

Metabolic/Bariatric Surgery Worldwide 2008

Henry Buchwald · Danette M. Oien

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Abstract Periodically, the state of bariatric surgery worldwide should be assessed; the most recent prior evaluation was in 2003. An email survey was sent to the leadership of the 36 International Federation for the Surgery of Obesity and Metabolic Disorders nations or national groupings, as well as Denmark, Norway, and Sweden. Responses were tabulated; calculation of relative prevalence of specific procedures was done by weighted averages. Out of a potential 39, 36 nations or national groupings responded. In 2008, 344,221 bariatric surgery operations were performed by 4,680 bariatric surgeons; 220,000 of these operations were performed in USA/Canada by 1,625 surgeons. The most commonly-performed procedures were laparoscopic adjustable gastric banding (AGB; 42.3%), laparoscopic standard Roux-Y gastric bypass (RYGB; 39.7%), and total sleeve gastrectomies 4.5%. Over 90% of procedures were performed laparoscopically. Comparing the 5-year trend from 2003 to 2008, all categories of procedures, with the exception of biliopancreatic diversion/duodenal switch, increased in absolute numbers performed. However, the relative percent of all RYGBs decreased from 65.1% to 49.0%; whereas, AGB increased from 24.4% to 42.3%. Markedly, different trends were found for Europe and USA/Canada: in Europe, AGB decreased

from 63.7% to 43.2% and RYGB increased from 11.1% to 39.0%; whereas, in USA/Canada, AGB increased from 9.0% to 44.0% and RYGB decreased from 85.0% to 51.0%. The absolute growth rate of bariatric surgery decreased over the past 5 years (135% increase), in comparison to the preceding 5 years (266% increase). Bariatric surgery continues to grow worldwide, but less so than in the past. The types of procedures are in flux; trends in Europe vs USA/Canada are diametrically opposed.

Keywords Morbid obesity · Bariatric surgery · Worldwide survey · Trends · Gastric banding · Gastric bypass · Sleeve gastrectomy

Introduction

To understand the influence and impact of bariatric surgery, it is useful to assess the field periodically worldwide, at least every 5 years. More precisely, now that bariatric surgery has been recognized to be metabolic surgery, it is the state of metabolic/bariatric surgery that needs to be examined. The procedures for weight loss, whether designated as restrictive, restrictive/malabsorptive, malabsorptive, and others, or neuro-hormonal, all fall under the definition we proposed in 1978: "We define metabolic surgery as the operative manipulation of a normal organ or organ system to achieve a biological result for a potential health gain" [1].

During the accelerating pandemic of global obesity, certain basic questions are being asked by the medical and the lay communities, as well as government and private funders of healthcare: how many metabolic/bariatric procedures are being performed, by how many surgeons, and where? Since

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H. Buchwald (✉) · D. M. Oien
Department of Surgery, University of Minnesota,
420 Delaware St SE, MMC 290,
Minneapolis, MN 55455, USA
e-mail: buchw001@umn.edu

there has been, and continues to be, a flux in the types of metabolic/bariatric procedures performed, a quantitative evaluation of operations done and the existing worldwide trends in procedures, seems to be called for as well.

In 1998, as part of his 1997 Presidential Address before the annual International Federation of Surgery for Obesity (IFSO) Congress in Genoa, Dr. Scopinaro published the first global survey of metabolic/bariatric surgery [2]. In 2004, we published a 5-year follow-up report titled: Bariatric Surgery Worldwide 2003 [3]. We now present a subsequent 5-year follow-up and global perspective of metabolic/bariatric surgery over the past 10 years.

Methods

Questionnaire

An email survey, consisting of three questions (Table 1), was sent to the leadership of the 36 IFSO nations or national groupings, and the three Scandinavian nations of Denmark, Norway, and Sweden (see acknowledgements). If necessary, these requests were followed by second and third email communications to obtain the data requested.

Data Analysis

Tabular and graphic presentations of the data received were prepared and certain derived data were calculated. For calculations of relative prevalence of specific procedures, weighted averages were used to compensate for the wide ranges of the number of procedures performed:

$$\frac{\sum \% \text{Variable} \times \text{Number of Variable}}{\sum \text{Number of Variable}}$$

Results

Response Rate

From the 36 IFSO nations or national groupings there were 33 responders (92%). Australia and New Zealand, Belgium and Luxembourg, and the United States of America (USA) and Canada were the three national groupings in the survey. With the participation of Denmark, Norway, and Sweden, the total global participating nations or national groupings numbered 36.

Number of Operations Performed

In response to the survey's first question—Approximately how many bariatric surgery operations are being done in

Table 1 Questionnaire

1. Approximately how many bariatric surgery operations are being done in your country yearly?
 2. Approximately how many surgeons practice bariatric surgery in your country?
 3. What is your estimate as to the relative percentages (adding up to 100%) distribution of bariatric operations in your country?
 - ___ open adjustable gastric banding
 - ___ laparoscopic adjustable gastric banding
 - ___ open vertical banded gastroplasty
 - ___ laparoscopic vertical banded gastroplasty
 - ___ open standard Roux gastric bypass (all technical variations)
 - ___ laparoscopic standard Roux gastric bypass (all technical variations)
 - ___ open long-limb and very long-limb gastric bypass
 - ___ laparoscopic long-limb and very long-limb gastric bypass
 - ___ open biliopancreatic diversion (Scopinaro procedure)
 - ___ laparoscopic biliopancreatic diversion (Scopinaro procedure)
 - ___ open duodenal switch
 - ___ laparoscopic duodenal switch
 - ___ open sleeve gastrectomy
 - ___ laparoscopic sleeve gastrectomy
 - ___ electronic pacers/blockers
 - ___ others
- 100%

your country yearly?—the global total came to 344,221 for 2008. The USA/Canada performed the vast majority of operations at 220,000. An additional four countries or national groupings performed more than 10,000 operations in 2008: Australia/New Zealand, Brazil, France, and Mexico; a further additional three countries or national groupings performed more than 5,000 operations in 2008: Belgium/Luxembourg, Spain, and United Kingdom (Table 2).

Number of Metabolic/Bariatric Surgeons

In response to the survey's second question—Approximately how many surgeons practice bariatric surgery in your country?—the global total came to 4,680 for 2008. The USA/Canada grouping had the most surgeons at 1,625. There were seven other countries or national groupings with more than 100 bariatric surgeons: Australia/New Zealand (118), Brazil (700), Chile (100), France (310), Italy (300), Mexico (150), and Spain (400; Table 3).

Types of Procedures Performed

The answers to the survey's third question—What is your estimate as to the relative percentages (adding up to 100%) distribution of bariatric operations in your country?—are

Table 2 Number of bariatric surgery operations being done yearly

Country	Number of bariatric surgery operations
Argentina	2,400
Australia/New Zealand	11,914
Austria	1,741
Belgium/Luxembourg	8,700
Brazil	25,000
Chile	1,500
Czech Republic	900
Denmark	2,004
Egypt	1,500
France	13,722
Germany	2,117
Greece	2,875
Hungary	300
India	1,216
Israel	2,500
Italy	4,842
Japan	80
Mexico	13,500
Netherlands	3,500
Norway	1,500
Peru	600
Poland	814
Portugal	1,323
Romania	837
Russia	750
Serbia	10
South Africa	400
Spain	6,000
Sweden	2,894
Switzerland	850
Turkey	500
Ukraine	190
United Kingdom	6,000
USA/Canada	220,000
Venezuela	1,242
Total	344,221

shown in Table 4. The most commonly performed procedures were laparoscopic adjustable gastric banding (AGB; 42.3%), and laparoscopic standard Roux-Y gastric bypass (RYGB; 39.7%). Considering all gastric bypasses together, i.e., laparoscopic and open standard, and laparoscopic and open long-limb and very long limb, the number of gastric bypasses exceeds AGBs (49.3%). In 2003, there were no sleeve gastrectomies (SG) reported; currently, sleeve gastrectomies totaled 5.4% (5.1% laparoscopic, 0.3% open).

Classification of Procedures Performed

Laparoscopic vs Open

Over 90% (91.4%) of world bariatric surgery was performed laparoscopically.

Type of Procedure

Categorizing the procedures on weighted averages into anatomic categories of purely restrictive (AGB, SG, vertical banded gastroplasty (VBG)), restrictive/malabsorptive

Table 3 Number of surgeons practicing bariatric surgery

Country	Number of surgeons
Argentina	50
Australia/New Zealand	118
Austria	52
Belgium/Luxembourg	82
Brazil	700
Chile	100
Czech Republic	15
Denmark	15
Egypt	8
France	310
Germany	75
Greece	45
Hungary	5
India	46
Israel	50
Italy	300
Japan	30
Mexico	150
Netherlands	45
Norway	25
Paraguay	2
Peru	15
Poland	20
Portugal	25
Romania	18
Russia	75
Serbia	5
South Africa	17
Spain	400
Sweden	90
Switzerland	40
Turkey	20
Ukraine	20
United Kingdom	60
USA/Canada	1,625
Venezuela	27
Total	4,680

Table 4 Estimate as to the relative percentages (adding up to 100%) distribution of bariatric operations

Distribution of bariatric operations	Percentage
Open adjustable gastric banding	0.1
Laparoscopic adjustable gastric banding	42.3
Open vertical banded gastroplasty	0.7
Laparoscopic vertical banded gastroplasty	0.4
Open standard Roux-en-Y gastric bypass	5.7
Laparoscopic standard Roux-en-Y gastric bypass	39.7
Open long-limb and very long limb gastric bypass	0.8
Laparoscopic long-limb and very long limb gastric bypass	3.1
Open biliopancreatic diversion (Scopinaro)	0.3
Laparoscopic biliopancreatic diversion (Scopinaro)	0.6
Open duodenal switch	0.2
Laparoscopic duodenal switch	0.6
Open sleeve gastrectomy	0.3
Laparoscopic sleeve gastrectomy	5.1
Electronic pacer/blockers	<0.1
Others	0.2
Total	100.0

(RYGB), and primarily malabsorptive (biliopancreatic diversion (BPD), duodenal switch (DS)). This distribution is 48.6%, 49.0%, and 2.0%, respectively.

Looking at the percent of countries performing these procedures, calculated averages were 97% purely restrictive, 94% restrictive/malabsorptive, and 83% primarily malabsorptive.

Global Trends

World Regions

Comparing the 5-year trend from 2003 [3] to 2008, all categories of procedures, with the exception of BPD/DS, increased in absolute numbers performed (Fig. 1). The

relative percent of RYGB, however, decreased from 65.1% to 49.0%; whereas, AGB rose from 24.4% to 42.3% (Fig. 2). SG entered the compilation, going from 0.0% to 5.3%.

The different world regions varied markedly in their respective 5-year trends. In Europe, though all procedures reported in 2003 [3] increased in numbers in 2008 (Table 5), the relative percent of AGB decreased from 63.7% to 43.2%, and the relative percent of RYGB increased from 11.1% to 39.0% (Fig. 3). Though the total number of procedures also increased from 2003 [3] to 2008 in the USA/Canada (Table 6), the trends in the relative percentages of AGB and RYGB were diametrically opposed to those in Europe—AGB increased from 9.0% to 44.0% and RYGB decreased from 85.0% to 51.0% (Fig. 4). Compa-

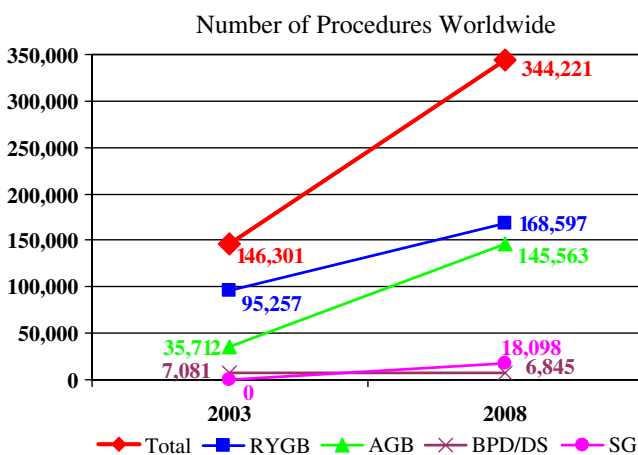


Fig. 1 Trends in number of procedures worldwide

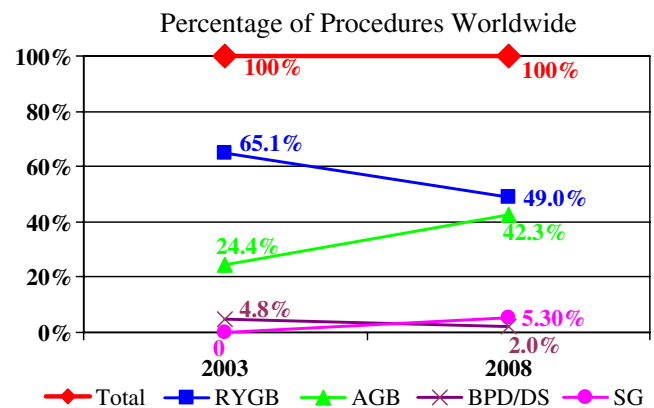


Fig. 2 Trends in percentage of procedures worldwide

Table 5 Regional trend Europe

	Number (Percentage) 2003	Operations (Percentage) 2008	Change (Percentage)
Total	33,771	66,769	+97.7
RYGB	3,744 (11.1)	26,023 (39.0)	+595.1
AGB	21,496 (63.7)	28,843 (43.2)	+34.2
BPD/DS	2,061 (6.1)	3,270 (4.9)	+58.7
SG	0 (0.0)	4,677 (7.0)	

Table 6 Regional trend USA/Canada

	Number (Percentage) 2003	Operations (Percentage) 2008	Change (Percentage)
Total	103,000	220,000	+113.6
RYGB	87,550 (85.0)	112,200 (51.0)	+28.2
AGB	9,270 (9.0)	96,800 (44.0)	+944.2
BPD/DS	4,635 (4.5)	2,200 (1.0)	-52.5
SG	0 (0.0)	8,800 (4.0)	

able to Europe, SG entered the compilation, going from 0.0% to 4.0%.

The data received from Latin and South America was insufficient to derive trends.

The regional trend in the Asia/Pacific area, with an overall 376.9% increase in the total number of procedure (Table 7), was one of consistency from 2003 [3] to 2008 (Fig. 5).

Total World

In 1998 [2], there were 40,000 operations per year, in 2003 [3], there were 146,301, and in 2008 there were 344,221. The percentage increase, therefore, for the 5-year span from 1998 to 2003 was 266%; for the 5-year span from 2003 to 2008 it was 135%; and for the 10-year span from 1998 to 2008 it was 761%.

Discussion

In summary, we conducted a survey of bariatric surgery worldwide in 2008. We canvassed 36 IFSO nations or national groupings, with a 92% (n=33) response rate, as well as the three Scandinavian affiliated nations of Denmark,

Norway, and Sweden. Globally, 344,221 procedures were reported to be performed annually by 4,680 bariatric surgeons. The laparoscopic approach was preferred (91.4%) over open surgery. The most common procedures, 86.6% of the total number of procedures, by weighted percentages, were AGB (32.3%), laparoscopic RYGB (39.7%; open plus laparoscopic RYGB 49.3%), and laparoscopic SG (5.1%). The most common type of procedures by weighted percentages, were 48.6% purely restrictive (i.e., AGB, VBG, and SG), 49.0% restrictive/malabsorptive (i.e., RYGB), and 2.0% primarily malabsorptive (i.e., BPD/DS). The regional trends over the past 5 years of which procedures are predominantly employed markedly varied between Europe (decreased use of AGB, increased use of laparoscopic RYGB) and the USA/Canada (increased use of laparoscopic AGB, decreased use of RYGB).

The data provided and derived from the three questions asked in this survey, immediately raise new questions, in particular: (1) Why, in the face of the accelerating world pandemic of obesity and morbid obesity, has the absolute rate of bariatric surgery decreased over the past 5 years (135% increase), in comparison to the preceding 5 years (266% increase)?; (2) why are there such diametrically opposed trends for laparoscopic AGB and laparoscopic

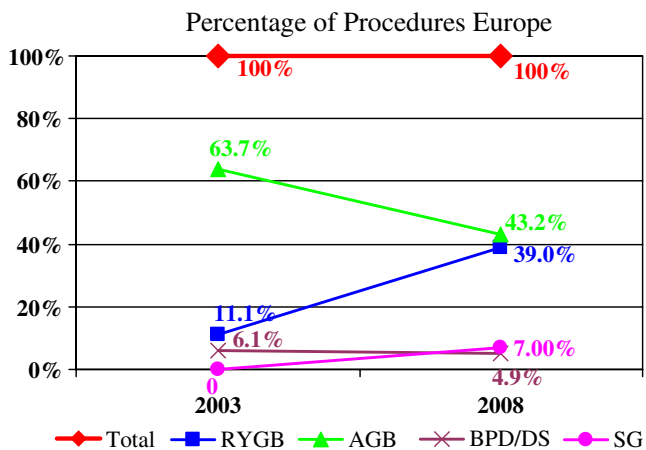


Fig. 3 Trends in percentage of procedures in Europe

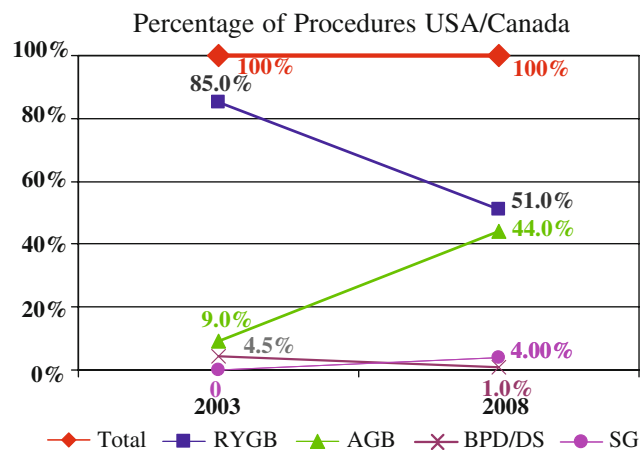


Fig. 4 Trends in percentage of procedures in USA/Canada

Table 7 Regional trend Asia/Pacific

	Number (Percentage) 2003	Operations (Percentage) 2008	Change (Percentage)
Total	2,770	13,210	+376.9
RYGB	234 (8.4)	1,198 (9.1)	+412.0
AGB	2,228 (80.4)	10,892 (82.5)	+388.9
BPD/DS	83 (3.0)	5 (0.04)	-94.0
SG	0 (0.0)	545 (4.1)	

RYGB in Europe vs USA/Canada?; and (3) why has SG captured 5.3% of the global frequency of bariatric procedures?

In response to the plateau in the number of bariatric procedures, this phenomenon cannot be explained by an overall lack of patients or exhaustion of the residual patient pool, since we operate on less than 1% of morbidly obese patients worldwide [3, 4], by the antiquated 1991 National Institutes of Health guidelines [5], and the annual global increase in the number of obese and morbidly obese individuals is about 1% [6]. It is also difficult to believe that only 1% of eligible individuals would elect surgery if it were available to them. The answer, therefore, must be denial of patient access to bariatric surgery by private or governmental payers for healthcare, lack of knowledge of the bariatric surgery option in some communities, misunderstanding about the management of obesity as a disease, and the continuing underlying prejudice against the obese.

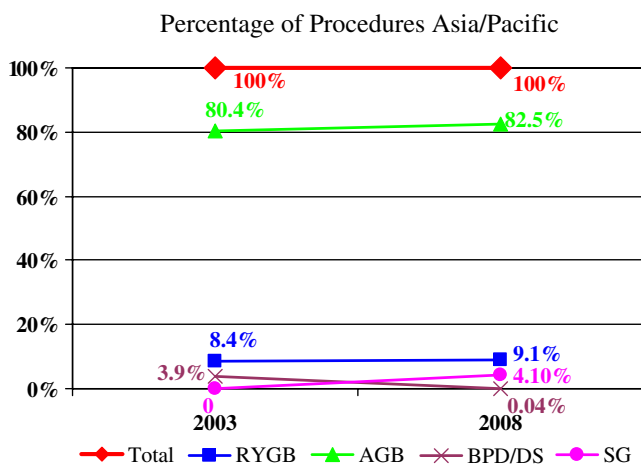
The differing operative trends between Europe and the USA/Canada can be stated to be due to disenchantment with AGB in Europe, a geographic area that has had a far longer experience with AGB than the USA/Canada and a comparable disenchantment with RYGB, the procedure with a longer history and greater experience of use in the

USA/Canada. After all, over time, essentially all procedures lose some of their early achieved success and luster. Further involved factors may be the predictable craving for something regionally newer, the imposition of payer mandates, media-derived prejudices and biases, advertisement campaigns by the bariatric surgery industry, increased patient sophistication and use of websites, and, of course, relative regional economic advantages for bariatric surgeons. Regional trends and countertrends are probably divorced from valid value assessments and judgments.

All the reasons that have been stated for the regional differences may well apply to the rise of SG independent of a DS. In addition, SG is one of the easiest and quickest of all bariatric procedures to perform [7]. Over time, this procedure will acquire long-term, follow-up data that will certainly influence its scientific assessment, and possibly influence its popular appeal.

The weaknesses of this survey reside, in part, in the following: not all nations performing bariatric surgery belong to IFSO and were, therefore, canvassed, with the exception of Denmark, Norway, and Sweden; the response rate from the IFSO nations and national groupings was 33 out of 36 (92%), though the three absent nations perform relatively few bariatric surgery procedures; the patient and procedure numbers often were best estimates and not precise; and discrepancies in the provided data often required reassessment and conciliation of numbers. On the other hand, the strengths of this study reside in its objective and diligent approach to obtaining and correlating the data, as well as the fact that this survey provides the best available global estimates of bariatric surgery numbers and trends.

What is needed in the future, in order to increase the accuracy, reliability, and universality of these essential global data would be for the establishment of an international IFSO registry with national compliance of all IFSO nations and national groupings, and the participation in IFSO of all nations performing metabolic/bariatric surgery.

**Fig. 5** Trends in percentage of procedures in Asia/Pacific

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