BLADDER AUGMENTATION USING THE GASTROINTESTINAL TRACT. INDICATION, FOLLOW UP AND COMPLICATIONS

R. Molina Escudero, G. Escribano Patiño, E. Rodríguez Fernández, M. J. Cancho Gil, E. Lledó García, A. Husillos Alonso, G. Ogaya Piniés, J. Piñero Sánchez y C. Hernández Fernández.

Urology Department. Hospital General Universitario Gregorio Marañón. Madrid. Spain.

Summary.- The purpose of bladder augmentation using the gastrointestinal tract is to create a low-pressure and high-capacity reservoir, permitting suitable continence and voiding, preserving the upper urinary tract.

OBJECTIVE: To analyze the indications, complications and results of our series of augmentation enterocystoplasties.

METHOD: We retrospectively reviewed patients undergoing augmentation enterocystoplasty in our department between 1997 and 2010, both included. The indications were: Interstitial cystitis, neurogenic bladder and inflammatory bladder retraction. In all cases a cystography, urethrocystoscopy, urodynamic study and voiding diary were performed, as well as the specific studies of each condition. Bladder release is performed by means of medial laparotomy and an extraperitoneal approach with bivalve opening to the urethral orifices. The bladder augmentation is performed with a 15-20 cm segment of detubularized ileum obtained at 20 cm from the ileocecal valve; in cases of kidney failure, a 7-cm gastric body wedge is added. The bladder catheter was removed following cystogram after 15 days.

Monitoring was performed by means of ultrasound with postvoid residual, blood analyses, urine culture and voiding diary. We performed a descriptive study of the demographic characteristics, postoperative complications according to the Clavien classification and in the long term.

RESULTS: We included 24 patients, 19 women and 5 men with a mean age of 48.5 years and a median of 47 (21-77). Mean follow up was 7.5 years with a median of 8 (1-11). The indications were: 7 interstitial cystitis, 8 bladder retraction and 7 neurogenic bladder. There were no intraoperative complications. The postoperative complications were 3 Clavien I, 2 type II, 2 IIIA and 1 IIIB.

In the long term, 3 patients presented urinary incontinence, 2 mild metabolic acidosis, 5 required self-catheterization, 6 bladder stones, 2 febrile urinary tract infections and 1 stricture of the anastomotic mouth. In three cases, an ileogastrocystoplasty was performed without hydroelectrolytic impairment or impairment of kidney function.

CONCLUSIONS: In selected patients, augmentation enterocystoplasty constitutes an efficacious therapeutic option in the treatment of lower urinary tract dysfunction with scant morbidity and few complications.

CORRESPONDENCE

Roberto Molina Escudero
Servicio Urología
Hospital General Universitario
Gregorio Marañón
C/ Doctor Esquerdo, 46
28007 Madrid (España)

robersescu@hotmail.com

Resumen.- *La ampliación vesical utilizando el tracto gastrointestinal tiene por objetivo crear un reservorio de baja presión y alta capacidad, permitiendo una continencia y vaciado adecuados, preservando el tracto urinario superior.*

OBJETIVO: Analizar las indicaciones, complicaciones y resultados de nuestra serie de enterocistoplastias de aumento.

MÉTODO: Revisamos retrospectivamente los pacientes sometidos a enterocistoplastia de aumento en nuestro servicio entre los años 1997 y 2010 ambos inclusive. Las indicaciones fueron: Cistitis intersticial, vejiga neurógena y retracción vesical inflamatoria. En todos los casos se realizó cistografía, uretrocistoscopia, estudio urodinámico y diario miccional, así como los estudios propios de cada patología. Mediante laparotomía media y abordaje extraperitoneal se realiza la liberación vesical con apertura bivalva hasta los orificios ureterales. La ampliación vesical se realiza con un segmento de 15-20 cm de íleon detubulizado a 20 cm de la válvula ileocecal; en los casos de insuficiencia renal se añadió una cuña de 7 cm de cuerpo gástrico. La sonda vesical se retiró tras cistografía a los 15 días. El seguimiento se realizó mediante ecografía con residuo postmiccional, analítica sanguínea, urocultivo y diario miccional.

Realizamos un estudio descriptivo de las características demográficas, complicaciones postoperatorias según la clasificación de Clavien y a largo plazo.

RESULTADOS: Incluimos 24 pacientes, 19 mujeres y 5 varones con una edad media de 48,5 años y una mediana de 47 (21-77). El seguimiento medio fue de 7,5 años con una mediana de 8. Las indicaciones fueron: 7 cistitis intersticiales, 9 retracciones vesicales y 8 vejigas neurógenas. No hubo complicaciones intraoperatorias. Las complicaciones postoperatorias fueron 3 Clavien I, 2 tipo II, 2 IIIa y 1 IIIb. A largo plazo 3 pacientes presentan incontinencia urinaria, 2 acidosis metabólica leve, 5 precisan autocateterismos, 6 litiasis vesicales, 2 infecciones urinarias febriles y 1 estenosis de la boca anastomótica. En tres casos se realizó ileogastrocistoplastia sin deterioro hidroelectrolitico ni de la función renal.

CONCLUSIONES En pacientes seleccionados la enterocistoplastia de aumento constituye una opción terapéutica eficaz con escasa morbilidad y complicaciones en el tratamiento de la disfunción del tracto urinario inferior.

Palabras clave: *Enterocistoplastia. Ampliación vesical. Amoniogénesis.*

INTRODUCTION

Bladder augmentation using the gastrointestinal tract is an important tool in the treatment of dysfunction and malformations of the lower urinary apparatus. It is indicated in situations in which the bladder loses its storage, continence or voiding functions.

The objective is to create a low-pressure and high-capacity reservoir, permitting suitable urinary continence and voiding in the absence of vesicoureteral reflux, preserving the upper urinary tract (1).

Historically, the augmentation cystoplasty has been performed using different digestive tube segments: stomach, ileum, sigma and even the cecum, with the ileum being currently the most used.

OBJECTIVE

To analyse the indications, complications and results of our series of augmentation enterocystoplasties.

MATERIAL AND METHOD

We retrospectively revised patients undergoing augmentation enterocystoplasty in our department between 1997 and 2010, both included.

The patients were operated after the different conservative treatment options were exhausted, according to the base condition. The surgical indications were: interstitial cystitis, neurogenic bladder and inflammatory bladder retraction.

The diagnosis of interstitial cystitis was made following the exclusion of other conditions, bladder hydrodistention and according to the NIH criteria (2).

In all cases a urethrocystoscopy and cystography were performed to evaluate the lower urinary apparatus, ultrasound and/or intravenous urography to study the upper urinary tract, urodynamic study, voiding diary and the studies corresponding to the base condition.

The medial laparotomy and extraperitoneal approach were used to complete the cystolysis to the ureteral implantation area with separation of the posterior wall of the peritoneum. The bivalvular opening was performed as far as the urethral orifices. Bladder application is performed mainly with a segment of

detubularised ileum of 15-20 cm to 20-25 cm from the ileocecal valve by means of a U-clip anastomosis with reabsorbable material; in two cases the segment used was sigma. In patients with prior renal failure, a wedge of 5-7 cm of gastric body was added to the intestinal segment in order to prevent alterations in renal function and hydroelectrolytic balance.

Following surgery, the patient remained in digestive rest for 48 hours until the presence of movement. The drainage was withdrawn after 72 hours following analysis thereof and the bladder catheter after 15 days after the absence of urinary leakage had been ascertained in the control cystography.

The choice of intestinal segment and its length depends on the surgeon's preferences due to the aetiology of the disorder, bladder capacity and characteristics of the surgical field.

Monitoring was performed by means of urine culture, blood analyses with venous gasometry, voiding diary and bladder-kidney ultrasound with measurement of post-mictional residue every three months during the first year, every six months as of the second year and annually as of the fifth year.

We performed a descriptive study of the demographic characteristics of the series, we analysed the postoperative complications according to the Clavien (3) classification and we studied long-term alterations: the presence of clinically significant urinary infections, alterations of hydroelectrolytic balance and renal function, urinary incontinence involving the need for absorbents and interfering in patient quality of life, the need for clean intermittent catheterisation and the presence of bladder stones requiring surgical treatment.

TABLE I. POSTOPERATIVE COMPLICATIONS.

CLAVIEN	COMPLICATIONS
I	Paralytic ileus: 2
	Fistula urinaria: 1
II	Bacteraemia: 2
IIIa	Surgery wound infection: 2
IIIb	Intestinal Obstruction: 1

RESULTS

We included a total of 24 patients, 19 women and 5 men with a mean age of 48.5 years and a median of 47 (21-77). Mean monitoring was 7.5 years with a median of 8 (1-11).

The indications were: Interstitial cystitis in 7 cases, 8 patients presented neurogenic bladder (6 for myelomeningocele and 2 for traumatic medullar lesion) and in 9 cases the cause was post-inflammatory bladder retraction (6 cases of genitourinary tuberculosis, 2 for pelvic radiotherapy and 1 for treatment with cyclophosphamide).

In all patients, the digestive tube segment used was the ileum, barring two cases in which the sigma was used. In three cases we performed an augmentation ileogastrocystoplasty due to the presence of previous renal failure.

Average surgery time was 3.5 hours (2 hours 45 minutes- 5 hours 30 minutes). We had no major surgical complications, with one case requiring a transfusion of two red blood cell concentrates.

Eight patients (33.3%) had some kind of postoperative complication. Three complications (12.5%) were Clavien I: two cases of paralytic ileus treated by means of digestive rest, and one urinary fistula treated by means of prolonged uretrovesical catheterisation. Two patients (8.3%) presented bacteraemia by E. coli, although they responded to endovenous antibiotic treatment (Clavien II). Two patients (8.3%) presented surgical wound infection and another (4.2%) intestinal obstruction that required surgical repair without associated intestinal resection (Clavien IIIa and b, respectively).

In terms of long-term complications, 3 patients (12.5%) presented urinary incontinence that required the daily use of absorbents, 2 patients (8.3%) have mild metabolic acidosis on treatment with low doses of bicarbonate. Five patients (20.8%) required intermittent catheterisation due to post-mictional residue, there were 6 cases (25%) of bladder stones that required surgical treatment (5 by endoscopic extraction and one open surgery), with no relapses for the moment. Four of the patients undergoing bladder stone surgery are on treatment with self-catheterisation. Three patients (12.5%) presented 2 or more episodes of febrile urinary tract infection that required long-term antibiotic treatment. There was one case of stricture of the anastomotic mouth of the enterovesical junction 6 months after surgery which was treated by means of transurethral resection, with the patient being currently symptom-free.

TABLE II. LONG TERM COMPLICATIONS.

COMPLICATIONS	N (%)
Bladder stones	6 (25%)
Self-catheterisation	5 (20%)
Urinary infection	3 (12,5%)
Urinary incontinence	3 (12,5%)
Metabolic acidosis	2 (8.3%)

In none of the three patients treated by ileogastrocystoplasty was there any alteration of previous renal function or of hydroelectrolytic balance. No patient in the series presented deterioration of the upper urinary apparatus or of renal function.

In our series we had no second tumours in the intestinal segment used for the augmentation.

DISCUSSION

The first publication on the use of the digestive apparatus in urology dates from the year 1850, when Simon performed a ureterosigmoidostomy in a child with bladder exstrophy (4). In 1899 Mikulicz, (5) described the use of small intestine for bladder augmentation, and Yates subsequently perfected the technique by introducing the detubularised use of the small intestine (6). However, it was not until Lapides (7) introduced clean intermittent catheterisation that the enterocystoplasty began to be used in the treatment of dysfunction of the lower urinary tract, rendering it possible to solve the post-surgical urine retention problems.

Supratrigonal bladder augmentation reduces intraoperative time and simplifies surgery, as no uretero-enteral anastomosis is required, the incidence of vesico-ureteral reflux is diminished as the antireflux mechanism is maintained, and it entails less need for self-catheterisation to permit bladder voiding (8), although according to Huges et al (9) the presence of an inflammatory component in the trigone can condition interstitial cystitis relapse, particularly in young patients. In our series, native ureteral insertion was preserved in all cases, with no relapse of the interstitial cystitis found in any patient.

Although multiple segments of digestive tract have been used, such as ileum, ileocolic, or sigmoid colon, there is no evidence as to which one is best. Works such as those by Benjellou (10) and Rodriguez (11) vouch for the use of distal ileum, which presents less need for intermittent catheterisation. In all cases, it is fundamental to use a detubularised segment to reduce the incidence of high-pressure contractions. In our series there were no differences between the intestinal segments, as we used terminal ileum in practically all of our patients.

The classic approach is the medial laparotomy, although in recent years, due to the development of laparoscopic surgery, some groups have performed this surgery with partial or total laparoscopy (12-14).

The surgical indications of our series were interstitial cystitis, overactive bladder and inflammatory bladder retraction. There are different therapeutic options for the treatment of interstitial cystitis, such as anticholinergics, endovesical instillation of hyaluronic acid or dimethyl sulphoxide and bladder hydrodistention under anaesthesia (15). Approximately 10% of patients are refractory to conservative measures and will require bladder augmentation to correct the symptoms (16).

Patients with neurogenic bladder and affection of the upper urinary tract due bladder hyperactivity are candidates for enterocystoplasty to maintain renal function despite the possibility of needing intermittent self-catheterisation. Inflammatory bladder retraction fundamentally of a tuberculous origin conditions an increase in voiding frequency by reduction of bladder capacity and may involve renal affection due to reflux or bladder voiding disorder, in which cases bladder augmentation is a suitable treatment option.

The most important postoperative complications are derived from the use of the intestinal segment: intestinal fistula of the entero-enteric anastomosis and intestinal obstruction fundamentally by bridles or volvuli (10%).

In our series, most complications were low grade as classified by Clavien, finding a single case of complication IIIB (4.2%) for intestinal obstruction.

The most common long-term complications are (17): repeat urinary infections, bladder stones, mucus production, intestinal absorption disorders, perforated bladder, appearance of second tumours and metabolic disorders.

Urinary infections

Bacteriuria and bacterial colonisation are common following bladder augmentation with the use of intestine, with a febrile infection rate of 13%. The need for self-catheterisation, mucus production and urinary stasis are the main factors involved (18). However, the incidence of urinary infections is lower in patients with self-catheterisation and cystoplasty than in patients with self-catheterisation without surgery. This may be due to lower pressure in the urinary tract and the presence of IgA in urine caused by the intestine which renders bacterial adherence to the epithelium more difficult (19). Significant asymptomatic bacteriuria should not be treated with antibiotics except in cases in which infection is caused by urealytic germs in order to prevent the formation of stones (20). These data are consistent with those found in our series, being the rate of febrile urinary tract infections 12%, being the most frequently isolated germ E. coli.

Bladder stones

The incidence varies from 6% to 50% of patients undergoing augmentation enterocystoplasty (21). There are multiple factors involved in the formation of bladder stones (22). Infection by urealytic germs , urinary stasis or mucus production facilitate the formation of a matrix to which urinary calcium binds. The exposure of the intestinal segment to urine produces urinary alterations such as low levels of pH and citrate and high levels of calcium oxalate, struvite and calcium phosphate. Patients with chronic secondary metabolic acidosis present a greater incidence of urinary calculi, i.e. due to the hypercalciuria secondary to the mobilisation of bone calcium and the increase in calcium reabsorption in the distal tubule and the associated hypocitraturia. No statistically significant differences were found in the incidence of stones depending on the intestinal segment used (23).

The most important preventive measures include guaranteeing proper hydration, avoiding the presence of elevated post-mictional residue by means of self-catheterisation, treating urinary infections caused by urealytic germs, restricting oxalate-rich foods in the diet and performing frequent bladder irrigations with serum to eliminate the mucus.

These data are consistent with those found in our series with a rate of bladder stones 25%, corresponding to 2 / 3 of cases patients with catheterization

Mucus production

The use of the ileum for bladder augmentation is associated with less production of mucus than the sigmoid colon. Mucus contributes to the formation of stones, the development of urinary infections and voiding difficulty. Mucus formation can be reduced with dietary modifications such as by reducing the intake of onion or adding cranberry to the diet. (24). Intestinal absorption disorders: The resection of the terminal ileum may produce malabsorption of fats, bile salts and liposoluble vitamins (A,D, E and K), conditioning a secreting diarrhoea with major water and hydrochloric acid losses. The resection of more than 1 metre of ileum produces an alteration of lipid absorption and bile salts regardless of the presence of terminal ileum and ileocecal valve (25). There is an alteration of the absorption of vitamin B12 (26) in 3%-20% of patients with resection of the terminal ileum. Symptomatic patients may be treated with oral cholestyramine and restriction of fat intake.

Spontaneous bladder perforation (27)

The estimated prevalence is 6%-13%. Aetiologically it has been associated with ischaemia and chronic inflammation caused by bad bladder voiding or trauma on the bladder wall during self-catheterisation. Clinically it is manifested by pain and abdominal distension, usually with fever. The diagnostic technique of choice is computed axial tomography with cystography since cystography alone has an incidence of false negatives of 10-20%. Treatment usually consists of closure by means of open laparotomy, while some cases with small perforations in patients in good clinical condition are handled conservatively. Perforation relapse rate is 25% according to the different series.

Second tumours (28)

The estimated risk of the appearance of second neoplasms is 1-5%, with a mean monitoring time of 17 years. The most frequent variant is intestinal adenocarcinoma, although transitional cell tumours have also been described. Characteristically they present in the vesico-enteric junction in chronic inflammation, and are most common in patients in whom the large intestine is used for the augmentation.

We had no case of neoplasia in the intestinal segment used, although the follow-up of the series is short for the development of tumors.

Metabolic disorders

The factors that determine the metabolic consequences of the contact between urine and the intestinal mucosa are: the intestinal segment used, the surface exposed to the urine, urine retention time, solute concentration and renal functional reserve.

In physiological conditions, in the mucosa of the ileum and the colon there is a double carrier that exchanges hydrogen with sodium and bicarbonate with chlorine, permitting excretion towards the lumen of the former and reabsorption of the latter.

Bladder augmentation surgery with ileum is followed by an increase in sodium reabsorption, which is directly proportional to its concentration in the loop, jointly with an unsaturable linear reabsorption of chlorine which is exchanged with bicarbonate (29).

The continuous absorption of chlorine and sodium generates an increase in intravascular osmolarity, giving rise to a reduction in the secretion of aldosterone and increased vasopressin secretion. This situation induces the formation of a more concentrated urine which, making contact with the intestinal mucosa again, further promotes salt absorption, thus perpetuating the physiopathological cycle (30). These patients would present hyperchloraemic metabolic acidosis. The main mechanism that leads to the production of acidosis is the absorption of ammonium chloride. Ammonia diffuses through the intestinal mucosa in non-ionised form in favour of a concentration gradient, or in ionised form using the K channels. Each ammonia ion absorbed is accompanied by a chlorine ion that is exchanged with bicarbonate (29-30).

When a metabolic alteration occurs in an intestinal bypass, the kidney attempts to correct the disorder by increasing the tubular reabsorption of bicarbonate, eliminating volatile acids in the form of titratable acidity and increasing bicarbonate synthesis (stimulus of renal ammoniagenesis) (29). These compensation mechanisms render it possible to control the acid base balance in patients with normal kidney function. In patients with kidney failure, the use of intestine in bladder augmentation is associated with a clinically relevant deterioration of renal function and metabolic acidosis due to the incapacity to increase the production of ammonia and secrete protons. In these cases, the use of the stomach permits secretion of a proton exchanged with potassium to the lumen, thus helping to avoid the metabolic acidosis conditioned by the poor renal adaptation capacity (29). In our series, the patients with renal impairment were treated by means of ileogastrocystoplasty, rendering it possible to maintain renal function without hydroelectrolytic alterations.

Our study presents limitations, as it is a retrospective and descriptive study with a limited number of patients. However, with regard to the Spanish literature, our series may be regarded as representative. Except in groups such as Rodríguez et al, (11) who performed a global analysis of their series, most of the series address the utility of the enterocystoplasty in specific conditions such as interstitial cystitis with a lower number of cases than ours (15,16), as well as isolated clinical cases (12).

CONCLUSIONS

In our experience, in screened patients, bladder augmentation with use of intestine constitutes an efficacious therapeutic option in the treatment of lower urinary tract dysfunction with minimum morbidity and a lower rate of complications.

The ileum is the most commonly used intestinal segment as it presents a lower rate of subsequent complications.

In patients with chronic kidney failure, the combination of a segment of gastric body with the intestinal segment helps to offset the increase in acid production, maintaining renal function and hydroelectric balance stable.

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