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Ophthalmic Anesthesia: Practice-Based Perspectives

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ABSTRACT

Anesthesia in ophthalmic surgery has a unique set of challenges since it applies to patients in the extremes of age; either those who are extremely young or old. Each age group that is subjected to ophthalmic surgery has its own unique set of problems and necessities. This paper reviews the preoperative preparations of the patient, the selection of the proper technique, the most suitable technique for different patients, and the complications that can take place and how to safeguard against them. Contents of this paper are based on my personal point of view based on years of experience in the field, and backed by international literature on the topic.

Keywords: Ophthalmic Anesthesia, Geriatric Patients, Infants

A great challenge in ophthalmic anesthesia is that we are confronted with extremes of age, either too young or too old. Patients belonging to either age group both need special care and handling during anesthesia and surgery. Hypertension (HTN), diabetes, Ischemic heart disease, congenital heart failure are among the challenges that accompany geriatric patients. The good news is that local anesthesia, which is associated with less risk, is probably suitable for such patients after proper screening and investigations. However, the specific case of Parkinson's geriatric patients requires high-risk general anesthesia to control tremors. Pediatric patients on the other hand come with another set of risks, including congenital abnormalities, a challenging airway and intravenous (IV) line insertion, the child's separation from parents, and of course the necessity of general anesthesia.

Anesthesia clinic
During the old days, we used to see the patient for the first time in the operating room (OR). During a busy list of operations, such a first interaction allowed for missing several important questions and details about the patient's history. Among the most important issues is *nil per os* (NPO), as post-operative vomiting can harm the patient and the surgery they just underwent. It is not

uncommon for patients that fear that their surgery will be postponed to give inaccurate information about their fasting hours, aspirin intake, anti-hypertensive or anti-diabetic medications consumed. A patient that is in the or after greeting relatives, leaving behind all belongings, and wearing a special gown in preparation for the operation is certainly in a different mood if compared to their mood in a more regular setting. I usually say that patients in the OR are in a similar state to that of someone who goes to the police station after a car accident, and that medical practitioners, should always take this state of mind into consideration. Nowadays, we meet the patients in a more normalized setting: the clinic. During the clinic visit, we discuss previous surgeries, medications that are taken by the patient, medications they will need to stop or continue taking, fasting hours, etc., when taking their medical history. Anti-hypertensive medications are usually continued until the day of the surgery, and taken with a sip of water. Oral hypoglycemic drugs are stopped before the surgery and continued after resuming the oral intake. Anti-coagulants carry a more significant challenge. Patients receiving oral anti-coagulants for atrial fibrillation (AF) for example should stop it for three to five days, allowing the prothrombin time to fall within 20% of the normal value. Clexan, instead (40 units) should be given and will be stopped 4-6 hours before the surgery. Oral anti-coagulant resumed the next day after surgery. Aspirin and Plavix are stopped at least five days prior to the surgery. These medications affect the platelet function at a rate of approximately 10% a day. Accordingly, stopping them for five days prior to the surgery should allow platelets to regain 50% of their function, which is enough to give acceptable coagulation functions. While heart and chest examinations usually receive

the most attention, practitioners should also pay attention to the patient's ability to lie on their back for the surgery's duration. In the case of patients who are not certain about their ability to lie flat on their back for the surgery's duration, it is advised to leave them lying flat on their back for half an hour while examining other patients. During the clinic, patients should also be educated about the procedure they will undergo, the drops they will take, and that they will receive oxygen through a nasal catheter. Moreover, investigations should also give you insight into the metabolic state of your patient. Over investigation is not recommended. However, in the case of pediatric patients, only a complete blood count (CBC) is recommended, unless the patient is known to have diabetes mellitus (DM) or other systemic diseases. For adults who are not known to be diabetic or hypertensive, a CBC is enough. For adults who are known to be diabetic, cardiac, hypertensive, hypothyroid, etc., a full set of blood sugar, kidney function, liver function, thyroid function, electro-cardiogram (ECG), and even echo-cardiograph are needed to accurately assess the condition of the patient.

The cardiac patient
The cardiac patient coming in for a surgery poses many more challenges to the practitioner; many investigations, pre-operative screenings procedures, and may be cardiac interventions were requested for this category of patients. Due to the current tough economic situation and to reduce inappropriate testing, we should direct such intensive testing and investigations to cases in which the perioperative management will be changed based on the results of these investigations only. The most important clinical risk factors in these patients are congestive heart failure (CHF), and coronary

artery disease[1]. The presence of CHF preoperatively is associated with the highest perioperative risk. Various diagnostic schemes have been used to clinically define CHF. The Boston criteria rely on three categories: history, physical examination, and chest X-Ray. Major clinical factors are heart rate and cardiomegaly, while minor criteria and decreased vital capacity. Dysrhythmias are important component of the disease process and its associated mortality. CHF patients who are not ischemic easily develop CHF attack postoperatively but not infractions, while those who have ischemic cardiomyopathy are at a high risk of postoperative infection. Optimization of the cardiac state before surgery, control of blood pressure, and coronary circulation, limitation of water and salt intake before, during and after surgery, and most importantly communication between the anesthetist and the physician or cardiologist to make the plan foe intra-operative and postoperative care.

Coronary artery diseases

The time period since a prior myocardial infarction (MI)[2] has traditionally been an important predictor of peri-operative risk. The more recent the occurrence (3-6 months), the greater the risk. However, advances in the management of acute MI[3] make the older data less valid. American heart association (AHA) guidelines advocate the use of 30 days as the acute period, with high risk continuing for up to six to eight weeks[4]. After that period, the patient is of moderate risk, and further evaluation depends on clinical symptoms. The presence of unstable angina carries the risk of up to 28% for development of postoperative MI. Such patients will benefit from delaying the surgery and more intensive treatment. Exercise tolerance is a good method of assessing risk. Patients who develop chest pain with minimal exercise and have associated shortness of breath are at high risk. In contrast, those who can tolerate moderate exercise and going up stairs for example are at much lower risk. DM patients carry the risk of developing silent ischemia and silent MI due to the presence of autonomic neuropathy.

Hypertension

HTN is the most prevalent of all the forms of cardiovascular diseases. It is an important marker in both CHF and ischemic heart disease (IHD). HTN results in increased vascular resistance, decreased intravascular volume, exaggerated pressure response and edema. Most HTN is essential, however, in certain patients, as indicated by history and investigations, a treatable cause can be discovered (Ex: renal artery stenosis). Blood pressure reading should be obtained using a proper sized cuff (covering 2/3 of the arm), and with the patient in a relaxed setting. For patients who are older than 18 years of age, HTN is defined as blood pressure that is higher than 140/90. Uncontrolled HTN will exert pressure on the left ventricle, which will lead to left ventricular hypertrophy and ischemia and will increase the risk of postoperative MI[3].

Diabetes mellitus

Diabetic patients have an increased incidence of cardiovascular disease, HTN, atherosclerosis, renal disease, and vascular diseases. In addition, they have a greater risk of MI. Uncontrolled diabetes will also carry the risk of wound infection, delayed wound healing and pneumonia. Autonomic neuropathy will put them at the risk of having silent ischemia. Blood sugar should be controlled preoperatively and delaying control of blood sugar is not recommended to

avoid complications. In order to stop the oral hypoglycemic, blood sugar should be measured and NPO should be kept on the day of the surgery. If blood sugar is lower than 70mg%, dextrose 5% should be administered at a rate of 150ml / hour. Proper hydration is important for these patients, with ringer solution, especially during lengthy operations. Postoperatively, the patient should resume oral feeding as soon as possible, and resume taking their oral hypoglycemic medication. In the case of patients on insulin, it is preferred to schedule the operation early in the day, and to postpone the morning insulin dose until after the surgery. If this is not possible, it is preferred to administer insulin infusion of 1-2u/hour, mixed with dextrose 5% at a rate of 100ml/ hour by adding 10-20 units to a 500ml bottle of dextrose 5% and running it at a rate of 100ml/ hour. Frequent measurement of blood sugar is important to adjust the infusion rate. The usual regimen is restored after the operation.

The pediatric patient

These patients should be operated early on the day to avoid lengthy fasting hours; four hours of NPO is enough for the pediatric patient. IV insertion will make it easy for the anesthetist during the whole procedure. Eutectic mixture of local anesthetics (EMLA) cream sometimes makes the needle pricks painful, but most of the children do not accept the principle of having a needle and the alternative will be inhalation induction of the anesthesia. This procedure goes smoothly if the child accepts it, which is especially the case with flavored masks. I usually prefer inserting a cannula over the struggle of inhalation induction because the needle prick is what remains in the child's memory, rather than the unforgettable experience of the struggle faced during inhalation induction.

Proper hydration is important during surgery to safeguard against dehydration. Post-operative nausea and vomiting is common among the pediatric age group. The administration of Atropine 0.2-0.4mg IV, especially in squint operations, is a must in my opinion. Bradycardia is very common during traction on the eye muscles in squint and retinal detachment surgery. I usually prefer to give Atropine to prevent the occurrence of bradycardia, rather than treating it.

Local anesthesia

Retrobulbar, peribulbar, subtenon, topical and intracameral anesthesia are the most used techniques for ophthalmology, using bupivacaine, lidocaine, ropivacaine, or mixtures of local anesthetics, with or without additives, to speed the onset and increase the potency of the block. Perforation of the globe, injury to extra ocular muscles, ptosis, hemorrhage, increased intra-ocular pressure or failure of the block are among the complications that can occur. In our institute, we have a wide range of practices of peribulbar. Retrobulbar block carries a much higher risk of injury to the globe, and extra-orbital vital tissues like the optic nerve and the dural sheath, and most of the anesthetists avoid it. The sub-tenon block procedure needs special instruments, and is time consuming. This is why it is not popular in our institute. Peribulbar block is rather the most popular technique and that is why I still try to focus on the complications that can occur while undergoing this block. Complications maybe local or may manifest systemically and may arise immediately, or may be delayed. Complications are related to the method of administration, the local anesthetic drug, or the adjuvant used. Ecchymosis may occur after needle block. Peribulbar block is associated with frequent

chemosis and sub-conjunctival hemorrhage than retrobulbar block, due to anterior spread of the local anesthetic and the damage of minor blood vessels with the needle tip. These minor complications do not interfere with surgery and resolve spontaneously within a few hours. Lid hemorrhage is another minor complication of needle bock and has been estimated to occur in 4% of patients[5]. Retrobulbar Hemorrhage is a serious complication of both retro and peribulbar blocks, which occurs after bleeding behind the globe. The hemorrhage may be either venous or arterial in origin, and maybe concealed or revealed. Spread of the blood into the peri-orbital tissues increases the tissue volume and pressure. The incidence is about 0.4% with peribulbar block and 0.7% with the retrobulbar technique[6]. Blindness from retrobulbar hemorrhage has been reported, but most patients have a good visual outcome[7]. Venous hemorrhage due to the perforation of a vein is slow in onset and usually presents as markedly blood stained chemosis and raised intraocular pressure. It is possible to reduce the intraocular pressure by the intermittent application of digital pressure with a gauze pad over the closed lids. Before the decision is made to proceed or postpone the surgery for a few days, it is advisable to measure the intra-ocular pressure[8]. Arterial hemorrhage due to perforation of artery occurs quickly and is more difficult to control. Firm digital pressure usually stops the bleeding. Considerations must then be taken to reduce the intra-ocular pressure so that blood supply to the retina is not compromised. Lateral canthotomy, intravenous acetazolamide, intravenous mannitol or even paracentesis need to be considered[9].

Globe damage

Damage to the globe is a rare, but serious complication that is reported following both peribulbar and retobulbar block[10], and even following other forms of local anesthesia for minor procedures such as eye lid surgery. Globe perforation refers to double puncture wounds (around entry and exit), whereas globe penetration only results in a wound of entry. The incidence of complication varies from 0-0.1%[6]. Patients with axial length of 26 mm are more prone to globe perforation[11]. Posterior staphyloma (out pouching of the globe) that can be associated with myopia, increases the risk of perforation. A single medial peribulbar technique is recommended in these patients[12]. A non-needle technique such as topical or sub-tenon may be also be a safer alternative in these patients. Other risk factors for globe perforation include: enophthalmos, repeated injections, uncooperative patient, previous scleral buckling, lack of knowledge of orbital anatomy, and patients who have undergone previous retinal detachment surgery or corneal refractive surgery[13]. Signs and symptoms of perforation include intense ocular pain, sudden loss of vision, and hypotony. Interestingly, about 50% of patients in one study had no immediate symptoms and signs of perforation[11]. In such cases, the surgeon should be informed, and ultra-sound is performed to assess the damage, cancelation of the surgery and referral to a retinal surgeon is strongly recommended. Long-term visual acuity is usually poor[14]. Retinal detachment occurring as a complication of globe perforation is of poor visual outcome[11]. Ocular explosion or rupture of the globe is another potential complication of globe penetration. It is caused by the injection of the local anesthetic agent into the globe. Experimental evidence shows that the globe will rupture if less than

2mm is injected into it[15]. Negative aspiration should always be done before injection, inspection of aspirate or blood should always be considered to quit the technique. It is also recommended to discontinue the block if corneal edema or resistance to the injection occurs. Damage to extra-ocular muscles from orbital blocks can result in strabismus (causing diplopia, ptosis and entropion). However, not all cases of extra-ocular eye muscle problems are caused by orbital block. Diplopia can happen due to the unmasking of a pre-existing condition after cataract extraction[16]. Possible mechanisms of extra-ocular eye muscle damage include direct needle trauma, ischemic pressure necrosis, caused by a large volume of local anesthetic, direct myotoxic effects of the local anesthetic and use of high concentration of lidocaine[17]. Transient strabismus on the first postoperative day is common after eye surgery. The most common injured muscle is the inferior rectus. Injection in the extreme infra-temporal quadrant just above the orbital rim and directly below the lateral canthus is safer than the traditional insertion point and is less likely to strike the orbital floor and the anterior aspect of the inferior rectus muscle[18]. Ptosis is common on the first postoperative day. It occurs in 50% of eye operations[19]. Ptosis resolves in 95% of patients by the 4th postoperative day and in 99% of patients within 5 weeks. It is associated with the use of large volumes of anesthetic[20]. Surgical causes of ptosis include the use of superior rectus bridle stitch, or the application of lid speculum[19].

Central spread of anesthetic agent Central spread of local anesthetic agent has been described[21]. The cerebral dura mater provides a tubular sheath for the optic nerve, it provides a potential conduct for the local anesthetic to pass to the brain. The spread can also happen if an orbital artery is cannulated by the needle tip. Immediate seizures would result and cardiovascular instability is possible in such cases. To reduce the risk of this complication, one should always aspirate before injecting the local anesthetic. The time of onset is variable, but major sequelae usually develop in the first 15 minutes. A range of different signs and symptoms has been described involving the cardiovascular and respiratory systems, such as vomiting, temporary hemiplegia, aphasia, and general convulsions. Palsy of the contralateral oculomotor and trochlear nerves with amaurosis is characteristic of central nervous system spread. Treatment consists of respiratory cardiac support; bay and mask ventilation is required. The block should always be made with the patients looking straight ahead in primary gaze position. The injection should not be made too deeply into the orbit and aspiration should be done before injection to avoid the complication.

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