Intralesional Antimony for Single Lesions of Bolivian Cutaneous Leishmaniasis

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Background. Cutaneous leishmaniasis is an ultimately self-curing disease for which systemic therapy with pentavalent antimony (Sb) is effective but with side effects. We evaluated 2 local treatments, intralesional (IL) Sb and cryotherapy, for single lesions due to Bolivian Leishmania (v.) braziliensis in a placebo-controlled study.

Methods. Patients were randomized between IL Sb (650 µg/mm² of lesion area on days 1, 3, and 5), cryotherapy (days 1 and 14), and placebo cream (daily for 20 days) in a 3:2:3 allocation. Lesion area was measured prior to therapy, and at 1, 3, and 6 months after therapy. The criteria for lesion cure were as follows: not doubling in size at 1 month, at least 50% diminution in size at 3 months, and complete reepithelialization at 6 months. Local adverse effects were recorded.

Results. Cure rates were 21 of 30 (70%; 95% confidence interval [CI], 52%–83%) for IL Sb, 4 of 20 (20%; 95% CI, 8%–42%) for cryotherapy, and 5 of 30 (17%; 95% CI, 7%–34%) for placebo cream (P < .001 for IL Sb vs each other group). IL Sb adverse events were limited to injection site pain, with a mean value of 1.0 (mild).

Conclusions. The comparative cure rate, small amount of drug administered, and tolerance data for IL Sb suggest that if local therapy for single L. braziliensis lesions is chosen, this treatment is attractive. Given the difficulties of performing placebo-controlled trials in the New World, the combined placebo and cryotherapy cure rate (18%; 95% CI, 10%–31%) is likely to become the standard against which future interventions for L. braziliensis are compared.

Clinical Trials Registration. NCT01300975.

Keywords. cutaneous leishmaniasis; Bolivia; L. braziliensis; intralesional antimony; placebo.

Cutaneous leishmaniasis (CL) in the New World (NW) is present from the Texas–Mexico border down through South America to the level of the Tropic of Capricorn. New World CL generally presents as a papule that enlarges and ulcerates over 1–3 months [1]. Lesions can develop in anybody who intrudes into an endemic region and gets bitten by an infected sand fly.

In recent years, industrialized nations have become more aware to the problem owing to increasing numbers of imported cases either in military personnel or travelers. The primary species causing NW CL are diverse, primarily L. (v.) braziliensis, L. (v.) panamensis, L. (v.) guyanensis, L. (v.) peruviana, L. (l.) mexicana, and L. (l.) amazonensis. [The subgenus designation v. (viannia) or l. (leishmania) is often omitted, thus, for example, L. (v.) braziliensis = L. braziliensis.] Because “members of the L. braziliensis complex are the species most frequently associated with human disease in the New World, especially L. braziliensis, [and] this species also has the widest geographic distribution in the Americas” [2], L. braziliensis is the species of most widespread clinical concern as well as the species that causes approximately 85% of disease in Bolivia [3].

The natural history of Leishmania infection depends on the ability of the host to mount an effective T helper cell 1 (Th1) response to the intramacrophage parasite. Th1 responses are generally present in routine CL, which self-heals in 3–15 months [1]. The specific
infecting species causing CL determines where in this wide range of time periods self-cure is likely to occur. Over the 6 months during which patients expect to be cured and during which clinical trials are performed, there are considerable data on the placebo cure rate for *L. panamensis* but much less for *L. braziliensis*. For *L. panamensis*, placebo rates vary from 0% (0/11 [4]) to 37% (17/46 [5]) and 38% (9/24 [6]). For *L. braziliensis*, we are only able to find data from Guatemala, for which 8% (2/25) of cases were cured [7]. The natural history of *L. braziliensis* in South America appears to be not yet reported.

Classic treatment for CL is pentavalent antimony (Glucantime or Pentostam) administered parenterally at a dose of 20 mg/kg/day for 20 consecutive days. A large study with time or Pentostam) administered parenterally at a dose of

METHODS AND PATIENTS

Study Design

The original design was a 4-arm, open-label comparison of IL Sb, cryotherapy, topical paromomycin cream, and placebo cream for the treatment of small, single lesions due to *L. braziliensis* in Bolivia.

When local formulation of topical paromomycin cream was unsuccessful, that arm was deleted and the final design was a comparison of IL Sb, cryotherapy, and placebo cream. Patients were assigned to the 3 groups via a randomized deck of cards in the ratio 3:2:3. The sample size, based on feasibility of accrual over 6 months, was adequate to differentiate putative cure rates of 80% (IL Sb group [12]) vs 10% (placebo group [7]).

Patients

Patients in the Chapare province, Bolivia, catchment area were identified and, after signing informed consent and meeting entrance criteria, were treated at the Hospital Local, Chipiriri, Bolivia. Patients were enrolled between May 2011 and January 2012.

The eligibility criteria were male or female sex; ≥12 years of age; 1 ulcerative lesion ≤30 mm in largest diameter, thus with a total lesion area of ≤900 mm²; parasitological diagnosis by visualization in the direct smear or biopsy, or culture from a lesion aspirate; no specific or putatively specific antileishmanial therapy (Sb, pentamidine, amphotericin B, miltefosine, imidazoles, allopurinol) in the last 3 months; no mucosal lesions in the nose and mouth by physical examination; and no history of concomitant diseases including immunosuppression that would be likely to interact, either positively or negatively,
with IL Sb treatment. Parasites were speciated by polymerase chain reaction [15].

**Interventions**

Intralesional Sb (N-methylglucamine [Glucantime Rhodia Laboratories, France]: 81 mg/mL) was administered on each of days 1, 3, and 5 as per Oliveira-Neto et al [12] and Layegh et al [14]. A small button of Xylocaine was applied by means of a thin needle at the 4 cardinal points of the lesion. Sb was then administered via a small-gauge (23 g) needle at each cardinal point, with the needle being moved in all directions to infiltrate the whole lesion. The amount injected was 650 µg (0.008 µL)/mm² of lesion area.

Cryotherapy was performed as per Asilian et al [11] and Layegh et al [14]. Liquid nitrogen was sprayed using a CryAc device (Brymill Co) for 5–20 seconds until the lesion and 1–2 mm of surrounding normal tissue appeared frozen. Cryotherapy was performed on days 1 and 14. Postoperative care included daily cleansing with an antiseptic solution and cream for 1 week following each cryotherapy application.

**Placebo**

An emollient cream compounded by the Facultad de Farmacia, Universidad Mayor de San Simón (Cochabamba, Bolivia), was spread evenly over the lesion daily for 20 days. Application was administered by medical personnel 1–2 times per week during clinic visits at those times and by the patient on the other days. The composition of the cream was 40% liquid paraffin, 9% hard paraffin, 7% wax, 9% glycerin, 35% water, and 0.1 g propylparaben.

For all experimental groups, apparent superinfection upon entrance into the study was treated with soap and water plus fusidic acid cream twice a day for 4–7 days, augmented by dicloxacillin if necessary (1.5 g orally for 7 days), prior to antileishmanial treatment. The size of the lesion after fusidic acid/dicloxacillin treatment was used as the lesion size prior to experimental treatment.

**Outcome Parameters and Analysis**

Patients were followed for a total of 6 months after the end of treatment and seen thrice during that time: at 1 month, 3 months, and 6 months after the end of therapy.

**Efficacy**

The endpoint parameter was reduction in lesion size. Lesion size was defined as the area of the lesion ulcer, and was computed as maximum ulcer width × maximum ulcer length. Lesion size was measured at study entrance, then at 1 month, 3 months, and 6 months after the end of therapy. The change in lesion size was calculated by expressing lesion sizes after therapy as a percentage of the lesion size prior to therapy.

The criteria for failure were doubling of lesion size by 1 month after therapy, <50% diminution in lesion size at 3 months after therapy, relapse (substantial enlargement after previous diminution), and not achieving a lesion size of 0 mm² at 6 months after therapy. Any lesion that did not fail was considered to be cured. Thus, for a patient to be cured, the lesion could not have doubled soon after therapy (1 month), failed to make substantial progress toward healing (at least 50% resolution by 3 months), relapsed, or failed to completely reepithelialize at 6 months.

**Adverse Effects**

Local adverse effects were assessed during treatment when treatments were applied by study personnel: days 1, 3, and 5 for the IL Sb group; days 1 and 14 for the cryotherapy group; and 1–2 days per each of the 3 weeks of therapy for the placebo cream group.

Patients were evaluated for local pain, itching, irritation demonstrated by erythema and/or edema, and vesicles/bullae. Each adverse effect was graded on a 0–3 scale: 0, absent; 1, mild (present but treatment not required); 2, moderate (present and needed specific treatment); 3, severe (present with such intensity that antileishmanial therapy had to be stopped).

Grade 2 adverse effects were treated as follows: pain, ibuprofen 400 mg 2–3 times a day for 1–3 days; itching, loratadine 10 mg for 2–4 days plus hydrocortisone 1% cream once a day for 1–3 days plus emollient cream twice a day for 1–4 days; irritation (erythema and/or edema), ice for 3–5 minutes for 1–3 times a day plus hydrocortisone 1% cream once a day for 1–3 days; vesicles/bullae, hydrocortisone 1% cream once a day for 1–3 days plus emollient cream twice a day for 1–4 days.

Systemic adverse effects were addressed for the first 5 IL Sb patients. When there were no abnormalities in electrocardiographic results, transaminase levels, complete blood count, and creatinine levels in those patients, per protocol, such investigations were not performed for subsequent IL Sb patients.

Categorical variables (number of patients cured, number of patients with lesions at specified body sites) were compared by the χ² test or Fisher exact test. Continuous variables (age and lesion size at entrance, adverse event grades, Sb dosages) were compared by Student t test.

**Ethical Review**

The study was approved by the Comité de Bioética de la Facultad de Medicina, Universidad Mayor de San Simón, Cochabamba, Bolivia.

**RESULTS**

Patient characteristics are shown in Table 1. Patients had a mean age of 29 years and a mean lesion size of 218 mm². The
lesion was predominately on the lower limb, and 86% of specified parasites were *L. braziliensis*.

**Treatment and Study Compliance**

IL Sb and cryotherapy treatments were administered by study staff, and the targeted number of administrations was achieved for all patients. The proportion of patients who were apparently superinfected and received treatment with fusidic acid alone or with dicloxacillin reflected the proportion of patients randomized to the treatment groups. Four patients in the IL Sb group, 2 patients in the cryotherapy group, and 3 patients in the placebo cream group were treated with fusidic acid. Of these patients, 2 (1 in the IL Sb group and 1 in the placebo cream group) also required dicloxacillin. Compliance with follow-up was excellent: only 3 of 80 patients (1 patient in each of the 3 treatment groups) were lost by the 6-month follow-up.

**Efficacy**

The cure rates per experimental group were 70% (52%–83%) for IL Sb, 20% (8%–42%) for cryotherapy, and 17% (7%–34%) for placebo cream (Table 1). The IL Sb cure rate was statistically larger than the cure rates for either the cryotherapy group or the placebo cream group (*P* ≤ .001).

For all groups, the reason for failure was predominately lack of sufficient improvement in the lesion size at 3 months.

**Table 1. Study Treatment Data**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>IL Sb</th>
<th>Cryotherapy</th>
<th>Placebo Cream</th>
<th>All Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of patients</td>
<td>30</td>
<td>20</td>
<td>30</td>
<td>80</td>
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<tr>
<td>Enrollment parameters</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Lesion size, mm², mean [SD]*</td>
<td>259 [191]</td>
<td>205 [118]</td>
<td>188 [145]</td>
<td>218 [160]</td>
</tr>
<tr>
<td>Lesion location, No. (%)*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arms/hand</td>
<td>3 (10%)</td>
<td>6 (20%)</td>
<td>8 (27%)</td>
<td>17 (21%)</td>
</tr>
<tr>
<td>Head/neck</td>
<td>3 (10%)</td>
<td>2 (10%)</td>
<td>6 (20%)</td>
<td>11 (14%)</td>
</tr>
<tr>
<td>Chest/back</td>
<td>2 (7%)</td>
<td>1 (5%)</td>
<td>0 (0%)</td>
<td>2 (3%)</td>
</tr>
<tr>
<td>Leg</td>
<td>22 (73%)</td>
<td>11 (55%)</td>
<td>16 (53%)</td>
<td>49 (61%)</td>
</tr>
<tr>
<td>Speciesa,*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. braz:15</td>
<td>5</td>
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<tr>
<td>L. braz:7</td>
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<td>L. amaz:2</td>
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<td>L. guy:1</td>
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<td>L. lain:2</td>
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<td>L. guy:2</td>
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<td>Efficacy parameters, No. of patients</td>
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<tr>
<td>Cure</td>
<td>21</td>
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<tr>
<td>1 mo*b</td>
<td>9</td>
<td>1</td>
<td>2</td>
<td>12</td>
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<td>3 mo*b</td>
<td>20</td>
<td>4</td>
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<td>28</td>
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<td>Failure</td>
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<td>1 mo</td>
<td>5</td>
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<td>16</td>
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<td>3 mo</td>
<td>3</td>
<td>9</td>
<td>17</td>
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<td>Relapse</td>
<td>0</td>
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<td>2</td>
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<tr>
<td>Lost to follow-up</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
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<tr>
<td>ITT cure rate (95% CI)c</td>
<td>70% (52%–83%)</td>
<td>20% (8%–42%)</td>
<td>17% (7%–34%)</td>
<td>38% (28%–48%)</td>
</tr>
<tr>
<td>Adverse event score, mean [SD]d</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pain</td>
<td>1 [0.74]</td>
<td>1.8 [0.44]</td>
<td>0.33 [0.18]</td>
<td>0.82 [0.85]</td>
</tr>
<tr>
<td>Itching</td>
<td>0.07 [0.25]</td>
<td>0.1 [0.31]</td>
<td>0.73 [0.91]</td>
<td>0.33 [0.67]</td>
</tr>
<tr>
<td>Irritation (erythema/edema)</td>
<td>0.17 [0.46]</td>
<td>1.6 [0.68]</td>
<td>0.4 [0.5]</td>
<td>0.62 [0.79]</td>
</tr>
<tr>
<td>Vesicles/bullae</td>
<td>0 [0]</td>
<td>1.2 [0.41]</td>
<td>0 [0]</td>
<td>0.3 [0.56]</td>
</tr>
</tbody>
</table>

*Abbreviations: CI, confidence interval; IL Sb, intralesional systemic therapy with pentavalent antimony; ITT, intent-to-treat; SD, standard deviation.

a  L. braz/amaz/guy/lain = Leishmania braziliensis/guyanensis/amazonensis/lainsoni.

b *“Cure” at 1 or 3 months signifies lesions that were 100% reepithelialized at that time and were later shown not to relapse at 6 months.

c IL Sb vs cryotherapy or cream (*P* < .001).

d Values are on a scale of 0–3 (see Methods).

*P > .05 for all groups.*
Twenty-nine of 47 failures (62%) were declared at the 3-month follow-up, whereas 16 of 47 failures (34%) occurred at 1 month. Failure criteria were lenient in this trial, in that only 50% diminution in lesion size was required at 3 months. However, 28 of the 30 cured lesions would also be declared cured if the stricter criterion of complete lesion reepithelialization at 3 months was employed. One ultimately cured lesion in the placebo cream group was 19% of its original size at 3 months and then completely reepithelialized at 6 months; one ultimately cured lesion in the IL Sb group was 46% of its original size at 3 months before completely reepithelializing at 6 months.

For the IL Sb group, the mean total amount of Sb administered to patients over the 3 injections was 503 mg (SD, 372 mg). There was no statistical difference in the amounts for the 21 cures (453 mg [SD, 278 mg]) vs the amounts for the 9 non-cures (618 mg [SD, 535 mg]; P = .61). Because the mean weight of the IL Sb patients was 65 kg, had the patients been treated with the standard course of antimony at 20 mg/kg/day for 20 days, the patients would have received a mean dose of 26,000 mg. The intralesionally administered dose was therefore 2% of the dose that would have been administered intramuscularly.

Of the 9 patients determined to be superinfected upon entrance, 4 were cured (44%), a cure rate similar to that for the 71 nonsuperinfected patients, of whom 26 were cured (37%).

Adverse Effects

No patient experienced grade 3 (severe) side effects such that therapy had to be stopped even transiently (Table 1). As expected, cryotherapy was more painful than topical application of cream. Cryotherapy was also significantly more painful than IL Sb injection (P ≤ .001). Also as expected, cryotherapy created more irritation (erythema and/or edema) and more vesicles/bullae than either topical application of cream or IL Sb injection (P ≤ .001). IL Sb was more painful (P ≤ .001) but showed a trend toward less irritation (P = .06) compared to cream application.

DISCUSSION

Intralesional injection of pentavalent antimony cured 70% (52%–83%) of single lesions due to Bolivian L. braziliensis in a controlled trial in which the placebo cure rate was 17% (95% CI, 7%–34%). This cure rate for Andean L. braziliensis compares well to the 80% cure rate found for L. braziliensis in Brazil [12] and establishes a 70%–80% cure rate for South American L. braziliensis generally.

Cutaneous leishmaniasis is an ultimately self-curing disease, but CL chemotherapy studies generally lack a placebo group, which makes it uncertain if the drug cure rate found in a particular trial is an improvement upon the unknown placebo cure rate. For South American L. braziliensis, drug cure rates might be compared to the 8% placebo rate in Guatemala, except that the biology of Guatemalan and South American L. braziliensis disease differs (mucosal disease is not seen in Guatemala), and the Guatemalan data are 20 years old. The inability to formulate a paromomycin cream that could be administered to patients caused our planned placebo group of 20 patients to be expanded to 30 subjects. The similarity of the 20% cure rate in the 20 cryotherapy patients to the cure rate in placebo patients may permit the data from the placebo cream and the “pseudo-placebo” cryotherapy group to be pooled. For the placebo and cryotherapy patients combined, 9 patients cured and 41 patients failed, for a cure rate of 18%. With the relatively large number of 50 “placebo” patients, the standard deviation is small (5%). Given the difficulties in performing placebo-controlled trials of CL in the New World and the lack of any data since 2004, these data are likely to be the standard of comparison for future interventions vs South American L. braziliensis.

For IL Sb, the primary adverse effect was injection-related pain, which had an average value of 1.0 on a 3-point scale where 1.0 signifies “mild (present but treatment for pain not required).” Because the total amount of Sb to be injected was approximately 2% of the amount needed to treat via the intramuscular route, systemic adverse events and laboratory abnormalities were not anticipated, or seen when investigated in the initial 5 patients.

Whether local therapy is appropriate for potentially disseminating NW CL is a complex issue. The answer will partially depend on the ability to follow patients for extended periods of time to rule out lymphatic and mucosal metastasis [16]. Another consideration is the number of Bolivian CL patients who meet present entrance criteria. Twenty-two of 45 patients in a 2004 study [8] met the criteria for single, <900 mm² lesions. Eighty-four percent of patients in a 2010–2011 epidemiological survey had single lesions (J. Soto, unpublished data). The present study can be considered proof-of-concept that if a decision is made to treat single Bolivian CL lesions with local therapy, 3 intralesional injections of Sb over 1 week is attractive: the cure rate is far higher than that of placebo; the small amount of drug administered is inexpensive; the route of administration obviates systemic side effects; 3 visits to medical facilities within 1 week is not inconvenient; and the adverse effect of local pain is well tolerated.

Notes

Financial support. This work was supported by the AB Foundation.

Potential conflicts of interest. All authors: No reported conflicts.

All authors have submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed.
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