A series of thyroplasty cases under general anaesthesia

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Thyroplasty is an operation on the upper airway to improve voice quality in patients with unilateral vocal cord paralysis. It requires access to an uninstrumented larynx and a functional assessment of vocal cord medialization. It is a difficult anaesthetic procedure that requires sharing the airway with the surgeon. We describe an anaesthetic technique to give good operating conditions and a safe airway, using total intravenous anaesthesia, a laryngeal mask airway and intraoperative fibreoptic endoscopic assessment of the larynx, and present a series of 13 patients. Other anaesthetic techniques for thyroplasty are described and discussed.

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Type 1 thyroplasty is a form of medialization laryngoplasty which is used to improve laryngeal competence and voice quality in patients with unilateral adductor vocal cord paralysis. It was first described by Isshiki in 1974, and has become popular since the late 1980s. It involves cutting a window in the thyroid ala lateral to the vocalis muscle. A silastic implant is then placed within this window between the inner and outer perichondrium. The paralysed vocal cord is displaced medially sufficient to abut against the non-paralysed vocal cord in adduction, hence achieving laryngeal closure.

Several different anaesthetic techniques have been described for thyroplasty. These include local anaesthesia both alone and combined with midazolam sedation and flumazenil reversal. General anaesthesia has been used for part of the procedure. Such techniques all require the patient to be awake and able to phonate to allow the surgeon to judge optimal vocal cord medialization. However, it can be difficult to perform precision surgery on the larynx in the awake patient if manipulation of the larynx leads to reflex responses such as swallowing and coughing. The technique we describe uses continuous general anaesthesia, and provides a quiet operative field. This facilitates exact surgery and allows an accurate assessment of vocal cord medialization. A single case report, employing a similar technique was published, which showed a successful outcome.

Method
Between May 1997 and January 2000, 13 adult patients with unilateral adductor vocal paralysis underwent a thyroplasty operation performed by the same surgeon using the following anaesthetic technique.

Temazepam 20 mg orally, was given as pre-medication. Anaesthetic monitoring consisted of ECG, non-invasive blood pressure, pulse oximetry and capnography. A total intravenous (i.v.) anaesthetic technique used a target controlled infusion of propofol (4–10 µg ml⁻¹). After induction of anaesthesia, a standard laryngeal mask airway (LMA¹) was inserted in the normal manner. A fibreoptic intubating endoscope was passed down the LMA to verify that the vocal cords were clearly visible through the distal aperture. Correct preoperative placement of the LMA is an essential requirement for thyroplasty using our technique. The breathing circuit was connected to the LMA using a catheter mount incorporating a rubber seal suction port. The patients breathed an oxygen enriched air mixture spontaneously. Small incremental i.v. doses of alfentanil were given as needed. Infiltration of the operation site with a mixture of lignocaine and epinephrine was carried out by the surgeon.

During the procedure a wide-bore flexible endoscope with an attached video camera was inserted through the suction port of the catheter mount and passed down the LMA. The resulting image of the vocal cords was displayed on a television screen. The surgeon used this image to carry out the thyroplasty and achieve optimal medialization of the paralysed vocal cord. Additional confirmation of a satisfactory airway was given by the presence of an adequate respiratory excursion of the breathing circuit reservoir bag and the display of a normal capnograph trace assessed both pre and postoperatively.

¹LMA® is the property of Intervent Limited.
Table 1 Patient data, measured range of parameters during thyroplasty surgery and complications observed peri and postoperatively

<table>
<thead>
<tr>
<th>Patient no.</th>
<th>Age (yr)</th>
<th>Primary condition causing vocal cord palsy</th>
<th>Duration of procedure (min)</th>
<th>(F_\text{OTU})</th>
<th>Pulse oximetry saturation (%)</th>
<th>(ET\text{CO}_2) (mm Hg)</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td>Closure of PDA</td>
<td>100</td>
<td>0.7</td>
<td>99</td>
<td>35–36</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>76</td>
<td>L. Radical pneumonectomy</td>
<td>110</td>
<td>0.6–1</td>
<td>93–99</td>
<td>52–60</td>
<td>Displaced LMA</td>
</tr>
<tr>
<td>3</td>
<td>73</td>
<td>L. Lung squamous cell carcinoma</td>
<td>135</td>
<td>0.5</td>
<td>92–98</td>
<td>47–62</td>
<td>Perforation of perichondrium</td>
</tr>
<tr>
<td>4</td>
<td>67</td>
<td>Squamous oesophageal carcinoma mediastinal nodes</td>
<td>130</td>
<td>0.6</td>
<td>98–99</td>
<td>56–61</td>
<td>None</td>
</tr>
<tr>
<td>5</td>
<td>54</td>
<td>L+R Lung adenocarcinoma</td>
<td>110</td>
<td>0.6</td>
<td>95–98</td>
<td>52–68</td>
<td>Wound breakdown post-op</td>
</tr>
<tr>
<td>6</td>
<td>54</td>
<td>L. Upper lobectomy clear cell carcinoma</td>
<td>95</td>
<td>0.9</td>
<td>95–98</td>
<td>52–68</td>
<td>None</td>
</tr>
<tr>
<td>7</td>
<td>51</td>
<td>L. Lung adenocarcinoma</td>
<td>115</td>
<td>0.9</td>
<td>97–99</td>
<td>37–54</td>
<td>None</td>
</tr>
<tr>
<td>8</td>
<td>67</td>
<td>L. Lung squamous cell carcinoma</td>
<td>90</td>
<td>0.5–0.6</td>
<td>99</td>
<td>30–61</td>
<td>None</td>
</tr>
<tr>
<td>9</td>
<td>61</td>
<td>Chronic fibrotic lung disease</td>
<td>80</td>
<td>0.8–0.9</td>
<td>97–98</td>
<td>50–74</td>
<td>None</td>
</tr>
<tr>
<td>10</td>
<td>69</td>
<td>L. Lung small cell carcinoma</td>
<td>90</td>
<td>0.5</td>
<td>93–98</td>
<td>35–36</td>
<td>None</td>
</tr>
<tr>
<td>11</td>
<td>75</td>
<td>L. Lung adenocarcinoma</td>
<td>145</td>
<td>0.5–1</td>
<td>97–99</td>
<td>40–68</td>
<td>Laryngeal oedema, difficult to ventilate ....</td>
</tr>
<tr>
<td>12</td>
<td>80</td>
<td>Thyroidectomy</td>
<td>120</td>
<td>1.0</td>
<td>99</td>
<td>35–36</td>
<td>None</td>
</tr>
<tr>
<td>13</td>
<td>57</td>
<td>L. Upper lobectomy squamous cell carcinoma</td>
<td>70</td>
<td>0.8</td>
<td>97–98</td>
<td>44–56</td>
<td>None</td>
</tr>
</tbody>
</table>

At the conclusion of surgery the propofol infusion was discontinued and the patient transferred to the recovery room. The LMA was removed upon emergence of the patient from anaesthesia. Requirement for analgesics after operation was minimal, and simple oral paracetamol based preparations were sufficient.

Results

Patient data are summarized in Table 1. There were seven females and six males in our study, mean age 61.8 yr (range 20–80 yr). All patients had a reasonable preoperative exercise tolerance and were predicted to breathe spontaneously under general anaesthesia satisfactorily. The condition causing vocal cord palsy was metastasizing bronchial carcinoma (six patients), oesophageal carcinoma (one patient) and a chronic fibrosing lung condition (one patient). In the remaining five patients surgical trauma had caused vocal cord palsy. The youngest and fittest patient in our series had hoarseness from a patent ductus arteriosus operation in infancy.

The fractional inspired oxygen concentration during the procedure ranged from 0.5 to 1.0. All the patients breathed spontaneously. The lowest pulse oxygen saturation during the procedure was 92%. End tidal \(P_{\text{CO}_2}\) ranged from 30 to 74 mm Hg. Of the 13 thyroplasties performed in this series only one has been incomplete. Twelve patients have had good results from their thyroplasty as judged by an improvement in voice quality. Voice quality was assessed before and after surgery with a standard set of phonation exercises. An improvement in cough effort and clearance of respiratory secretions was reported but this was not assessed objectively.

There were three anaesthetic complications. The first involved partial misplacement of the LMA and caused repeated short episodes of airway obstruction associated with surgical dissection of thyroid ala.

![Fig 1 Fibreoptic instrumentation of the LMA used to enable visualization of the vocal cords.](image-url)

When the fibreoptic endoscope was passed down the LMA the epiglottis was seen folded under the LMA and was partially obstructing the laryngeal inlet. The LMA was removed, correctly re-positioned and the thyroplasty then proceeded uneventfully. As a result of this complication we now check LMA placement in the anaesthetic room with the fibre scope and have had no further intraoperative problems with LMA placement. The second complication involved the intraoperative displacement of the silastic block perforating through the inner perichondrium and mucosa into the larynx. A small haematoma occurred but this was not associated with any clinical or endoscopic signs of airway obstruction.

The third complication occurred in the eleventh patient of our series. This case was surgically very difficult and involved numerous attempts at securing optimal vocal cord
medialization. The patient became stridulous; endoscopically both vocal cords could be clearly seen becoming increasingly oedematous. On anaesthetic advice this thyroplasty was abandoned. Dexamethasone 16 mg was given i.v., and epinephrine 5 mg was nebulised in oxygen down the LMA. The stridor decreased and by the time of LMA removal, in the recovery room, had largely resolved. During this episode of laryngeal oedema the oxygen saturation on 100% oxygen remained between 97 and 99% and the end-tidal carbon dioxide ranged between 40 and 68 mm Hg.

**Discussion**

The surgical impetus for thyroplasty stems from the expectation that it produces better voice quality in unilateral vocal cord paralysis than the conventional para-vocal cord injection of teflon. Surgery on the shared airway is challenging for the anaesthetist. This technique provides a safe anaesthetic airway and optimal operating conditions for the surgeon.

General anaesthesia for thyroplasty facilitates precision surgery with a quiet surgical field and suppression of reflex responses, which occur during laryngeal manipulation on an awake patient. By using an LMA the larynx remains uninstrumented and yet the airway is secure. The LMA also provides a conduit for fibroptic endoscopic assessment of vocal cord medialization. A functional assessment of airway patency at the time of the thyroplasty can also be made as the patient is breathing spontaneously. If breathing becomes inadequate positive pressure ventilation can be given via the LMA. This technique gives more airway control than to sedation techniques. The assessment of optimal vocal cord medialization can occur under anaesthesia during the procedure, so that the patient does not have to wake until the end of the operation compared with previous general anaesthetic techniques. With an oxygen/air mixture endoscopy is tolerated without any decrease in oxygen saturation.

Thyroplasty can cause airway obstruction by haematoma or oedema. Intraoperative stridor due to laryngeal oedema occurred in one of the above cases and responded to nebulized epinephrine and i.v. steroid. However, surgery was abandoned. We keep a cylinder containing a mixture of helium and oxygen available for the stridulous patient, but so far it has not been used. Facilities for emergency tracheostomy are mandatory during this procedure.

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**References**

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