Nepal J Ophthalmol 2012; 4 (7):102-107

Original articles

Nd: Yag laser treatment for sub-hyaloid hemorrhage in childhood acute leukemia

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Abstract

Introduction: Sub-hyaloid haemorrhage is common in acute leukemia.

Objective: To investigate the effects of Nd: YAG Laser hyaloidotomy in 11 eyes of 8 patients with pre-macular haemorrhage in acute childhood leukemia.

Materials and methods: Premacular sub-hyaloid haemorrhage is one of the leading causes of visual disability in children with acute leukemia. Eleven eyes of 8 patients attending Kanti Children Hospital and BP Koirala Lions Centre for Ophthalmic Studies from January 2006 to July 2007 with premacular subhyaloid haemorrhage were included in the study and treated with Nd: YAG Laser. The haemorrhage originated from acute myeloid leukemia (AML) in 4 cases (6 eyes) and acute lymphoblastic leukemia (ALL) in 4 cases (5 eyes).

Results: Drainage of premacular sub-hyaloid haemorrhage into the vitreous cavity within 3 months succeeded in 9 eyes out of 11 eyes treated. One eye had a dense clotted haemorrhage and the other had a re-bleed. Overall visual improvement was equal in both AML and ALL cases. No obvious epiretinal membrane, retinal breaks and tractional retinal detachment occurred in any eye.

Conclusion: Nd: Yag laser hyaloidotomy is a relatively safe, simple and alternative treatment for eyes with a dense premacular sub-hyaloid haemorrhage in acute childhood leukemia. The risks and benefits have to be weighed in randomized clinical trials to establish Nd: YAG hyaloidotomy treatment as a routine procedure in leukemic children.

Key-words: Nd: Yag laser hyaloidotomy, premacular sub-hyaloid haemorrhage

Introduction

The eye is involved in leukemia either directly or indirectly from thrombocytopenia, anaemia, hyper-viscosity or chemotherapeutic agents. The retina is the tissue most frequently involved in leukemic complication (Duke Elder, 1967). Haemorrhages in the retina are the most striking feature in leukemia. These tend to occur most commonly in posterior pole (Allen et al, 1983). Premacular subhyaloid haemorrhage is one of the important causes of poor vision in leukemic children. The haemorrhage can cause profound visual loss and if it is bilateral it can hamper the daily routine activities. Although spontaneous resolution of haemorrhage occurs it may take several months. In longstanding cases the macula may be damaged by pigmentary macular changes or formation of epiretinal membranes or

Received on: 13.04.2011 Accepted on: 15.11.2011
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iron and haemoglobin induced toxicity to the macula (O'hanley et al, 1985; Rennie et al, 2001). Various modalities of treatment for premacular subhyaloid haemorrhage are available including pars plana vitrectomy (O'hanley et al, 1985; Ramsay et al, 1986; Zhao et al, 2000) and pneumatic displacement by intravitreal use of gas and tissue plasminogen activator (Conway et al, 1999). Nd: YAG (Ulbig et al,1998; Celebi et al, 2001; Gabel et al, 1989) or green argon laser (Fechner et al, 1980) posterior hyaloidotomy is safe and easy alternative for releasing the entrapped subhyaloid blood into the vitreous and by this way absorption of blood cells in facilitated. The need for unnecessary general anaesthesia in already compromised leukemic children and vitrectomy and its complications are avoided.

Materials and methods

This interventional study was carried out in eleven eyes of 8 patients attending to Kanti Children Hospital and BP Koirala Lions' Centre for Ophthalmic Studies, Nepal from January 2006 to July 2007 with premacular subhyaloid haemorrhage. Only those children cooperative for Nd: YAG laser posterior hyaloidotomy and children with premacular subhyaloid haemorrhage without significant vitreous opacities precluding the use of Nd: YAG laser were included. Best corrected visual acuity, detail slit lamp microscope evaluation, intraocular pressure and fundus photography carried out before and after treatment and on subsequent visits. The procedure was explained and consent was taken from the parents. Mydriasis was achieved by tropicamide 0.5 % and topical anaesthesia with lignocaine 4 % eye drops. Nd: YAG laser emitting single burst was delivered using a Goldman triple mirror. The helium: neon beam was focussed on the inferior point on the sub-hyaloid haemorrhage which was far from the fovea and away from the major retinal vessels. Laser exposures were started from energies of 5mJ and increased one mJ each step until perforation becomes visible at the surface of haemorrhage and the blood flow into vitreous cavity were evident. The energy per exposure did not exceed 11mJ and the cases that did not drain after ten bursts were not given further exposures. Patients were followed up at one week, six weeks and at the end of three months post operative periods. The main outcome measures included releasing the entrapped blood into the vitreous and its quick re-sorption, postoperative improvement in visual acuity and postoperative complications which were recorded and analysed.

Results

The success of laser treatment was defined by clearing of premacular haemorrhage by 3 months. Eleven eyes of 8 patients with acute childhood leukemia were enrolled in this interventional series. These included 3 females and 5 males, with an average age of 11.5 ± 2.82 years (range: 7 to 14 years). Four (50 %) had acute lymphoid leukemia and four (50 %) had acute myeloid leukemia. Three patients (37.5 %) had bilateral premacular subhyaloid haemorrhage. The mean pretreatment haemorrhage as judged by fundus photography was 7.18 disc areas. Drainage of premacular subhyaloid haemorrhage with Nd: YAG posterior hyaloidotomy at the end of 3 month occurred in nine out of eleven eyes treated. Preoperative visual acuity ranged from hand motion to 2/60.

The mean power required to perform posterior hyaloidotomy was 6.55mJ and the mean number of laser energies required to perform posterior hyaloidotomy was 3.45. After 1 week, visual acuity ranged from hand motion to 6/6 (median, 6/18), six weeks after hyaloidotomy visual acuity ranged from hand motion to 6/6 (median, 6/9), and was not significantly different from visual acuity after 3 months. However at 3 months follow up, one patient with acute myeloid leukemia had rebleed resulting in deterioration of pre-existing vision and one patient with acute lymphoblastic leukemia had dense clotted premacular haemorrhage that did not drain into vitreous. None of the patients had persisting vitreous haemorrhage.

Table 1: (Nd: YAG laser hyaloidotomy for premacular subhyaloid hemorrhage in childhood acute leukemia: patients' characteristics)

					[Visual Acuity]					
Patient	Age/ Sex	Diagnosis	Eye	Size of Haemo rrhage	Before Treatment	After 1 week	After 6 weeks	After 3 months	Number of Laser shots	Energy per plasma (mj)
1	14/F	AML	RE	5DA	HM	6/12	6/9	6/9	2	5,6
			LE	8DA	HM	6/18	6/9	6/6	4	5,6,7,8
2	7/M	ALL	RE	10DA	HM	6/6	6/6	6/6	4	5,6,7,8
3	14/M	ALL	RE	10DA	HM	HM	HM	1/60	7	5,6,7,8,9,10,11
			LE	6DA	HM	6/9	6/6	6/6	3	5,6,7
4	13/M	ALL	LE	8DA	1/60	6/24	6/9	6/9	4	5,6,7,8
5	14/M	AML	LE	5DA	1/60	6/18	6/6	6/6	2	5,6
6	10/F	AML	RE	7DA	HM	6/18	6/12	6/9	3	5,6,7
			LE	3DA	1/60	6/12	6/12	6/12	2	5,6,
7	12/F	AML	RE	10DA	HM	6/36	6/18	1/60	5	5,6,7,8,9
8	8/M	ALL	RE	7DA	2/60	6/12	6/6	6/6	2	5,6

M, indicates Male; F, Female; AML, Acute Myeloid Leukemia; ALL, Acute Lymphoid Leukemia; DA, Disc Area; HM, Hand Motion

Overall visual improvement was equal in both acute lymphoblastic and acute myeloid leukemia. Table 1 and figure 1 and 2 summarise patients' characteristics and postoperative results. No special complication including increase in intraocular pressure, retinal and choroidal haemorrhage, macular hole, retinal breaks, epiretinal membrane, or tractional retinal detachment occurred during the follow up period over 3 months.

Fig 1: Nd: YAG Laser Hyaloidotomy Right Eye

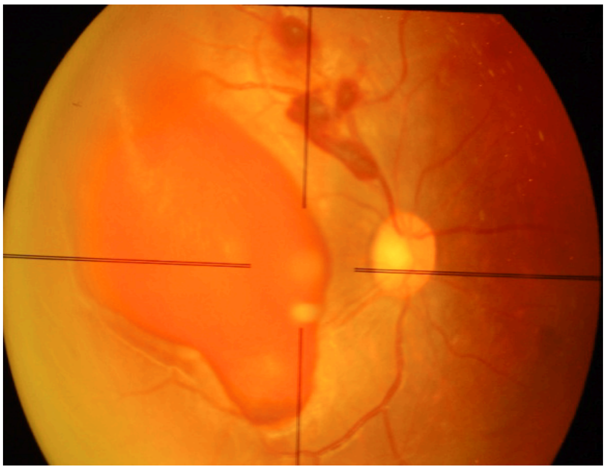

Fig 1a: Dense Subhyaloid Hemorrhage before treatment

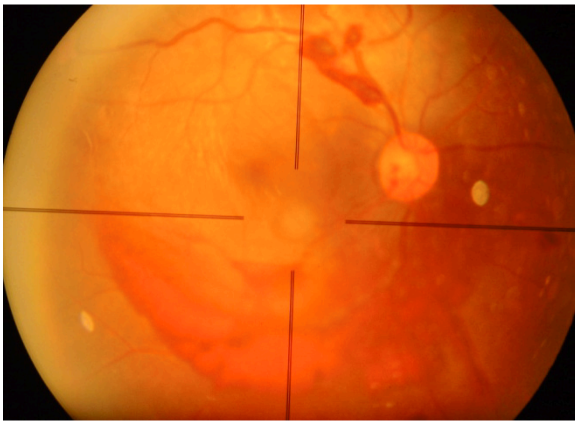

Fig 1b: Nd: One hour after YAG Laser Hyaloidotomy. Premacular blood draining into vitreous cavity.

Fig 2: Nd: YAG Laser Hyaloidotomy Left Eye

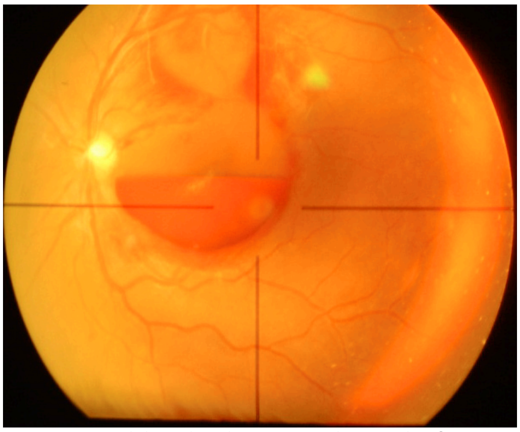

Fig 2a: Subhyaloid Hemorrhage before Treatment

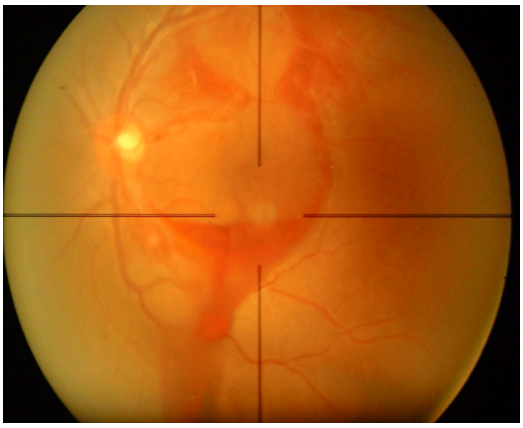

Fig 2b: Immediately after Nd: YAG Laser Hyaloidotomy.

Discussion

Leukemias are a group of heterogeneous neoplastic disorders of white blood cells. Leukemia can affect virtually any organ or system of the body. Knowledge of the ocular manifestations of leukemia is important not only because of the frequency with which changes are seen, but also reflects the disease state of the body. They may be the initial mode of presentation or first sign of relapse of systemic illness; indeed, before the use of bone marrow biopsy, the ophthalmologist was often called on to assist with the diagnosis of leukemias (Kinacid, 1983). Eye can be involved either directly or indirectly. Indirect involvements are secondary to haematological abnormalities of leukemia such as anaemia, thrombocytopenia, hyperviscosity and immunosuppression. These can manifest as retinal or vitreous haemorrhage, infections and vascular occlusions. Duke Elder (1967); Ridgeway et al (1976); Reddy et al (1998) and Schachat et al (1989) estimated the prevalence of ocular involvement in varied ranges from 9 to 90 %.

Duke Elder (1967) mentioned the retina is the tissue most frequently involved in leukemic complications. Alemayehu et al (1996) estimated that up to 69 % of all patients with leukemia show fundus changes at some point in the course of their disease. Retinal haemorrhage can occur in all levels of the retina, usually in the posterior pole, and may extend into the subretinal space or vitreous. Leukemic retinopathy was first described by Liebrih in 1860 and since that time, virtually all ocular structures have been found to become involved (Ridgeway, 1976; Mahneke, 1964).

Subhyaloid premacular haemorrhage usually causes profound visual loss in one or both eyes of patient with childhood acute leukemia. Spontaneous clearing of premacular haemorrhage usually occurs but usually takes several months and might cause permanent visual loss due to pigmentary macular changes or growth of epiretinal membrane (O'hanley et al, 1985) and toxic injury to the retina due to prolonged contact with haemoglobin and iron (Rennie et al, 2001).

Pars plana vitrectomy (O'hanley et al, 1985; Ramsay et al, 1986; Zhao et al, 2000), pneumatic displacement of haemorrhage by intravitreal injection of gas and tissue plasminogen activator (Conway et al, 1999), and posterior hyaloidotomy with Nd: YAG laser (Ulbig et al, 1998; Celebi S et al, 2001; Gabel et al, 1989) or with green laser (Fechner et al, 1980) are various treatment options available for premacular subhyaloid haemorrhage. Consequently, the obscured macular area is cleared and resorption of blood cells from the vitreous is facilitated (Ulbig et al, 1998; Celebi et al, 2001; Gabel et al, 1989). Early intervention seems crucial to prevent permanent visual loss by pigmentary macular changes.

Vitrectomy in children is an alternative treatment for premacular subhyaloid haemorrhage but general anaesthesia in already compromised child is risky and may be associated with numerous complications; cataract, intraoperative retinal breaks and Proliferative vitreoretinopathy (O'hanley et al, 1985). Perforating the posterior hyaloid face or internal limiting membrane by use of pulsed Nd: YAG laser has been described as a practical substitution to vitrectomy (Rennie et al, 2001; Ulbig et al, 1998; Gabel et al, 1989 and Farvardin, 2005). The only drawback particularly in children is lack of cooperation. In comparison to vitrectomy the laser procedure is the ambulatory and painless procedure. Ulbig et al (1998) mentioned that the Nd: YAG laser hyaloidotomy will not affect the outcome of deferred vitrectomy.

In this study, we performed posterior Nd: YAG laser hyaloidotomy in 11 eyes of 8 children with premacular subhyaloid haemorrhage. The haemorrhage started draining immediately after completion of hyaloidotomy (fig. 1.a, 1.b and fig. 2.a, 2.b). In 10 eyes, the trapped blood was released into the vitreous and the visual acuity was better than 6/36 (Snellen chart) at 1 week follow up. One eye had clotted blood that did not drain. Mansour et al (1989), Ulbig et al (1998) and Farvardin et al (2005) described the similar cases of premacular haemorrhage failed to drain after YAG hyaloidotomy due to clotted blood. After 3 month follow up, the haemorrhage was completely reabsorbed and the visual acuity was better than 6/12 (Snellen Chart) in 9 eyes. The eye with clotted blood did not drain even after 3 month and was subjected to vitrectomy. One eye with good vision at first week and three week follow up had poor visual acuity at 3 month follow up due to re-bleed.

Ulbig et al (1998) studied 21 patients with premacular subhyaloid haemorrhage of different aetiologies. Hyaloidotomy was successful in 16 (76.2 %) of their patients, with visual improvement in all cases.

Rennie et al (2001) evaluated 10 patients with premacular subhyaloid haemorrhage of different aetiologies. Nd: YAG laser hyaloidotomy was performed in 6 patients and 4 were taken as control. Nd: YAG laser hyaloidotomy achieved rapid resolution of subhyaloid haemorrhage in all cases and no patient has damage to retina and choroid due to treatment. Nevertheless, among the cases managed conservatively the haemorrhage resolved over 6 to 18 months.

Gabel et al (1989) evaluated 3 patients with premacular subhyaloid haemorrhage. Nd: YAG laser hyaloidotomy was successful in all cases.

Mehdi Nilli-Ahmadabadi et al (2004) evaluated twelve eyes of 12 patients with premacular subhyaloid haemorrhage of various aetiologies. Hyaloidotomy was successful in all (100 %) cases and the trapped blood was released into vitreous cavity and absorbed within 6 to 16 days. No complications were observed during their average follow up of 24.5 (range 8-72) months.

M. Farvardin et al (2005) evaluated 13 eyes with premacular subhyaloid haemorrhage various aetiologies. Drainage of premacular subhyaloid haemorrhage into the vitreous with Nd: YAG laser succeeded within three months is eleven, out of thirteen eyes treated without requiring further membranotomy. One eye had persistent, dense nonclearing vitreous opacity for at least 3 months. One clotted haemorrhage did not drain into vitreous. Overall visual improvement was best in eyes with acute myeloid leukemia. During follow up, neither macular epiretinal membranes nor tractional retinal detachments occurred in any eye.

Conclusion

Nd: YAG laser hyaloidotomy is a simple outpatient procedure which is relatively safe as compared to vitrectomy under general anaesthesia particularly in children with leukemia . It results in rapid visual rehabilitation in selected cases. The rapid resolution is particularly important for children with poor vision in fellow eye. The risks and benefits have to be considered in randomized clinical trials to establish Nd: YAG laser hyaloidotomy treatment as a routine procedure in leukemic children.

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Source of support: nil. Conflict of interest: none