ESMOLOL HYDROCHLORIDE FOR MANAGEMENT OF THE CARDIOVASCULAR STRESS RESPONSES TO LARYNGOSCOPY AND TRACHEAL INTUBATION

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SUMMARY

In a double-blind, randomized, controlled prospective study, 30 grade ASA I/II patients received a continuous i.v. infusion of normal saline or esmolol hydrochloride before induction of anaesthesia and tracheal intubation. Arterial pressure and heart rate were measured to assess the pressor response to laryngoscopy and intubation. The heart rate decreased in the esmolol group before induction of anaesthesia. The pressor response to laryngoscopy was significantly less marked in the esmolol group.

KEY WORDS


Laryngoscopy and tracheal intubation frequently induce a cardiovascular stress response, characterized by hypertension, tachycardia and increased serum concentrations of catecholamines [1]. This sympathoadrenal response to laryngoscopy results in an increase in cardiac workload which, in turn, may culminate in perioperative myocardial ischaemia and acute heart failure in susceptible individuals [2]. This response is undesirable in any patient with heart disease undergoing surgery, irrespective of the nature of surgery.

Esmolol hydrochloride is a relatively new cardioselective, i.v. beta adrenoceptor antagonist. It has a rapid onset of action, exerts a peak haemodynamic effect within minutes and possesses a short elimination half-life of 9 min [3]. Consequently, it should prove ideal for control of the short-lived haemodynamic sequelae associated with laryngoscopy and intubation [1].

This study was undertaken to compare the haemodynamic effects of laryngoscopy and tracheal intubation during an infusion of esmolol or an infusion of placebo (normal saline) in anaesthetized ASA I/II patients.

METHODS AND RESULTS

After obtaining hospital Ethics Committee approval and written, informed consent, we studied 30 ASA I/II patients undergoing laryngoscopy and intubation for elective abdominal surgery.

All patients were premedicated with diazepam 0.15 mg kg⁻¹ orally 2 h before operation. An 18-gauge i.v. cannula was inserted under local anaesthesia into a peripheral vein and a continuous i.v. infusion of esmolol or normal saline was administered for 10 min before the induction of anaesthesia. Patients in the study group received esmolol 500 μg kg⁻¹ min⁻¹ for 2 min as a loading dose and thereafter a maintenance infusion of 100 μg kg⁻¹ min⁻¹. This infusion was maintained for 5 min after tracheal intubation unless significant bradycardia (50 beat min⁻¹ or less), hypotension (systolic arterial pressure 90 mm Hg or less, or > 30% decrease from baseline), or both occurred. The control group received only normal saline.

After 10 min, anaesthesia was induced with thiopentone 5 mg kg⁻¹ and suxamethonium 1.5 mg kg⁻¹ was given to facilitate tracheal intubation. After manual ventilation of the lungs with 100% oxygen for 30-60 s, laryngoscopy and tracheal intubation were performed by the same investigator on each occasion and the duration of laryngoscopy noted. After intubation, the lungs were ventilated manually with 66% nitrous oxide and 1% isoflurane in oxygen until spontaneous ventilation resumed. No opioid analgesics or non-depolarizing neuromuscular blocking drugs were administered during the study.

Heart rate was recorded using an ECG and systolic, diastolic and mean arterial pressure were recorded non-invasively using a Dinamap automatic pressure machine. These measurements were made at 1-min intervals during the infusion period, but at 30-s intervals during laryngoscopy and intubation. Any deleterious cardiovascular events were noted.

Parametric data, including weight, baseline heart rate and arterial pressure were compared using unpaired Student’s t test. Changes in heart rate, arterial pressure and rate-pressure product were analysed also using unpaired Student’s t test and these were validated by analysis of covariance.

There were no significant differences between the two groups in age and weight. In addition, there were no significant differences between the two groups in the two principal response variables (systolic arterial pressure and heart rate) before induction of anaesthesia and tracheal intubation, respectively.
Table I. Systolic arterial pressure (SAP) and heart rate (HR) changes (mean (SD)). RPP = Rate-pressure product. Significant differences between groups: *P < 0.05; **P < 0.001

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<tr>
<th></th>
<th>Group A (esmolol)</th>
<th>Group B (normal saline)</th>
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<tbody>
<tr>
<td><strong>SAP (mm Hg)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>133 (16)</td>
<td>139 (14)</td>
</tr>
<tr>
<td>Before induction</td>
<td>130 (14)</td>
<td>135 (14)</td>
</tr>
<tr>
<td>Maximum after intubation</td>
<td>151 (18)</td>
<td>188 (23)** **</td>
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<tr>
<td><strong>HR (beat min⁻¹)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseline</td>
<td>79 (9)</td>
<td>83 (13)</td>
</tr>
<tr>
<td>Before induction</td>
<td>68 (5)</td>
<td>83 (13)** **</td>
</tr>
<tr>
<td>Maximum after intubation</td>
<td>92 (9)</td>
<td>110 (17)** **</td>
</tr>
<tr>
<td>Maximum RPP</td>
<td>13393 (1820)</td>
<td>19947 (4750)** **</td>
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The major finding of this study is that the maximum rate-pressure product recorded in association with laryngoscopy and tracheal intubation was reduced significantly in patients who received an infusion of esmolol hydrochloride. In addition, the regimen of esmolol used in this study did not result in any deleterious sequelae associated with beta adrenergic block.

Several techniques have been used with varying degrees of success to obtund the pressor response to laryngoscopy and intubation including i.v. or topical lignocaine, thoracic extradural analgesia, i.v. opioids and peripheral vasodilators. However, none of these techniques has gained widespread acceptance.

Current beta blockers have a relatively long duration of action and, in some cases, lack cardioselectivity. Esmolol possesses several properties which suggest that it might be valuable in obtunding responses to laryngoscopy and intubation. First, it is a highly cardioselective agent, analogous to metoprolol, and so is unlikely to induce bronchospasm. Second, it undergoes rapid esterase-mediated metabolism, characterized by an elimination half-life of 9.2 min and a total body clearance of 285 ml min⁻¹, culminating in a rapid offset of action when the infusion is discontinued [3]. Finally, significant drug interactions have not been reported yet and the only adverse effects reported, thus far, have been hypotension and thrombophlebitis at the site of injection. The latter sequela may be avoided by careful dilution of the agent (5 mg ml⁻¹) and the judicious use of doses.

Esmolol has been administered, with success, as a bolus injection to obtund the pressor response to laryngoscopy [4]. We preferred to use an infusion as it was felt this would be less likely to cause acute hypotension and bradycardia. In addition, an infusion enabled us to record the effects of esmolol before stimulation.

A rate-pressure product greater than 15000, which is considered undesirable in patients with coronary artery disease, was recorded in only one patient in the study group, who was subjected to the only prolonged laryngoscopy [5]. However, only two patients in the control group recorded a maximum product less than 15000. In both groups the cardiovascular response was instantaneous, peaking within 2 min of intubation in all patients, and was transient. This finding is consistent with the results of other authors [6].

It is the opinion of the authors that the anaesthetic technique used here, although widespread, is inappropriate in patients with significant cardiorespiratory disease and hence only ASA grade I/II patients were studied. We conclude that a continuous i.v. infusion of esmolol hydrochloride is a safe and effective technique for suppressing the cardiovascular stress response associated with laryngoscopy and intubation.

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References