A Pilot Study Comparing EMLA and LMX Topical Anesthetics in a Low Energy, Split Face Procedure Using Portrait Plasma

Melissa Bogle, MD, The Laser and Cosmetic Surgery Center of Houston, Houston, TX
Jeffrey Dover, MD; Kenneth Arndt, MD, SkinCare Physicians, Chestnut Hill, MA

Introduction

A four patient study was initiated in our practice to evaluate the energy absorption characteristics of human facial skin following the application and removal of two topical anesthetics prior to treatment with Portrait Plasma energy. The two topical anesthetics, EMLA® (AstraZeneca) and LMX® (Ferndale Laboratories), are both in daily use within dermatological practices and have different hydration properties. The proposal for the study came about when investigators observed anecdotal differences in the degree of patient recovery time (redness, peeling) between centers using different anesthetics in early low energy trials.

EMLA® (Eutectic Mixture of Local Anaesthetics) cream is composed of an oil-in-water emulsion of Lidocaine (25mg/g) and Prilocaine (25mg/g) local anaesthetics. Although the final proportion of anaesthetic in the cream is only 5%, which reduces the possibility of toxicity, the oil droplets within the emulsion are composed of 80% anaesthetic, which provides a highly effective analgesic concentration. In addition, the high water content of the cream provides good hydration of the skin, which aids absorption. The cream has often been used by applying for 90 minutes pre-treatment under occlusion.

LMX topical anesthetic cream contains Lidocaine in a variety of strengths, according to application. In dermatological applications, Lidocaine 4% or 5% is routinely employed to provide topical anesthesia. LMX works by way of a liposomal delivery system. Liposomes are comprised of lipid layers surrounded by aqueous layers. They are able to penetrate the stratum corneum because they resemble the lipid bilayers of the cell membrane. The cream is applied for 15-40 minutes pre-treatment without occlusion.

The objective of the investigation was to evaluate the post-treatment healing phase following the use of the 2 topical anesthetic regimes in a split-face study. Following treatment, the degree of desquamation, quality of regenerated epidermis, post-operative discomfort, amount of recovery time, crusting, and degree of erythema were recorded.

Methods

Four patients underwent a single, low energy, full face plasma skin regeneration treatment with topical anesthetic applied pre-procedure in a split-face fashion. All patients provided informed consent. The facial unit was divided vertically in half, with one half having EMLA applied under occlusion, whilst the other half had LMX applied without occlusion. Both were left in place for approximately 60 minutes.

Following removal of the topical anesthetics, a low energy PSR treatment was delivered to the face as a unit, avoiding obvious lines of demarcation. Each of the patients received a single treatment at a discrete energy setting (either 1.5, 1.6 1.7 or 1.8 Joules). Two 2 mm skin biopsies were taken from the perioral region on each side of the face at the day 4 follow-up. Digital photography was performed prior to each treatment, and at each follow-up visit. The degree of desquamation, quality of regenerated epidermis, post-operative discomfort, amount of recovery time, crusting, and degree of erythema were recorded.

Histology

Samples were provided as full thickness skin biopsies which were placed in formalin saline fixative. All samples were processed to wax embedding by automated routine procedures. Three 5 micron sections were cut from each sample, one stained with hematoxylin and eosin, one stained with Hart's modification of Millers elastin stain and one stained with picrosirius red 24B.

Sections were examined for the thickness of epidermis, the thickness of collagen present at the dermal/epidermal junction, the depth of collagen change, the presence of elastosis and the depth of tissue coagulation. The mean of five measurements were taken for each of the parameters measured per patient and overall, according to treatment (EMLA or LMX), and Portrait Plasma energy settings (1.5, 1.7 or 1.8 Joules).

Results

The five measurements taken across each section were consistent for each of the parameters within each of the sections per patient. Both epidermal thickness and thickness of collagen at the dermal/epidermal junction were consistently reduced on LMX prepared skin compared to treatment on EMLA prepared skin and this was the case for all Portrait Plasma energy settings applications. The zone of thermal collagen change was increased with the use of LMX compared to the use of EMLA but only for 1.5 Joules and 1.7 Joules PSR settings. However at the 1.8 Joules Portrait Plasma setting there was a very sight decrease in the depth thermal collagen change with the use of LMX compared to EMLA. The coagulation of tissue within the upper dermis was decreased with LMX compared to EMLA at 1.5 Joules Portrait Plasma setting but was increased with both 1.7 and 1.8 Joules.

When the mean was calculated for all parameters irrespective of PSR energy settings, epidermal thickness was reduced with LMX compared to EMLA. Collagen thickness at the dermal/epidermal junction was decreased, the zone of collagen change was increased and coagulation was decreased. However, when the data was looked at with respect to energy settings, the results were inconsistent at 1.7 Joules without a predictable pattern in terms of a graded increase.

Because these results and extrapolations are based on such a limited number of observations the data has not been subjected to statistical analysis.

Figures 1, 2, 3, 4 and 5 include samples from study subjects with the parameters measured: epidermal thickness, collagen thickness at the DEJ, zone of collagen change, and zone of elastin coagulation.

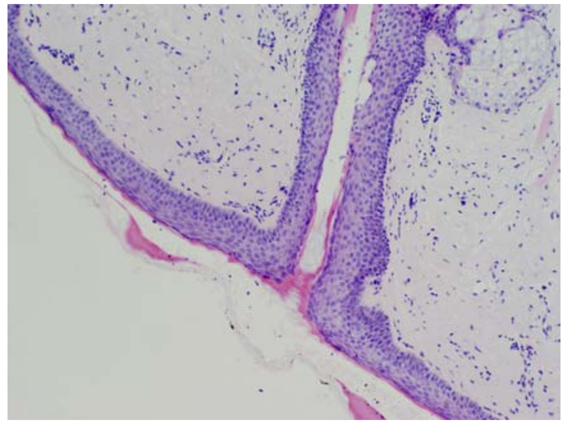

Figure 1 Epidermal thickness

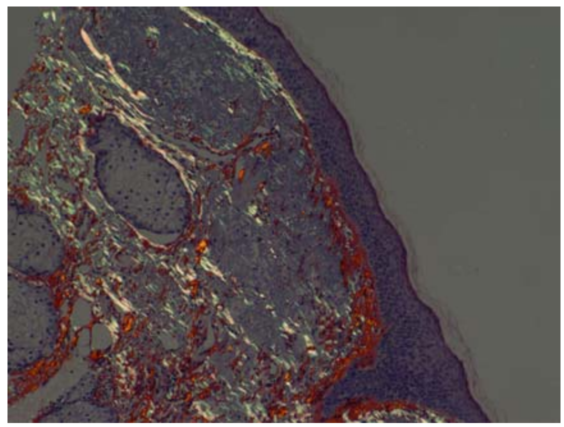

Figure 2 Collagen thickness at the dermal/epidermal junction (stained brown/red)

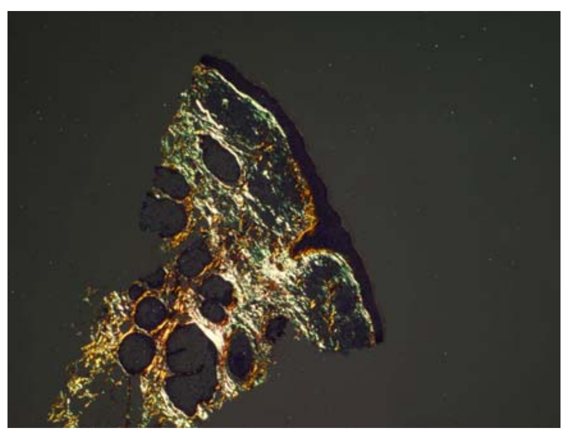

Figure 3 Zone of Collagen change

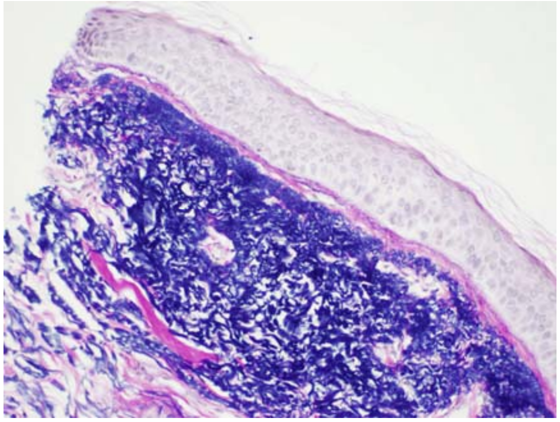

Figure 4 Thin zone of elastin coagulation

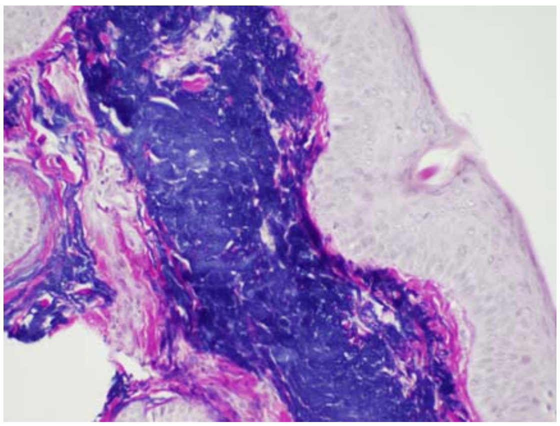

Figure 5. Thick zone of elastin coagulation

Discussion

This study was undertaken to evaluate the energy absorption characteristics of human facial skin following the application and removal of two topical anesthetics with different hydration properties: EMLA® (AstraZeneca) and LMX® (Ferndale Laboratories). The idea for the study came about when investigators observed anecdotal differences in the degree of patient recovery time (redness, peeling) between centers using different topical anesthetics in early low energy trials. Previous histologic studies have demonstrated the effects of hydration on the absorption of plasma energy in an animal model.[1] Skin having a greater hydration content appears to absorb less of the plasma energy. Topical anesthetics with differing hydration properties might then be expected to affect the absorption of plasma energy in a clinical treatment.

The results of this small study revealed recognizable differences between the use of LMX and EMLA which were independent of the Portrait Plasma energy settings, and others that were directly attributable to the treatment energy. In general, the LMX side showed greater absorption of plasma energy than the EMLA side. This was revealed on day 4 post-treatment by the LMX side having a thinner epidermal thickness and reduced thickness of collagen at the dermal-epidermal junction (DEJ) at all treatment levels compared to the EMLA side. Although occlusion may have enhanced the hydration, EMLA in general has a higher water content and likely caused a decrease in the absorption in the plasma energy by hydrating the skin pretreatment. The depth of the zone of thermal collagen change in the dermis on day 4 post-treatment was increased on the LMX side at the lower energy treatments (1.5 J and 1.7 J), but not at 1.8 J. At 1.8 J, there was an unexpected slight decrease in the depth thermal collagen change on the LMX side compared to the EMLA side. With such a small sample size, it is difficult to make conclusions as to why this might have happened. Although it could be simply random sampling error, the decrease in the depth of thermal collagen change at 1.8 J may represent a slope from 1.5 Joules to 1.8 Joules. This may indicate that after some threshold level, hydration plays less of a role on thermal effects to the dermis.

The main shortcoming in the study design is that the LMX and EMLA were not applied under equal conditions, creating an external factor which may have influenced the results. Although both were applied for the same length of time (60 minutes), the EMLA side was applied under occlusion and the LMX was applied without occlusion. This was done in the protocol to mirror conditions from the first early low energy study treatments where the differences were first hypothesized. Since hydration appears to be the key factor, the issue of only one side being occluded could explain or at least play a large part in the differences found. The vehicle of EMLA has a higher water content than that of LMX, however, so it is likely that the hydration properties of the topical anesthetic in its own right do influence plasma energy absorption. Expanded studies at higher energy ranges under equal application conditions will need to be done to resolve these issues.

Conclusion

The use of LMX topical anesthetic in conjunction with Low Energy Portrait Plasma treatments may result in a deeper thermal effect in terms of dermal collagen modification at the expense of a thinner epidermis and narrower band of new collagen at the dermal/epidermal junction compared to the use of EMLA topical anesthetic. One can only conclude that these results are valid for LMX and EMLA when they have been applied in the way they were used in this small study (i.e. EMLA under occlusion and LMX without occlusion, both applied for the same amount of time). Hydration clearly plays a role, but further studies defining the precise role of individual topical anesthetics without external variables is needed.

References

1. Penny K, Sibbons P, Andrews P, Southgate A. A histopathologic assessment of the effects of hydration on the absorption of plasma skin regeneration energy (PSR) in an animal model. Lasers Surg Med. 2005; 36(S17):7.