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Vitrectomy in stage 5 retinopathy of prematurity – surgical and functional results of 1000 vitrectomies

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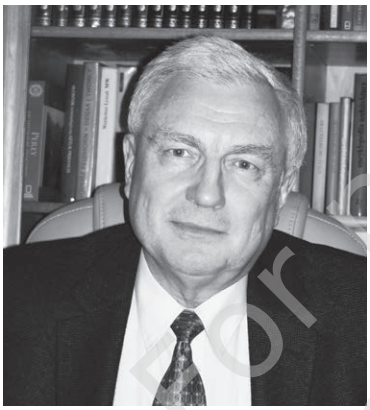

HIGHLIGHTS

In the paper surgical outcomes and functional results of 1000 vitrectomies preformed in children with stage 5 retinopathy were compared with the outcomes and results of unoperated children with the same stage of disease. Comparing the functional results of treated and untreated patients, it can be concluded that vitrectomy gives a better chance of gaining useful vision.

ABSTRACT

Despite improvements in neonatal care, retinopathy of prematurity is still leading cause of blindness in the world. The most treatment problems pose stage 4 and 5 of this disease. Performing vitrectomy in stage 5 is a subject of controversy among ophthalmologists due to unsatisfactory functional results after the surgery. Therefore, our aim was to present the results of 1000 vitrectomies performed by the author in years 1994–2019 in 1018 eyes of 692 children with stage 5 retinopathy of prematurity. In these children lens sparing vitrectomies and lensectomy-vitrectomy with limbal approach were performed. The results were compared with visual function of 127 untreated children with stage 5 retinopathy of prematurity. Visual acuity of treated patients ranged from 0.05 to no light perception in stage 5 and from no light perception to finger counting in the untreated group. Comparing the functional results of treated and untreated patients, it can be concluded that vitrectomy gives a better chance of gaining useful vision.

Key words: stage 5 retinopathy of prematurity, , vitrectomy, surgical outcomes, functional results

INTRODUCTION

Retinopathy of prematurity (ROP) was for the first time first described by USA ophthalmologist Terry in 1942 [1]. Although nearly 80 years have passed since that time it is still a leading cause of childhood blindness, both in industrialized and in developing countries [2]. It is estimated that globally every year, around 50,000 children goes blind because of ROP [3]. Despite improvements in screening protocols of premature babies and methods of treatment (laser ablation, anty-VEGF injections) still a lot of children suffer from severe vision loss due to the development of retinal folds, retrolental fibroplasia and retinal detachment which is the most serious complication that always leads to blindness. According to various publications, the retinal detachment (stage 4 and 5 of ROP) occurs in 10% to 30% of children with stage 3 of ROP, although this numbers has decreased significantly in recent years [4, 5]. Standard treatment of retinal detachment in the premature children is scleral buckling surgery or vitrectomy. The type of surgery depended on the configuration and extent of retinal detachment. In stage 4 with partial retinal detachment usually encircling or segmental scleral buckling surgery or lens sparing vitrectomy is performed with encouraging results including the diminution of vitreoretinal traction and retinal reattachment [6–13, 15]. Much more problems are associated with treating total retinal detachment (stage 5 ROP) both with open and closed funnel configuration of the detached retina. Different treatment methods have been proposed for this stage of the disease including encircling scleral buckling, open sky vitrectomy, lens-sparing vitrectomy, pars plana or pars plicata vitrectomy or limbal lensectomy-vitrectomy. However, reported visual results are not satisfactory with no light perception or light perception only in nearly all of the operated children [12–24]. Most studies report treatment results based on several dozen of patients. Therefore there are still controversies concerning what is the role of vitrectomy in the treatment of stage 5 ROP and whether it should be performed in the treatment of this stage of retinopathy.

The aim of the paper is to present surgical and functional results of 1000 vitrectomies in children with stage 5 ROP performed by the author in years 1994–2019 and to compare them with the vision of untreated children. Therefore, in the paper problems connected with the surgery itself (surgical techniques, intraoperative complications) will be not discussed.

MATERIAL AND METHODS

In years 1994–2019 author of the paper treated 760 children with stage 4 or 5 of ROP. 68 children were presented with stage 4a and 4b and were treated with scleral buckling, lens sparing vitrectomy and scleral resection and were not included in this study. In 692 children stage 5 was diagnosed and the results of their treatment are included in this paper. In all these children, except of 11, cryo-, laser therapy and/or intravitreal anti-VEGF injections were previously performed. In 60 eyes open and in 1324 eyes closed funnel configuration of retinal detachment was diagnosed. In 35 patients (52 eyes) with open funnel configuration lens sparing vitrectomy was performed and in the rest of patients lensectomy-vitrectomy through limbal approach was performed (966 eyes). Because some parents did not decided to operate the second eye the total number of operated eyes was 1018.

Surgical techniques

1. Lens sparing vitrectomy.
   Sclerotomies were placed 1–1.5 mm from limbus, Three-port vitrectomy was done to avoid hypotony when instruments were exchanged during surgery. Surgery was done with 23 gauge system instruments. After removal of preretinal membranes and proliferative tissue vitreous chamber was filled with hyaluronates or air to put retina in place and maintain eye pressure.

2. Lensectomy-vitrectomy through limbal approach.
   Three-port limbal approach system with anterior chamber maintainer system was used. After lens aspiration extensive fibrovascular membranes covering detached retina were excised with vitreous scissors and forceps. The dissection was continued till the posterior funnel was opened up and the fibrous stalk from the optic nerve head was removed. Peripheral trough was then opened up all around by careful dissection. Surgery was usually done with the use of 23 gauge vitreous instruments, but quite often it was necessary to use 20 gauge scissors because of the stiffness of the membranes. Needle coagulation of vessels of these membranes was usually done before their excision. At the end of surgery the eye was filled with 2% sodium hyaluronate and limbal incisions were sutured. Due to irido-corneal synechias and problems with pupil dilation, almost 90% operations were performed with the use of iris retractors. Perfluorocarbons liquids and silicone oil injection were given in some early vitrectomies, but their use was stopped due to the high number of intraoperative and postoperative complications.

The surgery was performed in the age of 4 to 12 months. Operated children were followed up by the author for a period of 1 to 24 years. During follow-up examinations visual acuity, IOP, pachymetry, slit lamp (usually hand held) examination of anterior segment and ophthalmoscopy were performed. Visual acuity was tested with different methods

(pictures, Lea symbols, letters or numbers charts) individually suited to the capabilities of examined children. Because of general health conditions in a lot of children it was possible to evaluate visual functions only by directly observing their behaviour by the examiner or basing on information provided by parents.

The control group consisted of 127 eyes of 76 children with 5 stages of retinopathy of prematurity, whose parents did not decide to perform vitrectomy or they decided to operate one eye only. These children were examined periodically. Their follow-up period was 0.5 to 24 years. During follow-up examinations visual acuity, IOP, pachymetry, slit lamp (usually hand held) examination of anterior segment and ophthalmoscopy were performed.

RESULTS

I. Operated children.
   1. Lens sparing vitrectomy.
      A. Surgical outcomes.
         In lens sparing vitrectomy group total retina reattachment initially after the surgery was observed in 33% and partial reattachment in 11%. During follow-up reattachment rate in the first group diminished in time to 26% and in the second group to 4% (tab. 1).

TABLE 1

Surgical outcomes of lens sparing and lensectomy-vitrectomy of stage 5 ROP.

	Total retinal reattachment		Partial retinal reattachment	
	After surgery	At the end of follow-up period	After surgery	At the end of follow--up period
Lens sparing vitrectomy	**33%**	**26%**	**11%**	**4%**
Lensectomy--vitrectomy	**21%**	**12%**	**7%**	**2%**

Main reason of retina redetachment (especially in partial reattachment group) during follow-up was development of vitreous, fibrous proliferations with the retinal traction.

      B. Functional results.
         Because the surgery was performed in the age of 4 to 12 months it was not possible to measure visual acuity after the operation. Functional results of the operated children were also changing in time. Therefore, visual acuity at the end of follow-up period was analysed in the paper (tab. 2).

TABLE 2

Visual acuity in children after lens sparing vitrectomy at the end of follow-up period.

No light perception	Light perception	Hand movements	Finger counting	0.01–0.03	0.03–0.1
38.5%	14%	26.5%	7.5%	7.5%	6.0%

      C. Ocular complications occurring during follow-up.
         A number of complications occurred during the follow-up of the patients (tab. 3).

TABLE 3

Ocular complications occurring in the group of lens sparing vitrectomy group during follow-up.

Cataract	38.5%
Irido-lenticular synechias	29%
Band keratopathy	10.5%
Corneal opacification	9.5%
Hypotony	7%
Glaucoma	5.5%

In some eyes several complications have occurred.

   2. Lensectomy-vitrectomy through limbal approach.
      A. Surgical outcomes.
         In lensectomy-vitrectomy group total retina reattachment after the surgery was observed initially in 21% and partial reattachment in 7%. During follow-up reattachment rate in the first group diminished in time to 12% and in the second group to 2% (tab. 1).

      B. Functional results.
         Visual acuity of operated children are presented in table 4. As in lens sparing vitrectomy group only visual acuity at the end of follow up period was analysed. Visual development was usually slow and end final visual acuity was not apparent till about 1 year after surgery.

TABLE 4

Visual acuity in children after lensectomy-vitrectomy at the end of follow-up period.

No light perception	Light perception	Hand movements	Finger counting	0.01–0.03	0.03–0.05
54%	28%	12%	5.5%	0.4%	0.6%

C. Ocular complications occurring during follow-up.
A number of complications occurred during the follow-up of the patients (tab. 5).

TABLE 5

Ocular complications occurring in the group of lensectomy--vitrectomy group during follow-up.

Total corneal opacification	15%
Partial corneal opacification	18%
Band keratopathy	41.5%
Irido-corneal synechias	13%
Intraocular haemorrhages	11%
Hypotony	9%
Glaucoma	1.5%

In some eyes several complications have occurred.

The results of treatment in some of these patients have been previously published [25, 26].

II. Control group.
Visual acuity in this group of patients was extremely poor. In most of them only no light perception or light perception (92%) was found. In some of them hand movements (6.5%) or finger counting (1.5%) was observed (tab. 6).

TABLE 6

Visual acuity in the group of unoperated children at the end of follow-up period.

No light perception	Light perception	Hand movements	Finger counting
78%	14%	6.5%	1.5%

Stage 5 ROP is not a stable condition. During the control examinations, the occurrence of a number of changes, that reduced visual capabilities, were observed in the eyes (tab. 7).

TABLE 7

Ocular complications occurring in the group of unoperated children during follow-up.

Cataract – partial or total	100%
Band keratopathy	71%
Irido-lenticular synechias/pupillary seclusion and occlusion	80%
Hypotony	35%
Corneal opacification – partial	23%
Corneal opacification – total	16%
Glaucoma	12%
Irido-corneal synechias	10%
Spontaneous hyphema	7%

In some eyes several complications have occurred.

DISCUSSION

The use of vitrectomy in the treatment of stage 5 ROP was described as early as 1977 by Treister and Machemer [27]. As mentioned already at the beginning of the paper there are still controversies concerning what is the role of vitrectomy in the treatment of stage 5 ROP and whether it should be performed [12–29]. Even the introduction of the most advanced and sophisticated methods of surgery has not changed a lot in the treatment of this stage of disease [12, 13, 30, 31]. As a result, vitrectomy has almost ceased in some centers and countries in children with stage 5 of ROP. However most of these papers report anatomical outcomes not a functional results and do not compare them with the natural course of untreated children with stage 5 ROP. Therefore in the paper author report results of treatment 1000 children with stage 5 ROP and compared the outcomes with the eye status of the children with stage 5 of retinopathy of prematurity, whose parents did not decide to perform vitrectomy or they decided to operate one eye only. The parents made the decision after discussing with the surgeon and presenting arguments for and against the surgery. The long-term follow-up of this group of children showed that stage 5 of ROP is not stabile condition and with the years in the eyes develop a number of pathological changes affecting the already severe visual impairment [30] (tab. 7). Total retinal detachment and complications that developed later caused that visual acuity at the end of follow-up period was limited to no light perception in 78%, light perception in 24% and in 1,5% of children only fin-

ger counting was found. When we compare the functional results of children with stage 5 ROP in whom lens sparing vitrectomy and lensectomy-vitrectomy was performed it can be concluded that visual function is better than in untreated children. Of course practically useful vision for everyday use was found in only a few percent of children. Much better results were observed in patients after lens sparing vitrectomy, which is obvious because this surgery was performed in the least advanced cases of total retinal detachment. Functional results were worse than rate of retina reattachment, probably because of irreversible injury to either the retina or visual nervous pathways, or both. The operated and control groups are not equal in numbers, which is a consequence of the fact that the vast majority of parents decided to perform a vitrectomy. The results obtained are comparable to those obtained in papers of Cusick, Narang and Fuchino [29, 32, 33].

There are few publications in the literature regarding vision in untreated stage 5 ROPs. However, these studies indicate that if untreated, in 96% of children it comes to total or practical blindness [34].

So in conclusion, despite generally poor visual acuity after vitrectomy and a small number of patients with useful vision, the visual function is better than in untreated patients with a natural course of the disease.

So should vitrectomy be performed in children with stage 5 ROP? From an health insurance companies perspective, the results aren't worth the cost because only a few percent of treated patients will benefit from this type of surgery. However, from the point of view of parents of sick children, this is assessed differently. Even the smallest possibility of improving vision of their children gives them hope for a better future. Currently, very expensive therapies are being introduced in the treatment of cancer, which offer the possibility of extending life by 6–9 months. Therefore, do children with 5 ROP degrees not deserve to have operations on them, even if only a few percent of them have a chance of obtaining useful vision? Besides, very often, the possibility of retina attachment can be accurately assessed only during the surgery, after excision of the retrolental fibroplastic membranes.

CONCLUSIONS

According to the author of the study, vitrectomy should be performed in children with stage 5 ROP to give children (albeit small) opportunity to regain vision, and for parents to feel that they did their best to save their children's eyesight.

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