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Systematic review of spinal anaesthesia using bupivacaine for ambulatory knee arthroscopy

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The use of lidocaine in spinal anaesthesia is associated with transient neurological syndrome (TNS). Bupivacaine has a lower incidence of TNS as an alternative but it may have a prolonged action. This study systematically reviews the literature about the recovery profile of patients undergoing spinal anaesthesia, using bupivacaine for arthroscopic knee surgery. We identified 17 eligible randomized clinical trials (RCTs) (1268 patients). All the articles in this review, except one, used hyperbaric bupivacaine. Five trials compared different doses of bupivacaine (range 3–15 mg). Large doses of bupivacaine (10 and 15 mg) were associated with delayed recovery, and supine positioning was associated with a high incidence of failure. With unilateral positioning, a dose as low as 4–5 mg seems to be sufficient. Five trials comparing bupivacaine or levobupivacaine with ropivacaine showed no significant difference in the time to home discharge. When bupivacaine was combined with fentanyl in two trials, marginal delay in recovery was found [time to discharge (min); weighted mean difference (WMD) 14.1, 95% CI 11.9–40.1] and increased nausea and pruritus but had reduced postoperative pain. Unilateral and bilateral spinal anaesthesia were assessed in two trials, and the latter group was associated with early recovery and discharge [time to discharge (min); WMD −41.6, 95% CI −63.6 to −19.6). The results of our systematic review suggest that 4–5 mg of hyperbaric bupivacaine can effectively produce spinal anaesthesia for knee arthroscopy with unilateral positioning. Ropivacaine or the addition of adjuvants did not improve the recovery time. There is a need for tighter RCTs with more consistent endpoints.

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The use of lidocaine in spinal anaesthesia has declined over the years and has become virtually nonexistent because of the high incidence of transient neurological syndrome (TNS). The abandonment of lidocaine in spinal anaesthesia, however, has been a setback for ambulatory anaesthesia, where early recovery is vital. Bupivacaine, the most common alternative to lidocaine, has a low incidence of TNS (0–1%)[32 33 36] but delays home discharge in ambulatory surgical patients if used in the usual doses.[49] Knee arthroscopy is a common procedure in the ambulatory setting. The incidence of TNS is increased with knee arthroscopy[49 53] because of the patient positioning[35] and ambulatory setting.[26] These factors make it necessary to evaluate the role of bupivacaine as an alternative anaesthetic agent to lidocaine for spinal anaesthesia in knee arthroscopy. The aim of this systematic review is to determine the optimal dosing of bupivacaine and to investigate the effect of other strategies such as unilateral patient positioning, using alternative agents or adding adjuvants on the efficacy of the medication in this setting.

Methods

Search strategy

This systematic review was carried out using the methods established by the Cochrane Collaboration.[34] We searched the Cochrane Central Register of Controlled Trials (CENTRAL) and the Database of Abstracts of Reviews of Effects (DARE) in The Cochrane Library (Issue 3, 2007) and conducted electronic searches utilizing MEDLINE from January 1950 to December 2007, EMBASE from January 1974 to December 2007, and CINAHL from January 1982 to December 2007. Both text-word and index-word terms were used; the text-word terms included in our search

strategies included: 'bupivacaine', 'spin$', 'an?esthesia', 'ambulatory', 'out?patient', 'day?case', 'surg$', 'knee', 'arthroscop$'. We also exploded the following index-word terms: 'ambulatory surgical procedures', 'anesthesia, spinal', 'bupivacaine', and 'arthroscopy'. We hand-searched reference lists from the already retrieved articles to identify further trials. In addition, contact was made with the principal authors and experts in the field to identify additional published or unpublished data relevant to the review.

Study selection criteria

Three reviewers (G.S.N., A.A., and J.L.) independently assessed titles, abstracts, or both of the hits retrieved from the electronic database and hand searches for possible inclusion according to the pre-defined selection criteria. Discrepancies were resolved by the fourth author (F.C.). Studies were eligible for inclusion if they were randomized clinical trials (RCTs) with parallel-group design, that evaluated the use of bupivacaine for spinal anaesthesia during elective knee arthroscopic surgery in ambulatory settings. Observational studies (e.g. non-randomized trials, case series) were not considered for review. There was no language restriction but all trials included in the review were published in English.

Data extraction

We extracted the following information about each study: method of randomization, number and characteristics of study participants, trial design, treatment regimens, time to onset of spinal block, duration of specific positioning after placing the block, incidence of unilateral and bilateral spinal block, time to recovery, time to voiding, time to home discharge, incidence of complications and failures. Data were extracted from each trial by two reviewers (G.S.N. and A.A.), checked for consistency and accuracy, and then entered into a computer database for analysis. The authors of included trials were contacted for the missing data.

Assessment of study methodological quality

Methodological quality was defined as the confidence that the design, conduct, and report restrict bias in the intervention comparison (Cochrane Handbook) as evaluated independently by the reviewers (G.S.N., A.A., and J.L.). Disagreements were resolved by the fourth author (F.C.). We assessed each study for the method of randomization, and of concealment of study intervention allocation, the degree of blinding, and the completeness of follow-up. Randomization method was considered adequate if it was generated by a table of random numbers, or computer-generated. Quasi-randomized trials (research design that does not ensure true randomization) were not included and assessed in this review. Allocation concealment was graded adequate if the allocation of patients is carried out by independent staffs who are not involved in the study, using methods such as serially numbered opaque-sealed envelopes, on-site locked computer, etc. Blinding was adequate if the patient, care givers, and outcome assessors are blinded to the treatment. Follow-up was adequate if the numbers and reasons for dropouts and withdrawals in all intervention groups are described or if it is specified that there were no dropouts or withdrawals.

Data analysis

Statistical methods of RevMan analyses (Review Manager, version 2.4, The Nordic Cochrane Centre, Copenhagen, Denmark) were used for analysing the data. In this review, pooling of the data was possible among the results of studies comparing bupivacaine with ropivacaine and studies evaluating the role of adjuvants and different positioning. Pooled treatment effects were estimated using both fixed- and random-effect methods. However, in the text, we have reported only the fixed-effect model, as the two analyses came into a similar conclusion in the sensitivity analyses. However, with regard to the different doses of bupivacaine, the available trials have reported the outcomes in variable formats. For example, time to discharge or voiding is reported as mean (SD) in some trials and as median with range or inter-quartiles in others. This factor along with the evident clinical heterogeneity (e.g. different design) among the trials led us not to proceed to meta-analysis in this group of studies. The results of these trials, however, were reported in the review for descriptive and qualitative analyses. For continuous variables, for example, time to voiding, we calculated the weighted mean difference (WMD) with corresponding 95% confidence intervals (CIs). No dichotomous data were pooled in this systematic review. The I^2 statistic was used to measure inconsistency among the study results. $I^2=[(Q-\mathrm{df})/Q]\times 100\%$, where Q is the χ^2 statistic and df is its degrees of freedom (*Cochrane Handbook*). This describes the percentage of the variability in effect estimates that is attributable to heterogeneity rather than to sampling error (chance). A value $>50\%$ may be considered substantial heterogeneity. Subgroup analyses and assessment of publication bias (funnel plot) were not possible because of the limited number of studies used for pooling of the data. We analysed data with both fixed- and random-effect model for sensitivity analyses.

Results

The literature search performed in December 2007 identified 626 articles of potential relevance. The study selection process eliminated 437 articles by a review of the abstracts and titles. Another 117 articles were excluded after a review of their methodology and results sections. This process left us with 72 articles on spinal anaesthesia