Brief Communication

SponTaneous Respiration using IntraVEnous anaesthesia and Hi-flow nasal oxygen (STRIVE Hi) in tracheal stenting: Experience of ten cases in a regional cancer center

INTRODUCTION

Tracheal stenting under anaesthesia can be a definitive or palliative treatment for many patients with tracheal obstruction due to various benign and malignant aetiologies.[1,2] Deep sedation is preferred in mild to moderate grades of tracheal stenosis over general anaesthesia due to surgical accessibility, greater cost-effectiveness, good patient and operator satisfaction.[3-5]

Oxygenation and airway management become difficult during this procedure due to a shared airway and a stenotic trachea. Intermittent ventilation can also interrupt the procedure. STRIVE Hi can mitigate this problem by delivering up to 70 $Lmin^{-1}$ of heated and humidified air--oxygen mixture up to 100% FiO_2 via a specialised nasal cannula.

This review assesses the safety and efficacy of STRIVE Hi in patients undergoing tracheal stenting surgery.

METHODS

This is a retrospective review which was conducted in a tertiary level regional cancer center. After obtaining a waiver from the institutional review board, data from August 2017 to July 2018 were collected retrospectively from the hospital electronic medical record (EMR) of the Hospital Management System (HMS) Software Version 1.2.0 of our hospital.

A total number of ten patients (n = 10) who underwent tracheal stenting with HFNO support during that period were included. In all the patients, HFNO was delivered using an AIRVO 2™ device (Fisher and Paykel Healthcare, Auckland, New Zealand).

Preprocedural preparations included intravenous (IV) injection of glycopyrrolate 4 μg/kg body weight and inj. ondansetron 4 mg. The airway was nebulised with 5 ml of 4% lignocaine topical solution in the preparation area under monitoring. The HFNO humidifier was turned on in the operating room for at least 10 min before the arrival of the patient, to allow the humidifier to warm. SpO2, Non Invasive Blood Pressure (NIBP), Electrocardiography (ECG), and respiratory waveform from the ECG leads were continuously monitored during the procedures.

The specialised HFNO nasal cannula was attached and preoxygenation was carried out with 100% oxygen at 30 L min^{-1}, which was continued until sedation was administered. The treating anaesthesiologist then administered a translaryngeal injection 4 ml of 4% lignocaine through the cricothyroid membrane to block the recurrent laryngeal nerve. A 10% lignocaine spray was given orally to the oropharynx and posterior pharyngeal area. A bite block was used in all patients to protect the bronchoscope. Sedative agents, such as midazolam, fentanyl, and/or propofol, were given, at the discretion of the anaesthesiologist, and titrated the sedation depth to the target of 'Deep Sedation' (Approved by the ASA House of Delegates on October 13, 1999, and last amended on October 15, 2014).[6] Sedation was maintained with intermittent intravenous boluses of the sedative agents. The spontaneous respiration was ensured by continuous clinical monitoring of chest excursion and respiratory waveform from the ECG leads.

The oxygen flow rate was increased to 50 L min^{-1} immediately after sedative agents were given and was maintained at 30--70 L min^{-1} during the procedure, according to the requirement and patient tolerance. At the end of the procedure, the patient was shifted to the recovery area with Hudson Mask and moist oxygen flow at 4--6 L $min.^{-1}$

The age, sex, American Society of Anesthesiologists (ASA) physical status grading, associated comorbidities, and primary diagnosis were noted. Baseline data included SpO_2 before and after preoxygenation was noted. Procedural data including the number of hypoxic episodes (SpO_2 below 90%); duration of hypoxia; minimum SpO_2 recorded; the number of interruptions during the procedure to allow anaesthetic interventions, duration of the procedure, any other complications including arrhythmia and cardiac arrest were noted.

RESULTS

The number of patients underwent tracheal stenting was ten (n = 10). Mean age was 59.2 years with SD of 5.45. Seven were male and three were females. One patient was of ASA I, two were of II and seven patients were of ASA III with common comorbidities like hypertension, diabetes mellitus, and hypothyroidism. The primary diagnosis was of lung carcinoma in five patients, oesophageal carcinoma in four patients, and one patient developed tracheo-oesophageal fistula as a result of oesophageal carcinoma [Table 1].

Preoperatively mean room air SpO_2 was 96.7% with an SD of 1.25%, which improved following preoxygenation. Mean post-pre-oxygenation SpO_2 99.6% with an SD of 0.699%. The mean minimum SpO_2 during the procedure was 92.7% with an SD of 4.667. The median minimum SpO_2 during the procedure was 94.5% [Table 2].

Only three out of ten patients had a single hypoxic episode of SpO_2 below 90%. The mean duration of hypoxia was 11.67 s with an SD of 2.89 s. The mean duration of the procedure was 54.5 min with an SD of 7.62 min. There were no interruptions for anaesthetic interventions or need for additional oxygenation during the procedure. No complications occurred during the procedure [Table 2].

Table 1: Demographic data

Serial number	Age	Sex	ASA grading[1]	Primary diagnosis	Comorbidity
1	55	M	2	Ca[2] esophagus	HTN[3], DM[4]
2	55	M	2	Ca lungs	HTN
3	60	F	3	Ca lungs	HTN
4	61	M	2	Ca esophagus	DM, hypothyroid
5	54	F	2	Ca esophagus with TOF[5]	HTN, DM
6	63	M	2	Ca lungs	DM
7	53	M	1	Ca esophagus	No
8	67	F	2	Ca lungs	DM
9	56	M	2	Ca esophagus	HTN
10	68	M	3	Ca lungs	HTN, hypothyroid
Mean	59.2				
SD[6]	5.45				
Median			2		

[1]American Society of Anesthesiologists physical status classification, [2]Carcinoma, [3]Hypertension, [4]Diabetes mellitus, [5]Tracheooesophageal fistula, [6]Standard deviation

DISCUSSION

Management of airway during tracheal stenting under deep sedation is often considered challenging which requires a constant effort to avoid desaturation and subsequent interruption during the procedure. This are the main disadvantages of deep sedation.[1-5] In this regard, General anaesthesia with tracheal intubation is beneficial to maintain adequate oxygenation and ventilation. Endotracheal intubation can be very difficult at times and can cause traumatic airway injury in a stenosed trachea.[7] Second, muscle paralysis with positive pressure ventilation may push the blood and the secretions to deeper parts of the lungs. Deep sedation with spontaneous respiration without endotracheal intubation (tubeless anaesthesia) has definite advantages over general anaesthesia as the oral aperture, larynx, face, neck, and all other areas apart from the nose remains free to be operated upon. This could include cases with a partially obstructed airway or patients undergoing instrumentation in

Table 2: Study observations

Serial number	Baseline SpO_2[1] in room air (%)	Post-pre - oxygenation SpO_2 (%)	Number of hypoxic episodes	Duration of hypoxic episodes (s)	Minimum SpO_2 (%)	Number of interruptions during the procedure	Duration of the procedure (min)	Complications if any
1	98	100	0	NA[2]	98	Nil	55	no
2	98	100	1	15	85	Nil	55	no
3	98	100	0	NA	94	Nil	50	no
4	96	100	0	NA	96	Nil	60	no
5	95	98	1	10	89	Nil	45	no
6	97	100	0	NA	96	Nil	60	no
7	95	99	0	NA	95	Nil	70	no
8	96	100	0	NA	94	Nil	45	no
9	98	100	0	NA	95	Nil	50	no
10	96	99	1	10	85	Nil	55	no
Mean	96.7	99.6		11.667	92.7		54.5	
SD	1.25	0.699		2.886	4.667		7.619	
Median					94.5			

[1]Oxygen saturation percentage, [2]Not applicable

the airway.[8] The addition of STRIVE Hi technique can make it safer by preventing desaturation.

Although no specific literature is available regarding the use of STRIVE Hi during tracheal stenting procedures, many studies have been published showing the efficacy of STRIVE Hi technique in other airway surgeries.[5,8,9] The safety of this technique is attributed to its mechanism of action which includes washout of pharyngeal dead space, reduction of work of breathing and airway resistance, effect of positive end expiratory pressure (mean values ranging between 2.7 and 7.4 cm H_2O), continuous positive airway pressure (CPAP), and delivery of a constant fraction of inspired oxygen up to 100%.[10-12] It also has good tolerability in awake patients. These properties made this device useful particularly during emergence from anaesthesia; hence, it can be used comfortably till the patient becomes fully awake in the recovery.

HFNO can be beneficial for procedures requiring periods of apnoea. Rise in carbon dioxide can be a major concern in patients undergoing HFNO therapy during apneic oxygenation (THRIVE).[9] However, it is reported to be insignificant in patients undergoing HFNO therapy during spontaneous breathing (STRIVE Hi), where expiration is not abolished.[6]

Risk of oxygen toxicity with the use of HFNO can be minimised by decreasing the FiO_2, as much of the benefit of HFNO is due to the high flow and less due to high FiO_2. Risk of worsening of pneumothorax is also present with HFNO due to its CPAP effect and hence it should be practiced with caution. Laser surgeries are to be done with caution using less FiO2, though not absolutely contraindicated.[9]

Our review was conducted to assess the adequacy of HFNO in spontaneously breathing patients which can avoid frequently associated problems of desaturation and procedural interruption. All patients were evaluated prior to the procedure by the pulmonologist with bronchoscopy for the site and the feasibility of passing the flexible bronchoscope through the stenosed area. Patients with Cotton--Myer grading II (50--70%) and III (70--90%), without extension of tracheal stenosis to any part of the bronchus, were planned for stenting with a flexible bronchoscope. Hence, no patient underwent Y-stenting and none of them had a critical stenosis. Patients with emergency obstruction and severe narrowing of trachea underwent stenting procedures without HFNO using rigid bronchoscopy and hence not included in this review. As patent airway is a necessary for STRIVE Hi to work efficiently, appropriate sedation and a mechanism to keep airway patent has to be ensured.

The elective cases which underwent stenting only through flexible bronchoscope with HFNO support were included. Out of the ten patients we have observed, only three patients had an episode of desaturation below 90% with a mean duration of 11.67 s, the lowest SpO_2 being 85%, all of which recovered spontaneously or needed minimum intervention like head tilt, chin lift, and jaw thrust only, but neither of them caused any interruption in the procedure. Our results are consistent with studies showing benefits of STRIVE Hi in various clinical scenarios.[10-12]

However, our review specifically considers the subset of patients who underwent tracheal stenting procedures in our hospital setup. As tracheal stenting is not a very common procedure, small sample size is the limitation of this review.

CONCLUSION

Spontaneous respiration and titrated sedation with HFNO STRIVE Hi provides adequate oxygenation during tracheal stenting procedures. HFNO STRIVE Hi is associated with a low incidence of desaturation and a low frequency of interruption in the procedure by the need to mechanically ventilate patients' lungs.

Acknowledgements

The authors wish to thank Department of Anaesthesia and Critical Care, Tata Medical Center, Kolkata for giving them support in carrying out the study.

Financial support and sponsorship

Tata Medical Center, Kolkata.

Conflicts of interest

There are no conflicts of interest.

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Received: 16th May, 2019
Revision: 21st May, 2019
Accepted: 02nd August, 2019
Publication: 08th November, 2019

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Access this article online	
Quick response code	Website: www.ijaweb.org
	DOI: 10.4103/ija.IJA_386_19

How to cite this article: Mandal S, Barman SM, Sarkar A, Goswami J. SponTaneous respiration using IntraVEnous anaesthesia and Hi-flow nasal oxygen (STRIVE Hi) in tracheal stenting: Experience of ten cases in a regional cancer center. Indian J Anaesth 2019;63:941-4.