

# Airway management in the presence of cervical spine instability: A cross-sectional survey of the members of the Indian Society of Neuroanaesthesiology and Critical Care

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## ABSTRACT

**Background and Aims:** There is a paucity of clinical practice guidelines for the ideal approach to airway management in patients with cervical spine instability (CSI). The aim of this survey was to evaluate preferences, perceptions and practices regarding airway management in patients with CSI among neuroanaesthesiologists practicing in India. **Methods:** A 25-item questionnaire was circulated for cross-sectional survey to 378 members of the Indian Society of Neuroanaesthesiology and Critical Care (ISNACC) by E-mail. We sent four reminders and again submitted our survey to non-responders during the 2017 annual ISNACC meeting. Apart from demographic information, the survey captured preferred methods of intubation and airway management for patients with CSI and their justification. Regression analysis was used to identify factors associated with the use of indirect technique for intubation. **Results:** Only 122 out of the 378 anaesthesiologists responded to our survey. Most respondents were senior consultants, working in training hospitals, and performed  $\geq 25$  intubations per year for CSI patients. The majority of neuroanaesthesiologists (78.7%;  $n = 96$ ) preferred indirect techniques for elective intubation. However, 45 anaesthesiologists (36.9%) preferred indirect techniques for emergency intubation. In an adjusted analysis, preference for patients to be conscious during intubation was significantly associated with the use of indirect techniques (odds ratio = 3.79; confidence interval = 1.52–9.49,  $P < 0.01$ ). **Conclusions:** Among ISNACC members, indirect techniques are preferred for elective intubation of patients with CSI, while direct laryngoscopy is preferred for emergency intubation.

**Key words:** Airway management, anaesthesiologists, cervical spine instability, survey

### Access this article online

Website: [www.ijaweb.org](http://www.ijaweb.org)

DOI: 10.4103/ija.IJA\_671\_17

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## INTRODUCTION

Prevention of secondary insult to the cervical spinal cord is paramount during airway management when cervical spine instability (CSI) is present.<sup>[1]</sup> A plethora of research on different intubation techniques in actual or simulated CSI has been published.<sup>[2-5]</sup> However, current studies largely focus on surrogate outcomes, such as intubation success rate or degree of cervical spine movement versus patient-centric outcomes such as intubation-associated neurological deficits. Further,

there are no guidelines provided by societies such as the Difficult Airway Society<sup>[6]</sup> or American Society of

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**How to cite this article:** Sriganesh K, Busse JW, Shanthanna H, Ramesh VJ. Airway management in the presence of cervical spine instability: A cross-sectional survey of the members of the Indian Society of Neuroanaesthesiology and Critical Care. *Indian J Anaesth* 2018;62:115-20.

Anesthesiologists<sup>[7]</sup> which address special concerns regarding intubation in patients with CSI. This has led to non-uniform airway management practices among anaesthesiologists.<sup>[8]</sup> Availability of umpteen airway management devices, each claiming superiority over others, has further complicated selection of the most appropriate tool for intubation.<sup>[9]</sup>

The purpose of this nationwide survey was to explore preferences among Indian neuroanaesthesiologists pertaining to intubation techniques in patients with CSI. The secondary objective was to evaluate the current beliefs and practices regarding airway management in patients at risk of secondary cervical spinal cord injury.

## METHODS

With the assistance of an epidemiologist and content experts, we developed a 25-item, English language questionnaire to evaluate practices among anaesthesiologists for intubation in patients with CSI. The questionnaire was pre-tested with six anaesthesiologists (a mix of anaesthesiologists with several years of experience in intubating patients with CSI and novice anaesthesiologists with special interest in airway management) who provided feedback on relevance, clarity and appropriateness of questions and responses. Based on their suggestions, we modified our questionnaire to include items regarding emergency airway management, previous training in difficult airway management and positioning of patients with CSI for surgery. The final questionnaire used closed-ended response options for all questions as a previous report has shown that this approach results in fewer incomplete questionnaires than open-ended formats.<sup>[10]</sup>

We used Kwiksurveys (<https://kwiksurveys.com>) to facilitate the online completion of our survey. Permission from the secretariat of the Indian Society of Neuroanaesthesiology and Critical Care (ISNACC), the official organisation of neuroanaesthesiologists in India, was obtained for distribution of our questionnaire to their members. The database we obtained from the ISNACC secretariat contained 539 entries (E-mails or names of members) after removal of seven duplicates. One-hundred and nineteen members did not list their E-mail in the database, and one E-mail did not list a corresponding name. We sent E-mails to the remaining 419 members in December 2016, with a letter introducing the study and a link to Kwiksurveys

to facilitate participation, of which 39 bounced back without delivery. Two members communicated that they were neurosurgeons and did not manage airway. After excluding these cases, four reminder E-mails were sent to 378 members over 45 days. The survey was also physically administered to non-responders at the 2017 annual meeting of the ISNACC to further improve the response rate. Ethical approval was not sought as the Institutional Ethics Committee does not require approval for surveys of healthcare professionals.

We generated frequencies for all collected data. We hypothesised that neuroanaesthesiologists would be more likely to use indirect techniques for intubation in the presence of CSI if they: (1) performed more intubations in patients with CSI, (2) practiced in hospitals with trainees, (3) felt that new-onset neurological deficits during intubation were more likely with direct techniques, (4) endorsed that airway management in patients with CSI is difficult, (5) reported availability of resource and expertise for intubation with at least one indirect technique, (6) had greater years of experience in anaesthesia, and (7) preferred patients with CSI to be conscious during intubation. For this survey, we defined an intubation technique as indirect if it did not involve conventional direct laryngoscopy with or without cervical spine stabilisation. The dependent variable was anaesthesiologist's preferred intubation technique for patients with CSI: direct or indirect.

We excluded independent variables with <20 observations, unless we were able to collapse them with other related variables to exceed this threshold. This was done to provide some reassurance that each variable had sufficient discriminant power to detect an association with preferred intubation approach, if such an association existed. We tested each independent variable in univariable regression models for significance, and any variable that resulted in  $P \leq 0.10$  was entered into our multivariable regression model. All associations were reported as an odds ratio (OR) and 95% confidence interval (CI). For the purpose of the multivariable regression model, significance was considered at  $P \leq 0.05$ . To avoid overfitting our models, we required at least ten observations per variable term for our adjusted model.<sup>[11]</sup> Goodness of fit for the multivariable regression model was determined by the Hosmer–Lemeshow (H-L) test. The H-L test measures predictive reliability by comparing the expected with the actual results of the dependent variable. Values

of H-L <15.5 indicate a statistically good fit at the 0.05 level of significance.<sup>[12]</sup> Analysis was performed using the Statistical Package for the Social Sciences software, version 16 (SPSS Inc., Chicago, IL).

**RESULTS**

We received 114 responses for the online survey and eight additional completed surveys at the ISNACC annual meeting. The overall response rate was 122/378 (32.3%). The proportion of anaesthesiologists using indirect technique for intubation in patients with CSI was 96/122 (78.7%) for elective intubation and 45/122 (36.9%) for emergency intubation. Demographic characteristics of respondents are summarised in Table 1.

Most of the respondents considered fiberoptic intubation as the ideal technique for elective intubation in patients with CSI (82.8%; *n* = 101), while they were divided between direct laryngoscopy with stabilisation (47.5%; *n* = 58) and videolaryngoscopy (37.7%; *n* = 46) for emergency intubation. Most of the respondents (69.5%; *n* = 85) rarely or never positioned patients awake for prone surgery after an awake intubation, with the main reasons being that patients or surgeons were unwilling to allow this approach (34.4%; *n* = 42 and 45.1%; *n* = 55, respectively). Most

(62.3%; *n* = 76) of the respondents felt that airway management in CSI patients was difficult and 84.4% (*n* = 103) felt that specific guidelines for airway management in this population would be useful [Table 2].

The most common reason for using a particular intubation technique was ‘familiarity and availability’ followed by ‘concern regarding new-onset neurological deficit and cervical spine movement during intubation’. Intubation time, ability to perform neurological assessment, success rate and cardiovascular changes were considered less important for choosing a particular technique [Figure 1].

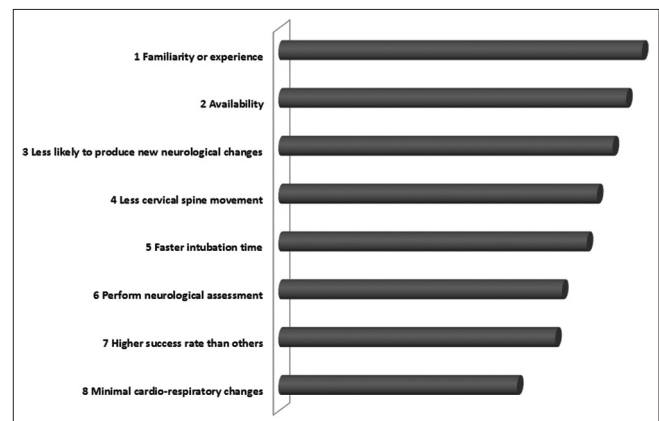
Respondents ranked chin lift, jaw thrust and head tilt interventions to produce the maximum cervical spine movement during airway management and awake fiberoptic intubation to produce the least movement. The other manoeuvres that responders ranked to cause significant cervical spine movement, in decreasing order, were chin lift and jaw thrust, direct laryngoscopy without stabilisation, mask ventilation, direct laryngoscopy with stabilisation, classic laryngeal mask airway (LMA), tracheostomy, intubating LMA, anaesthetised fiberoptic intubation and videolaryngoscopy [Figure 2].

Anaesthesiologists ranked surgical procedure as the most important factor contributing to post-operative neurological outcome. The other factors in descending order of importance were patient positioning, pre-operative neurological status, intubation technique, and anaesthetic factors with intraoperative haemodynamics being considered as the least important factor contributing to post-operative neurological outcome [Figure 3].

**Table 1: Demographic characteristics of the respondents (n=122)**

Characteristics assessed	n (%) of respondents
Practice environment	
Freelance practice	4 (3.3)
Non-training hospital	14 (11.5)
Training hospital	104 (85.2)
Designation	
Trainee	23 (18.9)
Junior consultant	36 (29.5)
Senior consultant	63 (51.6)
Years in practice	
<5	27 (22.1)
5-10	38 (31.1)
11-20	35 (28.7)
>20	22 (18.0)
Work category	
Government	70 (57.4)
Private	50 (41.0)
Both	2 (1.6)
Annual intubations for patients with CSI (years)	
>50	28 (23.0)
25-50	48 (39.3)
1-24	44 (36.1)
0	2 (1.6)

CSI – Cervical spine instability



**Figure 1:** Ranking by respondents of reasons for choosing a particular intubation technique (most important reason first)

**Table 2: Details of airway management practices and preferences in cervical spine instability (n=122)**

Characteristics evaluated	n (%) of respondents
Most commonly used intubation technique in elective scenario	
Direct	26 (21.3)
Indirect	96 (78.7)
Most commonly used backup intubation technique in elective scenario	
Direct	47 (38.5)
Indirect	75 (61.5)
Most commonly used intubation technique in emergency scenario	
Direct	77 (63.1)
Indirect	45 (36.9)
Most commonly used backup intubation technique in emergency scenario	
Direct	44 (36.1)
Indirect	78 (63.9)
Difficult airway training in the last 5 years	
Yes	44 (36.1)
No	78 (63.9)
Preferred technique for securing the airway in CSI	
Awake	83 (68.0)
Anesthetised	39 (32.0)
Position the patient awake for surgery after awake intubation	
Always	12 (9.8)
Mostly	25 (20.5)
Rarely	47 (38.5)
Never	38 (31.1)
Indirect intubation technique resources available*	
Fibreoptic intubation	116 (95.1)
Supraglottic airway assisted	109 (89.3)
Videolaryngoscopy	108 (88.5)
Tracheostomy	82 (67.2)
Cricothyroidotomy	51 (41.8)
Blind nasal	36 (29.5)
Retrograde intubation	29 (23.8)
Other gadgets	32 (26.2)
Reason for not using ideal intubation technique*	
Non-availability	54 (44.3)
Non-familiarity	21 (17.2)
Lack of time	34 (27.9)
Do not believe it makes a difference	10 (8.2)
Patient unwillingness	16 (13.1)
Surgeon unwillingness	9 (7.4)
Always use ideal technique	69 (56.6)
Reason for not positioning a CSI patient awake after awake intubation*	
No specific reason	20 (16.4)
Do not believe it makes a difference	16 (13.1)
Patient unwilling	42 (34.4)
Surgeon unwilling	55 (45.1)
Always position awake	18 (14.8)
Use electrophysiological monitor	13 (10.7)
Believe airway management to be difficult in CSI	
Always	25 (20.5)

Contd...

**Table 2: Contd...**

Characteristics evaluated	n (%) of respondents
Mostly	51 (41.8)
Occasionally	42 (34.4)
Rarely	4 (3.3)
Believe new neurological deficits with direct laryngoscopy is likely in CSI	
Yes	49 (40.2)
No	46 (37.7)
Don't know	27 (22.1)
Believe cervical spine movement to be more during direct than indirect laryngoscopy	
Yes	94 (77.0)
No	17 (14.0)
Don't know	11 (9.0)
Believe ideal elective intubation technique in CSI is	
Direct laryngoscopy with stabilisation	7 (5.7)
Fibreoptic intubation	101 (82.8)
Videolaryngoscopy	14 (11.5)
Believe ideal emergency intubation technique in CSI is	
Direct laryngoscopy without stabilisation	6 (4.9)
Direct laryngoscopy with stabilisation	58 (47.5)
Fibreoptic intubation	9 (7.4)
Videolaryngoscopy	46 (37.7)
Supraglottic airway assisted	3 (2.5)
Believe difficult airway management guidelines to be useful in airway management of patients with CSI	
Definitely	68 (55.7)
Somewhat	35 (28.7)
Probably not	12 (9.8)
Unsure	7 (5.7)
Believe airway management training programme specific to CSI to be useful for better management	
Definitely	87 (71.3)
Likely	33 (27.0)
Probably not	2 (1.6)

\*Total percentage is >100% as respondents could choose more than one option. CSI – Cervical spine instability

The fibreoptic scope was the most common resource available for indirect intubation technique in our survey; however, we excluded this factor from our analysis due to a low number of observations for 'no' (n = 6). When we tested the remaining variables in univariable regression models, years in practice and preference for patients to be conscious during intubation met the threshold for inclusion in our adjusted model. In our multivariable regression model, only preference for patients to be conscious during intubation was significantly associated with the preference for indirect intubation (OR = 3.79; 95% CI = 1.52, 9.49) [Table 3].

## DISCUSSION

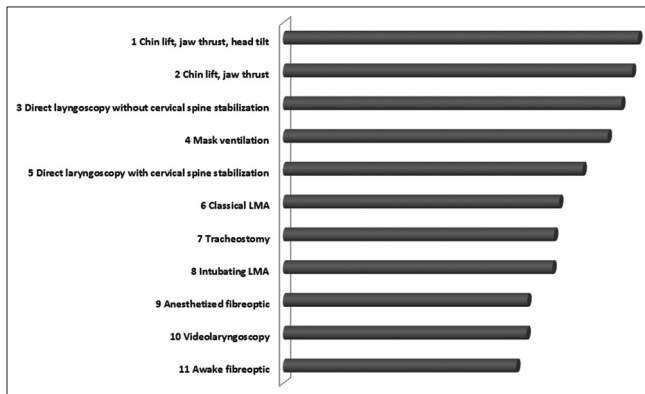
Most anaesthesiologists endorsed that intubation for CSI patients was difficult, and their choice of technique

was dependent on the clinical situation. Most of the respondents preferred indirect techniques for elective intubation, while direct techniques were preferred for emergency intubation. Most anaesthesiologists believed that direct laryngoscopy resulted in significant cervical spine motion, but less than half believed new-onset neurological deficits to be likely with direct laryngoscopy. The most common approaches for indirect intubation were fiberoptic scope followed by videolaryngoscopes and supraglottic airway devices. Use of indirect technique for elective intubation among CSI patients was associated with preference for patients to be conscious when securing the airway. Only a small proportion of anaesthesiologists positioned their patients in awake state for surgery in prone position, after awake intubation, primarily due to resistance by patients and surgeons.

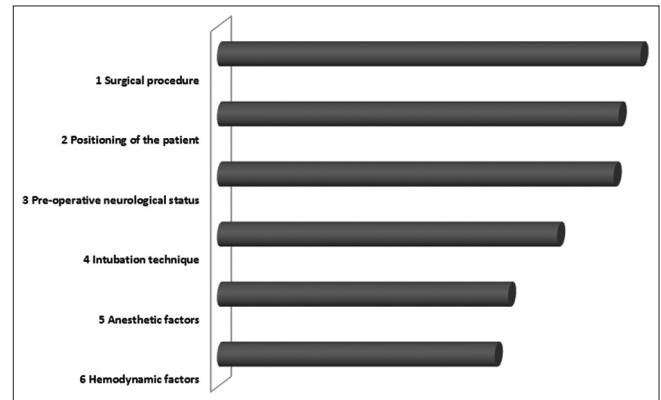
Strengths of our study are robust survey design and conduct of survey consistent with the best practices.<sup>[13]</sup> The 32% response rate and restriction of survey to anaesthesiologists who are members of the ISNACC

and manage airway in patients with CSI are limitations of this study. Hence, our findings may not apply to anaesthesiologists in general or to other circumstances of airway management in patients with CSI. Our model explored factors predicting the use of indirect intubation technique in the presence of CSI and found only one significant association, which suggests that there could be additional variables of importance that our survey did not capture.

Despite the lack of evidence demonstrating benefit with indirect intubation techniques on patient-important outcome (post-intubation new-onset neurological injury),<sup>[2]</sup> and the lack of evidence for harms with direct techniques,<sup>[14-19]</sup> indirect techniques of intubation continue to be widely used in patients with CSI.<sup>[20]</sup> Recently, two indirect intubation techniques (fiberoptic and intubating LMA) were found to be similar with respect to new-onset motor deficit (a patient-important outcome measure) and cervical spine movement.<sup>[21]</sup> There is an urgent need for evidence regarding the comparative effectiveness and



**Figure 2:** Ranking by respondents of airway manoeuvres causing cervical spine movement (maximum movement first)



**Figure 3:** Ranking by respondents of factors likely to cause adverse neurological outcomes after stabilisation surgery for cervical spine instability (most important factor first)

**Table 3: Variables associated with the use of indirect intubation techniques (n=122)\***

Factor	Univariable analysis OR (95% CI)	P	Multivariable analysis OR (95% CI)	P
Number of intubations in CSI/year	0.81 (0.46-1.40)	0.45		
Work environment**				
Non-trainee hospital	Reference standard			
Trainee hospital	3.67 (0.28-4.21)	0.91		
Anticipate new deficits with direct laryngoscopy				
Yes	Reference standard			
Uncertain	1.47 (0.42-5.24)	0.55		
No	0.73 (0.28-1.89)	0.51		
Believe airway management in CSI is difficult	0.72 (0.41-1.24)	0.23		
Years in practice	0.72 (0.47-1.11)	0.14	0.80 (0.51-1.25)	0.32
Prefer to have a conscious patient when securing the airway	4.09 (1.66-10.11)	<0.01	3.79 (1.52-9.49)	<0.01

\*The factor 'resources and expertise available for indirect intubation - fiberoptic' was removed due to low number of observations for 'no' (n=6), \*\*The category 'freelance practice' was removed due to low number of observations (n=4). OR – Odds ratio; CI – Confidence interval; CSI – Cervical spine instability



harms of competing intubation techniques in order to inform clinical decision-making, ensure availability of evidence-based resources and guide training of anaesthesiologists for management of patients with CSI.

An earlier survey from Europe evaluated airway management practices among emergency physicians and anaesthesiologists in patients with cervical spinal cord injury. In this European survey, emergency physicians preferred direct laryngoscopy while anaesthesiologists preferred indirect (fiberoptic) techniques.<sup>[22]</sup> Moreover, not all respondents, especially emergency physicians, were familiar with indirect intubation techniques. Further, the majority of respondents in the European survey did not consider mask ventilation to result in significant cervical spine movement.

Our findings support for the need clinical trials comparing direct and indirect techniques for intubation in patients with CSI. Furthermore, given the significant heterogeneity observed in the practice and understanding of airway management in patients with CSI, anaesthesia societies should consider developing specific guidelines for airway management in patients with CSI.

## CONCLUSIONS

Anaesthesiologists in this survey preferred indirect techniques for securing definitive airway during elective intubation, while direct laryngoscopy was the preferred choice during emergency in patients with CSI. Preference to awake intubation was associated with the choice of indirect techniques. There was wide variability in beliefs and practices regarding airway management in patients with CSI among anaesthesiologists who participated in this survey.

### Financial support and sponsorship

Nil.

### Conflicts of interest

There are no conflicts of interest.

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