Cover story: An Experience to Analogue MARS

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In today's world, high quality research has been identified as a major priority in every field. Over the last decade there has been a very significant increase in the quality and quantity of research in NASA with good standing. The developments of the new technologies have fresh impetus for research all over. To focus particularly on fascinating Aeronautical Dentistry- which is new upcoming field in this era, little of research has been done so far and this field appears to be almost untouched. NASA and Mars Desert Research Station have been organising programmes and events and encourage sceintists to participate to further explore this by complementing different participants to each other, by sharing their ideas of research.

One of a dentist Balwant Rai was selected amongst the crew members for MDRS and he was Health and safety officer for crew 78. He experienced the need of aeronautic dentist in missions to space and realised the importance of this profession in complementing such issues. His experience during these last two weeks helped us to understand this fact. He commented that he along with other crew members made a very good job in exchanging some of the crucial information that will be needed during further rotations.

After centuries of wonder, human beings finally realized the decisive possibility of going to the moon in early 19th century, and in late twentieth century this became a reality, no longer a dream. The human body, however, is designed to live under 1 g as on Earth. Thus, it is important to understand what happens in the human body under microgravity in order to make rapid

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progress in space development. One of the most serious problems produced by microgravity is a fluid shift from lower to upper body. According to MDRS crew-78 microgravity study reporting

and previous study (Kaur J, Rai B et al) is a long list of such effects, ranging from serious medical conditions to less severe side effects including oxerostomia, facial pain, teeth pain, teeth numbness, decreased heart rate and voltage, an increase in combustion of oxygen, decreased in respiratory rate, delay in reflexes related to central and peripheral nervous system, more mental and cognitive fatigue, more negative effect on ps

ychological activity and low physical activity.

During his first day on analog Mars, he already had some very interesting training on the ATVs, a new way of transportation, as well as his first panic: the generator Wendy stopped working for a while! Fortunately, crew's knowledgable engineer found the source of the problem in no time: a loose nut. Once this was done, an exploration of the surroundings began with all crew members contribution in their own field or profession that helped in locating interesting sites where everyone could be able to pursue for future experiments. So from their first contact with Mars, balwant can readily say that the whole crew seemed very excited to take part in that unique experience and all looked forward to start many projects on further days. On his second day on analog Mars everyone was still out of simulation, allowing the crew to better get accustomed to the Hab's surrounding and it was the new way of life. The crew still felt very excited to be there and they started performing some of their planned experiments. The first one they did concerned the analysis of some human factors under microgravity conditions. Balwant was the coordinator for that unique project, and also performed it every day for the rest of the rotation. Since, every crew member was required to perform this medical study about facial muscle sensation, oxygen and CO2 concentration, Dirk,

one of the crew member also proved to be very helpful in its organization and knowledge of all of the many sensors they used.

Balwant being one of the crew member experienced the microgravity condition and and conducted experiment on microgravity. Microgravity may be associated with an increase of mental and cognitive performance. The effect is more pronounced after long-duration space flight and can even last for several weeks after landing. To determine the influence of a simulated microgravity on mental and cognitive performance of the body, 5 healthy Marsonauts were studied before and during the simulated microgravity condition of -6° head-down-tilt (HDT) bed rest for 20 minutes. To properly asses these two conditions, thegroup under consideration had to fill out a rating questionnaire at every step of the study. According to Balwant, analyses of these subjective with their mental and cognitive performance data indicated that in a simulated microgravity environment, mental performance becomes decreased in comparison to normal gravity. Also,the cognitive performance in microgravity becomes low as well. However,mental performance becomes more affected than cognitive performance. In summary, the results of the report indicate a relationship between the microgravity and mental & cogitative performances. It further appears that this relationship has even more impact on the central nervous system than when it is not subjected to the normal gravity environment.

Also further experiments conducted by Balwant indicated that oral cavity symptoms' data indicated that in a simulated microgravity environment, tongue movement was decreased, while xerostomia, mild pain in mandibular and temporal region of face and tooth numbness were increased. In summary, the results of the report indicated mandibular pain might be due to saliva collected in salivary gland, xerostomia might have been due to salivary flow rate, tooth numbness due to fluid shift. It further appeared that this relationship had even more impact on oral cavity than when it is not subjected to the normal gravity environment.

Balwant also got a chance to discover changes in taste buds in microgravity. Microgravity might affect the taste of food. It was reported by him that microgravity affected the taste of food. To determine the influence of a simulated microgravity on taste, 5 healthy Marsonauts were studied by him before and during the simulated microgravity condition of -6° head-down-tilt (HDT) bed rest for 20 minutes. To properly assess these two conditions, the group under consideration had to fill out a questionnaire at (gave different types of test juice), steps of the study. Analyses of oral cavity symptoms' data indicated that in a simulated microgravity environment, sweet taste became less sweet , no effect on water taste and bitter taste become less bitter. In summary, the results of the report indicated that it was due to fluid shift. It further appeared that this relationship had even more impact on taste buds i e nervous system than when it is not subjected to the normal gravity environment.

Balwant fortunately conducted an experiment to study Heart rate in simulated microgravity environment while this Mission to Mars. Evidence reported that microgravity affected not only the cardiovascular system, but it also has an impact on the heart rate (Kaur J., Rai B., et al.). In order to determine the influence of simulated microgravity on heart rate, 5 healthy Marsonauts were studied before and during a simulated microgravity condition of -6° head-down-tilt (HDT) bed rest for 20 minutes. To properly assess these two conditions, some PASPort PASCO EKG sensors were used to analyse the subjects in the group at every to step of the study. After analysis of the heart rate data, it was noted that when subjected to a simulated microgravity environment, heart rate tended to substantially decrease (80 beat/min) compared to that under a normal gravity (Earth gravity) condition, where it reached an average of 108 beat/min. In summary, the results of the report indicated a decrease in heart rate due to a fluid shift. It further appeared that this relationship had even more impact on the cardiovascular system than when it is not subjected to the normal gravity environment. One new hypothesis could be proposed for this result: the decreased heart rate might not only cause a fluid shift, but also affect the sympathetic and non-sympathetic nervous systems, hormonal system and receptors. Nevertheless, further analysis will help us better understand thesechanges under a real microgravity environment.

Rai also conducted a project on Mood Rating in simulated microgravity environment while this Mission to Mars. he found that very little evidence had been reported that microgravity affects not only cognitive, but it also has an impact on the mood of subjects (Kaur J,Rai B et al). In order to determine the influence of a simulated microgravity on mood rating, 5 healthy marsonauts were studied before and during the simulated microgravity condition of -6° head-down-tilt (HDT) bed rest for 20 minutes. PANAS (Positive and negative affectSchedule) scale were used to measured the mood rating in both conditions. The PANAS is a short mood scale developed to assess the positive and negative characteristics of mood. PA is the degree to which a person feels enthusiastic, active and alert. While high PArefers to a state of high energy, full concentration and pleasurable engagement, a low PA is characterized by sadness and lethargy. As for NA, it's a dimension of subjective distress and unpleasant engagement. A high NA represents a state of anger, contempt, disgust, guilt, fear or loneliness, while a low NA reflects a state of calmness and serenity.The comparison between normal and microgravity conditions showed that under a microgravity condition, marsonauts reported significantly lower positive affect than the normal gravity marsonauts. In contrast, the results for a negative mood rating were mixed. Although the microgravity marsonauts had slightly higher NA levels than normal, their mean scores were not significantly lower than the normal ones. In overall, therefore, the microgravity marsonauts reported substantially lower levels of positive affect, but relatively normal levels of negative affect. In summary, analyses of PANAS mood data indicated that the microgravity marsonauts reported extremely low levels of positiveaffect, but essentially average levels of negative affect. So he would like to recommend that space agencies such as NASA, ESA, etc, should give psychological counselling to astronauts and marsonauts before sending them for long missions, as would be the case for a Mars explore mission.

Tooth sensitivity in simulated microgravity environment was interesting topic studied by balwant rai in his mission. He evaluated that current projects of missions to Mars, resulting in 2 years of microgravity conditions, might have serious effects on human physiology,including that of the tooth. Tooth sensitivity is characterized by tooth discomfort of one or more teeth that is triggered either by hot, cold, sweet or sour foods or drinks, or even by breathing cold air. The pain induced can be sharp, sudden, and reach deep into nerve endings of teeth. Numerous causes of teeth sensitivity have been proposed (Kaur J,Rai B et al). In order to determine the influence of a simulated microgravity on tooth sensitivity, 3 healthy marsonauts were studied before and during the simulated microgravity condition of -6° head-down-tilt (HDT) bed rest for 20 minutes. To properly asses these two conditions, the group under consideration was given different juice flavours and were asked to fill out a questionnaire

at every step of the study. Analyses of teeth sensitivity data indicated that in simulated microgravity, teeth became less sensitive compared to when subjected to normal gravity.In summary, teeth sensitivity decreased in microgravity condition. Although this could be due to a fluid shift mechanism, he would like to propose this new hypothesis: under microgravity level,that the teeth sensitivity might decrease due to a fluid shift which affects the apical foramen of the teeth, causing a pressure on the nerve. From this study,he would like to recommend that space agencies such as NASA, the European Space Agency (ESA) or the Indian Space Research Organization (ISRO), gives proper oral hygiene to astronauts and marsonauts before sending them for long missions, as would be the case for Mars or Moon exploration mission.

Another task handled by Balwant was Project on Respiratory system in simulated microgravity and hyper-gravity environment. He reported that the respiratory system is affected by microgravity environments. To determine the influence of simulated microgravity and hyper-gravity on the respiratory system, 4 healthy marsonauts were studied before and during the simulated microgravity condition of a -6° head-down-tilt (HDT) bed rest for 20 minutes, and for 40 seconds in centrifugal motion, to create the hyper-gravity environments. Respiratory rate, Carbon dioxide and oxygen concentration were then measured by the PASCO sensor for the three different gravity conditions. Analyses of these data indicated that in simulated microgravity, respiratory rate becomes decreased, and the concentration of oxygen consumption was increased. As for the simulated hyper-gravity,respiratory rate and consumption oxygen concentration tended to increase as compared to the normal gravity condition of the Earth. In summary, respiratory rate decreased in microgravity condition while having an opposite relationship under a hyper-gravity condition. Microgravity and hypergravity may

lead to hypoxia. Microgravity and hypergravity could also contribute to similar syndromes such as acute mountain sickness, high altitude pulmonary edema, and high altitude cerebral oedema. So it would be advisable for space agencies such as NASA, European Space Agency (ESA) or the Indian Space Research Organization (ISRO) to continue to properly examine the respiratory system and give preventive measures such as physical exercise, etc., to astronauts and marsonauts before, during and after sending them for long missions, as would be the case for a Mars or Moon exploration mission.

Nervous system in simulated microgravity environment was another project performed by Balwant Rai and he observed When human beings venture back to the moon and then on to Mars in the coming decade or so, space agencies will be riding on the accumulated data and experience from approximately 50 years of manned space exploration. Virtually every organ system functions differently in the absence of gravity, and some of these changes are maladaptive. From a biologic perspective, long duration space flight beyond low Earth orbit presents many unique challenges. Astronauts or marsonauts travelling to Mars will live in the absence of gravity for more than 1 year en route and will have to transition between weightlessness and planetary gravitational forces at the beginning, middle, and end of the mission. Microgravity will thus affect every system of the human body. It has also been reported that microgravity affects the nervous system of humans. In order to determine the influence of a simulated microgravity on the nervous system using the PANAS mood rating and standardized questionnaire, 3 healthy marsonauts were studied before and during the simulated microgravity condition of -6° head-down-tilt (HDT) bed rest for 20 minutes. The analyses of PANAS and the standardized questionnaire for the nervous system data depicted that the nervous system activity tended to decrease. So he would like to recommend that space agencies such as NASA, the European Space Agency (ESA) or the Indian Space Research Organization (ISRO), should give multimodal prevention measures such as exercise, hormonal, nutritional, and perhaps even pharmacological interventions to astronauts and marsonauts before sending them for long missions, as would be the case for a Mars exploration mission.

Finally balwant conducted an experiment to study the effect of simulated microgravity on Human body. After centuries of wonder, human being finally realized the decisive possibility of going to the moon a little more than 50 years ago, and in 1969 this became a reality, no longer a dream. The human body, however, is designed to live under 1 g as on Earth. Thus, it is important to understand what happens in the human body under microgravity in order to make rapid progress in space development. One of the most serious problems produced by microgravity is a fluid shift from lower to upper body. All life on Earth is accustomed to the presence of gravity. When that presence is removed or altered, biological processes can go awry. While humans have little difficulty surviving in space for short periods of time (with the necessary equipment, oxygen and food of course), long-term exposure to microgravity can trigger detrimental physiological responses in the human body. There is a long list of such effects, ranging from serious medical conditions to less severe side effects. In order to determine the influence of a simulated microgravity on human body using the different rating and standardized questionnaire and sensors, 5 healthy marsonauts were studied before and during the simulated microgravity condition of -6° head-down-tilt (HDT) bed rest for 20 minutes. This study indicated that that Fluid redistribution is one of these effects. It occurs when bodily fluids shift from the lower body to the head and upper body. The study data analysis indicated that micro gravity effect on human body would range from oxerostomia, facial pain, teeth pain, teeth numbness etch on oral cavity .It is also causesa decreased heart rate, heart voltage in cardiovascular system, an increased in consumption of oxygen , decrease in respiratory rate on respiratory system, delay in reflexes related to central and peripheral nervous system, more mental and cognitive fatigue, more negative effect on psychologically and low physical activity.Humans may not be perfectly suited to living in a microgravity environment,

but that won't stop us from exploring space. The many benefits of space exploration (such as inspiration, technological impetus and knowledge) easily outweigh the negative aspects.

Balwant concluded that humans may not be perfectly suited to living in a microgravity environment, but that won't stop us from exploring space. The many benefits of space exploration (such as making new drugs and technology to prevent serious medical and dental problems, also increasing the life of human beings (inspiration, technological impetus and knowledge)easily outweigh the negative aspects.