Transtracheal lidocaine injection reduces the anesthetic requirements in brachial plexus surgeries

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Abstract

**Aim:** The purpose of this study was to evaluate the efficacy of transtracheal lidocaine injection to reduce the anesthetic requirements in patients who underwent brachial plexus surgery under general anesthesia.

**Settings and Design:** This was a prospective randomized controlled study conducted in 40 consecutive adult patients.

**Materials and Methods:** The patients were randomly allotted to two groups of 20 patients each. Group A patients received a transtracheal injection of 4 ml of 2% lidocaine before induction of anesthesia and group B patients did not receive it. The two groups were compared in terms of intraoperative propofol requirements and hemodynamic parameters.

**Statistical Analysis Used:** Statistical analysis was done using Student’s *t*-test for independent samples.

**Results:** The propofol requirements were significantly less in group A in terms of the number of intraoperative events requiring propofol bolus at various time intervals in 3 h duration (4 vs. 77), the number of patients requiring propofol bolus injections (2 vs. 20), propofol infusion (0 vs. 20), and total propofol requirement (6 vs. 377 mg). After induction, patients in group B showed a statistically significant high heart rate, systolic blood pressure, and mean arterial pressure.

**Conclusion:** The present study showed that the group of patients who received transtracheal block with lidocaine had a reduction in the requirement of the induction agent, propofol, and were more stable hemodynamically in the intraoperative period compared to those patients who did not receive transtracheal lidocaine. We conclude that transtracheal injection of lidocaine performed just prior to induction of general anesthesia is an effective alternative to intraoperative propofol infusion when long-acting muscle relaxants are to be avoided.

**Key words:** Brachial plexus surgeries, lidocaine, transtracheal block

INTRODUCTION

The role of muscle relaxants in the safe conduct of general anesthesia is unquestionable as their use is often necessary to help the surgeon achieve the best possible operating conditions. But under certain circumstances, anesthesiologists are compelled to refrain from their use, such as in patients with brachial plexus injury undergoing...
nerve anastomosis. During this kind of surgeries, frequent nerve stimulation is required intraoperatively, either to identify ends of traumatized nerves or to check their integrity. Electric stimulation of a nerve should result in contraction of the muscle it supplies, if the nerve from the point of stimulation up to the muscle has functional continuity. Use of muscle relaxants interferes with conduction of these impulses across the neuromuscular junction, and hence their use is not advocated during brachial plexus surgeries.

Maintaining general anesthesia without muscle relaxants usually requires a deeper plane of anesthesia, mainly for the endotracheal tube tolerance. Deeper planes can be achieved either with higher inspired concentration of volatile anesthetics or by additional doses of induction agents like propofol. Transtracheal injection of a local anesthetic agent abolishes the laryngeal and tracheal stimulation due to the presence of the endotracheal tube, and hence should result in a reduction in requirement of depth of anesthesia.

The purpose of this study was to evaluate the efficacy of transtracheal lidocaine injection to reduce the anesthetic requirements in patients who underwent surgery for brachial plexus injury under general anesthesia.

MATERIALS AND METHODS

This was a prospective randomized controlled study done in 40 consecutive adult patients of American Society of Anesthesiologist (ASA) grade I and II with brachial plexus injury who underwent nerve coaptations or nerve crossovers under general anesthesia. The study was approved by the institutional review board. Written informed consent was obtained from all the patients. The study period was between January 2007 and December 2010.

General anesthesia was induced and maintained in all patients following a standardized protocol. All patients received injection (Inj.) glycopyrrolate 0.2 mg, Inj. midazolam 2 mg, and Inj. morphine 0.2 mg/kg body weight. The patients were randomly allotted to two groups of 20 patients each. Group A patients received a transtracheal injection of 4 ml of 2% lidocaine just before the induction of anesthesia, whereas group B patients did not receive the transtracheal block.

Induction of anesthesia was with Inj. propofol 2.5 mg/kg body weight and intubation of trachea was facilitated with Inj. suxamethonium 2 mg/kg body weight. Intubation was performed with endotracheal tube of 7.5 or 8 mm inner diameter. Anesthesia was maintained with oxygen with nitrous oxide 33%+66% and isoflurane 1% with mechanical ventilation to maintain end-tidal carbon dioxide levels between 30 and 35 mmHg. Heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and mean arterial blood pressures (MAP) were documented at preinduction, 5, 10, 15, 30, 45, 60, 90, 120, and 180 min after induction of anesthesia.

Intraoperatively if there were signs of inadequate depth of anesthesia like patient movements, bucking on endotracheal tube, tachycardia (HR > 100/min), or hypertension (SBP > 140 mmHg), the plane of anesthesia was deepened with a bolus of propofol 30 mg intravenously. If a patient needed more than three boluses of propofol in 30 min or less, IV infusion of propofol was started at a rate of 10 ml/h. Thereafter, if required, intermittent injection of 30 mg of propofol intravenously was repeated.

The two groups were compared in terms of the following:
- Number of intraoperative events requiring propofol bolus at various time intervals in 3 h duration,
- Number of patients requiring propofol bolus injections,
- Number of patients requiring propofol infusion,
- Number of patients requiring intermittent propofol injections even after starting propofol infusion,
- Maximum duration up to which a propofol bolus was required,
- Total propofol requirement (bolus + infusion + additional injections) in milligrams at various time intervals,
- The difference between preinduction HR value and HR values at various time intervals, and
- The difference between preinduction MAP value and MAP values at various time intervals.

Statistical analysis was done using Student’s t-test for independent samples. 95% confidence intervals were also worked out. The level of statistical significance (P value) was taken as less than 0.05.

RESULTS

Table 1 summarizes the results of comparisons between the groups in terms of propofol requirement. The number of intraoperative events needing propofol was significantly higher in group B up to 45 min. After 45 min, there was no significant difference between the groups until 90 min. After 90 min, no patient in group A or B had any events necessitating propofol administration [Table 2]. In group A, 30 min post induction, no patient needed intermittent propofol bolus. But in group B, all patients required first bolus of propofol within 15 min intraoperatively.

No patient required propofol infusion in group A, whereas all patients in group B needed propofol infusion by 30 min. In group B, 9 out of 20 patients required propofol infusion to be started within 15 min post induction. In the remaining 11 patients also, propofol infusion was started within 30 min post induction. In addition to IV infusion of propofol, 11 patients in group B still required intermittent injections of propofol.
intraoperatively. Total propofol requirement was markedly high in group B at all time intervals [Table 3]. The mean propofol requirement per patient in group A was 6 mg, whereas in group B it was 376.75 mg.

When hemodynamic parameters of both groups were compared, it was observed that preinduction rather values were comparable between both groups. But after induction, patients in group B showed a statistically significant high HR than patients in group A up to 45 min intraoperatively. But later, the HR between groups did not show statistically significant difference at 60, 90, and 120 min, except at 180 min [Table 4, Figure 1].

When the SBP values of both groups were compared, it was seen that preinduction SBP values were statistically comparable between both groups. But after induction, group B patients showed a statistically significant high SBP than group A patients at 5, 10, 30, and 45 min intraoperatively. At 15, 60, 90, 120, and 180 min, SBP between groups did not show statistically significant difference [Table 5, Figure 2].

**DISCUSSION**

Intraoperatively, in patients with brachial plexus injury undergoing surgical nerve repair (nerve coaptations and crossovers), direct nerve stimulation is required and the use of long-acting muscle relaxants is not advocated. Using long-acting muscle relaxants and reversing their effects with neostigmine intraoperatively, as in wake-up test during scoliosis surgery[1] or after carotid endarterectomy,[2] is not practical in these surgeries as nerve stimulation will be required frequently in the intraoperative period.

Minimum alveolar concentration (MAC) which causes immobility in 50% of patients for intubation is always higher than the MAC for incision for all the volatile anesthetic agents, implying that stimulus from trachea due to presence of endotracheal tube in the trachea is more intense than surgical stimulus. Hence, anesthetizing larynx and trachea results in a reduction in requirement of depth of anesthesia intraoperatively. Though the lower airway can be anesthetized by several ways, transtracheal injection of local anesthetic provides the most reliable and definite block.

Transtracheal administration of local anesthetics is commonly used during bronchoscopy done in awake patients[3,4] and is also performed immediately prior to induction of general anesthesia to reduce the stress response and to prevent cardiac dysrhythmias[5] during laryngoscopy and intubation.[6] Cough reflex elicited from transmitted pressure on the trachea during thyroidectomies performed under local anesthesia can be abolished with transtracheal injection of local anesthetics.[7] It is also reported as effective in the treatment for post-extubation stridor.[8]

The present study has shown that the group of patients who received transtracheal block with lidocaine had a statistically significant reduction in intraoperative events needing additional doses of the induction agent,
propofol. The dose of propofol used to deepen the plane of anesthesia in this group was significantly low.

Providing patient immobility with propofol boluses or infusion is not an easy task. A dose that does not compromise the hemodynamic stability and at the same time provides adequate depth of anesthesia has to be determined. A higher dose can result in profound hypotension, compromising patient safety. Too low a dose can result in a poor surgical condition brought about by patient movements in response to surgical stimuli or coughing on movements of the head or neck. There can be individual variations in response to effects of propofol also.

The present study has shown that the patients in whom transtracheal block with lidocaine was done also

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**Table 4: Mean and SD of difference between preinduction HR value and HR values at various time intervals**

| Preinduction | Group A | Group B | t value | P value |
|--------------|---------|---------|---------|---------|
| Difference of mean from preinduction value | 75.7 (Mean) 7.035 (SD) | 78.6 (Mean) 8.255 (SD) | −1.17 | NS |
| Time (min) | | | | |
| 5 | 3.25 | 11.95 | 27.15 | 11.69 | −6.23 | 0.000 |
| 10 | 5.72 | 19 | 28.15 | 19.29 | −3.62 | 0.003 |
| 15 | 1.55 | 10.72 | 42.7 | 12.57 | −10.86 | 0.000 |
| 30 | 5.05 | 14.3 | 27.6 | 12.71 | −5.14 | 0.000 |
| 45 | 2.4 | 12.1 | 27.3 | 21.08 | −4.47 | 0.000 |
| 60 | −7.25 | 13.09 | 2.55 | 20.57 | −1.75 | NS |
| 90 | 2.45 | 10.69 | 2.2 | 13.09 | 0.06 | NS |
| 120 | 3.55 | 12.31 | −3.7 | 11.12 | 1.91 | NS |
| 180 | 6.8 | 8.29 | | | | |

HR = Heart rates

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**Table 5: Mean and SD of difference between preinduction SBP value and SBP values at various time intervals**

| Preinduction | Group A | Group B | t value | P value |
|--------------|---------|---------|---------|---------|
| Difference of mean from preinduction value | 122.55 (Mean) 9.144(SD) | 122.25 (Mean) 6.298 (SD) | 0.12 | NS |
| Time (min) | | | | |
| 5 | −16.7 | 13.14 | 14.2 | 12.85 | −7.32 | 0.000 |
| 10 | −3.15 | 11.78 | 17.45 | 13.35 | −5.04 | 0.000 |
| 15 | 0.85 | 15.40 | 9.05 | 18.17 | −1.5 | NS |
| 30 | 0.55 | 11.18 | 21.65 | 16.19 | −4.54 | 0.000 |
| 45 | −0.3 | 10.38 | 11.8 | 17.97 | −2.54 | 0.02 |
| 60 | −1.7 | 12.48 | −1.35 | 11.16 | −0.09 | NS |
| 90 | 1 | 12.31 | 0.25 | 12.20 | 0.19 | NS |
| 120 | −7.2 | 11.73 | −2.6 | 8.67 | −1.38 | NS |
| 180 | −1.6 | 12.51 | −2.9 | 11.53 | 0.33 | NS |

SBP = Systolic blood pressure

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**Figure 1:** Graph showing the mean heart rate at the preinduction and at various time intervals intraoperatively

**Figure 2:** Graph showing the mean systolic blood pressure in millimeters of mercury (SBP, mm of Hg) at the preinduction and at various time intervals intraoperatively
more stable hemodynamically in the intraoperative period compared to those patients who did not receive transtracheal lidocaine. During the initial period of the study, HR, SBP, and MAP remained high in group B, but the observation was not consistent [Table 6, Figure 3]. This can be explained by the fact that most of the patients in group B had started to receive propofol boluses as early as 10 min and they continued to receive propofol either as repeated boluses, infusion, or both, during rest of the surgery, which might have helped to bring down the HR and arterial pressures in this group.

Transtracheal block is a simple, easy, and commonly performed procedure. Contraindications for the technique are limited, like bleeding disorders, local infection, or mass in lower neck. Since this is an invasive technique and has to be given before induction of anesthesia, some amount of patient discomfort can occur. Another disadvantage is that airway reflexes will take time to return and may result in delayed extubation if this technique is used in short surgeries.

While conducting this study, we did not come across any delay in extubation, which may be probably because all surgeries in our study lasted more than 3 h. Early extubation following a short surgery in a patient who received transtracheal block will make patients prone for aspiration in the event of regurgitation. But this can be easily overcome by delaying extubation till protective airway reflexes return. There is no need for postoperative ventilation as such; oxygen supplementation with a T piece with the patient breathing spontaneously will be more than sufficient as the patient will comfortably tolerate the endotracheal tube due to absence of airway reflexes.

Indications for this technique are not just limited to brachial plexus surgeries. The extended indications of this technique would be in parotidectomy (for the purpose of nerve identification), myasthenia gravis, and Guillain-Barré syndrome, where anesthetic safety can be improved by avoidance of muscle relaxants. Based on our experience and the above evidence, we recommend transtracheal block as a safe and successful alternative to propofol infusion during surgeries where muscle relaxants are to be avoided.

**CONCLUSIONS**

The present study showed that the group of patients who received transtracheal block with lidocaine had a significant reduction in the requirement of the induction agent, propofol, intraoperatively. The present study also showed that the patients who received transtracheal block with lidocaine were more stable hemodynamically in the intraoperative period compared to those patients who did not receive transtracheal lidocaine. Hence, we conclude that transtracheal injection of lidocaine performed just prior to induction of general anesthesia is an effective alternative to intraoperative propofol infusion when long-acting muscle relaxants are to be avoided.

**Table 6: Mean and SD of difference between preinduction MAP value and MAP values at various time intervals**

| Time (min) | Group A | Group B |
|------------|---------|---------|
| 5          | 93.25 (Mean) ± 8.154 (SD) | 93.18 (Mean) ± 6.229 (SD) |
| 10         | 7.92 (Mean) ± 6.21 (SD) | 7.60 (Mean) ± 5.87 (SD) |
| 15         | 3.85 (Mean) ± 8.38 (SD) | 1.5 (Mean) ± 7.48 (SD) |
| 30         | 9.32 (Mean) ± 9.59 (SD) | 5.87 (Mean) ± 7.60 (SD) |
| 45         | 3.85 (Mean) ± 8.38 (SD) | 1.5 (Mean) ± 7.48 (SD) |
| 60         | 2.58 (Mean) ± 9.10 (SD) | 2.58 (Mean) ± 9.10 (SD) |
| 90         | 2.58 (Mean) ± 9.10 (SD) | 2.58 (Mean) ± 9.10 (SD) |
| 120        | 2.58 (Mean) ± 9.10 (SD) | 2.58 (Mean) ± 9.10 (SD) |
| 180        | 2.58 (Mean) ± 9.10 (SD) | 2.58 (Mean) ± 9.10 (SD) |

**Figure 3:** Graph showing the mean arterial pressure in millimeters of mercury (MAP, mm of Hg) at the preinduction and at various time intervals intraoperatively.
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