ABSTRACT

Aim: Proliferative diabetic retinopathy (PDR) is a more serious clinical presentation of diabetic retinopathy. Panretinal photocoagulation (PRP) is an effective laser treatment for PDR. The heat from the laser shrinks the blood vessels to prevent them from regrowing. However, in most cases, severe visual loss still develops despite therapy. The aim of this study was to examine the effect on visual acuity after PRP in PDR by conducting a systematic review.

Methods: The search was systematically done on seven databases: MEDLINE, SCIENCE DIRECT, CINAHL, COMPLETE, COCHRANE, SCOPUS, WEB OF SCIENCE and EMBASE. The search focused on any studies related to the effect of PRP on visual acuity in PDR. The search strategies were done by using keywords related to “Proliferative Diabetic Retinopathy”, “Panretinal Photocoagulation” and “Visual Acuity”.

Results: A total of 1775 abstracts were initially identified. 575 abstracts were removed after duplication. The remaining of 1200 abstracts were reviewed by looking at the titles, abstracts and full papers using predetermined inclusion and exclusion criteria, after which only two were included in the review. These two studies showed that there is loss on visual acuity immediately after PRP treatment on PDR, but time to the recovery of vision varies from nine days to three months.

Conclusion: There were only two studies on the effect of PRP on visual acuity in PDR. Therefore, more research which specifically focused on the effect of PRP should be carried out to investigate more on the effectiveness of the treatment.

Keywords: Diabetes; Diabetic Mellitus; Eye; Laser Photocoagulation; Proliferative Diabetic Retinopathy; Visual Acuity

List of abbreviation
PDR: Proliferative diabetic retinopathy
PRP: Pan retinal photocoagulation
ETDRS: The early treatment diabetic retinopathy study
DM: Diabetes Mellitus
Conflict of interest
The authors declare that they have no competing interests.

1. INTRODUCTION

WHO (World Health Organisation) estimates that the global prevalence of Diabetes Mellitus (DM) will increase from 2.8% to 4.4% from the year 2000 to 2030 (Wild, Roglic et al. 2004). In the latest report, the overall prevalence of Diabetes Mellitus was 11.6% and 14.9% in those aged above 18 years of age (Letchuman, Wan Nazaimoon et al. 2010). Diabetic retinopathy is a common complication of diabetes mellitus and leading cause of blindness. From 93 million people worldwide, prevalence of proliferative diabetic retinopathy is 7% (Yau, Rogers et al. 2012). In Malaysia, the prevalence of Diabetic retinopathy among diabetics who are above 40 years with more than five years duration is higher, which is 14.6% (Addoor, Bhandary et al. 2011). It exists to some degree in nearly all individuals who have had diabetes for more than 15 years, regardless of type. (Barber 2003). Risk factors that increase the prevalence are type 1 diabetes, increased levels of HBA1c, high blood pressure, and cholesterol. (Wong, Khan et al. 2008, Yau, Rogers et al. 2012)

Photocoagulation is a standard treatment for proliferative diabetic retinopathy (PDR). It has been shown to induce regression of neovascularization and arrest of progression of diabetic retinopathy. (Dogru, Nakamura et al. 1999). Typically, 1200 to 1600 laser burns (approximately 500 µm in size) on the retina are evenly spaced or scattered throughout the retinal tissue away from the macula and retinal pigment epithelium. (Bressler, Beck et al. 2011). All proliferative diabetic retinopathy eyes will receive panretinal photocoagulation therapy. The pupils will be dilated with 2.5% phenylephrine and 1% tropicamide and argon laser light will delivered by a standard slit-lamp system (Coherent model 900 argon laser) through a one-, quadriseptic or three-mirror Goldmann-type contact lens. Each patient will receive argon-green on one eye (514 nm) laser burns, analogous to the DRS/ETDRS (Group 2004) protocol (with instruments set at a 100 to 500 um spot diameter, 250 to 750 mW power, and 0.1 to 0.2 second duration. The laser area will be extended to 20° to 50° from the fovea. Complete PRP in high-risk eyes with angiographic evidence of disc and retinal neovascularization associated with retinal capillary non-perfusion, a target of approximately 1300–1500, 500 micron-sized burns spaced between one half and 1 burn width apart, beginning just outside the vascular arcades and 3 disc diameters temporal to the macula, and extending to or just beyond the equator, are typical on the temporal side of the fundus. On the nasal
side of the fundus, burns begin about 1 disc diameter nasal to the optic disc and also extend to or just beyond the equator and it was divided into several sessions. Intensity and topography will be documented by fundus photography using a fundus camera. (Group 2004) Scatter laser photocoagulation is associated with moderate visual loss, some diminished visual field, reduced colour vision, and reduced contrast sensitivity. (Fong, Grach et al. 2007)

The importance of the present systematic review is that there may be a short-term loss of visual acuity after panretinal photocoagulation. (Bressler, Beck et al. 2011). A temporary decrease in visual acuity is frequently noted after extensive scatter photocoagulation, with recovery to the pretreatment level in most cases within several weeks. (Danis and Davis 2008).

The aim of this systematic review is to provide a comprehensive overview of the published literature pertaining to the effect of Panretinal Photocoagulation on visual acuity loss in proliferative diabetic retinopathy.

2. METHODOLOGY

2.1 Eligibility criteria

The evidence database using establishes Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) statement was used to search the effect of Panretinal Photocoagulation on visual acuity in Proliferative Diabetic Retinopathy. A descriptive study involving a literature review of randomized clinical trials involving Panretinal Photocoagulation published was conducted. Indexing terms are similar between databases. The following inclusion criteria were applied to the abstracts to identify relevant studies: Both type 1 and type 2 diabetes were eligible for inclusion if they specifically addressed visual acuity and proliferative diabetic retinopathy. Each and every abstract of the retrieved reports were read and evaluated. When there was uncertainty, the full paper was obtained to determine inclusion. Full papers were sourced for all abstracts deemed appropriate for inclusion. The full papers obtained were then read. The search terms used in the search were “Proliferative Diabetic Retinopathy”, “Pan Retinal Photocoagulation” and “Visual Acuity”. There were no date restrictions in the electronic searches for trials. The last search of the electronic databases was on the 1st August 2015. In this paper, there were case study and prospective study included. The participants were people with pre-proliferative (DR) or proliferative diabetic retinopathy (PDR). Figure 1 shows the flow diagram of the study selection.

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Fig 1. Summary of the studies
2.2 Data sources and search strategies

Articles were retrieved using seven electronic bibliographic databases of medical literature (Medline, Embase, Science Direct, Cochrane, Scopus, Web of Science and Cinahl Complete) were used by customized searches. The searches were limited to report studies on humans. The Publication Type filter was applied to exclude comments, letters, and editorial citations. In addition, the 64 additional articles identified from pilot electronic searches were hand-searched to identify articles incorrectly indexed and those awaiting indexing. The resulting abstracts were compiled in individual libraries using the software Endnote. Intra-search and inter-search duplicates were identified and removed.

2.3 Study selection

At this stage of the selection process, the emphasis is on excluding studies that clearly meet the exclusion criteria. Studies are eliminated from the endnote software if the titles and abstracts clearly disqualify them. The abstracts found in journal databases shows the statement of the problem, a description of participants, and specification of the experimental design. The screening process was performed independently and disagreements were resolved by asking co-researchers. We also excluded secondary complications of proliferative Diabetic Retinopathy such as glaucoma, tractional retinal detachment and vitreous haemorrhage, as they were beyond the scope of this review.

2.4 Assessment of Risk Bias

In this systematic review, Ferris et al., 1988 used case study as his study design and only 7 cases were included. Small sample size may have contributed to risk bias. The study is included once there is regression in visual in proliferative diabetic retinopathy after panretinal photocoagulation without any restriction on study design.

2.5 Summary measurement

This study was done qualitatively synthesised the effect of panretinal photocoagulation on visual acuity. Meta-analysis was not attempted due to exploration design of the study.

3. RESULTS

The electronic searches yielded a total of 1775 references and entered in endnote. From Medline, a total of 201 articles were found, from Science Direct a total of 855 articles were found, from Cinahl complete a total of 43 articles were found, from Cochrane a total of 2 articles were found, from Scopus a total number of 285 articles were found, from Web of Science a total number of 86 articles were found and from Embase a total of 303 articles were found. A total of 639 removed duplicate records, screened the remaining 1200 records and removed 1183 references that were not relevant to the scope of the review. We reviewed 17 full-text reports and included 2 reports of studies that were eligible for inclusion in the review. We were unable to assess 4 reports, either because the full-text copy was unavailable or because a translation was needed.

Yoon et al. (1996) selected 21 patients with untreated severe diabetic retinopathy and PRP directed according to the ETDRS protocol in this study. The inclusion criteria included were visual acuity, clear media to permit PRP and slight macular thickening and no previous photocoagulation treatment. The patients go through PRP in two settings one week apart. Photocoagulation enclosed the whole maculopathy beyond equator, and posterior to area enclosed by the temporal vascular arcades, nasal disc border and two disc diameter temporal to fovea. Green or blue-green argon laser used to treat all the eyes. Roughly, 1500-2000 burns of 100 or 200 micron spot size were placed with 1/2-l burn space apart through double aspheric lens. Before the treatment, complete ocular examination including visual acuity, intraocular pressure and fluorescein angiography were executed. All the variations in retinal sensitivity threshold values were measured from the numeric format. A paired t-test was applied to compare the results.

In Ferris et al. (1988), there were seven case studies reviewed. Each of the case study has different stages of disease and different appearance but all of them gave a certain reading on visual acuity after PRP. The time of onset and duration of visual loss in the seven patients were different. Pre-treatment visual acuity reduced to no light perception. All the patients were insulin dependent. Five of them develop diabetes before 20 years of age. However, all five of the patients experience return of visual acuity to within two Snellen lines of the pre-treatment level. Patient 1, 2 and 3 lost vision in three days or less. Patient 2 and 3 regained vision in less than two weeks. Patients 4, 5, 6 and 7 lost vision over one to four weeks and regained vision around three weeks to four months. On the whole all patients experience some degree of visual recovery within four months or less.
Table 1. Figure shows the flow diagram of the study selection

<table>
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<tr>
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<td>Ferris et al., 1988</td>
<td>Case Study</td>
<td>7 patients</td>
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4. DISCUSSION

This study provides a comprehensive overview of the published literature concerning the effect of Panretinal Photocoagulation on visual acuity in proliferative diabetic retinopathy. Diabetic retinopathy is a serious and vision threatening complication of diabetes (Aiello 2014). There are various treatment modalities for diabetes such as close monitoring of blood glucose, blood pressure, HbA1c, regular follow up, intravitreal steroid. The ETDRS and the DRS have accepted pan-retinal photocoagulation as the gold-standard for treatment of proliferative diabetic retinopathy, (Giuliari 2012)

The Diabetic Retinopathy Study has reported that eyes that received more laser burns showed a decreased risk of visual loss when compared to eyes that received less treatment. (Grunwald, Brucker et al. 1989). (Yoon, Lee et al. 1996), showed that PRP is safe when the burn area is smaller as compared to larger ones. The ideal burn produced does not depend on only the spot size but also on the power and duration of the laser. The required power for a burn depends on the clarity of the media and the pigmentation of the fundus, even though spot-size setting and duration are kept constant. (Danis and Davis 2008).

Multiple Random Control Trial, including the Diabetic Retinopathy Study and Early Treatment Diabetic Retinopathy Study, have shown that panretinal photocoagulation (Muraly, Limbad et al.) significantly reduces the risk of severe vision loss (best corrected visual acuity <5/200) from PDR by at least 50%. The adverse effects of laser can occur in three main ways. Firstly, the unintended laser absorption which is damage to cornea, pupil, lens or retina. Secondly, inadvertent coagulation will damage to central vision. Thirdly, injury to blood vessel will lead to bleeding into vitreous haemorrhage or blockage. (Googe, Brucker et al. 2011) The duration of the adverse effects may be transient (seven to 10 days) where they will experience headache and blurring of vision which may be due to raised intraocular pressure. In the medium term adverse effect which is three to six months there was only blurring of vision. Long term (permanent) effects include which are reduced vision near and distance, poor night vision, poor colour vision, reduced peripheral vision preventing driving, light sensitivity (Muraly, Limbad et al. 2011). Patients should be aware that the cornea will be numb for a few hours. While laser photocoagulation treatment is well tolerated, with relatively rare serious adverse effects, and has excellent efficacy when applied appropriately, there is still opportunity to improve upon this great success.

PRP was also studied by (McDonald and Schatz 1985) who found that the main causes of defective vision were macular edema (32%), vitreous haemorrhage (23%), tractional retinal detachment (14%), epiretinal membrane (9%), macular ischaemia (7%), cataract, and neovascular glaucoma (5%). It was recently reported by (Soman, Ganekal et al. 2012) that (2.6%) developed significant vitreous haemorrhage, but none developed tractional retinal detachment or neovascular glaucoma.

The use of anti-VEGF (vascular endothelial growth factor) were introduced by (Waisbourd, Goldstein et al. 2011). VEGF has been identified as having a major role in the pathogenesis of diabetic retinopathy (Simó and HERNandez 2009). Other treatment that may be effective to treat proliferative diabetic retinopathy is anti-VEGF. Panretinal photocoagulation remains the gold standard for treatment of proliferative diabetic retinopathy even though there is a temporary visual loss which may last for a few weeks.
5. CONCLUSION

The aim of the treatment to prevent proliferation of blood vessel without any severe visual impairment. However, PRP may cause a temporary reduction in vision in the early post laser phase. This may be seen as early as one week after PRP and can normalize by 3 months. There were two studies on the effect of PRP on visual acuity in PDR. Therefore, more studies should be done to lessen the side effects of PRP. Panretinal photocoagulation is recommended treatment for patients and therefore, it is prudent to warn patients of this potential outcome.

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REFERENCES


