Journal of Life Science 2007 Vol. 17. No. 11. 1472~1476 ©JLS / ISSN 1225-9918

The Influence of Cranial Cervical Ganglion Block in Beagle Dogs with Normal Intraocular Pressure

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Received October 18, 2007 / Accepted November 5, 2007

This study was performed to observe changes of the intraocular pressure following cranial cervical ganglion block with the four different concentrations of lidocaine in beagle dogs with the normal intraocular pressure. We performed by the crossover test in ten beagle dogs divided into four groups, which were 2%, 1%, 0.5% and 0.25% lidocaine group. All experimental dogs received each four times cranial cervical ganglion block using 2 ml of lidocaine with the four different concentrations. The blocks were separately done at a week intervals in random order. Horner's syndrome was observed in all groups. The intraocular pressure in the blocked side was significantly increased to 5 min in the 1% lidocaine group compared to the baseline ($p<0.05$). The intraocular pressure of 2% and 1% lidocaine groups were decreased between 25 and 45 min following cranial cervical ganglion block, while those of 0.5% and 0.25% lidocaine groups were unchanged. In conclusion, these results suggest that cranial cervical ganglion block affect on the change of intraocular pressure and 0.5% and 0.25% lidocaine are inadequate concentrations for the change of intraocular pressure in the dog with normal intraocular pressure.

Key words : Eye, Horner's syndrome, nerve block, sympathetic nervous system

Introduction

The sympathetic ganglion block was known to be used for sympathetic diseases however, recently, it is proved to be effective in more than 100 whole body diseases including the pain treatment, the blood circulation, immune system, endocrine system and psychosomatic disease [13,17]. Especially, the effort of curing glaucoma by the sympathetic ganglion block has been processing for a long time and is recently more activated [14].

The cranial cervical ganglion block for dog is the technique which block the cranial cervical ganglion positioned on the first cervical vertebra with the lidocane in order to compensate the problem that the stellate ganglion block has, which is that its operation is difficult to repeatedly and painful.

There is a report about cranial cervical ganglion block used for rabbits [5] and white mice [8], but reports about intraocular pressure, especially about dog's since the cranial cervical ganglion block is recently developed for dogs, are very scarce. Moreover, the report about the effects that the concentration of lidocaine and the blocking time give to the intraocular pressure is scarce too.

This experiment was processed in order to give effective cure for the dog's glaucoma by using the various concentration of lidocaine and observing the intraocular pressure change.

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Materials and Methods

Experimental animals and its Breeding

The animals that were used for this experiment were 10 Beagles (5 male and 5 female) which are 2~5 years (3.7±1.3) old and weigh 9.9~13.4 kg (10.5±2.1). All the dogs were selected after having physical examination, chest and abdomen radiation examination and basis eye inspection and was adapted to the experimental environment for a week, then was put in to the experiment after fasting the food for 12 hr. The breeding and supervising was processed under the regulation of NIH guideline for experimental animal care and breeding and the dogs were raised in different cages one by one which was kept isolated from the sound and the day and night was provided equally. The dog's food was the feed for adult dogs

(Line-up®, S.C.F Co, Korea) and was limited to the 2% of its weight once in a day but the water was freely taken.

The composition of experimental subjects

The experimental subjects were divided into four groups which were differentiated by the concentration of lidocaine injected by crossover test (2%, 1%, 0.5% and 0.25% lidocaine group, n=10). Nerve blocking was executed in terms of a week and the intraocular pressure before injection was used as a control group.

The procedure of cranial cervical ganglion block and its index to sucess

The procedure of cranial cervical ganglion block is to have the first cervical vertebral's upper part as the landmark and executed by the Wakusugi technique [17] and the lidocaine was used as a method of nerve block. Lidocaine (2% lidocaine *HCl*®, Daihan Pharm Co, Korea) was diluted with the distilled water (Daihan distilled water®, Daihan Pharm Co, Korea) by the 3 ml injection (Hwajin medical, Korea) which had 25 gauge needle (length: 2 cm) and was given 2 ml each to the subject by different concentration of 2%, 1%, 0.5% and 0.25%. The cranial cervical ganglion block was regarded as success when the miosis, ptosis, enophthalmos and prolapse of third eyelid were found having the Horner's syndrome as a index (Fig. 1).

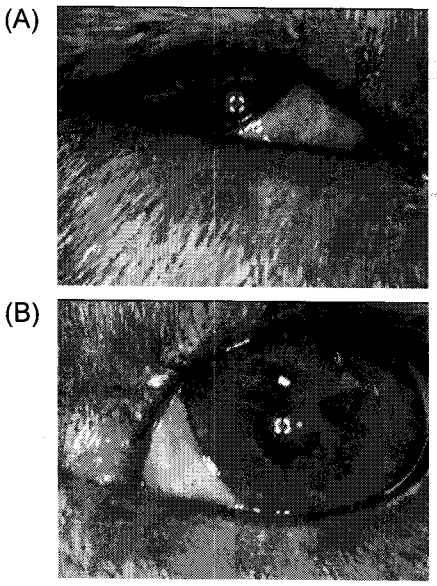

Fig. 1. The eye in the blocked side (A) showing miosis, nictitating membrane prolapse and ptosis after cranial cervical ganglion block comparing to the normal eye (B).

The method of measuring intraocular pressure

The intraocular pressure was measured while the dog was sitting with its head paralled to the ground. It was measured 5 times while centering the cornea and the intraocular which was measured before blocking was compared with the each intraocular pressure blocked for 5, 15, 25, 35, 45, 60, 75 and 90 min.

Tonovet® tonometer (TV01, measurement accuracy; 2% (5-30 mmHg), 10% (30-80 mmHg), Finland) was used to measure intraocular pressure.

Statistical analysis

The result of this research was indicated as mean±S.D. and the statistical analysis was analysed by SPSS for windows 12.0k (SPSS korea, Korea). The change of intraocular pressure before and after blocking was analysed by Wilcoxon signed-rank test and the differences of each subjects' intraocular pressure were regarded statistically significant difference when it was $p<0.05$.

Results

The result of the change before and after the intraocular pressure by different concentration was as Fig. 2 indicates. The intraocular pressure of the 2% lidocaine group before blocking was 15.7±3.2 mmHg but increased to 16.8±5.3 mmHg after 5 min. After blocking, it decreased from 15

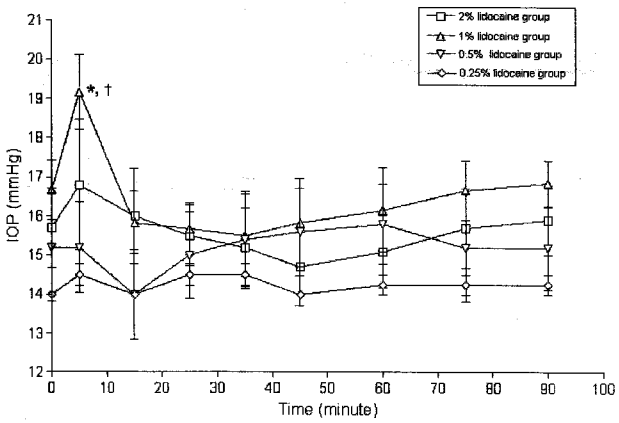

Fig. 2. Changes of intraocular pressure after cranial cervical ganglion block using the lidocaine with the four different concentrations in beagle dogs with normal IOP. 1) Statistical significances were tested by Kruskal-Wallis test and by Wilcoxon signed-rank test 2) IOP: intraocular pressure 3) *: $p<0.05$ compared to 2%, 0.5% and 0.25% lidocaine group, † : $p<0.05$ compared to the control value.

min to 45 min and then increased. The mean intraocular pressure of each time periods' weren't statistically significant difference but it increased 1.1±2.1 mmHg after 5 min and decreased 1.0±0.1 mmHg in 45 min.

The 1% lidocaine group's mean intraocular pressure before blocking was 16.7±1.9 mmHg and increased after 5 min to 19.2±2.3 mmHg. It decreased after 15 min to 45 min and showed similar rate of intraocular pressure after blocking 60 min. The statistical significant difference of 1% lidocaine group's intraocular pressure according to each time period showed significantly increase after 5 min and though there wasn't any statistical significant difference, the intraocular pressure decreased 1.2±0.7 mmHg after 35 min ($p<0.05$).

The 0.5% lidocaine group's mean intraocular pressure before blocking was 15.2±3.1 mmHg and decreased after 15 min to 14.0±2.6 mmHg. There was no statistical significant difference for each time period, but the intraocular pressure decreased to 1.2±0.5 mmHg after 15 min.

The 0.25% lidocaine group didn't show any changes so the statistical significant difference also wasn't found.

The statistical significant difference of the intraocular pressure according to each time period among groups, showed significant increasement in 1% lidocaine group compared to the other groups after 5 min but other time periods didn't show any significant differences ($p<0.05$, Fig. 2).

Discussion

The research of the changes of intraocular pressure after the sympathetic ganglion block was first reported by Jonnesco [7] in 1899 which was about the treatment of glaucoma by blocking the stellate ganglion and Linkz [10] reported that the intraocular pressure was fixed regularly after cervical sympathetic nerve surgical removal. Also, the Miller [12] in 1953 and Endo [3] in 1966, reported that they got the good result of for the glaucoma patients by stellate ganglion block by using lidocaine.

The factors that directly effects intraocular pressure are the mean pressure of body circulation blood pressure, retinal blood pressure [2], choroid blood pressure and vein pressure as well as the blood pressure inside eye, resistance of aqueous outflow, blood osmotic pressure, blood PH and drug. The intraocular pressure change by this factors is the secondary change according to the autonomic nervous system, which occurs for various reasons and the main reasons are the change of the amount of blood influx and reduction of resistance of aqueous outflow [14].

The effects that the cervical sympathetic ganglion block has toward the intraocular pressure was well reported through animal experiment [4,6,15] and it is reported that the cervical sympathetic ganglion block increase the intraocular blood pressure [9,10].

There are various reports of explaining the cause of increasement in the intraocular blood pressure and Bill [1] report that the cervical nerve stimulation increases the resistance of blood vessel which causes the reduction of blood flow rate and Machura and Mitaku [11] report that cervical sympathetic ganglion block increases the blood pressure at first and then reduces the resistance of the blood vessel which is the reason of the increasement of the blood flow rate in eye.

At 5 min after the cranial cervical ganglion block, the increase of intraocular pressure was found in 2% and 1% lidocaine group. This was the cause of increasement in aqueous outflow according to the extended volume of capillary in eye as well as the outflow vein's dissonance of adaption [8,14]. Moreover, the 1% lidocaine group showed similar increasement of the intraocular pressure than other lidocaine groups which indicates the tendency of relying on concentration except the 2% lidocaine group. Regarding the groups which intraocular pressure was set higher than the 2% lidocaine group need to be measured within 5 min since the high concentration lidocaine and differences of blood pressure can cause the faster action. Also it seemed that the effect that the low concentration lidocaine group was scarce, since the reduction of intraocular pressure after blocking didn't develop in 0.5% and 0.25% lidocaine group.

The decrease of the intraocular pressure can be first occurred by the reduced pressure of the efflux vein and then later, by the precess of aqueous outflow accelerated by the temporarily increased intraocular pressure after blocking. It also seemed that the factors that change the intraocular pressure after the cranial cervical ganglion block seemed to be the result of the increasement of aqueous fluid, due to the reduced amount of aqueous fluid and extended volume of capillary and reduction of resistance in the efflux vein as well as the acceleration of aqueous outflow due to the temporarily increased intraocular pressure[18], when estimating by the decrease of intraocular pressure by episclera vein pressure's reduction caused by the efflux vein's

extension [16].

Song and Suh [15] reported that the affect existing time after blocking the nerve, is in proportion with the concentration, but the affect that the concentration gives to the intraocular pressure showed difference in proportion with the concentration. However, the 0.25% lidocaine had scarce effects on the intraocular pressure that it was regarded inadequate to treat glaucoma and in case of 0.5% lidocaine, it had effects but works for too short time that was regarded as inadequate.

1% lidocaine was usually used for the cervical sympathetic block and Song and Suh [15] suggested 0.5% as the minimal concentration of sympathetic block, and suggested that 0.25% lidocaine isn't appropriate. Its result accords with this experiment and it is considered that the 0.5% and 0.25% lidocaine will be difficult to be used since it showed low blocking rate.

Usage of the low concentration lidocaine for sympathetic ganglion block was considered too much low to act, however, on the contrary, the usage of high concentration lidocaine had long duration but often had side effects. Therefore, 1% lidocaine is most recommended for the reducing intraocular pressure while minimizing the side effects.

Moreover, the cranial cervical ganglion block is considered to have the affect in reducing the intraocular pressure by giving influences, and the appropriate concentration of lidocaine was found. However, even though the cranial cervical ganglion block worked or the normal eyed dogs, it can not be certain that it would also work for the dogs with abnormal intraocular pressured eyes. Also the lidocaine used to block the nerve has different existing time and affect according to its concentration that the need of experiment by using other lidocaine was brought up.

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초록 : 비글견에서 앞쪽목신경절 차단술이 정상 안압에 미치는 영향

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본 연구는 정상적인 안압을 가진 비글견에서 4 가지의 다른 농도를 가진 lidocaine을 사용하여 앞쪽목신경절 차단 후 안압의 변화를 관찰하기 위하여 시행하였다. 실험군은 전향적 교차시험으로 10두의 비글견을 2%, 1%, 0.5% 및 0.25% lidocaine group으로 4군으로 나뉘었다. 모든 실험견들은 4 가지의 다른 농도를 가진 2 ml의 lidocaine을 사용하여 각 4번의 앞쪽목신경절 차단을 받았으며 신경 차단은 무작위로 1주일 간격으로 각각 시행되었다. 실험결과 호르너 증후군은 모든 실험군에서 관찰되었다. 1% lidocaine group에서는 대조군과 비교하여 차단 후 5분에서 안압의 유의한 상승이 있었으며($p<0.05$), 2%와 1% lidocaine group의 안압은 앞쪽목신경절 차단 후 25분과 45분 사이 감소하였으나, 0.5%와 0.25% lidocaine group은 변화가 없었다. 이상의 결과를 종합하면, 앞쪽목신경절 차단술은 정상 안압의 변화에 영향을 미치며 0.5%와 0.25% lidocaine은 안압을 변화시키기에는 부적당한 농도로 사료된다.