The THAI Journal of SURGERY 2009; 30:66-74.
Official Publication of the Royal College of Surgeons of Thailand

Two New Shapes of Continent Gastric Pouch (Choomsai Gastric Pouch) and a New Technique of a Continent Catheterizable Tube

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Abstract

Objectives: **To evaluate the shape, function, catheterization feasibility and complication of two shapes of continent gastric pouch (Choomsai Gastric Pouch 1 & 2).**

Patients and Methods: **Data of 24 female patients (mean age 53.08 ± 9.32, range 34-68 years) with vesicovaginal (V-V) or vesicovaginorectal fistulae after external beam radiotherapy for cervical cancer treated with two new shapes of continent gastric pouches were collected from 2002 to 2007. There were 12 pouches of Shape 1 from 2002-2004 and 12 pouches of Shape 2 from 2004-2007. Pouchometry was performed after operation with an average of 18.25 ± 13.6 months for Shape 1 and 6.92 ± 6.24 months for Shape 2 (range of Shape 1/Shape 2 = 1-36/3-24 months). Maximum pouch volume and volume at 30 cmH2O of pouch pressure or at 30 cmH2O of the amplitude of pressure wave, if there were contractions of the pouch, were assessed by aspiration. Pouch volume at 30 cmH2O of intra-pouch pressure was classified into 4 grades, i.e. poor (volume of less than 200 mL), fair (volume of 200-300 mL), good (volume of 300-400 mL) and very good (volume of more than 400 mL). Complications such as metabolic disturbances, stomal skin excoriation, disruption or stenosis of skin-gastric tube anastomosis and problem of catheterization were evaluated.**

Results: **There was no peri-operative mortality. After gastric pouch construction, three patients with Shape 1 pouch died at 6, 8 and 30 months respectively; one with V-V fistula from external beam radiotherapy developed generalized metastasis, another one with recurrent cervical cancer received chemotherapy and the third one with arterial occlusion of left leg had severe pressure sore and septicemia after amputation. The Shape 1 pouch was triangular shaped or "Pizza puff" and Shape 2 was barrel-shaped. Average pouch volume at 30 cmH_2O of Shape 1 (8 patients) was 396 ± 120.28 (range = 233-540) mL. Of these patients, four (50%) were very good, two (25%) were good and two (25%) were fair. There was one who had leakage at volume of 233 mL and had catheterization interval of 3-4 hours. Compared with patients of Shape 2 pouch (12 patients), average volume at 30 cmH_2O was 377.5 ± 117.41 (range = 200-550) mL ($p = 0.76$). In patients with the Shape 2 pouch, 4 (33.33%) were very good, 4 (33.33%) were good, and 4 (33.33%) were fair. For post-operative complications, patients with Shape 1 pouch had catheterization difficulty with stomal skin excoriation in three cases and stenosis of skin-gastric tube anastomosis in two cases. Two of Shape 2 pouch had partial disruption of skin-gastric tube anastomosis with stomal skin excoriation and one had catheterization difficulty due to stenosis of the anastomosis. Twenty three patients (95.83%) were dry with a catheterization interval of 4-6 hours. One patient of Shape 2 pouch had right pouch-ureteral reflux (PUR). Mucous production of both pouch shapes was clear and thin. Therefore, it was unnecessary to perform everyday pouch irrigation. Metabolic disturbance was not found in this series.**

Conclusions: **The results of this study suggest that body segment of stomach is the best part of GI tract to be used for creating urinary reservoir with good appearance and easy catheterization, especially of Shape 2 pouch. All are acceptable continence (dry interval of 3-6 hours) with safe pressure and easy care. No metabolic abnormalities are found in early or late follow-up.**

Key words: **cervical cancer, continent stomas, gastric pouch, post radiation, v-v fistula**

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INTRODUCTION

Various continent reservoirs have been used for orthotopic bladder substitution or continent urinary diversion. Most of them are ileal, ileocecal or colonic pouch for treating severe bladder damage such as severe interstitial cystitis, neuropathic bladder with small and thickened bladder, vesicovaginal or vesicovaginorectal fistulae after radiotherapy for cervical cancer. All of them have more or less complications. Therefore, the ideal pouch should provide: 1) low pressure reservoir for preserving upper tract and renal function, 2) complete continence for acceptable intervals usually greater than 3 hours with easy catheterization, 3) less mucous production and easy to care, and 4) normal acid-base and electrolyte balance.[1,2]

Metabolic derangements may develop whenever urine is in contact with segments of intestine used for construction of reservoir because of its absorption and secretory functions. In case of the stomach, it acts as a reservoir for ingested food and facilitates digestion through a variety of secretory and motor functions. Stomach secretory functions include the production of acid, pepsin, intrinsic factors, mucous, and GI hormones. Its motor functions include food storage (receptive relaxation and accommodation), grinding and mixing, controlled emptying of ingested food, and periodic inter-prandial housekeeping.[3,4] In addition, gastric tissues are impermeable to most ions, particularly chloride ion which is transported into urine, thus, offers a protective mechanism against metabolic acidosis, especially in case of renal failure and the stomach has clear and thin mucous which is easy to be evacuated. Therefore, the opportunity for stone formation is also reduced.[4]

Sinaiko had published the first study of using gastric segment as a bladder replacement in 1956.[5] Thereafter, several modifications were introduced.[6-8] At present, there were only few publications dealing with continent gastric reservoir construction and the ideal pouch has yet to be found. The purposes of the present study were to evaluate the pouch named "Choomsai gastric pouch 1 & 2" clinically and to compare the shape, capacity, catheterization feasibility and surgical complications between the two pouch shapes.

PATIENTS AND METHODS

Between February 2002 and September 2007, 24 female patients with vesicovaginal and vesicovaginorectal fistulae after external beam radiotherapy (mean = 10.6 ± 9.46 years, range = 1.5-30 years) for cervical cancer underwent continent gastric pouch construction. Mean patient age was 53.08 ± 9.32 years (range 34-68 years). Pre- and post-operative serum BUN, creatinine (Cr) and elec-trolytes were assessed. Two shapes of continent gastric pouches were created. Shape 1 pouch construction was performed in 12 patients between February 2002-June 2004. Between July 2004 -May 2007, Shape 2 pouch was constructed in other 12 female patients. A bowel preparation was not required for all patients. Informed consent was obtained from all patients before operation.

Surgical Technique

Midline transperitoneal incision was performed from xiphoid to just above the pubic symphysis. After exploratory laparotomy, the stomach was exposed. The greater omentum was separated first from the gastroepiploic vessel (right and left) by staying away from it about 3-4 cm. Each individual large vessel of the omentum was ligated and divided. To prevent shortening of the pedicle and slipping of the ligatures, mass ligation must be avoided.

For mobilization of the right gastroepiploic vessel as a pedicle of the segment of gastric body, each gastric branch of the right gastroepiploic vessel to the antrum was ligated and divided individually near the stomach wall by starting at the point where the line drawn from the angular notch at about 45° from the vertical struck the greater curvature at the arbitrary termination of the body,[9] (similar to the line perpendicularly strikes the greater curvature). Above this line was the proposed gastric body, and then working to the pylorus or the gastroduodenal artery. On the lesser curvature, dissection was started at just above the angular notch to preserve crow's foot and nerve of Latarjet by ligation and division of short vessels of anterior and posterior branches of the left gastric vessel close to the serosa of the stomach and working upwards about 5-6 cm long. The length of gastric segment starting at the arbitrary termination of the body along the greater curvature upwards is about 12 to 15 cm (average 13 cm) long and from angular notch on the lesser curvature about 4-5 cm long depending on the stomach size and shape. If it had an elongated shape, the length should be 14-15 cm, and another small segment with size of about 22 Fr

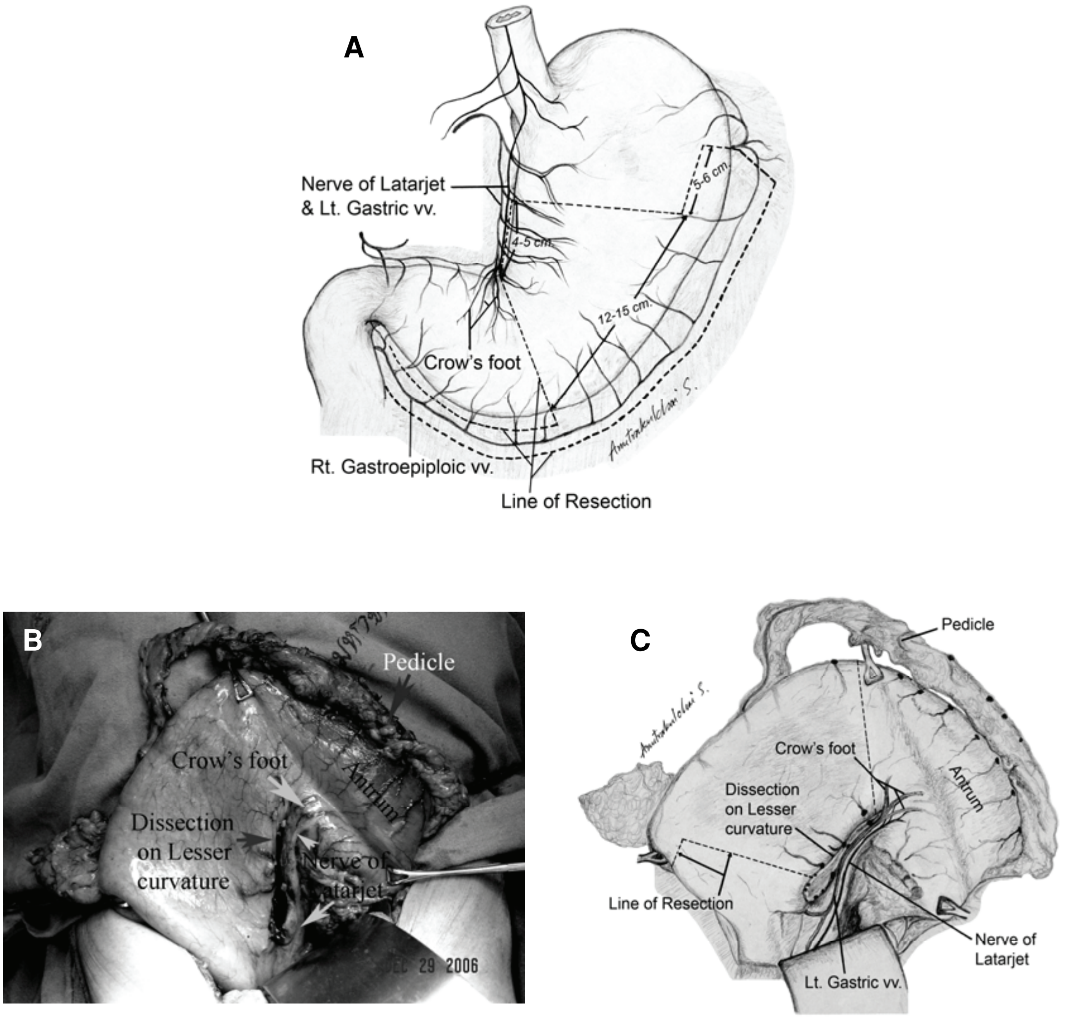
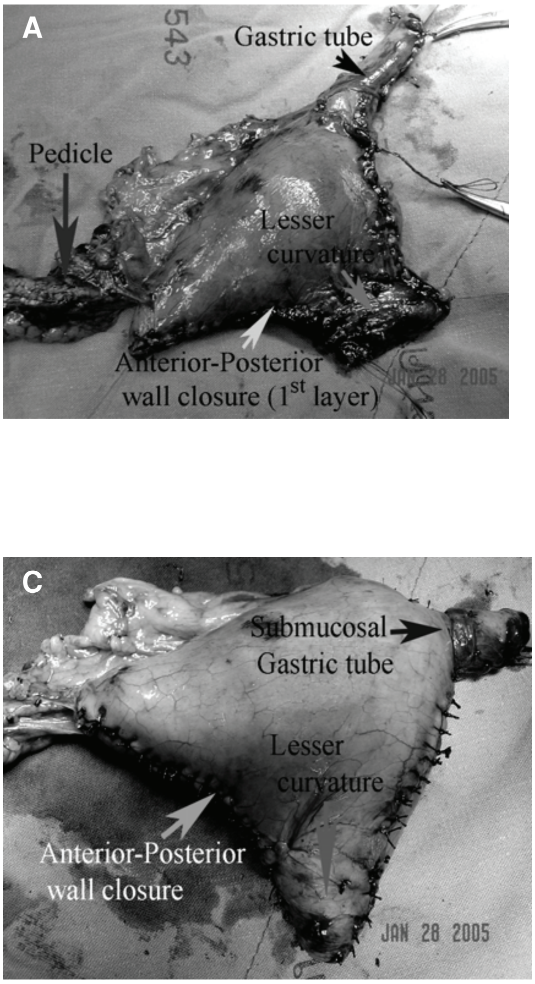


Figure 1 A, Scheme of resected area for pouch construction; B, Picture; and C, scheme of stomach portion after dissection

catheter extending contiguously from the main segment along the greater curvature of about 5-6 cm long must be preserved for creating the pouch and the catheterizable tube, respectively (Fig. 1A-C). The newly constructed gastric pouch with tube segment was incised between the two atraumatic bowel clamps and brought with its blood supply through the avascular area of transverse mesocolon and ileocolic mesentery into the pelvis. The residual stomach segments were anastomosed to each other in one or two layers with 4-0 or 5-0 polyglactin (vicryl) suture.

For construction of the Shape 1 pouch, the distal end of the gastric segment was closed in two layers by suturing the anterior and posterior leaflets with running interlocking 5-0 polyglactin sutures. The upper end was also closed in two layers with running interlocking 5-0 polyglactin sutures except at the intended gastric tube portion which was formed into the tube by tapering snugly over a 14 Fr Foley's catheter before closing in layers with running interlocking 5-0 polyglactin sutures. This catheter was left in the pouch and then, the submucosal trough was created for embedding the tube in the pouch wall by starting detaching seromuscular layer of both leaflets of the pouch from underlying mucosal layer at the entrance of the tube about 3-4 cm long. Thereafter, both seromuscular layers were closed over the tube with interrupted 5-0 polyglactin sutures (Fig. 2A-E). For construction of the Shape 1 pouch, the distal end was first closed by suturing the leaflet on the greater curvature side to the lesser curvature side with running interlocking 5-0 polyglactin sutures in two layers. The upper end was also closed as was Shape 1 pouch. For creating the catheterizable tube, only mucosal layer was tapered and sutured together over 14 Fr Foley's catheter with running interlocking 5-0 polyglactin sutures. To



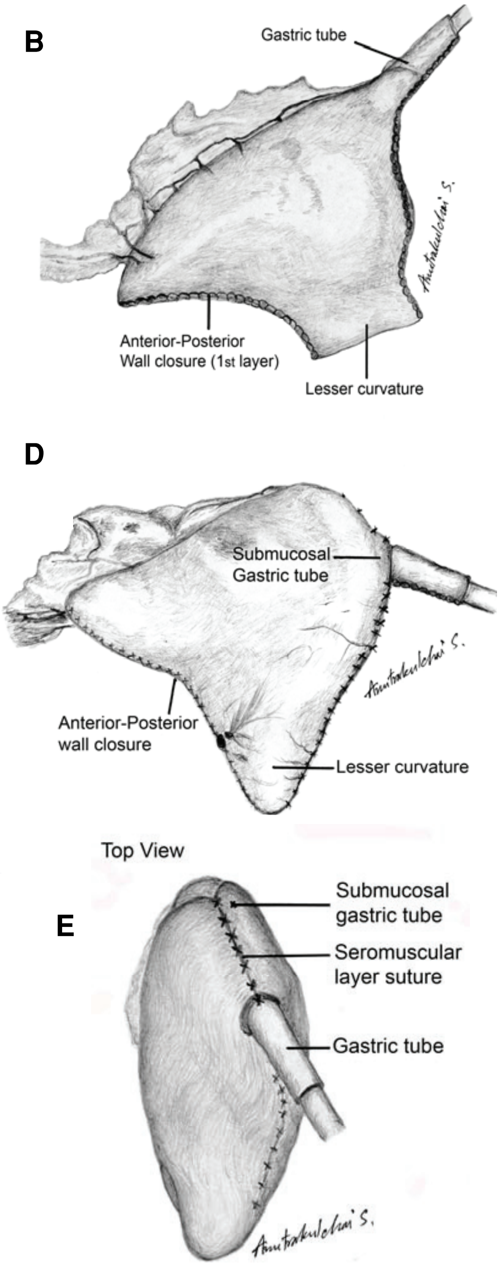


Figure 2 The continent gastric pouch shape 1. A-B, 1st layer closure of upper and lower end; C-E, 2nd layer closure and embedding of the gastric tube submucosally.

strengthen the tube, the seromuscular layer of one side was undermined to form space for placing the opposite seromuscular wall over the mucosal layer, and it was sutured to the other seromuscular wall with horizontal mattress 5-0 polyglactin sutures, and then overlapping with the rest. This overlapping wall would act like a compressible lid. After this, the tube was embedded in submucosal position of the pouch wall as was Shape 1 pouch (Fig. 3A-H).

After the pouch construction was completed, the mobilized ureters cut at just below common iliac artery were reimplanted submucosally into the base of the pouch about 3-4 cm long by using extra-vesical technique (Fig.4A-B), no ureteral stenting was necessary. Then, the pouch was placed into the pelvic cavity by fixing its base to just below the promontory of sacrum with 3-0 polyglactin suture, and the top of the pouch was fixed to posterior abdominal wall with 4 interrupted 3-0 polyglactin sutures, 2 each on wall of the top adjacent to the submucosal part of gastric tube. The catheterizable gastric tube was placed in the midline of lower abdomen between umbilicus and pubic symphysis. For reducing excoriation of peristoma due to stomal secretion, the skin tube was formed to fit

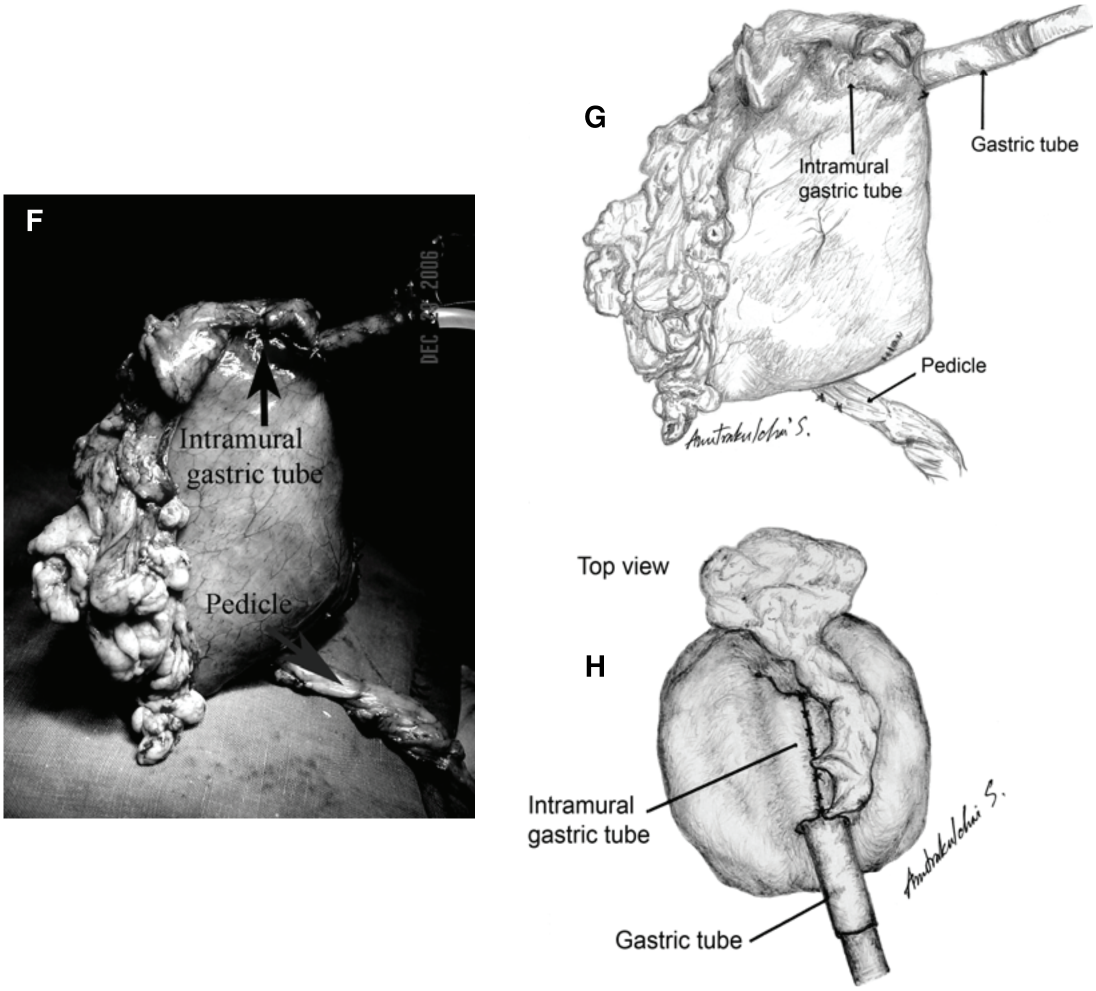


Figure 3 Construction of the pouch and continent catheterizable tube shape 2. A-B, suturing of lesser to greater curvature on the distal end; C, tubularization of mucosal tube with 14 Fr Foley's catheter; D-E, covering mucosal tube with seromuscular leaflet and overlapping of seromuscular leaflet; F-H, completion of the construction.

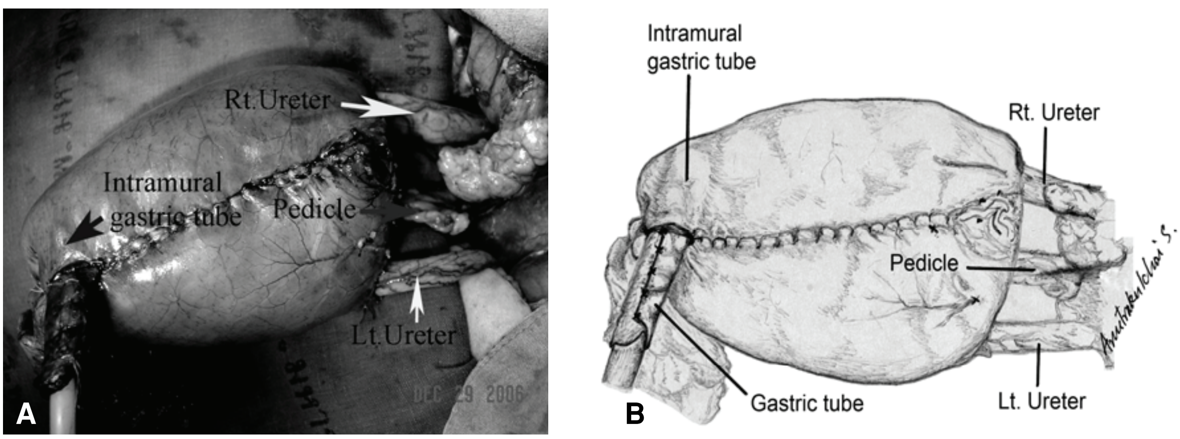


Figure 4 Bilateral ureteral re-implantation into the base of gastric pouch (A and B).

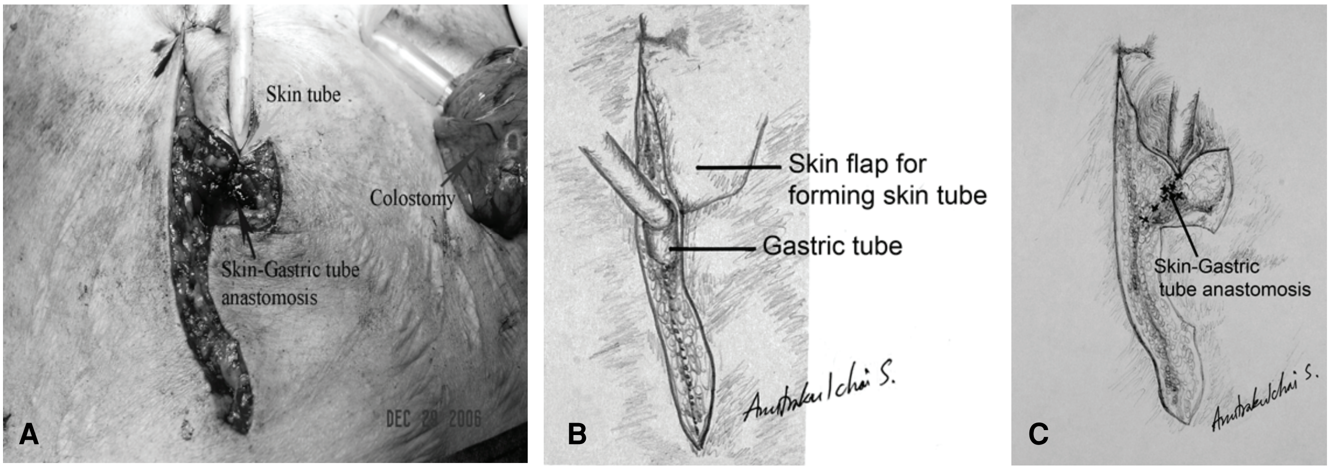


Figure 5 Construction of skin tube for catheterizable stoma (A-C)

to 14 Fr Foley's catheter of about 1-2 cm long and anastomosed to the gastric tube (Fig. 5A-C).

Postoperative Management

The stomal catheter was left in place for three weeks. Pouch irrigation was performed for 4-5 days postoperatively, if necessary. H_2 blockers or proton pump inhibitors were given if the patients had urine pH below 5 or symptoms of heartburn and/or dyspepsia. Clean intermittent self-catheterization (CISC) every 4-6 hours could be started after stomal catheter was removed.

Evaluation

After gastric pouch construction, three patients with Shape 1 pouch died at 6, 8 and 30 months respectively; one who developed V-V fistula after 18 months of external beam radiotherapy had generalized metastasis, another one was due to adverse reactions to chemotherapy for treating recurrent cervical cancer, and the third one had septicemia from severe pressure sore after amputation of left leg due to arterial occlusion. These three patients had no leakage or complications after operation even at the end of their lives. The data of 12 Shape 1 pouches (including three of the dead patients) and 12 Shape 2 pouches were assessed for stomal status and catheterizability. Only 21 patients whose serum BUN, Cr, electrolytes and urine pH were examined before surgery and at 1 to 36 months (average 15.7 ± 13.6 months) post-operatively. Since the serum BUN, Cr, and electrolytes and the urine pH varied considerably among patients, the last values of each parameter were therefore used for statistical analysis.

One of the remaining nine patients with Shape 1 pouch denied pouchometry, therefore pouchometry was performed only on eight patients with Shape 1 pouch and 12 patients with Shape 2 pouch in supine position with an average of 18.25 ± 13.6 months for Shape 1 pouch and 6.92 ± 6.24 months for Shape 2 pouch (range of Shape 1 pouch/Shape 2 pouch = 1-36/3-24 months) post-operatively with 7 Fr double-lumen catheter connected to Janus V 3.7 (Life Tech Inc.). Telebix was used as an infusion medium at a rate about 10% of its pouch capacity (cal-culated from frequency/volume chart). Measurement of maximum pouch volume was obtained by aspiration after filling to maximal feeling of distension or leakage around stoma and pouch volume at 30 cmH_2O of intra-pouch pressure or at 30 cmH_2O of the amplitude of pressure wave caused by pouch contractility shown on tracing (this pressure is safe for upper tract and can be used for regulating catheterized interval).[10-12] Pouch volume at 30 cmH_2O was classified into 4 grades; poor (if <200 mL), fair (200-300 mL), good (300-400 mL), and very good (>400 mL). The Mann-Whitney U test was used for statistical analysis and $p < 0.05$ was considered significant.

RESULTS

There was no peri-operative mortality and 23 of 24 patients were totally continent day and night with catheterization intervals of 4-6 hours. Only one patient of shape 1 pouch having daytime leakage at pouch volume of 233 mL in upright position had catheterization intervals of 3-4 hours. The Shape 1 pouch was triangular shaped or "Pizza puff" and the Shape 2 was barrel-shaped.

Of 12 patients with Shape 1 pouch, three had stomal skin excoriation and catheterization difficulty, one of which was due to its stretchable wall by the tip of catheter and solved by using larger bore catheter (10 to 14 Fr) and the remaining two due to stenosis of skin-gastric tube anastomosis which were treated by stomal revision after failure of dilatation. One had blood-stained stoma after catheterization, and another one had incontinence at pouch volume of 233 mL (Table 1). Of 12 patients with Shape 2 pouch, two had partial disruption of skin-gastric tube anastomosis with stomal skin excoriation which were completely healed after two months and one had stomal stenosis causing catheterization difficulty which was treated by stomal dilatation. Two had blood-stained stoma after catheterization (Table 1). Pouch-ureteral reflux (PUR) was found in one ureter (Table 1) because of inadequate intramural ureteral length. Pouch ischemia or perforation, especially on the lesser curvature, was not found in both shaped pouches.

Mean maximum volumes of Shape 1 and Shape 2 pouches were 435 ± 139.56 mL (range, 233-600 mL) and 413.25 ± 105.05 mL (range, 276-565 mL), respectively ($p = 0.70$) whereas mean maximum pressures were 33(10.77 cmH_2O (range = 17-47 cmH_2O) and 41.17(17.46 cmH_2O (range, 20-75 cmH_2O) ($p = 0.56$) (Table 2). Mean pouch volumes of Shape 1 and Shape 2 pouches at 30 cmH_2O were 396 ± 120.28 mL (range, 233-540) and 377.5 ± 117.41 mL

Table 1 Stomal complications of Shape 1 and Shape 2 pouches

Complication*	Shape 1 pouch (12 cases)	Shape 2 pouch (12 cases)
Partial disruption of skin-gastric tube anastomosis	-	2 (16.7%)
Stenosis of skin-gastric tube anastomosis	2 (16.7%)	1 (8.3%)
Stomal skin excoriation	3 (25%)	2 (16.7%)
Catheterization difficulty	3 (25%)	1 (8.3%)
Blood-stained stoma after catheterization	1 (8.3%)	2 (16.7%)
Pouch-ureteral reflux (PUR)/ureter	-	1 (8.3%)
Incontinence	1 (8.3%)	-

*Individual patient may have more than one complication.

Table 2 Pouchometry of Shape 1 and 2 continent gastric pouches

Parameter	Shape 1 pouch (8 cases)	Shape 2 pouch (12 cases)	p value
Post-operative pouchometry, mo (range)	18.25 ± 13.6 (1-36)	6.92 ± 6.42 (3-24)	-
Maximum volume, mL (range)	435 ± 139.56 (233-600)	413.25 ± 105.05 (276-565)	0.70
Maximum pressure, cmH_2O (range)	33 ± 10.77 (17-47)	41.17 ± 17.46 (20-75)	0.56
Volume at 30 cmH_2O, mL (range)	396 ± 120.28 (233-540)	377.5 ± 117.41 (200-550)	0.76
No. of patients having volume of			
> 400 mL (very good)	4 cases (50%)	4 cases (33.3%)	-
300-400 mL (good)	2 cases (25%)	4 cases (33.3%)	-
200-299 mL (fair)	2 cases (25%)	4 cases (33.3%)	-
< 200 mL (poor)	None	None	-

Table 3 Serum chemistry and urine pH of Pre- and post-operative studies of 21 patients with mean follow-up 15.7 ± 13.6 months

Parameter	Pre-operative	Post-operative	p value
BUN (mg/dL)	19.29 ± 8.23	16.90 ± 10.59	0.001
Cr (mg/dL)	1.70 ± 0.97	1.31 ± 0.62	0.019
Na (mmol/L)	139.38 ± 7.34	139.14 ± 3.40	0.711
K (mmol/L)	3.79 ± 0.53	3.68 ± 0.47	0.081
Cl (mmol/L)	106.95 ± 6.18	103.95 ± 6.44	0.483
CO_2 (mmol/L)	23.95 ± 3.53	26.33 ± 4.28	0.043
Urine pH	-	6.55 ± 1.05 (5-8)	-

(range, 200-550 mL), respectively (p = 0.76) (Table 2). Of 8 Shape 1 pouches, four (50%) were classified as very good, two (25%) were good, and two (25%) were fair. On the other hand, of 12 Shape 2 pouches, 4 (33.33%) were classified as very good, 4 (33.33%) were good, and 4 (33.33%) were fair. Importantly, no pouch of both shapes was in the poor grade category (Table 2).

Pre- and post-operative serum BUN, Cr, Na , K, Cl, and CO_2 were 19.29 ± 8.23 and 16.90 ± 10.59 mg/dl (p = 0.001), 1.70(0.97 and 1.31 ± 0.62 mg/dl (p = 0.019), 139.38 ± 7.34 and 139.14 ± 3.40 mmol/L (p = 0.711), 3.79 ± 0.53 and 3.68 ± 0.47 mmol/L (p = 0.081), 106.95 ± 6.18 and 103.95 ± 6.44 mmol/L (p = 0.483), and 23.95±3.53 and 26.33 ± 4.28 mmol/L (p = 0.043), respectively (Table 3). Postoperative urine pH was 6.55(1.05 (range, 5-8) (Table 3).

Discussion

The ideal part of the GI tract to be used for constructing urinary reservoir has not yet been found. The stomach segment, especially the gastric body could be an ideal material for urinary reservoir. It provides a low pressure storage function for the urinary content similar to the native bladder, produces thin mucous and hydrochloric acid and does not absorb urinary constituents. The new shapes of continent catheterizable gastric pouch in the present study suggest an attitude of optimism about simple surgical technique, catheterization feasibility, fewer complications, and low or acceptable pressure reservoir. Minor complications were equally found in both shaped pouches. Of five patients having stomal skin excoriation caused by mucous exuded from gastric tube to accumulate in the skin tube portion could be easily managed by wiping off with cotton bud and applying steroid with antibiotic cream inside and around the stoma. Only 3 of 24 pouches had stomal stenosis, of which 2 required stomal revision. Of four patients (three with Shape 1 and one with Shape 2 pouches) with catheterization difficulty, CISC could be managed with ease after correction of minor complication. One who had daytime incontinence could be managed by CISC every 3-4 hours. Pouch-ureteral reflux (PUR) occurring at the volume of 315 mL was successfully treated by CISC every 4-5 hours, and the refluxing ureter could easily drain urine into the pouch. An ischemia of the lesser curvature which is of concern does not occur because the stomach is the richly vascularized portion of GI tract and has the extensive anastomotic connections.[3]

There were no significant differences in maximum volume, maximum pressure, and volume at pressure of 30 cmH_2O between Shape 1 and Shape 2 pouches in the present study. Lin et al[13] reported eight male patients undergoing orthotopic gastric neobladder construction using Mitchell's technique. The urodynamic parameters of all men after long-term follow-up are not satisfactory. Their average maximum capacity of 309 mL with mean compliance of 27 mL/cmH_2O is lower than the ileal or ileocecal neobladder with average maximum volume of 525-572 mL and mean compliance of 52-66 mL/cmH_2O. Acar et al[14] performed urodynamic study of the gastric pouch on six men who had undergone radical cystectomy, the mean maximum capacity is 376 mL (before meal) with mean compliance of 24.4 mL/cmH_2O. Five of six patients in this report are satisfied with this procedure. However, the individual pouch capacity varies, depending on the stomach size and shape, the greater the degree of the width, the greater capacity of the pouch. Due to the length of the stomach resected that is rather limited, therefore, barrel shape gives the greater capacity than cylindrical or elongated shape according to LaPlace's law.

Gosalbez et al[1] reported hypochloremic and hypokalemic metabolic alkalosis disturbances in two pediatric patients who underwent gastrocystoplasty. However, these complications were not found in our series and some patients even had significant improvement of post-operative serum BUN, Cr and CO_2, and no patient had post-operative urine pH less than 5. Nevertheless, 2 of 5 patients having stomal skin excoriation received oral proton pump inhibitor, omeprazole 20 mg once daily on several occasions because of burning symptom inside the pouch, but their urine pH was in the range of 5.5 to 6.5. In contrast, Koraitim et al[4] reported that all 10 patients after gastrocystoplasty have urine pH of 5 or less. In our study, mucous production of the gastric pouch was thin and clear which was easy to evacuate during catheterization, thus, everyday pouch irrigation was unnecessary.

CONCLUSION

The use of gastric body for creating both shapes of the pouch in the present study was technically simple operations and provided attractive alternatives to other continent pouches. There were no differences in the capacity and pressure between Shape 1 and Shape 2 pouches, except for more minor complications of skin excoriation and catheterization difficulty with Shape 1 than Shape 2 pouches. Although the gastric pouch has physical properties similar to other intestinal pouches, it provides additional advantages of thin and clear mucous production, few or no metabolic abnormalities, lower risk of urinary tract infection, easy catheterization and care, and minimizing the need of daily irrigation. Thus, it meets most of the criteria for an ideal pouch and should be used for patients with severely damage bladder from interstitial cystitis or for patients with neurogenic lower urinary tract dysfunction with small bladder and poor hand function.

ACKNOWLEDGEMENTS

We wish to express our special thanks to Professor Vorvat Choomsai, the pioneer of urology in the north of Thailand for allowing his name to be used for the continent gastric pouch under this study and to Professor Sanit Makonkawkeyoon and Associate Professor Chaichan Sangdee for careful criticism of the manuscript.

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