

45 year old woman with
history of bariatric surgery
presenting with
hypoglycemia

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HPI

- 45 yo F h/o duodenal switch 2004, s/p reversal 4/2013 due to malnutrition, txf from OSH after presenting with hypoglycemia
- Awoke feeling nauseated, no appetite 8/13 am
 - BG 111
- Went to dr's appt and returned home that afternoon
- LOC shortly after arrival home
- Family tried to arouse her for 15 min before calling EMS
- BG 46 by paramedics
- Given IV dextrose and taken to local hospital

HPI

- Found to have BG 157, C-peptide 6.03 shortly after arrival
- Started on D10 gtt
- Difficulty weaning off D10, continued decreased level of consciousness
- Octreotide 100 mcg x 3 on 8/14
- D10 then gradually weaned, off 8/16 6 pm
- Txf to U of C 8/16

Prior history of hypoglycemia

- Began to have night sweats after started on TPN 3/2013
- Obtained glucometer
- Reported BGs in 50s associated with sweating
- Sxs improved with OJ
- Occurred both on and off TPN infusion
- Denied relation to meals

Other PMH

- Morbid obesity
 - Wt 420 lbs, BMI 65 at time of bariatric surgery
- Duodenal switch 2004
 - Subsequent wt loss to 240 lbs
- OSA
- HTN
- Chronic abdominal pain
- Malnutrition
 - Worsening abdominal pain, N/V starting ~12/2012
 - Developed protein calorie malnutrition (albumin 1.7) and micronutrient deficiencies including vitamin A, zinc, copper
 - Optic neuritis 2/2 vitamin A deficiency
 - TPN started 3/26/13
 - Duodenal switch reversed 4/30/13
 - TPN subsequently weaned off

■ Medications PTA

- Amitriptyline
- Atenolol
- Creon
- Vitamin B12
- Colace
- Vicodin
- Prevacid
- Lidoderm
- Lisinopril-HCTZ
- Nystatin
- Zofran
- Lyrica
- MVI
- Vitamin A
- Vitamin B Complex

■ Family History

- No DM
- No hypoglycemia
- No known endocrine tumors

■ Social History

- Married, no children
- Former project manager for construction company
- No EtOH, tobacco, or illicit

Physical Exam

- Vitals: 106 kg, 175 cm, BMI 34.6, AF, P 83, R16, BP 127/85, SaO2 98% RA
- Constitutional: She is oriented to person, place, and time. No distress.
- Head: Normocephalic and atraumatic.
- Mouth/Throat: Oropharynx is clear and moist.
- Eyes: Conjunctivae normal and EOM are normal.
- Neck: Neck supple. No thyromegaly present.
- Cardiovascular: Normal rate, regular rhythm and normal heart sounds.
- Pulmonary/Chest: Effort normal and breath sounds normal.
- Abdominal: Soft. Bowel sounds are normal. No distension. Mild TTP right and middle upper abdomen. No HSM.
- Musculoskeletal: Normal range of motion. No edema.
- Neurological: She is alert and oriented to person, place, and time. She has normal reflexes.
- Skin: Skin is warm and dry. She is not diaphoretic.
No acanthosis or skin tags
- Psychiatric: She has a normal mood and affect.

Differential Diagnosis

- Non-insulin mediated
 - Adrenal insufficiency
 - Glucagon deficiency
 - Renal, hepatic, or cardiac failure
- Insulin-mediated
 - Surreptitious insulin or SU use
 - Insulin autoimmune hypoglycemia
 - Insulinoma
 - Dumping syndrome
 - Post gastric bypass hypoglycemia

Initial Evaluation

- 8/17 2:38 am
 - Na 138, K 4.3, Cl 106, HCO₃ 19, BUN 21, Cr 1.0, Glucose 113, Ca 9.0, Phos 4.9, Prot 7.1, Alb 3.8, Bili 0.5, Alk phos 108, AST 25, ALT 21
 - BOHB <0.10
 - Cortisol 1.0
 - Insulin 21.3
 - C-peptide 1.53
- 8/17 5:33 am
 - Proinsulin 18

Further Evaluation

- Critical sample if Accucheck <55
 - BMP, beta-hydroxybutyrate, insulin, proinsulin, C-peptide, cortisol
- Insulin Abs
 - Titer 0.00
- Glucagon
 - 31 (RR <80)
- Sulfonylurea screen
 - 8/18 negative
- Chromogranin A
 - 114 (RR <93)
- Cosyntropin stim test
 - 16.4->28.2->33.7

Hospital Course

- Accuchecks monitored qac, qhs, q4 overnight
- Ranged 67-206
- No sweats or other symptoms

72 hour fast

Time	8/20 4:34	8:17	11:40	14:38	17:52	22:17	8/21 4:00	10:00	18:05
Glucose	98	116	98	83	85	86	86	80	73
Insulin				4.0	2.2	2.2		2.1	<2.0
C-peptide				0.43	0.33	0.34	0.35	0.35	0.26
AG	10						11		
Pro-insulin				12					

Time	8/21 22:36	8/22 4:00	6:00	10:00	13:51	17:00	22:10	8/23 MN	8/23 4:00
Gluc	71	74	71	72	69	63	60	59	126
Insulin	<2.0		<2.0	<2.0	<2.0	<2.0	<2.0		
C-peptide	0.21	0.17	0.16	0.20	0.19	0.14	0.18		2.45
AG		15							13

Hospital Course

- Dx: Post-bariatric hypoglycemia
- Discharged with instructions to eat small, frequent low carbohydrate meals
- Patient and husband received glucagon pen and teaching

Can we make a diagnosis without capturing hypoglycemia?

	Threshold value	Sensitivity (%)	Specificity (%)
Insulin-IRMA	21 pmol/l	67	19
Insulin-ICL	21 pmol/l	90	10
C-peptide	0.2 nmol/l	100	12
Proinsulin	22 pmol/l	73	98
	20.7 pmol/l	76	97
Insulin-IRMA/blood glucose	30	100	0
	11.4	29	100
Insulin-ICL/blood glucose	30	100	0
	11	70	86
Tumer's ratio (with insulin-IRMA)	50	29	100
	20.7	64	95
Tumer's ratio (with insulin-ICL)	50	5	100
	21.8	59	90
Proinsulin/blood glucose	15.4	91	87
Proinsulin/insulin-IRMA	3.8	83	90
Proinsulin/insulin-ICL	2.9	56	93

How common is post-gastric bypass hypoglycemia?

Table 1 Preoperative incidence rate (IR) and incidence rate ratio (IRR) of hypoglycaemia and related disorders and corresponding postoperative HRs, with and without adjustments for diabetes in the postoperative period for all patients with gastric bypass (5,040) and their referents (50,400), and for patients (4,027) and referents (40,270) when participants with preoperative diabetes have been excluded

Disease	Preoperative period				Postoperative period			
	Preop. IR surgical cohort ^a per 10,000 person-years	Preop. IR reference cohort ^a per 10,000 person-years	Preop. IRR (95% CI) ^a	Preop. IRR (95% CI) ^b	Model 1 Postop. HR (95% CI) surgical vs reference cohort ^a	Model 2 Postop. HR (95% CI) surgical vs reference cohort diabetes ^a	Model 3 Postop. HR (95% CI) surgical vs reference cohort ^a	Model 4 Postop. HR (95% CI) surgical vs reference cohort ^b
Hypoglycaemia	0.7	0.6	1.2 (0.5–2.6)	0.8 (0.1–3.2)	2.7 (1.2–6.3)	1.7 (0.7–4.2)	1.9 (0.8–4.7)	10.0 (3.3–30.4)
Confusion	0.3	0.3	1.0 (0.2–3.3)	1.4 (0.3–4.8)	2.8 (1.3–6.0)	2.0 (0.9–4.7)	2.1 (0.9–4.8)	2.1 (0.7–6.1)
Syncope	3.5	2.0	1.8 (1.2–2.5)	1.7 (1.1–2.5)	4.9 (3.4–7.0)	4.5 (3.1–6.6)	4.5 (3.1–6.6)	5.5 (3.6–8.4)
Epilepsy	5.0	3.2	1.6 (1.2–2.1)	1.7 (1.2–2.3)	3.0 (2.1–4.3)	2.8 (1.9–4.1)	2.9 (2.0–4.2)	3.0 (2.0–4.6)
Seizures	2.3	1.3	1.8 (1.2–2.8)	2.2 (1.3–3.4)	7.3 (5.0–10.8)	7.9 (5.4–11.7)	7.9 (5.4–11.6)	9.0 (5.9–13.6)
Pancreatic surgery	0.2	0.1	1.4 (0.2–6.2)	2.9 (0.3–15.0)	0.7 (0.1–5.2)	0.9 (0.1–6.9)	0.9 (0.1–7.1)	0.9 (0.1–7.0)

^a All surgical patients and referents, including those with diabetes before surgery/inclusion

^b Surgical patients and referents with diabetes before surgery/inclusion have been excluded

Model 1: Adjusted for age at surgery, sex, educational level and morbidity of same disease (hypoglycaemia, confusion, syncope, epilepsy and seizures) before surgery/inclusion

Model 2: As model 1 but with additional adjustment for diabetes before surgery/inclusion

Model 3: As model 2 but with additional adjustment for diabetes after surgery/inclusion

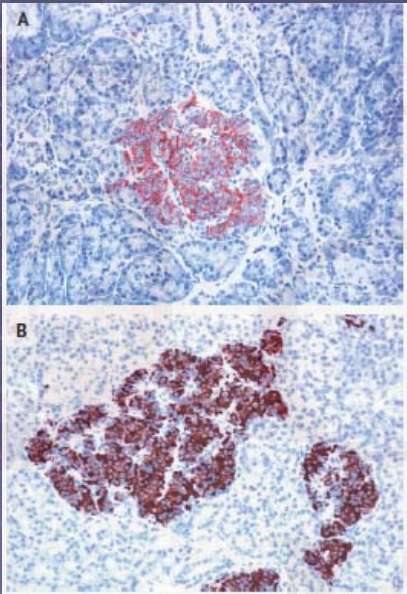
Model 4: As model 1 but with exclusion of participants with diabetes before surgery/inclusion

But absolute risk is still small...

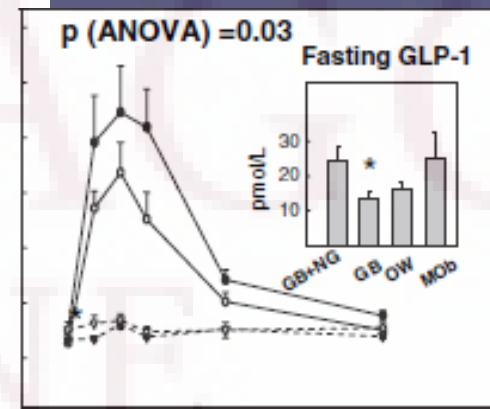
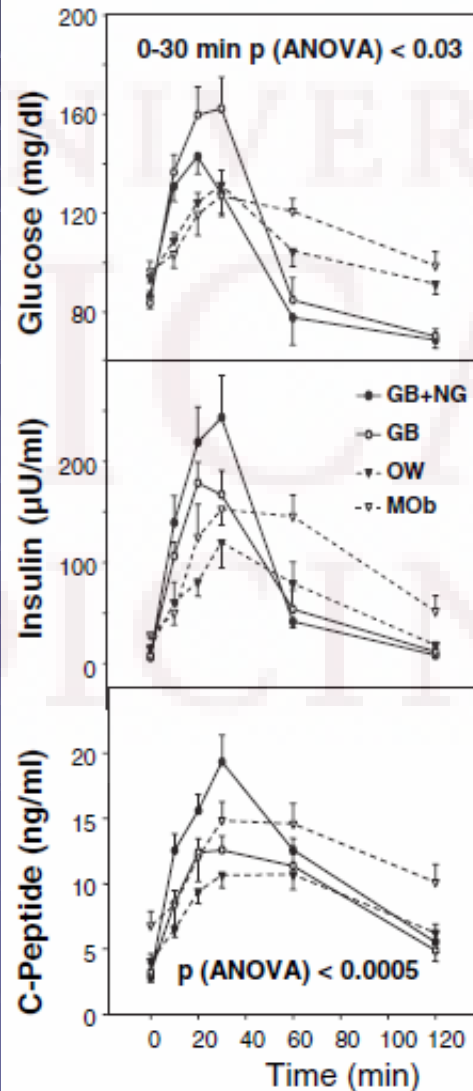
What is pathophysiology of post-GB hypoglycemia?

- Postulated mechanisms:
 - profound dumping syndrome
 - beta cell hyperfunction
 - improved insulin sensitivity following weight loss
 - lack of regression of increased functional beta cell mass that developed during prior obesity
 - GLP1-mediated active expansion of beta cell mass.

What is pathophysiology of post-GB hypoglycemia?



Some studies have shown islet hyperplasia and hypertrophy, others have shown increased nuclear size



Possible treatments

- Low carbohydrate diet
- Acarbose
- Diazoxide
- Octreotide
- Calcium channel blockers
- ?Reversal of gastric bypass
- G-tube placement
- Pancreatic resection

Back to the patient

- Initial f/u appt
 - Continued hypoglycemia despite low carbohydrate diet
 - Typically 3 hrs PP
 - 4x/week, lowest 48
 - Started on acarbose
- 2nd f/u appt
 - No hypoglycemia

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