Assessment of eye drop instillation technique in glaucoma patients

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ABSTRACT

Purpose: To study the technique of eye drop instillation in glaucoma patients and identify independent factors that may influence their performance.

Methods: In this cross-sectional study, 71 consecutive patients with glaucoma or ocular hypertension, self-administering topical anti-glaucoma medications for 26 months were evaluated. All patients instilled a tear substitute into the eye with the worst eye sight using the technique normally used at home. The following parameters were evaluated: age, number of years receiving treatment with ocular hypotensive eye drops, time spent to instill the first drop, number of drops instilled, correct location of the eye drops, contact of the bottle with the eye, closing of the eyelids or occlusion of the tear punctum, and asepsis of the hands.

Results: The mean age of the patients was 66 ± 10.8 years, and patients were on ocular hypotensive drugs for 11.3 ± 7.3 (range, 2-35) years. Only 28% of the patients were able to correctly instil the eye drops (squeeze out 1 drop and instill it into the conjunctival sac without bottle tip contact). Touching the tip of the bottle to the globe or periocular tissue occurred in 62% of the patients. In 49% of the patients, the eye drops fell on the eyelids or cheek. Two or more drops were squeezed by 27% of the patients.

Conclusions: The majority of glaucoma patients were unable to correctly instill eye drops. Age was an independent factor associated with eye drop instillation performance.

Keywords: Glaucoma/drug therapy; Medication adherence; Ophthalmic solutions/therapeutic use; Instillation drug

INTRODUCTION

The efficacy of topical ocular pharmacotherapy depends on patient adherence and compliance with the prescribed treatment regimen11. In ocular diseases, noncompliance could result even from improper technique of administering medication12,13. Although instillation of eye drops may be perceived as a simple task, studies have shown that patients frequently have difficulty instilling eye drops14,15. In chronic ocular diseases, such as glaucoma, wherein the elderly population constitutes a major share of those affected, this issue is of great importance16,17. The consequences of improper drop instillation are treatment failure, wastage of medication, overmedication with systemic adverse effects, predisposition to infection from contaminated bottle tips, corneal abrasions, and ulcersations18,19.

Eye care practitioners may prescribe eye drops without properly explaining or showing the technique for correct instillation of eye drops because of the lack of time in busy practice or lack of awareness of the fact that the patient does not know how to correctly instill drops12,13. Over the past decade, although several studies have reported that 25% to 90% of subjects fail to administer their eye drops correctly12,13, data is sparse about the technique of eye drop administration in a public practice of a developing country16 where the issue of noncompliance is considered to be very significant14,15.

Therefore, the purpose of this study was to evaluate the technique of eye drop instillation in glaucoma patients of a public hospital in the southeast of Brazil and to identify independent factors that may influence instillation performance.

METHODS

In this cross-sectional study, 71 consecutive patients with glaucoma or ocular hypertension, who had been self-administering topical anti-glaucoma medications for 26 months, were evaluated between July 10, 2015 and December 31, 2015. This study was approved by the following research ethics committee: Hospital Federal de Bonsucesso (CAAE: 03603512.0.0000.5253).
The results of the major parameters studied are summarized in Table 2. Only 20 (28%) patients were able to correctly instill the eye drops (squeeze out 1 drop and instill it into the conjunctival sac without the bottle tip contacting the eye or eyelid). Touching the tip of the bottle to the globe or periorcular tissue occurred in 44 (62%) patients (Table 2). In 35 (49%) patients, the eye drops fell on the eyelids or cheek. Two or more drops were squeezed by 19 (27%) patients. Only 8 (11%) patients washed their hands before drop instillation.

There was a trend toward better performance by women than by men. Those considered to have had a successful attempt had a mean age of 61.2 ± 12.9 years compared with those who did not (68.0 ± 9.2 years), (p=0.02) (Table 3). The univariate analysis showed that younger age was the only factor significantly associated with good technique (p=0.02). Table 4 shows the results of the univariate logistic regression for predicting proper drop instillation technique. Variables with a p<0.06 in the univariate analysis were included in the multivariate regression model. In the multivariate model, age remained significant (Table 5).

**DISCUSSION**

The present study focused on the “unintentional” noncompliance in the form of improper eye drop instillation and evaluated...
not only the technique of glaucoma patients but also the factors associated with their performance in a developing country.

A study conducted in a developing country reported a high non-compliance rate (53.6%) among glaucoma patients compared to the average of other studies in the developed world. Compliance is a multifactorial complex behavior and in developing countries, economic factors definitely have a role[5,13].

The results of the current study indicate that difficulty with self-instillation of eye drops is a significant problem for patients with glaucoma in a developing country. All subjects enrolled in this study admitted to instilling their own eye drops, not being reliant on others, and also had 6 months of experience in drop instillation. When defining proper instillation as “instilling a single drop in the eye without touching the bottle tip,” only 28% of patients were able to do it correctly. These results are generally consistent with those of previous studies, which demonstrates that even experienced patients frequently have difficulty instilling their drops[5,7,13,16].

For most patients with poor technique, the problem was contact between the tip of the bottle and the globe or eyelid. This finding is consistent with those of other studies that reported touching of the eye or ocular adnexa with the bottle as the most frequent error[4,18]. Besides the risk of trauma, this issue may also lead to contamination of the bottle tip[10,11]. Some devices to improve drop instillation have been reported to significantly reduce touching of the bottle tip to the eye and eyelid[20-22]. The drawbacks of these devices are that they are often suitable for only a single-bottle design and many patients find it easier to use drops without such a device[21].

Another important problem observed in this study was that a substantial amount of the eye drops were wasted because of faulty instillation technique; 35 (49%) of 75 patients missed the eye. Previous studies have reported that in 3% to 40% of subjects the drop missed the eye, and 2 drops were almost always needed to achieve a successful application[4,8,13]. Missing the eye may result in disease progression from missed drops and dermatitis from drops contacting the skin[21]. Moreover, poor drop administration techniques may also result in wasting drops, which has economic implications for patients, insurance companies, or government[9]. This assumes high importance in low-socioeconomic-level patients from public hospitals of developing countries, such as the setting of the present study[22]. The cost of anti-glaucoma eye drops has an economic monthly impact of 29.1% of the value of the minimal wage in Brazil[25]. A study reported that ≤41% of the glaucoma patients from a public hospital in Brazil abandoned treatment because of financial difficulties in buying the medication[27].

The results of this study indicate that more should be done to educate patients regarding correct drop instillation technique, particularly as 69% of patients had never received or could not recall having been instructed in the proper technique for eye drop instillation. This could explain why only 10 (14%) patients closed eyelids for > 1 min or occluded their tear duct and only 1 of the 4 patients using a suspension shook the bottle before using it. Moreover, washing hands was performed by only 11% of the patients. It is also important to reconsider the definition of what constitutes “successful” eye drop instillation because the only instructions on glaucoma medication bottles currently concern not touching the bottle to the eye[25].

In this study, younger age was the only factor significantly associated with good technique both in univariate and multivariate regression analysis. Similarly, the study of Hennessy et al. found that age was the only significant predictor of instillation technique in visually disabled glaucoma patients[26]. However, this finding does not mean that other factors are not important because that finding could have been caused by small sample size. Other authors have shown that older age[7,19], limited school education[13,26], and poor vision[21] were associated with poor instillation technique. History of previous eye drop education was strongly associated with good instillation technique when controlled for age in another study[18]. Moreover, the literature has shown that educating the patients about the correct instillation technique can significantly improve their performance[15].

The present study had several limitations. First, the history of previous education regarding drop instillation technique relied on patient recall. It is possible that patients with poor drop instillation technique may have forgotten previous instruction regarding eye drop instillation, which may have biased the results. We only used one 5-ml bottle type, and the ability of subjects to use the specific bottle type or shape in this study may have varied.

The Systane® 5-ml bottle for drop instillation used in this study also has been used in similar previous studies and is considered to be an adequate proxy from both a bottle size and viscosity standpoint for primary glaucoma treatment at present[5,18,20]. Another limitation is the fact that there was only one evaluation of drop instillation, and the patients were evaluated inside in a different environment, which may have influenced their performance. It also would have been

### Table 3. Comparison of descriptive statistics between patients who underwent good eye drop instillation technique (successful instillation) and those who underwent poor technique

<table>
<thead>
<tr>
<th>Variable</th>
<th>Good technique (n=20)</th>
<th>Poor technique (n=51)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>61.20 ± 12.90</td>
<td>68.00 ± 9.20</td>
<td>0.04</td>
</tr>
<tr>
<td>VA worse eye (logMAR)</td>
<td>0.63 ± 0.35</td>
<td>0.63 ± 0.34</td>
<td>0.94</td>
</tr>
<tr>
<td>IOP (mmHg)</td>
<td>17.90 ± 4.40</td>
<td>17.60 ± 4.10</td>
<td>0.81</td>
</tr>
<tr>
<td>Duration of eye drop use (years)</td>
<td>11.50 ± 8.40</td>
<td>11.20 ± 6.80</td>
<td>0.99</td>
</tr>
<tr>
<td>Posology (number of eye drops applied every day)</td>
<td>2.60 ± 1.30</td>
<td>2.60 ± 1.10</td>
<td>0.89</td>
</tr>
</tbody>
</table>

VA= visual acuity; IOP= intraocular pressure.

Good eye drop instillation technique (successful instillation)= placing just 1 drop on the eye without touching the surface of the eye.

E= t-test; §= Fisher’s exact test.

### Table 4. Univariate logistic regression for predicting instillation technique; log odds of improper/ proper technique

<table>
<thead>
<tr>
<th>Variable</th>
<th>Odds ratio</th>
<th>95% CI</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>1.1</td>
<td>1.1-1.2</td>
<td>0.02</td>
</tr>
<tr>
<td>Sex [female]</td>
<td>1.6</td>
<td>0.4-4.0</td>
<td>0.82</td>
</tr>
<tr>
<td>Level of education [low]</td>
<td>0.4-6.0</td>
<td>0.52</td>
<td></td>
</tr>
<tr>
<td>Previous drop education [no]</td>
<td>0.4-3.8</td>
<td>0.64</td>
<td></td>
</tr>
<tr>
<td>VA worse eye (logMAR)</td>
<td>0.2-5.0</td>
<td>0.94</td>
<td></td>
</tr>
<tr>
<td>IOP (mmHg)</td>
<td>0.9-1.2</td>
<td>0.80</td>
<td></td>
</tr>
<tr>
<td>Duration of eye drop use (years)</td>
<td>0.9-1.1</td>
<td>0.88</td>
<td></td>
</tr>
<tr>
<td>Posology (number of eye drops applied every day)</td>
<td>0.6-1.5</td>
<td>0.87</td>
<td></td>
</tr>
</tbody>
</table>

VA= visual acuity; IOP= intraocular pressure; CI= confidence interval.

Good eye drop instillation technique (successful instillation)= placing just 1 drop on the eye without touching the surface of the eye.

### Table 5. Results of multivariate logistic regression for predicting instillation technique; log odds of improper/ proper technique

<table>
<thead>
<tr>
<th>Variable</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>0.03</td>
</tr>
<tr>
<td>Previous drop education [no]</td>
<td>0.67</td>
</tr>
<tr>
<td>Sex [female]</td>
<td>0.72</td>
</tr>
<tr>
<td>Level of education [low]</td>
<td>0.97</td>
</tr>
</tbody>
</table>
interesting to consider fluorescein eye drops instead of Systane® because an objective view in the slit lamp would be obtained if the patient properly instilled the eye drop.

The results of this study emphasize the need to develop better instructional methods, devices, and techniques to deliver intraocular pressure-lowering medications especially to older patients because age is an independent factor that influences the performance of drop instillation. To improve skills on self-administering eye drops, it is important to better educate patients, perhaps with videotapes presenting the correct instillation technique(27). A previous study conducted in Brazil has shown a significant improvement in the technique of eye drop instillation as a result of an educational program(28). Care should be taken to present instructional information for patients that is easy to understand and appropriate for the instructional level of the patient(28).

In conclusion, we found that the majority of glaucoma patients in this study were unable to instill eye drops correctly and that age was an independent factor associated with drop instillation performance.

REFERENCES