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ORIGINAL SCIENTIFIC REPORT

Flatulence After Anti-reflux Treatment (FAART) Study

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Abstract

Background Flatulence is known to be a common side effect of laparoscopic fundoplication, yet the true incidence is unclear and its impact on patients' quality of life not well understood. This study aimed to assess the long-term incidence of flatulence, and its effect on quality of life, following fundoplication.

Methods All patients who underwent primary laparoscopic fundoplication between 1999 and 2009 were identified from a prospectively maintained institutional database. A cross-sectional analysis of post-operative gastrointestinal symptoms and quality of life was performed using a symptom-specific questionnaire. Statistical analysis of outcomes stratified by sex and type of fundoplication was performed.

Results 462 eligible patients were identified from the database, with follow-up obtained in 265 (57%). Median age at surgery was 53 (22–78) years. 137 patients (52%) were female. 138 (52%) underwent a 360° fundoplication, the remainder a partial fundoplication. At median follow-up of 11 (8–15) years, excessive flatulence was reported by 85%. Only 12% reported an adverse impact on social life, and 11% an adverse impact on quality of life. Flatulence was worse following a total than partial fundoplication, women reported more gas-related symptoms than men, yet neither sex nor wrap type had a significant impact on social life or quality of life.

Conclusions The majority of patients report excessive flatulence at long-term follow-up after anti-reflux surgery, yet the impact on social life and quality life was small. There was no evidence to support tailoring of wrap type by sex to avoid gas-related symptoms. The authors advocate that all patients understand the inevitable side effects of fundoplication to help manage expectations from surgery.

Introduction

Gastroesophageal reflux disease (GERD) is a significant problem affecting up to 20% of the population in the Western world, and there is growing evidence that laparoscopic fundoplication provides better symptomatic relief than long-term medical management [1–3]. Troublesome and persistent gastrointestinal side effects are seen in some patients who have undergone anti-reflux surgery [4]. Whilst the development of dysphagia following anti-reflux surgery has been studied in detail, relatively little is known about gas-related symptoms such as flatulence, bloating, the inability to belch, and the effect of these symptoms on patients' overall quality of life [5, 6]. Flatulence is present in at least 40% of the patients who undergo anti-reflux surgery [5, 7]. It has always been thought to be more of a problem following a total fundoplication (Nissen) than a partial fundoplication (Toupet or anterior) [5, 8, 9], although the incidence of gas-related side effects reported may in fact be similar at long-term follow-up [10].

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Despite flatulence being common after anti-reflux surgery, no study has specifically explored the long-term incidence of gas-related side effects and their impact on patients' quality of life. The primary aim of this study was to assess the long-term incidence of flatulence after anti-reflux surgery and its effects on patients' health-related quality of life using a symptom-specific questionnaire. A secondary aim was to assess the impact of baseline demographics such as age, sex, and type of fundoplication on the development of flatulence after anti-reflux surgery.

Materials and methods

All patients who underwent laparoscopic fundoplication at the Royal Adelaide Hospital or Flinders Medical Centre between 1999 and 2009 were identified from a prospectively maintained institutional database. All patients between the age of 18–80 years with a clinical diagnosis of gastroesophageal reflux disease and who underwent elective primary laparoscopic anti-reflux surgery were eligible for the study. Patients who had undergone surgery for large hiatus hernia or revisional fundoplication were excluded. Patients who had previously withheld consent to be contacted for audit or research and patients who were known to be inappropriate for questionnaire follow-up (e.g. dementia, terminal-illness) were also excluded. Approval for the study was obtained from the local Research Ethics Committee.

Baseline patient demographics and pre-operative and intra-operative data were retrieved from the institutional database. All eligible patients were posted an invitation to participate, a Flatulence Assessment Questionnaire ("Appendix 1"), and an opt-out slip. Forms were resent to non-responders after 6 weeks. The questionnaire was designed de novo by the authors to specifically assess post-fundoplication gastrointestinal symptoms and impact on quality of life using a four-point Likert scale. Patients were specifically asked to report the symptoms they had experienced in the preceding 2 weeks.

Nominal data were presented as percentages, and continuous data as median and range. Analysis of the effect of wrap type and gender on gastrointestinal symptoms were performed using Chi-square test. Statistical analysis was performed using SPSS version 25. Differences with a p value less than 0.05 were considered statistically significant.

Results

In the study period, 1382 patients underwent primary anti-reflux surgery. After exclusion of patients who underwent surgery for large hiatus hernias (n = 180), were outside age criteria (n = 64), deceased (n = 85), had withheld consent for research and audit follow-up (n = 74), had no valid contact details or were inappropriate for follow-up, e.g. due to dementia or terminal disease (n = 391), or had not had a pre-operative pH study or endoscopy (n = 126), a total of 462 eligible patients were identified to be eligible for the study. Two hundred and sixty-five patients (57%) returned completed questionnaires and were included in the analysis.

Table 1 Baseline demographics

Sex	
Male	128 (48%)
Female	137 (52%)
BMI median (range)	29.3 (17.3–55.1)
Age median years (range)	53 (22–78)
Indication for surgery	
Reflux poorly controlled with medication	161 (61%)
Regurgitation	98 (37%)
ENT problems	36 (14%)
Reflux controlled but not want lifelong medication	20 (8%)
Asthma exacerbation	8 (3%)
Bleeding/anaemia	2 (1%)
Wrap type	
90° anterior	46 (17%)
180° anterior	69 (26%)
270° posterior	12 (5%)
360° Nissen	138 (52%)
Conversion to open	3 (1.1%)
Follow-up median years (range)	11 (8–15)

Table 1 details the baseline demographics and intra-operative data for the 265 patients included in the study. There was an even split between males and females undergoing surgery. One hundred and thirty-eight patients (52%) received a 360° Nissen fundoplication, and 127 (48%) received a partial fundoplication. Perioperative outcomes and the incidence of dysphagia following anti-reflux surgery have previously been published in detail by the authors [11]. The current study focused on the incidence of gas-related symptoms and its impact on quality of life.

At long-term follow-up, flatulence was by far the most commonly reported side effect following anti-reflux surgery (Table 2). Eighty-five per cent of patients reported some excessive flatulence following surgery, with 54% of patients describing this as moderate or severe in nature. By contrast, only 10–15% of patients reported each of moderate-to-severe difficulty in burping, anxiety, or constipation. Almost half of all patients felt that excessive flatulence had a negative impact on their quality of life, but only 29 patients (11%) felt that their social life was

Table 2 Patient-reported symptoms in the preceding two weeks, at long-term follow-up following anti-reflux surgery

	Nil (%)	Mild (a few times) (%)	Moderate (most of the time) (%)	Severe (all of the time) (%)
Excessive flatulence	15	31	39	15
Excessive air swallowing	69	24	5	2
Anxiety	56	30	13	2
Excessive burping	46	39	12	4
Social life impacted by flatulence	57	31	9	3
Constipation	66	21	8	6
Quality of life impacted by flatulence	66	23	8	3

Table 3 Incidence of *moderate-to-severe* symptoms following different types of anti-reflux wrap

	90° (n = 46)	180° (n = 69)	270° (n = 12)	360° (n = 138)
Flatulence	19 (41%)	29 (42%)	8 (67%)	86 (62%)
Air swallowing	3 (7%)	5 (7%)	0 (0%)	9 (7%)
Anxiety	4 (9%)	9 (13%)	2 (17%)	22 (16%)
Burping	7 (15%)	15 (22%)	2 (17%)	19 (14%)
Constipation	3 (7%)	9 (13%)	1 (8%)	22 (16%)
Social life	4 (9%)	10 (15%)	1 (8%)	9 (14%)
Quality of life	3 (7%)	8 (12%)	1 (8%)	17 (12%)

moderately or severely impacted. Twenty-one patients (8%) wished that they had not undergone surgery or would consider reversal of their fundoplication because of problems with flatulence, although this was not associated with either the severity of flatulence or the impact of flatulence on quality of life. Ten per cent of patients with moderate-to-severe flatulence wished they had not had their surgery compared to 6% of patients with mild or no flatulence (p = 0.210). Patient age did not impact on the reporting of flatulence, the impact of flatulence on social life or quality of life, or dissatisfaction with surgery.

There was a difference in reported symptoms between males and females. Fifty-one per cent of women reported anxiety following surgery compared to 37% of men (p = 0.026), with 18% of women describing this as moderate to severe compared to only 10% of men (p = 0.06). More women than men reported moderate-to-severe problems with belching (20% vs. 10%, p = 0.021) and constipation (20% vs. 6%, p = 0.001) and more women than men described an overall negative effect of flatulence on their social life (50% vs. 36%, p = 0.018) although the proportion of women and men describing moderate-to-severe impact of flatulence on social life (14% vs. 12%) or quality of life (11% vs. 11%) was similar. A higher proportion of women than men also reported that they would consider having their surgery reversed or not having had their surgery at all due to problems with flatulence (11% vs. 5%, p = 0.059).

Comparing 360° Nissen fundoplication to partial fundoplication (Table 3), there was a significant increase in moderate-to-severe flatulence in patients who received a 360° wrap (62% vs. 44%, p = 0.003). The incidence of severe flatulence was markedly increased in those with a total wrap compared to those with a partial wrap, and this finding was consistent for both males (19% vs. 6%, p = 0.018) and females (22% vs. 10%, p = 0.081) (Table 4). Women who received a 360° wrap reported more anxiety than women receiving a partial fundoplication (61% vs. 43%, p = 0.03), whereas there was no effect of wrap type on anxiety in men (35% vs. 41%, p = 0.518). There was a higher proportion of moderate-to-severe anxiety amongst women than men who underwent 360° fundoplication (23% vs. 10%, p-0.025). A greater proportion of women also reported a negative impact of flatulence on their social life than men for both 360° wraps (63% vs. 45%, p = 0.036) and partial fundoplications (40% vs. 24%, p = 0.064). This impact was predominantly mild rather than moderate to severe in nature, and there was no

Table 4 Difference in incidence and severity of flatulence by type of wrap and sex

Flatulence	Partial fundoplication		Total fundoplication	
	Female (n = 73) (%)	Male (n = 54) (%)	Female (n = 64) (%)	Male (n = 74) (%)
Nil	18	22	11	14
Mild	34	41	27	26
Moderate	38	32	41	42
Severe	10	6	22	19

significant difference between 360° and partial wraps on the impact of flatulence on overall quality of life for either men or women.

Discussion

Flatulence is a recognized side effect of anti-reflux surgery, but whilst surgeons will typically discuss the risk of flatulence and other gas-related side effects during the preoperative consent process, the incidence of these symptoms may well be underappreciated and their impact on quality of life perhaps poorly understood. Our study set out to understand the long-term incidence and impact of gas-related symptoms after anti-reflux surgery. We demonstrated high long-term satisfaction with anti-reflux surgery, noting 92% of patients were satisfied with the overall results of their surgery at median of 11-year follow-up.

We, and others, have previously reported excessive flatulence following fundoplication in 37–75% of patients at 2–5-year follow-up [5, 8]. We found that 85% of patients continue to report flatulence at long-term (8–15 years) follow-up, similar to that seen at 10-year follow-up in small randomized controlled trials [10, 12]. However, it is important to note from the current study that over half of all patients reported *moderate-to-severe* flatulence at long-term follow-up, highlighting this as a persistent and potentially important issue for patients. As might be expected, severe flatulence was three times more likely in the Nissen fundoplication group compared to the partial fundoplication group.

It is important for any surgical intervention to explain to patients the risk of side effects, but it is particularly important to be able to put these side effects into context when counselling patients for benign or "lifestyle" surgery, such as fundoplication. In particular, any operation that is being performed to improve a patient's quality of life should involve a discussion of the inevitable short-term side effects on quality of life. A key finding of our study is that whilst the overwhelming majority of patients reported some excessive flatulence, and over 50% reported moderate-to-severe flatulence, only a small proportion (8–15%) indicated that this had a significant impact on either their social life or overall quality of life.

The second key finding of our study was the difference in symptom reporting between males and females. This is clinically relevant because some surgeons might choose to tailor their fundoplication based on patient sex. If gas-related symptoms are perceived to be either more common or less well tolerated in females than in males, then some surgeons might be more hesitant in performing a 360° fundoplication in women and choose instead to perform a partial wrap to minimize side effects. Our study demonstrated that females reported significantly higher rates of anxiety and excessive belching post-fundoplication than males, and more women than men reported that excessive flatulence had a *mild* impact on their social life. We also observed that the proportion of women who were dissatisfied with their wrap was higher than that of men, which is consistent with previous findings of increased post-operative symptom reporting and dissatisfaction in women compared to men at 5-year follow-up [13]. However, we found little difference between sexes in the proportion of patients reporting a *moderate or severe* impact of flatulence on social life or quality of life, irrespective of wrap type. This suggests that although females may be more likely to report gas-related symptoms following fundoplication, the impact of those symptoms may not be substantially different than in our male population. Tailoring of the wrap based on sex alone does not seem justified. To do so could even be considered paternalistic or sexist in the current social climate. Over the time period of this study, decision making for the choice of wrap was influenced either by surgeon preference or by randomization into one of a number of clinical trials. Decision making in our practice is now more influenced by the severity of reflux and patient age, favouring for example a total fundoplication for the younger patients and those with severe oesophagitis or long-segment Barrett's, but not necessarily by sex, baseline gastrointestinal symptoms, or perceived gastrointestinal

side effects of surgery. Patients who develop bloating and flatulence symptoms following fundoplication may benefit from specific dietary advice to help prevent symptoms and alleviate discomfort ("Appendix 2").

The results from the present study provide a snapshot of gas-related symptoms at long-term follow-up following fundoplication, and importantly, their impact on patients' quality of life. We acknowledge that the study design limits our ability to draw more extensive conclusions. Had this been a prospective study then the inclusion of a non-surgical control group and a baseline pre-operative questionnaire to identify pre-existing gastrointestinal symptoms would have allowed a more detailed analysis of both the evolution of new symptoms following surgery and the extent to which baseline symptoms are exacerbated by surgery. Similarly, the use of a validated quality of life questionnaire may have allowed a more detailed analysis of the impact of symptoms on different domains of quality of life. Nevertheless patient-reported outcomes and patients' perceptions of surgery, although subjective, are becoming increasingly important in assessing surgery for the control of symptoms and the results of this study offer a valuable insight in this area.

The key findings of this study are clear and of direct clinical relevance to the practicing surgeon. Whilst there is a greater incidence of gas-related symptoms following total compared to partial fundoplication, and women report more symptoms than men, there was no significant difference between sexes or between wrap types on the impact of flatulence on social life or quality of life. Tailoring of the wrap based on either of these factors is not justified, and the surgeon should choose the right wrap based on clinical factors. Perhaps most important is to recognize that the majority of patients, not a minority, will experience gas-related side effects following fundoplication. A consent process that explains these symptoms and attempts to understand what such symptoms mean for the patient would go a long way to managing patient expectations.

Conclusion

Over 90% of patients are pleased with the long-term results of their fundoplication, and whilst the majority of patients report excessive flatulence at long-term follow-up after anti-reflux surgery, the impact on social life and quality life was small with no evidence to support tailoring of wrap type by sex to avoid gas-related symptoms. The consent process should explain gas-related side effects and explore patients' understanding and tolerance of these to help manage expectations of anti-reflux surgery.

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Compliance with ethical standards

Conflict of interest The authors have no sources of financial support or conflicts of interest to disclose.

Ethical approval The study was approved by the local institutional research ethics committee.

Informed consent Informed consent was obtained from all individual participants in the study.

Appendix 1: Patient questionnaire

Assessment of flatulence after anti-reflux surgery questionnaire

Initials: **Date of birth (DD/MM/YYYY):**

We very much appreciate your time to complete the following questionnaire but if you do not wish to do so it is your choice and your decision will not impact on any future care you may receive from the Royal Adelaide Hospital. If you do not wish be contacted again, please complete the opt-out page included with this letter.
Please ensure that you complete both sides of this questionnaire.

1. Thinking back to your laparoscopic fundoplication surgery, do you have any ongoing symptoms and if so which symptoms trouble you the **most**:

The questions asked below pertains to symptoms that you may/may not be experiencing in the past **two weeks**. Please circle the response you think most accurately answers the question being asked. During the past two weeks

2. Have you (or your partner) noticed that you are passing wind excessively through your back passage (excessive flatulence)?

No (never) Mild (few times) Moderate (most times) Severe (all the time)

3. Were you conscious of swallowing air excessively?

No (never) Mild (few times) Moderate (most times) Severe (all the time)

4. Did you notice that you were anxious, under emotional stress or have panic disorder?

No (never) Mild (few times) Moderate (most times) Severe (all the time)

5. How often did you consume carbonated beverages (fizzy soft drinks or beer)?

No (never) Mild (1-2/wk) Moderate (once a day) Severe (>2-3/day)

6. Did you notice that you were burping or belching excessively?

No (never) Mild (few times) Moderate (most times) Severe (all the time)

7. Did you suffer with constipation or reduced bowel movements (fewer than three bowel motions per week)?

No (never) Mild (few times) Moderate (most times) Severe (all the time)

8. Did excessive flatulence have a negative impact on your social life?

No (never) Mild (few times) Moderate (most times) Severe (all the time)

9. Did excessive flatulence negatively affect your overall quality of life?

No (never) Mild (few times) Moderate (most times) Severe (all the time)

10. Did you feel like having your surgery reversed or not having had your surgery at all due to problems with flatulence?

No Yes

Have you had any operations on your abdomen since the anti-reflux procedure? If yes, can you please tell us what operation(s)?

If you have any further comments regarding your symptoms, please write them down in the space below.

We would like to thank you for your co-operation in completing this questionnaire.

Appendix 2: Patient information sheet

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UNIVERSITY DEPARTMENT OF SURGERY
FLINDERS MEDICAL CENTRE

ADELAIDE UNIVERSITY
AUSTRALIA

UNIVERSITY DEPARTMENT OF SURGERY
ROYAL ADELAIDE HOSPITAL

What can I do about…..

BLOATING AND FLATULENCE

Following your surgery it is common for some people to experience discomfort from bloating and flatulence. Because the operation is a one-way valve, any air or gas which is swallowed cannot easily be belched back. You may find it is worse immediately following the operation, but it often improves over time.

There are several measures you might like to try to prevent and / or alleviate the problem:

Prevention

- Watching your diet to see if any food make the condition worse, and avoiding these foods. Some common foods that can make bloating worse include legumes (beans and lentils), fermented foods and beverages including vinegar and alcohol, plus food rich in sulphur (eggs, onion and garlic), and raw foods. Milk may even cause excess bloating and flatulence, particularly in people who are lactose intolerant
- Avoid eating too much fat in a meal
- Avoid swallowing air whilst eating and drinking
- Ensure you chew your food thoroughly and eat slowly
- Avoid carbonated drinks (soft drinks, soda water and beer)
- Avoid chewing gum and smoking
- Avoid eating just before bed time
- Try eating smaller meals more often

Relief of discomfort

If the above measures do not help, you may like to try:

- Herbal products containing peppermint, Iberogast, slippery elm, chamomile, charcoal, fennel and gentian may help
- Regular exercise, particularly gentle exercise after meals
- Over the counter preparations such as De-Gas or No-Gas available from your pharmacist.

We stress that these measures may help but are not guaranteed to do so. If you are concerned about persistent symptoms it is essential you discuss your problems with your surgeon or GP.

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