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Research Article

NON-CONVENTIONAL MANAGEMENT OF BILATERAL PNEUMOTHORAX AND PULMONARY CONTUSION WITH HIGH-FLOW OXYGEN THERAPY AND PRONE POSITION

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ABSTRACT

Introduction. Pneumothorax is defined as the presence of air in the intrapleural space that generates positive pressure when it should be negative, causing partial or total pulmonary collapse. High-flow oxygen therapy has been used in the treatment of pneumothorax with controversial results, referring to complications such as subcutaneous emphysema and the perpetuation of pneumothorax, especially in the pediatric population. **Development.** We present the case of a 33-year-old male with bilateral traumatic pneumothorax and pulmonary contusion, managed with high-flow oxygen therapy and intermittent prone position during his stay in the intensive care unit, with satisfactory evolution until his discharge. **Conclusion.** High-flow oxygen therapy was used as adjuvant treatment in this patient with uncomplicated pneumothorax and with rapid remission thereof and subcutaneous emphysema. Pulmonary distensibility was also improved with the prone position and left basal atelectasis was resolved. The benefit of such therapies with a greater number of patients.

INTRODUCTION

Pneumothorax is defined as the presence of air in the intrapleural space that generates positive pressure when it should be negative, causing partial or total pulmonary collapse.(1) Its etiology is classified as:

- Spontaneous pneumothorax, which occurs in the absence of trauma; these in turn are classified as idiopathic and secondary. Idiopathic spontaneous pneumothoraces are frequent and have a high recurrence, mainly affects young patients and without known chronic lung disease, especially increases the chances associated with the use of smoking 22 times in men and 8 times in women, instead secondary spontaneous pneumothorax occur in patients with underlying lung diseases such as (COPD, alpha 1 antitrypsin deficiency, cystic fibrosis, histiocytosis, etc.) (1)
- Pneumothorax due to thoracic trauma, which is classified as iatrogenic and non-iatrogenic. (1) Approximately 40-50% of patients who suffer a thoracic trauma develop pneumothorax, and in terms of iatrogenic we can observe it when punctures are performed in anatomical areas surrounding the pulmonary pleura, especially if the procedure is blind. The incidence of this pathology after thoracentesis for example is up to 6% .(2) We can also find catamenial pneumothorax, which occurs after 72 hours of the menstrual cycle, is the most frequent manifestation of thoracic endometriosis.(3, 4)

Pathophysiology

While the patient is at rest, the intrapleural pressure is lower than the atmosphere (between -2 and -10), the intrapleural pressure is not uniform, at the apical level it is more negative to the contrary at baseline, causing greater distension in the area apical, it has been observed that it is even higher in high

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individuals favoring alveolar rupture or the appearance of apical bullae, 5 when this perforation occurs in the visceral pleura, the air "escapes" into the intrapleural space, causing the loss of negativity until become completely positive, so the lung is losing volume progressing to collapse it. When the pressures between lung and atmosphere are equalized, the pulmonary air movement is stopped, increasing the intrapleural pressure producing a decrease in venous return and consequently reducing the preload, which could condition a cardiovascular shock of obstructive origin and endanger the life of the patient. patient.(5)

Usually a spontaneous pneumothorax is the perforation of a subpleural bulla. Several theories are mentioned, however, the most accepted at present is the one proposed by West, which mentions that the alveolar rupture by the distension previously commented, the air would escape to the interstitial space, until the visceral pleura where it would produce small subpleural bullae, that when breaking they would cause the pneumothorax. It has been verified thanks to the electronic microscope that there is a degradation of the elastic fibers of the bullae wall, probably due to an imbalance between elastase and alpha1-antitrypsin.(6,7)

Statistically, there is a significant influence of tobacco, possibly due to the bronchial inflammation it produces, facilitating an increase in alveolar pressure. It is believed that intense physical exercise, by favoring pulmonary perfusion, prevents the production of pneumothorax in predisposed subjects. The secondary spontaneous pneumothorax, originated by an underlying pulmonary pathology causing an erosion in the visceral pleura, triggering the pathophysiology previously described.(8)

In case of catamenial pneumothorax, its etiological mechanism remains confused, it has been suggested that in 38% of cases there is a diaphragmatic lesion that would allow the passage of accumulated intra-abdominal air during menstruation.(9)

Clinical features

Commonly we can find in the physical examination the Gailliard triad: (10)

- Decrease or absence of vocal vibrations
- Hypersonality or timpanism
- Decrease or absence of vesicular murmur
- Among other signs / symptoms we find:
- Thoracic (pleuritic) pain associated with respiratory movements
- Cough
- Tachypnea
- Dyspnea hypoxemia / hypercapnia
- Respiratory alkalosis

It is important to evaluate the movements of both hemithorax, as well as the palpation of underlying structures and skin to identify subcutaneous emphysema.

Classification of pneumothorax according to its size

De la Torre and collaborators proposed to categorize the pneumothorax in three degrees according to the position of the edge of the collapsed lung with respect to the mid clavicular line:

- Grade I when the edge is outside of said line
- Grade II when it coincides with her
- Grade III when there is complete pulmonary collapse.

Pneumothorax minimum is less than 10%.

In the "Guide for the management of spontaneous pneumothorax" published by the British Thoracic Society in 1993 they used almost the same parameters to define 3 groups: small, moderate and complete. Nevertheless; in the 2003 update they propose to categorize it into small or large according to the pulmonary rim being less than 2 cm from the wall or more than 2 cm from it; posture criticized for being arbitrary and because it does not bring any improvement to the previous one.(12, 13)

Diagnosis

The ideal is to perform a posteroanterior and lateral chest radiograph since it usually confirms the diagnosis by identifying the margin line of the visceral pleura, separated from the parietal pleura, and there is a hyperclean air space between them without a vascular network, so that the lung adjacent is more dense to remain partially collapsed, however not in all patients it is possible to make these projections.(14)
Computed tomography (CT) is ideal for the detection of small, septate pneumothorax or pre-lung position as well as the combination with a hemothorax.(15)

Pulmonary ultrasound (USG) has been proposed for the diagnosis of occult pneumothorax to the radiography, above all above, since compared to the radiological studies described above, the USG is dynamic and in real time. Its sensitivity and specificity for the diagnosis of pneumothorax is 92% and 94% respectively.(16,17)

There are several signs that have been described, however, there are at least three that have greater diagnostic utility.

- Loss of pulmonary slip

The limit between the lung surface and the visceral pleura is visible as an echogenic line, so if it is not observable we are before a pneumothorax with a sensitivity of 100% .(18)

- B Lines

They are an artifact visualized as comet tail, in a normal lung it is isolated to be observed, nevertheless these increase in interstitial or alveolar affection, reason why when finding them we could suspect any occupational pathology in pulmonary parenchyma in this way excluding pneumothorax as a diagnosis. (19)

- Lung point

It is the point that separates the visceral from the pleural leaf, it is also a dynamic image, which is located by sliding the transducer toward the inferolateral portion of the thorax, medially, the pulmonary slip will be absent in the area of pneumothorax. It will be identified as the intermediate point where the pulmonary slip is visualized intermittently, because with the respiratory movement, the collapsed lung moves intermittently to the area of pneumothorax, it has a specificity of 100% .(20, 21)

Treatment

Goals:

- Evacuate the air from the pleural cavity
- Achieve a lasting expansion and avoid recurrence

General measures

The spontaneous absorption of pneumothorax ranges between 1.25-1.8% (50-75ml), which is accelerated by the use of supplemental oxygen 4 times more, since the inhalation of this gas reduces the partial pressure of nitrogen in the capillaries, increasing the resorption of nitrogen contained in the pleural space. Therefore, it is recommended to administer supplemental oxygen at high flows (at least 10ml / hr), but with caution in patients with COPD because of the risk of causing hypercapnia.(22)

Quitting smoking should be one of the priorities of patients and is an important preventive-therapeutic measure both in the onset, functional deterioration and recurrence of pneumothorax.(22)

Recommendations in special situations

According to the "SEPAR Regulation: Respiratory Pathology and Airplane Flight" 34, pneumothorax is a contraindication to flight and will only be accepted when the lung has completely re-expanded. Therefore, it should not be admitted to an aircraft until 72h after the pleural drainage is removed and with a chest x-ray done within 48 hours of removing the drainage that confirms the resolution (grade of recommendation C) .(23)

The BTS guide mentions aspects of diving; recommends that patients with a history of pneumothorax not perform this activity until they have undergone bilateral thoracotomy and apical pleurectomy or pleural abrasion. (24)

As soon as the decision to perform a procedure or not depends on the size of the pneumothorax as well as the patient's clinic. Observation is the attitude of choice in partial pneumothorax without dyspnea (grade of recommendation B).(25)

A partial pneumothorax in which dyspnea persists should be suspected in the possibility of an underlying disease. Some authors recommend keeping the patient under observation in the emergency area for 3-6h and repeat the simple chest X-ray before discharge to check that there is no progression (recommendation grade D) .(26) In pneumothorax greater than 25%, the use of thoracic drainage equipment is recommended, which can be removed once the re-expansion has been confirmed, with the clamping of the same for at least 24 hours and without recurrence. (25, 27)

High flow nasal cannula (HFNC) is designed to administer a heated and humidified mixture of air and oxygen at a flow higher than the patient's inspiratory flow (28), provides a degree of distending pressure and reduces the work of breathing, High flow presents several advantages over conventional 'low-flow' oxygen therapy in terms of humidification, oxygenation, gas exchange, and breathing pattern (29), however, high-flow oxygen therapy with nasal cannula induced subcutaneous emphysema and pneumothorax is a known entity in neonates and pediatric population. Pneumomediastinum with pneumothorax should be considered as a possible adverse effect associated with the use of this therapy.

Presentation of the case

Male patient of 33 years of age, without any chronic degenerative, as antecedent of importance previous fall 8 years ago 8 meters high on the floor. He begins his current condition on 06/05/2018 to be performing an act of acrobatics of about 9 meters height, presents free fall in dorsal decubitus, turning in the air and fall against pavement in decubitus supine, apparently showing loss of alertness, with full recovery to be in the emergency area. It is unknown protocol of sending to this institution. In the emergency department due to trauma, a skull tomography was performed with no evidence of lesions, chest tomography reporting bilateral left pneumothorax, as well as L1 fracture and 7th to 9th rib fractures of the right hemitorax, as well as pulmonary contusions, clinically in the emergency area referring to pain of intensity 9/10 in chest and sensation of respiratory difficulty at physical examination: conscious, cooperative, polyphenic with Fr 24 breaths per minute chest with absence respiratory sounds predominantly left hemitorax, rhythmic precordium, good tone, abdomen, functional extremities with left hemitorax ecchymosis, the clinic decided to place a bilateral intrapleural catheter, and entered the adult intensive care unit, where it was managed with high-flow nasal prongs, intermittent pronation for two days, and use of fentanyl as analgesia, is left under observation is performed tac control chest on the third day of in-hospital stay, resolution was observed in the left hemitorax, and discrete right pneumothorax, so it was decided to remove both intrapleural catheters, continuing with high-flow nasal tips, with control the next day with chest x-ray observing adequate bilateral normoaereacion, likewise is valued by the neurosurgery service for lumbar fracture who refers to conservative management with corset for at least 4 weeks, due to adequate clinical evolution is decided his discharge from the uci area, to continue management in hospitalization.

DISCUSSION

The patient with bilateral pneumothorax and pulmonary contusion was managed with intrapleural catheters and high-flow oxygen therapy. It has been described that oxygen therapy can lead to no resolution of the pneumothorax, as well as adverse effects such as the appearance or increase of subcutaneous emphysema, however. in this patient a significant decrease in subcutaneous emphysema was observed with the application of the endopleural probes and oxygen therapy with high-flow nasal cannulae (Figure 1 and figure 2), without complications, when observing atelectasis secondary to pulmonary contusion we decided to change its position to prone position intermittently and monitoring the patient's tolerance to increase the transpulmonary pressure and improve the pulmonary oxygenation area, the patient had a significant improvement and was graduated for improvement after five days in the intensive care unit.

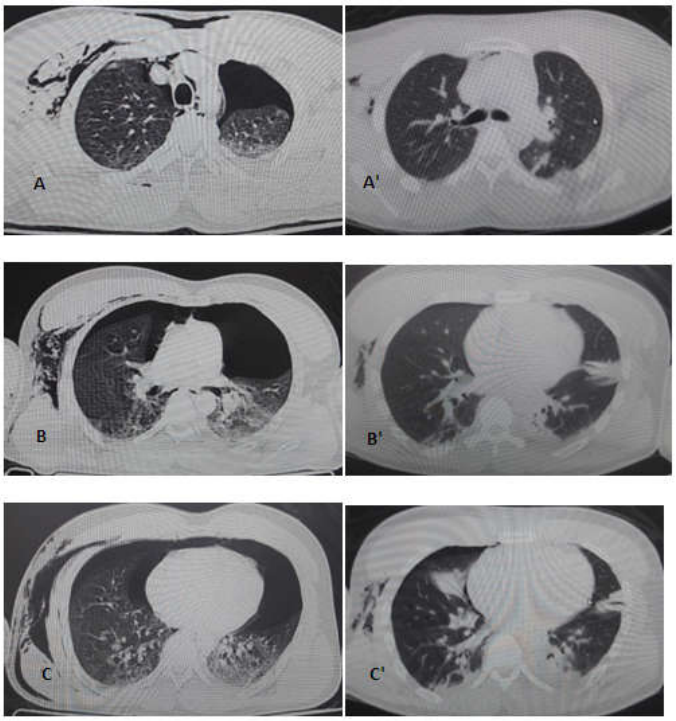

Figure 1 Chest tomography images of the patient, in the left column shows different tomographic slices showing bilateral pneumothorax and subcutaneous emphysema at the patient's entrance, in the right column, tomographic slices are observed after the placement of endopleural probes bilateral and high-flow oxygen therapy, the resolution of pneumothorax and a left basal atelectasis in B'y C'-secondary to pulmonary contusion is observed.

Figure 2 Portable antero-posterior chest radiograph images of the patient's evolution, in image 1 the right pneumothorax is not observed because it is anterior, in image 2 the patient is observed after the placement of endopleural tubes and high-flow oxygen therapy, note the corresponding left basal opacity with an atelectasis and in image 3 the resolution of the atelectasis after the prone position of the awake patient is observed.

CONCLUSION

High-flow oxygen therapy was used as adjuvant treatment in this patient with uncomplicated pneumothorax and with rapid remission thereof and subcutaneous emphysema. Pulmonary distensibility was also improved with the prone position and left basal atelectasis was resolved.

In this patient we used the combination of high flow oxygen therapy and the prone position improve lung volume at the end of expiration, its use cannot be recommended, so controlled studies of selected comparative cases should be performed

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