ORIGINAL ARTICLE

Anatomical Results of Cryosurgical Procedures in Rhegmatogenous Retinal Detachment – Our Experience

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SUMMARY

Aim: To evaluate retrospectively anatomical results of cryosurgical treatment of non-complicated idiopathic rhegmatogenous retinal detachment. To assess the successfulness of primary cryosurgical surgeries, permanent retinal re-attachment; to review the efficacy of cryosurgical procedures according to chosen surgical technique and patient's age as well.
Material and methods: In the evaluated group were included 120 eyes of 120 patients operated on in the years 2003- 2012 at the Department of Ophthalmology, Faculty Hospital and School of Medicine, Palacký University, Olomouc, Czech Republic, E.U. All of the patients were phakic. The patients were evaluated at one and three months after the surgery. The posterior pole examinations were done by means of biomicroscopic examination and indirect ophthalmoscopy. The retina was evaluated as attached in whole extent in case of re-established contact between the neurosensory retina and the retinal pigment epithelium in the whole periphery.
Results: In 106 (88 %) patients, the re-attachment of the retina was achieved by solely cryosurgical procedure; in 117 (97.5 %) patients, the definite re-attachment of the retina was achieved. In three patients (2.5 %), the retina remained detached. Statistically better results were obtained in patients with peroperative exodrainage of the subretinal fluid and in patients younger than 50 years of age. Conclusion: We established the usefulness of cryosurgical operative procedure in treatment of uncomplicated idiopathic rhegmatogenous retinal detachment in phakic patients. Especially in young phakic patients, the cryosurgical procedure may be protective to preserve the clear lens and eye accommodation.

Key words: rhegmatogenous retinal detachment, cryosurgical procedure

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INTRODUCTION AND EPIDEMIOLOGICAL DATA

Retinal detachment is the separation of its neurosensory retina and the retinal pigment epithelium. Most frequently we encounter rhegmatogenous retinal detachment, in which there is a tear of the neurosensory retina, through which fluid penetrates into the subretinal area, detaching it from the pigment epithelium. A great advance for the treatment of rhegmatogenous retinal detachment, with better anatomical and functional results, came with cryosurgical techniques with the use of episcleral fixed cerclage strips and fillings, to which Schepens referred in the 1950s [8, 9]. At the beginning of the 1970s Machemer introduced pars plana vitrectomy (PPV) as a suitable technique for the treatment of retinal detachment [7]. And in 1986 Hilton and Grizzard presented pneumatic retinopexy for the treatment of retinal detachment [6]. Cryosurgical procedures, PPV and pneumatic retinopexy, either separately or in mutual combination, represent the methods of choice for the treatment of retinal detachment. It is probably due to the reason that each of the above-named techniques has its advantages and disadvantages that to date there is no consensus amongst vitreoretinal surgeons on the matter of which of these techniques is the most suitable for the treatment of non-complicated rhegmatogenous retinal detachment. Decision-making between the techniques is also influenced by the state of the lens (phakia, artephakia, aphakia), and the method of treatment of non-complicated rhegmatogenous retinal detachments is often chosen precisely with regard to the state of the lens, whether the eye is phakic or artephakic/aphakic.
The aim of this article is to retrospectively evaluate the anatomical results of cryosurgical treatment of non-complicated idiopathic rhegmatogenous retinal detachment of phakic patients operated on at the Department of Ophthalmogy of the Faculty Hospital and School of Medicine at Palacký University, Olomouc in the period from 2003 to 2012. The first aim is to assess the success rate of initial cryosurgical surgeries, the second aim is to evaluate the success rate of definitive reattachment of the retina. The third and fourth aims are to assess the success rate of cryosurgical procedures depending on the chosen surgical technique and the age of the patient.

POPULATION AND METHOD

Patients with non-complicated idiopathic rhegmatogenous retinal detachment were included in the evaluation population. A statement of blunt eye injury was admissible in the patients' anamnesis. The cause of retinal detachment was one pre-equatorial retinal tear, two pre-equatorial tears anywhere

on the periphery of the retina or three adjacent pre-equatorial tears, whereas all three were located within the scope of one quadrant (90 perimeter degrees). All patients had their own lens, transparency of the lens and all optic media were problem-free and enabled reliable visualisation of the posterior segment of the eye.

The basis of the surgical treatment of rhegmatogenous retinal detachment on the patients in the sample group was transscleral cryocoagulation of the edges of the retinal tears under the control of indirect ophthalmoscope and subsequently episcleral fixation of a cerclage strip, accentuation of cerclage, radial or paralimbal fillings, or a mutual combination thereof on the basis of the peroperative decision of the surgeon. In the case that the condition was complicated by a high bullous retinal detachment which peroperatively excluded the possibility of localisation of the retinal tear, cryocoagulation of the retinal tear or contact of the retinal tear with the cerclage wall, accentuation or filling, transscleral puncture of the subretinal area was performed with exodrainage of the subretinal fluid. In the case that hypotonia of the bulb was diagnosed following exodrainage of the subretinal fluid, gas could be insufflated on the basis of the preoperative decision of the surgeon intravitreally, in the form of injection.

The evaluated population did not enrol patients in whom proliferative vitreoretinopathy (PVR) stage C1 or worse had been diagnosed before the operation. Patients who had suffered a penetrative eye injury, undergone complicated or non-complicated cataract surgery (artephakic, aphakic), patients in whom it was not possible to identify any retinal tear in the preoperative examination, who had a large tear with a displaced posterior edge, patients with a post-equatorial retinal tear and those in whom amotion of the retina was linked to the presence of three or more pre-equatorial tears located in two or more quadrants were excluded from the study. Also excluded were patients in whom there was insufficient transparency of optic media such as corneal oedema, cataract, hemophthalmos etc., and similarly insufficient mydriases prevented reliable transparency of the posterior segment of the eye. Patients in whom gas was insufflated into the vitreous body without prior exodrainage of the subretinal fluid following cryocoagulation treatment of the retinal tear and stitching of a cerclage strip or filling were also excluded.

During the course of the evaluated 10 years, 6 vitreoretinal surgeons shared in the performed and evaluated surgeries. All surgeries are evaluated, regardless of the length of practice and the level of knowledge of the individual operating surgeons.

The patients were evaluated 1 to 3 months after the surgery. An examination of the fundus was conducted on the patients biomicroscopically and by indirect ophthalmoscopy. The retina was evaluated as fully attached if contact of the neuroepithelium and the pigment epithelium had been restored on the posterior pole and in the entire periphery. The retina was evaluated as detached if a persisting separation of the neuroepithelium and the pigment epithelium was found at least in part on the posterior pole or in the periphery of the retina.

In the observed group we conducted 2 sub-analyses. In the first we observed the relationship between the success rate of the primary cryosurgical procedure and the used surgical technique, in the second the relationship between the success rate of the primary cryosurgical procedure and the age of the patient. Fischer's exact test was used for statistical processing of the sub-analyses.

We included 120 eyes of 120 patients in the evaluated group, 63 (52.5%) men and 57 (47.5%) women with an average age of 52.9 years, in which the oldest patient in the group was 88 years old at the time of operation and the youngest 9 years old. In 64 cases (53%) the right eye was afflicted and in 56 cases (47%) the left eye was afflicted. In 86 patients (72%) the cause of retinal detachment was one tear, in 21 patients (17%) there were two retinal tears and in 13 patients (11%) 3 retinal tears were found [Table 1]. All the patients were operated on under general anaesthesia.

RESULTS

We succeeded in reattaching the retina by means of a single cryosurgical procedure in 106 (88%) of patients, in 14 (12%) the retina was not reattached. The 14 initially unsuccessfully operated patients were re-operated on. For the re-operation the PPV technique was used, in 11 cases retinal reattachment was successful, in 3 cases reattachment did not succeed. Of 120 patients in the group we achieved a definitive attachment of the retina in 117 (97.5%), in 3 (2.5%) the retina remained detached. The success rate of the operations in the individual years is presented in Table 2.

In 47 patients (39%), transscleral

Table 1. Preoperative characteristics of patients in group operated on in period from 2003-2012

	Man	Woman	Age on day of surgery (years)	OD	OS	1 tear	2 tears	3 tears
2003	9	1	74, 72 ,64, 57, 55, 55, 51, 42, 42, 37, 34	4	6	6	4	0
2004	9	6	77, 72, 69, 68, 67, 66, 60, 60, 58, 55, 55, 37, 32, 25, 16	8	7	11	2	2
2005	31	11	88, 68, 65, 64, 64, 64, 64, 63, 63, 62, 62, 60, 59, 58, 56, 56, 55, 52, 52, 49, 45, 32, 25, 12	13	11	16	4	4
2006	13	9	75, 75, 68, 67, 66, 64, 63, 61, 60, 56, 56, 52, 51, 49, 49, 32, 24, 22, 21, 19, 13, 9	11	11	14	4	4
2007	6	7	73, 70, 65, 61, 61, 60, 59, 59, 53, 43, 42, 40, 36	9	4	10	2	1
2008	3	5	75, 75, 73, 71, 63, 41, 26, 19	6	2	7	0	1
2009	3	8	76, 76, 69, 66, 65, 49, 45, 29, 27, 24, 23	4	7	8	3	0
2010	1	4	70, 60, 52, 40, 25	3	2	4	1	0
2011	1	3	79, 57, 47, 36	1	3	2	1	1
2012	5	3	74, 71, 66, 59, 51, 42, 32, 23	5	3	8	0	0

cryocoagulation of the edges of the tears was conducted under the control of indirect ophthalmoscopy, a radial filling was fixed to the surface of the bulb 22 times (18%) by means of episcleral stitches, 18 times (15%) a cerclage strip with accentuation was fixed and 7 times (6%) a paralimbal filling. Of the 47 patients, reattachment of the retina was successful in 39 cases, in 8 the retina was not reattached, of whom 6 patients were operated on with a radial filling, 2 with cerclage strip with accentuation.

In 34 patients (28%), transscleral cryocoagulation of the edges of the tears was conducted under the control of and indirect ophthalmoscope, a cerclage strip with accentuation was fixed to the surface of the bulb 22 times (18%) by means of episcleral stitches, 11 times (9%) a radial filling fixed and 1 time (1%) a paralimbal filling, and transscleral exodrainage was performed during the surgical procedure in all the patients in this group. Of the 34 patients, reattachment of the retina was successful in 31 cases, in 3 the retina was not reattached, whereas 2 patients were treated by a cerclage strip with accentuation and 1 with paralimbal filling.

In 39 patients (33%) transscleral cryocoagulation of the edges of the tears was conducted under the control of an indirect ophthalmoscope, a cerclage strip with accentuation was fixed to the surface of the bulb 19 times (16%) by means of episcleral stitches, 19 times (16%) a radial filling fixed and 1 time (1%) a paralimbal filling, and transscleral exodrainage was performed and expansion gas was applied during the surgical procedure in all patients. Of the 39 patients, reattachment of the retina was successful in 36 cases, in 3 the retina was not reattached, out of whom 2 patients were operated on with a radial filling and 1 with paralimbal filling. The used cryosurgical techniques in the individual years are illustrated by table 3.

Of the 47 patients on whom exodrainage was not performed during the surgery, the retina was reattached in 39 (83%), in 8 (17%) it remained detached. Of the 73 patients operated on with the use of exodrainage, whether this was with or without the application of gas, the retina was reattached in 67 (92%), in 6 (8%) it remained detached. Although the difference between the success rate of the operating technique with exodrainage and without it did not appear statistically significant ($p = 0.157$), in the group of patients operated on with exodrainage the percentage of success is higher.

Of 120 patients in the group, 41 (34%) were aged < 50 years. The initial cryosurgical procedure succeeded in reattaching the retina in 38 (93%), in 3 (7%) the operation was unsuccessful. 79 (66%) patients were aged 50 and over. The initial cryosurgical procedure succeeded in reattaching the retina in 68 (86%), in 11 (14%) the operation was unsuccessful. Here also, even if the difference in the success rate of the cryosurgical operating technique between the group of patients aged < 50 years and the group aged > 50 years is not statistically significant ($p = 0.376$), the success rate in the group of patients aged < 50 years is higher.

DISCUSSION

In the treatment of rhegmatogenous retinal detachment, three therapeutic procedures are currently considered: pneumatic retinopexy, cryosurgical techniques and PPV. However, pneumatic retinopexy is indicated only in the case that retinal detachment is caused by a single tear, which is localised in the upper perimeter periphery between numbers 8-4 and the scope of this tear is maximally within the scope of one hour [6]. Tornambe states that primary anatomical success is achieved only in 75% of phakic and 67% of artephakic eyes [13]. For the above reasons the use of pneumatic retinopexy is limited in the treatment of rhegmatogenous retinal detachment, and doctors usually decide between cryosurgical techniques and PPV. No unequivocal boundary exists between the use of a cryosurgical procedure or PPV. The reason for this is the high variability of the clinical finding in connection with the diagnosis of rhegmatogenous retinal detachment, which may at one end of the spectrum be a case of non-complicated localised retinal detachment with a single tear, and at the other it may be total retinal detachment with multiple tears and preoperative PVR. With regard to the complexity of the preoperative clinical finding, it is possible to agree with the division of patients into three basic groups, as performed by Feltgen in his study [3]. In his study, Feltgen observed 50% of patients with localised retinal detachment (within a scope of up to 4 perimeter hours) with a single tear or adjacent tears. The majority of these patients were treated cryosurgically [3]. At the other end of the spectrum of clinical findings there were 20% of patients with complicated findings with PVR stage B and C, large tears, macular holes, in which indication for PPV dominated [3]. Between these two poles he observed 30% of patients with a medium-severe

Table 2. Expression of success rates of operations in individual years

	RLFS	Reoperation and success	Reoperation and failure
2003	8	1	1
2004	14	0	1
2005	21	3	0
2006	20	1	1
2007	12	1	0
2008	8	0	0
2009	10	1	0
2010	4	1	0
2011	3	1	0
2012	6	2	0

Key: RLFS = retina lying in full scope

Table 3. Overview of cryosurgical techniques used in individual years.

	C, A	C, A, E	C, A, E, gas C3F8	C, A, E, gas SF6	RF	RF, E	RF, E, gas C3F8	PF	PF, E	PF, E, gas C3F8
2003	6	3	0	1	0	0	0	0	0	0
2004	2	4	0	2	2	4	1	0	0	0
2005	6	6	3	0	5	1	3	0	0	0
2006	2	5	1	0	5	1	4	3	0	1
2007	0	1	5	0	2	1	3	1	0	0
2008	1	1	0	0	1	2	2	1	0	0
2009	0	1	5	0	0	2	3	0	0	0
2010	0	1	0	0	2	0	2	0	0	0
2011	1	0	0	0	0	0	0	2	1	0
2012	0	0	2	0	5	0	1	0	0	0

Key:
C – cerclage
A – accentuation of cerclage
E – exodrainage of subretinal fluid
RF – radial filling
PF – paralimbal filling
C3F8 – perfluoropropane
SF6 - hexafluorosulphide

finding. In this group he placed patients with multiple tears in various quadrants, bullous retinal detachment, tears spreading centrally beyond the equator, tears with perceptible vitreoretinal traction and patients with rhegmatogenous retinal detachment and unclear situation of the sides of the tears (preoperatively without finding of tears or with impossibility of identifying all tears preoperatively). In these patients PPV, cryosurgery or a combination of both was used [3].

In terms of the preoperative finding, the patients in our population would correspond to the group Feltgen indicated as favourable to medium-severe. It is possible to find studies for such patients in the literature that defend cryosurgical procedures and primary PPV, even if in recent years the tendency has been rather to treat this group of patients using PPV [11]. Kreissigová evaluated the results of a population of 1462 eyes, in which this concerned idiopathic retinal detachment. The population also included eyes with multiple tears, with tears of variable size and localisation. 2.9% of eyes had preoperative diagnosed PVR stage C1-C2. Tears larger than two perimeter hours and tears on the posterior pole of the eye were excluded. Kreissigová states that the initial operation using cryosurgical technique succeeded in reattaching the retina in 91% of cases, with definitive attachment of the retina in 97% [1].

Soni conducted a meta-analysis of prospective, randomised, controlled trials in order to evaluate the benefit of PPV versus cryosurgery for the treatment of non-complicated rhegmatogenous retinal detachment with PVR stage B and less [10]. The meta-analysis incorporated 1306 eyes, of which 636 underwent PPV and 670 were treated cryosurgically. 523 were phakic and 783 were artephakic/aphakic. Primary attachment of the retina was achieved in 177 of 260 (68%) PPV patients, and 179 of 263 (68%) cryosurgically operated phakic patients. Secondary attachment of the retina was achieved in 253 of 260 (97%) PPV operated patients and 256 of 263 (97%) cryosurgically operated phakic patients. In the group of phakic patients Soni did not demonstrate a statistically significant difference between the groups treated with PPV or cryosurgically in the sense of primary or secondary attachment of the retina [10]. In our group we achieved reattachment of the retina in 106 (88%) of patients with a single cryosurgical procedure. We achieved definitive attachment of the retina in 117 (97.5%) patients. We believe that the results of our group are comparable with the results of the above cited authors.

In our population we achieved better results in percentage terms if exodrainage of the subretinal fluid was performed during the operation. This result is surprising. For example, Kreissigová, as an advocate of “minimal scleral buckling procedures” recommends avoidance of exodrainage. She rather emphasises its risks, such as choroidal haemorrhage, retinal incarceration, retinal perforation and subsequent impacts on the final result of the surgery [1]. Other authors also highlight the risks of cryosurgical operations in connection with exodrainage [2, 4, 14]. In our population we did not encounter any fatal complications which would have an impact on the anatomical result of the operation in any of the 73 patients on whom exodrainage was performed. On the contrary, we are of the opinion that through judiciously and successfully performed exodrainage we contributed to better contact of the detached neuroepithelium and the pigment epithelium, and thus to the creation of the conditions for the establishment of firm, cicatrical adhesion. We believe that this contact following exodrainage is especially valuable in the case of cracks localised in the lower periphery of the retina, where it is less possible to influence the contact of the wall of the filling with the tear of the neuroepithelium by positioning the patient or by using intravitreally insufflated gas in the postoperative period.

We believe that another interesting result in our group is the higher percentage success rate of cryosurgical procedures in patients aged < 50 years. Although the difference in the success rate of cryosurgical operations in the groups of < 50 and > 50 years is not statistically significant ($p = 0.376$), in

the group of patients aged < 50 years the percentage of success is higher. Hassan operated cryosurgically on 94 patients with primary, non-complicated retinal detachment, including macula with initial vision of 20/200. By using a single cryosurgical procedure he achieved reattachment of the retina in 40 (95.2%) patients aged < 60 years, 31 (86.1%) patients aged 61-75 years and 12 patients (75%) aged > 75 years. In Hassan's group also the difference in the success rate of the cryosurgical procedure between the group of < 60 years and the group of 61-75 years (P = 0.66, Fisher's exact test) or the group of > 75 years (P = 0.12, Fisher's exact test) was not statistically significant. However, Hassan also observed a higher percentage success rate of operations in younger patients [5]. We believe that in the background of these results there may be the fact that by using the cryosurgical method we do not remove the vitreous body, and especially upon use of a localised filling we do not remove pathological traction in the entire periphery of the retina. In this context, retinal degenerations in the periphery increase with age, and if vitreous traction is not eliminated in a complex manner by surgery, a new retinal tear may appear, which is due to failure to attach or repeated detachment of the retina. The success rate we achieved through a primary cryosurgical procedure, of 93% in patients aged < 50 years, is important above all with reference to the fact that these patients usually have a clear lens, and according to age also have a certain usable degree of accommodation.

Soni observed statistically significantly better visual acuity 6 months after the surgery in patients following a cryosurgical procedure in comparison with patients after PPV. The reason for this is the statistically significant higher risk of progression of cataract in the postoperative period in patients after PPV than in patients after a cryosurgical procedure. Patients after PPV demonstrated a 4.11 times higher risk of the progression of a cataract than patients after a cryosurgical operation [10]. The reason is probably the impact of the removal of the vitreous body on the metabolism of the lens and the impact of the instruments of internal tamponade. We have already previously described that removal of the vitreous body has an impact on the metabolism of the retina [12]. Our results support the use of a cryosurgical technique in younger, phakic patients, since we can offer them a high probability of success of the performed surgery, whilst simultaneously retaining a clear lens and accommodation.

Recommendation

We believe that in our population we demonstrated the usefulness of cryosurgical operating technique for the treatment of non-complicated idiopathic rhegmatogenous retinal detachment in phakic patients. Especially in young, phakic patients, the performance of a cryosurgical procedure may be provident for retaining a clear lens and accommodation of the eye.

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