The Asia-Pacific Undersea and Hyperbaric Medical Society2nd Biennial Scientific Meeting 2015

日　時　November 15, 2015
会　場　Gunma University, Showa Campus, Maebashi City, Gunma
会　長　Mahito Kawashima, MD. PhD

Sunday, Nov. 15, 2015
Tojo Hall

8:55-9:00 am　Welcome and Announcement
Mahito Kawashima
9:00-10:30 am　Session I Free papers
Moderators　Shi Lu and Kazuyoshi Yagishita

1.『Efficacy of hyperbaric oxygen in ischemic stroke early rehabilitation and evaluation of health economics』
Kuang Xuyuan, Peng Zhengrong, Xiao Pingtian
Department of Hyperbaric Oxygen, Xiangya Hospital, Central South University

2.『Effect of Hyperbaric Oxygen on the expression of ECM-related Molecules of Intracephalic Angiogenesis in rats with Intracerebral Hemorrhage』
Zheng-Rong Peng[1], A-Li Yang[1], Qi-Dong Yang[2]
1. Department of Hyperbaric Oxygen, Xiangya Hospital of Central South University,
2. Institute of Neurology, Xiangya Hospital of Central South University

5.『The relevance of magnetic resonance imaging in spinal cord decompression sickness: a report of 7 cases』
Gao Guangkai, Wu Di, Sun Qing, Yang Ying, Yu Tao, Xue Juan, Wang Xiaohong
Department of Hyperbaric Medicine, No. 401 Hospital of PLA

『The effects of botulinum toxin A and hyperbaric therapy for muscle spasm after stroke』
Jie-wen Tan, Jiang Qiongchao, Zhang Fang
Sun-Yat sen memorial hospital, Sun-Yat Sen University

6.『Circulatory physiological change in scuba diving - Analysis of three aged male professional divers -』
Takashi Isaji[1] and Chiho Sasaki[2]
1. Teikyo university school of medicine, department of Rehabilitation medicine
2. Kumamoto Health Science University, Department of Rehabilitation

7.『Hyperbaric Oxygen Therapy for osteomyelitis』
Takashi Yamaguchi, Mahito Kawashima, Masayuki Kawashima, Hiroaki Tamura, Katsuhiro Takao, Kenji Miyata
Kawashima Orthopaedic Hospital

8.『The hyperbaric oxygen therapy for necrotizing fasciitis』
Yusuke Watanabe, Mahito Kawashima, Masayuki Kawashima, Hiroaki Tamura, Yamaguchi Takashi
Kawashima Orthopaedic Hospital

10:30-10:50 pm　Special Presentation
Moderator　Mahito Kawashima

9.『The state of Undersea and Hyperbaric Medical Society』
John S. Peters
Executive Director, UHMS

11:00-13:00 pm　Study Tour and Lunch
13:00 pm-14:00 pm　Special Lectures
Moderator　Shigeru Saito

10.『Effect of hyperbaric oxygen exposure on the IKK-NF-κB signaling pathway in of spinal cord injury』

『Study of Brain Function During simulated high altitude air and heliox Diving』

Gao Chunjin

The Affiliated Hospital of Xuzhou Medical College

11.『Hypobaric Hypoxia or Hyperbaric Oxygen Preconditioning Reduces High-Altitude Lung and Brain Injury in Rats』

Niu Ko-Chi[2], Li Zhuo[1], Lin Mao-Tsun[2], Gao Chunjin[1]

1. Beijing Chaoyang Hospital, Capital Medical University, Beijing, China.
2. Department of Hyperbaric Oxygen Therapy and Department of Medical Research, Chi Mei Medical Center, Tainan, Taiwan

12.『Effects of Hyperbaric Oxygen Preconditioning on Cardiac-vascular Function of Human Exercise at High Altitude』

『Study of Brain Function During simulated high altitude air and heliox Diving』

SHI Lu[1,6] ,Yang Qi[1,2], FENG En-zhi[3], LI Yang-yang[1], WU Nan-ning[4], ZHANG Yang-meng[1], JIANG Xi[5]

1. Institute of Underwater Technology, Shanghai Jiao Tong University
2. School of Naval Architecture, Ocean & Civil Engineering, Shanghai Jiao Tong University
3. China PLA forth hospital
4. China PLA General Armament, Department of Electronic Information Foundation
5. Qing Hai Yu Shu people hospital
6. Shanghai Jiao Tong University-Chiba University International Cooperative Research Centre

14:00-14:20 pm

Moderator Kazuyoshi Yagishita

PRESIDENTAL ADDRESS - Mahito Kawashima

13.『Hyperbaric oxygen therapy in Japan』

1. Efficacy of hyperbaric oxygen in ischemic stroke early rehabilitation and evaluation of health economics

Kuang Xuyuan, Peng Zhengrong, Xiao Pingtian

Affiliation: Department of Hyperbaric Oxygen, Xiangya Hospital, Central South University, China

Objective: Compare hyperbaric oxygen (HBO) therapy with conventional therapy in the efficacy and health economics of early rehabilitation.

Methods: This study included 60 patients who suffered acute ischemic stroke within 7 days, it uses randomized system to divide patients into control group (patients accepted conventional treatment), and HBO group (besides conventional treatment, patients accepted HBO therapy for more than 10 times within one month). General data were compared between two groups. One, three, six and twelve months after onset of ischemic stroke, patients were assessed with NISSH, BI, mRS and comparison was made between two groups. Health economics evaluation including calculation of cost-effectiveness and the incremental cost-effectiveness ratios. Reoccurrence and disability rate was recorded and compared between two groups using chi-squared test.

Results: The two groups made a significant improvement of the patient's condition in scores of NIHSS, BI and mRS, also reduced reoccurrence and disability rate. Compared with control group, the expenditure in the HBO group was lower than that in the control group, while NIHSS being 1-point decrease, BI being 5-point increase, mRS being 1-point decrease respectively.

Conclusion: Conventional treatment and HBO therapy for patients with acute ischemic stroke could significantly improve neural function; use of HBO therapy combined with conventional therapy in the early stage of acute ischemic stroke reduced the medical expense reaching the same effect.

Key words: acute ischemic stroke; early rehabilitation; hyperbaric oxygen; health economics evaluation

2. Effect of Hyperbaric Oxygen on the expression of ECM-related Molecules of Intracephalic Angiogenesis in rats with Intracerebral Hemorrhage

Zheng-Rong Peng [a,*], A-Li Yang [a], Qi-Dong Yang [b]

[a] *Department of Hyperbaric Oxygen, Xiangya Hospital of Central South University, Changsha 410008, Hunan Province, China*

[b] *Institute of Neurology, Xiangya Hospital of Central South University, Changsha 410008, Hunan Province, China*

Healthy SD rats were randomly divided into 3 groups as sham operation (group A), ICH (group B), and HBO_2 (group C). The behavioral change, angiogenesis and blood perfusion in brain tissues were investigated in each group. There were significant differences in behavior score between HBO_2 and ICH groups at 14, 21, and 28 days ($P<0.001$). In HBO_2 group, a large number of vessel-like structures and microvessels were observed in perihematomal brain tissues at 7 days, and reached the peak at 14 days. The HBO_2 group had regular distribution pattern of blood vessels with no leakage of FITC-dextran. There was statistically significant difference when compared the HBO_2 group with ICH group ($P<0.05$). Hyperbaric oxygen markedly increased the numbers of PCNA positive cells in vWF-positive blood vessels from 4 days. And the differences between HBO group and ICH group were statistically significant at 7d, 14d, 21d, 28d ($P<0.05$). Furthermore, to investigate the effect of hyperbaric oxygen on the expression of ECM-related molecules of intracephalic angiogenesis in rats with ICH, Immunohistochemistry and western blotting were used to detect the protein expression of collagen, MMP and integrin in rat brains. At 4 days after ICH, Collagen, MMP, integrin-positive vessels were detected mainly in the perihematomal tissue both in HBO_2 group and ICH group. And these positive vessels increased gradually and dilated shape. Increased positive vessels and expansion state in HBO_2 group were more obvious than in ICH group. The protein levels of Collagen, MMP and integrin in the perihematomal tissue in HBO_2 group were significantly increased compared with the ICH group (Collagen Ⅰ, Collagen Ⅲ, integrin $\alpha v\beta 3$, integrin $\alpha 5\beta 1$, at 21d and 28d, respectively, $P<0.05$; Collagen Ⅳ, at 7d, 14d, 21d, and 28d respectively, $P < 0.05$; MMP-2, MMP-9, MT1-MMP, at 14d, 21d, and 28d respectively, $P<0.05$). In conclusion, our results indicate that Hyperbaric oxygen increased the expression of collagen, MMPs and integrins of ECM-related molecules, promoted the formation of a large number of vessel-like structure and capillaries around the hematoma, improved ischemia and hypoxia of brain tissue and nerve cells, promoted recovery of neurological function, and corrected behavioral changes of ICH injury.

5. The relevance of magnetic resonance imaging in spinal cord decompression sickness: a report of 7 cases.

Gao Guangkai, Wu Di, Sun Qing,Yang Ying, Yu Tao, Xue Juan, Wang Xiaohong

Department of Hyperbaric Medicine, No. 401 Hospital of PLA , No.22 Minjiang Road, Qingdao 266071, P.R.China

To investigate the magnetic resonance imaging (MRI) features of spinal cord decompression sickness (DCS) on compressed-air divers, we hereby report seven cases diagnosed with spinal cord DCS. Only two patients out of seven showed positive MRI findings: A detailed case report will

be provided on each. In one of the cases, the MRI revealed extensive high signal within the central gray matter of the spinal cord. The other one showed patchy high signal on T2-weighted images as well as diffusion-weighted images (DWI) in the dorsal column white matter of the spinal cord. The findings in our collective suggest that the MRI focused on the spinal cord is not always appropriate for obtaining a quick diagnosis. The discrepancy between MRI findings and clinical evolution leads to the conclusion that MRI focused on the spinal cord does not always correlate with neurological improvement. Decision for hyperbaric oxygen (HBO2) treatment should not be based primarily on MRI findings.

(5-2) The effects of botulinum toxin A and hyperbaric therapy for muscle spasm after stroke

Jie-wen Tan, Jiang Qiongchao, Zhang Fang
Sun-Yat sen memorial hospital, Sun-Yat Sen University

Objective: To study the effect of botulinum toxin type A and hyperbaric therapy for muscle spasm after stroke.

Methods: 30 patients with muscle spasm were randomly divided into three groups. Group A is botulinum toxin type A and hyperbaric group, and group B is Botulinum toxin type A therapy group, and group C is conventional therapy group. Evaluation of Fugl-Meyer, WMFT (Wolf motor function test), modified ashworth scale.

Results: Fugl-Meyer, WMFT and modified ashworth scale in three group after treatment were significantly improved than those before treatment (P<0.05). Fugl-Meyer, WMFT and modified ashworth scale of Group A were significantly improved than other three groups after treatment (P<0.05).

Conclusion: The treatment of Botulinum toxin type A and hyperbaric therapy were benefit and safe for muscle spasm after stroke.

6. Circulatory physiological change in scuba diving - Analysis of three aged male professional divers -.

Takashi Isaji, MD, Ph.D.1, Chiho Sasaki, Speech-Language-Hearing Therapist, Ph.D. 2

1. Teikyo university school of medicine, department of Rehabilitation medicine
2. Kumamoto Health Science University, Department of Rehabilitation

[Objects]

Scuba Diving (SD) is loved by not only healthy young people but also elderly people and the disabled person as a recreation sport. Although loads, such as underwater high pressure and respiratory restriction, are applied, there are few researches about the influence on the body. Additionally evidences about the influence of SD for elderly people, people with illness and the disabled are very scarce, in order to carry out permission or restriction of SD.

Purpose of this research is to obtain the basic data about changes of the circulatory physiological index, and to know the influence on the body of SD, and to establish the standard of the safety and limit.

[Methods]

Subjects are three aged male professional divers (i.e. diving-instructors).

Portable Holter recorder (FM-800:Fukuda Denshi Co., Ltd., Tokyo, Japan) was put on the body, blood pressure (BP), electrocardiogram and oxygen saturation (SpO2) were measured for 24 hours, including two SDs performed by wearing special dry suit for waterproofing. Each SD of three subjects was performed for about 40 minutes by the boat entry, and they spent residual time as usual.

Data during SD, daytime, and sleeping time were compared.

[Results]

Both average heart rate and systolic BP during SD were significantly higher than daytime and sleeping in all subjects. Average SpO_2 during SD was also significantly higher than daytime and sleeping.

Although arrhythmia was seen throughout measurement time, it reduced during SD.

Elevation rate of systolic BP during SD compared with those of during daytime and sleeping was 120.7% and 146.2% respectively.

[Conclusions]

Both HR, BP and SpO_2 increased during SD same as middle age subjects analyzed previously, however no specific change became clear related with age factor.

7. Hyperbaric Oxygen Therapy for osteomyelitis

Takashi Yamaguchi, Mahito Kawashima, Masayuki Kawashima
Hiroaki Tamura, Katsuhiro Takao, and Kenji Miyata
Kawashima Orthopaedic Hospital

The osteomyelitis is occurred due to bacterial infection around bone marrow. The symptoms of it are swelling, redness, and pain in light cases. In sever cases, fistulas which go through from bone to surface are formed, and pus comes out from fistulas. Some cases have been received surgical operations repeatedly, and symptoms repeat quiet and recurrence. We use hyperbaric oxygen therapy (HBOT) for the treatment of osteomyelitis, in addition to antibiotics and/or wound dressing. If cases do not improve, we suppose them a surgical treatment, closed irrigation therapy. The closed irrigation therapies continue between 1 and 2 weeks. After it HBOT is started again. HBOT are done at 2.0 ATA (atmosphere absolute) for 60 minutes.

We treated 638 osteomyelitis cases from 1981 to 2014. The outline of the 638 cases is follows: The cause of osteomyelitis incidence is by trauma in 468 cases (73.0%), by hematogeneous in 125 cases (19.5%), and by radiation in 6 cases (1.3%). The parts of them are in decreasing order, tibia, femur, foot (tarsal bones/metaesal bones/phalanges), hand (carpal bones/metacarpal bones/phalanges), jaw bone, pelvis and so on. Detected bacteria ware in decreasing order, *MRSA, Corynebacterium, Staphyrococcus epidermidis, Pseudomonas aeruginosa, Enterococcus, Peptostreptococcus, Enterobacter cloacae, Escherichia coli, Streptococcus* and so on.

12 % cases of them had to be treated again due to recurrence. The total number was 755 cases including recurrences. We evaluated them using the following criteria: Good: no inflammation symptom and normal blood sedimentation rate and no sequesters, Improvement: improvement of the symptom, Failure: obvious inflammation and necessitate continuous treatment. When patients were treated by HBO alone, the results were as follows: 439 cases (81.8%)-good, 66 cases (12.3%) -improvement, 32 cases (6.0%)-failure. When patients were treated by HBO and irrigation therapy, the results were as follows: 177 cases (81.2%)-good, 33 cases (15.1%)-improvement, 8 cases (3.7%) - failure.

Additionally, we have been using the ozone-nano-bubble water for washing wounds and for closed irrigation therapy since 2009. It has sterilization effect against various bacteria. Therefore, it is helpful against multi antibiotics resistant bacteria.

CONCLUSION: We concluded that HBO alone is an effective treatment for osteomyelitis. However the combination therapy of HBO and irrigation and suction treatment is more effective.

8. The hyperbaric oxygen therapy for necrotizing fasciitis

Yusuke Watanabe, Mahito Kawashima, Masayuki Kawashima
Hiroaki Tamura, Yamaguchi Takashi,
Kawashima Orthopaedic Hospital

Background

Necrotizing fasciitis is a bacterial infection occurs in the shallow and the deep layers of the muscle membrane, rapidly subcutaneous tissue and skin is a disease of falling into widespread necrosis. Although the incidence is rare, the prognosis is often to take a serious turning point. We treated 18 cases of necrotizing fasciitis by Hyperbaric Oxygen Therapy (HBOT) to necrotizing fasciitis are used in combination.

Method and Results

Soft tissue infections associated with necrotic lesions who underwent HBOT at the hospital during the period of 1985 to 2013 was 18 cases. Cases, the contents of male 12 cases, female 6 cases .The average age was 57.3 years old. (18-82) Example onset site hand section 3, 1 cases upper limb with the exception of the hand, foot four cases, was higher in the lower limbs 9 cases and lower limbs, with the exception of the foot. Patients with diabetes in history was six cases. Two cases were sent to other hospital because of general condition. Three cases were amputated, 13cases were healed without amputation.

Conclusion

Fatality rate by the combined use of hyperbaric oxygen therapy against necrotizing fasciitis in our hospital is able to obtain the 0% and favorable outcome. But for necrotizing fasciitis requires the use of thorough debridement and antibiotics, we think that should be a combination of hyperbaric oxygen therapy.

11. Hypobaric Hypoxia or Hyperbaric Oxygen Preconditioning Reduces High-Altitude Lung and Brain Injury in Rats

Niu Ko-Chi[2], Li Zhuo[1], Lin Mao-Tsun[2], Gao Chunjin[1]
[1]Beijing Chaoyang Hospital, Capital Medical University, Beijing, China.
[2]Department of Hyperbaric Oxygen Therapy and Department of Medical Research, Chi Mei Medical Center, Tainan, Taiwan

High-altitude exposure (HAE) brain and lung edema are common problems among people who ascend to altitudes greater than 2,500 m. Currently, the most common method for preventing brain and lung edema is a gradual ascent, but there are serious drawbacks to this process that make the need for alternative methods quite urgent. After hyperbaric oxygen therapy (HBO_2T), the body experiences relative hypoxia as the oxygen levels return to a normal level of 21% (normoxia). Therefore, repeated HBO_2T treatments may produce a cycle of hyperoxia/normoxia, contributing to the accumulation of hypoxia inducing factor (HIF)-1a. Heat shock protein 70 (HSP-70) is upregulated during hypoxia and mediates cell protection and survival. Preinduction of HSP-70 promotes hypoxic tolerance and facilitates acclimatization to acute HAE in the mouse brain. Hyperbaric oxygen preconditioning (HBO_2P), similar to hypobaric hypoxia, significantly reduces pulmonary edema in rats caused by HAE. Thus, it is likely that HBO_2P or hypobaric hypoxia preconditioning (HHP) can reduce lung and brain edema, and cognitive dysfunction in HAE by upregulating HSP-70 expression.

12-1. Effects of Hyperbaric Oxygen Preconditioning on Cardiac-vascular Function of Human Exercise at High Altitude

SHI Lu[1,6] Yang Qi[1,2] FENG En-zhi[3] LI Yang-yang[1]*

WU Nan-ning[4] ZHANG Yang-meng[1] JIANG Xi[5]

1. Institute of Underwater Technology, Shanghai Jiao Tong University
2. School of Naval Architecture, Ocean & Civil Engineering, Shanghai Jiao Tong University
3. China PLA forth hospital
4. China PLA General Armament, Department of Electronic Information Foundation
5. Qing Hai Yu Shu people hospital
6. Shanghai Jiao Tong University-Chiba University International Cooperative Research Centre
   Corresponding author: Yang Qi, yangqi110@sjtu.edu.cn

Objective To investigate the effects of hyperbaric oxygen **preconditioning** on cardiac-vascular function of human exercise at high altitude hypoxic condition.

Methods 6 healthy male subjects who residenced at high altitude 3800 m for 6 to 24 months participated in this experiment. We recorded the stroke volume , left ventricular ejection time , heart rate, inter-beat interval and cardiac output during the physical load before and after the hyperbaric oxygen preconditioning for 5 and 7days.

Results After 7d HBO preconditioning the SV significantly increased after physical load in high altitude hypoxia compared with the control groups ($P<0.05$); After 5d HBO preconditioning , the LVET significantly prelonged after physical load in high altitude hypoxia compared with the control group ($P<0.05$),at the same time, HBO preconditioning showed positive effects on inter-beat interval extension, heart rate reduction and cardiac output enhancement.

Conclusions Hyperbaric oxygen preconditioning could significantly strengthened human cardiac-vascular function by improving hemodynamics during the physical load at high altitude area. Hyperbaric oxygen preconditioning can effectively reduce fatigue, improve labor efficiency of human body at high altitude hypoxic area.

12-2. Study of Brain Function During Simulated High Altitude Air and Heliox Diving

ZHANG Yang-meng[1] SHI Lu[1,2] Yang Qi[1,3] LI Yang-yang[1] WU Nan-ning[4] Shi Zhong-yuan[1]*

1. Institute of Underwater Technology, Shanghai Jiao Tong University
2. Shanghai Jiao Tong University-Chiba University International Cooperative Research Centre
3. School of Naval Architecture, Ocean & Civil Engineering, Shanghai Jiao Tong University
4. China PLA General Armament, Department of Electronic Information Foundation
   Corresponding author: Shi Zhong-yuan, shizhongyuan@sjtu.edu.cn

Objective To study human's brain function during simulated air or Helium-oxygen diving at high altitude in a high-low pressure chamber.

Method 15 or 5 professional divers participated in simulated high altitude air or heliox diving experiment. All of them passed the strict examination. The EEGs including alpha attenuation coefficient (AAC) and auditory-evoked event-related potentials (ERP) were recorded during the high altitude acute exposure at simulated 3000, 4000 and 5200 m and diving operation. The AAC, amplitude and latency of each component of ERP and subjective evaluations were analyzed.

Result During air diving, the power spectrum analysis of EEG indicated that when the divers were exposed to the altitude of 5000 m, the activity of δ, β 1 and β 2 increased, the activity of α decreased significantly. Headache, dizziness, anorexia, dyskoimesis and other symptoms appeared. But the activity of α increased and the activities

of δ, β1 and β2 decreased significantly when the simulated diving operation was curried out (P<0.05). Compared with the baseline, AAC at high altitude of 5200 m was significantly decreased during heliox diving (P<0.01). In addition, AAC was significant decreased at 5200 m compared with at 3000 m. Compared with the sea level, during the diving operations of 30m AAC was not significant different, but it increased compared with the 4000 m and 5200 m. This study demonstrated that compared with the sea level, at high altitude the P300 latency was prolonged significantly after exposure to hypebaric conditions, and there was no significant change in amplitude. At the same time, the symptoms of hypoxia were also relived.

Conclusion When the divers ascended from the sea level, the changes in EEG were closely related to the reactions of hypoxia. But when the condition transferred into the hyperbaric pressure for diving, their oxygen breathing increased and the hypoxic reactions also disappeared. At that time, their EEG had notable improvement in comparison with the condition of oxygen deficit at high altitude. The percent integral value of α wave increased and that of δ wave decreased markedly. The AAC increased significantly, while P300 latency was decreased. The subjective evaluations returned to the baseline value.