

Analysis of Experimental and Clinical Research of Destruction of Peripheral Branches of the Trigeminal Nerve

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SUMMARY

The clinical investigation was preceded to 468 patients, suffering from trigeminal nerve (TN) neuralgia. The destruction of affected TN peripheral branches has been performed to them using experimental methods having the biggest effect and with little harm on cardiovascular system. During the procedure the activity of cardiovascular system was registered as well as duration of remission of neuralgia was calculated. Following repetitive destructions that had no effect, the peripheral branches of TN have been resected followed by pathological investigation. During acute period of disease, in the resected peripheral branches of TN all the nerve fibers were vacuolized or destroyed in fragments of various sizes. Part of them was resorbed and mieline sheet was destroyed. Following each destruction, the number of neural fibers decreases in the nerve trunks. In the TN branches following multiple alcoholizations the reduction of the nerve trunks was observed. In these cases nerve trunks looked empty and only solitaire nerve fibers were found. Also, following multiple alcoholizations of TN branches we observed formation of neuromas.

Key words: trigeminal nerve, nerve fibres, destruction.

INTRODUCTION

For a long time the most popular treatment method of trigeminal nerve neuralgia has been alcoholization of peripheral nerve branches. Studies of most researchers indicate good results of the treatment with alcoholization (O. N. Sternberg, 1961; A. A. Kibec, 1965; J. Klammt, 1966).

However, some authors state that alcoholization has a short-term effect only (O. N. Savickaya, 1976; N. K. Karimchodzhayev, 1979). Besides, alcoholization causes morphological changes in the nerves, because of which efficiency after repetitive alcoholizations reduces. Therefore, probably there have recently been fewer publications about the treatment of trigeminal nerve neuralgia applying destructive methods.

However, some authors still propagate destructive methods of treatment of trigeminal nerve neuralgia as less traumatic and possible to be applied to older people (J. B. Epstein, J. N. Marcoe, 1994; A. B. Oturai and other, 1996; M. Elias, 1997; J. M. Taka, J. M. Tew, 1997; N. A. Wilkinson, 1999).

Injecting alcohol into the nerve is very painful. Pain has a negative influence on all organs, including cardiovascular system. Trigeminal nerve neuralgia commonly is a disease of older age people the majority

of which have some kind of ailments of the function of the cardiovascular system. Therefore, alcoholization may be contraindicated for them. Some clinics wishing to relief the pain use 80° of ethyl alcohol diluted with 2% of Novocain solution for alcoholization, but there is no big effect. The pain is less if before the alcoholization the nerve is blocked with local anesthetics, but some authors (O. A. Sternberg, 1961; A. A. Kibec, 1968) however think that local anesthetic mixes with alcohol, dilutes it and weakens a destructive effect.

The aim of our study was to find a destruction method of peripheral branches of the trigeminal nerve, which would least affect the cardiovascular system and would be an effective method of trigeminal nerve neuralgia treatment.

MATERIAL AND METHODS

The study consists of the parts of experimental and clinical investigations. We experimented on dogs. We injected the following solutions into peripheral branches of their trigeminal nerves: 80° ethyl alcohol with 2 per cents of Novocain solution without any previous nerve blocking and 86° and 96° ethyl alcohol and boiling physiological solution after the blocking the nerve with 4% of Novocain solution. Before the experiment and during the injecting of those solutions we measured systolic blood pressure, calculated the frequency of heart systoles, and registered an electrical cardiogram. We examined pathohistologically the peripheral branches of the trigeminal nerve of one

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group consisted of 5 dogs in 4 - 6 days after the injection, while others (5 dogs) - in 14 - 18 days. We colored the histological preparations by the methods of Bilshovskiy – Gros, and Marki and with hematoxylin – and – eosin.

Clinical examinations were done on 468 patients having trigeminal nerve neuralgia. According to the methods during the experimentation defined as the most effective and having the least influence on the function of the cardiovascular system they had the destruction of peripheral branches of the trigeminal nerve because suffered neuralgia. During the procedure the function of the cardiovascular system was registered, the duration of neuralgia remission was calculated. After the repetitive destructions with no effect the branches of the trigeminal nerve were resected and examined pathohistologically.

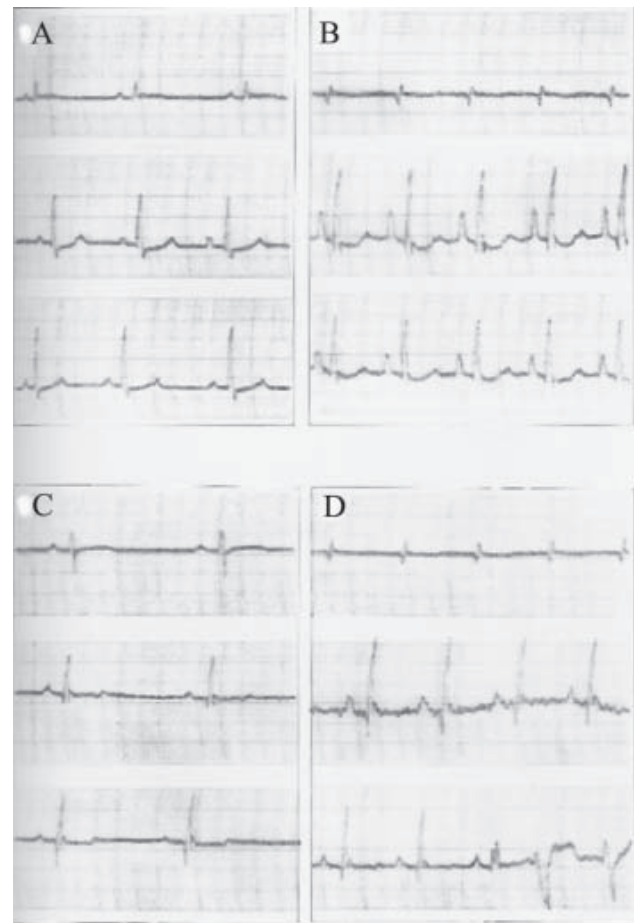
RESULTS AND DISCUSSION

The results of the experimental research showed that performing the destruction of branches of the trigeminal nerve when the nerve had not been blocked with Novocain the systolic pressure increased very much, the heart contracted more frequently, its ischemia occurred, arrhythmia and extrasystolia sometimes developed (table 1, picture 1). The heart activity and blood pressure change very little, because before nerve destruction it was blocked with 0,2 – 0,3 ml of Novocain solution. Nerve fibers in histological preparations for peripheral branches of the trigeminal nerve produced 4 to 6 days after the destruction according to all methods, are decomposed into fragments and flakes, fragments of some fibers are resorbed (picture 2), while in 14 to 18 days after the experiment nerve fibers of almost all nerve stems were resorbed (picture 3). However, when 96° alcohol is injected necrosis of surrounding tissues develops.

Basing on the information of the experiment research we did not use 96° alcohol for the destruction of peripheral branches of the trigeminal nerve of patients.

The data of the clinical research are analogous to the data of the experiment. The information about changes of patients' heart function and blood pressure performing the destruction of peripheral branches of the trigeminal nerve with 2% of Novocain solution in 80° ethyl alcohol and 86° ethyl alcohol and boiling physiological solution before 0,2-0,3 ml 4% of Novocain solution was injected into the nerve is delivered in Table. The data delivered in the table show that performing the destruction besides anesthesia done previously the pulse increases significantly and the blood pressure increases, too.

In picture 4 there are shown patients' electrical cardiograms recorded



Picture 1. Electrical cardiograms of the dogs before alcoholization (A, B) and during the alcoholization of peripheral branches of the trigeminal nerve without an advanced anesthesia with Novocain (C, D).

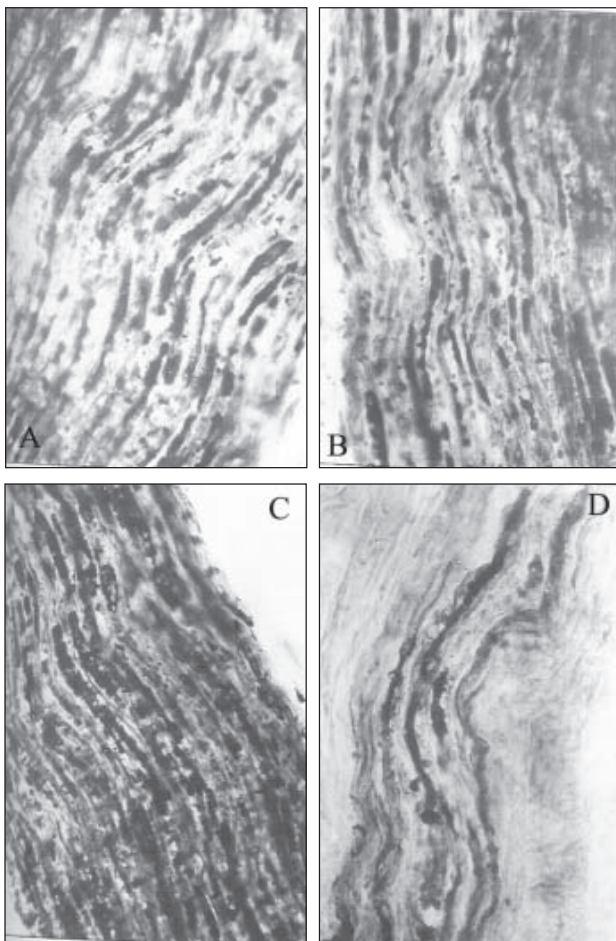
during the performance of the destruction of branches of the trigeminal nerve. The research of the efficiency of treatment of trigeminal nerve neuralgia with destructive methods showed that the first three procedures were effective almost for all patients (Table 3).

Table 1. Changes of the function of dogs' hearts performing a destruction of peripheral branches of the trigeminal nerve.

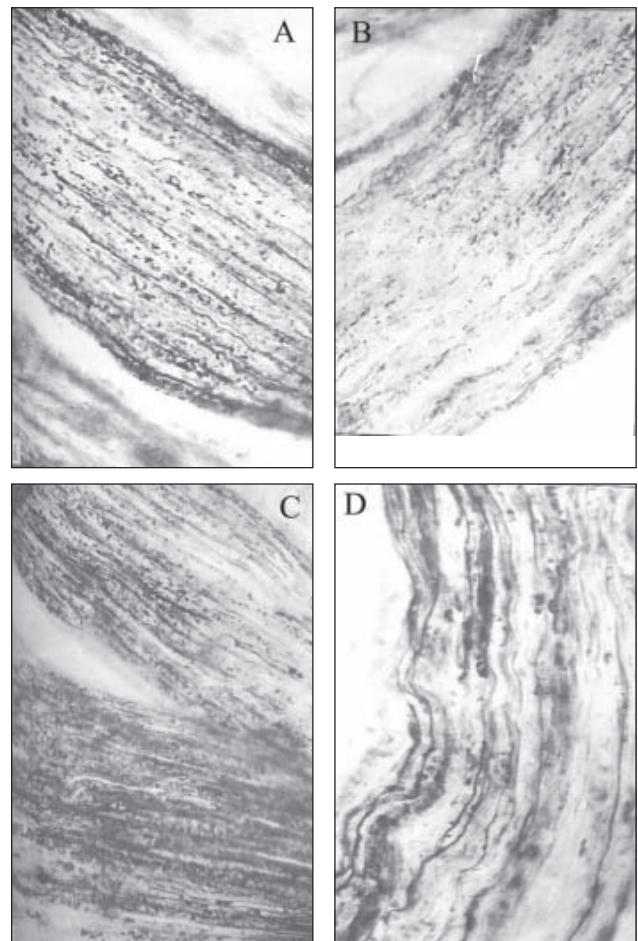
Solution injected	Increased heart rate, t/min	Growth of systolic blood pressure mmHg
2% Novocain solution in 80° ethyl alcohol	84,9-19,9	54,0-15,6
4% Novocain	39,2-19,2	19,0-11,6
86° ethyl alcohol	17,0-8,6	10,0-5,3
96° ethyl alcohol	19,0-7,6	12,0-6,3
Boiling physiological solution	14,0-3,6	9,0-1,8

Table 2. Results of the examination of the function of patients' cardiovascular system performing a destruction of peripheral branches of the trigeminal nerve.

Solution injected	Increased heart rate, t/min	Growth of systolic blood pressure mmHg	Growth of diastolic blood pressure mmHg
2% Novocain solution in 80° ethyl alcohol	72,6±11,7	60,6±8,3	23,5±5,4
86° ethyl alcohol	16,7±5,4	12,4±3,8	9,7±3,6
Boiling physiological solution	14,2± 7,8	9,5±4,9	4,8±1,1



Picture 2. The nerve apparatus of the peripheral branch of the trigeminal nerve and blood - vessels in the end of the first week after the destruction with 80° ethyl alcohol without anesthesia (A, B), with 86° ethyl alcohol (B,D) and boiling physiological solution with anesthesia (C). Method: Bilshovskiy - Gros. Magnification: A, B, C - 20x7,5; D - 20x7,5x2,0.



Picture 3. Peripheral branches of dogs' trigeminal nerve after 14 - 18 days after the destruction with 86° ethyl alcohol (A), 96° ethyl alcohol (B), boiling physiological solution (C) and 80° ethyl alcohol (D) after anesthesia with Novocain; A,B,C - in nerve stems instead of resorbed fibers there was argentofilling dust or fine remains of fragments, D - a part of nerve fibers is not changed. Method: Bilshovskiy-Gros. Magnified: A, B, C - 20x7,5x1,8; D - 20x7,5.

Table 3. Results of the treatment of trigeminal nerve neuralgia with destructive methods.

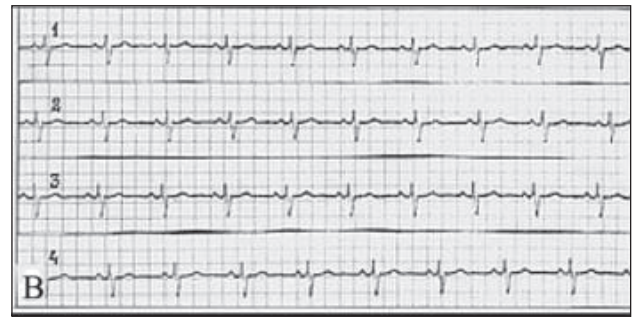
Item of destruction	2% Novocain solution in 80° ethyl alcohol				86° ethyl alcohol				Boiling physiological solution			
	Number of patients	average duration of remission (months)	Number of patients without any treatment effect		average duration of remission (months)	Number of patients without any treatment effect		Number of patients	average duration of remission (months)	Number of patients without any treatment effect		
			n	%		n	%			n	%	
1	432	12,4±4,3	-	-	19	11,2±5,6	-	-	17	13,7±6,4	-	-
2	391	13,1±6,5	6	1,5	18	10,8±4,7	-	-	17	11,4±4,6	-	-
3	307	9,2±5,9	4	1,3	18	8,4±4,9	1	5,5	16	7,3±3,2	2	13,3
4	223	7,3±4,8	36	16,1	15	6,1±3,8	4	26,7	11	-	2	18,2
5	175	6,6±3,7	46	26,3	10	-	3	30,0	-	-	-	-
6	121	5,8±3,6	42	37,7	-	-	-	-	-	-	-	-
7	74	5,4±3,7	27	36,5	-	-	-	-	-	-	-	-
8	41	3,9±2,9	19	46,3	-	-	-	-	-	-	-	-
9	22	3,2±2,6	10	45,4	-	-	-	-	-	-	-	-
10	12	-	7	58,3	-	-	-	-	-	-	-	-

After every subsequent procedure the duration of disease remission shortens and the quantity of the patients for whom the destruction is not effective increases.

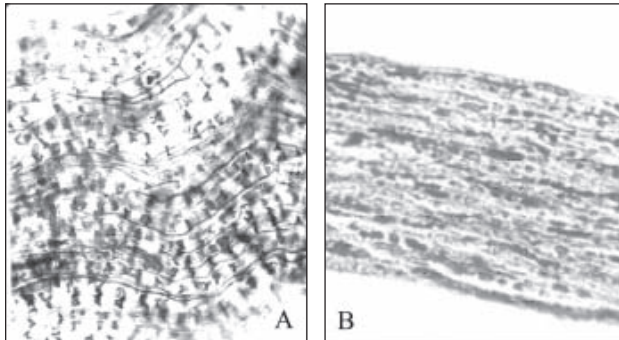
Performing repetitive nerve destructions, the clinical picture of recurrences changes. After the recurrence develops following 2 – 3 destructions pain

attacks are more frequent, and pain is stronger. In the cases of recurrences after a bigger quantity of destructions within inter – periods of attacks patients felt dull and strong pain or unpleasant feelings – nubs, ‘running of ants’.

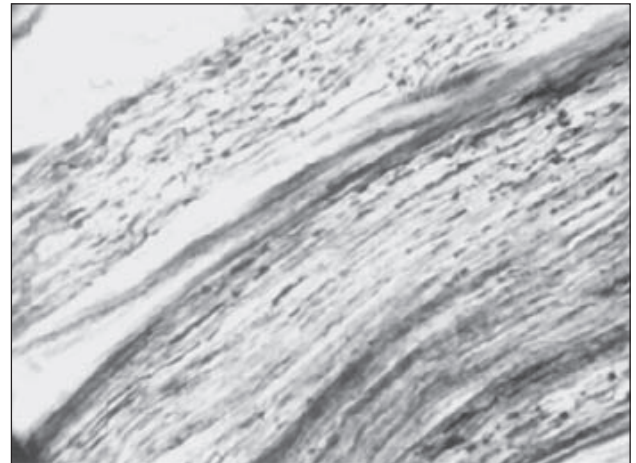
In the opinion of M. N. Puzin (1997) in the cases of recidives after repetitive nerve destructions the clinic



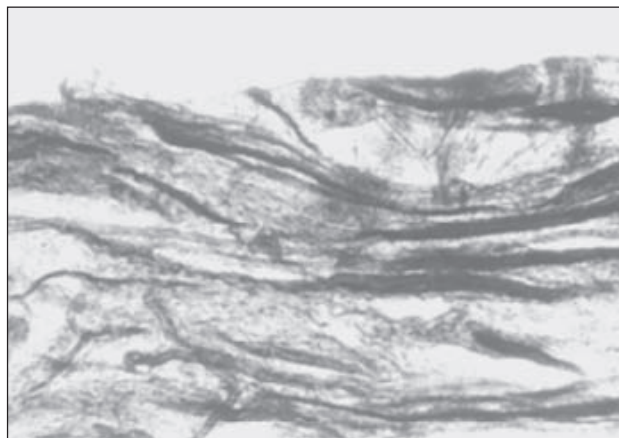
Picture 4. Electrical cardiograms of the patients who had the destruction of peripheral branches of the trigeminal nerve with 80° alcohol without anesthesia (A) and with boiling physiological solution after anesthesia with Novocain (B): 1 – before the destruction; 2 – in the beginning of the procedure; 3 – in the middle of the procedure; 4 – after 15 minutes after the procedure.



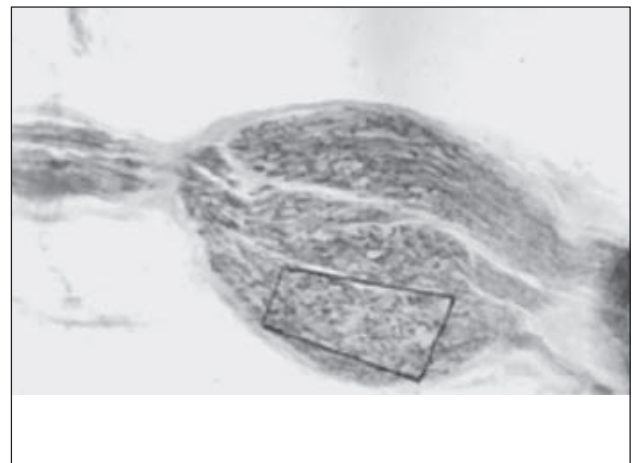
Picture 5. A – microphoto of the trigeminal nerve peripheral branch of the patient with neuropathia at the hasty recidive stage after the alcoholization. Nerve fibers are destroyed. B – myelin covering destroyed. Methods: A - Bilshovskiy-Gros; B - Marki. Magnified: A - 195 times, B - 105 times.



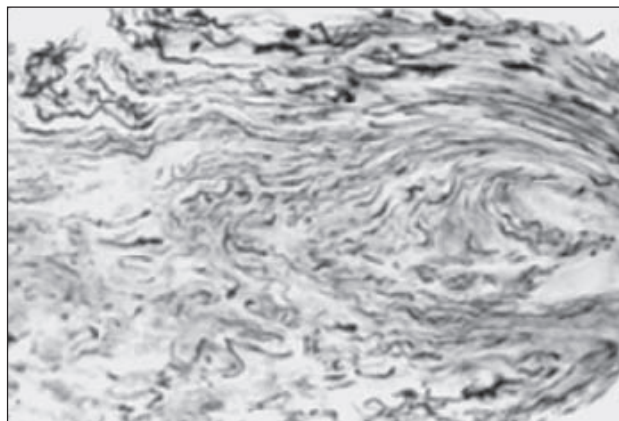
Picture 6. Microphoto of the trigeminal nerve peripheral branches of the patient with neuropathia at the post-hasty recidive stage after the alcoholization. Pathological regeneration of nerve fibers. Method: Bilshovskiy-Gros. Magnified 135 times.



Picture 7. Microphoto of the trigeminal nerve peripheral branch of the patient with neuropathia after repetitive alcoholization. Reduction of nerve fibers. Method Bilshovskiy-Gros. Magnified - 40 times.



Picture 8. Post – destructive neuroma of the trigeminal nerve peripheral branch of the patient with neuropathia. Colored by the method of Bilshovskiy-Gros. Magnified 75 times.



Picture 9. Fragments from picture 8. Magnified 420 times.

of disease can be caused by qualitative changes in the trigeminal nerve system. This hypothesis of the author is confirmed by the data of our morphological researches.

Within the peripheral branches of the trigeminal nerve were resected because of the recidive after the treatment with destructive methods during the acute period of the disease all nerve fibers were vacuolized or decomposed into fragments of various sizes, flakes, a part of them resorbed each other, the myelin cover of fibers was also destroyed (picture 5).

However, a part of nerve fibers do not regenerate. After each destruction the number of nerve fibers within nerve stems decreases. The reduction of nerve stems within the branches of the trigeminal nerve is noticed after repeated alcoholizations. In these cases nerve stems look like empty, individual nerve fibers can be seen there (picture 6 and picture 7).

Besides, after repeated alcoholizations of nerve branches neuromas form there.

We found postdestructive neuromas (we called them so) during operation of the patients who had a lot of alcoholization procedures of the branches of the trigeminal nerve because they suffered of neuralgia. In the alcoholization place, i.e. in the nerve branch, there was a round or oval hard knot. Its histological examination (picture 8 and picture 9) showed that it essentially consisted of narrow non-myelin fibers. Most of them are very sinuous, ending with hooks and loops of various shapes and sizes, or a nub of a round shape or a bobbin. The elements mentioned above are located within the knot disorderly and look like thin switches (thin tree branches), put disorderly into the pile. At the proximal end and the distal one of the nerve

we observed destructive changes of nerve fibers. We established that after the resection of peripheral branches of the trigeminal nerve affected earlier by destruction neuralgia recurred 6 times more often and the remission of the disease was 1,5 time shorter than after the resection of the branches not affected by destruction.

In summarizing the results of the researches the following conclusions can be made.

CONCLUSIONS

1. The function of cardiovascular system is disturbed the least when performing the destruction of peripheral branches of the trigeminal nerve with 86° ethyl alcohol or hot physiological solution when the nerve branch is blocked with local anesthetic or with the mixture of 2% of Novocain and 80° ethyl alcohol;

2. After the first two destructions of the nerve branches neuralgia attacks of almost all patients do not repeat for certain time duration. Every another destruction is effective for smaller number of patients, and the remission of the disease becomes shorter;

3. After each destruction the nerve is more affected by dystrophy. Therefore, the destruction of trigeminal nerve branches induces the progression of neuralgia, the phase of the disease starts earlier, when the conservative treatment becomes ineffective at all, and efficiency of the resection of nerve branches reduces;

The destructive methods for treatment of trigeminal nerve neuralgia should be used as rarely as possible and only according to the indications: when medical treatment is ineffective and surgical treatment is contraindicated.

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