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Research Article

BARODONTALGIA: PAIN AT HEIGHTS

Nisha*, Neeta Misra, Shiva Kumar GC, Saurabh Srivastava, Puja Rai and Anjum Sahar

Oral Medicine and Radiology, Babu Banarasi Das University, Lucknow

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ABSTRACT

Changes in the surrounding air occur during flying, diving, etc can cause different types of pathophysiological conditions and pain in teeth's (Barodontalgia). As per literature evidence numerous cases have been reported pain occurs during flight and persisted after landing. It is important for dental surgeons to understand the aetiology and features associated with barodontalgia to help prevent it. On the basics of this paper literature was reviewed to find out the diagnosis, prevention & treatment of barodontalgia.

INTRODUCTION

Barodontalgia is a pain which is caused by change in barometric pressure (Yahuda Z 2009). During World War II, tooth pain experienced by air crew in flight was given the name Aerodontalgia. However, as this tooth-related pain was also observed in divers, a broader, more appropriate term, barodontalgia, was subsequently given to this phenomenon (Holowatyj R 1996). Barodontalgia, which affects air crew and aircraft passengers as well as underwater divers, is pain or injury affecting teeth due to changes in pressure gradients (Kieser J, Holborow D 1997).

Barodontalgia comes from the Boyle's Law, stating that "At a given temperature, the volume of a gas is inversely proportional to the ambient pressure (Roland R, Mary E. McNally 2005)." Changes in ambient pressure, for example, during flying, diving or hyperbaric oxygen therapy, can lead to barotrauma. In a diving deeper, this pain is commonly known as ''tooth squeeze.'' Military and aerobatic pilots are usually associated with different types of pressure changes. As a result of the higher density of the surrounding medium, divers are exposed to very high ambient pressures. Compared with aircraft personnel, however, the duration of exposure is usually short. A complaint of dental pain due to barometric change may pose diagnostic challenge to the dental clinicians. Hence this article reviews the literature regarding barodontalgia, its aetiology and management.

Classification

Barodontalgia is subgrouped into direct (dental induced) and indirect (non-dental induced) pain (Yehuda Z 2009, 2010).

1. Direct Barodontalgia
2. Indirect Barodontalgia
   - Pulp/ periapical pathosis related barodontalgia.
   - Barotitis/ barosinusitis-induced barodontalgia.

The accepted classification of barodontalgia was developed by Ferjentsik and Aker 1982 and is primarily based on the underlying causes and clinical symptoms (Table1) which was established in 1940 consisted of three groups and included pulp pathologies as well as other possible causes of barodontalgia such as Barosinusitis, Barotitis media, and partially erupted teeth.

Table 1 Classification of Barodontalgia

Class	Cause	Symptoms
Class I	Irreversible pulpitis	Sharp pain on ascent
Class II	Reversible pulpitis	Dull pain on ascent
Class III	Necrotic pulp	Dull pain on descent
Class IV	Periapical pathology	Severe persistent pain on ascent or descent

Corresponding author:* **Nisha
Oral Medicine and Radiology, Babu Banarasi Das University, Lucknow

Table 2 Federation Dentaire Internationale (FDI) has also classified barodontalgia (Goethe 1989)

	Chief complaint	Clinical finding	Diagnosis	Treatment
Class I	Sharp momentary pain during ascent (decompression) Asymptomatic on descent (compression) and afterward	Caries or restoration with inadequate base Tooth is vital No periapical pathosis	Acute pulpitis	Zinc oxide eugenol temporary followed by a well‑based permanent restoration after 2 weeks Endodontic therapy, if irreversible
Class II	Dull throbbing pain during ascent (decompression) Asymptomatic on descent (compression) and afterward	Deep caries or restoration Tooth is vital/nonvital No periapical pathosis	Chronic pulpitis	Root canal therapy or extraction of unrestorable tooth
Class III	Dull throbbing pain during descent (compression) Asymptomatic on ascent (decompression) and afterward	Caries or restoration Tooth is nonvital Periapical pathosis is Present	Necrotic pulp	Root canal therapy or extraction of unrestorable tooth
Class IV	Severe persistent pain after ascent (decompression) or descent (ascent)	Caries or restoration Tooth is nonvital Definite Periapical pathosis is present	Periapical abscess or cyst	Root canal therapy and/or surgery or extraction of unrestorable tooth

Etiology

Barodontalgia is not a pathological condition. Most of the common pathologies have been reported as a sources of Baro pain (Holowatyj R 1996, Kollmann W 1993, Yehuda Z 2006). The most common pathologies of which were in-flight pain were faulty restorations and caries, Periapical inflammation, and recent dental treatment ("postoperative Barodontalgia") (Yehuda Z 2006).

Previous reports have documented that Dental pain causes Barodontalgia (Yehuda Z *et al* 2006). Kallman proposed three hypothesis for barodontalgia first, expansion of trapped air bubbles under a root filling or against dentin that activates nociceptors; second, stimulation of nociceptors in the maxillary sinuses, with pain referred to the teeth; and third, stimulation of nerve ending in chronic cases of inflamed pulp (Kollmann W 1993).

Clinically, people affected by baro pain were found to have acute or chronic periapical infection, caries, deep restorations, residual dental cysts, sinusitis and a history of recent surgery. Sinusitis may also contribute to barodontalgia (Krishna PS *et al* 2013). Although it may not be related to any tooth pathology. Barosinusitis is distinguishable from barodontalgia, as the former will always occur on descent, whereas the latter always begins on ascent.

Calder and Ramsey 1983 conducted a study on 86 extracted teeth subjected to the high-pressure environment and tested whether large, rapid pressure changes generated within a capsule would create visibly detectable damage to extracted restored and non restored teeth. Among which, 5 showed visible evidence of trauma and had poor quality restorations present before extraction or placed after extraction.

Holowatyj R 1996 described a patient as having pain in his left infraorbital area, as well as in the maxillary left canine and maxillary left first molar during both a commercial flight and while flying a Tutor jet trainer. Although no tooth pathology was present, the patient did have mild congestion in his left maxillary sinus, with referred pain in his maxillary teeth.

Prevalence and Incidence

The current incidence of barodontalgia during flight is similar to the reported incidence (9.5%) from the first half of the twentieth century (Yehuda Z 2009).

It was most prevalent in the third decade of life and without gender preference. Barodontalgia has been experienced by 9.2%-21.6% of American and Australian SCUBA divers. In-flight barodontalgia affects 11.0% of military aircrews. Such an incidence study for Indian population has not been reported yet (Yehuda Z 2010).

Pathogenesis

Since 1940, several hypothesis regarding pathogenesis of barodontalgia have been proposed.

1. Direct ischemia due to inflammation (Yehuda Zadik 2009).
2. Indirect ischemia resulting from increased intra-pulpal pressure as a result of the vasodilatation and fluid diffusion (Harvey W 1947).
3. The result of intra-pulpal gas expansion (Yehuda Z 2009).
4. The result of gas leakage through the vessels because of barometric- related reduced gas solubility. This theory, offered by Orban and Ritchey [1940], was based on a histologic view of gas bubbles on sectioned teeth that were extracted after barodontalgia.

Bergin [1949] accepted the solubility theory, but Lyon *et al* [1999] rejected that theory because the authors had seen gas bubbles only in six out of seventy five teeth. Another argument against the solubility theory is the possibility that the gas bubbles that they had seen were artefacts because of an inadequate fixation of the histological preparations (Yehuda Zadik 2009, Lyon KM 1999).

5. Hyperaemia in the pulp canal caused by decompression. This theory was also offered by Orban *et al* [1946].
6. Barometric pressure Changes in the cases of defective restorations may force oral fluids to be sucked from the inner dentin tubules, thus causing sensitivity or pain in the pulp chamber (Harvey W 1947).

During restorative treatments, Devoe and Motley (1945) created ''trapped air'' under restorations in eight patients by placing a loose pellet of cotton along with restorative material in the cleansed pulpal floor of the cavity. None of the patients reported pain in high-altitude exposures (Calder IM, Ramsey JD 1983).

So it was offered that barodontalgia in endodontically treated tooth, pain may be generated because of the expansion of trapped air bubbles under the root filling (Roland R, *et al* 2005). Barodontalgia due to apical periodontitis or impacted teeth is probably caused by the elevated pressure within the bony lesion or tooth crypt, respectively (Yehuda Zadik 2006).

Pain due to barodontalgia in diving conditions affects more commonly the upper teeth than lower teeth, and vast majority of episodes appeared upon descent (Tarun K G *et al* 2012). In a study, Calder and Ramsey 1983 mentioned that the physical properties of the gas mixture used during deep sea diving may contribute to barodontalgia.

Consistent with Boyle's Law, trapped gas will expand and the resulting stress may cause tooth fracture. This process has been called odontecrexis, a Greek word meaning tooth explosion (Krishna PS 2013). In recent times, the in-flight dental manifestations of pressure changes are relatively low because of the current pressurization measures taken in airplane cabins, high quality dental care and improvement of moral health. In-flight barodontalgia has been reported to occur at altitudes of 3,000-25,000 feet (Tarun K G *et al* 2012, Krishna PS 2013).

Upper & lower teeth are found to be equally affected, The most affected intraoral areas are upper and lower posterior tooth with upper first molar and lower first molar being the most affected teeth (Yehuda Zadik 2006) .

Diagnosis

Barodontalgia is a symptom itself. Most of the common dental pathologies have been reported as possible sources of barodontalgia including dental caries, defective restorations, pulpitis, pulp necrosis, apical periodontitis, periodontal pockets and impacted teeth (Tarun K G *et al* 2012, Krishna PS 2013).
literature evidence have documented that difficulty of obtaining a definitive diagnosis of barodontalgia practitioners cannot reproduce the pain trigger factor like barometric pressure change with ordinary dental facilities, and, even in a diagnostic altitude-chamber simulation, it is sometimes impossible to reproduce the pain (Kollmann, W 1993).

Therefore, the history is of greater importance. Data regarding recent dental treatments preceding symptoms like swelling, sensitivity to cold, percussion, and so on, and pain onset and the nature of the pain can direct practitioners toward the offending tooth because a significant number of barodontalgia cases involved teeth with faulty restorations (Yehuda Zadik 2009). So the dental surgeons are advised to look for faulty restorations and secondary carious lesions, to perform vitality test and needed periapical radiographs, and to rule out episodes of pain in the upper posterior region and pain originated from the temporomandibular joint or masticatory muscles in episodes of in-diving oral pain.

Prevention & Management

The treatment of Barodontalgia can range from palliative to definitive, subject to the accessibility of dental care. These options have been elaborated by the FDI[Table -2].
FDI also recommends that annual checkups be done for divers, submariners and pilots, with oral hygiene instructions from dentists. After a dental treatment requiring anaesthetic or 7 days following a surgical treatment, patients should be instructed not to dive or fly in non-pressurized cabins for the next 24 hours (Goethe, W. H 1989).

In the World War II era, for the aircrew patients all pulpless teeth were removed and all metallic restorations were replaced with non-metallic (plastic) restorations ''in order to minimize the pressure in the pulp chamber that may produce odontalgia''. Rossi (1995) 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.

During restorative treatment to aircrew or diver patients, after carious tissue is removed, A protective cavity liner/base should be applied before the tooth is restored (Roland R *et al* 2005, Krishna PS *et al* 2013).

This article reviewed the facts that are known to barodontalgia. Although it seems that this issue is neglected in dental education and research in recent decades, familiarity with and understanding of these facts may be of importance for dental practitioners. Dentists should employ the described preventive measures when treating pilot and diver patients, and should use the data available for diagnosing the causes of barodontalgia.
Periodic oral and dental examinations, including periapical radiographs and vitality tests, are recommended for the prevention of barodontalgia in high-risk populations (e.g., aircrews, divers).

CONCLUSIONS

According to the literature evidence, barodontalgia is a rare phenomenon so the controversy still there as to the exact aetiology of barodontalgia. Dental clinicians will be able to provide more efficient diagnosis and care by referring to FDI guidelines, as well as knowing how certain dental materials respond to pressure gradients. However, further understanding of diagnosis and treatment challenges would undoubtedly be useful from research broadened to include divers and civilian aviators.

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