

RÉUNION ANNUELLE
DU GROUPE FRANÇAIS

DE NEURO-GASTROENTÉROLOGIE



GFNG

2&3 MAI
2024
ANNECY
LES PENSIÈRES
VEYRIER-DU-LAC

BALLONNEMENT

Prévalence, facteurs de risque,
Physiopathologie
A propos d'un cas clinique

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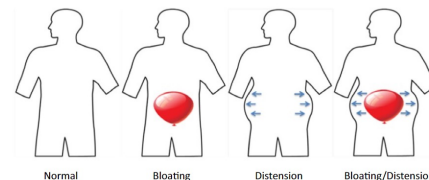
Groupe Français de
Neuro-Gastroentérologie

- Mme X, 55 ans, ballonnement
- Apparus il y a 5 ans
- ATCD: Syndrome d'apnée du sommeil (CPAP)
- Gêne au quotidien, déclenchée par la prise des repas, ↑ fin de journée
- Nécessité de défaire sa ceinture après le repas
- Transit: une selle un jour sur deux Bristol 1
- Examen: IMC 32 kg/m²
- Bilan NI: fibroscopie gastrique, coloscopie, TDM abdo pelvien
- Pense avoir un excès de gaz ou un SIBO





- **Ballonnement abdominal**= sensation **subjective** de n'importe quelle région de l'abdomen décrite comme une sensation de plénitude/pression/ gaz/ impression de distension abdominale
- **Distension abdominale** = augmentation **visible** de la circonférence abdominale



Moshiree, Gastroenterology 2023
Schmulson NGM 2023

Une pathologie organique est exceptionnellement en cause: Ascite, POIC, SIBO...

Le plus souvent en rapport avec un trouble fonctionnel:

- **Ballonnement Fonctionnel** : Rome IV (Stanghellini, Gastroenterology 2016)
 - Au moins un jour par semaine,
 - début il y a 6 mois, présent dans les 3 derniers mois
 - sans critères de SII, de Sd de détresse post prandiale, de constipation ou de diarrhée fonctionnelles.
- **Ballonnement associé à d'autres dysfonctions de l'axe cerveau-intestin**

Prévalence: ballonnements fonctionnels (Rome IV)



- Enquête dans la population générale
- 73 076 adultes, 33 pays
- Ballonnements fonctionnels (Rome IV) = 3,5%
 - Femme 4,6%, Homme 2,4%
 - France 6,0%
- Distension: 1,2%

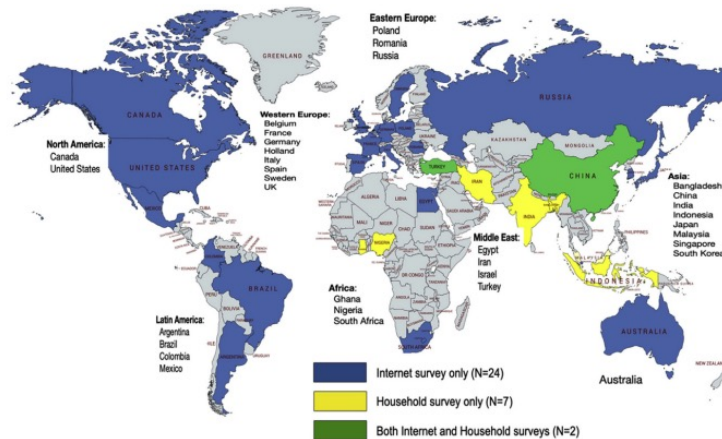


Figure 1. Global map showing study countries, colored-coded by data collection method: Internet, household interviews, or both. The Internet survey was conducted in 26 countries and the household survey in 9 countries, 2 (Turkey and China) used both methods, totaling 33 countries in all.



Prévalence: ballonnements/distension et troubles fonctionnels

2259 adultes (Olmsted County, Minnesota, 124277 habitants)

53% femmes

Âge moyen 62 ans

Troubles fonctionnels (Rome II)

ballonnements +/- distension: 19%

FDR (OR):

- Sexe F (1.5; 95% CI, 1.0 -2.1)
- Score de somatisation élevée (1.4; 95% CI, 1.1-1.8)
- SII-C (2.3; 95% CI, 1.3-4.1)
- Dyspepsia (1.9; 95% CI, 1.1-3.2),
- Gastro-intestinal symptom complex overlap (1.7; 95% CI, 1.1-2.7)

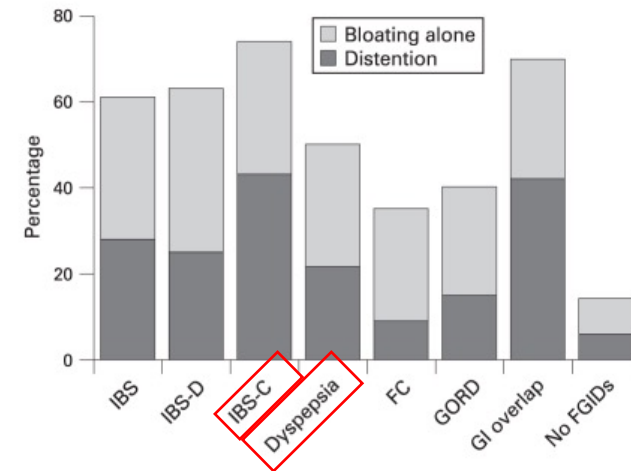


Figure 2.

The proportion of abdominal bloating and visible distention among FGIDs, GORD as well as in subjects with none of these disorders (no FGIDs). The lower part of each column shows the proportion with distention. The GI overlap group included all subjects with complex symptoms meeting the criteria for more than one of irritable bowel syndrome (IBS), functional constipation (FC), functional dyspepsia (FD) and gastro-oesophageal reflux disease (GORD). GI, gastrointestinal; IBS, irritable bowel syndrome; IBS-C, constipation-predominant IBS; IBS-D, diarrhoea-predominant IBS.



Table 2. Order of Bothersome Symptoms in the Population With IBS (n = 337)

Symptoms	Frequency (%)
Abdominal cramping	47 (13.9)
Bloating or feeling of fullness/distention/swelling	43 (12.8)
Abdominal pain or discomfort	38 (11.3)
Loose/watery stool	33 (9.8)
Straining to have bowel movements	31 (9.2)
Urgency	29 (8.6)
Fear that abdominal symptoms related to cancer or another illness	28 (8.3)
More frequent bowel movements	26 (7.7)
Losing control of bowels, bowel accidents, soiling underwear	16 (4.7)
Feeling of not having complete bowel movements	15 (4.5)
Firmer/harder stools	11 (3.3)
Fewer bowel movements	10 (3.0)
Passage of mucus with bowel movements	5 (1.5)

= 2^{ème} symptôme le plus gênant en cas de SII

Facteurs de risque de ballonnements sévères



N = 612 FGID, 78,3% F
Ballonnements: 85% des cas

Functional gastrointestinal disorder subtype [†]	N (%)
Functional dyspepsia [§]	305 (49.8%)
Irritable bowel syndrome	212 (34.6%)
Functional constipation	78 (12.8%)
Functional diarrhea	65 (10.6%)
FGID not meeting Rome IV criteria by questionnaire	145 (23.7%)

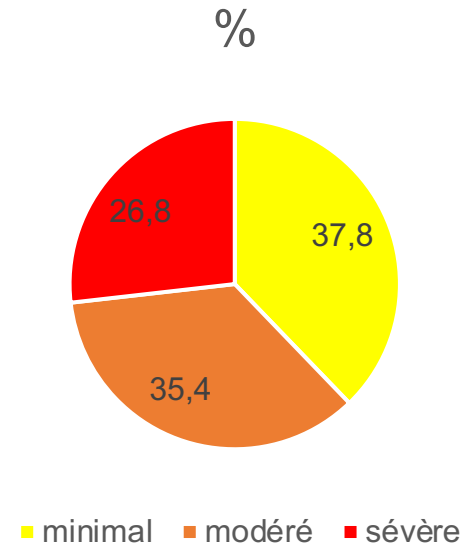




TABLE 4 Multivariable ordinal logistic regression comparing minimal, moderate, and severe bloating

	Odds ratio, 95% CI [LL, UL]	p Value
Age	-0.99 [-0.98, 0.99]	0.041
Sex	1.22 [0.81, 1.84]	0.336
FGID subtype		
IBS	0.65 [0.43, 0.98]	0.039
Functional dyspepsia	2.24 [1.58, 3.18]	<0.001
Functional constipation	1.8 [1.06, 3.07]	0.031
Severity of gastrointestinal symptoms (PROMIS T score)		
Abdominal pain	1.08 [1.06, 1.10]	<0.001
Constipation	1.04 [1.02, 1.06]	<0.001
Diarrhea	0.99 [0.97, 1.01]	0.308
Anxiety	1.00 [0.97, 1.02]	0.885
Depression	1.00 [0.98, 1.03]	0.858
Sleep disturbance	0.99 [0.97, 1.01]	0.397
PHQ-12 Score	1.08 [1.02, 1.14]	0.005

Bold value indicate those that were statistically significant (i.e., $p < 0.05$).

Pas d'influence du score HAD/troubles du sommeil

Obésité et ballonnements: relation IMC et symptômes



Table 2 Relationship between body mass index (BMI) and individual gastrointestinal symptoms ($n = 777$)

Analysis	Symptom n (%)	Underweight n (%)	Normal n (%)	Overweight n (%)	Obese n (%)	Missing n (%)*	Unadjusted†		Adjusted‡	
							OR (lower, upper)	P -value	OR (lower, upper)	P -value
Univariate										
	Nausea >1/month	0	32 (9.7)	23 (8.7)	17 (9.9)	7 (0.9)	1.05 (0.78, 1.41)	0.8	1.13 (0.83, 1.55)	0.4
	Vomiting >1/month	0	7 (2.1)	7 (2.7)	5 (2.9)	3 (0.4)	1.22 (0.70, 2.13)	0.5	1.28 (0.73, 2.24)	0.4
	Early satiety >25%	1 (8.3)	36 (10.9)	23 (8.7)	8 (4.7)	18 (2.3)	0.69 (0.5, 0.96)	0.03	0.77 (0.55, 1.10)	0.1
	Upper abdominal pain >1/month	2 (16.7)	68 (20.6)	67 (25.5)	45 (26.2)	0	1.19 (0.97, 1.46)	0.1	1.29 (1.03, 1.61)	0.03
	Lower abdominal pain >1/month	7 (58.3)	102 (30.9)	70 (26.6)	50 (29.1)	0	0.89 (0.73, 1.08)	0.2	0.96 (0.77, 1.18)	0.7
	Bloating >25%	1 (8.3)	96 (29.1)	81 (30.8)	59 (34.3)	56 (7.2)	1.20 (0.99, 1.46)	0.06	1.32 (1.07, 1.63)	0.009
	Postprandial fullness >25%	1 (8.3)	28 (8.5)	33 (12.3)	14 (8.1)	14 (1.8)	1.04 (0.78, 1.40)	0.8	1.13 (0.83, 1.53)	0.4
	Hard stool >25%	2 (16.7)	31 (9.4)	28 (10.6)	17 (9.9)	18 (2.3)	1.00 (0.75, 1.34)	>0.9	1.03 (0.75, 1.40)	0.9
	Decreased stools >25%	3 (25.0)	25 (7.6)	11 (4.2)	9 (5.2)	12 (1.5)	0.68 (0.47, 1.00)	0.05	0.79 (0.53, 1.17)	0.2
	Increased stool frequency >25%	3 (25.0)	77 (23.3)	71 (27.0)	67 (39.0)	12 (1.5)	1.42 (1.17, 1.72)	0.0005	1.41 (1.14, 1.74)	0.002
	Loose, watery stools >25%	1 (8.3)	32 (9.7)	20 (7.6)	31 (18.0)	20 (2.6)	1.39 (1.06, 1.84)	0.02	1.47 (1.10, 1.98)	0.01
	Heartburn >1/month	0	22 (6.7)	46 (17.5)	29 (16.9)	4 (0.5)	1.71 (1.31, 2.23)	<0.0001	1.87 (1.4, 2.48)	<0.0001
	Regurgitation >1/month	0	12 (3.6)	26 (9.9)	18 (10.5)	5 (0.6)	1.74 (1.24, 2.44)	0.001	2.05 (1.42, 2.94)	0.0001

*Percentage of total. †Unadjusted odds ratios. ‡ Adjusting for age, gender, education, alcohol consumption and smoking status.

Ballonnements = excès de gaz ?



TDM en basal, en cas de crise et après repas test

Volumes de gaz chez VS: 95 (71-141) mL

Patients avec profil anormal de gaz pdt les crises de ballonnements : 331 (251-384) mL

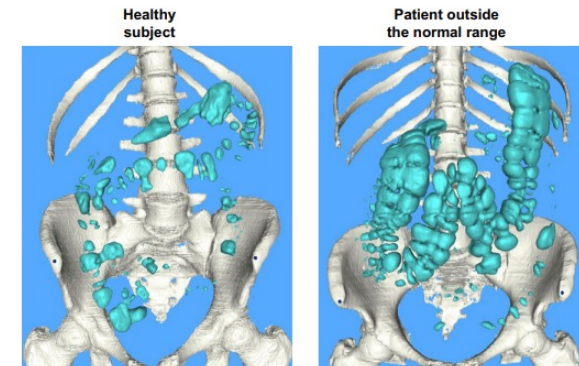
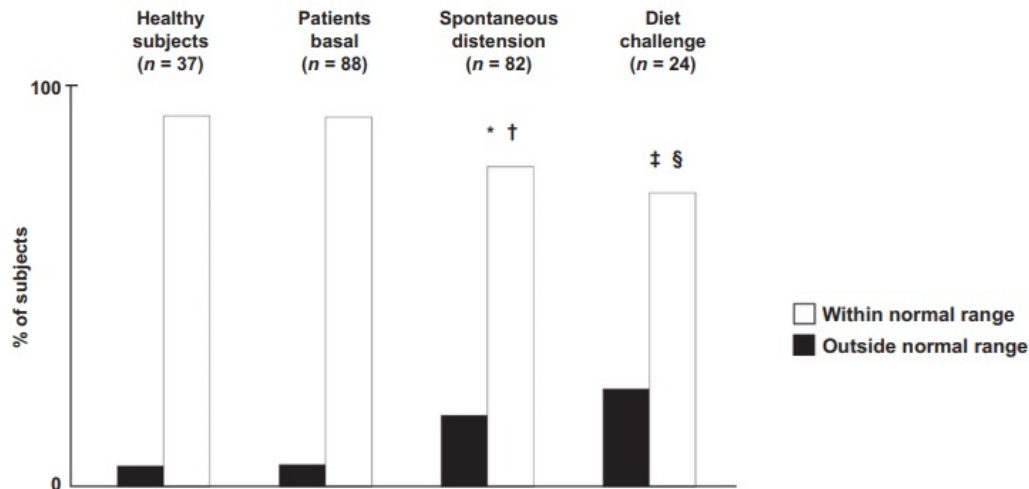


Figure 5 Examples of abdominal gas. Three-dimensional reconstruction from computed tomography (CT) scans in a healthy subject (70 mL total volume, 47 mL in colon) and a patient outside the normal range (383 mL total volume, 363 mL in colon).

Bendezú NGM 2015

➔ Seulement 25% des patients en crise ont une augmentation des gaz/distribution anormale des gaz dans la lumière intestinale (TDM)

Rôle des gaz et du diaphragme?

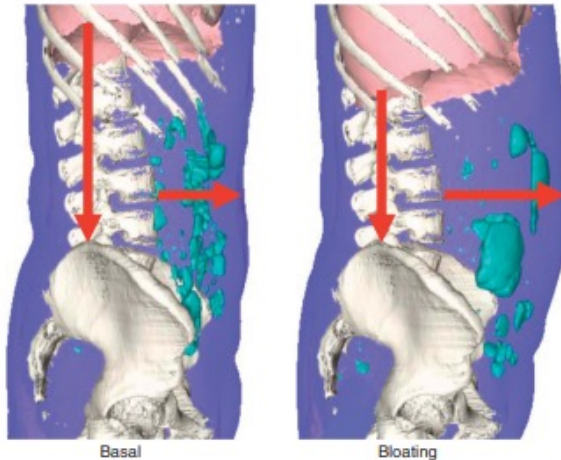


Ballonnements n = 56: 47 Rome II (17 FB, 10 SII-M, 20 SII -C), 9 troubles moteurs gastro intestinaux sévères
12 sujets sains

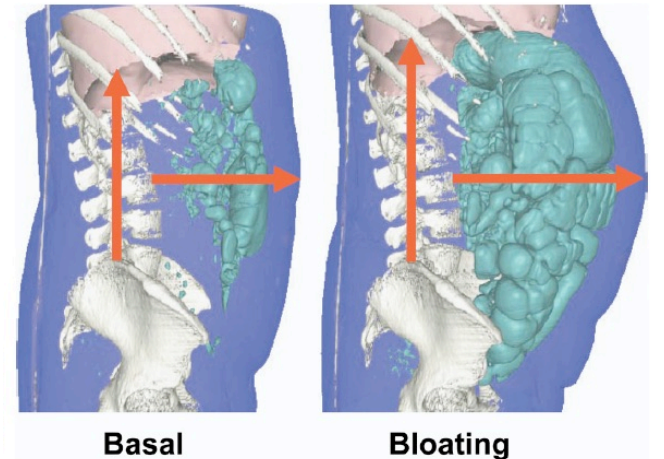
Scanners: avant et pendant une crise

Même scores de ballonnements; augmentation du volume abdo: $0,3 \text{ L} \pm 0,1$ vs $1.40.3 \text{ L} \pm 0,3$; $P < 0.001$

Protrusion abdo: $14 \pm 2 \text{ mm}$ vs $23 \pm 4 \text{ mm}$; $P < 0.05$



Patients fonctionnels



Troubles moteurs sévères



Perfusion de gaz jéjunum 12ml/min ± perf jéjunale de lipides

Rétention de gaz = gaz perfusé - gaz rectaux

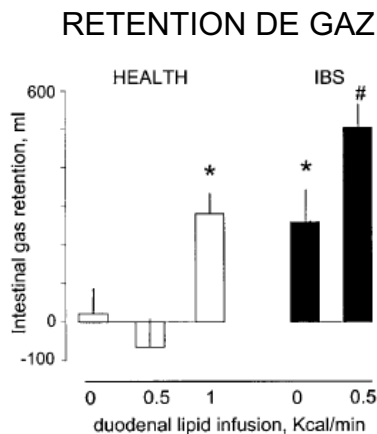


Figure 1. Effect of duodenal lipids on intestinal gas transit. Data are mean values \pm SE of gas retained after 2-hour infusion. Duodenal lipids delayed gas transit, and this effect was significantly more pronounced in patients with IBS. * $P < 0.05$ vs. 0 Kcal in health; # $P < 0.05$ vs. 0 Kcal in IBS and 0.5 Kcal in health.

SCORE DE PERCEPTION ABDO

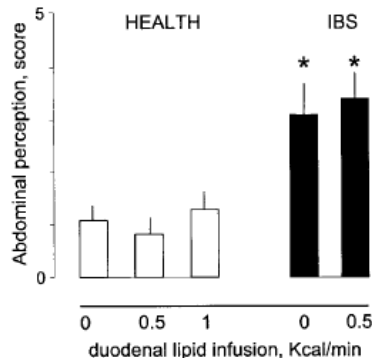


Figure 2. Effect of duodenal lipids on perception of intestinal gas infusion. Data are mean values \pm SE of perception scores after 2-hour infusion. Patients with IBS had significantly more symptoms than healthy subjects, but duodenal lipids did not modify perception. * $P < 0.05$ vs. health.

DISTENSION ABDO

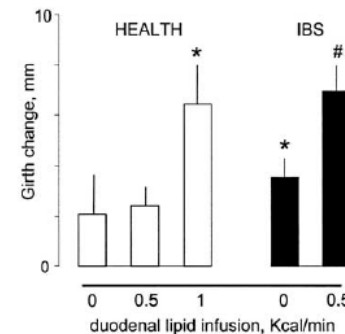


Figure 3. Effect of duodenal lipids on abdominal distention during intestinal gas infusion. Data are mean values \pm SE of girth change at the end of 2-hour infusion. Abdominal distention correlated with gas retention; abdominal distention increased with duodenal lipids, and this effect was significantly greater in patients with IBS. * $P < 0.05$ vs. 0 Kcal in health; # $P < 0.05$ vs. 0 Kcal in IBS and 0.5 Kcal in health.

Serra Gastroenterology 2002

En cas de SII vs volontaires sains:

- transit des gaz ralenti, ralentissement majoré si perfusion de lipides
- sensibilité viscérale augmentée, sans effet de la perfusion de lipides
- Distension abdominale plus marquée



- En cas de SII-C:
 - Si transit colique ou oro-caecal ralenti = **risque plus élevé de distension** mais pas plus de risque de ballonnement
 - Corrélation distension/ TTOC et TC

- Dysnergie: temps d'expulsion du ballonnet en MAR plus élevé en cas de constipation avec ballonnement si présence d'une **distension**

Agrawal, Am J Gastro 2009

Shim Am J Gastro 2010



Relationships between SIBO and symptoms in those without obvious predisposing factors are more tenuous and symptoms are weakly predictive at best. Contrary to common belief, **diarrhea and not bloating** has the strongest association with SIBO.

Quigley, Gastroenterology 2020

Table 1. Diseases and Disorders Associated With Small Intestinal Bacterial Overgrowth—A Pathophysiological Approach

Abnormal small intestinal motility	Anatomic abnormalities	Hypochlorhydria	Immune deficiency	Multifactorial	Relationship to SIBO unclear
Diabetic autonomic neuropathy	Small intestinal diverticulosis	Post-surgical Long-term acid suppression	Inherited immune deficiencies (eg, common variable immunodeficiency)	Chronic pancreatitis	Rosacea
Systemic sclerosis/scleroderma	Surgically-induced alterations in anatomy (Billroth II gastrectomy, bariatric surgery, end-to-side anastomosis)		Acquired immune deficiency (eg, AIDS, severe malnutrition)	Diabetes mellitus	Interstitial cystitis
Amyloidosis				Tropical sprue	Restless legs syndrome
Hypothyroidism				Crohn's disease	Parkinson's disease
Idiopathic intestinal pseudo-obstruction				Cystic fibrosis	Erosive esophagitis
Acromegaly				Intestinal failure	Severe obesity
Gastroparesis	Strictures (Crohn's disease, radiation, surgery)			Radiation enteropathy	Irritable bowel syndrome
Myotonic muscular dystrophy				Liver disease	
Chronic opiate use	Blind loops			End-stage renal disease	
Long-standing use of motility-suppressing drugs	Gastrocolic or jejunocecal fistula			The elderly	
	Ileocecal valve resection				



Relationships between SIBO and symptoms in those without obvious predisposing factors are more tenuous and symptoms are weakly predictive at best. Contrary to common belief, diarrhea and not bloating has the strongest association with SIBO.

Quigley, Gastroenterology 2020

Etude chez 97 patients constipés, test au glucose (H2 et CH4)
Pas de relation entre le taux de CH4 en basal ou max
Et la sévérité de la constipation et des ballonnements

Singh J Clin Gastro 2020

Rôle du SIBO ou d'une dysbiose ?



Table. Baseline Characteristics of Study Subjects

Variables	HC (n = 12)	FABD (n = 21)	P-value
Gender (n [%])			0.839
Male	8 (66.7)	13 (61.9)	
Female	4 (33.3)	8 (38.1)	
Age (yr)			0.012
Mean ± SD	34.5 ± 3.8	62.1 ± 14.7	
Range	33-45	22-81	
BMI (kg/m ²)			0.910
Mean ± SD	23.0 ± 2.9	24.2 ± 2.7	
Medical history (n [%])			0.122
Hypertension	0 (0.0)	5 (23.8)	
Diabetes	0 (0.0)	5 (23.8)	
Old CVA	0 (0.0)	0 (0.0)	
Smoking history (n [%])			0.839
None	9 (75.0)	16 (76.2)	
Past	0 (0.0)	3 (14.3)	
Current	3 (25.0)	2 (9.5)	
Alcohol history (n [%])			0.671
None	2 (16.7)	14 (66.7)	
Social	10 (83.3)	6 (28.6)	
More than twice a week	0 (0.0)	1 (4.7)	
Cholecystectomy (n [%])	0 (0.0)	0 (0.0)	1.000
Lack of exercise (n [%])	3 (25.0)	5 (23.8)	0.956
Bloating/distention (VAS score)			0.001
Mean ± SD	1.2 ± 0.4	6.5 ± 2.5	
Hydrogen breath test (n [%])			
Negative		12 (57.1)	
Positive		9 (42.9)	

HC, healthy control; FABD, functional abdominal bloating and distention; BMI, body mass index; CVA, cerebrovascular accident; VAS, visual analogue scale.

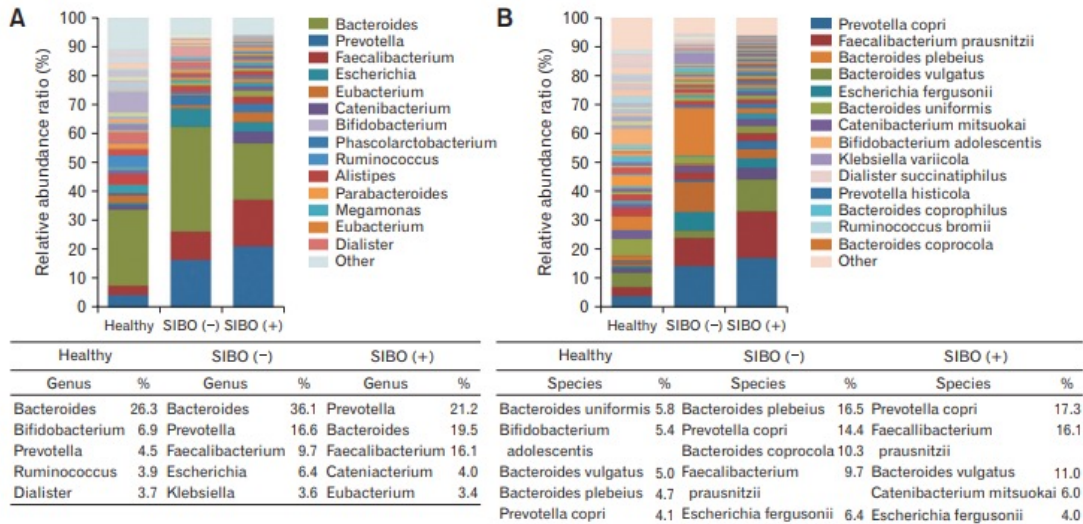


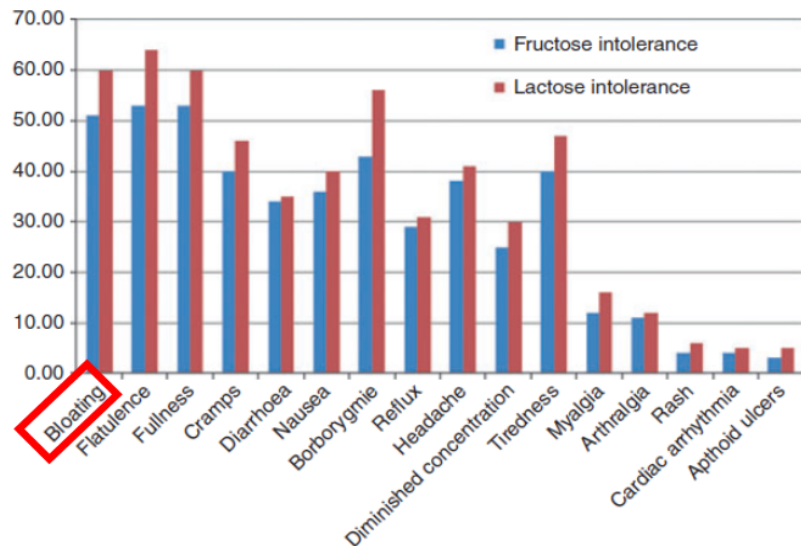
Figure 5. Relative abundance of bacteria at the genus (A) and species (B) levels. The top 15 bacterial genera or species that were detected are indicated. SIBO, small intestinal bacterial overgrowth.

→ Microbiote fécal ≠ si ballonnements fonctionnels vs VS et influencé par test au lactulose :
 ↓ diversité, abondance relative bactérienne ≠,
 Phylum: plus de Proteobacteria et moins d'Actinobactéria
 Genus: plus de *Prevotella* et de *Faecalibacterium*
Species: Plus de *P. copri* et de *F. prausnitzii*, moins *B. uniformis* et *B. adolescentis*

Prévalence des intolérances/malabsorption alimentaires ?



N = 1372, test au fructose et au lactose , symptômes ? Malabsorption ?



	Intolerance (%)	Malabsorption (%)	Intolerance and malabsorption (%)
Fructose			
Irritable Bowel Syndrome n = 212	59.9*	42.4	38.4
Functional dyspepsia n = 606	59.5*	41.6	37.2
Functional bloating n = 109	54.4*	41.8	39.2
All FGID n = 1372	60.4*	44.7	40.4
Lactose			
Irritable Bowel Syndrome n = 212	45.3*	29.1	25.0
Functional dyspepsia n = 606	49.7*	30.8	27.8
Functional bloating n = 109	43.0†	32.9	26.6
All FGID n = 1372	50.5*	31.5	28.1
Fructose and Lactose			
Irritable Bowel Syndrome n = 212	28.5*	14.0	11.0
Functional dyspepsia n = 606	31.0*	15.4	12.6
Functional bloating n = 109	27.8*	16.5	12.7
All FGID n = 1372	33.1*	15.9	12.9

* P < 0.01 or † P < 0.05 intolerance vs. malabsorption and vs. intolerance & malabsorption.

% de patients fonctionnels avec symptômes pdt les tests

Wilder-Smith, APT 2013

- ballonnement/gaz = un des symptômes les plus fréquents en cas d'intolérance
- Intolérance et malabsorption au fructose/lactose fréquente: 39,2%/ 26,6%
- 20% des patients ont une intolérance sans malabsorption (rôle hypersensibilité viscérale)

Distension abdo: présente chez volontaires sains

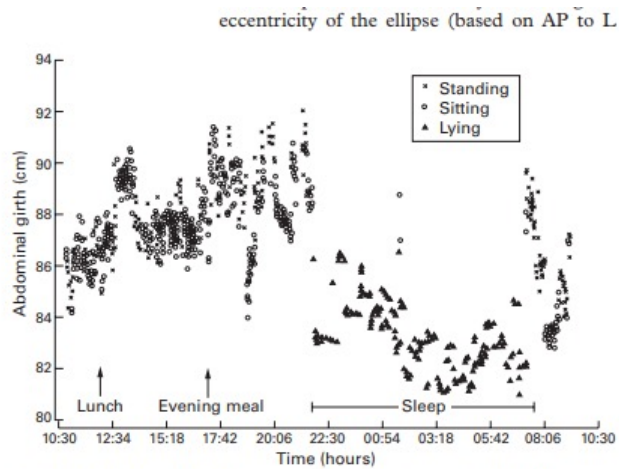
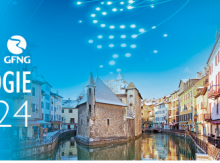


Figure 4 Typical recording of abdominal girth over 24 hours in a normal healthy volunteer. Note the gradual increase in girth during the day, increase with meal ingestion, and slow reduction in girth during sleep.

Etude par phlétysmographie

Augmentation significative du diamètre abdo en fin de journée vs début

en position debout (mais pas assise) , en médiane : (IQR), 3.2 cm (-1.0, 5.3); $p=0.03$

Lewis , Gut 2001

Distension abdo: SII vs volontaires sains sur 24h

Femmes,
SII-C n = 20, SII-D n = 20, SII-A n = 10, Rome II
Ballonnements chez 100%, 48% avec distension
Volontaires saines , n = 20

Table 2. Descriptive Characteristics of Maximal Abdominal Girth in IBS and Healthy Subjects

	HV (n = 20)	All IBS subgroups (n = 50)	IBS-D (n = 20)	IBS-C (n = 20)	IBS-alt (n = 10)
Maximum change in abdominal girth from beginning of day 1, cm	5.1 (3.3–6.9)	7.4 (6.2–8.7) ^a	7.6 (5.8–9.6) ^a	8.3 (5.9–10.7) ^a	5.2 (3.4–7.0)
Timing of maximum girth					
End of day	7 (35%)	23 (46%)	7 (35%)	13 (65%)	3 (30%)
Meal	6 (30%)	12 (24%)	8 (40%)	2 (10%)	2 (20%)
No specific event	7 (35%)	15 (30%)	5 (25%)	5 (25%)	5 (50%)

NOTE. Data are expressed as mean (95% CI). Numbers in parentheses represent percentage of total number of subjects in each group.
HV, healthy volunteers.

^a*P* ≤ .05 compared with healthy volunteers.

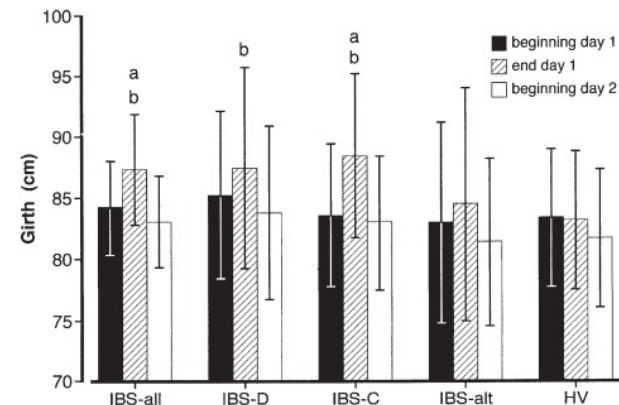


Figure 2. Comparison of abdominal girth at the beginning and end of day 1 and beginning of day 2 in IBS patients overall (IBS-all), IBS patients with diarrhea (IBS-D), IBS patients with constipation (IBS-C), IBS patients with an alternating bowel habit (IBS-alt), and healthy volunteers (HV). Data are expressed as mean and 95% confidence interval. a: *P* ≤ .001 compared with the beginning of day 1; b: *P* ≤ .001 compared with the beginning of day 2.

→ SII: augmentation du tour de taille en fin de journée



- CPAP (Continuous Positive Airway Pressure) : traitement du Sd Apnée du Sommeil
- E2: aérophagie 16% et ballonnements (CPAP belly syndrome Jaile, AJR 1991; Pepin, Chest 1995)
- Etude en double aveugle **randomisée en cross over**
- comparant autotitration de la Pression de CPAP et pression fixe. N = 56 aérophagie

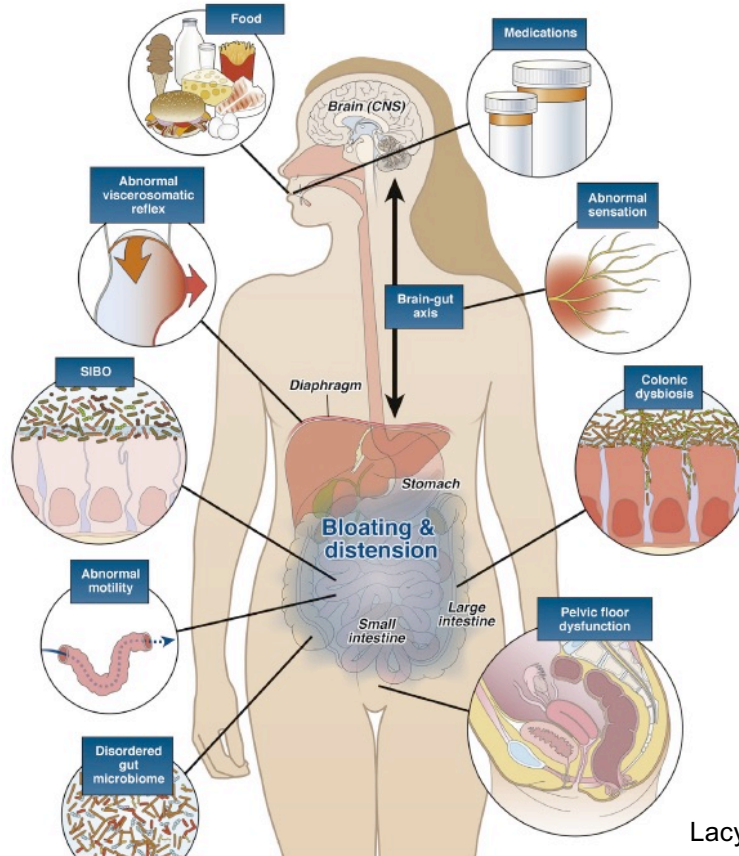
Table 1—Patient characteristics of the study cohort.

Parameter	Recruited	Withdrawn
Number	56	12
Age, y	65 ± 13	68 ± 12
BMI, kg/m ²	34.2 ± 6.2	39.0 ± 7.5
Neck circumference, cm	44 ± 4	44 ± 8
Sex, male : female	39 : 17	5 : 7
Titrated pressure, cm H ₂ O	14.6 ± 4.1	15.1 ± 3.2
Mask interface, full : nasal	39 : 17	9 : 3
Time on CPAP therapy, y	0.9 (0.3, 3.7)	0.4 (0.2, 5.9)

Table 3—Comparison of aerophagia-related symptoms during two weeks of CPAP and APAP treatment.

Parameter	Baseline	CPAP	APAP	Effect size
Total score	34.1 (27.4, 39.8)	24.3 (13.9, 36.7)*	13.2 (3.4, 23.8)*§	0.308
Abdominal pain	3.3 (0.4, 5.4)	2.6 (0.4, 4.5)	1.0 (0.2, 2.5)*	0.251
WE abdominal pain	5.4 (2.1, 8.0)	4.3 (0.6, 6.5)	1.3 (0.3, 4.6)*	0.282
Bloating	6.7 (4.4, 8.1)	3.8 (1.4, 7.4)*	1.5 (0.2, 4.6)*§	0.291
WE bloating	8.0 (5.5, 9.1)	5.2 (3.2, 8.1)*	2.3 (0.2, 6.3)*§	0.275
Flatulence	7.6 (4.8, 8.7)	5.1 (2.2, 7.4)*	3.3 (0.4, 5.9)*§	0.221
Belching	3.2 (1.2, 6.0)	2.7 (0.6, 5.5)	1.1 (0.2, 2.7)*§	0.319

Values presented as median (interquartile range). Effects sizes were calculated for comparisons between CPAP therapy and APAP therapy trial arms that were significantly different. APAP = autotitrating positive airway pressure, CPAP = continuous positive airway pressure, WE = worst episode. * = $P < .05$ versus baseline. § = $P < .05$ versus CPAP.





- Le ballonnement est **présent au moins une fois sur deux en cas de dysfonction de l'axe cerveau intestin**, et est associé à une distension dans la moitié des cas.
- Plus fréquent chez les **femmes**, en cas de **constipation/SII-C**, de **dyspepsie**.
- Mécanismes potentiels multiples : troubles moteurs, transit des gaz anormal, hypersensibilité viscérale, intolérances alimentaires, dysbiose, dysnergie ano-périnéale.
- L'augmentation du volume des gaz n'est présente que chez environ $\frac{1}{4}$ des patients

Le rôle du SIBO reste à être précisé.

- Mme X, 55 ans, ballonnement
- Apparus il y a 5 ans (travail en open space)
- ATCD: obésité, SASO (CPAP)
- Gêne au quotidien, déclenchée par la prise des repas, ↑ fin de journée
- Nécessité de défaire sa ceinture = distension
- Transit: une selle un jour sur deux Bristol 1
- Bilan NI: fibroscopie gastrique, coloscopie, TDM abdo pelvien
- Pense avoir un excès de gaz ou un SIBO = Peu probable

