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The Incidence of Urinary Tract Calculi After Small-Intestinal Bypass Operations for Treatment of Obesity

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Summary. Jejunoileal bypass operations have been used for more than 20 years for the treatment of massive obesity. This treatment results in malabsorption with diarrhoea, especially during the first year after the operation. A high incidence of urinary tract calculi have been found in these patients (4, 5, 15, 19, 24). Other known late complications are transient disturbances in liver function and electrolyte balance (5).

Key words: Jejunoileal bypass, Urinary calculi.

The aim of the present study was to estimate the frequency of urinary tract calculi in patients undergoing two types of intestinal bypass procedures for treatment of obesity and to seek possible differences in stone incidence between the different groups of patients.

MATERIAL AND METHODS

This is a retrospective study of 176 patients (48 men and 128 women) who underwent intestinal bypass because of obesity between 1969 and 1977. Clinical data on the patients are detailed in Table 1. All patients have been followed for at least 6 months. 140 out of 176 patients have been followed for 2 years or more after the operation and none of them had urinary tract calculi preoperatively.

The patients underwent two types of jejunoileostomies, either end-to-side (25) in 89 patients (57 followed for 2 years or more) or end-to-end with ileocaecostomy (12) in 87 patients (83 followed for 2 years or more) (Fig. 1).

Ten patients had pre-operative urinary tract calculi and were therefore excluded from the following estimation of the post-operative frequency of stones. Six of these were operated on with end-to-side anastomosis and 4 with end-to-end anastomosis.

After the operation all patients received vitamin B6 (300 mg/day), folic acid (5 mg x 3), vitamin B12 and polyvitamin preparations.

The rate of weight loss (b-value) during the period of main weight loss was recorded as the weekly change in Broca's body-height-weight index (21). A rate of weight loss of 0.013 weight-index-units per week (about 1 kg/week) was considered optimal (6).

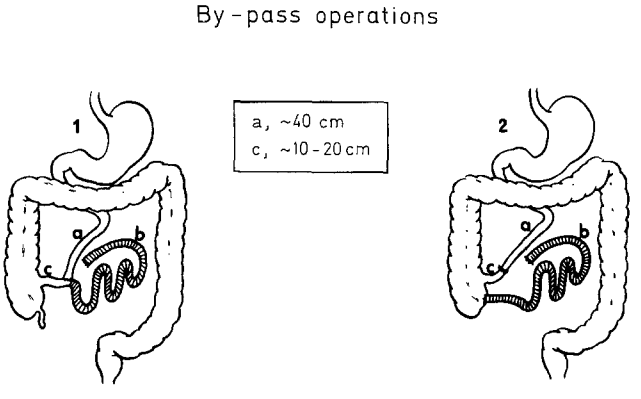

Fig. 1. 2 types of intestinal bypass operations for treatment of obesity in the present study
1: End-to-side jejuno-ileostomy (25). 2: End-to-end jejuno-ileostomy with ileo-caecostomy (12)

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Table 1. Data (mean and range) on 176 patients before and after jenunoileal bypass operations for treatment of obesity and their grouping according to complications. A. All operated patients. B. Patients with postoperative urinary tract calculi including 5 patients with liver injury and/or electrolyte disturbance. C. Patients without postoperative calculi. D. Patients with postoperative signs of liver injury and/or electrolyte disturbances including 5 patients with stones

Group	n	Age (years)	Preoperative body-weight (kg)	Preoperative body-height-weight index (Broca's index)	Postoperative rate of weight loss (index/week)
A.	176	37.4 (17-62)	136.2 (84-227)	1.95 (1.48-3.28)	0.010 (0.002-0.026)
B.	38	36.1 (22-52)	138.9 (113-176)	1.92 (1.58-2.75)	0.010 (0.003-0.017)
C.	138	37.8 (17-62)	135.2 (84-227)	1.98 (1.48-3.28)	0.011 (0.002-0.026)
D.	26	39.0 (26-53)	143.0 (105-180)	2.04 (1.50-2.75)	0.014 (0.004-0.023)

Blood samples for determination of electrolytes (S-Na, S-K, S-Ca, S-Mg, S-P), and liver function tests were obtained after an overnight fast before the operation and at intervals after the operation.

The definitions of some post-operative complications are as follows:

a) Urinary tract calculi with at least three of the following criteria: 1) renal colic, 2) haematuria, 3) stone passage, 4) intravenous pyelography showing stone, urinary tract stasis or ostial oedema. The incidence of calculi was expressed as the number of stones in a population of 1,000 individuals per year of observation. The incidence studied was either that of all stones or that of the first calculus (see text and tables).

b) Signs of liver injury of longstanding (more than 26 weeks), continuous absormality in five (or more) of the seven "liver tests": S-ASAT, S-ALAT, S-ALP, S-Bilirubin, S-LD, P-Prothrombin complex (Normotest) and S-Albumin (5).

c) Electrolyte disturbances of longstanding (more than 26 weeks), continuous simultaneous subnormal serum concentrations in S-Calcium, S-Potassium and S-Magnesium.

Conventional statistical methods were used (30).

RESULTS

Thirty-eight patients had urinary tract calculi after the operation, 6 of them also had pre-operative stones and are therefore excluded. Four patients with pre-operative calculi had no recurrence after the bypass operation.

Of the 32 patients developing their first calculus post-operatively there were 7 (out of 83) with an end-to-side anastomosis, and 25 (out of 83) with an end-to-end anastomosis. The difference in the incidence of urinary tract calculi in patients operated by the two methods was significant (χ^2: 11.52, $P < 0.001$).

The stone incidence in a sample of the Swedish population and in bypass operated patients is shown in Table 2. The stone incidence during the first two years after the bypass was 48 after end-to-side, and 121 per 1,000 individuals per year after end-to-end anastomosis, compared to 1/1,000 per year in the general population (1, 23). The difference in incidence of stones in patients operated by the two operative methods and observed for two years was significant (χ^2: 5.41, $P<0.05$).

18/48 (38%) of the men developed calculi but only 20/128 (16%) of the women.

The patients who developed stones were of the same age, had about the same pre-operative body-

Table 2. The incidence of urinary tract calculi per 1000 individuals per year in the general Swedish population and in our subjects after intestinal bypass for treatment of obesity

	Subjects n	Observation time (years)	Subjects with first stone n	Incidence of stone
General population				
(5)	285, 000	5	1429	1. 0
(23)	145, 000	1	138	1. 0
Jejuno-ileostomies (present series)	140	2	25	89
End-to-side anastomosis (present series)	57	2	5	48
End-to-end anastomosis (present series)	83	2	20	121

weight, had the same body-height-weight index (Broca' s), as the average of all operated patients (Table 1).

The patients operated with end-to-end anastomosis had a significantly ($P < 0.01$) higher rate of weight loss (b-value) than those operated with end-to side anastomosis. The patients who developed stones after the operation had about the same rate of weight loss (b-value) as the average of all operated patients (Table 1)

On the other hand, patients with signs of liver injury or electrolyte disturbance post-operatively had significantly ($P < 0.001$) higher rate of weight loss than the average of all the operated patients (Table 1).

The time (months post-operatively) for the appearance of the first sign of stones is given in Figure 2. Twenty-five of the 32 stones appeared within the first two years after the operation. In 11 patients the first calculus appeared within the first year post-operatively and only one had undergone an end-to-side anastomosis. There was no significant difference in the post-operative rate of weight loss in the 11 with stones in the first post-operative year compared to the 21 who got stones more than one year after the operation.

There were no differences in pre-operative liver function tests or in post-operative concentrations of S-Ca, S-Mg or S-P in stone and non-stone patients.

The percentage of patients with the first calculus after the operation was about the same in patients operated during different years (Table 3). In five

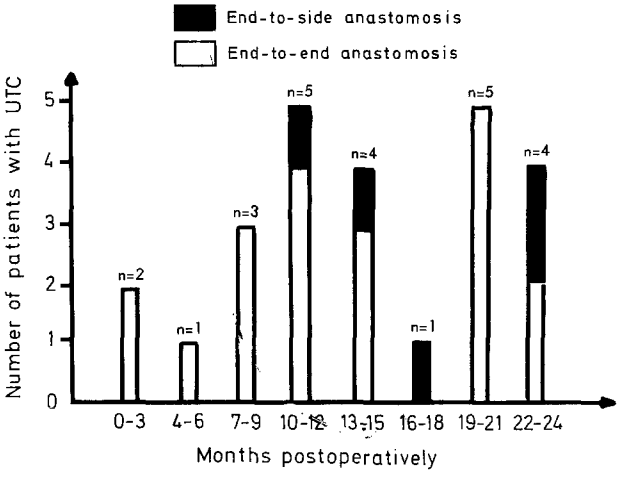

Fig. 2. The time (months postoperatively) for signs of the first urinary tract calculus in 140 patients followed for 2 years after 2 types of intestinal bypass operations (end-to-side anastomosis, n = 57, end-to-end anastomosos, n = 83) for treatment of obesity. None of the patients had stone before the operation

cases the first stone appeared more than 2 years after the operation.

The incidence of the first stone during the period July 1972-May 1974 was 2. 4/month and after that period 1. 7/month (Fig. 3).

20/32 (62. 5%) of the stone patients developed only one stone during the observation time of 2 years (Fig. 4).

Table 3. The number of first urinary tract calculi after jejunoileal bypass operations for treatment of obesity, in patients operated during different years. All patients are followed at least 2 years. A. Stone within the first 2 years after the operation; B. Stone more than 2 years after the operation

Year	Number of operated patients	Number of patients with first stone	
		A	B
1970	n = 8	n = 1 (13%)	0
1971	n = 24	n = 4 (17%)	1
1972	n = 32	n = 7 (22%)	3
1973	n = 21	n = 5 (24%)	0
1974	n = 12	n = 0 (0%)	1
1975	n = 34	n = 7 (21%)	0
1976	n = 9	n = 3 (33%)	--

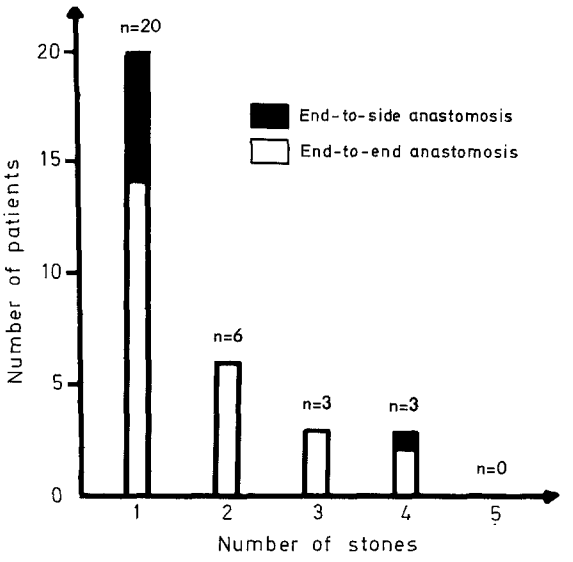

Fig. 4. Number of stones in 32 patients with urinary tract calculi after 2 types of intestinal bypass operations for treatment of obesity in 140 cases, all followed for at least 2 years. None of the patients had stones before the bypass operation

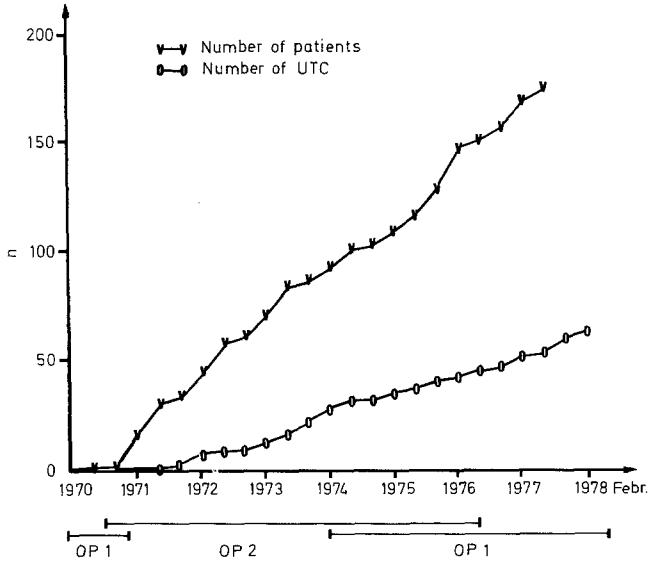

Fig. 3. Accumulated number of patients operated with two types of intestinal bypass (end-to-side = op1 and end-to-end = op2) for treatment of obesity and the accumulated number of urinary tract calculi in these patients. All patients are followed for more than 6 months

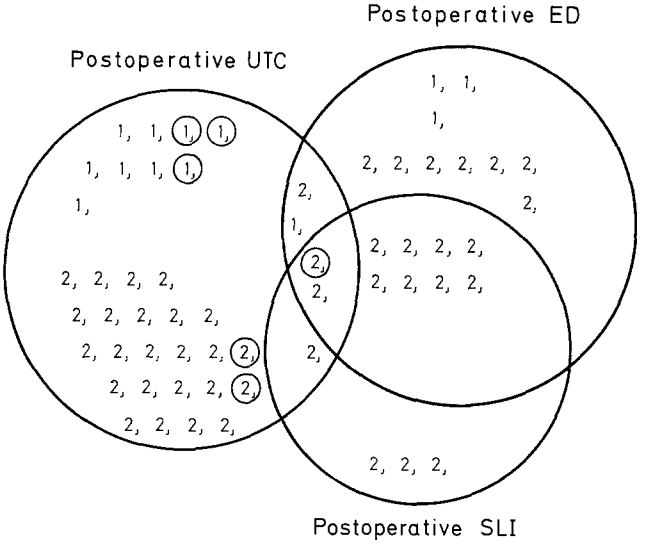

Fig. 5. Complication pattern in 59 of 176 patients after 2 types of intestinal bypass operations for treatment of massive obesity, either end-to-side anastomosis (in 89 patients) or end-to-end anastomosis with ileo-caecostomy (in 87 patients)

Symbol 1. = End-to-side anastomosis
2. = End-to-end anastomosis
O = Patients with stones before the operation
UTC = Urinary tract calculi
ED = Electrolyte disturbance
SLI = Liver injury

Patients undergoing end-to-side anastomosis developed fewer late post-operative complications of electrolyte disturbance and liver injury than after end-to-end anastomosis (13% against 48%) (Fig. 5). There were two different groups of patients - those who developed stones and those who developed liver function and electrolyte disturbance after the bypass operation.

In 30 of the 38 patients with post-operative calculi the stones passed spontaneously. Four patients were operated on and in the other four subjects extraction was performed with stone basket.

DISCUSSION

Patients with inflammatory bowel disease (10) or jejuno-ileal bypass (8, 15) have an increased incidence of hyperoxaluria and an increased risk of forming renal calculi. The incidence of stones is especially high after intestinal bypass operations but varies in different series from 0% to 32% (9, 15, 19, 27, 34). In our series 18% of the patients developed urinary calculi after the operation.

Several mechanisms have been proposed to explain this secondary form of hyperoxaluria. Hofman et al. postulated abnormalities in the bile salt metabolism (22). An endogenous mechanism for the hyperoxaluria is suggested by Starkloff et al. (31). That dietary oxalate is the source of urinary oxalate in patients with hyperoxaluria has been demonstrated (13, 16, 32). This hyperabsorption of dietary oxalate is related to the degree of steatorrhoea after intestinal resection (16).

Our retrospective study has demonstrated that stones occur more frequently after bypass surgery than in the general population. Furthermore, the incidence of stones in our study was significantly higher after end-to-end jenuno-ileostomy than after end-to-side anastomosis. In contrast Gregory et al. found a higher stone incidence after end-to-side jejuno-ileostomy than after end-to-end jenuno-ileostomy (19). This difference might be due to the surgical technique for drainage of the blind loop, which in Gregory's series was into the distal colon and in ours into the proximal. Reflux of intestinal content into the blind loop has been observed after most types of bypass operations (7). Different sites for the blind loop drainage probably implies different composition of the intestinal content in contact with the blind loop mucosa. This might explain the different findings in stone incidence. This might also indicate ileal absorption of oxalate in humans (17).

In our series the rate of weight loss after end-to-end jejuno-ileostomies was significantly higher than after the end-to-side type of operation. Shibata et al. demonstrated that the weight loss was proportional to faecal fat losses after jejuno-colostomy (29). Therefore higher faecal fat losses and an associated hyperoxaluria might be expected after the end-to-end type of operation. This could be one explanation of the high incidence of stones after end-to-end anastomosis, especially within the first post-operative year (Fig. 2). We have, however, found that the rate of weight loss in the patients with stones is no higher than the mean rate in the whole series (Table 1). Most of the patients developed their first signs of calculi after the first post-operative year (Fig. 2) when the body weight had already stabilized (3). Therefore, it seems that the degree of malnutrition (and energy balance) is of minor importance in the appearance of post-operative calculi.

Patients with the highest weight loss have the highest incidence of other signs of malabsorption e. g. electrolyte and liver disturbance and these patients did not get stones more often than the average of all the operated patients (Table 1, Fig. 5). There are apparently distinct differences in the post-operative complication pattern as one group of patients (nearly all operated with end-to-end jejuno-ileostomy) developed electrolyte and liver changes, whereas another group have stones (Fig. 5).

Other explanations for the hyperoxaluria than the steatorrhoea have to be sought. One explanation could be that the dietary intake of oxalate for some reason is higher in the patients with stones than in others (11, 14, 26).

Another explanation for the hyperoxaluria after intestinal bypass operations might be abnormal protein metabolism, especially that of glycine. Glycine which is a precursor of oxalate is one of the amino acids which increases in serum after bypass operations (8). In connection with a possible decrease in vitamin B6 concentration an increased conversion of glycine to glyoxalate and hence to oxalate is to be expected (18).

Some endogenous mechanism for the hyperoxaluria is suggested from studies by Starkloff et al. (31). In this study it was impossible to reduce the oxalate excretion to normal levels by total dietary restriction of oxalate or intravenous feeding. Some endogenous mechanism in rapid weight loss is also suggested by the finding of persistent hyperoxaluria in several patients after gastric bypass for treatment of obesity (20).

Theoretically, the following suggestions could be made for preventing the hyperoxaluria in bypass operated patients.

1. Restricted intake of oxalate containing food (spinach, beans, coca cola), (13)
2. Treatment with calcium and magnesium (28, 33)
3. Restricted intake of fat (2)
4. Increased water intake to decrease the concentration of urinary solute
5. Adequate vitamin supplement (18).

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