REGIONAL ANESTHESIA BY THE INTRAVENOUS ROUTE
(SLIGHT MODIFICATION OF BIER'S METHOD)

LT. COL. LUIS GARCIA HERREROS

Medical Corps, Mexican Army

The use of cocaine substitutes intravenously for regional anesthesia is
forgotten, unknown or is an historical incident to many surgeons and
anesthesiologists. Others consider it a mistake to employ these drugs
intravenously. I believe it would be of value to review this method
of anesthesia and consider its use on the war fronts and in various
countries where the following conditions prevail: (1) medical personnel
to attend the injured is limited; (2) 90 per cent of the patients are in
a state of shock; (3) 22 to 25 per cent of the patients suffer from in-
juries to the limbs, either open wounds or simple fractures; (4) speed
is essential in taking care of these patients so that they may be trans-
ported to another hospital, after relieving or stopping the progress
of shock by anesthetic agents; (5) personnel is trained only in the
rudiments of the technic of regional anesthesia and other special pro-
cedures. For these reasons I wish to review two methods of produc-
ing regional anesthesia by intravenous injection of cocaine or its
substitutes.

I. Under Venous Compression.—This technic is employed in cases
of simple fracture, dislocations of the distal limb, and for mobilization
of certain joints which have been fixed for a certain time.

The vein is compressed above the site of the lesion near the prox-
imal end of the limb by bandage, tourniquet or cord, using pressure
greater than the diastolic and less than the systolic reading. A
solution of 1 per cent procaine is injected into the most prominent
vein. The injection is made under pressure until discoloration of
the distal end of the limb below the tourniquet is obtained. The
amount of anesthetic solution required varies from 10 to 40 cc., accord-
ing to the size of the region to be anesthetized and the depth of anes-
thesia desired. Anesthesia is obtained in from five to eight minutes
after the injection. If a plaster cast is to be used, the bandage must
be applied tightly against the limb since it is swollen by excess ac-
cumulation of blood and it will decrease considerably in size after the
tourniquet is removed. If the bandage is not tight, a dead space will
be left between the bandage and the skin.

II. Under Arterial Compression.—This method is employed in all
cases in which it is necessary to deaden sensibility in the distal end of
the limb for a short time. It is less effective than the first method,
but is much simpler in that it is merely an intravenous injection.
The technic is similar to that suggested by August Bier in 1908. The modifications are as follows: The limb is slightly compressed so that the veins become engorged, making introduction of the needle easier. The tourniquet is removed and manual compression, if not painful, is applied. Any available means may be used to compress the limb above the region to be anesthetized, but the pressure applied should be greater than the systolic pressure. The arteries may be palpated to determine whether compression is adequate. Procaine solution, 0.5 to 1 per cent, is injected through the previously placed needle. To estimate the proper percentage of solution to be employed, the surgeon must take into account the volume of blood left in the limb after compression has been applied. With this method, as with the first method, discoloration of the limb below the tourniquet must be obtained and the amount of solution required varies with the extent of the region to be anesthetized and the depth of anesthesia desired. Anesthesia is accomplished in from three to five minutes. The compression may be lessened before sutures are placed if the surgeon so desires. The patient must be watched carefully for any toxic symptoms.

Barbituric compounds should be used in the usual way with both methods so that the quantity of cocaine substitutes required is as small as possible. To diminish any uncomfortable sensations to the patient, it is helpful in some cases to place a second tourniquet in the anesthetized zone below the original tourniquet before removing the latter.

Table 1 is a summary of 104 cases in which these methods were employed. Further experiences will be presented in a later publication.

<table>
<thead>
<tr>
<th>TABLE 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summary of 104 Cases</strong></td>
</tr>
<tr>
<td>Cases</td>
</tr>
<tr>
<td>Amputation at the joint................................. 19</td>
</tr>
<tr>
<td>Amputation of lower third of thigh.................. 1</td>
</tr>
<tr>
<td>Drainage of periosseal abscess of right tibia for osteomyelitis 1</td>
</tr>
<tr>
<td>Stretching of tendons................................ 4</td>
</tr>
<tr>
<td>Abscess.................................................. 3</td>
</tr>
<tr>
<td>Reduction of dislocation.............................. 6</td>
</tr>
<tr>
<td>Simple fracture......................................... 48</td>
</tr>
<tr>
<td>Compound fractures.................................... 12</td>
</tr>
<tr>
<td>Mobilization of joints................................ 10</td>
</tr>
<tr>
<td>Total..................................................... 104</td>
</tr>
</tbody>
</table>

Complications did not occur in any of the 104 cases. The ages of the patients varied from 5 to 62 years.

One case of simple fracture was in a child 5 years old, with fractures of the bones of both forearms. In one case of joint amputation, the second, third and fourth metatarsals were affected. The patient was a woman aged 62 years, with diabetic gangrene. The blood sugar was 130 mg. before operation; the patient was given insulin before the am-
putation. Drainage of the right tibial abscess for osteomyelitis was performed before the students at the Central Military Hospital, Mexico City.

I have substituted pontocaine for procaine for the following reasons. The ratio of the anesthetic value of pontocaine to procaine is assumed to be 1 to 10. The toxic dose of pontocaine given intravenously is 6 to 10 mg., or 30 mg. per kilogram of body weight when given subcutaneously. When a tourniquet is employed, absorption is slower and therefore toxicity is less than when the drug is given as a simple intravenous injection. If the minimal normal weight of a child 5 years of age is assumed to be 15 kilograms, the toxic dose of pontocaine given intravenously would be 90 to 150 mg. The average doses given are 300 to 400 mg. (30 to 40 cc. of a 1 per cent solution), well under the toxic dose. The slower absorption that results from compression makes this dose less dangerous. Similar computations can be made according to the age of the patient.

The results of the use of pontocaine by these two methods will be reported later when sufficient number of cases has been accumulated.