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Changes in Periodontal Health Status among Naval Personnel during Prolonged Sailing

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Abstract

Objectives: The aim of this study was to investigate the changes in periodontal status among some naval personnel of Chinese PLA during Gulf of Aden convoy and analyze possible causes.

Methods: The changes in oral hygiene index-simplified (OHI-S), gingival index (GI), plaque index (PLI), bleeding on probing (BOP), probing pocket depth (PD), clinical attachment loss (CAL), community periodontal index (CPI), tooth mobility (TM), and number of missing teeth (NMT) excluding third molars, and the prevalence of periodontal disease between post-sailing and pre-sailing were measured and analyzed among 186 naval personnel who participated in prolonged sailing.

Results: Each periodontal index on post-sailing was significantly higher than that of pre-sailing and there was significant difference between them. Before sailing, total prevalence of periodontal disease was 59.7%. After sailing, normal percentage decreased to 16.7% ($P<0.01$), total prevalence increased to 83.3%, the percentage of gingivitis and mild periodontitis increased to 38.7%, 27.4% respectively ($P<0.05$), and the percentage of moderate and severe periodontitis increased to 10.8%, 6.5% respectively ($P<0.01$). Significant differences were found in all indices between post-sailing and pre-sailing.

Conclusions: Our research indicates that prolonged sailing environment, food constraint and poor oral hygiene could notably influence periodontal status of naval personnel. It is essential for periodontal health of naval personnel during prolonged sailing to promote education on oral hygiene, develop the habit of correct toothbrushing, have balanced and rational diet, and perform proper periodontal non-surgical treatment and medication.

Keywords: Prolonged Sailing; Naval Personnel; Periodontal Disease.

INTRODUCTION

Periodontal diseases, including gingivitis and periodontitis, are a chronic bacterial infection that affects the gums and bone supporting the teeth, which can affect one tooth or many teeth. Gingivitis, or inflammation of the gums, occurs in response to the bacteria in plaque that accumulates near the gum line. It is characterized by redness, swelling or bleeding of the gums. Usually, gingivitis is a painless condition (Australian Research Centre for Population Oral Health 2009).

Periodontitis is inflammation of the tissues surrounding the tooth affecting the gingiva, the ligaments and the bone, which is caused by a bacterial infection. In some instances, the infection can cause an abscess and become painful (Australian Research Centre for Population Oral Health 2009). In its severe forms there can be loss of bone that supports the tooth, resulting in the tooth becoming loose and even causing tooth loss. The loss of supporting structures can result in the formation of "periodontal pockets" between the gum and the tooth. Probing pocket depth, measured in millimeters using a periodontal probe, is an indication of the severity of the destructive process. Regular dental treatment can prevent moderate periodontitis from progressing to the severe form (Australian Research Centre for Population Oral Health 2009).

Information regarding periodontal health improvement of Chinese navy personnel has been limited, and the severity of periodontal problems has generally been underestimated (Hu et al, 2011). With the increasing attention to oral health of naval personnel, periodontal diseases are becoming conspicuous health care problem (Ma et al, 2012). Moreover, naval personnel during prolonged sailing might have higher incidence of periodontal disease because of water shortage, poor water quality, and unhealthy dental habit (Zhang et al, 2012).

Therefore, grasping the changes of periodontal status during prolonged sailing will have important significance on oral disease precaution and medical care of naval personnel.

The author investigated the changes in periodontal disease among some naval personnel of Chinese PLA in both before and after Gulf of Aden navigation, which would provide basis for precaution and health care of periodontal disease during prolonged sailing.

MATERIALS AND METHODS

A total of 186 naval personnel who participated in prolonged sailing on one ship were selected for the subjects after written informed consent was obtained. All subjects enrolled in this study were volunteers and nonsmokers. They were 19~40 years old, average 25, and they were all male. Before leaving medical examinations were performed to everyone, the result indicated that they were healthy. Total time of this sailing was 196 days. Professional oral examinations were performed on the vessel at the start of the mission for going to the gulf of Aden and at the end of the mission, respectively. The examiner was only the first author herself because there is one dentist on the ship, and she was subjected to professional training. All procedures were approved by the Ethics Committee on Human Research, the 401 Hospital of Chinese People's Liberation Army, Qingdao, Shandong, China. The study was conducted from February to September in 2013.

Periodontal health status was evaluated by a simplified oral hygiene index (OHI-S, scores 0-3), gingival index (GI, scores 0-3), plaque index (PLI, scores 0-3), bleeding on probing (BOP, scores 0-1), probing pocket depth (PD, from the gingival margin to the bottom of pocket), clinical attachment loss (CAL, from cementoenamel junction to the bottom of the pocket), community periodontal index (CPI, scores 0-4), tooth mobility (TM, scores 0-3), and number of missing teeth (NMT) excluding third molars as previously described (Wang et al, 2007). All data in this study were obtained from ten teeth in each subject, the ten teeth were usually 11, 31, 16, 17, 26, 27, 36, 37, 46 and 47, but proximal teeth were used if the marked teeth were missing. Periodontal probing was measured from six sites of teeth: mesiobuccal, buccal, distobuccal, mesiolingual, lingual and distolingual (Wang et al, 2007).

The community periodontal index (CPI) was recorded in sextants according to WHO guidelines (WHO 1997). Examination for CPI includes gingiva bleeding, dental calculus and periodontal pocket depth. Ten teeth containing 11, 31, 16, 17, 26, 27, 36, 37 and 47 were examined respectively, and six sites of teeth were the same as mentioned above. Recording was conducted if two or more teeth (not considering root rests) were present. The highest value was recorded according to the CPI scale (0-4) (Holtfreter et al, 2010).

Each periodontal index was calculated and recorded using mean value ±standard deviation (SD) for each subject as described previously (Wang et al, 2007). The instruments used for examination were dental mirrors and calibrated manual UNC15 periodontal probes (Hu-Friedy, 0-15mm, tip diameter =0.5mm). The number of missing teeth excludes third molars.

Periodontitis prevalence was determined according to detections above. To provide comparability with other studies having included less sites, e.g., NHANES (Dye et al, 2007), we determined the prevalence of moderate and severe periodontitis based on mesiobuccal sites only. Severe periodontitis is defined as at least two sites with attachment loss ≥6mm (not on same tooth) and at least one site with PD≥5mm. At least two sites with attachment loss≥4mm (not on same tooth) or at least two sites with PD≥5mm indicate a moderate periodontitis. If neither moderate nor severe periodontitis applies, mild or no periodontitis was recorded (Holtfreter et al, 2010).

STATISTICAL ANALYSIS

Results were analyzed and expressed as mean ± standard deviation (SD). The statistical differences

were evaluated by paired *t* test and Analysis of Variance from SPSS Windows version 16.0 program (SPSS Inc, Chicago, IL). The level of statistical significance was defined as $P<0.05$.

RESULTS

Comparisons of periodontal indices Between Post-Sailing and Pre-Sailing

Each periodontal index post-sailing was significantly higher than that of pre-sailing and there was significant difference between them ($P<0.05$ or $P<0.01$, Tab.1). The *p*-values of OHI-S and BOP were <0.05 which mainly represented the severe degree of gingivitis, the other indices were all $P<0.01$ which displayed severe degree of periodontitis. The study results were similar to previous study by Hu et al. in 2011.

Table 1. Comparisons of periodontal indices From 186 Naval Personnel Between Post-Sailing and Pre-Sailing (mean ± SD)

Time	OHI-S	PI	GI	CPI	CAL	NMT	PD	BOP	TM
Pre-Sailing	1.21±0.27	1.43±0.18	1.15±0.13	1.37±0.23	0.56±0.15	1.27±0.26	0.78±0.23	0.38±0.12	0.65±0.28
Post-Sailing	1.98±0.34	2.38±0.25	2.11±0.24	2.58±0.19	1.48±0.26	2.16±0.17	2.56±0.35	0.72±0.15	1.26±0.19
p-value	0.048[a]	0.009[b]	0.008[b]	0.006[b]	0.003[b]	0.005[b]	0.001[b]	0.045[a]	0.006[b]

[a] stands for P<0.05,[b] stands for P<0.01.

Prevalence Comparisons of Periodontal Disease Between Post-Sailing and Pre-Sailing

Before sailing, total prevalence of periodontal disease was 59.7%, among them the prevalence of gingivitis and mild periodontitis accounted for 31.2%, 19.4%, moderate and severe periodontitis accounted for 5.9%, 3.2% respectively. After sailing, normal percentage decreased to 16.7% ($P<0.01$), total prevalence increased to 83.3%, the percentage of gingivitis and mild periodontitis increased to 38.7%, 27.4% respectively ($P<0.05$), and the percentage of moderate and severe periodontitis increased to 10.8%, 6.5% respectively ($P<0.01$). Significant differences were found in all indices between post-sailing and pre-sailing ($P<0.05$ or $P<0.01$, Tab.2).

Table 2. Prevalence Comparisons of Periodontal Disease From 186 Naval Personnel Between Post-Sailing and Pre-Sailing [Number(%)]

Time	normal	gingivitis	mild periodontitis	moderate periodontitis	severe periodontitis
Pre-Sailing	75(40.3)	58(31.2)	36 (19.4)	11 (5.9)	6 (3.2)
Post-Sailing	31[b] (16.7)	72[a] (38.7)	51[a] (27.4)	20 [b] (10.8)	12 [b] (6.5)

[a] stands for P<0.05, [b]stands for P<0.01.

DISCUSSION

This Gulf of Aden sailing lasted for a long time and the climate there varied following the spanning of several sea areas. Naval activation space was narrow and living environment was blocked. These factors would have different effect on the physiology and psychology of naval personnel, or further bring about various kinds of physical and mental diseases (Zhang et al, 2012). The medical staff might have not taken enough emphasis on oral periodontal status while preventing body serious illnesses (Zhang et al, 2012). It is well known that there has close correlation between periodontal disease and other disease of body organs (Li et al, 2009), which can directly affect the working and life quality of naval personnel, and also indirectly generate different kinds of complications (Li et al, 2009).

In this study, the author analyzed dental records to assess the prevalence and severity of

periodontal disease, and characterize changes in periodontal health among Chinese navy personnel in both before and after sailing.

The results indicated that each periodontal index after sailing was significantly higher than that of before sailing and there was significant difference between them (P<0.05 or P<0.01). After sailing, normal percentage decreased to 16.7% (P <0.01, total prevalence increased to 83.3%, among them the percentage of gingivitis and mild periodontitis increased to 38.7%, 27.4% respectively (P<0.05), and the percentage of moderate and severe periodontitis increased to 10.8%, 6.5% respectively (P<0.01). Significant differences were found in all indices between post-sailing and pre-sailing (P<0.05 or P<0.01). These changes indicate that after prolonged sailing of 196 days, periodontal status of Chinese naval personnel notably deteriorated. Namely, distant sailing environment could indeed have marked, harmful effects on periodontal health. The possible and specific causes were analyzed as follows.

First of all, the subjective factor was important. Fresh water supply was limited in naval vessel, some soldiers which were on duty or tired could not persist in toothbrushing twice a day and gargling after meals, a minority of personnel only brushed their teeth once a day or did not brush at all, and more than 40% of the subjects spent <1 min. brushing every time (Hu et al, 2011). These caused poor oral hygiene, lowered the resistance of local mucosa which resulted in oral bacteria breed with faster speed than before, bacteria plaque and dental calculus deposit around gingival margin, and stimulate gingival inflammation (Baelum et al, 2013). Poor dental hygiene can not only result in tooth decay, gingivitis, periodontitis, tooth mobility and loss, bad breath (halitosis), fungal infection or gum diseases (Wang et al, 2007), but also become risk factor of some body diseases (Li et al, 2009).

The climate around Gulf of Aden was dry and scorching, temperature and humidity changed greatly which could easily bring about hypertrophy and hyperemia of gingival papilla. Bacteria plaque microorganism is the initiation factor of periodontitis and poor oral hygiene has intimate relationship with development of periodontal disease (Wang et al, 2007).

In this research, periodontal examination of the selected teeth and sites is practical, convenient and quick, and is applied in most cross-sectional epidemiological studies. The ten marked teeth were used for periodontal examination because these teeth are considered to be the most periodontally involved and can be used to represent the extent of periodontitis in subjects. Comprehensive periodontal examination is considered to be the gold standard for accurate measurement and periodontal diagnosis, and it is required for periodontal prevention and treatment of naval personnel (Wang et al, 2007).

The underlying cause of both gingivitis and periodontitis is bacteria that accumulate in dental plaque, the sticky film that adheres to teeth. When plaque accumulates, typically due to infrequent or ineffective oral hygiene, the risk of both conditions increases. However, aspects of general health play additional roles in the severity of inflammation in response to plaque, and poor general health is a critical determinant of progression of disease from gingivitis to periodontitis (Australian Research Centre for Population Oral Health, 2009).

Secondly, it was an objective factor. Habitation space of naval personnel was limited and there was eight to ten persons in each room. Naval personnel took turns to be on duty and the working time was twelve to fourteen hours everyday with high labour intensity and overstressed spirit. Because of staggered on resting time, it led to interaction, poor sleep quality, individual insomnia and endocrine disturbance (Zhang et al, 2012).

Gulf of Aden and Somalia sea area locates in northern latitude 12.5^{o}, east longitude 44.8^{o} and near the equator. Thus the climate there is dry and hot all the year, surface water temperature

at August reaches 27℃-32℃, and it is one of the hottest tropical sea area. The afflux of surface water at Gulf of Aden changes with monsoon and has high salinity. Due to long-term working in hot environment, physical output and vitamin excretion of naval personnel are much faster than before. Once the emergency happens, naval personnel usually have meals in irregular time. Fresh vegetables and fruits equipped on departure were almost consumed in the previous three months, whereas canned creophagism, a little amounts of vegetables and fast food were supplied in the latter three and a half months (Hu et al, 2011). Insufficient green vegetables intake, especially the lack of vitamin could make the permeability of vessel wall increase. Once gingiva was subjected to outside stimulus, vessel wall was easy to disrupt and bleed, which could initiate gingivitis even periodontitis (Hu et al, 2011).

Consequently, It is of vital importance to enhance education on oral hygiene promptly and effectively, direct them to develop the habit of correct toothbrushing, have balanced and rational diet, and perform proper periodontal non-surgical treatment and medication for the benefits of periodontal health of naval personnel during prolonged sailing.

To maintain periodontal health in this population, appropriate preventive and periodontal therapies should be provided.

On the one hand, we need to aim directly at causative body factor in time to treat periodontal disease correctly. Sufficient vegetables and fresh fruits should be guaranteed, and mulvital, lactoflavin and vitamin C should be supplied. Additionally, the naval personnel also should keep moderate physical exercises, strive to combine work with rest, relieve psychentonia and further maintain healthy status. All these measures might be beneficial to the precaution of periodontal disease.

On the other hand, the naval personnel should accept prevention education of oral disease, develop the habit of favorable dental hygiene, persist in brushing three times daily and three to five minutes every time, gargling after meals or snacks, and then maintain dental and periodontal clearing.

The use of a toothbrush is the most important measure for oral hygiene. Toothbrushes with soft bristles operated carefully by hand or via an electric device help to remove plaque and to avoid mucosal trauma. Aids for suitable interdental cleaning, such as dental floss, interdental brushes or dental sticks should be operated correctly. To support dental care, the use of additional fluoride toothpaste or rinse is imperative for the daily oral hygiene (Irène et al, 2011). Products further containing antiseptics such as chlorhexidine or triclosan can reduce the quantity of bacteria in the mouth (Irène et al, 2011).

Gingiva should be massaged by fingers frequently so as to improve blood circulation of periodontium and disease resistance. Furthermore we also should take effective measures to rectify faulty restoration, perform oral prophylaxis, and avoid extraneous material stimulus and food impaction. Dephlogistication, preservation or astringent such as 2% iodoglycerin might be squashed inside the gingival sulcus or periodontal pocket (Manrikian et al, 2012). At acute inflammation stage, amoxicillin and tinidazole could be for oral use (Manrikian et al, 2012). These measures could make gingival inflammation gradually subsidized and restore the health of periodontium to some degree.

CONCLUSION

This study demonstrates comprehensively changes in periodontal condition among naval personnel during prolonged sailing. In a word, prolonged sailing environment, food constraint

and poor oral hygiene could significantly influence periodontal health of Chinese navy. Therefore, it is of vital importance to enhance education on oral hygiene promptly and effectively, direct them to develop the habit of correct toothbrushing, have balanced and rational diet, and perform proper periodontal non-surgical treatment and medication for the benefits of periodontal health of Chinese navy.

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