Int J Clin Exp Med 2011;4(3):205-213
www.ijcem.com /ISSN:1940-5901/IJCEM1106006

Original Article

Patients' subjective visual experiences during vitreous surgery under local anesthesia

Ji-Feng Yu[1], Li Liang[2], Yu-Qin Wen[3], Li Liu[1], Yi-Fei Huang[1]

[1]Department of Ophthalmology, Chinese PLA General Hospital, Beijing 100853, China; [2]Department of Stomatology, 309 Hospital of Chinese People's Liberation Army, Beijing 100091, China; [3]Center of Anesthesia and Surgery, Chinese PLA General Hospital, Beijing 100853, China.

Received June 29, 2011; August 27, 2011; Epub September 15, 2011; published September 30, 2011

Abstract: Objective: To investigate patient's visual experience during vitreous surgery under local anesthesia. Methods: A prospective and randomized study of 76 patients that underwent vitreous surgeries in our hospital between July 2010 and December 2010 was designed. All patients were interviewed half an hour before and within 1 hour after the surgery using a standardized questionnaire. Basic characteristics of patients and their intraoperative visual experiences like light, color, moving object, pain, fear, and the desire for general anesthesia before and after the surgery were recorded. Results: Sixty patients (78.9%) perceived at least light perception, and 16 patients (21.1%) got no light perception throughout the entire duration of the operation. Forty one patients (53.9%) perceived only light, while 19 patients (25%) experienced moving objects. Thirty nine patients (51.3%) were frightened during their intraoperative visual experiences. Patients with better preoperative best-corrected visual acuity (BCVA) were more likely to be frightened (p=0.002). The frightened experience was affected notably by the different perceptions during operation, moving object (p=0.024), light (p=0.071), and color (p=0.071). Patients below 50 years old, especially from 20 to 30, were more likely to choose general anesthesia after the vitreous surgery. Conclusions: Most patients (78.9%) experienced at least light perception during the vitreous surgery under local anesthesia. There were no significant differences between the various visual experiences and their basic characteristics. Patients with better preoperative BCVA, perceived moving objects in their visual sensations seemed more likely to be frightened.

Keywords: Visual experience, regional anesthesia, vitreous surgery

Introduction

With the development of modern intraocular surgery, the number of patients undergoing a general anesthetic for vitreous surgery is declining. The safe and reliable orbital blocks made it an increasing percentage for local anesthesia surgeries. Therefore, it is of much importance to know what the patients had experienced during the entire duration of the surgery under local anesthesia. However, the visual experience under local anesthesia was not well recognized or understood until a few years ago. Most patients underwent vitreous surgery under local anesthesia experience a variety of intraoperative visual sensations [1, 2]. In a multicentre prospective study of 65 patients, 61.5% saw colors, 55.4% movements, and 50.8% instruments [3]. The cross-sectional study of Sugisaka et al showed that 73 patients (72.3%) saw colors, and 57 (56.4%) movements or moving objects [4].

Comprehension of the visual perceptions during the vitreous surgery under regional anesthesia is very important for the ophthalmologists. In a questionnaire survey of UK ophthalmologists, 58% thought that patients might be frightened by their intraoperative visual perceptions and 77% thought that preoperative counseling could help reduce this fear [5]. The well understanding of the intraoperative visual experiences could help ophthalmologists in the preoperative counseling to prevent fright and nervous associated syndrome in patients.

Our study compared the characteristics of patients who can see moving objects, light percep-

tion only and no light perception during the vitreous surgery under local anesthesia. We also analyzed the feature of patients who intended the surgery being done under general anesthesia after the surgery. We aimed to study the reason why patients were frightened during the surgery. To determine if the patients were frightened by the visual experiences or the fear was related to the basic characteristics of their own.

Methods

This prospective, randomized study was conducted in the Chinese People's Liberation Army (PLA) General Hospital. A total of 76 patients who underwent vitreous surgeries between July 2010 and December 2010 were studied. All patients were undergoing vitreous surgeries for the first time. Patients had preoperative visual acuity of no light perception in the operated eye, previous vitreous surgery, or lacked insight was excluded from the study. Medication or sedation was not used before the surgery. All patients were interviewed by trained interviewers half an hour before and within 1 hour after the surgery. A standardized questionnaire was used in all patients. All the questions related to visual experiences in the operated eyes were clearly explained. No patients approached refused to participate in our study.

The patients were asked to fulfill their personal data like age, gender, education background, preoperative sensation (frighten or not), and if they had aspiration for general anesthesia before surgery. Within 1 hour after the surgery, the patients were asked whether they had experienced light perception with the operated eye during the surgery. They were also asked if they had various visual experiences in the operation. These subjective perceptions included moving objects (instruments, surgeon's finger or hands, and surgeon or medical staff), and the color of light (yellow, white, red, green, blue, and uncertain light). Meanwhile, each patient was asked if they feel pain, and was frightened or not during the surgery. Whether regretted for not choose general anesthesia before surgery was the last question in the questionnaire.

Each patient provided written, informed consented to participate. The study protocol conformed to the tenets of the Declaration of Helsinki and it received ethical approval from the China Eye Research Institute Review Board.

All statistical analyses were carried out using SPSS 13.0 (SPSS, Inc., Chicago, IL) to calculate results. Chi-square tests and K independent samples were used to compare the results of various groups, and One-Way ANOVA used to compare means, with P values <0.05 considered statistically significant.

Results

Of the 76 patients (76 eyes) who participated in this study, 50 (65.79%) were men and 26 (34.21%) were women. The mean age of the patients was 41.5 years (range, 15 to 83 years, standard deviation SD±17.70). The demographic characteristics of the study population are detailed in **Table 1**.

Sixty patients (78.9%) perceived at least light perception throughout the entire surgery, 16 patients (21.1%) got no light perception throughout the entire duration of the operation. Forty one patients (53.9%) perceived only light during the surgery. The patients also described experiences of a variety of other visual sensations like moving objects (19 patients, 25%), which including instruments (8 patients, 10.5%), the surgeon's fingers or hands (9 patients, 11.8%), and the surgeon or medical staff (2 patients, 2.6%).

All the sixty patients (78.9%) experienced more than light sensations reported that they had the perception of colors. Some patients could even see different colors during the surgery. The various colors reported were yellow (24 patients, 31.6%), white (32 patients, 42.1%), red (5 patients, 6.6%), green (5 patients, 6.6%), blue (5 patients, 6.6%), and nonspecific, uncertain colors (2 patient, 2.6%).

Fifty seven patients (75%) felt nervous or afraid before the vitreous surgery. The number declined into 39 (51.3%) after the process of the operation. Twenty patients (26.32%) had a desire for general anesthesia when the questionnaire was filled before the operation, wherever this became 8 (10.5%) after the surgery.

We found that the characteristics of patients had no significant association between the different visual sensations (moving object, light perception only, and no light perception) during the vitreous surgery under regional anesthesia. There were no conspicuous differences between

Table 1. Characteristics of patients undergoing vitreous surgery under regional anesthesia (n=76)

Characteristics	Number of Patients	Percentage of Patients
Gender		
Male	50	65.79%
Female	26	34.21%
Mean age (±SD)		
All patients	41.47±17.70 (range ,15-83)	
Male	36.29±17.24 (range ,15-83)	
Female	52.04±13.65 (range ,26-76)	
Eye operated		
Right	35	46.05%
Left	41	53.95%
Education background (university or not)		
Yes	24	31.58%
Not	52	68.42%
Preoperative best-corrected visual acuity (BCVA)		
20/20-20/40	14	18.42%
20/50-20/150	17	22.37%
20/200 & worse	45	59.21%
Reason for surgery		
Vitreous hemorrhage	22	28.95%
Retinal detachment	45	59.21%
Macular epiretinal membrane or macular hole	9	11.84%
Preoperative sensation (nervous or not)		
Yes	57	75%
Not	19	25%
Desire for general anesthesia before surgery		
Yes	20	26.32%
Not	56	73.68%

BCVA= best-corrected visual acuity; SD= standard deviation

various perception and the age, gender, eye operated on, education background, etiological factor (vitreous hemorrhage, retinal detachment, or macular disease), or preoperative felling (nervous or afraid). The relationship between preoperative best corrected visual acuity (BCVA) (20/200 and better or with finger counting and worse) and the proportion of patients who experienced the different visual sensations among patients also of no statistically difference (p=0.570) (**Table 2**).

There were no significant statistical differences between a pain experience and the patients who only perceived light and no light perception. The fear experience and the desire for general anesthesia after vitreous operation were also of no obvious relationship in the two groups (**Table 3**).

The patients who perceived moving objects or light perception only had experienced different colors during the whole operation. Yellow (24/76, 31.6%) and white (32/76, 42.1%) were the most two colors perceived in both of the two groups. There was no significant relationship between pain and fear in the two groups. A higher proportion of patients who perceived moving objects (12 patients, 63.2%) were frightened compared with those who could only experienced light sensation (20 patients, 48.8%) although this difference was not statistically significant (P=0.073) (**Table 4**).

Patients with better preoperative BCVA were more likely to be frightened (p=0.002). Besides, patients who were frightened by their visual experiences were more likely to see moving objects (14 patients, 35.9%) than those who were not frightened (5 patients, 13.5%). There was no significant association between a frightening visual experience and the patient's gender, eye operated on, education background, light and color perception, or the pain perceived during

Table 2. Comparison of possible factors of patients who can see moving object, light perception only or no light perception during vitreous surgery under regional anesthesia

Characteristics	Moving Object(%) (n=19)	Light Perception Only(%)(n=41)	No light Perception (%)(n=16)	P value
Gender				0.896
Male	13(68.4%)	26(63.4%)	11(68.8%)	
Female	6(31.6%)	15(36.6%)	5(31.2%)	
Mean age (±SD)				
All patients	45.21±16.23	40.78±17.29	38.81±20.63	0.536
Male	43.15±16.48	35.22±17.49	30.82±16.36	0.197
Female	49.67±16.19	51.5±10.97	56.4±19.11	0.717
Eye operated				0.873
Right	8(42.1%)	20(48.8%)	7(43.8%)	
Left	11(57.9%)	21(51.2%)	9(56.3%)	
Education background (university or not)				0.335
Yes	8(42.1%)	10(24.4%)	6(37.5%)	
Not	11(57.9%)	31(75.6%)	10(62.5%)	
Preoperative best-corrected visual acuity (BCVA)				0.570
20/20-20/40	4(21.1%)	7(17.1%)	3(18.8%)	
20/50-20/150	6(31.6%)	8(19.5%)	3(18.8%)	
20/200 & worse	9(47.4%)	26(63.4%)	10(62.5%)	
Reason for surgery				0.538
Vitreous hemorrhage	6(31.6%)	10(24.4%)	6(37.5%)	
Retinal detachment	12(63.2%)	25(61.0%)	8(50.0%)	
Macular hole or macular epiretinal membrane	1(5.3%)	6(14.6%)	2(12.5%)	
Preoperative sensation (nervous or not)				0.782
Yes	15(78.9%)	31(75.6%)	11(68.8%)	
Not	4(21.1%)	10(24.4%)	5(31.2%)	
Desire for general anesthesia before surgery				0.476
Yes	7(36.8%)	9(22.0%)	4(25.0%)	
Not	12(63.2%)	32(78.0%)	12(75.0%)	

BCVA= best-corrected visual acuity; SD= standard deviation

the surgery (**Table 5**).

Twenty patients (26.3%) had a desire for general anesthesia before the operation to avoid experiencing the intraoperative visual experiences, even after they were informed the complications might associate with general anesthesia. Eight patients (10.5%) indicated that they would have preferred general anesthesia after the surgery. Seven of 8 (87.5%) were men and 1 (12.5%) was women. The mean age of them was 34.13 (range, 19 to 73 years, standard deviation SD±18.60). Seven patients (87.5%) felt pain during the operation. Three patients (37.5%) chose regional anesthesia before operation (**Table 6**).

Discussion

Since more and more ophthalmic surgery is undergoing local anaesthesia, it has brought about an increasing awareness of the patient's subjective visual experiences during the operation. As cataract surgery is the most common and routine type of the intraocular surgery performed under local anesthesia, it has been widely reported previously [6-10]. In addition to seeing bright light, patients have reported see-

Table 3. Comparison of intraoperative visual experiences of patients who had light perception only and no light perception during vitreous surgery under regional anesthesia

Characteristics	Light Perception Only (%)(n=41)	No Light Perception(%) (n=16)	P value
Pain			0.269
Yes	27 (65.9%)	8 (50%)	
Not	14 (34.1%)	8 (50%)	
Fear			0.231
Yes	20 (48.8%)	5 (31.3%)	
Not	21 (51.2%)	11 (68.7%)	
Desire for general anesthesia after surgery			0.534
Yes	3 (7.3%)	2 (12.5%)	
Not	38(92.7%)	14(87.5%)	

Table 4. Comparison of intraoperative visual experiences of patients who perceived moving object and light perception only during vitreous surgery under regional anesthesia

Characteristics	Moving object (%) (n=19)	Light Perception (%)Only(n=41)	P value
Color of Light*			0.393
Yellow	10(52.6%)	14(34.1%)	
White	9(47.4%)	23(56.1%)	
Red	3(15.8%)	2(4.9%)	
Green	1(5.3%)	4(9.8%)	
Blue	1(5.3%)	2(4.9%)	
Uncertain	0	2(4.9%)	
Pain			0.839
Yes	12(63.2%)	27(65.9%)	
Not	7(36.8%)	14(34.1%)	
Fear			0.070
Yes	14 (63.2%)	20(48.8%)	
Not	5 (36.8%)	21(51.2%)	
Desire for general anesthesia after surgery			0.309
Yes	3(15.8%)	3(7.3%)	
Not	16(84.2%)	38(92.7%)	

* Some patients perceived more than 1 kind of colors.

ing various other visual perceptions. Although the surgical procedures differ considerably between cataract surgery and vitreous operation, our study demonstrates that most patients (60, 78.9%) retain at least light perception during the entire surgery. Sixteen (21.1%) of the patients reported a total loss of light perception, indicating that neural conduction along the optic nerve was completely blocked. This compared favorably with previous reports [3, 4, 9, 11, 12]. However, the proportion is higher than cataract surgery which ranged from 0% to 20% [13, 14]. The possible reason might be summarized as the volume of anesthetic agent, preexisting ocular pathology, the surgical procedure, the duration of the surgery, the mental status before operation, and so on.

We previously thought that the basic characteristics such as gender, age, the eye being operated on, education background, preoperative BCVA, or etiological factor might play a role in the visual experiences during the vitreous operation. However, our study showed no statistically difference when we compared the characteristics of the 3 groups of patients who had perceived moving objects, light sensation only, and no light perception (**Table 2**). Comparison of intraoperative visual experience of the 3 groups of patients is also of no significant difference

Table 5. Comparison of intraoperative visual experiences of patients who felt frightened against those who were not frightened

Characteristics	Patients who felt frightened (%) (n=39)	Patients who were not frightened (%) (n=37)	P value
Gender			0.750
Male	25(64.1%)	25(67.6%)	
Female	14(35.9%)	12(32.4%)	
Age			0.253
Below 50 years	29(74.4%)	23(62.2%)	
Above 50 years	10(25.6%)	14(37.8%)	
Eye operated			0.985
Right	18(46.2%)	17(45.9%)	
Left	21(53.8%)	20(54.1%)	
Education background (university or not)			0.876
Yes	12(30.8%)	12(32.4%)	
Not	27(69.2%)	25(67.6%)	
Preoperative best-corrected visual acuity (BCVA)			0.002*
20/20-20/40	13(33.3%)	1(2.7%)	
20/50-20/150	6(15.4%)	11(29.7%)	
20/200 & worse	20(51.3%)	25(67.6)	
Moving object			0.024*
Present	14(35.9%)	5(13.5%)	
Absent	25(64.1%)	32(86.5%)	
Light perception			0.071
Present	34(87.2%)	26(70.3%)	
Absent	5(12.8%)	11(29.7%)	
Colors			0.071
Present	34(87.2%)	26(70.3%)	
Absent	5(12.8%)	11(29.7%)	
Pain			0.955
Present	24(61.5%)	23(62.2%)	
Absent	15(38.5%)	14(37.8%)	

BCVA= best-corrected visual acuity * P<0.05

(**Table 3, 4**). That might means whatever patients perceived during the operation, moving objects, light only, or no light perception, the visual experience is identical in statistic. Gender, age, the eye being operated on, education background, preoperative BCVA, and etiological factor are not the primary key open the journey of their visual experience during vitreous surgery under local anesthesia.

Perception of fear is of the most interest during the entire surgery in majority previous reports. A frightening visual experience is clinically significant because it may lead to a sympathetic surge resulting in unwanted systemic side effects like tachycardia, hypertension, hyperventilation, and acute panic attacks [15]. The satisfaction of the operation could also be declined because of the frightened visual experience. It could make more patients choose general anesthesia next time if possible, and recommend to their friends. Thirty nine patients (51.3%) were frightened during their intraoperative visual experiences in our study. This proportion is much higher than patients undergoing cataract surgery and other vitreous operation [1, 3, 8, 10, 11, 12, 16, 17]. The possible reason might be the difference of education background. Fifty two patients (68.42%) in our study had never gone to college, and almost half of them came from rural area in China mainland. The use of preoperative counseling is of much importance

Table 6. Characteristics of patients who want general anesthesia after vitreous surgery under regional anesthesia (n=7)

Characteristics	Number of Patients	Percentage of Patients
Gender		
Male	7	87.5%
Female	1	12.5%
Eye operated		
Right	4	50%
Left	4	50%
Education background (university or not)		
Yes	5	62.5%
Not	3	37.5%
Preoperative best-corrected visual acuity (BCVA)		
20/20-20/40	3	37.5%
20/50-20/150	1	12.5%
20/200 & worse	4	50%
Reason for surgery		
Vitreous hemorrhage	3	37.5%
Retinal detachment	1	12.5%
Macular epiretinal membrane or macular hole	4	50%
Preoperative sensation (nervous or not)		
Yes	6	75%
Not	2	25%
Intraoperative visual experience		
Moving object	1	12.5%
Light perception only	5	62.5%
No light perception	2	25%
Color of Light		
Yes	6	75%
Not	2	25%
Pain		
Yes	7	87.5%
Not	1	12.5%
Fear		
Yes	3	37.5%
Not	5	62.5%

BCVA= best-corrected visual acuity

to prevent fright associated with visual experiences. Less understanding of preoperative counseling could significantly increase the fear sensation during the surgery after controlling for age, gender, and whether it was first or second eye operation [18].

Our study showed preoperative BCVA play an important role in patients who were frightened during their visual experience. Patients with better preoperative BCVA were more likely to be frightened (p=0.002). Meanwhile, the frightened experience was affected notably by the different perceptions during operation, moving object (p=0.024), light (p=0.071), and color (p=0.071) (**Table 5**). It is possibly because that the more and clear patients perceived the more inconceivability would happen. That might make them frightened. However, the data seemed conversely with the frighten experience in **Table 3** and **Table 4**. Although there was no statistical significance when we compared the 3 groups of visual experiences, more patients frightened in moving objects group (63.2%) and light perception only group (48.8%) than no light perception group (31.3%).

The multicenter study of Tan and associates showed that younger patients were statistically more likely to be frightened [3]. Some studies on patients undergoing cataract surgery also have reported similar findings in spite of the

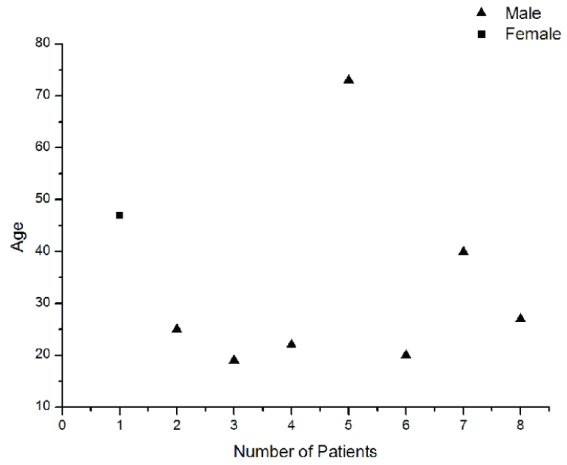

Figure 1. Characteristics of age distribution of patients who would like to choose general anesthesia after the vitreous surgery. Patients below 50 years old, especially from 20 to 30, were more likely to choose general anesthesia after the vitreous surgery.

differences were not statistically significant [1, 8, 16, 17]. In spite of no statistical difference in age in our study (p=0.253), we found patients below 50 years (29 patients, 38.2%) seemed more likely to be frightened compared with those aged 50 or older.

Fifty seven patients (75%) felt nervous or afraid, and 20 (26.32%) had a desire for general anesthesia when the questionnaire was filled before the operation. Eight patients (10.5%) insisted on general anesthesia after the surgery, even after being counseled on the higher risks associated with this form of anesthesia. This proportion is similar to the 7.7% in the multicenter study and a research about the cataract surgery [1, 3, 8]. Furthermore, we found patients below 50 years old, especially from 20 to 30, were more likely to choose general anesthesia after the vitreous surgery (**Figure 1**). Male patients (87.5%) and intraoperative pain perception (87.5%) might likewise contribute to the decision of general anesthesia (**Table 6**).

Subjective visual experiences during intraocular ophthalmic surgery like cataract, glaucoma, or vitreous surgery under regional anesthesia are now been well recognized. However, mechanisms of these visual perceptions are less understood. It might be a combination of images of objects close to but outside the eye, such as fingers and instruments, and entoptic phenomena produced by objects and structures on the corneal surface and in the eye [19]. The most likely explanation for visual perception is a combination of optical and entoptic phenomena [20]. Further researches need to focus on the genesis of visual experience and the different stage of visual sensation during the vitreous operation.

Our study demonstrated that most patients (78.9%) experienced at least light perception during the vitreous surgery under local anesthesia. There were no significant differences between the various visual experiences (moving object, light perception only, and no light perception) and their basic characteristics. About half of the patients perceived intraoperative frightened experience, which was much higher than previous reports. Patients with better preoperative BCVA, perceived moving objects in their visual sensations seemed more likely to be frightened. Additionally, we found patients below 50 years old, especially from 20 to 30 were more willing to choose general anesthesia after the vitreous surgery.

Acknowledgement

None. No authors have any financial/conflicting interests to disclose.

Address correspondence to: Yi-Fei Huang, Department of Ophthalmology, Chinese PLA General Hospital, 28 Fuxing Road, Haidian District, Beijing 100853, China Tel: 86-10-66937943; Fax: 86-10-68286682; E-mail: huangyf301@gmail.com

References

[1] Au Eong KG, Low CH, Heng WJ, et al. Subjective visual experience during phacoemulsification and intraocular lens implantation under topical anesthesia. Ophthalmology 2000; 107: 248–50.

[2] Prasad N, Kumar CM, Patil BB, Dowd TC. Subjective visual experience during phacoemulsification cataract surgery under sub-Tenon's block. Eye (Lond) 2003; 17: 407-9.

[3] Tan CS, Mahmood U, O'Brien PD, et al. Visual experiences during vitreous surgery under regional anesthesia: a multicenter study. Am J Ophthalmol 2005; 140: 971-5.

[4] Sugisaka E, Shinoda K, Ishida S, et al. Patients' descriptions of visual sensations during pars plana vitrectomy under retrobulbar anesthesia. Am J Ophthalmol 2007; 144: 245-51.

[5] Laude A, Eong Au, Mills KB. Knowledge of vis-

ual experience during cataract surgery under local anaesthesia: a nationwide survey of UK ophthalmologists. Br J Ophthalmol 2009; 93: 510-2.
[6] Murdoch IE, Sze P. Visual experience during cataract surgery. Eye (Lond) 1994; 8: 666–7.
[7] Newman DK. Visual experience during phacoemul-sification cataract surgery under topical anaesthesia. Br J Ophthalmol 2000; 84: 13-5.
[8] Yaylali V, Yildirim C, Tatlipinar S, Demirlenk I, Arik S, Ozden S. Subjective visual experience and pain level during phacoemulsification and intraocular lens implantation under topical anesthesia. Ophthalmologica 2003; 217: 413-6.
[9] Chung CF, Lai JS, Lam DS. Visual sensation during phacoemulsification and intraocular lens implantation using topical and regional anesthesia. J Cataract Refract Surg 2004; 30: 444–8.
[10] Ang CL, Au Eong KG, Lee SS, Chan SP, Tan CS. Patients' expectation and experience of visual sensations during phacoemulsification under topical anaesthesia. Eye(Lond) 2007; 21: 1162-7.
[11] Rengaraj V, Radhakrishnan M, Au Eong KG, et al. Visual experience during phacoemulsification under topical versus retrobulbar anesthesia: results of a prospective, randomized, controlled trial. Am J Ophthalmol 2004; 138: 782–7.
[12] Tan CS, Au Eong KG, Kumar CM. Visual experiences during cataract surgery: what anesthesia providers should know. Eur J Anaesthesiol 2005; 22: 413–9.
[13] Brent BD, Singh H. The effect of retrobulbar anesthesia on visual acuity in planned extracapsular cataract extraction. Ophthalmic Surg 1991; 22: 392-5.
[14] Schimek F, Steuhl KP, Fahle M. Retrobulbar blockade of somatic, motor, and visual nerves by local anesthetics. Ophthalmic Surg 1993; 24: 171-80.
[15] Tan CS, Rengaraj V, Au Eong KG. Visual experiences of cataract surgery. J Cataract Refract Surg 2003; 29: 1453–4.
[16] Au Eong KG, Lim TH, Lee HM, Yong VS. Subjective visual experience during phacoemulsification and intraocular lens implantation using retrobulbar anesthesia. J Cataract Refract Surg 2000; 26: 842-6.
[17] Tranos PG, Wickremasinghe SS, Sinclair N, et al. Visual perception during phacoemulsification cataract surgery under topical and regional anaesthesia. Acta Ophthalmol Scand 2003; 81: 118-22.
[18] Voon LW, Au Eong KG, Saw S-M, Verma D, Laude A. Effect of preoperative counseling on patient fear from the visual experience during phacoemulsification under topical anesthesia: multicentre randomized clinical trial. J Cataract Refract Surg 2005; 31: 1966-9.
[19] Sumich PM, Francis IC, Kappagoda MB, Alexander SL. Retained visual sensation during cataract surgery. Ophthalmology 2001; 108: 1003.
[20] Yavuz GA, Unver YB, Sinclair SH. Entoptic phenomenon following pars plana vitrectomy caused by retained preretinal gel. Ophthalmic Surg Lasers Imaging 2009; 40: 188-91.