Sleeve gastrectomy has a beneficial effect on plasma liver enzymes in comparison to bypass surgeries - a registry-based 2-year follow-up analysis

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Supporting information: Tables S1-S5

Table S1: characteristics of patients in the registry with 2-year follow-up data on ALT levels, including only primary surgery. BMI – body mass index; A1C - glycated hemoglobin; TG – triglycerides; SG – sleeve gastrectomy; RYGB – Roux en Y gastric bypass; OAGB – One Anastomosis Gastric Bypass; OSA – obstructive sleep apnea.

	Pre-surgery characteristics (n=4980)
ALT [IU/L]	25 [18-37]
AST [IU/L]	22 [18-29]
AST/ALT	0.89 [0.73-1.08]
A1C [%]	5.9 [5.5-6.6]
TG [mg/dL]	148 [108-204]
BMI [kg/m²]	41.12 [38.56-44.46]
Age [years]	45.39 [35.7-55.18]
Sex - Females	3439 (69%)
Ethnicity	Jewish: 4193 (84%)
Smokers	931 (19%)
Alcohol consumption	110 (7%)
Surgery type	SG: 4144 (83%)
	RYGB: 498 (10%)
	OAGB: 338 (7%)
Hypertension	1877 (38%)
Diabetes	1850 (37%)
OSA	838 (19%)

Table S2: Backwards elimination multivariate logistic model, predicting abnormal ALT levels (for men greater than 33, and women greater than 25) for all patients in the registry including ALT levels pre-surgery. β: Coefficient, SE: Standard Error, OR: Odds Ratio, CI: Confidence Interval, NA: not applicable, SG: sleeve gastrectomy. RYGB: Roux en Y gastric bypass. OAGB: one anastomosis gastric bypass. ALT: alanine aminotransferase.

predicted value-abnormal ALT levels (for men > 33, and for women > 25)							
	β	SE β	Wald's χ^2	p-value	OR	CI	
Constant	-4.51	0.26	304.42	<1e-5	NA	NA	
RYGB vs SG	1.19	0.12	91.54	<1e-5	3.30	[2.58	4.21]
OAGB vs SG	1.56	0.14	130.05	<1e-5	4.75	[3.63	6.20]
OAGB vs RYGB	0.36	0.16	4.86	<0.05	1.44	[1.04	1.99]
Sex - Female	0.59	0.11	28.64	<1e-5	1.81	[1.45	2.24]
Age [years]	0.01	0.004	11.21	<0.01	1.01	[1.01	1.02]
Ethnicity - Jewish	0.53	0.16	11.46	<0.01	1.69	[1.25	2.30]

ALT [IU/L]	0.02	0.002	90.29	<1e-5	1.02	[1.01	1.02]

<div align="center">Test overall model evaluation</div>

	χ^2	p-value
Log-Likelihood ratio	282.95	<1e-5
Wald test	1927.84	<1e-5

Table S3: pre- and two-year post-surgery outcomes for the three surgery types in the study population. BMI: body mass index; A1C: glycated hemoglobin; TG: triglycerides. p-values derived using Kruskal-Wallis H-tests for continuous variables and using χ^2 test for categorical variables. p-value<0.05 in post-hoc analysis [a]SG different form RYGB, [b]SG different from OAGB, and [c]RYGB different from OAGB.

	SG (n=4144)	RYGB (n=498)	OAGB (n=338)
BMI [kg/m²] Pre-surgery [a]	41.15 [38.68-44.53]	40.56 [37.85-43.80]	41.22 [38.21-44.44]
BMI [kg/m²] 2 years post-surgery [abc]	29.03 [26.17-32.46]	28.01 [25.19-30.82]	26.91 [24.03-29.52]
EWL [%] [abc]	75.02 [58.02-92.51]	79.61 [64.38-98.46]	88.81 [72.83-106.76]
A1C [%] Pre-surgery [ac]	5.9 [5.5-6.5]	6.2 [5.7-7.8]	6.0 [5.6-6.6]
TG [mg/dL] Pre-surgery	147 [107-102.03]	153 [115-214.9]	149.5 [106-2-3.5]
Age [years] [ab]	44.48 [34.56-54.62]	50.18 [41.38-58.6]	48.3 [37.85-57.06]
Sex - female	2880 (69%)	336 (67%)	223 (66%)
Ethnicity - Jewish	3485 (84%)	418 (84%)	290 (86%)
smokers	795 (19%)	79 (16%)	57 (17%)

Table S4: Retrospectively matched patients' pre-surgical parameters for the three surgery types in the study population. p-values derived using Kruskal-Wallis H-test for continuous variables and using χ^2 test for categorical variables.

	SG (n=319)	RYGB (n=319)	OAGB (n=319)	p-value
BMI [kg/m²] pre-surgery	41.02 [38.58-43.76]	41.04 [38.51-44.24]	41.09 [38.21-43.97]	0.94
A1C[%] pre-surgery	6.0 [5.6-6.55]	6.1 [5.6-6.9]	6 [5.5-6.6]	0.29
ALT [IU/L] pre-surgery	23 [18-32]	23 [18-32]	24 [18-31]	0.93
TG [mg/dL]	148 [110-203]	148 [110.5-204]	150 [106.5-205.5]	0.99
Age [years]	48.63 [40.25-57.91]	49.53 [40.26-58.24]	47.88 [37.89-57.82]	0.26
Hypertension comorbidity	142 (45%)	142 (45%)	142 (45%)	1
Ethnicity-Jewish	264 (83%)	264 (83%)	264 (83%)	1
Sex-Female	221 (69%)	221 (69%)	221 (69%)	1

Table S5: Characteristics of Responders and non-responders in reducing abnormal ALT levels 2-years after surgery divided according to surgery type. SG: sleeve gastrectomy. RYGB: Roux en Y gastric bypass. OAGB: one anastomosis gastric bypass. ALT: alanine aminotransferase

		Responders	Non-Responders
ΔBMI [kg/m2]	SG	12.10 [9.40-15.15]	11.20 [7.81-15.09]
	RYGB	11.81 [9.32-16.18]	11.71 [8.6-13.41]
	OAGB	13.15 [10.70-17.08]	14.66 [12.97-16.54]
ALT pre-surgery [IU/L]	SG	40 [33-53]	42 [33-57]
	RYGB	38.5 [31-52.5]	41.5 [35-58]
	OAGB	38 [30-49]	38 [31-62.5]
A1C 2 years post-surgery [%]	SG	5.5 [5.2-5.9]	5.5 [5.2-6]
	RYGB	5.6 [5.3-6]	5.8 [5.6-6.9]
	OAGB	5.5 [5.1-5.8]	5.4 [5.1-5.9]