

ESCALATION OF ANESTHESIA IN VITRECTOMY FOR CHRONIC KIDNEY DISEASE PATIENTS: FROM PERIBULBAR BLOCK TO GENERAL ANESTHESIA

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ABSTRACT

Patients with Stage V Chronic Kidney Disease (CKD) face a significantly higher risk of ocular pathologies, notably Tractional Retinal Detachment (TRD) resulting from proliferative diabetic retinopathy. Anesthetic management for these patients is complex due to impaired drug clearance, cardiovascular comorbidities (CHF, HHD), and the necessity for absolute ocular immobility during vitreoretinal surgery. Regional anesthesia is typically preferred to minimize systemic complications, though technical escalation may be required. A 43-year-old male with Stage V CKD on regular hemodialysis, CHF (FC II), and Type II Diabetes Mellitus was scheduled for a left eye vitrectomy. An initial peribulbar block (8 mL Lidocaine 2% and Bupivacaine 0.5%) resulted in partial akinesia (score 4/8). A rescue Sub-Tenon block successfully achieved total akinesia (score 0/8). However, intraoperative agitation necessitated propofol sedation, which led to oversedation and airway obstruction. Due to limited airway access during the procedure, the technique was escalated to general anesthesia. Induction utilized dose-adjusted fentanyl (75 mcg), propofol (100 mg), and atracurium (30 mg) to ensure renal-independent metabolism. The surgery proceeded with stable hemodynamics. A "deep" extubation was performed to prevent Valsalva-induced increases in intraocular pressure. The patient recovered well with an initial Aldrete score of 8/10. Peribulbar blocks are safer for uremic patients but success is volume-dependent and failure may require rescue techniques like Sub-Tenon blocks. When regional techniques and sedation fail or compromise the airway, conversion to general anesthesia is a necessary last resort. In CKD, the choice of agents and careful dose titration of opioids are critical to prevent prolonged respiratory depression and neuromuscular blockade. While regional anesthesia is the primary choice for fragile CKD patients, clinicians must remain prepared for technical escalation. Success in such cases depends on the timely conversion to general anesthesia using renal-independent agents and smooth emergence techniques to protect surgical outcomes.

Keywords: Chronic Kidney Disease, General Anesthesia Conversion, Peribulbar Block, Vitrectomy.

INTRODUCTION

Chronic Kidney Disease (CKD) and retinopathy, particularly Diabetic Retinopathy (DR), are two primary microvascular complications

that are closely interrelated through similar pathophysiological mechanisms. In Stage V CKD patients undergoing routine hemodialysis,

the ocular disease burden is significantly higher compared to the general population. (Su et al., 2018) According to longitudinal studies of large populations, patients with CKD have a 1.73 higher probability of developing various types of ocular pathologies. Furthermore, the risk of retinal complications shows a significant increase of 1.86. (Gong et al., 2021)

The most severe ocular manifestation in this population is Proliferative Diabetic Retinopathy (PDR). (Li et al., 2022) It is estimated that approximately 25% of diabetes-related vision loss is caused by PDR complications, where the condition can progress into advanced pathologies such as Tractional Retinal Detachment (TRD). Recent data indicates that the prevalence of posterior segment abnormalities in CKD patients reaches 72.09%, with PDR being a major contributor. Although the specific incidence of TRD was reported at approximately 2.33% in a hospital-based cross-sectional study, TRD remains the most common indication for vitreoretinal surgery in patients with PDR. (Gong et al., 2021)

The association between declining renal function and the severity of ocular disease is linear; a decrease in the Estimated Glomerular Filtration Rate (eGFR) consistently correlates with increased retinopathy severity. CKD patients tend to present with more severe ischemic retinal conditions, persistent macular edema, and a higher risk of intraoperative bleeding during vitrectomy. (Saran et al., 2025). The most critical pharmacological issue is impaired drug clearance. In CKD patients, renal elimination of anesthetic agents and their active metabolites is drastically reduced. Morphine metabolites (morphine-6-glucuronide) and aminosteroid

neuromuscular blocking agents (such as rocuronium) undergo accumulation, which can lead to prolonged respiratory depression or residual postoperative neuromuscular blockade. (Klimas & Mikus, 2014) The accumulation of these drugs increases the risk of pulmonary complications and extends recovery time in the Post-Anesthesia Care Unit (PACU). Therefore, comprehensive perioperative management, including the selection of regional anesthesia techniques such as the peribulbar block, is crucial to minimize systemic risks in these fragile patients. (Anker & Kaur, 2017; Davis & Mandel, 1994).

LITERATURE REVIEW

Conversion to general anesthesia remains the last resort if the integrity of the eyeball is threatened by patient movement. In Stage V CKD patients, airway management requires meticulous care regarding the selection of induction and maintenance agents. (Ackland & Laing, 2014) The dosage of induction agents must be reduced in critically ill patients or those who have recently undergone hemodialysis and remain in a state of relative hypovolemia. Propofol (1 to 2 mg/kg) may be utilized. Most opioids (fentanyl, sufentanil, and alfentanil) are inactivated by the liver; some of these metabolites are subsequently excreted in the urine. The pharmacokinetics of remifentanyl are unaffected by renal function due to rapid ester hydrolysis in the blood. (Dr P Dzanibe, 2025) With the exception of morphine and meperidine, the accumulation of metabolites—namely morphine-6-glucuronide and normeperidine—can prolong respiratory depression in patients

with renal failure. (Klimas & Mikus, 2014)

RESEARCH METHODS

CASE ILLUSTRATION

A 43-year-old male presented with Proliferative Diabetic Retinopathy and Tractional Retinal Detachment, scheduled for a vitrectomy. The patient's medical history included Type II Diabetes Mellitus, controlled with insulin since 2020, and Stage V Chronic Kidney Disease (CKD) on routine hemodialysis three times weekly (Monday, Wednesday, and Friday) since 2023. His last dialysis session was performed one day prior to admission. He also had a history of hypertension and Congestive Heart Failure (CHF) Functional Class II, managed with Valsartan 160 mg, Adalat Oros 30 mg, and Carvedilol 6.25 mg orally every 24 hours. The patient is a police officer who remains capable of moderate physical activity without complaints of dyspnea or chest pain. During the clinical interview, the patient was cooperative with a relatively low level of anxiety.

Physical examination revealed a body weight of 79 kg, height of 171 cm (BMI 27.33 kg/m²), and an axillary temperature of 36.8°C. Pain assessment showed an NRS of 0/10 at rest and during movement. The APFEL score was 2/4, and the functional capacity was estimated at 5-6 METs. Respiratory rate was 16 breaths per minute with vesicular breath sounds in both lung; no rhonchi or wheezing were detected, and peripheral oxygen saturation was 97% on room air. Blood pressure was 150/90 mmHg with a heart rate of 76 beats per minute; S1 and S2 heart sounds were single and regular, with no murmurs or gallops.

The abdomen was supple with normal bowel sounds and no distention. Spontaneous urination was present but with a relatively low volume. Airway assessment showed adequate neck flexion and extension, Mallampati Class III, incomplete dentition without dentures or loose teeth. Extremities were warm, CRT was < 2 seconds, and no pedal edema was observed.

Routine laboratory results showed WBC 9.55 x 10³/μL, Hb 11.5 g/dL, HCT 35.2%, and PLT 182 x 10³/μL. Coagulation profiles were within normal limits. Other findings included blood glucose (GDS) 209 mg/dL, SGOT 15 U/L, SGPT 11 U/L, BUN 53.8 mg/dL, and Creatinine 8.79 mg/dL, with a calculated creatinine clearance (CCT) of 5 mL/min. Radiological examination via PA chest X-ray revealed cardiomegaly (CTR 56%) with no pulmonary abnormalities. Echocardiography demonstrated LA dilatation, LV mixed hypertrophy, and a reduced LV systolic function (EF Teich 43%). LV diastolic function was decreased to Grade III. RV contractility was noted with a TAPSE of 2.0 cm. Regional wall motion abnormalities included hypokinesia in the basal-mid inferolateral and inferior segments, and mild mitral regurgitation (eRAP 4 mmHg). The Electrocardiogram (ECG) showed a normal sinus rhythm at 77 beats per minute, with a normal axis and no ST-T segment abnormalities. The patient was classified as PS ASA III, with the following active clinical issues: Cardiovascular: CHF FC II, Hypertensive Heart Disease (HHD), controlled Hypertension, and Cardiomegaly. Urogenital: Stage V CKD on regular hemodialysis. Endocrine: Type II Diabetes Mellitus on insulin (uncontrolled).

DISCUSSION

Peribulbar block techniques in CKD patients, systemic absorption of local anesthetics is minimal, resulting in a low risk of systemic drug accumulation and hemodynamic instability, spontaneous breathing and independent airway protection are maintained, leading to faster post-anesthesia recovery and a lower risk of postoperative pulmonary complications in uremic patients, making the peribulbar block a safer anesthetic choice. (Rizki Indrayani et al., 2024)

The success of a peribulbar block is highly dependent on the volume of local anesthetic injected into the extraconal space. Unlike the retrobulbar block, which requires a smaller volume due to direct drug deposition within the intraconal space, the peribulbar block relies on the physical diffusion of the drug from outside into the muscle cone to achieve akinesia of cranial nerves III, IV, and VI. (Gao et al., 2020) The average volume required to achieve adequate sensory and motor blockade in adults ranges from 6 to 10 mL. This volume is typically divided between two injection sites—inferotemporal and medial canthus—to ensure even distribution of the drug throughout the periorbital space. (Snoeck, 2013) The administered volume must be adjusted based on the monitoring of eyelid tension (a sensation of 'fullness' or resistance during injection) and orbital filling (the occurrence of mild proptosis and conjunctival chemosis, which serve as indicators that the volume is sufficient to fill the periorbital space). Rapid administration of high volumes (>10 mL) can significantly increase intraocular pressure (IOP). (Edge & Davist, 1995) Therefore, the use of external ocular compression (such as a Honan

Balloon) following the injection is highly recommended to reduce IOP and facilitate drug diffusion. (Kılıç et al., 2024)

In this case, a peribulbar block was performed on the left eye prior to the vitrectomy after obtaining informed consent. The patient was instructed to remain calm and cooperative during the procedure. Premedication was administered with 1 mg of Midazolam intravenously (IV) slowly, and two drops of Pantocaine were applied to the left eye, followed by aseptic technique and draping of the injection site. Once the onset of Pantocaine was achieved, a local anesthetic mixture of 2% Lidocaine and 0.5% plain Bupivacaine (at a 1:1 ratio) was injected. Specifically, 4 mL was administered at the inferotemporal site of the left eye, and another 4 mL was injected at the medial canthus. Subsequently, external ocular compression was applied using a Honan Balloon Pressure device at 30 mmHg for 10 minutes.

Peribulbar block failure is often partial, characterized by persistent mobility in one of the rectus muscles or the patient's perception of pain during conjunctival manipulation. Evaluation should be performed after 8-10 minutes (The 10-Minute Rule). Akinesia is assessed using a motor blockade score (0-8), where a score of 0 indicates total akinesia of the four rectus muscles. If akinesia is not achieved after 10 minutes, or if there is significant eyeball movement that could interfere with the surgery, rescue maneuvers are required. (Carvalho et al., 2020)

If the failure is localized to a specific muscle, additional injections may be performed: a medial canthus top-up (2-3 mL at the caruncle area) if the medial rectus

muscle remains active, or a repeated inferotemporal injection (2-3 mL) if the overall blockade remains shallow, provided that intraocular pressure (IOP) is strictly monitored. (Ribeiro et al., 2020) One of the most effective rescue strategies is switching to a Sub-Tenon block. This technique involves a small dissection of the conjunctiva and Tenon's capsule to insert a blunt cannula and deposit local anesthetic directly into the sub-Tenon space. This technique is highly effective for achieving akinesia when a peribulbar block fails, as the drug diffuses directly posteriorly toward the motor nerves. Furthermore, it is safer to perform when the eye is already chemotic from previous peribulbar injections because it utilizes a blunt cannula. (Chua et al., 2021)

If all regional anesthesia efforts fail and the patient experiences severe anxiety or unbearable pain, light sedation may be administered. This can include a small dose of midazolam (0.03 mg/kg), fentanyl (with at least a 50% dose adjustment for Stage V CKD patients), or propofol (25-50 mcg/kg/min). Strict monitoring is imperative to avoid the risk of oversedation, which can lead to involuntary head movements or respiratory depression. (Carvalho et al., 2020) Succinylcholine (1.5 mg/kg) can be used to facilitate endotracheal intubation provided that hyperkalemia is absent. Other muscle relaxants include rocuronium (1 mg/kg), vecuronium (0.1 mg/kg), cisatracurium (0.15 mg/kg), and atracurium (0.5 mg/kg). Volatile agents, propofol, fentanyl, sufentanil, alfentanil, and remifentanyl can be safely administered to patients with CKD, with the possible exception of sevoflurane when given at low gas flows for extended periods. The

interaction between sevoflurane and soda lime under low-flow conditions (< 2 L/min) can produce a degradation product (Compound A), which is nephrotoxic. (Chowdhury & McLure, 2022)

In this case, the post-peribulbar block evaluation revealed a block failure with partial akinesia; the motor blockade score was 4, with the patient's left eye still capable of inward and outward movement. A rescue Sub-Tenon block was performed, and a re-evaluation 10 minutes later showed a motor blockade score of 0, allowing the surgery to proceed. During the procedure, the patient became agitated and uncooperative, necessitating light sedation with propofol at a dose of 25-75 mcg/kg/min. Post-sedation

monitoring indicated oversedation, as the patient began snoring due to airway obstruction. Since airway manipulation is not feasible during active vitreoretinal surgery, the decision was made to convert to general anesthesia. Following preoxygenation, the patient was administered 75 mcg of fentanyl IV slowly (representing a 50% dose adjustment for CKD). Induction was performed using propofol at 1-2 mg/kg IV (100 mg), and intubation was facilitated with the muscle relaxant atracurium at 0.5 mg/kg IV (30 mg). Intubation was performed meticulously to prevent hemodynamic surges. Maintenance during surgery was achieved using propofol at 50-150 mcg/kg/min, with additional fentanyl at 0.25 mcg/kg if required. Hemodynamics remained relatively stable throughout the operation without significant fluctuations. Deep extubation was performed to prevent coughing, which could lead to increased intraocular pressure (IOP) post-vitreotomy, thereby avoiding suture dehiscence or re-

bleeding caused by the Valsalva maneuver. The patient was transferred to the PACU with an initial Aldrete score of 8/10 for postoperative monitoring of pain, consciousness, respiratory depression risk, and hemodynamic stability. Postoperatively, the patient was managed in the ward with oral paracetamol 750 mg every 8 hours.

CONCLUSION

Although regional anesthesia techniques are preferred in CKD patients to avoid drug accumulation, the readiness for conversion to general anesthesia—utilizing agents independent of renal excretion and implementing smooth extubation management—is paramount to ensuring patient safety and the success of vitreoretinal surgery.

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