The mixture of 1% lidocaine and 0.2% tetracaine with 1:200,000 epinephrine, so-called "supercaine," has been used extensively for axillary brachial plexus blockade for several decades. Since the advent of bupivacaine, the supercaine mixture has fallen into relative disuse despite its record of effectiveness and safety. No studies have been done recently to evaluate quality of anesthesia, duration of postoperative analgesia, and degree of patient satisfaction with this mixture when used for axillary brachial plexus blockade.

The assumptions were as follows: surgical anesthesia will be adequate, length of postoperative analgesia will be approximately 4 to 9 hours, and patients will be highly satisfied. The specific aim of the present study was to describe the anesthetic characteristics of supercaine.

Patients between 18 and 65 years of age received a standard mixture of supercaine, totaling 450-500 mg of lidocaine and 90 to 100 mg of tetracaine. Epinephrine in a solution of 1:200,000 and an 8.4% solution of sodium bicarbonate were added, and the transarterial technique was used. Patients were contacted on postoperative day 1 to determine the duration of sensory and motor block; overall satisfaction with the block was rated. Data were analyzed with the Statistical Program for the Social Sciences (SPSS, Chicago, Ill) and Stata (Stata Corp., College Station, Tex) computer programs. The mean ± SD findings were as follows: duration of sensory block, 465 ± 204 minutes; duration of motor block, 473 ± 214 minutes; patient satisfaction score, 9 ± 1 on a 1 to 10 scale. Data are reported within a 95% confidence interval. Variables examined and compared were not statistically significant.

We concluded that the duration of block supports findings reported in the literature, patients equate duration of sensory block with duration of motor block, differences in duration were probably due to levels of provider experience, and patients were extremely satisfied with the anesthetic.

Key words: Brachial plexus block (axillary), lidocaine, local anesthetic pharmacology, local anesthetic toxic effects, tetracaine.

Introduction
The purpose of the present study was to describe and evaluate the anesthetic characteristics of the mixture of 1% lidocaine and 0.2% tetracaine (so-called "supercaine") with a 1:200,000 solution of epinephrine and an 8.4% solution of sodium bicarbonate, using a transarterial axillary approach technique to the brachial plexus for surgical procedures on the forearm, wrist, and hand.

Described by Katz1 and Aantaa et al.,2 the transarterial, immobile needle technique of axillary bra-
chial plexus block (BPB) has proved effective for the provision of surgical anesthesia and analgesia for procedures of the forearm, wrist, and hand. Based on work by Eriksson, who placed a tourniquet below the injection site, Winnie further refined the technique by application of digital compression on the neurovascular bundle during injection, improving local anesthetic diffusion within the perivascular sheath to reach the axillary and musculocutaneous nerves. For a duration of 2 to 4 hours, lidocaine or mepivacaine, with or without epinephrine, has been administered extensively. For a duration of 10 to 15 hours, bupivacaine or etidocaine may be used. These agents leave a “gap” in duration from 4 to 9 hours, for which a mixture of drugs consisting of 1% lidocaine, an amino-amide agent; 0.2% tetracaine, an amino-ester agent; and epinephrine 1:200,000 has been used. First described in 1948 and 1950, tetracaine for BPB was reported to have a duration of anesthesia from 4 to 9 hours.

Mixing local anesthetic agents has long been an accepted practice to obtain a combination of desirable features of individual agents, such as rapid onset and long duration. Combinations of rapid-onset, medium-duration agents, such as lidocaine, mepivacaine, and chloroprocaine, with long-acting agents, such as bupivacaine and tetracaine, are useful in BPB to provide effective surgical anesthesia with prolonged postoperative analgesia. Toxicity is considered additive, allowing the practitioner to use maximal doses of both agents. Addition of epinephrine in concentrations of 1:200,000 to 1:250,000 to the solutions decreases systemic absorption owing to its vasoconstrictor effect and increases intensity and duration of block by 50% to 100%, to as long as 14 hours.

Local anesthetics prepared as hydrochloride salts require an acidic pH of approximately 6.0 to maintain their stability in prolonged storage. If epinephrine is added, the storage pH must be lower, approximately 4.0, owing to the inherent instability of epinephrine at an alkaline pH. An 8.4% solution of sodium bicarbonate may be added to the salt solutions to raise the pH (alkalinization) to a physiologic level. With alkalinization, the time to onset of block with lidocaine decreases. This decrease is believed to be due to a higher percentage of the ionized drug secondary to dissociation at a higher pH, increasing the number of drug molecules diffusing across the lipid membrane. Covino suggests the following dose for alkalinization of lidocaine: 1 mL of an 8.4% solution of sodium bicarbonate per 10 mL of agent, for final pH of 7.2.

Tetracaine used perineurally in a 0.15% to 0.2% concentration provides a dense motor and sensory block with a duration of 4 to 6 hours when epinephrine is added. Tetracaine’s safety and efficacy in most types of regional anesthesia has been confirmed. Tetracaine is well-distributed in highly perfused tissues, metabolized in the plasma by pseudocholinesterases and hepatically by hydrolysis and conjugation, and does not produce local toxic effects in concentrations used for nerve blocks or infiltration. Systemic allergic reactions are rare with tetracaine. Lidocaine, when used perineurally in a 1% concentration, provides rapid onset of motor and sensory block, with a duration of approximately 1 to 3.5 hours.

The benefits provided by the mixture of tetracaine and lidocaine are the immediate onset of dense surgical anesthesia provided by the alkalinized lidocaine and a prolonged duration of anesthesia and analgesia provided by the tetracaine. Many clinicians report a duration of blockade of 5 to 7 hours.

In mice, the median intravenous lethal dose (LD50) of tetracaine is 4 mg/kg and of lidocaine is 26 mg/kg. Tetracaine and lidocaine produce primarily respiratory arrest and seizures at toxic levels, and they do not present the threat of cardio-toxicity posed by bupivacaine.

A few more recent studies with the lidocaine-tetracaine and epinephrine combination have reported high success rates with no systemic toxicity. Balas used the combination for 300 consecutive patients scheduled for upper arm or shoulder procedures who received subclavian perivascular BPB. He found that the mixture of a 0.8% solution of lidocaine and a 0.2% solution of tetracaine with an epinephrine concentration of 1:200,000 provided acceptably rapid onset with a duration of adequate analgesia of 4 to 5 hours. No toxicity was reported.

More recently, Peterson performed 58 interscalene blocks with solutions of 0.375% to 0.4% lidocaine and 0.2% to 0.25% tetracaine with epinephrine 1:250,000 to 1:266,000. He used total amounts (mean ± SD) of anesthetic solution averaging 271 ± 69 mg of lidocaine and 168 ± 43 mg of tetracaine and reported no systemic toxicity.

Brown et al studied axillary, interscalene, and subclavian BPBs, epidural blocks, and caudal blocks in 25,697 patients; 7,532 of the blocks were of the brachial plexus. Using tetracaine, lidocaine, bupivacaine, procaine, chloroprocaine, and mepivacaine, he determined the frequency of seizures and associated cardiovascular changes in patients receiving regional anesthetics during the years 1985 through 1992. He reported no seizures associated with the use of tetracaine in any of the regional anesthetics administered (102 were BPBs with tetr-
raca ine, and 353 procedures using lidocaine). Of
the 15 seizures reported, all occurred with proce-
dures in which bupivaca ine alone or bupivaca ine
with chloroprocaine were used. He stratified the
rate of seizure development in BIP with supraclau-
cular and interscalene approaches having an inci-
dence greater than the axillary approach within
a confidence interval (CI) of 95%. However, he did
not delineate the concentrations or volumes of
agents used.

The maximum doses of lidocaine and tetra-
caine (with 1:200,000 epinephrine added) are given
in Table 1.

<table>
<thead>
<tr>
<th>Drug and references</th>
<th>Concentration (%)</th>
<th>Dose (mg/kg)</th>
<th>Maximum total dose (mg)</th>
</tr>
</thead>
</table>
| Lidocaine11(p112),
13(p520),21(p353) | 0.5-1.0 | 7 | 500 |
| Tetracaine8(p563),
11(p112),21(p353) | 0.1-0.25 | 1.0-1.5 | 100-200 |

The cardiotoxicity of bupivacaine, which is
used extensively in regional anesthesia because of
its dense sensory block and long duration, is well-
documented. According to de Jong,21 cardiotoxicity
with bupivacaine appears prior to signs of central
nervous system (CNS) toxicity, in opposition to all
the other local anesthetic agents, in which CNS
signs appear. The cardiac effects of bupivacaine
toxicity are negative inotropy and slow release from
Na+ and Ca2+ channels. In cardiac conductive tis-
sues, bupivacaine is bound preferentially in the
closed “resting” channel state, thus, the block is
most dense during cardiac phase 3 (terminal
repolarization) and phase 4 (recovery),21(p110) which
slows or prevents impulse conduction and predis-
poses to reentrant ventricular dysrhythmias.

In summary, the research reviewed supported
the lidocaine-tetracaine mixture as safe and effective
and without the major cardiotoxic effects of
bupivacaine. Since 1950, tetracaine has been used
safely for axillary BPB, providing effective surgical
anesthesia and postoperative analgesia for 5 to
7 hours. Lidocaine continues to serve as the “gold
standard” for rapid onset and dense surgical
blockade.

Although many clinicians reported effective use
of the lidocaine-tetracaine combination in BPB
techniques with a duration of 5 to 7 hours, we found
no recent studies evaluating the quality of surgical
anesthesia, duration of postoperative analgesia, and
degree of patient satisfaction when using this mix-
ture. We addressed the following assumptions in
the present study: (1) surgical anesthesia would be
adequate, (2) the length of postoperative comfort
would be approximately 5 to 10 hours, and (3) pa-

tient satisfaction with the technique would be high.

Materials and methods

This was a descriptive study of 58 patients be-
 tween the ages of 18 and 65 years undergoing sur-
gical procedures of the forearm, wrist, or hand in
 the main operating room or in the orthopedic clinic
during a 3-month period. Each patient was given a
standard solution of 1% lidocaine and 0.2% tetracaine
with 1:200,000 epinephrine and 8.4% sodium bicarbonate (1 mL/10 mL of solution). The volume
used was 45 to 50 mL. The patients were anesthe-
tized by staff anesthesiologists and Certified Regis-
tered Nurse Anesthetists and by anesthesia train-
ees at various periods in their training, with
 experience ranging from 1 to 36 months. Patients
undergoing surgery in the operating room were
given premedication of 1 to 3 mg of midazolam
and 50 μg of fentanyl intravenously before the axil-
lary BPB. Patients undergoing procedures in the
orthopedic clinic received the axillary BPB in the
pain clinic from 1 to 4 hours preoperatively, and
they did not receive premedication. The transar-
terial, immobile needle technique described by
Winnie1 and others11 was used, and the solution
was deposited within the sheath. Digital pressure
was maintained distal to the site of injection for 5
minutes. An additional “ring” of 5 mL was used to
anesthetize the musculocutaneous, intercostobra-
chial, and medial brachial cutaneous nerves. The
total dose of lidocaine was 450 to 500 mg, and the
total dose of tetracaine was 90 to 100 mg. If pares-
thesias were obtained during transarterial attempts,
injections were made at that time.

The degree of block was assessed at 5-, 15-, and
30-minute intervals. Sensory block was determined
d by discrimination of cold, pinprick, and pinch in
the musculocutaneous, radial, medial, and ulnar
cutaneous distributions. Strength of contraction of
biceps and triceps was used to evaluate degree of
motor block of the musculocutaneous and radial
nerves; median and ulnar block was assessed by
ability to adduct the thumb and by opposition of
the thumb and fourth finger. The assessments were
made by the primary anesthesia provider or other
anesthesia personnel. Surgical block was consid-
ered adequate if there was no requirement for ad-
ditional local anesthetic “touch up” or for conver-
sion to intraoperative general anesthesia. When a
 supplemental block was required, the choice of so-
lution was left to the discretion of the anesthesia
provider or to the surgeon for field block.
Each patient was contacted by telephone on
the first postoperative (lay...injection of oral
analgesic) and the mean duration of motor block
(assessed by time from block placement to time of
return to full movement). The Statistical Program
for the Social Sciences (SPSS, Chicago, Ill) and
Stata (Stata Corp., College Station, Tex) were
used to compute the means, SD, and SE within the 95% CI.
Patient satisfaction with the procedure was
evaluated by using the following criteria: perceived
presence or absence of comfort intraoperatively and
the willingness to undergo the block for future sur-
gical procedures. Overall satisfaction with axillary
BPB was rated by the patient using a numerical
scale from 1 (completely displeased) to 10 (com-
pletely pleased). The mean satisfaction score, SD,
and SE were determined and reported within the
95% CI. The Bartlett test for equal variances was
used to compare duration of sensory and motor
block with patient weight and site of surgery. The
adequacy of the block for surgery was compared
with duration of sensory and motor block by using
the t test. The Fisher exact and the 1-sided Fisher
exact tests were used to compare the adequacy of
the block and intraoperative comfort with surgical
site and sex with intraoperative comfort.

Results
The patient demographics, summarized in
Table 2, are consistent with the primarily active
duty military population at the medical center at
which the study was conducted. Most operations
were performed on the hand.

The data showed that the solution of local an-
esthetic agents used in transtertial axillary BPB
was adequate for surgery for 43 (74%) of 58. Of the
remaining 15 patients (26%), 13 blocks were placed
by relatively inexperienced trainees, and the re-
mainling 2 blocks were given to patients in the or-
thopedic clinic for whom the elapsed time from
block placement to surgery was 3 to 6 hours.

Of 58 patients, 44 (76%) reported being com-
fortable during the operative procedure. Of the 14
(24%) patients who experienced discomfort in-
traoperatively, 1 was extremely anxious and requested
sedation, 2 required additional anesthetic block for
specific nerves during the procedure, 1 felt pain at
the end of the procedure, 1 required general anes-
thesia, 1 required propofol for relief of tourniquet-
related pain, and for 1, the elapsed time between
block placement and time of surgery was 6 hours.

Of the 44 patients we were able to contact post-
operatively, 43 (98%) were willing to undergo an-
other block for future surgical procedures. For 1
patient, an elicited paresthesia and the pressure of
the injection of local anesthetics were intolerable.

<table>
<thead>
<tr>
<th>Table 2. Demographics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Variable</strong></td>
</tr>
<tr>
<td><strong>Age (y) (n = 60)</strong></td>
</tr>
<tr>
<td>18-50</td>
</tr>
<tr>
<td>51-60</td>
</tr>
<tr>
<td>&gt;60</td>
</tr>
<tr>
<td><strong>Sex (n = 61)</strong></td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td><strong>Weight (kg) (n = 59)</strong></td>
</tr>
<tr>
<td>&lt; 50</td>
</tr>
<tr>
<td>51-70</td>
</tr>
<tr>
<td>71-90</td>
</tr>
<tr>
<td><strong>Site of surgery (n = 56)</strong></td>
</tr>
<tr>
<td>Forearm</td>
</tr>
<tr>
<td>Wrist</td>
</tr>
<tr>
<td>Hand</td>
</tr>
<tr>
<td>Combination</td>
</tr>
</tbody>
</table>

*Percentages do not total 100 because of rounding.
†Number (n) differs due to inconsistent data collection by
multiple providers.

<table>
<thead>
<tr>
<th>Table 3. Duration of blockade in minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Block</strong></td>
</tr>
<tr>
<td>Sensory (n = 43)</td>
</tr>
<tr>
<td>Motor (n = 44)</td>
</tr>
</tbody>
</table>

Table 3 provides data about the duration of sensory and motor block. The duration of sensory and motor blockade were perceived by the patients as similar. The overall mean ± SD patient satisfaction score (n = 40) was 9 ± 1.2. The minimum satisfaction score was 6, and the maximum was 10. The SE was 1.2, and these data were reported within a 95% CI of 8.51 to 9.4. When patient weight, site of surgery, and adequacy of the block for the surgical procedure were compared with duration of sensory and motor block, the findings were not statistically significant (P > .05 for all). We found no signi-
ficance when the surgical site was compared with adequacy of the block and intraoperative comfort or when sex was compared with intraoperative comfort (P > .05).

Figures 1 and 2 illustrate the duration of sen-
sory and motor blocks within a normal distribu-
The results supported previous studies and reports by researchers using this technique and local anesthetic mixture. The lack of a significant relationship between duration of the block and patient weight supports a standard “dose” of 45 to 50 mL for most patients. One seizure occurred, which was believed due to direct intravascular injection by a beginning anesthesia resident, and the surgery was canceled. For the 58 surgical patients, no toxic effects were found using the volumes and concentrations stated in the “Materials and methods” section.

The axillary block technique worked well for most of the procedures, and most patients were comfortable during the surgery. Adequacy of the block for surgery is believed related to the skill of the provider for placing the full amount within the sheath and to the interval from block placement to time of surgery. The patient population was mixed between those receiving blocks 30 minutes to 1 hour before surgery in the main operating room and those receiving blocks in the pain clinic 1 to 4 hours before surgery in the orthopedic clinic. Delay to time of surgery for the clinic patients was believed responsible for a lack of intraoperative comfort and requirements for supplementation with a local anesthetic to complete the procedure. Despite variations in sedation or use of propofol, high satisfaction scores were obtained, and almost all patients contacted were willing to undergo the block again despite the minimal problems encountered.

There were multiple weaknesses inherent in the present study. Because the facility is a large teaching institution, the experience of the anesthesia provider performing the block varied widely, which may account for the large SD. There were multiple providers and multiple evaluators of the quality of the block. Although the method was well defined, the technique used and the amounts of sedation varied widely among individual practitioners.

Multiple data are missing, some from practitioners and some from patients who were unable to
answer questions definitively. We were unable to contact 14 patients by telephone. Many patients did not remember times to oral analgesia or first motor movement; several went to bed at night with the motor block still present and awoke with full motor sensation. Still others equated return of pain with return of movement and reported the same duration for both. Some took preemptive analgesics. With still others, duration of the motor block was reported as prolonged owing to immobility caused by pain. The combination of patients treated in the main operating room and those treated in the orthopedic clinic made interpretation difficult owing to the variation in time to surgery from time of block placement.

This study points out many of the difficulties inherent in conducting clinical research. Designation of one or two dedicated practitioners and collectors of data and obtaining confirmation from patients about their availability for follow-up contact may solve many of these problems. Delay of surgery time reinforces the need to use a long-acting agent for surgical anesthesia.

In summary, we found that the mean duration of sensory and motor block supported findings reported in the literature, that patients seem to equate duration of sensory block with duration of motor block, that differences in practitioner experience affect duration, adequacy for surgery, and intraoperative and postoperative comfort, and, importantly, that patients are very satisfied with this procedure. These conclusions support our initial assumptions.

More studies with better control of patient and clinical variables are needed. However, our findings confirm the usefulness of regional anesthesia for surgery below the elbow and illustrate the need to obtain proficiency in this technique. Military anesthesia providers will find this crucial for the provision of surgical anesthesia to multiple casualties.

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AUTHORS

LCDR Jeanette S. Berry, CRNA, MS, NC, USN, is a graduate of the Navy Nurse Corps Anesthesia Program, Naval School of Health Sciences, San Diego, Calif.

CDR Louis Heimel, CRNA, ND, NC, USN, is deputy director of the Navy Nurse Corps Anesthesia Program, Bethesda, Md.

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ADVERSE REACTIONS-ANZEMET Injection

CHEMOTHERAPY Patients

In controlled clinical trials, 2,665 adult patients received ANZEMET Injection. The overall adverse event rates were similar with a 1.8 mg ANZEMET Injection dose and an intravenous placebo. Rates of adverse events were higher following a 12 mg ANZEMET Injection dose than with a placebo or 12 mg placebo. A complete list of all adverse events reported in >2% of patients receiving either ANZEMET or placebo in these controlled clinical trials is provided in Table 7. ANZEMET Injection is indicated for the prevention of postoperative nausea and vomiting in adults undergoing abdominal surgery or upper abdominal surgery.

ADVERSE REACTIONS-ANZEMET Tablets

CHEMOTHERAPY Patients

Postoperative Patients


ADVERSE REACTIONS-ANZEMET Tablets

Table 7. Adverse Events >2% from Chemotherapy-Induced Nausea and Vomiting Studies

<table>
<thead>
<tr>
<th>Event</th>
<th>ANZEMET Injection</th>
<th>Placebo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>169 (24.3%)</td>
<td>70 (20.5%)</td>
</tr>
<tr>
<td>Dizziness</td>
<td>86 (12.4%)</td>
<td>70 (20.5%)</td>
</tr>
<tr>
<td>Fatigue</td>
<td>36 (5.3%)</td>
<td>18 (5.1%)</td>
</tr>
<tr>
<td>Fatigue</td>
<td>25 (3.6%)</td>
<td>36 (5.3%)</td>
</tr>
<tr>
<td>Abdominal Pain</td>
<td>24 (3.5%)</td>
<td>2 (0.6%)</td>
</tr>
<tr>
<td>Dizziness</td>
<td>15 (2.2%)</td>
<td>2 (0.6%)</td>
</tr>
<tr>
<td>Chills/Shivering</td>
<td>14 (2.0%)</td>
<td>6 (1.7%)</td>
</tr>
</tbody>
</table>

Table 8. Adverse Events >2% from Placebo-Controlled Postoperative Nausea and Vomiting Studies

<table>
<thead>
<tr>
<th>Event</th>
<th>ANZEMET Placebo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>58 (24.9%)</td>
</tr>
<tr>
<td>Dizziness</td>
<td>34 (15.5%)</td>
</tr>
<tr>
<td>Drowsiness</td>
<td>18 (8.4%)</td>
</tr>
<tr>
<td>Pain</td>
<td>15 (2.4%)</td>
</tr>
<tr>
<td>Nausea</td>
<td>12 (2.6%)</td>
</tr>
</tbody>
</table>


ADVERSE REACTIONS-ANZEMET Tablets

Table 9. Adverse Events >2% from Chemotherapy-Induced Nausea and Vomiting Studies

<table>
<thead>
<tr>
<th>Event</th>
<th>ANZEMET Placebo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>42 (17.9%)</td>
</tr>
<tr>
<td>Fatigue</td>
<td>6 (2.6%)</td>
</tr>
<tr>
<td>Dizziness</td>
<td>12 (5.1%)</td>
</tr>
<tr>
<td>Nausea</td>
<td>36 (15.9%)</td>
</tr>
<tr>
<td>Pain</td>
<td>7 (3.1%)</td>
</tr>
<tr>
<td>Drowsiness</td>
<td>10 (4.4%)</td>
</tr>
<tr>
<td>Chills/Shivering</td>
<td>3 (1.3%)</td>
</tr>
</tbody>
</table>