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The relationship between body mass index and short term postoperative outcomes in patients undergoing potentially curative surgery for colorectal cancer: A systematic review and meta-analysis

Arwa S. Almasaudi[b,*], Stephen T. McSorley[a], Christine A. Edwards[b], Donald C. McMillan[a]

[a] Academic Unit of Surgery, College of Medical, Veterinary and Life of Sciences- University of Glasgow, Royal Infirmary, Glasgow, G312ER, United Kingdom
[b] Human Nutrition, School of Medicine, Dentistry and Nursing, College of Medical, Veterinary and Life of Sciences, University of Glasgow, Glasgow Royal Infirmary, Glasgow, G312ER, United Kingdom

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ABSTRACT

Background: The prevalence of obesity has increased worldwide over the last few decades, and is a well-recognized risk factor for colorectal cancer. Surgical site infection is the most frequent complication following surgery for colorectal cancer, and the main cause of postoperative morbidity. The aim of the present systematic review and meta-analysis was to examine the relationship between increasing BMI and postoperative surgical site infection following surgery for colorectal cancer.

Methods: A systemic literature search was conducted using Medline, PubMed, Embase (Ovid) and Web of Science databases from inception to the end of August 2016. Studies examining the relationship between obesity and surgical site infection following surgery for colorectal cancer were included. Analysis of the data was performed using Review Manager version 5.3(The Nordic Cochrane Centre, The Cochrane Collaboration, Copen-hagen, Denmark,)

Results: In this meta-analysis, a total of 9535 patients from 16 studies were included. BMI < 30 vs ≥30 kg/m^2 was used to examine the association of obesity and surgical site infection in patients from Western countries. The estimated pooled OR demonstrated that obesity increased the risk of surgical site infection by approximately 100% (OR = 2.13; 95% CI 1.66-2.72, p < 0.001).BMI < 25 vs ≥25 kg/m^2 was used to examine the association of obesity and surgical site infection from Asian countries. The estimated pooled OR demonstrated that obesity increased the risk of surgical site infection by approximately 60% (OR = 1.63; 95% CI 1.29-2.06, p < 0.001). There was little evidence of publication bias in the meta-analysis.

Conclusion: From this systematic review and meta-analysis there was good evidence that obesity was associated with a significantly higher risk of developing surgical site infection following surgery for colorectal cancer in both ethnic groups. The magnitude of the effect warrants further investigation.

1. Introduction

The global prevalence of obesity has increased steadily over recent decades and continues to rise (World Health Organisation, 2015). In the United Kingdom, the prevalence of obesity increased from 15% in 1993 to 26% in 2014 (HSCIC, Health and Social Care Information Centre, 2016). The WHO defines overweight, as a body mass index (BMI) of 25–29·9 kg/m^2, while BMI of 30.00–34.99 kg/m^2 is defined as obese grade I, with obese grade II as BMI 35.00–39.99 kg/m^2 and obesity grade III as BMI ≥40.00 kg/m^2. However, the prevalence of obesity by using the WHO definition is variable across different populations. For example: the prevalence of obesity using BMI ≥30 kg/m^2 is less than 10 % in East Asian populations (Park et al., 2010). In addition, the incidence of obesity related disorder such as dyslipidemia, hyperglycemia and hypertension was higher at BMI > 25.0 kg/m^2. Therefore, the International Obesity Task Force (IOTF) has recommended a BMI threshold of 25.0 kg/m^2 for obesity in these populations.

Nevertheless, obesity is a well-established risk factor for the development of several chronic diseases, such as diabetes, heart disease, and certain cancers, such as colorectal cancer. Indeed, a large scale study in the UK with 5.24 million subjects (Bhaskaran et al., 2014) found statistically significant associations between increased BMI and 17 of the 22 most frequent cancers including colorectal cancer. Each 5 kg/m^2 increase in BMI was associated with a higher risk of cancer of the colon

* Corresponding author at: Human Nutrition, School of Medicine, University of Glasgow, New Lister Building Glasgow Royal Infirmary, Alexandra Parade, Glasgow, G312ER, United Kingdom.
E-mail address: a.almasaudi.1@research.gla.ac.uk (A.S. Almasaudi).

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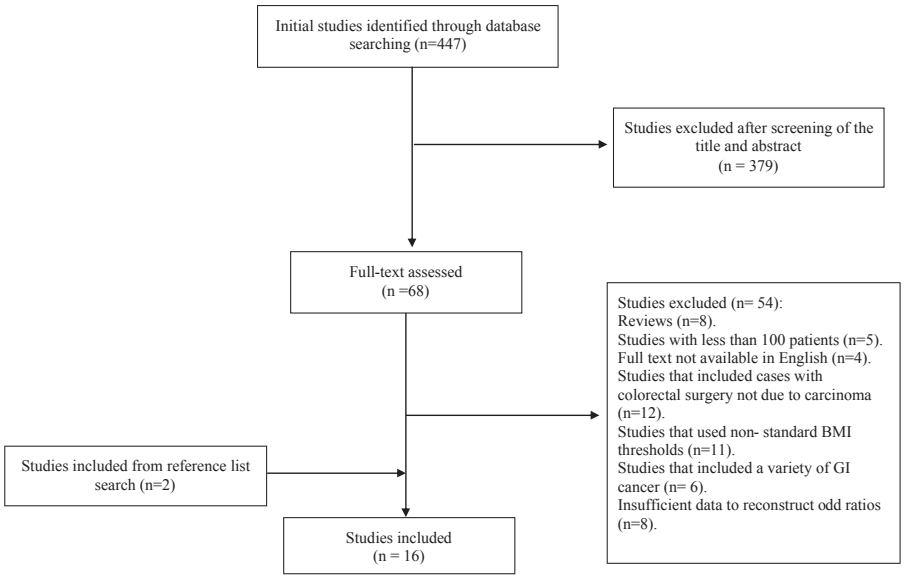

Fig. 1. Flow chart of studies selection process.

and rectum of approximately 10% and 5% respectively (Bhaskaran et al., 2014). There is also good evidence that obesity is an important risk factor of death from colorectal cancer. A recent meta-analysis by Doleman and coworkers (Doleman et al., 2016) showed that, compared with normal weight patients, obese patients with colorectal cancer (BMI > 30 kg/m^2) had an increased relative risk of all-cause mortality and cancer specific mortality of approximately 15%.

In colorectal cancer, surgical resection remains the primary treatment, and resection may be associated with appreciable morbidity and mortality. Surgical site infection (SSI) is the most frequent group of complications amongst colorectal surgery patients with an incidence of up to 38% (Konishi et al., 2006). It is associated with increased cost of treatment, longer hospital stay and occasionally leads to mortality (Smith et al., 2004).

Despite considerable attention to both the increasing prevalence of obesity and the frequent occurrence of surgical site infection after colorectal surgery, the data regarding the impact of increased BMI on surgical site infection after colorectal surgery is conflicting. For example, some researchers have reported an increased risk of surgical site infection in obese patients (Zhou et al., 2012), while others have reported no such association (Mrak et al., 2012). Such discrepancies in the literature may well reflect lack of statistical power. Therefore, the aim of the present systematic review and meta-analysis was to examine the relationship between increasing BMI and surgical site infection following surgery for colorectal cancer.

2. Methods

2.1. Literature search and data extraction:

A systematic search of the scientific literature was made using Medline, PubMed, Embase (Ovid) and Web of Science databases from inception to the end of August 2016.

The following search terms were used in free text and medical subject heading (MeSH) “body mass index OR obesity” AND “post-operative complications OR surgical site infection OR wound infections” AND colorectal “cancer OR neoplasms”. A search of the bibliographies of selected papers was carried out to identify any relevant articles missed during the primary search. The literature search and data extraction was carried out by a single author (AA), any uncertainty regarding the inclusion, or otherwise, of a paper was discussed with the senior author (DM). Data on study characteristics (including year of publication, country of origin, design, sample size, cancer site, surgical approach), BMI threshold and surgical site infections were extracted to preconstructed tables for each individual study.

2.2. Study eligibility criteria:

Studies in humans, published in English with documented BMI and patients having undergone surgery for colorectal cancer were included in the review. The primary outcome was surgical site infection, including wound infection, deep/organ space infection including anastomotic leak and abdominopelvic abscess. There were no restrictions in terms of age, ethnicity, and stage of colorectal cancer or surgical approach.

2.3. Statistical analysis:

Unadjusted odds ratios (ORs) for risk of surgical site infection based on BMI were used where presented in the included studies. Raw data was used to calculate ORs if they were not presented in the original study. Analysis of the data was performed using Review Manager version 5.3 (The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark,). ORs with a 95% confidence interval (CI) from each study were combined using a random effects model to account for variability in methodology. The Z test was used to assess the overall impact of BMI on surgical site infection. Heterogeneity was assessed by the I^2 test and two-tailed p-values < 0.05 were considered to be statistically significant. The review methodology and reporting was designed and completed in keeping with the PRISMA statement.

3. Results

3.1. Study selection process:

The study selection process is summarized in Fig. 1A total of 447 articles were initially identified. The title and abstracts of all studies returned by the search were examined by two authors (ASA and CAE). Of the 447 studies, 379 studies were excluded after screening of the title and abstract. Sixty eight studies were selected for full text reading. Of these 68 studies, 54 were excluded; eight were reviews, and five included only a small number of cases ($n < 100$), four studies had full text unavailable in English, 12 studies included cases with colorectal surgery not due to carcinoma, 11 used varying BMI thresholds, six included a variety of GI cancers, and in eight studies there was insufficient data to reconstruct odd ratios. The reference lists for the