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Original Article

Surgical site infection in overweight and obese Total Knee Arthroplasty patients

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ABSTRACT

Purpose: This aim of this study was to evaluate the rate of surgical site infection (SSI) in patients undergoing Total Knee Arthroplasty (TKA), to improve our understanding of the associations between infection rate and obesity.

Methods: Data was reviewed for 839 primary TKA procedures performed at a National Arthroplasty Centre over one year (April 2007–March 2008). SSI data was collected at 30 days and one year post-operatively. Patients were grouped guided by the WHO classifications of obesity; normal (BMI < 25.0), overweight (BMI 25.00–29.99), obese class I (BMI 30.00–34.99), obese class II (BMI 35.00–39.99), obese class III (BMI ≥ 40.00). Statistical significance was assessed by Fisher's Exact Test.

Results: When grouped by BMI, 30.9% of patients were obese class I, 19.0% obese class II and 8.7% obese class III. Of the total cohort, 22 patients (2.6%) had superficial SSI and 13 (1.5%) had deep SSI. When comparing the obese class III cohort to all other cohorts (non-obese class III), the odds ratios for superficial SSI was 4.20 (95% CI [1.59, 11.09]; p = 0.009) and deep SSI was 6.97 (95% CI [2.22, 21.89]; p = 0.003). In the obese class III cohort, superficial SSI rate was higher in females (8.9%) than males (5.9%), yet deep SSI demonstrated the opposite, with a higher occurrence in males (11.8%) compared to females (5.4%).

Conclusion: This study suggests that obese class III TKA patients are at increased odds of superficial and deep SSI compared to other BMI cohorts. Interestingly, male obese class III patients demonstrated a higher rate of deep infection compared to their female counterparts. However, it must be noted that study findings are limited as confounders were unable to be accounted for in this retrospective study design.

1. Introduction

Overweight and obesity are worldwide health epidemics, placing burden on healthcare systems. According to figures published by the Scottish government, in 2015, 65% of Scottish adults aged 16 years or older were overweight, and 29% of these adults were obese.[1] Equally as alarming, recent Australian reports have suggested increasing rates of overweight and obesity with age, displaying an increase from 39% of those aged 18–24, to 74% of people aged 65–74 years.[2]

Obesity has been shown to closely align with the incidence of osteoarthritis,[3,4] whereby obese individuals are more likely to require total joint arthroplasty at a younger age and have a higher revision rate.[5–7] Total joint replacement, although associated with excellent gains in quality of life, is a highly invasive surgery that is not devoid of complications, such as those associated with superficial or deep surgical site infection (SSI). The most common cause of SSI appears to be *Staphylococcus aureus*,[8,9] however some coagulase-negative *Staphlococci* have been reported in studies at similar or greater rates than *S. aureus*.[10,11] The bacterial origin of SSI is usually identified as a patient's own skin flora[12] and nasal carriage of *S. aureus* is a major factor for SSI.[13]

There are two types of commonly reported SSI; superficial infection which typically occurs up to 30 days after surgery; and deep infection, which can occur up to one year after surgery. Superficial infection is typically treatable with a course of antibiotics and occasionally debridement, which often resolves with minimal complications.[14] However,

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deep infection can require one or more surgeries, with revision of part or the complete prostheses, and occasionally arthrodesis.[15,16] Such surgeries come with significant morbidity to the patient. Furthermore, revision surgeries are expensive and complex, with infection responsible for 22.5% of primary total knee revisions.[17]

Obesity is considered a risk factor for SSI, demonstrating the paradigm that not only are obese patients more likely to require arthroplasty, they are at a greater risk of complications, which should be considered before surgery.[12,18–20] However, the literature remains contentious,[21] as studies have illustrated both no significant increases in infection risk,[22–25] or highly significant increases in risk.[26–29] These controversies exist, partly, as the link between obesity and infection remains unclear.[30] As obesity is typically associated with underlying comorbidities such as Diabetes Mellitus and components of metabolic syndrome,[31] these additional complications may be contributors to poor surgical outcomes such as SSI.[32,33] In addition, the use of body mass index (BMI) as a sole measure of obesity may not always accurately illustrate these complexities. Well-acknowledged limitations including the inability to distinguish between adipose tissue and lean mass, or account for body fat type and distribution result in the potential for misdiagnosis of obesity when using BMI.[34] Nevertheless BMI remains a widely adopted measure for categorisation of obesity.

Obesity is a pro-inflammatory state of increased chronic and low-grade inflammation, with the potential to augment the post-operative inflammatory response.[35] This altered inflammatory state has the potential to alter the way in which obese individuals respond to infection.[36–38] However, to better understand the molecular link between obesity and SSI, there needs to be improved clarity on the correlation between incidence and type of SSI in obese TKA patients. Therefore, this study retrospectively evaluated BMI and the incidence of SSI in 839 patients who underwent routine primary TKA at the Golden Jubilee National Hospital of Glasgow, to assess any potential correlation between obesity and SSI, to improve early identification of high risk cohorts.

2. Methods

2.1. Patient recruitment

In this study, 839 patients who had previously undergone routine primary TKA at the Golden Jubilee National Hospital of Glasgow were retrospectively evaluated for BMI levels and incidence of SSI over a one year period, April 2007 to March 2008. SSI data was collected from two sources. Infection data was collected prospectively by the independent hospital Infection Control Team for in-patient stays and post-discharge up to 30 days post-operatively. This data was available for all patients and issued in monthly reports, which was used to identify superficial SSI up to 30 days post-operatively. Data was also sourced from ISD (Information Services Division of NHS Scotland) who independently collected all re-admissions to any hospital in Scotland for infection within one year of operation. This data was used to identify all cases of deep SSI within one year.

Patient records were obtained and the results recorded for SSI and BMI. Patients were grouped based on the World Health Organisation (WHO) classifications of adult obesity according to BMI: normal (BMI < 25.0), overweight (BMI 25.00–29.99), obese class I (BMI 30.00–34.99), obese class II (BMI 35.00–39.99) and obese class III (BMI ≥ 40.00).[39] BMI is expressed in units of kg/m^2.

2.2. Data collection

Data was analysed by comparing SSI occurrence during the follow-up period of one year post-operative and the type of SSI that was found. Deep SSI (DSSI) was classed as any infection to the operative area that required a re-admission to hospital, up to one year following surgery, as per the Scottish Arthroplasty Project. Superficial SSI (SSSI) was classed as any infection that did not require re-hospitalisation and occurred during the first 30 days post-operative. Patients were grouped by BMI cohort as described in Section 2.1. Additionally, for data analyses SSSI and DSSI was assessed between the obese class III (BMI ≥ 40.00) and non-obese class III, which was inclusive of all cohorts with a BMI < 40.00. Analyses were also performed between the obese cohort (all patients with a BMI ≥ 30.00) and the non-obese cohort (all patients with a BMI < 30.00).

2.3. Statistical analyses

Statistical analyses were performed using GraphPad Prism (Version 6). Comparisons were made between obese class III and non-obese class III using Fisher's Exact Test (2-tailed) to determine the odds ratio (OR) of SSSI or DSSI incidence. Comparisons were also made between obese and non-obese cohorts to determine the odds ratio of SSSI or DSSI incidence. Where the confidence interval (CI) did not cross the y-axis, significance was achieved indicating $p < .05$.

3. Results

3.1. Patient characteristics and BMI

There were a total of 839 TKAs performed over the selected study period and BMI measurements were available for all 839 patients, with a mean BMI of 31.9. When grouped by BMI class, 9.8% of patients had normal BMI, 31.7% were overweight, 30.9% were obese class I, 19.0% were obese class II and 8.7% were obese class III. Of this cohort of patients, 498 were female and 341 were male, with females found to have a higher mean BMI. A breakdown of gender distribution across BMI groups is provided in Fig. 1.

3.2. Infection rate with BMI

There were 22 patients with SSSI at 30 days and 13 with DSSI at one year, with an overall SSSI rate of 2.6% and DSSI rate of 1.5%. The obese class III group had higher rates of both SSSI (8.2%) and DSSI (6.8%) when compared to all other BMI groups (Table 1). Furthermore, the obese class III group were at 4.20 times greater odds of SSSI (95% CI [1.59, 11.09]; p = 0.009) and 6.97 times greater odds of DSSI (95% CI [2.22, 21.89; p = 0.003), when compared to all other cohorts (denoted as non-obese class III) (Table 1, Fig. 2). However, for the cohort divided as either obese (all-inclusive BMI ≥ 30.00) vs. non-obese (all-inclusive BMI < 30.00) there were no significant differences in OR for either SSSI (1.54 [95% CI [0.62, 3.81, p = 0.389) or DSSI (1.14 [95% CI [0.37 to 3.50, p = 1.000).

3.3. Association between gender, obesity and SSI

While there were no significant changes in infection rate between males and females (data not shown), there tended to be more females constituting the obese class III cohort (11.2%) than males (5.0%)

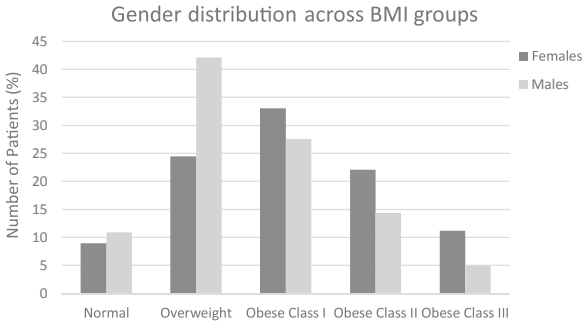

Fig. 1. Gender distribution across BMI cohorts.