Effects of flying on cavities

Aviation dentistry – New Horizon, New Challenge

Abstract:

After the innovations in aviation at the beginning of the 20 th century, many in -flight pathologic and physiologic conditions were reported. Changing atmospheric pressure, especially if it is rapid, can cause discomfort and damage to the oral cavities and maxillofacial areas unless the pressure within these cavities containing gas is able to equilibrate with the external air pressure. Out of these conditions- barodontalgia (pain due to gas entrapment) and barotrauma (pressure induced tooth fracture, restoration and tooth fracture) was most frequently seen to occur. Due to partial pressurisation of aeroplanes' cabins and improvement in dental techniques and oral health awareness, prevalence of flight-related oral manifestations has declined. It is important for the dental practioners to be familiar with these facts and not to neglect dental education with respect to aviation. Aircrew patients as well as air passengers often make it challenging for the dentist to treat several flight-related conditions. Correct diagnosis should be made before these conditions lead to serious complications. With thorough practice and experience, the aircrew are now able to avoid, or treat, these pressure related problems.

Keywords: Barodontalgia, Barotrauma, Aviation Dentistry.

INTRODUCTION

It is a known fact that at higher altitudes there is a reduction in air density and air pressure. The decrease in pressure is that at 18, 000ft, air pressure is half that of that at sea level and at 33, 000 ft. it is quarter as seen at sea

level. [1] This reduction in air pressure has a many negative effects on aviators.

When an aircraft is at a high altitude, atmospheric pressure will be too low but inside aircraft pressure is maintained such that it is comfortable for crew and passengers. The pressure and temperature regulation in aircraft is done by means of aircycle machines and outflow valves. [2]

During flight, the aircrew is responsible for the lives of the aircrew members and passengers for completing the flight successfully. Any problem within the flight could lead to failures in the flight's safety. [3]

Dental practice and education is evolving with technological advancements. The focus is now on prevention. With the advanced expansion in the airlines industry with air travel now being the chief mode of transport, special attention must be paid towards the crew members and air travellers. [4]

Aviation dentistry primarily deals with the oral and dental health status of the aviators. It deals with the diagnosis, principles of prevention and treatment, disorders or conditions which are related to the oral cavity and maxillofacial area and their impact on those who travel in such an environment where there is change in pressure than that of the normal atmospheric pressure. [5]

Several areas of the body normally contain gas which includes the lungs and air-passages, the sinuses of the face, the stomach and bowel, and the middle ear cavity. Gas may be present in other areas of the body under abnormal

circumstances such as the gas produced when a tooth abscess forms, or sometimes under a tooth's filling. [2]

A person in flight is subjected to reduced air pressure. Here, the gas present within the body will expand. This is not a problem if the gas communicates freely with the outside (as with the mouth, nose, and to a degree the sinuses and the middle ear cavity). The gas merely expands and escapes to the outside atmosphere. But if the gas doesn't communicate freely with the outside, its expansion will cause a build-up in pressure on the cavity walls causing discomfort . It can even impair the function of the organ involved . [6]

Large changes in altitude can cause toothache (Barodontalgia = pressure-tooth-pain). The reason this occurs is either the presence of small pockets of gas in deep (usually unlined) fillings, or collections of gas in areas of decay, gum inflammation, or root abscesses where the pain can be quite severe. [7]

Due to infrequent meals, the aircrew members may suffer some gastro-intestinal problems too. [8] With practice and experience aircrew are able to avoid, or treat, these pressure related problems . [5] We as dentists should prevent the creation of in-flight hazards when we treat aircrew members and frequent flyers.

BAROTRAUMA

Barotrauma refers to injury sustained from failure to equalize the pressure of an air-containing space with that of the surrounding environment. The most common examples of barotrauma occur in air travel, scuba diving , hyperbaric oxygen therapy or exposure to shock waves from an explosion . [9]

It is a tissue injury seen due to changes in pressure, wherein the gas compresses or expands which is present in various hard or soft body structures. In cases where there is increased pressure outside the body, this pressure is equally transmitted throughout the blood and body tissues, which do not compress because they are composed mainly of liquid. However, gases (such as the air inside the lungs, sinuses, or middle ears) compress or expand as outside pressure increases or decreases causing pain, numbness and damage to the involved tissue. [5, 10]

Barotrauma of non-dental origin

Barotrauma can commonly affect the ears which is also called aero-otitis or Barotitis . [11] It is observed that plane landing leads to extreme pain in the ear (the pressure change can create a vacuum in the middle ear that pulls the eardrum inward causing pain), dizziness (vertigo), bleeding or fluid coming from the ear (due to a ruptured eardrum) and ultimately hearing loss. [12, 13] Risk of barotrauma is increased by conditions that prevent air from freely flowing between spaces, such as sinus congestion or blockage of Eustachian tube or any other upper respiratory tract infection. [14] It may impair the balancing function of the Eustachian tube, thus predisposing the individual to barotrauma.

However, pulmonary barotrauma is the most serious amongst the other types of barotrauma. Pulmonary barotrauma may cause shortness of breath, chest pain, and feeling of fullness in the chest, pain that radiates to the neck and/or shoulders, light-headedness, seizure or coma. Potential complications can include pneumothorax and stroke. Measures that can help prevent

pulmonary barotrauma include ascending slowly and breathing during ascent . [15]

High altitudes can also cause acute or chronic inflammation of one or more of the paranasal sinuses, mainly the frontal sinus . This is produced by the development of a pressure difference (usually negative) between the air in the sinus cavity and that of the surrounding atmosphere . This condition is termed as Barosinusitis, Sinus barotrauma, Aerosinusitis or Sinus squeeze . [14] Normally, there is no air pressure differential between the sinuses and the outside environment. Barosinusitis can occur and be manifested as toothache (indirect barodontalgia) [16] .

Vacuum created inside the sinus may also seem to cause damage to the ethmoid cell mucosa which may trigger the ethmoid nerves (branches of the ophthalmic branch of the trigeminal nerve that innervate the mucosa on the inner surface of the sinus). This may lead to orbital and/or peri-orbital headache. [17]

To prevent the above risks from occurring, it’s better to postpone the flight for people suffering from a cold or congestion . Using a decongestant could help in some cases. To relieve the pressure during take-off and landing sucking candy, chewing gum, yawning or breathing with the mouth open can be beneficial . Usage of filtered earplugs can help to slowly equalize the air pressure against the eardrum. Since one does not swallow enough during sleep, keeping awake during descent can also prove helpful.

Barotrauma of dental origin

BARODONTALGIA

Barodontalgia is an oral (dental or nondental) pain caused by a change in barometric pressure in an otherwise asymptomatic organ. Gases are confined within the closed spaces due to which it is unable to contract to adjust the internal pressure. Individuals experience pain which may be sharp or squeezing in nature. Whether the pain occurs during ascent or descent depends entirely on the related pathology. [5] Generally, pain on ascent is related to vital pulp disease (i. e., pulpitis) and pain on descent to pulp necrosis or facial barotrauma . Pain related to periapical disease can appear during ascent as well as descent. [9] The pain usually ceases when returning to onset level or ground atmospheric level but can last longer if caused by periapical disease or facial barotrauma. Barodontalgia is a symptom rather than a pathologic condition itself. In most cases, it is an exacerbation of pre-existing subclinical oral disease. [18]

Several suggestions to explain the pathogenesis of barodontalgia were given. Strohaver [19] in 1972 advocated the differentiation of into direct and indirect types. In direct barodontalgia, reduced atmospheric pressure leads to direct effect on the affected tooth, whereas in the indirect type, dental pain is due to the stimulation of the superior alveolar nerves at the time of maxillary barosinusitis. Direct barodontalgia is characterised by moderate to severe pain, which usually develops during take-off. It is well localized and the patient can identify the involved tooth whereas indirect barodontalgia is a dull, poorly defined pain that generally involves the posterior maxillary teeth and develops during landing.

Exposure to altered atmospheric pressure is obviously a significant factor resulting in pain production in barodontalgia with disease of the pulp as one of the probable cause. Ferjentsik et al [20] stated that normal pulp tissue would not produce pressure associated pain, regardless of whether restorations or caries were present. However, Hodges [21] has reported that dental pain could be produced in apparently healthy teeth when the atmospheric pressure was increased.

Experimental research indicates that barodontalgia may depend on an increased pulpal pressure induced by pressure variations in the permeability of the dentinal tubules. Kollmann W (1933) said that barodontalgia could be due to expansion of trapped air bubbles under a restoration or against dentin that activates the pain receptors. [22] It could also be due to stimulation of nerve endings in an inflamed pulp or stimulation of nociceptors in the maxillary sinus with referred pain to the teeth.

BAROMETRIC TOOTH EXPLOSION

It was reported that teeth with pre-existing leaked restoration or remaining/recurrent caries lesions underneath restoration led to tooth explosion when exposed to changes in atmospheric pressure. [23] This condition is known as Barometric tooth explosion, Barodontocrexis or Odontocrexis. Although the destructive potential of arrested or remaining carious lesions in daily life is minimal, it seems that these lesions may not be as asymptomatic or minimal in a pressure-changed environment. Calder and Ramsey [24] reported that all the damaged teeth either had poor quality of amalgam restorations with unfavourable clearance between the tooth and

the amalgam or secondary caries under the restoration. Odontocrexis can potentially lead to severe pain, swallowing of the tooth fragments or even their aspiration. [25]

Patients should be advised not to fly while having provisional restorations or temporary cement in their mouth. Leaky or faulty restorations should be diagnosed and replaced. Carious lesions should also be excavated and restored. Placement of cuspal coverage crowns could also be a preventive measure.

PROSTHETIC CONSIDERATIONS

Lyons et al. studied the retention of crowns to extracted teeth in environmental pressure changing conditions. The crowns cemented with glass-ionomer cement or zinc phosphate cement had reduced retention with the tooth. Crowns cemented with resin cement did not have reduced retention. [26] This can be due to porosities incorporated at the time of manipulation of zinc phosphate cement and glass-ionomer cement. These microporosities expand and contract upon pressure changes leading to a weakened cement . [25] Microleakage was also detected in zinc phosphate and glass-ionomer cements after pressure changes , whereas no microleakage was detected in resin cement. [27]

Reduced barometric pressure can reduce the retention of full removable dentures (especially maxillary dentures) [28] Retention by osteointegrated dental implants is the best solution for edentulous fliers. [4]

RESTORATIVE DENTISTRY

Pure oxygen inhalation may cause corrosion of dental amalgam restorations in cases due to increased percentage of oxygen. [29] Differential thermal contraction in cases of low temperature of a high altitude environment is seen of amalgam materials as compared with tooth hard tissue. Harvey [30] reported that cold temperature is unlikely the dominant mechanism underlying dental fracture.

Excessive occlusal forces was also a factor in dental restoration dislodgement . Sognnaes, suggested that clenching or grinding of teeth was a causative factor for restorative failure. [18]

ENDODONTIC CONSIDERATIONS

Although not evidence based, Rossi [31] contraindicated direct pulp capping in aircrew patients and recommended endodontic treatment in each case of suspected invasion to the pulp chamber in order to prevent sub-acute pulpitis or silent pulp necrosis and their potential barometric pressure-related consequences. Open unfilled root canals may cause leakage of the intracanal infected content to the periradicular tissues and subcutaneous emphysema ·

PERIODONTAL CONSIDERATIONS

Decrease in salivation and dryness of mouth are few of the risk factors responsible for the development of caries lesions. Dryness of the mouth can be due to breathing of dry compressed gases in the aircraft. [32] There is increased risk of periodontal diseases because of xerostomia.

ORAL SURGERY

When maxillary teeth are extracted, the dental surgeons should always rule out the existence of an oroantral communication as it can lead to sinusitis when exposed to a pressure changing environment . [33]

PREVENTION

Caries excavations and restorations should be completed before airtravel. Leaky restorations should be replaced. During the restoration of a carious tooth, a thorough examination of the floor of the cavity should be done to rule out any penetration leading to the pulp chamber. In such cases a protective cavity liner should be applied (e. g. glass-ionomer cement) . During multi-visit endodontic treatment, the temporary restoration must be placed properly . When oroantral communication is diagnosed; referral to an oral surgeon for its closure is indicated. [9]

Cuspal coverage crowns could also be a preventive measure. Resin cements are preferred for cementation, as they give better retention. During flight, chewing gum or candy will increase salivation and prevent dryness in mouth.

CONCLUSION

There has been a tremendous increase in air travellers viz pilots, aircrew personnel, air passengers, flight attendants and leisure pilots. Special precautions must be taken during endodontic, restorative, prosthodontic and oral maxillo facial surgical treatments for the aircrew patients to prevent any kind of in -flight incapabilities leading to serious issues. Aviation dentistry is an emerging science which has been much neglected . With air travel gaining popularity, the in-flight dental hazards cannot be ignored anymore.

The dental clinicians should take an initiative to raise awareness levels and sensitize the air travellers about this issue. The need of the hour is to promote diagnostic tools and treatment guidelines to the aviation industry to ensure wellness of air travellers.