Management of the Airway in Patients Undergoing Cervical Spine Surgery

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Abstract: The perioperative management of the airway in patients with cervical spine disease requires careful consideration. In an observational prospective cohort study, we assessed the preoperative factors that may have influenced the anesthesiologists' choice for the technique of intubation and the incidence of postoperative airway complications. We recorded information from 327 patients: mean (± SD) age 51 ± 15 year, 138 females and 189 males, for anterior surgical approach (n = 195) and posterior (n = 132). The technique of intubation used was awake fiberoptic bronchoscopy (FOB) in 39% (n = 128), asleep FOB 32% (n = 103), asleep laryngoscopy 22% (n = 72), and other asleep 7% (n = 24). Awake FOB was predominately chosen for intubating patients with myelopathy (45%), unstable/fractured spine (73%), and spinal stenosis (55%) but patients with radiculopathy had more asleep FOB (49%) ($P < 0.001$). There was no association between method of intubation and postoperative airway complications. Acute postoperative airway obstruction occurred in 4 (1.2%) patients requiring reintubation. The technique of management of the airway for cervical spine surgery varied considerably among the anesthesiologists, although the choice was not associated with postoperative airway complications.

Key Words: cervical spine surgery, endotracheal intubation, airway complications, anesthesiologists

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The perioperative management of the airway in patients who have cervical spine trauma or disease requires careful consideration. The goal of any airway management plan is to avoid excessive movement and displacement of the cervical spine to prevent the development of new neurologic deficits or further neurologic injury. The best technique of intubation of the trachea in these patients remains unclear.[1–6] Most of the literature has reported on patients with traumatic cervical spine injuries and there is no clear consensus as to whether intubation should be performed with topical anesthesia or after induction of general anesthesia. The commonly reported intubation techniques include fiberoptic bronchoscopy (FOB), direct laryngoscopy with manual in line stabilization, and blind nasal intubation.[7,8] Similarly, there is no agreement on the most appropriate intubation techniques that should be used in patients with nontraumatic cervical spine disease. The objectives of this study were to determine the factors that may influence the anesthesiologist's choice for the technique of intubation for cervical spine surgery with an observational prospective cohort study and to assess the association of postoperative airway complications and the technique of intubation.

MATERIALS AND METHODS

Approval by the University Health Network institutional ethics review board was obtained for data collection. All patients undergoing cervical spine surgery during 2.5 years were followed postoperatively from the time of arrival in the post anesthesia care unit until discharge from hospital. Information collected included demographics, diagnosis, and presenting clinical symptoms of the cervical spine disease, surgical procedure performed, position of patient during surgery and the anesthetic management including the technique of intubation. Also noted were the anesthesiologists' preoperative assessment of the airway and description of the intubation both which were simply classified as "difficult" or "easy," no specific criteria were used in this classification. All postoperative airway complications were documented. Patients were also questioned regarding any complaints of a sore throat, hoarseness, and dysphagia. The anesthetic management of the patients including the choice of intubation technique was at the discretion of the anesthesiologist who did not know that we were collecting these data.

The technique of intubation of the patient's airway was classified as "awake FOB," "asleep FOB," "asleep laryngoscopy," and "asleep other." The latter included the use of Trachlight (Laerdal Medical Corp, Wappingers Falls, NY) and Glidescope video laryngoscope (GUL; Saturn Biomedical Systems, Burnaby, BC, Canada). The first attempted technique of intubation was used for classification of the patient. Positioning for surgery was divided into anterior and posterior approaches. Patients

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were classified according to their main presenting neurologic symptoms as myelopathy, radiculopathy, unstable/fractured spine, or other (tumor, abscess with nonspecific complaints such as pain). As well, patients were classified according to their presenting disease state; prolapsed disc, unstable/fractured, tumor/abscess, and spinal stenosis.

The proportions of patients intubated with the different techniques were calculated for every preoperative factor (Table 2). The association between the method chosen for intubation and the existing preoperative factors (preoperative disease, preoperative symptoms, surgical approach, difficult airway, and emergency procedures) and also for postoperative airway complications were determined using χ^2 test. Significance between proportions of patients intubated using the different techniques within the same preoperative factor was then calculated using the McNemar test for comparing proportions (Table 2). McNemar test was performed using an interactive on-line calculator created by Dimension Research, Inc (Peoria, IL) extracted from the world wide web: http://www.dimensionresearch.com/resources/calculators/mcnemar.html. A P value < 0.05 was considered statistically significant.

RESULTS

A total of 334 patients were followed after undergoing cervical spine surgery with either an anterior or posterior approach. Seven patients who arrived in the operating room already intubated from the ICU were eliminated from the data analysis. The total number of patients considered was 327 (Table 1). There was no significant difference in patient demographics among the 4 categories of intubation techniques.

The techniques of intubation chosen by the attending anesthesiologists consisted of awake FOB in 39% of patients and asleep intubating techniques in 61% of patients. The most common technique used to intubate patients after induction of anesthesia, that is, asleep intubation was FOB. All choices for technique of intubation and the performance of the intubation were by the consultant anesthesiologist either alone or in direct supervision of a trainee. The 20 consultant anesthesiologists involved in this review were all skilled in FOB. All performed intubations with both awake and asleep techniques. Using univariate analysis, there was a clear association between the categorical factors namely surgical approach ($P < 0.05$), preoperative symptoms ($P < 0.001$), preoperative disease ($P < 0.001$), and also potential difficult airway and emergency procedures ($P < 0.001$) and the method selected for intubation by the attending anesthesiologist. Several patterns can be identified pertaining to the relationship between individual preoperative factors and the chosen intubating technique (Table 2). Awake FOB was predominately chosen for intubating patients if their symptoms indicated myelopathy, their preoperative diagnosis was unstable/fractured spine or spinal canal stenosis or their surgical approach was posterior cervical surgery. In emergency cases and patients who were described as possibly difficult to intubate the anesthesiologists preferred an awake FOB. The selected intubating technique in patients who presented with symptoms suggesting radiculopathy was more likely to be asleep FOB. However, patients with spinal tumors were mostly intubated using direct laryngoscopy.

During the preoperative assessment of the patient a potential difficult airway had been indicated by an anesthesiologist in 42 (13%) patients (Table 2). However, in all but 4 patients the actual intubation was described to have been easy for the technique chosen by the anesthesiologist performing the intubation. There were 10 patients (3%) where the anesthesiologist had documented difficulty in intubation. In 5 patients, the anesthesiologist eventually intubated successfully with the chosen technique (awake FOB 1, asleep FOB 3, asleep other 1). The technique of intubation was changed in 5 patients; from awake FOB to asleep FOB (1), from awake to asleep FOB to asleep laryngoscopy (1), asleep FOB to asleep laryngoscopy (2), from asleep laryngoscopy to asleep FOB (1).

There was no association between postoperative airway complications and the method used for intubation. Acute airway obstruction occurred in 1.2% of patients (4/327) because of the development of neck swelling (n = 3) or macroglossia (n = 1). The initial intubation of the patients' trachea had been with an asleep FOB for anterior surgery (n = 1) and posterior surgery (n = 1) and asleep Glidescope for anterior surgery (n = 1) and posterior surgery (n = 1). Respiratory failure requiring reintubation from pneumonia, excessive secretions, or recurrent aspiration developed in 9 (2.8%) patients more than 48 hours after surgery.

TABLE 1. Results: Demographics According to the Technique of Intubation

	Awake FOB N = 128	Asleep FOB N = 103	Asleep Laryngoscopy N = 72	Asleep Other N = 24
Age (y)	53 ± 16	51 ± 14	51 ± 14	51 ± 14
Sex (M/F)	67/61	60/43	43/29	18/6
ASA [median (range)]	3 (1-4)	2 (1-4)	2 (1-3)	2 (1-3)
No. surgical levels	2.3 ± 1.5	2.0 ± 1.4	2.0 ± 2.2	2 ± 1.2

Values are mean ± SD.
ASA indicates American Society of Anesthesiologists.

TABLE 2. Classification of Patients by Preoperative Factors According to the Technique Used for Intubation of the Trachea

	Awake FOB N = 128	Asleep FOB N = 103	Asleep Laryngoscopy N = 72	Asleep Other N = 24	Total N = 327
Preoperative difficult airway	24 (57%)*†‡	10 (24%)§	6 (14%)‖	2 (5%)	N = 42 (100%)
Emergency procedures	18 (55%)*†‡	6 (18%)	8 (24%)‖	1 (3%)	N = 33 (100%)
Preoperative disease					
Disc	62 (31%)‡	78 (39%)¶§	45 (23%)‖	14 (7%)	N = 199 (100%)
Unstable/Fractured	33 (73%)*†‡	9 (21%)¶§	1 (2%)	2 (4%)	N = 45 (100%)
Tumor/Abscess	11 (26%)	8 (19%)¶	20 (47%)‖	4 (9%)	N = 43 (100%)
Stenosis	22 (55%)*†‡	7 (18%)	6 (15%)	5 (13%)	N = 40 (100%)
Preoperative symptoms					
Myelopathy	69 (45%)*†‡	47 (31%)¶§	26 (17%)‖	10 (7%)	N = 152 (100%)
Radiculopathy	16 (18%)*†‡	40 (44%)¶§	25 (28%)‖	9 (10%)	N = 90 (100%)
Other symptoms#	10 (25%)†‡	6 (15%)¶	20 (50%)‖	4 (10%)	N = 40 (100%)
Surgical approach					
Anterior	65 (33%)†‡	72 (37%)¶§	43 (22%)‖	15 (8%)	N = 195 (100%)
Posterior	63 (48%)*†‡	30 (23%)	29 (22%)	10 (8%)	N = 132 (100%)

$P < 0.05$ for *Awake FOB versus asleep FOB; †Awake FOB versus asleep laryngoscopy; ‡Awake FOB versus asleep other; §Asleep FOB versus asleep other; ‖Asleep laryngoscopy versus asleep other; and ¶Asleep FOB versus asleep laryngoscopy.

#Other symptoms include patients with nonspecific complaints such as pain and infection.

N indicates number of patients (%).

Postoperatively 19 (5.8%) patients were electively kept intubated for a duration ranging from 1 hour to 10 days. The reasons for prolonged intubation were preoperative severe myelopathy with respiratory compromise (5), preoperative spinal trauma (4), severe respiratory disease (5), upper airway edema (3), and delayed awakening (2). Overall, the incidence of a postoperative sore throat was 24%, hoarseness 17%, and dysphagia 16%. A change from the preoperative neurologic status was present in 2.4% of patients (8/327). Three patients (0.9%) had a new neurologic deficit, 1 was transient arm weakness and 2 were persistent leg weakness. Five patients with preoperative myelopathy experienced worsening of their deficits.

DISCUSSION

In this observational prospective cohort study, we reviewed the clinical practice of the anesthesiologists in our institution in their choice of intubating techniques in patients presenting for cervical spine surgery. We assessed the association between the method chosen for intubation by the anesthesiologist and the existing preoperative factors and the occurrence of postoperative airway complications. We did not inform the anesthesiologist about our collection of data nor did we ask them the reasons for their choice.

We found that an awake FOB was predominately chosen for intubating patients if their symptoms indicated myelopathy, their preoperative diagnosis was unstable/fractured spine or spinal canal stenosis or their surgical approach was posterior cervical surgery. The latter factor might have been significantly associated with awake FOB because a considerable number of cervical spine fractures, myelopathy, and patients with spinal stenosis had posterior decompression and instrumentation procedures. In contrast, patients presenting with symptoms of radiculopathy were more frequently intubated with asleep FOB. We had grouped our patients by their predominant symptoms, as patients may have had both myelopathy and radiculopathy.

It has been suggested that in patients with myelopathy an awake FOB or a technique that does not stress the cervical spine be used.[2] A greater number of our patients with fractured or unstable spines were intubated with awake FOB. The assumptions for recommendation of an awake intubation, particularly FOB, in cervical spine injured patients is that the head and neck are left in a neutral position, protective reflexes are present and minimal spinal movement is required.[4,5] There are also concerns with the use of general anesthesia, in particular muscle paralysis as this may result in the loss of the splinting action of the cervical muscles, although there is little evidence to support this. As well, a neurologic assessment after intubation and even positioning of the patient awake are possible, although there are little data to suggest that neurologic outcomes are better.[5] We were unable to accurately assess the frequency and extent of neurologic evaluation after intubation in our study owing to the lack of documentation. Endotracheal intubation with direct laryngoscopy after induction of general anesthesia has also been advocated in patients with cervical spine injuries.[4,5] The addition of manual in-line stabilization may help to decrease the movement of the head and neck. We did not assess the use of in line traction during intubation under general anesthesia. In patients where a difficult intubation is anticipated, awake intubation is also suggested as the best approach with the use of a FOB.[1,3] In past surveys, the use of awake FOB, laryngoscopy, and the laryngeal mask airway have been the preferred choices for difficult airways including patients with cervical spine disease.[7,8] In this study, it was not our intent to study the intubation techniques of difficult airways, as we did not have detailed information.

An awake intubation was conducted in 24 of 42 patients (57%) who had been assessed preoperatively as a possible difficult intubation, but in only 5 was there any difficulty.

We found no association between postoperative airway complications and the method of intubation used. Airway complications associated with anterior cervical spine surgery have been reported by Sagi et al[9] to occur in 6.1% of patients, and reintubation in 1.9%. They did not mention the intubation techniques used but none of the patients who developed an airway problem had had a difficult intubation. These authors also reviewed 20 previous articles that mentioned an airway complication after anterior cervical spine surgery and calculated an incidence of 2.4% and 9 deaths. The main causes of airway obstruction were pharyngeal edema and hematoma. Emery et al[10] reviewed 7 (5.2%) patients who developed upper airway obstruction after anterior multilevel corpectomy for myelopathy. Preoperatively, 3 patients were noted to have been a difficult intubation but FOB was not used in any patient. Wattenmaker et al[11] reviewed patients with rheumatoid arthritis undergoing posterior cervical spine surgery. An upper airway obstruction developed in 7% of all their patients; 14% of patients who had been intubated nasotracheally awake but without fiberoptic assistance compared with 1% of patients who had been intubated with awake fiberoptic technique. The authors suggested that the trauma of nonfiberoptic intubation lead to edema and airway obstruction. The incidence of acute airway obstruction in our series of patient was 1.2%, including both anterior and posterior surgery. There were no clear risk factors for the development of an airway obstruction in our patients. Other complications reported to have led to an acute airway obstruction included macroglossia and cerebrospinal fluid leak.[12,13]

Other common complaints and complications that may be affected by intubation and also surgery include sore throat and hoarseness.[9] Hoarseness has been reported in up to 51% of patients. Postoperative dysphagia occurs in up to 60% of patients and does not result from intubation alone.[9,14,15] The incidence of neurologic complications after cervical spine surgery has been reported to be 1.04%.[16] In review of 327 patients undergoing cervical spine surgery, Fuchs et al[17] reported that they had no neurologic deficits attributable to intubation. Reports of neurologic injury as a direct result of intubation are not common and are mostly in patients with cervical spine injuries.[18,19]

There are a number of limitations to our study. Lack of documentation of all events surrounding the intubation is lacking. The choice of the technique for each patient may have been based on a single or numerous factors, and also the experience of the anesthesiologist and of a trainee if they were involved. The number of patients intubated with other techniques such as the Glidescope is low in this study, as these newer techniques were just beginning to be introduced into our practice.

In summary, we found that the technique of choice for intubation of patients with cervical spine disease varied greatly at our institution. Patients with preoperative clinical symptoms of myelopathy and with unstable/fractured spines were more likely to be intubated with an awake FOB. Postoperative complications after cervical spine surgery did occur but their frequency was low and they were not associated with the method of intubation.

The lack of association between postoperative complications and method of intubation suggests 2 possibilities: (1) method of intubation does not affect postoperative complications in surgical spine patients, or (2) anesthesiologists seldom make inappropriate decisions regarding method of intubation in surgical spine surgery patients. Although our data do not address this distinction, logic and prior research strongly favor the latter possibility. As such, our recommendations are similar to those of previous studies; that is, anesthesiologist should continue to assess each patient individually and use that information to inform their choice of intubation method from among the methods in which they have the greatest expertise.

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