Anaesthesia-related diplopia after cataract surgery

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Background. We studied the incidence and clinical characteristics of persistent diplopia related to anaesthesia for cataract surgery in a general hospital.

Methods. This was a retrospective review of anaesthesia for 3587 cataract surgeries. Of all the cases of diplopia referred to the ocular motility clinic after cataract surgery, those involving anaesthesia-related diplopia lasting longer than 1 month were studied.

Results. During the study period, 3450 cataract surgeries were performed by phacoemulsification and 137 by extracapsular extraction. Retrobulbar block was used in 2024 cases, peribulbar block in 98, topical anaesthesia in 1420 and general anaesthesia in 43. Twenty-six cases of persistent diplopia were found (0.72% incidence), nine of which (0.25%) were considered to be related to anaesthetic factors; five of the latter involved the left eye. Five were caused by paralysis of the inferior rectus muscle and three by fibrosis. In one patient, the inferior oblique muscle was affected. Anaesthesia was by retrobulbar block in eight cases (0.39%) and by peribulbar block in one. No diplopia was found in patients who had topical or general anaesthesia. Treatment was with surgery in two patients and with prisms in six. One patient continues to be studied.

Conclusions. Persistent diplopia can occur after cataract surgery using retrobulbar block predominantly through direct damage to the inferior rectus muscle. The overall incidence of anaesthesia-related diplopia in this series was 0.25%.


Keywords: anaesthetic techniques, regional, peribulbar; anaesthetic techniques, regional, retrobulbar; complications; eye, cataract; surgery, ophthalmological.

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Cataract surgery is possibly the most frequently performed surgical procedure in the western world.1 The standard approach consists of phacoemulsification and intraocular lens implantation under regional or local anaesthesia as day-case surgery. Recently, a joint report from the Royal College of Anaesthetists and The Royal College of Ophthalmologists encouraged the involvement of anaesthetists in the administration of local anaesthesia,2 a practice that is becoming increasingly more frequent.3 Before this, anaesthetists monitored and cared for the patients with or without sedation, whereas ophthalmologists performed the blocks.

Complications associated with these blocks, although relatively rare, have been well documented. Those most frequently reported include retrobulbar haemorrhage, optic nerve damage, central retinal artery or vein obstruction, globe perforation and systemic side-effects such as brainstem anaesthesia and dysrhythmias related to stimulation of the oculocardiac reflex arc.4–6 On the other hand, transitory or persistent diplopia after uneventful cataract surgery has been increasingly recognized and associated with retrobulbar and peribulbar anaesthesia by ophthalmologists,7–21 but as it appears after the anaesthetic procedure, anaesthetists are usually unaware of this serious complication.

Most published series of persistent diplopia are anecdotal cases or clusters of patients referred to the study authors for evaluation, whereas the incidence of its occurrence is not considered. As most of the patients in these series are referred by ophthalmologists, we do not know the true
incidence of this complication in relation to who performs the procedure, or if the anaesthetic procedures, peribulbar or retrobulbar blocks, are equally safe whether performed by anaesthetists or by ophthalmologists. In this paper, we report the incidence and clinical characteristics of anaesthesia-related persistent diplopia after cataract surgery, in a general district hospital where all the ophthalmic blocks were performed by staff anaesthetists.

Patients and methods

The study was carried out in an acute district general hospital with 175 surgical beds serving a population of some 220,000 people. We studied all patients who had cataract surgery in our centre between March 1, 1998 and December 31, 2001.

All patients were assessed before surgery in the anaesthesia clinic. A retrospective review of the anaesthetic records was carried out and, when appropriate, the medical records were reviewed as well. All anaesthetic procedures were performed by staff anaesthetists and cataract surgery was always performed by staff ophthalmologists. Data collected included patient age, sex, ASA physical status, operative eye, surgical procedure, method of anaesthesia, block technique, local anaesthetic mixture and volume injected, and identification of the anaesthetist and surgeon involved.

All the blocks were performed with a 38 mm, 25-gauge atraumatic Atkinson retrobulbar needle (Eagle Lab, CA, USA). A pressure of 30–40 mm Hg was applied to the eye for 20 min after the block. Topical anaesthesia was performed with drops (tetracaine chlorhydrate 1 mg ml⁻¹ and oxybuprocaine 4 mg ml⁻¹), plus intracameral injection of lidocaine 1% without preservatives.

Patients for phacoemulsification were selected for retrobulbar or topical anaesthesia depending on current contraindications to topical anaesthesia (difficult or prolonged surgery, uncooperative patient, nystagmus) and the indications to topical anaesthesia (difficult or prolonged bulbar or topical anaesthesia depending on current contraindications).

Table 1 Type of anaesthesia and surgery carried out. *Surgery was bilateral in two patients

<table>
<thead>
<tr>
<th>Anaesthetic</th>
<th>Right eye</th>
<th>Left eye</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrobulbar</td>
<td>1058</td>
<td>966</td>
<td>2024</td>
</tr>
<tr>
<td>Peribulbar</td>
<td>47</td>
<td>51</td>
<td>98</td>
</tr>
<tr>
<td>Topical</td>
<td>661</td>
<td>759</td>
<td>1420</td>
</tr>
<tr>
<td>General</td>
<td>20</td>
<td>25</td>
<td>43*</td>
</tr>
<tr>
<td>Phacoemulsification</td>
<td>1716</td>
<td>1734</td>
<td>3450</td>
</tr>
<tr>
<td>Extracapsular</td>
<td>70</td>
<td>67</td>
<td>137</td>
</tr>
</tbody>
</table>

Table 2 Patient characteristics

<table>
<thead>
<tr>
<th>Anaesthesia</th>
<th>Male</th>
<th>Female</th>
<th>Mean age (yr)</th>
<th>ASA I</th>
<th>ASA II</th>
<th>ASA III</th>
<th>ASA IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retrobulbar or peribulbar</td>
<td>45%</td>
<td>55%</td>
<td>73.6</td>
<td>6%</td>
<td>65%</td>
<td>26%</td>
<td>2%</td>
</tr>
<tr>
<td>Topical</td>
<td>47%</td>
<td>53%</td>
<td>71.2</td>
<td>6%</td>
<td>57%</td>
<td>35%</td>
<td>2%</td>
</tr>
</tbody>
</table>

Results

During the specified period, 3587 cataract operations were performed. Details of the anaesthetic technique and type of surgery are shown in Table 1, with patient characteristics and ASA physical status in Table 2.

In all, 19 anaesthetists gave the anaesthetics. When a block was needed, two anaesthetists used either peribulbar or retrobulbar block, while the remainder always chose retrobulbar block. For the latter, the technique was always the same, consisting of the insertion of the retrobulbar needle through the lower lid in the inferotemporal quadrant, at the junction of the lateral and middle thirds of the orbital rim, and directed slightly below the apex of the orbit, with the eye in primary position. One anaesthetist asked the surgeon’s experience with the technique. Patients in whom phacoemulsification was inappropriate (difficult surgery, hard cataracts) received retrobulbar or peribulbar injection. A bridle suture under the superior rectus was occasionally used. After surgery, drops containing tobramycin plus dexamethasone were instilled in patients under topical anaesthesia. In patients who had retrobulbar or peribulbar anaesthesia, 1 ml of a mixture of gentamicin 40 IU, 0.5 ml plus dexamethasone chloride 0.5 ml was injected under the subconjunctival lower fornix.

Clinical details of the presence of diplopia, treatment given and outcome up to February 2002 were noted. During the period studied, all patients with diplopia identified after cataract surgery were referred to the ocular motility clinic of the ophthalmology unit and were examined and treated by the same ophthalmologist (JY). Only cases persisting for more than 1 month were considered, and those in whom there had been a change in the ocular motility before cataract surgery were excluded. A complete eye examination was performed, including measurement of visual acuity and intraocular pressure and assessment of anterior and posterior poles. Eye movement and areas of diplopia were evaluated in the nine diagnostic positions. Patients were made to fix their gaze at a distance of 5 m, except for those with poor acuity when the evaluation was carried out with a torch, and in near vision, and with the aid of prisms to establish the fields of the diplopia. A Hess Lancaster screen was carried out to support the diagnosis in six of the ten cases. To correct the diplopia, all the patients had a 30 min prism test in the outpatient clinic using ‘press-on’ prisms (3M Health Care) placed over the patient’s glasses or over test frames. Prismatic glasses were prescribed if the test results were satisfactory.

Diplopia after cataract surgery

Table 3 Clinical details of diplopia cases

<table>
<thead>
<tr>
<th>Sex</th>
<th>Age (yr)</th>
<th>ASA</th>
<th>Diplopia</th>
<th>Anaesthesia</th>
<th>Anaesthetic</th>
<th>ml</th>
<th>Follow-up (months)</th>
<th>Others</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>70</td>
<td>Fibrosis IR LE</td>
<td>Retrobulbar</td>
<td>B-L</td>
<td></td>
<td>37</td>
<td></td>
<td>Prisms</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>82</td>
<td>Fibrosis IR RE</td>
<td>Retrobulbar</td>
<td>B-L</td>
<td>5</td>
<td>2</td>
<td></td>
<td>None</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>72</td>
<td>Paresis IO RE</td>
<td>Retrobulbar</td>
<td>B-L</td>
<td>37</td>
<td></td>
<td>Antiplatelet therapy</td>
<td>Prisms</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>73</td>
<td>Paresis IR LE</td>
<td>Peribulbar</td>
<td>B-L-H</td>
<td>7</td>
<td>27</td>
<td></td>
<td>Prisms</td>
</tr>
<tr>
<td>5</td>
<td>M</td>
<td>81</td>
<td>Paresis IR RE</td>
<td>Retrobulbar</td>
<td>B-L</td>
<td>4</td>
<td>38</td>
<td>Antiplatelet therapy</td>
<td>Prisms</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>83</td>
<td>Paresis IR RE</td>
<td>Retrobulbar</td>
<td>B-M</td>
<td>4</td>
<td>38</td>
<td>Contralateral gaze. Sedation</td>
<td>Prisms</td>
</tr>
<tr>
<td>7</td>
<td>F</td>
<td>71</td>
<td>Fibrosis IR LE</td>
<td>Retrobulbar</td>
<td>L</td>
<td>6</td>
<td>45</td>
<td>Retrobulbar haematoma</td>
<td>Surgery</td>
</tr>
<tr>
<td>8</td>
<td>M</td>
<td>82</td>
<td>Paresis IR RE</td>
<td>Retrobulbar</td>
<td>B-L</td>
<td>4</td>
<td>22</td>
<td></td>
<td>Prisms</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>77</td>
<td>Paresis IR LE</td>
<td>Retrobulbar</td>
<td>B-L</td>
<td>4</td>
<td>15</td>
<td></td>
<td>Surgery</td>
</tr>
</tbody>
</table>

M, male; F, female; IR, inferior rectus muscle; IO, inferior oblique muscle; RE, right eye; LE, left eye; B-L, bupivacaine/lidocaine; H, hyaluronidase; B-M, bupivacaine/mepivacaine; L, lidocaine.

patient to direct the gaze contralaterally. A volume of 3 ml (n=243, 12%), 4–5 ml (n=1289, 63.7%) or 6 ml (n=486, 24%) was injected; and bupivacaine 0.5%/lidocaine 2% was employed in 82% of the cases (n=1660), bupivacaine 0.5%/mepivacaine 2% in 14% (n=283) and lidocaine 2% in 81 cases. Almost all the peribulbar blocks consisted of two injections, placed inferotemporally and superonasally, respectively; a volume of 7–8 ml was injected. In 102 patients, 1 ml of hyaluronidase (300 IU) was added to the anaesthetic. Akinesia was achieved by the block in 92% of cases, but was complete in only 62%. Ten of the anaesthetists used a second retrobulbar injection of 2 ml of the anaesthetic in 5.5% of the blocks. All the surgical procedures were performed by 12 ophthalmologists.

During the study period, 26 cases of postoperative diplopia were found (0.72%), nine of which (0.25%) were considered to be related to the anaesthesia. Of the remainder, 12 patients had diplopia secondary to binocular vision, or monocular, two were excluded because a complete clinical history was not available, another patient was excluded because he had undergone surgery for strabismus before the cataract operation. Two patients in whom retrobulbar block was used were not considered because their diplopia lasted for less than 48 h.

In the nine cases of diplopia caused by changes in eye movement related to the anaesthesia, the surgical procedure had consisted of phacoemulsification and intraocular lens implantation. The details of anaesthesia are shown in Table 3.

Surgery was required to correct the diplopia in two cases, prisms were employed in six and, in the remaining patient, treatment was not considered necessary. The outcome has been satisfactory in eight patients, while the ninth patient is still under review.

Discussion

In recent years, anaesthetists are becoming more involved in the administration of regional eye blocks. This practice saves theatre time and enables the surgeon to move rapidly from case to case. Such blocks are not without complications. Anaesthetists are usually aware of these problems, because most of them occur within 15–30 min of injection and are readily diagnosed. Diplopia is a well-recognized and important complication in patients having had local anaesthesia for cataract surgery. However, as it appears hours or days after surgery, when the dressing is removed or the patient regains vision, it may go undetected by the anaesthetist.

We found an incidence of 0.25% of persistent vertical diplopia after cataract surgery when regional anaesthesia was performed by anaesthetists. When stratified according to the different anaesthetic techniques, the rates were 0.39% for retrobulbar block, 1% for peribulbar block, and 0% for topical or general anaesthesia. To our knowledge, there are only two other studies assessing the occurrence of diplopia after uneventful cataract surgery. Golmik and colleagues observed an incidence of 0.85% in 118 patients studied prospectively. In a larger series, Johnson reported a rate of 0.23% after retrobulbar anaesthesia, whereas no patient undergoing topical anaesthesia developed diplopia. However, in that study, more than 95% of the retrobulbar blocks were done by three certified registered nurse anaesthetists, which is not common in Europe. More often, ophthalmic regional anaesthesia in an European general hospital is provided by several or all of the staff anaesthetists or alternatively by ophthalmologists. In turn, several or all of the ophthalmic surgeons perform the cataract surgery.

A number of mechanisms can cause vertical diplopia. They include direct needle injury to the muscle, especially the inferior rectus muscle, haemorrhage within the muscles or a myotoxic effect of injected local anaesthetics. If a relatively large amount of the anaesthetic is directly injected into the muscle or perimuscular space, this could elevate tissue pressure and cause secondary vascular compromise and muscle fibrosis and contracture. Whatever the mechanism is, the muscle damage can produce eye misalignment, resulting in diplopia. This is a prominent complication for a patient with good optical results after cataract surgery.

Diplopia is generally caused by inferior rectus muscle damage associated with the infraorbital injection. This causes either inferior rectus restriction, with hypotropia of the affected eye and limited upgaze, or paresis, with limited...
downgaze of the affected eye, usually followed by superior rectus muscle contracture and hypertropia.\textsuperscript{24} When other sites of injection or bridle sutures are employed, other muscles may be affected. Most of the patients undergoing retrobulbar or peribulbar block received a subconjunctival injection after surgery and we can not exclude this manoeuvre as possible cause in the development of the diplopia.

We found five cases with paresis of the inferior rectus muscle (Fig. 1) and three with fibrosis, associated with retrobulbar haematoma in one of the latter. Patient three presented inferior oblique paresis, a complication that has also been related to anaesthesia.\textsuperscript{25} However, when topical or general anaesthesia was employed, diplopia did not develop. Thus, in our experience, in agreement with that of other authors,\textsuperscript{8 9 15 19 23} there appears to be a close relationship between diplopia and retrobulbar or peribulbar block, although in our series the relationship of the latter technique is difficult to evaluate because of the small number of cases. A recent literature review found that current approaches to anaesthetic management, namely peribulbar, retrobulbar and sub-Tenon’s blocks and topical anaesthesia, gave adequate conditions for successful cataract surgery, but pain control was better under blocks.\textsuperscript{26} On the other hand, it seems that patients who experienced both topical and combined peribulbar and retrobulbar anaesthesia preferred the combined block.\textsuperscript{27} Other randomized studies concluded that topical anaesthesia can be used safely, compared with retrobulbar blocks, with only marginally greater discomfort,\textsuperscript{28} and it is now clear that in routine small incision cataract surgery, ocular anaesthesia with topical anaesthetics will usually suffice, depending, of course, on the surgeon’s experience.\textsuperscript{29} Despite this, retrobulbar or peribulbar blocks are still preferred by surgeons in several countries.\textsuperscript{24 30 31}

Associated factors may include a faulty injection technique, which would be more common in right-handed individuals blocking the left eye;\textsuperscript{16 32} injection of an excessive volume, which can cause ‘compartment syndrome’; and a second injection when the initial block is inadequate. In the current study, we show a slightly more frequent involvement of the left eye (55.5 vs 44.4%). In all but two cases, bupivacaine 0.5%/lidocaine 2% was employed. Although Corboy and Jiang\textsuperscript{16} propose the term postbupivacaine hypotropia to refer to postcataract surgery vertical diplopia of the left eye, other anaesthetics like lidocaine alone have also been associated with this complication.\textsuperscript{7 9} In our experience, it occurred with lower concentrations than those reported by other authors,\textsuperscript{14–16 19} and also developed when the combination bupivacaine-mepivacaine or lidocaine was used. Woodward and colleagues\textsuperscript{33} have recently shown that ropivacaine 1% with hyaluronidase is a suitable mixture for peribulbar block despite its motor-sparing properties. To date, it is not known whether diplopia is also produced by this anaesthetic. As stated by Brown and colleagues,\textsuperscript{37} the addition of hyaluronidase to the anaesthetic could be important in preventing anaesthetic-related damage to the extraocular muscles. We used hyaluronidase in about 100 patients in 1999, until the laboratory that manufactured it ceased its production, and have observed one case of diplopia in this subgroup. The volume injected in our series was similar to that used by other authors,\textsuperscript{7 14–16} as was the injection technique, with the patient in primary gaze. Although we are unable to determine whether any of the patients who developed diplopia received a second injection to supplement the block, in our experience, the rate of supplementation (under 6%) is less than that reported elsewhere.\textsuperscript{34} As most of the cataract operations involved phacoemulsification, the ophthalmic surgeons did not require complete akinesia and, thus, the supplementation rate was low. Even in extracapsular surgery, complete akinesia is seldom necessary for a safe procedure. A joint evaluation of the patient on the part of the anaesthetist and the surgeon may avoid some second injections.
Interestingly, two of our patients were taking antiplatelet drugs. We do not know if this might increase the risk for presenting diplopia after retrobulbar injection.

In conclusion, we report an incidence of anaesthesia-related persistent vertical diplopia of 0.25% after cataract surgery. The rate was 0.39% when retrobulbar block was employed, while there was one case among the 98 patients subjected to peribulbar block. Postoperative diplopia was not observed when topical or general anaesthesia was used. Although the cause of this complication is unknown, our results support the hypothesis that it is because of direct damage, preferentially to the inferior rectus muscle, by the needle or the anaesthetic.

In carefully selected patients, topical anaesthesia can be as safe as retrobulbar and peribulbar techniques for a successful outcome, and without the potential harmful effects associated with regional blocks, including diplopia secondary to muscle damage. Co-operation between anaesthetists and ophthalmologists is essential in order to choose the best option for each patient undergoing cataract surgery.

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