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Patient-centered outcomes after bariatric surgery for the treatment of type 2 diabetes mellitus in adolescents and adults

Tatyana A. Shamliyan*, Maria Middleton

Evidence-Based Medicine Center, Elsevier, 1600 John Fitzgerald Kennedy Blvd, Philadelphia, PA 19103, USA

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1. Introduction

A growing proportion of adolescents and adults globally have obesity and type 2 diabetes with corresponding burden on health, wellbeing and societal costs (Rubino et al., 2016a). While lifestyle modification and antidiabetic drugs remain important for improving health outcomes in individuals with type 2 diabetes, they may not result in sustained diabetes control in people with comorbid obesity. The most recent international guidelines recommend bariatric surgery for adults with type 2 diabetes and obesity who did not achieve clinically meaningful weight reduction and diabetes control after conservative behavioral and medical treatments (Rubino et al., 2016a,b).

However, available evidence has not been consistently appraised for the risk of bias, consistency, magnitude and precision of the treatment effects. The objectives of our rapid review included comparative effectiveness and safety of bariatric surgery when compared with conservative treatments and with each other.

2. Methods

According to our rapid review protocol (Appendix A) we conducted a comprehensive search in PubMed, EMBASE, the Cochrane library and clinicaltrials.gov from 2006 up to August 2016. We defined our target population as adolescents or adults with type 2 diabetes mellitus and obesity. Eligible interventions included various bariatric surgery procedures (Rubino et al., 2016a) compared with medical therapy for diabetes and obesity or with each other. We looked at all-cause mortality, cardiovascular morbidity and mortality, diabetes remission (no need for antidiabetic medications), diabetes control (defined as HbA1c < 6.0% or as defined in studies), quality of life and all reported harms. We rank the quality of the most current evidence regarding the benefits and harms of bariatric surgery in adolescents and adults with type 2 diabetes and obesity using criteria from the Grading of Recommendations Assessment, Development and Evaluation (GRADE) working group.

3. Results

Out of 202 references screened, we included 35 meta-analyses and systematic reviews (Baskota et al., 2015a; Cheung et al., 2015; Cho et al., 2015; Colquitt et al., 2014; Guo et al., 2013; Li et al., 2012, 2013a, b,2014; Parikh et al., 2013; Rao et al., 2015; Wang et al., 2015a; Yip et al., 2013; Yu et al., 2015; Zhang et al., 2014a; Baskota et al., 2015b; Chakravarty et al., 2012; Muller-Stich et al., 2015; Panunzi et al., 2015; Treadwell et al., 2008; Black et al., 2013; Buchwald et al., 2014; Chakhtoura et al., 2016; Göthberg et al., 2014; Hedberg et al., 2014; Li et al., 2016; Ollendorf et al., 2015; Ricci et al., 2014; Rohde et al., 2016; Shoar and Saber, 2016; Tang et al., 2015; Wang et al., 2013, 2015b; White et al., 2015; Yan et al., 2014),

43 publications of RCTs (Courcoulas et al., 2014, 2015a; Cummings et al., 2016; Ding et al., 2015; Dixon et al., 2008; Gersin et al., 2010; Gloy et al., 2013; Halperin et al., 2014; Howard et al., 1995; Ikramuddin et al., 2013, 2015; Kashyap et al., 2013; Kehagias et al., 2011; Keidar et al., 2013; Khoo et al., 2014; Koehestanie et al., 2014; Lee et al., 2010, 2014, 2011; Liang et al., 2013; Maghrabi et al., 2015; Malin et al., 2014a, 2014b; Mingrone et al., 2012; Mingrone et al., 2015; Nguyen et al., 2015; O'Brien et al., 2010; Parikh et al., 2014; Peterli et al., 2009; Petry et al.,

* Corresponding author.
E-mail addresses: t.shamliyan@elsevier.com (T.A. Shamliyan), m.middleton@elsevier.com (M. Middleton).

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Table 1
GRADE summary of findings. Bariatric surgery for obese adults (grade I obesity, BMI≤35 kg/m^2) with type 2 diabetes.

Outcomes at 1–5 years	Risk with intervention per 1000	Risk with comparator per 1000	Relative measure of association (95% confidence interval)	Patients (studies)	Quality (GRADE)	Comments
Glycemic control without the need for antidiabetic medication	**519**	**186 Attributable events per 1000 treated 357 (182; 531)**	**RR 2.7 (1.8; 4.1) NNT 3 (2; 5)**	790 (11 RCTs) (Courcoulas et al., 2015a; Courcoulas et al., 2014; Dixon et al., 2008; Halperin et al., 2014; Ikramuddin et al., 2013; Liang et al., 2013; Parikh et al., 2014; Petry et al., 2015; Schauer et al., 2014; Schauer et al., 2012; Wentworth et al., 2014)	Very low (*,†)	Favors surgery
Glycemic control without the need for antidiabetic medication	**373**	**0 Attributable events per 1000 treated 467 (122;812)**	**RR 18.1 (3.6;90.5) NNT 2 (1;8)**	**133 (3 observational studies)** (Muller-Stich et al., 2015)	**Very low (*,†)**	**Favors surgery**
Glycemic control with medications	**517**	**79 Attributable events per 1000 treated 489 (281;697)**	**RR 6.1 (2.8;13.3) NNT 2 (1;4)**	**535 (7 RCTs)** (Courcoulas et al., 2015a; Courcoulas et al., 2014; Ikramuddin et al., 2015; Ikramuddin et al., 2013; Liang et al., 2013; Parikh et al., 2014; Wentworth et al., 2014)	**Very low (*,†)**	**Favors surgery**
Glycemic control with antidiabetic medication	**544**	**12 Attributable events per 1000 treated 469 (25;913)**	**RR 14.2 (2.2;93.5) NNT 2 (1;40)**	**151 (3 observational studies)** (Muller-Stich et al., 2015)	**Low (†)**	**Favors surgery**
HbA1c, %	**NR**	**NR**	**MD -1.2 (-1.8; -0.5) SMD -0.9 (-1.2;-0.6)**	**527 (7 RCTs)** (Courcoulas et al., 2015a; Courcoulas et al., 2014; Ikramuddin et al., 2015; Ikramuddin et al., 2013; Liang et al., 2013; Parikh et al., 2014; Wentworth et al., 2014)	**Low (*)**	**Favors surgery**
BMI, kg/m (Rubino et al., 2016b)	**NR**	**NR**	**MD -5.4 (-6.6;-4.2) SMD -2.0 (-2.5;-1.6)**	**551 (7 RCTs)** (Muller-Stich et al., 2015)	**Low (*)**	**Favors surgery**
BMI, kg/m (Rubino et al., 2016b)	**NR**	**NR**	**MD -5.6 (-8.4;-2.9) SMD -2.5 (-3.9;-1.1)**	**215 (6 observational studies)** (Muller-Stich et al., 2015)	**Very low (*,†)**	**Favors surgery**
Arterial hypertension	**266**	**509 Attributable avoided events per 1000 treated 326 (95;556)**	**RR 0.4 (0.3;0.5) NNTp 3 (2;11)**	**411 (5 RCTs)** (Muller-Stich et al., 2015)	**Low (†)**	**Favors surgery**
Arterial hypertension	385	731	RR 0.4 (0.1; 2.4)	52 (2 observational studies) (Muller-Stich et al., 2015)	Very low (*,†)	No difference
Dyslipidemia	**313**	**518 Attributable avoided events per 1000 treated 276 (74;477)**	**RR 0.5 (0.4;0.6) NNTp 4 (2;14)**	**361 (4 RCTs)** (Muller-Stich et al., 2015)	**Low (†)**	**Favors surgery**
Dyslipidemia	**304**	**811 Attributable avoided events per 1000 treated 516 (217;815)**	**RR 0.4 (0.2;1.0) NNTp 2 (1;5)**	**99 (3 observational studies)** (Muller-Stich et al., 2015)	**Very low (*,†)**	**Favors surgery in absolute scale**
Serious adverse effects	**232**	**93**	**RR 2.4 (1.1;5.3)**	**185 (1 RCT)** (Schauer et al., 2014; Schauer et al., 2012)	**Very low (*,†)**	**Favors medical therapy**
Any adverse effects	**980**	**977**	**RR 1.0 (1.0;1.1)**	**185 (1 RCT)** (Schauer et al., 2014; Schauer et al., 2012)	**Very low(*,†)**	**Favors medical therapy**
Fatty liver, 1 year after **gastric bypass**	**520**	**0 Attributable events per 1000 treated 520 (379;661)**	**RR 45.7 (2.9;728.7) NNT 2 (2;3)**	**93(1 RCT)** (Schauer et al., 2014; Schauer et al., 2012)	**Very low(*,†)**	**Favors medical therapy**
Fatty liver, 1 year after sleeve gastrectomy	**490**	**0 Attributable events**	**RR 43.1 (2.7;688.5) NNT 2 (2;3)**	**92(1 RCT)** (Schauer et al., 2014; Schauer et al., 2012)	**Very low(*,†)**	**Favors medical therapy**