Can airway complications following multilevel anterior cervical surgery be avoided?

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Object. The authors conducted a study to determine how to avoid emergency postoperative reintubation and its associated morbidity in patients who have undergone multilevel anterior–posterior cervical spine surgery.

Methods. In a group effort between the departments of anesthesia and neurosurgery, a protocol was developed to avoid having to reintubate patients postoperatively. As a preventative measure, patients remained intubated overnight; on the 1st postoperative day or thereafter, based on direct fiberoptic visualization of reactive tracheal swelling, an anesthesiologist extubated the patients. Fifty-eight patients underwent multilevel anterior corpectomy with fusion (ACF; with 41 receiving plates and 17 not receiving plates), posterior wiring and fusion (PWF), and application of a halo. On average, ACF involved three levels, whereas PWF included 6.5 levels. Surgery typically lasted 10 hours, and an average 2.6 U of blood was required.

Forty patients were successfully extubated on the 1st, five on the 2nd, three on the 3rd, two on the 4th, two on the 5th, and three on the 7th postoperative day. Three elective tracheostomies were performed on the 7th postoperative day. Risk factors associated with delayed extubation or tracheostomy in 18 patients included: operative time longer than 10 hours (12 patients), obesity greater than 220 lbs (12 patients), transfusion of more than 4 U of blood (10 patients), ACF reoperations (nine patients), ACF including C-2 (seven patients), four-level ACF (five patients), and asthma (five patients). In the only case in which emergency reintubation was required, three risk factors were present.

Conclusions. Emergency reintubation following anterior–posterior cervical surgery and fusion can be avoided by maintaining intubation overnight and subsequently having an anesthesiologist remove the tube after healing is fiberoptically confirmed. Familiarity with major risk factors contributing to airway compromise, combined with this protocol, should minimize the significant morbidity associated with reintubation following multilevel anterior–posterior cervical fusion.

KEY WORDS • cervical fusion • prophylaxis • intubation • anterior–posterior approach

In patients who have just undergone extensive cervical spine procedures, emergency reintubation or tracheostomy can lead to a significant incidence of graft-related or neurological complications, hypoxia, and death. To avoid these complications, a protocol was developed with the anesthesiology department requiring 1) prophylactic intubation for the 1st postoperative night and 2) extubation the following day or thereafter, performed by an anesthesiologist after direct fiberoptic evaluation of the airway to rule out postoperative reactive swelling. This protocol was prospectively applied between 1993 and 1999 in 58 patients who underwent anterior–posterior cervical fusion (average three-level ACF and 6.5-level PWF) and halo brace application. Risk factors associated with prolonged intubation or tracheostomy were identified.

Clinical Material and Methods

Airway Management Protocol

Based on our protocol 58 patients, in whom multilevel cervical fusion had been performed, remained prophylactically intubated for at least the first postoperative night and longer when indicated. Smokers, patients with chronic obstructive pulmonary disease, and patients with asthma underwent formal preoperative pulmonary medical evaluations and were typically placed on preoperative bronchodilators and inhalational steroid medication (fluticasone propionate).
Postoperatively, in the recovery room and until extubation was completed, all patients underwent pulse oximeter monitoring and arterial blood gas values were measured every 4 hours. Prior to extubation, intravenous sedation was discontinued (for 2 hours), patients were weaned from the ventilator, and arterial blood gas levels were again determined (within 15 minutes). When oxygen levels were low extubation was delayed, whereas when oxygen levels were adequate extubation was promptly performed.

Exubtation was performed by a member of a skilled anesthesiology team the 1st postoperative day or thereafter. The anesthesiologist threaded the fiberoptic bronchoscope around the in situ nasotracheal tube, so as to assess directly the postoperative residual tracheal and/or vocal cord swelling; if it was difficult to thread the fiberoptic device around the nasotracheal tube and there was little to no air leakage with the balloon deflated (that is, no phonation), extubation was delayed. Alternatively, if there was minimal swelling and adequate air leakage when the balloon was deflated, extubation was performed over a tube changer, which was removed within 5 to 10 minutes. Initially, five patients were extubated in the operating room with an otolaryngologist present. The next 11 patients underwent a similar extubation procedure while in the intensive care unit. The last 39 patients were extubated in the intensive care unit by an anesthesiologist alone. During the course of this study, three patients required elective tracheostomy.

Clinical Data

Fifty-eight patients (average age 56 years) exhibited moderate/severe preoperative myeloradiculopathy (average Nurick Scale Grade 3.6) (Table 1): Nurick Grade 0, no myelopathy; Grade 1, mild myelopathy; Grade 2, mild/moderate myelopathy; Grade 3, moderate myelopathy; Grade 4, moderate/severe myelopathy; and Grade 5, severe myelopathy. Postoperatively, they improved to a similar extubation procedure while in the intensive care unit. The last 39 patients were extubated in the intensive care unit by an anesthesiologist alone. During the course of this study, three patients required elective tracheostomy.

Operative Procedure

The ACF procedure was performed across an average of three levels (in 41 patients plates were placed and in 17 no plates were used); the ACF was followed by placement of PWF (average 6.5 levels) and halo brace application. In the ACF procedures iliac crest autograft (42 patients) or fibula strut allograft (16 patients) was used. Posterior wiring and fusion was performed immediately after anterior procedures to stabilize the construct and to avoid anterior graft and/or plate extrusions that occurred in such series as that reported by Vaccaro, et al., in which construct failure occurred in 9% of two-level and 50% of three-level ACF procedures in which plates were used. In our study posterior fusion techniques included: 1) posterior interspinous process wiring and fusion in which braided titanium cable and iliac crest autograft (44 patients), or 2) fibula strut allografts segmentally wired to individual spinous processes with braided titanium cables accompanied by iliac crest autograft (14 patients) were used. Because these posterior fusion techniques do not provide as much immediate, rigid, dorsal fixation as that afforded by lateral mass plates, halo braces were additionally applied in all patients to maximize postoperative immobilization. Surgery, including the time for halo application, required an average of 10 hours, and approximately 2.6 U blood were required for transfusion. When anterior iliac crest strut autografts were harvested, an additional 30 minutes was required, and patients sustained an additional average 90 ml of blood loss. Successful bone union was typically documented within 4 postoperative months on plain and dynamic radiographs and CT studies. Patients were followed for a mean interval of 3 years.

Delayed–Extubation Risk Factors

Potential risk factors associated with delayed extubation or elective tracheostomy (> 24 hours postoperatively) included: obesity (> 220 lbs), operative time greater than 10 hours, a second ACF operation, ACF in which C-2 was included, greater than 4 U of transfused blood, asthma, advanced age (> 65 years of age), a CSF fistula, extent of surgery, and a severe preoperative neurological deficit (Nurick Grade 4–5).

Results

Timing of Extubation or Tracheostomy

By protocol, 40 patients were successfully extubated on the 1st, five on the 2nd, three on the 3rd, two on the 4th, two on the 5th, and three on the 7th postoperative day. All three elective tracheostomies were performed on the 7th postoperative day. Only one patient, in whom extubation was performed on the 3rd postoperative day, required immediate (< 15 minutes) reintubation. In this female patient three risk factors predisposed her to this complication: 1) a prior C4–7 ACF 5 years earlier; 2) a 14-hour-long secondary C3–7 ACF, C2–T1 PWF was used, and lumboperitoneal shunt placement for a CSF fistula; and 3) asthma.

Delayed–Extubation Risk Factors

In 18 patients, several risk factors were more frequently associated with delayed extubation or tracheostomy.
Airway complications following multilevel anterior surgery

TABLE 2
Risk factors associated with delayed extubation or tracheostomy

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Delayed Extubation or Tracheostomy</th>
<th>Extubation on Day 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>op time &gt; 10 hrs</td>
<td>12 (67)</td>
<td>4 (10)</td>
</tr>
<tr>
<td>obesity &gt; 220 lbs</td>
<td>12 (67)</td>
<td>8 (20)</td>
</tr>
<tr>
<td>2nd ACF op</td>
<td>9 (50)</td>
<td>2 (5)</td>
</tr>
<tr>
<td>ACF including C-2</td>
<td>7 (40)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>transfusion of &gt; 4 U blood</td>
<td>10 (56)</td>
<td>10 (25)</td>
</tr>
<tr>
<td>4-level ACF</td>
<td>5 (27)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>asthma</td>
<td>5 (27)</td>
<td>1 (2.5)</td>
</tr>
</tbody>
</table>

(Table 2). The frequency of each risk factor (occurrence of risk factor/number in population) was separately identified for the 18 patients in whom delayed extubation or tracheostomy and for the 40 patients in whom extubation was performed on the 1st postoperative day. Percentage differences in risk factor frequencies for the two populations (delayed and nondelayed) are presented here in descending order: operative time greater than 10 hours (67% and 10%, respectively), obesity greater than 220 lbs (67% and 20%, respectively), ACF reoperations (50% and 5%, respectively), ACF including the C-2 level (40% and 0%, respectively), transfusion of more than 4 U of blood (56% and 25%, respectively), five-level ACF or more (27% and 0%, respectively), asthma (27% and 2.5%, respectively), CSF fistula formation (16.7% and 5%, respectively), advanced age (> 65 years of age; 27% and 22.5%, respectively), and greater preoperative neurological deficit (Nurick Grade 4–5 moderate/severe myelopathy; 28% and 24%, respectively).

Discussion

Delayed Extubation or Tracheostomy

Combined anterior–posterior cervical surgery, performed electively or on an emergency basis for degenerative disease or traumatic injury, may be accomplished safely despite prolonged operative times.4,8,12,17 The goal of an airway management protocol following these complex procedures is to avoid emergency reintubation or tracheostomy that may result in graft or plate displacement and fracture, hypoxia, and possibly death. According to our protocol, the 58 patients in this series remained intubated the 1st postoperative night as a prophylactic measure. Subsequently, after fiberoptic confirmation of adequate healing, 40 patients underwent extubation on the 1st postoperative day, 15 on the 2nd through the 7th, and three required elective tracheostomy on the 7th postoperative day. Only one (1.7%) patient required emergency reintubation on the 3rd postoperative day. This 1.7% respiratory failure rate is comparable with the 1.1% incidence cited by Bertalanffy and Eggert1 in their series of patients in whom anterior cervical discectomy and fusion was performed. Of interest, in one study19 simultaneous tracheostomy and ACF did not lead to an increased incidence of infection.

Risk Factors

Risk factors contribute to delays in extubation or the
necessity of tracheostomy following complex cervical spine procedures. The risk factors we identified included obesity, operative time greater than 10 hours, a second ACF (performed in 19% of our patients as compared with an average of 12% in other series),1–10,12,13,15,16,20,24, ACF including the C-2 level, and asthma. Although rare, additional reported risk factors contributing to airway compromise following ACF include angioedema,13 recurrent laryngeal nerve palsy (<1% with left-sided approaches),1,4,5,12,15–17 transient (<3 months [11.5°–15°]), or permanent (10%),17 dysphagia with or without esophageal perforation,1,12,15–21 and new postoperative spinal cord deficits.1,2,4,6,14–22 Two of our patients experienced transient (3-month) recurrent laryngeal nerve injuries which, among other factors, contributed to delayed extubation in one patient and elective tracheostomy in the other. Transient dysphagia, present in 10% of patients, did not lead to increased postoperative respiratory compromise.

Conclusions

Emergency reintubation following multilevel anterior–posterior cervical surgery can be avoided using a strict airway management protocol requiring prophylactic intubation the 1st postoperative night, followed by elective extubation performed after fiberoptic confirmation of healing by an anesthesiologist. This protocol, combined with the identification of major risk factors contributing to airway compromise, should minimize respiratory-related morbidity associated with these extensive cervical procedures.

References


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