Local anaesthetic infusion with elastomeric pump after arthroscopic subacromial decompression

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ABSTRACT

INTRODUCTION The use of extended local anaesthesia for postoperative pain has previously been reported, and has several advantages over other methods, including ease of placement, safety, reliability, lower cost and effective analgesia. We present our experience with a portable elastomeric infusion device in patients undergoing arthroscopic subacromial decompression, and make a case for its potential to allow same-day discharge.

PATIENTS AND METHODS Forty patients undergoing arthroscopic subacromial decompression were followed-up. At the end of the procedure, an epidural catheter connected to a portable elastomeric local anaesthetic infusion system was inserted into the subacromial space. All patients were electively admitted for overnight stay postoperatively and assessed using a visual analogue scale (VAS) to evaluate their level of pain.

RESULTS No patient reported severe pain at any stage. None of the patients required any parenteral opiate analgesia with the pump *in situ*.

CONCLUSIONS These findings suggest that the use of this elastomeric infusion device following shoulder surgery allows safe and early discharge of patients with decreased need for parenteral opiate analgesia.

KEYWORDS

Day-case surgery – Local anaesthesia – Infusion

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Increasing demands on the health service and the well-recognised cost-effectiveness of day-case surgery have led to more procedures being considered suitable for out-patient surgery. The key to successful day-case surgery is achieving the four 'A's of alertness, ambulation, analgesia and alimentation.¹ Failure to address these tenets may result in delayed discharge and, consequently, render the patient unsuitable for day-case surgery.

We present our experience with a portable elastomeric infusion device in patients undergoing arthroscopic subacromial decompression, and make a case for its potential to allow same-day discharge. The advantages and disadvantages of this technique in relation to other forms of analgesia are also discussed.

Patients and Methods

We prospectively followed up 40 patients who underwent arthroscopic subacromial decompression over a 6-month

period at our hospital. An informed written consent was obtained from every patient. All procedures were carried out by the senior author (UGF). Arthroscopy was performed with the patients in the lateral position with arm traction. A standard, two-portal assessment of the glenohumeral joint was first carried out followed by subacromial bursectomy and acromioplasty using a combination of a burr and an electrosurgical ablator. No patient had any further procedure carried out at the time of the index operation.

At the end of the procedure, a multiport epidural catheter was inserted under arthroscopic visualisation into the subacromial space (Fig. 1). The catheter was secured to the skin using a Tegaderm dressing (3M, St Paul, MN, USA). This was then connected, under aseptic conditions, to a portable elastomeric infusion system (INFUSOR; Baxter Healthcare Corporation, Deerfield, IL, USA). The device used was a Two-day INFUSOR delivering 2 ml/h of local anaesthetic over a 24–48-h period (Fig. 2). The device is supplied with a carrying pouch, which can be attached to

Figure 1 Epidural catheter placed in subacromial space under arthroscopic visualisation.

the patient's clothing (Fig. 3). The device has a maximum capacity of 105 ml and, when filled, operates with a sustained internal pressure. Contents are delivered through a particulate-matter filter and a flow restrictor. For the purpose of the study, the pump was filled with 100 ml of 0.5% bupivacaine. All patients were electively admitted for overnight stay postoperatively, and the catheter was removed the following morning by nursing staff prior to discharge.

Postoperatively, patients were assessed on an hourly basis until discharge from hospital using a visual analogue scale (VAS) to evaluate their level of pain. The scale used was graded from 0 (no pain) to 5 (worst pain imaginable).

Figure 2 Portable elastomeric infusion system. (INFUSOR; Baxter Healthcare Corporation, Deerfield, IL, USA).

The amount and type of additional enteral or parenteral (particularly opiate-based) analgesia required by each patient was also recorded. Any complaints of nausea or sedation were also documented.

Six weeks following their discharge, all patients were reviewed at the out-patient department. At this visit, they were asked to rate their level of satisfaction with the quality of analgesia provided during the postoperative period. Patients were also asked to comment on their personal experience with using the pump and its suitability for home use. We also assessed the views of the nursing staff and physiotherapists involved in using the device.

Results

The study group contained 26 female and 14 male patients and the mean age was 42 years (range, 34–66 years). Of these, 24 patients had surgery on their right shoulder and 16 on their left shoulder. All patients were admitted for 24 h post surgery and all were available for follow-up at 6 weeks.

There were no catheter dislodgements and all patients retained their pumps for 24 h. There were no mechanical pump failures. All catheters were removed by the nursing staff the following day without incident. One patient had problems relating to inadequate delivery of the local anaesthetic due to incorrect positioning of the height of the pump with respect to the wound.

Postoperative pain scores (expressed as a percentage of patients) are tabulated in Table 1.

None of the patients required any parenteral analgesia with the pump *in situ*. Standard doses of oral paracetamol, diclofenac or tramadol provided sufficient analgesia as adjunct to the bupivacaine infusion. All of the patients had nausea and sedation scores of zero, and none had any

Figure 3 Infusor pump in its carrying pouch.

Table 1 Postoperative pain scores (expressed as a percentage of patients)

Time postoperatively	Pain				
	None (VAS 0/5)	Minimal (VAS 1/5)	Mild (VAS 2/5)	Moderate (VAS 3/5)	Severe (VAS 4+/5)
Recovery	0	0	20	80	0
6 h	0	66	33	0	0
12 h	10	90	0	0	0
24 h	67.5	32.5	0	0	0

motor blockade. We did not encounter any instance of local anaesthetic toxicity or wound-site infection.

At their 6-week follow-up, 70% of the patients rated the system as excellent, 20% as good and 10% as fair. Patients were of the opinion that they found the device effective, discreet, light-weight and easy to care for. Two patients complained that they found the sensation of catheter removal unpleasant, and one complained of local anaesthetic leak from the wound. The majority of patients felt it would be suitable for day-case surgery and home use.

None of our patients required re-admission to hospital after removal of the pump, and none reported any rebound pain after removal of the device severe enough to require opiate or parenteral analgesia.

We found both the nursing staff and the physiotherapists enthusiastic about the effectiveness of the device and its potential. The nurses felt that it reduced the analgesic requirements of patients and the physiotherapists felt that the device enabled the patients to participate in their rehabilitation programme earlier.

Discussion

Day-surgery is a cost-effective, quality approach to surgery that has expanded in recent years. Developments in both arthroscopic and anaesthetic techniques have brought shoulder surgery firmly into the realms of the day-unit. The success of day-surgery depends on both effective control of postoperative pain and minimisation of side effects such as sedation, nausea and vomiting. Day-surgery analgesia should allow the patient to be discharged safely and without delay. Additionally, once discharged from hospital, patients should not require close medical or nursing supervision, either for the administration of analgesia or for safety reasons.¹

Various techniques exist to augment enteral and parenteral analgesia in the day-case setting. These range from simple local anaesthetic wound infiltration, to continuous neural blockade.²⁻⁴ Single-dose, local anaesthetic infiltra-

tion of the surgical site is cheap, safe and initially effective. However, constrained by the fact that it is a single dose of limited volume, it only provides analgesia for a few hours before repetition is required. Whilst this has been shown to be feasible and effective in an in-patient environment, it is impractical for out-patients.² The use of brachial plexus blockade, either as a one-off injection or as continuous infusion for peri-operative analgesia in shoulder surgery is widely reported. These methods are not without their drawbacks. Weber and Jain⁵ found that 92% of patients required postoperative parenteral opiate analgesia, as scalene block provided inadequate pain control. Severe pain following the block wearing-off has been reported in up to 20% of patients, in some cases severe enough to warrant re-attendance at hospital.⁵

The placement of nerve blockade catheters requires specifically skilled anaesthetic staff, takes time to administer and to start acting. This could effectively reduce the actual operating time available in a theatre session. It also creates dependence upon anaesthetists being present who are proficient in the procedure, and their absence invariably affects the list. With regional neural blockade, both motor and sensory impairment is inevitable. This prevents accurate neurological assessment postoperatively, interferes with mobilisation to a variable extent, and can be unpleasant for the patient. The risk of long-term nerve damage also exists. Persisting neurological impairment following plexus blockade has been reported to be in the order of 2%.⁶

The use of extended local anaesthesia for postoperative pain was pioneered by Mallon and Thomas⁷ who described the use of a variation of the PCA pump to deliver a constant infusion and bolus delivery of lidocaine in the operative site. Although successful in pain control, the complexity of the PCA device and the skilled nursing care required eliminated any economic benefit and prevented its wide-spread acceptance.

The concept of at-home, continuous, nerve block was introduced by Rawal *et al.*⁸ and is well described in a day-case setting. They reported an elastomeric balloon pump designed to allow the patient to self-administer intermittent

boluses of local anaesthetic via a catheter placed in the wound bed. The main drawback of the system was the possibility of inadvertent overdose if the patient failed to close the catheter clamp. Savoie *et al.*⁹ have reported the use of a portable, spring-loaded, local anaesthetic pump in shoulder surgery. The constant rate elastomeric infuser used in our study is a simple, safe device with no danger of overdose and is lighter and more user-friendly than the spring-loaded pump. The pump is easy to fill with the anaesthetic agent, and virtually requires no further supervision. Manufacturer's performance data suggest that 95% of the product delivers the nominal volume of drug within 10% of the nominal delivery time.¹⁰

These devices can have several potential advantages over regional anaesthesia for postoperative pain especially in the day-case setting.⁹ The device does not require a specifically-trained anaesthetist to set up, and does not significantly add to the operation time. Placement of the infusion cannula under direct arthroscopic vision ensures optimal positioning in the operative field. This avoids vascular penetration, neural complications and pulmonary injury, which can occur with interscalene blocks. The multiport cannula prevents soft-tissue blockage. Also, the local anaesthetic is contained within the subacromial space during infusion, and does not produce any motor blockade thus affording early mobilisation and rehabilitation.

In our study, all patients had, at worst, mild pain 6-h post procedure and minimal discomfort at 12 h. None required parenteral analgesia. Oral analgesia provided adequate augmentation to the infusion device. Two patients, who rated the overall analgesia provided by the device as only fair, had large rotator cuff tears and, therefore, escape of local anaesthetic from the subacromial space may have occurred.

The height of the infusion pump with respect to the flow restrictor and the catheter tip has significant bearing on the delivery of the local anaesthetic.¹¹ If the elastomeric pump lies below the catheter tip, the delivery of the agent can be impaired to a variable extent. This was the case in one of our patients who attached the infusion device to his trouser belt and, as a result, may have received inadequate anaesthetic agent. Educating the patient and nursing staff on correct pump placement with respect to the wound is, therefore, paramount.

The use of a local anaesthetic infusion device costs substantially less than overnight hospital stay, and parenteral analgesic administration. Financial cost is not the sole issue, however. Safe and effective analgesia are fundamental. None of our patients had any complications associated with using the device, thus confirming its safety in this application. The rate of flow of the local anaesthetic is dictated by the elastomeric reservoir and the lumen of the tube, which prevents any large boluses and overdosing.

Though the INFUSOR device has its own bacterial filter, we used a second independent filter to increase the safety profile further.

Though our study was only a pilot and undertaken at a single centre, it provides further evidence of the effective use of local anaesthetic wound infusion devices in postoperative pain control. We intended to demonstrate its effectiveness in arthroscopic shoulder surgery, and its feasibility in the NHS day-case setting. Although the patients were all admitted for overnight observation as a safety measure, it can be seen that there were no adverse events; therefore, this device would be appropriate in facilitating same-day discharge.

It is our intention that, in future, patients are discharged the day of surgery and followed-up the next day by outpatient nursing staff for removal of the infusion catheter and feedback. They will also be given a patient information leaflet to assist with pump and catheter care.

Conclusions

The use of an elastomeric infusion device following shoulder surgery allows safe and early discharge of patients with decreased need for parenteral analgesia.

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