

## Obesity and metabolic surgery in type 1 diabetes mellitus

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### Abstract

**Background:** Obesity surgery is an effective method for treating obesity and diabetes mellitus type 2. This type of diabetes can be completely resolved in 78.1% of diabetic patients and can be improved or resolved in 86.6% of diabetic patients. But little is known about bariatric surgery in type 1 diabetes mellitus.

**Methods:** We report of 6 female obese patients with diabetes mellitus type 1 who had bariatric surgery. Two of them underwent Roux-en Y gastric bypass (RNYGB), one of them had sleeve gastrectomy and the remaining three had biliopancreatic diversion with duodenal-switch (BPD-DS).

**Results:** Our results showed a remarkable weight reduction as well as an improvement in their blood glucose control and the insulin requirement in the follow-up years after surgery. Pre-surgery the BMI of our 6 patients ranged between 37.3-46.0 kg/m<sup>2</sup> and improved to 25.8-29.0 kg/m<sup>2</sup> one year after surgery. HbA1c decreased from 6.7-9.8% pre-surgery to 5.7-8.5% after one year post-surgery. The total amount of daily insulin requirement was reduced from 62-150 IU/day pre-surgery to 15-54 IU/day after one year.

**Conclusion:** The results are impressive and show an improvement in insulin sensitivity following obesity surgery. However, an optimal blood glucose control still remains very important in the therapy of diabetes mellitus type 1 to avoid long-term-complications.

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Key words: Type 1 diabetes. Diabetes. Obesity surgery.

### OBESIDAD Y CIRUGÍA METABÓLICA EN LA DIABETES MELLITUS TIPO 1

#### Resumen

**Introducción:** La cirugía de la obesidad es un método eficaz para el tratamiento de la obesidad y la diabetes mellitus tipo 2. Este tipo de diabetes puede ser resuelto por completo en el 78,1% de los pacientes diabéticos y mejora en el 86,6% de los pacientes diabéticos. Sin embargo, poco se sabe acerca de la cirugía bariátrica en la diabetes mellitus tipo 1.

**Métodos:** Presentamos 6 pacientes mujeres obesas con diabetes mellitus tipo 1 que se sometieron a cirugía bariátrica. Dos de ellas fueron sometidas a un bypass gástrico en-Y-Roux (BPGYR), una se le realizó una gastrectomía en manga y a las tres restantes una derivación biliopancreática con-switch duodenal (DBP-SD).

**Resultados:** Nuestros resultados mostraron una reducción de peso notable, así como una mejora en el control de la glucosa en sangre y el requerimiento de insulina en los años de seguimiento después de la cirugía. El IMC prequirúrgico de las 6 pacientes osciló entre 37,3-46,0 kg/m<sup>2</sup> y mejoró a 25,8-29,0 kg/m<sup>2</sup> un año después de la cirugía. La HbA1c disminuyó de 6,7-9,8% antes de la cirugía a 5,7-8,5% un año después de la cirugía. El requerimiento diario de insulina se redujo de 62-150 UI/día antes de la cirugía a 15-54 UI/día al cabo de un año.

**Conclusión:** Los resultados son impresionantes y muestran una mejora en la sensibilidad a la insulina tras una cirugía de la obesidad. No obstante, un control óptimo de la glucosa de sangre sigue siendo muy importante en la terapia de la diabetes mellitus tipo 1 para evitar complicaciones a largo plazo.

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Palabras clave: Diabetes tipo 1. Diabetes. Cirugía de la obesidad.

### Introduction

The prevalence of obesity and type 2 diabetes mellitus is increasing worldwide. In 2011 the prevalence of diabetes was 8.5% (= 366 million people with

diabetes), this number is expected to reach 8.9% (= 552 million people with diabetes).<sup>4</sup>

Obesity surgery is an effective method for treating obesity and diabetes mellitus type 2. This type of diabetes can be completely resolved in 78.1% of diabetic patients and can be improved or resolved in 86.6% of diabetic patients. Weight loss and diabetes resolution is dependent on the type of surgery performed. After gastric banding there was a resolution of type 2 diabetes in 48% of patients, after gastric

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**Table I***Sachsenhausen Hospital, Frankfurt; St. Josef Krankenhaus, Monheim, own data, 2011*

	<i>Patient A RNYGB 05/2011</i>	<i>Patient B Sleeve 02/2010</i>	<i>Patient C RNYGB 07/2009</i>	<i>Patient D BPD-DS 02/2009</i>	<i>Patient E BPD-DS 01/2007</i>	<i>Patient F BPD-DS 02/2006</i>
Age at surgery	33	38	50	43	42	52
Diabetes duration at surgery	18	19	21	8 (LADA)	12	25
Therapy	CSII	CSII	ICT	ICT	ICT	CSII
Oral antidiabetics prior surgery	No	Yes	Yes	Yes	Yes, initial	No

bypass in 84% of patients and after biliopancreatic diversion in 98% of patients.<sup>1</sup>

But little is known about bariatric surgery in type 1 diabetes mellitus. Only 6 cases of bariatric surgery and type 1 diabetes mellitus have been described in the last years by Czupryniak et al in 2004 and 2010 respectively by Mendez et al. in 2010.<sup>2,3,5</sup>

## Methods

We report of 6 female obese patients with diabetes mellitus type 1 who had bariatric surgery.

Patient A and C underwent Roux-en Y gastric bypass (RNYGB). Patient A with RNYGB was 33 years old, had had diabetes for a period of 18 years and was treated with CSII (continuous subcutaneous insulin infusion system). The other one with RNYGB, Patient C was 50 years old, with a diabetes duration of 21 years at surgery. She controlled her diabetes with intensive insulin therapy (ICT) and metformin.

Patient B had sleeve gastrectomy. At surgery she was 38 years old, had had diabetes since 19 years and controlled her diabetes with CSII and metformin.

Patient D, E and F underwent biliopancreatic diversion with duodenal-switch (BPD-DS). At surgery they were 43, 42 and 52 years old and had had diabetes since 8, 12 and 25 years respectively. Patient D and E were also treated with intensive insulin therapy and metformin. Patient F controlled her diabetes with CSII (table I).

## Results

Our results showed for all patients a remarkable weight reduction as well as an improvement in their blood glucose control and the insulin requirement in the follow-up year after surgery. Pre-surgery the BMI of our 6 patients ranged between 37.3-43.0 kg/m<sup>2</sup> and improved to 25.3-29.0 kg/m<sup>2</sup> one year after surgery. HbA1c decreased from 6.7-9.8% pre-surgery to 5.7-8.5% after one year post-surgery. The insulin requirement (units per kg body weight) was reduced from 0.72-1.13 IU/kg pre-surgery to 0.14-0.62 IU/kg after one year. The total amount of daily insulin requirement was reduced from 62-150 IU/day pre-surgery to 15-54 IU/day one year post-surgery. Only few data we have for Patient C because she discontinued follow-up.

In Patient A we observed the blood glucose values and the insulin requirements during her stay in our hospital. The evening before surgery we started this control with the CGMS (Continuous subcutaneous glucose monitoring system). We observed an improvement of insulin sensitivity directly after surgery – the same effect which is described after gastric bypass surgery in type 2 diabetes mellitus (table II).

## Discussion

Several studies show that obesity surgery is an effective method for treating obesity and type 2 diabetes

**Table II***Patient A development of insulin requirements the first days after surgery*

<i>Patient A with CSII</i>	<i>Amount of insulin during stay in hospital</i>
1 <sup>st</sup> day	50% of basal rate (basal rate = 24.2 IU)
2 <sup>nd</sup> day – surgery in the morning	During surgery CSII was stopped
3 <sup>rd</sup> day	40% of basal rate (11 am CSII was started again)
4 <sup>th</sup> day	30-40% basal rate
5 <sup>th</sup> day	40 % basal rate
6 <sup>th</sup> day	During the night 40%, during the morning 30% due to more physical activity, in the afternoon 50%

mellitus although we do not clearly understand the mechanisms leading to resolution of type 2 diabetes mellitus after obesity surgery.

But we know little about obesity surgery in type 1 diabetes mellitus. As far as we know only 6 cases have been described in the literature till now.

In 2004 Czupryniak et al reported the first time about bariatric surgery in type 1 diabetes mellitus. They observed 2 female patients at the age of 23 and 28 who underwent gastric bypass. In both cases a reduction of the BMI (pre-surgery 38.8/46.3 kg/m<sup>2</sup> and one year post-surgery 26.6/30.1 kg/m<sup>2</sup>) and an improvement of insulin sensitivity could be described. The daily insulin requirement could be reduced from

68/120 IU prior surgery to 45/70IU one year after surgery.

In 2010 Czupryniak et al. described a third case. A 19 year old man underwent RNYGB with a BMI of 41.5 kg/m<sup>2</sup> and a daily insulin dose of 96 IU. Five years after surgery his BMI decreased to 30.4 kg/m<sup>2</sup> and the daily insulin requirement to 30 IU.

Mendez et al reported in the year 2010 of 3 female patients with type 1 diabetes mellitus who had gastric bypass surgery. The pre-surgery BMI was 40.6-53.3 kg/m<sup>2</sup> and the daily insulin dose ranged between 52.2-180 IU. One year post-surgery the authors could observe a remarkable improvement not only of body-weight but also of insulin sensitivity. The BMI was

**Table III**  
Overview – results after obesity surgery. Sachsenhausen Hospital, Frankfurt; St. Josef Krankenhaus, Monheim, own data, 2011

Type 1 diabetes mellitus overview						
Patient	A	B	C	D	E	F
Type of surgery	RNYGB 05/2011	Sleeve 02/2010	RNYGB 07/2009	BPD-DS 02/2009	BPD-DS 01/2007	BPD-DS 01/2006
BMI (kg/m <sup>2</sup> )						
Presurgery	43.9	37.3	38.3	43	46	42
4 weeks post-surgery	38.0	33.3	35			
3 months post-surgery		29.4		34.4	40.9	34.1
6 months post-surgery	29.7	26.3	29.3	29.2	34.5	31.8
1 year post-surgery		25.3		29	28.4	28.6
2 years post-surgery					26.4	
3 years post-surgery					27.1	
4 years post-surgery						28
HbA1c (in %)						
Presurgery	6.7	7.4	8.6	9.8	8.7	7.9
4 weeks post-surgery		6.5				
3 months post-surgery	6.9	6.6		8.1	7.3	7.6
6 months post-surgery	6.6	6.5	8.3	9.4	6.4	7.9
1 year post-surgery		7.2		6.4	5.7	8.5
2 years post-surgery					6.7	
3 years post-surgery					6.9	
4 years post-surgery						7.9
Total amount of insulin per day (IU)						
Presurgery	62.2	88.6		110	150	110
4 weeks post-surgery	21.7	45.5				
3 months post-surgery		62.5		18	37	40
6 months post-surgery	25.0	46.0		18	54	35
1 year post-surgery		48.0		15	54	30
2 years post-surgery				12	52	
3 years post-surgery					65	
4 years post-surgery						48
Amount of insulin (units per kg)						
Presurgery	0.54	0.72		1.13	0.93	1.2
4 weeks post-surgery	0.22	0.41				
3 months post-surgery		0.65		0.18	0.3	0.37
6 months post-surgery	0.32	0.53		0.18	0.51	0.35
1 year post-surgery		0.58		0.14	0.62	0.32
2 years post-surgery					0.65	
3 years post-surgery					0.79	
4 years post-surgery						0.53

reduced to 26.7-30.8 kg/m<sup>2</sup> and the daily amount of insulin was 25.6-48.2 IU.

We found the same results. Due to obesity we observed an impressive weight reduction in every patient. The BMI prior surgery ranged between 37.3-46.0 kg/m<sup>2</sup>. One year after surgery our patients reduced their weight to a BMI from 25.3-29.0 kg/m<sup>2</sup>.

The results regarding insulin sensitivity are remarkable too. We saw an improvement in insulin sensitivity not only due to the weight reduction but also in the first days after surgery. This effect is already described for patients with type 2 diabetes mellitus in the days directly after surgery.

In our 6 patients the total amount of daily insulin requirement could be reduced from 62-150 IU prior surgery to 15-54 IU/day one year after surgery.

But as we could observe a decrease in BMI does not automatically lead to a good glycemic control. The HbA1c prior surgery ranged between 6.7-9.8%. One year after surgery we found an HbA1c from 5.7-8.5%. An optimal blood glucose control and a regular consultation with the diabetologist remains very important in the therapy of diabetes mellitus type 1 to avoid long-term complications due to diabetes.

## Conclusion

Obesity surgery is an effective method for weight reduction and treatment of co-morbidities not only for type 2 diabetes mellitus but also for obese type 1 diabetes mellitus patients.

But patients with type 1 diabetes need to have an optimal glycemic control to prevent long-term complications due to diabetes. This remains a challenge for all.

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