EARLY EXTUBATION OF THE TRACHEA AFTER OPEN HEART SURGERY FOR CONGENITAL HEART DISEASE

A review of 3 years' experience

J. L. SCHULLER, J. G. BOVILL, A. NIJVELD, M. R. PATRICK AND C. MARCELLETTI

SUMMARY

The results of early extubation after open heart surgery for congenital heart disease in 209 consecutive patients have been reviewed. No patient younger than 3 months of age, 52% of those between 3 and 12 months, and 88% of those older than 12 months had the tracheal tube removed in the operating theatre. Four patients required reintubation of the trachea, three because of respiratory difficulty and one because of cerebral oedema. There were two deaths in the extubated group. Twelve patients had $P_{aO_2}$ values less than 8.0 kPa after operation, despite adequate oxygen therapy. In four of these, this was related to persistent intracardiac shunting. It is concluded that early extubation after open heart surgery for congenital heart disease has minimal risk in carefully selected patients.

Mechanical ventilation is used widely in the management of patients following open heart surgery (Hinds, 1982). However, it has been suggested (Quasha et al., 1980) that, in adults undergoing coronary artery surgery, early extubation of the trachea can have certain advantages such as a decrease in the need for sedation, and less cardiopulmonary morbidity.

In a study in children following cardiac and thoracic surgery, Barash and colleagues (1980) reported less patient discomfort, a shorter duration of stay in the intensive care unit and fewer respiratory complications after early extubation of the trachea. We have reported previously on the theoretical advantages and the practical feasibility of early extubation in patients undergoing a Fontan operation (Schuller et al., 1980). In this communication we describe our experiences with early extubation after a wider variety of open heart operations in children.

PATIENTS AND METHODS

Hospital records of all patients aged 18 yr or younger who underwent open heart surgery for congenital heart disease in our centre between June 1978 and June 1981 were reviewed retrospectively. Six patients who died in the operating theatre were excluded. Premedication was as follows:

- < 1 month of age: atropine 0.05–0.1 mg s.c.
- 1–10 months of age: atropine 0.01 mg kg$^{-1}$ i.m. and morphine 0.10–0.15 mg kg$^{-1}$ i.m.
- > 10 months of age: atropine 0.01 mg kg$^{-1}$ i.m. up to a maximum of 0.5 mg, morphine 0.10–0.15 mg kg$^{-1}$ i.m. up to a maximum of 10 mg and diazepam 0.3 mg kg$^{-1}$ orally up to a maximum of 10 mg.

A variety of drugs was used for the induction of anaesthesia: cyclopropane or halothane by inhalation, methohexitone 1–2 mg kg$^{-1}$ or ketamine 2 mg kg$^{-1}$ i.v. Pancuronium 0.1 mg kg$^{-1}$ was given to provide neuromuscular blockade, and the lungs were ventilated with either 100% oxygen or 50–65% nitrous oxide in oxygen using a Siemens-Servo ventilator. Anaesthesia was maintained with 0.5% halothane supplemented with fentanyl 10 μg kg$^{-1}$.

During cardiopulmonary bypass a constant positive airway pressure of 0.3–0.6 kPa was applied to the lungs. Cardiac arrest was achieved with a high potassium-containing crystalloid cardioplegic solution at 4°C. During or after cardiopulmonary bypass, frusemide was given when required to maintain an adequate urinary output. Discontinuation of cardiopulmonary bypass was not attempted until the nasopharyngeal temperature had reached 37°C. Concentrated red cells and fresh frozen plasma were given to replace blood volume. When, despite adequate volume loading, arterial pressure was 10–15% less than normal for the age of the child, inotropic
support was started. Our initial choice was dopamine, except when the heart rate was slow, when isoprenaline was preferred.

At the end of surgery, the patient was considered to be haemodynamically stable when the arterial pressure was normal for the age of the child with physiological or only moderately increased filling pressures, the peripheral circulation was good and there was no metabolic acidosis. Arterial oxygenation was considered to be adequate when arterial oxygen tensions \( (P_{\text{A}}O_2) \) after bypass were greater than 10 kPa \( (F_{\text{I}}O_2 \, 0.35-0.5) \) except in patients who, as a result of the nature of the surgery performed, were known to have persistent intracardiac right-to-left shunting.

Patients who had adequate gas exchange, were haemodynamically stable and had temperatures greater than 35°C received atropine 0.02 mg kg\(^{-1}\) and neostigmine 0.06 mg kg\(^{-1}\), and were allowed to breathe through a Mapleson C system. Ventilation was considered adequate when quiet breathing without nasal flaring, chest wall retraction or distress was present. Major changes in haemodynamic variables occurring after the start of spontaneous breathing were indications to restart mechanical ventilation. After 5 min of spontaneous breathing the trachea was extubated in those patients who responded to commands or, in the case of infants, those who opened their eyes and showed return of normal spontaneous activity. Patients not fulfilling these criteria within 20 min were either left breathing spontaneously through a T-piece system or returned to mechanical ventilation.

Following extubation, oxygen was given by face

**Table 1. Details of operations and patients (numbers of deaths after operation in parentheses)**

<table>
<thead>
<tr>
<th>Operation Description</th>
<th>Extubated group</th>
<th>T-piece group</th>
<th>Ventilated group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closure of secundum atrial septal defect</td>
<td>23</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Closure of incomplete atrioventricular septal defect</td>
<td>6</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Closure of complete atrioventricular septal defect</td>
<td>2</td>
<td>—</td>
<td>3 (1)</td>
</tr>
<tr>
<td>Correction of pulmonic stenosis (infundibular, valvular, supravalvular)</td>
<td>23</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Correction of aorta stenosis (valvular, subvalvular, supravalvular, including 1 Konno Rastan operation)</td>
<td>20</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Closure of ventricular septal defect (including 5 residual)</td>
<td>36 (1)</td>
<td>—</td>
<td>4</td>
</tr>
<tr>
<td>Total correction of tetralogy of Fallot (all with outflow patch enlargement)</td>
<td>26</td>
<td>1</td>
<td>2 (1)</td>
</tr>
<tr>
<td>Mustard or Senning operation (including 7 reoperations)</td>
<td>8 (1)</td>
<td>1</td>
<td>10 (1)</td>
</tr>
<tr>
<td>Fontan operation</td>
<td>14</td>
<td>2</td>
<td>4 (4)</td>
</tr>
<tr>
<td>Right ventricle outflow patch enlargement</td>
<td>2</td>
<td>—</td>
<td>3 (1)</td>
</tr>
<tr>
<td>Rastelli operation</td>
<td>—</td>
<td>1</td>
<td>4 (3)</td>
</tr>
<tr>
<td>Mitral valve replacement (all for congenital heart disease)</td>
<td>4</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Repair of truncus arteriosus type I</td>
<td>—</td>
<td>—</td>
<td>3 (2)</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>4</td>
<td>—</td>
<td>1 (1)</td>
</tr>
<tr>
<td>Total</td>
<td>168 (2)</td>
<td>6</td>
<td>35 (14)</td>
</tr>
</tbody>
</table>
TRACHEAL EXTUBATION AND OPEN-HEART SURGERY

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**TABLE II. Details of different postoperative groups (mean ± SEM)**

<table>
<thead>
<tr>
<th></th>
<th>Extubated group</th>
<th>T-piece group</th>
<th>Ventilated group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (month)</td>
<td>72.7 ± 4.0</td>
<td>51.0 ± 22.8</td>
<td>40.5 ± 8.9</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>20.6 ± 1.0</td>
<td>14.1 ± 5.2</td>
<td>12.0 ± 1.8</td>
</tr>
<tr>
<td>Bypass time (min)</td>
<td>72.5 ± 3.0</td>
<td>108.2 ± 19.1</td>
<td>123.3 ± 9.5</td>
</tr>
<tr>
<td>Time in intensive care unit (days)</td>
<td>1.9 ± 0.1</td>
<td>4.2 ± 1.1</td>
<td>6.0 ± 1.3</td>
</tr>
</tbody>
</table>

mask. In the period after operation patients were given 5–10% glucose 500–1000 ml m\(^{-2}\) per 24 h as maintenance fluid therapy. Morphine 0.1 mg kg\(^{-1}\) s.c. was given for relief of pain.

**RESULTS**

Hospital records of 209 consecutive patients were reviewed. In 168 of these (80.4%) the trachea was extubated in the operating theatre (extubated group), six were allowed to breathe through a T-piece system (T-piece group) and 35 were ventilated mechanically (ventilated group) after surgery. Details of patients are given in table I.

No patient younger than 3 months of age, 52% of those between 3 and 12 months and 88% of those older than 12 months of age had the tracheal tube removed in the operating theatre. Details of the different postoperative groups and of patients younger than 1 year of age are given in tables II and III.

Twenty patients had undergone previous open heart surgery. The tracheae of 15 of these (75%) were extubated in the operating theatre.

Deep hypothermia with circulatory arrest was used in 12 patients, all younger than 1 yr. Nine of these patients were ventilated mechanically in the period after operation. Of the remaining three one, aged 4 months, who had undergone closure of a ventricular septal defect (VSD) with an arrest period of 37 min, had the tracheal tube removed in the operating theatre. The other two, aged 1 and 8 months, who had undergone total correction of tetralogy of Fallot (CTF) and a Senning operation for simple transposition of the great arteries (TGA), with arrest periods of 52 and 66 min, respectively, were allowed to breathe through a T-piece system and were extubated within 3 h.

A major problem with the tracheal tube occurred in two of the 47 patients who had been intubated at some time during their stay in the intensive care unit. In one the tracheal tube became blocked because of the production of very thick sputum. In the other child, who was hypoxic because of persistent intracardiac right-to-left shunting, the nasotracheal tube slipped into the right main bronchus and a cardiac arrest occurred. Both patients survived.

**Extubated group**

Four (2.4%) of these patients required reintubation of the trachea. A boy of 7 yr with a deformed chest related to two previous mitral valvotomies was reintubated because of an unacceptably high \(P_{aCO_2}\) after mitral valve replacement. A girl aged 1 yr, with Down's syndrome, who underwent total CTF with

**TABLE III. Details of patients younger than 1 year of age (mean ± SEM)**

<table>
<thead>
<tr>
<th></th>
<th>Extubated group</th>
<th>T-piece group</th>
<th>Ventilated group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers</td>
<td>12</td>
<td>3</td>
<td>16</td>
</tr>
<tr>
<td>Age (month)</td>
<td>7.8 ± 0.8</td>
<td>3.3 ± 2.3</td>
<td>4.1 ± 0.9</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>6.9 ± 0.5</td>
<td>4.9 ± 0.8</td>
<td>4.8 ± 0.5</td>
</tr>
<tr>
<td>Bypass time (min)</td>
<td>69.5 ± 5.9</td>
<td>76.7 ± 20.7</td>
<td>92.7 ± 11.4</td>
</tr>
<tr>
<td>Circulatory arrest used (number of patients)</td>
<td>1</td>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>Time in intensive care unit (days)</td>
<td>2.3 ± 0.4</td>
<td>2.3 ± 0.3</td>
<td>5.4 ± 1.5</td>
</tr>
</tbody>
</table>
closure of a patent ductus arteriosus (PDA), required a further thoracotomy 5 h following surgery, for suspected tamponade. She was found to have a dilated right ventricle but no significant bleeding and the trachea was extubated 4 h later. She did well until the 2nd day after operation when sudden respiratory failure developed and reintubation was required. The third patient, aged 2 yr, underwent a second Mustard operation and developed respiratory failure. This was found to be the result of an unsuspected diaphragmatic paresis. In the fourth patient, aged 6 yr, the trachea was extubated after a second Mustard operation although he was not conscious. His level of consciousness did not improve and intubation was required following a convolution 10 h after the procedure. He died of cerebral oedema caused by massive cerebral infarction on the 16th day after operation.

Three patients in this group, including the patient mentioned above, underwent a repeat thoracotomy on the day of surgery. Of the other two, a boy of 4 yr who had undergone total CTF was again extubated in the operating theatre and a girl of 6 months who had undergone a Mustard operation required artificial ventilation afterwards.

Two patients required a further thoracotomy on the 1st day after operation. One, a girl of 2 yr with pulmonary hypertension who underwent closure of a VSD, developed massive bleeding following the withdrawal of a transthoracic pulmonary artery catheter. Despite immediate reintubation and thoracotomy she died 2 days later because of a low cardiac output. The other patient who had undergone a second Mustard operation, was extubated again immediately after the second thoracotomy.

\( \text{PaO}_2 \) values less than 8.0 kPa occurred in 34 patients (20%) during their stay in the intensive care unit. This was related to inadequate oxygen therapy in 22 patients. In the others, increasing the inspired oxygen concentration had minimal effect on \( \text{PaO}_2 \). In four patients this was a result of persistent intracardiac right-to-left shunting.

\( \text{PaCO}_2 \) values greater than 6.7 kPa were measured in 32 patients. In 20 patients this occurred only in the first sample after operation. Nine patients had \( \text{PaCO}_2 \) values greater than 7.3 kPa on one or more occasions. Arterial blood-gas tensions at different times following operation are given in table IV.

**T-piece group**

All patients in this group had the tracheal tube removed within 6 h. There were no reintubations or repeat thoracotomies in this group.

**Ventilated group**

The tracheae of two patients were extubated within 3 h and of 11 patients within 24 h. Only one patient older than 4 months of age required artificial ventilation after closure of a VSD. This patient was in severe cardiac failure before operation. Only two patients were ventilated after total CTF; both were younger than 1 year of age and had low \( \text{PaO}_2 \) values after bypass because of persistent intracardiac right-to-left shunting.

Two patients younger than 1 year of age, with simple TGA, had the tracheal tube removed within 12 h of undergoing uncomplicated Mustard operations. In both patients deep hypothermia with circulatory arrest for periods of 68 min was used. The eight other patients who required mechanical ventilation after a Mustard or Senning operation all had either complex TGA, or other significant problems, or both. These were diaphragmatic paresis, bronchospasm or low cardiac output after bypass.

**DISCUSSION**

The claimed decrease in respiratory and, consequently, cardiac workload in patients whose lungs

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**Table IV. Arterial blood-gas tensions in the extubated group (mean±SEM). Results from patients after repeat thoracotomy or reintubation are excluded**

<table>
<thead>
<tr>
<th>Hours after operation</th>
<th>Number of samples</th>
<th>((H^+)) (nmol litre(^{-1}))</th>
<th>(\text{PaCO}_2) (kPa)</th>
<th>(\text{PaO}_2) with oxygen therapy (kPa)</th>
<th>(\text{PaO}_2) without oxygen therapy (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–2</td>
<td>168</td>
<td>45.9 ± 0.45</td>
<td>5.8 ± 0.07</td>
<td>24.4 ± 0.84</td>
<td>10.4 ± 0.49</td>
</tr>
<tr>
<td>2–6</td>
<td>171</td>
<td>40.7 ± 0.34</td>
<td>5.4 ± 0.05</td>
<td>21.8 ± 0.89</td>
<td>10.8 ± 0.19</td>
</tr>
<tr>
<td>6–24</td>
<td>372</td>
<td>37.8 ± 0.20</td>
<td>5.2 ± 0.04</td>
<td>17.6 ± 0.61</td>
<td>10.2 ± 0.15</td>
</tr>
<tr>
<td>24 +</td>
<td>70</td>
<td>34.8 ± 0.42</td>
<td>5.5 ± 0.09</td>
<td>11.6 ± 0.79</td>
<td>9.0 ± 0.57</td>
</tr>
</tbody>
</table>
are ventilated mechanically after open heart surgery has been a major reason for the continuation of this technique. However, although Thung and colleagues (1963) found an increase in oxygen consumption when patients were allowed to breathe spontaneously after open heart surgery, this increase was modest in patients with good myocardial function and without a history of chronic lung disease.

Intrapulmonary shunting has been shown to increase after open heart surgery (Fordham, 1965; Hedley-White et al., 1965; McClanahan, Young and Sykes, 1965; Eltringham et al., 1968; Philbin et al., 1970; Sykes et al., 1970; Rea et al., 1978). After comparing arterial oxygenation in their series with other series where arterial oxygenation was measured after upper abdominal surgery Rea and co-workers (1978) suggested that cardiopulmonary bypass per se may have little or no effect on pulmonary gas exchange. In our series, 95% of the patients in the extubated group maintained adequate arterial oxygenation after surgery with inspired oxygen concentrations between 30 and 60%.

The overall repeat thoracotomy rate in the extubated group was 3%. One patient was still bleeding excessively at the end of surgery and in retrospect should not have been extubated. If this patient is excluded, the overall repeat thoracotomy rate becomes 2.4%. We do not feel that this low rate justifies tracheal intubation and mechanical ventilation in all patients.

Bleeding is a recognized hazard following removal of transthoracic catheters. Two patients in this series died of massive blood loss after removal of a transthoracic catheter on the 1st day after operation. As a result of these two deaths we changed our policy and thereafter removed transthoracic catheters on or after the 7th day after operation. It is clearly not reasonable to leave the trachea of the patient intubated for 7 days solely because of the risk of bleeding when such a catheter is removed.

Tracheal intubation and mechanical ventilation themselves are not without risk. Further pathology may be produced, notably pulmonary infection, pulmonary barotrauma, disturbances of haemodynamic stability (especially after a Fontan operation (Schuller et al., 1980)), and subglottic oedema may lead to subglottic stenosis. Problems can be associated with the tracheal tube: incorrect positioning, disconnection and obstruction by either kinking or foreign matter. Two of our patients had such problems. The presence of the tracheal tube may necessitate the administration of large quantities of sedative and analgesic drugs, and their use may prolong the duration of intubation unnecessarily.

No child had to be reintubated because of stridor. In our series, eight patients had Down's syndrome. In seven of these the trachea was extubated in the operating theatre. Sherry (1983) reported a much increased frequency of stridor requiring reintubation in these children. However, the patients in that series had the trachea intubated for periods of 1 day or more and this may have been responsible for the greater incidence of stridor.

In a series of 113 children undergoing open heart surgery, Barash and colleagues (1980) removed the tracheal tube in 50–54% of those younger than 1 yr and 80% of those older than 1 yr, either in the operating theatre or shortly after arrival in the intensive care unit. These authors claimed psychological advantages for early extubation as well as decreases in pulmonary complications, and in the duration of stay in the intensive care unit. Manners, Monro and Edwards (1980) extubated the tracheae of 65% of 135 children, mostly aged less than 1 yr, within 12 h of corrective surgery involving profound hypothermia and circulatory arrest. Their results compared favourably with other series where mechanical ventilation had been prolonged. In our series, we were able to extubate 46% of those children younger than 1 yr and 89% of those children older than 1 yr either in the operating theatre or within 3 h of operation although, in contrast with the study of Manners, Monro and Edwards, deep hypothermia with circulatory arrest was used in only 39% of our patients younger than 1 yr.

It is extremely difficult to make valid comparisons between the results from different groups because of differences in the techniques used and in the composition of the groups studied. However, the results of our study and those of Barash and colleagues (1980) and Manners, Monro and Edwards (1980) suggest that early extubation is feasible in selected patients. Factors of importance in selecting patients suitable for early extubation are the preoperative condition, the age of the patient, the anaesthetic technique used, the nature of the operative procedure, the duration of cardiopulmonary bypass including the use of circulatory arrest and, finally, the condition of the patient at the end of surgery.

All patients in severe cardiac failure before operation were ventilated artificially in the period after operation. Four patients in the extubated group had
The majority of patients undergoing closure of a VSD are suitable candidates for early extubation. Many of our patients underwent more complex procedures, including Spencer’s repair of aortic incompetence, patch enlargement for right ventricular outflow tract obstruction, or else they had previous open heart surgery. All these were extubated at the end of surgery. The four patients in whom the trachea was not extubated in the operating theatre were younger than 3 months, in severe cardiac failure before surgery, or the pulmonary artery pressure was still greater than 50% of the systemic arterial pressure after bypass. In our experience, patients with pulmonary artery pressures greater than 50% of the systemic arterial pressure after bypass should be ventilated in the period after operation.

All patients older than 1 year of age who underwent total CTF had the tracheal tube removed in the operating theatre. One of these, a child with Down’s syndrome and a PDA, required a further thoracotomy and her trachea was extubated 4 h afterwards. Two days later she developed sudden respiratory failure shortly after oxygen therapy was discontinued. We think that this child had significant pulmonary vascular obstructive disease and that her deterioration occurred as a result of an increase in pulmonary vascular resistance when her oxygen therapy was withdrawn. All the other patients did well following operation. None had significant right ventricular outflow tract obstruction. Two were found subsequently to have a residual VSD. No patient developed pulmonary oedema following operation. In our experience, postoperative pulmonary oedema is likely only when there is a large residual VSD. It is our policy to perform palliative surgery in patients younger than 1 year of age with TF whenever possible, therefore only three children underwent total correction before they were 1 year of age. All were left with a tracheal tube at the end of surgery. It is impossible to make recommendations on the basis of this small number.

In patients such as those undergoing a Rastelli operation, repair of truncus arteriosus type I and other very complex repairs, there are often major haemodynamic problems in the period after operation. This is particularly true in the presence of pulmonary hypertension. These patients are seldom suitable candidates for early extubation.

After a Fontan operation, central venous pressure is invariably high as it becomes the driving force for the pulmonary circulation. This can lead to sequestration of large amounts of fluid, manifesting initially as ascites and pleural effusions. Theoretically, these
patients should benefit from the lower intrathoracic pressure resulting from spontaneous ventilation. Therefore, we recommend that these patients be allowed to breathe spontaneously as early as possible after their operation (Schuller et al., 1980). In the series reported here no patient who required mechanical ventilation after a Fontan operation survived.

More than 50% of our patients needed postoperative mechanical ventilation when cardiopulmonary bypass lasted longer than 150 min. However, the only survivor of the six patients requiring cardiopulmonary bypass for longer than 200 min had the tracheal tube removed in the operating theatre without subsequent difficulty. The other five died during or shortly after surgery. It is impossible to assess the contribution of cardiopulmonary bypass per se to the condition of the patient at the end of surgery, because its duration is always a reflection of the complexity of the surgical procedure. The use of circulatory arrest, particularly of long duration, may contribute to a delay in the return of consciousness. We used this technique in only 12 (6%) patients. Since many had other problems contributing to their condition at the end of surgery, we cannot make a recommendation about early extubation after circulatory arrest has been used.

The question of whether to extubate the trachea of a patient who is receiving inotropic support is controversial. We feel that the use of low doses of these drugs does not preclude early extubation. It is our opinion that, if doses greater than dopamine 10 μg kg⁻¹ min⁻¹ or isoprenaline 0.01 μg kg⁻¹ min⁻¹ are needed, extubation should probably not be considered, since such large doses imply a poor haemodynamic state.

Two patients in the extubated group died, one because of cardiac failure probably related to pulmonary hypertension exacerbated by a short period of severe hypovolaemia. We do not think that postoperative artificial ventilation would have prevented the death of this child. The other patient died of persistent cerebral oedema caused by massive cerebral infarction. Subsequent review suggested that this was the result of a period of inadequate perfusion during cardiopulmonary bypass. At the end of surgery the patient was breathing well and, although not conscious, was extubated. He was expected to awaken within a short period of time. In retrospect this patient should not have had the tracheal tube removed. In the series as a whole, only one patient died of respiratory failure. This resulted from the accidental extravasation of Intralipid into the abdominal wall, causing necrosis.

The overall incidence of reintubation in the extubated group was 2.4% (four patients) and is comparable to the 4% reported by Barash and colleagues (1980) for their group of 197 children undergoing open or closed heart operations or thoracotomy. Reintubation following surgery, should it be necessary, constitutes only a minimal risk in skilled hands and should be carried out as soon as any doubt arises about the ability of the patient to maintain adequate spontaneous ventilation. We recommend that the tracheal tube be left in situ in those patients who were difficult to intubate at the induction of anaesthesia, as emergency reintubation is likely to be even more difficult.

In contrast to this, we find repeat thoracotomy a more dangerous procedure in the early-extubated patient. A further thoracotomy is often performed after a period of observation, during which further haemodynamic deterioration may have occurred. Induction of anaesthesia may then exacerbate the situation. In patients in whom there is an excessive rate of blood loss at the end of surgery, the trachea should be left intubated. It is impossible to define precisely what is an excessive rate. The combined experience of the anaesthetist and surgeon must decide the correct course of action. Meticulous haemostasis is of paramount importance.

In conclusion, we feel that it is feasible to extubate the trachea of many patients following open heart surgery for congenital heart disease at the end of surgery. There are advantages to early extubation and, with careful selection of patients, the risk is minimal.

ACKNOWLEDGEMENT

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EXTUBATION PRECOCE APRES CHIRURGIE A COEUR OUVERT POUR CARDIOPATHIE CONGENITALE
Revue de 3 années d’expérience

Nous avons compilé les résultats de l’extubation précoce après chirurgie à cœur ouvert pour cardiopathie congénitale, chez 209 patients consécutifs. Parmi les patients extubés en salle d’opération, aucun n’avait moins de 3 mois, et on retrouvait 52% de ceux qui avaient entre 3 et 12 mois et 88% de ceux de plus de 12 mois. Quatre patients ont dû être réintubés, trois à cause de problèmes respiratoires et un à cause d’un œdème du cerveau. Il y a eu deux morts dans le groupe des patients extubés précoce. Douze patients avaient une PaO₂ inférieure à 8 kPa après l’intervention malgré une oxygénothérapie correcte. Chez quatre d’entre eux, ceci a pu être rattaché à la persistance d’un shunt intracardiaque. Nous en concluons que l’extubation précoce après chirurgie à cœur ouvert pour cardiopathie congénitale, représente un très faible risque chez des sujets soigneusement choisis.

RAPIDA EXTUBACION DE LA TRAQUEA DESPUES DE CIRUGIA A CORAZON ABIERTO A RAIZ DE ENFERMEDAD CARDIACA CONGENITA

Se examinó los resultados de rápida extubación después de cirugía a corazón abierto a raíz de enfermedad cardíaca congénita en 209 pacientes consecutivos. Ningún paciente menor de 3 meses, el 52% de los entre 3 y 12 meses y el 88% de los mayores de 12 meses se les retiró el tubo traqueal en la sala de operaciones. Cuatro de los pacientes necesitaron una reintubación de la traquea: tres a raíz de dificultades respiratorias y el otro a raíz de un edema cerebral. Hubo dos muertes en el grupo extubado. Doce pacientes registraron valores de PaO₂ menores de 8,0 kPa después de la operación a pesar de una terapia de oxígeno adecuada. En cuatro de ellos, esto tenía relación con una derivación intracardíaca persistente. Se concluye que una rápida extubación después de cirugía a corazón abierto a raíz de enfermedad cardiaca congénita presenta riesgos mínimos en pacientes cuidadosamente seleccionados.