Techniques of facial nerve block

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Abstract

The efficacy of different techniques of facial nerve block for cataract surgery was investigated. Forty four patients underwent either modified O'Brien, Atkinson, van Lint, or lid blocks. Intentional muscle activity of the orbicularis oculi muscle was recorded and the area under the EMG curve calculated for quantitative comparison of muscle activity between the groups before and after injection of lignocaine with the vasoconstrictor naphazoline nitrate. In addition, the force of lid closure was measured and lid motility determined on a subjective score scale. Whereas the modified O'Brien and lid blocks nearly abolished the muscle activity recorded in the EMG ($p < 0.003$), the Atkinson and van Lint blocks did not significantly affect these variables. The O'Brien and lid blocks decreased the force of lid closure and lid movements far more effectively than the Atkinson and van Lint blocks ($p < 0.0001$). The topographic distribution of a mixture of metrizamide and lignocaine solutions was evaluated radiographically in eight additional patients, to assess potential causes for differences in the efficacy of the block techniques. The radiological results showed involvement of the region of the facial nerve trunk and its temporal and cervical divisions by the modified O'Brien block. The lid block, on the other hand, affected terminal branches of the facial nerve's temporal division. In this study, complete lid akinesia was achieved by both the modified O'Brien block and the lid block. However, because the modified O'Brien block involves the risk of neural injury to the facial nerve or its main divisions, the lid block is recommended as the most effective and safe method to achieve akinesia of the orbicularis oculi muscle. (*Br J Ophthalmol* 1995; 79: 166-173)

Several techniques of facial nerve block and their combinations are employed in ophthalmic surgery to achieve lid akinesia – that

is, temporary palsy of the orbicularis oculi muscle. In general, the conduction block is performed at three possible locations topographically related to the facial nerve and its ramifications: (a) proximally, affecting the nerve trunk and/or the temporofacial branch at or beyond the temporal and cervical trunk division, (b) peripherally, affecting terminal branches of the temporal division of the facial nerve, and (c) between those two locations. According to injection site, the techniques of the facial nerve block are usually referred to as: (a) O'Brien block, (b) van Lint block, and (c) Atkinson block. These blocks differ in injection site and in efficacy of the lid akinesia.¹ However, injections close to the facial nerve trunk or its temporofacial branch involve the risks of nerve injury^{2 3} and serious neurological complications.⁴⁻⁷ Such hazards can be avoided by blocking the terminal ramifications of the temporofacial branch at the orbital rim⁸⁻¹¹ or by injecting the local anaesthetic into the lids.¹² The block of facial nerve ramifications or their terminal branches at the orbital rim seems less effective than the block of facial nerve trunk,¹ however, the risk of complications seems higher with the latter block technique than with the former ones. Therefore, we compared the efficacy of the O'Brien, Atkinson, and van Lint blocks with that of the lid block.

Patients and methods

Forty four patients underwent conduction block of the facial nerve before cataract surgery with implantation of an intraocular lens. On the evening before the operation, a detailed explanation of the scheduled form of anaesthesia was given to the patients and only those capable of fully understanding the procedure participated in the study. All participants gave informed consent in writing which was approved by the university's ethics committee. The age of the patients ranged from 50 to 89 years; age and sex distributions for each block technique are shown in Table 1. The patients were assigned to one of the four groups according to a preassigned pseudo-randomised scheme based on the order of admission to the operation to avoid any possibility of the administrator to bias selection for the block techniques. Sex distribution did not differ among the groups; however, the age of patients in the Atkinson group was lower than that in the other groups. The patients received oral premedication with 0.3 to 0.7 mg flunitrazepam (Rohypnol), depending on the patient's age and accompanying diseases. The mean dosage of premedication did not differ significantly between the groups.

After skin disinfection with a solution of 70% alcohol (Kodan), we performed the facial

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Table 1 Age (years (SE)) and sex distribution (male/female) of patients with O'Brien (n=12), Atkinson (n=10), van Lint (n=10), and lid blocks (n=12)

Block technique	Age*	Mean rank	Sex†	p Value
O'Brien	78.3 (9.2)	30.9	7/5	ns
Atkinson	54.8 (6.9)	7.1	4/6	ns
van Lint	71.3 (9.3)	22.4	5/5	ns
Lid	75.3 (2.2)	27.0	6/6	ns

*H=20.377, $p=0.0001$ (Kruskal-Wallis test).

†Differences not significant (χ^2 test).

Fig 1A

Figure 1 (A) The modified O'Brien block: injection at the dorsal rim of the mandible near the tragus of the ear. 5 ml of the anaesthetic solution are injected at a maximal depth of 1.7 cm. (B) The Atkinson block: subcutaneous injection at the midpoint of a line between the lower edge of the zygoma and the jaw joint. 2.5 ml of the anaesthetic solution are injected along this line in both directions. (C) The modified van Lint block: injection at the crossing between a vertical line 1 cm lateral of the outer orbital rim and a horizontal line 1 cm below the inferior orbital rim. 2.5 ml of the anaesthetic solution are injected below the orbicularis oculi muscle along either line. (D) The lid block: subcutaneous injection into the lids, 0.5 cm (lower lid) or 1.0 cm (upper lid) from middle of the canthus. In the clinical setting, the orientation of the needle was parallel to the eye (horizontal) while the depth of needle insertion was about 0.3 cm.

Fig 1B

Fig 1C

nerve block with 5 ml 1% lignocaine (Xylocaine) plus the vasoconstrictor naphazoline (Privin, 1:20 000) via a 27 gauge, 17 mm long, hypodermic needle. One of four techniques of facial nerve block was used in each patient: (1) proximal block of the facial trunk and/or its temporal and cervical branches as described previously¹³ and referred to as the modified O'Brien block,¹⁴⁻¹⁶ (2) conduction block of the zygomatic, temporal, and buccal branches of the facial nerve referred to as the Atkinson block,¹⁷⁻²¹ (3) peripheral blockade of the zygomatic terminal ramifications at the rim of the orbit⁸⁻¹¹ referred to as the van Lint block, and finally, (4) infiltration anaesthesia of the lids referred to as the lid block. Twelve patients received the O'Brien block, two groups of 10 patients each underwent the Atkinson and van Lint blocks, and 15 patients received the lid block. The patients were pseudorandomly distributed in temporal order of admission to one of the four block techniques. The last (at 10 minutes) recordings could not be made in three patients undergoing lid blocks because of a busy operating schedule and the unwillingness of the surgeon to wait for the completion of the study, and these patients were therefore excluded from the evaluation. Hence, we present data on 44 patients.

The study was triple blind as far as the patient was not informed about the name of the administered block and both the investigator recording EMG, taking blepharometer readings, and rating lid motility and the investigator integrating the EMG and evaluating the data were blind in respect of the block technique used in a particular patient or group of patients.

Injection for the O'Brien block (Fig 1A) was at the posterior edge of the lower jaw, near the tragus of the ear; we injected 5 ml of the anaesthetic solution. The Atkinson block (Fig 1B) was similar to the original description by Wright.²² The injection site was in the middle of a line between the lower edge of zygoma and the temporomandibular joint. From there, we injected subcutaneously, towards both the zygoma and the temporomandibular joint, 2.5 ml 1% lignocaine each. Injection for the van Lint block (Fig 1C) was in the proximity of the orbital rim; the injection site was 1 cm lateral from the lower outer edge of the orbit, at the crossing of lines drawn parallel to the lower and temporal rim of the orbit. We injected 2.5 ml lignocaine below the orbicularis oculi along each of those lines. The lid block (Fig 1D) was administered to each lid; we injected 2.5 ml of the anaesthetic solution 0.5 cm below (lower lid) and 1.0 cm above (upper lid) the middle of the canthus.

An EMG recorder (MS91a; Medelec Ltd, England) monitored and stored the electrical activity of the orbicularis oculi muscle over a wide frequency band (2 Hz to 10 kHz). The insulated monopolar needle electrode (tip area 0.56 mm², length 25 mm) was located in the orbicularis oculi at the lower rim of the orbit, lateral to the infraorbital foramen. The ground electrode was located at the lower arm. We

Fig 1D

Figure 2 The evaluated area (shaded) under a representative EMG curve (replotted). This area represents the integral of the changes in electrical activity (voltage, μV) over time (t , ms) during an intentional contraction of the orbicularis oculi muscle.

recorded voluntary activity of the orbicularis muscle in each patient before, 1, 3, 5, and 10 minutes after administration of the block. The EMG curves, plotted on paper, were fed via a digitising tablet into a digital computer (MOP; Kontron, Germany) calculating the area under the curves (Fig 2). EMG integration was employed previously in evaluations of neuromuscular block²³ and studies comparing intramuscular electric activity and tension of the muscle²⁴; it provides a quantitative measure of excitation level in a muscle.²⁵ The needle EMG is an important tool in assessing peripheral nerve injuries and the functional integrity of a nerve plexus, in determining the extent and severity of a plexus lesion.²⁶

A Müller blepharometer²⁷ measured the force of lid closure. The instrument has a scale which corresponds to a force between 68 and 190 pond (Fig 3). The pond, a conventional unit of force, equals 9.806×10^{-3} newton.²⁸ If

the force of lid closure was below this scale, 0 pond was attributed to patients who were unable to move the lids, since these patients were obviously unable to close the eyes against any force. Patients who could move the lids but exerted a force below the measurable range were treated as if they had reached a force of 68 pond. This was the case in one patient receiving O'Brien block, who could close the eye 5 minutes after the block but was assigned the force of 68 pond. We assessed lid movement and closure on a subjective scale ranging from 1 to 3. Here, '1' corresponds to complete paralysis of the lids (no lid movement), '2' to impaired motility (movement but no lid closure), and '3' to complete lid closure.

The distribution of 2 ml metrizamide (Solutrast), mixed with 3 ml 1% lignocaine solution, was investigated in two additional patients for each of the O'Brien, Atkinson, van Lint, and lid blocks. Though the diffusion of lignocaine and metrizamide in tissue may differ over time, the deposition of such a mixture in several locations of the face permits radiological correlation of the initial spread of the mixture (independent of diffusion) at the respective location with the topography of the facial nerve and its branches at this location. Therefore, we took x ray pictures within 1 minute after the injection of the solution.

The Kruskal-Wallis test and one and two factor analysis of variance (ANOVA) served to compare the results. The Kruskal-Wallis test compared the age distribution between groups of either block technique (Table 1). The sex distribution was analysed by the χ^2 test and contingency table analysis which showed no sex differences among the groups ($p=0.24$, Pearson). The force of lid closure was estimated on a subjective scale. We treated the resulting values as pseudocontinuous in the statistical analysis.

Results

We achieved an effective akinesia of lids with the modified O'Brien and lid blocks. Figure 4 shows representative EMG recordings from the orbicularis oculi muscle before and after each block technique from two different patients. The area under the EMG curves decreased within 10 minutes after injection from (mm^2 (SE)) 725 (132) to 8 (6) (O'Brien

Figure 3 The Müller blepharometer before (left) and during contraction of the orbicularis oculi (right). Before the placement of the blepharometer specula the conjunctiva was anaesthetised with five drops of oxybuprocaine 0.45% (Benoxinate SE Thilo). Notice also the EMG electrode inserted into the lower portion of the orbicularis oculi muscle.

Figure 4 EMG recordings from the lower lid of two representative subjects before (0 min) and after the O'Brien, Atkinson, van Lint, and lid blocks. Notice that EMG extinction occurred only after the O'Brien and lid blocks.

block), 1283 (201) to 988 (192) (Atkinson block), 705 (139) to 847 (165) (van Lint block), and from 672 (144) to 25 (12) (lid block). The force of lid closure decreased after the different blocks from (pond (SE)) 142 (6) to 0 (0) (O'Brien), 158 (5) to 124 (7) (Atkinson), 140 (5) to 111 (7) (van Lint), and from 142 (12) to 0 (0) (lid; Fig 5). The subjective scores of lid movement after the respective block techniques are listed in Table 2. With Atkinson blocks, all patients were able to close the lids; with van Lint blocks, two patients could move but were unable to close the lids at 10 minutes after administration of the block.

We performed an analysis of variance to assess the significance of differences between the four block techniques. A two factor analysis of variance for block technique and time yielded error probabilities below 0.0001 for block technique, time, and the interaction between the two factors. Next, we conducted a two factor analysis of variance for all possible

pairs among the four block techniques. Table 3 gives the error levels for the area under the EMG curve, the force of lid closure measured with the Müller blepharometer, and the subjective assessment of lid movement in respect of the block technique versus time. While the force of lid closure and lid movement after O'Brien and lid block significantly differed from those after Atkinson and van Lint block ($p < 0.0001$), the area under the EMG curve was significantly different only between O'Brien and van Lint blocks and between Atkinson and lid blocks ($p < 0.0011$ and $p < 0.0001$; Table 3). No significant difference was present between the area under the EMG curve and the force of lid closure after the O'Brien and lid block (Table 3).

We used a one factor analysis of variance to estimate the effect of time on each of the block techniques. The results show that time has the most prominent effect on the EMG area, force of lid closure, and subjective assessment of lid

Figure 5 Area under the EMG curve recorded from the lower lid and force of lid closure (mean (SE)) before (0 min) and after the O'Brien, Atkinson, van Lint, and lid blocks.

movement after the O'Brien block (Table 4). The next best technique is the lid block, followed by the Atkinson block where time has a significant influence only on force of lid closure. The van Lint block did not significantly alter the EMG and lid movement, and the decrease of lid force was least of all four block techniques.

The radiological images obtained after the modified O'Brien block (Fig 6A) show the dye

distributed in the immediate neighbourhood of the bifurcation of the facial nerve into its temporal and cervical branches. The distribution of the injected dye after the Atkinson and van Lint blocks (Fig 6B and 6C) showed that neither of these techniques achieved a complete inclusion of the region of the anastomosing branches of the facial nerve. The distribution of the dye solution after the lid block (Fig 6D) indicated an involvement of the orbital region

Table 2 Subjective estimates of lid movements* (mean (SE)) before (0 min) and after the administration of the facial nerve blocks

Time (minutes)	O'Brien	Atkinson	van Lint	Lid block
0	3.0 (0.0)	3.0 (0.0)	3.0 (0.0)	3.0 (0.0)
1	2.8 (0.1)	3.0 (0.0)	3.0 (0.0)	3.0 (0.0)
3	2.5 (0.2)	3.0 (0.0)	3.0 (0.0)	2.7 (0.2)
5	1.7 (0.1)	3.0 (0.0)	3.0 (0.0)	2.3 (0.2)
10	1.3 (0.1)	3.0 (0.0)	2.8 (0.1)	1.7 (0.2)

*Lid movements: 1=no lid movements, 2=movement present but lid closure not complete, 3=complete lid closure.

Table 3 Comparisons of the different techniques of facial nerve block for the estimation of error levels ($p \leq$) regarding the area under the recorded curve (EMG), force of lid closure (force), and subjective assessment of lid movement (movement): the effect of block technique versus time*

Block technique	EMG	Force	Movement
O'Brien-Atkinson	0.4664	0.0001	0.0001
O'Brien-van Lint	0.0011	0.0001	0.0001
O'Brien-lid	0.1176	0.9388	0.0034
Atkinson-van Lint	0.4474	0.9294	0.0698
Atkinson-lid	0.0001	0.0001	0.0001
van Lint-lid	0.0989	0.0001	0.0001

*Two factor analysis of variance.

Table 4 Effect of time* on the area under the recorded curve (EMG), force of lid closure (force), and subjective assessment of lid movement (movement): the effect of time†

Block technique	EMG	Force	Movement
O'Brien	0.0001	0.0001	0.0001
Atkinson	0.5153	0.0032	1.0000
van Lint	0.9276	0.0044	0.0785
Lid	0.0001	0.0001	0.0001

*Error levels (p≤). †One factor analysis of variance.

of terminal branches of the temporal division of the facial nerve.

Discussion

We found effective lid akinesia after the modified O'Brien and lid blocks (Figs 4, 5; Table 2-4). In the original O'Brien block, the anaesthetic was injected near the tragus of the ear, directly above the condyloid process. In most cases, this leads only to anaesthesia of the temporofacial division of facial nerve that supplies the temporal and zygomatic branches to the orbicularis oculi.^{29 30} The modified O'Brien block differs from the original O'Brien block¹⁴⁻¹⁶ in that the author³ punctured the

skin over the most posterior, most superior palpable aspect of the mandible ramus (about 3 cm above the mandible angle). This position is posterior and inferior to the injection site of the original O'Brien block. Anatomical studies indicate that the injection site of the somewhat more proximally placed Spaeth block³ in general overlies the area of facial nerve's bifurcation into its temporal and cervical branches,²⁹⁻³¹ the bifurcation being located between the two lobes of the parotid gland, approximately 1.5 cm beneath the skin. Here, the injection of a rather large volume of lignocaine solution causes highly effective nerve block and lid akinesia (Figs 4, 5; Tables 2-4). Nadbath and Rehman, using a similar block technique as in this study, reported that after application of 1% mepivacaine the initial effects started within 1 minute and complete facial nerve palsy developed within 7 minutes,³² which agrees with the effects of 1% lignocaine administered via the modified O'Brien block found here (Figs 4, 5; Table 2). These functional results are confirmed by the radiological evaluation of the dye distribution administered via O'Brien block: the dye spreads over a large area that encloses the mandibular portion of the facial nerve (Fig 6A).

Fig 6A

Figure 6 The distribution of 2 ml metrizamide (Solutrast) mixed with 3 ml 1% lignocaine after the O'Brien block (A), Atkinson block (B), van Lint block (C), and lid block (D). The region involved is indicated with arrows.

Fig 6B

Fig 6C

Fig 6D

The van Lint and Atkinson blocks did not produce complete akinesia of the lids in this study (Figs 4, 5; Table 2). Most probably, the numerous anastomoses between the temporofacial and cervicofacial divisions as well as between the temporal, zygomatic, and buccal branches of the facial nerve caused this failure.^{29 33–35} These anastomoses guard against a complete paresis of the orbicularis oculi muscle in case of injuries,³⁶ but also prevent the occurrence of a selective block of both the temporal and zygomatic branches of the facial nerve. Since an anatomically identifiable 'lodge' for the branches of the facial nerve is not present between the zygoma and the jaw joint, local anaesthetics injected in this area may spread unpredictably, and therefore, may not involve all the branches and anastomoses leading to the orbicularis oculi muscle (Figs 6B and 6C). Such a 'lodge' can be identified more proximally, near the isthmus of the parotid gland,³⁷ where, as indicated by the dye distribution in Figure 6A, fan-like spread of anaesthetic solutions involving the main divisions of facial nerve may occur. The low efficacy of the Atkinson and van Lint blocks found here (Figs 4, 5; Tables 2, 4) might be due partially to the high variability of these block techniques (for

example, variation in angle of needle orientation, length of needle, exact injection site, and volume injected). We would like to stress, however, that the volume of the anaesthetic solution we injected was even larger than the volume used in the original van Lint and Atkinson block techniques. Atkinson later modified his block technique by injecting the local anaesthetic closer to the orbit.^{18–21} In contrast to our study, van Lint injected the anaesthetics with longer needles and along the immediate orbital rim.^{8 9} However, insufficient akinesia and the need for block augmentation when using the original van Lint technique of facial nerve block has been reported previously.³⁸ Regarding the efficacy of the van Lint block some confusion arises when eye surgeons believe they are applying the van Lint block while actually performing a lid block.³⁹ In fact, lid blocks via subconjunctival injection^{40 41} are also administered with some of the recent techniques of ophthalmic anaesthesia such as the peribulbar block.^{42 43}

We achieved effective lid akinesia with both the proximal O'Brien block and the most peripheral block of the terminal branches of

the facial nerve – that is, the lid block (Figs 4, 5; Tables 2, 4). Thus, our results agree with previous reports,^{12–44} as well as with the recent findings,^{45–47} that lid block produces effective akinesia of the orbicularis oculi muscle. The effects of the lid and O'Brien block on the EMG, the force of lid closure, and lid movements did not differ from each other. These variables were also very similar to each other after the Atkinson and van Lint blocks which were not effective in producing akinesia (Table 3). But overall, the Atkinson block showed little or no effect on the EMG and the force of lid closure or lid movement, respectively (Figs 4, 5; Table 4). The age difference between the patients in the Atkinson group and the other groups (Table 1) may be important since the numbers of fibres in the facial nerve decrease with age,⁴⁸ and the mimic musculature rarefies. These facts could account for the larger area under the EMG curve that we found, and for the larger force of lid closure before block in this group compared with the patients with higher mean age (Table 1). However, Jacobs found no differences in the force of lid closure between the young and the old, rather a tendency towards higher force values in male subjects.⁴⁹ The statistics used in the present study – that is, the two factor ANOVA for the effects of block technique versus time, eliminate all baseline differences between the groups since they are specific for all the changes over time in each group.

The present study shows that the lid block is as effective as the proximal blocks of the facial nerve, without bearing the risks of direct nerve trauma²³ with the destruction of nerve fibres^{50–52} or other neurological complications.^{4–7} We therefore prefer the administration of the lid block, if the akinesia of orbicularis oculi is required and the safety of the patient is of primary concern.

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