Local Anesthetic Administration for Awake Direct Laryngoscopy

Are Glossopharyngeal Nerve Blocks Superior?

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Background: Glossopharyngeal nerve (GPN) blocks may provide reliable analgesia for awake direct laryngoscopy, although this has not been evaluated prospectively. This study was designed to determine if GPN blocks provide a superior route of local anesthetic administration for awake direct laryngoscopy as measured by hemodynamic, gag, and subjective pain responses.

Methods: A prospective, randomized, single-blinded, crossover design was used. All participants (n = 11) were anesthesiologists. Three routes of local anesthetic administration were evaluated: 2 min of 2% viscous lidocaine swish and gargle (S&G); S&G combined with 10% lidocaine spray (S&G/spray); and S&G combined with 1% lidocaine bilateral GPN blocks (S&G/block; anterior tonsillar pillar method). Five minutes after the local anesthetic was administered, laryngoscopy was performed and sustained for 20 s. Noninvasive hemodynamic measurements and serum lidocaine concentrations were determined. Visual analogue scale scores and a poststudy questionnaire were used to assess participants' ability to tolerate local anesthetic administration and laryngoscopy and their choice for use in clinical practice.

Results: No significant hemodynamic changes were observed, although there was a modest increase (<15%) in heart rate in the S&G/block group in the first minute after laryngoscopy. Serum lidocaine concentrations were higher (P < 0.05) in the S&G/block group at 1 and 10 min (0.5 ± 0.1 and 1.0 ± 0.2 μg/mL) compared with the S&G group. Participants' visual analogue scale scores, which assessed their ability to tolerate laryngoscopy, showed that S&G (5.4 ± 0.9) resulted in more discomfort (P < 0.05) than either S&G/spray (5.5 ± 0.9) or S&G/block (3.3 ± 0.7). The laryngoscopist's visual analogue scale scores, which assessed the ease of visualization, revealed a trend (P < 0.08) toward less coughing and gagging with S&G/spray (1.8 ± 0.9) compared with S&G (4.0 ± 1.3) and S&G/block (3.7 ± 1.1). Oropharyngeal discomfort lasting 24 h or more was reported by 91% of participants after S&G/block, whereas no participant reported oropharyngeal discomfort after S&G or S&G/spray. Significantly more participants (73%) indicated their preference for using S&G/spray in future clinical practice compared with S&G (P < 0.01) and S&G/block (P < 0.05).

Conclusions: Glossopharyngeal nerve blocks do not provide a superior route of local anesthetic administration for awake direct laryngoscopy. Two minutes of 2% viscous lidocaine S&G followed by 10% lidocaine spray was the anesthetic route preferred by participants and laryngoscopists. (Key words: Airway; difficult. Anesthetic techniques: direct laryngoscopy; nerve block. Anesthetics, local: lidocaine. Nerve: glossopharyngeal.)

AWAKE direct laryngoscopy is a well-established technique for use in patients with an anticipated difficult airway, as well as for those who are at increased risk for loss of airway patency or protective airway reflexes after induction of general anesthesia.1,2 Although awake direct laryngoscopy is performed for patient safety, it is often accompanied by hemodynamic disturbances and patient discomfort. Therefore, local anesthetics are commonly administered before awake laryngoscopy.

There are several methods of administering local anesthetic before awake direct laryngoscopy,3-7 including (but not limited to) 2% viscous lidocaine swish and gargle, 10% lidocaine spray, and bilateral glossopharyngeal nerve (GPN) blocks. Topical anesthetics are admin-
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istered to provide analgesia by blocking tactile receptors in the peroral mucosa, but they are considered inadequate to block submucosal deep-pressure receptors. Deep-pressure receptors in the posterior one third of the tongue are innervated by sensory afferent branches of the GPN and are responsible for reflex-mediated gag and pressor responses to direct laryngoscopy.\(^8\) Given this, bilateral blockade of the GPN, or "tongue block," may be more successful at mitigating pressor, gag, and pain responses to direct laryngoscopy.\(^9 \text{-} \text{12}\) Nevertheless, it is unclear from previous studies which route of local anesthetic administration best prevents hemodynamic disturbances and discomfort during awake laryngoscopy. In addition, the effectiveness of bilateral GPN blocks for awake direct laryngoscopy has not been evaluated prospectively.

This study was designed to determine if GPN blocks provide a superior route of local anesthetic administration for awake direct laryngoscopy with regard to hemodynamic, gag, and subjective pain responses. A unique element of this study is that all participants were anesthesiologists who described, using a poststudy questionnaire, their experiences and preference for route of local anesthetic administration in clinical practice.

**Methods**

After receiving Human Investigation Committee approval and participant written informed consent, we collected complete data on 11 volunteers. Inclusion criteria included American Society of Anesthesiologists physical status classification 1 or 2, Mallampati-Samsoon upper airway class 1 or 2, and anesthesiology resident or faculty appointment. Exclusion criteria included a history of hypersensitivity to amide-type local anesthetics, seizure disorder, bleeding disorder, hypertension, or oropharyngeal disease. A crossover design was used, such that each participant received all three routes of lidocaine local anesthetic administration in a randomized order. Each administration was separated by a minimum of 96 h. An 18-gauge peripheral intravenous cannula was inserted, and 0.2 mg glycopyrrolate (A.H. Robbins, Richmond, VA) was administered as an antisialagogue 30 min before each study. Three routes of lidocaine local anesthetic administration were used.

*Swish and Gargle (S\&G)*

Fifteen milliliters of 2% viscous lidocaine (Roxane Labs, Columbus, OH) was administered using a swish-and-gargle technique for 2 min. The viscous lidocaine was then expectorated.

*Swish and Gargle plus Spray (S\&G/spray)*

Fifteen milliliters of 2% viscous lidocaine was administered using the swish-and-gargle technique. Two minutes later, 100 mg Xylocaine 10% oral spray (Astra Pharmaceutical Products, Westborough, MA) was applied as single sprays bilaterally to the soft palate, posterior oropharyngeal wall, palatopharyngeal arch, and base of the tongue, as well as two sprays to the vallecula region using a disposable spray cannula (for ten sprays in total).

*Swish and Gargle plus Glossopharyngeal Nerve Block (S\&G/block)*

Fifteen milliliters of 2% viscous lidocaine was administered using the swish-and-gargle technique. Two minutes later, a 22-gauge Quincke spinal needle (Becton Dickinson, Franklin Lakes, NJ) was inserted to a depth of 0.5 cm at the base of the anterior tonsillar pillar, where the base of the tongue opposes the palatoglossal fold. After negative aspiration tests, 5 ml 1% lidocaine HCl plain (Abbott Laboratories, Chicago, IL) was slowly injected bilaterally.

When local anesthetic administration was complete, the investigators performing laryngoscopy and taking hemodynamic measurements entered the study area. Both were blinded to the route of local anesthetic administration. Continuity was maintained by having the same investigators provide local anesthetic administration (B.T.S.) and perform laryngoscopy (G.S.L.) and hemodynamic measurements (G.F.R.) for all participants throughout the study. Each participant was fitted with a tooth guard and his or her eyes were covered with a cloth drape. Baseline noninvasive mean arterial blood pressure and heart rate were recorded (Series 7010RA; Marquette Electronics, Milwaukee, WI). Five minutes after anesthetic administration was complete, laryngoscopy was performed using a standard laryngoscope handle and a Macintosh-3 blade. Sufficient force was applied to obtain and sustain a grade 1 to 2 laryngoscopic view for 20 s.\(^7\) Noninvasive hemodynamic measurements were recorded at 1-minute intervals for 5 min after laryngoscopy.

After each laryngoscopic procedure was complete, 10-cm visual analogue scales (VAS) were scored by both participants and the laryngoscopist. Participants as-

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essed their impression of local anesthetic administration with VAS scores ranging from “not unpleasant” to “awful, never again” and their impression of the laryngoscopy with separate VAS scores ranging from “not unpleasant” to “intolerable.” The laryngoscopists assessed ease of laryngoscopy and visualization with VAS scores ranging from “no coughing or gagging” to “severe coughing or gagging making laryngoscopy impossible.” Neither the participants nor the laryngoscopist were aware of each other’s scores.

Venous blood samples were obtained from the participants at baseline and 5 and 10 min after lidocaine local anesthetic administration. Serum samples were analyzed for lidocaine concentration (µg/ml) by gas chromatography, which has a limit of detection of 0.01 µg/ml and a sensitivity of ±5%.13

One week after the study (that is, after participants had received all three routes), each participant completed a poststudy questionnaire. They were asked to (1) rank and discuss their impression of the local anesthetic administration route with regard to tolerability of administration and laryngoscopy, and (2) rank and discuss their choice of lidocaine local anesthetic administration route for awake direct laryngoscopy in future patients with anticipated difficult airways (i.e., for use in their clinical practice).

Continuous data are expressed as mean ± standard error of the mean (SEM) and analyzed using one-way analysis of variance. When overall between group significance was present, multiple pairwise comparisons of means (Tukey’s method) were performed. Nominal data are expressed as a proportion and analyzed using the Mantel-Haenszel test. Differences were considered significant at P < 0.05.

Results

Study participants (11 men, 1 woman) were either anesthesia residents (n = 10) or faculty (n = 2). One withdrew before completion of the study secondary to prolonged unilateral oropharyngeal discomfort after a GPN block. His data are not included in the results. Thus complete data were collected for 11 persons. Participant characteristics included age of 30 ± 1 y, weight of 77 ± 4 kg, and height of 177 ± 3 cm. All participants reported tongue and oropharyngeal numbness after each of the three methods.

There was no significant difference in baseline heart rate between the S&G (72 ± 5 bpm), S&G/spray (67 ± 5 bpm), and S&G/block (71 ± 6 bpm) groups. In addition, there was no significant difference in baseline mean arterial blood pressure between the S&G (91 ± 3 mmHg), S&G/spray (95 ± 4 mmHg), and S&G/block (92 ± 4 mmHg) groups. Hemodynamic changes after the 20 s laryngoscopy were not different among the three local anesthetic administration groups (fig. 1). Only the S&G/block group showed a significant increase in heart rate (P < 0.05) in the first minute after direct laryngoscopy. There were no other significant changes in heart rate or mean arterial blood pressure after direct laryngoscopy.

Serum lidocaine concentrations were very low but significantly greater in the S&G/block group at 5 and 10 min (0.5 ± 0.1 and 1.0 ± 0.2 µg/ml) than in the S&G group (fig. 2). There were no significant differences

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Fig. 1. There were no significant differences among the groups in hemodynamic changes after 20 s of awake direct laryngoscopy.
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Fig. 2. Serum lidocaine concentrations before (baseline) and after local anesthetic administration. Serum lidocaine concentrations were significantly higher in the S&G/block group at 5 and 10 min compared with the S&G group. There were no significant differences between the S&G/spray and S&G/block groups.

between the S&G/spray and the S&G/block groups. No individual local anesthetic concentration exceeded 4 μg/ml.

Figure 3 displays participant and laryngoscopist VAS scores. There were no significant differences in “administration” VAS scores (i.e., subject discomfort with local anesthetic administration) among the three groups. Regarding the participants’ impression of discomfort during “laryngoscopy,” the S&G group experienced significantly higher VAS scores (more discomfort) compared with the S&G/spray and S&G/block groups. There was no significant difference between the S&G/spray and S&G/block groups. The laryngoscopist VAS score, assessing ease of laryngoscopy and visualization, revealed a trend ($P < 0.08$) toward less coughing and gagging with S&G/spray compared with S&G and S&G/block. There were no significant differences among groups with regard to the number of participants unable to complete the full 20-s laryngoscopy (S&G = 3; S&G/spray = 2; S&G/block = 1).

Based on the poststudy questionnaire assessing participants’ ability to tolerate local anesthetic at the time of administration and laryngoscopy, 55% of participants ranked S&G/spray as the best method and 18% ranked it as the worst method (fig. 4). Forty-six percent of participants ranked S&G/block as the worst method. Nevertheless, none of these differences were statistically significant.

Ororopharyngeal discomfort lasting 24 h or more was reported by 91% of participants after S&G/block, with four persons (56%) reporting discomfort lasting 3 or more days. No participant reported oropharyngeal discomfort after S&G or S&G/spray. Before this study, 91% of participants ($P < 0.01$) reported GPN blocks as their first choice for use in clinical practice. However, after the study, more participants indicated their preference for S&G/spray (73%) compared with S&G ($P < 0.01$) and S&G/block ($P < 0.05$; fig. 4). Prolonged oropharyngeal discomfort after GPN block was the most common reason for this decision.

The poststudy questionnaire also revealed that most participants would modify at least some aspect of their anesthetic practice as a result of participating in this study. Eight of ten participants who ranked S&G/block as their first choice for awake direct laryngoscopy be-

![Visual Analog Scale](image)

Fig. 3. Participants’ and laryngoscopist’s visual analogue scale (VAS) scores. There were no significant differences in participant “administration” VAS scores among the three groups. Those in the S&G group reported significantly higher “laryngoscopy” VAS scores (i.e., more discomfort during laryngoscopy) compared with participants in the S&G/spray and S&G/block groups ($P < 0.05$). There were no significant differences in the laryngoscopists’ VAS scores assessing ease of visualization, although there was a trend ($P < 0.08$) toward less coughing or gagging in the S&G/spray group.
before the study subsequently ranked S&G/spray as their first choice after the study. These persons reported post-GPN block oropharyngeal discomfort as the reason for the change. In addition to their choice for local anesthetic administration in future patients, other changes would involve using an eye drape and less glycopyrrolate. Participants reported a marked antiala-
gogue effect from 0.2 mg glycopyrrolate given 30 min before laryngoscopy, often lasting 8 h or more.

Discussion

The key to a successful awake direct laryngoscopy is establishing reliable analgesia. Common routes of oropharyngeal local anesthetic administration include swish and gargle, topical spray, pledgets, nebulization, and nerve blocks (bilateral blockade of the lingual branch of the GPN and the internal branch of the super-
ior laryngeal nerve). Methodologic reports and case series have described advantages of using one route of local anesthetic administration over another. However, no study has prospectively compared local anesthetic techniques for awake laryngoscopy in persons who did not receive supplemental opioid or benzodiazepine premedication. Glossopharyngeal blocks have been well described and can be administered through several approaches. This study used the intraoral, anterior tonsillar pillar technique in which 5 ml 1% lidocaine HCl plain was injected bilaterally, which showed no benefit compared with less-invasive methods to establish topical anesthesia.

Previous studies reported variable effectiveness of lidocaine in blunting the hemodynamic response to direct laryngoscopy and intubation. Most studies used either topical or intravenous lidocaine as an adjunct to general anesthesia. Kauto and Heimonen compared viscous lidocaine gargle with aerosolized lido-
caine and found that topical anesthesia by either route attenuated the pressor response to direct laryngoscopy and intubation but had no effect on the heart rate response. Beneficial effects of local anesthetic administration have been reported from studies involving awake procedures (laryngoscopy, bronchoscopy, esophagoscop-

y), although all used supplemental intravenous opi-
oids and benzodiazepines. In this study, the hemodynamic response to direct laryngoscopy in awake unpremedicated persons was significant only in the S&G/block group (with an increase in heart rate 1 min after laryngoscopy). However, the response was clinically modest (<15%) in all three groups, even in the absence of supplemental analgesics and anxiolytics. These results indicate that S&G/block is not superior to S&G or S&G/spray in blunting the hemodynamic response to awake direct laryngoscopy.

Serum lidocaine concentrations 5 and 10 min after S&G/block were significantly higher than after S&G. Nevertheless, mean serum lidocaine concentrations were less than 1 µg/ml at 5 min (i.e., immediately before laryngoscopy) and 10 min after lidocaine administration in all three study groups. Although not measured, serum lidocaine concentrations may have been higher at 20 min but were unlikely to have been clinically significant based on previous studies. Our findings are similar to that of Ayuso and colleagues and suggest that attenuation of hemodynamic and pain responses to awake laryngoscopy after oropharyngeal lidocaine is the result of topical analgesia and not the systemic effects of lidocaine.

Participants recorded clinically higher administration VAS scores (i.e., VAS scores higher than 4, suggesting more discomfort) with S&G/block compared with S&G/spray and S&G routes, although this was not statistically significant. No participant reported pain when the 22-
gauge spinal needle was first placed. However, several reported intense “pressure” during injection of the 5 ml 1% lidocaine. This pressure probably represents stretching or dissection of pharyngeal tissues in the tonsillar region and is not likely related to the needle gauge.

Participants recorded significantly higher laryngoscopy VAS scores with S&G compared with either S&G/spray or S&G/block. However, opioid or anxiolytic premedication might have diminished this difference. Most importantly, this study shows that there is no difference in laryngoscopy VAS scores between S&G/spray and S&G/block. This indicates that GPN block does not offer an advantage over spray in patients with Mallampati-Samsoon upper-airway classification 1 and 2. However, we cannot state which method is advantageous in patients with higher airway classifications, or if advantages of one method exist during awake tracheal intubation. It is also possible that GPN blocks may be advantageous in patients who have blood or heavy secretions in the oropharynx, which may lessen the effectiveness of spray.

The laryngoscopist’s VAS scores revealed a trend (P < 0.08) toward better laryngoscopy and visualization conditions (i.e., less coughing and gagging) after S&G/spray compared with S&G and S&G/block. Several persons in the S&G/block group reported discomfort in the vallecula region during laryngoscopy. Although classic descriptions attribute innervation of the vallecula and anterior surface of the epiglottis to the GPN and innervation of the posterior surface of the epiglottis to the superior laryngeal nerve, there may be considerable sensory overlap in this region. Therefore, it is possible that the 10% lidocaine spray, specifically the two sprays to the vallecula region, provided anesthesia to mucosa innervated by the superior laryngeal nerve that was not adequately anesthetized by the GPN block.

Ten of the eleven participants had performed GPN blocks before the study. Ranking local anesthetic administration routes for awake direct laryngoscopy in patients with anticipated difficult airways, 91% of the anesthesiologists reported S&G/block as their first choice before participating in this study. In contrast, after having experienced GPN blocks themselves as a part of this study, 73% of them ranked S&G/spray as their first choice. The main reason for this change in practice was the prolonged oropharyngeal discomfort after GPN block. Although no participant reported oropharyngeal discomfort after S&G or S&G/spray, four (36%) experienced discomfort lasting 3 or more days after S&G/block. Otolaryngologic examination of the one person who withdrew from the study because of prolonged discomfort failed to reveal evidence of abscess or hemato. We used an injection volume of 5 ml, because this has been suggested to produce a superior laryngeal nerve block as well.12 Perhaps the use of 5 ml of local anesthetic actually stretched or dissected oropharyngeal tissue. This may not have occurred with smaller volumes of local anesthetic (2 ml).13,14 However, use of 5 ml bilaterally has been recommended by several authors,12,14 none of whom reported prolonged oropharyngeal discomfort as a complication. The lack of discomfort in previous studies may be secondary to the administration of perioperative opioids or the presence of an operative procedure that may mitigate or mask oropharyngeal discomfort. Although more participants might have resulted in more statistically significant differences among groups, we decided to end the study based on the many participants reporting prolonged oropharyngeal discomfort after GPN blocks. In addition, the results of this study revealed no clinical advantage for the administration of S&G/block over S&G/spray before awake direct laryngoscopy, even in the absence of oropharyngeal discomfort.

Using a prospective, randomized, single-blinded, crossover design, we evaluated the effects of three common routes of local anesthetic administration for awake direct laryngoscopy. The results of this study suggest that GPN blocks do not provide a superior route with regard to hemodynamic, gag, and subjective pain responses. In fact, bilateral GPN blocks, as performed in this study, may result in prolonged oropharyngeal discomfort. Two minutes of 2% viscous lidocaine swish and gargle followed by 10% lidocaine spray was the local anesthetic method preferred by participants and the laryngoscopist.

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