Intraocular pressure reduction and vitreous mass

Influence of retrobulbar anaesthesia and acetazolamide

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Recent studies have evaluated many methods of reducing vitreous mass and minimizing vitreous loss at lens extraction (Robbins and Galin, 1969; Robbins, Blumenthal, and Galin, 1970; Galin, Robbins, and Obstbaum, 1970). In the rabbit, it is clear that hyperosmolar solutions are effective, while digital massage is not (Obstbaum, Robbins, Best, and Galin, 1970).

It has been accepted that correctly-induced retrobulbar anaesthesia also reduces the risk of vitreous extrusion (Gartner, 1959; 1961). It is assumed that the loss of muscle tone prevents retraction of the globe and scleral shell, but any other direct or indirect effect of the anaesthetic on the vitreous mass has not hitherto been investigated.

Another common preoperative procedure is the use of acetazolamide (Gartner, 1959; Agarwal, Gupta, and Malik, 1959), but there have been no clinical or laboratory studies of the effect of this drug on the vitreous.

The present communication reports the results of a study of the effect of retrobulbar anaesthesia and acetazolamide on the vitreous mass in rabbit eyes.

Material and methods

Thirty New Zealand albino rabbits weighing 3 to 5 kg. were used. General anaesthesia was induced with intravenous sodium pentobarbital, 30 mg./kg. Intraocular pressures were determined by Schiötz tonometry with the 5.5 g. weight (Best, Pola, Blumenthal, and Galin, in press). Vitreous body weights were measured by a freezing technique (Robbins and Galin, 1969), which involves rapid enucleation of the eye, freezing it for 24 hours in dry ice at $-78^{\circ}\text{C}.$, isolating the frozen spheroid of vitreous by careful dissection, and then weighing the isolated intact frozen vitreous body to milligram accuracy.

(1) CONTROLS

Ten animals received no therapy. After each had been anaesthetized for 15 minutes, the intraocular pressures were measured. In all cases the pressures were normal and essentially equal. Both eyes were then enucleated rapidly and placed in the dry ice freezer. Vitreous isolation and weighing were performed 24 hours later.

(2) RETROBULBAR ANAESTHESIA

In ten animals general anaesthesia was administered and the initial intraocular pressures were measured. The intraocular pressures were measured again after 15 minutes and if they were stable, one orbit was injected with 1 ml. 2 per cent. lidocaine hydrochloride administered by standard

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retrobulbar technique. The homolateral pupils dilated in all animals after injection. The intraocular pressures were measured again 10 minutes after the injection and the eyes were then rapidly enucleated, frozen, and assayed for vitreous weight in the manner described above.

(3) ACETAZOLAMIDE

All animals in this group had general anaesthesia, initial intraocular pressure measurements, stabilization pressure measurements, and enucleation of the control eye in the manner described. Intravenous acetazolamide, 100 mg./kg. was then administered, and 45 minutes later the intraocular pressure was measured again and the eye rapidly enucleated. Both this eye and the untreated one were frozen and assayed for vitreous weight as indicated above.

Results

Table I shows the vitreous weights of the undisturbed rabbits and clearly indicates that one eye may be used as a control for the other.

Table I *Results in ten untreated eyes of control rabbits*

Rabbit no.	Vitreous weight (g.)		Per cent. variation
	Left eye	Right eye	
1	1.654	1.649	0.30
2	2.072	2.068	0.19
3	1.893	1.896	0.16
4	1.860	1.855	0.27
5	1.778	1.780	0.11
6	1.586	1.582	0.25
7	1.827	1.826	0.05
8	1.985	1.991	0.30
9	1.631	1.640	0.55
10	2.009	2.007	0.10

Average weight variation = 0.23 per cent.

Tables II and III (opposite) show the values found for vitreous weights and intraocular pressure changes after retrobulbar anaesthesia and acetazolamide. Using this technique, there is no significant change in the vitreous mass with either procedure.

Discussion

Retrobulbar anaesthesia and acetazolamide had no influence on vitreous weight in the unopened eye as determined by this method. Though there is little doubt that extraocular muscle paralysis reduces the potential for scleral retraction, it is this mechanical relaxation that is operative and there is no direct change in intraocular content.

The presumed basis for the use of acetazolamide to minimize vitreous loss stems from the ability of this drug to reduce intraocular pressure. The concept that hypotony *per se* may reduce the risk of vitreous loss is unsound, since hypotony and reduction of the vitreous mass are not synonymous, though techniques which reduce vitreous mass result in hypotony.

Retrobulbar anaesthesia has many beneficial effects in ocular surgery, including akinesia and the elimination of transmitted reflexes (Roper, 1966). Anaesthesia and akinesia

Table II *Results in ten rabbits undergoing retrobulbar anaesthesia*

Rabbit no.	Weight of vitreous (g.)		Induced weight change in vitreous (mg.)	Per cent. weight change*	Fall in intraocular pressure in treated eye (Schiotz 5.5 wt scale readings)
	Untreated	Treated			
21	1.857	1.853	-4	-0.22	3.5-5.0
22	1.813	1.817	+4	+0.22	3.0-4.0
23	1.584	1.593	+9	+0.57	3.5-4.5
24	1.648	1.652	+4	+0.24	4.0-5.5
25	1.960	1.950	-10	-0.51	3.0-4.5
26	1.472	1.461	-9	-0.61	4.5-6.0
27	1.721	1.730	+9	+0.52	4.0-5.0
28	2.039	2.030	-9	-0.44	3.5-4.0
29	1.795	1.780	-15	-0.84	4.5-5.5
30	1.666	1.679	+13	+0.78	3.0-4.0

*Average net weight change = 0.03 per cent. loss

Table III *Results in ten rabbits treated with acetazolamide*

Rabbit no.	Weight of vitreous (g.)		Induced weight change in vitreous (mg.)	Per cent. weight change*	Fall in intraocular pressure in treated eye (Schiotz 5.5 wt scale readings)
	Untreated	Treated			
31	1.648	1.640	-8	-0.49	3.0-6.0
32	1.931	1.916	-15	-0.78	4.5-8.5
33	1.516	1.524	+8	+0.53	4.0-7.5
34	1.593	1.588	-5	-0.31	3.5-6.0
35	1.780	1.770	-10	-0.56	3.5-6.5
36	1.877	1.880	+3	+0.16	3.0-6.5
37	1.462	1.471	+9	+0.62	4.0-7.5
38	2.105	2.094	-11	-0.52	3.0-7.0
39	1.759	1.769	+10	+0.57	3.0-6.5
40	2.024	2.011	-13	-0.64	2.5-6.5

*Average net weight change = 0.14 per cent. loss

are paramount in precluding vitreous loss. The possible effects of retrobulbar anaesthesia on aqueous production mediated through the ciliary ganglion do not appear to be relevant. The situation with acetazolamide is similar (Gundzik and Mayer, 1963).

These studies have been performed on the intact eye, which is not comparable to the eye undergoing lens extraction. It has been demonstrated that opening the rabbit eye

may by itself cause a significant loss of vitreous water (Galin and others, 1970), but preliminary data indicate that neither previous retrobulbar anaesthesia nor acetazolamide augments this loss.

Preoperative acetazolamide thus appears to be of no benefit to the patient. A prolonged reduction of vitreous mass can be effected only by hyperosmolar agents. The best way to prevent vitreous loss is to take precautions to preclude its expulsion.

Summary

Retrobulbar anaesthesia and the use of acetazolamide reduce intraocular pressure in the undisturbed rabbit eye, but do not alter vitreous weight. The former technique may be beneficial in lens extraction procedures in that it counteracts the mechanical forces which tend to extrude vitreous. The use of acetazolamide is of no value in preventing vitreous loss.

References

- AGARWAL, L. P., GUPTA, R. B. L., and MALIK, S. R. K. (1959) *Brit. J. Ophthalm.*, **43**, 302
 BEST, M., POLA, R., BLUMENTHAL, M., and GALIN, M. A. (1970) *Arch. Ophthalm. (Chicago)*, **84**, 200
 GALIN, M. A., ROBBINS, R., and OBSTBAUM, S. A. (1970) *Ibid.*, (In Press)
 GARTNER, S. (1959) *A.M.A. Arch. Ophthalm.*, **61**, 50
 ——— (1961) *Arch. Ophthalm. (Chicago)*, **66**, 76
 GUNDZIK, J. D., and MAYER, J. H., (1963) *Amer. J. Ophthalm.*, **56**, 933
 OBSTBAUM, S. A., ROBBINS, R., BEST, M., and GALIN, M. A. (1970) *Ibid.* (In Press)
 ROBBINS, R., BLUMENTHAL, M., and GALIN, M. A. (1970) *Ibid.*, **69**, 603
 ——— and GALIN, M. A. (1969) *Arch. Ophthalm. (Chicago)*, **82**, 694
 ROPER, K. L. (1966) *Amer. J. Ophthalm.*, **61**, 1278