Neuraxial steroids have been used in medicine since 1952. Although there has been controversy about the mechanisms of action, neural toxicity, and side effects of neuraxial steroids, few complications have been directly attributed to the pharmacology or chemistry of steroids. In the United States, triamcinolone acetonide, among other agents, is commonly used for neural blockade.

The addition of dexamethasone to lidocaine prolongs the anesthetic effect during axillary regional blockade. One study reported prolonged duration of analgesic when dexamethasone was added to the local anesthetic during brachial plexus blockade. Another study compared brachial plexus blocks performed with bupivacaine injection alone vs bupivacaine combined with dexamethasone for injection vs bupivacaine injection combined with intravenous dexamethasone. That study showed that the addition of both intravenous and perineural steroids increased the duration of analgesia to 25 hours compared with 13 hours with the use of bupivacaine alone.

This prospective comparative clinical study was performed to evaluate the effect of triamcinolone when added to bupivacaine during brachial plexus blockade in patients undergoing shoulder surgery. Interscalene brachial plexus blocks were performed on 910 patients before shoulder surgery. Of the patients, 574 were randomly allocated to receive steroids added to the injected local anesthetic and 336 patients received local anesthetic without steroids. All patients were followed prospectively to evaluate the rate of successful anesthesia, duration of anesthesia, side effects of the block, adverse events, and persistent neurologic complications associated with interscalene brachial plexus block. Patients who received steroids had statistically longer pain relief than those who did not receive steroids (P<.001). No difference was found in adverse events, complications, or side effects. Compared with blocks performed without steroids, a statistically longer duration of block analgesia occurred with the addition of steroids to the local anesthetic solution during brachial plexus blockade. Rates of side effects, adverse events, and persistent neurologic complications were similar between the groups.

Materials and Methods
Institutional review board approval was obtained for the study in 2003. Enrollment comparison of interscalene brachial plexus block performed with and without steroids Brian G. Webb, MD; Peter I. Sallay, MD; Sherman D. McMurray, MD; Gary W. Misamore, MD

abstract
This prospective comparative clinical study was performed to evaluate the effect of triamcinolone when added to bupivacaine during brachial plexus blockade in patients undergoing shoulder surgery. Interscalene brachial plexus blocks were performed on 910 patients before shoulder surgery. Of the patients, 574 were randomly allocated to receive steroids added to the injected local anesthetic and 336 patients received local anesthetic without steroids. All patients were followed prospectively to evaluate the rate of successful anesthesia, duration of anesthesia, side effects of the block, adverse events, and persistent neurologic complications associated with interscalene brachial plexus block. Patients who received steroids had statistically longer pain relief than those who did not receive steroids (P<.001). No difference was found in adverse events, complications, or side effects. Compared with blocks performed without steroids, a statistically longer duration of block analgesia occurred with the addition of steroids to the local anesthetic solution during brachial plexus blockade. Rates of side effects, adverse events, and persistent neurologic complications were similar between the groups. [Orthopedics. 2016; 39(6):e1100-e1103.]

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ment of patients was initiated in 2004, and follow-up of the enrolled patients was completed by 2007. Written informed consent was obtained from all subjects. Patients who were scheduled for elective shoulder surgery from a suburban private orthopedic practice were recruited for participation in the study over a 2-year period by the senior surgeons (P.I.S., G.W.M.). Arthroscopic and open procedures (acromioplasty, distal clavicle excision, rotator cuff repair, labral repair, capsulolabral repair, capsular shift, capsular release, arthroplasty, clavicle fracture reduction and fixation, and proximal humeral fracture reduction and fixation) were included. Patients with workers’ compensation claims were included. Exclusion criteria included pre-existing neurologic disorders affecting the shoulder or arm, chronic pain syndromes, narcotic addiction, inability to understand instructions, inability to complete forms accurately, and age younger than 18 years.

Seven board-certified anesthesiologists with extensive regional anesthesia experience (range, 9-21 years) performed the blocks. A blunt-tip (short-bevel), insulated Stimuplex 22-gauge needle (Braun Manufacturing, Melsungen, Germany) and a nerve stimulator were used to localize the upper cord of the brachial plexus, according to the technique described by Winnie.10 The needle was positioned to provide stimulation of the biceps brachial muscle, but not the phrenic nerve. The current produced by the nerve stimulator was set at less than 0.5 mA, and 40 mL 0.5% bupivacaine with epinephrine 1:200,000 was injected with 10-mL syringes.

By random choice of the surgeon, 25 mg triamcinolone acetonide was added to the anesthetic injection in some patients, and other patients received bupivacaine solution without steroids. The patients, but not the surgeons or anesthesiologists, were blinded to the use of steroids. To minimize the risk of intraneural injection, during brachial plexus block, local anesthetic solution was injected only when little or no resistance to the flow of solution was encountered. To maximize the tactile sense of resistance, small-volume (10-mL) syringes were used. To minimize the risk of intravascular injection, aspiration was performed after injection of every 5 mL anesthetic solution.

All data were collected prospectively. Information collected included documentation of initial success or failure of the block and duration of block analgesia. Success of the block was defined as complete pain relief immediately after surgery. Duration of block analgesia was defined as the interval between performance of the block and onset of postoperative pain. In addition, patients were monitored for adverse events associated with the block. Side effects such as shortness of breath, Horner’s syndrome, hoarseness related to recurrent laryngeal nerve dysfunction, and block-related anxiety related to dyspnea or loss of function of the affected upper extremity during the period of bupivacaine anesthetic effect and persistent neurologic complications such as weakness, loss of sensation, and paresthesia or dysesthesia that lasted longer than the anesthetic effect of the block were recorded. For this study, all persistent neurologic abnormalities were presumed to be caused by the brachial plexus block, even though some could have been the result of the shoulder surgery itself.

The surgeon and the anesthesiologist evaluated the patients in the postoperative recovery area for block success and side effects. Patients maintained logs during the first 2 postoperative days, and surgeons conducted telephone interviews within 36 hours postoperatively to document block duration and possible side effects or neurologic complications. Each patient had follow-up at the surgeon’s office within 10 days of surgery and at regular postoperative intervals for further evaluation of side effects and complications.

**Statistical Analysis**

Results are descriptively presented as means and standard deviations. Nominal data were analyzed with Fisher’s exact test. Continuous data were analyzed with Student’s t test if they were considered to be normally distributed. Categorical variables were summarized with percentages and compared between groups with Pearson’s chi-square test or Fisher’s exact test. P <.05 was considered statistically significant. All analyses were performed with standard statistical software (IBM SPSS Statistics; IBM, Armonk, New York).

**RESULTS**

A total of 910 patients provided consent and were available for data analysis. Of these patients, 574 were allocated to receive steroids and 336 did not receive steroids. Patients who did not receive steroids included 132 women and 204 men, with an average age of 47 years. The group of patients who received steroids included 205 women and 369 men, with an average age of 48 years. No significant difference was found between the 2 groups in sex (P = .282) or age (P = .486).

**Success and Duration of Block**

The overall block success rate was 98% (565 of 574) with steroids and 97% (326 of 336) without steroids. No statistically significant difference was found between the 2 groups (P = .584). Patients who received steroids had statistically longer pain relief than those who did not receive steroids (P < .001). The blocks with steroids lasted 27.8 hours (SD, 10.4 hours) vs 17.3 hours (SD, 8.8 hours) for those without steroids.

**Side Effects**

There were 168 immediate postoperative block side effects in 145 of the 910 (15.9%) patients. In the group without steroids, 53 of 336 (15.8%) patients had a side effect. The group with steroids, 115 of 574 (20%) patients had a side effect (Table). No statistically significant difference was found between the 2 groups (P = .555). All side effects resolved by the time the block analgesic effect resolved, and no treatment was required.
Neurologic Complications

The total percentage of persistent neurologic complications was 4.2% (38 of 910). These complications occurred in 2.7% (9 of 336) of patients in the group without steroids and 5.1% (29 of 574) of patients in the group with steroids (P=.084). In 30 patients, these persistent neurologic abnormalities resolved completely before 3 months postoperatively. In 8 patients (3 without steroids and 5 with steroids), persistent neurologic complications occurred and did not resolve during the time frame of the study. One of these involved clinically significant motor dysfunction (radial nerve palsy) that resulted in some disability to the patient. The others consisted of persistent minor paresthesia or dysesthesia in the hand that was not clinically significant. No statistically significant difference was found between the 2 groups in the number of unresolved persistent neurologic complications (P=.153).

Complications

Procedural complications (resistance during injection and aspiration of blood) occurred in 10 patients. Of the 574 patients who were given steroids, 5 (0.9%) had procedural complications vs 5 of 336 (1.5%) patients who did not receive steroids. No statistical difference was found between the 2 groups (P=.512). None of these patients had persistent neurologic complications.

DISCUSSION

Two earlier publications evaluated the effect of corticosteroids when added to brachial plexus blocks. Vieira et al found that the addition of dexamethasone significantly prolonged the duration of brachial plexus blockade. In that study, patients receiving steroids during brachial plexus block had a mean of 24.3 hours of sensory block compared with 13.9 hours in the control group (no steroids). Thus, steroid supplementation was associated with prolongation of analgesia by 1.7 times compared with block performed without steroids. Abdallah et al similarly found that the addition of dexamethasone prolonged the duration of analgesia associated with brachial plexus blockade. In that study, the addition of steroids increased the time frame of analgesia to 25 hours compared with 13.2 hours in the control group (no steroids).

The current study also found a significant increase in block duration with the use of triamcinolone. The group receiving steroids had significantly longer pain relief than the group without steroids. The blocks with steroids lasted 27.8 hours vs 17.3 hours for the blocks without steroids (duration of analgesia increased 1.6 times for the steroid group vs the control group). The success rates of the block were equal in the 2 groups, 98% and 97%, respectively. The block success rates in this study were comparable to earlier reports that described block success rates of 79% to 100%.11-23

Another important feature of this study was the finding that the rate of adverse events associated with the addition of steroids during brachial plexus blockade was not statistically different compared with brachial plexus blockade performed without steroids. Transient side effects related to the block occurred in 16.1% of patients in the group without steroids vs 18.5% in the group with steroids. In both groups, Horner’s syndrome was the most common side effect. The rates of persistent neurologic complications that remained after the block analgesic effect ceased were not significantly different in the 2 groups. Persistent neurologic complications affected 0.8% (5 of 574) of patients in the group with steroids and 0.8% (3 of 336) of patients in the group without steroids. The overall rate of persistent neurologic effects is in concordance with other large studies. Candido et al and Brull et al reported temporary neurologic complication rates of 2.3% and 4.5%, respectively. No other reports have shown increased complications with steroids.

Limitations

This study had several limitations. The study did not use computer randomization or blinding of the investigators. Patients were arbitrarily assigned to the groups by the treating surgeon. Data were collected by the same team that performed the brachial plexus blocks and the surgery. In addition, the effect of block with steroids on patients with diabetes was not examined. Because blood glucose measurements were not obtained prospectively in patients with diabetes, no information is available on the safety of steroid-enhanced blocks in this cohort. Finally, the occurrence of block-related persistent neurologic complications could be overstated because all persistent neurologic abnormalities were presumed to be caused by the brachial plexus block, even though some could have been the result of the surgical procedure itself.

CONCLUSION

This study found a statistically significantly longer duration of block analgesia with the addition of triamcinolone to the local anesthetic solution during brachial plexus blockade compared with block performed without steroids. The study found similar success rates and similar rates of block side effects, persistent neurologic complications. No statistically significant difference was found between the 2 groups in the number of unresolved persistent neurologic complications. No other reports have shown increased complications with steroids.

Table

<table>
<thead>
<tr>
<th>Side Effect</th>
<th>With Steroids (n=115)</th>
<th>Without Steroids (n=53)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horner’s syndrome</td>
<td>70</td>
<td>33</td>
</tr>
<tr>
<td>Hoarseness</td>
<td>26</td>
<td>12</td>
</tr>
<tr>
<td>Mild dyspnea</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Severe dyspnea</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Block-related anxiety</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

*Side Effects of Interscalene Block*
adverse events, and procedural complications in the 2 groups.

REFERENCES


