Int J Clin Exp Med 2019;12(8):10800-10804
www.ijcem.com /ISSN:1940-5901/IJCEM0093455

Original Article

The impact of contralateral eye in intraoperative visual assessment during ophthalmic surgery

Dezhi Zheng*, Zijing Huang*, Qi Zhang, Yi Shi, Haoyu Chen, Weiqi Chen

*Joint Shantou International Eye Center, Shantou University and The Chinese University of Hong Kong, Shantou 515041, P. R. China. *Equal contributors.*

Received March 6, 2019; Accepted June 5, 2019; Epub August 15, 2019; Published August 30, 2019

Abstract: Background: Visual experience is an important part of the safety evaluation in intraocular surgery. However, the incidence of no light perception after local ophthalmic anesthesia varied largely as reported. This study aims to investigate the impact of contralateral non-operative eye in intraoperative visual evaluation during ophthalmic surgery. Methods: Forty healthy volunteers were enrolled in this study. One eye from each subject was randomly chosen as the "operative eye" and the other as "non-operative" eye. The non-operative eye was then draped with cloths to simulate preoperative preparation. Under surgical illumination, the operative eye was tightly covered and volunteers were interviewed about their visual experience on the non-operative eye, including light perception, color changes and hand movement. Results: A majority of subjects reported no light perception (38/40) or hand movement feeling (39/40) under surgical illumination with their "non-operative" eyes closed. When asked to open the "non-operative" eye, all subjects (40/40) had light perception and could felt hand movement under surgical illumination. Nearly a third of subjects (15/40) sensed blue light, while a half (22/40) failed to distinguish the color of light. In addition, 60% (24/40) of the subjects detected the dimming of light when the ambient illumination of operation room was turned-off. There was no statistical difference in feeling of light perception, hand movement, and color between gender and age. Conclusions: During ophthalmic surgeries, light perception from the non-operative eye could impact visual evaluation on the operative eye, though it was draped with cloth. Surgeons should tightly cover the contralateral eye before intraoperative visual assessment of the operative eye.

Keywords: Ophthalmic surgery, visual evaluation, light perception, non-operative eye

Introduction

Local anesthesia, including retrobulbar, peribulbar and sub-Tenon's anesthesia are widely used for intraocular surgery for decades. Though it is generally considered to be safe, some adverse effects have also been reported [1, 2]. Intraoperative amaurosis is also mentioned after local anesthesia, which may make the surgeon and patient stressed [3, 4]. However, previous studies have revealed large variation in occurrence rate of post-anesthetic loss light perception, with an incidence rate of 3.6% to 53.8% [5-9].

Clinically, patients with contralateral eye blind or severe glaucoma were easier to complain loss light perception during surgery [10-12]. Previously, rare patients receiving intraocular surgery under sub-Tenon's anesthesia complained of lost light perception during surgery. However, interestingly, when their contralateral eyes were tightly covered, more than 90% of patients reported no light perception at different time period of the surgery [13]. This finding indicated that the non-operative eye might affect the evaluation of intraoperative visual experience. Since most of the previous studies paid less attention to the light perception of non-operative eye when evaluating post-anesthetic amaurosis, in this study, the impact of non-operative eye on the assessment of intraoperative visual perception was further investigated.

Methods

Subjects

The study followed the tenets of the Declaration of Helsinki and was approved by Research Ethics Committee of Joint Shantou International

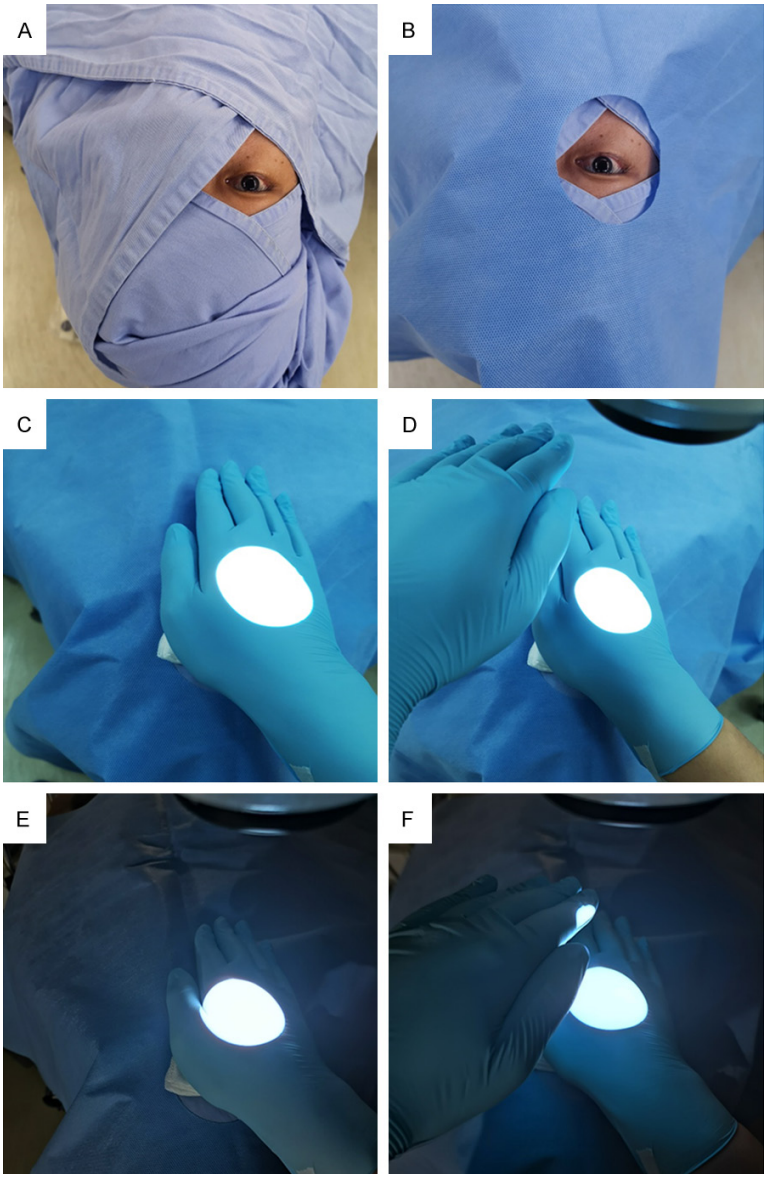

Figure 1. Investigation of visual experience on the non-operative eye under microscope and ambient illumination on/off. The right eye of volunteer was considered as the "operative" eye and the left eye as the "non-operative" one. (A, B) The non-operative eye was first draped routinely with double layer cloth (A) and single layer non-woven fabric (B). (C) Under ambient and microscope illumination, the operative eyes was covered with 5 pieces of gauze and the investigator's palm to make sure it could not feel any light. (D) Evaluation of hand movement on the non-operative eye was performed. (E, F) Same investigation was conducted without ambient lighting in order to mimic the surgical environment.

Eye Center (JSIEC). Volunteers are informed about the whole study procedure and understood all aspects of the informed consent.

Forty healthy volunteers were enrolled in this study, inducing 13 males (32.5%) and 27 females (67.5%). The average age was 26.6 ± 3.6 years old (range 23-38 years). Twenty-two left eyes (55.0%) and 18 right eyes (45.0%) were randomly chosen for investigation. The volunteers had no ocular diseases, with a best corrected visual acuity of 20/20. One eye in each volunteer was randomly selected as the simulative operative eye by using envelope method.

Assessment of visual perception during surgery

The study was conducted in the same operation room in JSIEC. Under ambient lighting, subjects were asked to lie in the operating bed as generally required. The "non-operative" eye was then draped routinely with double layer cloth (**Figure 1A**) and single layer non-woven fabric (**Figure 1B**). All the wraps were in blue. Light illumination of the ophthalmic surgical microscope (Opmi Lumera 700, Zeiss, Germany) was opened and focused on the cornea of "operative eye" with a light intensity of 85%. Then, their "operative eyes" were covered tightly with 5 pieces of gauze and the investigator's palm (**Figure 1C**) to make sure it could not feel any light. Subjects were interviewed about visual experience when they closed and opened their "non-operative" eyes respectively, including light perception, color identification and feeling of hand movement (**Figure 1D**) at 10 cm in front of the "non-operative eye".

In order to mimic the surgical environment, the ambient lighting of operation room was then turned off and volunteers are inquired about the visual experience respectively (**Figure 1E** and **1F**). In addition, subjects were also asked about whether the light became brighter or dimmer when the ambient lighting changed.

Table 1. Visual experience on contralateral eye under ambient and microscope illumination

	Light perception	Hand movement
Contralateral eye closed	5.0% (2/40)	2.5% (1/40)
Contralateral eye open	100%* (40/40)	95%* (38/40)

*$P < 0.001$.

Table 2. Experience of color in opened contralateral eye under surgical illumination

	White	Blue	Unidentified
Microscope and ambient illumination	7.5% (3/40)	37.5% (15/40)	55% (22/40)
Only microscope illumination	15% (6/40)	35% (14/40)	50% (20/40)

Table 3. Visual experience on contralateral eye under microscope illumination without ambient light

	Light perception	Hand movement
Contralateral eye closed	5.0% (2/40)	10% (4/40)
Contralateral eye open	100%* (40/40)	100%* (40/40)

*$P < 0.001$.

The results were recorded in time by the researchers.

Statistical analysis

The visual experiences of "non-operative eye" under different conditions were compared using the Pearson Chi-square test or Fisher's exact test. Statistical analysis was performed using SPSS for windows version 20.0 (SPSS Inc., Chicago, IL, USA). *P* values of less than 0.05 were considered statistically significant.

Results

The non-operative eye could have visual perception under ambient and microscope light

Under ambient and microscope illumination, only 5% (2/40) of subjects could feel the light and only one experienced hand movement when their "non-operative" eye kept closed with routine drape. However, when asked to open the "non-operative eye", all subjects (40/40) said they had light perception (**Table 1**). Among them, 37.5% (15/40) thought the light was blue and 7.5% (3/40) felt a white light, while more than half (55%, 22/40) could not distinguish the color of the light (**Table 2**). Furthermore, 95% of the subjects (38/40) were able to perceive hand movement with their "non-operative eye" open (**Table 1**). These results confirmed that the non-operative eye could impact the visual evaluation in the operative eye under both ambient and microscope illumination.

The non-operative eye could perceive light in the environment of vitreoretinal surgery

The ambient lighting of operating room was then turned off to mimic the environment of vitreoretinal surgery and asked if the volunteers could feel the light. As a result, only a few subjects reported light perception (5%, 2/40) or hand movement (10%, 4/40) with their "non-operative" eye closed. When asked to open the "non-operative" eye, all subjects could feel light perception and hand movement, which was consistently with the above results (**Table 3**). In addition, 35% (14/40) of subjects thought the light was blue and 15% (6/40) felt it was white, whereas half of them (20/40) failed to tell the color of the light (**Table 2**). These results showed that the non-operative eye could impact the visual evaluation in the operative eye under microscope illumination without ambient lighting.

The non-operative eye could sense the changes in light intensity in the operation room

In addition, subjects was asked whether they could feel the illumination changing when the ambient lighting light was turned on/off. As a result, more than half of subjects (60%, 24/40) believed that the light became darker when the ambient lighting was closed, while a few (12.5%, 5/40) reported a brighter microscope illumination. Some other (27.5%, 11/40) thought that the light was unchanged. The results further indicate that the non-operative eye had a sense of light from the ambient.

Discussion

In the present study, we investigated the visual experience of the "non-operative" eye in surgery and interestingly found that the "feeling of

light perception" mostly came from the non-operative eye when the operative eye were kept out of light. Most subjects could feel the light with the non-operative eye open, while lost light perception when it was closed. During surgical procedure, patients could randomly close and open their non-operative eyes. Post-surgical questionnaire therefore only reflected their visual impression in a certain stage of surgery, leading to different incidence rate of amaurosis. These studies provide a possible explanation for the different incident rate of post-anesthetic amaurosis after local anesthesia in previous study. To the best of our knowledge, this is the first study to investigate the visual experience of the non-operative eye in ocular surgery.

Local anesthesia is widely used for intraocular surgeries and has been proved to be relatively effective and safe. Since patients are conscious, they may have different visual experiences during the surgery, including flashes of light, vague movement of surgical instruments or hands, change in light brightness or colors, and transient loss of light perception [8, 14]. Among these feelings, light perception loss has been reported as a less common but severe situation, which may lead to stress of the surgeon and even impact the surgical procedure. However, the incidence of no light perception after local ophthalmic anesthesia varied largely in previous studies. Murdoch [8] reported only 3.6% of patient suffered from losing light perception during cataract surgeries after peribulbar anesthesia. However, Tan [9] found 53.8% of patients who received vitreous surgeries after retrobulbar or peribulbar anesthesia suffered from intraoperative loss light perception, with 29.2% reported transient light loss and 24.6% experienced no light perception throughout the entire duration of the surgery. Optic nerve block [15-17] and intraocular pressure increased [18, 19] after local anesthesia were assumed to be possible mechanisms. However, few study considered whether the contralateral eye impact the intraoperative visual perception assessment. In a pilot study, the contralateral non-operative eye in patients receiving vitreoretinal surgery was covered and surprisingly almost all patients reported no light perception after anesthesia [13]. Therefore, the aim of this research was to inspect the light perception of the non-operative eye with routine disinfected and draped under surgical illumination.

In ophthalmic surgery, the non-operative eye is generally draped closely with two or more layers of sterile cloth. However, because the cloth is often partial light transmissible, patients could very likely get light perception from their opened non-operative eye. When their non-operative eye kept closed, the eyelid could block the light in a larger extent and patient thus hardly felt the light. Therefore, the situation of the contralateral eye without covered tightly might disturb the light perception identification for the patients when the operative eye had already lost light perception after anesthesia. These might explain why the incidence of loss light perception varied largely in previous studies, since most investigators paid less attention to the situation of contralateral eye. This data, together with our previous study, indicate that post-anesthetic amaurosis appeared to be a more common phenomenon than expected and that light perception of the non-operative eye could influence the evaluation of post-anesthetic amaurosis in the "operative eye".

In this study, some volunteers considered the light to be blue which was the color of the therapy cloth. However, a large proportion of volunteers failed to identify the color, probably due to relatively low light entering their "non-operative" eye.

This research has some limitations. First, the therapy cloth used for draping varies in different hospitals, with different materials, thickness and colors, which may lead to different visual experience of the non-operative eye. Second, the subjects enrolled in this study were all young people with sensitive reaction, which could not well represent the clinical patients receiving intraocular surgeries. Further study in patients is needed to solve this problem.

In conclusion, during an ophthalmic surgery, most subjects could have light perception from the microscope illumination in their open contralateral "non-operative" eye. Covering the contralateral eye tightly is therefore necessary to accurately evaluate patients' visual perception during the surgery.

Acknowledgements

This study was supported by the Foundations of Innovation and Strong School Project of Sh-

antou University Medical College and Medical and Health Technology Plan of Shantou (NO. 180726214011420).

Disclosure of conflict of interest

None.

Address correspondence to: Weiqi Chen, Joint Shantou International Eye Center, Shantou University and The Chinese University of Hong Kong, Shantou 515041, P. R. China. Tel: 86 13692020576; E-mail: cwq@jsiec.org

References

[1] Schrader WF, Schargus M, Schneider E and Josifova T. Risks and sequelae of scleral perforation during peribulbar or retrobulbar anesthesia. J Cataract Refract Surg 2010; 36: 885-889.

[2] Ahmad S and Ahmad A. Complications of ophthalmologic nerve blocks: a review. J Clin Anesth 2003; 15: 564-569.

[3] Kiyohara LY, Kayano LK, Oliveira LM, Yamamoto MU, Inagaki MM, Ogawa NY, Gonzales PE, Mandelbaum R, Okubo ST, Watanuki T and Vieira JE. Surgery information reduces anxiety in the pre-operative period. Rev Hosp Clin Fac Med Sao Paulo 2004; 59: 51-56.

[4] Rengaraj V, Radhakrishnan M, Au Eong KG, Saw SM, Srinivasan A, Mathew J, Ramasamy K and Prajna NV. Visual experience during phacoemulsification under topical versus retrobulbar anesthesia: results of a prospective, randomized, controlled trial. Am J Ophthalmol 2004; 138: 782-787.

[5] Yu JF, Liang L, Wen YQ, Liu L, Huang YF. Patients' subjective visual experiences during vitreous sugery under local anesthesia. Int J Clin Exp Med 2011; 4: 205-213.

[6] Sathyan P, Venkatesh R, Muralikrishnan R and Au Eong KG. Visual experience during phacoemulsification-trabeculectomy under peribulbar anesthesia. Ophthalmic Surg Lasers Imaging 2010; 41: 337-341.

[7] Au Eong KG, Lim TH, Lee HM and Yong VS. Subjective visual experience during phacoemulsification and intraocular lens implantation using retrobulbar anesthesia. J Cataract Refract Surg 2000; 26: 842-846.

[8] Murdoch IE, Sze P. Visual experience during cataract surgery. Eye (Lond) 1994; 8: 666-667.

[9] Tan CS, Mahmood U, O'Brien PD, Beatty S, Kwok AK, Lee VY and Au Eong KG. Visual experiences during vitreous surgery under regional anesthesia: a multicenter study. Am J Ophthalmol 2005; 140: 971-975.

[10] Rupp-Montpetit K, Moody ML. Visual loss as a complication of nonophthalmologic surgery: a review of the literature. AANA J 2004; 72: 285-292.

[11] Topouzis F, Tranos P, Koskosas A, Pappas T, Anastasopoulos E, Dimitrakos S and Wilson MR. Risk of sudden visual loss following filtration surgery in end-stage glaucoma. Am J Ophthalmol 2005; 140: 661-666.

[12] Lin MG and Jin WP. Transient visual loss after retrobulbar anesthesia in glaucoma surgery: a literature review and an analysis of 2 cases. Chin Prev Med 2010.

[13] Chen WQ, Jhanji V, Chen HY, Zhang GH and Hou P. Visual impact of sub-Tenon anesthesia during combined phacoemulsification and vitrectomy surgery. Int J Ophthalmol 2014; 7: 860-863.

[14] Vohra SB, Kumar CM and Murray PI. Subjective visual perceptions during intraocular surgery under local anaesthesia: a review. Curr Anaesth Crit Care 2010; 21: 189-195.

[15] Ropo A, Ruusuvaara P and Setala K. Visual evoked potentials after retrobulbar or perioculars anaesthesia. Br J Ophthalmol 1992; 76: 541-544.

[16] Lavinsky J, Gus PI, Ehlers JA, Roehe D and Nora DB. Visual-evoked potentials: assessment of retrobulbar and peribulbar anesthesia. J Cataract Refract Surg 2000; 26: 1529-1532.

[17] Wu X, Jhanji V, Chen H, Lin H, Zhang G, Brelen M and Chen W. Change in flash visual evoked potentials in New Zealand albino rabbits after sub-tenon's anesthesia. Cutan Ocul Toxicol 2017; 36: 118-124.

[18] Pianka P, Weintraub-Padova H, Lazar M and Geyer O. Effect of sub-Tenon's and peribulbar anesthesia on intraocular pressure and ocular pulse amplitude. J Cataract Refract Surg 2001; 27: 1221-1226.

[19] Watkins R, Beigi B, Yates M, Chang B and Linardos E. Intraocular pressure and pulsatile ocular blood flow after retrobulbar and peribulbar anaesthesia. Br J Ophthalmol 2001; 85: 796-798.