In spite of advances in surgical technique over the previous decades, erectile and sexual dysfunction remain common complications of radical prostatectomy. In contemporary series, over half of men with normal preoperative sexual function will have persistent problems with erectile function affecting overall quality of life. Recovery of spontaneous return of erectile function depends on numerous factors including age, baseline sexual function, and technical factors of the nerve-sparing technique. Even under optimal circumstances, there appears to be a near-universal period without erections that may last for two years or longer.

In addition to erectile dysfunction, up to 70 per cent of men may also suffer from loss of penile length after prostatectomy and often have additional sexual complaints including low libido, dysorgasmia and climacturia.

The concept of penile rehabilitation has been around for decades and aims to increase the rate of eventual return of erections, decrease the time to recovery, and ultimately optimise the quality of erectile and sexual function. According to recent surveys, the majority of urologists offer some sort of penile rehabilitation after prostatectomy. Where there is extensive pre-clinical evidence supporting penile rehabilitation, clinical evidence is lacking and there is no consensus on the optimum rehabilitation regimen.

ARGUMENT FOR REHABILITATION

The primary argument for penile rehabilitation is to avoid the adverse structural and physiological changes that occur in the penis after prostatectomy. These changes include loss of corporal smooth muscle, impairments in veno-occlusive function, and ultimately penile fibrosis. They are hypoxia induced, and time dependent so that the potential for erectile function decreases with time after prostatectomy. Any rehabilitation, the reasoning goes, would be better than allowing uninhibited deterioration of penile tissue. An ideal penile rehabilitation protocol would intervene early.
postoperatively to prevent deterioration of penile tissues.

Additional components of an ideal penile rehabilitation protocol are early counselling and continued discussion of erectile function. In the absence of formal counselling and discussion, men with good preoperative erectile function and strong desire to maintain it will often not pursue postoperative therapy and, even if they do, often discontinue therapy after a short period of time. These findings are not surprising, given the many issues facing men after prostatectomy and the discouragingly long time before spontaneous recovery of erectile function. Unfortunately, by the time many men seek care for sexual issues after prostatectomy, significant and irreversible tissue damage has occurred. Therefore, we believe that discussion of the physiology of erectile dysfunction after prostatectomy and expectations for recovery is an important component of a rehabilitation programme.

ORAL THERAPIES WITH PDE5 INHIBITORS

Phosphodiesterase 5 (PDE5) inhibitors are the most commonly used form of rehabilitation therapy, with a strong scientific basis in pre-clinical studies. In animal models, there is consistent evidence that prolonged treatment with PDE5 inhibitors is protective and minimises cavernosal damage. Unfortunately, for the most part these findings have not been replicated in clinical studies, which suggests, at most, a much more modest effect in humans.

A small prospective study of nightly sildenafil starting one month postoperatively showed 27 per cent success at one year (defined by a combined score of 8 or more on International Index of Erectile Function [IIEF] questions 3 and 4) compared to 4 per cent of men receiving a placebo. Interestingly, a more recent study found that on-demand vardenafil was as good as nightly vardenafil in producing erections sufficient for penetration. However, IIEF scores at one year were no different for on-demand or nightly therapy and placebo. Both of these studies show at best a modest benefit at one year postoperatively, but it is possible that further benefits may be observed later on. In a contemporary retrospective review, erectile function at three years is significantly higher for patients using PDE5 inhibitors versus those who did not. These results may be influenced by factors such as patient or partner motivation and have not yet been confirmed by prospective studies.

We believe that some men may benefit from the use of PDE5 inhibitors and support their use, either nightly or on demand, as an alternative to no treatment. Emerging data on daily use of tadalafil suggest there could be additional benefits in terms of libido and ejaculatory function. However, at this time clinical data supporting more than a modest benefit are lacking, and we recommend offering additional therapies to motivated patients.

INJECTION THERAPIES

The first clinical study on penile rehabilitation was published by Montorsi et al. in 1997. This study, conducted in the pre-Viagra era, showed a 67 per cent return of spontaneous erections for patients receiving intracavernosal injections (ICI) with alprostadil three times weekly for 12 weeks compared to 20 per cent of men receiving no treatment (Figure 1). Only 12 men in the treatment group were analysed. While some subsequent observational studies suggest a benefit to ICI, to our knowledge no further placebo-controlled trials have been reported. Based on these limited data, we believe ICI with a vasoactive agent is a promising tool that may help maintain cavernosal oxygenation and prevent structural deterioration of erectile function after prostatectomy.

About 75 per cent of physicians responding to an International Society for Sexual Medicine survey reported using ICI, although many urologists will offer it only after failure of PDE5 inhibitors. Major limitations to ICI relate to psychosexual aspects of injection in addition to presence of penile pain, particularly for regimens including alprostadil. Pain may occur either at the injection site or generalised penile pain may occur with erection, leading to a high rate of discontinuation.

A recent study reported safe use of alprostadil ICI in men starting one month after nerve-sparing prostatectomy. The alprostadil dose started low and was uptitrated until erections were sufficient for vaginal penetration. Overall the rate of penile pain was 11 per cent and men who persisted with injections in spite of pain reported a decrease in pain intensity over time. Use of ICI formulations without alprostadil may also be associated with decreased pain and better satisfaction.

Overall, we believe that ICI has significant potential in preventing hypoxia-induced changes that may diminish or prevent eventual return of erections. Intervention as early as one month after prostatectomy appears safe, and we support offering ICI early in the postoperative course. ICI may be associated with pain or psychosexual distress and may require significant patient counselling and discussion.

INTRAURETHRAL THERAPY

Intraurethral therapy is less commonly used than PDE5 inhibitors and ICIs in penile rehabilitation, but allows for direct administration of alprostadil to penile tissues without the psychosexual issues surrounding an injection. Recently, a multicentre randomised controlled trial compared nine months of therapy with intraurethral alprostadil with nightly sildenafil, starting one month postoperatively and followed by a wash-out period. While intraurethral alprostadil was very well tolerated, it did not show any benefit over sildenafil in terms of recovery of spontaneous erections one year postoperatively. We believe that...
Erectile dysfunction, loss of penile length and orgasmic dysfunction remain common problems after nerve-sparing radical prostatectomy. Recovery of spontaneous erections may take two years or longer. Penile rehabilitation aims to prevent hypoxia-induced deterioration of penile tissues during this period. Any rehabilitation therapy is preferable to no treatment. We believe that discussion of the physiology of erectile dysfunction after prostatectomy and expectations for recovery is an important component of a rehabilitation programme.

Oral phosphodiesterase 5 inhibitors, used either nightly or on-demand, may offer modest benefits at best. Use of intraurethral alprostadil therapy may not offer additional benefits. We recommend offering additional therapies to motivated patients. Intracavernosal injections (ICI) may prevent deterioration of penile tissues and encourage faster or better return of erections. Use of ICI as early as the first month after prostatectomy appears safe, but may be associated with pain or psychosexual distress for some patients. Vacuum erection devices may prevent loss of penile length and allow for intercourse and sexual satisfaction early in the postoperative course. Data supporting a benefit in terms of assisting recovery of spontaneous erections are lacking. Future research on the role of androgens in post-prostatectomy sexual function may lead to new concepts and therapies for penile rehabilitation.

Intraurethral therapy appears harmless and may have some modest benefit for patients who are unwilling or unable to perform ICI.

**VACUUM ERECTION DEVICES**

Vacuum erection devices (VED) may be a safe and low-cost approach to penile rehabilitation. The device can be used on demand with a constriction ring for intercourse or used nightly with the idea of increasing blood flow to the penis and, possibly, preventing the collagen deposition and corporeal fibrosis.

Men randomised to use a VED with a goal of twice a week were no more likely to have return of spontaneous erections at nine months compared with men randomised to observation. However, there were some benefits from using a VED. Men who used the VED for intercourse had benefits in terms of patient and spouse satisfaction. Additionally, only 14 per cent of patients who used the VED lost penile length compared to more than 60 per cent of those who did not.

Other experts have reported spontaneous return of erections in men using VED, but these studies are purely observational and not placebo controlled. Overall, VEDs are very well tolerated. We believe that VEDs may have a role in preventing loss of penile length and may be particularly useful in achieving sexual satisfaction for some couples early in the postoperative course. However, at this time, we do not see any evidence that the use of VEDs facilitates return of spontaneous erections.

**EMERGING IDEAS IN PENILE REHABILITATION**

Currently, the main focus of research on the cause of erectile dysfunction after prostatectomy has been on technical aspects of the nerve-sparing technique. Emerging data suggest that the prostate may have an endocrine role in the production and metabolism of androgens and that serum levels of dihydrotestosterone (DHT) and gonadotrophins may decrease after prostatectomy. In addition to damage to the cavernosal nerves, some of the effects of prostatectomy on erectile function could also be a result of loss of prostatic endocrine function. This theory is supported by similarities in structural changes to the penis after prostatectomy and after castration. Furthermore, men after prostatectomy commonly report decreases in libido and orgasmic dysfunction, which are generally associated with low androgen levels.

Testosterone therapy may improve erectile function in hypogonadal men who do not respond to tadalafil, and we can hypothesise that testosterone therapy may also benefit men after radical prostatectomy. Testosterone supplementation in these men remains controversial, and we do not know of any studies examining the use of androgens to improve erectile or sexual function in men after prostatectomy. However, recent studies suggest that testosterone therapy may be safe in these men. In a small series of men with untreated, low-grade prostate cancer who underwent testosterone therapy, there was no evidence for an increased rate of disease progression. Additionally, elevated endogenous testosterone and DHT levels do not seem to be associated with an increased risk of prostate cancer. Future research on the role of androgens in post-prostatectomy sexual function may lead to new concepts and therapies for penile rehabilitation.

**SUMMARY**

Penile rehabilitation after prostatectomy may help prevent structural changes to penile tissue and lead to faster and better recovery. Recovery of spontaneous erections may take two years or longer. Penile rehabilitation aims to prevent hypoxia-induced deterioration of penile tissues during this period. Any rehabilitation therapy is preferable to no treatment. We believe that discussion of the physiology of erectile dysfunction after prostatectomy and expectations for recovery is an important component of a rehabilitation programme.

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recovery of erectile function. An effective approach to rehabilitation involves early intervention along with patient and partner counselling and discussion. Although clinical data are lacking, treatment with ICI may be an effective form of rehabilitation, but may be limited by penile pain and psychosexual issues. While efficacy has not been proven, many men may benefit from oral therapy with PDE5 inhibitors, intraurethral therapy, or the use of VEDs. Even in the absence of strong clinical evidence, we find rehabilitative techniques to be safe, and recommend that they be discussed with patients prior to undergoing prostatectomy.

Declaration of interests: none declared.

REFERENCES