

Critical Review of the Biomaterials Utilized in ASD Repair: A Historical Study

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Abstract

Atrial septal defect, or ASD, is the most common congenital heart defect in the United States. Many ASDs are small enough that symptoms may never occur, and the defect may in fact heal itself over time. However, in severe cases, the opening in the atrial septum can cause dilation of the right side of the heart as well as the lungs, and can cause total heart failure. Currently, there are two methods for closing significant defects; the most widely used being open heart surgery. Closure can also be achieved non-invasively via an occluder positioned by a catheter. However, transcatheter closure is still being optimized by means of biomaterial choice, device delivery, and occluder geometry. Significant progress has been made in reducing the risks associated with such devices, yet the biocompatibility and the thrombogenicity need to be further minimized in order to achieve better surgeon approval and usage in the United States.

Keywords: atrial septal defect, occluder, nitinol, polyester, biocompatibility

1. Introduction

With the advent of open heart surgery in World War II and the development of the cardiopulmonary bypass machine in the early 1950's, came the ability to mend the most common congenital heart defect in the United States, the atrial septal defect (ASD). The defect refers to a deformity of the heart, specifically a hole in the atrial septum. ASDs are classified as one of three types, each referring to the location of the defect (Figure 1). Sinus venosus defects are located in the upper-most portion of the atrial septum, typically at the junction of the right atrium and the superior vena cava. Ostium secundum ASDs are the most common and are located in the region of the fossa ovalis [1]. Ostium primum defects are also known as atrioventricular (AV) canal defects or endocardial cushion defects because severe cases generally involve a large ventricular septal defect in addition to an ASD, located in the lower portion of the atrial septum [1].

The effects of ASDs on a patient's health range from fatigue to total heart failure depending on the size of the defect(s) and the age and general fitness of the patient. Symptoms can manifest themselves at any age and can include heart murmur, pulmonary hypertension, as well as right atrial and right ventricular dilation in severe cases. Dilation is a result of the mixing of oxygenated and deoxygenated blood resulting from the hole in between the two atria. Over time, the mixing causes an enlargement of the right side of