Artificial Blood Vessels

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Abstract—Artificial blood vessels can be used supplement the body’s own veins, and provide an avenue for those who need frequent injections to have a site that will be the main access point. Implications for hemodialysis will be examined and possibilities for other treatments as well.

I. INTRODUCTION

The history of artificial blood vessels dates back to World War 1 where Alexis Carrel used a procedure to sew blood vessels together. Artificial vessels were also made using tubes of glass and aluminum in that period. Initially, when using donor vessels, arteriosclerosis occurred, and in other cases, donor arteries were rejected by the patient. This leads may lead to clotting, increased visits to the hospital, and risk of infection. More flexible and acceptable synthetic materials were then used as a focus on development. In end stage renal failure, where hemodialysis is used frequently, a cimino fistula can be created to allow easier withdrawal of blood. Repeated insertion of needles can damage a patient’s veins, and if the veins are too small or weak for the process, a graft is inserted and connected to an artery.

II. METHODS

The product is developed by in collaboration between Duke University and Humacyte. The process begins with donated human cells being processed on a rod scaffold using biodegradable mesh. The mesh can be adjusted to whatever size, shape, or length and imitates veins in its flexibility and sturdiness. Smooth muscle cells are distributed on the mesh and put in a nutrient bath, following which forms vessel. The vessel is then subjected to a pulsing rhythm to simulate the blood flow from the heart, and it will be fully formed after a couple months. To rid the mesh of any material that might be rejected, it is given a solution to rinse out the cellular properties and cleanse it, leaving a collagen tube. The finished product is an off-the-shelf product that will not be rejected by the body and contains no living cells, allowing for long term storage. For the trial, this will be implanted in hemodialysis patients on the arm, in a two hour process. The vein is connected to an artery to speed the flow of blood during treatment. In storage, it can last a year while refrigerated.

III. RESULTS

In animal trials, the veins were able to adopt the same properties as the animal’s own blood vessels and were accepted as normal. In December 2012 13 patients in Poland were implanted with these artificial veins, and in June 2013 the first US patient, Lawrence Breakley, was given this treatment. 20 kidney dialysis patients total are planned to be given this treatment, during Phase 1, and then the safety will be reviewed by the FDA, namely in that the vessels to not deteriorate dramatically over time. After 6 months, the Polish patients have not displayed any negative reaction.

IV. DISCUSSION

If this proves satisfactory, it can be used for a graft in heart bypasses, or to treat blockages in the veins of appendages. This would also be used for Heart Bypasses. Optimistically, these will be commercially available in a few years.

REFERENCES