Trends in Anaesthesia and Critical Care 5 (2015) 104–110

Contents lists available at ScienceDirect

Trends in Anaesthesia and Critical Care

journal homepage: www.elsevier.com/locate/tacc

Review

Total knee arthroplasty – The optimal analgesic regime

Kelly Byrne*, James Clark

Department of Anaesthesia, Waikato Hospital, Pembroke Street, Hamilton, New Zealand

Keywords:
Total knee arthroplasty
Analgesia
Review

A B S T R A C T

Despite over one million knee replacements being undertaken worldwide per year, there is still no widely accepted optimal analgesic regime for this procedure. This article examines and appraises the options for total knee arthroplasty in the current environment which mandates rapid discharge from hospital. Peripheral nerve blockade and multimodal analgesic options are covered in detail, along with newer techniques such as high volume local anaesthetic infiltration and infiltration with liposomal bupivacaine. Recommendations are made for the straightforward patient and the patient with chronic pain or opioid requirements.

1. Introduction

Total knee arthroplasty is one of the most frequently undertaken elective procedures in the Western world. In the United States in 2011 there were 718,000 hospital admissions for total knee arthroplasty [1]. Yet, despite this procedure being described in 1954 [2] and the number of procedures increasing at a rapid rate (91% between 1997 and 2011 in the United States) [1], there remains a wide variety of analgesic regimens in clinical practice.

The Procedure specific post-operative pain (PROSPECT) management group provided a meta-analysis of pre-, intra- and post-operative analgesic options for total knee arthroplasty that was published Anaesthesia in 2008 [3]. This is drawn from the literature up until 2005 and revision of this is warranted, especially with the introduction of new techniques such as high volume local anaesthetic infiltration. Despite a thorough examination of the literature all the PROSPECT recommendations for intra-operative management remain level of evidence D (Expert opinion, with inconclusive evidence).

Part of the reason for this is the paucity of large scale multicentre trials. A PubMed search for “total knee arthroplasty” and “analgesia” garners an astonishing 614 articles, but almost without exception all the prospective randomized trials in this collection include less than 100 patients. In Macfarlane et al.'s [4] excellent systematic review of whether regional anaesthesia affects outcome following knee arthroplasty, of the 28 studies identified, only 2 had participant numbers over 100, and both of these assessed epidural analgesia vs. intravenous opioid analgesia.

It seems surprising that for a procedure whose worldwide numbers almost certainly exceed one million procedures per year, the most well designed studies involve less than 100 participants. While large numbers are not needed to demonstrate a statistically significant difference if the effect size is large, the outcomes in these small single institution studies are likely to be highly influenced by the practitioners in these institutions and the patient populations they are serving.

A number of analgesic regimes appear to be beneficial following total knee arthroplasty, because while the pain is often considered to be severe in the post-operative period, the duration of severe pain is relatively short lived, and the majority of patients are able to mobilise and be discharged in a fairly timely fashion, probably based more on patient expectation and geographical circumstance rather than analgesic success or failure.

This review aims to cover the most pertinent analgesic options currently available and weigh the evidence for each in turn. There will be a summary of recommendations for the straightforward patient and one for the “difficult” patient, those with chronic pain diagnoses or chronic opioid use. Epidural analgesia will not be considered in this review. Epidurals clearly provide excellent analgesia when they are sited and managed correctly. However, it is our opinion that the groundswell of current practice is away from epidural use in routine arthroplasty surgery and it should be considered only when there are patient factors that necessitate its use. Additionally, intrathecal morphine is not considered in this review. We consider its analgesic benefit to be conclusively proven in total knee arthroplasty but its side effects of pruritus, nausea and

* Corresponding author. Tel.: +64 7 839 8718; fax: +64 7 839 8761.
E-mail addresses: kpa.byrne@gmail.com (K. Byrne), James.Clarke@waikatodhb.health.nz (J. Clark).

http://dx.doi.org/10.1016/j.tacc.2015.04.004
2210-8440/

vomiting and potential for delayed respiratory depression problematic enough to exclude it from use in our institution.

Innervation of the knee is illustrated in Fig. 1, and the sites of action of the potential analgesic interventions are illustrated in Fig. 2.

2. Femoral nerve block

The femoral nerve is a readily accessible and attractive target for reducing the pain of total knee arthroplasty, it is also one of the most widely studied techniques in this respect. There is level one evidence that it reduces pain scores and morphine consumption following total knee arthroplasty [5,6]. Further studies are not required to prove this. The controversial and not fully answered questions are whether continuous femoral nerve block (CFNB) has any benefit over a single shot femoral nerve block (SSFNB), whether femoral nerve block reduces the incidence of opioid related side effects (shown for nausea and vomiting and constipation but not for other side effects [5]), and whether femoral nerve block increases the risk of falls following total knee arthroplasty.

Several studies have investigated whether CFNB improves analgesia following total knee arthroplasty. The results have been divergent and no clear conclusion is able to currently drawn. Albrecht et al. showed no benefit of continuous femoral nerve block, with either a 0.1% ropivacaine or a 0.2% ropivacaine infusion over a placebo infusion when all patients received an initial single shot block [7]. There was differences in the morphine consumption between the groups, with the low concentration having the lowest use, the high concentration the highest use, and the placebo group being in the middle. Given there is no plausible explanation for this aside from unrecognised differences in the groups, or ropivacaine having some sort of systemic antagonistic effect on one of the other multimodal analgesics, it is probable that this is a chance finding. There were no differences in pain scores or opioid related side effects between the three groups.

Two studies have shown a benefit of CFNB over SSFNB, but in one of these studies both groups received a CFNB for the first 24 h [8] following surgery and in the other, continuous passive motion devices were used and long hospital stays were present in every group [9]. This blunts the weight that these two studies can be given and explains their omission from the previously mentioned meta-analysis [5].

A properly powered randomized multicentre trial is needed to conclusively answer this question. Differences in institutional practices and infusion regimes probably account for the divergent results, there is no reason to think that continuous femoral blockade should not be beneficial in this setting provided it is properly managed and has an acceptably low failure rate.

The evidence for CFNB improving long term outcome is also divided. A well designed study with a follow up period of 12 months showed no benefit [10]. One study showed some benefit of continuous femoral nerve block at 6 weeks [11], another study has shown some benefit at one month [12] (that was not maintained over a year) and yet another small study showed benefit in one measure of outcome (the Knee Society Score) at 12 months [13].

There is evidence from Paul et al.'s [5] meta-analysis in 2010 that both continuous and single shot femoral nerve block reduces nausea and vomiting and constipation in the post-operative period following total knee arthroplasty. Because of the small size of studies and the heterogeneity in reporting side effects, there is no strong evidence to suggest that it reduces other important opioid related side effects such as sedation or respiratory depression.

Femoral nerve blocks frequently bear the brunt of the blame for falls following knee replacement, however it is likely that falls following surgery are multifactorial. A large retrospective study was unable to show an association between the use of peripheral nerve block and inpatient falls following knee arthroplasty in 191,570 surgeries [14]. However, this study was unable to separate out CFNB from SSFNB. In a previous retrospective study of 2197 knee arthroplasties, CFNB was shown to have the strongest association with inpatient falls of the three risk factors identified, with an odds ratio of 4.4. SSFNB was not shown to be associated with inpatient falls [15]. Importantly, in terms of prevention, several studies have shown that adductor canal block is associated with less quadriceps weakness than femoral nerve block [16,17], thereby potentially providing an alternative that may have a lower risk of falls.

3. Adductor canal block

Adductor canal block has been long described as a method of blocking the saphenous nerve [18]. It has enjoyed a resurgence of interest with the advent of widely available ultrasound and the

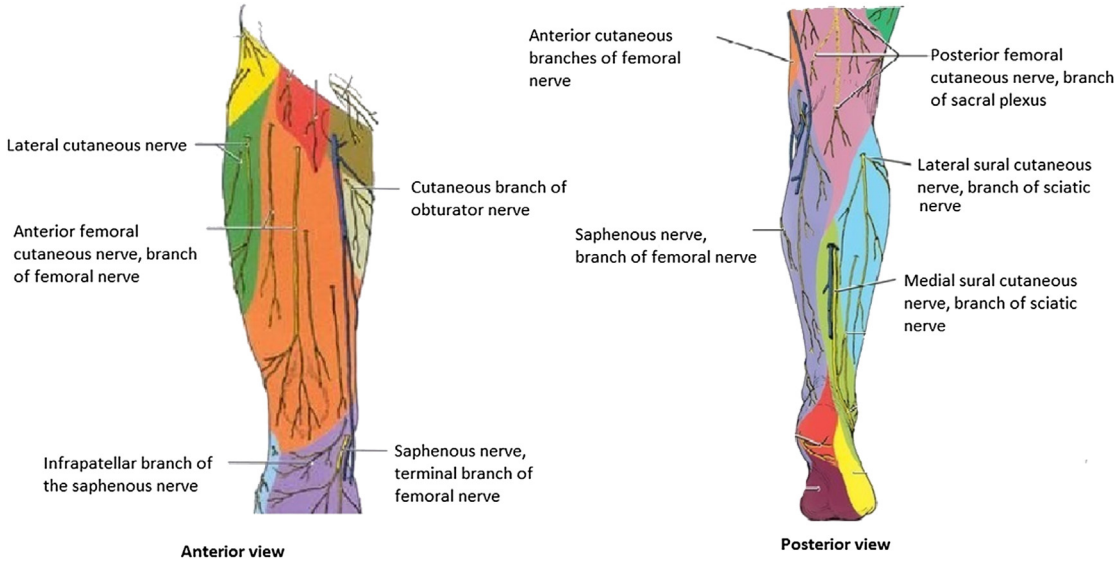

Fig. 1. Innervation of the knee. Adapted from http://quizlet.com/29786836/knee-and-popliteal-fossa-flash-cards (Unknown, 2014).