

The use of THRIVE in laryngology and phonosurgery

The team in Lewisham has been using THRIVE for our phonosurgical cases for about a year. Here, we discuss the pros, cons and potential pitfalls of setting up and using THRIVE as ventilation during anaesthesia rather than using an ML tube or jet ventilation. From the ENT surgeon's point of view, the benefits are easy to see, literally – when performing a microlaryngoscopy with an ETT, even a smaller diameter microlaryngoscopy tube gives a view of the anterior half of the vocal folds but obscures the posterior glottis. Jet ventilation

allows the surgeon an uninterrupted view of the larynx but the jet can move the vocal folds, potentially compromising delicate epithelial or intracordal dissections. This is in addition to the inherent risk of barotrauma. THRIVE appears to be the best of both worlds; an uninterrupted view of the larynx but with no vocal fold movement. This seems to be the oxymoron of apnoeic ventilation: how does the oxygen saturation remain at 100% without any positive pressure ventilation and where does the CO₂ go?

I spoke to Dr Anil Patel, Anaesthetist at the Royal National Throat, Nose and Ear Hospital, about his experience in setting up THRIVE as described in his 2014 paper [1].

Dr Patel, when did you start using THRIVE and at what point did you realise this would be good for operative cases?

I had been using THRIVE since 2013 as an adjunct to anaesthesia as there was plenty of literature describing its use in the preoperative and perioperative settings. I was interested to see if this would work or aid in the recovery setting. To my surprise, in patients who were not breathing spontaneously, the oxygen saturations remained high, so we started seeing how long the saturations remained and the time crept up from five minutes, to 10, 15 and so on. It was at that point that we started using THRIVE as intraoperative ventilation.



Anil Patel, MBBS FRCA,

Consultant Anaesthetist, Department of Anaesthesia, The Royal National Throat Nose and Ear Hospital, London; Honorary Senior Lecturer, University College London Hospital, UK.

So how does it work? It seems to maintain saturations and remove CO₂ without any obvious ventilation.

There has been a lot of work done on this with 3D imaging, liquid modelling, computational fluid dynamics and particle imaging. We have done work that seems to show that vortices are set up with the high flow oxygen. These move oxygen into the airways and seem to flush CO₂ out, so THRIVE really is apnoeic ventilation, rather than apnoeic oxygenation. My colleague, Reza Nouredi, has been instrumental in experimenting, analysing and describing these airway dynamics and was my co-author on our first paper on the subject [1].

What is the experience with THRIVE overall and with microlaryngoscopy or airway surgery?

So far we have performed over 700 cases, 500 of which have been microlaryngoscopy procedures and the other 200 difficult airways (stridor, tumours etc). We have found that it helps in almost any airway situation; in elective microlaryngoscopy procedures it can be used as ventilation for the whole operation, in difficult airways it can delay desaturation and CO₂ rise to give you more time to intubate or perform an awake intubation or tracheostomy, and with the knowledge that you have more time to intubate, it reduces the stress around difficult intubations, reducing the risk of iatrogenic intubation injuries. I think it will fundamentally change training juniors in the anaesthetic room, and industry thinks so too – GE healthcare that make a lot of anaesthetic machines are now manufacturing THRIVE components on their new products. Analysis of our cases seems to show that the rise of CO₂ concentration is between a third and a half

of the rate of apnoea without THRIVE. This has been repeated in a few institutions so we're pretty happy with those data.

It sounds like this might really help trainees in the anaesthetic room and ENT trainees in theatre with the difficult airway scenarios. Are there any tips you could give that you have picked up along the way?

THRIVE will not always work, it can and will fail. So you need to have other techniques available such as facemask ventilation. I think an area in which it is immediately applicable, and which doctors can get acquainted with the equipment, is in the critically compromised airways. Patients are struggling, working very hard, and will be going to theatre for an awake tracheostomy or intubation. When you put THRIVE on them whilst getting them to theatre, they immediately feel better. I think it should be in standard use for these patients.

Dr Andrew McKechnie, one of my anaesthetic colleagues, told me about his experiences in setting it up at our hospital:



Andrew McKechnie, FCAI MACadMed MBBS,

Consultant Anaesthetist; Airway Lead, Lewisham and Greenwich NHSTrust, UK.

**E: admckechnie@doctors.org.uk
@admckdoc**

“I think it will fundamentally change training juniors in the anaesthetic room, and industry thinks so too.”

How did you first come to consider THRIVE for laryngeal surgery?

I had attended a few airway days where it had been discussed and I had used THRIVE for pre-oxygenation in my bariatric patients and emergency cases with good results and I was keen to employ THRIVE as an apnoeic technique. We chatted about the surgical benefits of a clear view and on the next available case in a young, fit patient, we used it with the set-up as if we were going to do a standard low frequency jet ventilation in case it didn't work.

Can you describe the technique you use?

Our technique has evolved: the patient is brought directly into theatre and all monitoring is attached including depth of anaesthesia (BIS). The THRIVE is attached and started at 25-35 litres of oxygen. After a minimum of five mins, pre-oxygenation anaesthesia is induced using a TIVA TCI technique. Once the patient is asleep, O₂ flow is increased to the maximum 70 litres per minute.

The airway MUST remain patent at all times so I maintain the airway with a jaw thrust until the BIS drops to around 40. The surgeon then takes over the airway and inserts the standard laryngoscope. At the end of the case an I-gel is inserted, the CO₂ noted and the patient woken up. As we have performed more cases, we have moved the equipment around to find the best ergonomic position for each piece. When we started, there was a lot of equipment trying to compete for the same space in theatre!

Which phonosurgical patients do you think are suitable for THRIVE?

At first we were quite specific, selecting only ASA 1, fit and well patients. But as we have refined the technique, we have broadened the inclusion criteria. The ones to avoid seem to be the morbidly obese (BMI >35) - as although THRIVE pre-oxygenation works in this sub group, apnoeic ventilation is less well tolerated - and patients with significant respiratory co-morbidities.

In terms of surgical considerations, we are particularly careful in using THRIVE when LASER is planned although this is not an exclusion and we have had no issues. (Author's note - Dr Anil Patel turns off the THRIVE during laser work. There has been one incidence of airway flaming with the use of diathermy. This should never be used with THRIVE.)

We've done about 50 cases so far and most have been between 18 and 25 minutes apnoeic time with some lasting in excess of 35 minutes. CO₂ retention, even in the longer cases, does not appear to be a significant issue.

It must also be remembered that THRIVE maintains oxygenation and is not a rescue technique for falling saturations. If the saturations begin to drop, an alternative method has to be used so we have the jet on standby and sometimes 2-3 jets of oxygen bring the sats back up and then THRIVE technique can be restored. On rare occasions, the patient has required intubation but this eventuality needs to be anticipated and the relevant equipment on hand.

One of my anaesthetic colleagues, Dr Mick Jennings, was keen to get involved.

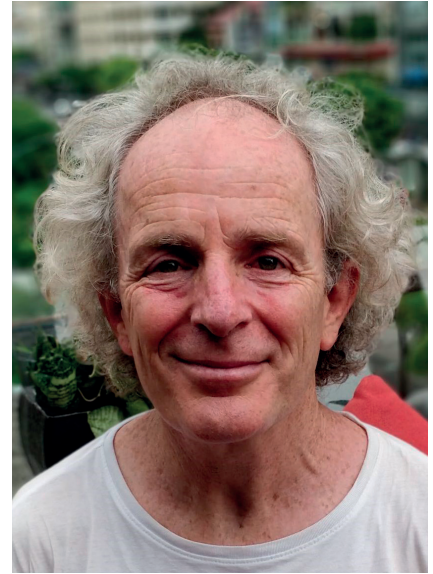
Mick, having used THRIVE a lot in various settings, what would your tips be for the anaesthetist thinking of introducing this at their hospital?

Firstly, THRIVE should not be for the occasional user. I also think that a really good pre-op airway assessment is important. The last thing you want is a 'can't intubate, can't ventilate' situation in someone who has already had two or three minutes of apnoea.

In terms of managing the equipment, it is a kit intensive exercise and you need to not be tripping up on the different bits but also have everything you need easily to hand. The first few, I would definitely have the jet set up, attached and ready to go.

How does the induction of anaesthesia differ for the THRIVE patient?

The big difference is that we anaesthetise the patient in theatre. This means that the theatre, the surgical equipment and the theatre nurses all need to be ready and in place before the patient comes in. When the patient was being anaesthetised in the anaesthetic room, some of this would still be going on before the patient came into theatre, so efficiency is essential. Also, I warn the patient that there will be a lot of equipment, a lot of people and just generally a lot of stuff going on while they are awake. I also tell them that when the O₂ is turned up it will feel a bit like sticking their head out of



Michael Peter Jennings, MBBS FRCA FFICM,

Consultant in Anaesthetics and Intensive Care, Lewisham and Greenwich NHS Trust, UK.

E: Mick.jennings@nhs.net

“THRIVE really is apnoeic ventilation, rather than apnoeic oxygenation.”

the car window so it doesn't take them by surprise.

With jet or ML tubes, we would comfortably get five cases done on a half day list. We can still get five THRIVEs done but the whole team need to be really slick to do it as it does take a little longer between patients.

Conclusion

Overall, the introduction of THRIVE for my phonosurgical cases has been a big step forward. The surgical view is clear and unhindered and I know I have 30 minutes or more to complete the operation.

THRIVE is already in common use in the ICU setting and it is likely to be in regular use for compromised airways very soon. It is probably only time before THRIVE is commonplace in the pre and perioperative setting, something equipment manufacturers are already working on, so the availability and use of THRIVE for your surgical cases may not be long coming.

With enormous thanks to Drs Anil Patel, Andrew McKechnie and Mick Jennings for their time and comments.

References

1. Patel A, Nouraei SA. Transnasal Humidified Rapid-Insufflation Ventilatory Exchange (THRIVE); a physiological method of increasing apnoea time in patients with difficult airways. *Anaesthesia* 2015;**70**(3):323-9

“With the knowledge that you have more time to intubate, it reduces the stress around difficult intubations, reducing the risk of iatrogenic intubation injuries.”

THRIVE key points from anaesthetists

1. If you are going to use THRIVE, use it regularly and as often as possible.
2. Get buy-in from your theatre staff and run through the technique with them using checklists to ensure everything is in place before you start.
3. Have several back-up plans if saturations start to fall. Once the saturations start dropping it is too late to start looking for equipment.
4. Refine your technique as you go – as much as you plan, things you don't expect crop up and you will need to adapt.

AUTHOR



Nicholas Gibbins, FRCS(ORL-HNS) MD,

Consultant ENT and Voice Surgeon,
University Hospital Lewisham, UK.

E: Nicholas.gibbins@nhs.net
www: www.londonentsurgeons.com
Twitter: @doctornickg

Declaration of competing interests: None declared.