Literature Review

Medium Duration Threshold Patterned Laser Photo-coagulation for Panretinal Photocoagulation

Habsyiyah, Elvioza, Andi Arus Victor, Ari Djatikusumo, Gitalisa Andayani, Anggun Rama Yudantha
Ophthalmology Department, Faculty of Medicine, University of Indonesia
Cipto Mangunkusumo Hospital, Jakarta

ABSTRACT

Background: *Laser photocoagulation is a crucial therapy for numerous retinal diseases. Laser can be delivered with different machines and modalities (slit lamp, endolaser, indirect laser) at different wavelengths (532 to 812 nm) with varying parameters (power, spot size, duration, number of spots). New developments using semi automatic pattern delivery of retinal laser burns which use smaller amounts of energy and shorter duration have been reported. This literature review is conducted to review various published article that reported efficacy, safety, and duration of medium duration threshold patterned (MDTP) laser photocoagulation.*

Methods: *This literature review was conducted from the Pubmed (NLM) database and Ophsource using the keyword panretinal photocoagulation, and Pascal or medium threshold or short exposure. The inculsion criteria of this review were all of studies which reported the use of medium duration threshold patterned which was applied as panretinal photocoagulation (PRP).*

Results: *Parameter used in MDTP laser were as follow, spot size was between 200 to 400 µm, duration was 20-30 ms, and average laser power was more than 200 to 630 mV. Compare to standard laser treatment, power used in MDTP laser were higher.*

Conclusion: *Medium duration threshold patterned laser photo-coagulation is as effective as conventional laser. MDTP laser can preserve the retinal sensitivity/visual field, also offers less pain and discomfort and safe to perform full scatter PRP in single sitting*

Keywords: *medium duration threshold patterned laser; panretinal photocoagulation*

Laser photocoagulation is a crucial therapy for numerous retinal diseases. Photocoagulation involves protein denaturation and is the result of tissue absorption of radiant energy with conversion to heat.[1]

The most notable laser amenable disease is proliferative diabetic retinopathy (PDR). Other retinal conditions treatable with laser photocoagulation include diabetic macular oedema (DMO), retinal vein occlusions, leaking arterial macroaneurysms, age-related macular degeneration (AMD), retinopathy of prematurity (ROP), and retinal tears. For each condition, laser is targeted at different tissue types in distinct areas of the retina. Therefore, the appropriate choice of wavelengths is imperative.[1,2] As technology has matured, not only are different wavelengths becoming more accesible, there is a wider variety of laser delivery methods that promise to enhance precision of laser burns or simplify the application of retinal laser.[1]

The innovations allowed for creating single laser spots of variable size, power, and duration on the retina with a high degree of precision and ushered in the modern era of retinal laser photocoagulation in the 1970s. The techniques enabled by these devices, termed focal photocoagulation, grid photocoagulation, and panretinal photocoagulation (PRP), were refined and shown to be effective in the treatment of proliferative diabetic retinopathy and advanced forms of nonproliferative diabetic retinopathy associated with macular edema in large, prospective, multicenter, randomized trials—the DRS and ETDRS.[3,4] These trials validated the efficacy and institutionalized the indications and parameters for treatment that have remained the gold standard since that time.[3,4,5]

PRP involves applying laser burns over the entire retina, sparing the centrak macular area. Laser can be delivered with different machines and modalities (slit lamp, endolaser, indirect laser) at different wavelengths (532 to 812 nm) with varying parameters (power, spot size, duration, number of spots). Conventional photocoagulation using a single application of laser energy per shot is usually delivered as 100-200 milliseconds (ms) duration burn.[6,7] Application starts in circumference of 500 μm from the disc and 2 disc diameters from the fovea to wall off the central retina. Moderate intensity burns of 200-500 μm (gray-white burns) are placed 1 spot size apart, except in areas of neovascularization where the entire frond is treated. This procedure is continued peripherally to achieve a total of 1200-1600 applications over 2-3 sessions.[8]

Despite the effectiveness of conventional single spot retinal photocoagulation, it remains an uncomfortable experience for the patient and the treatment is not without side effects.[9] Single sitting panretinal photocoagulation is reported to have exaggerated macular edema.[8] It is well reported by patients that conventional multisession PRP is associated with discomfort and painful experience, especially in the retinal periphery, which in some cases can result in nonattendance for further treatment and poor outpatient follow-up. The treatments are also time consuming and tedious for the patient and physician alike because the spot are delivered individually.[5,10] Several attempts have been made to decrease requirement on operator dexterity and inconvenience of multiple, interrupted laser applications placed one at a time with the help of multispot laser modalities.[11]

For new laser technology, the goal of retinal photocoagulation is to target the RPE with minimal collateral nerve fiber layer damage and perhaps barely visible scar formation.[12] A new semiautomated photocoagulator, pattern scan laser is becoming increasingly popular in practice as it delivers laser in different desired patterns and the laser sessions are relatively painless for the patient. It uses medium-pulse duration, 10-30 ms, burns for either PRP or macular photocoagulation. Importantly, this results in less destruction within the outer retina than with conventional burns, presumably due to less thermal diffusion to the choroid.[5]

More recently there has been considerable interest and debate as to whether 'quicker more painless' laser photocoagulation can be achieved, and there is evidence that many ophthalmologists no longer use the conventional parameters.[13] In addition, new, exciting developments using semi automatic pattern delivery of retinal laser burns have been developed and reported which use much smaller amounts of energy and shorter duration. How are the efficacy and safety of this medium duration threshold of patterned (MDTP) laser photocoagulation used as panretinal photocoagulation?

This literature review is conducted to review various published article that reported efficacy, safety, and duration of MDTP laser photocoagulation.

METHODS

This literature review was conducted from the Pubmed (NLM) database and Ophsource using the keyword panretinal photocoagulation, and Pascal or medium threshold or short exposure. The limit used of this review is using English and human. References list from included studies were also checked for potentially relevant articles.

The studies were then selected for further review and data extraction. As intial screening, abstracts were reviewed to obtain studies that fulfill the requirements of this literature review based on keywords. The complete studies related to the abstracts were then screened to meet the inclusion and exclusion criteria.

The inculsion criteria of this review were all of studies which reported the use of medium duration threshold patterned which was applied as PRP. If a study had different other treatment groups, only group with PRP treatment which included in this review. The studies were excluded if laser was applied in focal or grid fashion or not analyze the clinical outcome. Studies were also excluded if the full text could not be accessed.

All selected articles were then rated based on level of evidence. Level of evidence was assigned based on study design and methodological quality according to Oxford Centre of Evidence Based Medicine.[14] Level I rating was assigned to properly conduct, well-design, randomized conrolled trials, high quality meta analysis, and systemic reviews of randomized trial or randomized controlled trials with low risk bias. Level II rating was assigned to well-designed randomized trial or observasional study with dramatic effect. Level III rating was assigned to non-randomized controlled cohort/follow up study. Level IV was assigned to case series, case control studies, or historically controlled studies. Level V was assigned to expert opinion or mechanism-based reasoning.

Operational definition used in this reviewed were as following :

- Standard threshold is long pulse duration laser photocoagulation that used in conventional laser (100-200 ms).
- Medium threshold is medium or short pulse duration laser photocoagulation (10-30 ms).
- Efficacy is determined by regression of neovascular-ization.
- Safety is determined by complication which occurs during or after treatment, which also include pain, macular edema, and visual field loss.

RESULTS

The literature searching identified 30 articles that were related to the keywords. As many as 12 articles meet the inclusion criteria. Three articles were excluded because they did not analyze the clinical outcome. One article excluded because it is not using medium threshold parameter. From 12 articles included, 3 of them were continuous studies. From the reference list, three articles which meet the inclusion criteria were found. At the end, 12 articles (10 studies) were reviewed.

Characteristics of the reviewed articles are presented in table 1. It shows that all articles were published within the year 2008-2012. Amongst level I study the largest one was the one conducted by Muraly et al[16]. The longest mean follow up time is 12 weeks by Muqit et al in MAPAS[10,17,18] study. It showed that the most common indication for laser treatment was diabetic retinopathy especially proliferative type. The mean age of subject amongst studies was range between 44-62 years old.

The laser parameters of the comparative study are summarized in Table 2. Parameter used in MDTP laser were as follow, spot size was between 200 to 400 µm, duration was 20-30 ms, and average laser power was more than 200 to 630 mV. Compare to standard laser treatment, power used in MDTP laser were higher. It was statistically significant in MAPAS[10,17,18] and Salman[19] study ($p<0,001$).

Regression of neovascularization as the efficacy of treatment was presented in 7 studies. Regressions were found from 42% to 100% of the subjects. When compared to standard threshold, treatment with MDTP laser had better clinical outcomes in MAPAS[10,17,18] and Salman[19] studies.

In six studies that used visual acuity as one of the outcome, 5 of them were using Snellen. Only MAPAS[10,17,18] study used ETDRS chart. Post laser treatment visual acuity was slightly improved in four studies while two other study had no changes in visual acuity. No visual acuity deterioration was found in any studies.

Pain score of laser treatment were presented in Table 2. In five of studies which had pain score as one of the outcome, MDTP laser treatment has less pain than conventional laser treatment. It was statistically significant in MAPAS III[17], Nagpal et al[11] and Al-Hussainy et al[20]. The method used to evaluate pain score was different between studies. MAPAS[17] was using numerical pain score, while Nagpal et al[11] and Hussainy et al[20] were using Visual Analog Score. Muraly et al[16] used qualitative criteria. Modi et al[6] was just using scale of 1 to 10.

Table 1. Characteristics of reviewed articles

No	Author	Level of Evidence	No subject	Comparison	Follow up time	Mean age (range)	Type of retinopathy
1	Muqit, et al MAPAS[10,17,18]	I	40 eyes	PASCAL	12 wk	46 yo(29-60) 44 yo (29-60)	PDR
2	Muraly, et al[16]	I	100 eyes	ND Yag 532	6 mo	57,44 yo (32-78)	PDR
3	Nagpal, et al[11]	I	60 eyes	Green laser 532 nm	6 mo	52 yo (45-61)	PDR and severe NPDR
4	Al-Hussainy, et al[20]	I	20 eyes	NdYag 532 nm	6-45 mo	62 yo (26-76)	PDR CRVO Ocular ischemia
5	Salman[21]	II	60 eyes	Green 532 nm	9,9, wk	48,9 yo (41-86)	PDR
6	Chappelow, et al[21]	IV	41 eyes	Argon	6 mo	57,9 (±2,5)	PDR
7	Modi, et al[6]	IV	7 eyes	NA	5,9 ± 4 mo	NA	PDR Ischemic retinal vascular disorder
8	Velez-Montoya, et al[15]	IV	1036 eyes	NA	NA	62,04 ± 12,32 yo	DR Retina vein occlusion
9	Muqit, et al[22]	IV	121 eyes	NA	4,6 mo	59,3 ±13,3 (14-93	PDR
10	Sanghvi , et al[7]	IV	12 eyes	NA	10,8 wk	NA	PDR, ischemic vein occlusion

Table 2. Pain score

No	Author	Medium threshold	Standard threshold	P value
1	MAPAS[17]	2,4 (2,3)	4,9 (3,3)	0,006
2	Muraly, et al[16]	80% mild	50% severe	NA
3	Nagpal, et al[11]	0,33	4,6	0,007
4	Al-Hussainy, et al[20]	1,405	5,11	<0.001
5	Modi, et al[6]	3,6	-	NA

Only MAPAS I[10] study, Nagpal et al[11] and Muraly et al[16] mentioned duration of the treatment. In those study, Pascal was significantly need shorter time than conventional laser. In MAPAS[10] study, the comparison of time needed for treatment was per 1500 burns, which was done in 1 sitting in MDTP laser group and 3 sitting in standard threshold group. In Muraly[16] study, the time comparison was between needed time for completion of each treatment. The total spot numbers of MDTP laser was 2795 (range 2100-3892) while 1414 spots (1220-1672) were used to complete the whole PRP treatment in standard threshold group. Time compared in Nagpal[11] study was time taken per sitting. In Nagpal[11] study PRP was done in two sitting regardless the modality treatment. Table 3 showed retinal sensitivity comparison between MDTP laser and standard threshold. MAPAS I[10] study showed decreased retinal sensitivity.

Table 3. Retinal sensitivity

Author	Medium threshold		Standard threshold	
	Pre (SD)	Post (SD)	Pre (SD)	Post (SD)
MAPAS[10]	-5,94 Db (SD 2,9 db)	-6,67	-4,62 dB (SD 3,5dB)	-5,01
Nagpal, et al[11]		25,08 (central 15°) 22,08 (15-30°)		23,16 (central 15°) 17,15 (15-30°)

Only one study analysed the laser effect on retinal thickness. In MAPAS[10,17,18] study, central retinal thickness were increased compare to baseline at 4 weeks follow up, both in MDTP laser and standard threshold treatment, 2 µm (p = 0,4) and 22 µm (p <0,01) respectively.

Four study reported no complication, while three others did not mention about it. Al-Hussainy et al[20] and Chappelow et al[21] reported vitreous hemmorhage as their only complication. In Chappelow et al[21] study, complication number was higher on MDTP laser treatment.

Three studies mentioned no retreatment needed after MDTP laser procedure. In Muraly et al[16] and Nagpal et al[11], less subject need retreatment than the standard treatment. The rest of the study did not mention about retreatment.

DISCUSSION

The concept of retinal photocoagulation was introduced by Meyer-Schwickerath for the treatment of diabetic retinopathy in the 1950s and used with some success in the 1960s.[5,23] Since the 1950s, a number of laser systems have been used by ophthalmologists including xenon arc, ruby, and krypton.[17,23] Zweng et al from Stanford University co-developed the first comercially available argon laser slit-lamp photocoagulator. The advent of retinal photocoagulation in the early 1970s provided a noninvasive modality for treatment of proliferative retinal conditions. The significant degree of success and low complication rates of this procedure led to its widespread acceptance.

The treatment parameters for retinal photocoagulation have remained relatively constant since the first description of an argon laser coupled to slit lamp delivery sistem in 1970.[24] The three separate but interdependent variables available to the clinician are the beam size, power, and duration of the pulse. Typically, for diabetic retinopathy, retinal vascular applications, and the treatment of retinal breaks, the retinal laser spot sizes range from 100 to 500 µm; the pulse durations, from 100 to 200 ms; and the power, from 100 to 750 mW. The clinical appearance of the retinal lesions in these applications ranges from mild gray to a moderate white.[4,25]

The PASCAL is a 532 nm frequency-doubled neodymium-doped yttrium aluminium garnet (Nd:YAG) solid-state laser. It is an semiautimated patterned scanning laser retinal photocoagulator that allows for much greater speed and precision than single spot application. It can deliver numerous patterns including squares, arcs, full and subset grids, the shapes and sizes of which are adjustable, in addition to single spots.[7] Semiautomatic in this context means that the physician has control over the treatment at all times. Each pattern of spots is configured and positioned by means of a joystick. By using pulse duration in the 10-20 ms range, multiple spots can be delivered in the time required for a single conventional 100 ms pulse.[5]

Laser tissue interaction is influence by wavelength, spot size, power and exposure time. Retinal damage can be reduced by changing some of these parameters.[19] It is commonly accepted that the laser burn must produce a white-yellow biomicroscopic effect, meaning destruction of choriocapillaris, retinal pigment epithelium and retina.[26] Most of study reviewed revealed that medium threshold patterned laser treatment requires a higher power to achieve the desired therapeutic lesion, approximately two times or more higher than conventional parameters. In MAPAS[10,17,18] and Salman[19] study, these differences in power used were statistically significant.

Although MDTP laser required higher power, it was not resulting in higher complication. This may be reflection of the reduced laser energy per burn reaching the eye secondary to its shorter duration. Fluence is calculated as (power x time/area) and provided that spot size remains unchanged, with a burn duration of 20 ms the fluence is less than with 100 ms burn when titrating to the same burn intensity because of reduced diffusion of heat.[7,19] A lower fluence dosing of laser has been shown to result in fewer structural alterations in the outer retina.[25] According to result in MAPAS I[10] study, short pulse, low fluence 20 ms scatter PRP applied in a single sitting produced less intraretinal inflammatory in comparison with 100 ms PRP.

At different pulse duration, fluence may be titrated to achieve an optimal laser dosage and threshold burns in the outer retina, with healing of laser burns and minimization of photoreceptor injury. In a study by Muqit et al[27] which compare healing response of MDTP laser with standard threshold, they found that 20 ms burns allow the tissue to undergo a healing response that may not occur after standard duration photocoagulation. This healing response is associated with a significant reduction in burn size across time for 20 ms pulse duration, with no significant disruption to either the inner retina or the basal RPE. Higher fluence 100 ms burns developed larger defects due to thermal blooming and collateral damage, with no alteration in burn size across time or any healing laser-tissue interaction.[27]

Ocular neovascularization disease and retinal vascular leakage result from angiogenic factors produced in response to retinal inflammation and ischemia. While the exact mechanisms of laser treatment are unknown, one working assumption is that panretinal photocoagulation reduces ischemia and decreases the production of angiogenic factors in the poorly perfused portions of the retina by lowering the metabolic load because of killing of a fraction of retinal cells. Photoreceptors are the most numerous and metabolically active cells in the retina, with a large number of mitochondria, having high oxygen consumption. The cells of the inner nuclear layer and the ganglion cell layer represent 10% of the number of photoreceptors, and thus, additional damage to the inner retina is unlikely to significantly improve clinical efficacy. After a laser burn, the photoreceptor layer is partially replaced by glial tissue. This tissue has fewer mitochondria and therefore lowers overall oxygen demand. Other theories include improvement of oxygenation and metabolic transport between choroid and retina by creating photoreceptor-free glial 'windows' and stimulation of retinal pigment epithelial and choroidal cells by thermal stress. With all these mechanisms, the clinical effect is likely to be proportional to the total treated area.[26,28,29]

The DRS findings confirmed the benefits of PRP treatment in reducing the incidence of severe visual loss and regressing neovascularization in the majority of eyes with PDR.[8] In this review, as many as 7 articles mentioned the regression of neovascularization. Regression of neovascularization was considered as the effectivity of the laser treatment. Most study showed regression occurred more than 70% subjects, even in Sanghvi et al[7] study the regression ws 100%. In those study which comparing with conventional parameters, MDTP laser treatment showed better result, except in Chappelow et al[21] study. They explained that this result was cause by the inherent difference in the properties of the PASCAL and argon lasers that limits the efficacy of the MDTP laser when used in the context of traditional argon laser treatment parameter. The increased rate of neovascularization recurrence experienced in the MDTP laser-treated patients (vs argon-treated patients) suggests that given an equivalent number of treatment spots, the smaller total burn area created by the MDTP compared to the argon laser results in a significant decrease in efficacy. As such, they suggest either additional lesions or larger spot sizes may be required to achieve comparable efficacy with the MDTP laser compared to traditional argon green laser. In this study, the power used in both MDTP laser and argon laser were start at 200 mW, it was increased until a gray/white lesion was attained. They did not mention the total power used in the treatment, while in other study power used in MDTP laser treatment higher than conventional parameter as mention above. This Chappelow et al[21] study had limitation as the study design was comparative case series with low level of evidence based medicine.

The purpose of PRP, especially PDR case, was to prevent severe visual loss. Noteworthy side effects associated with scatter PRP include a decrease in night vision, color vision, and/or peripheral vision, as well as a loss of 1 or 2 lines of visual acuity in some patients.[2] Generally, there were no changes in visual acuity in those study reviewed. Some study that had changes in visual acuity after laser treatment as in MAPAS[10,17,18] and Nagpal et al[11] study, which had improved visual acuity, those were just slight changes without statistically significant.

Despite the effectiveness of conventional single spot retinal photocoagulation, it remains an uncomfortable experience for the patient and the treatment is not without side effects (refractive changes, angle closure, changes in contrast sensitivity and colour vision, macular edema, choroidal detachments, rupture of Bruch membrane, and so on).[9] Many of these side effects are due to the production of inflammatory cytokines by the neighbouring tissue that is damaged by expansion of the energy of the original burn but not completely destroyed by the laser burn itself.[9,15] Another theory stated that macular edema may occur due to increased permeability of the retinal capillaries and oncotic fluid accumulation related to the tissue destruction or PRP-induced inflammation leading to cytokine release.[30]

In the ETDRS, 18% of eyes underwent full PRP (1200-1600 spots) were noted to have macular edema on stereoscopic fundus photographs by 4 months (F. L. Ferris, MD, unpublished data, June 7, 2008). In Wade Blankenship[31] study which compare short versus long duration time of exposure (0,1 s and 0,5 s), increased macular thickening was noted in 45% and 38% respectively at 1 week after treatment. Most of this macular thickening were resolve at 1 month follow up. Diabetic Retinopathy Clinical Research Network[30] reported increased macular thickness were found in both 1-sitting and 4-sitting PRP. At the first week, macular thickening was greater in 1-sitting group, but at the end of follow up there were no differences between those groups.

The review shows that only MAPAS[10] study analysed about central retinal thickness. Increased macular thickness was decreased than baseline at 12 weeks follow up, those in multiple session group were remain increased than baseline. Although macular edema was not an outcome in Muraly[16] et al study, they mentioned that they did not found any macular edema after laser treatment.

Although the retina is devoid of pain sensitivity, ocular pain and photophobia are frequently reported post-laser. Laser induced eye nociception may be related to thermal effects within choroid, stimulation of ciliary nerves within suprachoroidal spaces, thermal diffusion to nerve fibre layer or perhaps direct photocoagulation of the long posterior ciliary nerve.[17,32] Treatment with reduced pulse duration may be associated with less pain. Longer burns may cause greater thermal diffusion, whereas short pulse duration give rise to minimal diffusion of heat to adjacent areas, resulting in localized homogeneous burns and less discomfort.[5]

Discomfort experiences by patient undergoing laser photocoagulation remains an important cause of suboptimal treatment as pain threshold is variable. Various factors affecting pain include patient anxiety, pigmentation of the fundus and laser re-treatment. PRP laser was opined to be painful by 88% of respondents in a survey by Richardson[33]. They found this factor increased the number of sessions the laser had to be delivered as patients may not cooperate for an adequate PRP or sometimes default the laser treatment due to previous painful PRP experience. The array method of multiple burn application in MDTP laser allows for a larger area of retina ablation in a shorter time, thus enhance patient and physician comfort.

Half of review study report that pain experienced by patient using medium threshold parameter were lower than conventional parameter. Those were statistically significant in MAPAS[10,17,18], Nagpal et all[11], and Al-Hussainy et al[20] study. Almost all study using topical anesthesia for their MDTP laser treatment, while Modi[6] and Velez-Montoya[15] did not mention what type of anesthesia were used. For those studies which not analysed pain response, requirement of subtenon or peribulbar anesthesia was consider as an outcome, but there was no patient who need changing in anesthesia method. Another study by Nalvira et al[34], which compare medium threshold with conventional laser, also found that medium threshold had lower pain experienced by patient. In Fok et al[35] study revealed that patient comfort were similar between pattern scan laser and conventional laser but patient cooperativeness was higher in pattern scan laser.

Due to the long duration of the conventional laser procedure, it could result in patient discomfort. Using patterns scan laser with multispot in single session could reduce treatment duration. The time taken for completing the treatment in Muraly[16] study was significantly lesser in MDTP laser than conventional laser. Similar results were also mentioned in MAPAS[10] and Nagpal[11] study. However, Fok et al[35] in their study reported that the use of patterned scan laser machine did not appear to reduce total time required for the procedure. This may be influenced by media opacities on some of their patients that could make the application and focusing of the patterned scan laser more difficult, thus prolonging the time required.[35]

Visual field loss after both full an scatter PRP has been reported by a number of studies and may be related to laser burn expansion over time.[36,37] In relation to the field defect, PRP has been shown to cause a loss to the binocular field that may result in the patient not meeting the standard required by the United Kingdom (UK) Driving and Vehicle Licensing Authority

(DVLA). This can have a major impact on a patien's quality of life.[10] In MAPAS[10] and Nagpal[11] study changes in visual field or retinal sensitivity were not statistically significant. However in Nagpal[11] study, better preservation of visual fields was obtained with MDTP laser compared with conventional laser on the basis of retinal sensitivity. Uniform spacing of the burns with hardly any coalescing of laser spot may also have a role in better retention of retinal sensitivity in these patients. Similar result was also reported by Nalvira et al[34].

Another complication of PRP that could occurred is blowout hemorrhages from the areas of neovascularization, particularly on the optic nerve. This may be caused by an increase in peripheral resistance secondary to photocoagulation or by an inadvertent Valsava maneuver by the patient.[23] Al-Hussainy et al[20] reported one vitreous hemorrhage. Chappelow[21] also found vitreous hemorrhages in more number of patients, even the complication occurred more in Pascal than conventional laser. Chappelow[21] study has several limitation, include too small sample size and retrospective design of the study. Retinal hemorrhages were reported in Modi[6] and Velez-Montoya[15], two retinal hemorrhages of seven patients treated and 17 of 1036 patients, respectively. They speculate that as application of the pattern arrays approaches the ora serrata, the clinician may find it to be more difficult to focus the entire array due to the radius or curvature of the globe and the need to be off-axis with the beam. In addition, the retinas become thinner anteriorly. If the spots are not all focused in the retina, the uptake will be uneven. The use of small patterns (2x2 and 3x3) provide a more easily focused spot in the anterior retina, thus decreasing the risk of unwanted bleeding due to a high-power burn. In the same way, the presence of peripheral lens opacities can block the energy at certain locations. If the surgeon has increased the power, he must remember to decrease the energy before moving the treatment to a different area. Otherwise, the probability of creating excessive power burns or perforations of Bruch's membrane increases.[6,15]

Complication were less observed as the duration was only 20 or 30 ms, thus causing less heat energy delivery, and less inflammation, which are though to be the main reasons for the development of retinal/choroidal detachment.[16] Velez-Montoya[15] also report serous choroidal detachment and exudative retinal detachment. The incident were 2/1036 and 1/1036 respectively. Choroidal detachments occur frequently after panretinal photocoagulation. However, most of these events go unnoticed because of their small size and their asymptomatic nature.[24,25] The two cases reported in Velez-Montoya[15] series were patients with detachments large enough to be observed during fundus examination, apparently of serous content and asymptomatic.

Exudative retinal detachment is a rare complication traditionally related to aggressive laser treatment in a single session modality. The case reported in Velez-Montoya[15] study occurred in a young male patient, who had been given a moderate number of burns with a lower than average power. Hence, the causes underlying the detachment are not very clear. However, the two patients with choroidal detachment and the young male patient had certain characteristics in common, including the fact that the three had diabetes, and had poor metabolic control. The three episodes effectively yielded to the administration of topical NSAIDs, which points to a probable inflammatory cause. According to Doft and Blankenship[38], exudative retinal detachment/choroidal detachment occurred more commonly in single sitting, but these adverse effect were transient with no long-term effect.

Retreatment is needed if there were persistence of neovascularization or fresh neovascularization found. Among five studies report about retreatment, three stated no retreatment required, but their follow-up time were quite short, between 9,9 to 12 weeks. However, Muraly[16] reported that retreatment needed in both MDTP laser and conventional laser at one month follow up, with less patient in MDTP laser group.

CONCLUSION

Medium duration threshold patterned laser photocoagulation is as effective as conventional laser. MDTP laser can preserve the retinal sensitivity/visual field. This treatment also offers less pain and discomfort. With shorter duration, this modality need higher power but this not increased the complication due to less fluence and less inflammation produced, thus it is safe to perform full scatter PRP in single sitting with MDTP laser. Therefore, less time needed for completing PRP treatment. However, prospective study with longer follow-up time is needed.

REFERENCES

1. Lock JH, Fong KCS. Retinal laser photocoagulation. Med J Malaysia 2010;65:88-94
2. Staff AAO. Retina and Vitreous. Basic and clinical science course 12. San Fransisco: American Academy of Ophthalmology;2009-2010. p337-348
3. The Early Treatment Diabetic Retinopathy Study Research Group. Techniques for scatter and local photocoagulation treatment of diabetic retinopathy. Early treatment diabetic retinopathy study report no. 3. Int Ophthalmol Clin 1987;27:254—264
4. The Early Treatment Diabetic Retinopathy Study Research Group. Treatment techniques and clinical guidelines for photocoagulation of diabetic macular edema. Early treatment diabetic retinopathy study report number 2. Ophthalmology 1987;94:761-774
5. Blumenkranz MS, Yellachich D, Andersen DA et al. Semiautomated patterned scanning laser for retinal photocoagulation. Retina 2006;26:370e6
6. Modi D, Chiranand P, Akduman L. Efficacy of patterned scan laser in treatment of macular edema and retinal neovascularization. Clin Ophthalmol 2009;3:465—470
7. Sangvhi C, McLauchlan R, Delgado C, Young L, Charles SJ, Marcellino G, Stanga PE. Initial experience with the Pascal photocoagulator: a pilot study of 75 procedures. Br J Ophthalmol 2008;92:1061-1064
8. Diabetic Retinopathy Study Research Group. Photocoagulation treatment of proliferative diabetic retinopathy: clinical application of Diabetic Retinopathy Study (DSR) findings. Diabetic Retinopathy Study (DRS) Report number 8. Ophthalmology 1981;88:583—600
9. Fong DS, Girach A, Boney A. Visual side effects of successful scatter laser photocoagulation surgery for proliferative diabetic retinopathy: a literature review. Retina 2007;27:816e24
10. Muqit MMK, Marcellino GR, Henson DB, Young LB, Charles SJ, et al. Single-session vs multiple-session scanning laser panretinal photocoagulation in proliferative diabetic retinopathy. Arch Ophthalmol 2010;128(5):525—533
11. Nagpal M, Marlecha S, Nagpal K. Comparison of laser photocoagulation for diabetic retinopathy using 532-nm, standard laser versus pattern scan laser. Retina 2010;30:452-458
12. Muqit MM, Gray JCB, Marcellino GR, Henson DB, Young LB, Charles SJ, et al. Fundus autofluorescence and Fourier-domain optical coherence tomography imaging of 10 and 20 millisecond Pascal retinal photocoagulation treatment. Br J Ophthalmol 2009;93:518—525
13. Rimmer T, Wykes W. Quicker painless diabetic laser. Eye 2007;21:140
14. Oxford Center for Evidence-Based Medicine – Levels of Evidence (March 2009). Available at http://www.cebm.net/index.Aspx?o=1025
15. Velez-Montoya R, Guerrero-Naranjo JL, Gonzales-Mijares CC, Fromow-Guera J, Marcellino GR, Quiroz-Mercado H, et al. Pattern scan laser photocoagulation: safety and complications, experience after 1301 consecutive cases. Br J Ophthalmol 2010;94:720-724
16. Muraly P, Limbad P, Srinivasan K, Ramasamy K. Single session of Pascal versus multiple sessions of conventional laser for panretinal photocoagulation in proliferative diabetic retinopathy: a comparative study. Retina 2011;31(7):1359-65
17. Muqit MMK, Marcellino GR, Gray JCB, McLauchlan R, Henson DB, Young LB, et al. pain responses of Pascal 20 ms multi-spot and 100 ms single-spot panretinal photocoagulation: Manchester Pascal Study, MAPASS report 2. Br J Ophthalmol 2010;94:1493-1498
18. Muqit MMK, Marcellino GR, Henson DB, Fenerty CH, Stanga PE. Randomized clinical trial to evaluate the effects of Pascal panretinal photocoagulation on macular nerve fiber layer. Retina 2011;31(7):1359-65
19. Salman AG. Pascal layer versus conventional laser for treatment of diabetic retinopathy. Saudi J Ophthalmol 2011;25:175-179
20. Al-Hussainy S, Dodson PM, Gibson JM. Pain response and follow-up patients undergoing panretinal laser photocoagulation with reduced exposure times. Eye 2008;22:96-99
21. Chappelow AV, Tan K, Waheed NK, Kaiser PK. Panretinal photocoagulation for proliferative diabetic retinopathy: pattern scan laser versus argon laser. Am J Ophthalmol 2012;153:137-142.
22. Muqit MMK, Sangvhi C, McLauchlan R, Delgado C, Young LB, Charles SJ, et al. Study of clinical application and safety fot Pascal laser photocagulation in retinal vascular disorder. Acta Ophthalmol 2010(epub ahead of print)
23. L'esperance, Francis A. Diabetic retinopathy in ophthalmic lasers. Third edition. Volume 1. Mosby Company. USA 1989. P347-424
24. Little HL, Zweng HC, Peabody RR. Argon laser slit-lamp retinal photocoagulation. Trans Am Acad Ophthalmol Otolaryngol 1970;74(1):85-97
25. Jain A, Blumenkranz MS, Paulus Y, Wiltberger MW, Andersen DE, Huie P, Palanker D. Effect of pulse duration on size and character of the lesion in retinal photocoagulation. Arch Ophthalmol 2008;126(1):78-85
26. Bandello F, Brancato R, Menchini U, Virgili G, Lanzetta P, Ferrari E, Incorvaia C. Light panretinal photocoagulation (LPRP) versus classic panretinal photocoagulation (CPRP) in proliferative diabetic retinopathy. Semin Ophthalmol 2001;16:12-18
27. Muqit MMK, Gray JCB, Marcellino GR, Henson DB, Young LB, Patton N, et al. In vivo laser tissue interactions and healing response from 20- vs 100-millisecond pulse Pascal photocoagulation burns. Arch Ophthalmol 2010;128(4):448-455
28. Palanker D, Lavinsky D, Blumenkranz MS, Marcellino G. The impact of pulse duration and burn grade on size of retinal photocoagulation lesion. Retina 2011;31:1664—1669
29. Paulus YM, Jain A, Gariano RF, et al. Healing of retinal photocoagulation lesions. Invest Ophthalmol Vis Sci 2008;49:5540-5545

30. Diabetic Retinopathy Clinical Research Network, Brucker AJ, Qin H, et al. Observational study of the development of diabetic macular edema following panretinal (scatter) photocoagulation Given in 1 or 4 sittings. Arch Ophthalmol 2009;127(2):132-140
31. Wade EC, Blankenship GW. The effect of short versus long exposure times of argon laser panretinal photocoagulation on proliferative diabetic retinopathy. Graefe's Arch Clin Exp Ophthalmol 1990;228:226-231
32. Dowler JGF. Laser management of diabetic retinopathy. J R Soc Med 2003;96:277-279
33. Richardson C, Waterman H. Pain relief during panretinal photocoagulation for diabetic retinopathy: a national survey. Eye 2009;23(12):2233-7
34. Nalvira F, Elvioza, Sidik M, Bardosono S. Comparison of photocoagulation effect of medium threshold and conventional laser diabetic retinopathy. Unpublished.
35. Fok ACT, Luk FOJ, Wong VWY, Chan PPM, Lai TTY. Patient comfort levels and treatment parameters in laser photocoagulation: comparison of patterned scanning versus single spot laser machines. HKJ Ophthalmol 2011;15:68—70
36. Maeshima K, Utsugi-Sutoh N, Otani T, Kishi S. Progressive enlargement of scattered photocoagulation scars in diabetic retinopathy. Retina 2004;24(4):507-511
37. Pahor D. Visual field loss after argon laser panretinal photocoagulation in diabetic retinopathy: full-versus mild-scatter coagulation. Int Ophthalmol 1998;22(5):507—511
38. Doft BH, Blankenship GW. Single versus multiple treatment session of argon laser panretinal photocoagulation for proliferative diabetic retinopathy. Ophthalmology 1982;89(7):772-779