Trends in Anaesthesia and Critical Care 28 (2019) 36–38

Contents lists available at ScienceDirect

Trends in Anaesthesia and Critical Care

journal homepage: www.elsevier.com/locate/tacc

Use of transnasal humidified rapid-insufflation ventilatory exchange in Electroconvulsive therapy, a tool to increase patient safety in a remote area: A case series

Gabriela Maria Rivas Land

Anaesthetist and Sedation Lead, Trafford General Hospital, Manchester University Hospitals Foundation Trust, Manchester, UK

ARTICLE INFO

Article history:
Received 5 March 2019
Received in revised form
24 June 2019
Accepted 25 June 2019

ABSTRACT

Background: Electroconvulsive therapy (ECT) remains a mainstay treatment option in psychiatry. In England, approximately 2240 treatments are administered annually. The anaesthetic requirements for the procedure include the control of haemodynamic changes, related complications, hypoventilation, hypoxia and hypercarbia due to an extended period of apnoea, amnesia and muscle relaxation. Transnasal humidified rapid-insufflation ventilator exchange (THRIVE), may offer a novel method of ventilation/oxygenation in the presence of apnea that makes the procedure safer especially when this is done outside main theatres.

Methods: Four sessions of Electroconvulsive therapy were conducted; in total 8 patients for ECT and 15 treatments applied during the period of the case series. All patients received general anaesthesia with an induction agent and muscle relaxant. The patients were oxygenated/ventilated with the use of THRIVE.

Results: No desaturation was present in any of the 15 treatments during or after the procedure. None of the patients reported any discomfort during the preoxygenation period with THRIVE.

Conclusion: Introducin ukg THRIVE to the Electroconvulsive therapy suite as a unique airway technique maintained adequate oxygen saturation airway patency during the period of apnoea in patients paralyzed. THRIVE also gives an alternative for oxygenation in high risk patients in the ECT suite remote to main theatres.

1. Background

Electroconvulsive therapy (ECT) remains an established treatment option in psychiatry since its introduction by Cerlitti and Bini in the 1930's. It is most commonly used to treat severe illness or medication-resistant/ intolerance depression and it can also be beneficial in mania and catatonia [1,2]. ECT induces a generalized, tonic-clonic epileptic seizure, although the mechanism of action remains elusive.

In England, approximately 2240 individuals were treated annually (2016–17), and in most cases the courses of ECT involved at least 10 acute treatment sessions. The number of patients as well as the number of treatments is on the rise [3].

At Trafford, Moorside Psychiatric Unit in Greater Manchester, cases are on the rise and the Unit treats both NHS and also private patients.(Tables 1 and 2)

Conventionally, the procedure is done under general anaesthetic with face mask ventilation and 100% oxygen administration. The anaesthetic requirements for the procedure include the control of haemodynamic changes, related complications, hypoventilation, hypoxia and hypercarbia due to an extended period of apnea, together with the primary requirements of amnesia and muscle relaxation [4].

One of the main concerns is patient safety and within, the presence of hypoxaemia (oxygen saturation below 90%) [5–7].

The significance of transient hypoxaemia is open to question since mortality during or immediately after ECT has been falling steadily, now to 1/100000 applications. [8].

The most common complications are also the most common causes of death and serious morbidity and include cardiovascular complications like arrhythmias and myocardial infarction or pulmonary complications like laryngospasm and aspiration [9,10].

However, there is new evidence that preoxygenation and hyperventilation (with oxygen) in ECT may improve not only safety but also enhance seizure quality [8,11, and 12].

E-mail address: gabriela.land@mft.nhs.uk.

https://doi.org/10.1016/j.tacc.2019.06.003
2210-8440/

Table 1
Cases of ECT at Trafford Moorside Psychiatric unit during a two-year period, characteristics of patients and complications associated with the procedure.

	2016	2017
Patient numbers	30	35
Female	20 (66%)	25 (72%)
Age (mean)	65 years	66 years
Total number of treatments	305	325
Patient diagnosis	1 Mania 1 Catatonia 28 Depression	1 Catatonia 34 Depression
Comorbidities and Problems in ECT	4 Patients with respiratory conditions (COPD 2/ Asthma 1, Recent chest infection 1) 10 Patients with desaturation problem 1 Patient requiring theatre due to severe desaturation (saturation <80%)	2 Patients with respiratory conditions (COPD 1/ OSA 1) 15 Patients with desaturation problems (Saturation <90%) 1 Patient requiring theatre due to poor health

Table 2
Distribution of cases of ECT during the use of THRIVE with diagnosis and preoperative assessment based of ASA classification.

	Patients	Treatments
	8	15
Female	4 (50%)	6 (40%)
Age (mean)	66 years (SD 25.44)	
Patient diagnosis	1 Mania 7 Depression	3 Mania 12 Depression
Preoperative (Co-morbidities)	4 Patients: ASA 1 3 Patients: ASA 2 1 Patients: ASA 3 (COPD, BMI 37)	
Problems with ECT	1 patient history of Desaturation during ECT (ASA 2 previously, smoker)	

A new method of oxygenation and ventilation has recently been used in theatre settings called Transnasal humidified rapid-insufflation ventilatory exchange (THRIVE). It is a physiological mechanism for oxygenating and ventilating patients who are under general anaesthesia and who have diminished or absent respiratory effort [13].

We want to observe the use of this new method of oxygenation and ventilation during ECT and its benefits. THRIVE could be potentially beneficial due to an extended period of apnea and also the comorbidities of the patients undergoing the procedure.

2. Aim

To report the use of Transnasal Humidified Rapid insufflation Ventilatory Exchange in patients undergoing Electroconvulsive Therapy and the tolerance of extended periods of apnoea.

3. Method

Four sessions of Electroconvulsive therapy were conducted between the months of February and March 2018 with the use of THRIVE. Each session had a different number of patients and some of the patients were having ECT on a regular basis. In total 14 patients for ECT.

All patients were lying supine at 30° in bed and had High Flow Nasal Oxygen through a THRIVE Optiflow, Fisher & Paykel Healthcare. An initial delivery of 40 L of oxygen and FiO2 100% was given to all patients while cannulation, monitoring and placement of EEG electrodes were placed. Once the induction was started the Nasal Flow was increased to 70 L and maintained at this rate throughout the procedure. Patients were given an induction dose of Propofol according to the patients' needs, and a reduced dose of Suxamethonium (0.5 mg/kg). Only one patient required Etomidate due to lack of Seizure with previous use of Propofol. During the first three patients a face mask was also applied providing 12 L of oxygen.

After we gained confidence with the procedure no mask was applied and only THRIVE was used. Jaw Thrust manoeuvre was also applied during induction. After fasciculations from the muscle relaxant was ended a mouth guard was also placed. During the ECT treatment the patient was not touched with any airway intervention until the seizure was extinguished on the EEG trace. Then, a guedel airway was put in place and we waited until the patient was breathing spontaneously to transfer to recovery on a face mask.

4. Results

8 patients were included but 15 treatments were achieved during 4 sessions of ECT. From 8 patients, 7 were treated for depression and 1 patient was treated for mania. No patients had titration of treatment at the time. 7 patients were ASA 1 and 2.1 patient was ASA 3 with COPD and high BMI 37. Another patient had a history of previous desaturation during ECT treatment.

During the treatment only one case dropped saturation to 95% although it was noticed that during the seizure the saturation probe was dislodged and clinically he did not look cyanotic.

No desaturation (saturation below 90%) was present in any of the 15 treatments during or after the procedure.

5. Discussion

We observed that introducing THRIVE to the Electroconvulsive therapy suite as a unique airway technique, did maintain adequate oxygen saturation airway patency during the period of apnoea in paralyzed patients. THRIVE also gives an alternative for oxygenation in high risk patients in the ECT suite remote to main theatres.

During the procedure we took into consideration the patient's comorbidities and risk factors for desaturation like obesity and pulmonary conditions, as well as the seizure duration. As the majority of patients undergo ECT several times a month, reducing the incidence of desaturation is very important.

A problem that can occur during the apnoeic period is absorption atelectasis due to alveoli filled with near 100% oxygen and the washout of nitrogen. This can lead to alveolar collapse as the

oxygen is taken up by pulmonary blood. The continuous insufflation that results from the continuous positive airway pressure of approximately 5–7 cmH2O can prevent alveolar collapse. This continuous insufflation also facilitates oxygenation and CO2 clearance through gaseous mixing and flushing of the nasopharyngeal dead space. [14,15].

A recent published study has described the use of THRIVE during ECT and reported its use as safe and effective for oxygenation during the procedure, and also a comfortable way of oxygenation during ECT [16]. Although this study did not compare mask ventilation with THRIVE during ECT because the sample size was too small.

During this case series, we had only one episode of lower saturation although no significant levels (recorded level was 95%) and a dislodged of saturation probe was noted. These findings are in line with previous studies.

Another consideration of this new method is the comfort it offers when compared with a facemask. In our small sample, none of the patients reported any discomfort with the humidified high nasal flow via nasal cannula. This was previously reported in other studies [17,18].

A number of patients reported fear of the face mask or even claustrophobia. This patient will benefit from THRIVE to feel more reassured and comfortable for the procedure. Anxiety is a very common factor associated with baseline conditions treated with ECT.

Useful indications of THRIVE for ECT include patients with certain anatomical variances, high BMI, difficult access to upper airway, anticipated difficult facemask ventilation, decreased apnea tolerance, due to obesity, anxiety or fear of the facemask or even prolonged seizure in case of titration of the treatment [19]. All of these could represent a challenge when preoxygenated with a facemask.

Electroconvulsive therapy induces a hypermetabolic state and increases oxygen consumption of the brain whilst more CO2 is produced than usual [20]. Accumulation of CO2 can increase the seizure threshold in patients receiving ECT. Hypocarbia may prolong seizures, but evidence of the antidepressant efficacy during a longer seizure is lacking.

Concerns have been raised about the presence of a shock in an oxygen-enriched environment. Understanding the potential risks associated with ECT procedures will help to promote a positive and safe treatment outcome. The current delivered is about 800 mA (0.8 W/volt) and most patients have an initial seizure threshold of about 50–100 mC. The electricity delivered could be equivalent to 40 J [21]. Measurements of the concentration of oxygen around the face could give us an idea of the hazard. However, other mechanisms of action for the risks of patient such us skin burns should be considered and this includes poor electrode site preparation, insufficient conductive gel between the electrode and skin, and poor preparation of the skin with alcohol-based solutions. [22,23].

Decreasing oxygen delivery to 21% during the shock in the presence of apnoea will decrease the risks and could be perfectly safe in the presence of adequate preoxygenation and ventilation with oxygen.

Our case series was purely observational. We have the opportunity to report the use of THRIVE as a novel method of ventilation/oxygenation and we did not encounter any complications associated with the use of this device. The opposite, we found no episodes of desaturation of patients that could possibly lead to hypoxemia and its consequences. We could observe that THRIVE can give the anaesthetist another option of ventilation/oxygenation for patients with comorbidities when it is a poor tolerance of extended period of apnea and in this case during titration of ECT treatments.

This case series had a very limited number of patients and it is necessary to have larger samples to be more conclusive. Also the evaluation of the difference between mask ventilation and THRIVE during ECT has to be done perhaps with randomized groups.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tacc.2019.06.003.

References

[1] The ECT Handbook, second ed., Royal College of Psychiatrist, 2005.
[2] GianniL. Faedda, Ina Beckera, Argelinda Baroni, Leonardo Tondo, Ellen Aspland, Athanasios Koukopoulos, The origins of electroconvulsive therapy: prof. Bini's first report on ECT, J. Affect. Disord. 120 (1–3) (January 2010) 12–15.
[3] J. Read, C. Harrop, J. Geekie, J. Renton, An audit of ECT in England 2011-2015: usage, demographics, and adherence to guidelines and legislation, Psychol Psychother 91 (3) (2018 Sep), 263-27.
[4] Vishal Uppal, Jonathan Dourish, Alan Macfarlane, Anaesthesia for electroconvulsive therapy, BJA.Educ 10 (6) (December 2010) 192–196.
[5] A.S. McCormick, D.A. Saunders, Oxygen desaturation of patients recovering from electroconvulsive therapy, Anaesthesia 51 (1996) 702–704.
[6] R. Surve, S. Bansal, K. Sriganesh, et al., Incidence and risk factors for oxygen desaturation during recovery from modified electroconvulsive therapy: a prospective observational study, J. Anaesthesiol. Clin. Pharmacol. 31 (2015) 99–103.
[7] J.K.L. Lew, R.J. Eastley, C.D. Hanning, Oxygenation during electroconvulsive therapy, Anaesthesia 41 (1986) 1092–1097.
[8] S.S.1 Aksay, J.M. Bumb, C. Janke, C. Hoyer, L. Kranaster, A. Sartorius, New evidence for seizure quality improvement by hyperoxia and Mild hypocapnia, J. ECT 30 (4) (2014 Dec) 287–291.
[9] T. Betts, Sudden Death in Epilepsy: can any lessons be learned from Convulsive therapy? Epilepsia 38 (Suppl. 11) (1997) S38–S40.
[10] G.H. Gaines, D.L. Rees, Electroconvulsive therapy and anaesthetic considerations, Anesth. Analg. 65 (1986) 1345–1356.
[11] K.F. Chung, Relationships between seizure duration and seizure threshold and stimulus dosage at electroconvulsive therapy: implications for electroconvulsive therapy practice, Psychiatr. Clin. Neurosci. 56 (2002) 521–526.
[12] E. Sawayama, M. Takahashi, A. Inoue, K. Nakajima, et al., Moderate hyperventilation prolongs electroencephalogram seizure duration of the first electroconvulsive therapy, J. ECT 24 (3) (2008 Sep) 195–198.
[13] A. Patel, S.A.R. Nouraei, Transnasal Humidified Rapid Insufflation Ventilation Exchange (THRIVE): a physiological method of increasing apnoea time in patients with difficult airways, Anaesthesia 70 (2015) 323–329.
[14] W. Moller, G. Celik, S. Feng, et al., Nasal high flow clears anatomical dead space in upper airway models, J. Appl. Physiol. 118 (1985) 1525–1532, 2015.
[15] G. Nuttall, M. Bowerson, O. William, K. Rasmussen, Morbidity and Mortality in the use of electroconvulsive therapy, J. ECT 20 (December 2004) 237–241.
[16] Yori Jonker, J. Rutten Dennis, et al., Transnasal Humidified Rapid-Insufflation Ventilatory exchange during electroconvulsive therapy. A feasibility study, J. ECT 00 (00) (March 2018) 1–5.
[17] F. Mir, A. Patel, R. Iqbal, M. Cecconi, S.A. R Nouraei, A randomized controlled trial comparing transnasal humidified rapid insufflation ventilatory exchange THRIVE pre-oxygenation with facemask pre-oxygenation in patients undergoing induction of anaesthesia, Anaesthesia 72 (2017) 439–443.
[18] A.W.G. Booth, K. Vidhani, P.K. Lee, C.-M. Thomsett, Spontaneous respiration using Intravenous anaesthesia and High Flow Nasal oxygen (STRIVE Hi) maintains oxygen and airway patency during management of the obstructed airway: an observational study, Br. J. Anaesth. 118 (3) (2017) 444–451.
[19] Amit R. Saxena, John G. Brock-Utne, Jay B. Brodsky, Stanford University, in: The Anesthesiologist Annual Meeting, ASA Abstracts; 21st October, 2017.
[20] O. Roca, J. Riera, et al., High flow oxygen therapy in acute respiratory failure, Respir. Care 55 (2010) 408–413.
[21] S. Saito, Anesthesia management for electroconvulsive therapy: hemodynamic and respiratory management, J. Anesth. 19 (2005) 142–149.
[22] Chittaranjan Andrade, Dose calculation with brief-pulse ECT demystified, Indian J. Psychiatr. 52 (3) (2010 Jul-Sep) 276–278.
[23] Airway Fires during Surgery. Patient Safety Advisory. ECRI institute and ISMP. Vol 4, No 1. March 2007. Pages 1-6