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AIR TRAVEL FOLLOWING TRAUMATIC PNEUMOTHORAX

SUMMARY

The safety of commercial air travel following traumatic pneumothorax has long been a subject of debate. Clinical recommendations are 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**
 - Commercial air travel may be possible immediately after resolution of a traumatic pneumothorax or even with an unresolved, small, stable pneumothorax.
 - If travel must be resumed immediately after resolution of a traumatic pneumothorax or with a small stable pneumothorax, air travel should be limited to the continental United States such that an emergency landing and access to medical care would be rapidly possible.

INTRODUCTION

Over 1 billion passengers travel by air worldwide each year (1). Limited data exists as to when commercial air travel is safe for patients who have sustained a traumatic pneumothorax. 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 and a single prospective clinical trial in a civilian trauma center (4-6).

The concern for allowing patients to fly stems from the physiology associated with gas containing body cavities during aircraft cabin pressurization. Boyle's law in relation to the property of gases defines that air trapped within a body cavity (such as a residual pneumothorax) will expand by up to 30% during flight at typical cruising altitudes (7). Changes in barometric pressure have been postulated as being potentially capable of causing a previously sealed pulmonary injury to reopen, further increasing the patient's risk for recurrent pneumothorax (7). Should a pneumothorax recur during air travel, the flight

EVIDENCE DEFINITIONS

- **Class I:** Prospective randomized controlled trial.
- **Class II:** Prospective clinical study or retrospective analysis of reliable data. Includes observational, cohort, prevalence, or case control studies.
- **Class III:** Retrospective study. Includes database or registry reviews, large series of case reports, expert opinion.
- **Technology assessment:** A technology study which does not lend itself to classification in the above-mentioned format. Devices are evaluated in terms of their accuracy, reliability, therapeutic potential, or cost effectiveness.

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.

crew is neither trained nor equipped to handle the respiratory distress that may develop (8,9). 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. Case reports describing recurrent pneumothorax during air travel and passenger-physician’s attempts to treat affected patients have been described, some requiring emergent insertion of a tube thoracostomy inflight (2-5). The magnitude of these recurrent symptomatic pneumothoraces is not well documented. The contribution of patient anxiety over their pneumothorax must also be considered. Hypobaric altitude simulation under controlled conditions has shown that patients tolerate small increases in pneumothorax without clinical consequence (10).

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 aircraft cabin is pressurized to the equivalent of 8,000 feet and 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 suggest that patients wait a minimum of 2-3 weeks following radiographic resolution of their traumatic pneumothorax before air travel (1).

The Federal Aviation Administration (FAA) rules governing air travel for pilots who sustain a traumatic pneumothorax are significantly different and are briefly summarized at the end of this guideline.

LITERATURE REVIEW

A single Class II study has been performed to address the issue of how soon patients sustaining a traumatic pneumothorax may safely travel by commercial aircraft (6). During a 14-month period, 15 consecutive patients with traumatic pneumothorax were enrolled in a prospective, Institutional Review Board-approved study. 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, 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, 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.

Although seemingly a small study, this represents the 14-month experience of a busy Level I trauma center with a large tourist population. The study supports the current recommendations of the Air Transport Medicine Committee suggesting 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.

Sacco and Calero challenged the need to wait 14 days between resolution of a traumatic pneumothorax and commercial air travel. They retrospectively reviewed patients admitted to the Alaska Native Medical Center (ANMC) in Anchorage, AK from 2001 to 2012. They examined 207 patients with a diagnosis of traumatic pneumothorax, hemopneumothorax requiring thoracostomy, or isolated pneumothorax on imaging not treated with a chest tube. The patients were allowed to immediately fly home after discharge from hospital or after follow up clinic appointment. The median interval until flight after chest tube removal was 6 days. Two thirds of the patients flew home within 9 days of chest tube removal. No complications were identified in any of these patients either during flight or after returning home. Five patients with a "small stable" pneumothorax were allowed to fly without recorded complication. This data led ANMC to establish the following clinical guidelines:

- A. Obtain a chest radiograph at least 4 hours after chest tube removal; if this shows no pneumothorax or a stable, unchanged small pneumothorax, the patient can be discharged locally or remain in the hospital to await discharge.
- B. Discharged patients follow up in clinic with a chest x-ray within 48 hours of chest tube removal; if this again shows no pneumothorax or stable unchanged small pneumothorax, the patient is cleared to fly home at that time.
- C. Patients who remain in the hospital after chest tube removal have a repeat chest radiograph approximately 24 hours later. If this shows no pneumothorax or a stable, unchanged small pneumothorax, they are cleared to fly home at time of hospital discharge.

SPECIAL RULES FOR PILOTS FROM THE FAA

A history of traumatic pneumothorax is considered disqualifying for a pilot's "airman medical certification" until there is x-ray evidence of resolution. A person who has such a history is usually able to resume airman duties 3 months after resolution (12).

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