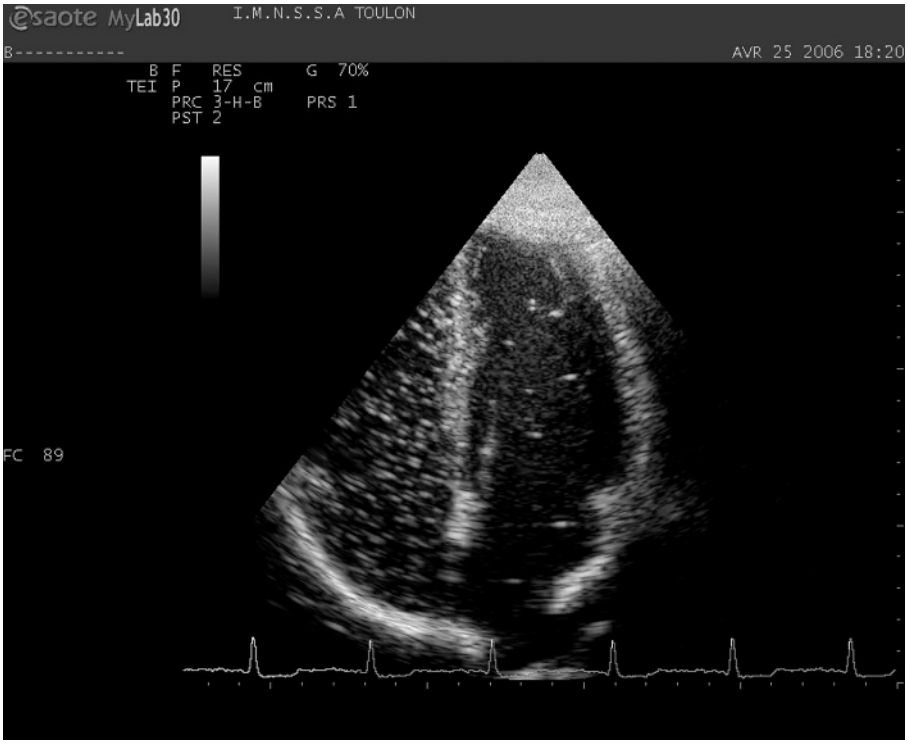
21. **Caiani EG,** Corsi C, Zamorano J, *et al*. Improved semiautomated quantification of left ventricular volumes and ejection fraction using 3-dimensional echocardiography with a full matrix-array transducer: comparison with magnetic resonance imaging. *J Am Soc Echocardiogr* 2005;**18**:779–88.
22. **Sugeng L,** Mor-Avi V, Weinert L, *et al*. Quantitative assessment of left ventricular size and function: side-by-side comparison of real-time three-dimensional echocardiography and computed tomography with magnetic resonance reference. *Circulation* 2006;**114**:654–61.
23. **Kuhl HP,** Schreckenberg M, Rulands D, *et al*. High-resolution transthoracic real-time three-dimensional echocardiography: quantitation of cardiac volumes and function using semi-automatic border detection and comparison with cardiac magnetic resonance imaging. *J Am Coll Cardiol* 2004;**43**:2083–90.
24. **Jenkins C,** Chan J, Hanekom L, *et al*. Accuracy and feasibility of online 3-dimensional echocardiography for measurement of left ventricular parameters. *J Am Soc Echocardiogr* 2006;**19**:1119–28.
25. **Akinboboye O,** Sumner J, Gopal A, *et al*. Visual estimation of ejection fraction by two-dimensional echocardiography: the learning curve. *Clin Cardiol* 1995;**18**:726–9.
26. **Dujardin KS,** Enriquez-Sarano M, Rossi A, *et al*. Echocardiographic assessment of left ventricular remodeling: are left ventricular diameters suitable tools? *J Am Coll Cardiol* 1997;**30**:1534–41.
27. **St John Sutton M.** Predictors of long-term survival after valve replacement for chronic aortic regurgitation. *Eur Heart J* 2001;**22**:808–10.
28. **Moss AJ,** Hall WJ, Cannom DS, *et al*. Improved survival with an implanted defibrillator in patients with coronary disease at high risk for ventricular arrhythmia. Multicenter Automatic Defibrillator Implantation Trial Investigators. *N Engl J Med* 1996;**335**:1933–40.
29. **Garg R,** Yusuf S. Overview of randomized trials of angiotensin-converting enzyme inhibitors on mortality and morbidity in patients with heart failure. Collaborative Group on ACE Inhibitor Trials. *JAMA* 1995;**273**:1450–6.

Images in cardiology

Bubbles in the left cardiac cavities after diving

After scuba diving, circulating nitrogen bubbles can be detected in the venous system. In two subjects, we detected circulating bubbles in both right and left cavities of the heart and in the cerebral circulation. Several risk factors of paradoxical gas embolism are suggested here. The two divers developed a high bubble grade after surfacing. The right to left shunting occurred through a large patent foramen ovale (PFO). An increase in bubble grade in right cavities and an increase in arterial passage through the inter-atrial septal defect were observed during isometric contraction of lower limb muscles. Although they remained asymptomatic, our two divers should be considered at high risk of developing neurological decompression sickness (DCS). Indeed, the presence of a PFO has been associated with the risk of developing a DCS[1] and with the incidence of ischaemic brain lesions.[2] Haemodynamic modifications were assessed using Doppler-echocardiography. All the parameter modifications were consistent and suggested a decrease in cardiac preload after the dive. Furthermore, an increase in pulmonary vascular resistance was observed, which could promote the right-to-left shunting. A closure of the PFO could be discussed in these subjects. However, this procedure did not change the high level of venous circulating bubbles and the risk of developing an unrelated interatrial shunt DCS. Consequently, in subjects wishing to pursue their diving activity an appropriate preventive measure could be the use of oxygen-enriched mixture to decrease the nitrogen load and the risk of all types of DCS.



Circulating bubbles in the right and the left cavities of the heart.

A Boussuges, J E Blatteau, J M Pontier

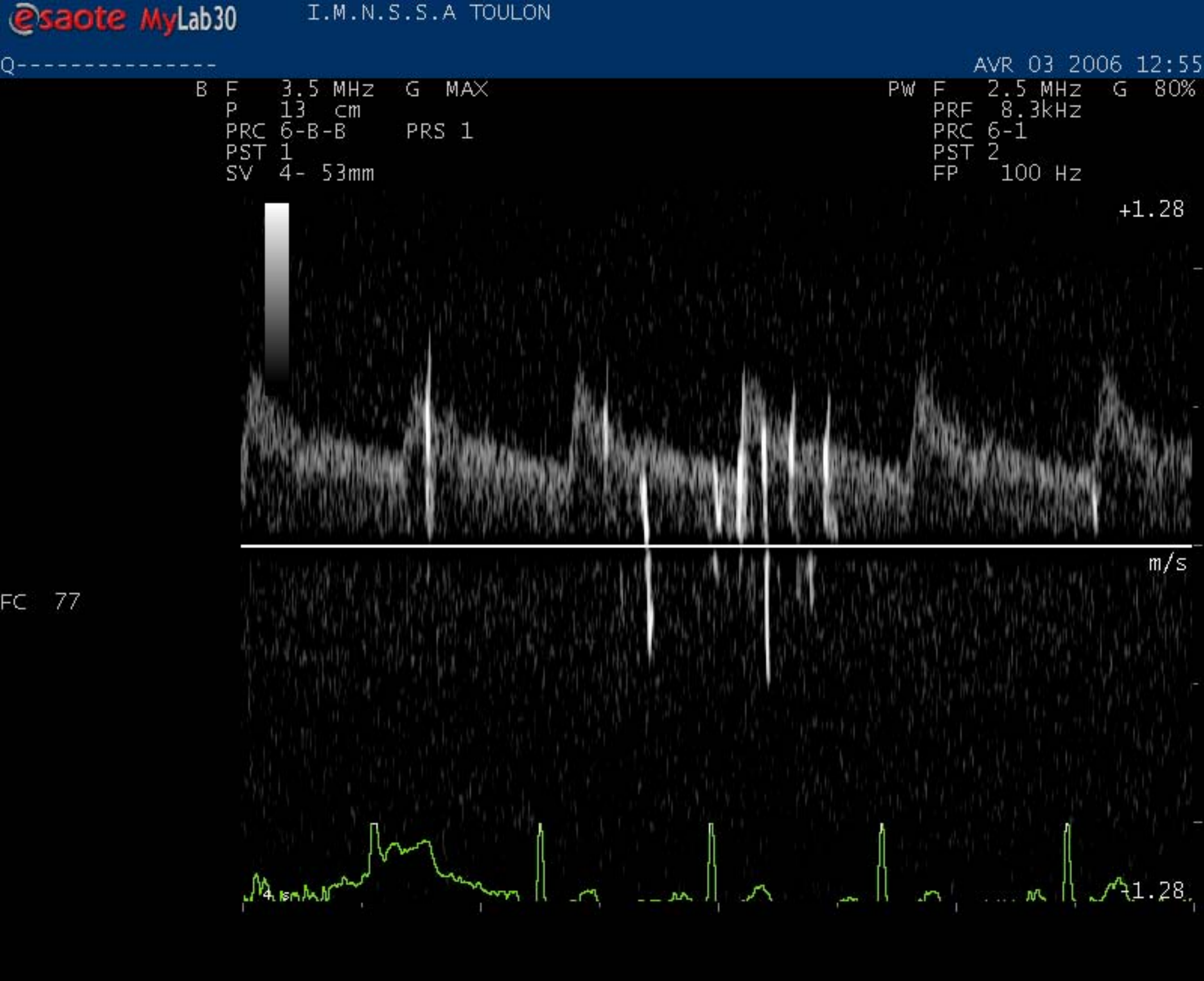
alainboussuges@libertysurf.fr; a.boussuges@imnssa.net

► Supplementary figure and video (passage of the circulating bubbles in the left cardiac cavities) available online at http://heart.bmj.com/content/vol94/issue4

Heart 2008;**94**:445. doi:10.1136/hrt.2006.109439

REFERENCES

1. **Wilmshurst PT,** Byrne JC, Webb-Peploe MM. Relation between interatrial shunts and decompression sickness in divers. *Lancet* 1989;**2**:1302–6.
2. **Schwerzmann M,** Seiler C, Lipp E, *et al*. Relation between directly detected patent foramen ovale and ischemic brain lesions in sport divers. *Ann Intern Med* 2001;**134**:21–4.


esaote MyLab30
I.M.N.S.A TOULON
Q--------------
AVR 03 2006 12:55
B F 3.5 MHz G MAX
P 13 cm
PRC 6-B-B PRS 1
PST 1
SV 4- 53mm
PW F 2.5 MHz G 80%
PRF 8.3kHz
PRC 6-1
PST 2
FP 100 Hz
+1.28
m/s
FC 77
-1.28