

Introduction

Over the past decades diving has become more and more popular. With the necessary knowledge and skills diving is generally a safe and low-risk activity. Nevertheless, despite of all precautions decompression accidents are reported from time to time. Some studies have shown a link between the occurrence of unexplained decompression illness and an opening between the heart chambers, called a Patent Foramen Ovale (PFO).

St. Jude Medical is focused on reducing risk by continuously finding ways to put more control into the hands of those who save and enhance lives.

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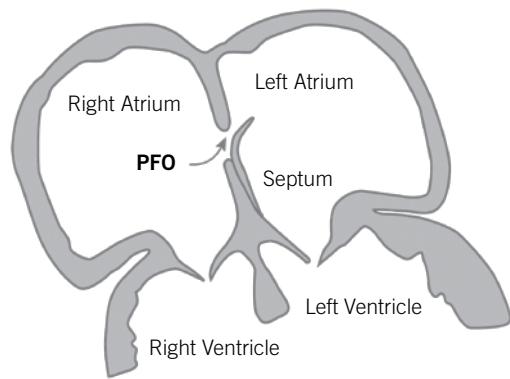
DIVER'S INFORMATION GUIDE

Decompression Illness and Patent Foramen Ovale



What is decompression illness?

During a dive, the body is exposed to changes in the surrounding pressure. This pressure change affects the gases contained within the body tissues and liquids, and which are normally exhaled through the lungs. When pressure reduces during the ascent, nitrogen will be released in the venous system in the form of little bubbles. Small amounts of nitrogen bubbles can easily be filtered by the lungs. However, if the proportion of bubbles is too large or bubbles are entering the arterial system, symptoms may appear. These symptoms are known as decompression illness (DCI) and may vary from joint pain and skin rashes to neurological symptoms. Though small amounts of nitrogen bubbles are always present in the venous blood for up to two hours after surfacing, the absolute risk for having a DCI event is small and only 2.5 events per 10,000 dives⁽¹⁾.



What is a PFO?

Patent Foramen Ovale (PFO) is a flap-like opening between the two upper chambers of the heart known as the left and right atrium. A PFO is present in ~27% of the population⁽²⁾. PFO is not a heart defect; it is a remnant of the fetal blood circulation. In the womb, all babies have this opening because it allows circulation of the blood during pregnancy. However, after birth this flap normally closes to form a solid wall (called a septum) between the chambers. If the PFO does not close, the opening can permit venous blood, normally filtered by the lungs, to pass unfiltered into the left

atrium and out to the body, including the brain. Several echocardiography methods can be used to detect a PFO. One of them is known under the term 'TEE.' This technique visualizes the heart through an echo probe in the esophagus.

Is a PFO a risk factor for decompression illness?

Several clinical studies have shown a potential association between the presence of PFO and divers suffering from DCI. Evidence has shown that ~60% of divers with DCI have a PFO⁽³⁾. In fact, anecdotal studies have found that PFO increases the risk for decompression illness five times⁽¹⁾. PFO-related DCI is presumed to be caused by nitrogen bubbles bypassing the lung filter and entering the arterial circulation through the PFO (called paradoxical embolization). Non-filtered bubbles may accumulate and obstruct blood vessels, blocking the blood and oxygen supply to body tissues resulting in DCI symptoms⁽³⁾.

Recommendations for divers⁽⁴⁾

Novice Diver / Asymptomatic Diver	
Routine screening for PFO with TEE not mandatory*	
Diver with a history of unexpected DCI	
Screening for PFO and other cardiac right-to-left shunt with TEE necessary:	
PFO present	No PFO
If diving continued, consider the following measures: <ul style="list-style-type: none"> - Strict adherence to decompression tables - No repetitive dives during a day - No deep dives (>25-30m) - Reduced rate of ascent during last 10m - No Valsalva maneuvers during ascent; no strenuous physical effort - Use nitrox instead of compressed air - PFO closure procedure 	<ul style="list-style-type: none"> - Consider other types of right-to-left shunt (shunt between venous and arterial circulation) - Use nitrox instead of compressed air to minimize tissue nitrogen load

*New divers to be informed on potentially increased DCI risk with PFO

How is a PFO closed?

Closing the PFO may prevent air bubbles from entering the arterial circulation through the PFO and forces the blood to be filtered by the lungs.

A PFO is typically closed with a minimally invasive, nonsurgical procedure during which a PFO closure device is implanted into the heart. Much safer than open-heart surgery, this procedure produces little discomfort and patients are generally able to leave the hospital the next day.

Most types of PFO closure devices consist of two anchors joined together. Starting with a catheter (a small, hollow tube) inserted into the femoral vein near the groin, the device is guided through this vein into the heart. Once in the heart, the anchors are deployed on either side of the septal wall, closing the PFO. The device then adjusts to the unique anatomy of the heart.

Soon after the device is implanted, tissue begins to form and eventually covers the PFO closure device completely. Endothelialization, or this process of tissue formation, is important because it helps prevent blood in the left atrium from reacting with the exposed device and forming clots (called thrombosis).

Transcatheter closure of the PFO is a safe and effective procedure and may reduce the risk for recurrent decompression events.

For more information, please visit sjm.com

References

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