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SUMMARY

The safety of commercial air travel following traumatic pneumothorax has long been a subject of debate with clinical recommendations being based largely upon anecdotal experience. A single Class II study confirms that commercial air travel is safe 14 days following radiographic resolution of a traumatic pneumothorax.

RECOMMENDATIONS

- **Level 1**
 - **None**
- **Level 2**
 - **Commercial air travel is safe 14 days following radiographic resolution of a traumatic pneumothorax.**
 - **A chest radiograph should be obtained immediately prior to air travel to confirm continued resolution of a patient's pneumothorax.**
- **Level 3**
 - **None**

INTRODUCTION

Over 1 billion passengers travel by air worldwide each year (1). Inflight medical emergencies are rare. Limited data exists as to when it is safe for patients who have sustained a traumatic pneumothorax to travel by air. Studies based on military experience with spontaneous pneumothorax in the 1950's and 1960's are widely quoted, but due to the significant pathophysiologic differences between spontaneous and traumatic pneumothorax, this experience is not applicable to patients with traumatic pneumothorax (2,3). The civilian experience with commercial air travel following traumatic pneumothorax is limited to a few anecdotal case reports (4-6). The true incidence of inflight pneumothorax – either worsening post-traumatic or spontaneous – is unknown due to a lack of comprehensive reporting of inflight medical emergencies, difficulty in diagnosis inflight, and delayed diagnosis of patient symptoms. A single prospective clinical trial of the safety of commercial air travel following traumatic pneumothorax has been conducted (7,8).

The concern for allowing such patients to fly stems from the physiology associated with gas containing body cavities during aircraft cabin pressurization. Air trapped within a body cavity (such as a residual pneumothorax) will expand by up to 30% during flight at typical cruising altitudes (9). Commercial aircraft cabins are typically only pressurized to a barometric pressure of 565 mmHg (equivalent to 8,000 feet) rather than to sea level (760 mmHg). Pressurization to sea level would require increased structural integrity that would prohibitively increase the weight of aircraft.

LEVEL OF RECOMMENDATION DEFINITIONS

- **Level 1:** Convincingly justifiable based on available scientific information alone. Usually based on Class I data or strong Class II evidence if randomized testing is inappropriate. Conversely, low quality or contradictory Class I data may be insufficient to support a Level I recommendation.
- **Level 2:** Reasonably justifiable based on available scientific evidence and strongly supported by expert opinion. Usually supported by Class II data or a preponderance of Class III evidence.
- **Level 3:** Supported by available data, but scientific evidence is lacking. Generally supported by Class III data. Useful for educational purposes and in guiding future clinical research.

DISCLAIMER: These guidelines were prepared by the Department of Surgical Education, Orlando Regional Medical Center. They are intended to serve as a general statement regarding appropriate patient care practices based on the medical literature and clinical expertise at the time of development. They should not be considered to be accepted protocol or policy, nor are intended to replace clinical judgment or dictate care of individual patients.

Changes in barometric pressure have been postulated as being potentially capable of causing a previously sealed pulmonary air leak to reopen, further increasing the patient's risk for recurrent pneumothorax (10). Should a pneumothorax recur during air travel, the flight crew is neither trained nor equipped to handle the respiratory distress that may develop (10,11). Appropriate medical care in such situations is dependent upon the fortuitous presence of a "passenger-physician" and their training and willingness to assist in caring for the passenger in distress. The presence of medical professionals on commercial flights is not uncommon, but expertise in handling such inflight emergencies is uncommon and the appropriate equipment to treat an inflight pneumothorax is rarely available. Case reports describing recurrent pneumothorax during air travel and passenger-physician's attempts to treat affected patients have been described (2-5).

As aircraft cabin pressure decreases during ascent, the partial pressure of oxygen also decreases. At a typical cruising altitude of 35,000-45,000 feet, the arterial oxygen tension of normal passengers will fall to between 55 and 68 mmHg (1). This decrease in arterial oxygenation is usually not noticed by the patient with normal pulmonary function but can be a major consideration in patients with impaired cardiopulmonary function. Patients with recent pulmonary trauma, such as pneumothorax, rib fractures, or pulmonary contusion, may already have marginal arterial oxygen saturations. With a decrease in oxygen saturation in-flight, hypoxia may develop with oxygenation rapidly becoming marginal or inadequate. Descent to a flight level of less than 12,500 feet, with its attendant increase in cabin pressure and arterial oxygen saturation, has often been recommended in the event of an in-flight medical emergency, although this is not always possible (1). Diversion to the nearest airport has also been suggested as a possible solution. Although a reasonable option for most transcontinental flights that can usually land within 20-40 minutes, transoceanic flights may be hours from the nearest airport (1). In the event of cardiopulmonary arrest, even 10 minutes may mean the difference between patient survival and death.

Most commercial airlines recognize that they are not equipped to manage such patients should problems arise in-flight and routinely recommend 2-4 weeks as the minimum waiting period before a patient can safely fly. The Air Transport Medicine Committee guidelines are similar suggesting that patients wait a minimum of 2-3 weeks following radiographic resolution of their traumatic pneumothorax before air travel (1).

LITERATURE REVIEW

In 1999, Cheatham et al. studied all patients during a 14-month period at a busy Level I trauma center who sustained traumatic pneumothorax and expressed a desire to return home by commercial air travel (7). Fifteen consecutive patients with traumatic pneumothorax were enrolled in a prospective study. Patients enrolled were provided with a survey detailing in-flight symptoms and post-arrival medical care that they were to complete and return by mail. All enrolled patients completed and returned their questionnaires. Three patients were unwilling to wait 14 days before flying and chose to travel by either car or train. All returned home uneventfully. Of the 12 patients who agreed to wait 14 days before traveling by air, 10 were tourists from Europe whose only mode of transportation was air travel. All had obvious traumatic pneumothoraces by anterior-posterior chest radiograph. All patients had pre-flight chest radiographs performed prior to air travel to confirm continued resolution of their pneumothorax. Ten of the 12 patients met the requirements of the study protocol waiting an average of 17.5 ± 4.9 days following radiographic resolution of their traumatic pneumothorax before flying. All 10 were completely asymptomatic in-flight. After initially agreeing to the study protocol, two patients subsequently flew prior to completing the 14-day waiting period. The first patient developed a recurrent pneumothorax 3 days into the 14-day waiting period requiring reinsertion of a chest tube. Following re-expansion of his lung, he had a persistent, but stable, apical pneumothorax. He ultimately flew home to Sweden by commercial airline 15 days after chest tube removal and 30 days post-injury with a small pneumothorax. He was accompanied by a physician and was asymptomatic in-flight. Upon arrival in Sweden, he was admitted to a hospital for ongoing rehabilitation. Chest radiograph demonstrated no change in the size of his apical pneumothorax. The second patient waited 14 days following radiographic resolution of their pneumothorax but was noted to have a small pneumothorax on her pre-flight chest radiograph. She was not allowed to fly and repeat radiograph 3 days later demonstrated complete resolution of her pneumothorax. She was advised to wait a total of 14 days following pneumothorax resolution (as per the study protocol), but anxious to return home chose to fly at that time. During her flight, she developed dyspnea, chest pain, nausea, vomiting, and diaphoresis that she likened to the symptoms she had had during her initial traumatic pneumothorax. These symptoms resolved within a few hours of landing in the United Kingdom. She presented to her physician the following day for evaluation, but a chest radiograph was not obtained. She subsequently did well without further sequelae.

In 2014, Sacco and Calero reported their retrospective experience with 75 patients in Alaska who sustained traumatic pneumothoraces and were allowed to fly home following chest tube removal (8). 58 patients flew home

within 9 days of chest tube removal (apparently with radiographic resolution of their pneumothorax); all were asymptomatic during their flight and did not require further treatment once home. Fifteen patients were allowed to fly with small pneumothoraces documented by either chest radiograph or computed tomography; none of these patients developed symptoms or complications. Many of these patients flew home in non-pressurized bush planes, however, and no data are provided as to what percentage of patients flew in commercial, pressurized aircraft. The true incidence of symptoms is unknown due to the retrospective nature of the 11-year study. It is unclear whether a questionnaire was utilized as in the Cheatham study.

Delaying air travel following traumatic pneumothorax can be frustrating and financially burdensome for patients. Both of these studies provide support to the current recommendations of the Air Transport Medicine Committee that commercial air travel is safe 14 days after radiographic resolution of a traumatic pneumothorax. Repeat chest radiographs should be obtained immediately prior to air travel to confirm continued resolution of a patient's pneumothorax. Air travel with a residual pneumothorax may result in respiratory distress in-flight. Air travel with a chest tube and a one-way Heimlich valve may be an option for appropriate patients that would allow them to travel by pressurized commercial aircraft earlier than 14 days.

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