

# Adductor Canal Block in the Outpatient Clinic for Pain Control Following Knee Surgery

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## Research article

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# Abstract

**Background:** The outcome of knee surgery is influenced by the surgery itself and the rehabilitation program. Post-operative pain management is the most important factor for a successful rehabilitation program. We hypothesized that an adductor canal block (ACB) in the outpatient clinic is safe, effective for pain relief, and decreases analgesic consumption.

**Methods:** We included patients who underwent knee surgery. Patients were scheduled to an ACB on post-operative day (POD) 14 at the outpatient clinic with 0.1% ropivacaine. We evaluated pain with the use of a visual analogue scale (VAS) and analgesic consumption on PODs 5, 7, 9, 15, 17, 19, 21, 23, 25, 27, and 29.

**Results:** We enrolled 115 patients. The mean VAS pain scores before ACB on PODs 5, 7, and 9 were 7.4, 7.2, and 6.2, respectively. After the patients received the ACB on POD 14, the mean VAS pain score significantly decreased to 1.6, then gradually increased at PODs 17, 19, 21, and 23. After POD 23, the VAS pain score flattened. Patients' mean analgesic (etoricoxib) consumption before receiving the ACB on PODs 5, 7, and 9 were 102 mg, 98 mg, and 98 mg, respectively. After receiving ACB, analgesic consumption significantly decreased (16 mg) on POD 15, then gradually increased on PODs 17, 19, and 21. After POD 21, analgesic consumption stabilized.

**Conclusions:** Single-shot ACB in the outpatient clinic is safe and significantly decreases pain and analgesic consumption and may enhance rehabilitation programs.

## Introduction

Surgery around the knee is difficult because the surgery technique is challenging, duration of the surgery is long, and it has a higher rate of complications and challenging outcomes because the recovery is painful and requires the patients' effort to train for range of motion and weight-bearing (1).

Quadriceps weakness is pronounced after some procedures of the knee, such as arthroplasty. The cause for muscle weakness is not fully clear, although it may be a result of the incision of the distal quadriceps when opening the knee joint. Early rehabilitation and quadriceps strengthening can prevent this impairment. A popular technique for knee surgery anaesthesia has been a femoral nerve block. Femoral nerve blocks can decrease post-operative pain; however, they can also reduce quadriceps muscle strength, which can lead to delays in mobilization and rehabilitation programs. The adductor canal block (ACB), a novel block recently becoming more popular for pain management after knee surgery, preserves muscle strength and enhances early mobilization (1,2).

Recently, many studies have stated that ACB is effective for pain control with minimal muscle strength impairment. This procedure is mainly for sensory nerves and to preserve muscle strength. For patients who underwent primary total knee arthroplasty, the ACB significantly decreased post-operative pain, reduced morphine intake, and enhanced the rehabilitation program (1,2).

Generally, the ACB is done after the surgery in the operating theatre, although there are limited studies that have reviewed the effects of ACB in the outpatient clinic.

We hypothesized that the ACB in the outpatient clinic is safe and can reduce post-operative pain. The primary outcome of this study was to assess the effect of the ACB on pain during a rehabilitation program. The secondary outcome was to evaluate daily analgesics (etoricoxib) consumption.

## Methods

This was a prospective cohort study; patients received an ACB on post-operative day (POD) 14 at an orthopaedic outpatient clinic between August 1st 2019 to March 31st, 2020. Eligible patients were adults willing to join the study who underwent knee surgery, aged 18–80 years, and with a body mass index of 20–35 kg/m<sup>2</sup>. The exclusion criteria were: a history of allergies, alcohol or drug abuse, declining to enrol in the study, having another surgery scheduled besides the knee surgery, and being lost to follow-up.

## Interventions

The ACB was performed on POD 14. After skin disinfection, a curve ultrasound transducer (Philips Epic 7) was placed on the medial side of the mid-thigh. The femoral artery and vein were ensured with a short-axis plane in the adductor canal below the sartorius muscle. A Sonoplex needle 21 G x 100 mm (Pajunk Medical Systems LP, USA) was inserted in plane from the lateral side of the transducer. The needle tip was placed underneath the sartorius muscle, penetrating the fascia just lateral to the femoral artery and vein, using 1–2 mL of saline to confirm correct positioning (confirm the enlarged adductor canal), then 15 mL of ropivacaine 0.1% was slowly injected. Using an USG monitor, it was confirmed that there was an enlargement of the adductor canal.

All subjects received ropivacaine 0.1%, 15 mL. We mixed ropivacaine 0.2% with isotonic saline and steroid in a 2:1:1 ratio. All blocks were performed by one of the orthopaedic surgeons (RTM), experienced in US-guided, orthopaedic residents/nurses assisted. Patients with daily consumption of analgesics (etoricoxib) received analgesic drugs during the study period and were allowed to increase them if they still felt disturbing pain.

## Outcomes

The primary outcome was the visual analogue scale (VAS) score of pain during the rehabilitation program of the knee on PODs 5, 7, 9, 15, 17, 19, 21, 23, 25, 27, and 29. The secondary endpoint was the daily dose of analgesics (etoricoxib) consumed.

## Assessment of outcomes

We evaluated outcomes on PODs 5, 7, 9, 15, 17, 19, 21, 23, 25, 27, and 29. Pain intensity was evaluated with VAS pain score, 0 = no pain, and 10 = severe pain. Patients could continue with their habitual analgesics (etoricoxib) during the study period and could increase them according to their pain.

## Results

During the study period, 115 patients were willing to participate in this study and filled out an informed consent. Patients' demographics and perioperative data are presented in Table 1, with a mean of age 45.12 years old and most subjects female, 69 patients (60%). According to each patient who participated in this study's diagnosis, the most common procedure was total knee replacement [(TKR), 55 patients (47%)], followed by anterior cruciate ligament reconstruction [27 patients (23.47%)], fracture around the knee [15 patients (13%)], posterior cruciate ligament reconstruction [10 patients (8.6%)], medial patella femoral ligament reconstruction [three patients (2.6%)], and multiple ligament reconstruction, meniscus surgery, and TKR revision (two patients, two patients, and one patient, respectively), as shown in Fig. 1.

Table 1  
Subjects characteristics

<b>No. subjects</b>	<b>115</b>
Age, y	45.12 (18–80)
Body mass index, kg/m <sup>2</sup>	28 ± 3
Sex, M / F	46 / 69

## Mean VAS pain score

The mean VAS pain scores of the knees on PODs 5, 7, and 9 (primary endpoint) were 7.4, 7.2, and 6.2, respectively. After receiving ACB on POD 14, the mean VAS pain score significantly decreased to 1.6, then gradually increased at PODs 17, 19, 21, and 23. After POD 23, the VAS pain score flattened (see Fig. 2).

## Analgesic (etoricoxib) consumption

The mean analgesics (etoricoxib) consumption before receiving the ACB on PODs 5, 7, and 9 were 102 mg, 98 mg, and 98 mg, respectively. After receiving ACB, analgesic consumption significantly decreased (16 mg) on POD 15, then gradually increased on days 17, 19, and 21. After POD 21, analgesic consumption stabilized (Fig. 3).

## Adverse events

One patient complained of hematoma in the thigh (insertion needle) and recovered.

## Discussion

The most important finding in this study was that ACB is safe when performed in the outpatient clinic and can reduce pain significantly, therefore it can help the rehabilitation program. Our study showed that injection of ropivacaine 0.11% (15 mL), confirmed filling the distal of the adductor canal, will in theory,

increase the optimal effect of the ACB by blocking the four nerves in the adductor canal (2). In our study, spread to the proximal canal and the femoral triangle was avoided because the total volume that we injected less than 20 mL. Spread proximal to the femoral triangle requires a volume of injection of more than 20 mL (1).

According to another study, volumes more than 20 mL are not required for ACB (1), because the success rate for the 15 mL dose was 90.2% compared to 95.1% for the 20 mL dose. Other studies stated that an ACB with more than 20 mL can cause a decrease in muscle strength, even though there was no statistically significant difference between anaesthetic volume and the number of subjects with quadriceps weakening (2). The quadriceps muscle is essential for mobilization. The ACB leaves three out of the four components of the quadriceps muscle unblocked, which potentially reduces the risk of falling caused by quadriceps weakness. Further studies are needed to validate the effect of ACB on muscle strength (2–4).

An ACB with less than a 20 mL dose and at mid-thigh is an almost pure sensory block, with the vastus medialis muscle as the only muscle with potentially affected motor function. Our results show that the blockade can reduce pain significantly and may enhance early ambulation and rehabilitation programs. Moreover, this procedure can be safely performed in the outpatient clinic. In our study, only one patient (0.8%) had hematoma a few days after the procedure, and it resolved conservatively. Katherine et al. reported massive thigh hematoma after ABC in a morbidly obese woman anticoagulated with apixaban; the author suggested that a conservative approach of close monitoring, instead of drain placement, resulted in an acceptable outcome without additional procedures (5).

Although vascular injuries resulting from peripheral nerve blocks are rare complications, the risk of bleeding due to anticoagulation status is also concerning. (5–8). The recently updated (2018) American Society of Regional Anesthesia (ASRA) guidelines recommend waiting 72 h after the last dose of apixaban for the block procedure (9). In our study, the patient was still on anticoagulants in the last 72 h, and the hematoma recovered with conservative treatment and stopping the intake of anticoagulant drugs.

Figure 2 shows that there is a significant decrease in pain on POD 15, after the procedure, but the pain gradually increases after POD 15, and the VAS pain score remained stable after POD 23. In our study, the duration of the decrease in pain (VAS score less than 5) after the ACB procedure remained for five days (POD 19), after which the patient still had moderate pain but still could tolerate a rehabilitation program. A study by Ludwigson et al. showed that a single ACB shot could enhance post-operative ambulation and knee flexion duration during the pain decrease and lasted for two days (10).

According to our study, we can repeat the ACB block one week after the first block if the patient still experiences pain, to enhance the rehabilitation program.

Figure 3 shows that there was a decrease in analgesics (etoricoxib) after the procedure, then analgesics consumption gradually increased after POD 17 and remained stable after POD 21. This may have been

because the soft tissue had already healed and the inflammation process had subsided. Pia Jager et al. compared between ACB and placebo regarding morphine consumption. They stated that there was no significant difference between groups.

The limitations of this study are that there was no comparison to other treatments and the results were from a single-centre study, which might not be generalizable. We hope in the future to perform a multicentre prospective study and to compare other procedures and treatments for pain relief.

## Conclusions

Single-shot ACB in the outpatient clinic is safe and significantly decreases pain and analgesic consumption and may enhance rehabilitation programs.

## Abbreviations

ACB

Adductor canal block

POD

Post-operative day

TKR

Total knee replacement

VAS

Visual analogue scale

## Declarations

### Ethics approval and consent to participate

- Ethics committee approval from Medical and Health Research Ethics Committee, Faculty of Medicine, Public health and Nursing, Universitas Gadjah Mada ,Ref.No :KE/FK/0554EC/2020
- All Patients provided of inform and signed a consent

### Funding

The authors declare that this study had no funding resource.

### Conflicts of interest/Competing interests

No potential conflict of interest relevant to this article was reported.

### Availability of data and material

Data will be provided by request

## Consent for Publication

Not Applicable

## Authors' contributions

Sholahuddin Rhatomy and Riky Setyawan conceived the study, collected the data, analysed data. Sholahuddin Rhatomy prepared and drafted the manuscript. Riky Setyawan and Faiz Alam Rasyid edited manuscript. Riky Setyawan visualized the data into table and graph. Sholahuddin Rhatomy, Faiz Alam Rasyid and Riky Setyawan reviewed and revised the manuscript.

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## Figures

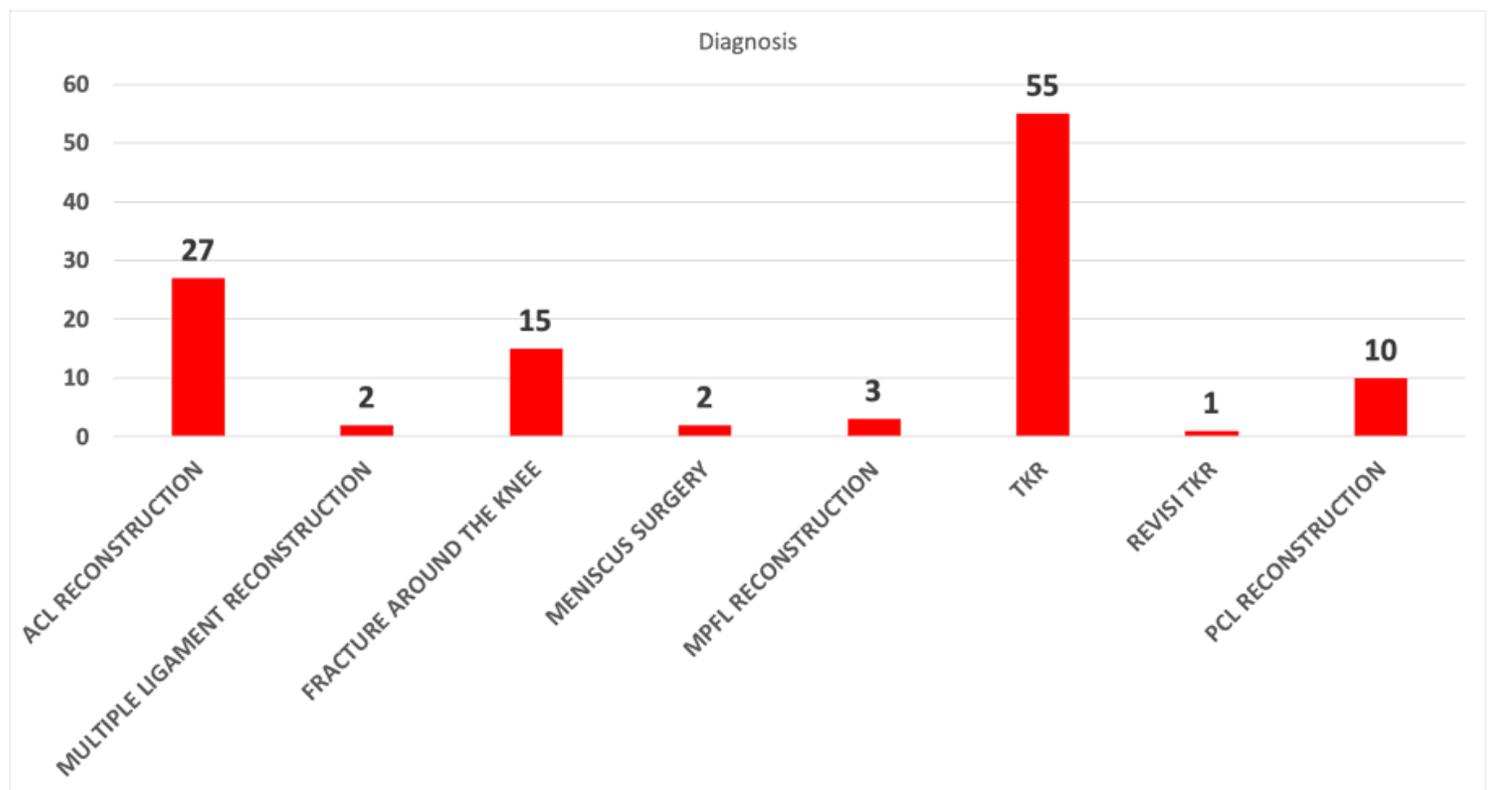
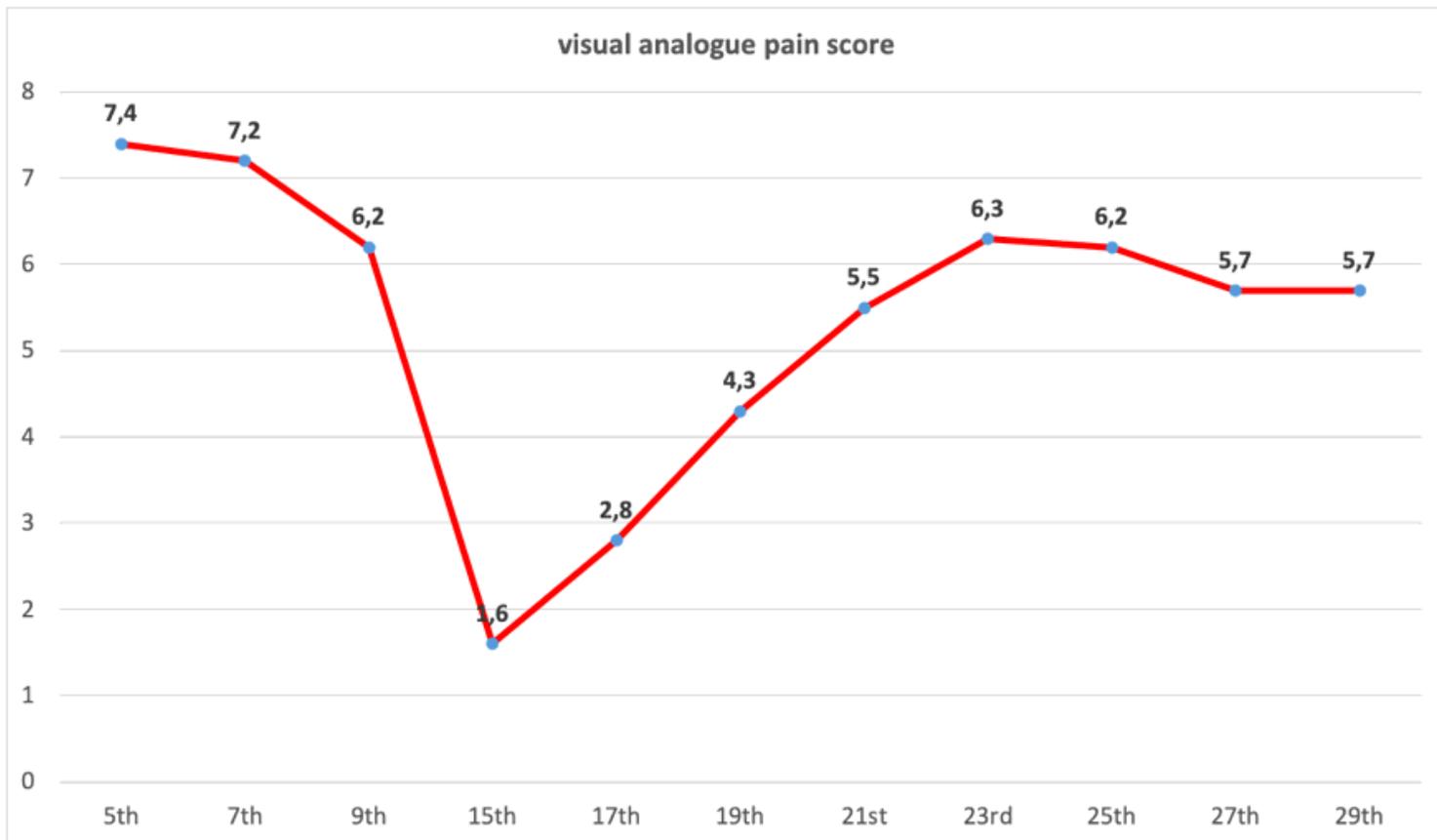


Figure 1

Diagnosis of subject



**Figure 2**

visual analogue scale pain score

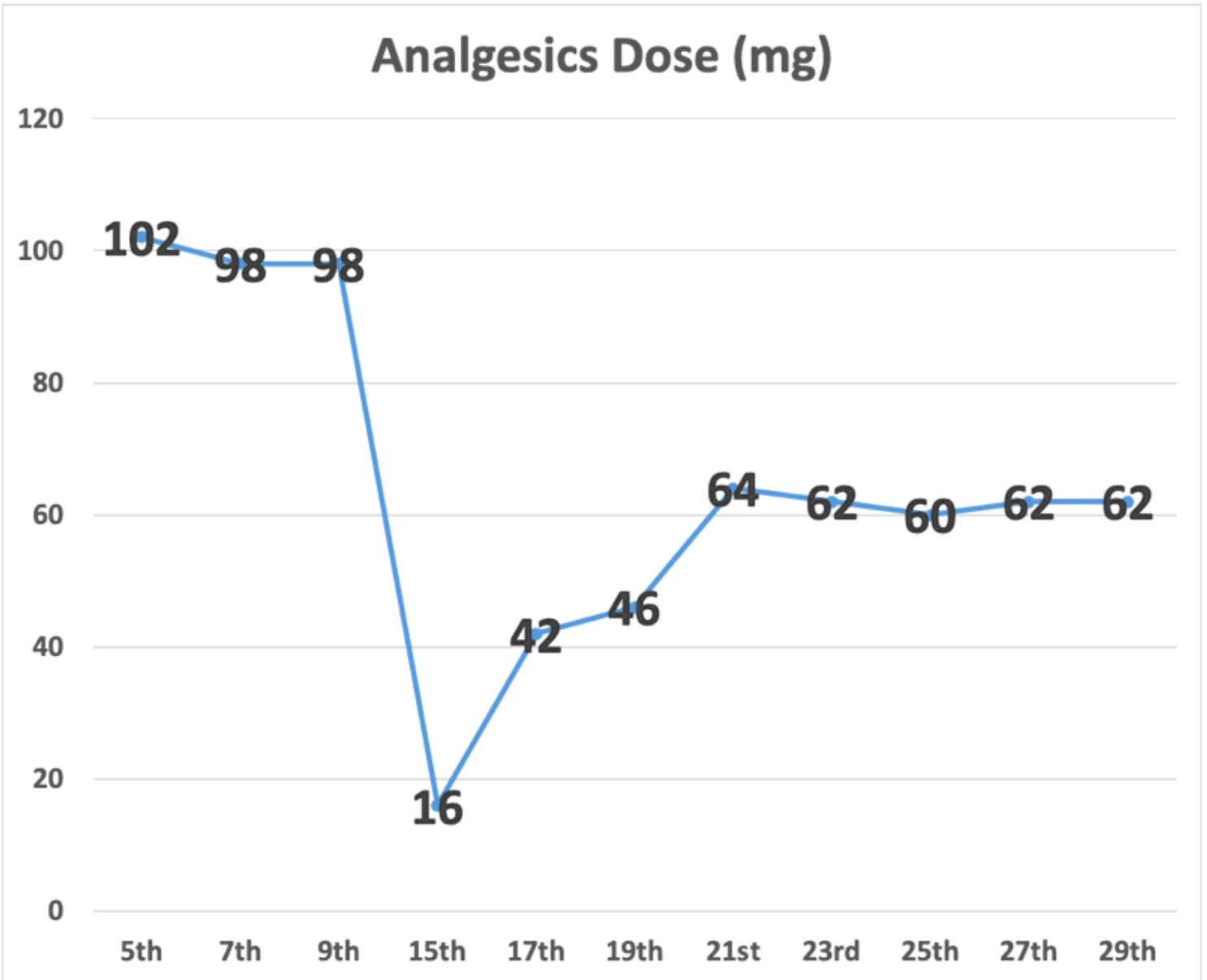


Figure 3

Analgesics dose