Osteoarthritis and Cartilage 22 (2014) 918–927

Osteoarthritis and Cartilage

The effect of body mass index on the risk of post-operative complications during the 6 months following total hip replacement or total knee replacement surgery

G. Wallace †, A. Judge † ‡ *, D. Prieto-Alhambra † ‡ §, F. de Vries ‖ ¶, N.K. Arden † ‡, C. Cooper † ‡

† *Oxford NIHR Musculoskeletal Biomedical Research Unit, Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, University of Oxford, Windmill Road, Headington, Oxford OX3 7LD, UK*
‡ *MRC Lifecourse Epidemiology Unit, University of Southampton, Southampton General Hospital, Southampton SO16 6YD, UK*
§ *GREMPAL Research Group, IDIAP Jordi Gol Universitat Autonoma de Barcelona, Spain*
‖ *Utrecht Institute for Pharmaceutical Sciences, Division of Pharmacoepidemiology and Clinical Pharmacology, Utrecht University, The Netherlands*
¶ *Department of Clinical Pharmacy and Toxicology, Maastricht University Medical Centre, Maastricht, The Netherlands*

ARTICLE INFO

Article history:
Received 25 October 2013
Accepted 16 April 2014

Keywords:
Arthroplasty
Obesity
Post-operative complications
Electronic health records
Epidemiology

SUMMARY

Objective: To assess the effect of obesity on 6-month post-operative complications following total knee (TKR) or hip (THR) replacement.
Design: Data for patients undergoing first THR or TKR between 1995 and 2011 was taken from the Clinical Practice Research Datalink. Logistic regression was used to assess whether body mass index (BMI) was associated with 6-month post-operative complications [deep vein thrombosis or pulmonary embolism (DVT/PE), myocardial infarction (MI), stroke, respiratory infection, anaemia, wound infection, urinary tract infection or death] after controlling for the effects of age, gender, smoking, drinking, socio-economic status (SES), co-morbidities and medications.
Results: 31,817 THR patients and 32,485 TKR patients were identified for inclusion. Increasing BMI was associated with a significantly higher risk of wound infections, from 1.6% to 3.5% in THR patients (adjusted $P < 0.01$), and from 3% to 4.1% (adjusted $P < 0.05$) in TKR patients. DVT/PE risk also increased with obesity from 2.2% to 3.3% (adjusted $P < 0.01$) in THR patients and from 2.0% to 3.3% (adjusted $P < 0.01$) in TKR patients. Obesity was not associated with increased risk of other complications.
Conclusion: Whilst an increased risk of wound infection and DVT/PE was observed amongst obese patients, absolute risks remain low and no such association was observed for MI, stroke and mortality. However this is a selected cohort (eligible for surgery according to judgement of NHS GPs and surgeons) and as such these results do not advocate surgery be given without consideration of BMI, but indicate that universal denial of surgery based on BMI is unwarranted.

Background

Total hip replacement (THR) and total knee replacement (TKR) surgeries are common and successful surgical interventions, providing substantial pain relief and improvement in functional disability for patients with hip and knee arthritis[1–5]. It is generally acknowledged that the key indications for surgery include joint pain, functional limitation and radiographic evidence of arthritis[6–8]. There is no consensus on the severity of symptoms that indicate surgery is required[7,9], and no universally accepted criteria to determine the indications for surgery[6] with many other factors such as age, obesity, co-morbidities, smoking, alcohol use, attempts at non-surgical treatments, and psychological factors potentially influencing the decision to perform or delay surgery[7,10,11].

Whilst some authors conclude that increasing obesity is associated with worse pain and functional outcomes following joint replacement[12–15], others have found no evidence of an

* Address correspondence and reprint requests to: A. Judge, The Botnar Research Centre, Institute of Musculoskeletal Sciences, Nuffield Orthopaedic Centre, Windmill Road, OX3 7LD Oxford, UK. Tel: 44-(0)-1865-737837.
E-mail addresses: gemma.wallace@ndorms.ox.ac.uk (G. Wallace), andrew.judge@ndorms.ox.ac.uk (A. Judge), daniel.prietoalhambra@ndorms.ox.ac.uk (D. Prieto-Alhambra), f.devries@uu.nl (F. de Vries), nigel.arden@ndorms.ox.ac.uk (N. Arden), cc@mrc.soton.ac.uk (C. Cooper).

http://dx.doi.org/10.1016/j.joca.2014.04.013
1063-4584/

association[16–21] and the literature supports that obese patients can still expect large symptomatic improvement and satisfaction, even though they may not attain the same level of post-operative pain and function scores[22,23].

However there is growing evidence that commissioners in the UK are restricting access or encouraging weight loss prior to joint replacement surgery for obese patients[24–28], stating that increasing levels of obesity increase the risk of complications. Surgeons have also expressed concerns that surgery is more difficult in obese patients with a perceived increased risk of complications[29]. Within the literature there is limited evidence to support this view, although such risks are more consistently observed amongst the morbidly obese [body mass index – BMI $\geq$ 40 kg/m^2][16,29–35].

The aim of this paper is to study the association between obesity and the risk of 6-month post-operative complications following THR or TKR in routinely collected UK data representative of actual clinical practice.

Methods

Source of data and study participants

NHS observational data for UK GP practices from the Clinical Practice Research Datalink (CPRD) (formerly the General Practice Research Database) was screened for all patients receiving a first primary THR or TKR between 1st January 1995 and 11th August 2011. To meet the inclusion criteria THR patients must have had no record of a previous primary hip replacement ever or any record of a primary total or uni-compartmental knee replacement in the 6 months prior to THR. Similarly, TKR patients must have had no record of a previous primary knee replacement ever nor any record of a primary total hip or uni-compartmental knee replacement in the 6 months prior to TKR. Further all patients must have had no knee or hip revision operation in the 6 months prior to TKR or THR, at least one valid BMI measure (between 10 kg/m^2 and 70 kg/m^2) in the 5 years prior to the TKR or THR, and at least 6 months subsequent follow-up prior to transferring out of the GP practice (unless the reason was death).

Outcomes

All patients meeting the inclusion criteria were followed up to ascertain whether they had a record of any of the following outcomes during the 6 months immediately following THR or TKR; deep vein thrombosis or pulmonary embolism (DVT/PE), myocardial infarction (MI), stroke, respiratory infection, anaemia, wound infection, urinary tract infection (UTI) or death. The validity of diagnoses in CPRD and their utility in epidemiological studies have been well documented[36].

Exposure: obesity

BMI measurements as coded by GPs and other staff in primary care records were identified, and the closest prior to index surgery was considered in these analyses. BMI was categorized according to the World Health Organization categories: underweight (<18.5 kg/m^2), normal (18–25 kg/m^2), overweight (25–30 kg/m^2), obese class I (30–35 kg/m^2), obese class II (35–40 kg/m^2), or obese class III (>40 kg/m^2).

Statistical analyses

For each operation (THR or TKR), logistic regression methods were used to assess whether the likelihood of experiencing each outcome varied by BMI category. Robust standard errors adjusting for clustering of patients within GP practices were used. Adjustment was made for potential confounding variables including: gender, age at operation, smoking (current, ex, never), drinking (current, ex, never), practice level socio-economic status (SES) (Index of Multiple Deprivation (IMD) quintiles), year of surgery (1995–2000, 2000–2005 or 2005 and later), previous record of diabetes, chronic pulmonary obstructive disease (COPD), ischaemic heart disease or atrial fibrillation, previous use of antihypertensives, statins, antidepressants, antibiotics, aspirin, or anticoagulants and previous record of the outcome in question. Previous record of a comorbidity or previous use of a medication was defined as any relevant record at anytime between registration and surgery date.

As sensitivity analyses further adjustment was made for any records of THR, TKR or uni-compartmental knee replacement and knee or hip revision operations in the 6 months following initial THR or TKR.

In all analyses excluding that where death was the outcome, only patients who survived the 6 months following the operation were included. To address any potential selection bias that this might introduce, a sensitivity analysis was conducted including all patients irrespective of whether death occurred in the 6-month period.

Results

Hip Replacement Cohort

Between 1995 and August 2011, 53,337 patients were identified with a first record of a THR in CPRD. Of these 505 were excluded due to records of other joint operations in the 6 months prior to THR, 559 left the practice before the end of the 6-month follow-up period and 20,456 did not have a relevant BMI measure. In total, 31,817 patients met the inclusion criteria (Fig. 1). Of these, 462 patients (1.5%) were underweight, 9006 (28%) were of normal weight, 12,619 (40%) were overweight, 6809 (21%) were obese class I, 2224 (7%) obese class II and 697 (2%) obese class III. Baseline characteristics for study participants in the Hip Replacement Cohort are shown in Table I.

Incidence rates for each of the outcomes range from 0% to 4.1% in the 6 months following THR (Table III). 307 individuals died within the 6-month follow-up period and were therefore excluded from the analysis of outcomes other than death.

Increasing BMI from 25 kg/m^2 to 35 kg/m^2+ was associated with a progressive and significant increased risk of wound infections within 6 months, with risk increasing from 1.6% in patients with BMI 20–25 kg/m^2 to 3.5% in patients with BMI over 35 kg/m^2 [adjusted odds ratio (OR) range from 1.34 to 2.18; all $P < 0.01$]. A similar pattern was observed for DVT/PE [risk increases from 2.2% to 3.3% in the moderately obese (30–35 kg/m^2)]. Interestingly there was some suggestion that above 35 kg/m^2, the outcome incidence reduces back (unadjusted risk of 3.1%) to being more in the range of that observed in overweight (25–30 kg/m^2) patients (>35 kg/m^2 OR = 1.51; 95% CI 1.16–1.96; 25–30 kg/m^2 OR = 1.39; 95% CI 1.16–1.66), although there was not a statistically significant difference in the risk experienced in the moderately and severely obese. For outcomes of respiratory infection, UTI, anaemia, MI and stroke, increasing BMI was not associated with a change in risk (Table III).

Multivariable analysis also indicates that being underweight (BMI <18.5 kg/m^2) may be protective for the outcomes of DVT/PE (OR = 0.75; 95% CI 0.35–1.60), MI (OR = 0.70; 95% CI 0.09–5.39) and stroke (OR = 0.56; 95% CI 0.07–4.69), although these did not reach statistical significance ($P = 0.454$; 0.734 and 0.595 respectively) likely reflecting the small number of underweight patients in this cohort ($n = 443$ excluding 19 deaths) and the very few