

# Obstetrical and Pediatric Anesthesia

## Canadian pediatric anesthesiologists prefer inhalational anesthesia to manage difficult airways: a survey

*[Les anesthésiologistes pédiatriques canadiens préfèrent l'anesthésie par inhalation dans les cas de problèmes des voies aériennes : une enquête]*

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**Purpose:** To survey Canadian pediatric anesthesiologists to assess practice patterns in managing pediatric patients with difficult airways.

**Methods:** Canadian pediatric anesthesiologists were invited to complete a web survey. Respondents selected their preferred anesthetic and airway management techniques in six clinical scenarios. The clinical scenarios involved airway management for cases where the difficulty was in visualizing the airway, sharing the airway and accessing a compromised airway.

**Results:** General inhalational anesthesia with spontaneous respiration was the preferred technique for managing difficult intubation especially in infants (90%) and younger children (97%), however, *iv* anesthesia was chosen for the management of the shared airway in the older child (51%) where there was little concern regarding difficulty of intubation. Most respondents would initially attempt direct laryngoscopy for the two scenarios of anticipated difficult airway (73% and 98%). The laryngeal mask airway is commonly used to guide fiberoptic endoscopy. The potential for complete airway obstruction would encourage respondents to employ a rigid bronchoscope as an alternate technique (17% and 44%).

**Conclusion:** Inhalational anesthesia remains the preferred technique for management of the difficult pediatric airway amongst Canadian pediatric anesthesiologists. Intravenous techniques are relatively more commonly chosen in cases where there is a shared airway but little concern regarding difficulty of intubation. In cases of anticipated difficult intubation, direct laryngoscopy remains the technique of choice and fiberoptic laryngoscopy makes a good alternate technique. The use of the laryngeal mask airway was preferred to facilitate fiberoptic intubation.

**Objectif :** Mener une enquête auprès des anesthésiologistes canadiens en pédiatrie pour évaluer les modèles de pratique face aux problèmes de voies aériennes.

**Méthode :** L'enquête a été menée sur le Web. Les répondants ont sélectionné leurs techniques préférées d'anesthésie et de prise en charge des voies aériennes dans six scénarios cliniques dont des cas de visualisation difficile du larynx, de partage des voies aériennes et d'accès à des voies aériennes anormales.

**Résultats :** L'anesthésie générale par inhalation avec respiration spontanée a été préférée pour gérer l'intubation difficile chez les bébés (90 %) et les jeunes enfants (97 %), mais l'anesthésie *iv* a été choisie en cas de voies aériennes partagées chez les enfants plus âgés (51 %) quand on n'avait pas à se soucier vraiment de difficulté d'intubation. La majorité des répondants essaieraient d'abord la laryngoscopie directe pour les deux scénarios de problèmes anticipés d'intubation (73 % et 98 %). Le masque laryngé sert couramment de guide dans l'endoscopie fibroscopique. La possibilité d'obstruction complète des voies aériennes inciterait les répondants à employer un bronchoscope rigide comme technique de remplacement (17 % et 44%).

**Conclusion :** L'anesthésie par inhalation demeure la technique préférée de prise en charge des problèmes de voies aériennes chez les enfants par les anesthésiologistes canadiens en pédiatrie. Les techniques intraveineuses sont choisies relativement plus souvent dans les cas de voies aériennes partagées, sans prévision d'intubation difficile. Pour une intubation difficile anticipée, la laryngoscopie directe demeure la technique de choix et la laryngoscopie fibroscopique remplace avantageusement. L'usage du masque laryngé est préféré pour faciliter l'intubation fibroscopique.

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**M**ANAGEMENT of the difficult pediatric airway is made more challenging by the anatomical, physiological, and developmental considerations of the pediatric patient and requires careful clinical assessment, thorough planning for potential difficulties and experienced execution. Developing primary and alternate strategies, as suggested in the ASA difficult airway algorithm, assists in clinical decision-making.<sup>1</sup> Although the incidence of difficult intubation in healthy children is unknown, the increased likelihood of difficult laryngoscopy in patients with certain rare diseases or syndromes has been documented.<sup>2,3</sup>

Recent reviews have provided guidelines for developing an approach to the pediatric patient with a difficult airway.<sup>4,5</sup> Use of the flexible fiberoptic bronchoscopic (FOB) has become common practice amongst anesthesiologists and the availability of airway adjuncts such as laryngeal mask airway (LMA) and lighted stylet widespread.<sup>6</sup>

Providing evidence for the best method of dealing with a difficult pediatric airway remains a challenge. Most anesthesiologists will be faced with few cases each year, particularly with the reduction in the need for endotracheal intubation brought about by the use of the LMA. Conducting randomized controlled trials is very difficult due to the small numbers of cases in each centre and therefore we rely on the advice of individual experts with unique experience<sup>2,3</sup> or on reviews of case studies<sup>4</sup> to provide us with practice guidelines. Surveying current practice and opinion of experienced clinicians can help to identify changes in practice, reinforce practice guidelines and assess the impact of new techniques and pharmacological approaches. In this study, we wished to understand how experienced pediatric anesthesiologists in Canada would plan to approach six defined difficult pediatric airway scenarios.

## Methods

Following a pilot study, a web-based survey of pediatric airway management was constructed using Quask™ (Bruttisellen, Switzerland) web survey software. One hundred and thirty six members of the pediatric section of the Canadian Anesthesiologists' Society, who

had provided e-mail addresses, were contacted by e-mail containing a link to the survey web site. Two follow up e-mail reminders were sent out after the initial contact. Six pediatric airway management scenarios were presented in the survey. As shown in Table I, they involved airway management for cases where the difficulty was in visualizing the airway (scenarios 1 and 2), sharing the airway (scenarios 3 and 4), and accessing a compromised airway (scenarios 5 and 6).

For each scenario, the respondents were asked to indicate how frequently they would encounter a similar case in clinical practice. They were asked to indicate their preferred anesthetic method for each case. The choices for anesthetic method included: 1) awake (with or without light sedation and local anesthesia); 2) general anesthesia; or 3) deep sedation with either *iv* or inhalational agents.

Respondents were also asked whether or not they would use a spontaneously breathing technique or controlled ventilation with or without a muscle relaxant. In keeping with the ASA difficult airway algorithm, the respondents were required to select their primary and alternate airway management technique. The choices for airway management technique included: direct laryngoscopy; FOB with or without a LMA; blind nasal; blind intubation through a LMA; lighted stylet; rigid fiberoptic laryngoscopes; Combitube™ (Life-Assist, Inc., CA, USA); rigid bronchoscope; retrograde wire; and surgical airway. Finally, respondents were asked to indicate, on a scale of 1 (least) to 5 (most), their level of experience and expectation of success with their choice of airway technique.

## Results

Our survey generated a response from 63 recipients. Sixteen invitations to participate were automatically returned as undeliverable, and five subjects indicated that they were unable to access the web site. For those who could access the web site, the response rate was 55%. Ninety-two percent of the respondents were attending staff anesthesiologists and 59% practiced pediatric anesthesia exclusively. The demographic data, summarized in Table II, indicate that the majority of the respondents were experienced pediatric

TABLE I Clinical scenarios

Scenario 1	A nine-month old infant with Pierre Robin sequence and severe mandibular hypoplasia for cleft palate repair.
Scenario 2	A five-year-old child with Pierre Robin sequence known to be a difficult intubation for a palatal fistula repair.
Scenario 3	A two-year-old child with an inhaled endobronchial foreign body for bronchoscopy and foreign body removal.
Scenario 4	An eight-year-old child with laryngeal papillomatosis for microlaryngoscopy and laser excision of papilloma.
Scenario 5	A ten-year-old child with a laryngeal fracture for emergency reduction of a forearm fracture.
Scenario 6	A two-year-old child with potential epiglottitis needing emergency endotracheal intubation.

TABLE II Demographic data

<i>Respondent characteristic</i>	<i>Category</i>	<i>Percent</i>
Professional level ( <i>n</i> = 61)	Attending staff	92%
	Fellow or resident	8%
Pediatric fellowship training ( <i>n</i> = 63)	Yes	60%
Type of practice ( <i>n</i> = 60)	Pediatric academic	83%
	Other	17%
Proportion of pediatric anesthesia ( <i>n</i> = 56)	0-10% of practice	11%
	10-90% of practice	23%
	> 90% of practice	66%
Years of practice ( <i>n</i> = 61)	0-5 yr	30%
	6-15 yr	32%
	> 15 yr	46%
Practice location ( <i>n</i> = 59)	British Columbia	25%
	Alberta	25%
	Ontario	27%
	Quebec	7%

anesthesiologists practicing in academic centres in Ontario, Alberta and British Columbia.

The majority of respondents encountered similar cases only one to three times per year. The compromised airway cases (scenarios 5 and 6) were rare with 94% and 63% reported seeing less than one similar scenario per year. A significant proportion had never managed cases of laryngeal trauma (54%) or epiglottitis (13%).

#### *Anesthetic method*

The majority of respondents chose to give a general anesthetic for all cases except the laryngeal fracture (scenario 5), in which 46% chose an awake technique for establishing control of the airway. For the Pierre Robin cases (scenarios 1 and 2), almost all respondents chose to give a general anesthetic (95% and 95%) using an inhalational agent (89% and 84%) while

maintaining spontaneous respiration (89% and 87%). For the shared airway cases, general anesthesia using inhalational agents was most commonly chosen in scenario 3 (76%), but in scenario 4, for the older child, *iv* and inhalational agents were chosen equally. Lastly, almost all chose to give a general anesthetic using an inhalational agent (97%), while keeping the patient with potential epiglottitis breathing spontaneously (95%). The results for preferred anesthetic method are displayed in Table III.

#### *Airway management technique*

Direct laryngoscopy was the preferred primary technique in cases of anticipated difficult intubation. It was the most commonly chosen primary airway technique (73%) in scenario 1. By way of contrast, FOB techniques with (24%) and without a LMA (30%) were chosen over direct laryngoscopy (30%) for scenario 2. Rigid bronchoscopy, insufflation, or direct laryngoscopy was chosen by 94% of the respondents in scenario 3. In scenario 4, direct laryngoscopy or insufflation was chosen by 81% of respondents, with 19% choosing jet ventilation. For the case of potential epiglottitis, direct laryngoscopy was the preferred initial airway technique (98%), with rigid bronchoscopy (44%) being most widely chosen as an alternate technique. The laryngeal fracture case (scenario 5) saw a lower preference for direct laryngoscopy (49%) as a primary technique and a higher preference for fibre-optic-guided intubation (37%) than in other scenarios.

FOB was favoured as an alternate technique or as the primary technique when the airway was known to be difficult. When a FOB technique was chosen, the use of a laryngeal mask to facilitate intubation was preferred. The results for preferred airway management techniques in scenarios 1, 2, 5 and 6 are displayed in Table IV.

TABLE III Preferred anesthetic method for each scenario

		<i>Scenario 1</i>	<i>Scenario 2</i>	<i>Scenario 3</i>	<i>Scenario 4</i>	<i>Scenario 5</i>	<i>Scenario 6</i>
		<i>Pierre Robin sequence</i>		<i>Inhaled foreign body</i>	<i>Laryngeal papilloma</i>	<i>Laryngeal trauma</i>	<i>Potential epiglottitis</i>
		<i>9 months</i>	<i>5 yr</i>	<i>2 yr</i>	<i>8 yr</i>	<i>10 yr</i>	<i>2 yr</i>
Experience with case	Average per year	2.1	1.4	3.2	3.1	0.2	1.0
Anesthesia	General	95%	95%	100%	100%	46%	100%
	Awake/light	5%	5%	-	-	54%	-
Sedation agent	Inhalational	90%	87%	76%	49%	71%	97%
	<i>iv</i>	10%	13%	24%	51%	29%	3%
Ventilation	Spontaneous	90%	90%	87%	68%	90%	97%
	Controlled	10%	10%	13%	32%	10%	3%
Muscle relaxant before intubation	Yes	11%	8%	15%	31%	10%	5%

TABLE IV Preferred airway management technique for each scenario

		Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
		<i>Pierre Robin sequence</i>	<i>Pierre Robin sequence</i>	<i>Inhaled foreign body</i>	<i>Laryngeal papilloma</i>	<i>Laryngeal trauma</i>	<i>Potential epiglottitis</i>
		9 months	5 yr	2 yr	8 yr	10 yr	2 yr
Direct laryngoscopy	Primary	73%	30%	17%	37%	49%	98%
	Alternate	6%	-	14%	24%	6%	-
Fibreoptic intubation	Primary	13%	30%	-	-	37%	-
	Alternate	22%	25%	8%	10%	16%	10%
Fibreoptic intubation via LMA	Primary	10%	24%	-	-	-	-
	Alternate	51%	44%	6%	11%	24%	10%
Lighted stylet	Primary	5%	16%	-	-	-	-
	Alternate	16%	19%	-	-	-	-
Rigid bronchoscopy	Primary	-	-	48%	-	-	-
	Alternate	-	5%	33%	10%	17%	44%
Insufflation	Primary	-	-	29%	44%	-	-
	Alternate	-	-	-	-	-	-
Jet ventilation	Primary	-	-	-	19%	-	-
	Alternate	-	-	-	13%	-	-
Surgical airway	Primary	-	-	-	-	6%	-
	Alternate	-	-	-	-	25%	30%

Techniques chosen by more than 4% of respondents are displayed. LMA = laryngeal mask airway.

TABLE V Level of experience and anticipated success for each airway management technique

<i>Airway management technique</i>	<i>Number of times chosen</i>	<i>Median level of experience with technique*</i>	<i>Median level of anticipated success with technique*</i>
Direct laryngoscopy - bougie/stylet	223	5	4
Fibreoptic laryngoscopy through LMA	116	4	4
Fibreoptic laryngoscopy	106	4	4
Rigid bronchoscope	101	4	5
Insufflation only	57	5	5
Surgical airway	41	3	5
Lighted stylet	40	4	4
Jet ventilation with Sanders injector	21	4	5

\*Graded on a scale of 1 (least) to 5 (most). LMA = laryngeal mask airway.

#### *Level of experience and anticipated success*

Respondents indicated that if they chose techniques for airway management with which they were experienced and anticipated were likely to be successful. On further analysis, there was no difference in level of experience and anticipated success for those choosing rigid bronchoscopy for the shared airway cases (scenarios 3 and 4) and the cases with potential for airway obstruction (scenarios 5 and 6). The results for level of experience and anticipated success for each airway technique are summarized in Table V.

#### **Discussion**

Our survey of pediatric difficult airway management practices suggests that the following cases of difficult intubation are uncommon: Pierre Robin sequence;

inhaled endobronchial foreign body; and laryngeal papillomatosis. Blunt laryngeal trauma in children is even more infrequent; respondents indicated that they had little or no experience with this scenario. In addition, in the absence of acute airway symptoms or an indication for surgery and following flexible laryngoscopic confirmation of a safe airway,<sup>7,8</sup> a conservative approach to management is recommended to avoid aggravation of an existing injury. The routine use of hemophilus influenzae vaccination accounts for the low rate of experience with managing acute epiglottitis.<sup>9,10</sup>

General anesthesia prior to intubation was by far the most widely chosen anesthetic method for pediatric difficult airway patients. The use of awake techniques, frequently employed in adult practice,<sup>2,11</sup> are not favoured in infants and young children, as coop-

eration is needed to produce topical anesthesia of the airway and obtain adequate conditions for endoscopic visualization of the airway. In the case of the ten-year-old with a traumatized airway (scenario 5), asleep and awake methods were chosen equally, which may reflect the fact that the child was potentially at an age to cooperate with an awake intubation.

#### *Anesthetic method*

The finding that inhalational anesthesia with spontaneous ventilation was used for most difficult airway cases concurs with the recommendations by most authors.<sup>12,13</sup> However, in the shared airway scenarios (scenarios 3 and 4), a relatively greater number of respondents chose an *iv* technique to allow airway manipulation by the surgeon. Potential advantages of total *iv* techniques in diagnostic and therapeutic airway endoscopy include: steady level of anesthesia, independent of ventilation; and reduced exposure of operating room personnel to waste anesthetic agents.<sup>9</sup> The use of muscle relaxants for airway management was also more prevalent in these scenarios. The traditional teaching for airway endoscopy for an inhaled foreign body, is to maintain spontaneous ventilation to avoid dislodging the foreign body deeper into the respiratory tract. However, in a retrospective review of anesthetic experience with bronchial or tracheal foreign body removal, neither spontaneous nor controlled ventilation was associated with an increased incidence of adverse events.<sup>14</sup>

#### *Airway management technique*

In cases of possible difficult intubation, direct laryngoscopy remains the primary technique of choice. The efficacy of a LMA both in providing a good airway in the pediatric patient with a difficult airway as well as a conduit for FOB has been well established in recent studies<sup>15,16</sup> and it was commonly chosen to guide fiberoptic endoscopy. The rigid bronchoscope was used fairly commonly (44%) for cases with the potential for airway obstruction (scenarios 3, 5 and 6). There was no difference in the level of experience or anticipated success when this technique was chosen despite the latter two scenarios being rare. We would therefore assume that the choice of rigid bronchoscopy implied the presence of an ENT surgeon.

In the scenarios of difficulty in airway visualization, FOB was chosen as the initial technique by 22% in scenario 1 and 53% in scenario 2. This difference may be due to the different developmental stages of the patients in the two cases, greater familiarity with direct laryngoscopy or the desire to grade the laryngoscopic view.

As an alternate technique, a strong majority chose FOB for both scenario 1 and scenario 2. A significant

proportion of those choosing FOB as an alternate technique for managing potential epiglottitis indicated that they had little or no experience of this condition. While there are no absolute contraindications to FOB, pharyngeal or laryngeal masses may distort anatomy and make FOB more difficult.<sup>15</sup> The use of rigid bronchoscopy or surgical airway is recommended as an alternate technique for managing failed intubation in acute epiglottitis<sup>12,13</sup> and as the primary technique for immediate airway management of blunt laryngotracheal trauma in children.<sup>7</sup>

The reliance on FOB in many of the clinical scenarios emphasizes the need to have suitable pediatric fiberoptic endoscopes available in locations dealing with these types of cases and need for appropriate training and maintenance of skills for FOB. The findings suggest that the number of cases available for training is limited and, thus, mandates the use of FOB in normal individuals and simulated scenarios for adequate training.

#### **Limitations**

Our study is subject to several limitations. The web survey sample may not be representative of all Canadian pediatric anesthesiologists. Anesthesiologists from three provinces accounted for three-quarters of the sample. In addition, the sampling frame of Canadian pediatric anesthesiologists included mostly those working at tertiary care pediatric hospitals, and may have excluded non-pediatric trained anesthesiologists that see relatively smaller proportions of pediatric patients. Failed delivery reports and reports of possible technological incompatibilities were also detrimental to the sample's robustness.

While selection bias may be present for both web surveys and mail surveys, the authors made numerous attempts to contact Canadian pediatric anesthesiologists to ensure equal chances of participating across this study's population. A random sample may have been collected using another modality but a web survey was preferable for several reasons. Firstly, it removed geographical constraints, allowing the investigators to sample pediatric anesthesiologists from across Canada. Secondly, the media richness of the survey was ideal for presenting respondents with clinical scenarios; pictures, video and audio can be incorporated. Thirdly, the modality allowed respondents to complete the survey at their convenience. Fourthly, the automated data collection offered time and resource efficiencies to the researcher. Lastly, the automatic summary of the responses and import to a spreadsheet prevented transcription error during data entry and facilitated data analysis.

In summary, general inhalational anesthesia with spontaneous respiration was the preferred technique for management of difficult intubation particularly in infants and younger children, however, *iv* anesthesia was chosen for the management of the shared airway where there was little concern regarding difficulty of intubation.

FOB was used most commonly as an alternate technique or as a primary technique for a known difficult intubation. When FOB was chosen, the majority of clinicians tended to use a LMA as a conduit for the bronchoscope indicating that this technique is now firmly established in the approach to the difficult pediatric airway. A rigid bronchoscope should be available when the risk for complete airway obstruction is present. This survey of expert clinicians illustrates existing practices and may be helpful in planning an approach to the difficult pediatric airway.

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