J Anesth (1994) 8:40–43

Journal of
Anesthesia

Statistical analysis of visual prognosis following stellate ganglion block treatment on patients with retinal vessel obstruction

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Abstract: The visual outcome in 308 patients treated for retinal vessel obstruction was examined retrospectively and the effectiveness of each treatment was evaluated using stepwise multiple linear regression analysis and the chi-square test. Visual acuity was used as the parameter for assessing treatment effectiveness and the variables investigated included treatment factors [stellate ganglion block (SGB), urokinase administration, and prostaglandin administration] and patient factors (age, duration of visual impairment before treatment, hypertension, and diabetes mellitus). SGB treatment, the duration of visual impairment, and the presence of diabetes mellitus were significantly correlated with the visual prognosis following treatment. These results support the current hypothesis that SGB is a viable treatment for patients with obstructive disease of the retinal vessels.

Key words: Retinal artery obstruction, Retinal vein obstruction, Stellate ganglion block

Introduction

Stellate ganglion block (SGB) has been used for the treatment of various ophthalmic diseases for over 40 years [1]. Many authors have studied the ocular symptoms of SGB and the effectiveness of this procedure in patients with ophthalmic disease. SGB has been used in many institutions to treat retinal vessel obstruction, including central retinal artery obstruction, retinal branch artery obstruction, and central or branch retinal vein obstruction. However, few studies have made a statistical analysis of the effectiveness of SGB. In this study, we retrospectively examined the visual prognosis following SGB treatment of retinal vessel obstruction, and evaluated the outcome in a statistical manner.

Address correspondence to: A. Sakamoto
Received for publication on November 24, 1992; accepted on May 6, 1993

Patients and methods

Patients

All 308 patients with retinal artery obstruction or retinal vein obstruction treated at the National Defense Medical College Hospital during a 13-year period (1979–1992) were reviewed. Patients with ophthalmic complications such as cataracts and those with recurrent obstruction were excluded.

Treatment protocol

All patients were given treatment according to hospital protocol at the time of admission. The treatment was begun immediately after the diagnosis was established. Every patient received a complete physical examination. Complete ophthalmic examination was repeated prior to discharge from hospital and again at 3 or more months after the initial treatment. The various treatment protocols used for the patients were as follows:

1979–1981: urokinase (UK) 12 000 IU/day for 14 days
1982: UK 24 000 IU/day for 7 days
1983–1984: For retinal artery occlusion and retinal central vein obstruction, UK 250 000 IU for days 1–3, 96 000 IU for days 4–6, and 48 000 IU for days 7–9. For retinal branch vein obstruction, 48 000 IU for 7 days
1985-present: Prostaglandin E_1 (PG) 60 μg twice a day for 7 days

Gradually reduced administration of warfarin (from 21 mg) and photocoagulation were also used for retinal vein occlusion.

To perform SGB, 0.25% bupivacaine containing 40 mg of vitamin B_1 and 1 mg of vitamin B_{12} was administered once a day for 20 days. SGB treatment was assigned randomly by the attending ophthalmologists.

Evaluation of efficacy

Visual acuity was used as the parameter for evaluating treatment effectiveness [2]. In each patient, the visual acuity was measured before treatment, just after treatment, 3 months after treatment, and at the final examination 3 or more months after the initial treatment. When the visual acuity improved by at least 3 gradations, the outcome of treatment was defined as "significant improvement". When there was improvement of 1 or 2 gradations, the outcome was defined as "improvement". When acuity was unchanged, the outcome was defined "unchanged", and when it was worsened the outcome was defined as "deterioration". When the visual acuity at the first examination was ≥0.1, a change of 0.1 was considered as 1 gradation. If it was less than 0.1, then 0.03 was considered as 1 gradation. In the final analysis, "significant improvement" and "improvement" were combined as "successful outcomes", patients who were "unchanged" or showed "deterioration" were defined as "failure".

Statistical analysis

Stepwise multiple linear regression analysis was performed to determine the variables related to treatment effectiveness. The variables included in the analysis were SGB treatment, UK administration, PG administration, age (<50, 50 to <70, and ≥70 years), duration of visual impairment before treatment (<7 days, 7 days to <1 month, and ≥1 month), and the presence of hypertension or diabetes mellitus. If F was >4, the variable was considered to be significantly correlated with improvement of visual acuity. The chi-square test was also performed to compare the success rate at the final examination between presence and absence of each factor mentioned above, and $P < 0.05$ was considered to be statistically significant.

Table 1. Effect of treatment factors on the success rate at the final follow-up examination

	Successa (n) /treatment (n)	Stepwise regression (F)	Chi-square test (P)
SGB treatment	97/149	>4 (5.55)	0.01
PGE_1	88/154	<4 (0.52)	0.65
Urokinase	65/109	<4 (1.26)	0.12

SGB, stellate ganglion block; PGE, prostaglandin E
[a] Those classified as "improved" or "significantly improved" were considered successful

Table 2. Effect of various factors on the success rate at the final follow-up examination in the stellate ganglion block (SGB) treatment group

	Successa (n) /treatment (n)	Stepwise regression (F)	Chi-square test (P)
PGE_1	70/112	<4 (1.35)	0.13
Urokinase	27/37	<4 (2.35)	0.08
Age			
≤49	29/39		
50 to ≤69	50/79	<4 (0.84)	0.50
70≤	18/31		
Duration before SGB			
≤1 week	39/51		
≤ 1 month	49/79	>4 (4.53)	0.05
> 1 month	9/21		
Hypertension	33/52	<4 (0.75)	0.38
Diabetes	1/12	>4 (9.05)	0.002

PGE, prostaglandin E
[a] Those classified as "improved" or "significantly improved" were considered successful

Results

Three hundred and eight patients were included in this study. They ranged in age from 29 to 82 years (average: 59 years) and there were 146 men (47%) and 162 women (53%).

As shown in Table 1, SGB treatment was significantly correlated with the visual outcome at the final examination. In patients undergoing SGB treatment, the duration of visual impairment before treatment and the presence of diabetes mellitus had a significant effect on the final visual acuity (Table 2).

The outcome immediately after treatment, 3 months after treatment, and at the final follow-up examination is shown in Tables 3–6. Among the 19 patients with central retinal artery obstruction, 18 received SGB treatment, and no factor was related to the final visual acuity. However, use of SGB treatment, and the duration of visual impairment before SGB treatment were significantly correlated with improvement of the final visual acuity in the other groups of patients.

Discussion

The main causes of retinal artery obstruction are vasospasm, emboli, and thrombosis due to vascular disease. The usual treatment of arterial obstruction consists of thrombolysis by the administration of fibrinolytic agents, as well as increasing blood flow and achieving vasodilation by the administration of vasodilators [3]. Because the sympathetic nervous system modulates the tone of the central retinal artery [4], SGB has been considered to be a useful method of achieving cervical and retinal arterial vasodilation and increased blood

Table 3. Outcome in patients with central retinal artery obstruction

Mean age (years)	UK + SGB 59.1			PG + SGB 68.5			UK + PG 77		
Time[a]	1	2	3	1	2	3	1	2	3
n	8	8	8	10	9	8	1	1	1
Sig. improv.	1	1	1	4	3	3	0	0	0
Improvement	5	4	4	3	2	2	1	0	0
Unchange	2	3	2	1	3	2	0	1	1
Deteriolation	0	0	1	2	1	1	0	0	0
Success rate	75%	63%	63%	70%	56%	63%	100%	0%	0%

SGB, stellate ganglion block; UK, urokinase; PG, prostaglandin E_1; sig. improv., significant improvement; time, time of assessment
[a] Time of assessment: 1, just after treatment; 2, three months after treatmen; 3, at the final examination

Table 4. Outcome in patients with retinal branch artery obstruction

Mean age (years)	UK + SGB 74			UK 64			PG + SGB 57.8			PG 59		
Time[a]	1	2	3	1	2	3	1	2	3	1	2	3
n	2	2	2	1	1	1	12	10	9	1	1	1
Sig. improv.	1	1	1	0	0	0	3	2	3	0	0	0
Improvement	0	0	0	0	1	1	3	2	2	1	0	0
Unchange	0	0	0	1	0	0	4	4	4	0	1	1
Deteriolation	1	1	1	0	0	0	2	2	0	0	0	0
Success rate	50%	50%	50%	0%	100%	100%	50%	40%	56%	100%	0%	0%

SGB, stellate ganglion block; UK, urokinase; PG, prostaglandin E_1; sig. improv., significant improvement; time, time of assessment
[a] Time of assessment: 1, just after treatment; 2, three months after treatment; 3, at the final examination

Table 5. Outcome in patients with central retinal vein obstruction

Mean age (years)	UK + SGB 51.9			UK 54.3			PG + SGB 60.0			PG 52.1		
Time[a]	1	2	3	1	2	3	1	2	3	1	2	3
n	14	12	12	12	12	12	18	18	17	15	14	9
Sig. improv.	2	1	1	3	3	5	3	3	4	3	4	2
Improvement	4	3	8	0	5	4	5	6	6	2	4	1
Unchange	5	6	1	6	2	2	5	4	4	4	3	5
Deterioration	3	2	2	3	2	1	5	5	3	6	3	1
Success rate	43%	33%	75%	25%	67%	75%	44%	50%	59%	33%	57%	33%

SGB, stellate ganglion block; UK, urokinase; PG, prostaglandin E_1; sig. improv., significant improvement; time, time of assessment
[a] Time of assessment: 1, just after treatment; 2, three month after treatment; 3, at the final examination

Table 6. Outcome in patients with retinal branch vein obstruction

Mean age (years)	UK + SGB 54.5			UK 58.6			PG + SGB 59.3			PG 56.1		
Time[a]	1	2	3	1	2	3	1	2	3	1	2	3
n	18	16	15	60	50	57	92	87	78	42	39	31
Sig. improv.	6	8	8	5	13	22	16	26	31	4	8	7
Improvement	3	3	4	17	13	17	21	21	19	14	14	8
Unchange	6	2	1	26	13	10	29	22	13	10	7	7
Deteriolation	3	3	2	10	11	8	26	18	15	14	10	9
Success rate	50%	69%	80%	37%	52%	65%	40%	54%	65%	43%	56%	48%

SGB, stellate ganglion block; UK, urokinase; PG, prostaglandin E_1; sig. improv., significant improvement; time, time of assessment
[a] Time of assessment: 1, just after treatment; 2, three months after treatment; 3, at the final examination

flow to the affected eye. Many studies have shown that SGB decreases the intraocular pressure and causes the dilation of spastic arterioles with an increase in the retinal blood flow, while having no effect on nonspastic arterioles [5,6] Matsuura et al. [7] also mentioned that SGB increased retinal blood flow and promoted autoregulation of blood flow at a lower perfusion pressure. They considered that these effects mainly resulted from elevation of the relative perfusion pressure of the ophthalmic artery.

The main causes of retinal vein obstruction are local thrombus formation and the influx of emboli. Since retinal vein obstruction often occurs at anatomically similar sites to arterial obstruction, it has also been proposed that such obstruction arises on the basis of circulatory insufficiency and slow blood flow in the retinal arteries [8]. Accordingly, SGB has also been considered to be useful for the treatment of retinal vein obstruction.

Although retinal artery and vein obstruction have separate pathogenic factors, both show marked similarity in the course of the disease and its consequences. Atherosclerotic change is the major causative factor of ophthalmic artery occlusion as well as occlusion of the major retinal arteries [9]. In this study, the presence of diabetes mellitus, one of the risk factors for atherosclerosis, reduced the final visual acuity after treatment and lessened the effectivenss of SGB.

Although there are numerous reports about the visual prognosis following treatment of retinal vessel obstruction [10,11], only a few authors have studied SGB and none of them assessed its effectiveness in a statistical manner. As shown in Tables 3–6, many patients, especially patients with retinal branch vein obstruction, did not show rapid improvement of visual acuity, while the subjective symptoms of almost all the patients who received SGB treatment improved. However, this study demonstrated that SGB treatment and the duration of visual impairment were the only variables that had a significant effect on the final visual acuity, while the effects of urokinase or PGE_1 administration showed no significant effect.

We are aware that this study has the following weaknesses. First, the selection of treatment was not random. Although SGB treatment was assigned randomly by the attending ophthalmologists, drug administration was performed according to a set protocol. Accordingly, we used multivariate analysis for statistical comparisons. Secondly, administration of warfarin and photocoagulation were used for almost all the patients with retinal vein obstruction, so we could not evaluate those treatments and their interactions with the other forms of treatment. Third, we evaluated the treatment outcome only on the basis of visual acuity. Although visual fields should also have been evaluated, this was difficult to do objectively and quantitatively, and further studies are necessary to resolve this issue.

In conclusion, SGB treatment for retinal vessel obstruction significantly improved the final visual acuity, and the duration of visual impairment before SGB treatment had a significant effect on the final outcome. These results suggest that SGB is a viable treatment for patients with retinal vessel obstruction.

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