Yang-Monti ileal ureter-bladder anastomosis or Yang-Monti ileal ureter-ureteral anastomosis for the treatment of ureteral stenosis: What is better?

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Abstract

Background: To establish an animal model of the minipigs of ileal ureter-bladder anastomosis and ureter-ureteral anastomosis using the Yang-Monti technique, and compare the advantages and disadvantages. Methods: 14 minipigs were randomly divided into two groups. Group A received the left Yang-Monti ileal ureter-ureteral anastomosis; group B received the left Yang-Monti ileal ureter-bladder anastomosis. The length of the incision and the operation time of the two groups were compared. Changes in serum creatinine and urea nitrogen were observed. IVU, cystography, Urinary culture examination and histological examination were performed. Results: the remaining 11 miniature pigs had no urinary fistula or intestinal fistula. The operation time and incision length of group A were longer than group B. All minipigs had normal renal function before and after surgery. There was no stenosis obstruction in the venous pyelography. The narrowest diameter of group A was larger than that of group B; no contrast agent was returned to the upper urinary tract in the two groups. Postoperative urine culture examinations were colonized with Escherichia coli. the obstruction and stenosis were found in group A; the ileal ureteral diameter of group A was larger than that of group B. Histological examination showed that the transitional epithelium and columnar epithelial mucosa in group A were not close together; the intestinal villi are slightly atrophied and shortened. Conclusions: Compared with the Yang-Monti ileal ureteral anastomosis, the Yang-Monti ileal ureter-bladder anastomosis is simpler, more reliable, and less complication.

Background

With the widespread development of urological endoscopic surgery, iatrogenic injury has become one of the most common causes of ureteral injury [1], and the proportion of long-term ureteral injury is increasing. Ureteral avulsion is the most serious complication of ureteroscopy, with an incidence rate of 0.06%-0.45% [2-5]. Most of the lower ureteral avulsion is treated with ureteral bladder replantation. Due to multiple operations, there are adhesions and stenosis in the lower ureter, difficult to separate during operation, poor blood supply to the ureter, difficult to heal after operation, easy to produce scars, and small diameter of the ureter and thin wall, which is not conducive to anastomosis.

Yang-Monti ileal ureter is used in clinical practice and has good curative effects [6-8]. This method is characterized by the fact that the alternative ureteral tube diameter is the same as the original ureter, the intestinal tube is short, the diameter of the tube is small, the intestinal tube is saved, the physiological function of the intestinal tract is small. The decreasing of the surface area of absorption and secretion, which is effectively reduced the intestinal secretion and absorption, meanwhile, preventing occlusion of the lumen and postoperative metabolic abnormalities.

Whether there is a need for anti-reflux in the postoperative ureter is still controversial. Some scholars advocate that there is no need to establish anti-reflux, some scholars advocate the establishment of anti-reflux [9-11], and there is no difference in efficacy as the previous report [12]. Non-anti-reflux is an ileal that replaces the ureter directly after the bladder. The operation is relatively simple and convenient. The
operation time is short and the incision is small. However, there may be a backflow of urine in the bladder to the replacement ureter or ipsilateral kidney, resulting in postoperative intestinal dilatation, ascending infection, pyelonephritis, hydronephrosis, and impaired renal function \cite{13}. Anti-reflux anastomosis has nipple structure at the ileal bladder junction \cite{14}, proximal ileal wall tunnel anti-reflux \cite{15,16}, extra-urinary ureter tunnel extension (Lich-Gregoir method) \cite{7,12}, etc, which are benefit to reduce the above complications.

When the lower ureter is well preserved, the ileal ureter can be anastomosed to the lower ureter, but the mucus obstruction and anastomotic stenosis may be complicated after surgery. If the lower ureter cannot be anastomosed, the intestine ureter needs to be re-implanted with the bladder. Establish anti-reflux. To this end, we established the Yang-Monti ileal ureter and bladder anastomosis and the Yang-Monti ileal ureter and the lower ureteral anastomosis two animal models, to understand which way is more convenient to operate, and compare the advantages and disadvantages of both.

**Methods**

1. **Materials**

14 experimental GuiZhou Minipigs (provided by Experimental Animal Center of Zunyi Medical College), male, 12-months-old, weight 21 ± 1.38 kg, were randomly divided into group A and group B: Group A (n = 7) received the left Yang-Monti ileal ureter, the left ileal ureter and the left ureter end of the anastomosis; group B (n = 7) received left Yang-Monti ileal ureter, left ileal ureter and bladder anastomosis. The contralateral kidney was removed from both groups 1 week after surgery and two experimental animal models were established. The experiment was approved by the Medical Ethics Committee of GuiZhou Provincial People's Hospital. Refinement refers to the improvement of conditions, the treatment of animals, and the improvement of animal welfare on the basis of scientific principles: or the improvement of experimental procedures and improvement of experimental techniques to avoid or alleviate the pain and nervousness of animals that are not related to the purpose of the experiment scientific method.

2. **Surgical procedures and postoperative treatment**

2.1 surgical steps

Group A surgical steps:

(1) Preparation before surgery: Animals were fasted for 24 hours and water for 12 hours before surgery.

(2) Anesthesia: After weighing, anesthetize with 3% pentobarbital sodium (Shanghai Xinya Pharmaceutical Co., Ltd.) 30 mg/kg intraperitoneal injection. Intravenous infusion of propofol (Sichuan Guorui Pharmaceutical Co., Ltd.) induced dose of 1–2mg/kg, maintained at 1–2mg/kg/h.

(3) Abdominal skin preparation, 2.5% iodophor disinfection, sterile surgical towel, take the left rectus abdominis incision, layer by layer to cut the skin, subcutaneous tissue, muscle, peritoneum.
(4) Fee ureter: push the left side of the colon to the medial side, reveal the left posterior peritoneum, cut the left posterior peritoneum, look for the left ureter, from the distance of the renal pelvis about 2 cm from the lower to the middle segment, remove the middle and upper ureter, to create a model that replicates exactly the real extended ureteral injuries.

(5) Selection of intestinal segments: A section of 2–3 independent mesenteric blood supply intestines was taken from the ileocecal area 40 cm and the surrounding tissues were protected with gauze.

(6) Restoration of intestinal continuity: The two broken ends of the intestine were thoroughly washed with physiological saline, then fully disinfected with 2.5% iodophor, and the intestine was anastomosed with 5–0 non-absorbable suture. The whole layer was sutured first, and the muscle layer was sutured to restore the continuity of the intestine and close the mesangial hole.

(7) Cutting of the intestine: The cutting method of the intestine is referred to [17] (Fig. 1). The intestine segments were thoroughly cleaned and disinfected with saline and 2.5% iodophor, and the intestine segments were cut into three segments, each of which was 2 cm in length and with independent and intact mesenteric vessels (Fig. 2a). The cross section of the intestine was taken from the mesentery at 6 o’clock. The three segments of the intestine were cut longitudinally at 9, 12, and 3, respectively, to form a three-section rectangular intestine (length 4–6 cm, width 1.5 cm) (Fig. 2b)). The adjacent intestine pieces were sequentially sutured with an antibacterial micro-chord line (4–0) to form a rectangular intestine piece having a length of about 12–18 cm and a width of 2 cm (Fig. 2c). The intestine piece was wrapped around a 30 cm long F12 silica ureteral stent tube, and the intestine piece was sutured longitudinally with a 5–0 absorbable suture (Johnson) to form a long tubular structure to form a ureter replacement segment (Fig. 2d).

(8) Reconstruction of the ureter and ureter stump anastomosis: one end of the ureteral stent has been placed in the renal pelvis and the other end of the ureteral stent has been inserted into the bladder through the naive ureteral stump, the top of the bladder is cut open, the stent tube is pulled out and the bladder is made, suture the bladder incision as a stent and drainage. The reconstructed ureteral upper end was anastomosed to the ureteral stump with a 5–0 absorbable suture. The lower end was anastomosed to the remaining ureteral lower end. The anastomosis was performed with a full-thickness suture and sutured for approximately 6–8 needles (Fig. 2e).

(9) The distal end of the ureteral stent tube was placed under the skin of the left lower abdomen, and the incision was closed layer by layer.

Group B surgical steps:

(1) - (7), (9) same surgical procedure as group A.

(8) The reconstructed ureter and the bladder stump are anastomosed: one end of the ureteral stent tube is placed in the renal pelvis, the other end is placed in the bladder on the left side of the bladder, and the top
of the bladder is cut open, the stent tube is pulled out and the bladder is made, and the suture is sutured. Bladder incision, as a stent and drainage. The reconstructed ureteral upper end was anastomosed to the ureteral stump with a 5–0 absorbable suture. The lower end was directly anastomosed to the bladder. The anastomosis was performed with a full-thickness suture and sutured for about 8–10 needles (Fig. 2f).

The contralateral kidney and ureter were removed in the two groups one week after surgery.

2.2 post-operative treatment:

Fasting for 24 hours after operation, liquid diet on the second day after surgery, normal feeding after 3–5 days, daily intramuscular injection of penicillin (1.5ml/kg), and metronidazole injection 50ml/day for total 5 days. The ureteral stent tube was indwelled for 4 weeks and then surgically removed and removed subcutaneously. When collecting tissues and organs for examination, abdominal anesthesia was performed first. After the completion of the collection, chemical euthanasia was used to terminate the life of the animals from intravenous high-dose anesthetics 3% pentobarbital sodium, 100 mg/Kg.

3. Observation indicators and data collection:

All the experimental animals in the two groups were examined for the following items after surgery:

(1) Operation time and length of surgical incision: The operation time and length of the surgical incision were compared between the two groups.

(2) Determination of blood and kidney function: Blood samples were taken to detect changes in serum creatinine and urea nitrogen before surgery, and 2 weeks, 6 weeks and 12 weeks after surgery.

(3) Intravenous pyelography (IVU) and cystography: intravenous pyelography (IVU) and cystography were performed 12 weeks after surgery to observe the ureteral patency and vesicoureteral reflux.

(4) Urine bacteriological determination: urine was collected from the bladder in the urine at 12 months after surgery to see if there was a urinary tract infection.

(5) Gross visual observation and histological examination: Gross macroscopic observation and histological examination of the intestine ureter were performed after 12 months of operation to understand the pathological changes of the anastomosis and intestinal ureter.

4. Statistical analysis:

Animal grouping was designed according to the principles of equilibrium, control and repetition. All measurement data were expressed as mean ± standard deviation. The t-test was used for comparison between the two groups. The test level: p was 0.05, and the difference was statistically significant at \( p < 0.05 \). Statistical analysis was performed using the SPSS 24.0 software package.
Results

In this study, 14 minipigs successfully completed the operation. One pig in group A died of anesthesia accident, another pig died of lung infection on the fourth day after surgery. And one pig in group B died of adhesive intestinal obstruction on the 7th day after surgery. The overall survival rate was 78.6%, and the remaining 11 miniature pigs had no urinary fistula or intestinal fistula. The lengths of the incision and the operation time were compared between the two groups (p = 0.01, p = 0.02). The operation time and length of the incision in group A were longer than those in group B (Table 1–1). There was no significant difference in serum creatinine and urea nitrogen between the two groups (p > 0.05). All minipigs had normal renal function before and after operation (Table 1–2). Intravenous pyelography showed no stenosis obstruction (Fig. 3a, b). The narrowest diameter of the ureter was compared between the two groups (p = 0.01). The diameter of group A was larger than that of group B (Table 1–3). In the two groups, no contrast agent was returned to the upper urinary tract (Fig. 3c, d). Postoperative urine culture examinations were colonized with Escherichia coli. At 12 months after operation, the specimens were collected with gross eyes. In group A, the distal end of the inferior ureter and the low ureter were completely obstructed. The other end of the inferior ureter and the low ureter were narrow, the two anastomosis and the adhesion of the surrounding tissues were heavy, obstructive stenosis above the intestine ureter and kidney water expansion is obvious, the renal parenchyma is thin, transparent, and the kidney is small (Fig. 4a). In group B, one pig was found to have moderate hydronephrosis, and the intestine ureter was slightly dilated. All ileal ureters and anastomotic patency were smooth (Fig. 4b); the rest of the intestine ureter is patency and the anastomosis is smooth, the color of the intestine ureter is ruddy, the shape is similar to that of the normal ureter, slightly thicker than the normal ureter, surrounded by fibrous tissue and adipose tissue. After the incision, the mucosa of the intestine and ureteral anastomosis is seen after the incision. Continuous, intestinal mucosa atrophy on the surface of the intestine and no hydronephrosis. The ileal ureteral diameter was compared between the two groups (p = 0.02), the diameter of group A is larger than that of group B (Table 1–3). Histological examination showed that in group A, the transitional epithelium of the upper and lower ends of the ureter of the two pigs was not close to the columnar epithelium, and there was granulation tissue hyperplasia. The two pigs with obstruction were found to have fibrous tissue and smooth muscle tissue hyperplasia and support stenosis at the anastomosis. (Fig. 5 a, b); group B six pigs with ureteral ureter at both ends of the anastomosis, two epithelial tissues close together (Figure 5 c, d); two groups of replacement intestinal segments of the intestine villi compared to normal intestinal villi Shortened and atrophied (Fig. 5e, f).

Discussion

In this experiment, we established an animal model of ileal ureter-bladder anastomosis and ileal ureter-ureteral anastomosis using the Yang-Monti technique. There were no significant differences in serum creatinine and urea nitrogen between the two groups at 2 weeks, 6 weeks and 12 weeks after surgery. Comparing with before surgery, renal function is stable and there is no renal dysfunction and failure after surgery. We believe that serum creatinine and urea nitrogen are stable at normal levels after surgery and
compared with those before surgery. No renal dysfunction was found. We successfully established the Yang-Monti ileal ureter animal model.

In our experiment, the average operation time and length of the surgical incision in group A were longer than those in group B, indicating that the group A intestine ureter and the ureteral anastomosis need to retain and fully free the lower ureter, the lower ureter is deeper, the intraoperative anastomosis operation space is relatively small, the anastomotic speed is slow, so the length of the surgical incision and surgery required The time is correspondingly prolonged; the intestine ureter of the group B is directly anastomosed to the bladder, and the lower segment of the ureter is not required. The bladder of the minipig is more easily recognized under filling conditions, and the top wall, the two side walls and the front and rear walls of the bladder are not connected to the surrounding pelvic wall. The relative position of the bladder in the pelvic cavity is not fixed, the activity is large, and it is easier to find than the lower part of the ureter. It is easier to re-integrate the ureter and the left side of the bladder during operation, and the operation space is large. This may be the length of the surgical incision and operation time required in group B were shorter than that of group A.

The most common recent complication of ileal ureteral surgery is urinary tract infection, which is related to bladder ileal reflux, intestinal mucus secretion, etc., and it is difficult to control and recurrent, eventually leading to hydronephrosis or multiple renal cortex abscess, pyelonephritis. Urine culture tests confirmed mostly E. coli infection, followed by Klebsiella pneumoniae. Yao Zhengzi et al. performed a short-term and long-term observation of 60 patients with ileal ureter, and found that there were abnormal changes in urine (including a small amount of protein, white blood cells, pus ball and intestinal mucus in urine), there are only 4 cases of urinary tract infections in the clinic, and the symptoms disappear after treatment with antibiotics. Therefore, they believe that changes in urine do not need to be considered excessively in the presence of urinary tract infections, antibiotic treatment is needed only when symptoms of acute infection occur. In this experiment, urine cultures suggest that Escherichia coli colonization was consistent with the literature reports. Escherichia coli is a pathogenic pathogen of the intestine, may be colonized with the intestine to the urinary tract during surgery and no antibiotic treatment because of asymptomatic Bacterial urinary.

There are two ways of ileal ureteral surgery and bladder anastomosis: non-anti-reflux and anti-reflux. Non-anti-reflux is an ileal that replaces the ureter directly after the bladder. The operation is relatively simple and convenient. The operation time is short and the incision is small. However, there may be a postoperative intravesical urine reflux to the replacement ureter or ipsilateral kidney, resulting in postoperative Intestinal dilatation, ascending infection, pyelonephritis, hydronephrosis, impaired renal function. Anti-reflux anastomosis is beneficial to reduce the above complications. In our experiment, no stenosis obstruction was observed in the two groups. The narrowest diameter of the intestine ureter was compared between the two groups. The diameter of the intestine ureteral tube was larger in group A than in group B.
We believe that intraoperative measurement of ureteral diameter, although according to the measured value of the selection and cutting of the ileum, the reconstructed intestinal ureteral diameter is still thicker than the normal ureteral tube diameter. Group A need to cut the ureter longitudinally after anastomosis. In the group A, the ureter should be longitudinally dissected after the anastomosis, and then the intestine ureter and the lower ureter should be anastomosed. The anastomosis is relatively small, the ileum is more stretched than the ureter, and the urine flows through the relatively small lower ureter after passing through the large intestine ureter. The urine flow rate is slowed down, the stagnation time is long, and the urine stays in the intestine. In the ureter, it is bound to have an expansion effect on the intestine ureter, and the indwelling endoscopic tube will also have an expansion effect after operation; while the intestine ureter of the group B is directly matched with the bladder, the anastomosis is wider than the A group, and the angiography of the venous pyelography is performed. The agent quickly enters the bladder through the intestine ureter and is not easy to reside. This may be the reason why the intestinal ureteral diameter of group B is slightly thinner than that of group A.

Since the Yang-Monti ileal ureter is directly matched with the bladder, the anastomosis is large, is it highly prone to reflux? In our experiment, no contrast agent was returned to the upper urinary tract in the two groups. The group A intestine ureter and the lower ureter were anastomosed, and the anti-reflux mechanism between the ureter and the bladder was retained, therefore there was no reflux. In group B, although the intestine ureter directly matched the bladder, the anastomosis was large and directly opened to the bladder, no reflux occurred. We believe that no reflux in group B may be related to intestinal ureteral diameter, because the intestinal ureteral diameter is close to the normal ureter, moreover, the intestine ureter has good elasticity and long length. The ileum still retains its peristaltic function after replacing the ureter, which is beneficial to combat intravesical pressure. This requires further measurement of intestinal ureter, renal pelvis and intravesical pressure to confirm. Secondly, the minipig has a short urethra, good bladder elasticity, and rapid urine emptying, so there is no reflux. Therefore, it is of little significance to establish an anti-reflux mechanism in the Yang-Monti ileal ureter.

The intestinal epithelium is a single-layer columnar epithelium, the urinary tract is a transitional epithelium, and the intestinal tract examination after ileal ureter replacement shows that all the anastomotic regions have unobstructed lumens, no epithelial proliferative changes in the junctional zone, and less than 1 adjacent to the junctional zone. A very short distance of centimeters, migration epithelial metaplasia cover [21]. In the animal experiment of ileal ureter with YM method in rabbits, histological sections at 12 weeks after operation showed that there were stratified transitional epithelial cells crawling to the intestinal mucosa at the anastomosis, covering part of the intestinal mucosa, and the intestinal mucosa on the inner surface of the ureter was obviously atrophied [22]. Minipigs were used for ileal ureteral surgery. The columnar epithelium was still visible in the middle ileum after 3 years of operation. The villi were atrophied and some of the villi became shorter and wider [23]. In our experiment, the histological examination of the intestine and ureter was consistent with the report in the literature. After the ileum was replaced by the ureter, its environment changed, and its histological characteristics also changed. This is the performance of the ileum to adapt to the urine environment. The transitional
epithelium and the columnar epithelium are continuous and replace the segmental columnar epithelium, indicating that the ileum replaces the ureter and maintains the shape and integrity of the epithelium, which may still have a mucosal barrier. Further experimental studies are needed to confirm whether the intestinal mucosal barrier has changed. Secondly, the intestinal mucosa shrinks, the villi become shorter, and the absorption and secretion of intestinal mucosa are correspondingly weakened. This may be related to the absence of obvious metabolic abnormalities and mucus secretion in the clinic. Further studies on the absorption and secretion functions of intestinal mucosal epithelial cells are needed to confirm.

In group A, the distal end of the inferior ureter and the lower end of the ureter were completely obstructed and stenotic. The upper ureter and ureter and renal hydronephrosis were obvious. In group B, one pig was found to have hydronephrosis and the intestine ureter was slightly dilated. Back to the anastomosis is smooth. Histological examination showed that group A found hyperplasia of fibrous tissue and smooth muscle tissue at the anastomosis, supporting stenosis or obstruction. We believe that group A intestinal ureter and ureteral anastomosis, inevitably free of the lower ureter, the ureteral wall is thin, may lead to poor blood supply in the lower ureter, although the ileal ureteral blood supply is good, the effective blood supply between the ureter and the ureter may be poor after the anastomosis, and more fibrosis or scarring occurs after surgery. Therefore, the incidence of stenosis or obstruction and hydronephrosis is higher than that of group B. Group B ureter and bladder directly match the bladder blood supply. Rich, with the intestine ureteral anastomosis at the blood supply, postoperative stenosis or obstruction may not be easy. Although no evidence of hydronephrosis and regurgitation was found in intravenous pyelography and cystography, it was found that there was a porcine hydronephrosis expansion, a mildly dilated ureter, and a visual observation of the intestinal ureteral diameter in group B. Before the thickening, no abnormal changes were found in the short-term imaging examination. Over time, the inguinal ureter may undergo compensatory changes after countering the persistent intravesical pressure.

Conclusions

In summary, we successfully established the Yang-Monti ileal ureteral animal model. Compared with the Yang-Monti ileal ureter-ureteral anastomosis, the Yang-Monti ileal ureter-bladder anastomosis is simpler, more reliable, and less complication. Two kinds of Yang-Monti ileal ureter can be used for the replacement of long ureteral stenosis. The first two methods of anastomosis were compared. We only showed that Yang-Monti ileal ureteral bladder anastomosis was slightly observed in animal experiments. The advantages also need to be further confirmed in clinical applications. We have not observed the experimental animal model for a long time, and it takes more time to confirm it.

Declarations

No conflict of interest exits in the submission of this manuscript, and the manuscript has been approved by all authors for publication. The work described herein is original research that has not been published previously and is not under consideration for publication elsewhere, in whole or in part. All authors of the
manuscript have read and agreed to its content and are accountable for all aspects of the accuracy and integrity of the manuscript in accordance with The Basel Declaration and all agree to the ethical guidelines of the International Council for Laboratory Animal Science (ICLAS), and all agree to the terms of the BioMed Central License Agreement and Open Data Policy.

- **Ethics approval and consent to participate:** The experiment was approved by the Medical Ethics Committee of GuiZhou Provincial People's Hospital.

Refinement refers to the improvement of conditions, the treatment of animals, and the improvement of animal welfare on the basis of scientific principles: or the improvement of experimental procedures and improvement of experimental techniques to avoid or alleviate the pain and nervousness of animals that are not related to the purpose of the experiment. scientific method.

- **Consent to publish:** The manuscript has been approved by all authors for publication.

- **Availability of data and materials:** Not applicable.

- **Competing interests:** The authors declare that they have no competing interests.

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- **Authors' Contributions**

ZW wrote the first draft of the manuscript. ZS,XY, GL, YT, LS, ZS and HL all reviewed the manuscript and were involved in its critical revision before submission. All authors read and approved the final manuscript.

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Tables

Table 1-1 Length of surgical incision and operation time (±s).

| Groups   | Numbers of samples | Surgical incision length (cm) | Operation time (min) |
|----------|--------------------|--------------------------------|----------------------|
| Group A  | 7                  | 30.86±2.41                     | 181.29±15.10         |
| Group B  | 7                  | 26.71±3.64                     | 157.71±20.49         |
| P Value  |                    |                                | 0.01                 | 0.02                 |

Table 1-2 Serum creatinine and urea nitrogen values of each group before and after surgery (±s)

| Groups   | Time                     | Sample number | Cr (μmol/L) | BUN (mmol/L) |
|----------|--------------------------|---------------|-------------|--------------|
| Group A  | Before surgery           | 5             | 102.30±27.60| 5.67±1.34    |
|          | 2 weeks after surgery    | 5             | 113.80±14.22| 7.35±3.63    |
|          | 6 weeks after surgery    | 5             | 117.70±30.09| 6.01±1.37    |
|          | 12 weeks after surgery   | 5             | 102.00±3.89 | 5.69±0.91    |
| Group B  | Preoperative             | 6             | 101.10±22.18| 5.97±1.07    |
|          | 2 weeks after surgery    | 6             | 101.10±5.53 | 6.24±1.08    |
|          | 6 weeks after surgery    | 6             | 102.10±3.99 | 6.11±1.08    |
|          | 12 weeks after surgery   | 6             | 100.70±15.19| 6.35±1.20    |

Table 1-3 Intestinal ureteral diameter (±s).

| Groups  | Number of samples | Intestinal ureteral diameter (mm) |
|---------|-------------------|-----------------------------------|
|         |                   | Intravenous pyelography           |
| Group A | 5                 | 7.26±1.06, 9.40±2.35              |
| Group B | 6                 | 5.90±0.30, 6.62±0.37              |
| P value |                   | 0.01, 0.02                        |

Figures
Figure 1

(a) Two adjacent ileal segments, each 2.5cm long, are isolated and detubularized through longitudinal incisions on one side, 0.5 cm from the mesentery implantation, and (b) two identical pediculated flaps are obtained. (c,d) These flaps are attached by the two short branches and the resulting flap is tubularized; a tube with two long branches separated by two insertions of mesentery is obtained.

Figure 2

(a) is the selection of each segment of the length of 2 cm with independent and complete mesenteric vessels; (b) longitudinally incision three segments of the intestine to form a three-section rectangular intestine; (c) sequential suture of the adjacent intestine The pieces are connected into a long rectangular intestine; (d) the suture is su-tured to form a long tubular structure; (e) the inferior ureter is anastomosed to the lower part of the ureter, and the anastomosis is marked with a blue rectangular frame (f) for the intestine ureter and bladder anastomosis, the anastomosis is marked with a blue rectangular frame.
Figure 3

(a) is a group B intravenous pyelography, (b) is a group A intravenous pyelography, marked with a red arrow, no stenosis obstruction in both groups; (c) a group of cystography, (d) B group cystography, no contrast agent reflux to the upper urinary tract.

Figure 4
(a) Group A inferior ureter and ureteral stenosis at the distal end of the ureter, the stenosis is marked with a red rectangular frame, the upper ureter and ureter and kidney water expansion is obvious, the renal parenchyma is thin, and the kidney is small; (b) The ileal ureter and anastomosis are unobstructed and no hydronephrosis.

![Image]

**Figure 5**

(a) 10×10 transitional epithelium and columnar epithelial mucosa are not close to-gether, there is granulation tissue hyperplasia, lamina propria and fibrous tissue hy-perplasia; (b) 4×10 lamina propria and myometrial fibrous tissue and smooth muscle tissue Hyperplasia, hyaline degeneration; (c) 10 × 10, (d) 40 × 10 on the left side of the transitional epithelium, the right side of the intestinal epithelium, transitional epithelial cells crawling to the intestinal mucosa, covering part of the intestinal mucosa, are marked with red arrows; (e) 4 x 10 normal intestinal villi, (f) 4 x 10 ileal ureteral villi.

**Supplementary Files**

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- supplement1.pdf