LONG-TERMED ASSESSMENT OF 307 RETINAL DETACHMENTS WITH SEVERE VITREO-RETINOPATHY TREATED WITH SILICONE OIL INJECTION AND VITRECTOMY

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SUMMARY

We retrospectively reviewed the retinal detachment accompanied by advanced proliferative vitreo-retinopathy in 307 eyes of 300 patients who have been operated with silicone oil injection combined with vitrectomy, between 1975 and 1985. A complete retinal reattachment has been achieved in 80.45 % of cases, and a visual acuity of I/60 or better has also been obtained in 46.25 % of cases post operatively. The final rate of anatomic reattachment was 77.19 % and the final rate of visual acuity of I/60 or better was 35.83 % at the end of a mean period of two years follow-up.

Silicone oil, for the time being is the only alternative for the treatment of complex retinal detachment in which conventional surgery fails.

Key Words : Silicone oil, complex retinal detachment, proliferative vitreo-retinopathy.

INTRODUCTION

Liquid silicone, in other words polydimethyl siloxane is a colorless, inert, transparent fluid having a specific gravity of ranging from 0.973 to 0.975 and a surface tension ranging from 21.2 to 21.3 with regard to water. The viscosity which is used surgically is ranging from 1000 to 5.000 centistoke. It has a refractive index of 1.4035.

CH3	CH3	CH3	CH3
Si-O	Ch3-Si-O-	Si-O-	Si
CH3	CH3	CH3	CH3

unite of siloxane chain of polysiloxane (I).

Because it has a low gravity as compared with the aqueous humor and vitreous, silicone oil floats on the surface of the aqueous and vitreous. Its high surface tension, possibilises the internal drainage of subretinal fluid during fluid/silicone exchange and closure of the retinal break (2). Interest in the intreocular use of liquid silicone followed very soon after the realization that scleral buckles and drainage of subretinal fluid were not always successful in the treatment of complex vitreo-retinal disorders. In 1961, it was suggested that liquid silicone might be used in patients with complicated retinal problems to replace the vitreous and push the retina back into place (3). This idea was developed by Cibis (4) and others (5) who felt that a dysfunctional membrane could be separated from the retina by injecting silicone between the membrane and the retina.

The most important cause of failure in retinal reattachment surgery is the proliferation and contraction of the membrane on both surfaces of the detached retina and on the posterior surface of detached vitreous gel. This condition has variously been called "massive vitreous retraction", "massive pereretinal retraction", "massive periretinal proliferation" or "massive preretinal fibroplasia"(6).

The Retina Society Terminology Committee proposed the term "Proliferative vitreo-retinopathy (PVR)" to refer to this clinical condition with a classification of PVR into phases, A-minimal, B-moderate, C-marked, D-massive (7). Each stage is further divided into three grades.

We have retrospectively reviewed 307 eyes of 300 patient with-retinal detachment associated with the more advanced stages of PVR, who have been seen between 1975 and 1985. The purpose of this paper is to assess the silicone oil injection and to report its long termed effects.

MATERIALS AND METHODS

Of more than 3.000 cases which have undergone retinal detachment surgery and silicone oil injection at Addenbrooke's hospital in Cambridge between January 1975 and January 1985, 307 eyes of 300 patients with complex retinal detachment (such as : severe VRP, giant tear, recurrent detachment etc.) were selected for this study. Of the 300 patients, 207 were male, and 93 were female. 168 of the 307 eyes were right eye, 139 were left eye. 13.68 % of eyes had mild degree of myopia, 20.19 % of eyes had a high degree of myopia. 74.59 % of 307 eyes were phakic, 25.40 % were aphakic. 14 of the 300 patients had diabetes, 2 were hypertensive, 2 were premature, 1 was sarcoid, 1 had toxoplasmosis, 3 stickler syndrome, one Simmond's disease, 1 pan uveitis, 1 subdural heamorrhage, 1 Sjogren's syndrome and 1 was the choroidal malign melanoma extracted patient. The ages of the patients ranged from 3 years to 90 years (Table I). The silicone oil which was used had a viscosity of 2.000 centistoke and the volume of the silicone injected ranged from 3 ml. to 9 ml. The mean volume was 4 ml. (Table II). The follow-up ranged from 3 months to 12 years. The mean follow-up was 2 years (Table III). The information about each patient were taken from the records of the patients, which contained the ocular history of the patients, visual acuity, intraocular pressure, anterior and posterior segment findings, detailed fundus drawings and notes of operations. We used the preoperative fundus drawings to evaluate and locate the retinal breaks. We also used the PVR classification proposed by The Retina Society Terminology Committee. The grades of PVR were determined retrospectively from the detailed preoperative fundus drawings.

RESULTS

Of the 307 eyes, 4 had atraumatic retinal detachments, 8 had rhegmatogenous retinal detachments, 1 had en exudative retinal detachment, 294 had recurrent retinal detachments, 229 had two operations before, 40 had three operations, 17 had four operations, and 8 had 5 operations before (Table IV). Four of the 307 eyes had a minimal degree of PVR, 9 had a moderate degree of PVR, 77 eyes had a marked degree of PVR (5 of which had a G2 PVR, 72 had a G3 PVR), 217 eyes had a massive PVR (30 of which had a G1, 53 had a G2, 134 had a G3 PVR) (Table V). In 105 of 307 eyes, retinal tears were present, 63 of which were located in equatorial region of the retina, 25 in periphery, 17 in posterior region of the retina. Retinal holes were found in 109 eyes. In 59 eyes retinal holes were located in periphery of the retina, in 28 they were in the equatorial region, and in 22 they were in the posterior pole of the retina. Retinal giant tears were present in 61 of the 307 eyes, 8 eyes had dialysis and 15 eyes had macular holes (Table VI). Of the 307 eyes, in 242 (80.45 %) complete retinal reattachment was obtained, 9 of them were redetached during a mean period of two years follow-up. In 36 (11.72 %) of 307 eyes retina has still remained partially detached, in 20 cases (7.81 %) retina was totally detached, in the post operative period.

Retinal heamorrhage was seen in 5 cases (1.62 %). In 4 cases silicone oil was found in the subretinal space (Table VII-a). While in the 237 (77.19 %) cases, retina remained attached during a mean period of 2 years, 20 (6.51 %) were partially detached, 50 (16.28 %) were totally detached (Table VII-b). In 163 of 307 eyes additional reoperation were performed. Of 163 eyes, in 87 (28.33 %) retinal surgery combined by silicone oil top-up was performed. In 15 eyes (4.88 %) of 163 eyes, conventional retinal surgery was carried out. Silicone oil removal was carried out in 61 eyes (19.86 %) of 163 reoperated eyes In 9 cases (2.93 %) of 307 eyes, additional second operation, in 6 eyes (1.95 %) additional third operation was performed (Table VIII).

In 142 eyes (46.25 %) of 307 eyes, a visual acuity of 1/60 or better was achieved post operatively, while a visual acuity of 1/60 or better had been in 27 eyes (8.79 %) preoperatively. At the end of the mean two years follow-up a visual acuity of 1/60 or better was found in 110 eyes (35.83 %) of 307 eyes (Table IX-a, b, c).

Corneal decompensation occurred in 81 (26.38 %) of the 307 eyes, 31 of which were corneal oedema, 39 corneal dystrophy, 11 were bandshaped keratopathy. Of the 307 eyes, in 73 (23.77 %), silicone oil was found in the anterior chamber (53 of which were emulsified silicone, 20 were silicone bubble.) Glaucoma was seen in 29 eyes (9.44 %) of 307 eyes.

In 22 eyes, elevated intraocular pressure has been kept under control with antiglaucomatous drugs. In one eye optic atrophy developed even though several retrieving operations. (Table X). In the 54 (17.58 %) eyes of 307 eyes hypotony was present at the end of a mean period of 2 years. In 61 eyes (19.86 %), intraocular pressure was higher than 21 mm. Hg. at the end of the final examination (Table-XI).

Of our series of 307 eyes, in 153 eyes (49.83 %) several types of lens opacities have developed.

DISCUSSION

The treatment of proliferative vitreo retinopathy with silicone oil was introduced by Cibis et al (4), in 1962 and was further developed in Europe by Scott (3). Cox et al (9) who reported that they were able to achieve complete retinal reattachment in 65 % in a series of 51 eyes with PVR. The final rate of retinal reattachment is reported to be 64 % by McCuen et al (8), Sell et al (10), Grey, and Leaver (11). In our cases, the final rate of retinal reattachment is 77, 19 %. In our series consisting 307 eyes, the final rate of visual-acuity of 1/60 (or better) is 35.83 %. This rate was 34 % in McCuen et al. 's series, and 28 % in that of Grey et al. Silicone oil is helpful, because of its optic qualities and its permanence. Fundus details are clearly visible through the silicone oil tamponade. Laser photocoagulation can be applied accurately both intraoperatively and post oparetively. Residual and recurrent traction can be detected and eliminated by membrane surgery under the oil. The permanent nature of the silicone tamponade provides a time of interval between the onset of reproliferation and the eventually stabilization of the PVR process. Newly developed contractural forces are resisted during the vitrectomy and can be eliminated if necessary. Failures occur when such forces are not recognized and interrupted or when they are intractable (9). In 26.38% of the cases, corneal decompensation has developed. Most of them were accompanied by aphakic cases. Intraocular silicone may enter the anterior chamber of aphakic eyes and get into contact with the corneal endothelium. Should this happen, a specific keratopathy is observed. After about six months, Bowman's membrane begins to discolor and corneal thickness decreases slightly (3). Silicone keratopathy frequently presents as a band keratopathy in younger patients, and as a bullous keratopathy in the older age groups (12). The cause of corneal decompensation is not clear. This is perhaps that silicone oil serves to provide a barrier to the nutrition of the cornea, normally provided by the aqueuous humor. Corneal decompensation may be removed or reduced by eliminating or reducing the amount of contact between silicone oil and the corneal endothelium (13). Since the specific gravity of silicone oil is less than that of both aqueous and vitreous, the silicone bubble floats and can occlude both the pupil and any superior iridectomy if present. Therefore, an intact iris diaphragm especially, superiorly is important. Ando (14) referred to a relative pupillary block due to silicone oil in aphakic eyes, and recommended creation of an inferior iridectomy in order to avoid this. The late development of silicone oil contact with the cornea is frequently due to recurrent retinal detachment. When recurrent detachment occurs, the subretinal fluid is usually aqueous rather than a posterior migration of the silicone oil. With the development of recurrent detachment, the intravitreal volume shrinks. Silicone is then forced into the anterior chamber, despite an initially appropriate filling and still patent inferior iridectomy. The treatment of this situation is to reoperate the retina (12).

It is reported that the late complications of silicone oil were not frequent when the silicone oil was routinely removed six to eight weeks after injection (16). Zivojnovic et al (15), Cox et al (9), Sell et al (10) reported that retinal redetachment occurred after silicone removal. In 19.86 % of our cases, silicone oil had to be removed due to the emulsification and uncontrollable intraocular pressure. We have also observed retinal redetachment in ten eyes from which silicone oil was removed. In 9.77 % of 307 eyes, hypotony has been seen during the final follow-up examination. There are several possible explanations of this. The reason for hypotony is over coagulation of the retina during retinal cryopexy due to the increased heat capacity of silicone oil (16). Others have stated that the most likely, proliferative process continues post operatively, eventually leading to involvement of the ciliary body with subsequent decreased production or increased outflow (12). Cataract developed in 34.52 % of the cases. We believe that cataract formation is not directly related to the silicone oil. Gonvers (16) has noted that eyes from which the silicone oil was removed at six weeks still had a high incidence of subsequent cataract formation. There is a high incidence of cataract in massive vitreous retraction whether liquid silicone is used or not. Eyes which have not been affected by massive vitreous retraction and received intraocular silicone for other reasons (e.g. the treatment of primary macular holes in highly myopic eyes) do not suffer cataract beyond the slowly developing nuclear sclerosis, and posterior subcapsular cataract is not a feature of these eyes. In brief, cataract, following the use of intraocular silicone is a result of the underlying diseases and not due to any possible toxic effect of the silicone (3).

At the present time, the major problem in the use of intraocular silicone is emulsification. In 17.26 % of our 307 cases, silicone emulsification occurred, and caused the glaucoma in the 9.44 % of the cases, which could only be controlled by silicone removal and drainage using tubes of Molteno type. The cause of emulsification is unknown. It may be related to the methods of sterilization, or to the mobility of silicone

into the eye, or to the activity of macrophages. Emulsification or dispersion is a basically tiny bubble of silicone due to a break down of surface tension. Some authours have suggested that the use of high viscosity silicone oil may reduce the incidence of emulsification (17-18). In conclusion, when the conventional methods of retinal surgery fails in the treatment of complex retinal detachment, silicone oil combined by vitrectomy, is the only possible treatment for cases which otherwise would be hopelessly blind.

Table I Delivery of patients regarding to age

Age	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	80 +	Total
Num.of Patient	16	40	34	36	35	66	54	16	3	300
%	5.33	13.33	11.33	12	11.66	22	18	5.33	1	100

Table II Delivery of patients related to volume of silicone oil

Vol. of silicone	3	4-5	6-7	7 +	Total
Num.of patient	118	148	24	17	307
%	38.43	48.20	7.81	5.33	100

Table III Follow-up

Time	0-3 month	4-7 month	8-12 month	1-2 year	3-4 year	5-6 year	7-8 year	9-10 year	10 year	Total
Num.of patient	30	28	5	105	63	29	28	11	8	307
%	9.77	9.12	1.62	34.20	20.52	9.44	9.12	3.58	2.60	100

Table IV Delivery of the eyes related to type of retinal detachment

Type of R.Detach.		NUMBER OF OPERATION					
	1	2	3	4	5	Total	%
Recurrent R.Detach.		229	40	17	8	294	95.78
Travm.R.D.	4						1.30
Rheg.R.D.	8						2.60
Exud.R.D.	1						0.32
Total	13	229	40	17	8	307	100

Table V Delivery of R.Detachment related to degree of PVR

PVR		G/1	G/2	G/3	Total	%
Minimal	4				4	1.3
Moderate	9				9	2.9
Marked			5	72	77	25.0
Massive		30	53	134	217	70.6
Total					307	100

Table VI Delivery of tear with respect to location and size of tear

	Periph.	Equat.	Post.	0-30	60-90	90-120	120-150	150-180	180-210	210-240	240-270	270 +	Total	%
Tear	63	25	17										105	35.23
Hole	59	28	22										109	36.57
M.Hole			15										15	5.04
G.Tear				2	2	9	13	9	15	3	1	7	61	20.48
Dialysis				1	3	2			1		1		8	2.68
Total													298	100

Table VII-a Delivery of eyes according to post op. retinal state

Post operative Retinal State			
Retinal State	Num. of patient	Total	%
Flat	242	242	80.45
Part Detach.	36	36	11.72
Totally Detach.	20	20	7.81
Ret. Heamor.	5	5	1.62
Sub. Ret.Silicone.	4	4	1.30

Table VII-b Delivery of eyes regarding to final retinal state

Retinal State During Final Exam.			
Retinal State	Num. of patient	Total	%
Flat	237	237	77.19
Part. Detach.	20	20	6.51
Totally Detach.	50	50	16.28

Table VIII Delivery of eyes with regard to additional operations

	ADDITIONAL OPERATIONS									
Time		FIRST OPERATION							2 nd. op.	3 rd op.
Type of opr.	0-3 month.	4-7 month	8-12 month	1-2 year	3-4 year	4 + year	Total	%		
Retinal surg. + Silicone oil	50	14	8	13		2	87	28.33	9	6
Retinal surg.	5	1	4	4	1		15	4.88		
Silicone Removal	10	9	9	18	10	5	61	19.86		
Total							163	53.09		

Delivery of eyes with regard to visual acuity

Table IX - a b c

Preoperative Visual Acuity			Postoperative Visual Acuity			Visual Acuity During Final Exam		
V.A.	Number of patients	%	V.A.	Number of patients	%	V.A.	Number of patients	%
L/P	90	29.31	L/P	21	6.84	No-L/P	27	8.79
H/M	159	51.79	H/M	82	26.71	L/P	40	13.02
C/F	31	10.09	C/F	62	20.19	H/M	89	28.99
1/60	6	1.95	1/60	30	9.77	C/F	41	13.35
3/60	5	1.62	3/60	32	10.42	1/60	17	5.53
6/60	9	2.93	6/60	40	13.02	3/60	28	9.12
6/36	4	1.30	6/36	24	7.81	6/60	36	11.72
6/18	3	0.97	6/24	6	1.95	6/36	12	3.90
			6/18	4	1.30	6/24	8	2.60
			6/12	6	1.95	6/18	9	2.93
Total	307	100	Total	307	100	Total	307	100

VA: Visual acuity H/M: Hand movement
L/P: Light perception C/F: Counting finger

Delivery of eyes related to complications

Table X

Type of lesion	Gra-nuloma	Oedem.	Dyst.	Band kera.	Emul-sification	Sil. Bubble	Total	%
Conjunc.	1						1	0.32
Cornea		31	39	11			81	26.40
Anterior Chamber					53	20	73	23.77
Glaucoma							29	9.44
Total							184	59.93

Delivery of eyes related to I.O.P

Table XI

Preoperative I.O.P.			I.O.P. During final exam		
I.O.P.	Num. of patient	%	I.O.P.	Num. of patient	%
0-5	30	9.77	0-10	54	17.60
6-10	99	32.24	11-20	192	62.54
11-15	111	36.15	21-30	39	12.70
16-20	52	16.94	31 +	22	7.16
21-30	12	13.90			
30+	3	1			
Total	307	100	Total	307	100

I.O.P.: Intraocular pressure

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