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Incidence of delirium following total joint replacement in older adults: a meta-analysis

J.E. Scott, B.Psych. (Hons) [a], J.L. Mathias, B.A., B.A. (Hons), Ph.D., M.A.P.S. [a,*], A.C. Kneebone, B.A., Dip.App.Psych., M.A., Ph.D., F.A.P.S. [b,a]

[a] School of Psychology, University of Adelaide, South Australia, Australia 5005
[b] Department of Clinical Psychology, Flinders Medical Centre, South Australia, Australia 5042

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ABSTRACT

Objective: Delirium is common in older adults following total joint replacement (TJR) of the hip and knee. However, reports of the incidence of delirium vary widely, limiting their usefulness. The current meta-analysis therefore examined (1) the incidence of delirium in older patients who underwent TJR and (2) whether these rates vary according to the (a) joint (hip/knee replacement), (b) inclusion/exclusion of patients who underwent simultaneous bilateral surgery, (c) inclusion/exclusion of patients with preexisting cognitive impairments, (d) type of anesthesia (regional/general), (e) method/frequency of assessment, and (f) postoperative interval.
Method: Data from 24 studies (2,895 patients) that measured postsurgical delirium following TJR were analyzed. Mean weighted proportions were calculated using a random-effects model to assess the overall incidence of delirium and whether the rate varied according to the aforementioned variables.
Results: Overall, 17% of patients who underwent TJR developed delirium during hospital admission. Individual estimates varied from 0% to 82%, but this variability was not adequately explained by the variables that were examined.
Conclusions: Delirium is relatively common following TJR; however, it remains unclear why individual estimates vary so widely. Health professionals working with these patients should remain alert to the presentation, diagnosis and management of delirium to optimize postsurgical outcomes.

1. Introduction

Delirium involves disturbances in attention, awareness and other cognitive abilities, and is characterized by a sudden onset and symptoms that fluctuate throughout the day [1]. Approximately 30% of medical inpatients [2], 60% of surgical patients and 80% of intensive care patients [3] develop delirium during their hospital stay. While the causes remain controversial, delirium has been associated with a variety of predisposing factors, including older age, dementia, multiple medical comorbidities and polypharmacy [4]. In addition, precipitating factors include pain, lack of environmental stimulation, specific medications (e.g., sedatives, anticholinergic drugs), dehydration [4] and certain medical conditions, such as urinary tract infections [5] and obstructive sleep apnea [6].

Delirium is especially common among intensive care patients [7] and those admitted for emergency surgery [8], possibly because they possess multiple risk factors (e.g., older age [9], dementia, chronic illnesses [10], greater pain [11], acute trauma [4]). Patients who undergo *elective* surgery, such as total joint replacement (TJR) of the hip or knee, are also susceptible [12–14] despite the relatively predictable perioperative course [15], the presence of fewer risk factors, [16] and the relatively good health of these patients (elective procedures are generally contraindicated if major comorbid conditions are unstable or poorly managed).

Importantly, postsurgical delirium increases the risk of a person experiencing poorer cognitive and functional outcomes, even after controlling for age, comorbid conditions and presurgical cognitive status [17–19]. Furthermore, delirium may have significant financial implications for both the patient and the broader health sector, in part due to the extended hospital admissions that are associated with this diagnosis [7,20–23]. At present, however, there are limited data regarding the outcomes of older patients who underwent TJR and who developed postsurgical delirium, although the available research suggests that these patients may similarly be at risk [17,19].

Given the associated burden of delirium, it is important to consider its incidence among patients who undergo TJR. A meta-analysis of research examining delirium following elective orthopedic surgery reported that approximately 9–12% of patients developed postsurgical delirium [14]. However, more recent studies that used TJR-specific samples have reported rates of delirium that vary between 0% [24] and 48% [25]. Such variability limits the clinical utility of these data when trying to determine the risk of delirium after TJR.

* Corresponding author. School of Psychology, University of Adelaide, Adelaide, South Australia, Australia 5005. Fax: +61-8-8313-3770.
E-mail addresses: julia.scott@adelaide.edu.au (J.E. Scott), jane.mathias@adelaide.edu.au (J.L. Mathias), tony.kneebone@flinders.edu.au (A.C. Kneebone).

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Differences in the samples and methodologies used to investigate delirium may contribute to some of this variability [14]. Specifically, the inclusion of patients who have been diagnosed with dementia [14], have undergone simultaneous bilateral replacements [26], and/or had general, rather than regional, anesthesia [27] may all lead to higher rates of delirium. In addition, the measures used to assess delirium may vary in their sensitivity [14], with the qualifications and experience of the staff who perform these assessments also potentially impacting on the reported incidence of delirium [28]. Lastly, patients who are assessed more frequently and over a longer period of time may have higher rates of delirium because it is more likely to be detected [14].

Given the frequency of TJR surgery [29] and the fact that delirium is known to be associated with poorer outcomes [21], it is important to determine how frequently delirium occurs following TJR. Based on research with similar clinical samples, it is likely to be common and to be affected by many of the aforementioned variables. The current meta-analysis therefore examined the overall incidence of delirium after TJR and whether this rate differed according to the type of surgery (hip or knee replacement), the presurgical cognitive status of patients (i.e., inclusion or exclusion of patients with dementia), the inclusion of patients who underwent simultaneous bilateral surgery, the use of general or regional anesthesia, the method (measure of delirium, professional assessing delirium) and frequency of assessment, and the postsurgical assessment interval.

2. Method

2.1. Search strategy and research design

The Pubmed, PsycINFO, Embase and Scopus electronic databases were searched using a broad range of terms to identify original research, published between January 1980 and January 2014, that screened TJR patients for delirium (see Appendix A, Supplementary Materials for search terms). The reference lists of reviews that examined TJR and delirium were also searched to identify further research.

To be eligible for inclusion, studies needed to have: (1) assessed patients who had undergone elective TJR of the hip or knee and received "standard care" (i.e., did not receive any experimental treatment); (2) examined participants who were 50 years of age or more (based on age range or mean age minus 1 S.D.≥50 years); (3) screened for postsurgical delirium using either *Diagnostic and Statistical Manual of Mental Disorders* (*DSM*) [30] or *International Classification of Disease* [31] criteria or a published delirium-specific screening tool (e.g., Confusion Assessment Method (CAM) [32]); (4) reported prevalence data or provided data from which an effect size could be computed (e.g., number of cases); (5) had a sample size >1 (i.e., excludes case studies) and (6) been published in English in a journal. Data from studies that evaluated an experimental surgical procedure were only eligible if there was a "standard care" TJR group, as opposed to a treatment or placebo group. Studies were also deemed eligible if patients underwent "elective" hip or knee replacement surgery because, although this may refer to partial/revision/TJR, the majority of elective joint procedures involve TJRs (72–96%) [33–35]. Three studies [36–38] reported "elective hip/knee surgery" but did not specify whether patients underwent replacement procedures, as opposed to other forms of elective surgery (e.g., arthroscopy); therefore, the authors were contacted for confirmation. Two authors responded [37,38] and these studies were subsequently included. Studies were excluded if they recruited an elective "orthopedic" sample [39,40] because these studies may include other types of surgery (e.g., shoulder). Finally, studies were excluded if prevalence data were based on informal assessments, such as entries in medical files by staff who were not specifically instructed to assess delirium (e.g., see Ref. [41]). These data were considered less reliable because delirium may not have been a primary concern and, without specific training, symptoms may not have been recognized [28,42].

The original search located 1,359 studies, excluding duplicates (for full details, see Supplementary Materials Fig. A). An examination of all titles and abstracts revealed that 197 papers were potentially eligible and warranted further attention. The full-text versions of these studies were therefore retrieved. One hundred and ten of these papers were subsequently excluded on the basis of ineligible methodologies (e.g., data collected retrospectively from medical records) or samples (e.g., aged less than 50 years), unusable data or a combination of factors. In total, 29 studies met all of the inclusion criteria. The reference lists of reviews were also examined: one additional study [43] was located using this method, increasing the number to 30 studies.

Lastly, these studies were screened to ensure that all samples were independent of one another. Three studies by both Cerejeira et al. [44–46] and Dupplis et al. [19,47,48], and two by Lowery et al. [49,50], used non-independent samples. In addition, the independence of samples used in two studies by Kudoh et al. could not be confirmed [51,52]. The data for these authors were therefore combined, leaving a total of 24 independent studies in the final review.

2.2. Effect size calculations and analyses

Most data were reported as proportions ($N_{studies}=23$) — which are an effect size in themselves [53] — indicating the rate with which patients developed delirium following TJR during their hospital admission. One study provided means and S.D. values, but met all of the other inclusion/exclusion criteria [37]. Incidence data were therefore requested via email, which the corresponding author provided. All effect size calculations and analyses were conducted using Comprehensive Meta-Analysis Software Version 2 (Biostat, Englewood, NJ) [54]. A random-effects model, which assumes that effect sizes vary as a consequence of both sampling error and methodological differences [53,55], was used to calculate mean effects. The proportions obtained from individual studies were weighted by sample size and were combined to calculate mean effect sizes (mean proportions), for which 95% confidence intervals (CIs) were computed. 95% CIs that do not include zero indicate that the population prevalence is significantly different from zero. All mean effect sizes and CIs were expressed as percentages, and a forest plot of the individual and mean percentages together with 95% CIs were created using the Forest Plot Viewer software (National Toxicology Program, Research Triangle Park, North Carolina) [56]. A funnel plot was used to assess the potential for publication bias, which refers to the over-representation of statistically significant results within the published literature. The logit-transformed proportions for individual studies were plotted against their standard errors, with a line in the middle representing the mean effect size. The individual study "plots" form a symmetrical funnel shape around the mean effect size when publication bias is unlikely. An asymmetrical funnel, on the other hand, may indicate publication bias [57].

A number of analyses were performed to determine whether a selection of sampling and methodological variables were associated with some of the variation in the rates of delirium. First, the overall incidence of delirium following TJR was examined, after which separate rates were calculated for those undergoing hip and knee replacements and for studies that included or excluded patients who underwent simultaneous bilateral procedures. Next, study data were examined in terms of whether they included or excluded patients who had pre-existing cognitive impairments. The "unselected" group comprised studies that did not exclude participants on the basis of presurgical cognitive status (i.e., potentially included people with dementia/cognitive impairment) and the "no impairment" group included studies that either excluded cognitively impaired participants or reported post-hoc that there were no such participants. Two studies [47,58] only excluded those participants with very low Mini Mental Status Exam Scores (<11) and two excluded patients who could not give informed consent [8,43], which meant that persons with mild or moderate cognitive deficits may have been included. As a result, these studies were included in the