International Journal of Medical Anesthesiology

E-ISSN: 2664-3774
P-ISSN: 2664-3766
www.anesthesiologypaper.com
IJMA 2020; 3(4): 143-147
Received: 13-08-2020
Accepted: 21-09-2020

Abdul Rasool Ibadi Abdulhasan Al-Krizi
MBChB FICMS & IC (Anesthetist),
Ministry of Health - Baghdad Medical Office - Al-Karkh, Al Karkh General Hospital, Baghdad, Iraq

Abeer kamal husein Alkashab
MBChB D.A (Anesthetist)
Ministry of Health - Baghdad Medical office - Al-Karkh, Al Karama Educational Hospital, Baghdad, Iraq

Aysar Abd Oun Ali Al-Zubaidi
MBChB DA CABA & IC (Anesthetist)
Head of department of anesthesia, Ministry of Health - Baghdad Medical Office - Al-Karkh, Al Karkh General Hospital, Baghdad, Iraq

Corresponding Author:
Abdul Rasool Ibadi Abdulhasan Al-Krizi
MBChB FICMS & IC (Anesthetist)
Ministry of Health - Baghdad Medical Office - Al-Karkh, Al Karkh General Hospital, Baghdad, Iraq

Anesthesia for ophthalmic surgery in children (review)

Abdul Rasool Ibadi Abdulhasan Al-Krizi, Abeer kamal husein Alkashab and Aysar Abd Oun Ali Al-Zubaidi

DOI: https://doi.org/10.33545/26643766.2020.v3.i4b.176

Abstract
The literature review is devoted to the analysis of the applied anesthesia techniques in ophthalmic surgical interventions in children from the point of view of the drugs used and the methods of anesthesia. In the preparation of the material, the databases Cyberleninka, PubMed, Medline were used with targeted searches based on the keywords: propofol, sevoflurane, paracetamol, regional anesthesia, ophthalmology, children. The depth of search by the date of publication of works was not limited, the emphasis was on publications of the last 10 years. The purpose of the review was to assess the breadth of application of various methods of anesthesia (general anesthesia and regional blockade), anesthesia drugs (sevoflurane, propofol, paracetamol, local anesthetics) in ophthalmosurgery in children.

Keywords: anesthesia, ophthalmic surgery, children

Introduction
The active development of eye microsurgery within the last decade, undoubtedly, requires im- provement of anesthetic support in such interven- tions. The specifics of anesthesia in the pediatric eye surgery is based on solution of such problems as suf- ficient sedation, effective intra- and postoperative analgesia, prevention of adverse reflex reactions (oculocardiac, laryngeal), relief of postoperative nau- sea and vomiting (PONV), and prevention of post- anesthesia agitation [1–12].

Ketamine and propofol as components of general anesthesia in pediatric eye surgery
Various authors consider that low doses of keta- mine permit to improve the intraoperative status, reduce the risk of the oculocardiac reflex (OCR) and do not re- quire the use of atropine for OCR prevention [13, 14].

Ketamine anesthesia with obligatory premedica- tion with atropine and seduxen has been considered a method of choice in pediatric eye surgery for a long time. [15–17]. However, this option did not com- pletely meet the requirements set by surgeons, who tried to avoid postoperative agitation, nausea and vomiting, i.e. factors that can elevate the intraocular pressure and, therefore, spoil he results of the surgical intervention [18]. This problem could be partially solved by the use of a combination of ketamine and propofol, which provide a fast and smooth induction of anesthesia [19–22] with a dose-dependent cardio- respiratory effect related to suppression of the sympa- thetic nervous system and produce a vagotonic and bronchodilating effect [8, 19, 23–25]; at that, the exact dosing of the drug permits to avoid possible hypoven- tilation [26]; and the patient recovers within a short period of time following a single dose.

Beletsky A. V. *et al.* (2015) describe propofol as a drug that meets all requirements to an anesthetic support in eye surgery. The authors note that propofol does not elevate the intraocular pressure; general anes- thesia is induced quickly as it has been predicted; the anesthesia is stable with subsequent quick and smooth recovery of consciousness and somatic functions with- out straining efforts and vomiting. A combined anes- thesia with propofol permits to arrange the most adequate conditions for the surgery, minimize adverse effects of its elements and ensure the specific tasks of the anesthesiological support in eye surgery [27]. Complete characteristics of propofol was by Sorokin E. Yu. (2014) [28] and Dmitriev D. V. (2014) [29]; they indicated both positive and negative character- istics of the drug, as well as the ability of the drug to reduce intraocular pressure, which is important in eye surgery. Many colleagues show their interest in a com- bined anesthesia with propofol and ketamine or fen- tanyl, indicating that this combination allows to maintain spontaneous breathing, reduce the time of recovery, provide a gradual recovery from anesthesia without excitation, and reduce the need for antiemetic agents [30]. Whereas ketamine has the most pro- nounced damaging effect on the mental status, accord- ing to Elkin I. O. (2006), the combined anesthesia with propofol damages the mental status by sedation. Therefore, the combination of ketamine-propofol is more favorable [31].

Singh Bajwa (2010) studied advantages of total intravenous anesthesia (TVA) and found that at the time of anesthesia induction, the combination of propofol-fentanyl led to significant bradycardia and a marked decrease in systolic and diastolic pressure as compared to the combination of propofol-ketamine, however, in the maintenance phase, both combinations demonstrated stable hemodynamic parameters [32]. Wilhelm S. (1996), studied propofol in combination with sufentanil in children with surgical correction of strabismus and noted a high risk of bradycardia and oculocardiac reflex, but the risk of postoperative nau- sea and vomiting was not high [22]. Hahnenkamp K. (2000) studied ketamine, sevoflurane, propofol, mida- zolam and halothane in eye surgery and found that ke- tamine demonstrated the lowest hemodynamic changes and the risk of an oculocardiac reflex [33]. However, the study of St. Pierre M. (2002) has shown that the combination of propofol-ketamine has a longer post-anesthesia recovery; at that PONV is not reduced in comparison with the propofol-opioid combination [34]. Bröking K. (2011) recommends induction of anesthesia using ketamine and midazolam and notes that propofol and remifentanil lead to an increased risk of oculocardiac reflex. [35]. However, Lili X. (2012) studied propofol in combination with sufentanil and remifentanil and did not note undesirable complica- tions in the form oculocardiac, oculopulmonal and ocu- logastral reflexes during and after the surgery [36].

Choi S. R. (2009) presented a broad study on the use of ketamine in combination with sevoflurane, des- flurane, propofol, remifentanil, and midazolam during anesthesia in eye surgeries. In all cases, no premedica- tion was carried out. To ensure airway patency, a la- ryngeal mask was used. The author comes to the conclusion that a combination of ketamine-propofol and ketamine-remifentanil and midazolam-propofol and midazolam-remifentanil often lead to oculocardiac reflex [37]. Tramиr M. R. (1997) [21] indicates the high frequency of symptoms oculocardiac reflex after the use of propofol (1444 cases of bradycardia).

In their studies I. E. Skobeido (2004) and D. Yu. Ignatenko (2016) with co-authors compared propofol and opioid anesthesia with a combined anesthesia im- plying the use of sub-tenon or retrobulbar blockade in combination with intravenous administration of propofol. The authors point to negative aspects of ad- ministration of fentanyl which is manifested in respi- ratory depression, increased the duration of post-anesthesia recovery; and earlier recovery of con- sciousness and spontaneous respiration was noted in patients who underwent regional anesthesia [38, 39]. A.D.Dubok demonstrates the advantages of multicomponent anesthesia based on the use of in- halation sevoflurane anesthesia and intravenous anesthesia with propofol in combination with retrob- ulbar anesthesia (2011). The author reasons that the combination of general anesthesia with retrobulbar block in surgeries for strabismus eliminates oculogas- tral and oculocardiac reflexes and provides effective intra - and postoperative analgesia creating a favor- able psychological background both in children and their parents [40].

The use of sevoflurane in inhalation anesthesia for pediatric eye surgery

Sevoflurane, an inhalation anesthetic, is one of drugs of choice for anesthesia in eye surgery, which is the most widely used drug in pediatrics. The drug is characterized by dose-dependent respiratory depres- sion, with minimal effect on the cardiovascular system, allows to carry out highly controlled inhalation anes- thesia with instant induction and rapid recovery, con- tributing to a rapid postoperative recovery of the patient. Sevoflurane has a more favorable cardiac pro- file compared to other halogen-containing inhalation anesthetics (halothane, isoflurane, desflurane) [41]. It reduces the brain metabolism, adapting it to ischemia [42]; it is characterized by a dose-dependent increase in intracranial pressure and a slight increase in cere- bral blood flow in normocapnia [43]. Positive charac- teristics of inhalation anesthesia, including the use of sevoflurane, include the ability to perform anesthesia by low- and minimum-flow methods, providing more favorable conditions in the respiratory circuit, as well as good cost-effectiveness [44, 45].

However, the serious disadvantages of sevoflurane, which are crucial for patients after eye surgery, include post-anesthesia agitation, expressed in behavioral and psycho-emotional instability, especially in young chil- dren (up to 6 years). Study by Ignatenko D. Yu. (2009, has menostrated that the agitation after sevoflurane ad- ministration occurs in 45% of cases and is typical for chil- dren aged from 1 to 5 years. The recovery was accompanied by motor hyperactivity (crying, negativism towards parents and medical staff). The author indicated that the use of midazolam as a premedication, as well as conduction anesthesia before the surgery, resulted in achieving the adequate postoperative analgesia reducing the incidence of the agitation syndrome at a recovery rate of 5% of cases [46]. In turn, Costi D. (2014), while em- phasizing the basic problem of sevoflurane, also indicated behavioral disorders or manifestations of delirium after its application and recommends to apply a multimodal approach in order to reduce the agitation, using propofol, halothane, dexmedetomidine, clonidine, opioids (fen- tanyl), and ketamine [19]. Van Hoff S. L. (2015) offers to administer propofol for reduction of agitation after sevoflurane application, at the end of the surgical inter- vention [47]. Egorov V. M. and Elkin I. O. (2012) say that sevoflurane provides the greatest preservation of mental functions, like dormicum and propofol [48].

At present, sevoflurane is a drug of choice from a wide range of inhalation anesthetics in pediatric oph- thalmic anesthesia that provides rapid induction of anesthesia and rapid recovery, without significant neg- ative hemodynamic effects, with minor effects on in- tracranial and intraocular pressures. However, despite many important and positive characteristics of the drug, it has a significant negative effect, i.e. the post- anesthesia agitation, whose frequency and severity can be reduced by propofol.

Paracetamol as a component of analgesia in general anesthesia in pediatric eye surgery

A significant number of papers devoted to anes- thesia in eye surgery dwell on the issues of a combined use of non-opioid analgesics; and in the pediatric prac- tice they most often discuss paracetamol, which has a relatively strong analgesic effect and is permitted for use in all age categories [49–51]. The analgesic effect of the drug occurs within 5–10 minutes after the start of infusion and reaches its maximum within 1 hour; the peak analgesic effect is achieved within 4–6 hours. According to Zakharenko G. and Goncharuk V. (2016), there is enough evidence related to the clinical use of intravenous paracetamol (in the form of monotherapy or as a component of multimodal anes- thesia) [52]. According to Macintyre P. E. (2010), the analgesic effect of paracetamol is equal to 30 mg of ke- torol, 75 mg of diclofenac, 10 mg of metamizole and morphine [20].

Paracetamol is widely used as a non-opioid anal- gesic for the treatment of acute and early postopera- tive pain [53]. Savustyanenko A.V. (2014), analyzed their five-year experience (2005–2010) in the use of intravenous paracetamol and data of Macario, Royal (2011) [54] and demonstrated the scale of its surgical application, including the strabismus surgery [49]. In- traoperative intravenous administration of paraceta- mol (15mg/kg) does not lead to the development of postoperative nausea and vomiting within 24 hours after surgery; and its effectiveness is greater, if the drug is used for prevention before surgery or intraop- eratively as compared to its introduction to relief pain. Preoperative intravenous administration of paraceta- mol is comparable to the effect of analgesia after sur- gery [55–57], which is explained by processes of prevention of central and peripheral sensitization [53]. While treating patients with glaucoma, authors found that paracetamol reduced intraocular pressure [58].

Undoubtedly, conclusions can be made on the positive role of paracetamol as an effective analgesic in intraoperative anesthesia of eye surgery and post- operative analgesia in children, but it is also clear that the drug is used as a co-analgesic in most cases, pro- viding a reduction in the dosage of opioid analgesics during general anesthesia.

Regional blockades as a component of combined anesthesia in pediatric eye surgery

Almost most requirements to arranging condi- tions for eye surgery can be met by the use of regional blockades, which include: retrobulbar, parabulbar, per- ilimbal, epibulbar, sub-tenon, epibulbar-intrachamber anaesthesia, wing-orbital block (WOB) and drip (in- stillation) anesthesia [8, 9]. For example, sub-tenon anesthesia in combination with postoperative admin istration of NSAIDs and serotonin receptor antago- nists significantly reduces pain, as well as prevents the risk of postoperative nausea and vomiting in children with surgical treatment of strabismus, due to a more complete interruption of afferent impulses from the area of eye surgery [59]. There is no doubt that retrob- ulbar anesthesia provides a deeper suppression of sen- sitivity and akinesia, allows to stabilize the eyeball during the surgery, but unfortunately, the risk of com- plications is very high [60]. Since the autonomic in- nervation of the eye is comes from two nodes, the ciliary and pterygopalatine [61], it is advisable to af- fect the two ganglia simultaneously. Prokop'ev M. A. (2011) indicates pterygopalatine ganglion as an anatomical and physiological structure that is impor- tant for eye surgery, noting that the blockade of the pterygopalatine ganglion provides the denervation of the nerve structures related to the eye, orbit, and pe- riorbital tissue [9, 62]. In adult eye surgery, as well as in the treatment of post-concussion ocular hyperten- sion, a wing-orbital blockade (zygomatic access to the pterygopalatine fossa) is used [63].

A lot of research is devoted to the use of WOB in glaucoma, although Vaisblat SN. (1962) noted the positive effect of the blockade of the pterygopalatine ganglion for the treatment of patients with glaucoma [64]. Tatarinov N. *et al.* (2009) and Zelentsov S. N. *et al.* (2014) noted that the blockade of the pterygopala- tine fossa is one of the components of patient's an- tinociceptive protection in surgery [61,65], in which it is possible to operate on the ciliary and pterygopala- tine vegetative nodes simultaneously. Prokop'ev M. A. *et al.* (2011) emphasize that the more selective the blockade is, the more effective it is. With such a block- ade, drug deposition is formed, the effect of which is softer, and the effect lasts longer. They indicate that this technique is useful in a number of operations, in- cluding vitreous surgeries and dacryocystorhinos- tomy, and to relieve a glaucoma episode [62].

Vaiysblat S. N. (1962) describes several methods of the pterygopalatine blockade through different ac- cesses [64], indicating that pterygopalatine fossa but not round foramen should be the injection site for anesthesia of the maxillary nerve. This route is easily accessible and accurate, and the passage of a needle in the palatine pathway, through the pterygopalatine canal, along the vessels and nerves embedded in it does not have any adverse consequences, because their hy- draulic removal takes place by a slowly introduced a local anesthetic. The technique is successfully used in adult rhinosurgery [66, 67]. Malamed S. F. pays atten- tion to the positive results of the anesthesia. The use of the technique ensures success and a low level of complications. In 90% of cases, this anesthesia is de- termined as adequate by the authors [25]. However, Hawkins J. M. *et al.* (1998) found that in the case of a higher fornix of the oral cavity, greater palatine fora- men is located closer to the dentition; and in the case of a lower fornix, it is closer to the midline [68]. While performing palatine anesthesia in children, McDonald R. E. (2003) notes that an imaginary line should be drawn from the gingival margin of the last molar to the midline in order to determine the direction of the needle. The needle should be moved distally, placing the syringe on the opposite side. [69].

It is always necessary to determine the volume of injected local anesthetic (LA) during regional block in eye surgery due to a constant risk of diplopia that oc- curs when the LA penetrates into the orbit through the inferior orbital fissure [22, 70]. Coronado G. C. A. (2008) confirms the likelihood of penetration of the local anesthetic into the orbit through the inferior or- bital fissure during the palatine blockade. Based on the anatomical position and average volume of the ptery- gopalatine fossa, he determines the maximum amount of anesthetic (1.2 ml), which can be deposited in it [71]. The following characteristics of the local anes- thetics are important in ensuring the effectiveness and safety of regional blockades: analgesic potential, latent period, effect duration, and toxicity [72]. Currently, ropivacaine is actively used in the pediatric practice due to the most pronounced positive pharmacological properties among all local anesthetics. The duration of its effect depends on the route of administration and dose, and is from 4 to 10 hours. It is low-toxic; the la- tent period is 10–15 minutes; the maximum single dose is 250 mg; the daily dose is 800 mg, which, ac- cording to Prokopiev M. *et al.* (2011), is more than enough for eye surgeries [62]. Wang *et al.* (2001) noted that ropivacaine is a long-acting local anesthetic with a high cardiovascular safety potential, a signifi- cant sensory/motor differential block and a shorter half-life (tS), and with a less accumulation potential than that of bupivacaine. However, high safety of ropi- vacaine is its most important feature as compared to bupivacaine when taken in equal doses, manifested in lower cardiovascular toxicity than that of bupivacaine in relation to the direct myocardial depression. [73]. Bachinin E. *et al.* (2017) recommend to use ropiva- caine 0.75% alone or in the combination with lido- caine as a LA in the surgical treatment of glaucoma. They claim that the effectiveness of anesthesia is due to the rapid sensory block (due to the action of lido- caine) and prolonged postoperative anesthesia (due to the action of ropivacaine) [74]. Regional blockades in eye surgery have been and are still used not only by anesthesiologists but also by ophthalmic surgeons due to its attractive efficacy, relative safety and development of new safer local anesthetics [75–81].

Conclusion

Despite the active use of regional anesthesia in eye surgery, there are very few papers devoted to its use in children. In particular, there are almost only a few works on the application of the blockade of the in- fraorbital nerve and palatine anesthesia; and there is no data on the volume of the LA used in ophthalmic surgery to ensure the effective blockade in children. We also could not find any relevant information about the combination of different blockades to achieve the desired result of anesthesia and specific technologies that contribute to the directed spread of the injected local anesthetic in the eye area in children. In the available literature, we did not find data on the choice of the most optimal options for anesthesia in eye sur- geries from the standpoint of their effectiveness, safety, comfort for the child and his parents, and economic feasibility. There is no doubt that this can and should be the subject of further research.

References

1. Ducloyer JB, Couret C, Magne C, Lejus-Bourdeau C, Weber M, Le Meur G, Lebranchu P. Prospective evaluation of anesthetic protocols during pediatric ophthalmic surgery. Eur. J. Ophthalmol 2018;28(5):112-116. DOI: 10.1177/1120672118804798. PMID: 30280604
2. Keilhauer J, Trieschmann U, Böttiger BW. Special aspects of pediatric anesthesia in ophthalmic surgery. Ophthalmologe 2015;112 (2):118-121. DOI: 10.1007/s00347-014-3223-9. PMID: 25614349
3. Mikhail M, Sabri K, Levin AV. Effect of anesthesia on intraocular pres- sure measurement in children. Surv. Ophthalmol 2017;62(5):648-658. DOI: 10.1016/j.survophthal.2017.04.003. PMID: 28438591
4. Onakpoya OH, Asudo FD, Adeoye AO. Anaesthesia for ophthalmic sur- gical procedures. East Afr. Med. J. 2014;91(3):105-108. PMID: 26859039
5. Schaefer MS, Kranke P, Weibel S, Kreysing R, Ochel J, Kienbaum P. Total intravenous anesthesia vs single pharmacological prophylaxis to prevent postoperative vomiting in children: a systematic review and meta-analysis. Paediatr. Anaesth 2017;27(12):1202-1209. DOI: 10.1111/pan.13268. PMID: 29094418
6. Schönfeld CL, Reith M. Methods of anesthesia in eyesurgery. Ophthalmologe 2013;110(2):175-178. DOI: 10.1007/s00347-012-2739-0. PMID: 23288314
7. Waxweiler S. Anaesthesia in ophthalmic surgery. Klin. Monbl. Augenheilkd 2016;233(6):757-784. DOI: 10.1055/s-0033-1358229. PMID: 27203733
8. Takhchidi KhP, Sakhnov SN, Myasnikova VV, Galenko-Yaroshevsky PA. (eds.). Anesthesia in ophthalmology. Guidance. Moscow: Meditsinskoe Informatsionnoe Agentstvo 2007:552.ISBN5-89481-625-4. [In Russ.]
9. Chukhraev AM, Sakhnov SN, Myasnikova VV. Anesthesia and periop- erative management in ophthalmic surgery. Moscow: Prakticheskaya Meditsina 2018;480:ISBN 5988114865. [In Russ.]
10. Ha SG, Huh J, Lee BR, Kim SH. Surgical factors affecting oculocardiac reflex during strabismus surgery. BMC Ophthalmology 2018;18(1):103. DOI: 10.1186/s12886-018-0771-9. PMID: 29673326
11. Tuzcu K, Coskun H, Tuzcu EA, Karcioglu H, Davarci I, Hakimogly S *et al*. Effectiveness of sub-Tenons block in pediatric strabismus surgery. Bras. J. Anestesiol 2015;65(5):349-352. DOI: 10.1016/j.bjane.2014.02.003. PMID: 26323732
12. Lin Y, Chen Y, Huang J, Chen H, Shen W, Guo W *et al*. Efficacy of premedication with intranasal dexmedetomidine on in- halational induction and postoperative emergence agitation in pediatric undergoing cataract surgery with sevoflurane. J. Clin. Anesth 2016;33:289-295. DOI: 10.1016/j.jclinane.2016.04.027. PMID: 27555179
13. Espahboli E, Sanatkar M, Sadrossadat H, Darabi Vafsi VE, Azarshahin M *et al*. Ketamin or atropine: which one better prevents oculo- cardiac reflex during eye surgery? A prospective randomized clinical trial. Acta Med. Iran 2015;53(3):158-161. PMID: 25796021
14. Abdolahi M, Soltani HA, Montazeri K, Soleymani B. Preemptive low- dose of ketamine does not effective on anesthetic consumption, periop- erative analgesiereguerement and postoperative pain nausea and vomiting in painful ophthalmic surgery. J. Res. Med. Sci 2013;18(7):583-587. PMID: 24516491
15. Mishunin YuV, Petrochenkov VN, Bykovsky VV. Intramuscular admin- istration of ketamine in pediatric ophthalmology. Vestnik Smolenskoi Go- sudarstvennoi Meditsinskoi Akademii 2006;2:68-69. [In Russ.]
16. Altiparmak B, Akça B, Yilbasø AA, Çelebi N. All about ketamine preme- dication for children undergoing ophtalmic surgery. Int. J. Clin. Exp. Med 2015;8(11):21525-21532. PMID: 26885101
17. Qiao H, Xie Z, Jia J. Pediatric premedication: a double-blind randomized trial of dexmedetomidine or ketamine alone versus a combination of dexmedetomidine and ketamine. BMC Anesthesiol 2017;17(1):158. DOI: 10.1186/s12871-017-0454-8. PMID: 29187151
18. Shchukin VV, Kharkin AV, Spiridonova EA, Lazarev VV, Tsypin LE, Aizenberg VL. Anesthetic management of minimally invasive interven- tion in pediatric oncohematology: possibilities and limitations of inhala-tion and intravenous anesthesia. Onkogematologiya 2013;8(4):32-36. DOI: 10.17650/1818-8346-2013-8-4-32-36. [In Russ.]
19. Costi D, Cyna AM, Ahmed S, Stephens K, Strickland P, Ellwood J *et al*. Effects of sevoflurane ver- sus other general anaesthesia on emergence agitation in children.

Cochrane Database Syst. Rev 2014;9:CD007084. DOI: 10.1002/14651858.CD007084.pub2. PMID: 25212274
20. Macintyre PE, Scott DA, Schug S, Visser E, Walker SM. Acute pain management: scientific evidence. 3-rd ed. Melbourne, Australia: ANZCA & FPM 2010;347:ISBN 9780977517442.
21. Tramèr MR, Moore RA, McQuay HJ. Propofol and bradycardia: cau- sation, frequency and severity. Br. J. Anaesth 1997;78(6):642-651. DOI: 10.1093/bja/78.6.642. PMID: 9215013.
22. Wilhelm S, Standl T. Does propofol have advantages over isoflurane for sufentanil supplemented anesthesia in children for strabismus surgery? Anasthesiol. Intensivmed. Notfallmed. Schmerzther 1996;31(7):414-419. DOI: 10.1055/s-2007-995950. PMID: 8991468
23. Walker M, Drangsholt M, Czartoski TJ, Longstreth WT. Jr. Dental diplo- pia with transient abducens palsy. Neurology 2004;63(12):2449-2450. DOI: 10.1212/01.WNL.0000147323.73848.BE. PMID: 15623733
24. Mayer M, Ochmann O, Doenicke A, Angster R, Suttmann H. The effect of propofol-ketamine anesthesia on hemodynamics and analgesia in com-parison with propofol-fentanyl. Anaesthesist 1990;39(12):609-616. PMID: 2073045
25. Malamed SF, Trieger N. Intraoral maxillary nerve block: an anatomical and clinical study. Anesth. Prog 1983;30(2):44-48. PMID: 6587797
26. Mizikov VM. Diprivan (propofolum): pharmacokinetics, pharmacody- namics, application. Vestnik Intensivnoi Terapii 1995;Supplement:1-5. [In Russ.]
27. Beletsky AV, Saenko SA, Avdeyev AV. Application of propofol as a com- ponent of anesthesia in ophthalmological practice. Meditsina Neotloz- hnykh Sostoyanii 2015;1:87-90. [In Russ.]
28. Sorokina E.Yu. Propofol in modern multicomponent general anesthesia. Meditsina Neotlozhnykh Sostoyanii 2014;3:69-74. [In Russ.]
29. Dmitriev DV. Propofol usage in children or a few words about known drug. Meditsina Neotlozhnykh Sostoyanii 2014;6:67-70. [In Russ.]
30. Kanyukov VN, Korolikhin FS, Skobeido IE, Bolotnikov VN. Postopera- tive nausea and vomiting in a combined anesthesia with ketamine and propofol. Vestnik Orenburgskogo Gosudarstvennogo Universiteta 2008;12:55-57. [In Russ.]
31. Elkin IO. The state of long-term mechanical memory after various vari- ants of anesthesia during ophthalmic surgery in children of school age. Sibirsky Konsilium 2006;1:24-25. [In Russ.]
32. Singh Bajwa SJ, Bajwa SK, Kaur J. Comparison of two drug combinations in total intravenous anesthesia: propofol-ketamine and propofol-fentanyl. Saudi J. Anaesth 2010;4(2):72-79. DOI: 10.4103/1658-354X.65132. PMID: 20927266
33. Hahnenkamp K, Hönemann CW, Fischer LG, Durieux ME., Muehlen-dyck H, Braun U. Effect of different anaesthetic regimes on the oculo- cardiac reflex during paediatric strabismus surgery. Paediatr. Anaesth 2000;10(6):601-608. DOI: 10.1111/j.1460-9592.2000.00588.x. PMID: 11119192
34. St Pierre M, Kessebohm K, Schmid M, Kundt HJ, Hering W. Recovery from anaesthesia and incidence and intensity of postoperative nausea and vomiting following a total intravenous anaesthesia (TIVA) with S-(+)-ketamine/propofol compared to alfentanil/propofol. Anaesthesist 2002;51(12):973-979. DOI: 10.1007/s00101-002-0410-x. PMID: 12486585
35. Bröking K. Pitfalls of anesthesiologic management in paediatric strabis- mus surgery. Anasthesiol. Intensivmed. Notfallmed. Schmerzther 2011;46(2):88-93. DOI: 10.1055/s-0031-1272876. PMID: 21312141
36. Lili X, Zhiyong H, Jianjun S. Asleep-awake-asleep technique in children du- ring strabismus surgery under sufentanil balanced anesthesia. Paediatr. Ana- esth 2012;22(12):1216-1220. DOI: 10.1111/j.1460-9592.2012.03901.x. PMID: 22712670
37. Choi SR, Park SW, Lee JH, Lee SC, Chung CJ. Effect of different anest- hetic agents on oculocardiac reflex in pediatric strabismus surgery. J. Anesth 2009;23(4):489-493. DOI: 10.1007/s00540-009-0801-0. PMID: 19921355
38. Skobeido IE, Korolikhin FS, Bolotnikov VV. Benefits of multimodal anesthesia for ophthalmic interventions in children. Vestnik Orenburg- skogo Gosudarstvennogo Universiteta 2004;13:212-213. [In Russ.]
39. Ignatenko DYu, Utkin SI, Khalfin RN, Bachinin EA, Stolyarov MV. The use of combined anesthesia during surgery for the correction of stra- bismus in children. Sovremennye Tekhnologii v Oftalmologii 2016;2:141-143. OAI-PMH ID: eyepress.ru: article 21026. [In Russ.]
40. Dubok AD. Multicomponent anesthesia in the treatment of strabismus in children. Fedorov's readings — 2011; Chapter — IX. Patologiya Gla- zodvigatelnoi Sistemy i binokulyarnogo Zreniya. OAI-PMH ID: eyepress.ru: article 9035. [In Russ.]
41. Barash PD, Cullen BF, Stalting RK. Clinical anesthesiology. Moscow: Meditsinskaya Literatura 2006:592:ISBN 589677-037-5. [In Russ.]
42. Gelfand BR. (ed.). Anesthesiology and intensive care. Practical guide. Moscow: Litterra 2006;576:ISBN 5-98216-026-1. [In Russ.]
43. Mizikov VM, Bunyatyan AA. Thematic review: Opportunities and pro- spects for the use of sevoflurane in pediatric anesthesia. Moscow: Inform- Pravo 2005, 32. [In Russ.]
44. Likhvantsev VV., Pecheritsa VV. Modern inhalation anesthesia. Moscow: GEOTAR — MED 2003, 25-39. [In Russ.]
45. Turlekieva ZhM, Sultankulova GT, Ordakhanov UE. Anesthesia for ophthalmic surdery in children. Vestnik Kazakhskogo Natsionalnogo Me- ditsinskogo Universiteta 2016;1:274-275. [In Russ.]
46. Ignatenko DYu, Utkin SI. Prevention of anesthesia awareness syndrome with sevoflurane in pediatric ophthalmic surgery. Fedorov's readings — 2009; Chapter — X. Oftalmoanesteziologiya. OAI-PMH ID: eyepress.ru: article 6454. [In Russ.]
47. Van Hoff SL, O'Neill ES, Cohen LC, Collins BA. Does a prophylactic dose of propofol reduce emergence agitation in children receiving anest- hesia? Paediatr. Anaesth 2015;25(7):668-676. DOI: 10.1111/pan.12669. PMID: 25917689
48. Egorov VM, Elkin IO. Comparative assessment of the effect of general anesthesia and surgical stress on higher mental functions in children. Iz- vestiya Uralskogo Federalnogo Universiteta. Seriya 3. Obshchestvennye Nauki 2012;2(103):99-108. [In Russ.]