New generation urethral stents in treatment bladder outlet obstruction caused by prostate cancer

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Our clinical trial included until now, 22 patients in whom new generation urethral stent named Allium, were inserted due to bladder outlet obstruction caused in 7 patients (pt) with benign prostate hyperplasia, in 13 pt with bulbar urethral stricture of different ethiology and in 2 pt with prostate cancer. Allium prostatic stents, designed by Daniel Yachia differs in some crucial characteristics from previously used stents: they are covered for the first time in urethra stenting history, without relatively low radiation force and because of that nonirritative. the indications, contraindications and preliminary results in this study are discussed concerning the patients with cancer of the prostate.

Key words: prostate cancer, bladder outlet obstruction, urethral stent, new generation

INTRODUCTION

Upon a definition stent is a small, hallow medical device which placed inside a tubular body structure acts as an internal scaffold or support to maintain the lumen. Intraprostatic stents are medical endoprotheses which enable vesicourethral communication without interfering with external urethral sphincter.

The idea of stents includes and is based upon a history of bladder catheterization. Foley catheter was constructed in 1937. when for the first time in urological practice, the obstructed urethra was successfully spanned. Stents technology era dated up to 30 years ago, when Finney in 1978, described and applied "double J" stent. During this mentioned period vascular stent regain a true clinical expansion. Encouraged with stent application in cardiovascular pathology field, endoluminal prostheses-stents began their usage in treatment benign and malignant esophageal, biliary and upper urinary tract obstructions.

As a logical extension of these efforts, construction and manufacture of stents for lower urinary tract recanalisation happened. In 1984. and 1985. Fabian and Fabricius were started with intraoperative insertion of temporary partial catheter in order to prevent postoperative retention, incontinency and eventual urethral stricture formation. Nordling constructed in 1989. Prostakath-permanent prostatic stent made of steel. It was mounted onto endoscopic delivery device. At the same time . Markovic authorized IFS (intraprostatic functional spiral) designed as a gold plated steel spiral. It was applied as a permanent scaffold in patients with obstructive benign prostate hyperplasia who were unfit for surgery treatment. Daniel Yachia designed Prostacoil in 1990. and Nordling constructed Memokath stent in 1994. After that in 1995. Firm Meditech division USA produced Ultraflex stent. Titan and Trestle stents were next stent designs. Based upon an idea of resorptive surgical sewing materials so well clinically approved for decades, biodegradable urethral stents were manufactured. Such stent after a period of time would degrade and be spontaneously expelled from the body eliminating the second procedure of stent extraction. Clinical application was disappointment and showed that due to individual differences in urine pH values they disintegrated in unpredictable time and in large, rigid fragments.

All previously mentioned different urethral stents, show clearly that ideal urethral stent does not exist, yet. Rigidity, small lumen caliber, inappropriate stent shape, shortening during stent deployment, tissue proliferation, technically complex procedures of stent insertion and extraction are just some disadvantages of previous urethral stent generations.

Stents nowadays differs in shape, length, dimensions as well as in physical and biological properties and are designed either for permanent or temporary usage. Application of one specific, available urethral stent defines the physician according to his/her knowledge, experience and to patient itself.

Urethral stents are divided into two large groups, according to a time interval:
Permanent urethral stents intend to be incorporated into the urethral wall after a wire when epithelium overgrowth the interstices and covers the whole inner surface of the stent. Most of the permanent urethral stents are made of stainless steel or nitinol open wire mesh and are designed to remain in the body for the lifetime-permanently.

Temporary urethral stents are used in medical situations and conditions where body is undergoing self repair after a recanalization procedure, for a days, months or a few years period. The major disadvantage of temporary stents is encrustation and salt deposition in the lumen of the stent. The can be:

1. Expandable metal stents-balloon expandable and self expandable

2. Nonexpansible polymeric stents. Polymeric stents have fixed and in comparison to expandable stents they are much smaller in diameter. These catheter based endoluminal devices are convenient for short time period stenting, when they are simply extracted just with pulling the outer thread.

New generation urethral stent Allium is designed in Israel by Daniel Yachia in 2003. It is a self expandable, temporary device. Alliums stent is made of one and only zik-zak coiled nitinol wire, completely covered with bio-compatible co-polymer. For the first time in the history of urology, covered urethral stent is manufactured. Alliums stent underwent laboratory faze and in vivo experimental study on animal models. After fulfilling all relevant criteria it got the Ethical Comity approval for clinical trial on human models. Clinical study for the only and the first time in the world is conducted and is still running in the Institute of radiology and Institute of urology and nephrology, Clinical Centre of Serbia in Belgrade.

Alliums stent is specifically designed in order to become physiological stent. Authors thought that many disadvantages of urethral stents of older generations are due to morphological and physiological differences according to vascular structures. Structure and shape of these stents are actually replica of vascular stents.

Ideal urethral stent:
-should vary in caliber and cross section in different points along the length of the stent,
-radial force along the stent should accommodate to external urethral sphincter activity,
-cross section shape should replicate the real lumen shape of the prostatic urethra which individually varies and can be triangular, crescent, like a send watch or round,
-should be radiopaque to enable radiographic visibility, track ability and control,
-polymeric cover should minimize salt deposition,
-insertion, reposition and extraction of the stent should be easy to perform,
-should not fragmentate into large, rigid parts.

Allium urethral stent is specifically designed for prostatic and bulbar urethra (Picture 1). Allium intraprostatic stent is designed in Israel by Daniel Yachia in 2003. It is a self expandable, flexible one. Alliums stent is specifically designed in order to be incorporated into the urethral wall after a wire when epithelium overgrowth the interstices and covers the whole inner surface of the stent. Most of the permanent urethral stents are made of stainless steel or nitinol open wire mesh and are designed to remain in the body for the lifetime-permanently.

3. anchoring-bulbar segment

Main body and sphincteric part consist the prostatic part of the intraprostatic Alliums tent. Body of the stent has a triangular cross section, while the sphincteric part is conical and 1 centimeter long. Trans-sphincteric segment is 2 cm long loosely coiled wire. Anchoring segment is conical 1,6 cm long part to be placed into the bulbar urethra in order to prevent cranial migration of the stent. Allium intraprostatic stent is manufactured in 3 lengths, meaning the length of the main body segment: 3,5cm, 4,5cm, 5,5cm. Fully expanded stent reaches 14mm in diameter.

Allium intraprostatic stent is delivered mounted on insertion device where is crimped on 21Fr diameter (about 7mm). Delivery device differs for endoscopic insertion when it is rigid and for radioscopic insertion when it is a flexible one.

Our clinical trial included until now 22 patients. In 9 patients intraprostatic and in 13 bulbar urethra stents were inserted.

Insertion and accurate positioning of Allium triangular prostatic stent are relatively simple and in ambulatory conditions, conducted procedures. Stent implantation can be monitored under direct vision (endoscopy) or under radioscopic control.

Patient preparation include a broad spectrum oral antibiotics and oral or rectal non-steroid anti-inflammatory drugs to be started at least 3 hours before the procedure and continue 3 to 5 days after. The procedure of stent insertion itself is done under local anesthesia (anesthetic jelly) and is well tolerated by patients.

In 2 of our patients indication for Allium triangular prostatic stent insertion was bladder outlet obstruction caused by prostate cancer.

Patient 73 years old with lower urinary tract obstructive symptoms, had a prostate volume 109 ml, total serum PSA level 83 mg, and enlarged, obstructive prostate (cystoscopy findings). Residual voiding volume of urine in urinary bladder, measured on ultrasonography was 160 ml. Hormonal medication therapy was prescribed. In the meantime while waiting medications to show their effects, instead of indwelling catheter Allium (temporary Triangular Prostatic Stent) TPS 3,5 cm was inserted. Voluntary, active voiding was preserved.

Other patient 72 years old, year before underwent radical prostatectomy. Vesicourethral anastomotic stricture occurred and was verified as a cause of his voiding and bladder emptying disorders. Post voiding residual urine volume, on ultrasonography was 220 ml. Allium TPS 3,5 was inserted.

In Allium TPS efficiency assessment subjective and objective parameters were used:
-patient tolerance of stent presence
-voluntary voiding control
-urolflowmetry findings before and after stent implantation
-residual voiding urine volume before and after stent insertion
-plain radiograms and urethrocistograms
-urine analyzes

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From the early-3 hours post insertion evaluation, first control visit was 15 days after the procedure and after that scheduled monthly. In both our patients TPS stent is indwelling for already 7 months. They are satisfied with their ability to empty the bladder as well as with their life quality. Our group of patients in whom Allium urethral stents were inserted is small. Based upon this limited experience can be conclude that potential complications related to insertion, indwelling and removal of Alliums stents are identical to catheter insertion or other urological instrumentation. Irritative symptoms were present in all cases but significantly decreased and almost disappeared after a few days. Fool bladder feeling, bacteriuria with transitory infections, urgent micturation, post procedural hematuria, malposition of the stent, are adverse effects and complications that we deal with in our study.

Contraindications for Allium urethral stent implantation can be temporary or permanent, relative or absolute:
- acute infection of prostate and/or urethra,
- acute upper urinary tract infection,
- patients receiving anticoagulation drugs,
- diabetes type 1
- atonic and neurogenic urinary bladder, interstitial cystitis, urinary bladder tumors and calculi,
- patients with artificial urinary sphincters, penile implants and prostheses.

Indications for prostatic urethra stent placement include, until these days, all cases treated with indwelling catheter. Urethral catheterization is accompanied with patient discomfort and great percentage of recurrent urethral infection leading to a stricture formation which is in direct correlation with the duration of indwelling period. This obviates the need for "urethra friendly", widely available urethral stent with economic price.

According to data from American National Institute for Statistic, incidence of new diagnosed patients with prostate cancer is 30% per year while in 11% of all deaths cancer of prostate is the cause. Cancer of prostate is the most frequent malignancy in males.

Summarizing the experience of interventional radiologists and urologist from Clinical Centre of Serbia in previous generation’s urethral stents usage and comparing them to data referred in literature, indications are established.

**Indications** for Allium temporary urethral stent insertion in patients with cancer of prostate diagnosis are:
1. patients with serious cardiopulmonary, cerebrovascular and other disorders which are graded with high ASA gradient
2. patients with locally advanced cancer of prostate, instead of palliative transurethral resection of prostate in order to resolve or prevent obstruction
3. patients with locally obstructive prostate cancer where interstitial radio or criotherapy are planned, in order to prevent urinary retention
4. patients with metastatic malignancy, in the meantime while some of the treatment modalities does not deobstruct the urethra
5. patients with vesico-urethral anastomotic stricture after radical prostatectomy
6. patients with prostatic urethra stricture after irradiation therapy.

All previously mentioned data, indications and contraindications, as well as minimal complications that occur in our group of patients, in preliminary conclusion we can say that:
- Allium urethral stent insertion is simple in ambulatory conditions conducted procedure
- voiding control is good
- according to ultrasonography findings, emptying of the urinary bladder is complete
- patient tolerance of insertion procedure and stent indwelling is good
- uroflowmetry data are significantly better after the insertion than before it
- endoscopic removal of the stent is easy to perform
- until now no tissue overgrowth or encrustation were noticed
- catheterization through the lumen of the stent is possible (12Fr catheter was introduced)
- urethral infections are rare and transitional
- good radio opacity
- early migration of the stent did not occur
- late migration happened once (1 of 9 pt with TPS inserted)

Group of patients included in our clinical trial, until now, is small and screening period is too short. Long term results are going to be estimated in the next years. Accent will be placed on recanalization durability after stent removal, according to the stricture etiology and segment of the urethra. Allium stent characteristics such as triangular lumen shape replicates the most common lumen shape of the prostatic urethra, low radial force which differ along the length of the stent and polymeric cover preventing the encrustation-are significant improvement compared to previous urethral stent designs. Although first, results in urethral recanalization with Allium stents are promising.

**REZIME**

Naša klinička studija od 2003. godine pa do sada, obuhvatila je 22 bolesnika u kojih je zbog otežanog pražnjenja mokraće bešike urađena insercija Allium uretralnog stenta. Kod 7 bolesnika zbog benigno hiperplazije prostate, u 13 bolesnika usled rekurentne strikture bulbarne uretre različite etiologije, dok je u 2 bolesnika karcinom prostate uzrokovala opstrukčne tegobe. Allium intraprostatični stent dizajnirao je Daniel Yachia i u nekoliko bitnih karakteristika razlikuje se od uretralnih stentova predhodnih generacija: prvi su pokriveni uretralni stentovi, na preseku su trouglastog oblika, imaju malu radijalnu snagu koja se menja u različitim segmentima stenta što smanjuje irritativne tegobe, nema prednjeg skraćenja tokom insercije. U ovom radu indikacije, kontraindikacije kao i preliminarni rezultati razmatrani su sa posebnim osvrtom na karcinom prostate.

Ključne reči: karcinom prostate, opstrukcija mokraće bešike, uretralni stent, nova generacija
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