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BLADDER AUGMENTATION USING ACELLULAR DERMIS IN AN ALLOGENEIC PORCINE MODEL

Aims of Study

The ideal material for bladder augmentation would consist of a readily available substance that allows for the orderly regeneration of native bladder. Although several biodegradable matrices and collagen-based materials have previously been used, no material has yet achieved general acceptance in clinical use. Bladder augmentation using human acellular dermis as a xenograft in a rat model was shown to promote complete regeneration of native bladder tissue with functional properties conducive to the purpose of augmentation cystoplasty. The present study was designed to assess the surgical feasibility, the time-course of cellular ingrowth, and structural and functional tissue regeneration using acellular dermis in an allogeneic porcine host.

Methods

Twelve female Yukatan miniature pigs weighing 20-28 kg (age:16-18 weeks old) underwent partial cystectomy followed by augmentation cystoplasty using a 4x4 cm porcine acellular dermal patch marked by permanent corner sutures. No catheters or drains were used postoperatively. The animals were sacrificed 3 and 6 months after augmentation surgery. At the time of sacrifice sonography, cystometry, cystoscopy and VCUG were performed. Tissue regeneration was assessed histologically using specific immunohistochemical stains. In-vitro muscle bath studies were performed to evaluate the functional characteristics of the regenerated bladder wall such as contractility, compliance and intramural neural regulation.

Results

No immediate perioperative complications occurred. However, one pig died 3 months after the operation from urinary ascites due to bladder perforation in the patch area. At the time of sacrifice, the augmented bladders had a spherical shape identical to that of the native organ. Sonography showed normal upper urinary tracts. At cystoscopy no difference could be detected macroscopically between the regenerated and the normal bladder epithelium. Cystometry demonstrated normal compliance of the augmented bladders. Histology showed ingrowth of all structural components of the bladder wall, with a tri-layered architecture reaching the center of the patch at 6 months. The regenerated bladder tissue responded to electrical field stimulation with contractions that were 40% of the response of the control tissue and with a similar innervation pattern to that of the host bladder. Compliance of the regenerated bladder wall was the same as that of the normal host bladder.

Conclusions

These long-term results in an allogeneic porcine model provide evidence that acellular dermis is a suitable biodegradable scaffold for bladder wall regeneration. Augmentation cystoplasty with acellular dermal matrix, a readily available “off-the-shelf” product, results in an augmentation segment with both histological and functional properties favorable in the augmentation setting.