

Ileal Interposition with Diverted sleeve gastrectomy for treatment of Type 2 diabetes

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ABSTRACT

Objective: The objective of the present study was to prospectively evaluate the results of laparoscopic ileal interposition (II) with diverted sleeve gastrectomy (DSG) for control of type 2 diabetes mellitus (T2DM) and related metabolic abnormalities. **Materials and Methods:** All patients underwent II +DSG. They had T2DM ≥ 5 years with poor glycemic control despite adequate dosage of oral hypoglycemic agents (OHAs) and/or insulin. The primary outcome was remission of diabetes (HbA1C $< 6.5\%$ without OHAs/insulin), and secondary outcomes were reduction in antidiabetic agent requirement and components of metabolic syndrome. **Results:** We report the preliminary postoperative follow-up data of 13.1 ± 5.3 months (range: 3–26 months). There were 32 patients (Male: female = 21:11) with mean age of 48.7 ± 7.8 (range, 34–66 years), duration of diabetes of 13.1 ± 5.8 years (range, 5–30 years), and preoperative body mass index of 29.1 ± 6.9 kg/m² (range: 22.4–39.5 kg/m²). Sixteen patients (50%) had hypertension, while dyslipidemia and microalbuminuria were present in 12 patients (39%) each. Twenty-two patients (70.5%) had diabetes remission. Fifteen/sixteen (93%) patients had remission in hypertension. All participants had weight loss ranging between 15% and 25%. Postoperatively, statistically significant decline was observed in the glycemic and lipid parameters, microalbuminuria at all intervals ($P < 0.05$). Patients with duration of follow up more than 6 months demonstrated to have better improvement in terms of reduction in glycemic, lipid parameters, and microalbuminuria. Three patients had vitamin B12 deficiency 1 year after surgery. **Conclusion:** Ileal interposition combined with DSG addresses both foregut and hindgut theories and brings about remissions in T2DM patients with reasonable safety. Our preliminary observations demonstrated the feasibility and efficacy of this novel surgical procedure as a promising option in T2DM.

Key words: Sleeve gastrectomy, type-2 diabetes, obesity

INTRODUCTION

Metabolic surgery is an evolving concept designed to address type 2 diabetes mellitus (T2DM) and the ensuing metabolic abnormalities.^[1] The objective of the present study was to prospectively evaluate the results of laparoscopic ileal interposition (II) with diverted sleeve gastrectomy (DSG) for control of T2DM and related metabolic abnormalities.

MATERIALS AND METHODS

All patients underwent II +DSG. The inclusion criteria were type 2 DM of ≥ 5 years duration, inadequate glycemic control with HbA1C $> 7\%$ on optimum dosage of insulin \pm oral hypoglycemic agents (OHA), age between 25 and 70 years, stable weight for the last 3 months (variation in weight $< 3\%$), body mass index (BMI) ≥ 20 kg/m², and stimulated C-peptide level > 1 ng/ml. The exclusion criteria were type 1 diabetes mellitus, undetectable fasting C-peptide, positive urine ketones, pregnancy, coexisting severe hepatic, pulmonary, renal, cardiovascular, neurological and psychiatric diseases, and obesity due to organic illness. The primary outcome was remission of diabetes (HbA1C $< 6.5\%$ without OHAs/insulin), and secondary outcomes were reduction in antidiabetic agent requirement and components of metabolic syndrome.

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Table 1: Postoperative metabolic parameters in 32 patients

Parameter	FBS (mg/ dl)	PLBS (mg/dl)	HbA1C (%)	BMI (kg/m ²)	Cholesterol (mg/dl)	LDL-C (mg/dl)	Trigly. (mg/dl)	Micralb. (mg/24hr)
Follow up								
Preop	236.52 ± 88.4	305. 1 ± 124.3	9.8 ± 1.8	29.1± 6.9	164.2± 52.7	97. 4 ± 41.7	184.8± 85. 8	42.5± 30.1
1 mth	*121.6 ± 21.5	*160 ± 23.5	*9.7± 1.0	*22.3 ± 6.4	*128.6 ± 22.1	*74.9 ± 12.8	*89.1 ± 10.5	*33.9 ± 25.3
3 mth	*111.8± 38.1	*169.6± 33.5	*7.8± 0.9	*23.7± 3.5	*144.7± 18.3	*83.8± 23.2	*130.5± 22.5	*43.2± 16.8
6 mth	*126.1± 31.2	*173.2± 54.2	*7.3± 0.8	*22.4± 3.1	*139.1± 29.5	*76.6± 24.8	*96.9 ± 32.3	*27.2± 13.3
12 mth	*103.1± 18.2	*138.4± 38.9	*6.6± 0.6	*22.1± 2.9	*135.3± 18.2	*83.1± 15.1	*88.5 ± 27.7	*16.0± 7.8
18 mth	114.2 ± 22.1 *	134.2 ± 3.5 *	6.4± 0.7*	23.4 ± 2.8 *	140.4 ± 21.1 *	94. 6 ± 13.1 *	90.6 ± 23.4 *	10.8 ± 9.6 *
24 mth #	115	142	6.8	22.9	142	95	97	18

*P value <0.05 (student's t test), Data expressed as mean ± SD values, #Statistical analysis could not be done as only one patient has completed 24 months follow-up. BMI: Body mass index, FBS: Fasting blood sugar, PLBS: Post lunch blood sugar, LDL-C: Low density lipoprotein cholesterol. Three patients had vitamin B12 deficiency 1 year after surgery

RESULTS

There were 32 patients (Male: female = 21:11) with mean age of 48.7 ± 7.8 years (range, 34-66 years), duration of diabetes of 13.1 ± 5.8 years (range, 5-30 years), and preoperative BMI of 29.1 ± 6.9 kg/m² (range: 22.4-39.5 kg/m²). They had poorly controlled diabetes with mean FBS: 236.52 ± 88.4 mg/dl, PLBS: 305.1 ± 124.3 , and HbA1C: $9.8 \pm 1.8\%$. Sixteen patients (50%) had hypertension, while dyslipidemia and microalbuminuria was present in 12 patients (39%) each. The mean operative time was 387.7 ± 84.3 minutes and the mean postoperative hospital stay was 8.8 ± 5.4 days. Intraoperative complications were noted in four patients (12.5%). One patient had dusky duodenal stump leading to application of drain. Another patient's tip suture broke into abdominal wall which was extricated by C arm. A 2-cm opening at gastric antrum in another patient was closed with PDS because of faulty stapling and 4-cm segment of bluish proximal ileal segment had to be resected in the same patient. On third postoperative day, one patient complained of pain abdomen and distension, diagnostic laparoscopy revealed no abnormality. In view of persisting pain abdomen on 7th day with gas under diaphragm, patient was subjected to exploratory laparotomy followed by closure of ileal perforation and appendectomy. Inflamed appendix adherent to uterine fundus was an incidental finding. Nausea and loss of appetite was observed in three patients (10%), which improved over a period of 2 weeks. At 3 months postoperative follow up, none of these patients had any complications with regards to the intraoperative and immediate postoperative events.

We report the preliminary postoperative follow-up data of 13.1 ± 5.3 months (range: 3–26 months). Twenty-two patients (70.5%) had diabetes remission. Of the 16 patients with hypertension, 15 (93%) became normotensive. All

participants had weight loss ranging between 15% and 25%. Postoperatively, statistically significant decline in the glycemic and lipid parameters, microalbuminuria at all intervals ($P < 0.05$) [Table 1] was observed.

CONCLUSION

Ileal interposition combined with DSG addresses both foregut and hindgut theories and brings about remissions in T2DM patients.^[2] This is achieved without significant issues of nutrient malabsorption, postoperative dumping, and intractable hypoglycemia. We have previously demonstrated that II+ SG had better remission results in T2DM and overall metabolic improvement in patients with shorter duration of diabetes, better C-peptide response, and higher BMI.^[3] The current procedure is even helpful in bringing about remissions in patients with adverse baseline clinical profile including longer duration of diabetes, lesser BMI, and lower C-Peptide reserve. Our preliminary observations demonstrated the feasibility and efficacy of this novel surgical procedure as a promising option in T2DM.

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