Role of tissue engineered buccal mucosa for treatment of urethral stricture

Vaddi S¹, Godala C¹, Reddy V¹, Senthilkumar R², Srinivasan T², Reena H², Preethy S², Abraham S³–⁴

Abstract

Introduction

Cell based therapies in Urology:

Cell based therapy for tissue engineering in urology, like in other branches of medicine uses the principles of cell transplantation, materials science, and biomedical engineering to develop biologic substitutes that can restore and maintain function of the damaged or lost genitourinary organs. Most current strategies for tissue engineering depend on a sample of autologous cells from the diseased organ of the host. However in cases where primary autologous cells cannot be expanded, pluripotent stem cells are an ideal source. Biomaterials play a major role in genitourinary tissue engineering. They are used to replace biologic and mechanical functions of the native extracellular matrix. Three classes of biomaterials have been used for the engineering of genitourinary tissues: naturally derived materials, such as collagen and alginate; acellular tissue matrices, such as bladder submucosa and synthetic polymers, such as polyglycolic acid [1]. A lot of research is ongoing in urethral regeneration by tissue engineering and cell based therapy. Tubularized collagen matrices seeded with autologous cells are used to regenerate the urethra [2]. Urinary Bladder reconstruction is possible with bladder shaped biodegradable scaffold seeded with autologous urothelial cells and smooth muscle cells [3]. Ureretral acellular tubular grafts have been used to replace ureteral loss but with poor functional results [4]. Cell-seeded biodegradable polymer scaffolds have been used with more success to reconstruct ureteral tissues [3]. The kidney is the most challenging organ in the genitourinary system to reconstruct because of its complex structure and function. Cell based therapies are used for creation of functional renal structures in vivo. Renal tubular cells have been harvested, expanded in culture and seeded onto a tubular device to function as nephron [5]. The expansion of this system to larger three-dimensional structures is the next challenge awaiting researchers in the urogenital tissue engineering field. Genitalia reconstruction is also possible with cell therapy. Engineered penile prosthesis can be reconstructed by culturing autologous chondrocytes which are seeded onto a Poly-glycolic acid scaffold and then implanting the scaffold into the corporal space of penis [6]. Microencapsulated Leydig cells in animal studies have been used to replace or supplement testosterone in testicular failure [7]. Cell therapy techniques are also used for treatment of urinary incontinence, vesicoureteric reflux by injecting cultured myoblasts or adipocytes [5]. The major limitation in engineering solid organs is the vascularisation of the regenerated tissue. Recent developments in angiogenesis research [8] may provide answer to this complex problem and accomplish the goal. Most of the research to date in urological tissue engineering is done in animals. Before these engineering techniques can be applied to humans, further studies need to be performed.

Buccal Mucosal Epithelium for repair of the short segment urethral stricture:

Urethral stricture is the narrowing of the lumen of the urethra which occurs as a terminal event secondary to many etiologies. Patients present with difficulty in voiding urine. There are endoscopic and open surgical reconstructive procedures to treat this disorder. Endoscopic treatment is often temporary and eventually results in recurrence of the disease. Many open surgical procedures have been described but none of the procedures offer permanent cure. The use of buccal mucosal grafts for stricture repair is in practice [9,10] with considerable success. However the donor site morbidity and complications like stricture recurrence with the present techniques [11,12] warrant the advent of novel techniques. The use of buccal mucosal grafts for stricture repair is in practice [9,10] with considerable success. However the donor site morbidity and complications like stricture recurrence with the present techniques [11,12] warrant the advent of novel techniques. The use of buccal mucosal cells which can be obtained by harvesting a 2mm x 2mm tissue bit compared to that of 5-6cm tissue usually harvested in conventional techniques for a graft and the culture-expansion of these cells in a suitable in vitro scaffold which can also act as a substrate after transplantation in vivo for optimal repair provides a viable
option. Preliminary results of the application of autologous human buccal epithelial cells expanded & encapsulated in a nanopolymer scaffold after confirmation of their phenotype and genotype, in a male patient with inflammatory urethral stricture have been encouraging. This approach we have named as the Buccal Epithelium Expanded & encapsulated in Scaffold - Hybrid Approach to Urethral Stricture (BEES-HAUS) and is seemingly a promising one and further studies are needed for its validation.

References:

4. Osman Y, Shokeir A, Gabr M, El-Tabey N, Mohsen T, El-Baz M. Canine ureteral replacement with long