Objective: To analyze the outcome of Mainz Pouch II urinary diversion related to complications and life quality.

Patients and Methods: From 1995 to 2006, a total of 67 patients (60 male and 7 female, mean age 58.4 years, range 48 to 70) who underwent modified ureterosigmoidostomy (Mainz Pouch II) procedure have been retrospectively analyzed. The mean follow-up was 18 (1 – 72) months and it was available for 56 patients (84%). Early and late postoperative complications as well as quality of life after surgery were analyzed. An clinical questionnaire has been used for examination specific urinary diversion items.

Results: Early postoperative complications (<30 days) were detected in 9 patients (13%) and late complications (>30 days) in 19 patients (28%). Early complications consisted of urine leakage of moderate degree in 5 (7%) and ileus requiring surgical revision in 4 (6%) patients.

The late complications included acute pyelonephritis in 12 patients (18%) and uretero-sigmoidal anastomotic site stenosis in 7 (11%). Ureterosigmoidal anastomatic site stenosis was detected in 7 patients with 7 re-nouretic units (RU). In 4 RU, metal Strecker stent was successfully applied. In 3 RU, permanent nephrostomy catheter was applied. Oral alkalinizing agents were applied in 22 patients (33%) due to metabolic acidosis. Two patients died due to severe acidosis. Continent rate was 96%.

The mean voiding frequency during the day and night was 5.2±1.8 and 2.7±0.5, respectively. Global life quality was bad for 3 (8%), acceptable for 15 (38%) and good for 22 (54%) patients.

Conclusion: The Mainz Pouch II urinary diversion is simple and safe procedure regarding complications rate, continence and quality of life. It is good alternative to other forms of continent urinary diversion. Patient selection and compliance following by meticulous follow-up are of utmost importance for successful operative outcome.

Key words: Mainz pouch II, urinary diversion, ureterosigmoidostomy, complications, quality of life

INTRODUCTION

Ureterosigmoidostomy was the first form of continent urinary diversion. It was first introduced in 1852 by Simon and had gained much popularity during the first half of 20th century. In the following years, the technique fell into disfavour due to high incidence of complications such as hyperchloremic acidosis, ureterocolonic anastomotic strictures with hydronephrosis, urinary incontinence, recurrent pyelonephritis, loss of renal function and more recently malignant transformation of the ureterointestinal anastomosis1,2.

In 1950, the use of ileal conduit, established by Bricker, replaced the ureterosigmoidostomy as the standard form of urinary diversion3. In 1967, Henley created a rectal bladder which had gained broad popularity due to its simplicity and safety to the upper urinary tract4.

In recent years, a better understanding of the pathophysiology of complications associated with ureterosigmoidostomy has minimized the risk of serious metabolic imbalance. This was followed by new advances in suture materials, surgical techniques of ureteral reimplantation, alkalinizing agents and antibiotics which had contributed to the achievement of better results of the procedure5,6,7.

Interest for ureterosigmoidostomy was regained since its simplicity and benefits for patients with bladder cancer that are not suitable for orthotopic bladder substitutes. Additionally, long-term follow up of alternative urinary diversion methods, demonstrated considerable complication rate regarding upper urinary tract dilatation, pyelonephritis and stomal complications8,9,10.
The technique of ureterosigmoidostomy had many modifications up to date. Expecting to obtain better continence rates and better protection of the upper tract than are achievable by ureterosigmoidostomy, a low pressure recto sigmoid pouch (Mainz Pouch II) has been created by detubularization of the recto sigmoid.

Current problems include ureterosigmoidal anastomotic site stenosis, need for oral alkalizing agents and malignant transformation at the ureteric implantation site. In the present study we review the results of modified sigma rectum pouch (Mainz Pouch II) procedure performed on 67 patients, in respect of early and late complications, as well as, in postoperative quality of life.

**PATIENTS AND METHODS**

From 1995 to 2006, a total of 67 patients (60 male and 7 female, mean age 58.4 years, range 48 to 70) underwent modified ureterosigmoidostomy (Mainz Pouch I) due to following indications:

- bladder cancer in 65 patients and functional bladder loss in two. Incompetent anal sphincter, sigma diverticulosis or polyps and serum creatinine level 1.5mg/dl, were considered contraindications for the procedure.

All patients have been prepared preoperatively as described by Fish et al.

The anal sphincter competence was tested by asking the patient to hold a 350-400 ml water enema for at least 4 hours during daytime and at night. Postoperative tumour staging is summarized in Table 1.

The Mainz Pouch II urinary diversion was constructed as originally described with following modifications:

- ureteric implantation into the pouch by Camey - Le Duc technique;
- ureteric stents fixation to the pouch mucosa with plain catgut sutures;
- ureteric stents fixation to the gluteal region skin exteriorly.

Radical cystoprostatectomy with bilateral pelvic lymph node dissection or anterior pelvic exenteration in females were performed through the midline abdominal transperitoneal incision. Approximately 12 centimeters of sigmoid colon, distal and proximal to the rectosigmoid junction are opened along its antimesenteric border.

The antimesenteric border of the rectum and sigmoid colon is incised using diathermy knife and then by scissors. A pouch plate was created by side to side 2-layer running Vicryl 3-0 sutures of posterior wall.

The ureters were implanted in a special ureteral bearing by Camey Le Duck technique.

Then, anterior wall of the pouch was closed and the pouch was sutured to the anterior longitudinal cord of the promontory.

The pouch was drained via rectal tube for 2 weeks. Abdominal drains were removed after they stopped functioning and ureteric stents were removed on 10th postoperative day.

**RESULTS**

The mean (range) operative time for standard Mainz Pouch II procedure was 5.5 (4 to 8.5) hours. Postoperative hospital stay was on average 18 days (15 to 43) days. Ureteric stents have been removed or expelled after 11 (9–14) days.

Early postoperative complications (days) were detected in 9 patients (13%) and late complications (30 days) in 19 patients (28%).

Early complications consisted of urine leakage in 5 (7%) and ileus in 4 (6%) patients. Urinary leakage was of moderate degree (less than 500ml/daily) and in all patients it spontaneously resolved with prolonged drainage by rectal tube during the early postoperative course. All patients with postoperative ileus required open surgical revision and it has been performed with satisfied outcome.

Patient monitoring consisted of detailed serum biochemistry, blood gas analysis and renal ultrasound at 2nd and every 3 months for the 1st and second year and biannually thereafter.

Oral sodium bicarbonate was administrated if a base excess value was below -2.0 mmol/l or arterial pH value below 7.35. Oral sodium bicarbonate dosage varied between 3 and 10g/daily depends on the degree of acidosis.

Follow-up was not available for 11 patients.

During the postoperative period, in postoperative follow-up, an non validated questionnaire was used to evaluate specific urinary diversion problems. The questionnaire included questions about urinary frequency and continence (day and night), impact on social and family life, change of eating habits, dressing or sexual habits, daily activities on the work etc.

**TABLE 1**

<table>
<thead>
<tr>
<th>Tumour stage</th>
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<td>6</td>
</tr>
<tr>
<td>Total</td>
<td>67</td>
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</tr>
</tbody>
</table>

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The mean follow up was 18 (1–72) months and it was available for 56 patients (84%).

Follow-up was not available for 11 patients.

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The late complications included acute pyelonephritis in 12 patients (18%), comprising 14 RU and uretero-sigmoidal anastomotic site stenosis in 7 (11%). Pyelonephritis was unilateral in 10 and bilateral in 2 patients. In 8 RU (7 patients), pyelonephritis was caused by postoperative upper urinary tract dilatation which required temporary percutaneous nephrostomy catheter, which had been removed after 3-4 weeks.
Ureterosigmoidal anastomotic site stenosis in was detected in 7 patients with 7 RU. In 4 RU, metal Strecker stent was applied by radiologist along with the protective percutaneous nephrostomy catheter. The procedure was successful in all of these patients and they have been released from percutaneous nephrostomy catheter after 3–4 weeks. In the rest of 3 RU, permanent nephrostomy tube was applied.

Oral alkalinizing agents and potassium supplementation were applied in 22 patients (33%) due to hyperchloremic metabolic acidosis. Seven patients (10%) required hospital treatment related to severe acidosis and hypokalemia. In 2 patients, percutaneous nephrostomy tube was applied, while in the rest of 5 acidosis has been treated by conservative therapeutical measures. Of these, five patients had successful outcome and have been discharged after a few days, but in 2 cases lethal outcome was noted.

After the removal of the rectal tube, all patients were continent during the day and night except three (4%), which had urinary leakage sometimes during the night, but it was not felt to be disturbing. The mean voiding frequency during the day and night was 5.2±1.8 and 2.7±0.5, respectively. The voiding frequency was on average one to three times in 14 patients (25%), three to six times in 25 (45%) and 6 times in 17 (30%).

Night-time voiding frequency was one to three times in 35 patients (63%), three to six times in 17 (30%) and 6 times in 4 (7%). Intermittent night-time urinary leakage was noted in 15 patients (27%).

Forty patients (62%) have been included into the postoperative life quality analysis by clinical questionnaire with three categories of answers: bad, acceptable and good.

Regarding personal feelings and interest in life, the answer was: bad for 4 (10%), acceptable for 6 (16%), good for 30 (74%), and bad for 4 (10%), acceptable for 16 (40%) and good for 20 (50%) patients, respectively. The quality of family life 1 patient (3%) marked as bad, 10 (24%) as acceptable and 29 (73%) as good.

Related to global life quality, the answer was: bad for 3 (8%), acceptable for 15 (38%) and good for 22 (54%) patients.

By their own experience with applied Mainz Pouch II technique, a total of 38 patients (95%) would undergo the same urinary diversion again.

**DISCUSSION**

The objective of the present retrospective study was to report the complications of the Mainz Pouch II procedure. In the past, ureterosigmoidostomy has been strongly criticized mainly due to its complications. In order to overcome these drawbacks, following Himman’s principles of detubularization, the Mainz Pouch II technique was introduced as a simple detubularized ureterosigmoidostomy procedure, by Fisch et al.6,8,10. It has been demonstrated that detubularization of bowel segments reduces the frequency and amplitude of contractions and thus reduces the risk of pyelonephritis and reflux of urine in antiperistaltic direction. Additionally, it allows a creation of the reservoir with the highest possible capacity from given length of the bowel.5,6,8,10,11,12,17,18

Complications such as ureterosigmoidal anastomotic strictures, hyperchloremic metabolic acidosis, pyelonephritis and secondary malignant transformation at the ureteric implantation site are not unique for ureterosigmoidal anastomosis.

The reported incidence of early postoperative complications after Mainz Pouch II procedure is between 3.3% and 28.6% in large series.5,7,8,19

It has been reported that the most common early complication following cystectomy and urinary diversion was prolonged ileus, with the rate up to 18%20,21. Ileus following ureterosigmoidostomy is less frequent since the procedure requires less intraoperative bowel mobilization.19 Urine leakage is reported to be up to 14% in some series6. Early complications rate of 13% from our series and the rates of urine leakage and ileus of 7% and 6%, respectively, are consistent with reported data.

The late complications included acute pyelonephritis in 12 patients (18%), comprising 14 RU and ureterosigmoidal anastomotic site stenosis in 7 (11%).

The main late complication was pyelonephritis with an incidence of 18%. In majority of these patients (n=7), tumour stage was =T3b with preoperative hydronephrosis of moderate degree which was, by our consideration the major predisposing factor in appearing of postoperative pyelonephritis. In a total of 8 RU, temporary percutaneous nephrostomy catheter was applied. Other series showed rates of pyelonephritis from 0-8%.5,6,12,13,19

Bastian et al.19 consider that pyelonephritis after Mainz Pouch II procedure is to be more frequent among younger patients, suggesting that there is good protection of the upper urinary tract in elderly patients. Generally, reported incidence of this complication from a large series suggests that low pressure reservoir, straight ureteral path by its fixation to the promontory in Mainz Pouch II procedure provides upper urinary tract protection as good as other urinary diversions.5,11,17,20,21

Upper urinary tract dilatation due to ureterosigmoidal site stenosis as a late complication was found to be 2.9% to 19% in large series6,7,22. In our series, the rate of these complication was 11% (7 patients). It seems to be an acceptable incidence which correlates with our learning curve and occurs less frequently with experience. It has been demonstrated that the technique of ureteric implantation does not correlate with the increased risk of stenosis19.

If submucosal tunnel is performed, stenosis predominately occurs during the first two years after surgery. Some authors consider that those stenotic complications are not suitable for balloon dilatation or cold knife incision, as early stenotic complications are.21,22 In the present study, success of the treatment by metal Strecker stent insertion was 100%. The procedure was performed during the first six months after surgery.
In 3 patients with advanced bladder cancer and short life-expectancy period, permanent nephrostomy catheter was applied. In our series we didn’t perform neourethropathy.

Metabolic consequences following incorporation of the intestinal segments into the urinary tract are well known. Although urine storage lasts longer in sigmoidrectal pouch then in classic ureterosigmoidostomy, available surface for the resorption of ions is smaller. Hyperchloremic acidosis and metabolic complications can be prevented by appropriate monitoring of acid status and administration of alkalinizing medications.

Twenty two patients (33%) initially required oral medications. In large series, the reported incidence of use of oral alkalinizing medications ranges from 51-65%. In some series, there were no need for oral medications.

Serious metabolic, death-related complications in our 2 patients are addressed on patient noncompliance on diet and treatment, which is of utmost importance to overcome these drawbacks. We agree that in prediction of acidosis, arterial blood gas analysis are more important than serum electrolytes.

The Mainz Pouch II procedure provides a low pressure, high capacity reservoir, which prevents overdistension of the colon and consequent stimulation of motility and evacuation of the content. A good continence rate in the group of patients who were not evaluated by rectodynamic studies preoperatively, shows that it is unneccessary.

It has been demonstrated that classic ureterosigmoidostomy is associated with bowel frequency and urge incontinence, with night-time incontinence in more than 50% and day-time incontinence 7%. However, the sphincter competency decreases with increasing age.

Our 3 patients (4%) had urinary leakage sometimes during the night, which was probably caused by neural stimulation since all of these patients got up one to three times to urinate. Regarding available data on this issue, a Mainz Pouch II procedure offers satisfactory continence rates, even in elderly patients who have been previously considered as poor candidates for classic ureterosigmoidostomy. There is a lack of clear consensus related to preoperative rectodynamic evaluation. Fisch et al suggests it as routine preoperative evaluation. Wee agree with some reported data that these evaluation should be performed in high risk patients for incontinence. Our experience is consistent with findings that complete day continence rate in the group of patients who were not evaluated by rectodynamic studies preoperatively, shows that it is unnecessary for predicting the postoperative continence.

Regarding secondary malignancies development, it has been most frequently associated with ureterosigmoidostomy. The risk has not been changed by numerous modification of ureterosigmoidostomy, including Mainz Pouch II procedure. Since it has been reported from large series that mean latent period for malignant transformation is 26 years, development of secondary malignancies is specially important in patients with long life expectancy. However, meticulous follow up by sigmoidoscopy on regular base is mandatory for screening.

In conclusion, The Mainz Pouch II is simple, safe and stoma free continent urinary diversion with short operation period and satisfactory results regarding morbidity and protection of the upper urinary tract.

Providing excellent contience rate and good quality of life, it represents an optimal therapeutic option in selected cases in which orthotopic bladder substitute or other type of continent urinary diversion is not indicated or acceptable.

The presence of metabolic acidosis represents the main disadvantage of the procedure. Careful preoperative selection and patient compliance along with meticulous follow-up are of utmost importance to avoid complications and obtain good functional results.

**REZIME**

**MODIFIKOVANA MAINZ PAUČ II (SIGMA REKTUM POUCH) URINARNA DERIVACIJA: ISKUSTVO OD 15 GODINA**

Cilj rada: U radu je analiziran ishod Mainz Pouch II urinarno derivacije u odnosu na komplikacije i kvalitet života

Pacijenti i metode: Retrospektivno je analizirano ukupno 67 pacijenata (60 muškaraca i 7 žena, prosečne starosti 58.4 godine, od 48 do 70 godina) kojima je u periodu od 1995. do 2006. godine uradjena modifikovana ureterosigmoidostomija (Mainz Pouch II). Prosečno vreme praćenja iznosilo je 18 (1–72) meseci i bilo je dostupno za 56 pacijenata (84%). Analizirane su rane i kasne postoperativne komplikacije kao i kvalitet života posle uradjene operacije. Za analizu pitanja koja su specifična za pacijente sa urinarnom derivacijom, korišćen je poseban klinički upitnik.

Rezultati: Rane postoperativne komplikacije (<30 dana) otkrivena su kod 9 (13%), dok su kasne komplikacije (>30 dana) otkrivena kod 19 pacijenata (28%). Rane komplikacije sastojale su se od ekstrazacije urina umerenog stepena kod 5 (7%) i ileusa koji je zahteva hiruršku reviziju kod 4 (6%) pacijent. Kasne komplikacije uključile su akutni pijelonefritis kod 11 pacijenata (18%) i stenozu na mestu ureterosigmoidne anastomoze kod 7 (11%). Stenoza na mestu ureterosigmoidne anastomoze otkrivena je kod 7 pacijenata sa renoureteralnim jedinicama (RU). Kod 4 RU metal Strecker stent uspelo je postaviti. Kod 3 RU plasiran je permanentni nefrostomski kateter.

In conclusion, The Mainz Pouch II is simple, safe and stoma free continent urinary diversion with short operation period and satisfactory results regarding morbidity and protection of the upper urinary tract.

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tiva ostalim formama kontinentnih urinarnih derivacija. Odabir pacijenata i njihova saradnja zajedno sa pažljivim postoperativnim praćenjem, od najvećeg su značaja za uspešan ishod operacije.

Ključne reči: Mainz Pouch II, urinarna derivacija, ureterosigmoidostomija, komplikacije, kvalitet ivota

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