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Case Report

Airway Management with Tracheal Stents -Ventrain® System: Report of Two Cases

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Abstract

Introduction: At the global level, lung cancer has high mortality. In advanced stages of the disease, stent placement in the air road is a challenge in the management of isolation, oxygenation and ventilation, which ensures patient safety.

Methods: Report of 2 clinical cases, conducted in the first half of 2023, section Anesthesiology Torácica and Pneumology, Son Espases University Hospital, where the form of isolation, ventilation and oxygenation of the airway is described for the placement of a prosthesis endotracheal.

Results: Oxygenation and ventilation with the VENTRAIN system was successful in airway control during the endottracheal stent placement procedure.

The rebuilding of pre-procedural 3D images and video complements the planning of safe scenarios in air handling.

Conclusion: In our case experience with the use of VENTRAIN system and the reconstruction of 3D images and videos, they would constitute an alternative in the management of oxygenation, ventilation and isolation of the air route when performing this procedure.

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Introduction

Several patients with lung cancer are at an advanced stage of disease at the time of clinical onset, occurring in approximately 25-40% of cases [1]. Dyspnea is an ubiquitous symptom in patients with lung cancer at diagnosis, and may be caused either by extrinsic or intraluminal airway obstruction or by atelectasia.

Tracheal Stents (SMA) have been gaining ground as a valid treatment in cases of neoplastic, not resectable stenosis when only palliative oncological therapies are eligible.

In order to facilitate their placement under general anesthesia, devices such as Ventrain® for apneic ventilation and oxygenation have increased their popularity. Ventrain® is a manually controlled device for oxygenating and/or ventilating in cases of difficult airway, composed of a small endotracheal or transtracheal lumen catheter.

3D Reconstruction patient's airway allows anesthesiologists to plan the safest scenarios for our patients.

Clinical Cases

Case 1

Female, 66 years, 168 cm, 56 kg, caucasian, with history of high blood pressure and systemic scleroderma. Diagnosed with locally advanced pulmonary adenocarcinoma N3 as a casual finding in a follow up CT.

***Pulmonary function test (PFT) 2022:** FVC 2.05 (71%); FEV1 1.71 (79%); FEV1/FVC 83.09; DLCO 12.53 (59%); KCO 3.00 (72%).

***CT SCAN OF CHEST WITH NO CONTRAST 29/06/2023:** ILD without significant changes compared to previous study. Achalasia.

***Bronchoscopy 02/10/2023:** Orotracheal tube inlet. Thickened main carina and both main bronchi with signs of extrinsic compression and infiltration of neoplastic appearance.

Case 2

Male, 71 years, 165 cm, 90 kg, 1, caucasian, with history of high blood pressure, obesity, COPD and Obstructive Sleep Apnea, diagnosed with infiltrating squamous carcinoma, PDL1 0%, KRAS WT.

***PFT 2021:** FEV1/FVC preBD 46%; FEV1 preBD 35%, FVC preBD 55%; FEV1/FVC postBD 51%; FEV1 postBD 42%; FVpostBD 60%; PBD positive. SAtO2 (aa): 96%.

***AngioCT 23/09/2023:** Mass of soft tissue density in the carina with endobronchial component that obstructs both main bronchi almost completely.

***Bronchoscopy 09/2023:** Endotracheal mass located in the main carina area ~~that~~ obstructing both main bronchi almost completely.

No tumor infiltration was found distal to the tracheal lesion and both bronchial trees remain free.

Therefore, the placement of a tracheal prosthesis was indicated in both cases.

Procedure

First patient was already sedated with propofol and remifentanil continuous perfusion, connected to invasive mechanical ventilation (IMV) through a nº7 endotracheal tube.

In the second case, rapid-sequence anaesthetic induction and connection to IMV was performed. A number 8 ET was placed using a C-MAC videolaryngoscope with spade nº3.

Invasive and non- invasive monitoring of BP, as well as Oxygen peripheral saturation, ECG, BIS, hourly diuresis by vesical probing and hemodynamic monitoring by Mostcare UP system was carried out.

Anaesthetic maintenance with TIVA TCI, with Propofol 2% ug/ml and Remifentanilo ng/ml, neuromuscular relaxation with Rocuronium, controlled by TOF. Mechanical ventilation with Datex-Ohmeda anesthesia station with lung protection parameters.

In both cases we proceeded to introduce Dumon-Harrel Sorz/ Chevalier-Jackson Wolf rigid laryngoscope, check for intubation of the trachea and visualization of glottic structures by otorhinolaryngologist, and change of TET to a larger caliber (TET No 8). We introduced the Tritube or oxygenation probe on the side of the rigid laryngoscope, connected the dipositive VENTRAIN and started the apneic ventilation and oxygenation following the ratios recommended.

A balanced and coordinated sequence was performed by Pneumologyst-Otorhinolaringologyst-Anesthesiologyst consisting of: Withdrawal of ETT- Apneic oxygenation VENTRAIN®- introduction of endotracheo-bronchial prosthesis.

Apneic oxygenation was performed by maintaining an inspiration:expiration ratio of 1:3. A correct oxygenation was achieved with stable PsO2 >99%, pO2 >80 mmHg, without increase of pulmonary pressures (peak pressure and plateau pressure <30) and with a driving pressure <15 during the whole procedure.

In the second case, the prosthesis was rejected after its insertion since the tumor obstruction of the right main bronchus persisted. The patient was extubated in the operating room and placed in a hemodynamically stable critical post-operative care unit under non-invasive ventilatory support.

In order to improve the airway approach, we visualized the patient's 3D images. It was necessary to segment the trachea and bronchi to virtually navigate and take measurements.

The segmentation process involves specialized image processing techniques and software tools that enable the identification, delineation and separation of areas of interest in medical images.

The process was performed in the 3D Unit of Hospital Universitario Son Espases in conjunction with the thoracic surgery and pneumology section of the Anesthesiology and Resuscitation service.

D2P software of 3D Systems was used to perform this task, which was later visualized in virtual reality through the Oculus Quest 2 glasses, where the performance technique was planned (Videos 1 & 2).

Video 1: Fibroscopic view of the trachea and involvement of tumor lesion in the carina and main bronchi

https://www.heraldopenaccess.us/fulltext/Anesthesia-&-Clinical-care/Video_1.mp4

Video 2: Vision 3D Systems of trachea and involvement of tumor lesion in carina and main bronchi.

https://www.heraldopenaccess.us/fulltext/Anesthesia-&-Clinical-care/Video_2.mp4

Both Videos correspond to the description of case number.

Discussion

Endotracheal stents provides support to the trachea to improve or maintain airway permeability in patients with tumors, stenosis, or tracheal collapse.

A completely clear surgical field for the placement of the prosthesis could be achieved by intermittently removing the airway device (in this case an ETT) from the trachea during limited periods of apnea. This poses up a challenge in maintaining an adequate oxygenation of the patient.

The Ventrain® device can ensure sufficient oxygenation and ventilation through a small-bore transtracheal catheter when the airway is open, partly obstructed, or completely closed [2]. Furthermore, it provides the advantage of not needing the placement of an endotracheal tube, allowing oxygenation/ ventilation of the patient during the therapeutic or surgical intervention. However, it entails the disadvantage of carrying a higher risk of barotrauma and does not guarantee gas exchange, unlike conventional ventilation does [3].

Only a few cases have been reported of the use of Ventrain for the placement of tracheal stents, and to the best of our knowledge, this is the first case to combine its use with a 3D reconstruction of the patient's airway to design an anaesthetic plan.

Conclusion

The use of oxygenation-ventilation through Ventrain® system constitutes an effective alternative to maintain the patient's oxygenation during the periods of apnea necessary for the placement of a tracheal prosthesis in the context of an obstructed airway.

The recreation of 3D images and videos allows us to plan a safer scenario for the total control of the airway.

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