



PROSTHESIS IN UROLOGY: FUTURE NEEDS?

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INTRODUCTION:

In Urology, the male external genitalia are symbols of masculinity and loss of such organs can cause significant mental stress and disruption in the quality of life of the patient as well as his partner. Hence, the need to replace these organs with functional prostheses has been a work in progress since many centuries. Only in the last few decades has seen some real progress. This was largely due to advancements in material science. But sustenance of function and resistance to infection are still formidable challenges.[1]

Characteristics of an ideal prosthesis are: It should be durable, inert, stable, low infectivity, resilient, easy to handle, cost effective. The most common and dreaded dangers of such material use are infections, on which research has thrown more light with the discovery of biofilms. As in any other surgical procedure, proper patient and prosthesis selection is important. Though not in the strict sense of the word, stoma bags, stents, catheters, nephrostomies and neuromodulation are also included in the prosthetics.

We already know about the stents, catheter, drains, testicular prosthesis, penile implants, artificial sphincters, slings, meshes and neuromodulation devices. We have read or used them in our day to day urological practices. These mentioned urological prostheses are well into our present life and knowledge.

The Future:

"Necessity is the mother of invention"

To start with the most basic need in urology is stents, biodegradable stents can help avoid a second procedure for their removal, reduce discomfort and the chances of infection. Polyglycolic acid, poly lactic co glycolic (PLGA) and alginate are being studied. Drug eluting stents could reduce UTI rates, provide chemo or hormonal therapy. Ureteral stent tracker is a smart phone application is a means to reduce forgotten stents. Ureteric catheters that emit light during surgery or smart stents that use microelectromechanical sensors to communicate could be the next frontier. Use of nanoparticles to reduce problems of encrustation and migration and newer designs to reduce discomfort could improve tolerance for these devices.[2]

Over time the stress on newer prosthesis development has been on function preservation from the initial replacement of form or physical characteristics. Advances in Regenerative medicine take a significant step in that direction. Stem cells have been demonstrated to successfully treat Diabetes, post prostatectomy Erectile Dysfunction and Stress Urinary

Incontinence for short term in early reports. Larger studies are ongoing. Construction of tissue "scaffolds" by tissue engineering using autologous/heterologous/synthetic or xenogenic tissues incorporate collagen and laminin. These materials are also compatible with printer technologies and advances in printer technologies have now allowed three dimensional printing. The challenge however is to reproduce a functional matrix tissue. Immunogenicity of non autologous tissues is another area of concern for tissues produced thus. Potential applications of this field could be to construct urinary bladder post cystectomy, urethral tissue for stricture patients with longer defects, tunica or corporal tissue and the at the very best, produce fully functional renal tissue. This could potentially be life changing to the countless Chronic Kidney Disease patients who languish in long waiting lists for cadaveric transplants and cannot find suitable living donors.[3-4]

Combination matrices and synthetic polymers such as woven mesh from polyglycolic acid have been used to improve outcomes in bridging defects in stricture urethra. Successful animal studies have demonstrated use of acellular collagen matrices seeded with porcine fibroblasts in a bioreactor for treatment of Peyronie's disease. Tissue engineering for replacement of bladder tissue is in the nascent stages. Nanofibres produced by self assembly or thermally induced phase separation (TIPS) can help direct cell behaviour (Eg: stem cells) and spatial organization on biodegradable synthetic materials to form functional tissues. This is also compatible with 3D printing. Nanotubules if made safe for tissue use, can help in tracking and labelling cells, modifying and influencing cellular behaviour. We look at a future where prosthesis can be individualised using genetic material of the recipient and tissue culture, regenerative medicine and 3D printing. [5]

Further improvements such as the novel intracorporeal cast made of synthetic high purity calcium sulphate which delivers anti microbial agents in the interim period before implantation of new prosthesis in revision cases. This helps preserve shape and reduces rates of infection. Incorporation of "tissue grips" to prevent implant extrusion, better materials in penile implants that resist aneurysm and fracture The nickel titanium based shape memory alloy (SMA) helps do away with additional components such as the reservoir and pump and can reduce adverse events related to these structures.[6]

Hormone releasing testicular prosthesis can provide physiological support for patients with a loss of gonadal function. A further improvement could be production of a

functional testicular tissue using regenerative medicine that could induce autologous spermatogenesis. Smaller alternating sphincters with microdrive control units and newer nanotechnology devices could bring an improvement in the currently used artificial urinary sphincters. Stem cell derived agents could also optimize results from injectable agents for SUI. [7]

CONCLUSION

We have progressed significantly from using wooden sticks to today's advanced implantable prosthesis, from penile clamps for Incontinence to the internalized implants today. Prosthetic Urology awaits the next big leap which could come from regenerative medicine, Immune biology and nanotechnology. However, until then, patient selection and counselling, early detection of complications and a commitment to lifelong follow up will help achieve the best out of the current available options. "Life is all about evolution."

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