

Provide an example of a medical device or biomaterial implant that failed due to the host immune response and describe why it failed.

Alternatively, discuss the issues leading to failure of transplants of a specific organ.

Very broadly, how would you modify the biomaterial device or transplant treatment to improve or reduce the host immune response?

The Synergrafte valve, a decellularized porcine heart valve, was launched in Europe as an innovative biological valve alternative. However, early failures have been reported. Implanted in four children, these valves exhibited good initial function, but three children died within a year due to valve degeneration or rupture. All explanted valves showed inflammation, leading to structural failure and significant calcification. These outcomes suggested a strong inflammatory response to the xenogeneic collagen matrix.

The Scaffold could be reengineered, and we could modify the valve's framework to help immune cells heal and rebuild tissue. But if the framework wears out too fast, it might stop the valve from working properly. Also, too much long-term swelling from the valve material can cause scarring or hardening, as observed in some valves after 6 weeks and again after a year.

We can control how fast the valve's support structure breaks down by choosing the right types of plastic materials and adjusting their mix. To make the valve work better, we can add substances that attract healing cells or that encourage the growth of new blood vessels. We can also add other substances that prevent too many immune cells from coming in and causing inflammation. These helpful substances can be added to the valve's structure from the start: having a valve that's already prepared with these molecules.