Kliniğimizde Lazer Fotokoagülasyon İşlemi Gerçekleştirilen Prematüre Retinopatili Hastaların Perioperatif Özelliklerinin İncelenmesi

ÖZET

Amaç: Prematüre retinopatisi (Retinopathy of Prematurity, PR), düşük doğum ağırlıklı ve erken doğan bebeklerde görülen retinal damarların anormal proliferasyonuna bağlı ve patogenezi tam olarak bilinmeyen bir hastalıktır. Günümüzde kabul gören en etkin ve güvenilir tedavi yöntemi; tüm avasküler retina sahalarının lazer fotokoagülasyonudur. Bu çalışmanın amacı, kliniğimizde lazer fotokoagülasyonu uygulanan hastaların özellikleri, kullanılan anestezi yönetimleri ve bu özelliklerin postoperatif yoğun bakım sürecine etkilerini araştırmaktı.

Yöntem: Bu çalışmamızda Nisan 2003 ve Nisan 2017 tarihleri arasında PR'si bulunan ve Başkent Üniversitesi Tıp Fakültesi Ankara Hastanesi'nde lazer fotokoagülasyon ameliyatı geçiren toplam 504 hastanın dosyaları ve ameliyat kayıtları geriye dönük olarak değerlendirildi. Anestezi yöntemi ve perioperatif veriler toplanarak postoperatif seyirle ilişkilendirildi.

Bulgular: Çalışmaya dahil edilen 504 PR'li hastanın 290'ı (%57,5) erkek, 214'i (%42,5) kadındı. İşlemdeki güncel yaşları 37 ± 4 hafta, güncel ağırlıkları 2168 ± 765 gramdı. Hastalara en sık eşlik eden komorbid hastalık RDS (Respiratuvar distres sendromu) (%72,4) ve anestezik olarak en çok kullanılan ilaç ketamin idi (%91,5). İntraoperatif dönemde bradikardi 7 hastada, desatürasyon 21 hastada gözlendi. Yoğun bakımda toplam kalış süreleri ortalama 6,4 ± 10,0 gündü. Hastaların doğumdaki ve güncel yaş ve ağırlıkları yoğun bakımda kalış süreleri ve yoğun bakımda apne, CPAP ve entübasyon ile ters orantılı olarak ilişkili bulundu.

Sonuç: Kliniğimizde lazer fotokoagülasyon işleminde en çok kullanılan anestezik ilaç kombinasyonu düşük doz ketamin + midazolam idi. Preoperatif akciğer hastalığı, düşük doğum ağırlığı ve yaş, intraoperatif hava yolunun korunmasında zorluklara neden olan faktörlerdir. Ayrıca bu hastaların ameliyat sonrası yoğun bakım izlemlerinde düşük yaş ve kilo en olumsuz faktörlerdi.

Anahtar kelimeler: prematürite, retinopati, lazer fotokoagülasyon, prematüre anestezisi, yenidoğan yoğun bakım ünitesi

Investigation of Perioperative Characteristics of Patients with Retinopathy of Prematurity Who Had Laser Photocoagulation Procedure in Our Clinic

Abstract

Objective: Retinopathy of prematurity (ROP) is characterized by abnormal proliferation of retinal vessels occurring in low-birth-weight preterm infants. The most widely accepted treatment method is laser photocoagulation of avascular retinal areas. The aim of the present study was to investigate the characteristics of patients, anesthesia management and the effects of these features on the postoperative intensive care process in children who underwent laser treatment of ROP in our clinic.

Materials and Method: We retrospectively analyzed the medical records of 504 children who underwent laser photocoagulation in Baskent University Hospital between April 2003 and April 2017. Perioperative data related to anesthetic management and intraoperative events were collected along with information related to the postoperative course.

Results: Of the 504 patients with ROP included hundred in the study, 290 (57.5%) were male and 214 (42.5%) were female. Their current age at the procedure was 37±4 weeks, and their current weight was 2168±765 grams. Respiratory distress syndrome was the most common comorbidity (72.4%) and ketamine was the most used anesthetic agent (91.5%). Seven patients had bradycardia and 21 patients had desaturation intraoperatively. The mean postoperative length of stay in the intensive care unit was 6.4±10.0 days. There was a negative correlation between age and weight at surgery and length of stay in the intensive care unit, frequency of apnea, continue positive airway pressure, and endotracheal intubation requirement in the intensive care unit.

Conclusion: In our clinic, the most commonly used anesthetic drug combination in laser photocoagulation was low-dose ketamine + midazolam. Preoperative lung disease, low birth weight and age are factors that cause difficulties in protecting the intraoperative airway. In

addition, low age and weight were the most negative factors in the course of the postoperative ICU follow-up of these patients.

Key words: prematurity, retinopathy, laser photocoagulation, anesthesia of prematurity, neonatal intensive care unit

Introduction

Retinopathy of prematurity (ROP) is a clinical pathology characterized by abnormal development of retinal vessels. The pathogenesis of ROP is not clear. It is generally observed in premature and low-birth-weight infants, and also one of the most common causes of blindness in children [1]. The development of neonatal intensive care units (NICUs) provided an important decrease in the mortality rate of premature and low-birth-weight babies. One of the important pathologies seen in these prematurely born babies is ROP. This pathology necessitates urgent treatment. Laser photocoagulation is the most accepted, effective, and reliable method of all avascular retinal areas at the high-risk pre-threshold disease stage [2]. During the procedure, anesthesia is required to ensure the immobility of the patient. The procedure is usually performed under general anesthesia in an operating room. Complication potential and anesthesia risk are increased in premature babies due to the incomplete anatomic and physiologic development and manipulation difficulties. Growth retardation and functional insufficiencies cause more respiratory complications in preterm infants after anesthesia [3]. Establishment of a safe and practical anesthesia management guide in patients who will undergo laser treatment is of great importance in order to ensure that each case receives the most appropriate intervention. In preoperative evaluation; inquiries pertaining to the gestational process and delivery, gestational age and weight, current age and weight should be examined in detail [4]. A general examination of the patient should be made, alertness, muscle tone and skin turgor, skin and mucous membrane moisture and temperature, heart rate and variability during the day, respiration pattern, and if there are apnea periods, their frequency and duration are determined. A detailed examination should be performed against the appearance of the upper respiratory tract and the possibility of difficult intubation. If the patient has been previously intubated, the size and length of the endotracheal tube (ETT) should be recorded. Laboratory tests and routine preoperative echocardiographic examination should be ready. Preterm newborns undergoing retinopathy of prematurity surgery can be given breast milk up to 4 hours before anesthesia and clear liquids up to 2 hours before surgery [5]. Premedication is not usually considered. Two operational pulse oximeters should be available for intraoperative monitoring. Appropriately sized blood pressure cuffs should be available for accurate pressure measurement, as this can damage poorly ossified and calcium-deficient bones. Electrocardiography monitor should be done. Although end-tidal CO2 measurement is less reliable due to very small tidal volumes and low maximum expiratory flow rate, it is important for monitoring respiratory parameters in mechanical ventilation.

Since heat loss is an important potential source of stress in prematurity, it is very important to keep the ambient temperature constant throughout the entire surgical period. Patients should be covered with waterproof surgical drapes. The operating table should be equipped with an effective warming device that includes active heating methods such as a warming bed or a warm air blanket device. Intravenous fluids, blood and blood products are applied by heating. There should be a temperature probe suitable for the size of the patient in the operating room room, which can be placed without damaging the tissues. Airway safety is difficult to ensure in premature infants, short-term problems with airway patency or respiratory depression may have serious consequences in sedated patients. Appropriately sized endotracheal tubes, masks, and airways should be readily accessible in sedated patients. The place of ETT is very important in patients intubated under general anesthesia. Even with very small movements of the head, the tube may be dislodged or there may be one-lung intubation. Again, these small and very thin tubes can be twisted and folded with the slightest movement. For all these reasons, airline safety must be ensured at all times.

Premature newborns have high alveolar ventilation rates. Their functional residual capacity is low. Concentrations of inhalation anesthetics rise rapidly due to high vascularity and high blood flow. As a result, the induction of inhalation anesthetics is very rapid and care must be taken for overdose. Sale et al. [6] suggested that mild general anesthesia (GA) with *sevoflurane or desflurane* is the best available technique for high-risk preterm neonates in their study of preterm infants below 47 weeks postconceptional who underwent inguinal herniotomy. However, recent data suggest a neurotoxic effect in fetuses and neonates in animals receiving some of these inhalation agents. Since the respiratory suppressive effect of *ketamine* is not evident, it is added to opioids as an alternative anesthetic. With central sympathetic stimulation, it increases heart rate, cardiac output, intraocular pressure, as well as cerebral blood flow, oxygen consumption and intracranial pressure. It is of particular importance in children, frail, elderly patients, and in patients with asthma, as it may rarely cause bronchospasm. In previous studies, they reported that they used atropine premedication and ketamine sedation in the treatment of ROP, and complications were low [7]. *Midazolam* is a benzodiazepine derivative approved by the *Food and Drug Administration* (FDA) for use in newborns. A rapid bolus should not be administered. It does not cause analgesia. Concomitant use with narcotics should be avoided due to the risk of respiratory depression. *Propofol* suppresses respiration relatively more, causes temporary apnea, decreases cardiac output, and decreases blood pressure. Concerns exist regarding the use of this drug in the

newborn. *Morphine* has a lower clearance in the newborn and, due to its long half-life, high plasma levels are achieved even at low doses [8] and cause greater respiratory depression. The level of morphine in the brain was found to be higher in neonatal rats than in adult rats. The reason for this has been attributed to blood-brain barrier immaturity in the newborn [9]. Although *meperidine* causes less respiratory depression in newborns than morphine; It is not recommended in neonates due to its cumulative effect and active metabolites in long-term use [10]. *Fentanyl (sufentanil, alfentanil, remifentanil)* has higher potency than morphine and meperidine. Two major drawbacks; respiratory slowdown or apnea due to respiratory center depression, and general striated muscle tone increase (rigidity), especially with rapid intravenous administration. Opioids have safety concerns in preterm, but fentanyl is recommended as part of balanced anesthesia [11]. The neuromuscular junction is not fully developed at birth. The ratio of muscle mass to body weight in newborn babies is quite low compared to adults. In addition, excess extracellular fluid volume and incomplete maturation of organs lead to prolongation of the half-life and clearance of nondepolarizing muscle relaxants.

In this study, we retrospectively reviewed the demographic characteristics, perioperative characteristics of premature patients who underwent laser photocoagulation treatment for ROP in our clinic, and our different anesthesia experiences applied by different anesthesia doctors, which have changed over 14 years, and examined the factors affecting complications in the postoperative period.

Materials and Methods

After obtaining approval from the Institutional Review Board (KA17/219), the medical records of the patients who underwent laser photocoagulation surgery for the treatment of ROP between April 2003 and April 2017 were reviewed, retrospectively.

The subjects were categorized according to birth weight into three groups as low birth weight (2500-1501g), very low birth weight (1500-1001g), and extremely low birth weight (<1000g), and birth weeks into two groups as moderately premature (32-36 weeks) and extremely premature (24-31 weeks) for a better evaluation.

Statistical analyses were performed using the SPSS 21.0 program (SPSS Inc., Chicago, IL) developed for Windows. Descriptive statistics and the preoperative data of the subjects are indicated as mean ± standard deviation (SD) and as number and percentage (%) at appropriate places. The *Mann-Whitney U* test was used to compare the groups. The *Chi-square* test was used to compare categorical variables. Additionally, *one-way analysis of variance (ANOVA)* was used in the comparison of the groups. *p* values less than 0.05 were considered statistically significant.

Results

The data of 504 patients were collected and analyzed. In our study, the birth age of 88% of the patients was between 24 and 32 weeks and 87.5% of the patients had a birth weight below 1500 grams. The descriptive characteristics of the patients are shown in Table 1.

The categorized numbers of patients according to their age and weight are given in Figure 1, 2, 3 and 4.

Forty-eight patients were twins and 10 were triplets and 397 (78.8%) had at least one systemic disease. The most common accompanying disease was respiratory distress syndrome (RDS) (72.4%). Preoperatively, the majority of patients (71.8%) were intubated for various reasons. Ten of these patients (1.9%) were taken to the operation as intubated. The preoperative medical characteristics of the patients are shown in Table 2.

Fifty-nine (11.8%) of the patients had a surgical history, 31 (6.2%) ROP surgery, 12 (2.4%) patent ductus arteriosus (PDA) closure surgery, 5 (1%) ventriculoperitoneal shunt surgery, 4 (0.8%) bowel surgery, 2 (0.4%) aortic coarctation surgery, 2 (0.4%) inguinal hernia repairing surgery, 2 (0.4%) vesicostomy surgery, and one (0.2%) retinal detachment surgery.

The preoperative intubation, cardiac disease, RDS, BPD, and infection rates were found to be significantly higher in extremely premature patients. In addition, all comorbid conditions were found to be significantly higher in the low-birth-weight group ($p<0.05$). The preoperative characteristics of the patients according to their birth weeks and weights are shown in Table 3.

Ten patients had been intubated before surgery. In addition, 41 (8.1%) were intubated intraoperatively, and 16 (3.1%) needed intraoperative laryngeal mask airway (LMA) insertion and 136 (27%) of the patients required respiratory support via a facemask. Laryngeal mask

airway was more preferred in the last few years of the study period. The most commonly used anesthetic agent was ketamine (91.5%). Seven patients had bradicardia (heart rate <100 beats/min) and 21 patients had desaturation (SpO_2<90), intraoperatively. All patients were stabilized without complications and the surgeries continued.The intraoperative details of the patients are presented in Table 4.

All patients transferred to the NICU after the surgery. The postoperative data of the patients are given in Table 5.

Patients with low birth weight, small gestational age, and respiratory diseases such as RDS and/or BPD stayed longer in the NICU, and the minimum SpO_2 values observed during the postoperative period were significantly lower in these patients.

The effects of the preoperative and intraoperative data of these patients on the apnea and need for continuous positive airway pressure (CPAP) therapy and intubation during the postoperative intensive care period are given in Table 6.

Discussion

With the new advances in the care of premature newborns, the number of patients receiving ROP treatment is increasing. Laser photocoagulation is the most common method in ROP treatments. The anesthetic management of these babies is specific in many aspects. In this retrospective study, perioperative data of patients who underwent laser photocoagulation for ROP in our hospital were analyzed. This study is one of the most comprehensive studies to examine and evaluate the relationship between the number of patients receiving laser treatment for ROP and their perioperative data.

The data indicated a positive correlation between patients age and weight and the problems experienced after the surgery; prematurity and low weight pose more problems after the procedure. Conflictingly, in a recent study Kaur et al. showed that, the incidence of perioperative adverse events were not related to the patient's age and current weight [12].

Respiratory distress syndrome requiring surfactant treatment and BPD are risk factors for ROP [13, 14]. In our study, RDS was the most common accompanying comorbidity (72.4%) and BPD incidence was 10.7%. In our study, 71.8% of patients were intubated at least once preoperatively. However, 2% of the patients were being followed up as intubated at the time

of surgery. In patients with a history of preoperative intubation, it should be kept in mind that functional or mechanical problems may persist.

Seizures are one of the most common comorbidities in ROP patients. In this study, 8.7% of the patients had a history of seizures and although there was no seizure incidence during surgery in this group, the duration of postoperative intensive care stay was longer.

Systemic infection facilitates the development of ROP and reduces the success rate of treatment due to the tissue perfusion the increase in inflammation [15, 16]. Also increases the risk of anesthesia and postoperative complications [17]. Laser photocoagulation for ROP is considered as an urgent procedure and decision is made on the basis of profit and loss balance [18]. Systemic infection was present in 15.3% of our patients in the preoperative period. Necrotizing enterocolitis (NEC) is another risk factor that facilitates ROP formation [19]. In this study, 8.9% of the patients had NEC, and 9% of these patients had NEC surgery before laser photocoagulation. Postoperative length of stay in NICU, CPAP and intubation needs were higher in these patients with NEC or systemic infection.

The frequency of congenital cardiac anomalies is high in premature babies.. It is important to maintain heart rate, contraction and preload during anesthesia. In 81 (16.1%) of our patients had concomitant heart disease. PDA was the most common cardiac abnormality (n = 54, (67%)) and ligated in 12 of the patients. Interestingly, the frequency of apnea, CPAP and intubation need in the postoperative period was similar to those without heart problems ($p>0.05$).

The immobility of the patients during laser photocoagulation is important in terms of burning and/or protecting the correct areas. Local anesthesia alone is usually insufficient and requires anesthesia and analgesia. [20]. Also, repetitive and severe painful stimuli may cause bradycardia and apnea in premature infants who received topical anesthesia [21, 22]. The method of anesthesia for these procedures is often based on clinical experience rather than scientific evidence [23], patients should be carefully selected and airway patency should be safely ensured by using appropriate airway equipment. In our study, 67 patients (13.3%) needed LMA or endotracheal intubation. Ventilation support was not required for 301 patients (59.7%). Surgical duration and laser shot numbers were significantly less in patients who did not required airway instrumentation.

In premature infants, the pharmacodynamic and pharmacokinetic effects of anesthetic agents show significant changes due to insufficient function of the immature organs and differences in body fluid distribution and plasma albumin levels. Therefore, drug selection is very important in the anesthetic management of these babies. It has been reported that especially opioid analgesics can cause apnea attacks that last up to 12-24 hours after administration. Remifentanil, a short-acting opioid, has been reported to provide an advantage for early recovery in newborns, but prolonged recovery in infants younger than 7 days [24]. Lyon et al. [7] reported that three of 11 patients who received ketamine sedation in ROP treatment developed minor intraoperative complications and two infants developed apnea postoperatively requiring CPAP or mechanical ventilation support. Ketamine is an anesthetic agent with significant advantages in that it does not cause intraoperative and postoperative respiratory depression and has sympathomimetic effects. In our study, a ketamine-midazolam combination was the most commonly used anesthetic in the intraoperative period. It was observed that ketamine was used for 91.5% of the patients, and midazolam was used for 56.3%. In patients with airway instrumentation, maintenance of anesthesia was provided with intermittent ketamine boluses or inhaler sevoflurane, depending on the duration of the surgery and the expected postoperative course of the patient. The fact that spontaneous breathing was not suppressed with the use of ketamine may have decreased the frequency of airway intervention. At the same time, its positive contribution to hemodynamic stability has increased the frequency of preference.

Newborns are at higher risk in the postoperative period in intensive care units than older infants [25]. Due to the many complications, the length of intensive care stay is prolonged. The average total length of stay of our patients in NICU was 6.4±10 days. Thirty-six patients needed intensive care for more than 30 days due to their comorbid diseases, independent of laser photocoagulation. Accordingly, this extended the mean length of stay in intensive care in our results. The length of stay in the NICU and the number of intubated days decreased significantly inversely with the current age and weight both at birth and during the procedure. In patients with RDS, the length of stay and the number of intubated days in NICU were significantly high.

The most common postoperative complication in patients with ROP after laser photocoagulation performed with general anesthesia was apnea [26]. In our study, apnea was observed in 176 (34%) patients in NICU. Current age, preoperative apnea, severe comorbidity

and anemia are important risk factors for the development of postoperative apnea [27]. The frequency of apnea in the NICU was higher in patients with low birth age and weight and history of preoperative intubation.

In this study we collected the preoperative, intraoperative, and postoperative data of babies who underwent laser photocoagulation due to retinopathy of prematurity and examined their relations in detail. It has advantages such as the number of patients and being a single-center study. Additionally, laser photocoagulation was performed by a single physician in all patients. The limitations of our study are that it was retrospective, covering 14 years, and different anesthesiologists performed anesthesia.

In conclusion, preoperative and intraoperative SpO2 (minimum / maximum) values are significantly lower in children with a birth weight below 1000 g (ELBW). During the procedure, ketamine + midazolam combination was administered as an anesthetic drug in most patients. With this combination, intraoperative LMA application and the need for intubation were less than in the literature, no mortal complications were observed in any patient, and it did not increase the frequency of postoperative apnea. Therefore, the combination of low doses of ketamine + midazolam can be recommended in the anesthetic management of laser photocoagulation for ROP. Having preoperative lung disease significantly increased the need for intraoperative LMA and intubation. Low birth and current age and weight increased the need for intubation and CPAP in intensive care. Factors prolonging ICU stay include preoperative lung disease, young age and weight, and intraoperative intubation. Laser photocoagulation for ROP requires experience in anesthetic management. Considering the postoperative follow-up, it should be performed by experienced anesthesiologists in a multidisciplinary hospital.

References

1. Verdier KD, Ulla E, Löfgren S, Fernell E. Children with blindness – major causes, developmental outcomes and implications for habilitation and educational support: a two-decade, Swedish population-based study. Acta Ophthalmologica. 2017;96(3):295-300.
2. Jiang JB, Strauss R, Luo XQ, Nie C, Wang YL, Zhang ZW. Anaesthesia modalities during laser photocoagulation for retinopathy of prematurity: a retrospective, longitudinal study. BMJ Open 2017 Jan 24;7(1):133-44.
3. Ulgey A, Güneş I, Bayram A, Aksu R, Biçer C, Uğur F, Karaca C, Boyacı A. Decreasing the need for mechanical ventilation after surgery for retinopathy of prematurity: sedoanalgesia vs.

general anesthesia. Turk J Med Sci 2015;45(6):1292-9.

4. Hatch D, Summer E, Hellmann J. The Surgical Neonate: Anaesthesia and Intensive Care. 3rd ed. Boston: Edward Arnold Group; 1995:150-1.
5. Mancuso TJ. Anesthesia for preterm newborn. In: Holzman RS, Mancuso TJ, Polaner DM, Eds. A Practical Approach to Pediatric Anesthesia.1st edn: Lippincott Williams and Wilkins, 2008;601-9.
6. Sale SM, Read JA, Stoddart PA, Wolf AR. Prospective comparison of sevoflurane and desflurane in formerly premature infants undergoing inguinal herniotomy. Br J Anaesth 2006;96:774-8.
7. Lyon F, Dabbs T, O'Meara M. Ketamine sedation during the treatment of retinopathy of prematurity. Eye 2007;21:1-3.
8. Glikman L, Bruce EA, Caro FG, Avorn J. Physicions knowledge of drug costs fort he elderly. J Am Geriatr Soc 1994;42:992-6.
9. Avorn J, Chen M, Hartley R. Scientific versus commercial sources of influence on the prescribing behavior of physicions. Am J Med 1982;73:4-8.
10. Kuhls E, Gauntlett IS. Lau M, Brown R, Rudolph CD, Teitel DF, Fisher DM. Effect of increased intraabdominal pressure on hepatic extraction and clearence of fentanyl in neonatal lambs. J Pharmacol Exp Ther 1995;274:115-9.
11. Friesen R, Williams GD. Anesthetic management of children with pulmonary arterial hypertension. Paediatr Anaesth 2008;18:208–16.
12. Kaur B, Carden SM, Wong J, Frawley G. Anesthesia management of laser photocoagulation for retinopathy of prematurity. A retrospective review of perioperative adverse events. Pediatric Anesthesia 2020;00:1-8.
13. Chen Y,Li X,Gilbert C Beijing; ROP Survey Group. Risk factors for retinopathy of prematurity in six neonatal intensive care units in Beijing, China. Br J Ophthalmol 2008;92:326-331.
14. Kumar P, Sankar MJ, Deorari A, Azad R, Chandra P, Agarwal R, Paul V. Risk factors for severe retinopathy of prematurity in preterm low birth weight neonates. Indian J Pediatr. 2011;78(7):812-6.
15. Tolsma KW, Allred EN, Chen ML, Duker J, Leviton A, Dammann O. Neonatal bacteremia and retinopathy of prematurity: the ELGAN study. Arch Ophthalmol 2011; 129(12):1555-63
16. Manzoni P, Maestri A, Leonessa M, Mostert M, Farina D, Gomirato G. Fungal and bacterial sepsis and threshold ROP in preterm very low birth weight neonates. J Perinatol. 2006;26(1):23-30.
17. Egbuta C, Mason KP. Recognizing Risks and Optimizing Perioperative Care to Reduce Respiratory Complications in the Pediatric Patient. J Clin Med. 2020 Jun 22;9(6):1942.
18. Brown AC, Nwanyanwu K. Retinopathy Of Prematurity. 2020 Sep 10. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2021 Jan–. PMID: 3296599.

19. Shah VA, Yeo CL, Ling YL, Ho LY. Incidence, risk factors of retinopathy of prematurity among very low birth weight infants in Singapore. Ann Acad Med Singapore. 2005;34(2):169-78.
20. SIGN. Safe sedation of children undergoing diagnostic and therapeutic procedures. A national clinical guideline. Scottish Intercollegiate Guidelines Network, 2004.
21. Beck S, Wojdyla D, Say L, Betran AP, Merialdi M, Requejo JH, et al. The worldwide incidence of preterm birth: A systematic review of maternal mortality and morbidity. Bull World Health Organ. 2010;88:31–8.
22. Haigh PM, Chiswick ML, O'Donoghue EP. Retinopathy of prematurity: systemic complications associated with different anaesthetic techniques at treatment. Br J Ophthalmol 1997;81:283–7.
23. Sato Y, Oshiro M, Takemoto K, Hosono H, Saito A, Kondo T et al. Multicenter observational study comparing sedation/analgesia protocols for laser photocoagulation treatment of retinopathy of prematurity. J Perinatol 2015;35:965–9.
24. Kirwan C, O'Keefe M, Prendergast M, Twomey A, Murphy J. Morphine analgesia as an alternative to general anaesthesia during laser treatment of retinopathy of prematurity. Acta Ophthalmol Scand. 2007 Sep;85(6):644-7.
25. Long JB, Fiedorek MC, Oraedu O, Austin TM. Neonatal intensive care unit patients recovering in the post anesthesia care unit: An observational analysis of postextubation complications. Paediatr Anaesth. 2019;29(12):1186-1193.
26. Yavaşcaoğlu B, Kaya FN, Ozcan B, Yılmaz C,Tore G, Ata F et al. Prematüre Retinopatili Yenidoğanların Laser Tedavisinde Genel Anestezi Uygulamalarımız: Retrospektif Değerlendirme Uludağ Üniversitesi Tıp Fakültesi Dergisi 2007;33(2):65-9.
27. Walther-Larsen S, Rasmussen LS. The former preterm infant and risk of post-operative apnoea: recommendations for management. Acta Anaesthesiol Scand 2006;50:888-93.

Tables

Table 1. Descriptive characteristics [Mean ± SD (Min – Max]

Table 2 . Preoperative medical characteristics of the patients

Table 3. Preoperative features of the patients according to their birth weeks and weights

Table 4. Intraoperative details of the patients [Mean ± SD (Minimum - Maximum)]

Table 5. Postoperative data of the patients [Mean ± SD (Minimum - Maximum)]

Table 6. Effects of perioperative data on the intensive care process

Figure Legends

Figure 1: Numbers of patients according to their birth age

Figure 2: Numbers of patients according to their birth weight

Figure 3: Numbers of patients according to their current age

Figure 4: Numbers of patients according to their current weight

Table 1. Descriptive characteristics [Mean ± SD (Min – Max]	
Birth age (weeks)	28.4 ± 2.3 (23 - 36)
Birth weight (g)	1143 ± 311 (460 - 2560)
Current age (weeks)	37.3 ± 4.5 (29 - 67)
Current weight (g)	2168 ± 765 (920 - 9000)
Gender (Female/Male)	214 (42.5%) / 290 (57.5%)
ASA scores (ASA I-II / III-IV)	83 (16.5%) / 421 (83.5%)

Table 2. Preoperative medical characteristics of the patients

Accompanying disease (+) / (-)	397 (78.8%) / 107 (21.2%)
Respiratory distress syndrome	365 (72.4%)
Bronchopulmonary dysplasia	54 (10.7%)
Infection	77 (15.3%)
Necrotizing enterocolitis (NEC)	45 (8.9%)
Cardiac disease	81 (16.1%)
Seizure	44 (8.7%)
Preoperative intubation history (+) / (-)	362 (71.8%) / 142 (28.2%)

Preoperative anesthesia history (+) / (-)	60 (11.9%) / 444 (88.1%)
ROP stages	
Stage 2	45 (8.9%)
Stage 3	438 (86.9%)
Stage 4	21 (4.2%)

Table 3. Preoperative features of the patients according to their birth weeks and weights

	Preoperative Intubation history	Preoperative Anesthesia history	Cardiac disease	RDS	BPD	NEC	Seizure	Infection
Birth weeks								
MP (n/60)	36	5	4	34	2	2	4	4
EP (n/444)	326	55	77	331	52	43	40	73
p	**0.030**	0.363	**0.035**	**0.004**	**0.049**	0.105	0.546	**0.048**
Birth weight								
LBW (n/57)	33	5	7	32	3	2	2	4
VLBW (n/241)	155	20	28	163	9	15	15	26
ELBW (n/206)	174	35	46	170	42	28	27	47
p	**<0.001**	**0.013**	**0.006**	**<0.001**	**<0.001**	**0.008**	**0.012**	**<0.001**

MP (modaretely premature), EP (extremely premature), LBW (low birth weight), VLBW (very low birth weight), ELBW (extremely low birth weight),

Table 4. Intraoperative details of the patients [Mean ± SD (Minimum - Maximum)]

Airway instrumentation	
Endotracheal intubation	51 (10.1%)
Laryngeal mask airway	16 (3.2%)
Facemask	136 (27.0%)
Nasal cannula	301 (59.7%)

SpO_2 (minimum-maximum)	97.9 ± 4 (50-100) – 99.5 ± 1 (92-100)
Heart rate (minimum-maximum)	157 ± 23 (60-220) - 177 ± 22 (115-230)
Anesthetic agents	
Ketamine	461 (91.5%)
Midazolam	284 (56.3%)
Sevoflurane	57 (11.3%)
Surgical duration (minutes)	70.8 ± 29.3 (15-250)
Total number of laser shots	3132 ± 1320 (320–8000)

Table 5. Postoperative data of the patients [Mean ± SD (Minimum - Maximum)]

Postoperative SpO_2 (maximum)	99.3 ± 1 (92-100)
Postoperative SpO_2 (minimum)	81.6 ± 22 (50-100)
Apnea in intensive care	176 (34.9%)
CPAP requirements in intensive care	131 (26%)
Intubation in intensive care	39 (7.7%)
Length of stay in intensive care (days)	6.4 ± 10 (1-90)

Table 6. Effects of perioperative data on the intensive care process

	Apnea	CPAP	Intubation
Birth weeks			
MP	13/60 (22%)	11/60 (18%)	4/60 (7%)
EP	163/444 (37%)	120/444 (27%)	35/444 (8%)
p	**0.022**	0.150	0.741
Birth weight			
LBW	14/57 (25%)	9/57 (16%)	4/57 (7%)
VLBW	65/241 (27%)	43/241 (18%)	9/241 (4%)
ELBW	97/206 (47%)	79/206 (38%)	26/206 (13%)
p	**<0.001**	**<0.001**	**0.002**
Current weeks			

<36 weeks	84/184 (46%)	66/184 (36%)	26/184 (14%)
>36 weeks	92/320 (29%)	65/320 (20%)	13/320 (4%)
p	**<0.001**	**<0.001**	**<0.001**
Current weight			
<1500 g	39/76 (51%)	33/76 (43%)	13/76 (17%)
1500-2500 g	114/301 (38%)	79/301 (26%)	20/301 (7%)
>2500 g	23/127 (18%)	19/127 (15%)	6/127 (5%)
p	**<0.001**	**0.001**	0.142
Other factors			
Preoperative intubation history	140/362 (39%)	102/362 (28%)	36/362 (10%)
p	**0.005**	0.074	**0.003**
Ketamine	162/461 (35%)	119/461 (26%)	27/461 (6%)
p	0.734	0.765	**<0.001**
Midazolam	92/284 (3%)	64/284 (22%)	13/284 (5%)
p	0.176	**0.044**	**0.003**
Sevoflurane	21/57 (37%)	22/57 (39%)	20/57 (35%)
p	0.747	0.021	**<0.001**
Intraoperative intubation	22/51 (43%)	24/51 (47%)	28/51 (55%)
p	0.194	**<0.001**	**<0.001**

EP (extremely premature), MP (modaretely premature), ELBW (extremely low birth weight), VLBW (very low birth weight), LBW (low birth weight)