. Postoperative vision loss after colorectal laparoscopic surgery. *Surg Laparosc Endosc Percutan Tech.* 2013, 23(2), e87-88. <https://doi.org/10.1097/SLE.0b013e318277d2ae>
- [28] Kawaguchi M, Hayashi H, Kurita N, Furuya H. Postoperative visual disturbances after non-ophthalmic surgery. *Masui.* 2009, 58, 952–961.
- [29] Kirkali P, Kansu T. A case of unilateral posterior ischemic optic neuropathy after radical neck dissection. *Ann Ophthalmol.* 1990, 22(8), 297-298.
- [30] Nawa Y, Jaques JD, Miller NR, Palermo RA, Green WR. Bilateral posterior optic neuropathy after bilateral radical neck dissection and hypotension. *Graefes Arch Clin Exp Ophthalmol.* 1992, 230(4), 301-308. <https://doi.org/10.1007/BF00165935>
- [31] Reddy A, Foroozan R, Edmond JC, Hinckley LK. Dilated superior ophthalmic veins and posterior ischemic optic neuropathy after prolonged spine surgery. *J Neuroophthalmol.* 2008, 28(4), 327-328. <https://doi.org/10.1097/WNO.0b013e318175c86c>
- [32] Park B, Choi SW, Han S, Youm JY, Lim JW, Kwon HJ. Cushing Syndrome: A Potential Risk of Bilateral Postoperative Ischemic Optic Neuropathy after Lumbar Fusion. *Korean J Neurotrauma.* 2019, 15(2), 221-226. <https://doi.org/10.13004/kjnt.2019.15.e39>
- [33] Obuchowska I, Mariak Z. Tylina niedokrwienna neuropatia nerwu wzrokowego zwiazana z zabiegiem operacyjnym--patogeneza i charakterystyka kliniczna [Perioperative posterior ischemic optic neuropathy--pathogenesis and clinical characteristics]. *Klin Oczna.* 2009, 111(10-12), 375-377. Polish.
- [34] Shahriari M, Nikkhah H, Mahjoob MP, Behnaz N, Barkhordari S, Cheraqpour K. Impact of coronary artery bypass grafting surgery on the chorioretinal biomicroscopic characteristics. *World J Clin Cases.* 2023, 11(28), 6754-6762. <https://doi.org/10.12998/wjcc.v11.i28.6754>
- [35] Epstein NE. How to avoid perioperative visual loss following prone spinal surgery. *Surg Neurol Int.* 2016, 7(Suppl 13), S328-30. <https://doi.org/10.4103/2152-7806.182543>
- [36] Mulukutla RD, Yelamarthy PKK, Vadapalli R. Cortical Blindness after Cervical Spine Surgery in Supine Position - A Rare Case Report and Review of the Literature. *Asian J Neurosurg.* 2021, 16(2), 406-411. https://doi.org/10.4103/ajns.AJNS_473_20
- [37] Chokron S. La cecite corticale [Cortical blindness]. *J Fr Ophthalmol.* 2014, 37(2), 166-172. French. <https://doi.org/10.1016/j.jfo.2013.10.001>
- [38] Corecha Santos R, Gupta B, Santiago RB, et al. Endoscopic endonasal optic nerve sheath decompression (EONSD) for idiopathic intracranial hypertension: Technical details and meta-analysis. *Clin Neurol Neurosurg.* 2023, 229, 107750. <https://doi.org/10.1016/j.clineuro.2023.107750>
- [39] Li Z, Cheng L, Xu Y, Sun Q, Zhang J, Bai L, Feng T, Tan S, Wang H, Deng B, Li Q, Gui Y, Chen H. Optic Nerve Sheath Fenestration for Progressive Visual Loss in Cerebral Venous Sinus Thrombosis: A Long-Term Retrospective Observational Study. *Neurol Ther.* 2023, 12(2), 441-457. <https://doi.org/10.1007/s40120-022-00434-9>
- [40] Pereira E A, Plaha P, Chari A, Paranathala M, Haslam N, Rogers A, Korevaar T, Tran D, Olarinde R, Karavitaki N, Grossman AB, Cudlip SA. Transsphenoidal pituitary surgery in the elderly is safe and effective. *Br J Neurosurg.* 2014,(5), 616-621. <https://doi.org/10.3109/02688697.2013.872225>
- [41] Agam MS, Wedemeyer MA, Wrobel B, Weiss MH, Carmichael JD, Zada G. Complications associated with microscopic and endoscopic transsphenoidal pituitary surgery: experience of 1153 consecutive cases treated at a single tertiary care pituitary center. *J Neurosurg.* 2018, 130(5), 1576-1583. <https://doi.org/10.3171/2017.12.JNS172318>
- [42] Roth S. Perioperative visual loss: what do we know, what can we do? *Br J Anaesth.* 2009, 103 Suppl 1(Suppl 1): i31-40. <https://doi.org/10.1093/bja/aep295>
- [43] Allashem HM, Sward DG, Sethuraman K, Matthews MK. Hyperbaric oxygen therapy for perioperative posterior ischemic optic neuropathy: a case report. *Undersea Hyperb Med.* 2019, 46(5), 701-707.
- [44] Roth S, Moss HE. Update on Perioperative Ischemic Optic Neuropathy Associated With Non-ophthalmic Surgery. *Front Neurol.* 2018, 9, 557. <https://doi.org/10.3389/fneur.2018.00557>

- [45] Kalyani SD, Miller NR, Dong LM, Baumgartner WA, Alejo DE, Gilbert TB. Incidence of and risk factors for perioperative optic neuropathy after cardiac surgery. *Ann Thorac Surg*. 2004; 78(1), 34-37. <https://doi.org/10.1016/j.athoracsur.2004.02.015>
- [46] Biouesse V, Newman NJ: Ischemic Optic Neuropathies. *N Engl J Med*. 2015, 372, 2428-2436.
- [47] Biouesse V, Nahab F, Newman NJ: Management of Acute Retinal Ischemia: Follow the Guidelines! *Ophthalmology*. 2018, 125, 1597-1607.
- [48] Shah SH, Xiao L, Chen YF, Moss HE, Rubin DS, Roth S. Perioperative Ischemic Optic Neuropathy after Cardiac Surgery: Development and Validation of a Preoperative Risk Prediction Model. *J Cardiothorac Vasc Anesth*. 2022, 36(12), 4266-4272. <https://doi.org/10.1053/j.jvca.2022.08.005>
- [49] Moster ML. Visual loss after coronary artery bypass surgery. *Surv Ophthalmol*. 1998, 42(5), 453-457. [https://doi.org/10.1016/s0039-6257\(97\)00137-9](https://doi.org/10.1016/s0039-6257(97)00137-9)
- [50] Tiskaoğlu NS, Yazıcı A, Ercan A, Tınç K. The effect of off-pump coronary bypass graft surgery on subfoveal choroidal thickness, ganglion cell complex, and retinal nerve fiber layer thickness. *Ther Adv Ophthalmol*. 2023, 15, 25158414231204106. <https://doi.org/10.1177/25158414231204106>
- [51] Blauth C, Arnold J, Kohner EM, et al.: Retinal microembolism during cardiopulmonary bypass demonstrated by fluorescein angiography. *Lancet*. 1986, 837-839.
- [52] Blauth CI, Smith PL, Arnold JV, et al.: Influence of oxygenator type on the prevalence and extent of microembolic retinal ischemia during cardiopulmonary bypass. Assessment by digital image analysis. *J Thoracic Cardiovasc Surg*. 1990, 99, 61-69.
- [53] Janarek G, Colecha JR. Visual loss after hip and shoulder arthroplasty, two case reports. *Rev Esp Anesthesiol Reanim*. 2015, 62(5), 285-288. <https://doi.org/10.1016/j.redar.2014.07.009>
- [54] Rubin DS, Parakati I, Lee LA, Moss HE, Joslin CE, Roth S. Perioperative Visual Loss in Spine Fusion Surgery: Ischemic Optic Neuropathy in the United States from 1998 to 2012 in the Nationwide Inpatient Sample. *Anesthesiology*. 2016, 125(3), 457-464. <https://doi.org/10.1097/ALN.0000000000001211>
- [55] Nathan ST, Jain V, Lykissas MG, Crawford AH, West CE. Transient cortical blindness as a complication of posterior spinal surgery in a pediatric patient. *J Pediatr Orthop B*. 2013, 22(5): 416-419. <https://doi.org/10.1097/BPB.0b013e32835ec658>
- [56] Galetta MS, Fang T, Goyal DKC, Divi SN, Schroeder GD, Kepler CK, Vaccaro AR. Fellow Versus Resident: Graduate Medical Education and Patient Outcomes After Anterior Cervical Discectomy and Fusion Surgery. *J Am Acad Orthop Surg*. 2020, 28(9), e401-e407. <https://doi.org/10.5435/JAAOS-D-18-00645>
- [57] Emery SE, Daffner SD, France JC, Ellison M, Grose BW, Hobbs GR, Clovis NB. Effect of Head Position on Intraocular Pressure During Lumbar Spine Fusion: A Randomized, Prospective Study. *J Bone Joint Surg Am*. 2015, 97(22), 1817-1823. <https://doi.org/10.2106/JBJS.O.00091>
- [58] Nuzzi R, Tridico F. Ocular Complications in Laparoscopic Surgery: Review of Existing Literature and Possible Prevention and Treatment. *Semin Ophthalmol*. 2016, 31(6), 584-592. <https://doi.org/10.3109/08820538.2015.1009557>
- [59] Agarwal N, Hansberry DR, Goldstein IM. Cortical blindness following posterior lumbar decompression and fusion. *J Clin Neurosci*. 2014, 21(1), 155-159. <https://doi.org/10.1016/j.jocn.2012.12.019>
- [60] Delmotte C, Depeyre A, Barthelemy I, Ferri J. Postoperative Visual Loss: A Report of One Patient With Unilateral Blindness After Orthognathic Surgery. *J Craniofac Surg*. 2019, 30(1), 223-225. <https://doi.org/10.1097/SCS.00000000000005151>
- [61] Parizek T, Skulec R, Liehneova I, Prasek P, Cerny V. No significant retinal damage induced by major orthopedic surgery - a pilot study. *Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub*. 2022, 166(2), 217-221. <https://doi.org/10.5507/bp.2021.022>
- [62] Obuchowska I, Mariak Z. Neuropatia niedokrwienna nerwu wzrokowego. Patogeneza, obraz kliniczny, diagnostyka i leczenie [Ischemic optic neuropathy. Pathogenesis, clinical features, diagnostics and treatment]. *Klin Oczna*. 2006, 108(4-6), 238-242.
- [63] Stoffelns BM. Sehschärfenminderung und Gesichtsfeldausfall nach Leistenhernien-Operation [Decreased visual acuity and loss of field of vision after inguinal hernia surgery]. *Ophthalmologe*. 2009, 106(5), 448-451. German. <https://doi.org/10.1007/s00347-008-1874-0>
- [64] Krasnikova A, Kreutzer K, Angermair S, Heiland M, Koerdts S. Blindness following bilateral neck dissection. A case report and review of the literature. *Int J Surg Case Rep*. 2020, 77, 201-205. <https://doi.org/10.1016/j.ijscr.2020.10.138>
- [65] Aydin O, Memisoglu I, Ozturk M, Altintas O. Anterior ischemic optic neuropathy after unilateral radical neck dissection: case report and review. *Auris Nasus Larynx*. 2008, 35(2), 308-312. <https://doi.org/10.1016/j.anl.2007.08.008>
- [66] Obuchowska I, Mariak Z, Budrowski R. Tylina niedokrwienna neuropatia nerwu wzrokowego jako powikłanie obustronnej radykalnej operacji usunięcia węzłów chłonnych szyi [Posterior ischemic optic neuropathy following bilateral radical dissection of cervical lymph nodes]. *Klin Oczna*. 2010, 112(1-3), 63-66.
- [67] Gazzah W, Masmoudi S, Chakroun H, Lahouar R, Zaidi B, Khalifa BB, Naouar S, Salem B. Sudden transient blindness following ureteroscopy: an uncommon complication of a common procedure (a case report). *Pan Afr Med J*. 2024, 47, 201. <https://doi.org/10.11604/pamj.2024.47.201.42952>
- [68] Sadaba LM, Garcia-Layana A, Maldonado MJ, Berian JM. Bilateral ischemic optic neuropathy after transurethral prostatic resection: a case report. *BMC Ophthalmol*. 2006, 6, 32. <https://doi.org/10.1186/1471-2415-6-32>

- [69] Neto AR, Mendonça FT, de Aviz MAB, Novas RGM, Freitas RDNB. Stroke with postoperative visual loss as the first clinical manifestation of antiphospholipid antibody syndrome: Case report. *Int J Surg Case Rep.* 2023, 106, 108231. <https://doi.org/10.1016/j.ijscr.2023.108231>
- [70] Bojinova RI, Konieczka K, Meyer P, Todorova MG. The trilateral link between anaesthesia, perioperative visual loss and Flammer syndrome. *BMC Anesthesiol.* 2016, 16, 10. Published 2016 Feb 4. <https://doi.org/10.1186/s12871-016-0176-3>
- [71] Elwood KF, Wong RW. Paracentral acute middle maculopathy after preworkout havok ingestion. *Retin Cases Brief Rep.* 2018 Mar 8. <https://doi.org/10.1097/ICB.0000000000000739>
- [72] Hayreh SS: Blood supply of the optic nerve head: A “reality check”, in Pillunat LE, Harris A, Anderson DR, et al. (eds): Current concepts in ocular blood flow in glaucoma. The Hague, Netherlands, Kugler, 1999, pp. 3–31.
- [73] Hassani V, Homaei MM, Shahbazi A, Zamani MM, Safari S, Nadi S, Rahimizadeh A, Lashkari MH, Alizadeh Zendeirood S. Human erythropoietin effect in postoperative visual loss following spine surgery: a case report. *Anesth Pain Med.* 2014, 4(2), e7291. <https://doi.org/10.5812/aapm.7291>
- [74] Liu YF, Hong CK, Hsu KL, Kuan FC, Chen Y, Yeh ML, Su WR. Intravenous Administration of Tranexamic Acid Significantly Improved Clarity of the Visual Field in Arthroscopic Shoulder Surgery. A Prospective, Double-Blind, and Randomized Controlled Trial. *Arthroscopy.* 2020, 36(3), 640-647.
- [75] Ortmaier R, Resch H, Stieböck C, Stundner O, Arlt EM. Purtscher's retinopathy after intramedullary nailing of a femoral shaft fracture in a 20-year old healthy female - report of a rare case and review of the literature. *BMC Musculoskeletal Disord.* 2014, 15, 42. <https://doi.org/10.1186/1471-2474-15-42>

Biography



Xuefeng Zhang, a associate chief physician in thoracic surgery, is currently working at the Department of Thoracic Surgery, General Hospital of Heilongjiang Forest Industry Group. In 2008, he obtained a Doctor of Medicine degree in cardiothoracic surgery from Harbin Medical University (Harbin, China). Currently, he mainly works as a clinical physician in thoracic surgery while also engaging in research work. His main research direction is to discover, identify, and study the pharmacological effects of chemical substances related to the immune system. He is also seeking new drugs that can adjust the body's immune system.

Research Field

Xuefeng Zhang: Complications of thoracic surgery, Extraction of active ingredients from herbal medicines, Immunopharmacology, tumor pharmacology.

XiaYu: Perioperative Nursing in Thoracic Surgery, Pharmacology of Chinese Herbal Medicine.