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Clinical Investigation

CLINICAL INVESTIGATION

Persistent postoperative pain after total knee arthroplasty: a prospective cohort study of potential risk factors

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Abstract

Background: Persistent postoperative pain (PPP) is common after total knee arthroplasty (TKA). The primary aim of this prospective cohort study was to identify important predictors of moderate to severe PPP 6 and 12 months after TKA.
Methods: Consenting patients (n=300) undergoing primary unilateral TKA attended a preoperative session to collect clinical information (age, gender, BMI, preoperative knee pain, comorbid pain, likely neuropathic pain) and psychological variables (depression, anxiety, catastrophising, expected pain). Quantitative sensory testing (pressure pain thresholds, temporal summation, conditioned pain modulation) was performed, and blood samples were obtained for subsequent genotyping of OPRM1 and COMT. Acute postoperative pain was measured at rest and during movement. Surgical factors (surgery time, patella resurfacing, anaesthetic type) were collected after operation. Follow-up questionnaires were sent 6 and 12 months after surgery. Multivariate logistic regression was used to identify predictors of PPP.
Results: The prevalence of moderate to severe PPP was 21% (n=60) and 16% (n=45) 6 and 12 months after surgery, with 55% (n=33) and 60% (n=31) of PPP likely neuropathic in nature. At 6 months, a combination of preoperative pain intensity, expected pain, trait anxiety, and temporal summation (Akaike information criterion, 309.9; area under receiver operating characteristic (ROC) curve, 0.70) was able to correctly classify 66% of patients into moderate to severe PPP and no to mild PPP groups. At 12 months, preoperative pain intensity, expected pain, and trait anxiety (Akaike information criterion, 286.8; area under ROC curve, 0.66) correctly classified 66% of patients.

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Conclusions: Findings from this study highlight several factors that may be targeted in future intervention studies to reduce the development of PPP.
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Keywords: postoperative pain; risk factors; total knee arthroplasty

Editor's key points

- Managing persistent pain after total knee arthroplasty needs improved understanding of modifiable risk factors.
- Clinical, psychological, psychophysical, and genetic factors were assessed up to 12 months after surgery.
- Persistent pain and disability was present in 16% of patients at 12 months.
- Predictive factors for persistent pain (12 months) were preoperative pain intensity, trait anxiety, and expected pain.
- Future work is required to assess the impact of interventions to modify these factors.

Total knee arthroplasty (TKA) is an effective intervention to improve physical function and reduce joint pain in those with end-stage knee arthritis.[1] Although TKA relieves pain in most patients, between 10% and 34% continue to experience moderate to severe persistent postoperative pain (PPP) in the operated knee ≥3 months after surgery.[2] PPP adversely affects quality of life,[3] is the most important predictor of patient dissatisfaction after TKA,[4] and is a common reason for undergoing revision surgery.[5]

The aetiology of PPP after TKA is multifactorial and likely involves both patient- and treatment-related factors.[6] Although a number of studies have examined preoperative risk factors for the development of PPP after TKA,[7] many of these have been retrospective in nature or focused on a limited number of variables. Including a range of potential clinical, psychological, neurophysiological, genetic, and surgical risk factors for PPP may better control for confounding variables and allow the relative importance of these factors to be evaluated.[6,8]

The primary aim of this prospective cohort study was to identify key predictors of moderate to severe PPP 6 and 12 months after primary unilateral TKA. The secondary aims were to evaluate the proportion of patients with moderate to severe PPP whose pain was likely neuropathic in nature and to explore the link between PPP and functional outcome.

Methods

Patients and study design

This prospective cohort study was approved by the New Zealand Northern Regional Y Ethics Committee (NTY12/02/014) and registered (ACTRN12612001089820). All patients provided written, informed consent. Inclusion criteria were planned primary unilateral TKA and fluent in English. Exclusion criteria were <18 yr old, diagnosed learning disability, Raynaud's syndrome, unsuitable for neuraxial anaesthesia, and a diagnosed neurological condition that may affect quantitative sensory testing (QST) or revision surgery within the follow-up period. Patients were recruited between November 2012 and September 2015 from the Waitemata District Health Board, an Auckland-based hospital board with three operating sites. Consenting patients attended a preoperative assessment session in the 2 weeks before surgery. Clinical information was collected, questionnaires completed, QST procedures undertaken and a 6 ml blood sample collected for subsequent genetic analysis. Acute postoperative pain (APOP) was measured on Days 1, 2, 3, 7, and 14 after surgery. Follow-up questionnaires were sent to patients 6 and 12 months after surgery.

Intervention

All patients underwent a unilateral, cemented TKA. Patella resurfacing was performed according to clinical indication. A standard enhanced recovery after surgery (ERAS) protocol was recommended for all study patients, including combined spinal epidural (CSE) with sedation. During the study period there was the introduction of high volume local infiltration analgesia (LIA) through a modified ERAS programme. As such, the initial CSE protocol transitioned into single shot spinal with LIA. All other aspects of the anaesthesia/analgesia protocol remained the same. For patients undergoing CSE, patient-controlled epidural analgesia (PCEA) was utilised for 48 h after surgery, with no background infusion. All patients, including those who received single shot spinal plus LIA, had multimodal postoperative analgesia including regular oral acetaminophen (paracetamol), NSAIDs, and oral opioids (oxycodone) as required. Gabapentin was available as 'rescue' medication only.

Predictor variables

The predictor variables included are listed in Table 1 and were based on existing literature.

Clinical factors

Age, gender, and preoperative BMI were collected before operation. The Western Ontario McMaster Universities Osteoarthritis Index (WOMAC) pain scale was completed to obtain a measure of preoperative knee pain intensity.[9] A preoperative comorbid pain score was calculated by counting the number of additional pain sites where pain was present for 1 month or longer and rated ≥3/10.[10,11] The Leeds Assessment of Neuropathic Signs and Symptoms Pain Questionnaire (LANSS) was completed before operation. The LANSS was utilised both to identify participants with likely neuropathic pain before surgery (cut point of ≥12), and as a predictor (continuous score) of PPP.[12]

APOP in the operated knee was measured at rest and during movement.[13] Resting APOP was recorded in supine with the