Anaesthetic management of tracheal restenosis in operated cases of tracheal resection and anastomosis: A retrospective review

INTRODUCTION

Tracheal restenosis in operated cases of tracheal resection and anastomosis (TRA) can pose various challenges to anaesthesiologists in terms of critical narrowing of an operated airway, maintenance of ventilation and oxygenation, sharing the compromised airway with surgeons and a potential need to avoid

tracheostomy to prevent the vicious cycle of tracheal stenosis. The incidence of tracheal restenosis is 5% and early recognition and prompt management is the key to avoid repeat surgery.[1]

We report a retrospective analysis of the anaesthetic management of tracheal restenosis in operated cases of TRA. The general anaesthesia protocol included total intravenous anaesthesia (TIVA) using propofol and dexmedetomidine plus topical anaesthesia supplementation (TA), without muscle relaxants, with spontaneous-assisted ventilation (SAV).

METHODS

This retrospective review of 17 procedures was approved by the institutional ethics committee and waiver of written informed consent was granted. Patients operated for TRA from June 2015 to June 2017 and who had developed tracheal stenosis at the anastomotic site were included. The diagnosis of tracheal restenosis was confirmed by bedside evaluation and direct visualization using flexible fiberoptic bronchoscope. Stenosis was judged using grading system by Meyer *et al*. [Table 1].[2] These patients were subjected subsequently to rigid bronchoscopic evaluation and surgical procedures [Figure 1]. All the procedures were performed by the same surgeon and anaesthesia team. Demographic data, grade of restenosis, details of interventions done, anaesthesia drugs used, operative time, haemodynamics, complications and postoperative course were reviewed from anaesthesia charts.

All the patients were nebulized with 4% lignocaine 5 mL in the preoperative holding area. In the operation theater, patients were monitored using pulse oximetry, nasal capnography, electrocardiography, and noninvasive blood pressure. Rigid ventilating bronchoscope (RVB), jet ventilation, difficult airway and tracheostomy cart was kept ready. Humidified oxygen was administered with nasal prongs at 15 L/min in a 20 degrees head up position throughout the procedure. Intravenous glycopyrollate 0.2 mg, midazolam 0.02 mg/kg and fentanyl 2 μg/kg were administered. Intravenous dexmedetomidine loading 1 μg/kg for 10 min followed by maintenance at 0.5 μg/kg/h was commenced. Continuous infusion of propofol at 50 μg/kg/min was also started simultaneously with loading dose of dexmedetomidine, and was continued throughout the procedure. After loading dose of dexmedetomidine, graded doses of propofol, up to 2 mg/kg was given, till adequate jaw relaxation. After laryngoscopy, vocal cords and perilaryngeal structures were sprayed with lidocaine spray 2% (10 mg/puff) by the surgeon. Anaesthesia was maintained with titrated doses (as per clinical judgement) of propofol and dexmedetomidine infusion up to 50 mcg/kg/min and 0.5 μg/kg/h, respectively to keep the patients spontaneously breathing. Additionally, intermittent boluses of propofol (20 mg) were administered based on clinical judgement (patient movement, cough, etc.). In

Table 1: Grade of stenosis in individual procedures, summary of interventions done, adverse events and managemen

S. no	Total procedures	Grade of stenosis[1] as per presentation during individual procedures	Procedures done with range of size of bougie (minimum-maximum)	Adverse events	Management of adverse event
Patient 1	2	P1: Grade 3	P1: BD (28-32), MA, SHA	Coughing in P1, P2	P1: propofol bolus
		P2: Grade 3	P2: BD (28-34), MA, SHA		P2: Bougie withdrawal
Patient 2	2	P1: Grade 3	P1: GTR, BD (20-26), MA, SHA	Coughing in P2	Propofol bolus
		P2: Grade 2	P2: BD (20-28), MA		
Patient 3	3	P1: Grade 2	P1: GTR, BD (20-26), MA, SHA	Coughing in P1	Bougie withdrawal
		P2: Grade 1	P2: BD (20-26), MA, SHA		
		P3: Grade 2	P3: BD (20-28), MA, SHA		
Patient 4	5	P1: Grade 3	P1: BD (16), T tube insertion	Nil	
		P2: Grade 3	P2: BD (16-18), GTR, MA, SHA		
		P3: Grade 2	P3: BD (16-24), GTR, MA, SHA		
		P4: Grade 1	P4: T tube removal, MA, SHA		
		P5: Grade 1	P5: BD (20-26)		
Patient 5	1	Grade 1	BD (26-30)	Nil	
Patient 6	2	P1: Grade 3	P1: BD (24-28)	Coughing, laryngospasm in P1	Succinylcholine
		P2: Grade 2	P2: BD (24-28), GTR, MA		Propofol bolus
Patient 7	1	Grade 3	BD (24-28)	Coughing	Propofol bolus
Patient 8	1	Grade 2	BD (26-30)	Coughing	Propofol bolus

Grades of stenosis1: Grade 1: Lesions causing ≤50% obstruction; Grade 2: Lesions causing 51-70% obstruction; Grade 3: Lesions causing 71-99%obstruction; Grade 4: Complete obstruction. P1, P2, P3, P4, P5: Procedure 1, 2, 3, 4, 5 respectively. BD – Bougie dilatation; GTR – Granulation tissue removal; MA – Mitomycin application; SHA – Steroid plus hyaluronidase application

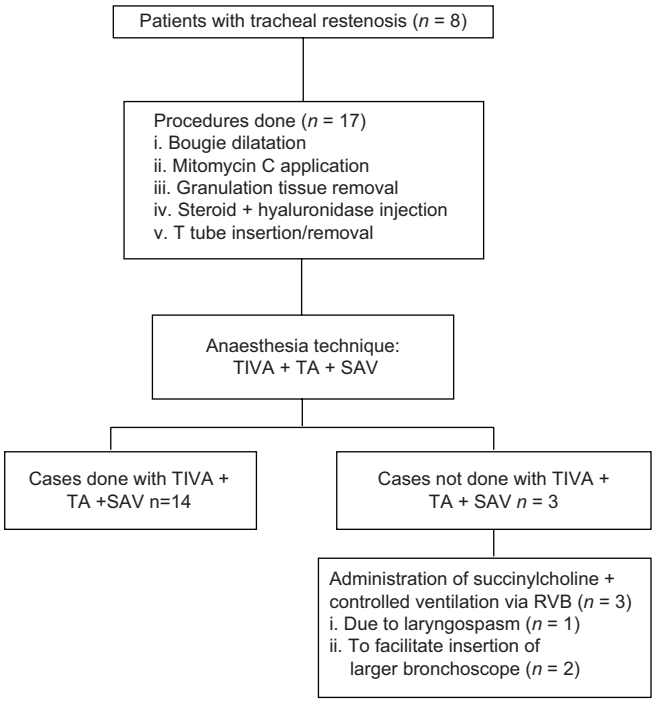

Figure 1: Procedures performed and anaesthesia technique used in patients with tracheal restenosis. TIVA – Total intravenous anaesthesia; TA – Topical anaesthesia; SAV – Spontaneous-assisted ventilation; RVB – Rigid ventilating bronchoscope

case of bradypnoea or shallow respiration, ventilation was assisted either through mask ventilation or through side arm of RVB using Bain's circuit. Use of muscle relaxants, inhalational agents, controlled or jet ventilation or any other technique apart from the above protocol was noted. Adverse events, namely desaturation, laryngospasm, coughing, bucking, gross purposeful movements, haemodynamic instability (within 20% of baseline), arrhythmias, etc., and treatment administered for the same were noted. Statistical analysis was performed using Microsoft® Excel® 2016 and data expressed in mean and standard deviation or median and range as appropriate.

RESULTS

Out of a total of 20 TRA surgeries that were performed from June 2015 to June 2017, 8 patients (5 females, 3 males) were diagnosed to have restenosis at the anastomotic site and they underwent multiple procedures [Table 1]. Seventeen procedures were reviewed. Dyspnoea on exertion (DOE) New York Heart Association grade 1 and grade 2, was present prior to 10 and 7 procedures respectively. The median (interquartile range) age and weight of the patients was 20.5 (19.25–30) years and 50 (45–60) kg. Mean duration of the procedures was 31.17 ± 6.25 min.

One patient (patient 4) with grade 3 stenosis had a nearly pinpoint opening, which accommodated only a number 16 bougie. A Montgomery T tube was inserted by making a small incision on the neck under local anaesthesia. Its position was confirmed using flexible bronchoscope. This patient subsequently underwent two endoscopic evaluations with bougie dilatation, granulation tissue removal, and mitomycin application followed by T tube removal in the fourth sitting.

Adverse events with their management are highlighted in Table 1. No patient experienced desaturation. Inhalational agents were not required. Haemodynamics were maintained within 20% of baseline. Median respiratory rate was 10 (range 8–14) breaths/min. End tidal CO_2 could not be measured during the procedure in view of constant leaks, however, nasal capnography at the beginning and end of the procedure showed normal range of values (37.82 ± 4.55 mmHg) in all the patients.

DISCUSSION

Airway management techniques in tracheal stenosis differ significantly among anaesthesiologists.[3] Bronchoscopy may be associated with inadequate ventilation, episodes of apnoea and desaturation, need to remove bronchoscope to ventilate, cardiac arrhythmias, sympathetic response, bronchospasm, and pneumothorax.

The critical fixed narrowing through which anaesthetized patients can spontaneously breathe without an increase in $PaCO_2$ is 4.0–4.5 mm.[3] Since none of our patients presented with stridor, the minimum tracheal diameter was at least 6 mm.[4] Therefore, spontaneous breathing or mechanical ventilation via RVB (no. 2.5/3) would have been possible through the stenosed segment in our cases.[3] Controlled ventilation may cause air trapping and pressure control ventilation or spontaneous breathing may be a better option.[3]

SAV with TIVA is one of the methods to conduct rigid bronchoscopy.[5] All cases of adult bronchoscopies with or without tracheal stenosis are usually managed with this protocol in our institute. Dexmedetomidine is known to maintain spontaneous respiration. Use of local anaesthetics and dexmedetomidine[5] significantly reduces propofol requirement, further helping in maintaining spontaneous respiration and haemodynamic stability. In spite of infusions, intermittent boluses of propofol are needed as per surgical stimulus to maintain an immobile surgical

field.[6] Muscle relaxants were administered if required to facilitate negotiation of bougie/RVB, for inadequate vocal cord relaxation, or if coughing, bucking events were encountered. The backup plan in an event of desaturation was bag and mask ventilation, or insertion of appropriate size RVB with controlled ventilation or manual jet ventilation. Also, RVB is a useful backup in cases of lower tracheal stenosis, where tracheostomy is not possible.[6] A prospective study evaluating TIVA with SAV for rigid bronchoscopic-guided therapeutic procedures had reported severe hypoxemia in 15% of the patients.[7] We probably did not experience desaturation as humidified high flow oxygen was administered throughout the case.[8]

Ventilation via endotracheal tube involves repeated intubation and extubation for the surgical procedure, which can cause injury, bleeding, edema, and dehiscence at the delicate anastomotic site. Complete neuromuscular blockade with jet ventilation is also an option; however, there is a risk of hypercarbia and pneumothorax due to inadequate exhalation.[3]

The commonest adverse event, coughing, was associated with the bougie touching the carina, bougie kept in place for a short time, or inadequate planes of anaesthesia for rigid bronchoscopy. This is a limitation of the TIVA with SAV protocol. Elective use of muscle relaxants could have avoided this event, but use of muscle relaxants may cause hypoxia and awareness.[5] The titration of drug boluses and infusions were solely on clinical judgement as bispectral index monitor was not available. Serial arterial blood gas would have given an accurate idea about hypercarbia before, during, and after the procedures, however, it could not be performed in view of cost constraints. The utility of this protocol in lower tracheal stenosis cannot be commented upon as all our patients had upper or midtracheal stenosis.

CONCLUSION

TIVA using dexmedetomidine and propofol with TA supplementation and SAV is an alternative option for anaesthesia management of upper and midlevel tracheal restenosis in operated cases of TRA. Coughing or airway instrumentation may cause airway obstruction and a backup plan is necessary.

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Conflicts of interest
There are no conflicts of interest.

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