Advance growing animal penile erectile tissue in lab may benefit patients

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In an advance that could one day enable surgeons to reconstruct and restore function to damaged or diseased penile tissue in humans, researchers at Wake Forest University Baptist Medical Center's Institute for Regenerative Medicine have used tissue engineering techniques to completely replace penile erectile tissue in animals.

In the online early edition (Nov. 9-13) of the Proceedings of the National Academy of Sciences, the researchers report success using cells from rabbits to grow replacement penile erectile tissue for the animals in the laboratory. After implantation with the replacement tissue, the rabbits had normal sexual function and produced offspring. This is the most complete replacement of functional penile erectile tissue reported to date.

"Further studies are required, of course, but our results are encouraging and suggest that the technology has considerable potential for patients who need penile reconstruction," said Anthony Atala, M.D., institute director. "Our hope is that patients with congenital abnormalities, penile cancer, traumatic injury and some cases of erectile dysfunction will benefit from this technology in the future."

Reconstructing damaged or diseased penile erectile tissue has traditionally been a challenge because of the tissue's unique structure and complex function. There is no replacement for this tissue that allows for normal sexual function. Various surgeries have been attempted, often multi-stage procedures that can involve a silicone penile prosthesis, but

natural erectile function is generally not restored.

The Wake Forest Baptist scientists set out to solve this problem by working to engineer replacement erectile tissue in the lab. In an earlier study, also in rabbits, they engineered short segments of erectile tissue that had 50 percent of the function of native tissue. The current study attempted to improve on those results.

The Wake Forest Baptist team was the first in the world to engineer a human organ in the laboratory --bladders that have been implanted in almost 30 children and adults. Many of the same techniques used to build bladders were used in the current study.

The scientists first harvested smooth muscle cells and endothelial cells, the same type of cells that line blood vessels, from the animals' erectile tissue. These cells were multiplied in the laboratory. Using a two-step process, the cells were injected into a three-dimensional scaffold that provided support while the cells developed. As early as one month after implanting the scaffold in the animal's penis, organized tissue with vessel structures began to form.

The cells were injected into scaffolds on two separate days, enabling them to hold almost six times as many smooth muscle cells as in the previous studies - which the scientists believe was a key to success. During an erection, it is the relaxation of smooth muscle tissue that allows an influx of blood into the penis. The relaxation is triggered by the release of nitric oxide from endothelial cells.

"Increasing the density of smooth muscle cells led to normal erectile pressures within the tissue," said Atala, who is also a professor and chair of urology at Wake Forest Baptist.

Functional testing of the implanted tissue showed that vessel pressure

within the erectile tissue was normal, that blood flowed smoothly through it, that the response to nitric oxide-induced relaxation was normal as early as one month after implantation, and that veins drained normally after erection.

When the animals with the engineered tissue mated with females, vaginal swabs contained sperm in eight of 12 instances and four of the 12 females were impregnated.

"These results are encouraging," said Atala. "They indicate the possibility of using laboratory-engineered tissue in men who require reconstructive procedures. A lack of erectile tissue currently prevents us from restoring sexual function to these patients."

The erectile tissue the scientists engineered is known as the corpora cavernosa penis. Two columns of this sponge-like tissue form a significant part of the penis. These structures, which are bound together with connective tissue and covered with skin, fill with blood during erection.

Source: Wake Forest University Baptist Medical Center (news : web)