Is peri-articular multimodal drug infiltration in knee arthroplasty safe when used in conjunction with autologous retransfusion drains?

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ABSTRACT

INTRODUCTION Adequate peri-operative analgesia following total knee arthroplasty (TKA) promotes earlier rehabilitation but remains problematic because of the drug side-effects. Peri-articular multimodal drug infiltration (PMDI) has been developed as an alternative strategy to avoid such complications. Autologous retransfusion drains reduce the need for peri-operative allogenic blood transfusions and the consequent risk. There is a theoretical risk of local anaesthesia toxicity when these systems are used concurrently. We performed a review of current practice to quantify this risk.

PATIENTS AND METHODS A series of 10 patients undergoing TKA by the senior author (CAB) had drain fluid analysed for the concentration of ropivacaine. At the same time, the patients completed a questionnaire to establish the presence of ropivacaine-induced side-effects.

RESULTS The ropivacaine level in the retransfusion blood was less than 10 mg in all patients. This concentration was a factor of 6 below the published safe level. Three patients had minor neurological disturbances which recovered spontaneously and quickly. There were no cases of significant cardiovascular compromise.

CONCLUSIONS The theoretical risk of local anaesthesia toxicity when these systems are used together is negligible and we conclude that peri-articular multimodal drug infiltration is safe in conjunction with the use of autotransfusion drains.

KEYWORDS

Arthroplasty – Knee – Analgesia – Drain

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Total knee arthroplasty (TKA) is one of the most common elective orthopaedic operations performed in the UK with over 70,000 procedures performed in 2007–2008.¹ The surgery is associated with considerable postoperative pain. Adequate analgesia is essential for optimising rehabilitation.^{2,3} Multiple modes of analgesia have been used, such as epidurals, patient-controlled analgesia and continuous intra-articular infusions. However, side effects remain common and often problematic.^{4,5} This has led to the development of multimodal peri-articular infiltration, consisting of a local anaesthetic, morphine, non-steroidal anti-inflammatory drugs (NSAIDs) and epinephrine. This technique has proven to reduce peri-operative pain over other methods allowing good pain relief, reduced hospital stay and improved patient satisfaction.⁶ The technique involves injecting some of the mixture just prior to implantation of the component, into the posterior aspect of the capsule and the medial and lateral collateral ligaments. Then, injecting into the quadriceps mechanism and the retinacular tissues

whilst the cement cures. Finally, the remaining volume is infiltrated into the fat and subcuticular tissues.⁶

TKA surgery is associated with the need for peri-operative blood transfusion. However, all transfusions have risks of both side effects and the transmission of pathogens. Strategies to reduce transfusion requirements have, therefore, become popular. A technique which has found favour is the use of autologous retransfusion drains.⁷ This technique allows for collected blood from the joint cavity to be retransfused.

There is a theoretical risk of systemic toxicity due to intravenous administration of some of the components from the multimodal infiltration cocktail accumulated in the blood for retransfusion. The greatest potential for toxicity comes from ropivacaine, which can lead to neurological and cardiovascular symptoms.

We decided to perform a review of our current standard technique to ensure that ropivacaine levels in the retransfused blood were well within safe limits and did not cause significant cardiovascular or neurological side effects.

Patients and Methods

A consecutive series of 10 patients undergoing TKR using peri-articular multimodal analgesics were identified. The PMDI consisted of: 40 ml Naropin (ropivacaine) 10 mg/ml; 1 ml Toradol (ketorolac) 30 mg/ml; 0.6 ml epinephrine 1:1000; 0.5 ml morphine 10 mg/ml; and 50 ml 0.9% normal saline. Autologous retransfusion drains were used. The blood to be retransfused was analysed for ropivacaine levels. A postoperative questionnaire was completed by the patients with help from junior doctors to establish the presence of signs of systemic toxicity over the period of transfusion (Appendix 1).

Results

Ropivacaine levels

The maximum ropivacaine level identified was 9.62 mg/l with a mean value of 6.2 mg/l (range, 1.6–9.6 mg/l). The mean volume transfused was 0.53 l (range 0–1.25 l). The total dose received was less than 6 mg with a theoretical maximum of 12 mg (highest concentration and highest volume). The observed dose of ropivacaine versus reported safe dose is shown in Figure 1.

Questionnaire results

All patients completed the questionnaire and no evidence of cardiovascular compromise in any of the patients retransfused was reported. Neurological symptoms occurred in three patients. One patient reported a transitory metallic taste at the time of the retransfusion, another complained of light-headedness and a further patient of pins and needles, each lasting a few hours.

Discussion

Postoperative pain associated with TKA is described as severe in 60% and moderate in 30% of patients. Inadequate control of peri-operative pain impairs effective rehabilitation.⁸ The idea of administering pre-emptive pain relief is a logical option as it can prevent central sensitisation and improve postoperative pain.⁹ PMDI is a safe and effective method of reducing peri-operative pain levels associated with TKA.⁶

Blood-conserving measures which reduce the need for allogenic peri-operative blood transfusion and its associated risks are important. The use of autologous retransfusion drains has greatly reduced the need for allogenic transfusion in patients undergoing total knee replacement.⁷

Ropivacaine is a representative of the amino-amide class of local anaesthetics and has been developed to have an improved safety profile over other agents.¹⁰ However, adverse effects tend to be either cardiovascular or neurological in nature, although multiple other effects have been reported.¹¹

Figure 1 Total dose and safe dose for ropivacaine.

The safety profile of anaesthetic agents is variable due to multiple factors, including site of use, local vascularity, metabolism, systemic clearance and potency of agent.

A 400-mg dose of ropivacaine used in this study represents a relatively high dose but, due to the site of injection and other agents (epinephrine), blood concentrations are reported to be around 60 mg/l.⁶ The literature reports mild neurological symptoms with an intravenous bolus of 60 mg and toxic symptoms with a blood concentration of 150 mg/l.^{12,15}

This study demonstrates that the concentration of ropivacaine in retransfused blood is a factor of 6 less than the concentration thought to produce mild neurological symptoms in healthy volunteers and around a 10-fold reduction to cause toxic effects.

Conclusions

The ropivacaine concentration in autologous transfused blood in patients undergoing TKA who have received peri-articular infiltration is negligible. Autologous retransfusion in patients undergoing TKA who have had peri-articular multimodal drug infiltration is safe and without serious side effects.

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Appendix 1: Ropivacaine questionnaire

Patient name.....Hospital numberDOB.....

Date of surgeryProcedureSide.....

Relevant PMHxPatient weightkg

Time of surgery

Time drain opened

Time drain collected for retransfusion

Volume retransfused (ml)

Time retransfusion over

Anaesthesia.....GeneralSpinal.....

AntibioticsYes/NoTeicoplanin & gentamycin

PCAYes/No

Volume usedmlConcentration

Opioids prescribedYes/NoAmount/time given.....

NSAIDs.....Yes/NoAmount/time given.....

Other relevant medication.....Yes/NoAmount/time given.....

CNS effects over transfusion period

Tongue numbness	Yes/No	Duration
Metallic taste	Yes/No	Duration
Hearing disturbance	Yes/No	Duration
Lightheaded	Yes/No	Duration
Headache	Yes/No	Duration
Visual disturbances	Yes/No	Duration
Muscle twitching	Yes/No	Duration
Pins/needles	Yes/No	Duration
Coma/convulsions	Yes/No	Duration

Respiratory/CVS depression over transfusion period

Respiratory depression	Yes/No	Duration
Respiratory rate change	Yes/No	Duration
SATS depression	Yes/No	Duration
CVS depression	Yes/No	Duration
Blood pressure depression	Yes/No	Duration
Heart rate change	Yes/No	Duration

Other relevant symptoms or signs

Any other information

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