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Original Research Article

Comparative effect of laser therapy and Fufang xueshuantong capsules in patients with diabetic retinopathy and ocular hemodynamic characteristics

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Abstract

Purpose: *To investigate the therapeutic effect of combined administration of laser and Fufang xueshuantong capsules in patients with diabetic retinopathy, and its influence on ocular hemodynamics.*
Methods: *A total of 193 patients with diabetic retinopathy in the Ophthalmology Department of Hebei University Affiliated Hospital from October 2020 to April 2022 were retrospectively analyzed. The patients were divided into two groups: study group (127 patients) and control group (66 patients). Control group received laser therapy in the fundus while the study group was administered 3 capsules (i.e., 1.5 g) of Fufang xueshuantong thrice daily for 7 days. Changes in the fundus and visual acuity, hemodynamic indices of the ophthalmic artery, and changes in macular edema diameter, and adverse reactions in both groups were recorded.*
Results: *In the study group, after treatment, eyeground changes were especially effective (67.37 %), effective (30.51 %), or ineffective (2.12 %). Visual acuity improved (58.90 %), (unchanged at 38.56 %), or decreased (2.54 %). In the control group, laser treatment was especially effective (42.61 %), effective (44.35 %), or ineffective (13.04 %); however, visual acuity increased (36.52 %), unchanged (47.83 %), or decreased (15.65 %). The changes were significant ($p < 0.05$). There was no significant difference in ophthalmic artery hemodynamics between the two groups before treatment ($p > 0.05$). After treatment, however, peak systolic velocity (Psv), end diastolic blood flow velocity (Edv), mean velocity (Vm), resistance index (RI), and pulsatile index (PI) in the study group were significantly different from those of the control group ($p < 0.05$); There was also no significant difference between the two groups before and 1 day after the operation ($p > 0.05$), neither was there a significant difference in adverse reactions between the two groups ($p < 0.05$).*
Conclusion: *Fufang xueshuantong capsule is effective in the treatment of diabetic retinopathy, and significantly improves ophthalmic artery hemodynamics. Further clinical trials, however, are required for the validation of the findings of this study.*

Keywords: *Laser, Fufang xueshuantong capsule, Diabetic retinopathy, Ophthalmic artery hemodynamics, Macula edema, Visual acuity*

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INTRODUCTION

Diabetes is a relatively common chronic disease in China, especially among the elderly. The disease has a long course and is prone to complications. Diabetes retinal disease (DR) can lead to vision loss and even blindness when the condition is serious [1-4]. At present, laser is widely used in clinical practice, and it is effective. However, it may impair the normal tissue function of the retina, causing damage to retinal function in the macula. Treatment options for DR include photocoagulation, surgery, and drugs. Compound *Xueshuantong* Capsule improves the retinal blood vessels in patients with diabetic retinopathy, and its therapeutic effect is up to 80 % [5-7]. This study retrospectively analyzed patients with diabetic retinopathy treated with either laser therapy or *Xueshuantong* capsule.

METHODS

General patient information

The retrospective data analysis of the data of 193 patients with diabetes retinopathy treated in Affiliated Hospital of Hebei University, Baoding, China from October 2020 to April 2022, was carried out. The 193 patients were those who met the diagnostic criteria, and were divided into two groups based on treatment method: study group (127 cases) and control group (66 cases). There were 69 males and 58 females in the study group (mean age: 46.28 ± 9.72 years old), while there were 36 males and 30 females in the control group; (mean age: 46.85 ± 10.71 years old).

The patients or their authorized carers signed the relevant consent form. The clinical data of the subjects are shown in Table 1.

Inclusion criteria

(1) Conformity to the diagnosis of diabetes retinopathy [8]; (2) Patients with concomitant macular edema.

Exclusion criteria

(1) Concomitant severe brain disease; (2) Concomitant severe organ failure; (3) Merge with other eye diseases.

Ethical approval

This study adopted a retrospective analysis method and does not involve human biomedical research or patient privacy. The Medical Research Ethics Committee of Hebei University Affiliated Hospital approved this study (approval no. IRB ZN/3.1/9.0) which complied with the guidelines of Helsinki Declaration.

Treatments

All subjects underwent dietary intervention and control of blood sugar. The control group received fundus laser therapy (Lumenis 532 Fundus Laser Treatment machine, ZEISS company, Germany). First, the subjects were anesthetized with local eye drops, and then macular grid photocoagulation as well as laser treatment were performed on the subtemporal, supratemporal, subnasal, and supranasal retina based on the quadrant. Diameter of the spot: 500 μm; exposure time: 0.1 - 0.2 s. The study group was treated with 3 capsules (i.e., 1.5 g) Fufang xueshuantong capsules, Guangdong Zhongsheng Pharmaceutical Co. Ltd, Chinese Medicine Zhunzi: Z20030017; specification: 0.5 g/capsule) administered orally 3 times a day for one week.

Evaluation of parameters/indices

Fluorescent angiography was used to measure the diameter of the macular edema in the two groups of patients at day 1, 3 months, and 6 months before and after treatment. The visual changes in the two groups of subjects were observed before and after treatment, Subjects' visual acuity, fundus fluorescein angiography and fundus examination were performed with color ultrasound instrument (Ge Vivid General Electric Company). Hemodynamic monitoring was performed with 4 -8 MHz high-frequency probes, to examine the ophthalmic artery blood flow spectrum study indicators: peak systolic blood flow velocity (Psv), end diastolic blood flow velocity (Edv), mean velocity (Vm), resistance index (RI) and pulse index (PI). Each indicator was measured three times and the mean value taken. The observed complications and adverse reactions during treatment in both groups of patients were recorded.

Judgment criteria

(1) The visual changes in the two groups of subjects were observed using the International Vision Chart. An increase in visual acuity implies that it was greater than two lines after treatment; No change refers to an increase or decrease of 1 line after treatment compared to before treatment; A decrease refers to greater than 1 line before and after treatment.

(2) Criteria for changes in the fundus of the eyes in the two groups: microvascular tumors and neovascularization mostly disappear, retinal

edema disappears, and exudation significantly decreases, indicating significant improvement; A small amount or most of retinal edema disappears in microangioma and neovascularization, and a reduction in exudate is considered effective; An increase in the number of microangiomas and neovascularization, with no improvement or aggravation of retinal edema, and an increase in exudation are considered ineffective.

Statistical analysis

The data was analyzed using SPSS21.0 software. Count data were analyzed by χ^2 tes and expressed as percentage while t-test was used for analysis of measurement data which were expressed as mean ± SD. $P < 0.05$ was considered statistically significant.

RESULTS

General information on patients

There were no significant differences in gender, age, BMI, average course of disease and DR stage between the two groups ($p > 0.05$), as shown in Table 1.

Fundus and visual acuity changes

The effective rate of fundus changes in the study group was higher than in the control group, with a significant difference (U = 8.687, $p = 0.003$); The improvement of visual acuity in the study group was significantly higher than in the control group (U=14.842, $p = 0.001$), as shown in Table 2.

Ophthalmic artery hemodynamic indices

There was no significant difference in ophthalmic artery hemodynamics between the two groups before treatment ($p > 0.05$); After treatment, the Psv, Edv, Vm, RI, and PI of the study group were significantly higher than those of the control group (t = 17.548, 12.689, 8.769, 11.567, 7.681, $p = 0.003, 0.000, 0.031, 0.045, 0.035$), as detailed in Table 3.

Changes in macular edema diameter

Table 4 shows that there was no significant difference between the two groups before and 1 day after surgery (p>0.05). The diameter of the macular edema in the study group was significantly different from the control group at 3 and 6 months after surgery (t = 9.284, 8.933, p = 0.003, 0.000).

Adverse reactions

Table 5 shows that there was no significant difference in the incidence of adverse reactions between the two groups ($p < 0.05$).

DISCUSSION

In recent years, the prevalence of diabetes worldwide has been on the increase. Elevated blood sugar may cause several co-morbidities. Diabetes retinopathy (DR) is a common disease, and it is mainly due to the proliferation of tiny blood vessels in the retina, which may cause retinal ischemia and hypoxia, resulting in decreased vision and severe blindness. In recent years, it has been demonstrated that fundus laser treatment does not only inhibits the formation of new blood vessels, it also ameliorates hypoxia condition in the retina and the vision of patients by promoting the production of angiogenesis. It may also alleviates hypoxia in the patient's retina by promoting the production of angiogenesis, thus reducing visual decline. Although the current laser treatment has a good effect on DR, it also has certain limitations, that is, it is not helpful for retinal vascular rupture and central vein occlusion [9-12].

Blood supply to the eyeballs and ocular accessory organs come mainly from the ophthalmic artery. Except for the superficial fundus surface and a small section of the fundus artery, the rest are supplied from the ophthalmic artery, while the blood vessels on the retina are gradually formed by branching from the fundus arteries. Therefore, fundus artery hemodynamic index better reflects the blood supply of the optic disc and retina. Increase in prorenin content in the plasma of DR patients is proportional to the degree of damage by DR. Therefore, the blood flow rate of DR patients is significantly reduced [13].

Optical and electronic microscopic studies have revealed that the microvascular changes in diabetes patients are characterized by the thickness of the normal vascular basic membrane which is about 80 - 250 nm, while the thickness of the vascular basic membrane in diabetes patients is about 500 - 800 nm. This type of microarterial disease is usually associated with microcirculatory abnormalities and serves as the pathological basis for various organ damage [14,15].

Table 1: General information on patients (mean ± SD)

Group	No. of eyes	Male/female (N)	Mean age (years)	BMI (kg/m^2)	Mean disease duration (years)	DR staging		
						II	III	IV
Study	236	69/58	46.28 ± 1.42	24.64 ± 2.74	7.31 ± 1.26	40	44	43
Control	115	36/30	46.85 ± 1.71	24.76 ± 2.81	7.45 ± 1.32	21	23	22
U/*t*/χ^2		11.339	9.624	8.671	9.145		13.842	
P-value		0.757	0.874	0.676	0.768		0.872	

Table 2: Comparison of fundus and visual acuity changes between the two groups {n (%)}

Group	No. of eyes	Change in fundus			Change in visual acuity		
		Especially effective	*Effective*	*Ineffective*	*Improved*	*Unchanged*	*Decreased*
Study (*n* = 236)	236	159(67.37)	72(30.51)	5(2.12)	139(58.90)	91(38.56)	6(2.54)
Control (*n* = 115)	115	49(42.61)	51(44.35)	15(13.04)	42(36.52)	55(47.83)	18(15.65)
U			8.687			14.842	
P-value			0.003			0.001	

Table 3: Comparison of ophthalmic artery hemodynamic indices between the two groups (mean ± SD)

Group	Study group (*n* = 236)		Control group (*n* = 115)		*t*	*P*-value
	Before therapy	*After treatment*	*Before therapy*	*After treatment*		
Psv(cm/s)	8.16 ± 1.34	25.64 ± 3.71	8.19 ± 2.46	19.73 ± 2.58	17.548	0.003
Vm(cm/s)	4.07 ± 0.93	15.72 ± 2.36	4.11 ± 0.96	11.24 ± 1.74	8.769	0.031
RI	0.75 ± 0.06	0.54 ± 0.04	0.76 ± 0.07	0.65 ± 0.05	11.567	0.045
PI	1.67 ± 0.13	1.21 ± 0.09	1.69 ± 0.12	1.44 ± 0.11	7.681	0.035

Table 4: Comparison of changes in the diameter of macular edema between the two groups (cm, mean ± SD)

Group	Before surgery	1 day after surgery	3 months after surgery	6 months after surgery
Study (*n*=236)	2.84±0.50	3.15±0.48	2.21±0.35	1.46±0.27
Control (*n*=115)	2.83±0.47	3.17±0.51	2.75±0.42	2.71±0.39
χ^2	14.748	11.267	9.284	8.933
P-value	0.634	0.627	0.003	0.000

Table 5: Comparison of incidence of adverse reactions between the two groups (N, %)

Group	Increased intraocular pressure	Iris burn	Vitreous hemorrhage	Total incidence
Study (*n* = 236)	3 (1.27)	2 (0.85)	1 (0.42)	6 (2.54)
Control (*n* = 115)	2 (1.74)	2 (1.74)	0 (0.00)	4 (3.48)
χ^2				14.163
P-value				0.871

Research in traditional Chinese medicine has shown that the blockage of the meridians is caused by insufficient qi and blood and poor *qi* and blood. Therefore, on the basis of traditional Chinese medicine, it is mainly about nourishing *yin* and promoting body fluid, stopping bleeding and removing blood stasis. *Fufang xueshuantong* capsule is a traditional Chinese medicine formula that is mainly composed of *Astragalus*, *Panax notoginseng* and *Salvia miltiorrhiza*. It does not only stop bleeding and remove blood stasis, it also relieves pain, invigorates Qi and reduces swelling as well as blood viscosity, and promotes blood microcirculation. It effectively relieves the clinical manifestations of diabetic patients, improves blood flow in fundus blood vessels of diabetic patients, ameliorates the fundus damage caused by microcirculation disorders, and promotes visual recovery in patients.

Retrospective analysis of the results of this study also showed that the changes in fundus and visual acuity, ophthalmic artery hemodynamics and macular edema diameter in the study group were better than those in the laser group, and there was no significant difference in the incidence of adverse reactions between the two groups; thus, the level of safety was high.

CONCLUSION

The findings of this study shows that the use of *Fufang xueshuantong* capsule in the treatment of diabetic retinopathy is more effective than laser therapy, and enhances ophthalmic artery hemodynamic index as well. It is also a safe treatment. However, further clinical trials are recommended prior to its introduction into clinical practice.

DECLARATIONS

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None provided.

Ethical approval

None provided.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of Interest

No conflict of interest associated with this work.

Contribution of Authors

The authors declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by them. Xinming Peng and Peng Chen contributed equally to this work and should be regarded as co-first authors.

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