A retrospective analysis of 509 consecutive interscalene catheter insertions for ambulatory surgery


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Summary
Effective pain therapy after shoulder surgery is the main prerequisite for safe management in an ambulatory setting. We evaluated adverse events and hospital re-admission using a database of 509 interscalene catheters inserted during ambulatory shoulder surgery. Adverse events were recorded for 34 (6.7%) patients (9 (1.8%) catheter dislocations diagnosed in the recovery room, 9 (1.8%) catheter dislocations at home with pain, 2 (0.4%) pain without catheter dislocation, 1 (0.2%) ‘secondary’ pneumothorax without intervention and 13 (2.6%) other). Twelve (2.4%) patients were re-admitted to hospital (8 (1.6%) for pain, 2 (0.4%) for dyspnoea and 2 (0.4%) for nausea and vomiting), 9 of whom had rotator cuff repair. A well-organised infrastructure, optimally trained medical professionals and appropriate patient selection are the main prerequisites for the safe, effective implementation of ambulatory interscalene catheters in routine clinical practice.

Organised peri-operative facilities are required in order to facilitate experienced practitioners’ inserting interscalene catheters without significant time delays to operating lists, and to avoid the logistical problems of postoperative management.

Fast-track ambulatory shoulder surgery is economically and clinically beneficial for hospitals and patients, reducing the incidence of hospital acquired infections, and facilitating remobilisation and rehabilitation [1–3]. Interscalene catheter usage is an important component in such management, providing optimal postoperative pain therapy, in turn enabling early physiotherapy, resulting in optimal surgical outcome. However, clear guidance for catheter care at
We conceived a retrospective database analysis of consecutive patients receiving interscalene catheters for ambulatory shoulder surgery, in order to ascertain the prevalence and type of adverse events encountered with their use and reasons for re-admission to hospital, with the aim of developing further guidance for the safe use of this technique.

Methods
Following approval from the local ethical committee of the St. Vincent Hospital, Vienna, Austria, recorded data were analysed for all consecutive interscalene catheter insertions for ambulatory shoulder surgery at the St. Vincent Hospital between December 2011 and August 2013 (21 months). Study data were compiled from several databases: Medlinq anaesthesia recording system (Medlinq Softwaresystem Corp., Hamburg, Germany; patient list; sex; secondary dose of local anaesthetic in the post-anaesthesia care unit; ultrasound confirmation of catheter position before hospital discharge; ultrasound investigation of ipsilateral hemidiaphragm movement (yes/no); ultrasound investigation of the ipsilateral lung sliding movement (yes/no)); SAP patient recording system (SAP Inc., Walldorf, Germany; main diagnosis; body mass index (BMI; ASA physical status; type of surgery; position during surgery; time of interscalene catheter tip placement; re-admission to hospital within 12 h postoperatively); MCC Meierhofer documentation system (Meierhofer Inc., Munich, Germany; operation time); and the printed medical record of the individual patients (visual analogue pain score (VAS), catheter-related problems, new insertion of catheter in the post-anaesthesia care unit).

Our routine management protocol for patients undergoing ambulatory shoulder surgery is as follows. In addition to general health screening, patients are scheduled for surgery at their pre-operative visit 10–14 days before admission, provided they are of ASA physical status 1–3, have a third party to care for them after discharge, have no contraindications to interscalene blockade and agree to follow the written instructions provided to them regarding postoperative pain management and catheter handling.

Patients are transferred to the post-anaesthesia care unit 60 min before surgery for interscalene block insertion, having established venous access and standard cardiorespiratory monitoring (electrocardiogram, non-invasive blood pressure, oxygen saturation).

An initial ultrasound scan of the relevant anatomical structures for interscalene brachial plexus blockade was performed with a SonoSite M-Turbo transportable ultrasound equipment and a 38-mm 13–6 MHz HFL linear ultrasound transducer (SonoSite Inc., Bothell, WA, USA). Thereafter, the puncture area and the ultrasound transducer was prepared in a sterile manner (Safersonic Conti sterile sonography cover; Safersonic Inc., Ybbs, Austria) and the nerve roots identified between the anterior and middle scalene muscles in a transverse view. After raising a skin wheal with 2 ml mepivacaine 1% (Mepinaest™ purum 1%; Gebro Pharma Inc., Fieberbrunn, Austria), an 18-G facet tip needle (‘Plexolong Nanoline according to Meier’ set for continuous peripheral nerve blockade; Pajunk Inc., Geisingen, Germany) was introduced out-of-plane, with caudal needle orientation.

After ultrasound confirmation of extra-epineural distribution of 5 ml mepivacaine 1% below the superficial cervical fascia, a 20-G catheter was introduced 4 cm distally to the tip of the needle and the needle was withdrawn. Subsequently, 10 ml ropivacaine 0.5% (Ropine™; Gebro Pharma Inc., Fieberbrunn, Austria) was administered intermittently through the catheter under direct ultrasound guidance. Correct distribution was confirmed by local anaesthetic administration adjacent to the C5–7 nerve roots, with the catheter carefully withdrawn until this was achieved [13]. The catheter was fixed using sterile tapes and a perineural catheter fixation set (BBraun Perifix catheter fixation set; BBraun Melsungen AG, Melsungen, Germany), with a 0.2-μm filter was connected at the proximal end of the catheter to provide sterile administration of local anaesthetics.

After transfer into theatre, general anaesthesia was introduced with 100 μg fentanyl and 2–4 mg·kg⁻¹ propofol. A laryngeal mask airway was inserted and anaesthesia maintained with 1 MAC sevoflurane in an oxygen/air mixture, with pressure controlled or spontaneous ventilation. The patients were positioned in the lateral or beach-chair position, depending on the surgical procedure and the individual surgeons’ preference. General anaesthesia was used in preference to
sedation for ease of airway management under conditions of limited airway access.

The position of the catheter and the level of pain were evaluated 90–120 min postoperatively. An additional bolus of 10 ml ropivacaine 0.5% was administered if the VAS was > 0. Using the same method described above, a new interscalene catheter was inserted if the original catheter had dislocated, or become kinked/obstructed. A disposable Post-Operative Pain Control Pump (Beeline Disposable Post-Operative Pain Control Pump 110 ml, Moog Medical Devices Group, Salt Lake City, UT, USA) was connected to the interscalene catheter with a fixed infusion rate of 4 ml.h⁻¹ ropivacaine 0.2%.

An ultrasound investigation was performed in all patients before discharge, to confirm positive movement of the hemi-diaphragm [14, 15] and to exclude pneumothorax by observing lung sliding [16–18]. Clear instructions about catheter management were provided again before discharge, together with emergency telephone numbers.

Catheters were removed on the first postoperative day, when all patients revisited the hospital for surgical and anaesthesia consultation, during which VAS score and patient peri-operative satisfaction scores (1, satisfied; 6, dissatisfied) were recorded. Further analgesia was prescribed at the individual physicians’ discretion. The catheter insertion site was assessed for signs of infection or haematoma 10 days after surgery when the surgeon removed cutaneous sutures. R 2.15.1 (R Foundation for Statistical Computing, Vienna, Austria) was used for statistical analysis. A p < 0.05 was considered statistically significant.

Results
We analysed data from 509 consecutive patients undergoing ambulatory shoulder surgery during the 21-month period. The median (IQR [range]) age of patients was 54 (46–62 [17–87]) years. Two hundred and seventy (53%) patients were ASA 1, 234 (46%) ASA 2 and 5 (1%) ASA 3. The median (IQR [range]) BMI of patients was 27 (24–29 [16–44]) kg.m⁻². The surgical procedures undertaken are shown in Table 1.

Catheter-related adverse events and reasons for hospital re-admission within 12 h postoperatively are shown in Tables 2 and 3.

<table>
<thead>
<tr>
<th>Table 1 Surgical procedures undertaken (n = 509). Values are number (proportion).</th>
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<tbody>
<tr>
<td>Rotator cuff repair</td>
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<tr>
<td>Subacromial decompression</td>
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<tr>
<td>Removal of calcification</td>
</tr>
<tr>
<td>Acromioclavicular joint resection</td>
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<tr>
<td>Tenotomy or tenodesis</td>
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<tr>
<td>Capsular plication</td>
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<tr>
<td>Capsulotomy</td>
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<tr>
<td>Debridement of the supraspinatus tendon</td>
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<td>Labrum refixation</td>
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<tr>
<td>Removal of screw(s)</td>
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<tr>
<td>Arthrolysis</td>
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<tr>
<td>Diagnostic arthroscopy</td>
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<tr>
<td>Shoulder prosthesis</td>
</tr>
<tr>
<td>Acromioclavicular stabilisation</td>
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</tbody>
</table>

Overall, patients’ satisfaction with peri-operative care was high, with 473 (93%) describing themselves ‘very satisfied’ or ‘satisfied’, 25 (5%) ‘moderately satisfied’ and only 11 (2%) ‘dissatisfied’.

No interscalene catheter-related signs of infection or haematoma were observed by surgeons 10 days postoperatively.

Discussion
This is the largest consecutive case series of interscalene catheters for shoulder surgery in an ambulatory setting, and reports an uneventful peri-operative course in 93.3% of cases with 93% of patients describing themselves satisfied with their peri-operative care. Among the 6.7% of patients who had an adverse outcome, most commonly insufficient analgesia at home with or without catheter dislocation (2.2%), none suffered more than minor harm. We identified rotator cuff repair as the procedure with the highest apparent re-admission rate to hospital.

Shoulder surgery is commonly associated with severe, unpredictable peri-operative pain and prolonged hospital stay [19–26]. Modern anaesthetic management involves interscalene brachial plexus blockade, with or without general anaesthesia, the reliability and safety of which is improved by ultrasound-guided placement [27, 28] compared with previously described techniques, such as the perpendicular needle guidance (Winnie) technique [29]. The safe, correct placement of perineural catheters is facilitated by ultrasound guidance [13] and advancement of the catheter in a medial direction [30].
Previous case series have reported the use of interscalene catheters in various settings. Bryan et al. found a 9.7% prevalence of adverse events in a retrospective analysis of 144 catheters used for ambulatory shoulder surgery [1]. Fredrickson et al. performed a prospective study of 300 interscalene catheters, where 88 of patients were managed in an ambulatory setting [3], among which long-term neurological sequelae were observed in three cases, with one case of infection relating directly to an interscalene catheter.

We were encouraged to find such a low rate of adverse events in our study. Although pain and dyspnoea are of subjective concern to patients, our provision of well-structured patient follow up allowed rapid re-assessment and treatment of patients with these, and other types of event.

The most serious of our events, an apical pneumothorax, was not apparent on ultrasound before patient discharge, and we can only speculate that catheter migration after discharge may have been causative [31].

Catheter dislocation was the most common adverse event associated with interscalene catheters. We have previously found a 5% rate of dislocation in volunteers [13], similar to the 3.6% observed in this study, half of which occurred in the immediate postoperative period. We suggest that that the catheter dislocation rate increases with the length of use, although further studies are required to confirm this.

We attribute the apparent safety and effectiveness of interscalene catheter use at our hospital to the comprehensive package of patient care that supports their use, involving structured communication channels between patients and healthcare professionals, highly trained anaesthetists, highly trained surgeons capable of short procedure times, highly trained anaesthesia nursing staff, effective computer-based data capture, a protocol for the fast and effective treatment of adverse events, and a protocol for suitable patient selection.

We justify the relatively short time of catheter use (24 h) with reference to the time course of pain after shoulder surgery [32] and our own clinical experience. A longer duration of catheter use is associated with more administrative demands, more complications (e.g. catheter dislocation, catheter disconnection and obstruction, infections, neurological sequelae) and more hospital re-admissions consequent to these.

<table>
<thead>
<tr>
<th>Reason for re-admission</th>
<th>Surgical procedure</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Shoulder pain</td>
<td>6 rotator cuff repair; 1 capsular plication</td>
<td>Mild adverse event after surgery</td>
</tr>
<tr>
<td>Hemi-thorax pain</td>
<td>1 rotator cuff repair</td>
<td>Five patients were re-admitted during the first 12 postoperative hours</td>
</tr>
<tr>
<td>Dyspnoea</td>
<td>1 subacromial decompression</td>
<td>Two patients were re-admitted during the first 12 postoperative hours, one catheter was reinserted</td>
</tr>
<tr>
<td>Nausea and vomiting</td>
<td>1 rotator cuff repair; 1 biceps tenotomy</td>
<td>Diagnosis of catheter dislocation after 24 h</td>
</tr>
<tr>
<td>Total</td>
<td>34 (6.7%)</td>
<td>In both cases the patients reported mild to moderate pain</td>
</tr>
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</table>

Table 3 Reasons for re-admission within 12 h of hospital discharge after surgery (n = 509). An apical pneumothorax was diagnosed by ultrasound in one of the two patients admitted with dyspnoea, but required no further intervention. Values are number (proportion).
Postoperative use of interscalene catheters beyond 24 h requires further investigation, as does the technique of catheter fixation on prolonging safe catheter use (such as tunnelling [33]), patient-controlled bolus augmentation of background ropivacaine infusion for more painful surgical procedures (such as rotator cuff repair) with a possible reduced incidence of re-admissions, and co-administration effect/side-effect profile of other analgesics, such as dexmedetomidine [11].

This retrospective consecutive case series has several limitations. All procedures were performed in one hospital with considerable experience of interscalene catheterisation for shoulder surgery. The techniques described (needle guidance, catheter fixation, postoperative catheter care etc.) reflect the experience of the one hospital, limiting extrapolation of the results to other hospitals using other techniques for ambulatory shoulder surgery [1, 4, 5, 34]. Nevertheless, the technique described in this series is associated with a low hospital re-admission rate and high patient satisfaction, and future prospective studies may seek to confirm the clinical usefulness of the methodology described.

In summary, this large retrospective consecutive case series analysed the management of interscalene catheters for ambulatory shoulder surgery. The incidence of adverse events was 6.7% and of hospital re-admission, 2.4%. Most of the adverse events were pain related. Rotator cuff repair was identified as the only predictor for unplanned re-admission to hospital. Patient satisfaction was high. Well-trained staff and a well-organised infrastructure are the main prerequisites for the successful and safe implementation of this technique in the daily clinical practice.

Competing interests
Departmental resources supported this study only. PM has received honoraria for lectures from SonoSite Inc. DM has received unrestricted grants from Pajunk Inc. and Temena Inc.

References