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Letter to Editor Open Access

Use of VivaSight™ Double Lumen Endotracheal Tube in a Patient with Pulmonary Alveolar Proteinosis Undergoing Left Whole Lung Lavage

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Abstract

Whole Lung Lavage under general anesthesia and lung separation with a double lumen tube has been considered the definitive therapy for pulmonary alveolar proteinosis for a long time. Whole Lung Lavage is related with complications like tube displacement and inundation during the filling and the drainage phases of the lavage. Herein, we describe Whole Left Lung Lavage with a 39 Fr Vivasight left double lumen tube with a high-resolution camera at the tip of tracheal lumen that provides a real time view of proper tube placement during the whole procedure.

Keywords: Whole lung lavage; Double lumen tube; Pulmonary alveolar proteinosis

Abbreviations

PAP: Pulmonary Alveolar Proteinosis; WLL: Whole Lung Lavage; FBS: Fiberoscopic; DLT: Double Lumen Tube: BAL: Bronchoalveolar Lavage: TLC: Total Lung Capacity; DLCO: Diffusing capacity of the Lung for Carbon monoxide; TIVA: Total Intravenous Anesthesia

Discussion

Pulmonary alveolar proteinosis (PAP) is a rare diffuse lung disease defined by the accumulation of surfactant lipids and proteins in the alveoli [1] secondary to abnormal processing of surfactant by macrophages. Nowadays three forms of PAP are recognized: congenital, secondary and acquired [2,3]. Whole Lung Lavage (WLL) has been considered the definitive therapy for PAP for a long time [4]. WLL requires prolonged general anesthesia, is complex to perform, is associated with potential morbidity [5]. Anesthesiologic management is burdened by a difficult check of lung isolation. This implies the necessity of frequents fiberoscopic (FBS) controls of the right left double lumen tube (DLT) placement and observation of the pressure/volume loop (spirometry) on a breath-to-breath basis also to prevent flooding of the ventilated lung [6]. WLL is frequently performed as a bilateral and sometimes as mono lateral procedure on the sickest lung and after a recovery period of 2-3 weeks on the contra lateral lung [7].

79 years-old man BMI 26.7 referred to our team for Left WLL with chronic cough and progressively worsening dyspnea on exercise of one year duration with no fever or weight loss. The diagnosis of PAP was based on compatible imaging studies, chest tomography showed interstitial infiltrates and "crazy paving" aspect, and characteristic milky bronchoalveolar-lavage (BAL) fluid with granular material staining with periodic acid-Schiff. Respiratory function test performed two days before the unilateral WLL showed a forced expiratory volume in the first second (FEV1) of 2.27 L (88% of predicted), total lung capacity (TLC) of 3.62 L (55 % of predicted) and diffusing capacity of the lung for carbon monoxide (DLCO) 45% of predicted. The idea of pulmonologist was to perform unilateral WLL and three weeks later to treat the contra lateral lung. The left WLL was carried out in Intensive Care Unit (ICU) at Arcispedale Santa Maria Nuova IRCCS Hospital (Reggio Emilia, Italy) under general anesthesia and lung separation. The patient had a standard monitoring (electrocardiography, pulse oximetry), an arterial cannulation, a two lumen catheter inserted into the right jugular vein, urine catheter, PICCO® and a central temperature. The ventilator monitor on the anesthesia machine produced the essential information during the left WLL like loss of lung isolation preventing contamination of the ventilated lung. A total intravenous anesthesia (TIVA) was performed and curarization was maintained throughout the entire procedure. A left double lumen tube (DLT) 39 Fr Vivasight (ETVIEW Medical LTD, Israel) was introduced to ensure lung isolation. Vivasight DLT has an integrated high-resolution camera at the tip of the tracheal lumen that allows a visual confirmation of proper DLT placement and the vision is provided by a 7" medical-grade LCD monitor connected to the DLT through a cable connection. Vivasight also possesses an integrated flushing system that gives a rapid and efficient camera lens clearing, that was useful once at the end of the procedure after aspiration through the tracheal lumen before extubation. The proper DLT placement was verified by direct real time vision during oro-tracheal intubation and checked using fiberopticscope [8].

The procedure lasted for 5 hours and the nonlavaged lung was ventilated 5 ml/kg with a FiO_2 of 0.5. The volume of warm normal saline (37°) to be instilled was calculated by preoperative measurements of functional residual capacity (FRC) and it was 3/5 of the FRC. The solution was instilled under gravitational effect and it was suspended about 40 cm above the patient's mid chest level and the instillation took about 10 minutes. Two physiotherapists performed manual percussions of the left chest in supine and right full lateral decubitus; some reports describes a 30° lateral decubitus positioning to avoid the contralateral inundation and to preserve the ventilation/

perfusion ratio. There was no necessity to check the correct positioning of the DLT because the Vivasight DLT allowed operators to watch continuously the position of the blue cuff during percussions, vibrations in the filling phase of WLL and the drainage phase (Figure 1). Positional modifications were very useful and the team worked safely avoiding the risk of leakage from the lavaged lung into the ventilated one. When the lung was completely filled with normal saline it was drained into a container positioned below the patient mid chest level. The process was repeated 15 times when a clear effluent lavage fluid was obtained. At the end of the procedure the central temperature was 37.3°C and the SpO_2 100% with FiO_2 0.5. Conventional ventilation was continued for 4 h and the patient was maintained sedated with propofol until gas exchange was adequate for weaning; observation in the ICU lasted 24 h. Post procedural chest X-rays demonstrated an improvement of alveolar opacities compared to the preprocedural chest X-rays that showed hazy, diffuse, bilateral alveolar infiltrates. A FBS control two weeks later the WLL didn't find any lesion to the trachea and main left bronchus imputable to Vivasight Left DLT.

This is the first report in literature of WLL with a Vivasight Left DLT. WLL main complication is the flooding of the ventilated lung. This often causes possible desaturation and interruption of the lavage resulting in prolonged procedural time as well. The main strategy to prevent this complication with the DLT traditionally used, consisted in: a secure fixation of the DLT, the use of a DLT with a carinal hook; finally, one should take care not to dislodge the DLT during patient and head manipulations [5]. The only way to detect inundation of the ventilated lung was to observe continuously the pressure/volume loop with a visual confirmation through FBS check. Thanks to Vivasight DLT we gain a continuous direct view of sudden leakage in the ventilated lung through its integrated camera. The application of this device allows an easier and safer lavage also in case of difficult decubitus such as fully right lateral that is normally not performed due to the high risk of contralateral inundation. Another benefit of this device is achieved in case of mild leakage around the left bronchial cuff. Thanks to its direct vision, in fact, it's possible to detect the leakage in real time, allowing the operator to aspirate the lipoproteinaceus substance, preventing contamination of the ventilated lung without any interruption of the procedure. Furthermore the direct vision allows operating effective and safer percussion manoeuvres, normally related with a high risk of contralateral leakage. Finally frequent FBS controls, needed to check the proper DLT placement, and are avoided with benefits in terms of improved management of ventilation, weaning and reduction of the procedural time. The limit of this device takes place when it's necessary to perform sequential bilateral WLL in a single time or monolateral right WLL because there is no Right Vivasight DLT yet and the view can be obscured by saline solution or by lipoproteinaceous material.

We hope that in the future will be available a right double lumen tube with an integrated camera at the tip of the tracheal lumen that will allow to get over this limit. The device is very expensive if compared with the once traditionally used. However, the impact of the higher costs is limited since the low frequencies of the cases where its usage could be suggested.

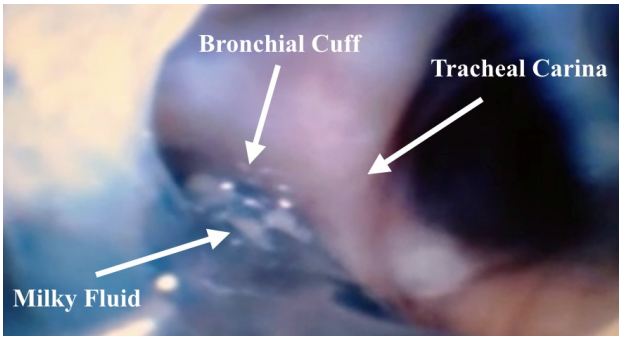

Figure 1: Direct vision of proper DLT placement and of the milky fluid into the right lung, related to the Alveolar Proteinosis.

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