to determine if the GES study can be reliably truncated to less than 4 hr. **Methods:** Patients with symptoms of gastroparesis underwent GES using Tc-99m LFEWS with imaging at 0, 0.5, 1, 2, 3, 4 hr after meal ingestion. Percent gastric retention was calculated using geometric center decay corrected radioactive counts at each time point. Curve fitting was performed with power exponential curve (PEC) fitting (Tougas et al), modified power exponential (MPE) curve (Siegel et al), and linear (LIN) fitting (y=mt+b). These were performed with all imaging points up to 4 hr, and then recalculated using only data up to 3 hr, 2 hr, and then 1 hr. Fitting with the standard 0, 1, 2 and 4 hr times was also performed. **Results:** 267 GES tests in patients undergoing this test for clinical evaluation were analyzed. For each of the three different types of analyses (PEC, MPE, LIN), shortening the imaging time from 4 hr prolongs the calculated T-1/2, more so with LIN (Table 1). This was pronounced especially for <2 hours. Using the standard imaging times of 0, 1, 2 and 4 hr gave similar values to using all points. Patients were grouped according to the percent retention at 2 and 4 hr: 131 patients had normal retention at 2 and 4 hr, 9 patients had increased retention at 2 hr, but normal at 4 hr, 53 patients had normal retention at 2 hr, but increased at 4 hr, and 73 patients had increased retention at both 2 and 4 hr. The inaccurate T-1/2 values for shorter imaging durations were greatest for patients with increased retention at both 2 and 4 hr (Table 2). **Conclusions:** Curve fitting techniques of gastric emptying data provide estimates of T-1/2. MPE and PEC curve fitting techniques to estimate gastric emptying T-1/2 appear equivalent whereas LIN appears less accurate. Shorter imaging protocols provide less reliable T-1/2 assessments, especially for patients with delayed gastric emptying. In patients with delayed gastric emptying, duration of at least 3 hr is needed to estimate the T-1/2. Thus, in patients undergoing GES, imaging at selected time points of at least 3 hr with use of either the MPE or PEC to calculate T-1/2 predicts the gastric emptying process.

Table 1. T-1/2 by three curve fitting techniques and different imaging durations in patients

| | 0,0.5,1,2,3,4 hrs | 0,0.5,1,2,3 hrs | 0,0.5,1,2 hrs | 0,0.5,1 hrs | 0,1,2,4 hrs |
|---|---|---|---|---|---|
| PEC | 135±7 | 151±13 | 163±14 | 237±20 | 141±11 |
| MPE | 134±7 | 147±15 | 155±9 | 214±17 | 136±8 |
| Linear | 148±10 | 185±8 | 442±108 | 1900±231 | 148±6 |

T-1/2 results expressed in minutes; mean±SEM

Table 2. T-1/2 in patients grouped by retention at 2 and 4 hours: Influence of curve fitting technique used and imaging duration

| | 0,0.5,1,2,3,4 hrs | 0,0.5,1,2,3 hrs | 0.0.5,1,2 hrs | 0,0.5,1 hrs | 0,1,2,4 hrs |
|---|---|---|---|---|---|
| Normal retention at 2 and 4 hrs | | | | | |
| PEC | 87±2 | 87±2 | 89±2 | 126±11 | 87±2 |
| MPE | 84±2 | 85±2 | 88±2 | 119±10 | 85±2 |
| Linear | 105±2 | 127±2 | 201±6 | 954±117 | 106±17 |
| Increased retention at 2 hrs, normal at 4 hrs | | | | | |
| PEC | 133±2 | 137±3 | 170±9 | 361±143 | 135±2 |
| MPE | 127±2 | 135±10 | 171±8 | 395±155 | 130±2 |
| Linear | 134±1 | 170±6 | 349±24 | 2956±1569 | 136±2 |
| Normal retention at 2 hrs, increased at 4 hrs | | | | | |
| PEC | 125±2 | 126±3 | 125±3 | 161±20 | 123±3 |
| MPE | 124±2 | 125±2 | 124±3 | 155±15 | 122±3 |
| Linear | 139±2 | 169±3 | 271±6 | 1127±89 | 141±2 |
| Increased retention at 2 and 4 hrs | | | | | |
| PEC | 233±22 | 286±48 | 324±43 | 489±60 | 254±35 |
| MPE | 233±27 | 274±41 | 297±27 | 409±47 | 236±27 |
| Linear | 233±22 | 303±29 | 633±57 | 4084±56 | 231±21 |

T-1/2 resuts expressed in minutes; mean±SEM

**Mo2084**

**Healthcare Delivery for Gastroparesis Across the United States**

Klaus Bielefeldt

An increasing awareness led to a rise in hospitalizations for gastroparesis within the last 15 years, while limited data suggest a stable prevalence. The goal of the present study was to determine hospitalization rates and outcomes in patients admitted in different states across the United States for gastroparesis. METHODS: Using the State Inpatient Database of the Agency for Healthcare Research and Quality, the number of admissions for gastroparesis, age and sex distribution, presence of diabetes mellitus, congestive heart failure or renal failure, inpatient mortality, length of stay, rates of regular discharge, and rates of interventions with endoscopy, gastrostomy placement, hemodialysis and nutritional support were assessed for 2007 to 2010. Results were normalized as admissions per 100,000 or percent of admissions for gastroparesis. RESULTS: When controlled for population size, admissions for gastroparesis ranged from 24.3±0.8 per 100,000 in Utah to 117.1±9.7 per 100,000 in Maryland. A similar variability was noted for outcomes with inpatient mortality rates between 0.9±0.1% in Colorado and 3.2±0.4% in Hawaii, a length of stay of 4.5±0.1 days in Utah or New Hampshire and 7.8±0.1 days in Florida, and a regular discharge rate of 79.6±1.8% in Hawaii and 51.5±0.9% in Massachusetts. Similarly, the frequencies of interventions differed between states with endoscopy rates of 6.8±0.8% in Wyoming versus 23.1±0.4% in Florida, with gastrostomy rates of 0.8±0.1% in North Carolina versus 3.3±0.8% in Hawaii, and rates of nutritional support of 1.2±0.2% in West Virginia versus 7.0±0.6% in New Jersey. Using stepwise linear regression analysis, gastrostomy placement was the best independent predictor of higher mortality rates (r2=0.72) and longer inpatient stays (r2=0.66). Longer stays also correlated with the percentage of minority patients (2=0.06). A higher number of patients over 45 years (r2=0.36) and rates of nutritional support (r2=0.15) correlated with lower rates of regular discharge. Gastrostomy placements were associated with a higher fraction of patients with cardiac problems (r2=0.29), initiation of nutritional support correlated with higher rates of privately insured patients (r2=0.14). CONCLUSIONS: While admission rates do not allow conclusions about disease prevalence, the data fall within the range of the only published population-based study. The results also show a significant variability in admissions, interventions and outcomes, which are affected by comorbidities and age, but are also related to socioeconomic variables. Interestingly, higher rates of gastrostomy or nutritional support correlated with increased likelihood of poor outcomes, even when controlling for age and comorbidities, which should caution providers when contemplating the use of more aggressive interventions for gastroparesis.

**Mo2085**

**Stimulation of Appetite by Rikkunshito, a KAMPO MEDICINE, Increases Vitality in Patients With Functional Dyspepsia**

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Background/Aim: Rikkunshito, a Japanese traditional herbal (Kampo) medicine, is widely prescribed for patients with dyspeptic symptoms such as anorexia, fullness, heartburn, belching, and nausea. Our previous study demonstrated that rikkunshito stimulated the gastric accommodation reflex, gastric emptying and gastroduodenal motility, and improved abdominal pain, heartburn and abdominal distension in patients with functional dyspepsia (FD)(Internal Medicine 49, 2010). Recently, it was reported that rikkunshito increased appetite via stimulation of ghrelin secretion and up-regulation of ghrelin receptors (GHS-R). To clarify whether improvement of appetite contributes to the patient's sense of well-being and the functional cause of that improvement, we investigated posttreatment changes of both health-related quality of life (HRQOL) and gastrointestinal motor function in a responder group (patients whose appetite improved after treatment with rikkunshito) and a non-responder group. Methods: Sixteen FD patients (10 men and 6 women; median age, 45 years) were enrolled for this study. HRQOL and appetite were assessed using Short-Form Health Survey-8 (SF-8)and the 5-point Likert scale before and after 14 days of treatment with rikkunshito (7.5g/day). To evaluate gastrointestinal motor function, the expansion rate in the proximal stomach and gastric emptying rate (GER) were measured after ingestion of a liquid meal (consommé soup 300 and 400 mL) by extracorporeal ultrasonography, as previously described. Results: Appetite improved after treatment with rikkunshito in 5 patients (responder group), but not in the other 11 patients (non-responder group). The category scores of general health perception and vitality in the responder group were 39.6 vs. 46.9 (p=0.091) and 41.98 vs. 50.0 (p=0.048) before vs. after treatment, respectively. In contrast, those in the non-responder group were 41.3 vs. 43.4 (p=0.443) and 45.4 vs. 46.2 (p=0.638), respectively. The expansion rates (mean ± SE) in the proximal stomach were 24.3 ± 1.3 vs. 29.9±3.2 (p=0.248; 300 mL ingestion) and 29.1 ± 1.6 vs. 38.0 ± 3.7 (p= 0.099; 400 mL ingestion) in the responder group. In contrast, those in the non-responder group were 22.5 ± 2.2 vs. 28.9 ± 2.1 (p=0.003; 300 mL ingestion) and 26.3 ± 2.6 vs. 34.9 ± 2.4 (p=0.001; 400 mL ingestion). GER was 64.1 ± 5.4 vs. 88.1 ± 3.1 (p=0.004) and 64.5 ± 4.3 vs. 72.1 ± 6.4 (p=0.229) in the responder group and the non-responder group, respectively. Conclusion: The category score of vitality and the GER were significantly higher in FD patients whose appetite improved after treatment with rikkunshito. Stimulation of appetite by rikkunshito may lead to an increase of vitality in FD patients.

**Mo2086**

**Transcutaneous Intraluminal Impedance Measurements (TIIM): A New Minimally-Invasive Technique for Long-Term Monitoring of Gastric Motility**

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BACKGROUND. The stomach plays a critical role in digestion. When gastric motility is compromised digestion is adversely affected, leading to a variety of disorders including gastroparesis and functional dyspepsia. Presently, gastric motility is assessed by short-term stationary tests involving monitoring food transit, radiation, and/or upper endoscopy. AIM. The study explored the feasibility of a novel, minimally-invasive technique for long-term ambulatory monitoring of gastric motility by transcutaneous intraluminal impedance measurements (TIIM). METHODS. Minimally invasive catheter-based system was initially designed, which was subsequently modified to a swallowable, gastric retentive, wireless capsule. The catheter-based system contained miniature electronic oscillator on its tip emitting a 50-KHz, 200-mV sinusoidal signal. The catheter was laboratory tested and when functionality was confirmed was inserted transorally in the stomachs of two unconscious mongrel dogs. Two standard cutaneous electrodes were placed over the abdominal projection of the gastric axis (one over the pylorus, and another 6-7 cm proximal to it) to complete the electric circuit with the internal oscillator and measure transluminally two TIIM channels. Gastric contractions were pharmacologically induced by 0.04 mg/kg IV Neostigmine and 15-minutes recordings were made. The contractions were simultaneously registered by TIIM and two force transducers (FT) sutured onto the antral serosa (one prepyloric, and another 6-7 cm proximal to it) at laparotomy. All signals were custom-amplified, conditioned and digitized. Normalized one-minute gastric motility indices were calculated, and Pearson correlation coefficients between TIIM and FT tracings were obtained. After the catheter-based TIIM was verified, a wireless capsule converting the catheter into an autonomous ingestible gastric bezoar containing the electronic oscillator was designed and laboratory tested on a tripe cow stomach. A single-channel TIIM signal was measured by two external

electrodes (one active, one ground). Gastric contractions were simulated by manually manipulating the stomach tripe layers encompassing the capsule, and were recorded for 15 minutes by a single FT sutured onto the tripe. One-minute TIIM and FT motility indices were compared. Pearson correlation coefficient was calculated. RESULTS. Statistically-significant correlations were observed between the motility indices calculated from the 2-channel TIIM and the two FT channels (proximal-distal) in the catheter setting (0.661-0.724 for dog 1, and 0.551-0.513 for dog 2, $p<0.05$), and between gastric tissue manipulations registered by the TIIM and the FT in the capsule system (0.511, $p<0.05$). CONCLUSION. The proposed TIIM technique can be a feasible avenue for minimally-invasive long-term ( > 24 hrs) ambulatory monitoring of gastric motility.

**Mo2087**

### Phase 1, Randomized, Placebo-Controlled, Single-Dose, Two-Period, Crossover Study of RM-131 on Pharmacodynamics and Symptoms in Type 1 Diabetics With Documented Delayed Gastric Emptying

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**Background:** Ghrelin is an endogenous ligand for GHS-1a receptor and a potential treatment for delayed gastric emptying (DGE). RM-131 is a synthetic ghrelin agonist which we had previously shown greatly accelerates solid gastric emptying (GE) in type 2 diabetics with DGE. **Aim:** To investigate the pharmacodynamic (PD) profile of a single dose of RM-131 in type 1 diabetes mellitus (T1DM) patients with prior documentation of DGE and upper gastrointestinal symptoms. **Methods:** In a randomized, double-blind, placebo-controlled, single-dose, two-period, crossover study with a 7-day washout, 10 patients with T1DM and prior DGE received RM-131 (100µg s.c.) or placebo. Eligibility was confirmed by medical history, physical examination, concomitant medication review, clinical laboratory tests, and a 12-lead electrocardiogram (ECG). Using a solid-liquid radiolabeled meal and scintigraphy, we assessed GE over 4 hours and colonic filling at 6 hours (CF6); the meal was ingested 30 minutes after study drug administration. Adverse events and vital signs were assessed in both periods. We also assessed upper GI symptoms using a daily gastroparesis cardinal symptom index (total GCSI-DD) and a combination of nausea, vomiting, fullness and pain (NVFP) using 0-5 scale. Treatment effects were assessed using a paired t-test or Wilcoxon signed rank test (2-sided $\alpha$=0.05). Intra-individual coefficient of variation of GE solids $T_{1/2}$ was 24%, justifying study of 10 patients. **Results:** At screening, HbA1c was 9.1±0.5% (SEM); age 45.7±4.4y; BMI 24.1±1.1 kg/m$^2$; total GCSI-DD score 1.66±0.38 (median 1.71); total NVFP score 1.73±0.39. Absence of sinus arrhythmia on baseline ECG was observed in 6/10 patients, indicating the presence of cardiovagal dysfunction. RM-131 decreased mean solid GE $T_{1/2}$ by -33.8 minutes (118.7±26.7 for placebo; 84.9±31.6 for RM-131); similarly, median solid GE $T_{1/2}$ was faster (-33.8 min, IQR -12, -49; or -54.7%, IQR -21, -110) for RM-131 vs. placebo (p=ns). RM-131 decreased gastric retention of solids at 1 hour (GE 1h, p=0.003) and 2 hours (GE 2h, p=0.019) with a mean difference of 24.7 [±14.7 (SEM) %] relative to overall mean at 2h. Presence of vagal dysfunction did not modulate the effect of RM-131; thus, the drug-placebo differences were not different in those without or with vagal dysfunction. Numerical differences in liquid GE $T_{1/2}$, lag time and CF6, were not statistically significant. There were no significant adverse effects. **Conclusions:** RM-131 significantly accelerates early phase gastric emptying of solids and numerically improves GE solid $T_{1/2}$ (-54.7%, comparable to -66% decrease in GE $T_{1/2}$ solid in type 2 DM previously) and reduces upper GI symptoms in patients with T1DM and documented DGE. The presence of cardiovagal dysfunction did not impact the response to treatment with RM-131. **Funding:** Rhythm Pharmaceuticals

| Data show median, IQR (n=10) | Placebo | RM-131 | P value |
|---|---|---|---|
| Daily total GCSI-DD score | 0.79 (0.75, 2.08) | 0.17 (0.00, 0.67) | <0.02 |
| Daily NVFP score | 1.00 (0.50, 2.00) | 0.25 (0.00, 0.50) | <0.05 |
| GE $T_{1/2}$ solid, min | 75.7 (66.4, 188.6) | 58.2 (40.4, 86.6) | ns |
| GE 1h, solid %# | 40.3 (21.0, 44.4) | 55.6 (40.5, 73.1) | 0.005* |
| GE 2h solid, % | 74.6 (38.5, 79.4) | 88.7 (72.2, 97.4) | 0.019* |
| GE 4h solid, % | 97.1 (57.2, 100) | 100 (92.9, 100) | ns |
| GE solid lag time (t10% GE), min | 9.0 (5.0, 20.0) | 5.9 (2.8, 21.4) | ns |
| GE $T_{1/2}$ liquid, min | 26.4 (12.7, 51.92) | 13.0 (10.4, 32.6) | ns |
| CF6 solid, % | 19.0 (0.0, 41.0) | 28.5 (10.0, 45.0) | ns |
| Blood glucose at 120 min, mg/dL | 248 (182, 273) | 231 (152, 290) | ns |

Data compared using Wilcoxon signed rank test or * paired t-test; one participant had missing 1h gastric emptying data at both study visits; ns = not significant

**Mo2088**

### Clinical Role and Cardiovascular Safety Profile of Chronic Domperidone Use

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Background: Domperidone as a non-FDA approved drug in the USA is available under IND-approved protocol for the treatment of gastroparesis (GP) and nausea and vomiting. This drug is a dopamine receptor antagonist with peripheral prokinetic and central antiemetic properties. During the last 30 years there have been reports of oral domperidone prolonging the QT interval and thus predisposing the patient to ventricular arrhythmias. Aims: 1) Review clinical profiles and indications for chronic use of domperidone; 2) Investigate possible correlations of domperidone with electrocardiographic changes (ECG); 3) Identify electrolyte disturbances and cardiovascular (CV) events associated with domperidone. Methods: A retrospective chart review of 163 patients referred to a tertiary GI Motility Center was performed. Patient demographics, GI diagnoses, domperidone dose, cardiovascular complaints and ECG readings were examined at the baseline and follow up (F/U) visits. Prolonged QTc was verified if longer than 470 milliseconds (ms) in F and longer than 450 ms in M patients. Results: Out of 163 patients 39 (24%) were identified as receiving domperidone at some point during their clinical care. Mean age was 41 (SD±17.4); 59% were F; 61% were Caucasian, 28% Hispanic, 8% African American. Clinical indications for use of domperidone were: Diabetic GP in 19 (49%); Idiopathic GP in 11(28%); other diagnoses in 23% of patients including: cyclic vomiting Syndrome, Dumping Syndrome and chronic vomiting. The mean F/U was 6 months (range 3 months to 3 years) and the majority of patients, 58%, were taking 20 mg QID, 25% were on 30mg QID and 17% received 10 mg QID. Baseline and follow up ECG tracings were reviewed in 28 and 16 patients, respectively, showing a mean value of QTc intervals of 428.8 milliseconds (ms) (SD± 24.8) vs. 439.4ms (SD± 30.2) P=0.22. Four (25%) patients (3 M and 1F) were identified with prolongation of QTc intervals 453, 463, 509, 481ms and they were on 30, 80, 80 and 120 mg of domperidone/day respectively for 3 to 12 months. The medication was stopped in all these cases. Heart rate data compared between baseline and F/U visits was the same with a mean value of 85 bpm. Sinus tachycardia was present in 6 (29%) of patients at baseline and in 2 (13%) of patients at FU visit. No meaningful changes between these visits were observed in regards to mean systolic (114 vs 118 mmHg) and diastolic (68 vs.74) blood pressure. There were no significant K and Na electrolytes changes before and after domperidone use. Two patients were complaining about palpitation, while none had chest pain or other CV symptoms. Conclusions: 1) In a large single center experience Domperidone had a safe cardiac profile without causing noticeable cardiovascular complications 2) There was no correlation of prolonged QTc intervals, dose of the drug and duration of treatment.

**Mo2089**

### Applying the ROME III Questionnaire in Asia Leads to Substantial Misclassification of Irritable Bowel Syndrome (IBS) Patients As Functional Dyspepsia (FD)

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Background and Aims Pending the identification of biomarkers, FGID diagnostic and sub-classification criteria are currently symptom based. These criteria were defined and described in English, and then translated and validated in other languages. However, the validity is premised on the fidelity of direct translation and the fidelity of patient symptom reporting with physician interpretation. For example, epigastric pain and post-prandial fullness (PPF) are ascribed to the upper GI and FD, and abdominal pain and distension ascribed to the lower GI and IBS. Our observations indicated that patients in Asia may not differentiate fullness and distension, and IBS is a common cause of epigastric pain. We hypothesized applying the Rome III criteria without cultural adaptation could create systemic bias, resulting in substantial misclassification of IBS patients as FD. Methods The Rome III Questionnaire was reviewed by a panel of experts from Asia, and where applicable, clarifying questions were added. One of this was the question on PPF; additional questions consisted of its relationship to meal, its location, relief pathway and whether followed by urgent desire to defecate. This expanded questionnaire was then translated into the various Asian languages and validated according to standard requirements. To avoid creating a self-fulfilling prophecy, participating physicians were instructed to disregard the Rome criteria and to recruit consecutive patients presenting with any GI symptoms. Patients with abnormal biochemical or imaging tests were excluded. To study what proportion patients with IBS maybe misclassified as FD, we analyzed our results by the following steps. All patients who fulfilled Rome III criteria for FD were classified as FD-IBS overlap if they also had abdominal pain or discomfort fulfilling IBS criteria. The remaining patients were classified as apparent FD. In this group of apparent FD patients, we identified those patients whose epigastric pain was relieved by passing flatus or stools and whose fullness was relieved by passing flatus or stools or followed by urgent desire to defecate. Results (See Figure 1.) Conclusions These results suggest that a substantial proportion of patients who experience fullness or epigastric pain may be re-classified as IBS if they were asked specifically whether their fullness or epigastric pain was relieved with passage of stool or flatus. These observations call into question the validity of Asian studies sub-classifying fullness or epigastric pain as FD based on existing and earlier iterations of the Rome criteria. It is unclear whether the discrepancy arose due to a systemic problem with the questionnaire, or due to socio-cultural differences.