Awake Fiberoptic Intubation and Self-positioning in Patients at Risk of Secondary Cervical Injury: A Pilot Study

Michael Joerg Malcharek, MD,* Birgit Rogos, MD,* Stefan Watzlawek, MD,* Oliver Sorge, MD,† Armin Sablotzki, MD, PhD,* Jochen Gille, MD,* and C. Philip Larson Jr, MD‡

Background: This study was designed to document the feasibility of self-positioning after awake fiberoptic intubation of the trachea using primarily effective topical anesthesia rather than sedation.

Methods: We investigated 14 patients (ASA physical status 1 to 3) with a neurosurgical diagnosis of cervical instability or at risk of secondary cervical injury, who were scheduled for awake fiberoptic intubation and self-positioning prone. Topical anesthesia was accomplished using an oropharyngeal spray of lidocaine alone or in combination with a transtracheal injection of lidocaine for awake fiberoptic intubation and self-positioning prone. Patients evidencing anxiolysis were given midazolam 2 to 4 mg, IV. We assessed the need for sedation, tolerance of the endotracheal tube, patient comfort, incidence of coughing or gagging, and changes in heart rate, blood pressure, and oxygen saturation. In addition, patients were interviewed on the first postoperative day and asked to categorize the experience of awake intubation and positioning as a positive, neutral, or negative experience, or to have no recall.

Results: Eleven of the 14 patients turned themselves prone after awake fiberoptic intubation. No additional sedation was necessary for accomplishing positioning. Whereas 50% of the patients (7/14) showed mostly slight coughing or gagging during fiberoptic intubation, none of the patients who were positioned awake had coughing or gagging during tube fixation and prone positioning. The technique was unsuccessful in 3 patients. None of the patients viewed this as a negative experience.

Conclusions: Our study demonstrates that awake fiberoptic intubation and patient self-positioning was feasible in this sample of patients at risk of secondary cervical injury. This technique may extend the opportunity of continuous neurologic monitoring in patients with a risk of position-related cervical injury, especially where electrophysiological monitoring is not possible or is unavailable.

Key Words: awake fiberoptic intubation, self-positioning, cervical instability, secondary cervical spine injury, topical anesthesia, position-related injuries

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Conventional intubation of the trachea and subsequent positioning prone of anesthetized patients with cervical spine instability may result in neurological injury as a result of hyperflexion or rotation of the head and neck and compression of the cervical spine or vertebral arteries, especially in patients with an unexpected difficult airway.1–3 Awake fiberoptic intubation and self-positioning prone before inducing general anesthesia may be a safer option in these patients because it allows both the anesthesia provider and the patient to evaluate and optimize the neurological function during tracheal intubation and positioning. However, there are very few studies that evaluate the feasibility of this technique under neuroleptanalgesia.4–6

Our investigation was designed as a prospective pilot study to determine the feasibility of awake fiberoptic intubation of the trachea and self-positioning prone using little or no sedation in patients at risk of secondary cervical spine injury. In addition, we evaluated patients’ recall and comfort of the intubation and positioning postoperatively.

METHODS

Fourteen patients were scheduled to have elective neurosurgical or neurotrauma intervention in the prone position. Each patient signed an informed consent form, and the project had prior approval of the ethics committee of Saxony (Saechsische Landesaerztekammer, Schuetzenhoehe 16, 01099 Dresden, Reference No.: EK-BR 34/08-1). Six patients were at risk of secondary cervical injury during positioning prone as a result of cervical disk prolapse,
stenois, or prior cervical fusion and were scheduled for lumbar decompression. Another 6 patients were scheduled for dorsal cervical decompression for spinal stenois or disk prolapse. One patient had a cervical tumor and another had a fracture of a cervical vertebra. All patients were considered by neurosurgeons to have cervical instability or to be at risk of secondary cervical injury on the basis of abnormal cervical movement during fluoroscopy, neurological symptoms and signs with or without pain, or surgical compression of the cervical spine on myelography.

The patients consisted of 6 women and 8 men, with a mean age of 55 years (range, 43 to 77 y), a mean body mass index of 30 (range, 20 to 42), and an ASA status of 1 to 3. All patients received midazolam 7.5 mg orally as premedication.

Before starting topical anesthesia, all patients were given glycopyrrolate, 0.2 mg and midazolam, 1 mg intravenously. Topical anesthesia of the oral cavity was accomplished with lidocaine 10% spray. Anesthesia of the vocal cords and upper trachea was accomplished with lidocaine 4% either nebulized through the endoscope (spray as you go) or by a translaryngeal injection of 4 mL using a 23 G needle. The anesthesia provider was allowed to administer further doses of midazolam for anxiolysis if needed during the procedure.

Once tracheal intubation was accomplished, a small tube was placed inside the endotracheal tube to provide supplemental oxygen. The patients were then asked to move to the prone position on the bolsters. The anesthesia provider guarded the head and tube during the move (see Video, Supplemental Digital Content 1, http://links.lww.com/JNA/A8, which demonstrates the process of self-positioning). Ten of the 14 patients were wearing a soft or rigid c-collar, which was maintained in place during the process of self-positioning. All patients who were turned for lumbar surgery positioned their head in the neutral position. Once in position, the presence of end tidal carbon dioxide was confirmed and general anesthesia was instituted. The management was supervised by one of the authors.

Measurements were made of coughing and gagging during and after intubation using a scale of 1 to 4 (1, none; 2, <3 times (slight coughing and gagging comparable to “clearing ones throat”); 3, >2 times (mild coughing or gagging lasting less than a minute); 4, persistent coughing or gagging). Coughing and gagging were also recorded separately by an independent party not involved in the intubation. The level of sedation was determined after tracheal intubation using a score modified by the authors from the Ramsay score (1, eyes open, alert, cooperative, no sedation; 2, eyes mostly open, alert, cooperative, light sedation; 3, eyes closed; open to speech commands, responsive, cooperative, moderate sedation; 4, patient asleep, only responsive to painful stimuli, not cooperative, deep sedation).

Time to intubation, defined as the interval from translaryngeal injection or the start of endoscopy to the completion of intubation was recorded. Motor function in terms of the ability to move arms and legs was assessed after tracheal intubation and after positioning prone. Patients were interviewed on the first postoperative day and asked to categorize the experience of awake intubation and positioning as positive, negative, or neutral, or having no recall. Awake intubation and positioning were evaluated as a single experience.

RESULTS

Awake fiberoptic intubation was achieved in all 14 patients. Ten patients received a translaryngeal injection and 4 nebulized aerosol, the mean lidocaine dose being 4.7 mg/kg (range, 3.2 to 6.6 mg/kg; Table 1). The mean dose of midazolam given during the procedure was 3.1 mg (range, 1 to 4 mg). No midazolam was necessary after intubation or for positioning. The mean intubation time was 3.4 minutes (range, 2 to 5 min).

Fifty percent (7/14) of the patients showed at least slight coughing/gagging during fiberoptic intubation, whereas only 14% (2/14) still had coughing/gagging during tube fixation.

Eleven patients were able to position themselves prone in response to a request to do so. Awake positioning after intubation failed in 3 patients because of gagging and coughing in one and an uncomfortable feeling about moving prone in another. The third patient could not position herself prone because of technical problems with the operating table. In these 3 patients, positioning was performed under general anesthesia with neurophysiological monitoring of somatosensory and motor-evoked potentials of upper and lower extremities.

All patients (11) who were positioned awake did not show coughing/gagging at all during positioning. None of these patients coughed or gagged during fixation of the endotracheal tube.

Postoperatively, 7 patients had no recall of the intubation or positioning, 6 recalled the experience as positive, and 1 as neutral (Table 1).

DISCUSSION

This study documents that awake fiberoptic intubation and self-positioning prone can be accomplished successfully in patients at risk of secondary cervical spine injury without the need of neuroleptanalgesia or deep sedation with suppression of airway reflexes. The technique was safe and effective in this sample of patients.

Coughing and gagging during awake fixation of the endotracheal tube and concern about prone positioning were the only reasons for failure in 2 patients.

Severe coughing and gagging occurred even during fixation of the endotracheal tube in case number 4 probably because of insufficient local anesthesia in a patient who was a heavy smoker. Thus, we avoided having the patient position himself awake because of the potential risk of cervical injury from the combination of coughing and prone positioning.

However, none of the patients who were positioned awake (11/14) had coughing or gagging during prone positioning. Hereby, the absence of coughing/gagging
TABLE 1. Data of 14 Patients With Demographic Details, Anesthetic Technique/Dose, Side Effects of the Technique, Patient Experience About the Procedure, and Indication for Awake Positioning

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>Age</th>
<th>Sex</th>
<th>BMI</th>
<th>Regional Anesthesia (SAYGO; TLI)</th>
<th>Anxiolysis (M)</th>
<th>Sedation Score</th>
<th>Lidocaine for Regional Anesthesia (mg/kg)</th>
<th>Coughing/Gagging During FOI**</th>
<th>Coughing or Gagging During Fixation of the Tube</th>
<th>Coughing or Gagging During Self-positioning</th>
<th>Procedure Experience (as Assessed on Postoperative Day 1)</th>
<th>Reason for Awake Fiberoptic Intubation and Self-positioning</th>
<th>Planned Surgical Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>76</td>
<td>F</td>
<td>31.6</td>
<td>TLI</td>
<td>2.5</td>
<td>1</td>
<td>3.7</td>
<td>1/1</td>
<td>1</td>
<td>1</td>
<td>Positive</td>
<td>Cervical myelopathy after former prolapse§ C5/C6, obesity</td>
<td>Decompression for lumbar stenosis</td>
</tr>
<tr>
<td>2</td>
<td>65</td>
<td>F</td>
<td>30.1</td>
<td>SAYGO</td>
<td>2.5</td>
<td>1</td>
<td>4.5</td>
<td>2/2</td>
<td>1</td>
<td>1</td>
<td>No recall</td>
<td>Degenerative flexion/extension instability C3/C4, C5/C6 with spinal stenosis</td>
<td>Dorsal decompression C3/C4 and C5/C6</td>
</tr>
<tr>
<td>3</td>
<td>43</td>
<td>F</td>
<td>23.7</td>
<td>TLI</td>
<td>4</td>
<td>1</td>
<td>5.5</td>
<td>1/1</td>
<td>1</td>
<td>1</td>
<td>No recall</td>
<td>Degenerative extension instability C2/C3</td>
<td>Decompression for lumbar stenosis</td>
</tr>
<tr>
<td>4</td>
<td>54</td>
<td>M</td>
<td>30.5</td>
<td>SAYGO</td>
<td>4</td>
<td>1</td>
<td>4.5</td>
<td>3/2</td>
<td>3</td>
<td>No self-positioning*</td>
<td>Positive</td>
<td>Deformation of cervical/thoracic spinal columns, obesity</td>
<td>Decompression for lumbar stenosis</td>
</tr>
<tr>
<td>5</td>
<td>77</td>
<td>F</td>
<td>31.1</td>
<td>TLI</td>
<td>2.5</td>
<td>2</td>
<td>4.9</td>
<td>1/3</td>
<td>1</td>
<td>1</td>
<td>No recall</td>
<td>Disk prolapse with myelopathy§ C4/ C5, obesity</td>
<td>Decompression C4/C5 in prone position</td>
</tr>
<tr>
<td>6</td>
<td>56</td>
<td>M</td>
<td>34.6</td>
<td>SAYGO</td>
<td>3</td>
<td>1</td>
<td>4.1</td>
<td>1/2</td>
<td>1</td>
<td>1</td>
<td>Positive</td>
<td>Former fusion of C5-C7 due to disk prolapse§ C5/C6, obesity</td>
<td>Decompression for lumbar stenosis in prone position</td>
</tr>
<tr>
<td>7</td>
<td>68</td>
<td>F</td>
<td>26.9</td>
<td>TLI</td>
<td>2.5</td>
<td>3</td>
<td>4.8</td>
<td>1/1</td>
<td>1</td>
<td>No self-positioning†</td>
<td>Positive</td>
<td>Neurinoma C3 with spinal cord compression</td>
<td>Removal of the tumor by laminectomy in prone position</td>
</tr>
<tr>
<td>8</td>
<td>46</td>
<td>M</td>
<td>41.9</td>
<td>TLI</td>
<td>5</td>
<td>1</td>
<td>3.2</td>
<td>2/3</td>
<td>2</td>
<td>No self-positioning‡</td>
<td>Positive</td>
<td>Former fusion C5/C6 due to disk prolapse§ C5/C6, obesity</td>
<td>Decompression C5/C6 in prone position</td>
</tr>
<tr>
<td>9</td>
<td>66</td>
<td>M</td>
<td>38.1</td>
<td>TLI</td>
<td>3</td>
<td>1</td>
<td>4.3</td>
<td>1/1</td>
<td>1</td>
<td>1</td>
<td>No recall</td>
<td>Spinal stenosis with myelopathy§ C5/C6, obesity</td>
<td>Decompression C6/C7 in prone position</td>
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<tr>
<td>10</td>
<td>62</td>
<td>M</td>
<td>23.4</td>
<td>TLI</td>
<td>1</td>
<td>2</td>
<td>4.7</td>
<td>3/2</td>
<td>1</td>
<td>1</td>
<td>No recall</td>
<td>Former fusion C4/C6 due to disk prolapse§ C5/C6, obesity</td>
<td>Decompression for lumbar stenosis</td>
</tr>
<tr>
<td>11</td>
<td>57</td>
<td>M</td>
<td>32.4</td>
<td>SAYGO</td>
<td>3</td>
<td>1</td>
<td>5.4</td>
<td>1/1</td>
<td>1</td>
<td>1</td>
<td>Positive</td>
<td>Disk prolapse with myelopathy§ C5/C6, obesity</td>
<td>Dorsal decompression C5/C6</td>
</tr>
<tr>
<td>12</td>
<td>44</td>
<td>F</td>
<td>20</td>
<td>TLI</td>
<td>3</td>
<td>2</td>
<td>6.6</td>
<td>1/1</td>
<td>1</td>
<td>1</td>
<td>Neutral</td>
<td>Suspicious degenerative flexion/extension instability C4/C5</td>
<td>Decompression for lumbar stenosis</td>
</tr>
<tr>
<td>13</td>
<td>57</td>
<td>M</td>
<td>23.6</td>
<td>TLI</td>
<td>3</td>
<td>1</td>
<td>4.8</td>
<td>2/1</td>
<td>1</td>
<td>1</td>
<td>No recall</td>
<td>Spinal stenosis with myelopathy§ C4/C6</td>
<td>Decompression C4/C6 in prone position</td>
</tr>
</tbody>
</table>

(continued)
during tube fixation predicted successful awake turning of these patients. These results suggest that the appearance of coughing/gagging during awake fiberoptic intubation (7/14) may be distinctly different to coughing/gagging during awake tube fixation (2/14) and self-positioning (0/11). Thus, passing of oropharyngeal or laryngeal structures by an endoscope or a breathing tube seems to be more traumatic than careful taping of the tube or self-positioning, even though most of these patients showed only slight coughing/gagging (Table 1). Supposedly, empathic treatment and distraction of the patient by invitation to bite on the biteblock while tube fixation or to follow commands during self-positioning are essential psychological tools next to the sufficient regional anesthesia.

Both Lee et al$^4$ and Wu et al$^6$ reported successful self-positioning in obese patients after awake tracheal intubation by direct laryngoscopy or endoscopy. None of their patients had an increased risk of secondary cervical injury. We concur with this finding as 5 of our patients were also obese, and awake positioning made it easier and safer for both the patients and the staff. Hirasaki et al$^7$ reported successful awake nasal fiberoptic intubation and self-positioning prone in 12 of the 18 patients with cervical disease. However, both Hirasaki et al$^7$ and Lee et al$^4$ used neuroepitanalgesia in addition to topical anesthesia of the throat and the larynx. In contrast, our study demonstrates that with effective topical anesthesia and no or at most light sedation, it is possible to perform awake tracheal intubation and have the patients position themselves prone safely and comfortably. However, dexmedetomidine may be a better drug as compared with midazolam in this setting, but it is expensive and one must be continuously aware of the blood pressure during administration as it is more likely to cause hypotension than midazolam. Unfortunately, it was not available in Europe at the time of our investigation.

Reports concerning position-related injuries during lateral or prone positioning under general anesthesia are rare but they do occur.$^8–11$ Most of the position-related injuries occurred in patients not at risk of cervical spine injury. The presence of cervical disease adds an additional risk to positioning prone under general anesthesia. We highlight the feasibility of awake positioning in those patients as an alternative to positioning under general anesthesia using neurophysiological monitoring.

Even though none of our patients developed occult neurological injury or neurological deterioration, we cannot generally rule out the potential risk of secondary cervical spine injury due to coughing, gagging, uncontrolled excitement, or movement in awake patients. According to our results, coughing and gagging are more likely to occur during awake intubation than during awake fixation of the endotracheal tube or self-positioning. Whether it is better to perform the intubation awake and risk coughing and gagging or to perform it under general anesthesia and risk injury during moving and positioning is not answered in this study. In a multicenter study, Levi et al$^{12}$ recorded fatal complications in patients

**TABLE 1. (continued)**

<table>
<thead>
<tr>
<th>No.</th>
<th>Age</th>
<th>Sex</th>
<th>BMI (kg/m$^2$)</th>
<th>TLI TLI</th>
<th>Sedation (mg)</th>
<th>Midazolam (mg/kg)</th>
<th>Regional Anesthesia (SAYGO: TLI)</th>
<th>Fixation of the Tube</th>
<th>Coughing or Gagging During Self-positioning</th>
<th>Coughing or Gagging During Fixation of the Tube</th>
<th>Patient Experience of SAYGO (as Assessed on Day 1)</th>
<th>Planned Surgical Procedure</th>
</tr>
</thead>
</table>
| 14  | 45  | M   | 32.2           | TLI    | 2             | 4                | Midazolam in this setting, detomidine may be a better drug as compared with selves prone safely and comfortably. However, dexmedetomidine may be a better drug as compared with midazolam in this setting, but it is expensive and one must be continuously aware of the blood pressure during administration as it is more likely to cause hypotension than midazolam. Unfortunately, it was not available in Europe at the time of our investigation. Reports concerning position-related injuries during lateral or prone positioning under general anesthesia are rare but they do occur. $^8–11$ Most of the position-related injuries occurred in patients not at risk of cervical spine injury. The presence of cervical disease adds an additional risk to positioning prone under general anesthesia. We highlight the feasibility of awake positioning in those patients as an alternative to positioning under general anesthesia using neurophysiological monitoring. Even though none of our patients developed occult neurological injury or neurological deterioration, we cannot generally rule out the potential risk of secondary cervical spine injury due to coughing, gagging, uncontrolled excitement, or movement in awake patients. According to our results, coughing and gagging are more likely to occur during awake intubation than during awake fixation of the endotracheal tube or self-positioning. Whether it is better to perform the intubation awake and risk coughing and gagging or to perform it under general anesthesia and risk injury during moving and positioning is not answered in this study. In a multicenter study, Levi et al$^{12}$ recorded fatal complications in patients

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*Remarkable coughing and gagging during fixation of the tube.

**Technical problem with the operating table.

Pathologic symptoms in addition to pain depending on the posture.

Compressed spinal cord with myelopathy and the necessity of movement of the cervical spine for posture.

1: alert, eyes open; 2: alert, eyes closed; 3: sleepy but responsive; 4: sleeps and unresponsive.

BMI indicates body mass index; FOI, fiberoptic intubation; SAYGO, spray as you go; TLI, translaryngeal injection.
with missed cervical spine injuries. Even though it is difficult to compare those data with our results, it has to be considered that even patients who are conscious may not always reliably protect themselves.

In addition, the empathic treatment of the patient by an experienced anesthesia team along with close collaboration with our neurosurgeons may have contributed to the successful outcome in our patients.

More prospective studies are needed to determine whether positioning prone using clinical neurological monitoring in awake patients with preserved muscle tone is superior to patients under general anesthesia and neurophysiological monitoring. Because of the low incidence of neurological injury during prone positioning, a large numbers of patients will be needed to answer this question.

CONCLUSIONS

Our study demonstrates that awake fiberoptic intubation and patient self-positioning were feasible in this sample of patients at risk of secondary cervical injury. The technique of awake prone positioning may extend the opportunity of continuous neurological monitoring in these patients, especially where electrophysiological monitoring is not possible or is unavailable. The absence of coughing or gagging during awake tube fixation predicted the success of self-positioning. Sufficient topical anesthesia, empathic treatment of the patient by an experienced anesthesia team, and close collaboration with the surgeon are equivalent requirements for successful awake prone positioning.

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REFERENCES