

The Effects of Neuromuscular Blocking Agents in Soft Tissue Balancing During Primary Total Knee Arthroplasty

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Abstract

We present a case of elective total knee arthroplasty where the surgical procedure was affected by the neuromuscular blocking agent administered at induction of general anaesthesia. Recognition of this effect was vital to avoid additional bone resection at the soft tissue balancing stage of the procedure.

Keywords: Total knee arthroplasty balancing; Neuromuscular; Hypertension

that it was not possible to remove the trial polyethylene spacer from the knee, the stage of the procedure was subsequently delayed.

Case Report

A 59 year old male with a medical history of hypertension, non-insulin dependent diabetes mellitus, angina and benign prostatic hyperplasia whom underwent simultaneous bilateral primary total knee arthroplasty surgery for osteoarthritis (Figure 1). The patient received Atracurium 50 mg IV at the induction of general anaesthesia for muscle relaxant purposes.



Figure 1: Patient's left knee radiographs pre and immediately post operation

Surgery on the first side was uneventful, with soft tissues balanced using conventional techniques. Surgery to the second knee commenced upon closure of the first knee. Soft tissue balancing of the left knee initially seemed uneventful. A 10 mm trial spacer was used for flexion and extension gap balancing and movements were normal.

During preparation of the tibia, it was then noticed that the trial components became increasingly difficult to remove, and after removal both flexion and extension gaps had decreased significantly. At 1 hour and fifteen minutes post induction the knee gap had decreased such

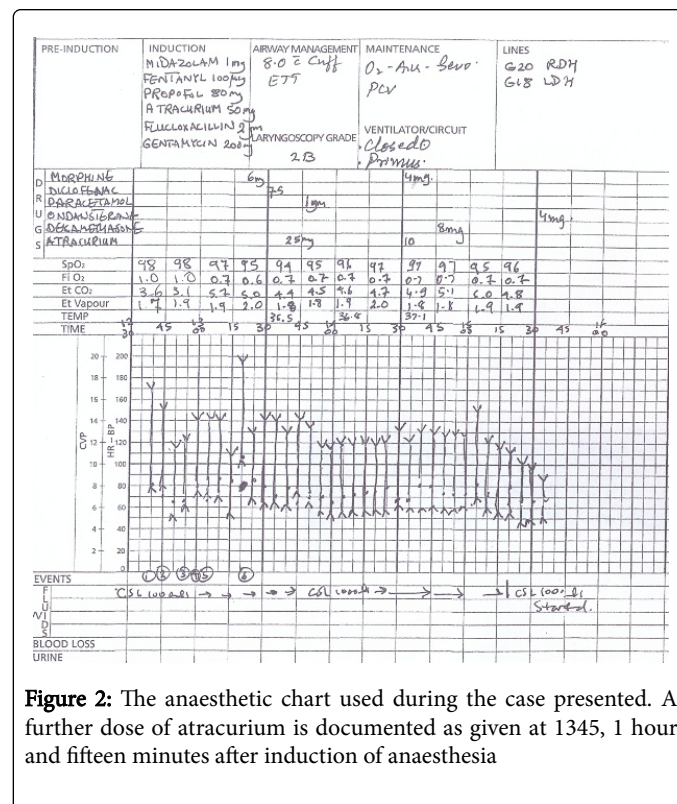


Figure 2: The anaesthetic chart used during the case presented. A further dose of atracurium is documented as given at 1345, 1 hour and fifteen minutes after induction of anaesthesia

A further 25 mg IV bolus of Atracurium (Figure 2) was then given. This enabled sufficient relaxation to enable soft tissue balancing to continue without difficulty. A 10 mm trial spacer was then used to check the gap and was put into the knee without problems encountered beforehand. The operation was finished as planned with a cemented total knee replacement and 10 mm polyethylene spacer (Figure 1). EUA post wound closure, and clinical evaluation at clinic follow up revealed good collateral stability both in flexion and extension.

Discussion

Soft tissue management has a major influence on outcome in primary total knee replacement [1]. It is therefore essential that possible sources for error in soft tissue balancing are eliminated. We report one such source of error, associated with the use of muscle relaxant during anaesthesia.

At induction of anaesthesia, patients commonly receive a dose of neuromuscular blocking drugs such as Atracurium, when having an endotracheal tube placed for the general anaesthetic [2,3]. Neuromuscular blocking drugs such as atracurium block the transmission through the neuromuscular junction at nicotinic receptors and thus reduce skeletal muscle tone [2]. Non-depolarising agents bind to receptors and prevent acetylcholine from stimulating receptors. Their effect is to compete with acetylcholine for nicotinic receptors. Their blockade is competitive and therefore gradual in onset [2].

Neuromuscular blocking drugs administered to patients during the induction of anaesthesia prior to arthroplasty surgery are detailed in Table 1. A difference in their duration of action times is noted between 5 and 40 minutes depending on the dose given [2-6].

Muscle relaxant	Dose (mg/kg)	Duration of action (minutes)
Atracurium	0.3-0.6	20-40
Suxamethonium	1-2	5-10
Vecuronium	0.08-0.1	15-30
Rocuronium	0.6	30-40

Table 1: Duration of action of muscle relaxants [4,6-8]

Atracurium is a non-depolarising muscle relaxant. It is a short-acting relaxant, which is rapidly broken down by the body. This makes atracurium very predictable, as it wears off rapidly compared with the longer-acting relaxants. A dose of 0.3-0.6 mg/kg will provide relaxation for 20-40 minutes [3]. Depending on the nature of the surgery and the physique of the patient, the return of muscle tone during surgery could have an effect on soft tissue tension [3,7]. Therefore, the return of muscle tone could theoretically affect the flexion and extension gap during total knee replacement.

When considered in terms of timing during primary total arthroplasty, and in particular simultaneous bilateral primary total arthroplasty or complex primary total arthroplasty of the knee, the upper limits of the duration of action are likely to coincide with the soft tissue balancing of the knee.

As the effect of the muscle relaxants administered diminishes, contraction of the knee may occur and significantly impede the soft tissue balancing stage of the operation, in particular when balancing the flexion and extension gaps. If this is not recognized it may lead to an unnecessary recut of the femur or tibia. These may then create an uneven soft tissue envelope around the implanted arthroplasty components and alter the long term outcome of the primary arthroplasty procedure [1,8].

Conclusion

The diminishing action of neuromuscular blockade may cause contraction of the knee during arthroplasty, which if unrecognised can lead to inappropriate bone resection. This should be understood by both the surgeon and anaesthetist.

We suggest surgical teams should be aware of the use of neuromuscular blocking agents administered during primary knee arthroplasty operations and the timings of their duration of action as this may coincide with crucial stages of the operation.

Likewise, anaesthetic teams should appreciate the importance of the soft tissue balancing in the outcome of primary total arthroplasty and should be prepared to adjust the timings or give further doses of neuromuscular blocking agents accordingly.

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