Comparison of Effectiveness of Pupil Dilatation Methods in Patients of Eye Ear Nose Throat Department at BNH Hospital

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OBJECTIVE: This descriptive study aims to compare the effectiveness between two methods of pupil dilatation in patients of the Eye Ear Nose Throat (ENT) Department at the BNH Hospital.

MATERIALS AND METHODS: The specifically selected subjects are 222 ENT out-patients who received mydriatic agents for an eye examination from January 1, 2014 to February 28, 2014. The mydriatic drugs were administered to these patients using two different methods: 1) a mixture of tropicamide 0.75% and phenylephrine 2.5% given every 5 minutes for 4 times and 2) a mixture of tropicamide 0.75% and phenylephrine 2.5% given every 5 minutes for 2 times. A data collection sheet was designed to record personal information, pupil dilatation method and pupil size at 20, 30 and 45 minutes after drug instillation. The pupil size was measured using a Glasgow Coma Scale instrument. The measurement was done by trained nurses who knew the purpose of this study. The descriptive statistics, which included the number, percentage, mean and standard deviation, were used to present personal information and pupil size at 20, 30 and 45 minutes after drop instillation. The pupil sizes from the two methods were compared by using the non-parametric statistics: Friedman Test and Wilcoxon Signed Rank Test.

RESULTS: From the comparison at 20, 30 and 45 minutes after the first drop instillation, both methods showed that the difference of pupil size between the time points was statistically significant ($p > 0.001$). The comparison between the first and the second method illustrates that the difference of pupil size at each time point was not statistically significant ($p = 0.032, 0.800$ and 0.102, respectively) at the 99.9% confidence interval level. Thus, the second method should be used because it requires only two times of instillation (2 times less than the first method) and the pupil measurement at 20 minutes after the first drop instillation reduces waiting times for patients.

CONCLUSION: The study supports pupil dilatation by using a mixture of 0.75% Tropicamide plus 2.5% phenylephrine and improves the process by reducing the waiting times of patients. Patients receive a lower amount of the drug, decreasing from 4 times to 2 times, so the risk of side effects is reduced.

Pupil dilatation is an essential technique for ophthalmologists to diagnose eye diseases or to perform eye surgery more easily. Commonly-used mydriatic agents include: single drugs, such as 10% phenylephrine, 1% Mydriacal, 1% Tropicamide, 1% Cyclogyl, Cyclopentolate, 1% Isopto atropine, and Atropine, and a combination of two mydriatic agents, such as 1% Mydriacyl plus 10% Phenylephrine and 0.75% Mydriacal plus 2.5% phenylephrine.[1] Previous studies reveal that each mydriatic drug varies in the effectiveness of pupil dilatation. Besides the drug type, the

effectiveness depends on the technique of drop instillation used. Some research suggests alternate applications of single drugs every 5 minutes for 2-5 times.[1-4] However, choosing the most appropriate drug type and instillation technique requires careful consideration. Alternate applications of single drugs can lead to confusion and mistakes especially drop instillation with alternate sequence of mydriatic agents. The use of more drugs in a mixture causes more mistakes in the nursing practice. Almost all published studies show a significant difference of pupil dilatation in every method used in the research. Analysis and synthesis of research in evidence-based practice is the key that all ophthalmologists use when making a clinical decision. Mostly, ophthalmologists draw different conclusions, leading to different treatment plans.[5] This explains why ophthalmologist choose different ophthalmologic agents, both drug type and method, in their treatment plan.

Several studies support the use of drug combination, which shows higher effectiveness than single drugs. Anderson, et al.[3] investigated pupil dilation between two methods, 1% Tropicamide plus 2.5% phenylephrine and 1% Tropicamide plus 1% cyclopentolate. Each subject randomly received one drop of a mixture in each eye. Only one mixture was applied to both eyes of a subject and pupils were measured at 5, 10, 15, 20, 40 and 60 minutes to compare the effectiveness. It was found that the first method showed statistically more effectiveness of pupil dilatation of 7 mm than the second method ($p = 0.0062$).

Majid, et al.[4] conducted research into pupil dilatation with two regimens of mydriatic agents, 1) 0.75% Tropicamide plus 2.5% phenylephrine and 2) 1% Tropicamide plus 10% phenylephrine. One drop of each combination was delivered 10 minutes apart for 2 times and the pupil size was measured every 5 minutes until the size reached 7 mm. to compare the effectiveness of pupil dilatation. It was found that the first method significantly showed higher effectiveness than the second method ($p = 0.004$). However, the research results were inconsistent with those of Forman's study.[6] There was no significantly statistical difference of pupil size between the two methods (mean of the 1st method = 7.4 mm., mean of the 2nd method = 7.6 mm.). Phamonvaechavan, et al.[7] compared pupil dilatation between two methods of instilling a mixture of 0.75% Tropicamide and 2.5% phenylephrine. In the first method, drop instillation was given at 0 minute (the first time) and 5 minutes (the second time). For the second method, drop instillation was given at 0 minute (the first time) and 30 minutes (the second time). It was found that the difference of the effectiveness of pupil dilatation between the two methods was not statistically significant. It is assumed that if the number of instillation is reduced from 4 times to 2 times and the pupil sizes of both methods do not differ, this will reduce the number of steps and waiting times. Therefore, the teams designed the present study to compare the effectiveness of pupil dilatation between two methods.

Method and Material

This descriptive research was conducted in the Eye Ear Nose Throat Department at the BNH Hospital. The subjects were 222 patients in the ENT out-patient department, specifically chosen from 1 January to 28 February 2014. These patients were administered a mixture of 0.75% Tropicamide plus 2.5% phenylephrine with two methods as follows:

Method 1 (research from 1 to 31 January 2014):
The procedure started with instilling one drop of the drug combination, instilling another drop at 5 minutes (2nd time), instilling another drop at 10 minutes (3rd time), and instilling another drop at 15 minutes (4th time). Then, the pupil size was measured at 20 minutes (1st time), 30 minutes (2nd time), and 45 minutes (3rd time) to compare the difference in pupil size at each time point.

Method 2 (research from 1 to 28 February 2014):
The procedure started with instilling one drop of the drug combination, instilling another drop at 5 minutes (2nd time), resting at 10 minutes and 15 minutes. Then, the pupil size was measured at 20 minutes (1st time), 30 minutes (2nd time), and 45 minutes (3rd time) to compare the difference in pupil size at each time point.

	Method 1	Method 2
Start	1st Eye drop	1st Eye drop
5 min	2nd Eye drop	2nd Eye drop
10 min	3rd Eye drop	Rest
15 min	4th Eye drop	Rest
20 min	1st measure	1st measure
30 min	2nd measure	2nd measure
45 min	3rd measure	3rd measure

The research instruments include a data collection sheet designed by the researcher to record personal information, eye drop instillation and measurement of pupil size at 20, 30 and 45 minutes, and an instrument for measuring pupil size in the Glasgow Coma Scale. The measurement was done by nurses in the ENT out-patient department of the BNH Hospital.

Data analysis

The data were analyzed by using descriptive statistics, which include the number, percentage, mean and standard deviation, to present personal information and pupil size at 20, 30 and 45 minutes after drop instillation. The pupil sizes from the two methods were compared by using the non-parametric statistics: Friedman Test and Wilcoxon

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Table 1: The number and percentage of out-patients in the ENT department at the BNH Hospital from 1 January 2014 to 28 February 2014.

	n (%)
Patient	222 (100)
January	105 (47.3)
February	117 (52.7)
Sex	
Female	116 (52.3)
Men	106 (47.7)
Age (year)	
Youngest	15
Oldest	97
Mean age	52.96

Table 2: The pupil size of patients receiving mydriatic agents with the 1st and the 2nd method at 20, 30 and 45 minutes.

Time	Method	Lowest	Highest	Mean (SD)
20 min	1	5	8	5.49 (0.71)
	2	4	7	5.38 (0.71)
30 min	1	5	8	7.00 (0.62)
	2	5	8	7.04 (0.56)
45 min	1	7	8	7.94 (0.23)
	2	7	8	7.91 (0.23)

Table 3: Comparison of pupil size between the 1st and the 2nd method at 20, 30 and 45 minutes using the Friedman Test.

	Time	Mean	*p*
Method 1	20 min	5.49	0.000
	30 min	7.00	
	45 min	7.94	
Method 2	20 min	5.38	0.000
	30 min	7.04	
	45 min	7.91	

Table 4: Comparison of pupil dilatation between the 1st and the 2nd method at 20, 30 and 45 minutes using the Wilcoxon Signed Rank Test.

Time	Method 2	Method 1	*p*
20 min	5.38	5.49	0.032
30 min	7.04	7.00	0.800
45 min	7.91	7.94	0.102

Signed Rank Test. As the collected data violated the assumption of normality, parametric statistics (one-way analysis of variance) cannot be used.

Result

There were 222 ENT out-patients who received Mydriatic drugs for an eye examination at the BNH Hospital from 1 January 2014 to 28 February 2014. There were 105 patients (47.3%) in January and 117 patients (52.7%) in February. Most of the patients were female (n = 116, 52.3%). There were 106 male patients (47.7%). The mean age of the patients was 52.96 years. The youngest and oldest patient was 15 and 97 years old, respectively (See Table 1). The average pupil sizes after drop instillation by using the first method at 20, 30 and 45 minutes were 5.49 mm. (SD = 0.71), 7.00 mm. (SD = 0.56), and 7.91 (SD = 0.23), respectively. The means of pupil size increased gradually. For the second method, the average pupil sizes after drop instillation at 20, 30 and 45 minutes were 5.38 mm. (SD = 0.71), 7.04 mm. (SD = 0.56), and 7.91 (SD = 0.23), respectively. The means of pupil size also increased gradually (See Table 2).

Based on the comparison of pupil size in the first method at different time points, the differences of pupil size between time points were statistically significant at $p < 0.001$. For the second method, the pupil sizes at three time points also differed significantly at $p < 0.001$ (See Table 3). From the comparison of pupil size at 20 minutes after the first drop instillation, both methods showed the difference of pupil size with no statistical significance ($p = 0.032$). At 30 minutes, the difference of pupil size between two methods was not statistically significant ($p = 0.800$). Also, at 45 minutes after the first drop instillation, both methods showed the difference of pupil size with no statistical significance ($p = 0.102$) (See Table 4).

Discussion

This research compared the effectiveness of pupil dilatation between two methods used in the ENT out-patients at the BNH Hospital. It was found that the pupil size increased at 20, 30 and 45 minutes with statistical significance at $p < 0.001$. This is consistent with the action of 0.75% Tropicamide plus 2.5% phenylephrine combination, which starts 15 minutes after instillation and lasts for three hours.[7] The comparison of pupil size between the 1st and the 2nd method showed that at 20, 30 and 45 minutes the pupil size differed with no statistical significance at the 99.9% confidence interval level % ($p = 0.032$, $p = 0.800$ and $p = 0.102$, respectively). The results from this study suggest the use of the second method, as it requires only two times of instillation; the first drop and the second drop, given 5 minutes apart. In addition, the pupil measurement is done at 20 minutes after the first drop instillation.

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These studies show the following benefits:

1. Shorter preparation time of eye examination.
2. Patients receive fewer amounts of drugs, decreasing from 4 times to 2 times, so the risk of side effects is reduced.
3. Decrease in steps of drug administration, from 4 times to 2 times. Thus, the nurses can spend more time with other patients.
4. The error of drug administration is reduced.

Conclusion

With evidence-based medicine, extending the knowledge from previous research leads to the development of a process for pupil dilatation. The study supports pupil dilatation by using a mixture of 0.75% Tropicamide plus 2.5% phenylephrine and improves the process by reducing the waiting times of patients. Patients receive fewer amounts of drugs, decreasing from 4 times to 2 times, so the risk of side effects is reduced.

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Recommendations

Future research should investigate factors increasing the rate of pupil dilatation to reduce the waiting time of 20 minutes after the first drop instillation.

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