Sequential Changes in Glucose Metrics after MBS Using a CGM System in Individuals with T2DM and Obesity

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CONFLICT OF INTEREST DISCLOSURE

I have the following potential conflict(s) of interest to report:

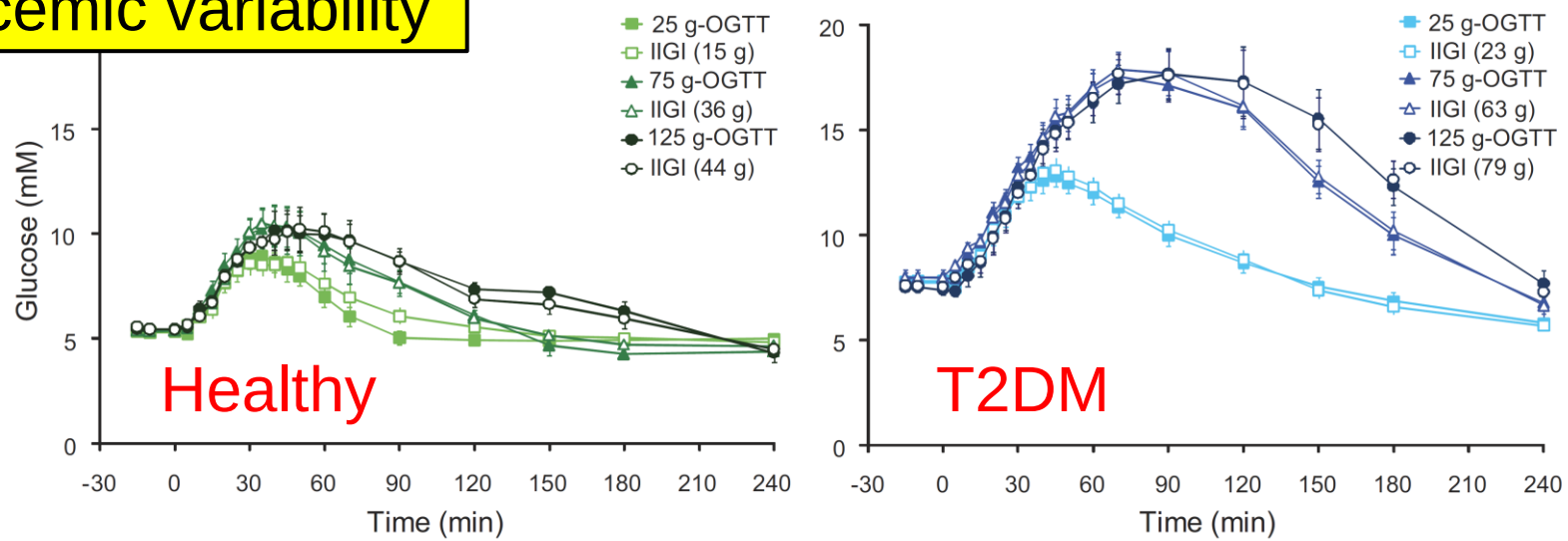
- Receipt of grants/research supports: a **Korea Medical Device Development Fund grant** funded by the Korean government (Ministry of Science and ICT)

Background: Importance of Glycemic Variability

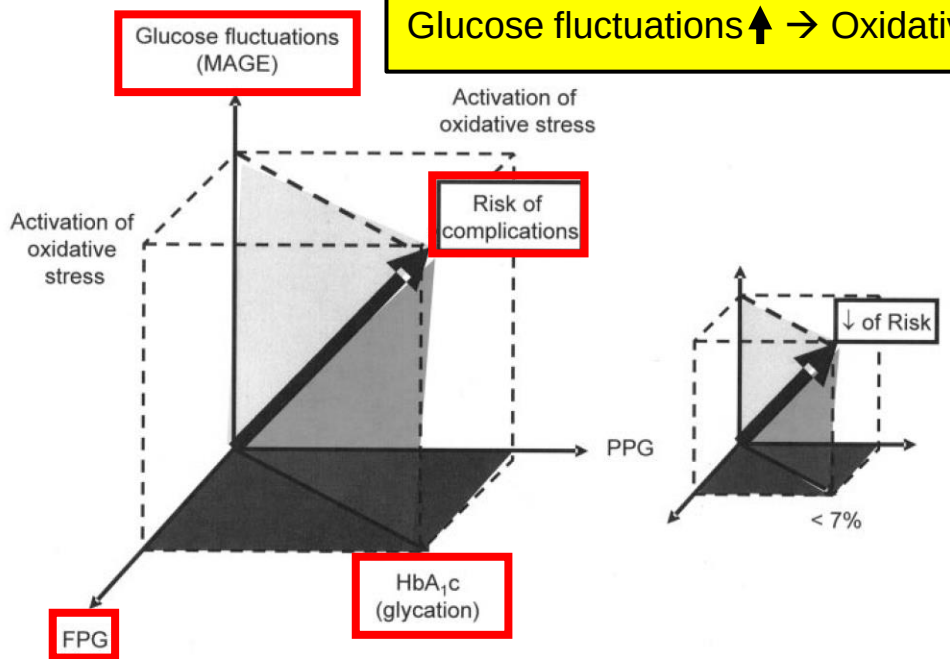
Glycemic variability

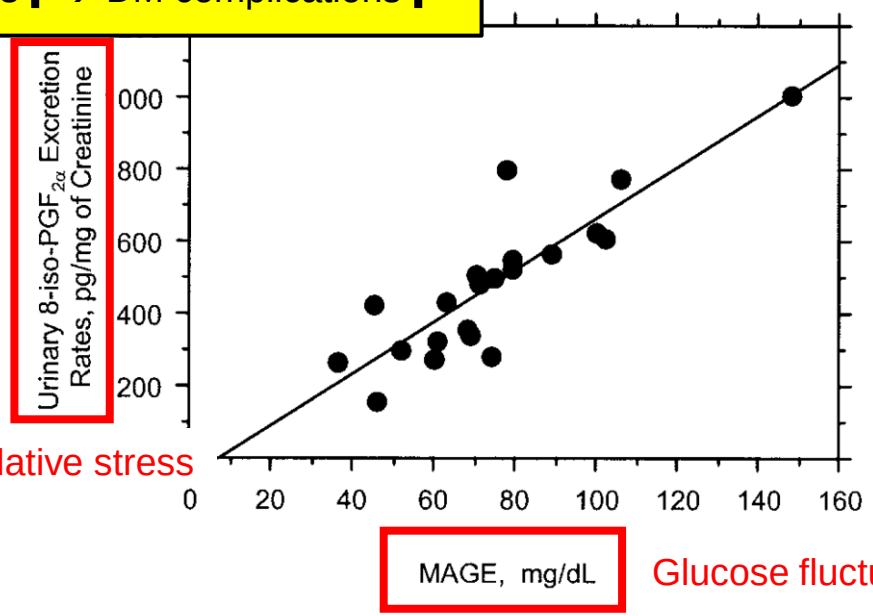
*2011 J Clin Endocrinol Metab Bagger et al.

**2008 Diabetes Care Monnier et al.



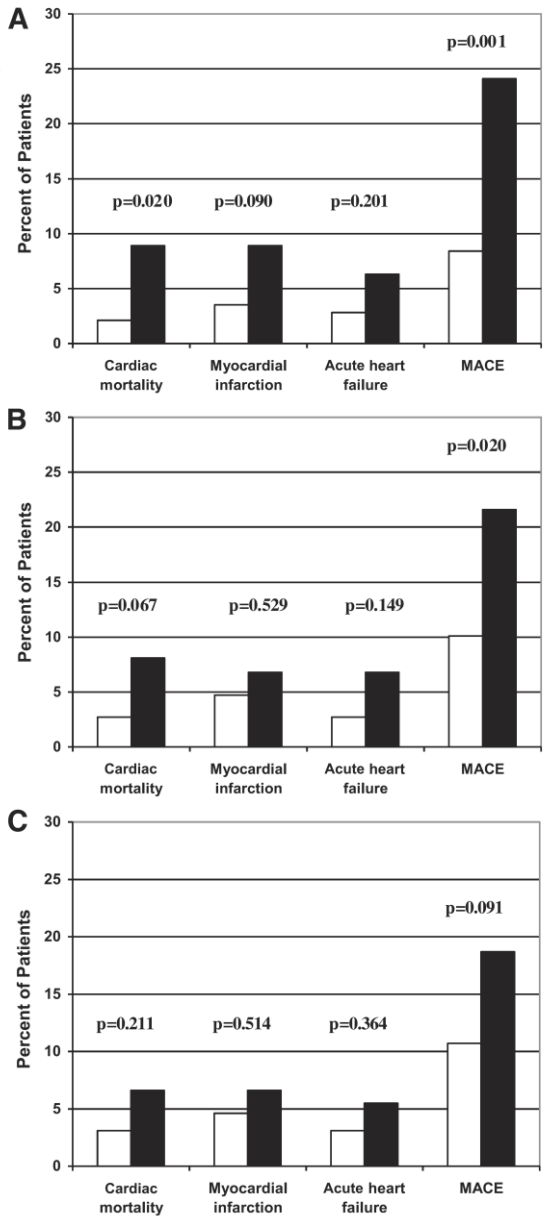
Glucose fluctuations ↑ → Oxidative stress ↑ → DM complications ↑



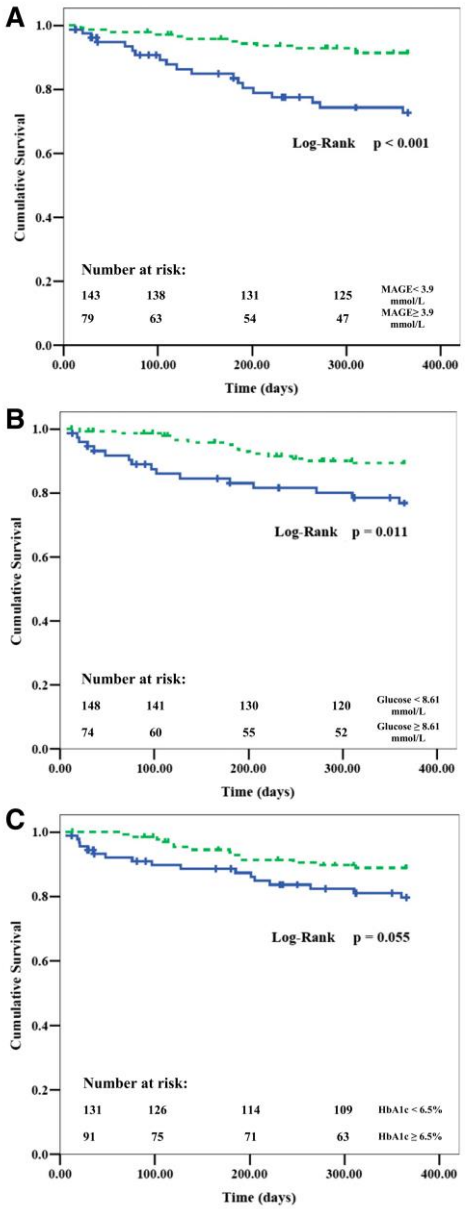


Background: Importance of Glycemic Variability

CVD risk



Mortality



A: Glycemic variability (MAGE)

CVD risk p=0.001

Mortality p<0.001

B: Fasting plasma glucose

CVD risk p=0.020

Mortality p=0.011

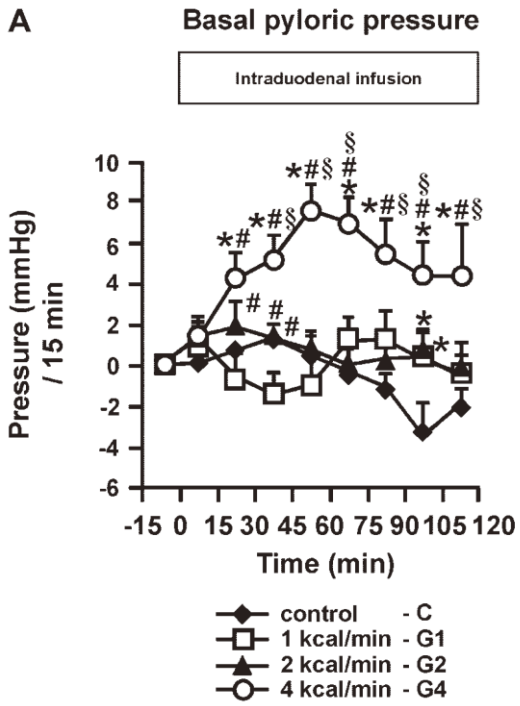
C: HbA1c

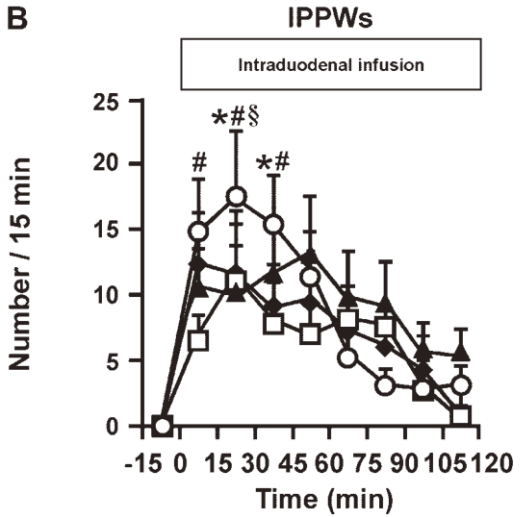
CVD risk p=0.091

Mortality p=0.055

*2013 Diabetes Care Su et al.

Background: Theoretical Evidence of Sleeve G. with DJB





-Pylorus function*

: infuse glucose into small intestine

→ increase pyloric pressure

→ delay gastric emptying time

-Theoretical evidence of Sleeve G. + duodenal-jejunal bypass**

: preservation of pylorus

→ delay gastric emptying time

→ may decrease postprandial glycemic variability

→ no scientific evidence

*2007 Am J Physiol Endocrinol Metab Pilichiewicz et al.

**2020 J Minim Invasive Surg Kim et al.

Aim of This Study

1. To analyze the effect of metabolic-bariatric surgery (MBS) on glucose control more accurately by investigating sequential changes in glucose metrics using a continuous glucose monitoring system (CGM) in individuals with T2DM & obesity.

2. To find the most advantageous procedure in terms of glycemic variability by comparing glucose metrics according to type of procedure.

FreeStyle Libre (Abbott Diabetes Care Inc.)

Materials & Methods

1. **40 Patients** who underwent primary MBS with BMI ≥ 30kg/m^2 & T2DM from prospectively collected database in single institution from Feb. 2022 – Jan. 2024

2. **CGM** measurement time point: **baseline**, **immediate postop**., & postop. **3 months**

3. Outcome parameters

   - Baseline characteristics: Age, Sex, Height, Weight, Co-morbidities, Type of surgery

   - **Glucose metrics**:

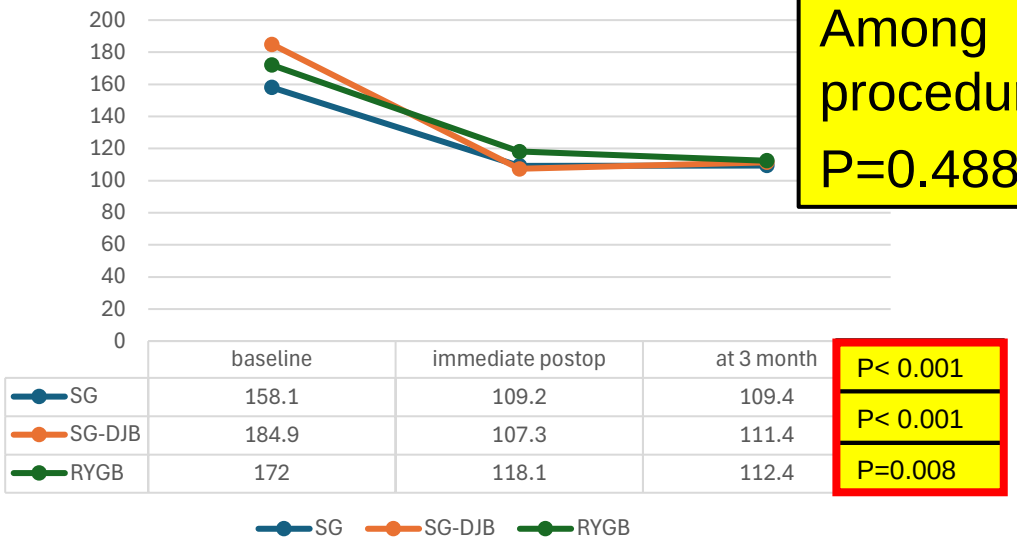
- using **CGM**: Average glucose, Glucose management index (GMI), Glucose variability, %Time in range; Target range (70 to 180 mg/dL), Very high (>250 mg/dL), High (>180 mg/dL), Low (<70 mg/dL), Very low (<54 mg/dL) ranges, Low glycemic event (<70 mg/dL)
- using **laboratory profiles**: HbA1c, Fasting plasma glucose, Fasting insulin, C-peptide

Baseline Characteristics

	SG (N=21)	SG-DJB (N=10)	RYGB (N=8)	p
Female	15 (71.4%)	8 (80.0%)	5 (62.5%)	0.713
Age	33.3 ± 7.6	46.3 ± 6.7	42.2 ± 10.8	< 0.001
Body Weight	126.4 ± 36.5	105.6 ± 14.6	102.2 ± 26.7	0.087
BMI	43.9 ± 11.3	37.5 ± 4.9	36.1 ± 7.6	0.080
Hemoglobin A1c	7.9 ± 1.8	7.7 ± 1.0	9.4 ± 2.4	0.088
Fasting plasma glucose (mg/dL)	166.0 ± 53.3	171.2 ± 65.2	195.6 ± 73.0	0.504
C-peptide (ng/mL)	4.8 ± 2.1	4.6 ± 1.5	2.6 ± 1.1	0.018
Fasting Insulin (uIU/ml)	38.5 ± 16.8	37.6 ± 23.2	18.0 ± 7.9	0.021
Hypertension	13 (61.9%)	7 (70.0%)	4 (50.0%)	0.686
Dyslipidemia	12 (57.1%)	9 (90.0%)	8 (100.0%)	0.026
Obstructive sleep apnea	11 (52.4%)	2 (20.0%)	4 (50.0%)	0.217
GERD	4 (19.0%)	3 (30.0%)	3 (37.5%)	0.558
NAFLD	18 (85.7%)	10 (100.0%)	7 (87.5%)	0.459
Time sensor active at baseline	64.0 ± 24.5	52.5 ± 17.8	77.8 ± 18.5	0.065
Time sensor active at immediate postoperative	79.2 ± 16.0	79.8 ± 16.5	82.1 ± 26.5	0.934
Time sensor active at 3 months	68.6 ± 24.3	61.6 ± 22.6	80.8 ± 13.5	0.397

Glucose Metrics (1): CGM Profiles

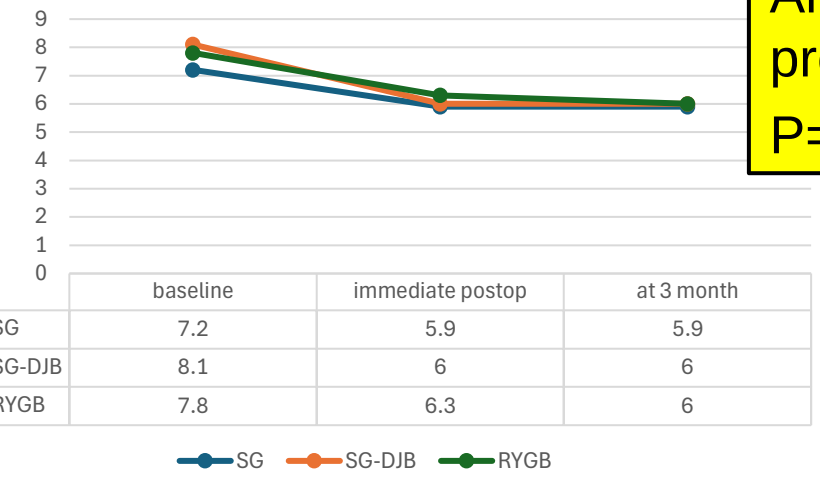
Average Glucose



	baseline	immediate postop	at 3 month	
SG	158.1	109.2	109.4	P< 0.001
SG-DJB	184.9	107.3	111.4	P< 0.001
RYGB	172	118.1	112.4	P=0.008

Among procedures P=0.488

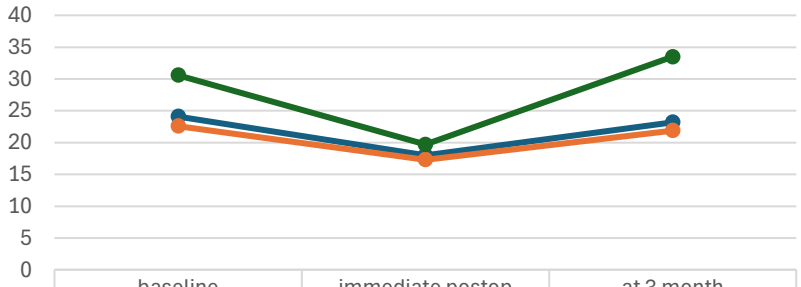
Glucose Management Index (GMI)



	baseline	immediate postop	at 3 month	
SG	7.2	5.9	5.9	P< 0.001
SG-DJB	8.1	6	6	P< 0.001
RYGB	7.8	6.3	6	P=0.015

Among procedures P=0.511

Glucose Variability



	baseline	immediate postop	at 3 month
SG	24.1	18	23.2
SG-DJB	22.6	17.3	21.9
RYGB	30.6	19.7	33.5

Glucose variability decreased immediately in all procedures.

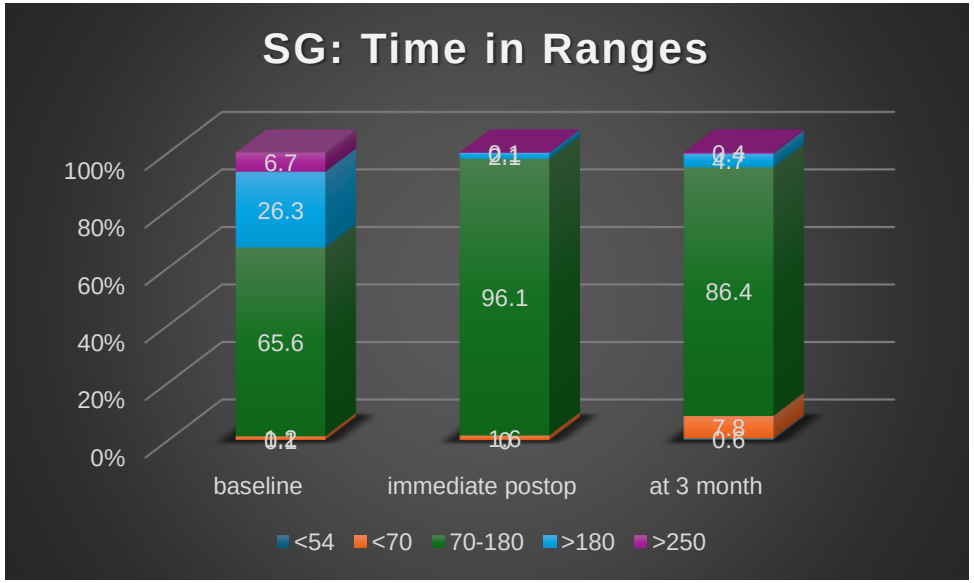
However, at 3-month (P=0.435)

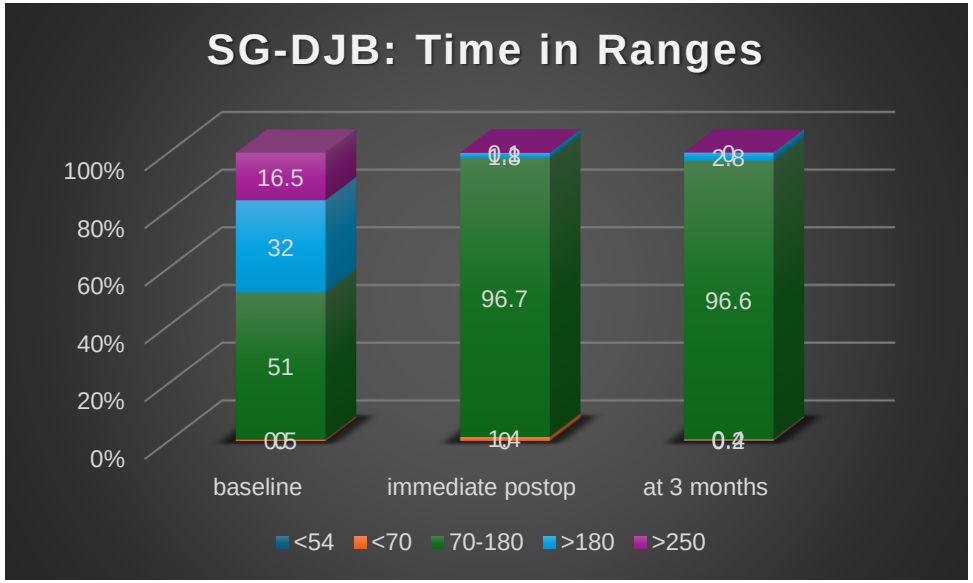
SG decrease -0.9

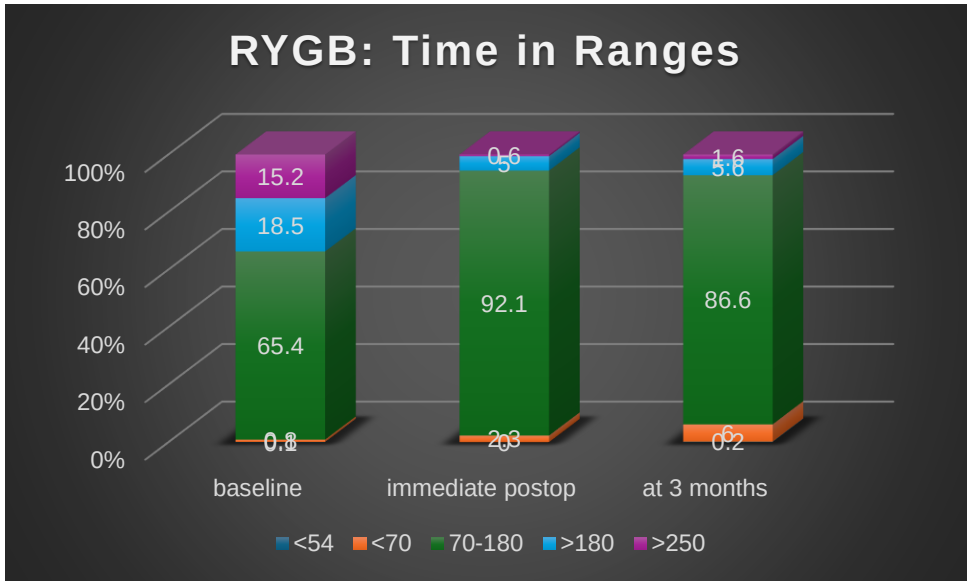
SG-DJB decrease -0.7

RYGB increase +2.9

Glucose Metrics (2): Time in Ranges

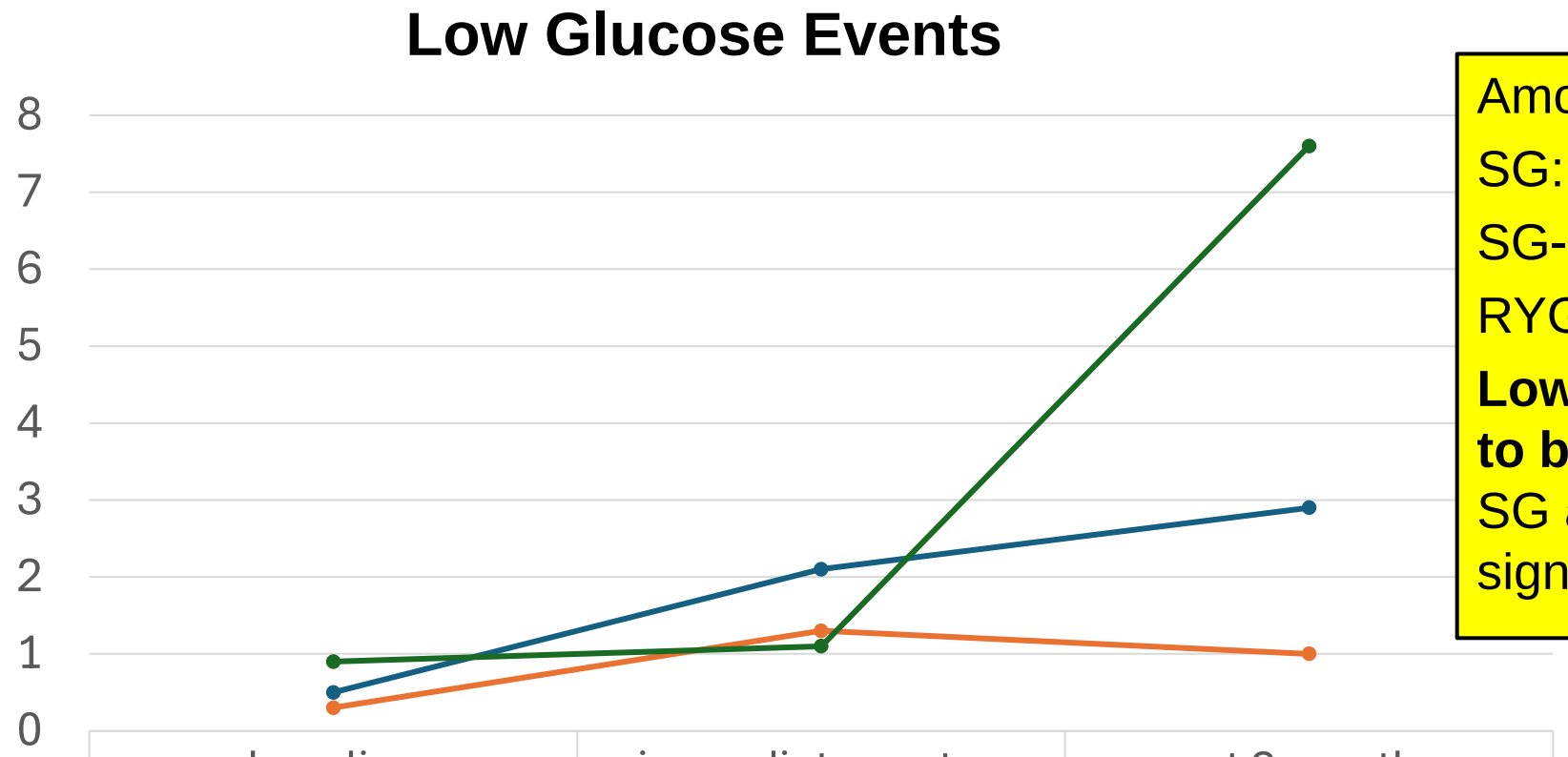






1. **Target range (70-180mg/dL) increased immediately** postop. in All procedures ($p<0.05$).
2. **Very High (>250), and High (>180) ranges decreased immediately** postop. in All procedures ($p<0.05$).
3. **Low (<70), and Very Low (<54) ranges** had **no difference** in All procedures ($p>0.05$).
4. Target range increased more in SG-DJB than other groups without significance ($p=0.150$)

Glucose Metrics (3): Low Glucose Events



	baseline	immediate postop	at 3 month
SG	0.5	2.1	2.9
SG-DJB	0.3	1.3	1
RYGB	0.9	1.1	7.6

Among groups,

SG: 2.6 ± 5.1

SG-DJB: 1.0 ± 2.2

RYGB: 6.8 ± 8.3

Low glucose events tend to be higher in RYGB than SG and SG-DJB without significance. (P=0.232)

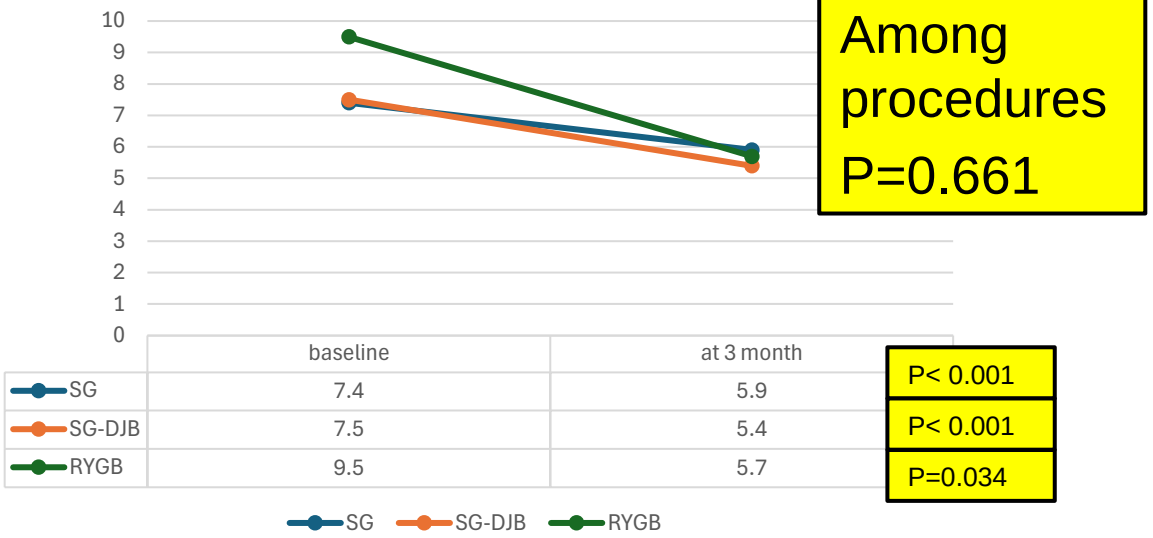
P=0.229

P=0.735

P=0.034

Glucose Metrics (4): Laboratory Profiles

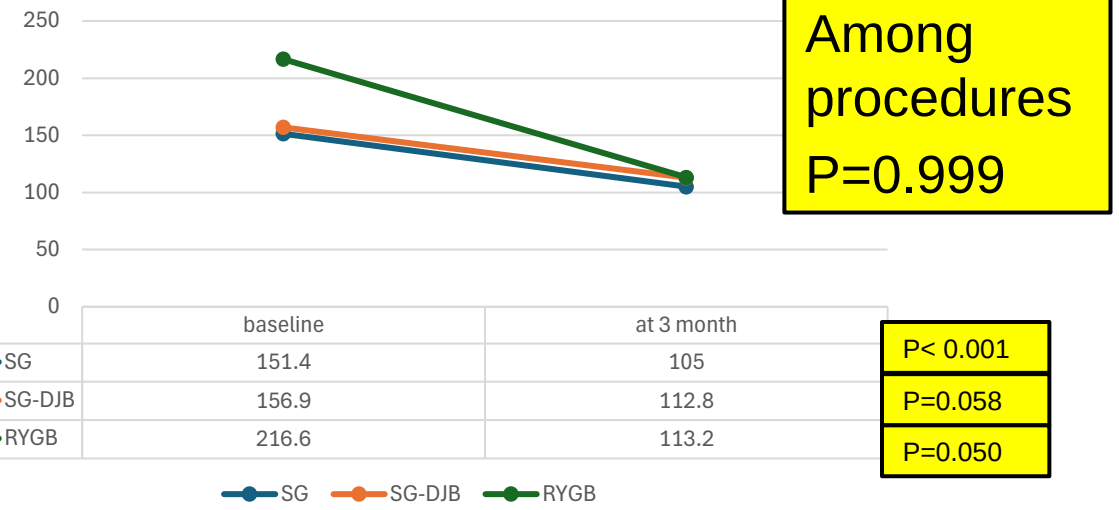
Hemoglobin A1c



	baseline	at 3 month	
SG	7.4	5.9	P< 0.001
SG-DJB	7.5	5.4	P< 0.001
RYGB	9.5	5.7	P=0.034

Among procedures P=0.661

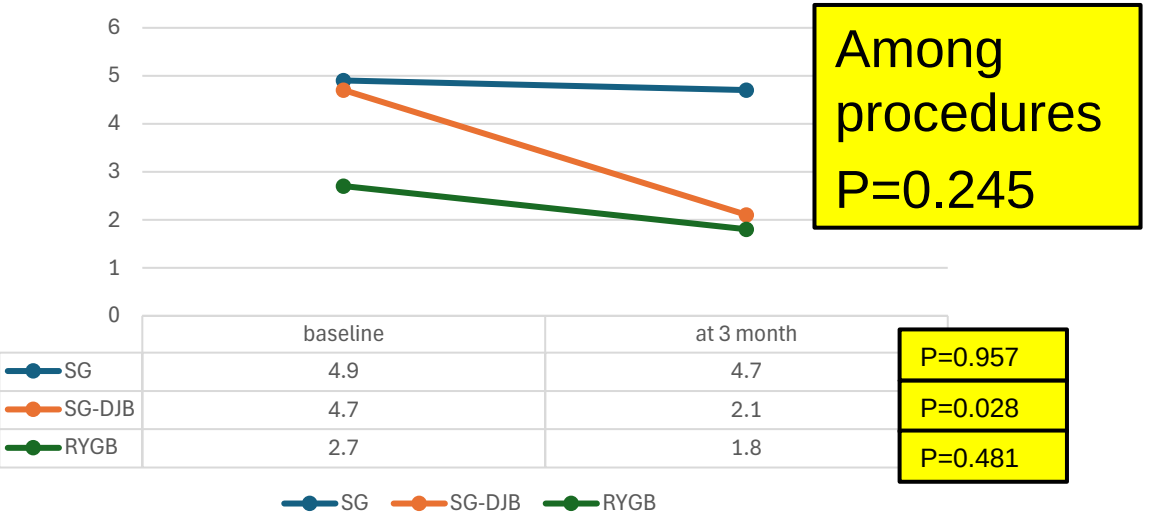
Fasting plasma glucose



	baseline	at 3 month	
SG	151.4	105	P< 0.001
SG-DJB	156.9	112.8	P=0.058
RYGB	216.6	113.2	P=0.050

Among procedures P=0.999

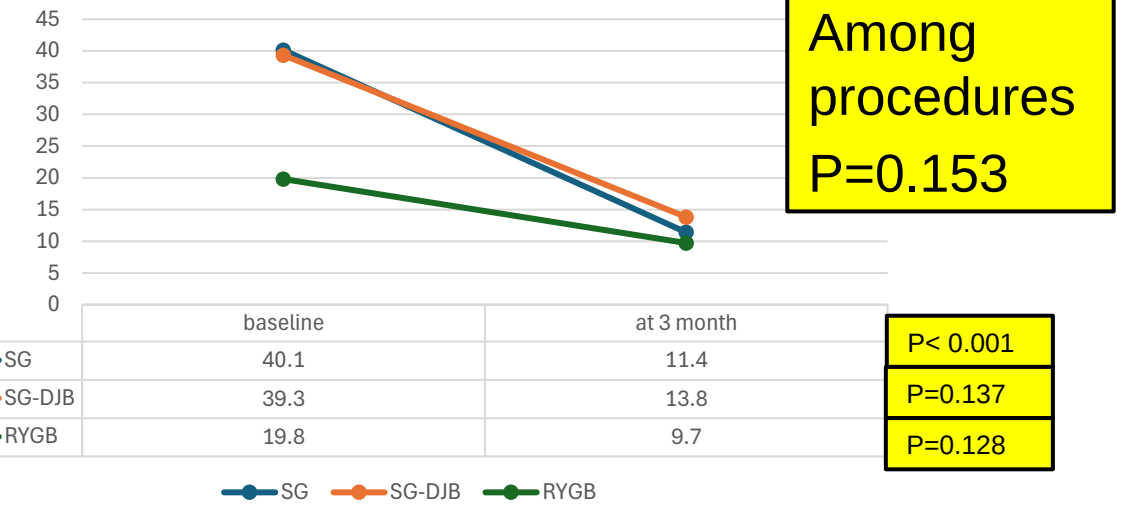
C-peptide



	baseline	at 3 month	
SG	4.9	4.7	P=0.957
SG-DJB	4.7	2.1	P=0.028
RYGB	2.7	1.8	P=0.481

Among procedures P=0.245

Fasting insulin



	baseline	at 3 month	
SG	40.1	11.4	P< 0.001
SG-DJB	39.3	13.8	P=0.137
RYGB	19.8	9.7	P=0.128

Among procedures P=0.153

Conclusion

1. Glucose metrics such as average glucose level, Glucose Management Index, %Time in range using CGM has improved immediately after all kinds of MBS.

2. Glucose variability decreased immediately after all kinds of MBS, however, did not maintain the effect until 3 month after surgery.

3. Low glucose events tend to be higher in RYGB than SG and SG-DJB without significance.