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Microgravity and Oral cavity: BR study review

Balwant Rai, BDS, MS*
Jasdeep Kaur, BDS, MSc**

ABSTRACT

For many years, the prevailing concept in space human factors research has been that microgravity has an impact on human physiology and astronauts are faced with several health risks during both short and long duration spaceflights. The review of our study found that reversible effect of microgravity is oedema of face, change in taste, abnormal expression of face, teeth pain and xerostomia. The non reversible effects of microgravity such as periodontal disease, dental caries but in different pattern than normal, stone formation in salivary duct, pre cancer or cancer, fracture of maxillary and mandibular bone and xerostomia are more prevalent in astronauts as compared to normal persons. Further study will be required on large scale on long term effects of microgavity on oral cavity to prevent the adverse effects.

Key words: Mars mission, human factors, Microgravity, Aeronautic Dentistry

INTRODUCTION

For many years, the prevailing concept in space human factors research has been that microgravity has an impact on human physiology and astronauts are faced with several health risks during both short and long duration spaceflights. Some of these health problems include bone loss, muscle atrophy, cardiac dysrhythmias, and altered orientation (Herault et al., 2000; Oganov et al. 1992). Our previous studies observed some adverse effects of simulated microgravity (HDT bed rest condition) on oral cavity (Rai, 2007; Rai, 2009; Rai et al., 2010). This paper reviews the adverse effect of microgravity on oral cavity.

Author's Affiliation *Oral Imaging Centre, School of Dentistry, Oral Pathology and Maxillofacial Surgery, USA, **Forensic Odontology section, School of Dentistry, Oral Pathology and Maxillofacial Surgery, Catholic University Leuven, Leuven, Belgium.

Reprints Requests: Dr. Balwant Rai, BDS, MS* Health and safety officer, Crew 78, Mars Mission, NASA, USA.

E-mail : drbalwantraissct@rediffmail.com

RESULTS AND DISCUSSIONS

Flow rate, sodium, potassium, calcium, phosphate, protein levels were increased in simulation environments as compared to normal, while same findings were observed in urine (Rai et al, 2009; Zerwekh, 2002). Increased bone resorption contribute significantly to raise the salivary state of saturation with respect to the calcium salts, namely calcium oxalate and calcium phosphate. In addition, other environmental and dietary factors may adversely affect salivary composition and increase stone formation risk during space flight. Although observations to date have suggested that there could actually be a reduced food intake during the early phase of flight, crew members on longer-duration flights could also increase food intake and be at increased risk for salivary stone formation. The most important effect of restricting energy intake is on calcium and bone metabolism. The MIP 1 alpha level was decreased in microgravity which is potential markers of bone loss (Rai et al , 2009; Fine et al, 2009). In agreement with earlier reports (Kirsch et al., 1984; Parazynski et al., 1991; Watenpaugh et al., 1992) , they found a 9%

increase in plasma protein concentration on flight day 1, and a 17% reduction in plasma volume by 22h of flight. This agrees with the early in-flight hemoconcentration seen by others (Kirsch et al., 1984) and establishes that plasma volume contraction occurs quickly in microgravity. This hemoconcentration probably results from increased upper-body vascular pressures in microgravity (Parazynski et al., 1991) and perhaps reduced interstitial pressures ; both factors would encourage transcapillary fluid filtration into upper-body interstitial spaces, and substantial filtration can occur in minutes (Watenpaugh et al., 1992). Increased plasma protein concentration increases plasma colloid osmotic pressure and, therefore, opposes capillary filtration. An increased fluid excretion was observed in simulated microgravity leads to dehydration and finally to a reduction of plasma volume and an increase in the haematocrit. A reduction of plasma volume may result in increase in serum electrolyte levels, and therefore serum osmolality and urine osmolality increase too. The plasma volume decrease together with increases in serum and urine osmolality and electrolyte levels, influences body fluid regulation by activating hormonal regulatory factors, i.e. vasopressin, renin and aldosterone .The levels of calcium were increased in microgravity as compared to control. Insufficient calcium consumption leads to a reduction in serum calcium levels and thereby to a secretion of parathyroid hormone (PTH) and calcitriol synthesis. Both a rise in PTH and calcitriol induce an increase in calcium retention either from the intestine or from bone. Based on that, a long-lasting insufficient calcium intake together with insufficient vitamin D are the main factors leading to a decrease in bone mineral density (Bronner , 1996) . The decreased levels of vitamins E and C and increased in malonaldehyde levels denoted increased in free radical activity as in microgravity environments (Bigard et al, 1998). So, the free radical activity increased in microgravity as compared to normal gravity. The 8-hydroxy deoxyguanosine levels were increased in saliva in microgravity environments' as compared to normal, it may be due to increased in oxidative stress (Bigard et al, 1998). The threshold for MSG and capsaicin increased about 1.5 dilution step, while sodium chloride decreased about 2 dilution during microgravity as compared to normal. It might be due to fluid shift mechanism. Mild pain of teeth, facial oedema, mild pain at mandibular angle regions, pain in sublingual and submandibular opening duct regions, abnormal facial expression, loss of sensation of pain and temperature, decreased tongue and mandibular movements in simulation microgravity environment were observed. It could be due to physiological changes including an upward shift of body fluids toward the head, which may lead to an attenuation of the olfactory component in the flavour of foods, pressing the nerve regions or dysfunction of nerve as well as increased activity of b-AR agonists (Vicker et al, 2001). These results suggest that reversible effect of microgravity is oedema of face, change in taste, abnormal expression of face, teeth pain and xerostomia. The non reversible effects of microgravity such as periodontal disease, dental caries but in different pattern than normal, stone formation in salivary duct, pre cancer or cancer, fracture of maxillary and mandibular bone and xerostomia are more prevalent in astronauts as compared to normal persons.

Further study will be required on large scale and on long term effects of microgavity on oral cavity to prevent the adverse effects.

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