Peribulbar Blocks: The Experience of a Specialized Ophthalmologic Surgery Centre

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Abstract

Background: Peribulbar blocks have been in clinical use for over half a century, but more recently the fear of complications has detracted many anaesthesiologists from their use, which has been decreasing in many countries. In this article we aim to characterize the safety profile of blocks performed at our Institution, by dedicated staff anaesthesiologists with vast experience.Methods: We performed a retrospective analysis of the anaesthetic register of patients undergoing peribulbar blocks for different ophthalmic procedures over a 9 months period, describing its safety, effectiveness and using logistic regression to identify possible factors influencing block quality.Results: In a total of 309 blocks there were 9 minor complications, none of which produced lasting consequences. Variables affecting sensory block depth were type of sedation during the block procedure, volume of local anaesthetic administered and type of surgery.

Index terms— anesthesia, regional ? nerve block ? eye ? ophthalmologic surgical procedures

1 I. Introduction

e've come a long way since the performance of the first invasive treatments for cataracts, dating back to the fifth century BC in India 1 . Nowadays, a whole range of Ophthalmologic procedures is available to treat many of the ailments once leading to inevitable blindness, in part boosted by the development of Anaesthesiology.

In striking opposition to what happened just a few decades ago, in most centers general anaesthesia is now seldom performed for ophthalmic surgery in mentally capable adults 2 (Table 1). Local and regional techniques allow not only avoidance of general anaesthesia in typically elderly patients with multiple comorbidities 2,3 , but also to take advantage of the faster recovery time loco-regional techniques allow 4,5 , which is particularly relevant when we consider the ambulatory setting usually involved. Many different options are available, be them topical anaesthesia, sub conjunctival anaesthesia, sub-Tenon's blocks, peribulbar blocks or retrobulbar blocks. Of course not all techniques are adequate for all types of surgery, but unfortunately there is no up-to-date in each case 2,6 , making practice differ considerably between institutions. In the current era of Medicine, where litigation is ever-increasing and feared, many professionals have now shifted their preference to topical anaesthesia with mild sedation whenever possible, as it perverts normal physiology the least and does not appear to be significantly associated with direct harm. After all, even though ophthalmic block complications (Table 2) are rare 7 , the risk is real 5,[8][9][10][11][12] , and the severity of potential consequences makes them the most frequent disabling injuries related to regional anaesthesia reported in the ASA Closed Claims Project database 10,13 , with retrobulbar blocks 14 in particular responsible for 38% of total permanent / disabling injuries in this part of the register. Unfortunately, this has been hampering the drive for block specialization and training of ophthalmic anaesthesiologists, representing a failed opportunity for those patients who would benefit the most from their use. Nowadays, in fact, some authors are so keen on using topical anaesthesia that they even advocate its adoption in carefully selected patients proposed for vitrectomy 5 -something unthinkable until recently and with many detractors. This despite concerns regarding patient satisfaction and surgical conditions.

Boezaart et al. conducted an interesting study in which patients who had cataract surgery for both eyes in different moments in time were assigned to receive combined peribulbar-retrobulbar block on one eye and topical

anaesthesia on the other. It was shown that patients generally preferred the intervention with the regional technique, which actually also helped make the surgery easier for the Ophthalmologist 15,16 . Accordingly, regional techniques remain the preferred anaesthetic approach for cataract surgery in some countries 17,18 , and are in fact regularly used at our own institution.

"Instituto Oftalmológico Dr. Gama Pinto" (IOGP) (Dr Gama Pinto Ophthalmology Center, located in Lisbon, Portugal) is a specialized stand-alone outpatient Ophthalmology centre whose Anaesthesiology team consists of 3 dedicated staff consultants performing peribulbar blocks on a routine basis since the year 2000, a fact that has allowed for considerable amount of experience to be gained. Considering the recent trend towards avoiding blocks in other countries, we decided to institute a register to keep track of all peribulbar blocks performed, so that an objective assessment of their safety could be made.

2 II. Methods

After obtaining approval from the local Ethics Committee we performed a retrospective analysis of the Anaesthetic register containing information from all patients who underwent a peribulbar block for ophthalmologic surgery at this Institution from December 1 st , 2014 to September 1 st 2015.

Throughout the study period no anaesthetic choices were influenced by the creation of the register, rather reflecting common local practice. Consequently, whenever clinically indicated, in the absence of contraindications and after the patient had manifested his/her informed consent, patients presenting for different ophthalmic surgeries were submitted to peribulbar blocks for surgical anaesthesia.

The blocks were performed using a doubleinjection technique, with inferolateral and superomedial approaches. A 27 G, 25 mm long Ophthalmic cannula with bevel (Steriseal TM , from Aspen Medical) was used, and a total volume of 1% ropivacaine cloridrate (Fresenius-Kabi TM) ranging from 4,0 to 6,0 mL was administered, depending on the intended surgery and anaesthesiologist's preference. After injection, external compression was routinely applied with a Honan balloon inflated to a pressure of 30 mm Hg and kept on for 12 minutes. Following block installation, its success was classified semi quantitatively on a scale of 1 to 3, 1 being insufficient, 2 sufficient and 3 very good, both for the sensory and motor aspects of blockade.

All these data were inserted into the register and later used to build a database imported into IBM SPSS Statistics TM version 21, which was used for all statistical calculations. We supplemented this study with data from anonymous inquiries to the surgeons, so that their views on the blocks performed at the institution could be assessed.

3 III. Results

During the study period we performed 309 blocks in a total of 267 patients, which means that some patients (34) were operated on more than once in this timeframe with a peribulbar block. In fact, one patient was actually intervened 5 times, always with a peribulbar block (repeat vitrectomies, both eyes).

To facilitate a prompt understanding of the data obtained we present them graphically, with Tables 3 and 4 summarizing patient characteristics in the sample, Table 5 focusing on the surgeries performed and Table 6 on the peribulbar blocks themselves. As we can see most patients were elderly with comorbidities, the most common of which involved the cardiovascular system (in 75,7% of blocks). Of note, 77 patients were also on antiplatelet medications at the time of surgery, and 15 were previously anticoagulated, having stopped the appropriate medications according to their respective half-lives or, in the case of warfarin and acenocumarol, INR 19 . Surgical procedures were divided into 4 classes for easier statistical treatment, with a clear predominance of facoemulsification and intraocular lens placement. Accordingly, almost half the interventions were relatively short (48,5% under 60 minutes). Sensory and motor block depth obtained is summarized in Table 6. a) Complications There were no complications with lasting sequelae in any of the 309 blocks performed. However, we did find a 2,9% rate of "adverse events", in a total of 9 cases, described on Table **??**.

Table **??**: Adverse events related to block performance in our study ? 2 cases of activation of the oculocardiac reflex, which responded promptly to atropine administration (one had received 6,0mL of local anaesthetic, the other 5,5mL); ? 4 accidental vessel punctures (always in the inferolateral approach), solved with reorientation of the needle; ? 2 palpebral ecchymosis (minor, which reabsorbed in a few days); ? 1 patient proposed for vitrectomy who became markedly anxious despite previous explanation of the block procedure and mild pre-block sedation and ultimately had to be induced (conversion to general anaesthesia before the start of the surgery).

4 b) Inferential analysis

We analysed the relations between sensory block success and the different collected variables. The data obtained did not allow for valid use of Chi-square tests nor multinomial logistic regression due to a markedly dissimilar distribution between classes. Therefore, we decided to study the set of data by removing the 6 patients with failed (class 1) sensory block and used binary logistic regression to analyse the remainder (binary outcome: class 3 versus class 2 sensory block). With this strategy we obtained statistically significant values for the relationship between the volume of local anaesthetic administered and the degree of sensory block obtained, with similar findings for the variables "type of surgery" and "use of propofol for sedation" (Table 8), but not for any of the comorbidities studied. We then built a multivariate logistic regression model, including the variables showing a positive relation

to the outcome in the univariate analysis and assessing their significance when considered together. As shown in Table 9, all of them maintained statistical significance. The resulting model was itself statistically significant, but there was still much variability not explained by it (Nagelkerke pseudo-R 2 of 0,234, correct classification rate of 84,8%, close to that of the null model). c) Surgeon questionnaires Table 10 summarizes the results obtained from anonymous questionnaires answered by Ophthalmologists.

5 IV. DISCUSSION

Most patients in this study were elderly, with a mean age of 73,5 and a median of 74 years old -as was to be expected considering the surgeries performed. Also in line with what is described in the literature 3 , the most common comorbidities affected the cardiovascular, endocrine and neurologic systems, adding to the complexity of perioperative management and making the alternative of peribulbar blocks particularly appealing.

6 a) Complications and adverse events

We should emphasize the inexistence of major complications in either of the 309 blocks performed, which is significant. Most likely, as defended by other authors, the fact that there is a dedicated, experienced anaesthesiology staff 3 routinely performing these blocks had an important influence on this safety profile. Still, we should mention that serious complications of peribulbar blocks reported in the literature are in the range of 1:1000 blocks 20 , and that means our study in underpowered to draw strong conclusions as to their overall safety. The adverse events mentioned in Table **??** were all minor and easily solved.

We also find it important to emphasize that in 77 blocks (24,9%) the patients were taking antiplatelet medications and in a further 15 (4,8%) they had been previously anticoagulated, having stopped the respective medications according to international guidelines 19 . These guidelines allow for block performance while on antiplatelet medications (as also defended elewhere [21][22][23]), and also suggest appropriate courses of action for anticoagulation -which were followed. Neither anticoagulated nor antiaggregated patients had significant haemorrhagic complications, and even in the two cases where a minor palpebral ecchymosis developed post-block none of them were taking any of these medications. As for patients with accidental vascular puncture, one was concurrently medicated with aspirin but still did not develop ecchymosis nor signs of intraorbital haemorrhage. Despite the relatively small sample, these results support international findings concerning safety in this setting.

Some authors uphold that the greatest risk factor for haemorrhagic complications is vessel fragility (from diabetes, prolonged arterial hypertension) and not drug-induced dyscrasia 19 . The same authors also advocate that the use of small, short needles is instrumental in the prevention of haemorrhagic complications, and we followed that rule. As for the puncture technique, they do suggest the avoidance of the superonasal injection, which we actually employed routinely. Interestingly, in our series vessel puncture and ecchymosis formation only occurred as a result of the inferolateral injection -not the superomedial one. Further studies with a larger sample size might help clarify the safety profile of this approach.

7 b) Effectiveness

Apart from safety, the second most important topic in peribulbar anaesthesia is no doubt its effectiveness rate, with some authors pointing the lack of predictability in block depth as its main drawback 3 . In some series the supplementation rate for peribulbar blocks is around 20% 24 , but can reach up to 66% when buckling surgery is considered 25 . In our study supplementation had to be performed in 6 cases (1,9%), but in an additional 15,9% the sensory block was not complete (grade 2), though deemed sufficient for surgery allowing adequate patient comfort and operating conditions with light 26 sedo-analgesia.

Regarding motor block, published studies attribute a 19% 20 to 28% 24 rate of poor akinesia to this type of anaesthetic technique. In our series, we had a total of 10,4% of blocks with insufficient (grade 1) motor block, and a further 27,2% of incomplete (grade 2) blocks, but such did not significantly impact the surgery.

8 c) Clues for improvement

Even though some authors found no correlation between volume of local anaesthetic and degree of block, they used volumes on average superior to ours 27 .

In our study, that relation was clearly present and statistically significant, not only as far as the amount of local anaesthetic is concerned but also in terms of type of surgery. While patients submitted to predictably more painful surgeries were already receiving a higher volume of local anaesthetic (at the anaesthesiologist's discretion), the lack of statistical significance for the interaction term between both in a logistic regression model evidences that this empirical compensation attempt did not completely succeed. The same is suggested by the fact that in more aggressive surgeries, even with larger volumes of LA, the percentage of complete sensory block was found to be smaller (Figures **??** and 2). Therefore, we should consider that patients submitted to vitrectomy (either alone or with facoemulsification and intraocular lens placement) may benefit from routinely receiving higher volumes of local anaesthetic than those actually administered in our daily practice. Further insight into the problem could be brought forth by the use of ultrasound to confirm adequate spread of local anesthetic 13 , the pattern of which appears to correlate with the efficacy of the block 24 . However, that is not routinely performed at our institution and corresponding data were thus not available in our series. Another interesting

point showing promise to improve our practice was the fact that propofol administration prior to the block procedure (on average 20mg) showed an OR of 2,462 (confidence interval: 1,215-4,991) in obtaining a class 3 as opposed to class 2 sensory block when compared to its absence (sedation with diazepam alone or no sedation). This suggests that patient conditions during block performance (anxiolysis, immobility and probably peribulbar muscle tone) are likely more favourable when propofol is used, suggesting we should rethink our practice in order to employ it more often. Clearly, future studies should assess whether such change could improve overall results. In the available literature some authors have suggested routinely including propofol in the sedation regimen for these patients, as a combination of midazolam, propofol and fentanyl in small doses 28 -though to our knowledge there was no proof of better block results consequent to its adoption.

9 d) Thoughts on using the Honan baloon

We have previously mentioned that at our institution ocular compression devices are routinely used after local anaesthetic injection, even though there is controversy in the literature concerning its efficacy. Some authors argue that compression has not been shown to enhance the quality of the block 3 and consequently elect not to use it routinely 27 . One study found no statistically significant changes in analgesia and/or akinesia with or without Honan balloon compression 29,30 , but it should be emphasized that the minimum amount of local anaesthetic used was 7 mLnot 4 mL like in ours. Other authors 8 (though not all 29) also mention that intraocular pressure (IOP) values before and after a period of balloon compression following injection of small volumes of local anaesthetic are similar. Though this fact has not been specifically addressed in our work, we believe compression may be particularly important when small volumes of local anaesthetic are used, probably not so much from the point of view of lowering IOP after injection into a confined space (as the volume used was relatively small) but mainly to facilitate appropriate diffusion of the local anaesthetic. Still, our data cannot confirm or refute this reasoning, which is also doubtful in the literature. Should higher volumes of local anaesthetic start to be used routinely, as suggested by our data analysis, clearly this matter should be readdressed.

10 e) Patient and surgeon satisfaction

While we do not have objective data concerning patient satisfaction with peribulbar blocks, we asked ophthalmologists in anonymous questionnaires what was their take on the subject, given that they routinely follow patients early in the postoperative period. Analysing the data from the 25 inquiries returned to us we found that only one of those surgeons thought patients were dissatisfied with the technique, with 20 (80%) considering their patient's satisfaction level was good or very good. The fact that 34 patients during the study period were operated on twice or more with peribulbar blocks also attests to their acceptance and satisfaction with the blocks, especially considering that their opinion is always taken into account at the time of choosing the anaesthetic technique.

One surgeon considered sensory-motor block to be usually inadequate with this technique, whereas the remaining 96% stated that it was usually adequate. 84% mentioned that their own degree of satisfaction with the technique was either good or very good, but none of those inquired would elect a peribulbar block as a first choice for an uncomplicated facoemulsification procedure with intraocular lens implantation (Figure 3). It is interesting to note that if the surgeon's themselves were to be intervened on, a significant proportion would rather receive a general anaesthetic (Figure 4), in frank opposition to what they chose for their patients. f) Limitations to the study Some limitations to the present study should be mentioned. To begin with, it was a retrospective study, drawing on previously collected data on the register, and such clearly limits the analysis to existing information. As an example, the grading system used for assessment of block depth was qualitative, and it would be interesting to use existing validated scores such as OASS (Ocular Anaesthetic Scoring System 31). Given its retrospective nature, however, with pre-existing data coded differently, such was not possible. It would also be interesting to analyse different aspects such as interference of block procedure on case turnover time, comparison of PONV and pain scores in patients submitted to peribulbar blocks versus general anaesthesia versus topical anaesthesia, but once again such data were not available for analysis.

Additionally, the fact that there was some variability in local anaesthetic volume administration, which was not protocolled but rather decided upon by the anaesthesiologist in normal daily practice taking into account the type of intended surgery, harboured a strong potential to become a confounding factor. However, statistical significance in the results obtained and testing for an interaction term minimized its influence.

Finally, we should realize that the rarity of complications advises larger studies to draw firm conclusions as to their incidence, and would also help create a logistic or even a multiple linear regression model with a higher discriminant value.

11 V. Conclusion

Despite the existence of risks, the present work suggests a favourable safety profile for peribulbar blocks, even in antiaggregated/anticoagulated patients -at least when performed by experienced, dedicated anaesthesiologists.

However, larger, adequately powered studies are advised to correctly define the incidence of complications.

Sample size limitations aside, some factors do appear to be positively related to the degree of intraoperative sensation, namely aggressiveness of surgery (naturally), amount of local anaesthetic administered and sedation

with propofol versus diazepam for the block procedure. Because the latter two variables can easily be manipulated, they present an opportunity to improve local practice increasing block effectiveness rates and, ultimately, patient care.

12 Competing Interests

The authors received no external funding for this work and have no competing interests to declare. [1]

Figure 1: F

Figure 2: F

Figure 3: F

Figure 4: F

12 

Figure 5: Figure 1 :FFigure 2 :

Figure 6: F

3

Figure 7: Figure 3 :

4

Figure 8: Figure 4 :

Figure 9: F

1

- ? Children
- ? Patients unable to cooperate either psychologically or due to communication problems
- ? Intense tremor or nystagmus
- ? Perforating eye injury
- ? Blindness in the non-operated eye (relative)
- ? Persistent cough
- ? Inability to tolerate the recumbent position
- ? Contraindication to other techniques, such as allergy to local anaesthetics
- ? Cases of block failure despite adequate supplementation

Figure 10: Table 1 :

2

Figure 11: Table 2 :

3

	Feature	Frequency	Percentage
	<40 years old	1	0,3%
	[40;50[years old	4	1,3%
	[50;60[years old	26	8,4%
Age (years)	[60;70[years old	71	23,0%
	[70;80[years old	123	39,8%
	[80;90[years old	77	24,9%
	?90 years old	7	2,3%
Sex	Female Male	149 160	48,2% 51,8%
	I	7	2,3%
ASA Class	II	218	70,6%
	III	84	27,2%

Figure 12: Table 3 :

4

System	Disease	Frequency	Percentage
	Coronary artery disease	12	3,88%
	Previous myocardial infarction in the last 6 months	9	2,91%
	Aortic valve implantation	2	0,65%
Cardiovascular system	Heart failure	5	1,62%
	Arterial Hypertension	218	70,55%
	Atrial Fibrillation	15	4,85%
	Pacemaker	6	1,94%
	Other dysrhythmia	16	5,18%
	Aspirin	62	20,06%
Treatment with antiaggregant or anticoagulant drugs	Clopidogrel Warfarin Dabigatran	15 9 4	4,85% 2,91% 1,29%
	Rivaroxaban	2	0,65%
	Type 2 DM	85	27,51%
Endocrine system	Thyroid pathology	15	4,85%
	Obesity	10	3,24%
Psychiatric disturbances	Depression	16	5,18%
	Generalized anxiety disorder	20	6,47%
	Cerebrovascular Transient ischaemic attack / accident	18	5,83%
Neurologic system	Epilepsy	3	0,97%
	Dementia	2	0,65%
	Parkinson's disease	4	1,29%
	Hypoacusia	5	1,62%
	COPD	12	3,88%
Respiratory system	Emphysema	3	0,97%
	Asthma	5	1,62%
	Rheumatoid arthritis	5	1,62%
Miscellaneous	Chronic kidney disease Hepatic dysfunction	6 3	1,94% 0,97%
	Others	8	2,59%

[Note: Peribulbar Blocks: The Experience of a Specialized Ophthalmologic Surgery Centre]

Figure 13: Table 4 :

5

Type of Surgery	Facoemulsification + intraocular lens implantation	147	47,6%
	Vitrectomy via pars plana / cerclage / endolaser Vitrectomy via pars plana / cerclage / endolaser + IOL implantation	79 57	25,6% 18,4%
	Trabeculectomy / ExPRESS TM valve placement / Cyclophoto-coagulation	26	8,4%
Duration of surgery	< 30 min	29	9,4%
	[30;60[min	121	39,1%
	[60;120[min	110	35,6%
	[120;180[min	42	13,6%
	? 180 min	7	2,3%

Figure 14: Table 5 :

6

Type of sedation for block	Propofol	134	43,4%
	No propofol (diazepam)	166	53,7%
	No sedation	9	2,9%
Volume of local anaesthetic administered	4,0 mL	16	5,2%
	4,5 mL 5,0 mL 5,5 mL	37 124 73	12,0% 40,1% 23,6%
	6,0 mL	59	19,1%
Degree of sensory block attained	1 2 3	6 49 254	1,9% 15,9% 82,2%
Degree of motor block attained	1 2 3	32 84 193	10,4% 27,2% 62,4%

Figure 15: Table 6 :

8

Independent variable	Omnibus test	Wald statistic	Hosmer-Lemeshow
Volume local anaesthetic	p<0,001	p<0,001	p>0,05
Type of surgery	p=0,003	p=0,005	p>0,05
Propofol use	p=0,001	p=0,002	p>0,05

Figure 16: Table 8 :

9

	Model characteristics in general	
Omnibus test	p<0,001	Statistically significant (differs from the null model)
Hosmer-Lemeshow test	p=0,965	Adequate fit of the model to the data
Nagelkerke's pseudo-R 2	0,234	Poor predictive value of the model
Correct classification rate	84,8%	Close to the null model's -poor discrimination of the model
	Variable characteristics in the model	
Independent variable	Wald statistic	p-value
Volume local anaesthetic	19,961	P=0,001
Type of surgery	8,299	p>0,040
Propofol use	6,248	P=0,012

Figure 17: Table 9 :

10

Question	Possible options	Frequency
Professional experience	Resident	7
	Fellow for less than 5 years	0
	Fellow for 5-9 years	2
	Fellow for 10 or more years	16
If you could choose the anaesthetic technique for your patient, what would you prefer if he/she were to be s		
	Topical anaesthesia	19
Facoemulsification + intraocular lens placement	Topical anaesthesia + intracameral injection of LA Peribulbar block	5 0
	General anaesthesia	1
	No response	0
	Topical anaesthesia	1
Extracapsular cataract extraction	Topical anaesthesia + intracameral injection	4
	of LA Peribulbar block	17
	General anaesthesia	2
	No response	1
	Peribulbar block	10
Vitrectomy	General anaesthesia	8
	No response	7
	Topical anaesthesia	0
Cyclophotocoagulation / cryoapplication	Topical anaesthesia + intracameral injection	0
	of LA Peribulbar block	24
	General anaesthesia	0
	No response	0
If you were Facoemulsification + intraocular lens placement	Topical anaesthesia Topical anaesthesia + intracameral injection of LA Peribulbar block	9 4 0
	General anaesthesia	12
	No response	0
Extracapsular cataract extraction	Topical anaesthesia Topical anaesthesia +	0 4

Figure 18: Table 10 :

[Saudi Med J ()] , *Saudi Med J* 2007. 28 p. .

[Oman J Ophthalmol ()] , *Oman J Ophthalmol* 2010. 3 p. .

[Cehajic-Kapetanovic et al. ()] 'A novel Ocular Anaesthetic Scoring System, OASS, tool to measure both motor and sensory function following local anaesthesia'. J Cehajic-Kapetanovic , P N Bishop , S Liyanage , T King , M Muldoon , I M Wearne . *Br J Ophthalmol* 2010. 94 p. .

[Kallio and Rosenberg ()] 'Advances in ophthalmic regional anaesthesia'. H Kallio , P H Rosenberg . *Best practice & Research Clinical Anaesthesiology* 2005. 19 p. .

[Clarke and Plummer ()] 'Adverse events associated with regional ophthalmic anaesthesia in an Australian teaching hospital'. J P Clarke , J Plummer . *Anaesth Intensive Care* 2011. 39 p. .

[Nouvellon et al. ()] 'Anaesthesia for Cataract Surgery'. E Nouvellon , P Cuvillon , J Ripart , E J Viel . *Drugs Aging* 2010. 27 p. .

[Eichel and Goldberg ()] 'Anaesthesia techniques for cataract surgery: a survey of delegates to the Congress of the International Council of Ophthalmology'. R Eichel , I Goldberg . *Clin Experiment Ophthalmol* 2002. 2005. 33 p. .

[Clausel et al. ()] 'Anesthésie péribulbaire: efficacité d'une seule injection et d'un volume d'anesthésiques locaux limité'. H Clausel , L Touffet , M Havaux , M Lamard , J Savean , B Cochener , C Arvieux , G Gueret . *J Fr Ophtalmol* 2008. 31 p. .

[Mavrakanas et al. ()] 'Are ocular injection anesthetic blocks obsolete? Indications and guidelines'. N A Mavrakanas , C Stathopoulos , J S Schutz . *Curr Opin Ophthalmol* 2011. 22 p. .

[Celiker et al.] *Comparison of midazolam, propofol and fentanyl combinations for sedation and hemodynamic parameters in cataract extraction*, V Celiker , E Basgul , A Sahin , S Uzun , B Bahadir , U Aypar .

[Mahajan et al. ()] 'Comparison of topical anesthesia and peribulbar anesthesia for 23-gauge vitrectomy without sedation'. D Mahajan , S Sain , S Azad , T Arora , R Azad . *Retina* 2013. 33 p. .

[Lee et al. ()] 'Complications associated with peripheral nerve blocks: lessons from the ASA Closed Claims Project'. L A Lee , K L Posner , C D Kent , K B Domino . *Int Anesthesiol Clin* 2011. 49 p. .

[Adekoya et al. ()] 'Current practice of ophthalmic anesthesia in Nigeria'. B J Adekoya , A O Onakoya , B G Balogun , O Oworu . *Middle East Afr J Ophthalmol* 2013. 20 p. .

[Ling et al. ()] 'Effect of Honan balloon compression on peribulbar anesthesia adequacy in cataract surgery'. R Ling , B Beigi , A Quinn , J Jacob , B Foot , T Eke . *J Cataract Refract Surg* 2002. 28 p. .

[Riad ()] 'Effect of pressure-reducing devices on the quality of anterior orbit anesthesia'. W Riad . *J Anesth* 2011. 25 p. .

[Hendrick et al. ()] 'Efficacy and safety of single injection peribulbar block performed by anesthesiologists prior to cataract surgery'. S W Hendrick , M K Rosenberg , M H Lebendom-Mansour . *J Clin Anesth* 1997. 9 p. .

[Kallio et al. ()] 'Haemorrhage and risk factors associated with retrobulbar / peribulbar block: a prospective study in 1383 patients'. H Kallio , M Paloheimo , E-L Maunuksela . *Br J Anaesth* 2000. 85 p. .

[Katz et al. ()] 'Injectable versus topical anesthesia for cataract surgery -Patient perceptions of pain and side effects'. J Katz , M A Feldman , E B Bass , L H Lubomski , J M Tielsch , B G Petty , L A Fleisher , O D Schein . *Ophthalmology* 2000. 107 p. .

[Newsom et al. ()] 'Local anaesthesia for 1221 vitreoretinal procedures'. Rsb Newsom , A C Wainwright , C R Canning . *Br J Ophthalmol* 2001. 85 p. .

[Bonhomme et al. ()] 'Management of antithrombotic therapies in patients scheduled for eye surgery'. F Bonhomme , F Hafezi , F Boehlen , W Habre . *Eur J Anaesthesiol* 2013. 30 p. .

[Jaichandran ()] 'Ophthalmic regional anaesthesia: A review and update'. V V Jaichandran . *Indian J Anaesth* 2013. 57 p. .

[Rizzo et al. ()] 'Peribulbar anesthesia: a percutaneous single injection technique with a small volume of anesthetic'. L Rizzo , M Marini , C Rosati , I Calamai , M Nesi , R Salvini , C Mazzini , F Campana , E Brizzi . *Anesth Analg* 2005. 100 p. .

[Calenda et al. ()] 'Peribulbar block in 500 patients scheduled for eye procedures and treated with acetyl salicylic acid'. E Calenda , A Cardon-Guiton , O Genevois , J Gueudry , M Muraine . *Acta Anaesthesiol Taiwan* 2011. 49 p. .

[Calenda et al. ()] 'Peribulbar block in patients scheduled for eye procedures and treated with clopidogrel'. E Calenda , L Lamothe , O Genevois , A Cardon , M Muraine . *J Anesth* 2012. 26 p. .

[Riad ()] 'Peribulbar blockade with a short needle for phacoemulsification surgery'. W Riad . *Acta Anaesthesiol Scand* 2009. 53 p. .

12 COMPETING INTERESTS

[Peribulbar Blocks: The Experience of a Specialized Ophthalmologic Surgery Centre] *Peribulbar Blocks: The Experience of a Specialized Ophthalmologic Surgery Centre*,

[Alhassan et al. ()] *Peribulbar versus retrobulbar anaesthesia for cataract surgery (Review). The Cochrane Library*, M B Alhassan , F Kyari , Hod Ejere . 2011. 4 p. .

[Luyet et al. ()] 'Real-time evaluation of diffusion of the local anesthetic solution during peribulbar block using ultrasound imaging and clinical correlates of diffusion'. C Luyet , K T Eng , P J Kertes , A Avila , R H Muni , P Mchardy . *Reg Anesth Pain Med* 2012. 37 p. .

[Chandradeva et al. ()] 'Role of the anaesthetist during cataract surgery under local anaesthesia in the UK: a national survey'. K Chandradeva , V Nangalia , C E Hugkulstone . *Br J Anaesth* 2010. 104 p. .

[Ahmad et al. ()] 'Satisfaction level with topical versus peribulbar anesthesia experienced by same patient for phacoemulsification'. N Ahmad , A Zahoor , S A Motowa , S Jastaneiah , W Riad . *Saudi J Anaesth* 2012. 6 p. .

[Frow et al. ()] 'Single injection peribulbar anaesthesia'. M W Frow , J I Miranda-Caraballo , T M Akhtar , C E Hugkulstone . *Anaesthesia* 2000. 55 p. .

[Friedman et al. ()] 'Synthesis of the literature on the effectiveness of regional anesthesia for cataract surgery'. D S Friedman , E B Bass , L H Lubomski , L A Fleisher , J H Kempen , J Magaziner , M Sprintz , K Robinson , O D Schein . *Ophthalmology* 2001. 108 p. .

[Boezaart et al. ()] 'Topical anesthesia versus retrobulbar block for cataract surgery: the patient's perspective'. A Boezaart , R Berry , M Nell . *J Clin Anesth* 2000. 12 p. .