SFO COMMUNICATION

Topical versus peribulbar anesthesia in non-penetrating deep sclerectomy. A cost-effectiveness analysis

Anesthésie topique versus péribulbaire dans la sclérectomie profonde non perforante. Une analyse de coût-efficacité

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KEYWORDS
Glaucoma; Filtering surgery; Local anesthesia; Costs; Cost-effectiveness

Summary
Aim. — To assess the costs and cost-effectiveness ratio of topical and peribulbar anesthesia in non-penetrating deep sclerectomy for the surgical treatment of open-angle glaucoma.

Patients and methods. — We evaluated the associated direct costs with both topical and peribulbar anesthesia. Effectiveness was defined as the proportion of patients that experienced no pain during the surgical procedure and was obtained from the literature. Cost-effectiveness was defined as direct cost of anesthesia per patient with no pain. We also calculated the incremental cost-effectiveness ratio (ICER) in order to determine which intervention was dominant.

Results. — Direct costs were US$ 45.60 and US$ 49.18 for topical and peribulbar anesthesia respectively. The great majority of patients experienced no pain with any of the procedures (91.7% for the topical group and 69.7% for the peribulbar group). Cost-effectiveness ratio was US$ 49.73 for topical anesthesia and US$ 70.56 for peribulbar anesthesia. The ICER was negative and topical anesthesia was dominant over peribulbar anesthesia.

Conclusion. — Topical anesthesia was less costly and more effective than peribulbar anesthesia in avoiding pain in non-penetrating deep sclerectomy.

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Glaucome ; Chirurgie filtrante ; Anesthésie locale ; Coût ; Coût-effectivité

Résumé
But. — Évaluer les coûts et le rapport coût-efficacité des anesthésies topique et péribulbaire dans le traitement chirurgical du glaucome à angle ouvert par la sclérectomie profonde non perforante (SPNP).

Patients et méthodes. — Cette évaluation économique a inclus les coûts directs liés à chaque type d’anesthésie (topique et péribulbaire). L’efficacité a été définie comme la proportion de patients ayant bénéficié d’une SPNP sans aucune sensation de douleur quel que soit le type d’anesthésie. Les données d’efficacité ont été obtenues à partir des résultats de la littérature. Le rapport coût-efficacité a été défini par le coût pour chaque patient sans douleur. Les auteurs ont calculé le rapport coût-efficacité marginal (ICER).

Résultats. — Les coûts directs de l’anesthésie topique et de la péribulbaire ont été : US$ 45,60 et US$ 49,18, respectivement. La proportion de patients avec une absence totale de douleur a été : 91,7 % pour la topique et 69,7 % pour la péribulbaire. Le rapport coût-efficacité a été : US$ 49,73 par patient sans sensation de douleur dans le groupe d’anesthésie topique et US$ 70,56 par patient sans sensation de douleur dans le groupe d’anesthésie péribulbaire. L’anesthésie topique a été supérieure selon le rapport coût-efficacité marginal.

Conclusion. — En termes de coût de soins de santé, l’anesthésie topique reste une bonne option pour la sclérectomie profonde non perforante. L’anesthésie topique est moins coûteuse et plus efficace que la technique péribulbaire pour éliminer la sensation de douleur dans la sclérectomie profonde non perforante.

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Introduction

In the past, the most common technique for ophthalmic anesthesia was retrobulbar anesthesia [1]. In this technique, the local anesthetic agent is injected behind the ocular globe (within the muscle cone) in order to provide adequate anesthesia, akinesia and postoperative analgesia [1]. Due to an increased risk of intra-ocular or intradural injection and direct optic nerve injury, retrobulbar anesthesia has been replaced by peribulbar anesthesia for the past 20 years [2,3]. The latter consists in the injection of a local anesthetic agent around the ocular globe (outside the muscle cone) with usually more than one injection and a greater amount of local anesthetic agent [2]. Although the rate of complications of peribulbar anesthesia is lower than retrobulbar anesthesia, it can still lead to ocular perforations, orbital hemorrhages, oculomotor disorders, among others [4].

Topical anesthesia was first used in cataract surgery and has gained many adepts over the last years. It has many advantages, as follows: intra-ocular pressure remains stable during the procedure, quicker visual recovery, absence of systemic toxicity of local anesthetic and avoids any needle-related complication (perforation, hemorrhage, etc.) [5].

Most common form of anesthesia for glaucoma surgery is peribulbar [6]. However, many studies have been published on the use of topical anesthesia in different glaucoma surgery techniques, such as: trabeculectomy [7,8], non-penetrating deep sclerectomy [9] and aqueous drainage implants [10].

Health economists believe that innovation in health technology (medications, medical and surgical procedures and medical equipments) has a major role in increasing health care budget [11]. Health resources are scarce; therefore, a health technology economic assessment has a great value and may help decision makers and clinicians to choose the best alternative for the patient and for the health system.

The aim of this study was to assess the cost-effectiveness of topical and peribulbar anesthesia in non-penetrating deep sclerectomy in Brazil.

Patients and methods

Based on a previous randomized study, published by the same authors [9], a decision model was built. On that study, a visual analogue pain scale (0 – 10) was applied 15 minutes and 24 hours after a non-penetrating deep sclerectomy to 69 patients. The pain assessment included both the anesthesia technique and the glaucoma procedure in each group. Inclusion criteria for that study were: open angle glaucoma not controlled by medication and only one eye of each patient was included. Topical anesthesia (proximethacaine 0.5% drops) associated to an intravenous sedation with propofol was used in 36 patients (group 1) and peribulbar anesthesia (lidocaine 2% associated to bupivacaine 0.5%) was performed in 33 patients (group 2) in a randomized and prospective way. Mean age (± standard deviation) was 60.25 ± 15.90 years in group 1 and 59.15 ± 15.36 years in group 2. The surgical team was the same for all procedures.

The authors concluded that topical anesthesia (associated to propofol sedation) was a valuable and interesting alternative to patients undergoing non-penetrating deep sclerectomy, providing the same or slightly better comfort than peribulbar anesthesia [9].

Peribulbar anesthesia technique was preceded with two drops of 0.5% proparacaine (Anestalcon, Alcon Lab. Fort Worth TX, USA) within a 5-minute interval, followed by scrubbing the area with 70% alcohol. Two local anesthetic injections (one below the ocular globe [5 mL], in the
inferior-temporal quadrant and another above the ocular globe [3 mL], in the superior-nasal quadrant), using a mix of 2% lidocaine and 0.75% bupivacaine, were performed. At the same time, a little intravenous sedation with propofol was done. The ocular globe was then submitted to compression for 10 to 15 minutes. During the glaucoma procedure, no sedation was done and an oxygen mask was used. At the end of the surgery, a bandage was placed and the patient used it for the next 12 to 24 hours.

Topical anesthesia consisted in three to four drops of 0.5% proximethacaine (Anestalcon, Alcon Lab. Fort Worth TX, USA) with five-minute intervals immediately before the surgery. Continuously intravenous propofol sedation was performed during the whole glaucoma procedure, associated with an oxygen mask. Patients did not use any bandage after the surgery.

Costs were based on the reference guidebook used by the hospitals (Brasindice 2009) and converted into US dollars (reference date: December 11, 2009: 1 dollar = 1.76 reais). Perspective is from health care payer (Brazilian Public Health System — SUS).

Effectiveness outcomes were derived from that previous study done by the same researchers [9] and were defined as the proportion of patients that experienced no pain whatsoever related to the procedure (patients whose answers were zero in the first evaluation, 15 minutes after the procedure, using the visual analogue pain scale).

Cost-effectiveness was defined as direct cost of anesthesia per patient with no pain and it was calculated by dividing the costs by the effectiveness. We also calculated the incremental cost-effectiveness ratio (ICER), by dividing the incremental cost by the incremental effectiveness, in order to determine which intervention was dominant.

Univariate sensitivity analysis is a test of the effect of error on model outputs in which the variable of interest is varied over a range of plausible values while holding all other variables constant. Univariate sensitivity analysis was done to test the increment in cost if a subconjunctival injection of 2% lidocaine were used along with the topical anesthesia.

No discount rate was used and all calculations were made in Excel 2007 (Microsoft Inc.).

Table 1 Direct costs for topical anesthesia.

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Cost (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70% Alcohol</td>
<td>20 mL</td>
<td>0.23</td>
</tr>
<tr>
<td>0.5% Proximethacaine eye drops bottle</td>
<td>1</td>
<td>3.97</td>
</tr>
<tr>
<td>0.9% saline solution</td>
<td>250 mL</td>
<td>3.34</td>
</tr>
<tr>
<td>Propofol</td>
<td>20 mL</td>
<td>23.69</td>
</tr>
<tr>
<td>IV infusion line</td>
<td>1</td>
<td>9.66</td>
</tr>
<tr>
<td>IV cannula</td>
<td>1</td>
<td>0.80</td>
</tr>
<tr>
<td>10 mL syringe</td>
<td>1</td>
<td>0.34</td>
</tr>
<tr>
<td>Needle (40/12)</td>
<td>1</td>
<td>0.17</td>
</tr>
<tr>
<td>Oxygen mask (time)</td>
<td>30 min</td>
<td>3.41</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>45.60</td>
</tr>
</tbody>
</table>

Table 2 Direct costs for peribulbar anesthesia.

<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
<th>Cost (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70% Alcohol</td>
<td>20 mL</td>
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</tr>
<tr>
<td>0.9% saline solution</td>
<td>250 mL</td>
<td>3.34</td>
</tr>
<tr>
<td>Propofol</td>
<td>10 mL</td>
<td>13.39</td>
</tr>
<tr>
<td>IV infusion line</td>
<td>1</td>
<td>9.66</td>
</tr>
<tr>
<td>IV cannula</td>
<td>1</td>
<td>0.80</td>
</tr>
<tr>
<td>10 mL syringe</td>
<td>2</td>
<td>0.68</td>
</tr>
<tr>
<td>5 mL syringe</td>
<td>1</td>
<td>0.41</td>
</tr>
<tr>
<td>Needle (40/12)</td>
<td>3</td>
<td>0.51</td>
</tr>
<tr>
<td>Needle (25/6)</td>
<td>1</td>
<td>0.07</td>
</tr>
<tr>
<td>2% lidocaine bottle</td>
<td>1</td>
<td>1.52</td>
</tr>
<tr>
<td>0.75% bupivacaine bottle</td>
<td>1</td>
<td>7.22</td>
</tr>
<tr>
<td>Oxygen mask (time)</td>
<td>30 min</td>
<td>3.41</td>
</tr>
<tr>
<td>Bandage</td>
<td>1</td>
<td>3.99</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>49.18</td>
</tr>
</tbody>
</table>

Results

The decision model with the corresponding effectiveness of each intervention option is presented in Fig. 1. Thirty-three out of 36 patients (91.7%) had no perception of any pain in the topical group compared to 23 out of 33 patients (69.7%) in the peribulbar group. Tables 1 and 2 demonstrate the direct costs of both anesthesia techniques. Total cost for topical anesthesia and peribulbar anesthesia were US$ 45.60 and US$ 49.18. Cost-effectiveness results, incremental cost and incremental effectiveness are displayed in Table 3. Topical anesthesia was both less costly and more effective in avoiding perception of pain by the patient; therefore it was dominant over peribulbar anesthesia. Total cost for topical anesthesia with the association of a 2% lidocaine subconjunctival injection was US$ 47.63. Through this sensitivity analysis and assuming the same effectiveness level, topical anesthesia still remains dominant over peribulbar anesthesia.
Table 3  Cost-effectiveness analysis and incremental cost-effectiveness analysis.

<table>
<thead>
<tr>
<th>Interventions</th>
<th>Cost (US$)</th>
<th>Effectiveness(^a)</th>
<th>Cost-effectiveness(^b)</th>
<th>Incremental costs (US$)</th>
<th>Incremental effectiveness(^a)</th>
<th>ICER(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peribulbar anesthesia</td>
<td>49.18</td>
<td>0.697</td>
<td>70.56</td>
<td>-3.58</td>
<td>0.22</td>
<td>-16.27 (Dominant)</td>
</tr>
<tr>
<td>Topical anesthesia</td>
<td>45.60</td>
<td>0.917</td>
<td>49.73</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ICER: incremental cost-effectiveness ratio.
\(^a\) Proportion of patients with no pain perception during the procedure.
\(^b\) US$ / patient with no pain perception during the procedure.

Discussion

Innovation in health technology has a major impact in health care expenditures. Economic and comparative effectiveness studies are useful to identify the real place of such innovative interventions among usual ones.

Topical anesthesia has had a growing interest in ophthalmic surgery, especially in anterior segment procedures, such as: cataract, refractive and glaucoma surgery. Different techniques of glaucoma surgeries under topical anesthesia have been evaluated. Sauder and Jonas evaluated, in a prospective randomized trial, trabeculectomy under topical or retrobulbar anesthesia. The duration of the procedure, surgeon difficulty score in performing the surgery and pain sensation by the patient were not different between groups [12]. Zabriskie et al. [7] and Pablo Júlvez et al. [8] found similar results.

Paletta Guedes et al. demonstrated that patient’s comfort were very similar between topical and peribulbar anesthesia in non-penetrating deep sclerectomy. In this glaucoma procedure, there is no perforation into the anterior chamber; hence there is a lower sensation of pain than in trabeculectomy, mainly because the latter is usually associated with a peripheral iridectomy. In this study, a higher proportion of patients rated 0 (zero) in the pain visual analogue scale for topical anesthesia rather than peribulbar anesthesia (33/36 and 23/33, respectively). We decided to use these results as our effectiveness outcome for this economic analysis. During the analysis of this previous study, we have observed that the main cause of discomfort in the peribulbar group was the moment of the local anesthetic injection around the globe. The glaucoma surgery itself was not painful at all, reaffirming the capacity of the peribulbar anesthesia in avoiding pain. However, patients’ perception of pain includes both anesthesia and glaucoma procedures.

Costs included all the necessary material to perform each anesthesia and they reflect the usual technique used in our environment. Topical anesthesia was less costly than peribulbar anesthesia because it uses fewer resources. Even if we consider the addition of a subconjunctival injection of 2% lidocaine in the topical anesthesia group, as in Gutiérrez-Ortiz et al. [13], it still remains less costly than the peribulbar anesthesia.

Propofol amount differed between the two studied techniques. Topical anesthesia used a larger amount of propofol.

This difference is explained by the fact that propofol sedation was only necessary during the anesthetic injection in the peribulbar technique and not during the glaucoma procedure. Conversely, in the topical anesthesia, a propofol sedation was used during the whole glaucoma surgery. Propofol represents more than half of topical anesthesia total costs. If we could reduce or even avoid its use and keep only under topical anesthetic drops, its costs could be much lower.

In the cost-effectiveness analysis, topical anesthesia was more cost-effective than peribulbar anesthesia, because it was more effective and less costly. According to these results, each patient with no sensation of pain in non-penetrating deep sclerectomy costs US$ 49.73 under topical anesthesia and US$ 70.56 under peribulbar anesthesia.

The ICER is calculated through the division of the incremental cost (US$ — 3.58) by the incremental effectiveness (0.22). The ICER provides the consumers of our research with information that more readily allows comparisons. The ICER not only provides which intervention saves costs and improves health, but also tells you how much one will spend to buy additional health relative to the competing alternative. When the ICER value is negative, as in our result, the intervention saves money and improves health, therefore it is dominant [11]. So, in the case of non-penetrating deep sclerectomy, topical anesthesia associated with propofol sedation is dominant over peribulbar anesthesia. To our knowledge, there is no other study trying to elucidate the cost-effectiveness of different anesthesia techniques for glaucoma surgery in the literature, making comparisons impossible.

Our study has some limitations. It is based on only one prospective randomized study [9] and may not reflect the patients’ perception of pain under different circumstances. There is a great variability of peribulbar anesthesia techniques, as in topical anesthesia. These differences can influence both costs and effectiveness, thus altering the results [14].

Conclusion

Topical anesthesia was more cost-effective than peribulbar anesthesia in non-penetrating deep sclerectomy. From the payer’s perspective, more non-penetrating glaucoma surgeons should be encouraged to use it for their patients.
Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References