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SARA RAMOS BARATA

***Pediatric cataract surgery: outcomes in a large Portuguese cohort***

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JOAQUIM CARLOS NETO MURTA

MIGUEL DE OLIVEIRA TAVARES MENDES RAIMUNDO

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## **AUTORES E AFILIAÇÕES**

Barata, Sara<sup>1</sup>; Raimundo, Miguel<sup>1,2,3,4</sup>; Murta, Joaquim<sup>1,2,3,4</sup>

1 – Faculdade de Medicina da Universidade de Coimbra (FMUC), Coimbra, Portugal

2 – Centro de Responsabilidade Integrado em Oftalmologia, Centro Hospitalar e  
Universitário de Coimbra (CHUC), Coimbra, Portugal

3 – Unidade de Oftalmologia de Coimbra (UOC), Coimbra, Portugal

4- Centro Clínico Académico de Coimbra

### **\*Autor Correspondente**

Sara Ramos Barata

Faculdade de Medicina, Universidade de Coimbra (Pólo III)

Azinhaga de Santa Comba, Celas

3000-548 Coimbra, Portugal

Endereço de correio eletrónico para correspondência: sara.barata97@gmail.com

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## **ABBREVIATIONS LIST**

VAO – Visual Axis Opacification

AV – Anterior Vitrectomy

IOL – Intraocular Lens

pIOL – Primary IOL implantation

VA – Visual Acuity

PCCC – Posterior continuous curvilinear capsulorhexis

CHUC – Centro Hospitalar e Universitário de Coimbra

## ABSTRACT

**INTRODUCTION:** Pediatric cataract is one of the leading preventable causes of blindness worldwide. Timely diagnosis and treatment of the cataract are crucial to avoid irreversible visual effects. The visual axis opacification (VAO) is the most frequent complication arising from pediatric cataract surgery. According to most scientific evidence, an anterior and posterior continuous curvilinear capsulorhexis with anterior vitrectomy (AV) is recommended to prevent VAO. The necessity of its inclusion in the treatment of pediatric cataracts, however, is still questioned. Secondary glaucoma, one of the most feared complications, can occur at any moment after surgery, demanding a life-long follow-up.

**PURPOSE:** To describe a large Portuguese pediatric cataract cohort and determine whether the VAO is prevented by AV and access glaucoma development.

**METHODS:** A review of 340 eyes from 245 individuals of pediatric age who underwent pediatric cataract surgery at Centro Hospitalar e Universitário de Coimbra (CHUC) between 1990 and 2019. A retrospective, non-interventional statistical analysis was carried. For sub-analysis of the impact of AV in OEV, need for reoperation or YAG-laser due to it, and occurrence of inflammatory membranes, the sample was divided into 3 groups regarding age at surgery: < 2 years; 2 to 5 years; and >5 years. For sub-analysis of the association of glaucoma with age at surgery we considered 4 groups regarding age at surgery: <1 month, 1 to 12 months, 1 to 5 years, and >5 years; and 3 groups to study the association with follow-up duration: <1 year, 1 to 5 years, and >5 years; respectively. The association of glaucoma with primary intraocular lens implantation (pIOL) was studied.

**RESULTS:** The median age at surgery was 39,33 months, with a mean follow-up time of 66,44 months. Most patients had congenital cataract (67,7% n=157) and 51,9 % were bilateral (n=123). Primary IOL implantation was performed in 55,7% (n=206) and was associated with lower glaucoma rates (1,1% vs 9,0%, p=0,001). Patients who underwent AV (76,5% of eyes, n=235) had lower postoperative complications and VAO rates (39,3% vs 65,3%, p=0,001 and 4,7% vs 16,8%, p=0,001, respectively) and less reoperation or YAG-laser rates due to VAO (3,4% vs 15,3%, p=0,001). Glaucoma (total incidence of 5,3%, n=18) was associated with premature surgery (p=0,005) - higher on the first month - and longer follow-up (p<0,001) – higher with 5 or more years of follow-up.

**CONCLUSION:** The inclusion of anterior vitrectomy has proven to be a better approach to prevent postoperative complications, visual axis opacification, and the need for reoperation or YAG-laser due to this complication. A lifelong follow-up is crucial to evaluate the long-term outcomes and late complications, namely glaucoma.

## **KEYWORDS**

Child

Cataract Extraction

Vitrectomy

Postoperative complications

Capsule opacification

Glaucoma

## RESUMO

**INTRODUÇÃO:** A catarata pediátrica constitui uma das principais causas de cegueira prevenível a nível mundial. Um diagnóstico e tratamento atempados são cruciais para evitar defeitos visuais irreversíveis. A opacificação do eixo visual (OEV) é a complicação mais frequente da cirurgia de catarata pediátrica. Atualmente e de acordo com a maioria da evidência científica, recomenda-se a realização de capsulorrexis circular curvilínea posterior com vitrectomia anterior (VA), até aos 5 anos, por prevenir a OEV. No entanto, a necessidade da sua inclusão no tratamento ainda é questionada. O glaucoma, é uma das complicações mais temidas e pode surgir a qualquer momento após a cirurgia exigindo vigilância a longo prazo.

**OBJETIVO:** Descrever uma coorte portuguesa em idade pediátrica submetida a cirurgia de catarata, e determinar se a VA previne a OEV e avaliar o desenvolvimento de glaucoma.

**MÉTODOS:** Foram avaliados 340 olhos de 245 indivíduos em idade pediátrica submetidos a cirurgia de catarata pediátrica no CHUC entre 1990 e 2019. A amostra foi alvo de uma análise estatística retrospectiva, não intervencional. Para análise do impacto da VA na OEV, conseqüente necessidade de reoperação ou YAG-laser, e desenvolvimento de membranas inflamatórias, a amostra foi dividida em 3 grupos de acordo com a idade na cirurgia: <2 anos; 2 a 5 anos; e >5 anos. Foi estudada a associação de glaucoma com a idade na cirurgia tendo em conta 4 grupos: <1 mês, 1 a 12 meses, 1 a 5 anos, e >5 anos; e com a duração do follow-up tendo em conta 3 grupos: <1 ano, 1 a 5 anos, e >5 anos. A associação de glaucoma com a implantação primária de lente intraocular foi estudada.

**RESULTADOS:** A mediana da idade aquando da cirurgia foi 39,22 meses e a média do follow-up 66,44 meses. A etiologia foi maioritariamente congénita (67,7% n=157) e 51,9 % tinha catarata bilateral (n=123). Foi implantada lente intraocular primária em 55,7% (n=206), estabelecendo-se a sua associação com menor incidência de glaucoma (1,1% vs 9,0%, p=0,001). Verificou-se a associação de VA (76,5% dos olhos, n=235) com menor incidência de complicações pós-operatórias e OEV (39,3% vs 65,3%, p=0,001 e 4,7% vs 16,8%, p=0,001, respetivamente) e menor necessidade de reoperação ou YAG-laser devido a OEV (3,4% vs 15,3%, p=0,001). A ocorrência de glaucoma está associada à realização de cirurgia mais cedo na vida (p=0,005), sendo mais elevada no primeiro mês de vida, e a maior duração do follow-up (p<0,001) – maior no grupo seguido por 5 ou mais anos.

**CONCLUSÃO:** A realização de VA provou ser uma melhor abordagem para prevenção de complicações pós-operatórias, OEV, e diminuição da reoperação ou YAG-laser devido a esta complicação. A cirurgia da catarata pediátrica exige um follow-up contínuo para avaliar os resultados a longo-prazo e as complicações tardias, nomeadamente o glaucoma.

## **PALAVRAS CHAVE**

Criança

Extração de catarata

Vitrectomia

Complicações pós-operatórias

Opacificação da cápsula

Glaucoma



## INTRODUCTION

Pediatric cataract is one of the leading preventable causes of blindness worldwide. It affects about 200.000 children, [1] with an incidence of 0.6 to 9.3 in 10.000 live births. [2] It is an opacification of the lens that causes an altered sensorial visual stimulus during the development and maturation of the optical pathway, being responsible for irreversible visual defects. [2] Timely diagnosis and treatment of the cataract are crucial to avoid amblyopia. [3]

Lens opacities can have multiple etiologies, of which idiopathic is the most common. [4, 5] According to their cause, cataracts can also be syndromic, hereditary with or without systemic abnormalities, associated with metabolic disorders, related to intrauterine infections, or other conditions such as uveitis or traumatic. [5, 6]

Pediatric cataracts can be classified according to their morphology as total, lamellar or zonular, nuclear, cortical, pulvurulent, cerulean, anterior or posterior polar, posterior subcapsular, sutural, coraliform, wedge-shaped, and associated with persistent hyperplastic primary vitreous. [2, 4, 7] A child's eye is different from that of an adult. It is characterized by a rapid axial axis elongation, having a much more elastic lens capsule and mitotically more active cells in the lens. [1, 6, 8]

The approach of pediatric cataracts remains a challenge despite the great advances that have been made in this field. [4, 6, 9] More sophisticated surgical techniques that allow access and treatment through microincisions, the enormous diversity of the intraocular lenses available, improvement of the materials utilized, as well as better knowledge about the visual development and postoperative rehabilitation allowed an improvement in the outcomes of pediatric cataract surgery. [1, 4, 6] The main challenges lie in the growth of the human eye, the emmetropization, the ideal timing for surgery, the more aggressive inflammation, and the postoperative complications, namely visual axis opacification (VAO), inflammation, and glaucoma. [1] A better understanding of these issues and ways to overcome them will lead to better visual outcomes.

Postoperative complications vary according to the age at the time of surgery, type of cataract, and surgical technique. They can affect the anterior and posterior portion of the eye and can occur intraoperatively or postoperatively. Postoperative complications can be immediate (such as wound leakage, intraocular pressure spikes, inflammation or retinal detachment) or appear within a few months to several years after (like glaucoma, retinal detachment or visual axis opacification). [10]

Visual axis opacification is the most frequent complication arising from pediatric cataract surgery. [6, 9] It occurs in 40% of the patients [8] due to the proliferation of the lens epithelial cells in the posterior capsule of the lens and the anterior hyaloid membrane of the

vitreous body, affecting and impairing the normal visual development. [8, 11] The age of the patient, the surgical technique, and the characteristics of the intraocular lens take part in the development of visual axis opacification. [8] Posterior continuous curvilinear capsulorhexis (PCCC), anterior vitrectomy (AV), thorough removal of lens substance, hydrophobic acrylic IOL, in-the-bag IOL placement, minimal iris trauma, and minimizing postoperative inflammation may prevent and delay VAO. [1, 9, 10] Eyes with traumatic cataract have a higher risk of developing VAO. [10]

The AV prevents the anterior surface of the vitreous body from acting as a scaffold for the migration of epithelial cells that ends in VAO. [6, 9, 10] However, there is some evidence that questions the necessity of AV up to the age of 5, admitting that there is no benefit of its performance in reducing postoperative complications and treating the resulting amblyopia. [12]

Secondary glaucoma, one of the most feared complications, can occur at any moment after surgery. The pathophysiology is unclear. [10] However, its development appears to be related to age at the time of surgery. [13] If performed before 4 weeks of age, the risk increases significantly often requiring additional surgical procedures. [4, 11, 14] The risk of postoperative glaucoma increases in direct proportion to the follow-up time. [15] Certain types of cataracts, like persistent hyperplastic primary vitreous associated cataracts, are also associated with an increased risk for this complication. Postoperative glaucoma can often be diagnosed while the child is asymptomatic. [10] The severity of this complication and the fact that it can arise at any moment after surgery justifies long-term surveillance of these patients. [15, 16]

Surgery of pediatric cataract demands a balance between age at the time of surgery and the risk of developing postoperative complications. Current recommendations indicate that unilateral cataract cases should undergo surgery between 4 and 6 weeks of age, while in children with bilateral cataract, surgery beyond 8 weeks of age is not recommended. [1, 4, 14, 15] In older children, the timing recommended for surgery depends on the severity of the opacity, among other factors.

Nowadays, according to most scientific evidence, it is recommended that an anterior and posterior continuous curvilinear capsulorhexis with AV should be performed between the 2 to 5 years of age [8, 11, 15] as it has been shown to be an effective approach in the prevention of VAO. Evidence shows 100% of the cases where the posterior capsule is left intact in children under 6 years old end in opacification. [1, 8, 10] Beyond the age of 5, in addition to the PCCC, many authors no longer advocate AV. [4] Children with less than 2 years old should undergo lensectomy with AV, but contrarily to patients older than 2, an intraocular lens should not be implanted, particularly under 1 year old. [11, 17] Nonetheless, this rule is not absolute. Primary IOL implantation is an attractive alternative in patients with unilateral

cataracts, [6] in children where a continuous and regular follow-up is not possible, and where poor compliance is expected. [14]

The purpose of this retrospective observational study was to describe a large Portuguese pediatric cataract cohort and determine whether AV prevents the VAO and thus help to clarify the current uncertainty regarding the necessity of its inclusion in the treatment of the pediatric cataract and assess the development of glaucoma. The results were evaluated considering the different age groups of children undergoing surgery and the surgical technique performed.

## MATERIALS AND METHODS

This retrospective observational study used a pre-existing anonymized database of individuals of pediatric age who underwent unilateral or bilateral pediatric cataract surgery at the Department of Ophthalmology, Centro Hospitalar e Universitário de Coimbra between 1990 and 2019. A sample of 340 eyes from 245 children was obtained.

The data collected included age, sex, baseline visual acuity, etiology, type, and morphology of cataract, laterality, age at the time of surgery, surgical technique performed, development of postoperative complications (immediate or late), need for reoperation, follow-up duration and visual acuity at the last visit. Extracapsular extraction cases were excluded.

A retrospective, non-interventional statistical analysis was carried. The group of patients was characterized considering the sex, type, and etiology of the cataract. The sample of eyes was characterized considering the morphology of the cataract, the age at time of surgery, the preoperative and postoperative visual acuity, the duration of the follow-up, the surgical technique performed, and the postoperative complications observed.

For sub-analysis of the impact of anterior vitrectomy in VAO and need for reoperation or YAG-laser due to it, the sample was divided into 3 groups regarding age at surgery: < 2 years; 2 to 5 years; and >5 years. For sub-analysis of the association of glaucoma with age at the time of surgery we considered 4 groups regarding age at surgery: <1 month, 1 to 12 months, 1 to 5 years, and >5 years; and 3 groups to study the association with follow-up duration: <1 year, 1 to 5 years, and >5 years. The association of glaucoma with pIOL was also studied.

Data analysis was performed using IBM SPSS Statistics 26<sup>®</sup>. Descriptive statistics were applied, mean and standard deviation for normally distributed continuous variables, median and interquartile range for non-normal or ordinal continuous variables, and proportions in the case of categorical or binary variables. Chi-Square and Fisher's Test were carried out to study the association between variables, with a particular interest in the study of subgroups by surgical technique performed concerning the primary outcomes (opacification of the visual axis, glaucoma, refraction).

## RESULTS

Of the 245 children included in this study 56,7% (n=152), 43,3% (n=116) were female and 51,9% (n=123) had bilateral cataract. One hundred and fifty-seven (67,6%) children had congenital cataract, followed by traumatic cataract in 19,4% (n=45) and uveitic cataract in 7,3% (n=17). Three hundred and forty eyes that underwent pediatric cataract surgery were studied. Concerning the morphology of the cataract, 26,4% (n=69) of the patients presented with total cataract, 17,2% (n=45) with subcapsular cataract, 14,2% (n=37) with nuclear cataract, 9,6% (n=25) with lamellar cataract, 9,6% (n=25) with polar posterior and 6,1% (n=16) with polar anterior. The median and mean age at the time of surgery were 39,33 and 55,17 months, respectively, with a range of 0,46 to 213,86 months. The mean follow-up time was 66,44 months, ranging from 0,00 to 261,24 months. Forty-nine (41,2%) eyes had a visual acuity before surgery of 3/60 or lower, and 22 (18,5%) had a visual acuity of at least 6/18. Visual acuity at the last follow-up visit was greater than 6/18 in 78 (64,5%) eyes, and 9 (7,4%) eyes had a visual acuity of 3/60 or lower. The surgical techniques performed included pars plana phacophagia or phacoemulsification as well as AV, posterior capsulorhexis, and IOL implantation. Two hundred and thirty-five (76,5%) patients underwent AV, and in 181 (55,7%) a primary IOL was placed. Primary IOL was implanted in 24,2% (n=33) of the eyes that underwent surgery before 2 years old, 73,8% (n=48) of the eyes operated between 2 to 5 years of age, and 81,3% (n=100) of the eyes of patients older than 5 at the time of surgery. A total of 113 (44,7%) eyes developed at least one postoperative complication, VAO occurred in 28 (8,2%) eyes and 23 (6,8%) needed reoperation or YAG-laser due to it, and 18 (5,3%) developed glaucoma. (Table 1)

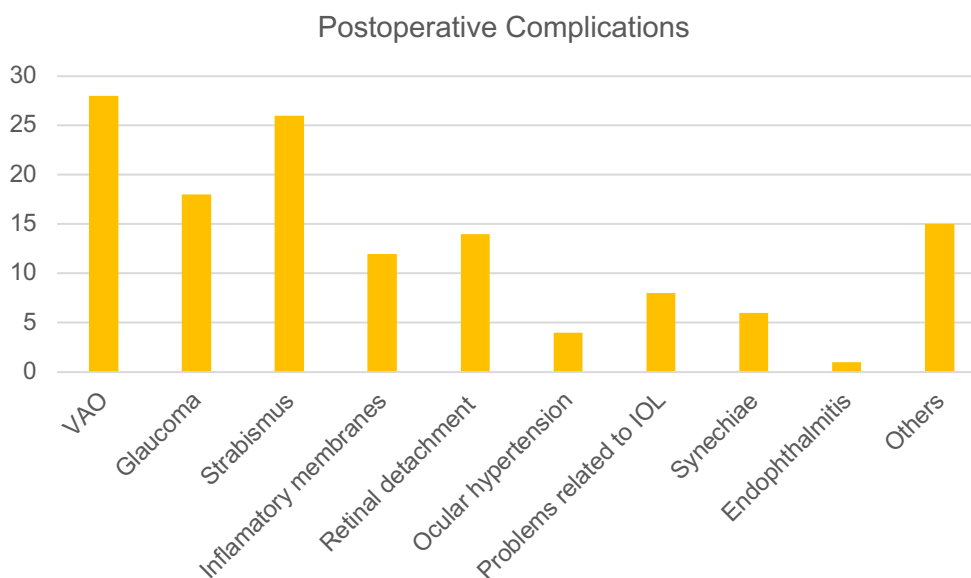
In total 132 postoperative complications were noted of which VAO was the most common, occurring in 21,21% (n=28), followed by strabismus in 19,70% (n=26), followed glaucoma in 13,64% (n=18). (Figure 1)

**Table 1 – Characterization of the cohort of patients and the cohort of eyes included in the study.**

<b>PATIENTS</b>	
<b>GENDER</b>	
Female	43,3% (n=116)
Male	56,7% (n=152)
<b>ETIOLOGY</b>	
Congenital	67,7% (n=157)
Traumatic	19,4% (n=45)
Uveitic	7,3% (n=17)
Subluxation of the lens	5,6% (n=13)
<b>TYPE OF CATARACT</b>	
Unilateral	48,1% (n=114)
Bilateral	51,9% (n=123)
<b>EYES</b>	
<b>MORPHOLOGY OF THE CATARACT</b>	
Total	26,4% (n=69)
Lamellar	9,6% (n=25)
Nuclear	14,2% (n=37)
Subcapsular	17,2% (n=45)
Polar anterior	6,1% (n=16)
Polar posterior	9,6% (n=25)
Sutural	1,1% (n=3)
Other	15,7% (n=41)
<b>AGE</b>	
At time of surgery (months)	55,17
<b>FOLLOW-UP</b>	
Duration of follow-up (months)	66,44
<b>BASELINE VISUAL ACUITY</b>	
<3/60	41,2% (n=49)
3/60 – 6/18	40,3% (n=48)
>6/18	18,5% (n=22)
<b>VISUAL ACUITY AT THE LAST VISIT</b>	
<3/60	7,4% (n=9)
3/60 - 6/18	38,1% (n=34)
>6/18	64,5% (n=78)
<b>SURGICAL TECHNIQUE INCLUDING AV</b>	
Yes	76,5% (n=235)
No	23,5% (n=72)
<b>IOL PRIMARY IMPLANTATION</b>	
Yes	55,7% (n=181)
No	44,3% (n=144)
<b>POSTOPERATIVE COMPLICATIONS</b>	
Yes	44,7% (n=113)
No	55,3 (n=140)
<b>VISUAL AXIS OPACIFICATION</b>	
Yes	8,2% (n=28)
No	91,8% (n=312)
<b>REOPERATION OR YAG-LASER DUE TO VAO</b>	
Yes	6,8% (n=23)
No	93,2% (n=317)
<b>GLAUCOMA</b>	
Yes	5,3% (n=18)
No	94,7% (n=322)

AV, anterior vitrectomy; IOL, intraocular lens; VAO, visual axis opacification.

**Figure 1 – Frequency of the postoperative complications noted.**



IOL, intraocular lens; VAO, visual axis opacification.

The cohort of eyes was then divided into 3 groups according to the age at the time of surgery to evaluate the association of AV with postoperative complications, VAO, need for reoperation or YAG-laser due to VAO, and the occurrence of inflammatory membranes. One hundred and forty-six were younger than 2 years old, sixty-eight were between 2 to 5 years of age, and 126 were older than 5 years old. Anterior vitrectomy was performed in 79,41% (n=108) of the eyes of patients 2 years old or younger, 89,06% (n=57) of the patients with age between 2 to 5, and in 65,42% (n=70) of the patients older than 5.

The occurrence of postoperative complications was significantly ( $p=0,001$ ) associated with the performance of AV, with lower rates in the group that underwent AV (39,3% n=70 vs 65,3% n=32). The same association was found in the age groups 2 to 5 years old (35,4% n=17 vs 100,0% n=4,  $p=0,022$ ) and 5 years old or older (30,4% n=17 vs 57,1% n=20,  $p=0,011$ ), but not in the group of 2 years old or younger. (Table 2)

The development of VAO was significantly ( $p=0,001$ ) associated with the performance of AV, with lower rates in the group that underwent AV (39,3% n=11 vs 16,8% n=12). The same association was found in the age group 5 years old or older (7,1% n=5 vs 32,4% n=12,  $p=0,001$ ). This association was not significant in the groups of 2 years old ( $p=0,581$ ) or younger and 2 to 5 years old ( $p=1,00$ ). (Table 3)

**Table 2 – Comparison of the occurrence of postoperative complications in eyes that underwent AV and eyes that underwent surgery without AV, according to different age groups.**

<b>&lt;2 YEARS OLD</b>			
	<b>With AV</b>	<b>Without AV</b>	
<b>Post-op complications</b>			p=0,092
Yes	36 (48,6%)	8 (80,0%)	
No	38 (51,4%)	2 (20,0%)	
Total	74	10	
<b>2-5 YEARS OLD</b>			
	<b>With AV</b>	<b>Without AV</b>	
<b>Post-op complications</b>			p=0,022
Yes	17 (35,4%)	4 (100,0%)	
No	31 (64,6%)	0 (0,0%)	
Total	48	4	
<b>&gt;5 YEARS OLD</b>			
	<b>With AV</b>	<b>Without AV</b>	
<b>Post-op complications</b>			p=0,011
Yes	17 (30,4%)	20 (57,1%)	
No	39 (69,6%)	15 (42,9%)	
Total	56	35	
<b>TOTAL</b>			
	<b>With AV</b>	<b>Without AV</b>	
<b>Post-op complications</b>			p=0,001
Yes	70 (39,3%)	32 (65,3%)	
No	108 (60,7%)	17 (34,7%)	
Total	178	49	

AV, anterior vitrectomy, Post-op, postoperative.

**Table 3 – Comparison of the occurrence of VAO in eyes that underwent AV and eyes that underwent surgery without AV, according to different age groups.**

<b>&lt;2 YEARS OLD</b>			
	<b>With AV</b>	<b>Without AV</b>	
<b>VAO</b>			p=0,581
Yes	4 (3,7%)	0 (0,0%)	
No	104 (96,3%)	28 (100,0%)	
Total	108	28	
<b>2-5 YEARS OLD</b>			
	<b>With AV</b>	<b>Without AV</b>	
<b>VAO</b>			p=1,00
Yes	2 (3,5%)	0 (0,0%)	
No	55 (96,5%)	7 (100,0%)	
Total	57	7	
<b>&gt;5 YEARS OLD</b>			
	<b>With AV</b>	<b>Without AV</b>	
<b>VAO</b>			p=0,001
Yes	5 (7,1%)	12 (32,4%)	
No	65 (92,9%)	25 (67,6%)	
Total	70	37	
<b>TOTAL</b>			
	<b>With AV</b>	<b>Without AV</b>	
<b>VAO</b>			p=0,001
Yes	11 (4,7%)	12 (16,8%)	
No	224 (95,3%)	60 (83,3%)	
Total	235	72	

AV, anterior vitrectomy, VAO, visual axis opacification.



Regarding the need for reoperation or YAG-laser due to VAO, significant ( $p=0,001$ ) association with the performance of AV was noted, with lower rates in the group that underwent AV (3,4%  $n=5$  vs 15,3%  $n=11$ ). The same association was found in the age group 5 years old or older (7,1%  $n=5$  vs 29,7%  $n=11$ ,  $p=0,002$ ). This association was not significant in the group of 2 years old ( $p=1,00$ ) or younger. In the age group of 2 to 5 years old no need for reoperation or VAO was noted in any group. (Table 4)

**Table 4 – Comparison of the need for reoperation or YAG-laser due to VAO in eyes that underwent AV and eyes that underwent surgery without AV, according to different age groups.**

<b>&lt;2 YEARS OLD</b>			
	<b>With AV</b>	<b>Without AV</b>	
<b>Reoperation due to VAO</b>			$p=1,00$
Yes	3 (2,8%)	0 (0,0%)	
No	105 (97,2%)	28 (100,0%)	
Total	108	28	
<b>2-5 YEARS OLD</b>			
	<b>With AV</b>	<b>Without AV</b>	
<b>Reoperation due to VAO</b>			-
Yes	0 (0,0%)	0 (0,0%)	
No	57 (100,0%)	7 (100,0%)	
Total	57	7	
<b>&gt;5 YEARS OLD</b>			
	<b>With AV</b>	<b>Without AV</b>	
<b>Reoperation due to VAO</b>			$p=0,002$
Yes	5 (7,1%)	11 (29,7%)	
No	65 (92,9%)	26 (70,3%)	
Total	70	37	
<b>TOTAL</b>			
	<b>With AV</b>	<b>Without AV</b>	
<b>Reoperation due to VAO</b>			$p=0,001$
Yes	8 (3,4%)	11 (15,3%)	
No	227 (96,6%)	61 (84,7%)	
Total	235	72	

AV, anterior vitrectomy, VAO, visual axis opacification.

No association was found between the occurrence of inflammatory membranes and performance of anterior vitrectomy ( $p=1,00$ ), even when comparing the different age groups ( $p=0,58$ ,  $p=1,00$ , and  $p=0,27$ ). Inflammatory membranes occurred in 3,8% ( $n=9$ ) of the eyes that underwent surgery with AV and in 2,8% ( $n=2$ ) of the eyes where surgery did not include AV.

Outcomes regarding visual acuity at the last follow-up visit were significantly associated with the performance of AV ( $p=0,025$ ). Better visual acuity was found in patients that underwent AV (80,0%  $n=56$  vs 20,0%  $n=14$ ).

To assess the association between glaucoma and age at the time of surgery, the cohort was divided into 4 groups. Eight eyes underwent surgery at 1 month old or younger, 102 at 1

to 12 months old, 104 at 1 to 5 years old, and 126 at 5 years old or older. Additionally, to study the association of glaucoma with the duration of the follow-up, 3 different groups were considered. Sixty-five patients were followed for at least 1 year, 130 were followed for more than 5 years, and 139 were followed from 1 to 5 years.

Glaucoma was not significantly associated with the performance of AV ( $p=0,770$ ). Primary IOL implantation, age at the time of surgery, and duration of follow-up were significantly associated with the development of postoperative glaucoma ( $p=0,001$ ,  $p=0,005$ , and  $p<0,001$ , respectively). IOL placement is associated with lower glaucoma rates (1,1%  $n=2$  vs 9,0%  $n=13$ ). Higher glaucoma incidence is associated with younger age at time of surgery, higher in the first month of age (37,5%  $n=3$ , 6,9%  $n=7$ , 4,8%  $n=5$ , and 2,4%  $n=3$ ) and a longer follow-up, higher in the group followed for at least 5 years (0,0%  $n=0$ , 1,4%  $n=2$ , and 12,3%  $n=16$ ). (Table 5)

**Table 5 – Comparison of glaucoma development in eyes that underwent surgery with or without AV, in eyes with or without primary IOL implantation, in different age groups at the time of surgery, and in groups with different follow-up duration.**

		SURGERY INCLUDING AV				
		WITH AV		WITHOUT AV		
GLAUCOMA	Yes	14 (6,0%)		3 (4,2%)		$p=0,770$
	No	221 (94,0%)		69 (95,8%)		
	Total	235		72		
		pIOL IMPLANTATION				
		pIOL		WITHOUT pIOL		
GLAUCOMA	Yes	2 (1,1%)		13 (9,0%)		$p=0,001$
	No	179 (98,9%)		131 (91,0%)		
	Total	181		144		
		AGE AT SURGERY (MONTHS OLD)				
		<1	1-12	12-60	>60	
GLAUCOMA	Yes	3 (37,5%)	7 (6,9%)	5 (4,8%)	3 (2,4%)	$p=0,005$
	No	5 (62,5%)	95 (93,1%)	99 (95,2%)	123 (97,6%)	
	Total	8	102	104	126	
		FOLLOW-UP				
		0-1 year	1-5 years	>5 years		
GLAUCOMA	Yes	0 (0,0%)	2 (1,4%)	16 (12,3%)	$p<0,001$	
	No	65 (100,0%)	137 (98,6%)	114 (87,7%)		
	Total	65	139	130		

AV, anterior vitrectomy; pIOL, primary intraocular lens implantation.

## DISCUSSION

The surgical approach of pediatric cataract has gone through great advances, notwithstanding a substantial number of patients still develops postoperative complications. [18, 19] VAO was the most common complication noted. This finding is in accordance with the bibliography. It occurred in 8,2% of the eyes. This incidence is lower than what is described in the literature. [20] Glaucoma occurred in 5,3% of the eyes, which is lower than what is reported in the literature. [15, 21, 22]

The main purpose of this study was to assess the importance of including AV in the treatment of pediatric cataract. We corroborated what is described in the majority of literature regarding this matter. VAO rates in eyes that underwent AV are consistent with those described in previous studies. [9] Postoperative complications, VAO rates, and need for reoperation or YAG-laser due to VAO were lower in patients undergoing AV when comparing the total of eyes operated. The same statistically significant association was found when analyzing the eyes undergoing surgery after 5 years old alone. In the group of eyes where surgery was performed at ages ranging from 2 to 5 years old, a statistically significant association of postoperative complications with the performance of AV was noted. Postoperative complications were lower in the group undergoing AV. Nowadays, for patients older than 5 it is recommended capsulotomy without AV. [4] However, in this study we found that patients 5 years old or older might still benefit from the performance of AV.

Additionally, AV was found to lead to better visual outcomes regarding postoperative visual acuity. This finding may be supported by the fact that the occurrence of VAO may impair visual rehabilitation following pediatric cataract surgery, affecting normal visual development and overcoming the attempt to prevent amblyopia.

Younger age at the time of surgery has been reported to be a risk factor for the development of postoperative glaucoma. [4, 11, 4] In this study, a significant incidence of glaucoma was noted in the few patients that underwent surgery before 1 month of age, adding strength to current recommendations against the performance of pediatric cataract surgery in patients younger than 1 month. [21, 23]

In this study, we found that pIOL seems to lower the risk of secondary glaucoma, as the incidence in these eyes was lower. Some authors have reported the same association. However, other studies, including the Infant Aphakia Treatment Study, found no association between IOL implantation and glaucoma. [15] The fact that lower rates of glaucoma were reported in patients where an IOL is placed might be due to the fact that it is not current practice to implant an IOL in patients younger than 1 year old, and glaucoma incidence is higher in patients undergoing surgery at a younger age.

Longer follow-up has been reported to be related to higher incidence of glaucoma, occurring at a mean of 4 to 5 years of follow-up after surgery. [11, 21] Similarly, in this study we, also found that a longer duration of the follow-up is associated with increasing glaucoma rates, higher in the group of eyes followed for at least 5 years.

Strengths of the current study include enrolling a large cohort of eyes, bilateral and unilateral aphakic and pseudophakic cases, with good age and gender distribution.

The main limitation is the fact that this is a retrospective non-interventional study. Another limitation is that all patients were enrolled regardless of follow-up time, and some stopped being followed at this center. Shorter follow-up time might not be enough to screen postoperative complications, mainly late postoperative complications like glaucoma and retinal detachment.

In conclusion, this study underscores the importance of including AV in the treatment of pediatric cataract. Additionally, it has shown that patients with older age might benefit from AV as well. It reduced the incidence of postoperative complications, VAO, and reoperation or YAG-laser due to VAO. Moreover, AV seems to have an impact on the postoperative visual outcomes, leading to better final visual acuity. Postoperative glaucoma is a sight-threatening complication that can occur at any time following pediatric cataract surgery. The risk of glaucoma increases with longer follow-up, demanding a life-long follow-up.

Treatment of pediatric cataracts lies not only in the surgery but also in continuous follow-up, use of the appropriate correction and treatment of the operative complications that may occur.

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