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Transnasal humidified rapid-insufflation ventilatory exchange (THRIVE) for endoscopic procedures: A non-intubating approach in high-risk patients - a case series

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Abstract
Background: Endoscopic procedures such as ERCP, EUS, EBUS, and upper GI endoscopy often necessitate airway management under sedation or general anesthesia. In high-risk patients—especially those with ischemic heart disease (IHD), obesity, anticipated difficult airway, or compromised pulmonary reserve—intubation may exacerbate risks due to hemodynamic fluctuations or delayed recovery.
Methods: We present a case series of 10 high-risk patients undergoing endoscopic procedures where THRIVE was used to maintain oxygenation and avoid intubation. Preoperative assessments included airway evaluation and comorbidity optimization. THRIVE was applied via high-flow nasal cannula with continuous monitoring of $EtCO_2$, SpO_2, and hemodynamics. Sedation included fentanyl in all cases to provide analgesia and attenuate sympathetic responses.
Results: All procedures were completed successfully without conversion to intubation. No episodes of desaturation, aspiration, or airway obstruction occurred. Patients demonstrated stable hemodynamics, minimal sedation-related complications, and rapid recovery post-procedure. THRIVE provided prolonged apneic oxygenation and CO_2 washout, even in patients with IHD, morbid obesity, or OSA.
Conclusion: THRIVE, combined with a multimodal sedation regimen including fentanyl, is a safe and effective non-intubating ventilatory strategy for select high-risk patients undergoing endoscopic procedures. It offers excellent oxygenation, reduces pressor response, and avoids the complications associated with airway instrumentation.

Keywords: THRIVE, endoscopic anesthesia, high-risk patients, non-intubation, apneic oxygenation, difficult airway, ischemic heart disease

Introduction
Endoscopic procedures have become increasingly common in both diagnostic and therapeutic contexts, ranging from gastrointestinal to bronchopulmonary interventions. Traditionally, general anesthesia with endotracheal intubation or deep sedation with airway support has been used to facilitate these procedures. However, in patients with comorbidities such as IHD, OSA, morbid obesity, or anticipated difficult airways, intubation and mechanical ventilation carry significant risks. Hemodynamic instability, exaggerated pressor responses during laryngoscopy, postoperative respiratory complications, and delayed emergence are not uncommon in this population [1-3].
THRIVE has emerged as a promising technique for maintaining oxygenation in spontaneously breathing or apneic patients. Delivering warm, humidified oxygen at high flow rates (up to 70 L/min) through nasal cannulae, THRIVE provides apneic oxygenation, flushes anatomical dead space, and allows some degree of CO_2 clearance. It prolongs safe apnea time and supports oxygenation without the need for invasive airway instrumentation [1, 2, 4, 5].
This case series presents our institutional experience of using THRIVE as a non-intubating strategy in 10 high-risk patients undergoing various endoscopic procedures.

Methodology
This prospective observational case series was conducted at the Department of Anaesthesia, Jupiter Hospital, Thane, from June 2025 to August 2025.

Inclusion Criteria
- Age >18 years
- High-risk features such as
- Ischemic heart disease (IHD)
- Morbid obesity (BMI >35)
- Obstructive sleep apnea (OSA)
- Restricted mouth opening/anticipated difficult airway
- Compromised pulmonary function (e.g., COPD)

Exclusion Criteria
- Emergency procedures
- Full stomach (increased aspiration risk)
- Inability to tolerate nasal oxygen delivery

Protocol
All patients underwent detailed preoperative assessment. THRIVE was delivered via high-flow nasal cannula (Optiflow™, Fisher & Paykel) at 50-70 L/min with 100% humidified oxygen, initiated before induction and maintained throughout the procedure.

Sedation included
- **Propofol:** bolus 0.5-1 mg/kg; infusion 25-75 mcg/kg/min in selected prolonged procedures
- **Ketamine:** bolus 0.25-0.5 mg/kg
- **Dexmedetomidine:** infusion 0.2-0.5 mcg/kg/hr as needed
- **Fentanyl:** bolus 0.5-1 mcg/kg in all cases for analgesia and sympathetic attenuation

$EtCO_2$ was monitored via nasal sampling when feasible. Continuous monitoring of SpO_2, heart rate, non-invasive blood pressure, respiratory rate, and procedural tolerance was performed.

Table 1: Patient Demographics and Clinical Profile

Patient	Age	Gender	BMI	Comorbidities	Procedure	Sedation Used	Duration (min)	Outcome
1	65	M	32	IHD, OSA	ERCP	Propofol + Dexmedetomidine + Fentanyl	45	Successful
2	58	F	38	OSA, HTN	EUS	Propofol + Ketamine + Fentanyl	40	Successful
3	72	M	29	IHD, COPD	EBUS	Propofol + Fentanyl	50	Successful
4	80	F	26	IHD, CKD	ERCP	Propofol + Fentanyl	35	Successful
5	62	M	34	Morbid Obesity, OSA	Gastroscopy	Dexmedetomidine + Ketamine + Fentanyl	25	Successful
6	68	M	33	COPD, OSA	ERCP	Propofol + Ketamine + Fentanyl	48	Successful
7	55	F	35	IHD, difficult airway	EUS	Propofol + Dexmedetomidine + Fentanyl	42	Successful
8	77	M	28	IHD, HTN	EBUS	Propofol + Fentanyl	50	Successful
9	60	M	37	Morbid Obesity, DM	ERCP	Propofol + Fentanyl	38	Successful
10	70	F	30	IHD, OSA, HTN	EUS	Propofol + Fentanyl	44	Successful

Results: All procedures were completed successfully without conversion to intubation. No episodes of desaturation, aspiration, or airway obstruction occurred. Hemodynamics remained stable, sedation-related complications were minimal, and recovery was rapid. Fentanyl use in all patients contributed to blunting of sympathetic responses during instrumentation, particularly in IHD patients.

Discussion: Endoscopic procedures in high-risk patients pose significant challenges due to the need for airway control, oxygenation, and hemodynamic stability. The traditional approach involving endotracheal intubation or supraglottic airway devices increases the risk of pressor responses, airway trauma, and delayed recovery. THRIVE provides an elegant alternative by maintaining oxygenation and allowing apneic ventilation without instrumentation.

THRIVE facilitates oxygenation by delivering high-flow, humidified oxygen through nasal cannulae. The technique provides continuous positive airway pressure (CPAP), reduces anatomical dead space, and enables limited CO_2 washout, thus extending apneic time safely [1, 2].

In our series, all 10 patients tolerated the procedure well without conversion to intubation. The use of THRIVE was particularly beneficial in patients with ischemic heart disease, where avoiding laryngoscopy and employing fentanyl to blunt sympathetic stimulation helped maintain hemodynamic stability. Previous studies have confirmed similar benefits—Patel *et al.* [1] reported THRIVE prolonged apnea time during intubation in patients with difficult airways, while Gustafsson *et al.* [2] demonstrated effective oxygenation during upper airway surgery without intubation.

Moreover, our obese and OSA patients benefited from the continuous oxygenation provided by THRIVE. Wong *et al.* [3] found that THRIVE improved oxygenation and reduced desaturation events during sedation in obese individuals undergoing endoscopy.

A recent study by Douglas *et al.* [4] emphasized the role of THRIVE in bronchoscopy under sedation, highlighting reduced procedure time and faster recovery. Similarly, Kristensen *et al.* [5] recommended THRIVE as a safe tool in difficult airway scenarios during shared airway procedures.

The combined use of THRIVE with a multimodal sedation regimen, including fentanyl for analgesia and sympathetic attenuation, likely contributed to smooth intra-procedural conditions and rapid recovery in our cohort. No patient experienced desaturation, hypercapnia requiring intervention, or aspiration.

Advantages Observed
- Reduced need for airway instrumentation
- Stable hemodynamics in IHD patients, aided by fentanyl use
- Effective oxygenation in obese and OSA patients
- Improved patient satisfaction and recovery profile

Limitations
- Small sample size
- Requires expertise in THRIVE setup and patient selection
- Continuous $EtCO_2$ monitoring via nasal route is less accurate

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