Govilkar et al., Orthop Muscular Syst 2018, 7:2
DOI: 10.4172/2161-0533.1000253

Orthopedic & Muscular System: Current Research

Review Article Open Access

To Fly or Not to Fly? – A Review of the Pertinent Literature

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Abstract

Air travel is still the fastest growing mode of transportation with International Air Transport Association (IATA) figures expecting to surpass over a billion passengers annually. The safety of air travel following a surgical procedure is becoming an important issue with the increasing frequency of ambulatory surgery and increasing trauma workload. Serious consideration must be given to the optimal timing of a postoperative flight, the assessment of patient stability, and special medical needs. This paper summarises the current International Air Transport Association (IATA) and Civil Aviation Authority (CAA) guidance whilst highlighting the lack of substantive evidence in current literature.

Keywords: Air travel; Fitness to fly; NICE guidance; DVT; Civil aviation authority; International air transport association

Introduction

Annually, over three billion people travel by air and the governing body for civil aviation, the International Air Transport Association (IATA) expect this figure is to double in the next two decades. Air travel is a comfortable and a safe means of transport and is increasingly more accessible to all sectors of the population. This significant increase in travel, confounded by an ever increasingly ageing population, has resulted in a significant increase in older passengers and those with multiple medical and surgical morbidities wishing to travel.

Health professionals are increasingly being asked to assess a patient's fitness to fly, including both UK nationals planning to travel abroad and visitors from overseas who need to be repatriated following an accident or illness while in the UK.

Majority of patients will be able to fly safely, but some may require additional measures such as in-flight supplementary oxygen. Multiply injured and unstable patients, potentially require special in-flight medical care up-to the level of intensive care which can usually be provided by air ambulance.

Out patient department setting

The out patient setting is the most common situation in which patients who may be post injury or post surgery, will often challenge a clinician regarding their safety and readiness to fly. On discussing the frequency of this question with peers and seniors in multiple trusts it has become apparent that this important question is often answered with little or no knowledge of current IATA guidelines, principles and policy.

To gain a better understanding of the most relevant policies regarding this matter all the large airline representatives were contacted. The majority of the global airlines fall into three key airline alliances. These are Star Alliance, Oneworld, and Skyteam. The Discussions undertaken with representatives of the alliances for the purpose of this article were generally unsatisfactory as there was often no consistency between groups. Key questions regarding the perceived safety of passengers to fly post surgery were inadequately answered and the airline representatives consistently referred me to the medical officer of the relevant alliance.

After much correspondence with the medical officers representing the world's largest alliance - STAR, We were directed to the medical manual from IATA and the relevant assessment forms which should be completed prior to a patient being considered safe to fly.

The IATA medical manual is an extensive document which addresses many issues regarding overall flight safety. A sub section within this document clarifies that specific and simple medical matters can be assessed by the treating clinician and provides them with the authority to be able to provide a letter documenting safety of flying. It is clear that many clinicians who are challenged to make these important and complex decisions may not have the appropriate knowledge base to do so.

The IATA state that the more complex cases should be referred by the practicing clinician to the airlines medical officer for further evaluation and when a definitive decision can be established.

To clarify this matter further for clinicians we have summarised some of the relevant aspects such as physiology of flying, the NICE guidance for flying and DVT, IATA medical manual and have constructed a concise and reproducible algorithm to support the practicing clinician who is often challenged by this problem.

Relevant aspects of flight physiology

To better understand some of the specific issues that need to be considered by the clinician, it is important to understand the physiology of flight and its relevance to the patient's physiology.

The primary concern relates to relative hypoxia within 'cabin altitude' in commercial aircraft. This results in a concomitant decrease in the partial pressure of alveolar oxygen (PaO2). Due to the shape of the oxy-haemoglobin dissociation curve, this only results in a fall of arterial oxygen saturation to around 90% which is well tolerated in healthy travellers.

However those passengers recovering from recent surgery, those recovering from polytrauma or those with multiple medical conditions may not tolerate the reduction in barometric pressure without additional support, leading to hypoxia.

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Received February 21, 2018 ; **Accepted** March 06, 2018; **Published** March 19, 2018

Citation: Govilkar S, Patel M, Bolt A, Hay S (2018) To Fly or Not to Fly? – A Review of the Pertinent Literature. Orthop Muscular Syst 7: 253. doi:10.4172/2161-0533.1000253

Another influential factor relates to the decrease in ambient pressure in the cabin as the aircraft climbs to its cruising altitude, which (according to Boyle's Law) will cause any gas to increase in volume by approximately 30%. Gas pockets within body cavities may cause problems where it is trapped and unable to expand freely. This phenomenon is similar to the effects of Barotrauma on the lungs and thoracic cavity. The compressed gas in the lungs expands as the ambient pressure decreases potentially causing the lungs to over-expand and to rupture. The effects of this are rare but seen in passengers suffering from significant chest trauma with concomitant respiratory infection.

Similar or indeed potentially more serious issues may occur following surgery if gas has been introduced to the abdominal cavity or to the eye. It may also affect people with lung bullae or an undiagnosed pneumothorax following surgery or following polytrauma.

Evidence

Over the last six decades there has been much disagreement between the relationship between Deep Venous Thrombosis (DVT) and air travel [1]. In the era following the second world war air travel accelerated dramatically and the major airline companies had aligned themselves to studies which discredited the link between air travel and thrombotic disease. Clearly this standpoint had very important commercial implications.

Since the 1960's much research has been performed in view of trials, case control studies with a varied level of evidence to support and contradict the concept that air travels will lead to an increased risk of venous thrombotic disease [2].

A set of ground-breaking studies and further systematic reviews have all but resolved this debate. Consequently the airlines companies now concur with the evidence supporting a prothrombotic link between long haul travel and deep vein thrombosis [3]. The first of the studies, the Lonflit1 study was planned to evaluate the incidence of deep venous thrombosis (DVT) occurring as a consequence of long flights. In the Lonflit 1 study 355 subjects at low-risk for DVT and 389 at high-risk were studied [4,5]. Low-risk subjects had no cardiovascular disease and used no drugs. DVT diagnosis was made by ultrasound scans after the flights (within 24 hours).

In low-risk subjects no events were recorded while in high-risk subjects 11 had DVT (2.8%) with 13 thromboses in 11 subjects and 6 superficial thromboses (total of 19 thrombotic events in 389 patients [4.9%]).

In the Lonflit2 study the authors studied 833 subjects (randomized into 422 control subjects and 411 using below-knee anti-thrombotic stockings) [6,7]. Scans were made before and after the flights. Amongst the control group 4.5% of subjects had DVT while only 0.24% had DVTs amongst the stockinged subjects). The difference was significant. The incidence of DVT observed when subjects were wearing stockings was 18.75 times lower than in controls.

Long-haul flights are associated with DVT in some 4-5% of high-risk subjects. Below-knee stockings are beneficial in reducing the incidence of DVT.

The Lonflit3 study aimed to evaluate methods of DVT prevention in high-risk subjects. Four hundred and seventy six subjects were contacted about the study and 300 were included. These 300 subjects at high risk for DVT were randomized, into three groups: 1) a control group that had no prophylaxis; 2) an aspirin treatment group, in which patients were treated with 400 mg, (tablets of oral, soluble aspirin; one dose daily for 3 days, starting 12 hours before the beginning of the flight); and 3) a low-molecular-weight heparin (LMWH) group, in which one dose of enoxaparine was injected between 2 and 4 hours before the flight. The dose was weight-adjusted (1000 IU [equivalent to 0.1 mL] per 10 kg of body weight).

One hundred participants were included in each group, a total of 249 subjects completed the study (dropouts due to low compliance or traveling/connections problems were 17%). Amongst 82 subjects in the control group, there were 4.82% diagnosed with DVT with two superficial thromboses [8-14]. In total 4.8% of limbs suffered a thrombotic event. Of 84 subjects in the aspirin treatment group, there were 3.6% of patients with DVT and three superficial thrombosis. In total 3.6% of limbs had a thrombotic event. Amongst those receiving LMWH (82 subjects), there were no cases of DVT. Only one superficial thrombosis was documented. In total only 0.6% of limbs had a thrombotic event ($p<0.002$ in comparison with the other two groups).

DVT was asymptomatic in 60% of subjects; 85% of DVT's were observed in passengers in non-aisle seats. One dose of LMWH is an important option to consider in high-risk subjects during long-haul flights.

Further to this, two large studies one a systematic review of all literature from 1966 to 2005 which analysed the risk of DVT post air travel from medline and the second a further Cochrane review was performed. This identified that all passengers, regardless of VTE risk, should avoid dehydration and frequently exercise leg muscles. Travellers on a flight of less than 6 hours and those with no known risk factors for VTE, regardless of the duration of the flight, do not need DVT prophylaxis [15-20]. Travellers with 1 or more risk factors for VTE should consider graduated compression stockings and/or LMWH for flights longer than 6 hours.

This evidence lead to the development of the NICE guidance regarding DVT prevention post air travel.

NICE guidance for deep vein thrombosis prevention

The National Institute for Clinical Excellence (NICE) states that Deep vein thrombosis (DVT) can occur as a result of long distance travel. The risk of travel-related DVT in healthy people is extremely low, and increases with the duration of travel: the risk has been reported as 1 event per 4656 flights lasting over 4 hours, increasing to 1 event per 1264 flights for flights lasting 16 hours or more. For flights lasting less than 4 hours the risk is much lower.

The main factor influencing the development of a travel-related DVT is prolonged immobility. Other factors that further increase the risk include:

- Previous DVT or pulmonary embolus (PE).
- History of DVT or PE in a close family member.
- Use of oestrogens (oral contraceptive pill and hormone replacement therapy)
- Pregnancy.
- Recent surgery/trauma, particularly to the abdomen, pelvic region, or legs.
- Cancer.
- Obesity.
- Some inherited blood-clotting abnormalities.

The NICE guidelines differentiate between patients by categorizing mild, moderate and high risk, giving specific recommendations regarding management. NICE also make a further differentiation between short haul (< 6 hours) and long haul (>6 hours) flights stating that there is a statistical increase in DVT rate with longer flights.

NICE guidance post surgery

NICE also provides further clear guidance regarding surgical patients. This states that patients having had any anaesthetic lasting 30 minutes or longer within the last 4 weeks are moderate risk, whilst those patients having undergone any orthopaedic joint replacement procedure within 4 weeks are to be regarded as high risk.

Moderate risk patients should consider compression stockings only, whilst high-risk patients should be given compression stockings and commenced on Low Molecular Weight Heparin (LMWH) under the advice of haematologists [20,21].

In summary every patient who has undergone joint replacement should avoid long haul flight for a minimum of 3 months, as they are high risk, but if they need to travel should do so with compression stockings, LMWH and an understanding of their risks.

Those who have undergone isolated fracture fixation are at moderate risk and should ideally avoid flying for 4 weeks to reduce their risk. This patient group should also be provided with compression stockings and educated of the risk.

Those patients who have suffered polytrauma are at a high risk of DVT due to their heightened prothrombotic state against a likely background of multiple injuries and surgeries. The recommendation also states that these individuals also need chemical prophylaxis such as LMWH or even mechanical prophylaxis in the form of inferior vena cava filter insertion. A discussion must involve a hematology specialist and is common practice in management of polytrauma within the military setting.

International air transport association (IATA): medical manual

The issue of air travel following surgery has become increasingly important with the wider use of day surgery. It should be kept in mind that post-operative patients are in a state of increased oxygen consumption due to the trauma of surgery, the increased adrenergic outflow and this may be exacerbated by the co-existence of sepsis.

The International Air Transport Association (IATA) and Civil Aviation Authority (CAA) are the governing bodies, which legislate on the airline industry. In addition there are some very broad guidelines that advise passengers regarding safety issues via the Medical Manual 2015 March edition [22-28].

The IATA Medical Manual has been produced by12 major airline directors in close collaboration with medical faculties of universities, travel medicine training organizations, World Health Organizations and government authorities worldwide. The Medical Manual covers many of the facets of airline administration and operations from the medical perspective. It draws on the various medical specialties that are essential to the safe and smooth operation of an airline and includes public health, aviation medicine, occupational health and travel medicine.

These guidelines specify that the patient's physician will be unaware of all the specific medical challenges involved in certifying patients for air travel and thus the airline's medical officer must assess each case on its own merit. Patients with a significant and or complex medical history need to be referred to the airlines medical officer with a relevant medical information form (MEDIF) and a frequent traveller medical card (FREMEC cards) [2,29-32]. These require completion and subsequent review by the airline's medical department before a decision can be made.

The IATA acknowledges that the medical manual has been compiled with expert medical opinion (level 3 evidence) from a wide array of national and international specialists from multiple modalities but with no level 1 evidence and limited research data on this subject. The structure of the guidelines based on practical experience from these experts and from lessons learnt through previous dealings.

Disturbingly, there are significant variations in the application of the IATA Medical Manual by each airline and their associated groups [33]. The sub-sections of the manual cover the surgical specialties of concern.

General surgical guidance: Many post-abdominal surgical patients have a relative ileus for some days, thereby increasing their risk of tearing suture lines, bleeding or indeed, in extreme circumstances perforation. Stretching intestinal or gastric mucosa may also result in haemorrhage.

Travel should be avoided for 10 days following abdominal surgery [34-37]. Following other procedures, such as colonoscopy where a large amount of gas has been introduced into the colon, it is advisable to avoid travel by air for 24 hours.

Neurosurgical guidance: Intervention may leave gas trapped within the skull, which again may expand at altitude. It is therefore advisable to avoid air travel for 7 days post procedure.

Ophthalmological guidance: Those procedures designed to treat retinal detachment also involve the introduction of gas by intra-ocular injections, which will temporarily increase intra-ocular pressure. It is recommended to delay travel for approximately 2 weeks if sulphur hexafluoride is used and 6 weeks with the use of perfluoropropane

Trauma / orthopaedics guidance: Following the application of a plaster cast, the majority of airlines and IATA recommend no air travel for 24 hours on short haul flights or 48 hours for longer haul flights. It is clear from laboratory studies that the cytokines released within injured and traumatized tissue will improve the blood supply, thereby resulting in increased vascularity and potential limb swelling. This can result in a high risk of circulatory impairment as a result, especially in relation to lower limb injuries and particularly if the leg cannot be elevated during travel. If there is an urgent need for travel within these time limits, the plaster cast may be bi-valved.

Those patients whom have experienced polytrauma are generally regarded as complex due to both their injuries and the staged surgery which they may have undergone [38-41]. They will be at high risk and consequently need individual review by an airline's medical officer before the relevant decisions can be made.

Anaesthetic guideance: General anesthesia, which is frequently used for ambulatory (day case) surgery, is not a contraindication to flying because the cardiac depressant effects and the changes in vascular resistance of anesthetic agents are rapidly reversible following emergence. However, severe post-spinal headache precipitated by airline travel has been reported 7 days after a spinal anesthetic, possibly because of ambient cabin pressure changes inducing a dural leak.

Summary

The International Air Transport Association (IATA), The Civil Aviation Authority (CAA) and NICE guidance for passengers who have undergone surgery is largely based on expert opinion of specialists and their clinical experience due to a paucity of Ramdonised Controlled Trials and level 1 evidence [42].

The specific matter of DVT risk following surgery in association with long haul flight has been thoroughly covered in detail by NICE guidance. These guidelines are supported by a mixture of level 1 and 2 evidence and sound evidence based medicine.

Attached below is a guidance sheet which represent a distillation of the summarised evidence and which we believe will aid the clinician in answering the often vexed and emotive question " Doctor am I fit to fly".

Orthopaedic patients

Isolated upper limb fractures and soft tissue trauma - Mx Non surgical (Safe to fly 48 hrs post casting).

Isolated lower limb fractures and soft tissue trauma - Mx Non surgical (Safe to fly 48 hrs post casting).

Pelvic + spinal + polytrauma - Mx Non-surgical or surgical needs to be discussed with airlines medical officer with the relevant Medical Information (MEDIF) form necessary as each cases assessed on its own merit [43].

Anaesthetic and post surgical guidance

General anesthesia, frequently used for ambulatory surgery, is not a contraindication but severe post-spinal headache precipitated by airline travel has been reported 7 days after a spinal anesthetic thus travel in not advised.

Any passenger having had surgical intervention is potentially safe to fly but NICE guidance regarding DVT post surgery should be strictly observed [44]. The clinician should explain and document the relevant information within the patients notes.

NICE guidance for deep vein thrombosis prevention (March 2013)

The NICE guidelines differentiate between patients by categorizing mild, moderate and high risk, giving specific recommendations regarding management. NICE also make a further differentiation between short haul (< 6 hours) and long haul (> 6 hours) flights stating that there is a statistical increase in DVT rate with longer flights. Long haul > Short haul increases probabilities and risk of DVT and its complications [45,46].

Mild

Trauma, fractures, surgical pathology leading to immobility. Mx- Compression stockings.

Moderate

Surgery (All types + fracture fixation) lasting > 30 minutes within 4 weeks. Mx- Compression stockings.

High

Polytrauma, general surgery and joint replacements within 4 weeks. Mx- Compression stockings + Haematology R/V.

Haematology opinion- Anticoagulation (LMWH ± Warfarin and IVC filter insertion).

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