

Recreational scuba diving in patients with congenital heart disease : Time for new guidelines.

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With the progress made in their management, the prognosis and quality of life of patients suffering from congenital heart diseases have improved considerably, enabling them to engage in physical and sports endeavours.

As a consequence, the ability of these patients to dive has become a regular and recurrent issue.

Because of the diversity and broad heterogeneity of congenital heart diseases, a detailed evaluation of each patient's performance based on **clinical criteria common** to all congenital heart diseases **is recommended**.

Budts W, Börjesson M, Chessa M, & al. Physical activity in adolescents and adults with congenital heart defects: individualized exercise prescription. Eur Heart J 2013;34:3669-3674.

Van Hare G, Ackerman M & al. Eligibility and disqualification recommendations for competitive athletes with cardiovascular abnormalities : Task Force 4 Congenital Heart Disease. Circulation 2015; 132: e281-e291

Rules to discriminate patients able or unable to practice sports used to be based mainly on the type of cardiopathy. In this review, the authors attempted to build a simple rule for scuba diving based on 3 criteria :

1/ Geometrical and functional data (mostly echocardiography)

Left ventricular evaluation male / female :

Ejection fraction > 50 %
 Endiastolic diameter < 56 mm (m) < 52 mm (f)
 Endsystolic diameter < 41 mm (m) < 37 mm (f)
 Septal thickness < 13 mm (m) < 12 mm (f)

Right ventricular evaluation :

Fractional shortening > 35 %
 Ejection fraction by 3D > 45 %
 or by isotope or RMN imaging > 50 %
 Tricuspid annular plane systolic excursion > 16 cm
 S' wave > 10 cm /sec

Gradient measurement :

Mean aortic < 25 mm Hg
 Left intraventricular < 30 mm Hg
 Maximum Pulmonic < 40 mm Hg
 Mean pulmonary artery pressure < 20 mm Hg

Ascending aorta

Diameter < 45 mm or z score < 3

Kou S, Caballero L, Dulgheru R, & al. Echocardiographic reference ranges for normal cardiac chamber size: results from the NORRE study. Eur Heart J Cardiovasc Imaging 2014;15:680-690.

2/ Electrocardiogram and exercise testing

Absence of functional symptoms.

Absence of major change in repolarisation
 Maximum functional capacity > 8 MET
 1st ventilatory threshold > 4 MET
 Normal adaptation of the systemic blood pressure.
 Transcutaneous oxygen arterial saturation > 95 %

Absence of significant arrhythmia including Holter recording during exercise

In case of **arrhythmia**, implanted cardioverter stimulator or **defibrillator**, refer to French underwater federation guidelines :



3/ In cases of cardiac shunts

Since the shunt is **exclusively left → right**, and **cannot be reversed** (intra-ventricular shunts, *ductus arteriosus*) : **No contraindication.**

Inter-atrial shunts are a **contraindication** because they **may reverse** when intrathoracic pressure increases and enable the passage of large bubbles in a desaturation phase.

With regard to **patent foramen ovale**, which is not strictly defined as a congenital heart disease, refer to French underwater federation guidelines :



We originally wrote this document with a view to allow scuba diving under certain circumstances, by patients for whom this activity used to be formally contraindicated.

This is based on fragile and debatable scientific data. Therefore, these recommendations are a tool to help in the decision-making based on individual evaluations and openly discuss the possible restrictions that might be imposed.

