



**société de physiologie et de médecine
subaquatiques et hyperbares
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LETTRE TRIMESTRIELLE D'INFORMATIONS 2^{ème} Trimestre 2006. N°62

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EDITORIAL

Le bureau de la société est enfin en ordre. Le président Bruno Grandjean a donc un nouveau mandat jusqu'à la réunion de printemps 2007 à Marseille. Le quatrième poste de vice-président, vacant, a été attribué à François-Michel Galland qui est responsable du site internet et grâce auquel ce site a évolué de façon remarquable. En tant qu'utilisateurs de ce site, il est important de faire connaître vos attentes et vos souhaits.

La réunion d'automne aura lieu à Besançon, le 14 octobre 2006 avec pour thèmes : *Sécurité en hyperbarie et plongée souterraine*. Vous en trouverez le programme détaillé dans cette lettre ainsi que sur le site internet. Cette réunion est organisée par Gilles Capellier et Jacques Regnard. Afin d'en faciliter l'organisation matérielle, il vous est demandé de vous inscrire pour le repas. Dans tous les cas, un mail d'intention de participer à cette réunion est fortement souhaité et à adresser aux

organiseurs gilles.capellier@ufc-chu.univ-fcomte.fr ou jacques.regnard@ufc-chu.univ-fcomte.fr.

Enfin, vous trouverez dans cette lettre les annonces habituelles des réunions et congrès de médecine hyperbare et de médecine de plongée, ainsi que la rubrique « alerte bibliographique ». Nous avons sélectionné quelques articles qui devraient vous intéresser, dont « intoxication par le monoxyde de carbone et atteinte cardiaque secondaire », « OHB et douleur inflammatoire », « hémodynamique et plongée », « variation du shunt droit-gauche au cours du cycle menstruel », « traitement des accidents de décompression » et enfin un article paru dans la revue *Nature* à propos de petits insectes très futés. Il est important que nous ayons un retour de votre satisfaction ou insatisfaction et de vos attentes à propos de cette rubrique.

Nous vous souhaitons à toutes et tous de bonnes vacances.

REUNION D'AUTOMNE

Société Française de Médecine SubAquatique et Hyperbare - **Pr CAPELLIER - Pr REGNARD**
Besançon, Samedi 14 Octobre 2006

Lieu : Chambre de Commerce et d'Industrie du Doubs
46 avenue Villarceau – 25000 Besançon

PROGRAMME

8 H 00	Accueil des Participants	
8 H 45	Ouverture de la journée	F. BARALE
9 H 00	Sécurité en Hyperbarie 1^{ère} partie	
	• Sécurité du matériel - Modérateur : JC. LE PECHON	
	- Sécurité des installations – méthodes d'évaluation des risques	R. HOUMAN
	- Contrainte de l'hyperbarie pour les équipements et le caisson	FM. GALLAND
	- Communications libres	
	- 1 ^{ère} communication (10 mn)	B. GRANDJEAN, S. KUCZENISKY
	Ergonomie des équipements de sécurité contre le feu.	

- 2ème communication : (10 mn)
Contraintes sécuritaires lors du transfert d'un centre hyperbare

JM LAPOUSSIERE, C. SANTI,
B. GAMAIN, A. KAUERT,
O. SIMON, P. COLOMBANI.

Synthèse et cadre réglementaire (5mn)

JC LE PECHON

10 H 30 - 10 H 45 **Pause**

10 H 45 - 12 H 30 **Sécurité en Hyperbarie 2ème partie**

• **Sécurité du malade** - Modérateur : **B. GRANDJEAN**

- Etude prospective de l'incidence et des facteurs de risque des effets iatrogènes de l'oxygénothérapie hyperbare.

V. SOUDAY

- Contraintes cardiaques de l'hyperbarie

A. BOUSSUGES

- Communications libres

- 1ère communication (10 mn)

D. MATHIEU

Sécurité des malades en hyperbarie: analyse de l'expérience d'un centre hyperbare.

- 2ème communication (10 mn)

Enquête sur la sécurité du personnel et des patients des centres hyperbares en France

JM LAPOUSSIERE, C. SANTI,
B. GAMAIN, A. KAUERT, O. SIMON, P. COLOMBANI

• **Sécurité du personnel** - Modérateur :

A. BARTHELEMY

- Evaluation des risques pour le personnel

M. COULANGE, A. BARTHELEMY

Communications libres

- 1ère communication (10 mn)

Accidents de décompression chez le personnel

DR FORTIN

- 2ème communication (10 mn)

Suivi médical du personnel d'un centre hyperbare .

JM LAPOUSSIERE, B. GAMAIN,
A. KAUERT, O. SIMON, P. COLOMBANI.

12 H 30 – 13 H 45 **Déjeuner**

14 H 00 – 15 H 30 **Plongée et Cavités 1ère partie**

• **Cavités souterraines : plongée sous-terraine** - Modérateur : J. REGNARD

Particularités – Techniques de la plongée souterraine (avec un film vidéo)
Secours en plongée souterraine

J. MICHEL
H. ROY

Communications libres

- 1ère communication (10 mn)

M. WALZ

Procédures de décompression après plongée spéléo (160m) dans le Chaudanne

- 2ème communication (10 mn)

Spécificité de l'accident de plongée en eaux intérieures

JJ. GRENAUD, M. COULANGE

- 3ème communication (10 mn)

Accidents de décompression en plongée souterraine. Illustré par le cas d'un accident vestibulaire en recycleur à 209 m en plongée Spéléo.

O. SIMON, S. REDOUTEY, F. MARTIN, F. LASSALLE

15 H 30 – 15 H 45 **Pause**

15 H 45 – 17 H 30 **Plongée et Cavités 2ème partie**

• **Cavités humaines** - Modérateur : FM GALLAND

Cavités cardiaques et plongée

A. BOUSSUGES

Vessie et plongée

P. DECAVEL

Incidents et accidents digestifs au cours de la plongée

J. WATELET

Œdèmes pulmonaires en immersion

B. DELAFOSSE

M. COULANGE, A. BARTHELEMY

Communications libres

- 1^{ère} communication (10 mn)

JE. BLATTEAU

Les phénomènes de cavitation

- 2^{ème} communication (10 mn)

E. BERGMANN

Dystrophies bulleuses, pneumothorax

ALERTE BIBLIOGRAPHIQUE

Boussuges, A., F. Blanc, et al. (2006). "Hemodynamic changes induced by recreational scuba diving." *Chest* **129**(5): 1337-43. OBJECTIVE: Cardiac changes induced by scuba diving were investigated using Doppler echocardiography. MATERIAL AND METHODS: Ten healthy scuba divers dove to a mean depth of 34.3 +/- 2.7 m of sea water (113 +/- 9 feet) and a mean duration of 25.3 +/- 3.5 min. RESULTS: One hour after the dive, microbubbles could be detected in the right-heart chambers of all subjects. Left atrial and left ventricular (LV) diameters significantly decreased after the dive. Cardiac output, assessed by aortic blood flow, remained unchanged. Heart rate increased and stroke volume (SV) decreased after the dive. LV filling was assessed on transmural profile. An increase of the contribution of the atrial contraction to LV filling was observed. Right cavity diameters were unchanged, but an increase of the right ventricular/right atrial gradient pressure was found. CONCLUSION: The diving profile studied promotes a rather important bubble grade in all volunteers. A significantly reduced cardiac diameters and SV was found by our hemodynamic study 1 h after diving. Two factors can explain these results: low volemia secondary to immersion, and venous gas embolism induced by nitrogen desaturation. Consequently, restoration of the water balance of the body should be considered in the recovery process after diving.

Eckmann, D. M., S. C. Armstead, et al. (2005). "Surfactants reduce platelet-bubble and platelet-platelet binding induced by in vitro air embolism." *Anesthesiology* **103**(6): 1204-10. BACKGROUND: The effect of gas bubbles on platelet behavior is poorly characterized. The authors assessed platelet-bubble and platelet-platelet binding in platelet-rich plasma in the presence and absence of bubbles and three surface-active compounds. METHODS: Platelet-rich plasma was prepared from blood drawn from 16 volunteers. Experimental groups were surfactant alone, sparging (microbubble embolization) alone, sparging with surfactant, and neither sparging nor surfactant. The surfactants were Pluronic F-127 (Molecular Probes, Eugene, OR), Perforan (OJSC SPC Perforan, Moscow, Russia), and Dow Corning Antifoam 1510US (Dow Corning, Midland, MI). Videomicroscopy images of specimens drawn through rectangular glass microcapillaries on an inverted microscope and Coulter counter measurements were used to assess platelet-bubble and platelet-platelet binding, respectively, in calcium-free and recalcified samples. Histamine-induced and adenosine diphosphate-induced platelet-platelet binding were measured in unsparged samples. Differences between groups were considered significant for $P < 0.05$ using analysis of variance and the Bonferroni correction. RESULTS: Sixty to 100 platelets adhered to bubbles in sparged, surfactant-free samples. With sparging and surfactant, few platelets adhered to bubbles. Numbers of platelet singlets and multimers not adherent to bubbles were different ($P < 0.05$) compared both with unsparged samples and sparged samples without surfactant. No significant platelet-platelet binding occurred in uncalcified, sparged samples, although 20-30 platelets adhered to bubbles. Without sparging, histamine and adenosine diphosphate provoked platelet-platelet binding with and without surfactants present. CONCLUSIONS: Sparging causes platelets to bind to air bubbles and each other. Surfactants added before sparging attenuate platelet-bubble and platelet-platelet binding. Surfactants may have a clinical role in attenuating gas embolism-induced platelet-bubble and platelet-platelet binding.

Fraisse, T., B. Nicolas, et al. (2005). "[Evaluation of self-medication by scuba divers]." *Therapie* **60**(4): 409-12. AIM: The aim of the study was to evaluate drug use amongst French scuba divers. METHODS: An anonymous questionnaire was distributed to 220 people, out of which 106 responded. RESULTS: Fifteen percent of respondents were receiving long-term medication whereas 60.33% of respondents reported taking medication only occasionally when diving. Thirty-seven percent of respondents were taking prescribed medicines. Drugs consumed occasionally included analgesics (43.5%), corticosteroids (14.5%) and antiemetics. A detailed study of aspirin and steroid consumption revealed their misuse for performance-enhancing purposes, the level of risk varying with the type of diving activity. The influence of drug use on personal performance was recognised by 72.6% of divers, but only 59.4% considered that they were putting themselves at risk by self-medicating.

Henry, C. R., D. Satran, et al. (2006). "Myocardial injury and long-term mortality following moderate to severe carbon monoxide poisoning." *Jama* **295**(4): 398-402. CONTEXT: Carbon monoxide (CO) poisoning is a common cause of toxicological morbidity and mortality. Myocardial injury is a frequent consequence of moderate to severe CO poisoning. While the in-hospital mortality for these patients is low, the long-term outcome of myocardial injury in this setting is unknown. OBJECTIVE: To determine the association between myocardial injury and long-term mortality in patients following moderate to severe CO poisoning. DESIGN, SETTING, AND PARTICIPANTS: Prospective cohort study of 230 consecutive adult patients treated for moderate to severe CO poisoning with hyperbaric oxygen and admitted to the Hennepin County Medical Center, a regional center for treatment of CO poisoning, between January 1, 1994, and January 1, 2002. Follow-up was through November 11, 2005. MAIN OUTCOME MEASURE: All-cause mortality. RESULTS: Myocardial injury (cardiac troponin I level $>$ or $= 0.7$ ng/mL or creatine kinase-MB level $>$ or $= 5.0$ ng/mL and/or diagnostic electrocardiogram changes) occurred in 85 (37%) of 230 patients. At a median follow-up of 7.6 years (range: in-hospital only to 11.8 years), there were 54 deaths (24%). Twelve of those deaths (5%) occurred in the hospital as a result of a combination of burn injury and anoxic brain injury ($n = 8$) or cardiac arrest and anoxic brain injury ($n = 4$). Among the 85 patients who sustained myocardial injury from CO poisoning, 32 (38%) eventually died compared with 22 (15%) of 145 patients who did not sustain myocardial injury (adjusted hazard ratio, 2.1; 95% confidence interval, 1.2-3.7; $P = .009$). CONCLUSION: Myocardial injury occurs frequently in patients hospitalized for moderate to severe CO poisoning and is a significant predictor of mortality.

Klien, S., M. Spiegel, et al. (2005). "Menstrual cycle dependent right-to-left shunting: a single-blinded transcranial Doppler sonography study." *Undersea Hyperb Med* **32**(6): 403-7. BACKGROUND AND PURPOSE: Menstruation has been described as risk factor for neurological decompression sickness in divers. In considering this for paradoxical gas embolism, we hypothesized that there may be a link between cycle-dependent hormonal changes and the manifestation of a right-to-left shunt (RLS). METHODS: 40 women with a regular cycle of 28 days underwent transcranial Doppler sonography examinations (TCD) on day 1 and on day 15 of the menstrual cycle. Cerebral high intensity transient signs (HITS) proved a RLS. RESULTS: We found a 25% RLS incidence consistent with the literature. In 7 of 10 shunt-positive women it was detected mainly or exclusively on day 15. This difference in PFO detection rate is statistically significant ($p = 0.031$), indicating more RLS during the peri-ovulatory period. CONCLUSIONS: Our results do not support menstruation as a risk factor for neurological decompression sickness. The peri-ovulatory estrogen peak, which leads to systemic vasodilation, may explain our data. Factors that increase the risk for developing a RLS and thereby paradoxical embolism should be avoided, perhaps including diving during the peri-ovulatory period of the menstrual cycle. Furthermore, contrast PFO testing in fertile females may be most sensitive if conducted mid-cycle.

Matthews, P. G. and R. S. Seymour (2006). "Diving insects boost their buoyancy bubbles." *Nature* **441**(7090): 171. Backswimmers (Notonectidae) are common diving insects found around the world that exploit the mid-water zone for predation--they breathe by using an air bubble collected at the

surface. Here we show that backswimmers achieve prolonged periods of neutral buoyancy by using oxygen stored in their haemoglobin to stabilize the volume of the bubble as they breathe from it. This enables them to maintain their position in the water column without continually swimming.

Nims, M., H. Hallonquist, et al. (2006). "Coronary arterial air embolus occurring during cesarean delivery." *Int J Obstet Anesth* **15**(2): 166-9. We present a case of a severe systemic (paradoxical) air embolism occurring during spinal anesthesia for cesarean delivery in an otherwise healthy 35-year-old parturient. Uncomplicated spinal anesthesia and satisfactory surgical anesthesia were obtained; no sedatives were used and the patient was awake and alert and tolerating the procedure well. Immediately following infant and placental delivery (approximately 25 min after the spinal anesthetic was induced) the patient had acute onset of markedly decreased mental status, profound ventricular ectopy and labile blood pressure. The event lasted for approximately 10 min with spontaneous resolution. Neurologic status returned to normal by the end of the surgery, but electrocardiogram findings in the immediate postoperative period were consistent with myocardial ischemia and serial cardiac troponin levels confirmed myocardial injury. On postoperative day 1, an echocardiogram demonstrated the presence of a patent foramen ovale. The events in this case are likely to be due to paradoxical coronary and cerebral air embolism.

Pollock, N. W., D. M. Ugucioni, et al. (2006). "Plasma glucose response to recreational diving in novice teenage divers with insulin-requiring diabetes mellitus." *Undersea Hyperb Med* **33**(2): 125-33. A growing number of individuals with insulin-requiring diabetes mellitus (IRDM) dive, but data on plasma glucose (PG) response to diving are limited, particularly for adolescents. We report on seven 16-17 year old novice divers with IRDM participating in a tropical diving camp who had recent at least moderate PG control (HbA1c 7.3 +/- 1.1%) (mean +/- SD). PG was measured at 60, 30 and 10 min pre-dive and immediately following 42 dives. Maximum depth (17 +/- 6 msw) and total underwater times (44 +/- 14 min) were not extreme. Pre-dive PG exceeded 16.7 mmol x L(-1) (300 mg x dL(-1)) in 22% of dives. Males had significantly higher pre-dive levels (15.4 +/- 5.6 mmol x L(-1) [277 +/- 100 mg x dL(-1)] vs. 12.8 +/- 2.9 mmol x L(-1) [230 +/- 52 mg x dL(-1)], respectively) and greater pre-post-dive changes (-4.3 +/- 4.4 mmol x L(-1) [-78 +/- 79 mg x dL(-1)] vs. -0.5 +/- 4.3 mmol x L(-1) [-9 +/- 77 mg x dL(-1)], respectively). Post-dive PG was < 4.4 mmol x L(-1) [< 80 mg x dL(-1)] in two dives by two different males (3.4 and 3.9 mmol x L(-1) [61 and 70 mg x dL(-1)]). No symptoms or complications of hypoglycemia were reported. These data show that in a closely monitored situation, and with benign diving conditions, some diabetic adolescents with good control and no secondary complications may be able to dive safely. The impact of purposeful elevation of PG to protect against hypoglycemia during diving remains to be determined.

Ridgway, L. and K. McFarland (2006). "Apnea diving: long-term neurocognitive sequelae of repeated hypoxemia." *Clin Neuropsychol* **20**(1): 160-76. This article examines the neurocognitive sequelae of repeated exposure to hypoxemia in apnea (breath-hold) divers. A brief review of the literature on the physiological and neurological adaptations involved in the "human diving reflex" is presented. The results from a neuropsychological investigation of N = 21 elite apnea divers are evaluated. Standard neuropsychological tests, with known sensitivity to mild brain insults, included speed of visuo-motor responding, speed of language comprehension, response inhibition, and visual and verbal attention and recall tasks. Results indicated that the breath-hold divers performed tasks within the average range compared to norms on all tests, suggesting that 1-20 years of repeated exposure to hypoxemia including multiple adverse neurological events did not impact on performance on standard neuropsychological tasks. The results are discussed in relation to implications for clinical conditions such as sleep apnea, respiratory disorders, altitude sickness, and recreational apnea activities.

Smerz, R. W., R. K. Overlock, et al. (2005). "Hawaiian deep treatments: efficacy and outcomes, 1983-2003." *Undersea Hyperb Med* **32**(5): 363-73. This paper reports on the outcomes and efficacy of the deep treatment schedules employed at the University of Hawaii to treat diving accident victims. These tables utilize increased atmospheric pressures, several mixed gas combinations, and a more gradual staged decompression rate than US Navy treatment schedules. The majority of our study population (72.4%) was treated using a single specific treatment schedule. 90% were treated using deep tables either singly or in combination with other tables. 91.6% of cases treated on deep tables achieved complete functional recovery. The percentage of cases obtaining complete functional recovery ranged from 91.3% to 99% based upon condition treated, and from 77.5% to 100% based upon treatment schedule employed. Number of treatments required by type of injury ranged from 1.3 to 2.4 treatments. 74.5 % of cases required two or less treatments to obtain complete functional recovery. Severity of injury and age of the diver were the most sensitive predictors of outcome while delay to treatment did not influence outcomes in this study population.

Trevett, A. J., C. Sheehan, et al. (2006). "Decompression illness presenting as breast pain." *Undersea Hyperb Med* **33**(2): 77-9. We present two cases of decompression illness in women in whom the initial symptom causing distress after completion of the dives was breast pain. Both women were also subsequently found to have a patent foramen ovale. We postulate that breast pain may be an unusual under-recognized manifestation of decompression illness.

Wilson, H. D., J. R. Wilson, et al. (2006). "Hyperbaric oxygen treatment decreases inflammation and mechanical hypersensitivity in an animal model of inflammatory pain." *Brain Res*. Hyperbaric oxygen therapy has been used to treat a variety of ailments from carbon monoxide poisoning to fibromyalgia. The purpose of this experiment was to explore the effect of hyperbaric oxygen treatment on carrageenan-induced inflammation and pain in rats. Hyperbaric oxygen treatment significantly decreased inflammation and pain following carrageenan injection. Clinically hyperbaric oxygen may be used in situations where NSAIDs are contraindicated or in persistent cases of inflammation.

CALENDRIER MEDSUBHYP 2006

14 octobre 2006 : Réunion d'automne à Besançon : *Sécurité en hyperbarie et Plongée et cavités.*

LES AUTRES DATES A NOTER

6 août 2006 : 80^{ème} anniversaire de la première plongée autonome réalisée en 1926 par Yves Le Prieur au moyen d'un scaphandre Fernex, dans la piscine des Tourelles, près de la Porte des Lilas à Paris.

23-26 Août 2006 : **Bergen – Norvège.** Réunion annuelle de l'EUBS. <http://www.eubs.org>

27 – 28 octobre 2006 - Ravenne – Italie : VIII^{ème} Conférence de l'ECHM sur le thème Oxygène et réparation tissulaire. Contact : direzione@iperbaricoravenna.it.