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Review Article

The analgesic efficacy of local infiltration analgesia *vs* femoral nerve block after total knee arthroplasty: a systematic review and meta-analysis

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Abstract

Many consider femoral nerve block the gold standard in pain management following knee arthroplasty. Local infiltration analgesia is an alternate approach that applies the concept of surgical wound infiltration with local anaesthetics. This meta-analysis aims to compare both analgesic treatments for analgesia and functional outcomes after total knee arthroplasty. This meta-analysis was performed according to the PRISMA statement guidelines. The primary outcomes were cumulative i.v. morphine consumption, pain scores at rest and on movement on postoperative day one (analogue scale,0–10). Secondary outcomes included range of motion, quadriceps muscle strength, length of stay and rates of complications (neurologic events, cardiovascular events, falls and knee infections). Fourteen trials, including 1122 adult patients were identified. There was no difference in i.v. morphine consumption (mean difference: −2.0 mg; 95% CI: −4.9, 0.9 mg; I^2=69%; *P*=0.19), pain scores at rest (mean difference: −0.1; 95% CI: −0.4, 0.3; I^2=72%; *P*=0.80) and pain scores on movement (mean difference: 0.2; 95% CI: −0.5, 0.8; I^2=80%; *P*=0.64) on postoperative day one (a negative mean difference favours local infiltration analgesia). The qualities of evidence for our primary outcomes were moderate according to the GRADE system. There were no clinical differences in functional outcomes or rates of complications. Complication rates were captured by three trials or fewer with exception of knee infection, which was sought by eight trials. Local infiltration analgesia provides similar postoperative analgesia after total knee arthroplasty to femoral nerve block. Although this meta-analysis did not capture any difference in rates of complications, the low number of trials that specifically sought these outcomes dictates caution.

Key words: analgesia; nerve block; postoperative pain; regional anaesthesia; total knee arthroplasty

Total knee arthroplasty (TKA) causes moderate to severe post-surgical pain,[1] with femoral nerve block (FNB) considered by many as the gold standard analgesic therapy after this surgery.[2–5]

Local infiltration analgesia (LIA) applies the concept of surgical wound infiltration with local anaesthetics[6 7] to joint surgery.[8] The technique was first reported for knee arthroplasty by Bianconi and colleagues[9] fewer than 15 years ago. Since then, it has gained widespread popularity among orthopaedic surgeons because of its ease of application, cost effectiveness and lack of apparent motor block of the lower limb.[10 11] The initial enthusiasm prompted a number of randomized controlled trials comparing LIA with FNB, which reported conflicting results for analgesic efficacy.[12–14] Several systematic reviews have endeavoured to clarify the magnitude of analgesic effect of both procedures, but their results are limited by the absence of quantitative meta-analysis

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assessment,[15–18] the fact that they do not address this question directly,[19] or did not investigate the relative benefit of each intervention on functional recovery.[20]

This meta-analysis aims to compare the analgesic efficacy, the functional outcomes and the technique-related complications of FNB and LIA after TKA in adult patients.

Methods

Literature search and inclusion criteria

The authors applied the recommendations of the 'Preferred Reporting Items for Systematic Reviews and Meta-Analyses' (PRISMA) statement.[21] The electronic databases MEDLINE (until February 2016), the Cochrane Central Register of Controlled Clinical Trials (until February 2016), and the Excerpta Medica database, EMBASE (until February 2016) were searched with the following terms: Knee joint OR Knee surgery OR Total knee replacement OR Total knee arthroplasty. These search results were associated with Local infiltration analgesia OR Periarticular infiltration OR Peri-articular infiltration OR Periarticular injection OR Peri-articular injection OR Intraarticular infiltration OR Intra-articular infiltration OR Intraarticular injection OR Intra-articular injection OR Intraarticular analgesia OR Intra-articular analgesia. Findings were further restricted by associating with Regional anaesthesia OR Regional anesthesia OR Anaesthetic technique OR Anesthetic technique OR Anaesthesia conduction OR Anesthesia conduction OR Local anaesthetics OR Local anesthetics OR Nerve block OR Peripheral nerve block OR Femoral nerve block OR Adductor canal block OR Saphenous nerve block. The following keywords were also searched: Anaesth*, Anesth*, Nerve*, Replacement*, Arthroplasty*. Search results were limited to randomized controlled trials and humans. No language restriction was placed on the search. Lastly, bibliographies of retrieved articles were scrutinized for any relevant trials not yet identified in the primary search.

Population

The meta-analysis addresses male or female adults undergoing TKA.

Intervention and comparator

Only randomized trials comparing LIA to a group of patients having single-shot or continuous femoral nerve, saphenous nerve, or adductor canal blocks were included in the present meta-analysis. Any article that applied the LIA technique described by Kerr and Kohan,[11] in total or in part to a group (infiltration of any layer of the knee joint: posterior part, anterior part, periarticular soft tissue), was included. We excluded trials comparing LIA with a combination of epidural analgesia and FNB[22–24] or investigating the analgesic efficacy of the combination of LIA and FNB with the combination of sciatic nerve block and FNB.[25–27]

Outcomes

The specific outcomes sought from each article were derived following our approach described in a previous meta-analysis on acute postoperative pain.[28] The primary acute pain-related outcomes were cumulative i.v. morphine consumption, and pain scores at rest and on movement on postoperative day one (24 postoperative h). Secondary acute pain-related outcomes sought were cumulative i.v. morphine consumption at two and 12 postoperative h, and on postoperative day two and three; pain scores at rest and on movement measured at two and 12 postoperative h, and on postoperative day two and three; incidences of postoperative nausea or vomiting, pruritus within the first 24 h postoperatively, and chronic postoperative pain. Additional functional outcomes evaluated were range of motion or knee flexion on postoperative days one, two and three; quadriceps muscle strength on postoperative days one, two and three; Knee Society score[29] at six weeks, three and 12 months postoperatively; and length of stay. We also aimed to capture any analgesic technique-related complication, such as rates of neurologic events, cardiovascular events, falls, knee joint infections, prosthesis loosening, or revision surgery. Finally, local anaesthetic plasma concentrations were retrieved whenever possible.

Trial characteristics

Extracted trial characteristics included type (single-shot injection or catheter insertion) and technique of LIA and peripheral nerve block, respectively; type, concentration and volume of local anaesthetics; type of other components used; anaesthetic strategy for surgery, and type and modality of postoperative analgesia.

Rating of the studies

The quality of the research methodology of each randomized trial was assessed following the Cochrane Collaboration's Risk of Bias Tool for randomized controlled trials.[30] Two authors (A.J.G. and K.K.) separately screened, reviewed and rated the items for each trial using this method and extracted data for the analyses. Disagreements with scoring or extracted data were addressed after discussion with a third author (E.A.).

Data extraction

Means, standard deviation, standard error of means, 95% confidence interval (CI), number of events and total number of participants were extracted from the text, tables or graphs from each source study. The authors of trials that failed to report the sample size or results as a mean and standard deviation, or standard error of the mean, or 95% CI, were contacted twice by email to request the missing data or raw data. If no response was obtained, median and interquartile range were used for means and standard deviation approximation, as follows: the mean was estimated as equivalent to the median and the standard deviation was approximated to be the interquartile range divided by 1.35.[31] All opioids were converted into equi-analgesic doses of i.v. morphine for analysis (i.v. morphine 10 mg=oral morphine 30 mg=IV hydromorphone 1.5 mg=oral hydromorphone 7.5 mg=IV pethidine 75 mg=oral oxycodone 20 mg=IV tramadol 100 mg).[32 33] Pain scores reported as Visual, Verbal or Numeric Rating Scales were converted to a standardized 0–10 analogue scale for quantitative evaluations. Finally, we rated the quality of evidence for each outcome following the Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) Working Group system.[34]

Statistical analysis

Review Manager software (RevMan version 5.3.5; Copenhagen, The Nordic Cochrane Centre, The Cochrane Collaboration 2014) was used to perform meta-analyses. This software estimates the weighted mean differences for continuous data and risk ratio for categorical data between groups. It produces an overall estimate of the pooled effect. As most data sets were heterogeneous, they were analysed using a random effects model, and are presented as the mean difference or relative risk (RR) with