



RESEARCH ARTICLE

CLINICAL SIGNIFICANCE OF PATENT FORAMEN OVALE

¹Bindhu, S., ²Dhanesh Kumar, K. U., ³Avadhani, R. and ^{4,*}Jinu Merlin Koshy

²Nitte Institute of Physiotherapy, Nitte University, Mangalore, Karnataka, India

^{1,3}Department of Anatomy, Yenepoya Medical College, Yenepoya University, Mangalore, Karnataka, India

⁴Department of Anatomy, Sree Balaji Dental College and Hospital, Chennai, Tamil Nadu

ARTICLE INFO

Article History:

Received 17th April, 2013
Received in revised form
25th May, 2013
Accepted 09th June, 2013
Published online 18th July, 2013

Key words:

Foramen ovale,
Cerebral ischemia,
Stroke,
Migraine.

ABSTRACT

A patent foramen ovale is a connection between the right and left atria that persists after birth. The foramen ovale is found in fetal anatomy normally and closed after birth but can remain open for life resulting in patent foramen ovale. Patent foramen ovale is an embryological remnant of the fetal circulation. Oxygenated placental blood enters the right atrium via the inferior vena cava and crosses the valve of the foramen ovale to enter the systemic arterial system. The inferior vena cava flow preferentially flows toward the inter atrial septum and foramen ovale. At birth, pulmonary vascular resistance and right-sided cardiac pressures drop with a reversal of the right atrium-to-left atrium pressure gradient. The flap of the foramen ovale closes against the atrial septum with fusion usually occurring within the first two years of life. Fusion is incomplete in about 25% of people, resulting in an oblique slit-like defect. Though patent foramen ovale is usually considered non threatening but it can be associated with cerebral ischemic events such as stroke and migraine. A patient can undergo for an ultrasonography to identify patent foramen ovale. When a patent foramen ovale is detected, the patient can receive surgical placement of a closure device.

Copyright, IJCR, 2013, Academic Journals. All rights reserved.

INTRODUCTION

Patent foramen ovale (PFO) is a flap like opening between the atrial septum primum and secundum at the location of the fossa ovalis that persists after the first year of life. With increasing evidence being found that PFO is the culprit in paradoxical embolic events, the relative importance of the anomaly is being reevaluated¹. As the cardiovascular system develops, the embryonic circulation is modified into a fetal circulation which maintains a placental circulation and is also able to establish the pulmonary circulation at birth. The primitive atrial chamber gets divided into two by septum primum, septum secundum, and septum inter medium. septum intermedium appears at the roof of atrium on the left of the septum spurium. It grows down to meet the septum intermedium. Before their fusion an opening between the lower edge of septum inter medium and septum intermedium exists. It is called the ostium primum. The fusion of the septum intermedium with the septum intermedium is followed by the appearance of another opening in the dorsal part of the septum primum. The opening is known as the ostium secundum. Meanwhile septum secundum appears and grows down from the roof of the atrium on the right side of the septum primum. As it grows down and its lower crescentic edge overlaps the upper edge of the septum primum. The gap between the two, forms the valvular slit allowing blood from right to the left. This opening is called foramen ovale². The fetal circulation contains a number of relatively large vessels which permit the majority of the blood flow to the liver and lungs. The placenta serves as the organ for fetal nutrition and excretion, receiving deoxygenated fetal blood and returning it oxygenated and detoxified. Fetal blood reaches the placenta via two umbilical arteries and in early fetal life returns by two umbilical veins. The refreshed placental blood pass almost directly to the aorta for distribution to the head and upper limbs. Blood from the ductus venosus and hepatic veins mixes in the

inferior vena cava with blood from the lower limb and abdominal wall and enters the right atrium. Because right atrial pressure is much greater than left atrial pressure, it forces the flap-like valve of the septum primum to the left which permits passage of blood from the right to left atrium. The valve of inferior vena cava is so placed as to direct 75% of the richly oxygenated blood from the umbilical vein to the foramen ovale and left atrium, where it mingles with limited venous return from the pulmonary veins, from the left atrium, blood enters the left ventricle and then aorta³. At birth, as pulmonary respiration begins increased amounts of blood from the pulmonary trunk flow through the pulmonary arteries to the lungs and return by the pulmonary veins to the left atrium, pressure therefore increases within the left atrium. A decrease in pressure also occurs in the inferior vena cava as a result of the reduction of venous return concomitant with occlusion of the umbilical vein. Atrial pressure becomes equal and the valvular foramen ovale is closed by apposition, and subsequent fusion of the septum primum to the rims of the foramen. Although the foramen ovale closes functionally after pulmonary respiration is established it does not become structurally closed until sometime later. It is obliterated in fewer than 3% of infants 2 weeks after birth, and in 87% by 4th month after birth⁴. Fusion is sometimes incomplete and a potential atrial communication persist throughout life. Patent foramen ovale is not a great anatomical variation. An estimated 20-30% of the population has a patent foramen ovale. Though a patent foramen ovale is a discrepancy from typical anatomy, it most often does not pose a threat for the patient but it can give symptoms like history of stroke or transient ischemic event of undefined etiology, migraine, neurologic decompression sickness, paradoxical embolism caused by right atrial tumors that increase right atrial pressure, fat embolism in some percentage of people⁵.

MATERIALS AND METHODS

Twenty two hearts from embalmed cadavers allotted for 1st year MBBS dissection in the Department of Anatomy, were used for the study. All the hearts were observed for the presence of patent foramen

*Corresponding author: Jinu Merlin Koshy
Department of Anatomy, Sree Balaji Dental College and Hospital,
Chennai, Tamil Nadu

ovale and the size of the chambers. Among 22 hearts, one heart was showing a probed patent foramen ovale with 0.5cm diameter and with cardiomegaly (Fig.1).



Fig.1. Probe showing Patent foramen ovale

DISCUSSION

A patent foramen ovale can develop a complication because of the crossing of fetal blood flow with newborn body. If the patent foramen ovale does not close shortly after birth, it may result in a movable flap between atria. The foramen can open up when the pressure in the right atrium exceeds that of the left atrium. The blood from the right atrium is then able to enter directly into the left atrium, bypassing filtration of the lungs and new oxygen. The blood flowing like that in fetal circulation, needs a newborn circulatory pattern. Deoxygenated blood cycling back into the body can carry blood borne materials like thrombi, air, or vaso-active substances, with potential to cause a cerebrovascular event. These waste materials have potential to produce negative conditions in a patient. Patent foramen ovale has been associated with many adverse symptoms such as stroke, migraine, decompression illness and arterial embolism. Stroke and migraine are two commonly associated symptoms of patent foramen ovale⁶. The paradoxical embolism through a patent foramen ovale is a well recognized complication of deep venous thrombosis, especially in the context of pulmonary embolism with its attending increase in right sided pressure⁷. The patent foramen is a predisposing risk factor for decompression sickness in divers because a proportion of venous blood carrying inert gases like helium and nitrogen does not pass through lungs⁸.

The only way to release the excess gases through the lungs, is exhalation. If some of the inert gases –laden blood passes through the PFO, it avoids the lungs and the inert gas is more likely to form large bubbles in the arterial blood stream causing decompression sickness.

Conclusion

If a patient is experiencing possible patent foramen ovale associated symptoms the physician can advise his patient for an ultrasonography. If a patient undergoes tests and does have a patent foramen ovale, there are two options for the treatment. The first one is thrombus prophylaxis through anti platelet therapy and the second method is surgery. Though patent foramen ovale is not a threatening variation, there is always a chance, that it can have a negative impact on a patient's life. With the proper diagnosis, a patent foramen ovale can be monitored and precautionary measurements can be taken.

REFERENCES

1. Sandy N Shah, DO, MBA, FACC, FACOI; Chief Editor: Park W Willis IV, MD; Patent Foramen Ovale; Medscape References; April 29,2013.
2. Kadasne D; Text book of Embryology.1st ed.2011; pp206-207.Jaypee pub: New Delhi.
3. Moore K.L.; *The Developing Human. Clinically Oriented Embryology*. 2nd ed. 1977 W.B. Saunders Philadelphia, PA
4. Hagen PT, Scholz DG, Edwards WD. Incidence and size of patent foramen ovale during the first 10 decades of life: an autopsy study of 965 normal hearts. *Mayo Clin Proc*. Jan 1984;59(1):17-20
5. Bartz PJ, Cetta F, Cabalka AK, et al. Paradoxical emboli in children and young adults: role of atrial septal defect and patent foramen ovale device closure. *Mayo Clin Proc*. May 2006;81(5):615-8.
6. Kruit MC, van Buchem MA, Hofman PA, Bakkers JT, Terwindt GM, Ferrari MD. Migraine as a risk factor for subclinical brain lesions. *JAMA*. Jan 28 2004; 291(4):427-34.
7. Filippi L, Palermo L, Pezzati M, et al. Paradoxical embolism in a preterm infant. *Dev Med Child Neurol*. Oct 2004; 46(10):713-6.
8. Lier H, Schroeder S, Hering R (2004). "Patent foramen ovale: an underrated risk for divers?". *Dtsch Med Wochenschr* 129 (1–2): 27–30.doi:10.1055/s-2004-812652.
