Air Medical Journal xxx (2017) 1–4

Contents lists available at ScienceDirect

Air Medical Journal

journal homepage: http://www.airmedicaljournal.com/

Case Report

Air Repatriation With a Medium-sized Pneumothorax Without Thoracic Tube: A Special Case of a Repatriation Accompanied by an Experienced Surgeon

Melissa B. Blau, MD, Michael Weinlich, MD, Werner Lauchart, MD, Stefan Piatek, MD, Felix Walcher, MD

A B S T R A C T

We report on the repatriation of a 28-year old female from Germany, who was involved in a serious bus accident and was transported to the nearest hospital in Oruro, Bolivia. CT scans and x-rays performed in this hospital demonstrated a complete pneumothorax right. Thorax drainage was inserted, which was removed after 5 days. Since the hospital refused to acknowledge the presence of a residual middle-sized pneumothorax on the repatriation day and did not want to insert another tube, the decision was made to repatriate the patient on commercial flight back home to Germany without a thoracic tube.

We report on the repatriation of a 28-year-old woman from Germany who was involved in a serious bus accident and was transported to the nearest hospital in Oruro, Bolivia. Computed tomographic (CT) scans and X-rays performed in this hospital showed a complete right-sided pneumothorax. A thorax drain was inserted, which was removed after 5 days. Because the hospital refused to acknowledge the presence of a residual middle-sized pneumothorax on the repatriation day and did not want to insert another tube, the decision was made to repatriate the patient on a commercial flight back home to Germany without a thoracic tube.

A pneumothorax is a common complication of trauma, especially of serial rib fracture. The therapy of a pneumothorax is based on the elimination of the trapped air from the pleura cavity using thorax drainage systems. If a pneumothorax occurs abroad and repatriation by flight is necessary, the trapped gas in the body halls is known to expand during flight up to 30%.[1-3] Therefore, a pneumothorax was announced to be an absolute contraindication for flying.[4,5]

We report on an uneventful repatriation of a 28-year-old woman from Germany with a pneumothorax without thorax drainage who was involved in a serious bus accident in Bolivia (Fig. 1) in which 9 guests, mostly tourists, died at the scene of the accident. The female patient could be transported by rescue service to a hospital in Oruro where X-rays and CT scans were performed for lung images, the mandible, and the ribs. The results showed a fracture of the 9th and 10th right ribs, a complete pneumothorax of the right lung, a fractured right clavicle, and a dislocated mandibular fracture. She was admitted to the intensive care unit ward of the hospital in Oruro and treated by thorax drainage and oxygen administration. The treatment plan was to correct the anemia and stabilize the vital parameters. In the next 24 hours, the condition of the patient improved, and the plan was to move her to the medical floor if she remained in stable condition. Regarding the mandible fracture, the patient and her spouse indicated that she wanted to go back to Germany for surgery. After 5 days, the thorax drain was removed, and the written medical report announced that the pneumothorax had disappeared on X-rays.

Upon these reports, the alarm center in Germany started to plan the repatriation of the patient from Bolivia back to Germany with an accompanying medical doctor and paramedic on a commercial flight. The medical team, deciding on the indication for the repatriation, had found, other than reported and expected, a 4-cm right-sided pneumothorax in the newest CT scan. They decided to repatriate the patient with a thoracic tube on standby because a flight offered better conditions because the cabin pressure lay in the range of 2,450 m above sea level. The hospital in Oruro, in which she had been treated, or in La Paz, to which she could have been transferred by ground ambulance, are located even higher (3,710 m and 4,061 m above sea level, respectively). The use of a chest tube was considered in case the patient became distressed during the flight. Regular oxygen saturation measurements were planned for the flight. Using a chest tube in case of respiratory distress was considered superior to the use of a pneumo cath system. Because the patient was accompanied by

1067-991X/$36.00

http://dx.doi.org/10.1016/j.amj.2017.05.004

an experienced surgeon who was able to insert a chest tube at any time during the flight, a diversion would only be necessary if major complications occurred (eg, through complications during the affixation of a thoracic tube installed in case of respiratory distress during flight).[6] The patient was taken by air ambulance from Oruro to La Paz. Commercial flights were used to transport the patient from La Paz to Lima, from Lima to Madrid, and from Madrid to Frankfurt. She was admitted to the Department of Oral and Maxillofacial Surgery at the University Hospital Frankfurt, Frankfurt, Germany. During the repatriation, the patient was absolutely stable, and there were no hypotension, tachycardia, complaints about dyspnea, or oxygen desaturation. Upon arrival at the University Hospital Frankfurt, newer X-rays were performed, showing an improved condition of the preexisting right-sided pneumothorax.

Figure 1. A serious bus accident in Bolivia in which the patient was involved.

Discussion

This case report emphasizes the difficulty of coping with misjudgment in foreign hospitals and appropriately preparing a patient for repatriation. It is an example that shows that under well-considered circumstances, a guideline can be violated. It also underlines the merits of flexible case management by the repatriation team, who had to reach a decision regarding a situation that per se contraindicates a flight. Flying with a pneumothorax has its limitations because the trapped air in the pneumonic hall can expand by 30% and can lead to respiratory insufficiency and shortness of breath during flight. However, none of these complications occurred in this patient during the long flight to Frankfurt. The radiologic examination after repatriation in Frankfurt showed a significantly improved pneumothorax of the right lung, which was treated with a second thorax drain. Measurements of the pneumothorax of the patient before and after repatriation revealed a 34.83% improvement in the X-rays in Frankfurt compared with the X-rays in Bolivia at discharge. This is clearly in accordance with the well-known amount of gas volume reduction (Boyle-Marionette law) because of the higher air pressure inside the airplane and in the hospital in Frankfurt, which is located at 212 m above sea level, compared with the hospital in Bolivia.[1-3] According to Boyle's law, the theoretic reduction of intrathoracic gas was calculated as 35% for the hospital in Frankfurt (988.0 hectopascals) and 15% inside the airplane (751.6 hectopascals).

The staging of the pneumothorax is based on determining the size of a pneumothorax by means of the “light index.” For this purpose, the lung's collapse at an anteroposterior chest radiograph is judged in inspiration. As a prerequisite, it is assumed that the volume of the lung and hemithorax is proportionate to the diameter cubed. The distance between the contracted lung to the chest wall and the diameter of the bony hemithorax is measured. The light index corresponds to the size of the pneumothorax percentage of collapsed lung in relation to the hemithorax[7] as follows: % pneumothorax = $100 - 100 \cdot (Ø/ ØH)^3$, where ØL = the diameter of the lung and ØH = the diameter of the hemithorax.

In the recommendations for the treatment of a pneumothorax, the British Thoracic Surgery Society in 2003 made the following classification: a small pneumothorax is present when the distance of the lung tissue to the chest wall is less than 2 cm, and a large pneumothorax is present if this distance is more than 2 cm. According to this, the patient's pneumothorax in this case can be classified as large.

Altitude exposure and air travel influence the volume of any air in cavities (Boyle's law)[3] so that a pneumothorax or closed lung bulla will expand and may cause respiratory distress. Currently available recommendations and guidelines (eg, Aerospace Medical Association) propose to delay air travel for 1 to 3 weeks after thoracic surgery and 1 week after resolution of the pneumothorax.[7] However, both Aerospace Medical Association guidelines and thoracic surgeons' recommendations for postoperative air travel require further examination.[8] Although some guidelines provide that a pneumothorax is an absolute contraindication for boarding,[9] several studies reported on uneventful and safe air travel in patients with a small persisting pneumothorax or with those only noted in the CT scan.[2] One review article showed that poor agreement exists not only in these various guidelines but also among medical practitioners.[5]

In addition, several studies report safe air travel in patients with a chronic pneumothorax.[3] Furthermore, in a case report, exacerbation of preexisting pneumomediastinum after commercial air travel was reported.[10] In another study, 65 patients with a postbiopsy pneumothorax underwent air travel within 4 days of the final postbiopsy chest radiograph.[11] Worsening of existing respiratory symptoms or the development of new symptoms during or after the flight was reported in 14 of 183 patients with a pneumothorax (8%) in this study. The only adverse in-flight event reported in 1 study[6] investigating patients with a postoperative pneumothorax was a case of thoracic pain during ascent. In interstitial lung diseases with a high prevalence of spontaneous pneumothoraces, there is a relatively low risk of a pneumothorax after air travel. Regarding patients with lymphangioleiomyomatosis, the presence of a pneumothorax associated with air travel was concluded to be related to the high incidence of pneumothoraces and not to travel itself.[12] Therefore, further studies are needed to investigate the real risk for air travel in patients with a pneumothorax and especially for a small and chronic persistent pneumothorax.

Emphysema bullae occur in emphysema under the rarefaction of the lung parenchyma. Extensive bullae displace healthy lung tissue and impair lung function. The bursting of an emphysema bulla on the outside of the lung can cause a pneumothorax. Although air travel in such cases has been frequently advised against, a review of the available literature shows that this concern is ultimately unfounded. After promotion to a simulated altitude of up to 5,500 m with a rapid ascent rate, no radiologic evidence of augmentation of bullae or new pneumothorax were found in patients with chronic obstructive